ESD-S 第三届静电防护与标准化国际研讨会
3rd Electrostatic Protection and Standardization International Conference

美国贸易开发署（USTDA）
The United States Trade and Development Agency (USTDA)

中国–美国标准与合格评定合作项目（SCACP）
U.S.–China Standards and Conformity Assessment Cooperation Program (SCACP)

第三届静电防护与标准化国际研讨会

3rd Electrostatic Protection and Standardization International Conference

——智慧城市建设与静电防护

Wisdom city construction and electrostatic protection

主办单位：

中国标准化研究院 *China National Institute of Standardization*

中国空间技术研究院 *China Academy of Space Technology*

电磁环境效应国家级重点实验室
National Key Laboratory for Electromagnetic Environmental Effects

美国贸易开发署（USTDA）
The United States Trade and Development Agency (USTDA)

美国国家标准协会（ANSI）
American National Standards Institute (ANSI)

美国静电放电协会（ESDA）
Electrostatic Discharge Association (ESDA)

协办单位：

北京东方计量测试研究所
Beijing Orient Institute of Measurement and Test

中国电子仪器行业协会防静电装备分会
China's Electronic Instrument Industry Association: Anti-static Equipment Branch

韩国静电放电协会 *KOREA Chapter of ESD Association*

日本防静电协会 *The Institute of Electrostatics Japan*

台湾静电放电工程学会 *Taiwan ESD Association（T-ESDA)*

承办单位：

上海防静电工业协会
Shanghai Electrostatic Protection Industry Association

中国标准化杂志社 *China Standardization Press*

支持单位：

上海市经济和信息化委员会
Iabn Shanghai Municipal Commission of Economy and Informatization

上海市质量技术监督局
Shanghai Municipal Bureau Of Quality and Technical Supervision

上海浦东新区科技发展基金会
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SMT表面组装技术 *SMT China*

第三届静电防护与标准化国际研讨会
——智慧城市建设与静电防护

2014年10月14日

中国 • 上海　Shanghai • China

上海浦东龙东商务酒店　Shanghai Riverfront Business Hotel

目录
Table of Contents

会场介绍 The Venue 4

研讨会日程表 Conference Program 5

主办、协办及承办单位介绍/ Sponsor and Organizer Overviews 9

演讲摘要和演讲人简介 Presentation Abstracts and Speaker Biographies 23

演讲及参展公司简介 Company Profiles 48

演讲内容 Presentation 65-184

中国城市可持续发展及静电防护标准化进展
Sustainable Development of Cities and Progress of Electrostatic Protection Standardization in China A2 65

ANSI/ ESD S20.20 的更新及与IEC 61340-5-1的关系
The Updates to ANSI/ ESD S20.20 and Their Relation to IEC 61340-5-1 ..... A3 73

中国智慧城市建设现状与发展态势
Chinese smart city construction present situation and development trend A4 82

中国航天系统静电防护体系认证的试点经验
Pilot Experience of Electrostatic Protection System Certification in China Aerospace System A5 94

关注智慧城市建设中的静电危害
Focus on the electrostatic hazard of smart city construction A6 101

智慧城市建设中电子类产品静电防护现状、问题及对策
During Smart City Construction, the Electrostatic Protection Present Situation,
Problems and Countermeasures of Electricity Products AA1 107

微波器件和电路ESD损伤案例分析
Microwave Device and Circuit ESD Damage Case Analysis AA2 123

美国异常敏感设备的静电放电控制技术
ESD Control Techniques for Very Sensitive Devices in the US B1 138

环境湿度对防静电产品静电性能的影响
Influence of Environmental Humidity on Anti-static Property of Anti-static Products B2 146

本征静电耗散材料的应用对集成电路封装所用包材的重要意义
Significance of Intrinsic Electrostatic Dissipative Material Application in
Packing Materials for Integrated Circuit Package B3 152

防静电工作服和防静电标准
Antistatic Work Clothes and Antistatic Standards B4 156

韩国静电标准及产业情况
South Korea electrostatic standards and industry situation B5 161

防静电工作区检验标准使用中的几个问题——使用ANSI/ESD S20.20和IEC61340-5-1的几点体会
Questions in the Use of Inspection Standards for Antistatic Work Areas
Experience from Using IEC61340-5-1 and ANSI/ESD S20.20 ..... B6 164

卫星充放电效应评价与防护技术研究现状
Evaluation of Satellite Charging/ Discharging Effects And Related Protection Techniques B7 167

新版ANSI/ JEDEC/ ESDA JS-002 CDM 标准
The New ANSI/ JEDEC/ ESDA JS-002 CDM Standard B8 175

TLP测试与静电放电敏感度HBM、MM、CDM测试对比分析
Tests Comparison between TLP and HBM/ MM/ CDM ESD Sensitivity B9 178

EOS/ ESD传导引发失效的控制
EOS/ ESD Conduction Failure Causing Control B10 181

上海市龙东商务酒店 - Shanghai Riverfront Business Hotel

龙东商务酒店位于上海市张江高科技园区，地处上海市浦东新区龙东大道与张东路交汇处，距浦东国际机场 23公里，距新国际博览中心7公里，张江环线穿梭于地铁张江高科站与集电港之间，交通便利。

张江集电港会展中心是张江高科技园区内最大的会展场所。中心拥有配备先进舞台和视频放映设备、能容纳660位宾客的剧院式报告厅； 近千平方米的多功能厅和宴会厅及12套大小会议室，总面积达3000多平方米，音响、灯光、网络等各项会议设施一应俱全。中心先后承办举行过国际知名集成电路企业SEMICON技术论坛、 国际射频识别技术RFID论坛、“相约张江”科技文化节、“名校校长论坛”等众多大型国际或地区性会展活动和政府重要会议。中心还与一批高水平展览策划、设计、制作服务企业保持有良好合作关系，是各类中小型会展、商务会议、培训活动的理想选择。

Located in the Shanghai Zhangjiang Hi-tech Park, Riverfront Business Hotel is well situated New Area on the intersection between Longdong Avenue and Zhangdong Road in Shanghai Pudong. It is 23km away from Pudong International Airport, and 7km from New Inter-expo Center. With the Zhangjiang shuttle bus running between Zhangjiang Hi-tech Park metro station and integrated circuit port, the route to hotel becomes very convenient.

Zhangjiang Riverfront Convention Center is the largest convention facility in Zhangjiang Hi-tech Park. It is equipped with advanced stage, video projector and 660-seat theatre-style conference hall. It has a multi-function hall which is nearly 1000 square meters large and 12 meeting rooms of different sizes, which add up to over 3000 square meters in total. Other conference facilities include audio system, lighting and internet connection. The Center has hosted a number of large international and regional exhibition events as well as important government meetings, which include SEMICON Technology Forum, RFID Forum, "Meet in Zhangjiang" Scientific and Technological Culture Festival, and Forum of Prestigious Universities? Presidents. The Center has maintained a good working relationship with companies that provide quality services in exhibition planning, design and execution, making the Center an ideal place for small and medium meetings, business conferences and training programs.

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美国贸易开发署（USTDA）
中国-美国标准与合格评定合作项目（SCACP）
第三届静电防护与标准化国际研讨会

10 月 14 日 , 星期二		主持：黄建华 , 上海防静电工业协会理事长
	08:30-09:00	**签到**
	09:00-12:00	**主题演讲**
A1	09:00-09:20	**欢迎辞**
A2	09:20-09:50	**中国城市可持续发展及静电防护标准化进展** 郭德华 - 副所长 中国标准化研究院公共安全标准化研究所
A3	09:50-10:20	**ANSI/ESD S20.20 的更新及与 IEC 61340-5-1 的关系** 约翰 • 金尼尔 - 高级工程师 美国静电放电协会（ESDA）
	10:20-10:40	**茶歇**
A4	10:40-11:10	**中国智慧城市建设现状与发展态势** 郭石泉 - 会员管理中心主任 工业和信息化部中国智慧城市产业联盟
A5	11:10-11:40	**中国航天系统静电防护体系认证的试点经验** 刘民 - 总工程师 北京东方计量测试研究所
A6	11:40-11:55	**关注智慧城市建设中的静电危害** 黄山明 - 民进上海市委秘书长
	11:55-13:30	**午餐时间**
	时段 A	**智慧城市建设与静电防护**
AA1	13:30-13:50	**智慧城市建设中电子类产品静电防护现状、问题及对策** 黄建华 - 理事长 上海防静电工业协会
AA2	13:50-14:10	**微波器件和电路 ESD 损伤案例分析** 来萍 - 研高 北京中国赛宝实验室
AA3	14:10-14:20	**互动交流**
	时段 B	**新材料、新技术与标准化**
B1	14:20-14:35	**美国异常敏感设备的静电放电控制技术** 泰瑞 • L • Welsher - 博士 美国静电放电协会（ESDA）
B2	14:35-14:45	**环境湿度对防静电产品静电性能的影响** 徐明 - 主任 上海佰洁静电检测技术中心

B3	14:45-14:55	**本征静电耗散材料的应用对集成电路封装所用包材的重要意义** 毕戈雄 - 总工程师 三创包装
	14:55-15:15	**茶歇**
B4	15:15-15:30	**防静电工作服和防静电标准** 松尾 义辉 - 日本防静电学会委员 日本防静电协会
B5	15:30-15:45	**韩国静电标准及产业情况** Joshua Yoo - 总裁 韩国防静电协会
B6	15:45-16:00	**防静电工作区检验标准使用中的几个问题—— 使用 ANSI/ESD S20.20 和 IEC61340-5-1 的几点体会** 廖志坚 - 总工程师 信息产业防静电产品质量监督检验中心
B7	16:00-16:10	**卫星充放电效应评价与防护技术研究现状** 原青云 - 博士 电磁环境效应国家重点实验室
B8	16:10-16:20	**新版 ANSI/JEDEC/ESDA JS-002 CDM 标准** 纳撒尼尔 • 皮奇 - 博士 美国静电放电协会（ESDA）
B9	16:20-16:30	**TLP 测试与静电放电敏感度 HBM、MM、CDM 测试对比分析** 黄久生 - 高级工程师 北京华晶汇科技有限公司
B10	16:30-16:40	**EOS/ESD 传导引发失效的控制** 张明 - 原副总工艺师 上海航天电子有限公司
	16:40-17:00	**互动交流**
	17:00	**幸运抽奖**

会议结束后请交回听众反馈表
会议期间产品展示区同期开放，欢迎业内人士自由参观
最终议程，以现场为准

The United States Trade and Development Agency (USTDA)
U.S.-China Standards and
Conformity Assessment Cooperation Program (SCACP)

3rd Electrostatic Protection and Standardization International Conference

Oct 14, Tuesday		Chairman: Jianghua Huang, President, SEPIA , Shanghai Electrostatic Protective Industrial Association
	08:30-09:00	**Registration**
	09:00-12:00	**Keynote Speech**
A1	09:00-09:20	**Welcome Speech**
A2	09:20-09:50	**Standardization Progress of Sustainable Development of Communities and Electrostatic Protection** Guo Dehua - Vice Director Institute of Public Security Standardization, China National Institute of Standardization
A3	09:50-10:20	**The Updates to ANSI/ESD S20.20 and Their Relation to IEC 61340-5-1** John Kinnear - IBM Senior Electrostatic Discharge Association (ESDA)
	10:20-10:40	**Tea Break**
A4	10:40-11:10	**Chinese smart city construction present situation and development trend** Guo Shiquan - Director of Member Management Center China smart City IndusTry Alliance
A5	11:10-11:40	**The Experience of ESD Protection System Certification in China Aerospace Industry** Liu Min - Head Engineer Beijing Orient Institute of Measurement and Test
A6	11:40-11:55	**Focus on the electrostatic hazard of wisdom city construction** Huang Shanming - secretary of Shanghai municipal party committee
	11:55-13:30	**Lunch**
	时段 A	**Wisdom city construction and electrostatic protection**
AA1	13:30-13:50	**During wisdom city construction, the electrostatic protection present situation, problems and countermeasures of electricity products** Huang jianhua - President Shanghai Electrostatic Protective Industrial Association
AA2	13:50-14:10	**Microwave Device and Circuit ESD Damage Case Analysis** Ping Lai - Senior Engineer China Electronic Product Reliability and Environmental Testing Research Institute (CEPREI)
AA3	14:10-14:20	**Interactive Communication**
	时段 B	**New material, new technology and standardization**
B1	14:20-14:35	**ESD Control Techniques for Very Sensitive Devices in the US** Terry L. Welsher - Doctor Electrostatic Discharge Association (ESDA)
B2	14:35-14:45	**Influence of Environmental Humidity on Anti-static Property of Anti-static Products** Xu Ming - Director Shanghai Hi-Clean Static Test Technology Center

B3	14:45-14:55	**Significance of Intrinsic Electrostatic Dissipative Material Application in Packing Materials for Integrated Circuit Package** Robin Bi - Technical Director SSC-Pak Mackage Material
	14:55-15:15	**Tea Break**
B4	15:15-15:30	**Antistatic Work Clothes and Antistatic Standards** 松尾 义辉 - Member of the Institute of Electrostatics Japan The Institute of Electrostatics Japan
B5	15:30-15:45	**South Korea electrostatic standards and industry situation** Joshua Yoo - President KOREA Chapter of ESD Association
B6	15:45-16:00	**Questions in the Use of Inspection Standards for Antistatic Work Areas —— Experience from Using IEC61340-5-1 and ANSI/ESD S20.20** Zhijian Liao - Head Engineer MII Anti-Static Products Quality Supervision &Testing Center
B7	16:00-16:10	**Evaluation of Satellite Charging/Discharging Effects And Related Protection Techniques** Yuan Qingyun - Doctor Electromagnetic Environmental Effects State Key Laboratory
B8	16:10-16:20	**The New ANSI/JEDEC/ESDA JS-002 CDM Standard** Nathaniel Peachey - Doctor Electrostatic Discharge Association (ESDA)
B9	16:20-16:30	**Tests Comparison between TLP and HBM/MM/CDM ESD Sensitivity** Jiusheng Huang - Senior Engineer Beijing HuaJingHui
B10	16:30-16:40	**EOS/ESD Conduction Failure Causing Control** Zhangming - Vice General Engineer Shanghai Aerospace Electronic Co Ltd
	16:40-17:00	**Interactive Communication**
	17:00	**Lucky Draw**

Please return the Feedback Form to our staff at the end of the conference to qualify.
Exhibition area will be open to public, welcomes professional visitors.
Final agenda subject to onsite.

中国标准化研究院
China National Institute of Standardization

中国标准化研究院（初名国家科委标准化综合研究所）始建于 1963 年，是直属于国家质量监督检验检疫总局，从事标准化研究的国家级社会公益类科研机构，主要针对我国国民经济和社会发展中全局性、战略性和综合性的标准化问题进行研究。
全院现有职工 500 余人，包括研究员 27 名、博士及博士后 87 名，主要开展标准化发展战略、基础理论、原理方法和标准体系研究。承担节能减排、质量管理、公共安全、视觉健康与安全防护、现代服务、公共管理与政务信息化、信息分类编码、人类工效、食品感官分析等领域标准化研究及相关标准的制修订工作。承担相关领域的全国专业标准化技术委员会、分技术委员会秘书处工作。承担相关标准科学实验、测试等研发及科研成果的推广与应用工作。组织开展能效标识、顾客满意度测评工作，承担地理标志产品保护研究及技术支持工作。负责标准文献资源建设与社会化服务工作，承担国家标准文献共享服务平台运行和标准化基础科学数据资源建设与应用工作。同时，我院的工作直接支撑着国家质量监督检验检疫总局以及国家标准化管理委员会的相关管理职能，包括我国缺陷产品召回管理、国家标准技术审查、全国工业产品生产许可证审查、全国质检中心审查管理等工作。
作为国家级社会公益类科研机构，中国标准化研究院一直致力于积极参与并主导国际组织活动，维护国家利益，承担了国际地理标志网络组织（ORIGIN）副主席职务，承担了国际标准化组织 (ISO) 的技术委员会副主席、秘书等 13 个关键职务，主持制定 ISO 标准 20 余项。

Affiliated with the General Administration of Quality Supervision and Inspection and Quarantine of the People's Republic of China (AQSIQ), China National Institute of Standardization (CNIS) is a non-profit national research body engaging in standardization research. The main responsibilities of CNIS are to conduct all-round, strategic, and comprehensive research of standardization during the development process of economy and society, to research and develop comprehensive fundamental standards, as well as to provide authoritative standards information services. CNIS is poised to provide all-round support in standardization for China's economic development and social progress, to support technical progress, industrial upgrading, and product's quality improvement, and to provide scientific evidence for government policy-making on standardization.
Since its founding in 1963, CNIS has undertaken many national key scientific and research projects. Among them, three important projects of the 10th Five-Year Plan (2000-2005) Key Science and Technology Special Program, namely, Research on Development Strategies for Chinese Technical Standards, Research on Development of China's National Technical Standards System, and Basic Research on and Technological Measures for the Safety Standards of Main Foods, have played important supportive roles for promotion of national standardization. One of our projects, Development of a National Terminology and Graphic Symbol System, has been awarded the State-level Second Prize for Advancement of Science and Technology, the highest prize so far in the field of scientific research on standardization. In addition, many of our projects have been awarded state-level and ministry-level prizes for advancement of science and technology and prizes for key scientific research achievements of the 8th (1990-1995), and 9th (1995-2000) Five-Year Plan periods. Our research has brought about significant influence home and abroad, and has made outstanding contributions to development of China's economic development and the progress of science and technology.

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中国空间技术研究院简介
China Academy of Space Technology (CAST)

中国空间技术研究院成立于 1968 年，隶属中国航天科技集团公司。经过 40 余年的发展，中国空间技术研究院已成为中国主要的空间技术及其产品研制基地，是中国空间事业最具实力的骨干力量，主要从事空间技术开发、航天器研制，空间领域对外技术交流与合作、航天技术应用等业务。

自 1970 年，中国空间技术研究院先后成功研制并发射了中国第一颗人造地球卫星——东方红一号、实现环月运行的中国首颗月球探测器、实现中国航天员首次空间出舱活动的神舟七号载人飞船等，为中国航天事业发展做出了突出贡献。中国空间技术研究院在北京航天城建成了集系统设计与集成、总装、测试、试验一体化的新型航天器研制生产基地，现在拥有员工 1 万余人，其中包括 8 名两院院士、12 名国家级突出贡献专家和 1700 多名高级专业技术人才。

中国空间技术研究院是我国飞船和卫星的重点研制单位，十分重视电子元器件、单机及整机系统的电磁兼容设计，开展了大量的地面和星上静电防护技术研究工作，并在静电防护管理体系、静电防护技术、防静电系统测试、防静电工作区配置等方面建立了一系列的静电防护院级标准 Q/W 1300~1303-2010，组建了院静电防护管理体系认证委员会和认证中心，在认证中心办公室和审核专家组的协助下，明确了静电防护系统建设与认证管理流程，已经完成对多家院内单位及外协单位开展了静电防护管理体系认证工作，推进了航天领域的静电安全防护进程。

China Academy of Space Technology (CAST), subordinated to China Aerospace Science and Technology Corporation (CASC), was established on February 20, 1968. Through 44-year development, it has become the main development base for space technology and products in China and the most powerful backbone strength for China’s space endeavor. It is mainly engaged in such fields as development and manufacturing of spacecraft, external exchange and cooperation in space technology, satellite applications, etc. CAST also participates in formulating the state space technology development plans, studies the technological approaches to exploration, exploitation and utilization of outer space, and develops a variety of spacecraft and ground application equipments.

CAST successfully developed and launched china’s first artificial earth satellite. To date, the academy has successfully developed and launched 129 satellites of various kinds and nine Shenzhou spaceships, including scientific and technological test satellites, communications and broadcasting satellites, meteorological satellites, returnable remote sensing satellites and ocean satellites.

CAST has built in Beijing Space City a new spacecraft development and production base which combines system design, assembly, integration, checkout and test in one place. CAST has more than 20,000 staff members, including 8 members of Chinese Academy of Sciences and Chinese Academy of Engineering, 12 national level experts making outstanding contributions, and over 1700 senior specialists. CAST has been making wide contacts with the astronautical companies and space research institutes throughout over a dozen countries and regions.

CAST has engaged in electrostatic field of development of spacecraft and ground application equipments for years, and published series of standards for electrostatic discharge protection management system. It has established certification committee and Electrostatic Discharge Certification of the system, and organized the electrostatic certification of units subordinated to CAST and other co-operation units.

美中标准与合格评定合作项目

由美国贸易发展署 (USTDA) 提供资助、 美国国家标准协会 (ANSI) 负责协调的美中标准与合格评定合作项目 (SCCP) 在以下几个方面为美国和中国相关行业和政府代表提供了一个论坛：

- 在标准、合格评定以及技术法规等领域的合作;
- 为促进美中在标准、合格评定以及技术法规等领域的技术交流建立必要的联系;
- 及时交流关于标准、合格评定以及技术法规等领域的 最新议题和发展情况的相关信息

根据 SCCP 项目规定，从 2013 年开始的三年内，ANSI 将在中国协调举办20场研讨会。根据美国私营业界相关组织的建议，研讨会内容将覆盖不同的行业和领域。研讨会的主题将由相关行业组织、ANSI 以及 USTDA 协调选定。

欲了解该项目的更多情况或有意赞助或参与该项目，请访问下列网站：

www.standardsportal.org/us-chinasccp

了解其他信息，请联系
Ms. Madeleine McDougall
项目经 理
美国国家标准协会(ANSI)
1899 L St. NW – Eleventh Floor
Washington, DC 20036

T: 202.331.3624
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美国国家标准学会
American National Standards Institute (ANSI)

American National Standards Institute（ANSI——美国国家标准学会）是由公司、政府和其他成员组成的自愿组织，负责协商与标准有关的活动，审议美国国家标准，并努力提高美国在国际标准化组织中的地位。ANSI 是 IEC 和 ISO 的 5 个常任理事成员之一，也是 4 个理事局成员之一，参加 79% 的 ISO/TC 的活动，参加 89% 的 IEC/TC 活动。ANSI 是泛美技术标准委员会（COPANT）和太平洋地区标准会议（PASC）的成员。

美国国家标准学会（American National Standards Institute: ANSI）成立于 1918 年。当时，美国的许多企业和专业技术团体，已开始了标准化工作，但因彼此间没有协调，存在不少矛盾和问题。为了进一步提高效率，数百个科技学会、协会组织和团体，均认为有必要成立一个专门的标准化机构，并制订统一的通用标准。1918 年，美国材料试验协会（ASTM）、与美国机械工程师协会（ASME）、美国矿业与冶金工程师协会（ASMME）、美国土木工程师协会（ASCE）、美国电气工程师协会（AIEE）等组织，共同成立了美国工程标准委员会（AESC）。美国政府的三个部（商务部、陆军部、海军部）也参与了该委员会的筹备工作。1928 年，美国工程标准委员会改组为美国标准学会（ASA）。为致力于国际标准化事业和消费品方面的标准化，1966 年 8 月，又改组为美利坚合众国标准学会（USASI）。1969 年 10 月 6 日改成现名：美国国家标准学会（ANSI）。

美国国家标准学会是非赢利性质的民间标准化组织，是美国国家标准化活动的中心，许多美国标准化学协会的标准制修订都同它进行联合，ANSI 批准标准成为美国国家标准，但它本身不制定标准，标准是由相应的标准化团体和技术团体及行业协会和自愿将标准送交给 ANSI 批准的组织来制定，同时 ANSI 起到了联邦政府和民间的标准系统之间的协调作用，指导全国标准化活动，ANSI 遵循自愿性、公开性、透明性、协商一致性的原则，采用 3 种方式制定、审批 ANSI 标准。

ANSI 现有工业学、协会等团体会员约 200 个，公司（企业）会员约 1400 个。领导机构是由主席、副主席及 50 名高级业务代表组成的董事会，行使领导权。董事会闭会期间，由执行委员会行使职权，执行委员会下设标准评审委员会，由 15 人组成。总部设在纽约，卫星办公室设在华盛顿。

As the voice of the U.S. standards and conformity assessment system, the American National Standards Institute (ANSI) empowers its members and constituents to strengthen the U.S. marketplace position in the global economy while helping to assure the safety and health of consumers and the protection of the environment.

The Institute oversees the creation, promulgation and use of thousands of norms and guidelines that directly impact businesses in nearly every sector: from acoustical devices to construction equipment, from dairy and livestock production to energy distribution, and many more. ANSI is also actively engaged in accrediting programs that assess conformance to standards – including globally-recognized cross-sector programs such as the ISO 9000 (quality) and ISO 14000 (environmental) management systems.

ANSI has served in its capacity as administrator and coordinator of the United States private sector voluntary standardization system for more than 90 years. Founded in 1918 by five engineering societies and three government agencies, the Institute remains a private, nonprofit membership organization supported by a diverse constituency of private and public sector organizations.

Throughout its history, ANSI has maintained as its primary goal the enhancement of global competitiveness of U.S. business and the American quality of life by promoting and facilitating voluntary consensus standards and conformity assessment systems and promoting their integrity. The Institute represents the interests of its nearly 1,000 companies, organization, government agency, institutional and international members through its office in New York City, and its headquarters in Washington, D.C.

美国静电放电协会
Electrostatic Discharge Association (ESDA)

Electrostatic Discharge Association（ESDA——美国静电放电协会）于 1982 年在美国成立，总部设在纽约，是一个专业的自愿组织，从事静电放电理论和实践研究。其成员从成立初期不到 100 名，发展到遍布全球、总数超过 2,000 名。其领域从仅限于电子元器件的 ESD 影响，拓宽到纺织品、塑料、居室清洁和形象艺术等领域。该协会授权通过标准开发、教育节目、专业书籍、出版物、指南、认证工作和座谈会宣传 ESD 知识。
ESDA 是一个国际化组织，其成员来自 30 多个国家。他们服务于协会标准委员会，在 EOS/ESD 年会上进行技术研讨，并为其它国家的相关组织提供资讯联系。协会已经和不同国家的类似组织建立了正式和非正式联系，正式联系包括日本可靠性中心，新加坡生产力标准部（PSB），日本电子工业协会（EIAJ），德国 ESD 论坛，欧洲的 ESREF，以及巴西的 ABRICEM。
ESDA 的职责是在国际电工委员会（IEC）静电学领域代表美国利益。随着标准领域全球协调性要求的增加，ESD 协会日益受到广泛关注。

Founded in 1982, the ESD Association (ESDA) is a professional voluntary association dedicated to advancing the theory and practice of electrostatic discharge (ESD) avoidance. From fewer than 100 members, the Association has grown to more than 2,000 members throughout the world. From an initial emphasis on the effects of ESD on electronic components, the Association has broadened its horizons to include areas such as textiles, plastics, web processing, clean-rooms, and graphic arts. To meet the needs of a continually changing environment, the Association is chartered to expand ESD awareness through standards development, educational programs, local chapters, publications, tutorials, certification, and symposia.
Although founded and headquartered in the United States, the ESD Association has a strong international flavor. Its members come from more than 30 countries throughout the world. They serve on Association Standards Committees, present technical papers at the annual EOS/ESD Symposium, and provide the communication links with similar organizations in other countries.
The Association has established informal and formal relationships with similar organizations in various countries. The formal relationships include the Reliability Center of Japan, Productivity Standards Board (PSB) in Singapore, Electronics Industry Association of Japan (EIAJ), ESD Forum of Germany, ESREF in Europe, and ABRICEM in Brazil.
The ESD Association has the responsibility of representing the interest of the United States at the International Electrotechnical Commission (IEC) in the area of electrostatics. With the increasing need for global harmonization in the area of standards, the international focus of the ESD Association is vitally important.

中国电子仪器行业协会防静电装备分会

China's Electronic Instrument Industry Association Anti-static Equipment Branch

中国电子仪器行业协会防静电装备分会成立于一九九七年。业务上受国家工业和信息化部相关部门的指导，隶属于中国电子仪器行业协会。是由从事静电与净化控制产业研发、制造、销售、工程施工、检测、培训及应用的相关企事业单位、大专院校、科研院所、业内有关社会团体，以及专家、学者等热心静电与净化控制事业的个人，不受部门和地区限制，自愿组成的全国非盈利性社会团体。本协会经国家民政部批准依法登记，具有社会团体法人资格的社会组织，现有会员单位 280 余家。

协会的宗旨是：为会员单位服务，维护本行业和会员单位的合法权益，贯彻执行国家的政策法律法规，推动防静电装备行业的发展。

防静电装备分会的主要任务包括：

1、协助政府部门制定本行业的技术与产业发展规划；
2、组织行业内外有关单位的联合技术攻关和开发新产品；
3、征集会员单位建议，向政府有关部门反映、沟通情况；
4、组织行业概况调研，制定行规行约；
5、组织并参与制、修定本行业的 GB、GJB、SJ/T 等标准工作；
6、开展技术研究、产品开发、投资项目的论证、评估等咨询服务；
7、开展本行业经营管理业务的培训；
8、利用协会网站组织防静电技术及应用的推广普及，开展市场调研，协助会员单位开拓市场、沟通生产单位与用户之间的联系；
9、开展与国内外有关学术团体、企事业单位、行业协会、信息网及杂志社等联系与合作，组织技术、产品及应用市场等方面的交流，组织国内国际展览会、展示会和技术研讨会等；
10、出版行业刊物《中国防静电》杂志，向政府部门、会员单位、相关用户免费赠阅；
11、根据政府部门委托和会员单位要求，举办其他有关活动。

联系方式：(010) 68647410/51246352（电话）(010) 68647410（传真），北京市石景山区万达广场 CRD 银座 B-1128 室，100040。网站为 66 防静电网，邮箱 chinaesd@chinaesd.org.cn

协会 LOGO：

Anti-static equipment branch is the anti-static equipment industry engaged in scientific research, production and management of enterprises and institutions, not affected by departments and regions limit is composed of voluntary social organizations. Belongs to the Chinese electronic instrument industry association, the association the approval of the ministry of civil affairs shall be registered according to law, have the corporative qualifications of social group, more than 280 members of the existing units.

Association's objective is: for the member unit service and maintain the industry member unit and the lawful rights and interests of the implement state policy laws and regulations, and promote the development of anti-static equipment industry.

Anti-static equipment branch is the government department of anti-static equipment industry to industry management assistant and staff. In the government department and the enterprises and institutions between the bridge and button take effect, to reflect the government enterprises and wishes and requirements, maintain the lawful rights and interests of the industry, assisting the government do a good job in industry management, in business by state ministry of industry and information related departments guidance.

Association tasks include:
Assisting the government department to make the industry technology and industry development planning;
Inside and outside the industry organization of the units concerned joint technology research and development of new products;
Suggestions for the member unit, convey to the government departments, communication circumstance;
An overview of the industry organization investigation, formulate guild regulations HangYao;
Carry out technology research, product development, investment project argumentation, evaluate consulting services;
Participate in making relevant industry standards work;
To carry out the industry management business training;
Use association website organization antistatic technology and application of the popularization and carry out market research, assist member unit to expand the market, communication production unit and the connection between the users;
Development and domestic and foreign related research institutions, enterprises and institutions, industry association, the information network and magazines, etc contact and cooperation, organization technology, product and application market exchanges, organize the domestic and international exhibitions, exhibitions and technical seminars, etc.;
Publishing industry publication national defence in electrostatic magazine, to government departments, the member unit, the related users provide free;
According to the government commission and member unit requirements, hold other relevant activities;
China's electronic instrument industry association anti-static equipment branch address:
Address: Beijing city wanda plaza CRD ginza B - 1128 room
Zip code: 100040 Telephone: (010) 68647410 51246352 fax: (010) 68647410
Web site: 66 antistatic grid E-mail: chinaesd@chinaesd.org.cn

中国标准化杂志社
China Standardization Press

中国标准化杂志社
China Standardization Press

中国标准化杂志社是由中国标准化协会和中国标准化研究院的全资公司——中国标准科技集团有限公司共同出资的股份制企业。由国家质检总局主管，中国标准化研究院和中国标准化协会共同主办。本着顺应国家新闻出版总署关于中央新闻出版业文化体制改革精神的要求，依据国家新闻出版总署及有关部门规定，经国家质检总局同意，2010年9月，由中国标准化研究院主办的标准科学杂志社(出版刊物为：《标准科学》、《标准生活》、《术语标准化与信息技术》)与中国标准化协会主办的中国标准化杂志社(出版刊物为:《中国标准化》、《China Standardization》)正式合并，2011年12月《术语标准化与信息技术》更名为《产品安全与召回》。现五本杂志涵盖了中国标准化领用领域的政策形势时事政策、发展动态、研究成果、国行标权威发布、标准科技前沿和热点探讨、标准化理论与实践、中国标准化文化历史，以及与百姓生活息息相关的标准知识普及等内容，是目前中国标准化领域最全面、最权威和最具实力的传媒机构。

China Standardization Press is a professional media institution in the field of standardization jointly established by China National Institute of Standardization (CNIS) and China Standardization Association (CAS). It is dedicated to be an authoritative media group in China standardization and make great contributions to its development.

China Standardization Press has five journals:

China Standardization (Chinese)
Started in 1958, it is the most influential professional media in China's standardization field.

China Standardization (Overseas)
Started in 2004, it reports the China standardization development in an all-round to the international community, expressing the viewpoints of experts from home and abroad and displaying the standardization culture with Chinese characteristics. It is the only English journal for exchange with overseas standardization organizations.

Standard Science
Started in 1964, it is a core journal in science and technology in China focusing on probing and research of theories of standardization science. It is also a platform for communication of standardization theory and academic exchanges.

Standard Living
Started in 1964, it is a fashionable magazine for science popularization, using popular and easy ways to explain standards, plain and simple language to report news of standardization, and adopting shocking cases to strengthen standards, so as to serve as a standardization guide for common people.

主办、协办及承办单位介绍
Sponsor and Organizer Overviews

Product Safety and Recall

Started in 1996, it was originally named as Terminology of Standardization and Information Technology. It is professional periodical for introduction of policies, laws, regulations and standards of product safety, analysis of current status and development trend of product safety management at home and abroad, summing up and exchange of experiences in enterprises' product safety management, promotion of product safety technologies, and popularization of product safety knowledge.

2012-9

北京东方计量测试研究所
中国航天 Beijing Orient Institute of Measurement & Test

北京东方计量测试研究所
Beijing Orient Institute of Measurement and Test

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北京东方计量测试研究所是中国航天科技集团公司下属的专业计量测试研究所，国防电学一级计量站。开展电学、无线电、时间频率、几何量、热学、力学、真空等参数的计量校准业务。开展地线、静电、洁净度、用电安全、电源设备、无损检测、电磁辐射、环保、节能、理化分析等检测业务。设计开发电学计量测试仪器设备。受中国空间技术研究院委托建立了静电防护管理体系认证中心，开展航天电子产品静电防护管理体系认证，培训与咨询、人员资质认证等工作，拥有静电防护与应用实验室，开展静电防护技术、测试方法研究，起草了系列静电防护标准。

Beijing orient institute of measurement and test (BOIMT) is belong China Aerospace Science and technology corporation (CASC), is the first class metrology station in electricity specialty. It works at metrology of electricity, radio frequency, time and frequency, geometry, thermometry, mechanics, vacuum specialty. And it work at test of ground, ESD, clean room, safety of electricity, power supply, EM radiation, scatheless detection, environment protection, energy economize, and analysis of physical chemistry. It also develop and design calibration and test instrument in the field of electricity. China Academy of Space and Technology (CAST) authorize BOIMT to found a electrostatic protection management system certification center (ESDC). It work on certification, training, consultation, person certify. ESDC hold a laboratory of electrostatic protection and application, it work at ESD technology, method of test, and draft ESD protection standard.

KOREA Chapter of ESD Association

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韩国防静电协会分会在 2011 年 1 月收到总部的信函后成立。花了大约一年时间最后通过 ESDA 必需的文件审查和董事会投票而成立。韩国分会执行委员会由高级工程师、各种高技术产业领导人和董事，总经理如半导体 . 平板显示器、自动化等组成。韩国分会不仅仅是标准发展更是具有独特的 ESD 应用行业的工作团队。这些工作团队有 ESD 设计、半导体晶圆厂、半导体后端组装、平板显示器、汽车和电子装配。他们致力于广泛的 ESD 控制行业课题和应用研究的改进。

Korea Chapter of ESD Association has started its foundation with a letter from ESD Association Headquarter in January 2011. It took about a year its foundation and finally accepted by ESDA pass all required documents review and votes by Board of Directors meeting. Korea chapter formed executive committee with senior engineers, leaders and managing directors from various high technology industries like semiconductor, flat panel display and automotives etc. Korea chapter has unique working group for ESD application industries rather than standard development. These working groups are ESD design, semiconductor fab, semiconductor back-end assembly, flat panel display, automotives and electronic assembly. They are focusing on industry wide subject for ESD control and improvement with application study.

上海防静电工业协会
Shanghai Electrostatic Protective Industrial Association

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电话：021-6852 3368
传真：021-5889 8195
网址：www.esdchina.org.cn

上海防静电工业协会 Shanghai ElectrostaticProtective Industrial Association（缩写：SEPIA），成立于 2004 年 9 月。本协会是由从事防静电产业的企业、事业单位自愿发起组成的专业性、跨行业、跨地区的非盈利性组织，是上海市一级行业协会，社会团体法人。会员单位主要是覆盖长三角地区的生产防静电服装、地板、包装、耗材、装备设备或有关设计等领域的骨干企业，现有会员单位 95 个，理事单位 22 个。
随着我国信息化建设发展，计算机、通讯、集成电路等行业进入了快速发展期，静电危害问题突出。防静电装备、器材、工具以及防静电环境工程，生产线防静电系统等防静电产业逐步成为先进制造业配套服务的充满活力的新兴产业。由于防静电装备产品有近 100 类，2000 多种，初期生产加工相对容易，部分企业质量管理水平较低，产品生产没有标准，迫切需要加以提高。协会设：标准化委员会、专家委员会等，并投资成立具有独立法人资格的 " 上海工业静电技术研发服务中心 "，负责技术咨询、检测、评估、组织培训、项目开发等。协会有内部季刊《上海防静电工业》。协会成立以来，已多次牵头组织会员单位参与制定防静电方面国家、行业、地方标准；召开国际、国内有关新技术、新产品研讨会；开展相关知识、技术培训及静电专业职称申报评审等。

Shanghai ElectrostaticProtective Industrial Association（SEPIA）, established in Sept. 2004, is a professional, cross-industry, cross-region non-profit organization founded voluntarily by enterprises and institutions in antistatic industry, one of Shanghai Class I industrial associations and a social organization as legal person, with members of 95 member units and 22 director units mainly from backbone enterprises in production of antistatic clothes, floor, packings, consumables, plant equipment or relevant designs in Yangtze River Delta region.
With information construction and development in China, industries of computer, communication and integrated circuit, etc have entered a period of rapid growth, so electrostatic damage becomes striking, and antistatic industries such as antistatic equipment, apparatus and tools and antistatic environmental engineering have gradually become dynamic emerging ones with matching services for advanced manufacture. Today, there are more than 2,000 antistatic products in nearly 100 kinds in antistatic equipment field.As initial production and processing is relatively easy, some enterprises run at low quality management level and have no standard for their products, urgently needing improvement. Under the Association there are standardization committee and expert committee, etc, and "Shanghai Industrial Electrostatic Technical R&D & Service Center" with independent legal person qualification for technical consulting, testing, evaluation, organization training and project development,etc. The Association also issues quarterly journal Shanghai Antistatic Industry.
Since its establishment, the Association has for many times led organization of member units to participate in formulating relevant national, industrial and local standards for electrostatic protection, held international and domestic seminars on new technologies and new products in the field, and conducted relevant knowledge and technical trainings and application and appraisal of electrostatic professional titles.

台湾静电放电防护工程学会
Taiwan ESD Association (T-ESDA)

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台湾静电放电防护工程学会成立于 2001 年，本会的目标是为共同研究开发有关静电放电防护工程科学、技术及其应用，加强国际间学术交流，并协助地区静电放电防护工程科学之发展。本会定期举办的活动包含：支持并协助电子工业之发展；举行静电放电防护科学、技术之学术活动，以及相关技术训练；刊发会志、会报或有关静电放电防护科技之各项图书刊物；与国内、外有关机构、学术团体、工业界联系，促进学术交流。

事务局

日本防静电学会
The Institute of Electrostatics Japan

网站：www.iesj.org

本学会是于 1976 年 10 月 12 日由与静电相关的研究人员和技术人员超越学科界限，旨在使静电知识和技术向国际化发展为目的，经过共同的努力成立的。最初的领导班子是由增田閃一会長，村崎憲雄・上田実两位副会長组成。

本学会的会员主要是由关注静电技术的研究人员、技术人员和一些特定的团体组成，个人会员约 600 名，赞助会员约 70 家。随后 20 多年中，由于社会原因，经济原因等的影响，学会一度也面临了会员减少等一系列的危机，但是现在，本学会已达到正式会员、学生会员、国外会员共计约 700 名，赞助会员约 100 家单位。

The Institute was established by electrostatic researchers and technical personnel jointly on Oct.12, 1976 beyond discipline boundary, for international development of electrostatic knowledge and technology. The initial leading group consisted of 増田闪一 as the director and 村崎憲雄 and 上田実 as two vice directors.

Members of the Institute are mainly researchers, technical personnel and some special organizations focusing on electrostatic technology, totaling about 600 individual members and about 70 sponsorship members. In 20 years after the establishment, due to social and economic reasons, the Institute faced a series of crisis such as decrease of members. But currently the Institute has about 700 individual members including official members, student members and foreign members and about 100 sponsorship members.

A2 09:20 - 09:50

中国城市可持续发展及静电防护标准化进展

Standardization Progress of Sustainable Development of Communities and Electrostatic Protection

演讲人 Speaker:
郭德华
中国标准化研究院公共安全标准化研究所 副所长，研究员
Guo Dehua
China Natioanl Institute of Standardization, Sub Institute of Public Security,
Vice Director, Researcher

内容摘要：
在介绍中国标准体制和改革动向的基础上，从国际标准化发展背景介绍城市可持续发展与智慧城市标准化的关系，ISO 城市服务和生活质量指标国际标准，中国在城市可持续发展方面的标准化工作。最后，就静电防护这一具体的技术支撑领域的中国标准现状、技术组织建设进展等进行了介绍。

Abstract of the Presentation:
On the basis of introduction to Chinese standard system and reform trends, the presentation explains relations between sustainable development of communities and wisdom city standardization, international standard for ISO urban service and quality of life, and China’s standardization in sustainable development of communities, against the backdrop of international standardization development. Finally, the presentation introduces current situations of standard and progress in technical organization construction of China in electrostatic technical support.

演讲人简介：
郭德华，博士，中国标准化研究院公共安全标准化研究所副所长，研究员。多年从事标准化研究，具体领域涉及：标准化管理与运行机制、标准情报与标准知识组织、眼面部防护标准化、静电防护标准化。主持和参与国家级和省部级及其他科研与工作项目 30 多项，主编或参与著作或译著 11 部，发表论文 40 余篇。

Speaker’s biography:
Guo Dehua, doctor, vice director and research fellow of Institute of Public Security Standardization, China National Institute of Standardization; many years of standardization research, with specific fields involving: standardization management and operation mechanism, standard intelligence and standard knowledge organization, eye and face protection standardization, and electrostatic protection standardization; chaired and participated in more than 30 state-level and provincial-level as well as other research and work projects, in-chief edited, compiled or translated 11 works and published more than 40 papers.

A3 09:50 - 10:20

ANSI/ESD S20.20 的更新及与 IEC 61340-5-1 的关系

The Updates to ANSI/ESD S20.20 and Their Relation to IEC 61340-5-1

演讲人 Speaker:
约翰 • 金尼尔
美国静电放电协会（ESDA）高级工程师
John Kinnear
ESD Association, Senior Engineer

演讲人简介：
约翰 • 金尼尔，IBM 高级工程师，专门从事过程和系统技术，以及 ANSI / ESD S20.20 工厂认证。他获得过布法罗大学的学士学位和锡拉丘兹大学的硕士学位。
约翰因为对国家标准和国际标准的突出技术贡献而享誉全球。自 1989 年以来，他一直担任波基普西（美国纽约州）工厂的 IBM 现场静电防护协调员。他是 IBM 跨部门静电防护技术联络委员会原主席，和 IBM 企业静电防护大纲制定和实施委员会的重要成员之一。约翰致力于大型商业服务器的 EMC、安全、环境、运输和挥发性有机化合物排放标准的符合性测试。他同时也是以 FCC（美国联邦通信委员会认证）、CE 标志（欧盟安全认证）、VCCI（日本电磁兼容认证）和其他国家要求测试大型商业服务器系统的 EMC 辐射和抗扰度标准的首席工程师。自 1990 年成为 ESD 协会成员以来，约翰曾在几个标准发展委员会任职，并担任协会管理职位。约翰是代表美国向国际电工委员会（IEC）委任的美国全国委员会 / IEC 101 技术委员会技术顾问。在这个职位上，他促进国际静电防护标准的发展，并支持国际上采用 ANSI / ESD S20.20。作为 ESDA（美国静电放电协会）的工厂认证（ANSI / ESD S20.20）发展计划的主席，约翰在该计划的开发和发行中扮演主要角色。特别是，约翰致力于协调主任评审员培训、国际注册认证和现场审核的初步发展。约翰曾担任过 ESD 协会的每个职位，包括副总裁，高级副总裁，总裁。他是 EOS / ESD 研讨会技术委员会的原主席和 2004 年 EOS / ESD 研讨会的大会主席。由于约翰对 ESD 协会的不懈贡献，约翰在 2006 年 9 月获得协会颁发的杰出贡献奖。

Speaker's biography:
John Kinnear is an IBM Senior Engineer specializing in process & system technology, and facility certification in accordance with ANSI/ESD S20.20. He has a BS degree from University of Buffalo and a MS degree from Syracuse University. John is well known globally for his technical contributions to national and international standards He has been the IBM ESD Site Coordinator for the Poughkeepsie site since 1989. He is the past chairman of the IBM Inter-divisional Technical Liaison Committee for ESD Protection and is an important member of his company's committee to develop and implement the ESD Corporate program for IBM. John has coordinated the testing of large mainframes for compliance to EMC, Safety, Environmental, Shipping and Volatile Organic Emission standards. He has also been the lead engineer on testing large mainframe systems to EMC emissions and immunity standards for FCC, CE Mark, VCCI and other national requirements. As a member of the ESD Association since 1990, John has served in several Standards Development Committees as well as association management positions. John is the appointed Technical Adviser to the United States National Committee/

IEC Technical Committee 101, where he represents the United States to the International Electrotechnical Commission（IEC）. In this position he assisted in the evolution of international ESD standards and supports international adoption of ANSI/ESD S20.20. As Chair of the ESDA's Facility Certification（ANSI/ESD S20.20）development program, John played major roles in the program's development and industry launch. In particular, John coordinated the initial development of Lead Assessor training, ISO Registrar Certification, and witness audits. John has served in every ESD Association officer's position, including Vice President, Senior Vice President and President. He is the past Chairman of the EOS/ESD Symposium Technical Program Committee and past General Chairman of the 2004 EOS/ESD Symposium. For his contributions to the ESD Association, John was presented with the Outstanding Contribution Award in September, 2006, from the ESD Association.

A4 10:40 - 11:10

中国智慧城市建设现状与发展态势
Chinese smart city construction present situation and development trend

演讲人 Speaker:
郭石泉
工业和信息化部中国智慧城市产业联盟 会员管理中心主任
Shiquan Guo
China smart City IndusTry Alliance, Director of Member Management Center

内容摘要：
当前中国国家智慧城市建设的相关政策和标准化工作的现状和动态，智慧城市建设目前的发展步骤和目标，中国智慧城市建设的参与模式研究，对智慧城市建设的几点意见

Abstract of the Presentation:
Current situations and developments of national policy and standardization of China for wisdom city construction; current development procedures and goal of wisdom city construction; research of mode of participation in China wisdom city construction and several opinions on wisdom city construction

演讲人简介：
现任工业和信息化部中国智慧城市产业联盟会员管理中心主任，分管联盟成员单位的会籍管理和项目服务工作、联盟专家委员会和项目专家评审工作、联盟标准化以及对外新闻工作。
毕业于首都师范大学中文系，曾任国家质检总局中国质量万里行促进会会员管理部部长、名牌部 部长，中日技术创新产业推进基地秘书长助理，英国标准化协会中 国 CAC 管理委员会委员、活好营养管理（中国）有限公司总经理助理等职。

Speaker's biography:
Director of Member Management Center, China wisdom City IndusTry Alliance, the Ministry of Industry and Information Technology, in charge of the Alliance's member unit membership management and project service, the Alliance's expert committee and project expert appraisal and the Alliance's standardization and external press work.
Graduated from Department of Chinese Studies, Capital Normal University;
Former positions:
Director of Member Management Department and of Famous Brand Department, China Association for Quality Promotion of the State Administration of Quality Supervision, Inspection and Quarantine;
Assistant to the Secretary General of China-Japan Technology Innovation Industry Promotion Base
Member of China CAC Management Committee of British Standards Institution
Assistant to General Manager of Good Health Nutrition Management (China) Co., Ltd

A5 11:10 - 11:40

中国航天系统静电防护体系认证的试点经验

Pilot Experience of Electrostatic Protection System Certification in China Aerospace System

演讲人 Speaker:
刘民
北京东方计量测试研究所 总工程师
Liu Min
Beijing Orient Institute of Measurement and Test, Head Engineer

内容摘要：
航天电子产品非常重视静电防护，先后出台了测试标准、管理体系认证标准，成立了认证中心。对航天内部企业开展第三方认证，对外协单位开展第二方认证。讲座介绍了航天电子产品静电防护系列标准 Q/QJA118-120《航天电子产品静电防护管理体系要求》的内容、结构和特点。对比了与国际标准 ANSI/ESD S20.20 和 IEC61340-5-1 之间的异同。分析了体系化管理的特点，例举了认证中心开展认证以来发现的问题统计，总结了认证过程中的经验。

Abstract of the Presentation:
Electronic product in Aerospace industry is very emphasis focus on electrostatic protection, the test standard and manage system certification standard is put forward successively, and certification center had been build up. It does third-party certificating for inner corporation, and does second-party certificating for outside corporation. This lecture introduce the content and characteristic of serial standard Q/QJA118-120 'the requirement of Aerospace electronic product electrostatic protection management system'. Compare with ANSI/ESD S20.20 and IEC61340-5-1. analyze the characteristic of systemic management. Giving example of problem form certification center. Summarize the experience form process of certificating.

演讲人简介：
刘民，1969 年出生，研究员，博导。现任中国空间技术研究院北京东方计量测试研究所总工程师。国际无线电科学联盟 URSI 中国委员会电磁计量分委会主席。《电子测量与仪器学报》《计测技术》编委委员。宇航学会计量测试分会委员。中国航天科技集团学术技术带头人、中国空间技术研究院计量与标定专业学术技术带头人。iNarte 国际认证 ESD 工程师。
刘总师从事电磁学测量和计量前沿的研究工作，在阻抗、电功率、静电、地线等方面造诣精深，发表相关论文 40 多篇，起草国家军用标准、航天行业标准、中国空间技术研究院标准。获 6 项发明专利，其中一项获第十二届中国专利奖优秀奖。在静电防护方面开展多年的 ESD 培训、测试以及静电防护管理体系认证咨询工作，被中国空间技术研究院静电防护管理体系认证中心聘为 ESD 高级审核员。

Speaker's biography:

Liu Min, born in 1969, Professor, doctoral supervisor, head engineer of Beijing Oriental Institute of Measurement and Test in China Academy of Space Technology（CAST）, chairman of electromagnetic measurement subcommittee of China committee of URSI, member of editorial board of "Journal of Electronic Measurement and Instrument" and "Metrology & Measurement Technology", member of metrology subcommittee of Astronautics Committee, academic and technologic leader in China Aerospace Science and Technology Corporation（CASC）, academic leader of metrology and calibration technology in CAST, iNarte international ESD certification engineer.

Liu engages in research on electromagnetics metrology and metrology frontiers, proficient in impedance, electric power, electrostatic and ground. He has published over 40 papers, drafted national military standards, industry standards and CAST standards. Liu has 6 invention patents, one of which won the twelfth China patent award of excellence. He has engaged in the field of electrostatic discharge, on ESD training, test and advisory work in Electrostatic Discharge Certification（ESDC）, he has been hired as ESD senior auditor by ESDC of CAST.

A6 11:40 - 11:55

关于在市政协提出“重视在智慧城市建设及城市运行安全中的静电隐患的建议”提案的情况

Proposal of Focusing on Static Electricity Threat in Smart City Construction and Safe City Operation in Municipal CPPCC

演讲人 Speaker:
黄山明
中国民主促进会上海市委员会 秘书长
Huang Shanming
China Association for Promoting Democracy Shanghai Committee, Secretary General

内容摘要：
在市政协十二届 2 次会议上提出该提案，提案阐述了智慧城市建设与防静电产业的关系，分析了我国防静电产业现状，针对我国尚未成立防静电标准化技术委员会，国内对防静电认识不足、标准整体落后，微电子产品生产企业静电防护现状堪忧，有关行业协会作用有待进一步发挥的问题，提出要积极组建上海地方性静电专业委员会，重视静电知识普及和人才培养，在政府采购中明确有关中标企业静电防护要求，充分发挥行业协会作用的建议，得到市质量技监局、市经济信息化委的重视，采纳了相关意见。该提案转化为社情民意信息又在今年全国两会期间，递交全国政协。

Abstract of the Presentation:
The Proposal, advanced in the 2nd session of the 12th Municipal CPPCC, elaborates relations between smart city construction and antistatic industry, analyzes current situations of antistatic industry in China and suggests actively establishing local electrostatic professional committee of Shanghai, emphasizing electrostatic knowledge popularization and talent training, clarifying requirements for electrostatic protection on bid winners in government procurement and giving full play to industry association, against the backdrop of no technical committee for antistatic standardization in China, insufficient understanding of antistatic work, overall backward antistatic standard and anxious current situations of electrostatic protection in production enterprises. The proposal won attention from and was adopted by the municipal administration of quality and technology supervision and the municipal economic information committee. The Proposal was also delivered to CPPCC as one on social conditions and popular sentiments during the 2014 NPC and CPPCC period.

演讲人简介：
担任民进上海市委会秘书长、上海市政协提案委员会副主任。积极参政议政，认真履行职能，关注社会热点，开展课题调研，反映民生需求。《关于开发推广电子课本的建议》等 5 件提案曾获市政协优秀提案奖。

Speaker's biography:

Secretary-general of Shanghai Committee, China Association for Promoting Democracy and vice director of Shanghai CPPCC Proposal Committee; actively participating in politics, seriously performing duties, focusing on social hot discussion, conducting topic research and reflecting livelihood demands. 5 proposals including Suggestion on Development and Popularization of E-text Books won awards for excellent proposals of the Municipal CPPCC.

AA1 13:30 - 13:50

智慧城市建设中电子类产品静电防护现状、问题及对策

During Wisdom City Construction, the Electrostatic Protection Present Situation, Problems and Countermeasures of Electricity Products

演讲人 Speaker:
黄建华
上海防静电工业协会 理事长
Jianhua Huang
Shanghai Electrostatic Protective Industrial Association

内容摘要：
本文主要阐明了电子类产品的静电防护水平对于智慧城市建设具有重要意义的观点，分析了我国防静电产业发展和电子行业静电防护水平的现状，并在此基础上提出提高我国智慧城市建设中电子类产品静电防护水平的设想和建议。

Abstract of the Presentation:
This presentation mainly gives an exposition of the view that electronics' electrostatic protection level is of important significance in wisdom city construction, analyzes current situations of antistatic industry development and electrostatic protection level in electronic industry of China, and advances tentative ideas and suggestions on improving electronics electrostatic protection level in China wisdom city construction.

演讲人简介：
黄建华，上海防静电工业协会理事长，中国制冷空调工业协会洁净室技术委员会理事，全国洁净室及相关受控环境标准化技术委员会（SAC/TC 319）委员，全国电磁屏蔽材料标准化技术委员会（SAC/TC 323）副主任委员。上海晨隆国际贸易有限公司、上海晨隆静电科技有限公司、上海晨隆纺织新材料有限公司董事长。中国首批洁净室工程师、防静电高级工程师。
主持编写的国家标准及行业标准有 GB/T 24249-2009《防静电洁净织物》、GB/T 30131-2013《纺织品 服装系统静电性能的评定 穿着法》、FZ/T 80014-2012《洁净室服装 通用技术规范》、FZ/T 80013-2012《洁净室服装 易脱落大颗粒物测试方法》、FZ/T 80012-2012《洁净室服装 电阻测试方法》。参与编写的国家标准有 GB/T 25915.5-2010《洁净室及相关受控环境 第五部分：运行》、GB/T 26667-2011《电磁屏蔽材料 术语》、GB/T 30139-2013《工业用电磁屏蔽织物通用技术要求》、GB/T 30142-2013《平面型电磁屏蔽材料屏蔽效能测试方法》。目前正在主持编写的国家标准有：GB/T《纺织品 静电性能的评定 静电衰减法》。

Speaker's biography:

Huang Jianhua, the chairman of Shanghai Electrostatic Protective Industrial Association, director of Cleanroom Technology Committee of China Refrigeration and Air Conditioning Industry Association, director of national clean room and controlled environment for Standardization Technical Committee（SAC/TC 319）, and the vice chairman of electromagnetic shielding materials Standardization Technical Committee（SAC/TC 323）.

He is the chairman of Shanghai Chen Long International Trade Co., Ltd., Shanghai Chen Long Electrostatic Technology Co., Ltd. and Shanghai Chen Long textiles and new materials Co., Ltd.. Huang is also one of the first cleanroom engineers and senior engineers on anti-electrostatic.

Huang presided and complied the national standard GB/T 24249-2009 "anti-electrostatic cleanroom fabric", GB/T 30131-2013 "evaluation of the electrostatic properties of textile and apparel dressing method", FZ/T 80014-2012 "general technical specification of cleanroom garment "FZ/T 80013-2012 "testing method of easily fall off large particulate matter cleanroom garments", FZ/T 80012-2012 "resistance testing methods of cleanroom garments ".

He involved in the complation of the national standard GB/T 25915.5-2010 "cleanroom and controlled environments associated, Part V: Run" and GB/T 26667-2011 "electromagnetic shielding material: terms". GB/T 30139-2013 "shielding effectiveness test method of planar electromagnetic shielding material ".

Now he is presiding and compiling the national standard: GB/T "evaluation of the electrostatic properties of textile and apparel: electrostatic decay method".

AA2 13:50 - 14:10

微波器件和电路 ESD 损伤案例分析
Microwave Device and Circuit ESD Damage Case Analysis

演讲人 Speaker:
来萍
中国赛宝实验室 研高
Ping Lai
China Electronic Product Reliability and Environmental Testing Research Institute (CEPREI), Senior Engineer

内容摘要：
本演讲的主题是微波器件和电路的 ESD 损失案例分析。首先阐述了 ESD 损伤分析的重要作用，然后对 6 个微波器件和电路的 ESD 损伤案例进行了详细介绍，包括样品失效背景，电参数测试、ESD 模拟试验验证，物理分析、综合分析、分析结论和改进建议等。最后总结了开展电子元器件 ESD 失效分析的主要步骤以及常用的分析设备。

Abstract of the Presentation:
Title of the presentation: ESD Damage Analysis on Microwave Devices and Circuits. The presentation first elaborates important role of ESD damage, then introduces in detail 6 microwave device and circuit damage cases, including sample failure background, electric parameter testing, ESD model test validation, physical analysis, comprehensive analysis, analysis conclusion and improvement suggestions, etc. Finally the presentation summarizes main procedures for electronic component ESD failure analysis and common analysis equipment.

演讲人简介：
来萍（Lai Ping），中国赛宝实验室（工业和信息化部电子第五研究所）研究员级高工，中国赛宝认证中心 ESD 认证项目技术审核专家，IEEE 会员，国际 iNARTE ESD 工程师资质。
现在从事电子元器件可靠性工作。在电子元器件抗 ESD 技术研究方面，自 1994 年起就承担或参加了国家关于电子元器件抗 ESD 水平检测及 ESD 失效机理分析等方面的技术服务及科研项目。在电子元器件 ESD 损伤检测和失效机理分析、制造业静电防护技术等方面有较丰富的知识和经验。从 2001 年开始，开设了关于电子制造 ESD 防护和检测技术方面的咨询及培训课程。近十几年，发表关于电子元器件可靠性及静电方面的论文三十多篇，2009 年参与了《军用电子元器件失效分析及经典案例》编撰工作，2014 年主持翻译出版了《ESD 揭秘——静电防护原理和典型应用》。

Speaker's biography:
Lai Ping, researcher-level senior engineer of China CEPREI Laboratory (The Fifth Electronics Research Institute of Ministry of Industry and Information Technology), technical examination expert for ESD qualification of China CEPREI Certification

Center, IEEE member, international iNARTE ESD engineer.

Currently in field of electronic component reliability; in research of electronic component anti-ESD technology, has undertaken or joined national technical service and research projects about electronic component anti-ESD level test and ESD failure mechanism analysis; with rich knowledge and experience in electronic component ESD damage test and failure mechanism analysis and manufacturing electrostatic protection technology; from 2001, offered consulting and training programs of electronic-manufacturing ESD protection and testing technique; in recent more than 10 years, published 30 plus papers on electronic components reliability and static electricity; in 2009, joined compilation of Military Electronic Component Failure Analysis and Classical Cases; in 2014, chaired translation of and published ESD Basics: From Semiconductor Manufacturing to Product Use.

B1 14:20 - 14:35

美国的高敏感器件 ESD 控制技术
ESD Control Techniques for Very Sensitive Devices in the US

演讲人 Speaker:
泰瑞 • L • Welsher
美国静电放电协会（ESDA）博士
Terry L. Welsher
ESD Association, Doctor

演讲人简介：

泰瑞 • L • Welsher 博士于 2001 年在朗讯科技贝尔实验室的工程技术研究中心的质量、测试及可靠性部门主管的位置上退休。1978 年在贝尔实验室开始了他的职业生涯，研究绝缘聚合物的电传导机制和电气互连材料的电解腐蚀失效机制。 1984 年，由于他的出色工作他被任命为这些领域的杰出会员。1986 年，他被晋升为技术经理，重组贝尔实验室的静电放电（ESD）领域的核心专长。新成立的小组着手在这个领域创造了一系列开创性贡献，并在推动行业标准起到了关键作用。1994，将他的小组的活动拓宽到了朗讯科技公司硬件可靠性的所有方面，特别强调在环境压力测试（EST）和产品可靠性预测与规划。1997 年，他被晋升为质量、测试及可靠性中心的主任，在这里他负责朗讯科技公司业务单位的产品质量、测试和可靠性保证措施的发展和部署。这项工作包括集成电路、电路板和系统级测试和诊断的可测性设计，及射频与光电系统和元件测试的特殊技术的可测性设计。离开朗讯后，他成为了 Lasersharp 公司的可靠性主管，这是一家光纤激光放大器公司，在那里他负责产品质量、可靠性和适应性。2004 年以来，他一直担任 Dangelmayer（丹格尔迈尔）Associates 有限责任公司的高级副总裁，这是一家 EOS / ESD 咨询公司。

Welsher 博士是 1988-1989 ESD 协会标准委员会主席。1991 年担任技术程序主席，1992 年担任副主席，1993 年担任 EOS / ESD 研讨会大会主席。1993-1995 年他曾担任研讨会理事会成员。他也一直活跃在与 ESD 协会，JEDEC 的 14 质量和可靠性委员会等机构有关的质量标准和路线图活动。1999 年至 2001 年他曾担任 JEDEC 理事会理事。他目前是 JEDEC / ESDA 的 HBM 和 CDM ESD 工作组的联合主席，ESD 协会副主席和 iNARTE（国际无线电与电信工程师协会）理事会成员。最近，他带头努力协调和合并 JEDEC 和 ESDA 的设备测试标准。他获得了佛罗里达州立大学化学学士学位和得克萨斯大学奥斯汀分校化学物理学博士学位。他在固体物理、应用数学、有机化学、电子产品可靠性和静电放电等领域发表或联合发表了四十篇论文。

Speaker's biography:

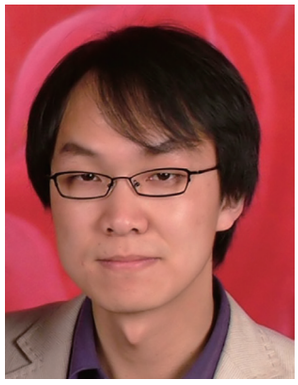
Dr. Terry L. Welsher retired from Lucent Technologies-Bell Laboratories Engineering Research Center in 2001 as the director of the quality, test & reliability department. He began his career in Bell Labs in 1978; where he worked on electrical conduction mechanisms in insulating polymers and electrolytic corrosion failure mechanisms in electrical interconnection materials. In 1984, he was appointed distinguished member of technical staff for his work in these fields. In 1986, he was promoted to technical manager to re-constitute the Bell Laboratories core expertise in electrostatic discharge（ESD）. The newly formed group proceeded to produce a string of ground-breaking contributions to the field and played a key role in advancing industry standards. In 1994, he broadened his group's activities to all aspects of hardware reliability for Lucent Technologies with special emphasis in environmental stress testing（EST）and product reliability prediction and planning. In 1997, he was promoted to director of

the quality, test & reliability center of excellence where he directed the development and deployment of product quality, test and reliability assurance practices for Lucent Technologies business units. This work included design for testability of integrated circuits, board and system level test and diagnosis and special techniques for testing of RF and optoelectronic systems and components. After leaving Lucent, he became reliability director for LaserSharp Corporation, an optical fiber laser amplifier company, where he was responsible for product quality, reliability, and compliance. Since 2004, he has been senior vice president of Dangelmayer Associates, LLC, an EOS/ESD consulting firm.

Dr. Welsher was chairman of the ESD Association standards committee 1988-1989. He was technical program chair in 1991, vice general chair in 1992, and general chair in 1993 of the EOS/ESD Symposium. He served as member of the Symposium board of directors 1993-1995. He has also been active in quality standards and roadmapping activities with Sematech, the ESD Association, and the JEDEC 14 quality and reliability committee. He served on the board of directors of JEDEC 1999-2001. He is currently co-chair of the joint JEDEC/ESDA HBM and CDM ESD working groups, vice president of the ESD Association, and a member of the board of directors of iNARTE, a telecommunications technical certification organization. Recently, he has led the effort to harmonize and merge JEDEC and ESDA device testing standards. He holds a BS in chemistry from Florida State University and a PhD in chemical physics from the University of Texas at Austin. He is author or co-author of forty papers in solid state physics, applied mathematics, organic chemistry, electronics reliability, and electrostatic discharge.

B2 14:35 - 14:45

环境湿度对防静电产品静电性能的影响
Influence of Environmental Humidity on Anti-static Property of Anti-static Products



演讲人 Speaker:
徐明
上海佰洁静电检测技术中心 主任
Xu Ming
Shanghai Hi-Clean Static Test Technology Center, Director

内容摘要：
增加湿度和增加吸湿性通常是相对易用和廉价的防静电手段，但是其缺点也非常显著，对湿度的过度依赖和耐久性缺失，导致通过吸湿来防静电的手段在很多地方无法适用。本文主要通过具体的检测实例说明，在不同湿度状态下，“永久性”防静电产品和“吸湿性”防静电产品的境地性能差异。

Abstract of the Presentation:
Increasing humidity and increasing moisture absorption are relatively easy and cheap antistatic approaches generally, but have very striking shortcomings. Over-dependence on humidity and deficiency of durability makes moisture-absorption antistatic approach unsuitable in many places. This presentation mainly illustrates conditional performance difference between “permanent” antistatic product and “moisture-absorption” antistatic product under different humidity states through specific test cases.

演讲人简介：
上海佰洁静电检测技术中心主任，上海防静电工业协会项目经理，防静电高级工程师，多年深入用户企业开展 ESD 咨询、检测、培训工作经验。多项国家防静电标准的主要起草人和参与起草人。

Speaker’s biography:
Director of Shanghai Hi-Clean Static Test Technology Center, manager of Shanghai Electrostatic Protective Industrial Association , senior antistatic engineer; many years of experience of ESD consulting, testing and training in user enterprises; major participant and draft maker of multiple national antistatic standards.

B3 14:45 - 14:55

本征静电耗散材料的应用对集成电路封装所用包材的重要意义

Significance of Intrinsic Electrostatic Dissipative Material Application in Packing Materials for Integrated Circuit Package

演讲人 Speaker:
毕戈雄
三创包装 总工程师
Robin Bi
SSC-Pak Package Material, Technical Director

内容摘要：
传统导电类包材有碳析出污染，又不适用于 CDM 模式敏感微电子器件。传统抗静电剂产品虽然是静电耗散材料，适用于所有微电子元器件，但他们也有析出污染，而且，在低湿度的环境下，没有防静电性能。本征静电耗散材料静电性能永久，不依赖湿度，无污染，是微电子包材现今技术上唯一可行的选择。

Abstract of the Presentation:
Traditional Carbon based conductive packaging material is not suitable for CDM mode sensitive Microelectronic device. And the Carbon contamination is not acceptable to Microelectronics industry. The traditional Antistatic agent doped or coated packaging materials have no antistatic function in low humidity enviorment. So now day Inherently Dissipative packaging material is only choice for its good, permanent effect which is independent to humidity and no contamination.

演讲人简介：
1992-1995，中科院上海微系统和信息科学研究所，硕士
1995-1997，上海飞利浦半导体，工程师
1997- 至今，上海创纪科技有限公司，总经理
2013，SCC-PAK, 总工

Speaker's biography:
2013-now, SCC-Pak general engineer
1997-now, Newera company, general manager
1995-1997, Shanghai Philips semiconductor, engineer
1992-1995, Master degree, Simc, Chinese academy of sciences

B4 15:15 - 15:30

防静电工作服和防静电标准
Antistatic Work Clothes and Antistatic Standards

演讲人 Speaker:
松尾 义辉
可乐丽株式会社 日本防静电学会委员
松尾 义辉
Kuraray Co., Ltd. Member of the Institute of Electrostatics Japan

内容摘要：
日本的防静电工作服标准（JIS）和其判定方法。
☐ JIS 标准制定的历史
☐ 防静电性能的判定方法
☐ 适用的导电纤维的结构

Abstract of the Presentation:
Japanese standard for antistatic work clothes (JIS) and the judgment method
☐ History of JIS Standard formulation
☐ Antistatic property judgment method
☐ Structure of suitable conductive fiber

演讲人简介：
任职于可乐丽株式会社
从事纤维工作，专门从事防静电工作的研究。日本静电学会委员，日本防静电工作服国家标准（JIS）参编人员

Speaker's biography:
An employee of Kuraray Co., Ltd
In field of fiber, specializing in research of antistatic work clothes; member of the Institute of Electrostatics Japan, contributor to the national standard JIS of Japanese standard for antistatic work clothes.

B5 15:30 - 15:45

韩国静电标准及产业情况
South Korea electrostatic standards and industry situation

演讲人 Speaker:
Joshua Yoo
韩国防静电协会 总裁
Joshua Yoo
KOREA Chapter of ESD Association, President

内容摘要：
ESD 协会韩国分会简介

Abstract of the Presentation:
Introduction of Korea Chapter of ESD Association

演讲人简介：
CORE INSIGHT FOUNDER 公司 ESD 控制计划顾问 / 总裁，ESD 协会韩国分会会长，iNARTE 认证的工程师
ESD 协会认证的专业 ESD 计划管理人
SEMI ESD 任务组团队成员

Speaker's biography:
ESD Control Program Consultant/President at CORE INSIGHT
Founder & President at Korea Chapter of ESD Association
ESD Engineer Certified by iNARTE
Professional ESD Program Manager Certified by ESD Association
SEMI ESD Task Force Team Member

B6 15:45 - 16:00

防静电工作区检验标准使用中的几个问题——使用 ANSI/ESD S20.20 和 IEC61340-5-1 的几点体会

Questions in the Use of Inspection Standards for Antistatic Work Areas —— Experience from Using IEC61340-5-1 and ANSI/ESD S20.20

演讲人 Speaker:

廖志坚

信息产业防静电产品质量监督检验中心 总工程师

Zhijian Liao

MII Anti-Static Products Quality Supervision &Testing Center, Head Engineer

内容摘要：

静电防护国际标准中的核心内容 ANSI/ESD S20.20 和 IEC61340-5-1，是指导防静电系统工作的体系认证标准。在防静电工作区检验工作实践中两者的相同之处和不同之处对 ESD 防护体系的核查有着非常重要的意义。这里重点介绍两者的不同点对检验工作影响，相同点对静电防护的指导作用。交流的内容有 EPA 的接地系统和电阻类指标的检测。结合国内相关标准和规定进行分析，希望对国内的相关工作有借鉴作用。

Abstract of the Presentation:

ANSI/ ESD S20.20 and IEC61340-5-1, the core content of international ESD standards, is the system certification standards to guide the system work of ESD .In the inspection practice of ESD workspace, both the similarities and differences have a very important significance on the verification of the ESD protection evaluation and certification. Here we focus on the two strands, the differences effect on the inspection work and the same points on guiding ESD protection. This communication includes EPA grounding system and resistance type indicators test.

演讲人简介：

廖志坚，1957 年出生，1983 年毕业于北京工业学院，工学学士学位，高级工程师。电子行业职业技能鉴定指导中心培训讲师。职业技能鉴定质量督导员。现任信息产业防静电产品质量监督检验中心总工程师兼检测室主任。《中国防静电》编委委员。

廖志坚早期在研究所从事电子产品的研制、设计和生产技术研究，曾代表单位赴日本与世界领先音响企业交流学习，在无线电、电子、物理学领域造诣深厚，多年担任总工程师工作。

廖志坚总工自担任检测中心总工以来，带领中心年轻的技术团队注重静电防护理论知识在检测过程中的实际应用，同时在防静电装备生产企业中普及静电防护原理与技术，帮助企业改进、提高防静电装备用品的质量水平。

Speaker's biography:

Zhijian Liao, born in 1957, graduated from Beijing Institute of Technology, Bachelor of Engineering, senior engineer, training instructor of Occupational Skills Appraisal & Guide Center of Electronics Industry of the Ministry of Information Industry of PRC, quality supervisor of Occupational Skill Testing, Currently, he assumed the chief engineer and inspection department director of MII Anti-Static Products Quality Supervision &Testing Center.

In the early strage, Mr. Liao engaged in electronic products in a research institute and represented the research institute to communicate with the world's leading audio company. Mr. Liao was highly tech-savvy in radio, electronics and physics areas and assumed the chief engineer for many years.

Since assuming the chief engineer of MII Anti-Static Products Quality Supervision & Testing Center, Mr. Liao led the young technical team to focus on the testing practical application of electrostatic protection theoretical knowledge, moreover he popularize electrostatic protection theoretical knowledge among anti-static equipment manufacturing enterprises and helped them to improve the quality of anti-static equipments.

B7 16:00 - 16:10

卫星充放电效应评价与防护技术研究现状
Evaluation of Satellite Charging/ Discharging Effects And Related Protection Techniques

演讲人 Speaker:
原青云
电磁环境效应国家重点实验室 博士
Yuan Qingyun
Electromagnetic Environmental Effects State Key Laboratory, Doctor

内容摘要：
针对卫星充放电效应问题，介绍了用于航天器充放电效应评价的地面模拟系统、航天器静电电位动态测试系统、放电脉冲测试装置，从被动防护和主动防护两方面介绍了航天器表面带电防护方法，最后提出了发展设想。

Abstract of the Presentation:
To the satellite charging/discharging problem, the space charged environment simulation system、method-spacecraft electrostatic potential dynamic testing system and ESD pulse test device used for the evaluation of satellite charging/discharging effects were introduced, and two methods used for the protection of satellite charging/discharging:passive protection and active protection were also introduced, some development prospect were provided in the end.

演讲人简介：
原青云，1979 – 2003 年获得石家庄机械工程学院计算机专业学士学位，2006 年和 2010 年分别获得石家庄机械工程学院电磁场与微波技术学科硕士和博士学位。自 2003 年开始静电和电磁防护研究，在国内外期刊和会议发表论文 20 多篇。中国物理学会会员。

Speaker's biography:
Qingyun Yuan was born in 1979. He received the B.S. degree in computer application, the M.S. and Ph.D. degrees in electromagnetic filed and microwave technology from Mechanical Engineering College, Shijiazhuang, China, in 2003, 2006 and 2010, respectively.

Since 2003, he has been studying in the Electrostatic & Electromagnetic Protection Institute, Mechanical Engineering College, Shijiazhuang, China. His research interests include electrostatic discharge（ESD）test, and electromagnetic compatibility（EMC）. He is the author of more than 20 publications. He is a member of the China Physical Society.

B8 16:10- 16:20

新版 ANSI/ JEDEC/ ESDA JS-002 CDM 标准

The New ANSI/ JEDEC/ ESDA JS-002 CDM Standard

演讲人 Speaker:
纳撒尼尔 • 皮奇
美国静电放电协会（ESDA）博士
Nathaniel Peachey
ESD Association, Doctor

演讲人简介：

1994 年纳撒尼尔 • 皮奇在林肯市的内布拉斯加大学获得博士学位，然后在洛斯阿拉莫斯国家实验室被授予董事资助的博士后奖学金。 1996 年，他在科罗拉多斯普林斯加入了 Atmel 公司。在之后的几年中，皮奇博士在 Atmel 公司担任过多个职位，包括工艺工程师、技术开发工程师、设备工程师、电路设计工程师。从 2003 年他开始专注于 ESD 防护和 I / O 设计问题。

2005 年皮奇博士担任 RF Micro Devices 公司新成立的 ESD 设计组的工程经理。在担任此职务期间，他负责为 RFMD 设计的所有技术（包括硅和砷化镓）提供 ESD 防护研发。除了对芯片的保护，他还领导发展和改进了射频天线 ESD 防护。

皮奇博士撰写和合作撰写了超过 20 篇技术期刊论文。他还提交了 6 个专利，已被授权或等待授权。皮奇博士 2009 年首次当选 ESD 协会理事会的理事。他曾在教育委员会任职，担任第一业务部经理。目前，他担任 ESD 协会的标准业务部经理，是 IEEE 高级会员。

Speaker's biography:

Nathaniel Peachey received his Ph.D. in 1994 from the University of Nebraska at Lincoln and then was awarded a director's funded postdoctoral fellowship at the Los Alamos National Laboratory. In 1996, he joined Atmel Corporation in Colorado Springs. Over the next several years, Dr. Peachey held various positions at Atmel; including process engineer, technology development engineer, device engineer, and circuit design engineer. In 2003, he began focusing exclusively on ESD protection and I/O design issues.

In 2005, Dr. Peachey accepted the position of engineering manager for the newly formed ESD design group at RF Micro Devices. In this capacity he was responsible for the development of ESD protection for all of the technologies that RFMD designed, including both silicon and GaAs. Besides on-chip protection, he led the development and improvement of the RF antenna ESD protection.

Dr. Peachey has authored and co-authored over 20 technical journal submissions. He has also submitted six patents that have either been granted or are pending. Dr. Peachey was initially elected to the board of directors for the ESD Association in 2009. He has served on the education council and was the first business unit manager for advanced topics. Currently, he is serving as the standards business unit manager for the Association. Dr. Peachey is a senior member of IEEE.

B9 16:20 - 16:30

TLP 测试与静电放电敏感度 HBM、MM、CDM 测试对比分析

Tests Comparison between TLP and HBM/ MM/ CDM ESD Sensitivity

演讲人 Speaker:
黄久生
北京华晶汇科技有限公司 高级工程师
Jiusheng Huang
Beijing HuaJingHui, Senior Engineer

内容摘要：
如何获得最敏感的静电放电敏感度（HBM/MM/CDM）是科学合理制定静电控制方案如 ESD S20.20 或 IEC61340-5-1 关键的第一步。但是静电敏感度测试只能为被动 ESD 防护提供非常有限的数据，很难为主动防护设计者 ESD 提供多少有益的信息，而 TLP I-V 的测试能为静电防护设计者减少静电放电的损失提供主动防护的重要信息如触发电压和电流以及漏电流或失效点等大量关键信息。对典型的 TLP 测试 与（HBM/MM/CDM）敏感度测试的应用做了对比。

Abstract of the Presentation:
ESD sensitive is the crucial data for the reasonable design of ESD protection program such as ESD S20.20 or IEC61340-5-1. TLP I-V test provides the designer with active protection from ESD damagers and more key parameters such as snapback trigger voltages and currents, leakage current failure point for analysis. TLP I-V curve characterization for typical protection components were tested and comparisons of results and applications between TLP and HBM、MM and CDM is presented.

演讲人简介：
黄久生博士 , 北京华晶汇科技有限公司高级工程师。从事静电测试和静电技术培训 30 多年，2002 年获得美国 iNARTE 认证 ESD 工程师后率先在国内开展 S20.20 的培训与咨询，30 多年 ESD 科研与培训经历为电子、石化、科研院校、航天军工等数百企业上千学员开展 ESD 培训和解决各种静电难题，对电子设备 ESD 抗扰度设计与器件敏感度试验和设计有丰富经验。黄博士从重视静电科研（获 3 项国家自然科学基金静电研究项目和军队科技进步一等奖，美国密苏里大学电磁兼容实验室资助的客座研究员 2002.9-2003.7）转变到即重视静电科技又熟悉静电管理的 ESD 工程师，多年来为国内外企业制定科学合理的静电防护方案。

Speaker's biography:
Dr. Js Huang, senior engineer at Beijing HJH, iNARTE certified ESD Engineer since 2002 and visiting researcher at EMC lab of UMR from 2002-2003,and then promoting ESD S20.20 control program and system level ESD design and consulting for electronic, petroleum and military industry in China. Interested in ESD consulting and ESD test and ESD training.

B10 16:30 - 16:40

EOS/ ESD 传导引发失效的控制
EOS/ ESD Conduction Failure Causing Control

演讲人 Speaker:
张明
上海航天电子有限公司 原副总工艺师
Zhangming
Shanghai Aerospace Electronic Co,. Ltd. Vice General Engineer

内容摘要：
你是否遇到电烙铁焊接敏感集成电路后，器件失效，而分析原因怀疑接地是否良好？手腕带脱扣？
你是否在对电子产品进行调试、实验时，碰到讨厌的干扰问题，出现的误码、误动作，让人没有思绪，无从下手解决。这些问题，你是否考虑过因电气过电压（EOS）引发的干扰予以解决？
本文从典型的器件失效分析着手，采用‘敏感体、路径、干扰源’的干扰三要素分析方法，分析了 EOS 产生的原因、场合；用实验的数据，检测到 EOS 产生的量值；同时对敏感体耐受的电压值引入了相关的标准；通过 EOS 导致 RMI 传递到敏感器件的路径分析，提出了抑制 EOS 的控制方法。

Abstract of the Presentation:
Do you have ever met the situationg that after electric soldering iron soldered sensitive integrated circuit, electronic component became invalid, and analysis of the causes is that if the ground or the wrist strap is good?
When you are debugging, experiments, whether you encounter electronics interference problems, or error, error action, let a person have no thoughts.
For these problems, have you considered due to electrical voltage（EOS）causes interference to solve?
In this paper, according to the typical device failure analysis, deponding on sensitive body, path, interference analysis method. We analyzed the reason, EOS occasions; with the experimental data, the detection to the EOS value; at the same time, voltage sensitive body tolerance value into the relevant standards; through the EOS RMI delivery resulted in the path to the sensitive device analysis, put forward the control methods of inhibiting EOS.

演讲人简介：
张明，1959 年生，1983 年毕业于哈尔滨工业大学无线电系信息工程专业，从事航天电子产品的设计与制造，曾担任中巴合作资源卫星 UHF 接收机的主管设计师，上海航天电子有限公司物资处副处长，行政处处长，副总工艺师。目前主要研究电子工业静电防护及 EOS 抗干扰措施。
在主持上海航天电子有限公司的静电防护管理体系的管理工作中，运用国际先进的静电防护管理技术，成功地建立了电子企业生产静电防护管理体系。现为上海市防静电工业协会专家组成员。

Speaker's biography:
Zhang Ming, born in 1959, graduated from Harbin Institute of Technology in 1983 the radio Department of information engineering, manufacturing in the aerospace electronic products, served as a head designer in Pakistan resources satellite

UHF receiver, deputy director of the Shanghai Aerospace Electronics Co., Ltd. supplies, executive director ande a vice general engineer. His main research is about electronic industrial electrostatic protection and EOS anti interference measures at present.

In the electrostatic protection management system presided over the Shanghai Aerospace Electronics Co. Ltd. in the management, using of electrostatic protection and management of international advanced technology, he successfully established the production of electrostatic protection management system of electronic business. Shanghai is now the anti electrostatic Industry Association expert group members.

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北京华晶汇主要研制生产静电电压 / 电场、电荷量及高阻计 / 微电流测试设备、HBM/MM/CDM/TLP/HMM 等静电放电抗扰度测试设备、静电放电敏感度试验设备、静电火花感度测试仪、静电衰减测试仪、工业静电应用与静电消除设备、雷电预警系统、静电吸附静电分选以及提供静电技术培训与咨询。从 2001 年起公司先后 20 多人次参加美国 ESD 和 EMC 年会，发表论文和产品展示，公司骨干 2002 年获得美国 iNARTE 认证 ESD 和 EMC 工程师认证后从事静电技术培训和咨询辅导，与美国密苏里科技大学电磁兼容实验室建立了长期友好合作关系，2007 年被美国 iNARTE 批准为 ESD 培训中心，2010 年起代理美国 ESDEMC 公司的 TLP 电子元件、IC、晶元器件 I-V 测试系统与静电枪、高压脉冲衰减器 5kV/ /4GHz、IEC61000-4-2 标准静电放电发生器校准“电流靶（2Ω/4GHz）- 衰减器 - 电缆”链 , 电流靶校准用适配器（target adapter line）、输入阻抗 100GΩ/100kV (0.1 ～ 1%) 高阻高压表等产品和静电技术支持。

Beijing HJH provides ESD test equipment such as electrostatic field meter and electrostatic voltage meter, static charge meter and high resistivity/picoampere meter, HBM/MM/CDM/TLP/HMM test equipment, IEC ESD immunity test and ESD sensitivity test equipment. Lightning alarm equipment.
Beijing HJH is the first approved ESD training center by iNARTE in China in 2007. Beijing HJH provides professional ESD training for engineers and technician for over 20 years.
Beijing HJH is also TLP I-V curve test system and EMC equipment distributor for ESDEMC.

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《洁净室》CleanRooms China 自 2001 年开始以简体中文出版发行，每年出版四期 , 免费赠阅给六千多符合资格的中国洁净与污染控制行业的管理与技术人员，是中国洁净技术领域最有权威、最受欢迎的刊物。同时发行电子版发送给超过 10,000 专业读者。

《洁净室》为中国微电子、制药、医疗设备、生物工程、食品等高精行业领域使用污染控制技术的工程师和高级管理人员，包括运行工程师、采购主管，设计院、工程公司及承包商的专业工程师，科研院所及大专院校，与洁净技术相关的产品制造商，提供有关先进的污染控制技术及应用、设备、材料、技术标准及其发展趋势等全球市场的最新信息。

《洁净室》杂志社每年举办洁净室研讨会及运营网站。并于 2013 年 11 月正式成为广东省洁净技　行业协会会刊 , 为协会会员提供一个良好的技术交流平台。

CleanRooms China magazine was launched since 2001, published in Simplified Chinese for 4 issues each year, CleanRooms China is distributed freeof-charge to over 6,000 qualified engineers and senior executives working in the China contamination control industries, it is the most authoritive and popular publication for the industry in China.

CleanRooms China provides contamination controls engineers and senior executives, purchasers, sub-contractors, designers who work in China microelectronics, pharmaceutical, medical equipment, life science and food processing industry with in-depth technical information and up-to-date news about the world and China market.

CleanRooms China organizes annual conference and operates technical website. It is also the official publication of Guangdong Association of Cleanroom Technology since November 2013, provide an effective technology communication platform for the members of the association.

中国民主促进会上海市委员会

China Association for Promoting Democracy Shanghai Committee

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中国民主促进会（简称民进）是以从事教育文化出版工作的高中级知识分子为主、具有政治联盟性质、致力于建设中国特色社会主义事业的政党，是同中国共产党通力合作的参政党。
民进注重加强参政议政能力建设，完善工作机制，搭建工作平台，以求真务实精神，围绕经济社会发展中的全局性和前瞻性问题深入调查研究。一方面发挥界别优势，坚持以新作为巩固“老阵地”，在参与教育立法、促进教育均衡发展、实施文化强国战略等方面积极建言献策；另一方面坚持开拓“新领域”，根据全面建设小康社会的需要，围绕可持续发展中的资源节约和环境保护，经济转型和科技创新等方面持续反映社情民意，积极贡献智慧和力量。

China Association for Promoting Democracy (CAPD) is a party with main members from senior and middle intellectuals in education and cultural publishing fields, having nature of political alliance, devoting itself to building socialism with Chinese characteristics, and wholeheartedly cooperating with CPC.
CAPD emphasizes building ability of participating in politics, perfecting work mechanism, erecting work platform and making in-depth investigation and research of overall and forward-looking issues centering on economic and social development in realistic and pragmatic manner. On the one hand, it always gives play to its advantages as an independent party, sticks to consolidate “old front” with new actions, and actively makes suggestions and proposals on participation in educational legislation, balanced education development and strengthening the country with culture; on the other hand, it insists on developing “new field”, continuously reflects social conditions and popular sentiments, and actively offers its wisdom and share to efficient use of resources, environmental protection, economic transformation and sci-tech innovation.

CEPREI

中国赛宝实验室

China Electronic Product Reliability and Environmental Testing Research Institute (CEPREI)

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中国赛宝实验室（工业和信息化部电子第五研究所），又名中国电子产品可靠性与环境试验研究所，始建于 1955 年，是中国最早从事可靠性研究的权威机构。
实验室位于广州市天河区，拥有各类试验、分析测试和计量等仪器设备 5000 多台（套）；现有职工 1800 多人，各类科技人员 700 多人，工程师及以上人员占 70%。
实验室可提供从元器件到整机设备、从硬件到软件直至复杂大系统的产品检测试验、分析评价、认证计量、信息服务、技术培训、专用设备和专用软件开发等技术服务。具有多项认证、检测资质和授权，建立了国际合作互认关系，可在世界范围内开展认证、检测业务，代表中国进行标准和法规的制订。作为工信部的直属单位，为部的行业管理和地方政府提供技术支撑，为电子信息企业提供技术支持与服务，每年服务企业过万家。

China CEPREI Laboratory (The Fifth Electronics Research Institute of Ministry of Industry and Information Technology), or China Institute of Electronics Reliability and Environmental Test, established in 1955, is an authoritative organization first in reliability research in China.
The Laboratory, located in Tianhe District, Guangzhou, boasts more than 5,000 sets(units) of various instrument and equipment for test, analysis and testing and measurement, etc; more than 1,800 employees, consisting of more than 700 scientific and technological personnel, with engineers and higher ones accounting for 70%.
The Laboratory can offer technical services of product test, analysis and evaluation, certification measurement, information, technical training, special equipment and special software development in fields from components to complete equipment, from hardware to software till complicated big system, has multiple certification and test qualifications and authorizations, has established international cooperation mutual recognition relations, can carry out certification and test businesses around the world and formulation of standards and regulations on behalf of China.
As one directly under the Ministry of Industry and Information Technology, the Laboratory offers technical supports for industrial management of the Ministry and local government and technical supports and services to electronic information enterprises, with service receivers more than 10,000 per year.

中国智慧城市产业联盟
China smart City IndusTry Alliance

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联盟成立于 2013 年 8 月，由中国国家工业和信息化部信息化推进司发文批准成立，由中国电子商会、航天科工、航天科技、中兴通讯、太极计算机等国内 100 余家大中型企业、高校、科研院所、行业协会共同发起成立。主要致力于配合国家有关部门开展智慧城市建设的政策咨询、标准化建设，为各地政府提供智慧城市建设应用咨询、规划服务、产业化落地，促进企业间的产业合作。

The Alliance was established in Aug. 2013 as approved by the Information Promotion Department, the Ministry of Industry and Information Technology of China, by more than 100 large- and med.-sized enterprises, universities, research institutes and industry associations including China Electronics Chamber of Commerce, China Aerospace Science and Technology Corporation, China Aerospace Corporation, ZTE and Taiji Computer, etc, mainly in fields of cooperating with relevant government authorities in wisdom city construction policy consulting and standardization construction, providing local governments with wisdom construction application consulting, planning service, industrialization landing, and promoting industrial cooperation between enterprises.

kuraray

可乐丽株式会社
KURARAY CORPORATION

可乐丽是于 1926 年为了实现把当时非常先进的人造丝产业化而创立的。在第二世界大战后的 1950 年又成功地在世界首先实现了 PVA(波瓦尔) 纤维维尼纶的产业化，生产出了日本第一个国产合成纤维，开创了日本化合纤维产业的先河。

Kuraray was created in 1926 to achieve the advanced rayon industrialization . After the second world war in 1950 , it also first achieved PVA nylon fiber industrialized successfully in the world and produced the first domestic synthetic fiber in Japan, created the precedent of Japanese chemical fiber industry.

Marubeni

丸红株式会社
MARUBENI CORPORATION

丸红（中国）有限公司是世界五百强　　丸红株式会社在华的独资企业，从事日中两国间的进出口贸易、第三国贸易以及技术、服务和投融资业务，并运用母公司遍布全球 121 处的分支机构和商业网络，拥有贸易、租赁、项目组织、投资、城市开发和智库等多项功能，还兼备强大的资金实力、丰富的人才、经验诀窍和技术。

本公司在创业 150 年所积累的丰富经验的基础上，今后将进一步发挥综合商社的多样化功能，遵循正、新、和之精神，通过公开透明的企业活动，成为对社会经济发展有所贡献，引以为豪的企业。

Marubeni (China) co., LTD., is the world's top five hundreds, marubeni joint-stock company owned in China enterprise, which is engaged in import and export trade between two countries, the third countries trade and technology, services, investment and financing business. By using the parent company across the world's 121 branches and business network, it owns multiple functions such as trade and leasing, project organization, investment, urban development and so on, and also possess a strong financial strength, rich talent, experience, and technology.

The company was created on the basis of rich experience for 150 years, and it will make further diversified functions which is agreed and followed the spirit of right, new and harmonious . Through open and transparent business activities, the company becomes an enterprise which was proud and makes contributions to social economic development.

信息产业防静电产品质量监督检验中心
MII Anti-Static Products Quality Supervision & Testing Center

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信息产业防静电产品质量监督检验中心是工信部下属的电子行业防静电产品质量检测机构，接受对电子工业及有关行业中的防静电产品装备和工程进行质量监督和检验 . 中心同时开展检测分析工作 , 并对提高产品质量和发展新产品提供技术咨询、服务和 ESD 知识的培训及受理质量争议仲裁检验。根据需要 , 可为企业的静电防护系统按照 ANSI/ESD S20.20、IEC 61340-5-1、GJB 3007A 标准进行体系认证辅导。中心作为防静电行业协会的技术支持单位，还承担行业防静电标准制订和修订的组织工作。

MII Anti-Static Products Quality Supervision & Testing Center,underling by Ministry of Industry and Information Technology is the anti-static product quality inspection agencies in the electronics industry, accept anti-static products in electronic industry and relevant industry equipment and engineering quality supervision, inspection and arbitration; And product quality analysis in development of new products technical advice and services, for enterprises to provide electrostatic protection system certification, assessment and ESD knowledge training, at the same time bear the anti-static industry standard formulation and revision work.

中国航天

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上海航天电子有限公司，是我国最早从事航天产品研制，集研究、设计、试制、生产以及环模试验为一体的航天高新技术企业之一，在我国所有重大航天工程项目中均载有公司产品，公司产品先后荣获 150 余项省部级以上科研成果奖，其中国家级科技进步特等奖 5 项，一等奖 16 项，荣获“航天部重大贡献单位”称号。公司现参与了国家中长期科技和技术发展规划 16 个重大专项中 3 个专项的攻关工作，为我国的航天事业、国防建设、国民经济发展作出了重要贡献。

公司是国家武器装备科研生产一级保密资格单位，也是上海市首批高新技术企业，连续 8 年被评为上海市诚信企业，是上海市百家“重合同、守信用”优秀单位，被国家工商行政总局评为全国 1000 家“守合同、重信用”优秀单位。

Shanghai Aerospace Electronics Co., Ltd., is one of China's earliest for an aerospace high-tech enterprises in our country, engaged in the development of aerospace products, set design, production, research, production and environmental test all the major aerospace projects contain products, our products have won more than 150 provincial and ministerial level scientific research achievement awards, the national scientific and technological progress award 5, first prize 16, awarded the "Ministry of aerospace great contribution unit" title. The company is involved in the development of science and technology in the long-term national planning 16 major projects of 3 special research work, and made important contribution to the national economic development in China, national defense, aerospace industry.

The company is the national weapons and equipment research and production of a confidential qualification units, is the first batch of Shanghai high-tech enterprises, for 8 consecutive years that named the integrity of enterprises in Shanghai City, Shanghai city is the hundreds of "heavy contract, keep promise" outstanding unit, was named the 1000 "Shou contract, re credit" units outstanding national administration administration for Industry and commerce.

SCL 静电科技

上海晨隆静电科技有限公司
Shanghai Chenlong Static Technology Co., Ltd.

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上海晨隆静电科技有限公司成立于 2005 年 9 月，它的前身是上海晨隆国际贸易有限公司防静电洁净产品部，由于业务的不断扩大，独立成为一家集研发、生产、销售为一体的专业从事防静电及洁净方面科技产品的企业，是上海防静电工业协会理事长单位；中国制冷空调协会洁净技术委员会理事单位；中国电子学会洁净技术分会会员单位。
公司拥有雄厚的技术研发能力及拥有一支素质高、专业精的技术队伍。公司董事长近年来多次在洁净技术专业论坛上发表论文；2007 年担任《防静电洁净面料》标准制订负责人，此标准已成为国家推荐标准。因此公司在防静电洁净纺织材料的研制、开发、生产技术方面具有坚实的理论基础和丰富的实践经验和深厚的造诣。
公司拥有健全、完善的质量管理网络，已通过 ISO9001 质量管理体系认证。为了给社会提供更专业的防静电洁净技术服务，公司建立了设备齐全、符合国家标准的防静电洁净技术检测中心，并将申报计量认证和国家实验室认证。

Shanghai Chenlong Static Technology, once a division of antistatic cleanroom products of Shanghai Chenlong International Trade Co., Ltd., was established in September 2005. With its quick development of business, it becomes to be a sole professional entity that focuses on R&D, production and sales of antistatic cleanroom products. It is the director member of Shanghai Antistatic Industry Association, member of Cheanroom Technology Committee of China Refrigeration and Air Conditioning, member of Chinese Contamination Control Society.
It has a professional group with strong R&D ability and with good reputation nationwide. The chairman of the company issued paper at professional clean tech forum for many times. In 2007, he was in charge of the compiling of the national standard of antistatic cleanroom fabric. This standard has become the recommended one for use. So, the company has profound base both in theory and practice of the research, development, and production technology of antistatic cleanroom products.
It has systematic quality control management network, and been awarded ISO9001 quality management system authentication. In order to provide more professional service to this industry, Shanghai Chenlong set up antistatic cleanroom technology test center, equipped with advanced instruments, which meets the national standards. And this lab will be inspected for CNAL and CMA approval soon.

HI-CLEAN 佰洁静电检测

上海佰洁静电检测技术中心
Shanghai Hi-Clean Static Test Technology Center

地址：上海市浦东新区杨思玉泉街 57 号　邮编 : 200126
电话：021-5103 5035
传真：021-5889 8195
邮箱：esd@esdtest.org
网站：www.esdtest.org

上海佰洁静电检测技术中心的上海防静电工业协会唯一指定的第三方检测机构，是专业从事静电防护领域检测、咨询、培训、资讯的综合性服务机构，主营项目包括：各类防静电产品及洁净产品的检测、生产场所防静电设施的现场评估、防静电体系的辅导咨询、防静电洁净技术的咨询培训、防静电体系的外包管理等。
上海佰洁静电检测技术中心拥有专业技术人员，所有技术人员均获得防静电（高级）工程师职称，有多年从事静电检测、咨询的经验；拥有与国际接轨的检测设备和检测环境，所有设施设备均符合 ESD S20.20、IEC 61340、IEST-RP-CC003.3 的要求，其中 12%RH 相对湿度的恒湿检测室属国内先进水平；拥有先进的静电防护理论，通过多年实践，将美国防静电协会和国际电工委员会的防静电标准与中国国情相结合并融会贯通，形成符合发展趋势与国际接轨的防静电理论系统。

Shanghai Hi-Clean Static Test Technology Center is the only third-party testing organization designated by Shanghai Electrostatic Protective Industrial Association, and a comprehensive service organization professional in antistatic protection related test, consulting, training and information, with main services including: test of various antistatic products and cleaning products, site evaluation of antistatic facilities in production place, tutorial consulting of antistatic system, consulting and training of antistatic cleaning technology and antistatic system outsourcing management, etc.
Shanghai Hi-Clean Static Test Technology Center boasts professional technical personnel, all of which are equipped with professional titles of antistatic engineer (senior engineer) and many years of experience in static testing and consulting; international-level testing equipment and environment, and facilities in line with ESD S20.20, IEC61340, IEST-RP-CC003.3, of which 12%RH(relative-humidity) constant-humidity testing room is an advanced one in China. The Center also boasts advanced electrostatic protection theory, and has well combined US ESD Association and IEC standards with national situations of China and formed antistatic theory system conforming to development trend and geared to international standards.

加富® FJ™
吉祥® KJ-3®

上海加富橡胶制品有限公司
Shanghai Jiafu Rubber Products Co., Ltd.

地址：上海市崇明县东风公路 3001 号　邮编 : 202177
电话：021-5964 1403
传真：021-5964 3837
邮箱：zb@shdongfengrb.com
网站：www.shdongfengrb.com

上海加富橡胶制品有限公司已有近 30 年生产历史的国企改制企业。现有员工 130 名，技术人员 29 名，固定资产逾千万元，是一家专业研发生产各类橡胶地板、防静电橡胶制品、高低压绝缘地毯、耐油膜及食品级输送带等各种橡胶制品的专业生产企业，是国内生产防静电橡胶制品品种最多、规模最大的企业。企业已通过 ISO9001：2008 质量和 ISO14001：2004 环境管理体系认证，已获得上海高新技术企业、“上海市清洁生产企业”的认定。“加富”、“KJ-3”防静电台垫被上海市品牌建设推进委员会认定为“上海市品牌产品”。企业拥有较强的技术开发能力，已获得亚光抗静电胶板等 12 项国家专利。

Shanghai Jiafu rubber products co., LTD has nearly 30 years production history of state-owned enterprises. Existing 130 employees, technicians, 29, fixed assets of more than ten million yuan, is a professional research and development production of various kinds of rubber flooring, antistatic rubber products, high and low voltage insulation, oil film and food grade conveyor belt and other rubber products specializing in the production of enterprises, is the domestic production of anti-static rubber products most varieties, the largest enterprises. Enterprise has passed ISO9001:2008 quality and ISO14001:2004 environmental management system certification, has acquired Shanghai high and new technology enterprise, the cognizance of "clean production enterprises in Shanghai"."Jiafu", "KJ-3" radio antistatic mat is Shanghai brand construction to promote committee identified as "brand products of Shanghai". Enterprise has strong technical development capabilities, have been got smooth antistatic rubber mat, etc. 12 national patents.

上海金嘉乐空气技术有限公司
SHANGHAI JINJIALE AIR TECHNOLOGY CO., LTD.

地址：上海市闵行区吴河路 118 号　邮编 : 201109
电话：021-6490 4806
传真：021-6490 4806
邮箱：fengzhixin@jiashiqi.com
网站：www.jiashiqi.com

金嘉乐集团始创于 1999 年，是专业从事工业加湿器、除湿机设备研发、设计生产、销售的高新技术企业，现拥有上海金嘉乐空气技术有限公司、北京金嘉乐科技开发有限公司、多个加工组装工厂，并在全国多个打城市设有办事处。拥有全球尖端的空调加湿应用技术，加湿器国家标准制定单位，连续十三年产销量遥遥领先。金嘉乐电子厂加湿器 2003 年中国始创，累计 1000 多个客户安装经验。

金嘉乐集团 上海金嘉乐空气技术有限公司 加湿专家 * 湿度专家 * 除湿专家 ww.jiashiqi.com 中国加湿器网　www.chushiji.com.cn 中国除湿机网　公司地址：上海市莘建东路 58 弄绿地技岛广场 B 座 1207

上海路阳仪器有限公司
Shanghai Luyor Instrument Co., Ltd.

地址：上海市南乐路 1276 弄 115 号 10 号楼 6 楼　邮编 : 201161
电话：021-6049 8696
传真：021-5186 1392
邮箱：574242291@qq.com
网站：www.luyor.net

上海路阳仪器有限公司是美国路阳仪器公司在中国投资设立的分公司，负责中国地区的研发、生产、销售和服务公司，主要从事特殊光源的研发，产品主要有便携式紫外线手电筒、手持式紫外线黑光灯、吊挂式黑光灯，主要应用于产品表面灰尘、纤维、油污等污染检测，产品被广泛用在半导体行业、航空航天的航空器组装企业以及洁净室机台表面的污染检查。

Shanghai Luyor Instrument Co. Ltd. which is invested by American luyor Instrument Co. Ltd. has sole proprietorship. Luyor specializes in developing special light source and has successfully produced portable blacklight , uv flashlight and suspended blacklight . Blacklight are mainly used in detecting particles on the products or dust particles on equipment in the clean room and in validating cleaning process in pharmaceutical factories. Green light surface inspection lamps are mainly used in detecting particles and scratches on wafer, glass screen and stainless steel.

深圳市中明科技开发有限公司
Shenzhen HORB Technologies Development Co., Ltd.

地址：深圳宝安福永新田大道福宁高新产业园 B 栋 5-7 楼　邮编 : 201109
电话：0755-2946 1997
传真：0755-2946 1361
邮箱：jack0026@horb.com.cn
网站：www.horb.com.cn

深圳市中明科技开发有限公司是一家集研发、生产、销售为一体，专业从事防静电用品、无尘室净化用品及各类静电检测设备的公司，是中国电子仪器行业协会防静电装备分会的理事单位、上海防静电协会会员单位、美国 ESDA 防静电协会会员单位。

旗下有：上海泽蓝电子有限公司、深圳市海峰科技开发有限公司、深圳市博瑞思咨询服务有限公司。我们致力站在专业的基石上，从软、硬件两方面抓起，力争成为我们客户心中最专业的供应商。

随着社会经济的不断发展，同行业竞争日烈加剧，市场只是提供了机会，而品质才是公司赖以生存的命脉，公司不断引进先进的科学管理软件和仪器设备，广纳技术、销售人才，力求在产品质量、销售价格上达到客户的满意。树立 品牌，进一步提高市场的竞争力。我们会一直坚持以踏实的营销理念，敏锐的市场触觉，科技完善的管理体系，优质快捷的服务，在业界享有良好信誉，并且我们将会一直遵循“以持续改进提升系统管理，以质量服务追求客户满意”的质量方针，真诚为广大客户服务！

Shenzhen HORB Technologies Development Co., Ltd. is a collectivize company related to R&D, manufacture and marketing in the areas of antistatic and clean room products, electronic tools, checkout equipments and electronic chemical products. We are the member of Antistatic Device Committee of China Electronic Instrument Association, board of directors of Shanghai Antistatic Association and also the member of the ESDA of USA.

We successfully obtained ISO 9001:2000 Quality Management System certification. We enhance system management by continuous innovation, and raise customer satisfaction by offering excellent service and price.

As national economy transfers to market-oriented one from planned one, the competition becomes more and more cut- throat. The markets offer the opportunities, while quality of product is company's lifeline. We've deployed advanced management software and facilities, and invited many technical specialists and talented salespersons to join us to offer our customers excellent products at titive price. We've built “ ” brand, and are working hard to hold more market shares. We've established partnerships with many domestic and overseas famous electronics manufacturers, and get their supports.

In order to provide more comprehensive services, we have set some branches and offices both in China and abroad. Sincerely looking forward to cooperating with you in near future!

SSC-Pak

三创包装
SSC-Pak Package Material

地址：上海嘉定黄渡工业园春雨路 132 弄 6 号 2 栋东　邮编 : 201804
电话：021-3206 0161, 5269 3024
邮箱：newera2000@139.com

SSC-Pak 系列微电子包装材料含 carrier tape,cover tape,reel, IC-tray,IC-Tube,Sheilding bag,moisture vapor barrier bag, 主要技术优势是有别于传统的碳基导电和抗静电剂产品，提供永久防静电的耗散型的相应产品，是真正意义上用于抽真空条件下防静电包装产品。行业中三家资深的企业浙江三威防静电装备有限公司，浙江三和塑料有限公司，上海创纪科技发展有限公司发挥各自的优势，联合推出的品牌，品牌产品提供系统化的包装解决方案，最大限度的为客户节省成本。客户可联系三家企业中任何一家。电话：

三威：021-62446776

三和：0579-849199888

创纪：021-32060161

SSC-Pak seriers package material for Micro-electronics industry include carrier tape, cover tape, reel, IC-tray,IC –tube, shielding bag, moisture vapor barrier bag. The technical advantage is application of inherently disspative polymer in these products. And these products are different from traditional ones that apply carbon-based technology and antistaic-agent doped technology. The ssc-pak seriels package material is real antistatic products in Vacuum or low humidity condition.

The three companys as Zhejiang sanwei,zhejiangsanhe,and shanghai newera are famous in the electrostatic-protection industry in china mainland. The SSC-Pak is jointly launched brand by these three companys based on their different advantage. The brand “SSC-Pak” products supply system solution for Microelectronics package plan.

Customer can contact anyone of the three company:

Sanwei: 021-62446776

Sanhe: 0579-84919988

Newera: 021-32060161

JiNGR® 景瑞科技

苏州景瑞静电科技有限公司

Suzhou jingrui electrostatic Technology Co., Ltd.

地址：江苏苏州相城区凤阳路 438 号 2 号　邮编 : 215138
电话：0512-6290 5377
传真：0512-6274 2799
邮箱：wrj@jrjdkj.com
网站：www.jrjdkj.com

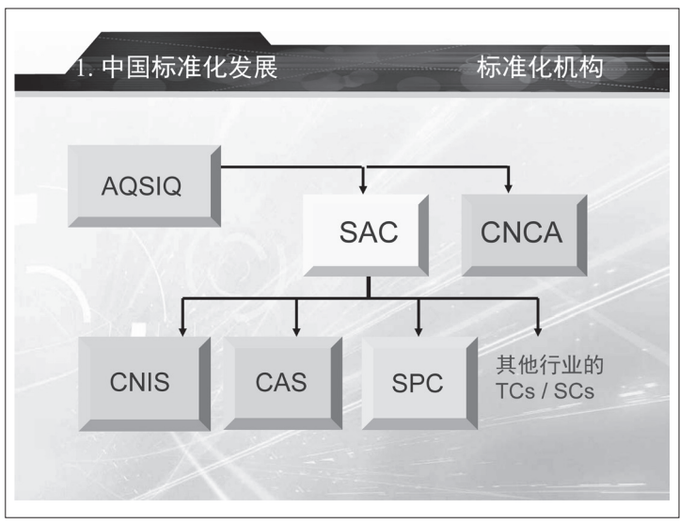
景瑞企业是一家专业生产防静电、无尘工作服、特种防护服、防静电手套及净化产品的高科技企业。公司拥有国内目前最先进的生产流水线，雄厚的技术力量，严格的管理体制和完善的检验标准，公司生产的每件产品的质量都符合国家 GB12014-2009 标准。

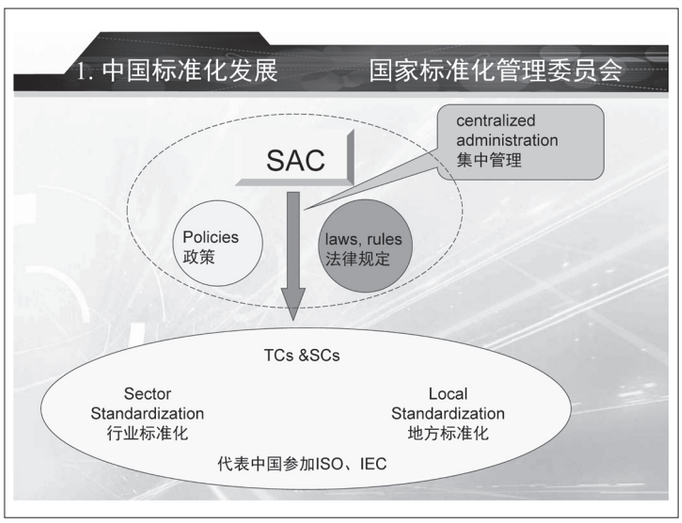
公司产品广泛应用于光电、IT、通讯、电子加工、生物医疗、石化及食品等行业。产品主要包括人体静电防护类（防静电服、工鞋、手套、手腕带、口罩、帽子等）；生产静电防护类（防静电台垫、防静电工作椅等）；净化室用品类（无尘纸、无尘抹布、粘尘垫、棉签等）；特种防护类（耐酸碱工作服、防辐射工作服、阻燃服）。

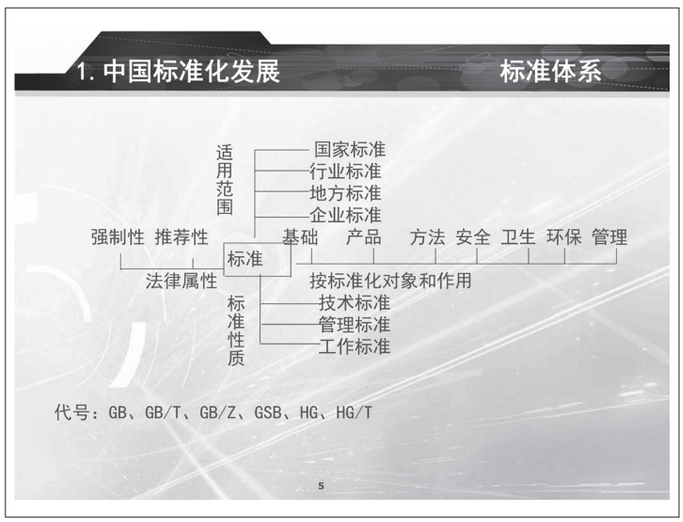
公司生产的防静电超净工装，面料织入了国际上最新型的进口导电纤维，完全不同于传统的防静电整理，属于永久性的防静电面料。从而达到耐洗涤，导电丝不断裂，导电性能好同时又减少了产品本身对尘埃微粒的附着力。

景瑞科技自成立以来，以自身的竞争力在防静电装备行业站住了绝对的优势，“质量高、技术硬、交货快、服务好”是景瑞对广大客户的一贯承诺。公司因良好的发展态势，正处于不断壮大之中，我们真诚期望与您合作，共创辉煌！

A2 中国城市可持续发展及静电防护标准化进展
Standardization Progress of Sustainable Development of Communities and Electrostatic Protection







A2 中国城市可持续发展及静电防护标准化进展
Standardization Progress of Sustainable Development of Communities and Electrostatic Protection

1. 中国标准化发展 发展规划

- 质量发展纲要（2011-2020）
  国发[2012]9号，国务院，2012年2月6日
- “十二五”技术标准科技发展专项规划
  国科发计[2012]1100号，科技部、质检总局、国家标准委，2012年11月30日
- 标准化事业发展“十二五”规划
  国标委综合[2011]79号，国家标准委，2011年12月23日

1. 中国标准化发展 改革动向

- 2014年全国标准化工作会议
  构建新型标准体制（标准自身、标准管理）
- 两种性质、三种类型
  - 强制性、推荐性
  - 国家强制标准、政府推荐标准、社会组织标准
- 国家强制性标准 ---技术法规
- 政府推荐标准---基础通用、方法（强制性标准配套）
- 社会组织标准---发展到一定程度，被引用、采用
- 改革强制性标准、优化推荐性标准、培育发展社会组织标准

内容

1. 中国标准化发展
2. 城市可持续发展
3. 静电防护标准化进展

2.城市可持续发展

ISO/TC 268 城市可持续发展技术委员会
ISO/TC 268/SC1 智慧城市基础设施分技术委员会

- 2012年2月23日，ISO（国际标准化组织）批准成立
- 联合国、世界银行等国际组织，以及各国对可持续发展标准化的需求

2.城市可持续发展

组织结构	工作范围	标准
ISO/TC 268 主席咨询组（CAG） —TC 主席、秘书 —SC 分技术委员会主席，秘书 —WG 工作组召集人		
WG1	管理体系标准	ISO/WD 37101
WG2	城市指标	ISO/37120 ISO/TR 37121
WG3	术语	ISO NWIP 37102
ISO/TC 268/SC1 智慧城市基础设施 WG1	智慧城市基础设施量化	ISO/PWI 37151 ISO/ TR 37150
WG2	智慧城市基础设施的集成和交互框架	

2.城市可持续发展

- ISO 37120:2014

  城市可持续发展 —— 城市服务和生活质量指标
- 2014年5月14日发布
- ISO/TC 268发布的第一项标准

通过建立了一套指标体系以帮助不同类型的城市衡量其城市服务和生活品质，其根本目的是衡量一段时间内城市的城市服务和生活品质的管理绩效，通过同类型城市之间的绩效横向比较，及时发现城市推进可持续发展过程中的不足之处，并与其他城市分享成功经验。

A2 中国城市可持续发展及静电防护标准化进展
Standardization Progress of Sustainable Development of Communities and Electrostatic Protection

1.城市可持续发展

ISO 37120:2014

NO.	类别	核心指标	辅助指标
1	经济	3	4
2	教育	4	3
3	能源	4	3
4	环境	3	5
5	财政	1	3
6	火灾及应急	3	3
7	治理	2	4
8	健康（卫生）	4	3
9	娱乐		2
10	安全	2	3
11	避难所	1	2
12	固体废弃物	3	7
13	电信及创新	2	1
14	运输	4	5
15	城市规划	1	3
16	废水	5	
17	水及卫生	4	3

2.城市可持续发展

中国标准化研究院公共安全标准化研究所

- ❖承担ISO/TC268 城市可持续发展标准化技术委员会国内技术对口工作；
- ❖筹建国内标准化技术委员会；
- ❖研究方向
  - ☆ 城市可持续发展基础理论研究
  - ☆ 城市可持续发展标准体系建设
  - ☆ 城市可持续发展管理体系标准研究
  - ☆ 城市可持续发展评估体系标准研究
  - ☆ 智慧城市标准研究

14

2.城市可持续发展

ISO 37120:2014 试点城市

2. 城市可持续发展

组织ISO 37120:2014 在中国的试点城市

试点工作的目的

——了解ISO 37120在全球范围内的适用性，为ISO 37120的修订工作（2014年9月2日完成投票）提供数据和案例支撑。

——将具有中国特色的城市可持续发展成熟经验和做法融入到新版本的ISO 37120标准中去。

内容

1. 中国标准化发展
2. 城市可持续发展
3. 静电防护标准化进展

3、静电防护标准化进展

国家ESD标准（GB）

TC49包装（1）、TC272表面活性剂和洗涤用品（1）、TC150地毯（1）、TC209纺织品（9）、TC219服装（3）、TC39纤维增强塑料（1）、TC35橡胶与橡胶制品（2）、TC113消防（2）、TC36带电作业（1）、TC112个体防护装备（2）、TC231工业机械电气系统（1）、TC154量度继电器和保护设备（1）、TC246电磁兼容（1）、TC114汽车（1）、TC288安全生产（1）、TC71橡胶塑料机械（1）、TC25电气安全（1）

化学工业专业标准化技术归口单位（1）

中国兵器工业集团公司（1）

中华人民共和国工业和信息化部（1）

国家安全生产监督管理局（1）

A2 中国城市可持续发展及静电防护标准化进展
Standardization Progress of Sustainable Development of Communities and Electrostatic Protection

3、静电防护标准化进展

军用、国防ESD标准（GJB、GJB-K）

共22项，侧重于防静电设计与通用要求、静电防护装备、静电放电试验及危险品静电安全性试验方法等。

19类行业标准共71项

电子、通信、兵工民品、化工、煤炭、航天、核工业、安全生产、纺织、石油、邮电通信、交通、轻工、石油化工、民用航空、劳动和劳动安全、铁道、教育、林业等19个行业发布了ESD相关行业标准共71项。

其中，多个行业普遍对产品防静电技术、检测方法、安全规程、静电放电敏感度测试、接地设计、静电性能测试等方面提出了标准化要求。

3、静电防护标准化进展

“静电防护与标准化学术交流会”

http://www.esd-conf.org/cn/zwh/

主办单位：

中国标准化研究院

中国空间技术研究院

电磁环境效应国家级重点实验室

美国贸易开发署

美国国家标准学会（ANSI）

美国静电放电协会（ESDA）

- 2012年11月， 第一届，北京
- 2013年11月， 第二届，苏州
- 2014年10月， 第三届，上海

3、静电防护标准化进展

- 中国标准化研究院上报筹建TC申请；
- 组织国家标准立项：
  - 静电防护管理体系通用要求；
  - 静电屏蔽包装袋要求及检测方法；
  - 防静电台垫
- “培育发展社会组织标准”
  - 静电防护标准化
  - 社会组织标准 ⟹ 政府标准

谢谢！

中国标准化研究院
公共安全标准化研究所
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电话：010-58811385
E-mail: guodh@cnis.gov.cn

Standardization Progress of Sustainable Development of Communities and Electrostatic Protection

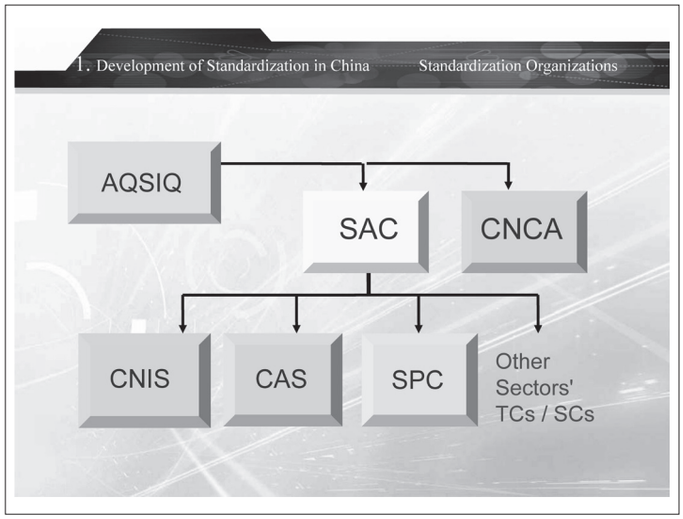
China National Institute of Standardization
Institute of Public Security Standardization
Guo Dehua

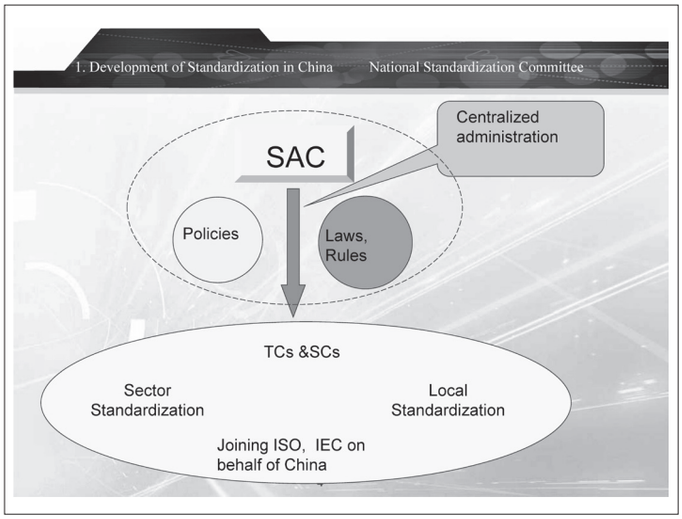
Oct. 14, 2014

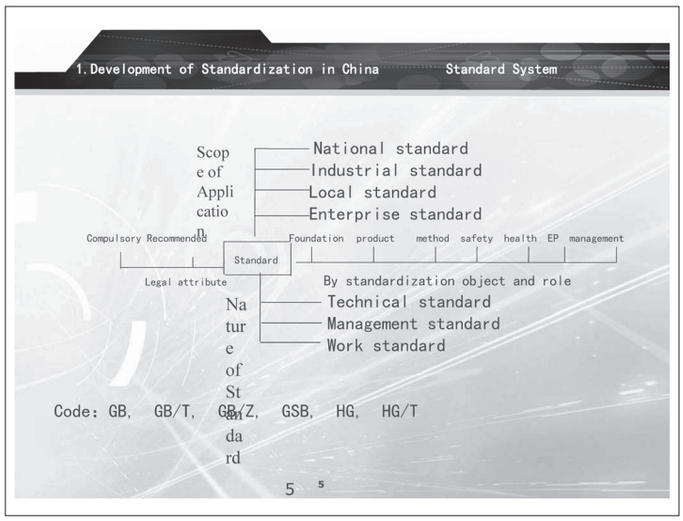
Contents

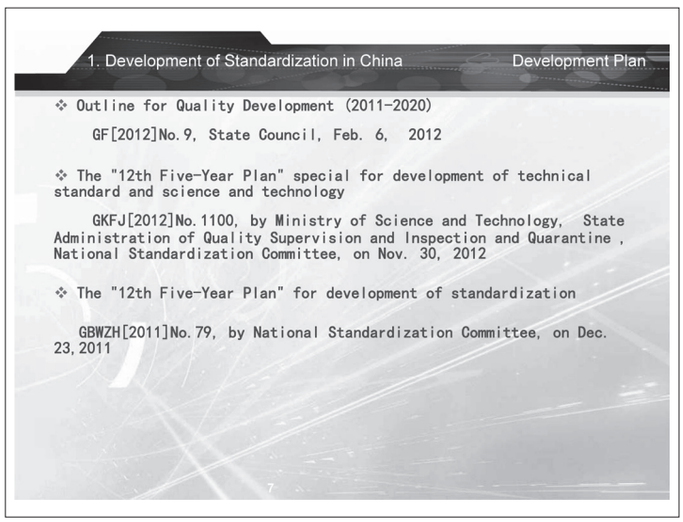
1 Development of Standardization in China
2 Sustainable Development of Communities
3 Progress in Electrostatic Protection Standardization

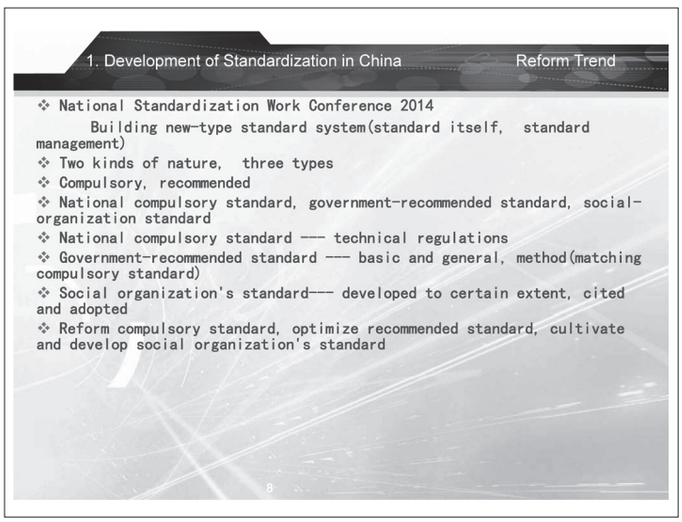
A2 中国城市可持续发展及静电防护标准化进展
Standardization Progress of Sustainable Development of Communities and Electrostatic Protection











A2 中国城市可持续发展及静电防护标准化进展
Standardization Progress of Sustainable Development of Communities and Electrostatic Protection

Contents

1. Development of Standardization in China
2. Sustainable Development of Communities
3. Progress in Electrostatic Protection Standardization

2.Sustainable Development of Communities

ISO/TC 268 Technical Committee for Sustainable Development of Communities

ISO/TC 268/SC1 Sub-Technical Committee for Smart City Infrastructure

❖ Established on Feb. 23, 2012 as approved by ISO(International Standardization Organization)

❖ Demands for standardization of sustainable development of international organizations such as UN, World Bank and all countries

10

2.Sustainable Development of

Organization Structure	Scope of Work	Standard
ISO/TC 268 Chairman Advisory Group(CAG) —TC Chairman, Secretary —SC Sub-Technical Committee Chairman, Secretary —WG Working Group convener		
WG1	Management system standard	ISO/WD 37101
WG2	City Indicator	ISO/37120 ISO/TR 37121
WG3	Term	ISO NWIP 37102
ISO/TC 268/SC1 Smart City Infrastructure — WG1	Smart City infrastructure quantization	ISO/PWI 37151 ISO/ TR 37150
WG2	Smart City infrastructure integration and interactive frame	

2.Sustainable Development of Communities

- *ISO 37120:2014*

  Sustainable Development of Communities —— Indicators for City Services and Quality of Life

- *Released on May 14, 2014*
- *The first standard released by* ISO/TC

通过建立了一套指标体系以帮助不同类型的城市衡量其城市服务和生活品质。其根本目的是衡量一段时间内城市的城市服务和生活品质的管理绩效，通过同类型城市之间的绩效横向比较，及时发现城市推进可持续发展过程中的不足之处，并与其他城市分享成功经验。

ISO 37120

Sustainable development of communities

Indicators for city services and quality of life

First edition 2014-05-15

1.Sustainable Development of Communities

ISO 37120:2014

NO.	Type	Core Indicator	Auxiliary Indicator
1	Economy	3	4
2	Education	4	3
3	Energy	4	3
4	Environment	3	5
5	Finance	1	3
6	Fire and emergency response	3	3
7	Treatment	2	4
8	Health	4	3
9	Entertainment		2
10	Safety	2	3
11	Refuge	1	2
12	Solid waste	3	7
13	Telecommunication and innovation	2	1
14	Transportation	4	5
15	City planning	1	3
16	Waste water	5	
17	Water and health	4	3

2.Sustainable Development of Communities

China National Institute of Standardization

Institute of Public Security Standardization

❖undertake domestic technical connection with the Technical Committee for ISO/TC268 Standardization of Sustainable Development of Communities ;

❖ prepare domestic technical committee for standardization;

❖Research orientation

☆ Research on basic theory for Sustainable Development of Communities

☆ Building of standard system for Sustainable Development of Communities

☆ Research on management system standard for Sustainable Development of Communities

☆ Research on evaluation system standard for Sustainable Development of Communities

☆ Research on standard for smart city

14

A2 中国城市可持续发展及静电防护标准化进展
Standardization Progress of Sustainable Development of Communities and Electrostatic Protection

2.Sustainable Development of Communities

ISO 37120:2014 Pilot Cities

2. Sustainable Development of Communities

Organizing pilot cities in China of ISO 37120:2014

试点工作的目的

——了解ISO 37120在全球范围内的适用性，为ISO 37120的修订工作（2014年9月2日完成投票）提供数据和案例支撑。

——将具有中国特色的城市可持续发展成熟经验和做法融入到新版本的ISO 37120标准中去。

Contents

1. Development of Standardization in China
2. Sustainable Development of Communities
3. Progress in Electrostatic Protection Standardization

3. Progress in Electrostatic Protection Standardization

National ESD Standard(GB)

TC49 Packing(1), TC272 Surfactant and Cleaning Article(1), TC150 Carpet(1), TC209 Textiles(9), TC219 Garment(3), TC39 Fiber-Glass-Reinforced Plastic(1), TC35 Rubber and Rubber Products(2), TC113 Fire Control(2), TC36 Live-line Work(1), TC112 PPE(2), TC231 Industrial Machinery Electric System(1), TC154 Measuring Relay and Protection Device(1), TC246 Electromagnetic Compatibility(1), TC114 Automobile(1), TC288 Safety in Production(1), TC71 Rubber Plastic Machinery(1), TC25 Electric Safety (1)

Competent technial unit for standardization of chemical industry(1)

China North Industries Group Corporation (1)

Ministry of Industry and Information Technology, the People's Republic of China(1)

State Administration of Work Safety(1)

3. Progress in Electrostatic Protection Standardization

Military and national defense ESD standards(GJB, GJB-K)

Totaling 22 standards, with particular emphasis on antistatic design and general requirements, electrostatic protection equipment, ESD test and hazardous articles electrostatic safety test method, etc.

71 standards in 19 industries

19 industries, including electronics, communication, arsenal and civil products, chemicals, coal, space, nuclear industry, safety in production, textile, oil, post and telecommunication, traffic, light industry, petrochemicals, civil air, labor and labor safety, railway, education and forestry, etc, released 71 ESD-related industrial standards.

Of which, multiple sectors advanced requirements for standardization in product antistatic technique, testing method, rules for safety, ESD sensitivity test, grounding design, electrostatic property test, etc.

3. Progress in Electrostatic Protection Standardization

" Electrostatic Protection and Standardization Seminar"

http://www.esd-conf.org/cn/zwh/

Sponsors:

China National Institute of Standardization

China Academy of Space Technology

National Key Laboratory for Electromagnetic Environmental Effects

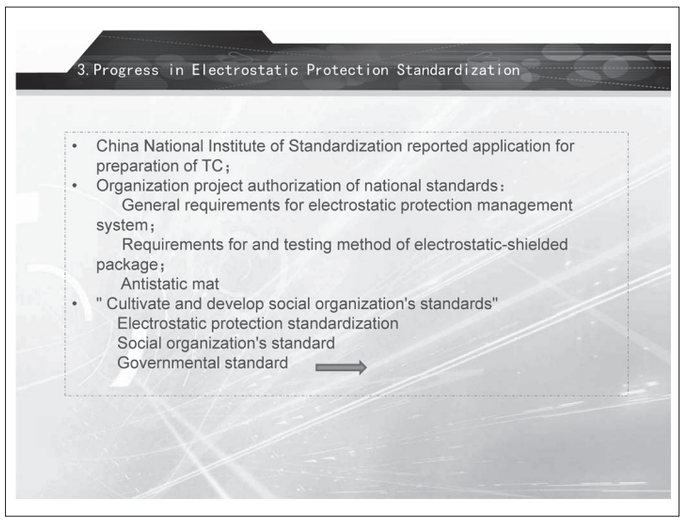
US Trade and Development Agency

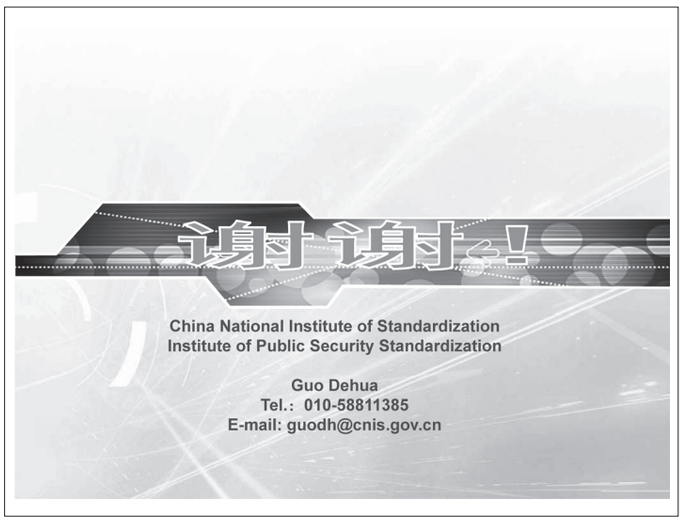
American National Standard Institute(ANSI)

US Electrostatic Discharge Association(ESDA)

- Nov. 2012, the first session, Beijing
- Nov. 2013, the second session, Suzhou
- Oct. 2014, the third session, Shanghai

A2 中国城市可持续发展及静电防护标准化进展
Standardization Progress of Sustainable Development of Communities and Electrostatic Protection





A3 ANSI/ESD S20.20 的更新及与IEC 61340-5-1的关系
The Updates to ANSI/ESD S20.20 and Their Relation to IEC 61340-5-1

ANSI/ESD S20.20-2014

John Kinnear

ANSI/ESD S20.20 – 2014

- 2014年8月发布
- 最新资料包括下列内容
  - 范围
  - 裁剪条款
  - 产品质量检测
  - 人体接地
    - 表 2

ANSI/ESD S20.20 – 2014

- 工艺过程中必要的绝缘物
- 孤立导体
- 表3 项目
  - 腕带插孔检查
  - 烙铁
  - 电离作用（离子化）
- 包装
- 附录

范围 （2.0）

- 人体模型（HBM）目标保持不变
  - 2007 版 100 v HBM
  - 2014 版 100 v HBM
- 增加了充电装置模型（CDM）
  - 2014 版 200 v CDM
    - 注意，对绝缘物的控制和CDM模型感应部位的控制
- 孤立导体
  - 2014 版 35 v，用于孤立导体上
    - 以前处置过程控制中，对机械模型的控制多少有些相关

- 该标准不要求对装置进行机器模型测试

裁剪条款 （6.3）

- 对有关部分进行了澄清（解释）
- 删除了要求条件
  - 仍要求技术论证
- 极限值设定在20.20范围之内
  - 不要求做出改编说明
    - 例如，工作面对地电阻为$1x10^5$ 欧姆 – $1x10^8$ 欧姆
- 极限值设定在20.20范围之外
  - 仍要求进行改编说明
    - 例如，工作面对地电阻为低于$1x10^{10}$ 欧姆

产品质量检测 （7.3）

- 产品质量检测 （7.3）
  - 增加了整个部分 （说明，不是新的）
  - “应制定产品质量检测计划，确保所选择的ESD控制项目符合计划的要求。测试方法和要求的极限值列于表2和表3的产品质量检测栏中。产品质量检测正常情况下在初始选择ESD控制项目期间进行。下列方法中的任何一种均可使用：产品规格审核，独立实验室评价或内部实验室评价。 对于在采纳本标准前由组织设置的ESD控制项目，现行的合规验证记录可以用作产品质量检测的证据。”

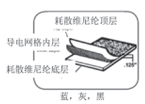
A3 ANSI/ESD S20.20 的更新及与IEC 61340-5-1的关系
The Updates to ANSI/ESD S20.20 and Their Relation to IEC 61340-5-1

产品质量检测

表3 EPA ESD 控制项目

技术要求	ESD 控制项目	产品鉴定（1）		合规验证	
		测试方法	要求的极限值（7）	测试方法	要求的极限值
EPA	工作面（8,9）	ANSI/ESD S4.1	点对点电阻<1×10⁹欧姆 点对可接地点电阻<1×10⁹欧姆	ESD TR53工作面部分	点对点电阻<1×10⁹欧姆
		ANSI/ESD STM4.2	<200V		
	腕带	ANSI/ESD S1.1	0.8×10⁶欧姆~1.2×10⁸欧姆	有关腕带系统的合规验证，参见表2。	
	腕环	ANSI/ESD S1.1	内部<1×10⁹欧姆 外部>1×10⁶欧姆		
	人员接地腕带的连接（非监控式）	ANSI/ESD S6.1	点对地电阻 <2欧姆	ESD TR53 接地加固系统	对地电阻<2欧姆
	工作鞋	ANSI/ESD STM9.1	点对可接地点电阻<1×10⁹欧姆	有关工作鞋和地板系统的合规验证，参见表2。	
	接地脚环	ESD SP9.2	点对可接地点电阻<1×10⁹欧姆		
	地板	ANSI/ESD S7.1	点对点电阻<1×109欧姆 点对可接地点电阻<1×109欧姆		
	支架	ANSI/ESD STM12.1	点对可接地点电阻<1×109欧姆	ESD TR53 底座部分	点对地电阻<1×109欧姆

产品质量检测实例



描述：
Z2TM垫子是一种125英寸厚3层耗散性热熔融维尼伦复合材料，旨在提供一种接地通路，在用作工作面办公桌垫、货架衬板和手推车货架衬板时消除静电电荷的产生。其表层的表面电阻（1×10E6<1×10E9欧姆Rtt）符合ANSI/ESD S20.20工作面要求极限以及ANSI/ESD S4.1对与ESD敏感项目接触的推荐要求。导电的（<10E4 欧姆Rtt）中间层能够减少从垫子表层到可接地点地面的对地电阻（Rtg），并使垫子可用于ESD工作站连续监控器。有耗散性（1×10E6<1×10E9欧姆Rtt）垫层的底层还可以吸收能量，用于对物理震动敏感的部件。

电性能：

性能	测试方法	测试值
电荷衰减：	FTMS 101C, M4046	<0.01秒
Rtt电阻：	ANSI/ESD S4.1	1×10E6<1×10E9欧姆
Rtg电阻：	ANSI/ESD S4.1	1×10E6<1×10E9欧姆

规格：
结构： 热熔融维尼伦复合结构
厚度： 0.125英寸（3.2mm）
颜色：* 蓝色，灰色，黑色
纹理：* 浅压花
硬度： 45邵肖氏“A”，按ASTM-D412标准
抗拉强度：大于300psi，按ASTM-D412标准
撕裂强度：大于80lbs/英寸，按ASTM-D624标准
伸长率： 大于80%，按ASTM-D412标准
耐磨度： 大于750吨，按Taber-CS17标准
耐热性： -20° F - 140° F，连续
耐化学性：耐无机酸、有机酸、还原剂、链烃、矿物油、乙醇和胺类造成的降解。

*颜色和纹理各批次和工厂之间会有变化。
接地：这种材料必须妥善接地才能保证最佳电性能。 垫子接地说明查阅技术公告TB-2000。
清洁：为了保证最佳电性能，表面必须用ESD热清洁剂定期清洁。我们建议使用我们的Rextore表面和垫子清洁剂。不要使用含硅酮的清洁剂。硅酮聚积会在有面产生一层绝缘膜。

铺垫材料初次展开时易轻微收缩，在长度很关键的应用场合，要先让这种材料保持松弛至少4小时才能裁切到要求的规格。要始终用锋利的刀子或剃须刀片进行修整。

免责声明：
本文件中的所有声明、技术资料和建议均基于我们相信可靠的测试，然而，对这些测试的准确性或完整性不做保证。妥善、正确地应用相关产品和资料是用户的责任。本文件中不含的声明或建议均无效力，除非其出现在授权官员签字的书面协议中。

有限期使用寿命保证：
Desco有限公司保证铺垫产品一年内不会出现材料和工艺方面的缺陷，且防静电/导电垫的性能在垫子的使用寿命期间保持正常。因任何误用对垫子造成的损坏，包括使用不当的清洁剂的情况，不包括在Desco有限公司的质保范围内。

RoHS合规声明

人体接地

- 腕带系统没有变化
- 地板/工作鞋系统
  - 2007 版
    - 如果低于 3.5x10⁷ 欧姆， 考虑电阻法
    - 对于高于3.5x10⁷ 欧姆低于1x10⁹ 欧姆的系统要求进行行走测试
  - 2014 版
    - 对地板/工作鞋系统要求进行电阻和行走测试

人体接地

2007 版

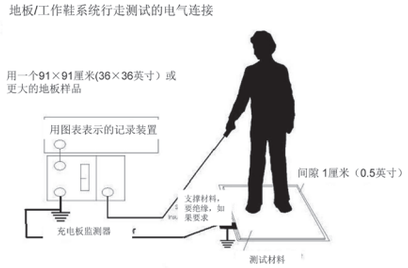
个人接地技术要求	产品鉴定[1]		合规验证	
	Test Method	Required Limit(s)	Test Method	Required Limit(s)
腕带系统[2]	ANSI/ESD S1.1 (Section 5.11)	< 3.5 x 10^7 ohms	ESD TR53 Wrist Strap Section	< 3.5 x 10^7 ohms
地板/工作鞋系统 - 方法1	ANSI/ESD STM97.1	< 3.5 x 10^7 ohms	ESD TR53 Flooring Section	< 3.5 x 10^7 ohms
			ESD TR53 Footwear Section	< 3.5 x 10^7 ohms
地板/工作鞋系统 - 方法2（两个都要求）	ANSI/ESD STM97.1	< 10^9 ohms	ESD TR53 Flooring Section	< 1.0 x 10^8 ohms
	ANSI/ESD STM97.2	< 100 volts	ESD TR53 Footwear Section	< 1.0 x 10^8 ohms

2014 版

技术要求	产品鉴定[1]		合规验证	
	Test Method(s)	Required Limit(s)	Test Method(s)	Required Limit(s)
腕带系统	ANSI/ESD S1.1 (Section 5.11)	< 3.5 x 10^7 ohms	ESD TR53 Wrist Strap Section	< 3.5 x 10^7 ohms
地板/工作鞋系统 - 方法（2）（两个极限值都必须满足）	ANSI/ESD STM97.1	< 1.0 x 10^9 ohms	ESD TR53 Footwear Section	< 1.0 x 10^9 ohms[5]
	ANSI/ESD STM97.2	< 100 volts Peak	ESD TR53 Flooring Section	< 1.0 x 10^8 ohms[6]

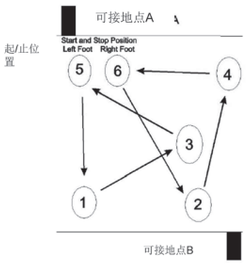
人体接地

- 对于所有的地板/工作鞋系统现在均要求按ANSI/ESD STM 97.2进行行走测试。



人体接地

- 按ANSI/ESD S97.2进行行走测试
  - 允许备选模式（范型），参见附录

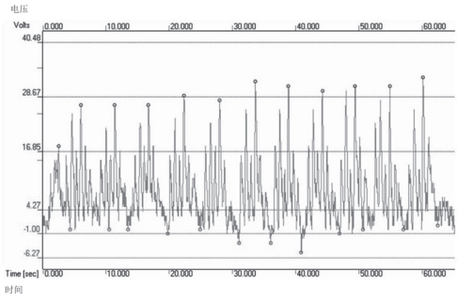


A3 ANSI/ESD S20.20 的更新及与IEC 61340-5-1的关系
The Updates to ANSI/ESD S20.20 and Their Relation to IEC 61340-5-1

2014/10/9 ESD 协会 13

人体接地 – 为什么?

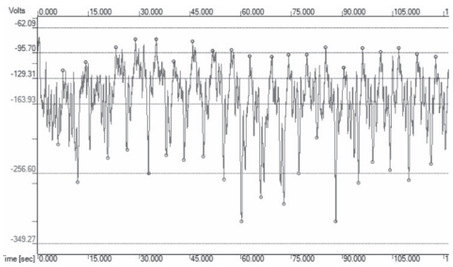
- 符合电阻规格要求的地板/工作鞋系统典型测试数据



2014/10/9 ESD 协会 14

人体接地 – 为什么?

- 该地板也符合2007标准的电阻要求



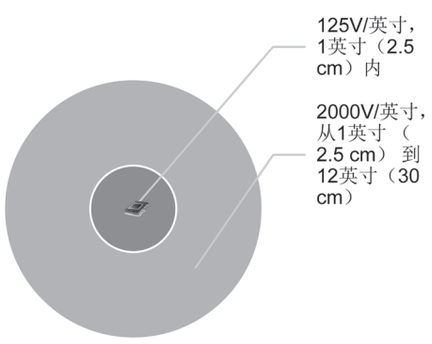
2014/10/9 ESD 协会 15

工艺过程中必要的绝缘物

- 当电场小于2000V/in(或79000V/m)时，绝缘物应距离ESDS 30cm（12英寸）以上，此要求没有改变
- 当电场小于125V/in(或5000V/m)时，绝缘物应距离ESDS 2.5cm（1英寸）以上，是新的要求
- 该规定支持范围内的新CDM目标

2014/10/9 ESD 协会 16

工艺过程中必要的绝缘物



2014/10/9 ESD 协会 17

孤立导体（新增）

- 与ESD敏感器件接触的孤立导体应具有不超过 ±35V的电压
- 测量应该用静电非接触式电压表或高阻抗接触式电压表进行

2014/10/9 ESD 协会 18

表3 变化项目

- 腕带
  - 删除了腕带软线弯曲寿命部分
- 增加了人体接地腕带连接部分
  - 2 欧姆对地电阻（除非线路中有1 Meg（兆欧）的电阻器）
- 电离作用（离子化）
  - 删除了室内系统
  - 将残余电压改为 35V
- 增加了电焊/解焊手动工具
  - 根据新规范ANSI/ESD S13.1

A3 ANSI/ESD S20.20 的更新及与IEC 61340-5-1的关系
The Updates to ANSI/ESD S20.20 and Their Relation to IEC 61340-5-1

表3

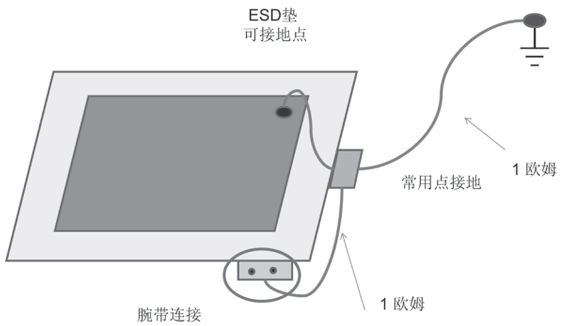
技术要求	ESD控制项目	产品鉴定 (7) Test Method	产品鉴定 (7) Required Limit(s) (8)	合规验证 Test Method	合规验证 Required Limit(s)
EPA	飞线面（鉴定可通过两个测试方法中的任意一个进行）	ANSI/ESD S4.1	Point to Point < 1 x 10^9 ohms Point to Groundable Point < 1 x 10^9 ohms	ESD TR53 Worksurface Section	Point to Ground < 1 x 10^9 ohms
		ANSI/ESD STM4.2	< 200 volts		
	腕带	ANSI/ESD S1.1	0.8 x 10^6 to 1.2 x 10^8 ohms	有关腕带系统的合规验证，参见表2。	
	腕环	ANSI/ESD S1.1	Interior < 1 x 10^9 ohms Exterior < 1 x 10^9 ohms		
	人员接地腕带的连接（非监控式）	ANSI/ESD S6.1	Point to Ground < 2 ohms	ESD TR53 Grounding Bonding Systems	Point to Ground < 2 ohms
	工作鞋	ANSI/ESD STM9.1	Point to Groundable Point < 1 x 10^9 ohms	For compliance verification of Footwear / Flooring System, see Table 2	
	接地脚环	ESD SP9.2	Point to Groundable Point < 1 x 10^9 ohms		
	地板	ANSI/ESD STM7.1	Point to Point < 1 x 10^9 ohms Point to Groundable Point < 1 x 10^9 ohms		
	座椅	ANSI/ESD STM12.1	Point to Groundable Point < 1 x 10^9 ohms	ESD TR53 Seating Section	Point to Ground < 1 x 10^9 ohms

清楚说明测量值

表3

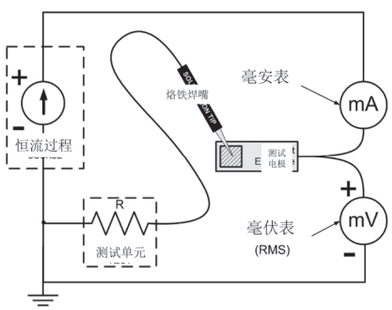
技术要求	ESD控制项目	产品鉴定 (7) Test Method	产品鉴定 (7) Required Limit(s) (8)	合规验证 Test Method	合规验证 Required Limit(s)
EPA	室内系统之外的电离作用	ANSI/ESD STM3.1	Discharge Time User defined Offset Voltage 35 < V_{offset} < 35	ESD TR53 (11) Ionization Section	Discharge Time User defined Offset Voltage 35 < V_{offset} < 35
	上架 shelving (用于后铺未经防护的ESDS时)	ANSI/ESD S4.1	Point to Point < 1 x 10^9 ohms Point to Groundable Point < 1 x 10^9 ohms	ESD TR53 Worksurface Section	Point to Ground < 1 x 10^9 ohms
	移动设备（工作面）	ANSI/ESD S4.1	Point to Point < 1 x 10^9 ohms Point to Groundable Point < 1 x 10^9 ohms	ESD TR53 Worksurface Section	Point to Ground < 1 x 10^9 ohms
	电焊/解焊手动工具	ANSI/ESD S13.1	Tip to Ground < 2.0 ohms Tip < 20 millivolts Tip Leakage < 10 milliamps	ESD TR53 Soldering Iron Section Or ANSI/ESD S13.1 Section 6.1	Tip to Ground < 10 ohms
	连续监控器	User defined	User defined	ESD TR53 Continuous Monitors Section	Manufacturer defined
	静电控制服	ANSI/ESD STM2.1	Point to Point < 1 x 10^{11} ohms	ESD TR53 Garments Section	Resistance Point to Point < 1 x 10^{11} ohms
	可接地静电控制服	ANSI/ESD STM2.1	Point to Groundable Point < 1 x 10^9 ohms	ESD TR53 Garments Section	Resistance to Groundable Point < 1 x 10^9 ohms
	可接地静电控制服系统	ANSI/ESD STM2.1	< 3.5 x 10^7 ohms	ESD TR53 Personal Grounding with Garments Section	< 3.5 x 10^7 ohms

腕带插入式弹簧开关的连接



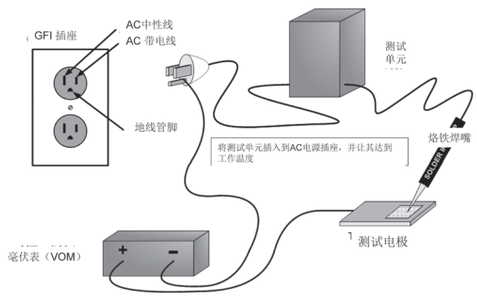
烙铁检测

- 焊嘴对地电阻



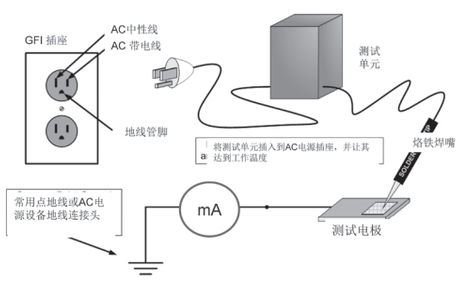
烙铁鉴定

- 焊嘴电压



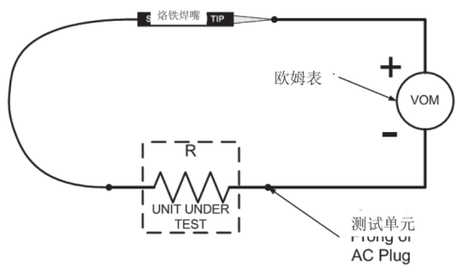
烙铁鉴定

- 焊嘴漏电



A3 ANSI/ESD S20.20 的更新及与IEC 61340-5-1的关系
The Updates to ANSI/ESD S20.20 and Their Relation to IEC 61340-5-1

烙铁合规验证



包装

- 包装部分加上了下列注释
  - “当ESDS项目置于包装材料上且ESDS项目上要进行有关工作时，包装材料就变成了工作面。这时即适用工作面对地电阻要求。”

IEC 61340-5-1

- 工作组于2014年6月举行了会议
- 对61340-5-1进行了更新，以使两个文件在技术上等效
- IEC更新时间表
  - 委员会草案（CD）2014年9月
  - 委员会表决草案（CDV）2014年12月
  - 国际标准最终草案（FDIS）2015年6月

ANSI/ESD S20.20-2014

John Kinnear

ANSI/ESD S20.20 – 2014

- Released in August 2014
- Update include the following
  - Scope
  - Tailoring
  - Product Qualification
  - Personal Grounding
    - Table 2

ANSI/ESD S20.20 – 2014

- Process Required Insulators
- Isolated Conductors
- Table 3 Items
  - Wrist Strap Jack Check
  - Soldering Irons
  - Ionization
- Packaging
- Appendix

A3 ANSI/ESD S20.20 的更新及与IEC 61340-5-1的关系
The Updates to ANSI/ESD S20.20 and Their Relation to IEC 61340-5-1

Scope (2.0)

- Human Body Model target remains unchanged
  - 2007 Version 100 v HBM
  - 2014 Version 100 v HBM
- Charge Device Model Added
  - 2014 Version 200 v CDM
    - Note this for the control of insulators or Induced part of model
- Isolated Conductors
  - 2014 Version 35 v on isolated conductors
    - There is some direction to relate this to the previous Machine Model for process control
- Standard does not require Machine Model testing of devices

Tailoring (6.3)

- Clarification was made to section
- Deleting Requirements
  - Still requires technical justification
- Limits set within 20.20
  - Does not require a tailoring statement
    - For example, resistance to ground of a worksurface as $1x10^5$ ohms to $1x10^8$ ohms
- Limits set outside 20.20
  - Does still require a tailoring statement
    - For example, resistance to ground of a worksuface as less the $1x10^{10}$ ohms

Product Qualification (7.3)

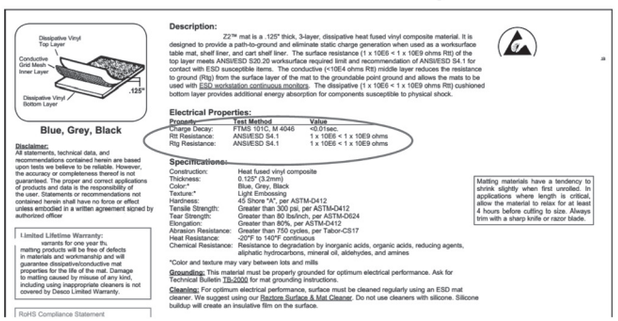
- Product Qualification (7.3)
  - Entire section was added (clarification, not new)
  - "A Product Qualification Plan shall be established to ensure that the ESD control items that have been selected meet the requirements in the plan. The test methods and required limits are located in the product qualification columns in Tables 2 and 3. Product qualification is normally conducted during the initial selection of ESD control items. Any of the following methods can be used: product specification review, independent laboratory evaluation or internal laboratory evaluation. For ESD control items that were installed by the Organization before the adoption of this standard, on-going compliance verification records can be used as evidence of product qualification."

Product Qualification

Table 3. EPA ESD Control Items

Technical Requirement	ESD Control Item	Product Qualification[a]		Compliance Verification	
		Test Method	Required Limit(s)[b]	Test Method	Required Limit(s)
EPA	Worksurface [c,h]	ANSI/ESD S4.1	Resistance Point to Point < 1 x 10^9 ohms; Resistance Point to Groundable Point < 1 x 10^9 ohms	ESD TR53 Worksurface Section	Resistance Point to Ground < 1 x 10^9 ohms
		ANSI/ESD STM4.2	< 200 volts		
	Wrist Strap	ANSI/ESD S1.1	0.8 x 10^6 to 1.2 x 10^9 ohms	For compliance verification of a wrist strap system, see Table 2.	
	Wristband	ANSI/ESD S1.1	Interior < 1 x 10^9 ohms; Exterior > 1 x 10^7 ohms		
	Personnel Ground wrist strap Connection (non monitored)	ANSI/ESD S6.1	Resistance Point to Ground < 2 ohms	ESD TR53 Grounding Bonding Systems	Resistance to Ground < 2 ohms
	Footwear	ANSI/ESD STM9.1	Resistance Point to Groundable Point < 1 x 10^9 ohms	For compliance verification of footwear and flooring system, see Table 2.	
	Foot Grounders	ESD SP9.2	Resistance Point to Groundable Point < 1 x 10^9 ohms		
	Flooring	ANSI/ESD S7.1	Resistance Point to Point < 1 x 10^9 ohms; Resistance Point to Groundable Point < 1 x 10^9 ohms		
	Seating	ANSI/ESD STM12.1	Resistance Point to Groundable Point < 1 x 10^9 ohms	ESD TR53 Seating Section	Resistance Point to Ground < 1 x 10^9 ohms

Product Qualification Example



Personal Grounding

- No Change to Wrist Strap System
- Flooring/Footwear System
  - 2007 Version
    - Allowed for a resistance method if less the $3.5x10^7$ ohms
    - Required a walking test for system greater than $3.5x10^7$ ohms and less than $1x10^9$ ohms
  - 2014 Version
    - Resistance and walking tests are required for flooring/footwear system

A3 ANSI/ESD S20.20 的更新及与IEC 61340-5-1的关系
The Updates to ANSI/ESD S20.20 and Their Relation to IEC 61340-5-1

Personal Grounding

2007 Version

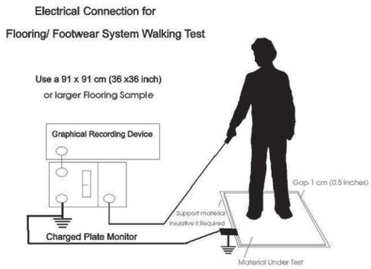
Personnel Grounding Technical Requirement	Product Qualification[1]		Compliance Verification	
	Test Method	Required Limit(s)	Test Method	Required Limit(s)
Wrist Strap System[2]	ANSI/ESD S1.1 (Section 5.11)	< 3.5 x 10^7 ohms	ESD TR53 Wrist Strap Section	< 3.5 x 10^7 ohms
Flooring / Footwear System – Method 1	ANSI/ESD STM97.1	< 3.5 x 10^7 ohms	ESD TR53 Flooring Section	< 3.5 x 10^7 ohms
			ESD TR53 Footwear Section	< 3.5 x 10^7 ohms
Flooring / Footwear System – Method 2 (both required)	ANSI/ESD STM97.1	< 10^9 ohms	ESD TR53 Flooring Section	< 1.0 x 10^9 ohms
	ANSI/ESD STM97.2	< 100 volts	ESD TR53 Footwear Section	< 1.0 x 10^9 ohms

2014 Version

Technical Requirement	Product Qualification[1]		Compliance Verification	
	Test Method(s)	Required Limit(s)	Test Method(s)	Required Limit(s)
Wrist Strap System	ANSI/ESD S1.1 (Section 5.11)	< 3.5 x 10^7 ohms	ESD TR53 Wrist Strap Section	< 3.5 x 10^7 ohms
Footwear / Flooring System[2] – (Both limits must be met)	ANSI/ESD STM97.1	< 1.0 x 10^9 ohms	ESD TR53 Footwear Section	< 1.0 x 10^9 ohms[3]
	ANSI/ESD STM97.2	< 100 volts Peak	ESD TR53 Flooring Section	< 1.0 x 10^9 ohms[4]

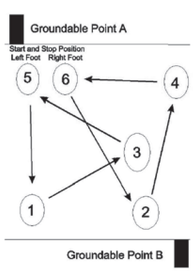
Personal Grounding

- Walking test per ANSI/ESD STM 97.2 is now required for all flooring/footwear systems.



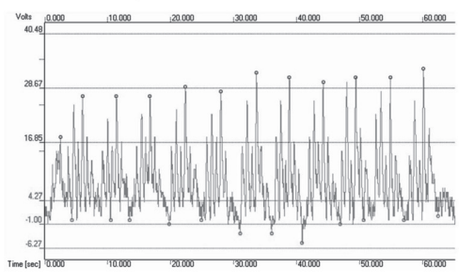
Personal Grounding

- Walking Test per ANSI/ESD S97.2
  - Alternate patterns allowed, see Appendix



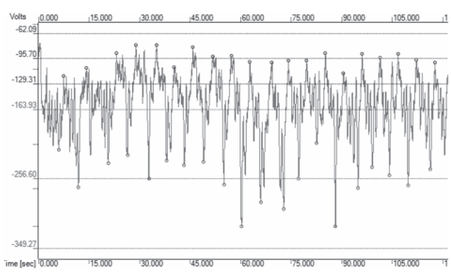
Personal Grounding – Why?

- Typical Result of Flooring/Footwear System that met the Resistance Specification



Personal Grounding – Why?

- This floor also met the resistance requirements of the 2007 standard



Process Required Insulators

- Current requirement of less than 2000 volts/in (or 79000 volts/meter) within 30 cm (12 in) of ESDS remains the same
- New requirement of less than 125 volts/in (or 5000 volts/meter) within 2.5 cm (1 in) of ESDS is new
- This is to support the new CDM target in the scope

A3 ANSI/ESD S20.20 的更新及与IEC 61340-5-1的关系
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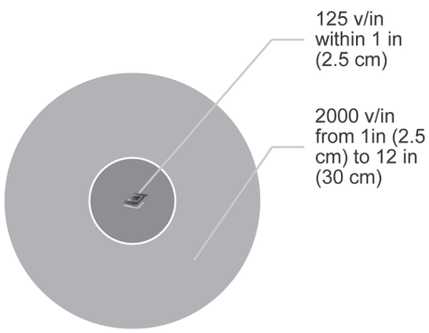
Process Required Insulators



Isolated Conductors (New)

- Isolated conductors that come into contact with ESD Sensitive Devices shall have a voltage no greater than ±35 v
- Measurement shall be done by an Electrostatic noncontacting voltmeter or a High Impedance Contact Voltmeter

Table 3 Changes

- Wrist Straps
  - Deleted Wrist Strap Cord Bending Life
- Added Personal Ground Wrist Strap Connection
  - 2 ohms to ground (unless 1 Meg resistor inline)
- Ionization
  - Deleted Room Systems
  - Changed offset to ± 35 volts
- Added Electrical Soldering / Desoldering Hand Tools
  - Based on new specification ANSI/ESD S13.1

Table 3

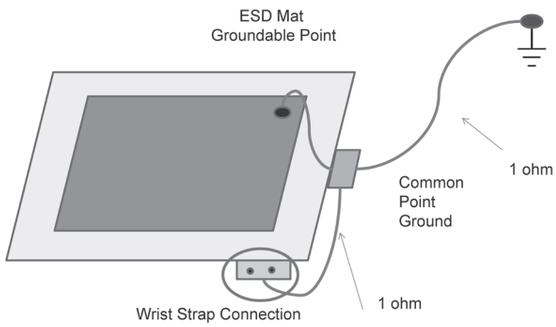
Technical Requirement	ESD Control Item	Product Qualification[2] Test Method	Product Qualification[2] Required Limit(s)[3]	Compliance Verification Test Method	Compliance Verification Required Limit(s)
EPA	Worksurface[9,10] (Qualification can be done by either Test Method)	ANSI/ESD S4.1	Point to Point < 1 x 10^9 ohms	ESD TR53 Worksurface Section	Point to Ground < 1 x 10^9 ohms
			Point to Groundable Point < 1 x 10^9 ohms		
		ANSI/ESD STM4.2	< 200 volts		
	Wrist Strap	ANSI/ESD S1.1	0.8 x 10^6 to 1.2 x 10^9 ohms	For compliance verification of a Wrist Strap System, see Table 2.	
	Wristband	ANSI/ESD S1.1	Interior < 1 x 10^9 ohms		
			Exterior > 1 x 10^7 ohms		
	Personnel Ground wrist strap Connection (non-monitored)	ANSI/ESD S6.1	Point to Ground < 2 ohms	ESD TR53 Grounding Bonding Systems	Point to Ground < 2 ohms
	Footwear	ANSI/ESD STM9.1	Point to Groundable Point < 1 x 10^9 ohms	For compliance verification of Footwear / Flooring System, see Table 2.	
	Foot Grounders	ESD SP9.2	Point to Groundable Point < 1 x 10^9 ohms		
	Flooring	ANSI/ESD STM7.1	Point to Point < 1 x 10^9 ohms		
			Point to Groundable Point < 1 x 10^9 ohms		
	Seating	ANSI/ESD STM12.1	Point to Groundable Point < 1 x 10^9 ohms	ESD TR53 Seating Section	Point to Ground < 1 x 10^9 ohms

Measurement Clearly Stated

Table 3

Technical Requirement	ESD Control Item	Product Qualification(1) Test Method	Product Qualification(1) Required Limit(s) (2)	Compliance Verification Test Method	Compliance Verification Required Limit(s)
EPA	Ionization other than Room Systems	ANSI/ESD STM3.1	Discharge Time User defined Offset Voltage -35 < V_{offset} < 35	ESD TR53[10] Ionization Section	Discharge Time User defined Offset Voltage -35 < V_{offset} < 35
	Shelving (When used to store unprotected ESDS)	ANSI/ESD S4.1	Point to Point < 1 x 10^9 ohms Point to Groundable Point < 1 x 10^9 ohms	ESD TR53 Worksurface Section	Point to Ground < 1 x 10^9 ohms
	Mobile Equipment (Working Surfaces)	ANSI/ESD S4.1	Point to Point < 1 x 10^9 ohms Point to Groundable Point < 1 x 10^9 ohms	ESD TR53 Worksurface Section	Point to Ground < 1 x 10^9 ohms
	Electrical Soldering / Desoldering Hand Tools	ANSI/ESD S13.1	Tip to Ground < 2.0 ohms Tip < 20 millivolts Tip Leakage < 10 milliamps	ESD TR53 Soldering Iron Section Or ANSI/ESD S13.1 Section 6.1	Tip to Ground < 10 ohms
	Continuous Monitors	User defined	User defined	ESD TR53 Continuous Monitors Section	Manufacturer defined
	Static Control Garment	ANSI/ESD STM2.1	Point to Point < 1 x 10^{11} ohms	ESD TR53 Garments Section	Resistance Point to Point < 1 x 10^{11} ohms
	Groundable Static Control Garment	ANSI/ESD STM2.1	Point to Groundable Point < 1 x 10^9 ohms	ESD TR53 Garments Section	Resistance to Groundable Point < 1 x 10^9 ohms
	Groundable Static Control Garment System	ANSI/ESD STM2.1	< 3.5 x 10^7 ohms	ESD TR53 Personal Grounding with Garments Section	< 3.5 x 10^7 ohms

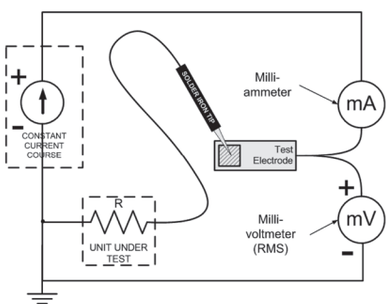
Wrist Strap Jack Connection



A3 ANSI/ESD S20.20 的更新及与IEC 61340-5-1的关系
The Updates to ANSI/ESD S20.20 and Their Relation to IEC 61340-5-1

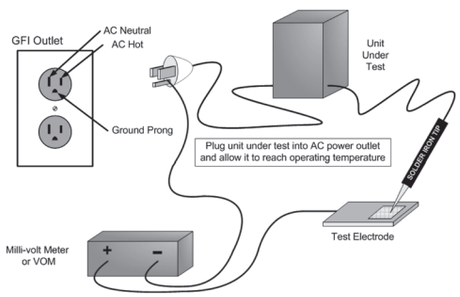
Soldering Iron Qualification

- Tip to Ground Resistance



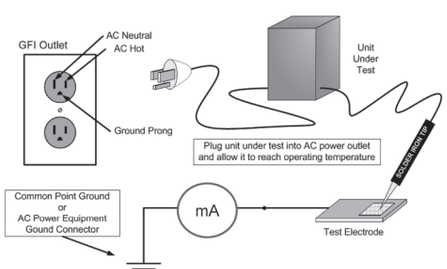
Soldering Iron Qualification

- Tip Voltage

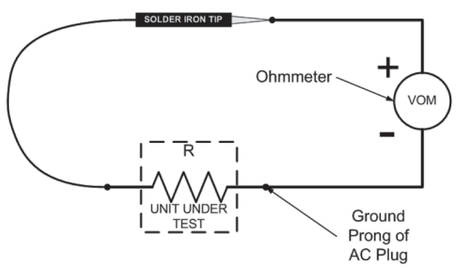


Soldering Iron Qualification

- Tip Leakage



Soldering Iron Compliance Verification



Packaging

- The following note was added to the packaging section
  - "When ESDS items are placed on packaging materials and the ESDS items have work being performed on them, then the packaging materials become worksurfaces. The worksurface requirements for resistance to ground apply."

IEC 61340-5-1

- Working Group met in June 2014
- Updates were made to 61340-5-1 to keep the two documents technically equivalent
- Timeline for IEC Update
  - Committee Draft (CD) September 2014
  - Committee Draft for Vote (CDV) December 2014
  - Final Draft International Standard (FDIS) June 2015

A4 中国智慧城市建设现状与发展态势
Chinese smart city construction present situation and development trend

中华人民共和国工业和信息化部主管

中国智慧城市产业联盟
China wisdom City IndusTry Alliance

中国智慧城市建设现状与发展态势

郭石泉

中国智慧城市产业联盟
2014年10月14日

中国智慧城市产业联盟

目 录

一 智慧城市的概念
二 中国对智慧城市的政策及现状
三 智慧城市建设的范围
四 智慧城市建设的参与模式
五 总结

中国智慧城市服务者

中国智慧城市产业联盟

一、 智慧城市的概念

智慧城市是在数字城市建立的基础框架上，通过物联网将现实世界与数字世界进行有效融合，自动和实时地感知现实世界中人和物的各种状态和变化，由云计算中心处理其中海量和复杂的计算与控制，为经济发展、城市管理和公众提供各种智能化的服务

智慧城市是智慧地球的重要组成部分

中国智慧城市服务者

中国智慧城市产业联盟

智慧城市的发展历程

信息化城市 ➡ 数字城市 ➡ 智慧城市

1993	1998	2006	2009
“信息高速公路”的提出标志着城市信息化建设开始起步	“数字化舒适社区建设”标志着城市信息化开始步入“数字城市”建设新阶段	物联网、云计算等新一代信息技术对城市信息系统的综合集成与整合应用	IBM提出了“智慧城市”新理念，标志着城市信息化开始迈向“智慧城市”建设新阶段

“智慧城市”的发展和早期的信息基础设施及“数字城市”的建设一脉相承，但更注重信息资源整合集成，更强调城市管理协调统筹，是信息化城市和数字城市建设的更高级阶段,是工业化和信息化的高度集成.

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中国智慧城市产业联盟

二、国家对于智慧城市工作的总体思路

党的十八大报告当中提出了要到2020年全面建成小康社会，并强调要促进工业化、信息化、城镇化、农业现代化同步发展，这是党中央基于对信息化的重要性、关联度和存在的问题所提出的科学分析作出的战略决策。四化不是孤立的，而是在融合、互动、协调中相互促进发展，当中信息化随着新加坡信息技术快速发展和普及应用信息化与工业化融合已经成为一种全面的、动态的、优化的资源配置方式，重塑全球化时代我国产业竞争新的优势。

建设智慧城市是一项重要的、基础性的发展工程、惠民工程，是一项复杂的系统工程、创新工程，也是一个需要不断完善和改进的动态发展的过程，要把信息化、城市化的趋势和规律虚心地学习，借鉴国内外已有的经验，这对一个城市来说是一项投资巨大、影响深远的工程。

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（一）文件支持

国务院办公厅2013年8月发布国发2013 32号文件《关于促进信息消费扩大内需的若干意见》：

35条明确指出，加快城市建设，在有条件的城市开展智慧城市试点、示范建设，试点城市主要出台鼓励市场化特融投资，鼓励各类市场主体共同参与智慧城市建设，在国务院批准发行的地方政府在建活动当中，由各省自治区、直辖市人民政府统筹考虑安排部分资金用于智慧城市的建设，鼓励符合条件的企业发行募集资金，用于智慧城市建设的企业债。

国家发改委、工信部等八部委2014年8月发布发改高技2014 1770号文件《关于促进智慧城市健康发展的指导意见》：

以人为本，务实推进；
因地制宜，科学有序；
市场为主，协同创新；
可管可控，确保安全。

公共服务便捷化
城市管理精细化
生活环境宜居化
基础设施智能化
网络安全长效化

中国智慧城市服务者

A4 中国智慧城市建设现状与发展态势
Chinese smart city construction present situation and development trend

中国智慧城市产业联盟

（二）标准支撑

国家标准化管理委员会、国家发改委、工信部、科技部、住建部等八部委2014年3月11日《关于成立智慧城市国家标准协调推进组、总体组、专家咨询组的通知》：

智慧城市标准是智慧城市有序健康发展的基本保障，是促进城市信息资源汇聚、共享和开发利用的必要条件，也是促进云计算、物联网、大数据、移动互联网等智能技术在智慧城市建设中有效应用的重要支撑。

目前，从智慧城市概念、术语、模型、数据编码规范、数据采集、顶层规划编制指南、数据共享等24项国家标准已经立项，进入到讨论、编写阶段。

中国智慧城市服务者

中国智慧城市产业联盟

三智慧城市建设的范围

中国智慧城市的动力与目标

城镇化
工业化
信息化

智慧城市

低炭
绿色
可持续

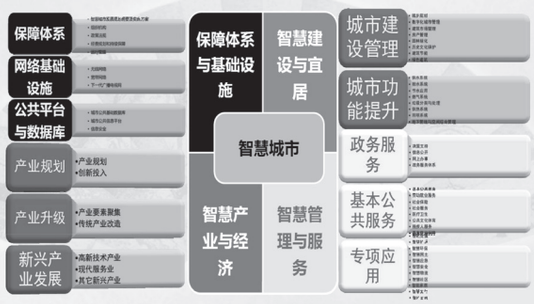
中国梦

中国智慧城市服务者

中国智慧城市产业联盟

智慧城市包含的功能

国家智慧城市（区、镇）试点指标体系（试行）指明了智慧城市包含“4个一级指标、11个二级指标和57个三级指标”



中国智慧城市服务者

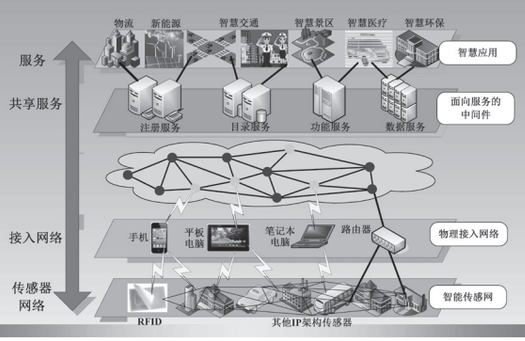
中国智慧城市产业联盟

智慧城市建设的技术基础

中国智慧城市服务者

物联网技术

物联网能够实现人与人、人与机器、机器与机器的互联互通



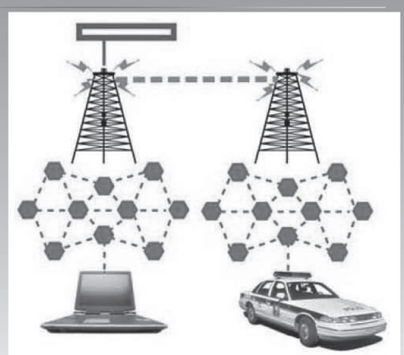
无所不在的网络基础设施

核心：有线光纤

传输：城域网

接入：局域网

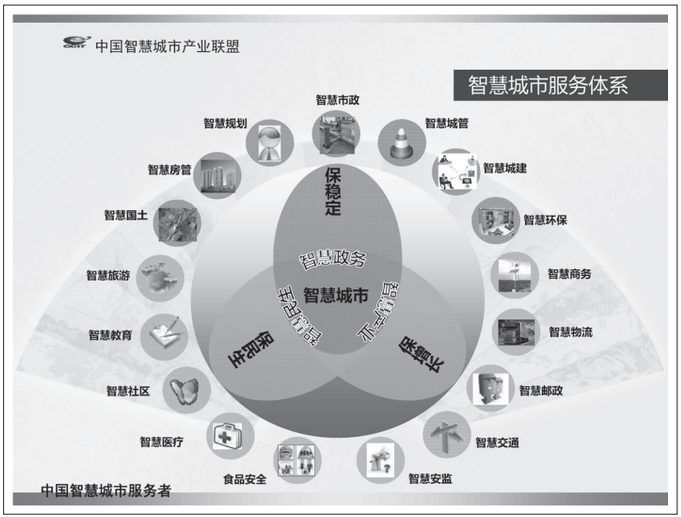
用户：固定、游牧、移动式应用



A4 中国智慧城市建设现状与发展态势
Chinese smart city construction present situation and development trend

智慧城市的应用

城市职能	智慧城市职能
生存繁衍	智慧安防\环保\能源\城管\养老
	智慧国土规划\社区\家居...
经济发展	智慧制造\工业互联网\物流.....
社会交往	智慧交通\购物\社会综合管理 ....
文化享受	智慧户外流媒体\教育\旅游....



智慧城市建设正迈向入大数据时代

❖ --大数据时代已经到来

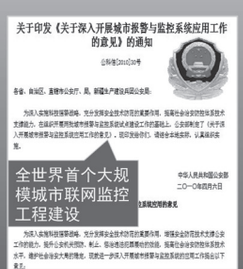
2011年2月，Science专刊指出大数据时代已到来

美国工程院院士Eric指出：我们正处在一个激动人心的时代，利用大规模有效数据分析预测建模、可视化和发现新规律的时代就要到来

奥巴马宣布美国政府正式启动“大数据研究和发展计划”，认为大数据是未来世界的石油，该计划的意义堪比上个世纪的“信息高速公路计划”

我国已建成世界最大的视频监控网

2005年国务院启动平安城市



街道、区、市、省、国家 五级监控网

国家多级联网监控工程今年将基本建成

大数据的挑战—存不起

全球电子行业领先的权威研究机构IMS Research在2011年的报告中预测：
“ 2012年全球仅新增的监控设备所需的存储规模就将达3300PB。”

以天津市为例分析未来存储成本的影响：

高清摄像头每小时产生3.6GB数据

天津市

十二五末，天津将安装60万摄像头

按3个月视频存储容量计算

天津市十二五末视频监控数据存储容量需要 4665.6PB

目前4T容量存储服务器5万/台

报价来自IT168.com

相当于西藏去年全年GDP总值

仅存储就需投入583.2亿元

快速增长的存储规模和投入成为制约城市监控系统发展的重要因素

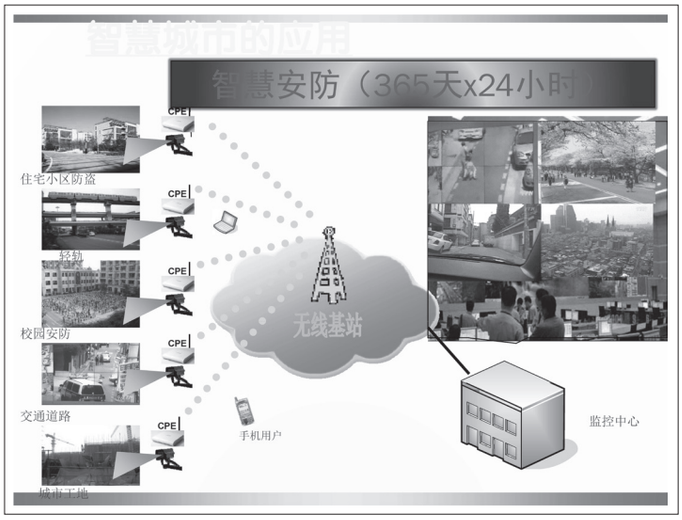
大数据时代面临的形势更为严峻

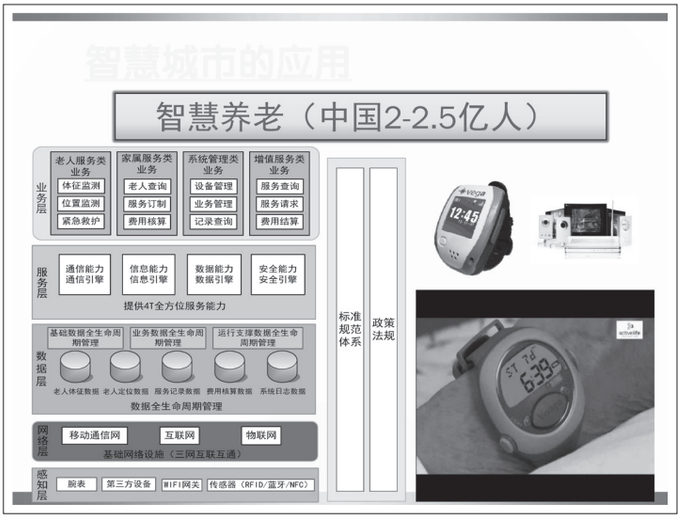
查不准 数据快速增长导致虚警输出规模超出人工处理的极限

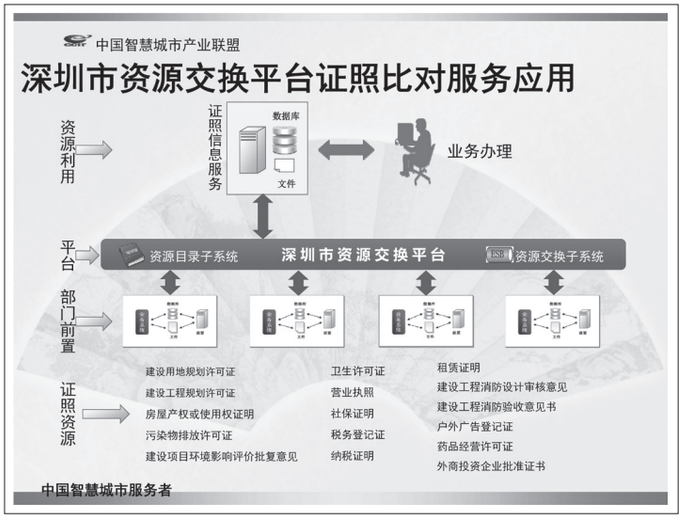
防不住 数据规模的急剧扩大进一步凸显传统预警分析技术的困境

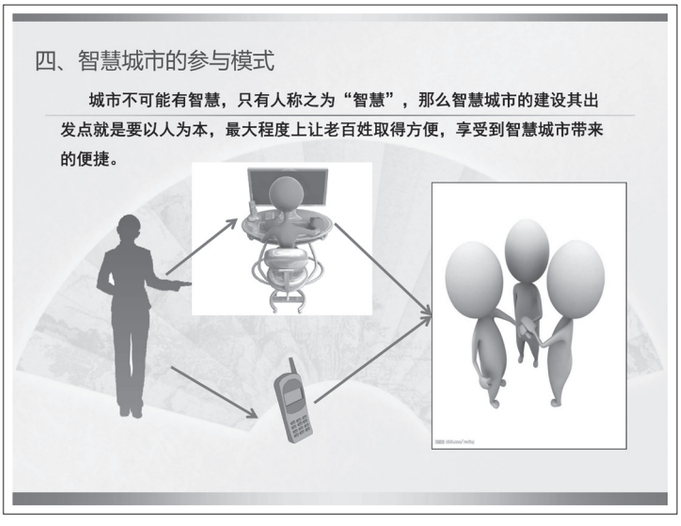
美国连环杀人案罪犯伊里斯·阿布拉赞在3个州先后持刀刺伤民众20多人，其中5人因此身亡。

A4 中国智慧城市建设现状与发展态势
Chinese smart city construction present situation and development trend









A4 中国智慧城市建设现状与发展态势
Chinese smart city construction present situation and development trend

（二）明确自己的商业模式

表1 智慧城市建设典型商业模式优劣势分析

典型模式	特征描述	优劣势分析		典型代表
		优势	劣势	
模式一：政府独自投资建设和运营	政府负责基础设施/平台的投资、建设、维护和运营	政府有绝对控制权	政府财政压力较大，必须获得足够的收益才能维持网络运转，同时也面临业务的运营、推广以及后期维护等困难	美国德克萨斯州的Corpus Christi市无线城市
模式二：政府和运营商共同投资，运营商建设并运营	由政府和运营商共同出资、共同拥有，日常建设及运营管理由电信运营商进行	可以减轻政府财政压力	面临着产权难以界定、利用运营商网络资源会产生纠纷等问题	费城“无线费城”
模式三：政府投资，委托运营商/第三方建设、运营	政府进行投资，并通过招标等方式委托一家或多家运营商建设和运营	政府有绝对控制权，专业公司进行运营和维护	政府财政压力较大，后续网络的升级、运维等容易导致权责不明朗	新加坡“智能国家2015”
模式四：政府牵头，BOT（建设—经营—转移）模式	通过市场化方式引入企业资金投资基础设施建设，许诺投资方在建成后的一段时期内拥有经营权，到期后再由政府收回管理经营	减轻政府财政压力	所有权和经营权的分离造成企业的短视，政府运营经验的缺乏导致到期收回对政府压力较大	台北“无线台北”
模式五：运营商/第三方独立投资建设和运营	综合实力较强的电信运营商或者第三方独立负责智慧城市子任务（例如一项基础设施、平台或者应用建设）的投资建设和运营工作	产权清晰，减少政府财政压力，可以充分利用电信运营商经验和实力解决“无线城市”的运营、管理和维护等问题	需要有持续的盈利模式	上海市智慧虹桥商务区
模式六：联合建设运营	产业链上电信运营商、应用开发商、系统集成商、终端设备提供商中的两家或多家联合开发智慧平台或应用并共同推广	利于产业链良性运转，综合解决能力较强	多方合作，合作协调工作量较大	台北市智慧园区
模式七：联合公司化运营	由产业链中成员，如电信运营商、应用开发商、系统集成商等共同成立一个管理公司及系列子公司进行智慧城市的投资、建设、运营	利于产业链良性运转，综合解决能力较强，公司化运作更加灵活	多方合作，合作协调工作量较大	杭州市一卡通项目

表2 “智慧城市”典型项目商业模式建议

业务大类	业务小类	特征描述	典型商业模式匹配建议
智慧基础类	有线传输等基础设施建设	投资规模大； 专业要求高； 共享要求高	模式三：政府投资，委托运营商/第三方建设、运营； 模式四：政府牵头，BOT模式
	数据库建设	涉密要求高； 维护运营要求低	模式一：政府独自投资建设和运营
	云计算数据中心	投资规模较大； 专业要求高； 涉密要求高	模式二：政府和运营商共同投资、运营商或第三方建设并运营； 模式三：政府投资，委托运营商/第三方建设、运营
	物联网感知层及平台建设	投资规模大； 维护要求高； 公益性质高	模式四：政府牵头，BOT模式； 模式二：政府和运营商共同投资，运营商建设并运营
智慧门户/平台/应用	智慧城市门户	形象关联度高； 投资规模不大； 维护要求中等	模式三：政府投资，委托运营商/第三方建设、运营； 模式二：运营商/第三方独立投资建设和运营
	综合管理平台政务类应用	政府类应用； 投资规模中等； 维护要求中等	模式三：政府投资，委托运营商/第三方建设、运营； 模式四：政府牵头，BOT模式
	产业类应用	投资规模中等； 维护要求中等	模式五：运营商/第三方独立投资建设和运营； 模式六：联合建设模式； 模式七：联合公司化运作
	民生类应用	应用内容庞大； 投资规模不一； 维护要求较高； 直接面向公众	模式五：运营商/第三方独立投资建设和运营； 模式六：联合建设模式； 模式七：联合公司化运作

资料来源：《移动通信》（2013年03期）-杨会华、樊耀东—《智慧城市典型商业模式分析和选择》

（三）不要单打独斗，形成团队力量

单一企业不能包打天下；

自主联合的企业存在一定局限性和不确定性；

第三方社会资源要利用好，不是花钱买牌子，而是要开发好第三方资源、平台的商业价值。

智慧城市建设是合作，是博弈。

（四）得标准者得天下

智慧城市涵盖智慧医疗、智慧养老、智慧政务、智慧国土、智慧环保、智慧交通、智慧城管、智慧公共服务、智慧社会管理、智慧旅游、智慧农业、智慧物流、智慧家居、智慧教育等等。

在中国，硬件标准企标、行标、国标、国际标准、强制标准很多，但是软件标准目前空白点很多，实验室标准、纯技术标准也有，但是应用标准、评价标准缺乏，要勇于参与标准的制定、修改。

标准是引领智慧城市建设的方向，要通过试点、总结、修改制定、颁布推荐、实施来实现。掌握标准就使自己立于不败之地。

五、总结

1、智慧城市建设要从实际出发

◆智慧城市的建设，包括数字化和网络化，是一个随着信息化而发展的长期的过程。为了智慧城市的健康发展，有效而充分地利用城市的各种资源，设计一个智慧的智慧城市的发展策略非常重要 。

◆对于任何一个城市而言，建设智慧城市，首先要搞清楚自己的起点在哪里。其中，比较重要的是对城市数字化和网络化状况有一个较为准确的评估，补好数字化和网络化的缺课。

◆数字化和网络化的补课也应该看作是智慧城市建设的基础，一个不可或缺的组成部分。

A4 中国智慧城市建设现状与发展态势
Chinese smart city construction present situation and development trend

2、智慧城市建设的战略原则---想的要大

◆研究和分析：第一，本市数字化和网络化发展现状，现有状态与智慧城市“状态”的主要差距；第二，本市经济社会发展的现状、城市经济社会的发展目标、以及经济社会发展对于“智能化”的紧迫需求；第三，本市拥有的各种资源，寻求“目标”、“需求”与“资源”之间的平衡点。
◆在此基础上，有针对性地提出建议，审慎地确定智慧城市建设的长远目标、近期目标，并制订一个切实可行的智慧城市发展规划，即一个期望实现的 “智慧城市”的蓝图和路线图。
◆规划的目标和产出应该是明确、可以测度的，而不是抽象、概念化的；规划要大处着眼，远处着眼；要有充分的洞察力和想象力。

3、智慧城市建设的战略原则---起步要小

◆以小的、容易实现的、效果明显的项目起步，确保“ 初战必胜” 。数字化和网络化发展相对成熟，从属于 “ 数字化、网络化补课” 的项目起步，风险较小，而胜算很大。
◆对于智能化的项目，应该认真分析其对于城市经济社会发展的紧迫性，一定要抓住有 “ 紧迫需求” 的项目，而审慎评估、从严控制那些属于 “ 有了更好 ” 或“锦上添花”的项目。
◆对于一定要上马的、较大的智能化工程项目，应该力图将其分解为若干个小的阶段性项目组织实施。这样做，不仅是为了在实践中锻炼队伍，获得经验，汲取教训；也是为了 “ 以小胜求大胜” ，取得信任和社会的支持。

4、智慧城市建设策略

◆建设智慧城市就是信息化参与城市发展的一个过程，城市只要资金充裕，信息化发展就好。
◆反之，信息化发展好了不一定100%能促进城市的发展。
◆所以智慧城市的模式是关键：建设模式、服务模式和运营模式。
◆没有一个标准的通用模式供参考，需要根据城市实际的状况定制模式，但是有一个原则：建设风险小，服务应该随需所变，运营应该能持续运营。

中国智慧城市产业联盟

郭石泉 现任工业和信息化部中国智慧城市产业联盟会员管理中心主任
分管联盟成员单位的会籍管理和项目服务工作
分管联盟专家委员会和项目专家评审工作
分管联盟标准化以及对外新闻工作

毕业于首都师范大学中文系，曾任国家质检总局中国质量万里行促进会会员管理部部长、名牌部 部长，中日技术创新产业推进基地秘书长助理，英国标准化协会中 国CAC管理委员会委员、活好营养管理（中国）有限公司总经理助理等职。

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中国智慧城市服务者

中国智慧城市产业联盟

中国智慧城市服务者

Under Administration of the Ministry of Industry & Information Technology, the People's Republic of China

China wisdom City IndusTry Alliance

Construction of China Wisdom City - Current Situations and Developments

Guo Shiquan

China wisdom City IndusTry Alliance
Oct. 14, 2014

A4 中国智慧城市建设现状与发展态势
Chinese smart city construction present situation and development trend

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Contents

1. Concepts of Wisdom City
2. Chinese Policy for and Current Situations of Wisdom City
3. Scope of Wisdom City Construction
4. Mode of Participation in Wisdom City Construction
5. Summary

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1. Concepts of Wisdom City

Wisdom City is designed to offer various intelligent services for economic development, urban management and the public on the basic frame of digital city, by effective combination of real world and digital world through Internet of Things to automatically and real-time have perception of various states and changes of people and things in real world, on the basis of massive and complicated calculation and control processed by cloud computing.

Wisdom City is an important part of wisdom earth

Wisdom City = digital city + Internet of Things + cloud computing

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Development Course of Wisdom City

Information City → Digital City → Wisdom City

1993	1998	2006	2009
Occurrence of "Information Expressway" indicated starting of urban informationization construction	"Digital comfortable community construction"indicated urban informationization had entered new stage of "digital city"construction	New-generation information technologies such as Internet of Things and cloud computing, etc made comprehensive integration and integrated application of urban information system	IBM suggested new idea of "Wisdom City", indicating urban informationization began to march toward to new stage of "Wisdom City" construction

Development of "Wisdom City" is in a continuous line with construction of early information infrastructure and"digital city", but lays more emphasis on information resources integration and on concerted and overall-arranged urban management; is a higher stage of information city and digital city construction, and high integration of industrialization and informationization.

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2. China's Overall Thinking of Wisdom City

The Report of the 18th CPC National Congress set the goal of building a well-off society in an all-round manner by 2020 and emphasized promoting concerted development of industrialization, informationization, urbanization and agro-modernization, which is the strategic decision of the CPC Central Committee on informationization importance, correlations and problems after scientific analysis. The Four Modernizations are not isolated from each other, but promote each other in a combined, interactive and concerted manner. With rapid development, popularization and application of information technology in Singapore, combination of informationization and industrialization combination has become an all-round, coming and optimized resources allocation mode, and will reshape new advantages of China's industrial competitiveness in the globalization times.

Construction of Wisdom City is an important basic development project, a people-benefiting project, a complicated system project, an innovation project, and a perfecting and improving dynamic development process. To learn with an open mind informationization and urbanization tendency and law and draw existing domestic and foreign experiences is a project needing huge investment and with far-reaching influence for a city.

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（1）Document support

In Aug. 2013, the General Office of the State Council issued GF2013 No.32 Document of *Several Opinions on Promoting Information Consumption and Expanding Domestic Demands*:

The Article 35 clearly points out: quickening urban construction, conducting pilot and demonstration construction of Wisdom City in cities with proper conditions. Pilot cities should map out policies encouraging marketized financing and investment and various market players to jointly participate in construction of Wisdom City. In construction of pilot cities as approved by the State Council, people's governments of relevant provinces, autonomous regions and municipalities should make overall consideration and arrangement of some funds for the construction. Enterprises meeting requirements are encouraged to issue enterprise bonds to raise funds for construction of Wisdom City.

Eight ministries and commissions including National Development & Reform Commission and Ministry of Industry and Information Technology, etc issued FGBJ2014 No.1770 Document of the *Guiding Opinions on Promoting Healthy Development of Wisdom City* in Aug. 2014:

People oriented, moving forward pragmatically;

Taking measures suited to local conditions, being scientific and orderly;

Market oriented, concerned and innovative;

Manageable and controllable, ensuring safety.

Express public service
Delicacy urban management
Livable living environment
Intelligent infrastructure
Long-term network safety

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（2）Standard support

Eight ministries and commissions of National Standardization Committee, National Development & Reform Commission, Ministry of Industry and Information Technology, Ministry of Science and Technology and Ministry of Housing and Urban-Rural Development, etc issued the *Circular on Establishing Concerted Progress Group, Overall Arrangement Group and Expert Consulting Group for National Wisdom City Standard*:

Wisdom City standard is the basic guarantee for orderly and healthy development of Wisdom City, an necessary condition to promote urban information resources gathering, sharing, developing and utilizing, and an important support to fuel effective application of wisdom technologies such as cloud computing, Internet of Things, big data and Mobile Internet in Wisdom City construction.

Currently, 24 national standards for Wisdom City concept, terminology, model, data coding specification, data acquisition, guide to top plan preparation and data sharing,etc have been placed in the list of projects, and relevant discussion and compilation have been started.

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A4 中国智慧城市建设现状与发展态势
Chinese smart city construction present situation and development trend

China wisdom City IndusTry Alliance

3. Scope of Wisdom City Construction

China Wisdom City,Power and Goal

Urbanization
Industrializatio
Informationizat
Low carbon
Green
Sustainable
Wisdom City
China Dream

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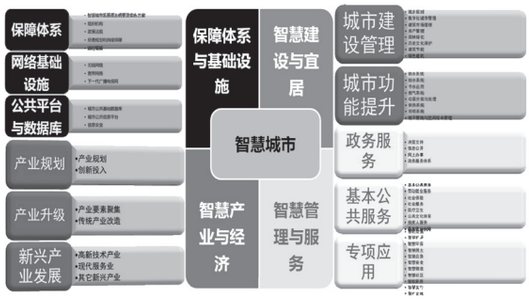
Functions included in Wisdom City

National Wisdom City (district, town) pilot indicator system (provisional) makes it clear that Wisdom City includes "4 Class I indicators, 11 Class II indicators and 57 Class III indicators"



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Technical Foundation for Wisdom City Construction

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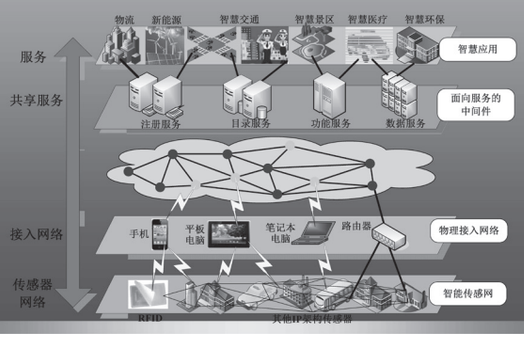
Internet of Things Technology

Internet of Things can realize man-man, man-machine and machine-machine interconnection and interworking



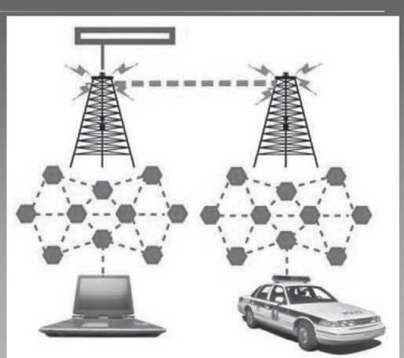
Network Infrastructure Existing everywhere

Core:
wired optical fiber

Transmission:
MAN

Access:
LAN

Users: fixed, roaming
mobile application



12

Wisdom City Application

City Functions

Wisdom City Functions

Survival and reproduction wisdom security\environmental protection\energy\urban management\home care

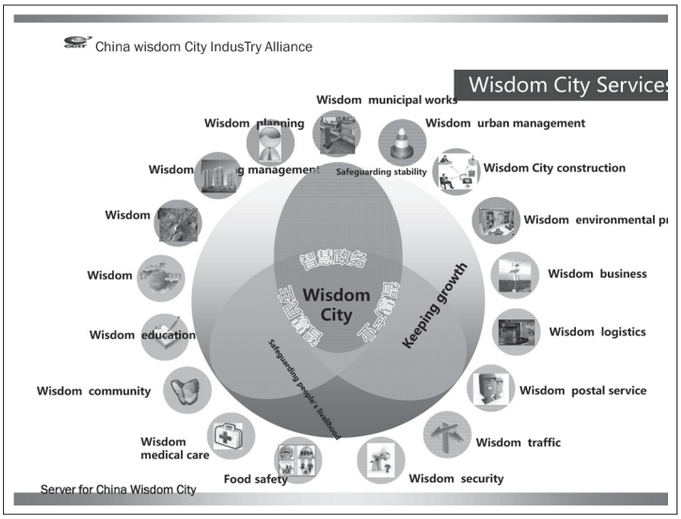
wisdom land planning\community\residence ...

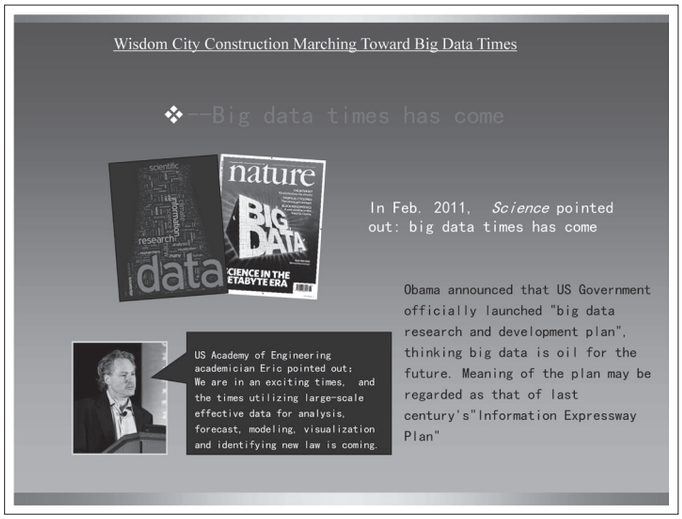
Economic development wisdom manufacturing\industrial Internet\logistics .....

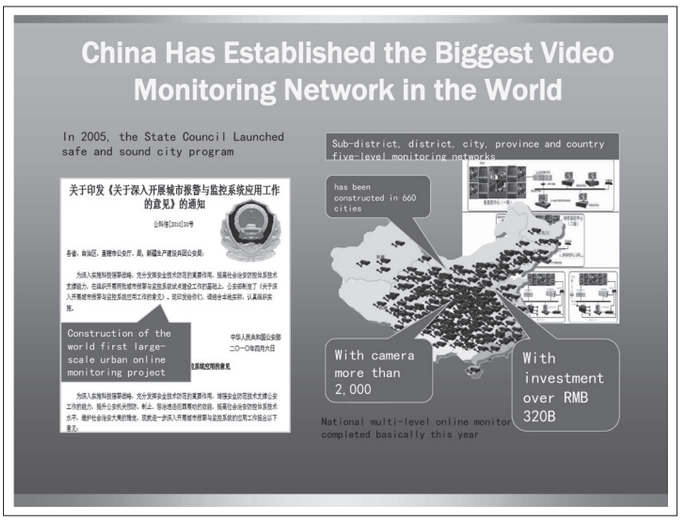
Social contacts wisdom traffic\shopping\comprehensive social management ....

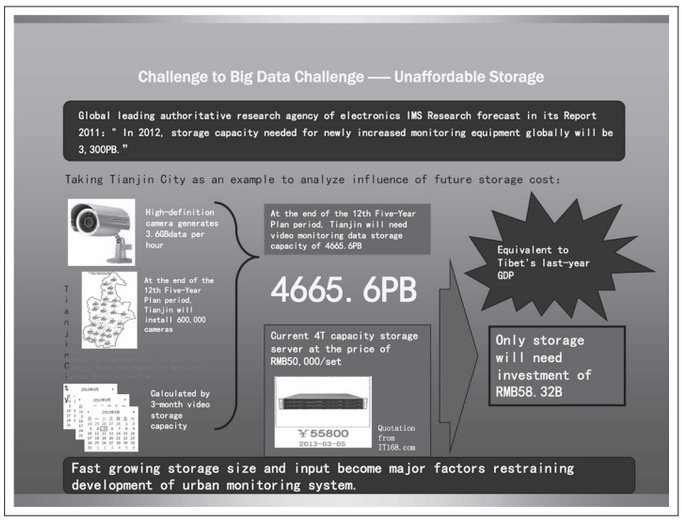
Enjoyment of culture wisdom outdoor streaming media\education\tourism ....

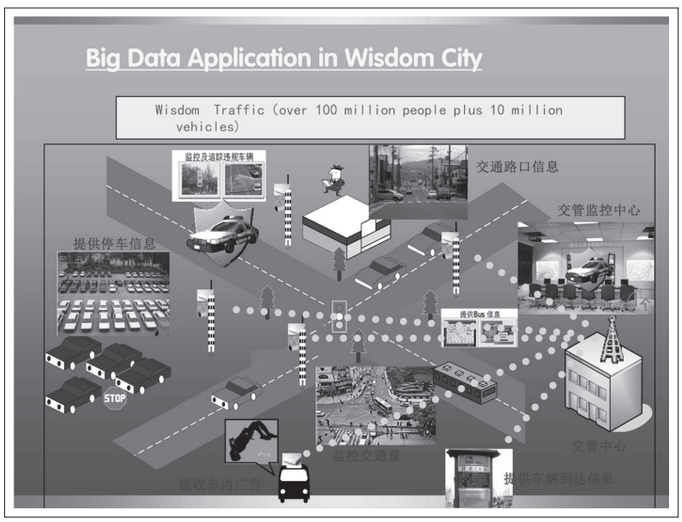
A4 中国智慧城市建设现状与发展态势
Chinese smart city construction present situation and development trend



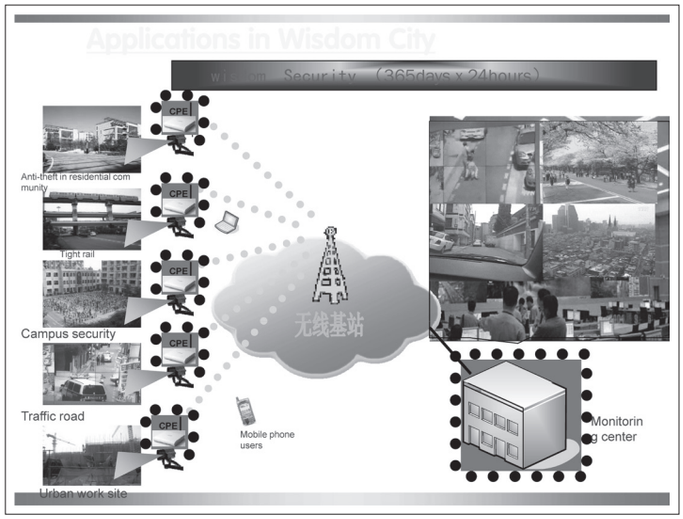


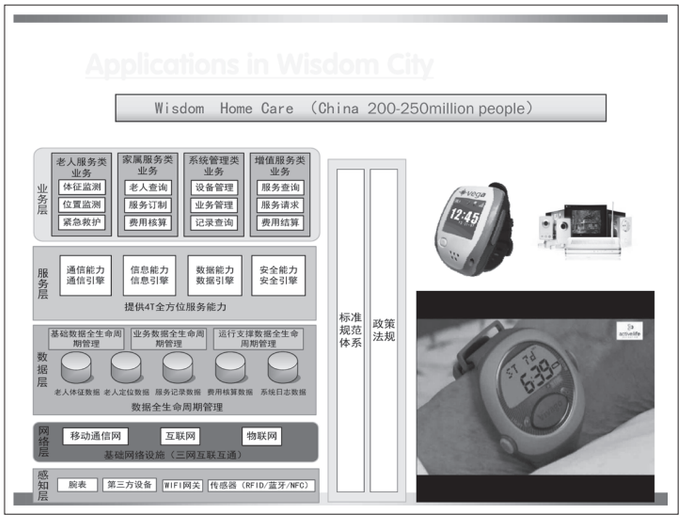


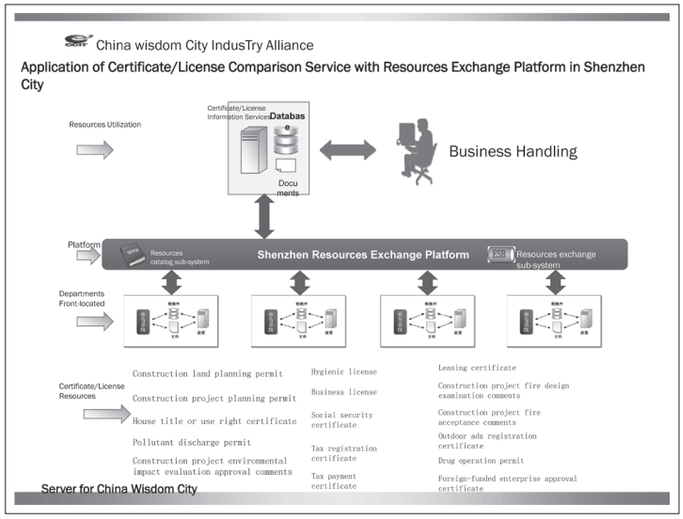


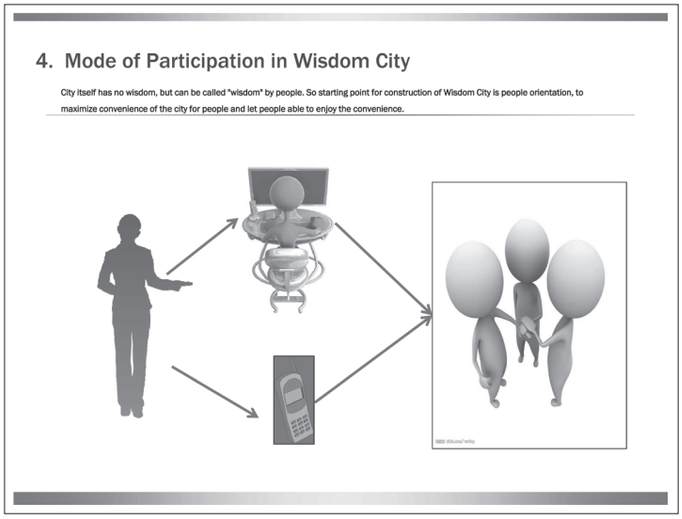


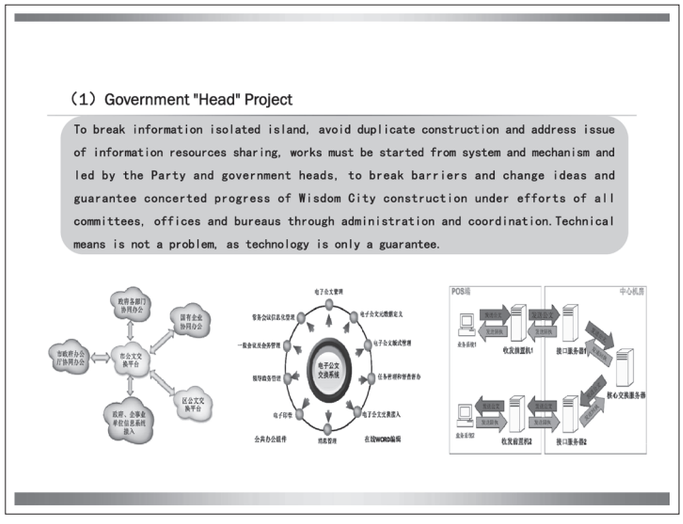
A4 中国智慧城市建设现状与发展态势
Chinese smart city construction present situation and development trend

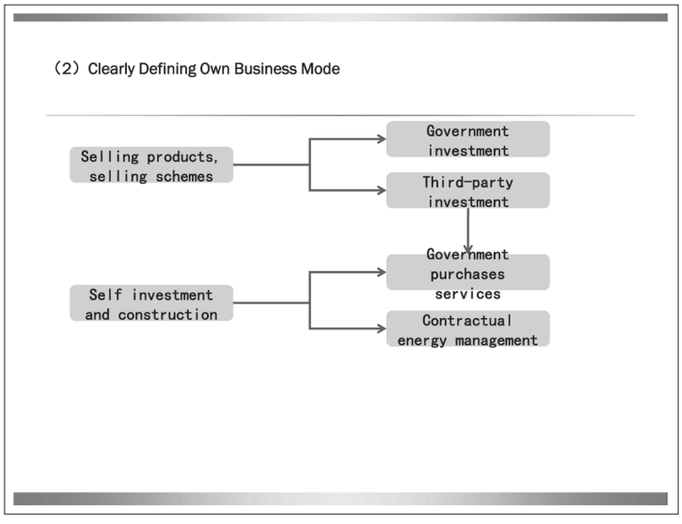












A4 中国智慧城市建设现状与发展态势
Chinese smart city construction present situation and development trend

表1 智慧城市建设典型商业模式优劣势分析

典型模式	特征描述	优劣势分析		典型代表
		优势	劣势	
模式一：政府独自投资建设和运营	政府负责基础设施/平台的投资、建设、维护和运营	政府有绝对控制权	政府财政压力较大，必须获得足够的收益才能维持网络运转，同时也面临业务的运营、推广以及后期维护等困难	美国德克萨斯州的Corpus Christi市无线城市
模式二：政府和运营商共同投资，运营商建设并运营	由政府和运营商共同出资、共同拥有，日常建设及运营管理由电信运营商进行	可以减轻政府财政压力	面临着产权难以界定、利用运营商网络资源会产生纠纷等问题	赛城“无线赛城”
模式三：政府投资，委托运营商/第三方建设、运营	政府进行投资，并通过招标等方式委托一家或多家运营商建设和运营	政府有绝对控制权，专业公司进行运营和维护	政府财政压力较大，后续网络的升级、运维等容易导致权责不明朗	新加坡“智能国家2015”
模式四：政府牵头，BOT（建设—经营—转移）模式	通过市场化方式引入企业资金投资基础设施建设，许诺投资方在建成后的一段时期内拥有经营权，到期后再由政府收回管理经营	减轻政府财政压力	所有权和经营权的分离造成企业的短视，政府运营经验的缺乏导致到期收回对政府压力较大	台北“无线台北”
模式五：运营商/第三方独立投资建设和运营	综合实力较强的电信运营商或者第三方独立负责智慧城市子任务（例如一项基础设施、平台或者应用建设）的投资建设和运营工作	产权清晰，减少政府财政压力，可以充分利用电信运营商经验和实力解决“无线城市”的运营、管理和维护等问题	需要有持续的盈利模式	上海市智慧虹桥商务区
模式六：联合建设运营	产业链上电信运营商、应用开发商、系统集成商、终端设备提供商中的两家或多家联合开发智慧平台或应用并共同推广	利于产业链良性运转，综合解决能力较强	多方合作，合作协调工作量较大	台北市智慧园区
模式七：联合公司化运营	由产业链中成员，如电信运营商、应用开发商、系统集成商等共同成立一个管理公司及系列子公司进行智慧城市的投资、建设、运营	利于产业链良性运转，综合解决能力较强，公司化运作更加灵活	多方合作，合作协调工作量较大	杭州市一卡通项目

表2 “智慧城市”典型项目商业模式建议

业务大类	业务小类	特征描述	典型商业模式匹配建议
智慧基础类	有线传输等基础设施建设	投资规模大； 专业要求高； 共享要求高	模式三：政府投资，委托运营商/第三方建设、运营； 模式四：政府牵头，BOT模式
	数据库建设	涉密要求高； 维护运营要求低	模式一：政府独自投资建设和运营
	云计算数据中心	投资规模较大； 专业要求高； 涉密要求高	模式二：政府和运营商共同投资、运营商或第三方建设并运营； 模式三：政府投资，委托运营商/第三方建设、运营
	物联网感知层及平台建设	投资规模大； 维护要求高； 公益性质高	模式四：政府牵头，BOT模式； 模式二：政府和运营商共同投资，运营商建设并运营
智慧门户/平台/应用	智慧城市门户	形象关联度高； 投资规模不大； 维护要求中等	模式三：政府投资，委托运营商/第三方建设、运营； 模式二：运营商/第三方独立投资建设和运营
	综合管理平台政务类应用	政府类应用； 投资规模中等； 维护要求中等	模式三：政府投资，委托运营商/第三方建设、运营； 模式四：政府牵头，BOT模式
	产业类应用	投资规模中等； 维护要求中等	模式五：运营商/第三方独立投资建设和运营； 模式六：联合建设模式； 模式七：联合公司化运作
	民生类应用	应用内容庞大； 投资规模不一； 维护要求较高； 直接面向公众	模式五：运营商/第三方独立投资建设和运营； 模式六：联合建设模式； 模式七：联合公司化运作

Data source:*Mobile Communication*（Issue 03，2013）- Yang Huihua，Fan Yaodong—*Analysis and*

（3）Don't go it alone, but form team power

Single enterprise can not run the whole show;

Autonomic-joint has certain limitation and uncertainty;

Third-party social resources should be utilized properly; it is a case of not buying brand with investment but properly developing business value of third-party resources and platform

Wisdom City construction means cooperation, means gaming.

（4）He who Gains Standards Will Win

Wisdom City covers wisdom medical care, wisdom home care, wisdom administration, wisdom land, wisdom environmental protection, wisdom traffic, wisdom urban management, wisdom public services, wisdom social management, wisdom tourism, wisdom agriculture, wisdom logistics, wisdom residence and wisdom education, etc. In China, there are many hardware standards such as enterprise standard, industry standard, national standard, international standard and compulsory standard, but many blanks exist with software standards. Lab standard and pure technical standard are available, but application standard and evlauation standard are in short. So relevant parties should be brave in joining standard formulation and revision.

Standard is the direction leading construction of Wisdom City and should be mastered through pilot, summary, revision, formulation, issue, recommendation and implementation. Mastering standards will make you remain unbeatable.

5. Summary

1. Wisdom City construction should proceed from reality

◆Wisdom City construction, including digital and network construction, is a long-term process developing with informationization. For healthy development of Wisdom City, effective and full utilization of various urban resources, it is very important to design a wisdom development strategy for Wisdom City.

◆For any city, to construct Wisdom City, the first is to well identify where its starting point is, of which the more important is having an accurate evaluation on the city's digital and network situations and well make up for digital and nework deficiency.

◆Digital and nework remedy should also be considered as foundation for Wisdom City construction, and an indispensable part.

2. Strategic Principle for Wisdom City Construction --- Thinking the Big

◆Research and analyze : first, main gap between the city's digital and network development situations and current states and Wisdom City "states"; second,current economic and social development of the city, urban economic and social development goal, and pressing demand of economic and social development for "intelligent"; third, the city's various resources, to seek balance point among "goal", "demands" and "resources".

◆On the basis of the above-mentioned, advance special proposal, cautiously determined long-term and short-term goals of Wisdom City construction, and formulate a workable Wisdom City development plan, namely a desired blueprint and roadmap for "Wisdom City".

◆Plan goal and output should be clear and measurable rather than abstract and conceptual; plan should keep the general goal and long-term goal in view; should be with full insight and imagination.

A4 中国智慧城市建设现状与发展态势
Chinese smart city construction present situation and development trend

3. Strategic Principle for Wisdom City Construction ---Starting from the Small

◆Start from small, easy and clear-return projects, to ensure " winning the first fight" . With relative mature digital and network development,start from "digital, network remedy" project, meaning low risk but high assurance of success.

◆For intelligent project, seriously analyze the urgency for the city's economic and social development. Be sure to seize the project with " pressing demand" , but cautiously evaluate and strictly control projects that may be "better if available" or "makes perfection still more perfect".

◆For intelligent project that must be constructed and is bigger, make efforts to translate it into several phasic works as far as possible for implementation, so as to temper team in practice, gain experience and draw lessons, and to accumulate "small success for big success" to win trust and social support.

4. Wisdom City Construction Strategy

◆Construction of Wisdom City is a process of urban development with informationization. A city will have better informationization development as long as its funds are sufficient.

◆However, better informationization development may not surely promote urban development.

◆So Wisdom City mode is the key : construction mode, service mode and operation mode.

◆There is not a standard general mode for reference, so it is needed to tailor the mode according to actual situations of the city, subject to a principle : construction risk should be low, services variable according to needs, and operation sustainable.

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Server for China Wisdom City

China wisdom City IndusTry Alliance

Server for China Wisdom City

A5 中国航天系统静电防护体系认证的试点经验
The Experience of ESD Protection System Certification in China Aerospace Industry

中国航天系统静电防护体系认证的试点经验

中国航天科技集团公司
学术技术带头人
刘民
2014年10月

背景

- 静电危害对航天电子产品造成严重影响
  - 在轨卫星电子产品功能失效，不可维修
  - 曾发生过多次卫星电子产品静电损伤事故
- 航天电子产品要求高质量、高可靠，超过一般电子产品
- **1987-2007**年，静电防护重点关注：技术方面
  - 接地、地面、工作台、测量仪器、定期检测、失效分析
- **2007**年以后，静电防护重点关注：管理方面
  - 主管部门，规章制度，培训，监督机制，相关标准
- **2010**年以后，静电防护管理体系认证成为主流
  - 中国空间技术研究院全面建设静电防护管理体系
  - 对外协单位提出全链条的防护要求

静电防护测试

- 技术标准建设
  - **2002**年中国空间技术研究院发布标准**Q/W968**防静电系统测试方法，（被**Q/W1302-2010**替代）
    - 每半年开展定期检测
    - 防静电工程验收检测：接地、地面、工作台等等
    - 防静电用品检测：服装、鞋、腕带、包装、椅子等
  - 北京东方计量测试研究所对静电测试仪器及其校准方法进行了全面地研究
    - 非接触式静电电压表校准规范（**GJB/J5972-2007**）
    - 充电平板检测仪检定规程**(JJG(**军工）**33-2014**）
    - 人体防静电综合测试仪检定规程（**Q/QJA123-2013**）
    - 静电放电屏蔽包装袋测试仪校准方法研究

静电防护测试

- 中国空间技术研究院物资部元器件失效分析中心
  - 开展**ESD/EOS**失效分析
  - 开展**HBM/MM**模型的静电敏感度试验

EPA配置要求（Q/W1303-2010)

- **I**类**EPA**：直接或间接处置**ESDS**的区域
- **II**类**EPA**：处置已有防护措施的**ESDS**区域
  - 接地、等电位：静电接地点、腕带插孔
  - 防静电设施：地面、桌面、椅子、货架、小车
  - 防静电设备：离子风机、人体综合测试仪、门禁系统
  - 防静电用品：腕带、鞋、服装、一次性鞋套、手套、指套
  - 标识
  - 包装：静电放电屏蔽袋、转运箱
  - 工具：电烙铁、热拨器

航天电子产品静电防护标准

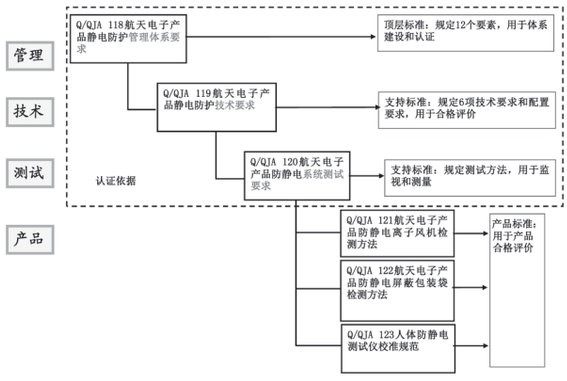
- 航天标准
  - **QJ 1693-1989**《电子元器件防静电要求》（被**QJ2245**代替）
  - **QJ 2245-1992**《电子仪器和设备防静电要求》（与**QJ1693**合并修订）
    - 一般要求：合同，**ESD**控制大纲
    - 详细要求：**ESD**敏感度分级，防静电设计，防静电工作区，防静电操作，标志/包装/运输和存储，质量保证（培训，设计审查，**EPA**检查，操作检查，失效分析）
  - **QJ 2846-1996**《防静电操作系统通用规范》（替代**QJ1950**）
  - **QJ 1875A-1998**《静电测试方法》
  - 五院标准：**Q/W 968-2002**《防静电系统测试方法》（**Q/W968A-2008**）
  - 五院标准：**Q/W 1165-2008**《电子产品静电防护通用要求》

A5 中国航天系统静电防护体系认证的试点经验
The Experience of ESD Protection System Certification in China Aerospace Industry

航天电子产品静电防护标准介绍

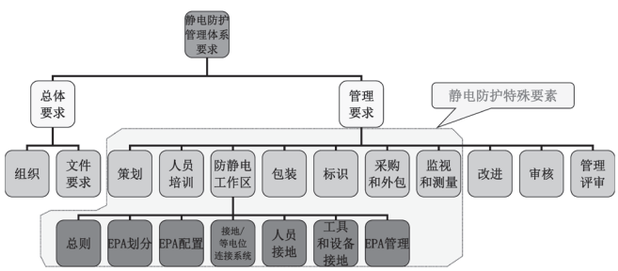
- 中国空间技术研究院，外协单位
  - Q/W 1300—2010 静电防护管理体系要求
  - Q/W 1301—2010 静电防护技术要求
  - Q/W 1302—2010 防静电系统测试要求
  - **Q/W 1303—2010 防静电工作区配置要求**
- 中国航天科技集团公司，外协单位
  - Q/QJA 118-2013 航天电子产品静电防护管理体系要求
  - Q/QJA 119-2013 航天电子产品静电防护技术要求
  - Q/QJA 120-2013 航天电子产品防静电系统测试要求
  - **Q/QJA 121-2013 航天电子产品防静电离子风机检测方法**
  - **Q/QJA 122-2013 航天电子产品防静电屏蔽包装袋检测方法**
  - **Q/QJA 123-2013 人体防静电测试仪校准规范**
- 国家标准，**SAC/TC425**全国宇航及其应用标准化技术委员会
  - 国家标准：航天电子产品静电防护要求（**2014**年底发布）

Q/QJA 118~119 系列标准



静电防护管理体系简介

- 静电防护管理体系组成
  - 形式上：方针-目标-组织-文件（四层次文件：管理手册、程序文件、操作（工艺）规范、记录表格）
  - 内容上：**12**个要素



Q/QJA118-120与S20.20和IEC 61340-5-1要素比较

标准号	Q/QJA118-120-2013	S20.20/ IEC 61340-5-1 （2007）
总体要求	组织机构：指定负责人，管理部门，明确职责。	组织机构：指定负责人，明确职责。
	文件控制：建立文件化的管理体系，制定《静电防护管理手册》和程序文件；对体系文件和记录进行控制。	文件控制：建立文件化的防护体系，制定《静电防护大纲》
管理要求	策划、人员培训、防静电工作区、包装、标识、采购和外包、监视测量、改进（纠正、预防措施）、审核、管理评审。	人员培训、符合性验证（监视测量）、包装、标识。

Q/QJA118-120与S20.20和IEC 61340-5-1要素比较

标准号	Q/QJA118-120-2013	S20.20/ IEC 61340-5-1 （2007）
技术要求	Q/QJA119包含：接地/等电位连接系统、人员接地、工具和设备接地、防静电工作区、包装、标识； 提出防静电配置要求	接地/等电位连接系统、人员接地、防静电工作区、包装、标识。
测试方法	Q/QJA120包含：防静电设施、设备、工具、用品、以及现场测试等12项	引用ANSI/ESD STM等15项产品和测试标准

Q/QJA118-123航天电子产品静电防护管理体系标准，属于集团公司独创，体现了集团公司领导对静电防护的高度重视，和大胆创新精神。它的有效实施，必将使航天器电子产品的静电防护提高到一个新的水平，有效提高航天电子产品的质量和可靠性。

静电防护认证中心

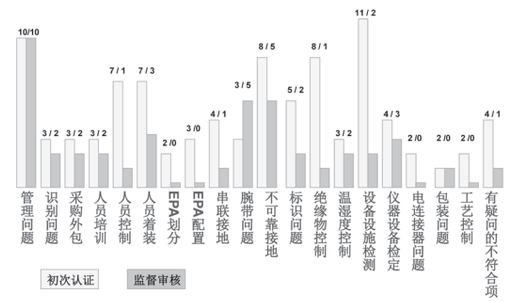
- **2010**年中国空间技术研究院成立静电防护认证中心
  - 依据**Q/W1300**和**Q/QJA118**系列认证标准
  - 依据静电防护认证内部管理文件
    - 静电防护管理体系认证规则
    - 审核员管理规定
    - 认证审核作业指导书
  - 有审核员资质**60**多人
- 目前已有**20**多家单位通过认证获得资质证书，其中有**2**家因监督检查不通过、变更延期等原因暂停资质。

A5 中国航天系统静电防护体系认证的试点经验
The Experience of ESD Protection System Certification in China Aerospace Industry

静电防护认证的效果

- 上下游之间统一静电防护的标准要求
  - 技术要求（含配置要求，检测要求）
  - 管理要求（组织、文件、管理、内审、持续改进）
- 静电防护意识普遍提高
  - 周期培训，考核
  - 监督审核，重点检查领导培训情况
- 静电防护能力增强
  - 防静电工程验收，定期检测，杜绝假冒伪劣防护产品
- 对产品质量的信心明显增强

现场审核真实案例



静电防护中心学术交流

- **2013**年出版了《电子工业静电防护技术与管理》专著，**48**万字
- **2012-2014**年代表中国空间技术研究院联合主办了首届和第二、第三届“静电防护与标准化学术交流会”
- 每年举办静电防护管理体系培训班
- 积极推动全国静电防护标准化技术委员会筹建
- 发表论文**40**多篇

体系化的管理特点

- 体系化管理是一种有效的、通行的、标准化的管理工具
- 各种管理体系趋向统一的流程：**PDCA**
  - 策划-运行-检查-改进（循环）
- 各种管理体系趋向一致的工具：认证
  - 一套包含全要素的标准（管理要素、技术要素）
  - 强调管理者重视（领导职责、部门职责）
  - 强调人员培训
  - 形式上：方针-目标-组织-文件（四层次文件：管理手册、程序文件、操作规范、记录表格）
  - 行动上：记录-监视测量-内审-改进预防-管理评审-外审-认证
  - 效果上：符合标准-多方互认-提高管理水平-增强竞争实力

静电防护认证的经验（1）

- 航天电子产品对静电防护提出了严格的要求，因此必须开展静电防护认证。
- 目前我们的认证中心是中国空间技术研究院**CAST**授权的，
  - 对于**CAST**之内的单位，认证的性质是第三方认证；
  - 对于**CAST**之外的单位，是第二方认证
- 我们的认证标准包含了管理体系的全要素
  - 可以独立运行，也可以配合**ISO9000**运行
  - **S20.20**和**IEC61340-5-1**均不能独立运行

静电防护认证的经验（2）

- 认证中心持续改进
  - 认证标准**Q/W1300**、**Q/QJA118**计划每**5**年修订一次。
  - 认证中心控制文件，每年讨论更新
  - 审核员队伍管理严格，
    - 每年培训**20**学时
    - 三年重新注册
    - 质量评价，客户监督

A5 中国航天系统静电防护体系认证的试点经验
The Experience of ESD Protection System Certification in China Aerospace Industry

谢谢！

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Experience of Electrostatic Protection Program Certification in China Aerospace System

China Aerospace Science and Technology Corporation
Academic Technology Leader
Liu Min
October, 2014

Background

- Electrostatic hazards cause serious influence on aerospace electronic products.
  - On-orbit satellite electronic products fail to function and can't be maintained.
  - There had been many electrostatic damage accidents of satellite electronic products in the past.
- The high quality and high reliability of aerospace electronic products surpass normal electronic products.
- The key point of electrostatic protection is the technical aspect since 1987-2007:
  - Earthing, floor, work surfaces, testing instrument, periodic verify and failure analysis;
- The key point of electrostatic protection was the management aspect after 2007.
  - Competent department, rules and regulations, training, supervision mechanism and standards
- The electrostatic protection management program certification has become the mainstream since 2010.
  - The China Academy of Space Technology (CAST) constructs electrostatic protection management system comprehensively.
  - Propose outsourcing manufactories for full-chain protection requirements

Electrostatic Protection Test

- Technical standard construction
  - The CAST released standard Q/W968 Electrostatic Protective system test method (substituted by Q/W1302-2010)
    - Periodic detection every half a year
    - ESD engineering acceptance test: earthing, floor, work surfaces, and so on
    - ESD product detection: clothing, shoes, wrist strap, packaging, chairs and so on
  - Beijing Oriental Institute of Measurement and Test (BOIMT) carries out comprehensive researches on electrostatic test instruments and their calibration methods.
    - Calibration Specification for Non-contact Static Voltmeter (GJB/J5972-2007）
    - Verification Regulation for Charged Plate Monitor (JJG(defense industry) 33-2014）
    - Verification Regulation for Tester for Human Body（Q/QJA123-2013）
    - Research on Calibration Method for Electrostatic Discharge Shield Package Tester

Electrostatic Protection Test

- Component Failure Analysis Center of the Materails Department of the CAST
  - Carry out ESD/EOS failure analysis
  - Carry out electrostatic sensitivity test of HBM/MM model.

EPA Configuration Requirements （Q/W1303-2010)

- Class I EPA：region where ESDS is handled directly or indirectly
- Class II EPA：region where ESDS provided with protection is handled
  - Earthing and equipotential: electrostatic grounding point and wrist jack
  - facilities: floor, work surface, chair, shelf and carriage
  - equipment: ion fan, human body tester and entrance guard system
  - products: wristlet, shoes, clothing, disposable shoe cover, gloves and finger cots.
  - marking
  - Package: ESD shielding bag and transfer box
  - Tools: electric iron and wire pulling heater

A5 中国航天系统静电防护体系认证的试点经验
The Experience of ESD Protection System Certification in China Aerospace Industry

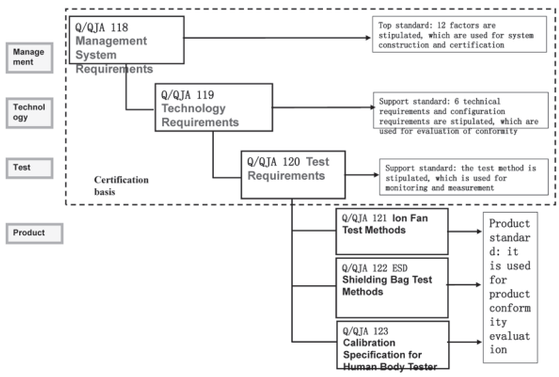
Electrostatic Protection Standards for Aerospace Electronic Products

- Aerospace Standards
  - QJ 1693-1989 Anti-static Requirements for Electronic Components (substituted by QJ2245)
  - QJ 2245-1992 Anti-static Requirements for Electronic Instrument and Equipment (combined and revised together with QJ1693）
    - General requirements: contract and ESD control program
    - Detailed requirements: ESD sensitivity classification, plan, EPA, operation, marking / package / transportation and storage, quality assurance (training, design review, EPA inspection, operation inspection and failure analysis)
  - QJ 2846-1996 General Specification for Anti-static Operation System (substituting QJ1950）
  - QJ 1875A-1998 Electrostatic Test Method
  - Standards for CAST:Q/W 968-2002 Electrostatic Protective system test method（Q/W968A-2008）
  - Standards for CAST： Q/W 1165-2008 General Requirements for Electrostatic Protection of Electronic Products

Introduction to Electrostatic Protection Standards for Aerospace Electronic Products

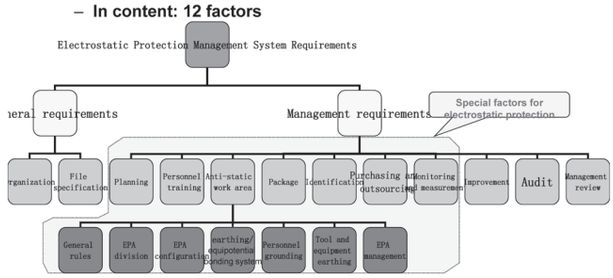
- China Academy of Space Technology and outsourcing manufactories
  - Q/W 1300—2010 Electrostatic Protection Management System Requirements
  - Q/W 1301—2010 Electrostatic Protection Technology Requirements
  - Q/W 1302—2010 Electrostatic Protection system Test Requirements
  - Q/W 1303—2010 Anti-static Work Area Configuration Requirements
- China Aerospace Science and Technology Corporation and outsourcing manufactories
  - Q/QJA 118-2013 Electrostatic Protection Management System Requirements for Aerospace Electronic Products
  - Q/QJA 119-2013 Electrostatic Protection Technology Requirements for Aerospace Electronic Products
  - Q/QJA 120-2013 Electrostatic Protection system Test Requirements for Aerospace Electronic Products
  - Q/QJA 121-2013 Ion Fan Test Methods for Aerospace Electronic Products
  - Q/QJA 122-2013 ESD Shielding Bag Test Methods for Aerospace Electronic Products
  - Q/QJA 123-2013 Calibration Specification for Human Body Tester
- National standard, SAC/TC425 National Technical Committee on Aerospace and Its Application Standardization
  - National Standards: Electrostatic Protection Requirements for Aerospace Electronic Products (released at the end of 2014)

Q/QJA 118~119 Series Standard



Introduction to Electrostatic Protection Management System

- Electrostatic Protection Management System Composition
  - In form: policy – objective – organization – document (four-level documents: management manual, program document, operation (technology: specification, record form))
  - In content: 12 factors



Factor Comparison between Q/QJA118-120 and S20.20/IEC 61340-5-1

Standard number	Q/QJA118-120-2013	S20.20/ IEC 61340-5-1 （2007）
General requirements	Organizational structure: assign the principal to manage the department and clarify the responsibilities	Organizational structure: assign the principal and clarify the responsibilities
	Document control: establish documented management system, formulate the Electrostatic Protection Management Manual and program documents and control system documents and records.	Document control: establish documented protection system and formulate the Electrostatic Protection Program.
Management requirements	Planning, personnel training, EPA, package, mark, purchasing and outsourcing, monitoring and measurement, improvement (corrective and preventive measures), audit and management review.	Personnel training, compliance verification (monitoring and measurement), package and mark.

Factor Comparison between Q/QJA118-120 and S20.20/IEC 61340-5-1

Standard number	Q/QJA118-120-2013	S20.20/ IEC 61340-5-1 （2007）
Technical requirements	Q/QJA119 comprises earthing / equipotential bonding system, personnel earthing, tool and equipment earthing, EPA, package and marking;	Earthing / equipotential bonding system, personnel earthing, EPA, package and marking.

Q/QJA118-123 Electrostatic Protection Management System Standards for Aerospace Electronic Products is created by the group company, which demonstrates the high attention the group company leaders pay to electrostatic protection and bold innovative spirit. The effective implementation of the standard will certainly improve electrostatic protection of aerospace electronic products to a new level and increase the quality and reliability of aerospace electronic products.

A5 中国航天系统静电防护体系认证的试点经验
The Experience of ESD Protection System Certification in China Aerospace Industry

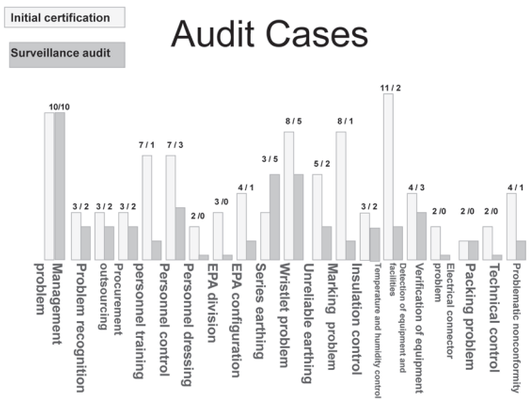
Electrostatic Protection Certification Center

- CAST established the Electrostatic Protection Certification Center (ESDC) in 2010.
  - Based on Q/W1300 and Q/QJA118 series certification standards
  - Based on internal management files for electrostatic protection certification
    - ESDC Rules
    - Auditor Management Regulations
    - Certification Audit Operating Instruction
  - Over 60 employees own auditor qualification.
- At present, more than 20 manufactories pass the certification and obtain the qualification certificate, among which the qualification of 2 manufactories is suspended owing to failing the supervision and inspection, modification and extension.

Electrostatic Protection Certification Effect

- The upstream and downstream industries unify electrostatic protection standard requirements.
  - Technical requirements (including configuration requirements and inspection requirements)
  - Management requirements (organization, documents, management, internal audit and continuous improvement)
- The electrostatic protection awareness is generally improved.
  - Periodic training and check
  - Surveilllance audit and focus on the training of leaders
- The electrostatic protection ability is reinforced.
  - Acceptance of ESD project, periodic testing and elimination of fake commodities.
- The confidence in product quality is enhanced obviously.

Audit Cases



Academic Exchange of the ESDC

- The Electrostatic Protection Technology and Management of the Electronic Industry was published in 2013, 480 thousand words in all.
- The ESDC held the 1st, 2nd and 3rd Seminar on Electrostatic Protection and Standardization on behalf of CAST from 2012 to 2014.
- It holds electrostatic protection management system training courses every year.
- It plays an active role in preparing to construct the National Standardization Technical Committee on Electrostatic Protection.
- It has published over 40 papers.

Systematic Management Features

- Systematic management is a kind of effective, general and standardized management tools.
- Various management systems tend towards unified processes: PDCA
  - Planning – Running – Checking –Advancement (cycle)
- Various management systems tend towards the same tool: certification
  - A set of standards comprising total factors (management factor and technological factor)
  - Emphasize the attention of administrators (leadership responsibilities and department responsibilities)
  - Emphasize personnel training
  - In form: policy – objective – organization – document (four-level documents: management manual, program document, operation (technology: specification, record form)
  - In action: record – monitoring and measurement – improvement and prevention – management review – external audit – certification
  - In effect: meeting standards – mutual recognition – improving the management level – enhancing the competitiveness

Electrostatic Protection Certification Experience (1)

- Aerospace electronic products have strict electrostatic protection requirements, so the electrostatic protection certification must be carried out.
- At present, our certification center is authorized by the China Academy of Space Technology (CAST).
  - These manufactories affiliated to the CAST adopt the third party certification.
  - These manufactories not affiliated to the CAST adopts the second party certification.
- Our certification standards comprise total factors of the management system.
  - They can be run independently or coordinated with ISO9000.
  - Neither S20.20 nor IEC61340-5-1 can be run independently.

A5 中国航天系统静电防护体系认证的试点经验
The Experience of ESD Protection System Certification in China Aerospace Industry

Electrostatic Protection Certification Experience (2)

- **The certification center is improved continuously**
  - **The certification standards Q/W1300 and Q/QJA118 are to be revised once every five years.**
  - **The control documents of the certification center are discussed and renewed every year.**
  - **The auditor team has strict management systems.**
    - **20 credit hours' training every year**
    - **Re-registration every three years**
    - **Quality evaluation and customer supervision**

Thank You!

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Liu Min

A6 关注智慧城市建设中的静电危害
Focus on the electrostatic hazard of wisdom city construction

中国民主促进会上海市委员会

重视智慧城市建设及城市运行安全中的静电隐患

黄山明
民进上海市委秘书长
2014年10月14日

中国民主促进会上海市委员会

目录

一、智慧城市建设与防静电产业

二、我国防静电产业现状

三、几点建议

四、提案办理情况

中国民主促进会上海市委员会

一、智慧城市建设与防静电产业

- 上海在“十二五”规划中首次明确提出建设智慧城市，2011年9月，市委、市政府召开智慧城市建设动员大会，公布了《上海市推进智慧城市建设2011-2013年行动计划》；明确了四个体系、24个专项、119个项目等。
- 2014年9月，市政府又发布了上海市推进智慧城市建设2014-2016年行动计划。未来三年，上海将着力实施智慧化引领的“活力上海五大应用行动”，强化信息基础设施、信息技术产业和网络安全保障“三大支撑体系”，引导推动50个重点专项。

中国民主促进会上海市委员会

一、智慧城市建设与防静电产业

- 智慧城市的标志是智慧基础设施、智慧运行、智慧服务和智慧产业，均以先进的信息技术为支撑。智慧城市的底层系统是由各种集成了微电子器件的信息采集、信息处理设备而组成的物理系统。微电子器件可以被看成是智慧城市的细胞。

中国民主促进会上海市委员会

一、智慧城市建设与防静电产业

- 静电是微电子工业的天敌，因静电放电造成隐形失效的元器件一旦被组装应用到智慧城市系统后，即在整个系统中埋下了“硬病毒”。如果被应用到城市运行的大系统中，其结果可能是灾难性的！

中国民主促进会上海市委员会

二、我国防静电产业现状

1. 我国还未成立防静电标准化技术委员会

- 静电技术是门边缘科学，涉及的学科多，至今全国还未设置防静电标准化技术委员会。
- 标准的申报、审议、管理归属于多个行政部门
- 存在多头管理，重复编写的问题
- 浪费了本来就很紧缺的标准资源

A6 关注智慧城市建设中的静电危害
Focus on the electrostatic hazard of wisdom city construction

中国民主促进会上海市委员会

二、我国防静电产业现状

2、国内防静电认识不足、标准整体落后

- 现有的防静电国家标准及行业标准主要存在四方面的问题：
- （1）标准不成体系，分类不明确
- （2）标龄太长，技术水平低
- （3）与国际标准不接轨
- （4）标准缺失现象严重

中国民主促进会上海市委员会

二、我国防静电产业现状

3.微电子产品生产企业静电防护现状堪忧

- 国内微电子生产企业在选择防静电产品时往往只单纯比较价格
- 很多企业将防静电产品作为劳防用品或办公用品来采购
- 绝大部分的微电子生产企业没有按照IEC或美国静电协会标准建立静电防护体系
- 静电防护只停留在采购一些防静电基础设施及产品的表面化初级阶段

中国民主促进会上海市委员会

二、我国防静电产业现状

3.微电子产品生产企业静电防护现状堪忧

- 主要问题在：
  （1）没有建立动态的静电敏感元器件清单（不知道那些要防静电）；
  （2）不知道现有静电敏感元器件的静电敏感度等级（不知道要如何防护）；
  （3）没有对有可能处置静电敏感元器件的人员进行识别；
  （4）没有制定涉及静电防护的规章制度（包括各类防静电设施检验规则、静电保护区管理要求、培训计划等）。

中国民主促进会上海市委员会

二、我国防静电产业现状

4.有关行业协会作用有待进一步发挥

- 行业协会是市场经济发展的产物，是现代社会的必然组成部分，是考量是否达到成熟市场经济国家的重要标准之一。行业协会“规范行为、提供服务、反映诉求”的职能随着经济、社会发展不断丰富。
- 目前上海部分协会在国内已有一定影响。但也有部分新型产业、综合性行业协会作用进一步发挥有待政府支持帮助。

中国民主促进会上海市委员会

三、几点建议

1.积极组建上海地方性静电专业委员会

- 筹建技术委员会是行业现状要求及其发展趋势，行业发展对标准需求在深化，标准体系又是动态的，是发展的，需要不断修订，完善和更新。
- 在全国未设置防静电标准化技术委员会之前，根据上海实际优势，可以先推动组建上海地方的防静电标准化技术委员会来改变这一局面。

中国民主促进会上海市委员会

三、几点建议

2.重视静电知识普及、人才培养

（1）调动相关企业、协会、社会专业人员积极性，增加投入，利用媒体网络、科技场馆、学校等场地加大静电知识科普宣传力度。

（2）将“防静电工程师”纳入上海市战略性新兴产业紧缺人才开发目录，以吸引更多人才参加培训，为智慧城市建设及城市运行安全提供智力支持和人才保障。

A6 关注智慧城市建设中的静电危害
Focus on the electrostatic hazard of wisdom city construction

中国民主促进会上海市委员会

三、几点建议

3. 在政府采购中明确有关中标企业静电防护要求

– 静电防护直接关系到电子产品质量，也涉及到智慧城市建设成果评估、建设成本降低、城市运行安全，政府各部门应提高对静电防护重要性的认识，在涉及电子类产品的政府采购招标中，将产品生产企业是否建立并通过静电防护体系认证作为一项重要的基础要求，以消除城市运行系统中的“硬病毒”。

中国民主促进会上海市委员会

三、几点建议

4. 充分发挥行业协会作用

– 静电防护技术性强，牵涉面广，应该发挥上海多家行业协会优势。

– 通过政府购买服务，委托协会开展本市电子行业静电防护方面的调研统计，提供评估、培训、产品检测、建立标准体系等服务。

– 支持开展“防静电产业联盟标准创新试点”工作，先行制定出一批与国际接轨的、市场急需的防静电标准。

中国民主促进会上海市委员会

四、提案办理情况

经过多次调研及反复讨论，“重视智慧城市建设及城市运行安全中的静电隐患”在上海市政协十二届二次会议上立为第**0192**号提案，并引起了有关方面的关注，承办提案的市质量技术监督局、市经信委等政府部门相当重视。

中国民主促进会上海市委员会

四、提案办理情况

市经济信息化委员会答复：

1、积极推进社会组织规范化建设

2、积极争取平台的支持

3、积极推动人才建设

中国民主促进会上海市委员会

四、提案办理情况

市质量技监局答复：

1、培育防静电领域相关标准化技术组织

2、加强防静电领域相关标准修订工作

3、支持行业组织开展防静电标准化工作

4、充分发挥本市标准化政策资金扶持作用

5、开展安全生产领域防静电标准化工作

中国民主促进会上海市委员会

Attaching Importance to Electrostatic Trouble in Wisdom City Construction and City Operation Safety

Huang Shaming
Secretary General of Shanghai Committee, China Association for Promoting Democracy
Oct. 14, 2014

A6 关注智慧城市建设中的静电危害
Focus on the electrostatic hazard of wisdom city construction

中国民主促进会上海市委员会

Contents

1. Wisdom City Construction and Antistatic Industry
2. Current Situations of Antistatic Industry in China
3. Several Suggestions

中国民主促进会上海市委员会

1. Wisdom City Construction and Antistatic Industry

- Shanghai clearly advanced construction of Wisdom City in its "12th Five-Year Plan" for the first time. In Sept. 2011, the Party Committee and the Municipal Government specially held Wisdom City construction mobilization conference and announced Shanghai Action Plan for Driving Wisdom City Construction 2011-2013：clarifying 4 systems, 24 special projects and 119 projects, etc.
- On Sept. 23, 2014, Shanghai Municipal Government released Shanghai Action Plan for Driving Wisdom City Construction 2014-2016. In the future three years, Shanghai will focus on implementation of wisdom-leading "Dynamic Shanghai Five Application Campaigns", strengthen information infrastructure, information technology industry and network security guarantee "three supporting systems", and guide and fuel 50 key special projects.

中国民主促进会上海市委员会

1. Wisdom City Construction and Antistatic Industry

- Marks of Wisdom City are wisdom infrastructure, wisdom operation, wisdom service and wisdom industry, all of which are based on advanced information technology. Bottom system of Wisdom City is a physical system of information acquisition and information processing equipment integrated with various microelectronic devices. Microelectronic devices can be considered as cell of Wisdom City.

中国民主促进会上海市委员会

1. Wisdom City Construction and Antistatic Industry

- Static electricity is the natural enemy of microelectronic industry. Once a component with invisible failure caused by ESD is assembled and used in Wisdom City system, it means a "hard virus" hidden in the entire system. If such kind of component is used in big system of city operation, the result may be a disaster!

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2. Current Situations of Antistatic Industry in China

1. China has not established antistatic standardization technical committee
- Electrostatic technology is an inter-discipline and involves many disciplines. By far China has not had antistatic standardization technical committee. Standard application, deliberation and administration are under several administrative departments, causing problems of multiple management and repeated preparation, etc, which not only waste basically very short standard resources, but also cause formulation of less workable and advanced standards due to not understanding international advanced antistatic standards, let alone antistatic industry standard R&D and long-term development direction.

中国民主促进会上海市委员会

2. Current Situations of Antistatic Industry in China

1. China has not established antistatic standardization technical committee
- In 2009, national individual protection standardization technical committee revised national standard *Antistatic Work Clothes*. However, almost at the same time, national garment standardization technical committee prepared its national standard *Antistatic Work Clothes* . The two standards refer to Japanese standard JIS T8118, but have different standard name and technical requirements, making many enterprises not know which to take.
- In 2007, Shanghai Electrostatic Protective Industrial Association made application to Standardization Administration of China three national standards through Shanghai Administration of Quality Supervision, Inspection and Quarantine. The standards were adopted after public disclosure, but no standard committee was found to undertake preparation of the standards, causing failure in project authorization of two standards of "antistatic mat" and "ionized static electricity eliminator" finally.
- Similar problems occurred in other antistatic product fields . So it is urgent to establish national electrostatic protection standardization technical committee to change the situations.

A6 关注智慧城市建设中的静电危害
Focus on the electrostatic hazard of wisdom city construction

中国民主促进会上海市委员会

2. Current Situations of Antistatic Industry in China

2. Domestic recognition of static electricity insufficient, standards backward overall

– Currently available national standard standards and industrial standards for electrostatic protection have problems in four aspects: (1)Standards are not systematic, classification is not clear: electrostatic protection application fields involve inflammable and explosive environment, microelectronic industry and clean production environment (such as pharmacy and food), different application environments have different static electricity release mechanism and control requirements. As there is no uniform planning, cross-industry citation of current standards are common very much. (2) Standard age is too old, technical level low: of current more than 100 standard, over 50% are older than 10 years, some standards have not been revised even for more than 20 years, which is serious in line with current situations of higher electrostatic protection technical requirements due to rapid development of microelectronic industry. (3) Not geared to international standards: of current standards, less than 50% adopt international standards, far away from international standards in regardless of technical requirements or testing method and environment. (4) Serious deficiency of standards: the phenomena exists not only with basic standards and testing method standards but also with product standards.

中国民主促进会上海市委员会

2. Current Situations of Antistatic Industry in China

3. Microelectronics production enterprises' current situations in electrostatic protection are anxious

– As China's antistatic standard is not geared to international advanced standard system, and many antistatic product are not supported by standards, domestic microelectronic production enterprises always compare prices when selecting antistatic products, but can not advance requirements for product performance. Many enterprises incorporate antistatic products purchase into management by logistic or administrative departments, and purchase such kind of products as PPE or office articles. According to statistics of Shanghai Electrostatic Protective Industrial Association, most domestic microelectronic production enterprises fail to establish electrostatic protection system in accordance with IEC or US ESD Association, and electrostatic protection just stands at the superficial initial stage of purchasing some basic antistatic facilities and product, which is anxious.

中国民主促进会上海市委员会

2. Current Situations of Antistatic Industry in China

3. Microelectronic production enterprises have electrostatic protection current situations anxious

– Main problems are:

(1)No dynamic electrostatic sensitive components list made(don't know which need electrostatic protection):

(2)Don't know electrostatic sensitivity class of current electrostatic sensitive components(don't know how to protect):

(3) Not identify personnel who may deal with electrostatic sensitive components:

(4)No rules and regulations for electrostatic protection(including various antistatic facilities testing rules, electrostatic protection area management requirements and training program, etc).

中国民主促进会上海市委员会

2. Current Situations of Antistatic Industry in China

4. Role of relevant industrial associations need to work further

– Industrial associations are products of market economy development, a natural part of modern society, and one of important indicators to judge whether compliance to standard for mature market economy country. Industrial associations' functions of "standardizing action, offering service and reflecting claims" will be enriched continuously with economic and social development.

– At present, Shanghai has 524 industrial associations at municipal and district/county levels, of which 108 at the municipal level and 416 at district/county level. The associations actively execute functions and lead member units to actively organize technical exchange and product development: formulate multiple-product national standards, industrial or local standards: gather a batch of professional and technical talents. some of the associations have had certain influence in Chian through government purchase of service and standardizing management. However, government support and help are expected for some new-type industry and comprehensive industrial associations to give play to their roles.

中国民主促进会上海市委员会

3. Several Suggestions

1. To actively establish Shanghai local electrostatic professional committee

– Preparing technical committee is requirements of industrial current situations and the trend of development . Industrial development demands for standards are deepening, and standard system is dynamic and developing, needing constant revision, perfection and updating.

– Before establishment of antistatic standardization technical committee in China, Shanghai can act first according to its actual advantages, to set up Shanghai local electrostatic standardization technical committee to change the situation.

中国民主促进会上海市委员会

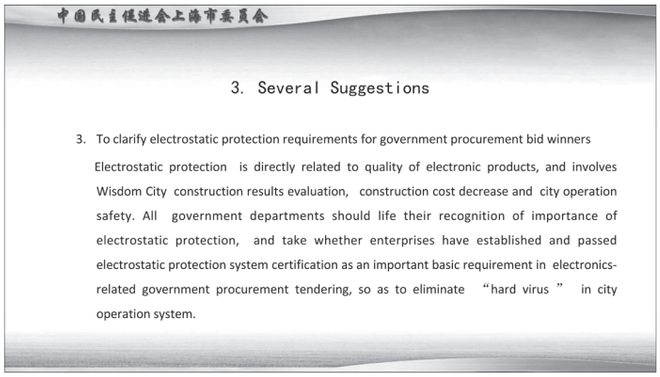
3. Several Suggestions

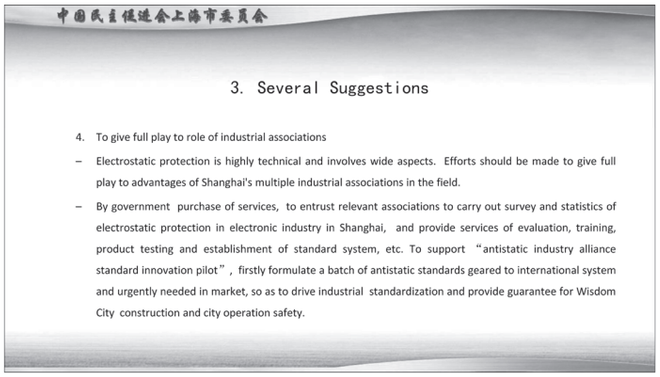
2. To attach importance to static electricity knowledge popularization and talents training

(1) Bringing initiative of relevant enterprises, associations and social professionals into play, increasing input and making use of media, network, sci-tech halls and places and schools, etc to intensify scientific popularization of electrostatic knowledge.

(2)Shanghai has formulated Shanghai Catalog for Development of Demanding Talents for Strategic Emerging Industry, it is proposed to include "antistatic engineer" into the catalog, so as to attract more talents to join relevant trainings and prepare powerful intelligent support and talents guarantee for Shanghai's Wisdom City construction and city operation safety.

A6 关注智慧城市建设中的静电危害
Focus on the electrostatic hazard of wisdom city construction





AA1 智慧城市建设中电子类产品静电防护现状、问题及对策
During wisdom city construction, the electrostatic protection present situation, problems and countermeasures of electricity products

智慧城市建设中电子类产品静电防护现状、问题及对策

摘要：本文主要阐明了电子类产品的静电防护水平对于智慧城市建设具有重要意义的观点，分析了我国防静电产业发展和电子行业静电防护水平的现状，并在此基础上提出提高我国智慧城市建设中电子类产品静电防护水平的设想和建议。
关键词：智慧城市、电子制造、静电防护、可靠性、城市运行安全、调研、项目建议

上海佰洁静电检测技术中心 徐明
上海防静电工业协会 黄建华
上海佰洁静电检测技术中心 任圣欣、黄伟、杨静雯

引言——静电与静电危害

在地板上行走会产生静电，穿脱衣物会产生静电，简单的摩擦接触也会产生静电，可以说，静电是无处不在、无时不有的。而大多数时间里，静电都是在人们的感知之外不断产生、积累和消散的，因为可感知的静电通常需达到1000V[1]以上的静电电压。

但，就是这些人们大部分时间无法感知的静电，在电子工业领域成为了危害巨大的“硬病毒”。一次几十伏的静电放电事件，就极有可能造成静电敏感器件的永久性损坏。据统计，由静电放电造成的电子产品平均损坏率达8%~33%[2]；而更加可怕的是，有90%[3]的电子元件静电失效是很难被检测发现的潜在性失效，这些性能减退、可靠性下降、稳定性缺失的潜在失效产品如果被运用于整机和系统，特别是被用在与智慧城市相关的大系统中，最终造成事故和损失可能是灾难性的。

智慧城市建设中的静电隐患

查阅所有有关智慧城市的资讯，找不到任何与静电有关的信息。智慧城市建设看似与静电毫无关系，但这正是反应了人们对智慧城市建设中静电危害重要性认识的缺失。

1.1 智慧城市建设方兴未艾，进展迅速也存在隐忧

智慧城市作为未来城市发展的趋势，是治疗“城市病”、解决“城市问题”的有效方案，也是我国促进经济可持续发展、争夺科技制高点和发展主动权的重要战略举措。随着国务院关于《关于促进信息消费扩大内需的若干意见》的发文和首批国家智慧城市试点名单的公布，智慧城市建设浪潮已经在我国正式拉开了大幕。

随着我国智慧城市建设的迅速发展，人们已开始享受其中的成果，例如：“智能交通”正在覆盖现有交通网络，一定程度上缓解了城市拥堵，减少了交通事故；“智慧物流”日趋成熟，加速了物资流转，降低了运输成本；“远程医疗”正走出试验室，提供了治疗的便利，造福了人民健康；“城市安防监控”日益普及，在减少犯罪、保障人民的生命财产安全方面发挥了作用；“电子政务”初见成效，提高了政府工作效率，节约了社会资源……总之，我国智慧城市建设拥有可以想见的美好前景。

但也要清醒的认识到，在高速发展的同时，我们城市智能体系也存在一些隐忧，除了有关专家已经指出的一些问题（包括盲目跟风、基础支撑不足、信息安全存在隐患等），还需要关注智慧城市背景下城市公共运行系统的安全问题。

1.2 智慧城市进程依赖电子技术，公共运行安全出现新命题

从技术层面讲，智慧城市建设要求通过以移动通讯技术为代表的物联网、云计算、大数据等新一代信息、电子技术的应用，

AA1 智慧城市建设中电子类产品静电防护现状、问题及对策
During wisdom city construction, the electrostatic protection present situation, problems and countermeasures of electricity products

健全、透明、充分的获取信息，通畅、广泛、安全的共享信息，有效、规范、科学的利用信息，来提高城市运行和管理效率，改善城市公共服务水平，增强城市处理突发事件的能力。在这些光鲜时髦的名词背后，电子技术是一切科技手段的基础，离开了电子技术，智慧城市就是空谈。

所谓电子技术（包括信息电子技术和电力电子技术两大分支），指的是根据电子学原理，运用电子器件设计和制造某种特定功能的电路以解决实际问题的科学。而电子器件正是电子技术的实物载体，功能再复杂的智能系统实现其功能，离不开一个个功能各异的电子器件的排列组合与分工合作。如果说智慧系统是智慧城市的组织器官，那么电子器件就是构成这些器官的细胞结构。

随着城市智能化的逐步推进，电子器件功能和数量在我们的城市中成级数的增加，并将最终覆盖生活、学习、工作的方方面面。目前，电子器件及其系统应用已经在家居、能源、金融、医疗、交通、物流、商贸等诸多领域生根立足，它们在让城市生活变得智能、便捷和高效的同时，也带来新的城市公共运行安全问题，例如：

在“电子政务”系统中的电子器件故障，可能导致办事网站的瘫痪、公民信息的丢失，社会的正常秩序将受到干扰；在“远程医疗”系统中的电子器件失效，可能导致治疗时机的贻误、病例的误诊或错诊，人们的身体健康将受到影响；在“智慧物流”系统中的电子器件问题，可能导致物资运输的延迟、货品财物的丢失，企业社会的利益将蒙受损失；在“智能交通”系统中的电子器件差错，可能导致旅客的滞留、重大交通事故的发生，人民的生命财产将出现隐患。查阅相关资料，在近几年的地铁、动车、高铁事故中，电子器件问题也经常成为了事件的主角和罪魁。

可以看出，城市运行安全问题已经在智能化的进程中发生了转变，电子器件的可靠性、稳定性和安全性在不知不觉中和我们的城市安全运行系统挂上钩了，不解决电子器件的安全问题，就谈不上城市安全，更加谈不上“以人为本”的智慧城市建设。

1.3 静电防护与智慧城市建设息息相关

如本文引言所述，静电无处不在，是电子工业的大敌。一个电子器件在其整个制造、处理、组装、装配、包装、标识、维修、测试、检验、运输，甚至使用的过程中，都可能面临静电放电导致失效的风险。需要把静电防护看做一个系统工程来重视和处理，因为在系统中任何一个环节出现失误和问题，都可能导致整个系统的瘫痪。

智慧城市的本质在于信息化与城市化的高度融合，是城市信息化向更高阶段发展的表现，需要通过电子信息化手段，实现对一切物品的智能化识别、定位、跟踪、监控、反馈与管理。这些要求要能实现和量产，除了需要技术层面的相关进步以外，可移动和便携也是其中非常重要的潜在要求，计算机体积应更小，更便携，计算更快；互联网带宽应更宽，速度更快，覆盖更广；移动终端应处理能力更强，应用更多等等。甚至可以说，不论是移动互联还是可穿戴设备，离开了便携和可移动就走不出实验室，走不进人们的生活。

归结为一点，未来的电子器件应该更微小、更轻薄，而且运算能力更强。而在绝大多数情况下，体积越小、功能越复杂的电子器件对静电的敏感度就越高，对静电防护的要求也越高。

最新资料表明，美国的静电防护体系标准已经演进至2014版，涉及防静电体系的进化和大量产品标准的改版，而国际电工委员会的静电工作组也在积极动作。从已公布的标准中可以看到，经济发达国家已经对于静电防护提出了更低的静电敏感电压和更高的静电防护要求，以适应技术进步和全球智慧化的需求。

所以，可得出的结论是，智慧城市正在离我们越来越近，而电子制造业的静电防护水平已经成了决定人民生活质量和安全水平的关键性因素。

我国电子制造业静电防护的现状和问题

了解电子制造业的静电防护水平，需要先从防静电的标准化发展和防静电供给市场说起。

2.1 我国静电防护标准化的发展概况

我国静电防护标准化在上世纪八十年代末、九十年代出现过一次高峰，在老一辈有关专家的领导和主持下，以国外标准为借鉴

AA1 智慧城市建设中电子类产品静电防护现状、问题及对策
During wisdom city construction, the electrostatic protection present situation, problems and countermeasures of electricity products

（日本标准占相当比例），制定了一系列的静电防护标准。到了2010年前后，随着技术进步，老版本的防静电标准已不再适用于新的生产和应用形式，在一些防静电企业和专家的联合推动下，第二次标准化高峰正在成形。

据不完全统计，我国现有涉及静电防护的标准计100余项，初步奠定了防护标准化基础，但也存在着不少问题，包括：相当的数量标准老化，不适用于新的应用，亟待更新；同一项产品有多个不同标准，且差异明显，用户无所适从；现行国标未与IEC 61340系列静电防护标准接轨，与国际先进水平脱节严重，不利于产品出口；标准化推动乏力，生产商和用户对于防静电标准不知道、不采纳、不理解，甚至有些产品无标可依。

所有问题归结到一个根本点，就是我国尚未建立专门的静电防护标准化技术委员会，未能有效的把我国的防静电产业、防静电专家组织协调起来，并形成强势的标准化推动力。

2.2 我国防静电产业的发展概况

与标准化事业相对应，我国防静电产业的发展始于上世纪60年代，以易燃易爆场所的静电防护为主要服务对象。70年代IT业在国内萌芽，电子工业静电防护的配套事业也开始起步。进入80年代，我国电子信息产业的蓬勃发展，为电子工业服务的静电防护产业逐步成型，并在90年代进入了高速发展期，年平均增长率超过15%[4]。到2010年前后，年销售额二百万元以上的防静电产品生产企业已超过400[4]余家，产品已基本覆盖了电子工业所需的全部防静电材料、设施、装备和仪器。

在高速发展和转型的阶段，我国的防静电产业也存在一些问题，例如：价格竞争激烈，质量水平参差不齐，行业自律有待提高；总体上，从业人员知识结构层次偏低，产品技术含量不高；标准化意识薄弱，部分企业不遵守标准，甚至不知道产品标准。

近年来，随着我国经济形式的转变，以及电子工业的升级、转型、发展，与之配套的防静电产业也面临着前所未有的机遇和挑战，出现了以下特点：低价竞争模式出现拐点，知识产权、产品质量和服务系统成为新的增长点；单一产品小规模生产不再适应竞争，扩充产品线，综合经营、联合发展成为主流趋势；原有防静电知识体系渐显滞后，国内兴起学习、引进国外先进防静电理论、标准和技术的热潮。

2.3 我国电子制造业静电防护水平不完全抽样调研报告

2.3.1. 调研的目的、范围、理论依据和开展形式

在经济高速增长期，核心技术的更替、产线规模的扩大、生产的能级提高等高端命题是电子制造业被社会关注的焦点，质量管理和可持续发展也随着近年的经济转型在被越来越多的企业和部门所重视，但是静电防护作为电子制造业一项至关重要的配套工程，却远远得不到有关方的足够重视。

为了了解我国电子制造业真实的静电防护水平，于2011至2014年间，笔者以代表了国际水平的美国防静电协会ANSI/ESD S20.20和国际电工委员IEC 61340-5-1标准体系为技术支撑，通过电子企业实地勘测、相关研讨会专家交流和问卷调查等形式，对近50家电子制造加工企业进行了调研和交流，地域范围跨越华东、华南、华北、西南。

需要说明的是，限于人力、物力和财力等因素，本次调研仅是一个不完全的抽样，例如，实地勘测对象主要集中在中小型企业，对于大型企业、尤其是超大型跨国企业以交流和问卷调查形式为主；调研区域以华东地区为主，其他区域覆盖较少；调研对象缺少城市公共运行系统等重点项目电子产品的直接供应商等。所以，本文的分析仅仅是有关活动的起始，笔者呼吁有关部门、企业参与到这项调研工作的后续活动中来，为我国的电子行业静电防护做出贡献。

2.3.2. 调研结果的汇总分析

2.3.2.1. 问卷调查（全球500强企业）的结果分析

问卷调查发起于2013年，对象是电子产品制造及应用系统全球500强企业，问卷为多项选择形式，以ANSI/ESD S20.20和IEC 61340-5-1条文为主干设计了9大条目55个选项，各选项根据其在防静电体系中的重要性设定不同分值，勾选即增加相应分值，满分150分，内容涉及静电管理制度、操作人员管理、人员培训、防静电接地、人员接地、防静电设施设备管理、运输储存转运管理、防静电标识管理等方面，交由企业中静电防护管理的相关人员填写。问卷中还附加了5个条目35个选项，用于了解相关企业获取防静电

AA1 智慧城市建设中电子类产品静电防护现状、问题及对策
During wisdom city construction, the electrostatic protection present situation, problems and countermeasures of electricity products

知识、防静电产品的途径，以及对于防静电体系的看法和认知。调研表设计如下（未包含附加的5个条目）：

1. **您的企业建立静电防护管理制度中是否规定了如下内容？**
   □企业的最高静电防护等级（5） □静电敏感元器件的管理清单（5） □各项防静电设施的技术要求[a]（5）
   □各项防静电设施的验证方法[b]（2） □各项防静电设施验证时的抽样方法[c]（1）
   □EPA 的划分和环境管理要求（4）□EPA 工作人员的操作要求（4） □EPA 内绝缘材料/静电源的处理计划[d]（4）

2. **您的企业是否指定了专门的人员来处理有关静电防护的相关事宜？**
   □ESD 专员负责处理有关静电防护的相关事宜（5） □ESD 体系内审员对静电防护体系的执行情况进行监督审查（4）
   □以上人员都得到了相应的授权和管理层的支持（2） □以上人员都经过相应专业培训，具备相应专业知识（3）

3. **有关静电防护，您企业对于员工培训有哪些规定？**
   □所有可能接触静电敏感元器件的员工（包括□管理、□仓储、□维修、□保洁和□进行盘点的财务人员等）在上岗前应进行培训，并确认合格（9） □必须对所有上述可能接触静电敏感元器件的工作人员进行周期性培训（4）
   □为确保培训效果，采购专业教材或不定期委托专业机构对相关人员进行静电防护知识、技能的培训（2）

4. **您企业是如何对静电防护设施进行验证的？**
   □采购前应对防静电产品进行评估，选择符合本表[a]项规定的产品（3）
   □所有采购的防静电产品须按照本表[b]项的规定验证合格方可投入使用（6）
   □在规定的周期内应对所有的防静电设施按照本表[b]项的规定进行验证（4）
   □使用经过校准的检测仪器对防静电设施进行验证（3）
   □在一定周期内将采购和正在使用中的防静电产品送第三方机构进行验证（2）
   □对防静电设施进行抽检的，应具有代表性，并符合本表[c]项的规定（2）
   □对验证不合格的防静电设施立即停用，并进行相应处置（5）

5. **您企业采取的防静电接地形式是怎样的，有哪些规定？**
   □所有的导体、静电耗散材料和人员都通过公共接地点进行接地（9）
   □使用保护地（或单独的功能地）作为防静电接地，当使用单独的防静电地时，应与保护地建立电气连接（5）

6. **您企业的人员接地形式是怎样的，有哪些规定？**
   □使用手腕带作为人员接地（1） □使用鞋/地系统作为人员接地（1） □使用可接地服装系统作为人员接地（1）
   □使用座椅/服装系统/地面作为人员接地（1） □所有人员只有在接地状态下才能接触静电敏感元器件（9）
   □每次上岗接触静电敏感元器件之前，必须对人员接地系统进行检测，合格后方能进行操作（5）

7. **您企业的防静电工作区使用了以下哪些防静电设施？**
   □地面（1） □工作表面（5） □座椅（1） □推车（1） □有绳手腕带（1） □各类包装（5） □货架（1）
   □鞋/脚束（1） □服装（1） □离子化静电消除器（1） □防静电烙铁（1）
   □其他工具（1）_____

8. **您企业在存储、转移、运输静电敏感元器件时，是如何对其进行防护的？**
   □生产制造、维修、装配、存放和运输敏感元器件时所使用的包装材料符合防静电要求（4）
   □对于供应商提供的静电敏感元器件的包装提出防静电要求，避免在运输途中存在 ESD 风险（3）
   □静电敏感元器件离开防静电工作区时，须存储在静电屏蔽包装内（7）
   □打开防静电包装的操作，应在防静电工作区内进行（4）

9. **您企业使用了那些标识形式来提高您的静电防护效果？**
   □对防静电工作区做明确划分，提示进入人员在区域内须遵守相关规定（2）
   □所有静电敏感元器件或其包装上都有明确标识，说明该器件的静电防护要求（4）
   □对所有经过验证的防静电设施和产品进行标识，以提示该设施和产品的状态（2）
   □对防静电工作区内的静电源（绝缘材料等）按本表[d]的规定进行明确标识，以便于管理和控制（2）

图1：防静电体系自查表

AA1 智慧城市建设中电子类产品静电防护现状、问题及对策
During wisdom city construction, the electrostatic protection present situation, problems and countermeasures of electricity products

发出问卷80份，截止至2014年3月，收回了反馈20份，情况整理汇总如下。

表1：防静电体系自查表反馈结果汇总

序号	项目	企业比例	内容	分析
1	有关静电敏感器件管理的调查分析	75%	建立了静电敏感元器件管理清单	①有1/4的企业未建立静电敏感器件控制清单； ②有4成的企业未规定防静电等级； ③有4成企业不知道静电敏感器件离开EPA后如何正确保护。
		60%	规定了最高的静电防护等级	
		75%	要求人员操作静电敏感器件时必须保持接地	
		90%	要求静电敏感器件的包装须具备防静电功能	
		85%	规定了防静电包装的使用要求	
		60%	规定敏感器件离开EPA时使用静电屏蔽包装	
		75%	对敏感器件及其包装有相关标识的规定和要求	
2	有关静电放电保护区管理的调查分析	80%	有明确的保护区划分	多数企业建立了静电放电保护区，但有近4成的企业未建立完整的保护区管理制度
		60%	对保护区的划分和环境管理做了要求	
		95%	都对区域内的导体进行了接地	
		65%	建立有保护区工作人员的操作要求	
3	有关静电源管理的调查分析	50%	有静电源的处理计划	近半数企业对于EPA内静电源的管理存在重大缺陷
		55%	对保护区内的静电源有明确标识	
4	有关人员管理的调查分析	75%	有静电项目专门管理人员	①1/4的企业没有静电项目专门管理人员； ②超过4成的管理人员没有专业培训经历； ③仅半数企业采购了ESD专业教材或聘请专家对有关人员进行静电培训； ④多数企业忽略了生产人员以外人员的静电培训
		65%	有静电防护体系内审员	
		70%	静电项目管理人员得到了充分授权	
		65%	相关人员经过专业培训具备专业知识	
		90%	要求生产人员上岗前必须进行防静电培训	
		95%	要求相关人员进行ESD防护的周期性培训	
		50%	采购了专业教材或委托专业机构进行ESD培训	
		25%	考虑到了管理、仓储、维修人员的ESD培训	
		20%	考虑到了保洁和财务人员的ESD培训	
5	有关防静电设施、设备管理的调查分析	70%	规定了防静电设施、设备的技术要求	①3成企业未规定防静电设施设备的技术要求； ②超过3成企业不知道如何验证防静电设施； ③4成企业对采购的防静电产品不经验证就直接投入使用； ④3成企业没有周期验证； ⑤半数企业对防静电设施设备没有指定抽样计划
		65%	规定了防静电设施、设备的验证方法和抽样方法	
		75%	采购前会对防静电产品的静电性能进行评估比较	
		60%	对采购的防静电设施验证合格后方投入使用	
		70%	对防静电设施有周期性的验证计划	
		60%	周期性的送第三方机构进行验证	
		70%	要求员工每次上岗前检测接地装置	
		85%	使用校准的仪器检验防静电设施	
		75%	对验证后的防静电设施有相关标识	
		50%	对防静电产品的检测设计了合理的抽样计划	
6	有关防静电设施设备应用情况的调查分析	90%	有防静电的地面、工作表面、有绳手腕带和货架	防静电包装是不可或缺的防静电要素，却有1/4的企业没有防静电包装
		85%	有防静电的座椅、推车、和服装	
		80%	使用了离子化静电消除器	
		75%	有防静电包装和防静电鞋	
		65%	使用了单独防静电地，并考虑了等电位	
		60%	配备了防静电的电烙铁	

可以说，调查结果并不是如预想中的乐观，特别突出和严重的问题包括：

1）静电敏感器件在运输、传递过程中普遍缺乏保护；

2）近4成企业的静电防护体系不完整；

3）一半的企业没有对内部实行专业的静电培训和辅导；

4）一半的企业对使用中的防静电设施没有周期性验证。

从调查表的附表部分还可以得出以下的一些信息：

1）用户企业在防静电知识方面过度依赖供应商提供的信息和一些网络未经验证的信息；

2）仅三成的企业通过专业培训和国内外标准学习防静电知识；

AA1 智慧城市建设中电子类产品静电防护现状、问题及对策
During wisdom city construction, the electrostatic protection present situation, problems and countermeasures of electricity products

3）半数以上的企业对在静电防护方面处于封闭状态，不愿与有关专家交流；

4）仅一半的企业通过了有关防静电体系的认证或者有认证的意向；

5）企业对于静电防护和防静电体系仍缺乏了解。

这些500强企业代表了电子制造业的领先水平，调查虽然不能代表全面，但也部分说明了问题，静电防护有待重视和提高。

2.3.2.2. 实地调查的结果分析

早于以上的问卷调查项目，笔者从2011年至今已在静电防护体系方面咨询、辅导了30余家电子企业，并参照欧美标准体系，协助10余家企业建立完成了符合自身要求的静电防护体系。在多年的静电检测、咨询、辅导、协助工作中，积累了大量的现场案例和数据。

综合现场检测、调研和交流的情况，我国内地独资的中小型电子企业在静电防护方面存在了诸多问题，根据各个问题点在企业中出现的频率，可以做如下列举（排在前面的问题点在受访企业中出现的频率较高）：

1) 企业的防静电设施、设备处于部分失控或完全失控状态。集中表现为：

a) 不知道该配置哪些防静电设施和产品；

b) 不知道所使用的防静电产品应该如何检测，检测指标应该是怎样的；

c) 合格的防静电产品投入使用后，没有周期性验证，产品失效后扔在继续使用；

d) 大量使用了供应商提供的不具备防静电功能、或者功能不合格的“防静电产品”。

2) 企业在静电项目的管理人员方面存在问题，集中表现为：

a) 没有专门的静电项目管理人员；

b) 由其他部门的人员监管静电防护，但不具备防静电的专业知识；

c) 静电项目管理人员没有足够的权限，无法推动防静电体系的有效执行。

3) 企业对静电防护的目标物不了解。集中表现为：

a) 不知道生产加工中的那些器件是需要进行静电防护的；

b) 不知道哪些生产、加工、存放区域是需要进行静电防护的；

c) 不知道本企业应按何种等级来进行静电防护。

4) 企业人员对防静电知识、静电防护体系不了解、不重视。集中表现为：

a) 从管理到操作人员均未进行过相关的静电知识培训；

b) 静电防护规定在很多企业中形同虚设，有规定无执行；

c) 多数员工不了解甚至没听说过静电防护体系；

d) 在一些实际运用中存在诸多的静电防护误区。例如，在没有铺设防静电地面的区域使用防静电鞋和人体电阻综合测试仪，使用防静电手套来代替防静电手腕带，在静电放电保护区大量使用可能产生高静电的绝缘材料，等。内容形式五花八门，无法一一列举。

需要补充说明的是，在笔者走访、考察、交流的企业中，出现以上情况的企业占比不少于6成，特别是静电防护设施的失控，几乎在绝大部分企业中都有存在。更严重问题在于，国内很多的电子企业对静电问题还相当缺乏重视，认为“静电没什么大不了的，不做静电防护，一样生产；静电防护是表面功夫，是做给领导看的；静电防护很容易，找个电工就能解决；企业的生命在于产量、产值，要降低成本，静电防护的预算还要押后”的思想大有人在，极大的阻碍了我国电子制造业静电防护水平的提升。

相对于外资、合资大中型企业，我国的中小型电子企业需要做更多的改进和提高。

2.4 我国电子制造业静电防护所面临的问题及分析

根据以上对我国的静电标准化、防静电产业、电子制造业静电防护现状的分析，把我国电子制造业静电防护所面临的主要问题

AA1 智慧城市建设中电子类产品静电防护现状、问题及对策
During wisdom city construction, the electrostatic protection present situation, problems and countermeasures of electricity products

归纳如下：

1）防静电标准化未形成统一的体系和框架，标准化宣传、执行力度不够，部分产品标准老化或者缺失，未形成全国有影响力的静电防护体系标准，未与国际先进水平接轨；

2）防静电产业发展迅速，但产业市场有待规范和监管，技术水平有待进一步提高；

3）我国电子制造业的静电防护的总体水平还不高，并且发展不均衡。几个问题比较突出：

a) 缺少专业的静电防护管理人员和管理机构；

b) 对静电危害的认识不够，在静电防护方面投入较少；

c) 欧美系外资和合资大型企业由于从国外引入了防静电理念，其防静电水平较国内中小企业高，但也存在一些问题，尤其表现在对跨领域的静电问题缺乏真正的了解和解决方案；

d) 国内还未建立健全静电防护体系的审核认证机制，大多数电子企业的静电体系辅导、认证依赖于国外协会的授权机构，而国内的辅导、认证机构水平参差不齐，不利于我国电子行业的静电防护水平提升。

提高我国智慧城市系统电子类产品静电防护水平的对策

在有关部门、协会、专家和企业的努力下，提高我国智慧城市系统电子产品防静电水平已经取得了一些进展。

3.1 上海市政协第0192号提案——“重视智慧城市建设及城市运行安全中的静电隐患”

简而言之，智慧城市建设离不开电子器件，而电子器件的稳定可靠影响着城市安全，又受限于静电防护水平，所以，要建设智慧城市，就必须重视其中的静电隐患。

2014年1月14日由上海防静电工业协会参与的提案稿“重视智慧城市建设及城市运行安全中的静电隐患”通过民进上海市委黄山明秘书长努力，在市政协十二届二次会议上立为第0192号提案。承办提案的市质量技术监督局、市经信委等政府部门相当重视。市经信委综合处还邀请本委外经处、信息化推进处等处室负责人研究建议落实。

针对提案建议，有关政府部门目前明确的措施有：

1）上海防静电工业协会申报有关产业发展的调研项目，争取通过专家评审获得政府购买；

2）将静电防护产业联盟标准（社团标准）纳入今年上海市标准化创新试点项目；

3）将“第三届静电防护与标准化国际研讨会”纳入到10月上海市“智慧城市宣传周”活动中；

4）积极推动人才建设。由市经信委会同市科委、市人社局于2012年发布的《上海市战略性新兴产业紧缺人才开发目录》，下次修订时（约2017年），将根据产业发展需要和企业实际情况，把“防静电工程师”作为人才子类纳入到修订调研范畴。

此外，上海市政协认为此提案有一定价值，已作为社情民意上报全国政协。

3.2 全面开展我国智慧城市系统相关电子产品静电防护水平产业调研

笔者以为，0192号提案是一个契机，而有关部门已经明确的几项措施也实实在在有利于提高我国电子行业的静电防护水平，而其中有关产业发展的调研项目，更是后续有关措施的起始点和数据支持。更全面、更具针对性的调研，不仅有利于精确掌握我国智慧城市相关电子企业的防静电水平、防静电需求，为下一步的相关标准、政策制订提供数据参考。还能通过有关的调研活动，普及静电知识，宣传静电危害，把相关力量调动起来，确实提高我国电子行业的静电防护水平。把调研项目做好做实，制作出我国第一份真实的、全面的、有代表性的电子行业静电防护水平调研报告，不仅是我国防静电产业和电子行业的一件大事，对我国智慧城市的建设也具有非常深远的意义。

3.3 政府重视是提升我国电子行业静电防护水平的关键

静电标准是典型的用户推动型标准，美国静电协会的标准都是各大知名微电子企业提出并参与制定的。欧美企业在中国选择合作伙伴或原材料供应商也往往将建立并通过静电防护体系标准作为前置条件。智慧城市建设中，政府是最大的用户，城市运行安全

AA1 智慧城市建设中电子类产品静电防护现状、问题及对策
During wisdom city construction, the electrostatic protection present situation, problems and countermeasures of electricity products

也是政府的首要责任。因此，建议政府的标准化相关机构将IEC61340-5-1标准转化成中国国家标准并开展认证工作。政府采购中涉及的电子元器件及系统的采购项目，在招投标文件中将生产企业建立并通过静电防护体系标准作为前置条件。政府重视是提高我国电子行业静电防护水平的关键。

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AA1 智慧城市建设中电子类产品静电防护现状、问题及对策
During wisdom city construction, the electrostatic protection present situation, problems and countermeasures of electricity products

Current Situation, Problems and Countermeasures Regarding Electrostatic Protection of Electronic Products in the Construction of a Smart City

[Abstract]: In this thesis, the view that electrostatic protection level of electronic products is of vital importance to the construction of smart cities is clarified, the current situation of the development of China's electrostatic protection industry and the level of electrostatic protection level in electronic industry is analyzed, and ideas and proposals on improving electrostatic protection level of electronic products in the construction of smart cities are brought up on the basis.
[Keywords]: Smart City; Electronic Manufacturing; Electrostatic Protection; Reliability; City Operation Safety; Survey; Project Proposals

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Introduction - Static Electricity and Electrostatic Hazards

Walking on the floor will give rise to static electricity, and so will putting on or taking off cloths or simply fractional contact; it can be said that static electricity is everywhere and exists always. Most of the time, static electricity is generated, accumulated and dissipated beyond the sensation of people, since only when the static electricity reaches above 1000V[1] volts can it be sensed by people.

However, it is just the static electricity people are not aware of most of the time that becomes a greatly harmful "hard virus" in the electronics industry. A tens-of-volts electrostatic discharge event is likely to cause permanent damage to electrostatic-sensitive devices. According to the statistics, the average failure rate of electronic products caused by electrostatic discharge is up to 8%~33%[2]; while what's more horrible, 90%[3]electrostatic failure of electronic components is potential failure which is difficult to detect; such potential failure products with their performance degraded, reliability lowered and stability lost, once being applied to a complete machine or system, especially being used in a large system related to a smart city, will cause possibly disastrous accidents or losses.

Electrostatic Hazards in Construction of a Smart City

When we consult all information related to smart cities, no information about static electricity is found. Construction of smart cities is seemingly unrelated to static electricity; however, this just reflects people's lack of awareness of the importance of static electricity in the construction of a smart city.

1.1 Construction of smart cities is on the rise and rapid progress also witnesses hidden threats.

Smart city, as the future trend of urban development, is an effective program to treat "urban sickness" and to solve "urban problems" as well as an important strategic measure of our country to facilitate sustainable economic development, to compete for technological highland and to develop initiative. With the issuance of Opinions on Promoting Information Consumption to Expand Domestic Demand by the State Council and the publication of the list of first-batch national pilot smart cities, the wave of constructing smart cities has formally opened its curtain in China.

With the rapid development of smart city construction in China, people have begun to enjoy the outcomes; for example, "smart transportation" is covering the existing transportation network, relieving urban congestion and reducing traffic accidents to a certain extent; "smart logistics" is becoming mature day by day, accelerating the circulation of materials and lowering transportation costs; "telemedicine" is going out of the laboratory, providing convenient treatment and benefiting health of people; "city security monitoring" is increasingly popularized, playing a role in reducing crimes and securing the life and property safety of people; "e-government" has witnessed initial success, improving working efficiency of the government and saving social resources..... In a word, construction of smart cities in our country has a wonderful prospect that we can imagine.

However, it should be soberly aware of that while developing rapidly, our urban smart systems also have some hidden threats; apart from some problems already pointed out by relevant experts (including blandly following, insufficient basic support, hidden threats to information safety, etc.), the security of urban public operation system against the background of smart cities should also be focused on.

1.2 The process of smart cities is dependent on electronic technology and new propositions concerning safety of public operation emerge.

Technically speaking, construction of smart cities requires acquiring information soundly, transparently and sufficiently, sharing information smoothly, widely and safety and making use of information efficiently, standardly and scientifically through the application of the new generation of information and electronic technology

AA1 智慧城市建设中电子类产品静电防护现状、问题及对策
During wisdom city construction, the electrostatic protection present situation, problems and countermeasures of electricity products

represented by mobile communication technology, including internet of things, cloud computing, big data, etc., to improve the efficiency of urban operation and management, to upgrade the level of urban public service and to enhance the ability to deal with emergencies. Behind these attractive and fashionable words, electronic technology is the basis of all technological means and without electronic technology, smart city is empty.

The so-called electronic technology (including informational electronics technology and power electronics technology) is defined as the science designing and manufacturing circuits of certain specific functions based on electronic theories and with electronic devices to solve actual problems. Electronic devices are just the physical carrier of electronic technology. A smart system with however complicated functions can never be independent from the arrangement, combination, labor division and cooperation of various functionally different electronic devices. If smart systems are tissues and organs of a smart city, then electronic devices are cell structures composing these issues and organs.

With the gradual advancement of smart cities, electronic devices in our cities are increasing by progression in terms of both function and quantity and will finally cover various aspects of our life, study and work. At present, electronic devices and their system application have taken root in various fields, including home, energy, finance, health care, transportation, logistics, trade, etc.; while they make urban life smart, convenient and efficient, they also bring new safety problems to public operation of cities.

Failure of electronic devices in the "e-government" system may cause paralysis of the affair handling website and loss of citizens' information, interfering the normal social order; failure of electronic devices in the "telemedicine" system may cause the delay of treatment opportunities and misdiagnosis or wrong diagnosis of medical cases, influencing the physical health of people; problems of electronic devices in the "smart logistics" system may cause the delay of materials transportation and loss of goods or properties, resulting in losses of interests of business community; errors of electronic devices in "smart transportation" system may cause the retention of passengers and occurrence of major accidents, leading to hidden threats to lives and properties of people. According to relevant data, electronic device problems have frequently been the culprit of subway, bullet train and high-speed rail accidents in recent years.

As can be seen that city operation safety problems have changed in the intellectualization process and reliability, stability and safety of electronic devices has been linked to the city safety operation system unconsciously; if safety problems of electronic devices are not solved, not to mention city safety and even not to mention construction of "people-oriented" smart cities.

1.3 Electrostatic protection is closely related with the construction of a smart city

As stated in the introduction, static electricity is everywhere and is a great enemy of the electronics industry. An electronic device may face electrostatic discharge, hence failure risks, in its entire process of manufacture, processing, assembling, fitting, packaging, labeling, maintenance, test, inspection, transportation and even use. Electrostatic protection should be highlighted and processed as a system engineering, since any error or problem in any link of the system may lead to the paralysis of the whole system.

The essence of smart city lies in the high degree of integration of informationalization and urbanization, which is the reflection of city informationalization developing to a higher stage and for which electronic informational means should be used to realize the intelligent identification, positioning, tracking, monitoring, feedback and management of all materials. For the realization of these requirements and volume production, apart from relevant progress in the technical level, mobility and portability is also very important potential requirements; computers should be smaller, more portable and compute faster, and internet bandwidth should be wider, with faster speed and wider coverage; mobile terminals should have stronger processing ability and more applications, etc. It can be even said that mobile internet or wearable devices can never get out of the laboratory or step into people's life without portability and mobility.

In a word, future electronic devices should be smaller, lighter and thinner, with stronger computing ability. However, in most cases, a smaller and functionally more complicated electronic device is more sensitive to static electricity and has higher requirements on electrostatic protection.

The latest data shows that the American standard of electrostatic protection systems have evolved to 2014 version, which is a revised version involves the evolution of electrostatic protection systems and a large number of product standards, while the Electrostatic Working Group of the International Electro-technical Commission is also taking actions actively. From published standards, it can be seen that economically developed countries have put forward lower static electricity-sensitive voltage and higher electrostatic protection requirements in terms of electrostatic protection to adapt to the demand of technical progress and global intellectualization.

Therefore, it can be concluded that smart cities are nearer and nearer to us, while electrostatic protection level of electronic manufacturing industry has become a key factor determining people's living quality and safety level.

Status and Problems of Electrostatic Protection in China's Electronic Manufacturing Industry

To understand the electrostatic protection level of electronic manufacturing industry, we should start from the development of electrostatic protection standardization and electrostatic protection supply market.

2.1 Development overview of standardization of electrostatic protection in China

Standardization of electrostatic protection in China witnessed a peak in the late eighties and the nineties of the last century, when a series of electrostatic protection standards were developed with reference to foreign standards (Japanese standards accounting for a considerable proportion) under the leadership and management of senior experts. Around 2010, with the technical progress, old versions of electrostatic protection standards were no longer applicable to new production and application forms and under the joint promotion of some electrostatic enterprises and experts, the second standardization peak was taking shape.

According to incomplete statistics, China has over 100 standards involving electrostatic protection, which lays the foundation of protection standardization.

AA1 智慧城市建设中电子类产品静电防护现状、问题及对策
During wisdom city construction, the electrostatic protection present situation, problems and countermeasures of electricity products

However, there are also many problems, for example, a considerable number of standards are aged, not applicable to new applications and urgently awaiting updates; for a single product, there are several different standards with obvious differences, making users be at a loss at how to proceed; the current national standards are not in line with IEC 61340 series electrostatic standards and seriously out of line with internationally advanced level, not conducive to exports; standardization is not promoted vigorously, while manufacturers and users don't know, adopt or understand the electrostatic standards, and for some products, there are even no standard to follow.

All problems boil down to a fundamental point, that is, China has not yet established a special Electrostatic Protection Standardization Technical Committee and failed to organize and coordinate electrostatic protection industry and electrostatic protection experts of our country to form a strong impetus for standardization.

2.2 Development overview of electrostatic protection industry in China

Corresponding to the standardization course, development electrostatic protection industry in China began in 1960s, with electrostatic protection in flammable and explosive places as the main service objects. In 1970s, IT industry sprouted in the country and supporting course of electrostatic protection in electronic industry also started. When it came to 1980s, electronic information industry of our country developed vigorously, and electrostatic protection industry serving electronic industry formed gradually and entered into a period of rapid development in 1990s, with annual average growth rate exceeding 15%[4]. Around 2010, the number of electrostatic protection product manufacturing enterprises with an annual sales volume of over CNY 2million has exceed 400[4], and the products have basically covered all electrostatic protection materials, facilities, equipment and instruments required by electronics industry.

In the stage of rapid development and transformation, electrostatic protection industry of our country also sees some problems, e.g. fierce price competition, irregular quality level, industrial self-regulation needs to be improved, etc.; generally, knowledge structure level of employees is lower and technical contents of products are insufficient; the awareness of standardization is week, with some enterprises not complying with the standards, or even not knowing product standards.

In recent years, with the changes of economic forms in China as well as the upgrade, transformation and development of electronic industry, the supporting electrostatic protection industry is also facing unprecedented opportunities and challenges, showing the following characteristics: price competition mode shows an inflection point, and intellectual property, product quality and service system becomes a new growth point; small-scale production of a single product can no longer adapt to the competition and expansion of product line, comprehensive operation and joint development has become a mainstream trend; the original electrostatic protection knowledge system gradually lags and an upsurge of learning and introducing foreign advanced electrostatic protection theories, standards and technology has emerged in the country.

2.3 Incomplete sampling research report on electrostatic protection level of electronic manufacturing industry in China

2.3.1. Purpose, scope, theoretical basis and development form of the survey

In a period of fast economic growth, such high-end propositions including replacement of core technologies, expansion of production line scale, level increase of production, etc. are the focus of social attention in electronic manufacturing industry, and quality management and sustainable development also attracts the attention of more and more enterprises and departments with the economic transformation in recent years; however, as an vitally important supporting engineering of electronic manufacturing industry, electrostatic protection is far from being emphasized by the relevant parties.

To understand the actual electrostatic protection level of electronic manufacturing industry in China, the author surveyed and exchanged with nearly 50 electronic manufacturing and processing enterprises with ANSI/ESD S20.20 of American ESD Association and IEC 61340-5-1 standard system of International Electro-technical Commission as the technical support and through site investigation on electronic enterprises, exchanges of experts on relevant seminars, questionnaire surveys and other forms, with the regional coverage involving East China, South China, North China and Southwest China.

It should be noted that due to limited human, material and financial resources and other factors, this survey is only an incomplete sampling research; for example, field survey objects are mainly small and medium enterprises, and for large enterprises, especially large multinational companies, the survey is carried out through exchanges and questionnaires; research area is East China-based, covering few other areas; and the survey covers no direct suppliers of electronic products for key projects including urban public operation system, etc. Therefore, the analysis herein is only the start of relevant activities and the author calls for relevant authorities and enterprises to participate in follow-up activities of this survey and contribute to electrostatic protection for our country's electronics industry.

2.3.2. Pooled analysis of survey results

2.3.2.1. Result analysis of questionnaire survey (World Top 500 companies)

The questionnaire survey was initiated in 2013, targeting at the electronic product manufacture and application system enterprises among the World Top 500 and in the form of multiple choice;9 items and 55 options are designed with articles in ANSI/ESD S20.20 and IEC 61340-5-1 as the principles and each option is set with a different score based on its importance in the electrostatic protection system; by clicking the option, the corresponding score will be gained, while the perfect score is 150 points. The contents involves electrostatic management system, operating personnel management, personnel training, electrostatic protection grounding, personnel grounding , anti-static facility management, transport and storage transport management, electrostatic protection identification management, etc. and the questionnaires are delivered to personnel related to electrostatic protection management of the enterprises for completion. 5 items and 35 options are also added in the questionnaire to get knowledge of the routines through which relevant enterprises acquire electrostatic protection knowledge and electrostatic protection products as well as their ideas and

AA1 智慧城市建设中电子类产品静电防护现状、问题及对策
During wisdom city construction, the electrostatic protection present situation, problems and countermeasures of electricity products

cognition regarding electrostatic protection system. The survey table is designed as follows (the additional 5 items not included):

1. **您的企业建立静电防护管理制度中是否规定了如下内容？**
   □企业的最高静电防护等级（5） □静电敏感元器件的管理清单（5） □各项防静电设施的技术要求[a]（5）
   □各项防静电设施的验证方法[b]（2） □各项防静电设施验证时的抽样方法[c]（1）
   □EPA 的划分和环境管理要求（4）□EPA 工作人员的操作要求（4） □EPA 内绝缘材料/静电源的处理计划[d]（4）

2. **您的企业是否指定了专门的人员来处理有关静电防护的相关事宜？**
   □ESD 专员负责处理有关静电防护的相关事宜（5） □ESD 体系内审员对静电防护体系的执行情况进行监督审查（4）
   □以上人员都得到了相应的授权和管理层的支持（2） □以上人员都经过相应专业培训，具备相应专业知识（3）

3. **有关静电防护，您企业对于员工培训有哪些规定？**
   □所有可能接触静电敏感元器件的员工（包括□管理、□仓储、□维修、□保洁和□进行盘点的财务人员等）在上岗前应进行培训，并确认合格（9） □必须对所有上述可能接触静电敏感元器件的工作人员进行周期性培训（4）
   □为确保培训效果，采购专业教材或不定期委托专业机构对相关人员进行静电防护知识、技能的培训（2）

4. **您企业是如何对静电防护设施进行验证的？**
   □采购前应对防静电产品进行评估，选择符合本表[a]项规定的产品（3）
   □所有采购的防静电产品须按照本表[b]项的规定验证合格方可投入使用（6）
   □在规定的周期内应对所有的防静电设施按照本表[b]项的规定进行验证（4）
   □使用经过校准的检测仪器对防静电设施进行验证（3）
   □在一定周期内将采购和正在使用中的防静电产品送第三方机构进行验证（2）
   □对防静电设施进行抽检的，应具有代表性，并符合本表[c]项的规定（2）
   □对验证不合格的防静电设施立即停用，并进行相应处置（5）

5. **您企业采取的防静电接地形式是怎样的，有哪些规定？**
   □所有的导体、静电耗散材料和人员都通过公共接地点进行接地（9）
   □使用保护地（或单独的功能地）作为防静电接地，当使用单独的防静电地时，应与保护地建立电气连接（5）

6. **您企业的人员接地形式是怎样的，有哪些规定？**
   □使用手腕带作为人员接地（1） □使用鞋/地系统作为人员接地（1） □使用可接地服装系统作为人员接地（1）
   □使用座椅/服装系统/地面作为人员接地（1） □所有人员只有在接地状态下才能接触静电敏感元器件（9）
   □每次上岗接触静电敏感元器件之前，必须对人员接地系统进行检测，合格后方能进行操作（5）

7. **您企业的防静电工作区使用了以下哪些防静电设施？**
   □地面（1） □工作表面（5） □座椅（1） □推车（1） □有绳手腕带（1） □各类包装（5） □货架（1）
   □鞋/脚束（1） □服装（1） □离子化静电消除器（1） □防静电烙铁（1）
   □其他工具（1）_____

8. **您企业在存储、转移、运输静电敏感元器件时，是如何对其进行防护的？**
   □生产制造、维修、装配、存放和运输敏感元器件时所使用的包装材料符合防静电要求（4）
   □对于供应商提供的静电敏感元器件的包装提出防静电要求，避免在运输途中存在 ESD 风险（3）
   □静电敏感元器件离开防静电工作区时，须存储在静电屏蔽包装内（7）
   □打开防静电包装的操作，应在防静电工作区内进行（4）

9. **您企业使用了那些标识形式来提高您的静电防护效果？**
   □对防静电工作区做明确划分，提示进入人员在区域内须遵守相关规定（2）
   □所有静电敏感元器件或其包装上都有明确标识，说明该器件的静电防护要求（4）
   □对所有经过验证的防静电设施和产品进行标识，以提示该设施和产品的状态（2）
   □对防静电工作区内的静电源（绝缘材料等）按本表[d]的规定进行明确标识，以便于管理和控制（2）

Fig 1. Anti-static System Checklist

AA1 智慧城市建设中电子类产品静电防护现状、问题及对策
During wisdom city construction, the electrostatic protection present situation, problems and countermeasures of electricity products

80 questionnaires are distributed and 20 feedbacks have been returned by March, 2014; the summary is as follows.

Table 1 Feedback on Electrostatic Protection System Checklist

SN	Item	Proportion	Content	Analysis
1	Investigation and analysis on control of static electricity-sensitive devices	75%	Create a control list of static electricity-sensitive devices	① 1/4 of the enterprises have not created a control list of static electricity-sensitive devices; ② 40% of the enterprises have not specified the electrostatic protection grade; ③ 40% of the enterprises don’t know how to protect the static electricity-sensitive devices properly outside the EPA.
		60%	Specify the highest grade of electrostatic protection	
		75%	Require the operator to maintain the static electricity-sensitive devices grounded when operating them	
		90%	Require the packaging of static electricity-sensitive devices to be anti-static	
		85%	Specify the operational requirements of anti-static packaging	
		60%	Provide sensitive devices using electrostatic shielding packaging when leaving EPA	
		75%	Regulations and requirements on relevant marks of sensitive devices and their packaging	
2	Investigation and analysis on the management of electrostatic protection area	80%	Have a clear division of protection areas	Most enterprises have built electrostatic protection areas, but still nearly 40% of the enterprises have not established a full management system in protection areas.
		60%	Make requirements for division and environmental management of protection areas	
		95%	Keep the conductors within protection areas grounded	
		65%	Specify the operational requirements for staff in protection areas	
3	Investigation and analysis on electrostatic power management	50%	Make a management plan on electrostatic power	Nearly half of the enterprises have major defects in management on electrostatic power within EPA
		55%	Post clear marks on electrostatic power within protection areas	
4	Investigation and analysis on relevant personnel management	75%	Have professional management of electrostatic operation	① 1/4 of the enterprises don’t have professional management of electrostatic operation; ② More than 40% of the managerial personnel have not received systematic training; ③ Only half of the enterprises have purchased electrostatic protection materials or invited ① 1/4 of the enterprises don’t have professional management of electrostatic operation; ② More than 40% of the managerial personnel have not received systematic training; ③ Only half of the enterprises have purchased electrostatic protection materials or invited experts to train relevant personnel with electrostatic operations; ④ Most enterprises have overlooked the electrostatic protection training to other personnel than production staff.
		65%	Have internal auditors for anti-static system	
		70%	The managerial personnel of electrostatic operations have been fully authorized	
		65%	Relevant personnel have received professional training	
		90%	Require the production personnel to receive electrostatic protection training	
		95%	Require the relevant personnel to receive periodic training on electrostatic protection	
		50%	Purchase professional materials or entrust professional institutions to conduct electrostatic protection training	
		25%	Consider electrostatic protection training for management, storage and maintenance personnel	
		20%	Consider electrostatic protection training for cleaning and financial personnel	
5	Investigation and analysis on anti-static facilities and equipment	70%	Specify the technical requirements for anti-static facilities and equipment	① 30% of the enterprises have not specified the technical requirements for anti-static facilities and equipment; ② More than 30% of the enterprises don’t know how to verify the anti-static facilities; ③ 40% of the enterprises use the purchased anti-static products directly without verification; ④ 30% of the enterprises have not verified the facilities regularly; ⑤ Half of the enterprises have not developed a sampling plan on anti-static facilities and equipment.
		65%	Specify the verification and sampling methods for anti-static facilities and equipment	
		75%	Evaluate and compare the electrostatic performance of anti-static products before purchase	
		60%	Use the purchased anti-static facilities and equipment only after certification	
		70%	Make periodic verification plan on anti-static facilities	
		60%	Deliver to a third-party agency for verification regularly	
		70%	Require employees to check the grounding device before each operation	
		85%	Use the calibrated devices to test the anti-static facilities	
		75%	Post relevant marks on the verified anti-static facilities	
		50%	Develop a reasonable sampling plan for detection of anti-static products	
6	Investigation and analysis on application of anti-static facilities and equipment	90%	Have the anti-static floor, working surface, corded wrist strap and shelf	The anti-static packaging is indispensable, but 1/4 of the enterprises have not prepared anti-static packaging
		85%	Have anti-static chairs, carts and clothes	
		80%	Use ionizing electrostatic eliminators	
		75%	Prepare anti-static packaging and anti-static shoes	
		65%	Use separate anti-static floor and consider the equal potential	
		60%	Be equipped with anti-static electric iron	

AA1 智慧城市建设中电子类产品静电防护现状、问题及对策
During wisdom city construction, the electrostatic protection present situation, problems and countermeasures of electricity products

We can say that, the findings are not optimistic as expectations, and the serious problems include:

1）Static electricity-sensitive devices are less protected during transport and transfer;

2）Nearly 40 percent of the enterprises have not created a full electrostatic protection system;

3）Half of the enterprises fail to provide professional training and guidance for internal personnel;

4）Half of the enterprises have not checked the anti-static facilities regularly.

We can also obtain the following information from the attached table of this questionnaire:

1）Regarding the anti-static data, enterprises rely much on the information provided by the suppliers and the unverified information on the Internet;

2）Only 30% of the enterprises obtain anti-static information from professional training and domestic and foreign standards.

3）More than half of the enterprises keep the electrostatic protection closed and are unwilling to communicate with relevant experts;

4）Only half of the enterprises have passed the certification of anti-static systems or intend to get the certification;

5）Enterprises have little knowledge about the electrostatic protection and anti-static systems.

The survey on World Top 500 enterprises in electronic manufacturing industry is not complete, but reveals some problems, such as the electrostatic protection needs to be taken seriously and improved.

2.3.2.1. Analysis on filed survey results

Before the above questionnaire survey, the author have sought consultations in electrostatic protection systems from over 30 electronic companies since 2011 and assisted more than 10 companies in establishing proper electrostatic protection systems. After years of electrostatic testing, consultation, guidance and assistance, the author has accumulated a large number of field cases and data.

Combined with on-site testing, research and communication, the domestic solely-invested small and medium-sized electronic companies have exposed many problems in electrostatic protection. Here is the list of problems created according to occurrence frequency (the problems ranking the top are of higher frequency):

1) The companies' anti-static facilities and equipment are out of control partially or wholly, which is mainly reflected in:

a) The companies don't know what anti-static facilities and products should be equipped;

b) The companies don't know how to detect the anti-static products and what the detection indexes are;

c) The companies don't verify the anti-static products periodically after they are put into operation, and continue to use the failure products;

d) The companies use many such "anti-static products" without anti-static function or with failed function.

2) There are also some problems in personnel management, mainly reflected in:

a) The companies have no professional management of electrostatic operations;

b) The electrostatic protection is supervised by personnel of other departments who have no professional antistatic expertise;

c) The managerial personnel of electrostatic operations have no sufficient permissions to push the effective implementation of anti-static system.

3) The companies have little knowledge about the targets under electrostatic protection, which is mainly reflected in:

a) The companies don't know what devices need to be performed with electrostatic protection in production and processing;

b) The companies don't know what production, processing and storage areas need to be performed with electrostatic protection;

c) The companies don't know what grades of electrostatic protection should be reached.

4) The employees have little knowledge and attention on anti-static information and electrostatic protection systems, which is mainly reflected in:

a) Personnel from managers to operators have not received the relevant electrostatic training;

b) In many companies, the regulations on electrostatic protection just exist in name only and are not observed;

c) Most employees don't understand and even have not heard about the electrostatic protection system;

d) There are various errors in the actual application of electrostatic protection. For example, anti-static shoes and human resistance testers are used in areas without anti-static floor; anti-static gloves are used to replace the static-proof wrist strap; the insulation materials that may generate high static electricity are frequently used in electrostatic protection areas, etc. The contents and forms are of wide variety, and here I will not list them one by one.

It is explained that, during my visit, investigation and communication, more than 60% of the companies have the above problems, especially the uncontrolled electrostatic protection facilities, which exists in nearly most enterprises. While, the more serious problems are that, a number of electronic companies take electrostatic protection lightly; electrostatic protection is just for visiting leaders; electrostatic protection can be easily realized by any electrician; the life of enterprises lies in output and output value, and the budget for electrostatic protection should be postponed for the purpose of cost reduction, which significantly block the upgrading of electrostatic protection in China's electronic manufacturing.

Compared with foreign-invested and joint-ventured large and medium-sized enterprises, China's small and medium-sized electronic companies are still to be improved and enhanced.

2.4 Problems in electrostatic protection in China's electronic manufacturing industry and analysis

AA1 智慧城市建设中电子类产品静电防护现状、问题及对策
During wisdom city construction, the electrostatic protection present situation, problems and countermeasures of electricity products

Based on the analysis on China's electrostatic standardization, electrostatic protection industry and electrostatic protection in electronic manufacturing industry, the main problems faced by China's electronic manufacturing industry are summarized as follows:

1）Electrostatic protection standardization have not formed a unified system and framework, and is less promoted and implemented; part of product standards are aged or insufficient; a national influential electrostatic protection standard has not shaped, falling behind the international advanced level;

2）The electrostatic protection industry is developing rapidly, but the market is lack of standardization and supervision, and the technology needs to be improved;

3）The electrostatic protection in China's electronic manufacturing is of low level and grows unequally, which is mainly reflected in:

a) The professional managerial personnel and agencies of electrostatic protection are insufficient;

b) The awareness of electrostatic hazards is weak and the investment in electrostatic protection is less;

c) Although some foreign-invested (European and American) and joint-ventured large enterprises have introduced the electrostatic protection concept, making their electrostatic protection level higher than domestic small and medium-sized enterprises, they are still facing some problems, which is especially reflected in less knowledge about the cross-border electrostatic protection issues and less resolutions;

d) China has not established a complete audit and certification mechanism in electrostatic protection system; most electronic companies rely on the authorized agency of foreign association in the guidance and certification of electrostatic system; the domestic consultation and certification authorities have not been standardized, which is not conducive to the upgrading of electrostatic protection in electronic industry.

Methods to improve electrostatic protection level of electronic products for smart city system

Progress has been made in improving electrostatic protection level of electronic products for smart city system with the joint efforts of relevant departments, associations and experts.

3.1 Proposal No.0192 made by CPPCC of Shanghai — "Place Value on Construction of Smart City and Hidden Threats in City Operation Safety"

In short, electronic products are essential for construction of a smart city, but they also influence safety of the city. Stability and reliability of electronic products depends on their electrostatic protection level. Therefore, hidden threats of static electricity must be paid attention to during construction of a smart city.

The proposal " Place Value on Construction of Smart City and Hidden Threats in City Operation Safety", in which Shanghai Electrostatic Protective Industrial Association participated, has been passed in the Second Session of the Tenth CPPCC as No.0192 proposal on January 14th, 2014, through the efforts made by Huang Shanming, the Secretary-General of Shanghai and a member of China Association for Promoting Democracy. Quality and Technology Supervision Bureau of Shanghai, Shanghai Municipal Commission of Economy and Information Technology as well as other government departments which undertake this proposal placed great value on it. The General Office of Shanghai Municipal Commission of Economy and Information Technology also invited directors of Outward investment and Economic Cooperation Office and Information Commission to research and make suggestions for implementation. As for suggestions in the Proposal, relevant government departments have made the following clear and definite measures:

1）Make efforts to make survey project related to industrial development declared by Shanghai Electrostatic Protective Industrial Association approved by expert review and purchased by government;

2）Bring Standard of Electrostatic Protection Industry Alliance (standard of community) into pilot projects of standardization innovation of Shanghai in this year;

3）Involve "the Third International Workshop on Electrostatic Protection and Standardization" in the "Publicity Week of Smart City" activity held in Shanghai in October;

4）Actively promote personnel development. According to the demand on development of industry and the actual situation of enterprises, "electrostatic protection engineer" will be included in the research range for next amendment of List for Development of Scarce Talent in Strategic Emerging Industries of Shanghai (about 2017) as a sub-class of talent, which was issued by Shanghai Municipal Commission of Economy and Information Technology, Science and Technology Commission of Shanghai and Shanghai Municipal Human Resources and Social Security Bureau in 2012.

In addition, CPPCC of Shanghai considered that this proposal is valuable to some extent and has submitted it to Chinese People's Political Consultative Conference as social conditions and public opinions.

3.2 Carry out a comprehensive industrial survey to electrostatic protection level of electronic products for smart city system

The author believes that No.0192 Proposal provides us with an opportunity. The above clear and definite measures made by relevant departments were really conducive to improve electrostatic protection level of electronics industry in China, of which survey projects related to development of industry are the starting point and data support for the follow-up measures. A more comprehensive survey with more targeted goal is helpful to know the accurate situation of electrostatic protection level and anti-static demand of relevant electronic enterprises in smart city in China, which provides reference data for the next relevant standard and policy making. In addition, it can indeed improve electrostatic protection level of electronics industry in China because it popularizes knowledge on hazards of static electricity as well gathers related forces through related survey activities. It is not only a major event of electrostatic protection industry and electronics industry in China to develop the first true, comprehensive and representative investigation report of electrostatic protection level in electronics industry, but also has a very far-reaching significance for

AA1 智慧城市建设中电子类产品静电防护现状、问题及对策
During wisdom city construction, the electrostatic protection present situation, problems and countermeasures of electricity products

construction of a smart city in China.

3.3 The value government places on electrostatic protection is the key to improve electrostatic protection level of electronics industry in China

Electrostatic standard is a typical user-driven standard. Standard of American ESD Association is put forward and made by various well-known microelectronics companies. Companies of America and Europe often first check if the company has established and passed electrostatic protection system standard when they select partners or suppliers of raw materials in China. During construction of a smart city, government of the largest user and safety of city is the primary responsibility of the government. Therefore, relevant government departments related to standardization are recommended to transform IEC61340-5-1 standard into a national standard of China and carry out certification. As for procurement of electronic components and systems made by government, whether the company has established and passed electrostatic protection system standard will be the pre-condition for the bidding and tendering document. The value the government places on electrostatic protection is the key to improving electrostatic protection level of electronics industry in China.

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AA2 微波器件和电路ESD损伤案例分析
Microwave Device and Circuit ESD Damage Case Analysis

CEPREI

微波器件和电路ESD损伤案例分析

报告人：来　萍
中国赛宝实验室
2014年10月

中国赛宝 1

CEPREI

主要内容

- 1　引言
- 2　微波器件和电路ESD损伤案例
- 3　小结

中国赛宝 2

CEPREI

1 引 言

- 1.1 多种电子元器件属于静电敏感器件
- 1.2 可能产生ESD损害的制造过程
- 1.3 ESD损伤分析的重要作用

中国赛宝 3

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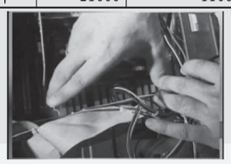
1.1 多数电子元器件是静电敏感器件

表1.1　电子生产中产生的静电势的典型值（单位：V）

事件	相对湿度		
	10%	40%	50%
走过乙烯地毯	12000	5000	3000
在工作椅上操作人员的移动	6000	800	400
将DIP封装的器件从塑料管中取出	2000	700	400
将印刷电路板装进泡沫包装盒中	21000	11000	5500

图片来自于IPC VEDEIO/CBT

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1.1 多数电子元器件是静电敏感器件

- 一些器件的静电敏感度

Device type	ESD withstand voltage sensitivity (V) HBM
MR heads, RF FETs	10 - 100
Power MOSFETs PIN diodes, laser diodes	100 - 300V
Pre - 1990 VLSI	400 - 1000V
Modern VSLI	1000 - 3000V
HCMOS	1500 - 3000V
CMOS B Series	2000 - 5000 V
Linear MOS	800 - 4000 V
Small geometry older bipolar	600 - 6000 V
Small geometry modern bipolar	2000 - 8000 V
Power bipolar	7000 - 25000 V
Film resistor	1000 - 5000 V

中国赛宝 5

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1.1 多数电子元器件是静电敏感器件

- 检测评价结果（HBM）
  - 光电二极管:50V～300V
  - RF FET及MMIC（单片电路）：100～500V
    - GaAs，GeSi等
  - 高频声表面波器件（SAW）:300～1000V
  - 模拟IC：500V～4000V
  - 数字IC：1000V～8000V
- 新技术、新器件
  - 尺寸减小（18nm）
  - RF IC
  - MEMS

中国赛宝 6

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1.1 多数电子元器件是静电敏感器件

- 标准关于ESD敏感度的等级分类
  - JS-001-2012（ESD HBM）（替代JEDEC JESD22a114 ）

Table 3. HBM ESD Component Classification Levels

Classification	Voltage Range (V)
0A	< 125
0B	125 to < 250
1A	250 to < 500
1B	500 to < 1000
1C	1000 to < 2000
2	2000 to < 4000
3A	4000 to < 8000
3B	≥ 8000

  - （注：2012 细分出0A，0B级）

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1.1 多数电子元器件是静电敏感器件

- 标准关于ESD敏感度的等级分类
  - Mil-STD-883F-2004以及之前

TABLE III. Device ESD failure threshold classification.

Class 1	0 volt to 1,999 volts
Class 2	2,000 volts to 3,999 volts
Class 3	4,000 volts and above

  - Mil-STD-883G-2006开始细分 →

TABLE III. Device ESD failure threshold classification.

Class 0	< 250 volts
Class 1A	250 volts to 499 volts
Class 1B	500 volts to 999 volts
Class 1C	1,000 volts to 1,999 volts
Class 2	2,000 volts to 3,999 volts
Class 3A	4,000 volts to 7,999 volts
Class 3B	≥ 8,000 volts

中国赛宝 8

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1.2 可能产生ESD损害的制造过程

元器件从生产到使用的整体过程中都可能遭受静电损伤，依各阶段的可分为：

- (1) 元器件制造过程…
- (2) 印刷电路版生产过程 …
- (3) 设备制造过程 …
- (4) 设备使用过程 …
- (5) 设备维修过程…



图片来自于IPC VEDEIO/CBT

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1.3 ESD损伤分析的重要作用

- 电子元器件ESD损伤分析的重要性
  - 对电子元器件ESD损伤分析来说，最重要的是确定损伤是ESD造成的，而不是其他电过应力造成的， 也不是因为存在工艺缺陷在加电工作时发生的。
  - 只有明确电子元器件损伤的根本原因是ESD，才能从设计、工艺或者应用防护方面进行改进和控制，从而减少ESD对电子元器件造成损伤。

中国赛宝 10

CEPREI

2 微波器件和电路ESD损伤案例

- 案例1：数控单刀双掷（ Single-Pole Double-Throw ）SPDT微波开关
- 案例2：数控SPDT微波开关
- 案例3：两路微波功分器
- 案例4：宽带低噪声放大器芯片
- 案例5：MMIC 放大器
- 案例6：MMIC 宽带放大器

中国赛宝 11

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2 微波器件和电路ESD损伤案例

- 案例1

（1）样品：

AS169型数控SPDT微波开关(PHEMT GaAs IC SPDT Switch)
Alpha公司标识，委托方应用于收发电路整板。

（2）失效背景

在装配后对整板测试时，发现整板的接收、发射功率有的下降，有的无功率。经检查，发现是板上的1个AS169器件失效所致。在同一块整板上有两个同样的AS169器件，但不同位置；一个位置无失效，另一个有50%的失效，有时高达60～70%。

中国赛宝 12

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Microwave Device and Circuit ESD Damage Case Analysis

2 微波器件和电路ESD损伤案例

案例1（续1）

（3）性能参数测试对比

制作直流和射频测试电路板，对提供的失效样品进行直流和微波参数测试，并与良品进行了对比，得到的结果是：失效样品（5只）端口特性异常，射频参数超差，开关功能失效。

样品描述	样品号	测试项目	测试结果及与良品对比	结论
良品	1#~10#	端口I—V特性	射频所有管脚与GND呈高阻，近似开路；射频端口与电压控制端呈结特性.	/
	1#, 2#, 4#	直流开关特性	有开关功能	
	7#, 8#	微波功能	功能参数正常	
第2批失效品	21#~25#	端口I—V特性	3个射频端口与GND之间呈电阻特性，近似短路	失效样品功能失效，端口特性异常。
	22#	微波功能	参数超差，功能失效	

中国赛宝 13

2 微波器件和电路ESD损伤案例

案例1（续2）

（4）抗ESD能力检测

对3只良品（1#~3#）进行了抗ESD能力检测。在经历200V人体模型的ESD试验后，3只样品的端口I—V特性未见明显变化；但在经历250V的ESD后，3只样品的端口特性均有明显变化，均表现为3个射频端口与GND之间由开路变为近似短路（与失效样品相同）。

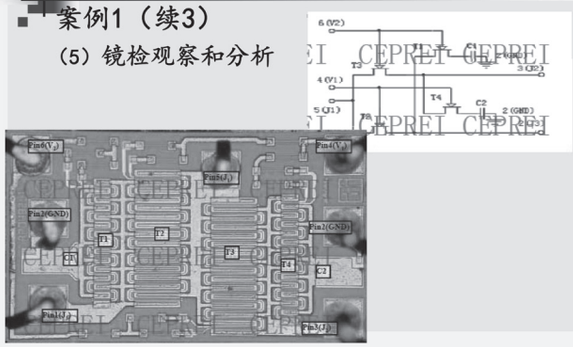
ESD检测结果表明，AS169的抗ESD能力很低，属于静电非常敏感器件。

中国赛宝 14

2 微波器件和电路ESD损伤案例

案例1（续3）

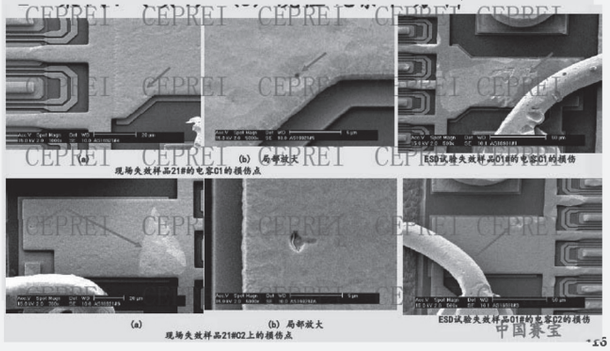
（5）镜检观察和分析



中国赛宝 15

2 微波器件和电路ESD损伤案例

案例1（续4）（5）镜检观察和分析



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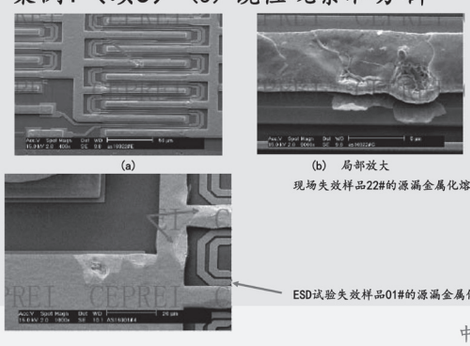
2 微波器件和电路ESD损伤案例

案例1（续5）（5）镜检观察和分析



中国赛宝 17

2 微波器件和电路ESD损伤案例

案例1（续6）

（5）镜检观察和分析

- 从镜检观察和分析看，开封的良品未见异常。2个失效样品（21#和22#）的电容都发现了明显的击穿现象，22#还有明显的源漏金属化熔融损伤的现象，说明样品发生了过电压导致的热电失效。
- 2只良品（1#和3#）经历了ESD 250V后，3个射频端口与GND之间由开路变为近似短路（与提供的第2批失效样品相同）。镜检和SEM的结果是：在电容上发现了明显的击穿现象，源漏金属化有熔融损伤。失效现象和现场失效样品的基本一致。

中国赛宝 18

AA2 微波器件和电路ESD损伤案例分析
Microwave Device and Circuit ESD Damage Case Analysis

2 微波器件和电路ESD损伤案例

- 案例1（续7）
- （6）综合分析
  - （1）端口I—V特性和射频功能测试表明，AS169的现场失效样品（第2批）均表现为GND和3个射频输出端之间变为电阻特性（近似为短路），射频开关控制功能失效。

    从电路原理图（图2）看，正常情况下，由于GND端口内有电容C1和C2，因此所有管脚对GND的I-V特性均应表现为开路，良品测试也证实了这点。

    失效品出现射频端口与GND端近似短路，说明电容C1或C2已经发生击穿失效。而一旦C1或C2失效，控制端（V1和V2）的正电压就无法施加，从而导致控制功能失效。

中国赛宝 19

2 微波器件和电路ESD损伤案例

- 案例1（续8）
- （6）综合分析
  - （2）对2个失效样品进行开封镜检和SEM分析，结果在电容C1和（或C2）上都观察到明显的击穿失效点，在源漏的金属化上还观察到明显的金属化热电失效现象。但栅金属基本没有损伤。
  - 因此，AS169失效样品的失效机理是：在射频端口和GND端之间受到了过电压应力，导致电容（C1或C2）击穿失效；电容击穿后，射频端口和GND之间形成低电阻通路，电流很大，导致通路中的金属化发生热电熔融损伤。
  - （3）对3个良品进行了从50V到250V的步进ESD（HBM）试验。结果表明AS169的抗ESD水平在200V到250V之间，属于静电非常敏感器件。
  - 在经历250V后，3只样品也表现为GND和3个射频端之间由开路变为电阻特性（近似为短路），失效模式与现场失效样品的相同。开封镜检也观察到电容和金属化的损伤现象，与现场失效品一致。

中国赛宝 20

2 微波器件和电路ESD损伤案例

- 案例1（续9）
- （7）结论
  - AS1690-73型数控SPDT微波开关失效的主要原因是：器件在射频和接地端之间发生了静电放电，使芯片内部接地电容击穿失效并发生金属化热电熔融损伤，导致器件端口特性异常，射频功能失效。
- （8）建议
  - （1）查找静电放电的来源。
  - （2）采取积极的防静电措施。
- （9）根本原因（委托方）
  - 收发电路整板上，失效器件靠近接插件，会经常触摸到；
  - 在防静电方面，防护措施和管理不完善，有些工人不带防静电腕带。

中国赛宝 21

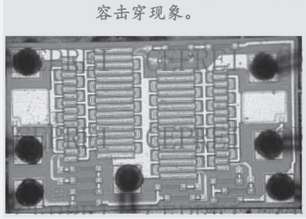
2 微波器件和电路ESD损伤案例

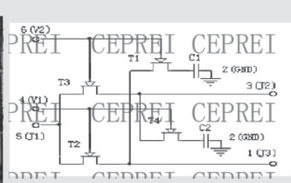
- 案例2
- 样品及失效背景
  - AS169型数控SPDT微波开关(PHEMT GaAs IC SPDT Switch)Skyworks公司标识，委托方应用于收发电路整板。在装配后对整板测试时，发现整板的发射功率最少下降3dB。经检查，发现AS169的插损和隔离度变差，用数字表测试，管脚未击穿。
- 性能参数测试对比
  - 失效样品中有7只开关功能失效，2只失效样品端口I-V特性异常，射频参数超差。
- 抗ESD能力检测
  - 250V和300V
- 结论
  - 在器件的控制端（6脚）和射频端口之间曾发生静电放电，导致器件端口特性异常，射频功能失效。

中国赛宝 22

2 微波器件和电路ESD损伤案例

- 案例2（续1）
- 镜检观察和分析
  - 与Alpha标识的样品电路原理相同，版图略有所不同；
  - 失效品和ESD试验品均有栅源击穿和金属化熔融现象，但未见电容击穿现象。

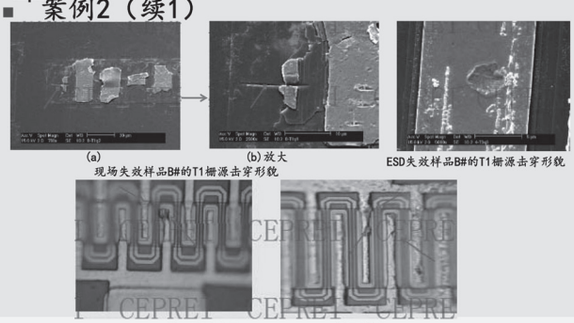




中国赛宝 23

2 微波器件和电路ESD损伤案例

- 案例2（续1）



中国赛宝 24

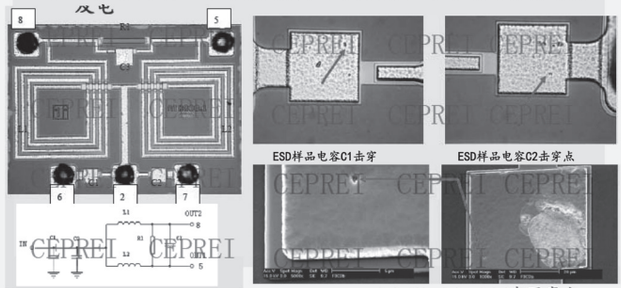
AA2 微波器件和电路ESD损伤案例分析
Microwave Device and Circuit ESD Damage Case Analysis

2 微波器件和电路ESD损伤案例

- 案例3
  - 样品及失效背景
    - PD09-12型两路微波功分器，委托方应用于某型单板。在常温下，对装配后的整板测试时一上电即出现故障，表现为PD09-12插损超大，正常情况下应为3.5dB，而失效品的插损粗测为12～15dB。生产300块单板，共有33块属于PD09-12故障，失效比例为11%。
  - 参数测试
    - 多管脚有短路现象
  - ESD试验
    - 250V-300V ，属静电非常敏感器件

2 微波器件和电路ESD损伤案例

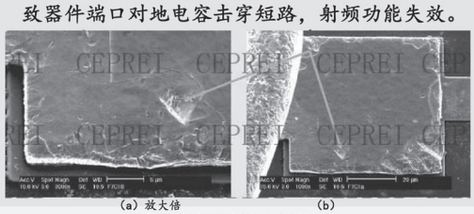
- 案例3（续1）
  - 镜检和分析：所有失效样品及ESD样品均有电容击穿现象



现场失效样品电容C2击穿点

2 微波器件和电路ESD损伤案例

- 案例3（续2）
  - 结论：
    - PD09－12两路微波功分器失效的主要原因是：在器件的射频输入端口与接地端口之间曾发生静电放电，导致器件端口对地电容击穿短路，射频功能失效。

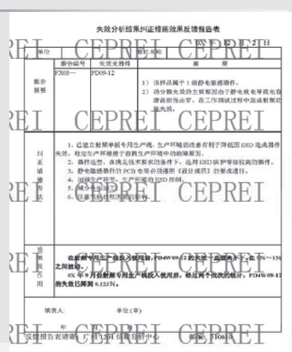


（a）放大倍　　（b）

图12　失效品F7电容C1击穿形貌

2 微波器件和电路ESD损伤案例

- 案例3（续　）
  - 改进反馈（失效分析结果纠正措施效果反馈报告表）
  - （1）报告摘要
    - 1）该样品属于1级静电敏感器件。
    - 2）功分器失效的主要原因由于静电放电导致电容潜在损伤击穿，在工作调试过程中造成射频功能失效。



2 微波器件和电路ESD损伤案例

- 案例3（续）-改进反馈
  - （2）改进措施
    - 1）已建立射频单板专用生产线，生产环境的改善有利于降低因ESD造成器件失效，稳定生产环境便于查找生产环境中的故障原因。
    - 2）器件选型，在满足技术要求的条件下，选用ESD防护等级较高的器件。
    - 3）静电敏感器件的PCB布局必须遵照《设计规范》的要求进行。
    - 4）加强生产环节，生产环境的ESD控制。
    - 5）减少外协加工。
    - 6）注意气候自然因素的影响。
  - 3）效果及作用
    - 在射频专用生产线投入使用前，PD4W09-12的失效一直居高不下，在9%～1%之间波动。
    - 04年9月份射频专用生产线投入使用后，经过两个批次的统计，PD4W09-12的失效已降到0.123%。

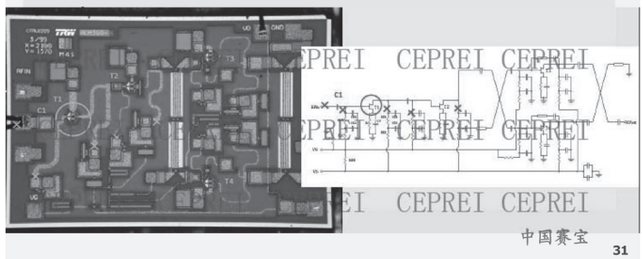
2 微波器件和电路ESD损伤案例

- 案例4
  - （1）样品概况
    - ALH369为美国Hittite公司标识的的24.0-40.0Ghz GaAs MMIC宽带低噪声放大器芯片。根据委托方提供的信息：该毫米波组件于200X年10月装机，在200X年2月15日整机调试时发生失效，失效表现为：增益下降8dB左右，噪声系数恶化约10dB。

AA2 微波器件和电路ESD损伤案例分析
Microwave Device and Circuit ESD Damage Case Analysis

2 微波器件和电路ESD损伤案例

- 案例4
- （2）电测定位
  - 运用聚焦离子束（FIB）和微探针，对失效点进行电测定位，通过隔离测试分析，确定为第1级放大管的栅源之间结特性退化，近似短路



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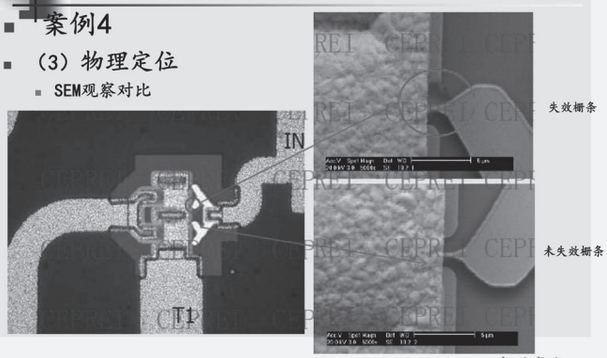
2 微波器件和电路ESD损伤案例

- 案例4
- （3）物理定位
  - SEM观察对比



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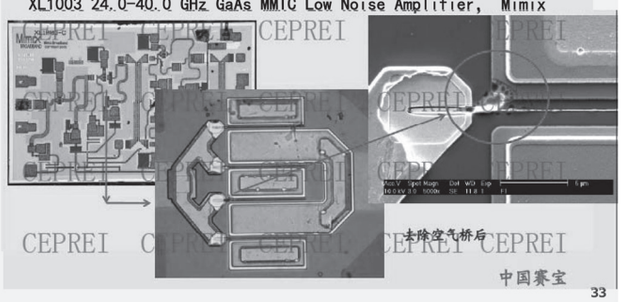
2 微波器件和电路ESD损伤案例

- 案例4
- （4）不同委托方的同类样品

XL1003 24.0-40.0 GHz GaAs MMIC Low Noise Amplifier, Mimix



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2 微波器件和电路ESD损伤案例

- 案例4
- （5）结论
  - 24.0-40.0Ghz GaAs MMIC宽带低噪声放大器芯片第一级放大管栅源之间过电击穿损伤，导致样品失效。
  - 过电应力的最可能来源是：输入端引入了静电或短脉冲过电压。
- （6）建议
  - 加强安装和测试时静电防护，尤其在接入输入线缆插头时注意消除插头带电的可能。

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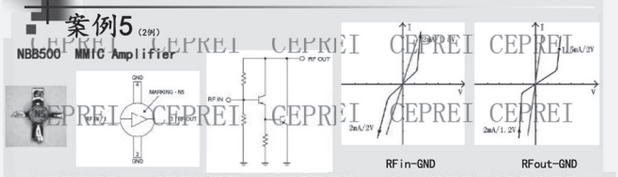
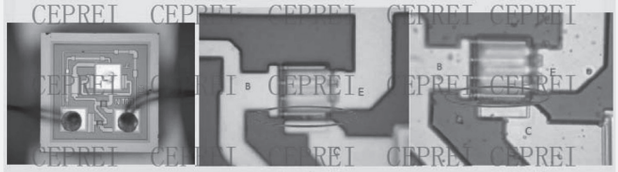
2 微波器件和电路ESD损伤案例

- 案例5 (2例)

NBB500 MMIC Amplifier





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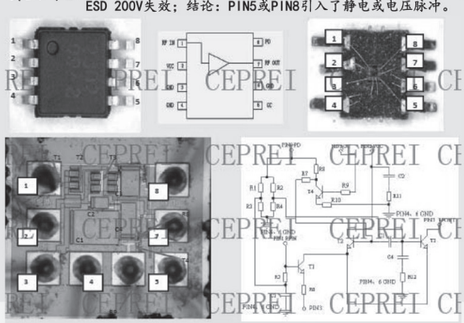
2 微波器件和电路ESD损伤案例

- 案例6 RF2302宽带线性可变增益放大器，共装机使用50只，失效4只，比例约为8%。ESD 200V失效；结论：PIN5或PIN8引入了静电或电压脉冲。

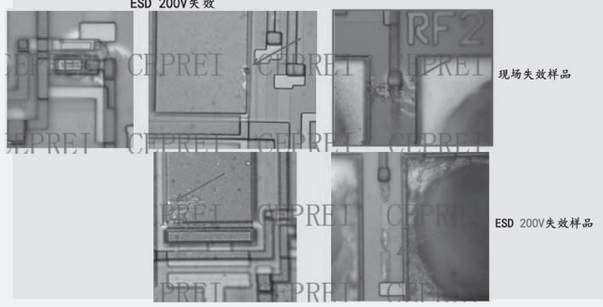


中国赛宝 36

AA2 微波器件和电路ESD损伤案例分析
Microwave Device and Circuit ESD Damage Case Analysis

2 微波器件和电路ESD损伤案例

- 案例6 RF2302宽带线性可变增益放大器，共装机使用50只，失效4只，比例约为8%
  ESD 200V失效



中国赛宝 37

3 ESD损伤案例分析小结

- 3.1 ESD失效分析的主要步骤
- 3.2 常用的分析设备

中国赛宝 38

3.1 ESD失效分析的主要步骤

- （1）失效背景信息了解
  - 如：失效发现的环节，之前经历的过程，失效是否具有批次性？失效比例？是否具有季节性？
- （2）失效样品资料收集和掌握
  - 产品规范（data sheet），ESD敏感度等级，运用电路要求等；
- （3）失效样品、失效模式确认、失效引脚定位
  - 功能测试，射频测试，直流特性测试，I-V特性测试；
  - 对比很重要！

中国赛宝 39

3.1 ESD失效分析的主要步骤

- （4）开封镜检分析
  - 一些可以直接观察到损伤点；
  - 一些需要对表面进行去层后才能观察到；
  - 一些复杂电路需要先进行电测定位和分析，再有针对性的进行观察
- （5）良品的ESD模拟验证
  - 进行相应引脚的ESD试验，确认敏感度；
  - 对ESD失效样品进行开封镜检，与现场失效样品进行对比
- （6）综合分析，给出结论

中国赛宝 40

3.2 常用的分析设备

- （1）电测试设备
  - 包括直流和微波测试设备，以及测试板或测试夹具的制作，微探针台等
- （2）ESD试验设备
  - 用于对良品进行ESD模拟验证试验（还可进行I-V特性测试）
- （3）显微观察设备
  - 光学显微镜
  - 扫描电子显微镜（SEM）
  - 光发射显微镜（PEM）
- （4）制样设备
  - 去层分析：化学腐蚀、等离子刻蚀等
  - 微区隔离和制样：聚焦离子束（FIB）

中国赛宝 41

主要内容

- 1 引言
  - 1.1 多种电子元器件属于静电敏感器件
  - 1.2 可能产生ESD损害的制造过程
  - 1.3 ESD损伤分析的重要作用
- 2 微波器件和电路ESD损伤案例
  - 案例1-6
- 3 小结
  - 3.1 ESD失效分析的主要步骤
  - 3.2 常用的分析设备

中国赛宝 42

AA2 微波器件和电路ESD损伤案例分析
Microwave Device and Circuit ESD Damage Case Analysis

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谢　谢！

Thank you!

中国赛宝 43

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Microwave Device and Circuit ESD Damage Case Analysis

Reporter: Lai Ping

CEPREI

Oct. 2014

CEPREI 1

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Main Contents

- 1. Introduction
- 2. Microwave Device and Circuit ESD Damage Case
- 3. Brief Summary

CEPREI 2

CEPREI

1. Introduction

- 1.1 Multiple electronic devices belong to element for electrostatic sensitivity
- 1.2 Manufacturing process that may generate ESD damage
- 1.3 Important role of ESD damage analysis

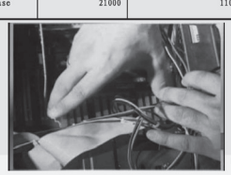
CEPREI 3

CEPREI

1.1 Most Electronic Devices are Element for Electrostatic Sensitivity

Table 1.1 Typical Value of Electrostatic Potential Generated in Electronic Production(Unit: V)

Event	Relative Humidity		
	10%	40%	50%
Walking across ethylene carpet	12000	5000	3000
Movement of operator in work chair	6000	800	400
Taking DIP device out from plastic tube	2000	700	400
Load printed circuit board into foam packing case	21000	11000	5500

Pictures from IPC VEDEIO/CBT

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1.1 Most Electronic Devices are Element for Electrostatic Sensitivity

- Electrostatic sensitivity of some devices

Device type	ESD withstand voltage sensitivity (V) HBM
MR heads, RF FETs	10 - 100
Power MOSFETs PIN diodes, laser diodes	100 - 300V
Pre - 1990 VLSI	400 - 1000V
Modern VSLI	1000 - 3000V
HCMOS	1500 - 3000V
CMOS B Series	2000 - 5000 V
Linear MOS	800 - 4000 V
Small geometry older bipolar	600 - 6000 V
Small geometry modern bipolar	2000 - 8000 V
Power bipolar	7000 - 25000 V
Film resistor	1000 - 5000 V

CEPREI 5

AA2 微波器件和电路ESD损伤案例分析
Microwave Device and Circuit ESD Damage Case Analysis

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1.1 Most Electronic Devices are Element for Electrostatic Sensitivity

- Test and appraisal results(HBM)
  - Photod: 50V～300V
  - RF FET and MMIC(monolithic circuit): 100～500V
    - GaAs , GeSi, etc
  - High frequency SAW Device (SAW): 300～1000V
  - Analogue IC: 500V～4000V
  - Digital IC: 1000V～8000V
- New technology, new device
  - Smaller size (18nm)
  - RF IC
  - MEMS

CEPREI 6

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1.1 Most Electronic Devices are Element for Electrostatic Sensitivity

- Standard ESD sensitivity classification levels
  - JS-001-2012(ESD HBM)(replacing JEDEC JESD22a114)
  - (Note: 2012 has Level 0A, 0B itemized)

Table 3. HBM ESD Component Classification Levels

Classification	Voltage Range (V)
0A	< 125
0B	125 to < 250
1A	250 to < 500
1B	500 to < 1000
1C	1000 to < 2000
2	2000 to < 4000
3A	4000 to < 8000
3B	≥ 8000

CEPREI 7

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1.1 Most Electronic Devices are Element for Electrostatic Sensitivity

- Standard ESD sensitivity classification levels
  - Mil-STD-883F-2004 and those before it

TABLE III. Device ESD failure threshold classification.

Class 1	0 volt to 1,999 volts
Class 2	2,000 volts to 3,999 volts
Class 3	4,000 volts and above

  - Mil-STD-883G-2006 begins itemization →

TABLE III. Device ESD failure threshold classification.

Class 0	< 250 volts
Class 1A	250 volts to 499 volts
Class 1B	500 volts to 999 volts
Class 1C	1,000 volts to 1,999 volts
Class 2	2,000 volts to 3,999 volts
Class 3A	4,000 volts to 7,999 volts
Class 3B	≥ 8,000 volts

CEPREI 8

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1.2 Manufacturing Process that may Generate ESD Damage

Electrostatic damage may occur to devices in the overall process from production to use, consisting of following stages:

- (1) Device manufacturing process …
- (2) Printed circuit board production process …
- (3) Equipment manufacturing process …
- (4) Equipment use process …
- (5) Equipment maintenance process …



Pictures from IPC VEDEIO/CBT

CEPREI 9

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1.3 Important Role of ESD Damage Analysis

- Importance of electronic device ESD damage analysis
  - In view of electronic device ESD damage analysis, the most important is to determine that damage is caused by ESD rather than other electrical overstress and does not occur during power-on hours due to process defect.
  - Only after ESD is identified as the basic reason for electronic device damage can improvement and control be achieved from design, process or application protection, so as to reduce ESD damage to electronic devices.

CEPREI 10

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2. Microwave Device and Circuit ESD Damage Case

- Case 1: NC single-pole double-throw (SPDT)microwave switch
- Case 2: NC SPDT microwave switch
- Case 3: Two-way microwave power divider
- Case 4: Wideband low-noise amplifier chip
- Case 5: MMIC amplifier
- Case 6: MMIC wideband amplifier

CEPREI 11

AA2 微波器件和电路ESD损伤案例分析
Microwave Device and Circuit ESD Damage Case Analysis

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2. Microwave Device and Circuit ESD Damage Case

- Case 1

(1) Sample:

Model AS169 NC SPDT microwave switch (PHEMT GaAs IC SPDT Switch) Alpha Company logo, used by the entruster in receiving and transmitting circuit board.

(2) Failure background

In board test after assembly, the board's receiving/transmitting power was found lower, some boards were found no power, which were caused by failure of a AS169 Device on board as check identified. On the same board there are two AS169 Devices, but with different positions, one of which has no failure, the other has 50% failure, even to 60～70% sometimes.

CEPREI 12

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2. Microwave Device and Circuit ESD Damage Case

- Case 1 (Continued 1)

(3) Performance parameter test comparison

Making DC and radiofrequency test circuit board, carrying out DC and microwave parameter test of the failed samples provided, and comparing them with qualified products, the result is: failed samples (5 pieces) have port characteristic abnormal, radiofrequency parameter overrun tolerance and switch function failed.

Sample Description	Sample No.	Test Item	Test Result and Comparison with Qualified Products	Conclusion
Qualified products	1#~10#	Port I—V characteristic	All radiofrequency prongs present high resistance to GND, approximately open circuit; junction characteristic between radiofrequency port and voltage control end	/
	1#, 2#, 4#	DC switch characteristic	With switch function	
	7#, 8#	Microwave function	Function parameter normal	
Batch 2 failed products	21#～25#	Port I—V characteristics	Resistance characteristic, approximately short circuit between three radiofrequency ports and GND	Failed sample has function failed; port characteristic abnormal
	22#	Microwave function	Parameter overrun tolerance , function failure	

CEPREI 13

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2. Microwave Device and Circuit ESD Damage Case

- Case 1 (Continued 2)

(4) ESD resistance testing

Three qualified products (1#~3#) were given ESD resistance testing. After 200V human body model ESD test, no clear change was found in three samples' port I—V characteristics; however, after 250V ESD, clear change was found in three samples' port characteristics, presenting the change from open circuit to approximate short-circuity between three radiofrequency ports and GND(the same as the failed sample).

ESD testing result shows that AS169 has ESD resistance very low, and is a device very sensitive to static electricity.

CEPREI 14

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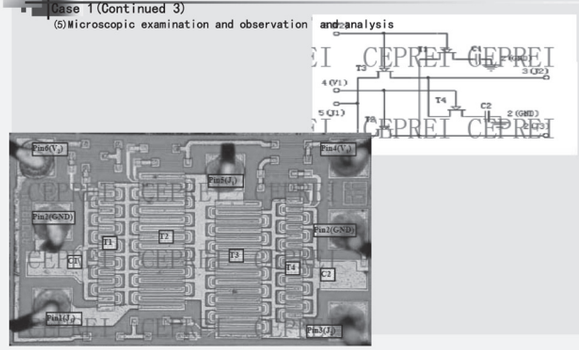
2. Microwave Device and Circuit ESD Damage Case

- Case 1 (Continued 3)

(5) Microscopic examination and observation and analysis



CEPREI 15

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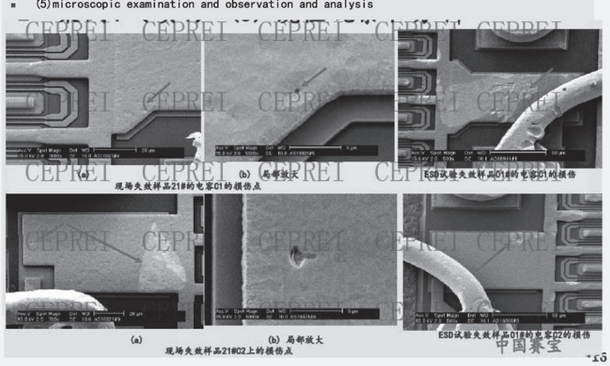
2. Microwave Device and Circuit ESD Damage Case

- Case 1 (Continued 4)
- (5) microscopic examination and observation and analysis



CEPREI 16

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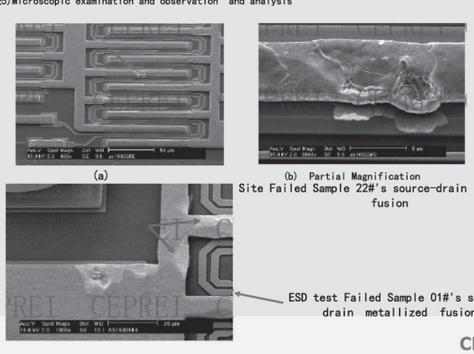
2. Microwave Device and Circuit ESD Damage Case

- Case 1 (Continued 5)
- (5) Microscopic examination and observation and analysis



CEPREI 17

AA2 微波器件和电路ESD损伤案例分析
Microwave Device and Circuit ESD Damage Case Analysis

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2. Microwave Device and Circuit ESD Damage Case

- Case 1 (Continued 6)
- (5) Microscopic examination and observation and analysis
  - According to microscopic examination and observation and analysis, no abnormality was found with the qualified products after breaking the seal. clear breakdown was found with capacitor of 2 failed samples (21# and 22#), and clear source-drain metallized fusion damage with Sample 22#, showing that the sample met overvoltage-caused thermoelectric failure.
  - After ESD 250V, 2 qualified products (1# and 3#) had change from open circuit to approximate short-circuit between 3 radiofrequency ports and GND(the same as the Batch 2 failed sample provided). Microscopic examination and SEM results: clear breakdown was found with capacitor, fusion damage with source-drain metallization. Failure phenomena is basically identical with site failed sample.

CEPREI 18

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2. Microwave Device and Circuit ESD Damage Case

- Case 1 (Continued 7)
- (6) Comprehensive analysis
  - (1) Port I—V characteristics and radiofrequency function test shows that all AS169's site failed samples (Batch 2) presented change to resistance characteristic (approximately short circuit) between GND and 3 radiofrequency output ends, and failure of radiofrequency switch control function.

    From circuit schematic diagram (Fig.2), it can be found that normally, with Capacitor C1 and C2 in GND Port, all prongs' I-V characteristics to GND should be open circuit, which has been demonstrated by qualified products test.

    Failed product presented approximate short-circuit between radiofrequency port and GND, showing breakdown failure had occurred with Capacitor C1 or C2. Once C1 or C2 becomes failed, positive voltage can not be applied to control end (V1 and V2), thus to cause control function failure.

CEPREI 19

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2. Microwave Device and Circuit ESD Damage Case

- Case 1 (Continued 8)
- (6) Comprehensive analysis
  - (2) Microscopic examination and SEM analysis of 2 failed samples after breaking the seal found clear breakdown failure points with Capacitor C1 and/or C2, and clear metallized thermoelectric failure with source-drain metallization but no damage to gate metal basically.
  - Therefore, failure mechanism of AS169 failed sample is: overvoltage stress between radiofrequency port and GND end causes breakdown failure of Capacitor (C1 or C2); after capacitor breakdown, low resistance passage forms between radiofrequency port and GND, with very high current, causing thermoelectric fusion damage to metallization in the passage.
  - (3) 3 qualified products were given 50V - 250V step-by-step ESD(HBM) tests, with the results showing that AS169's anti-ESD level is between 200V and 250V and it is a device vrey sensitive to static electricity.
  - After 250V, 3 samples presented change from open circuit to resistance characteristic (approximately short circuit) between GND and 3 radiofrequency ends, and failure mode the same as that of site failed sample. Microscopic examination after breaking the seal also observed damage to capacitor and metallized damage, the same as that of site failed product.

CEPREI 20

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2. Microwave Device and Circuit ESD Damage Case

- Case 1 (Continued 9)
- (7) Conclusion
  - Main reason for Model AS1690-73 NC SPDT microwave switch failure: the Device had electrostatic discharge between radiofrequency and grounding, making in-chip grounding capacitor broken down and failed and meet metallized thermoelectric fusion damage, to cause abnormal device port characteristics and failure of radiofrequency function.
  - (8) Suggestions
  - (1) Identifying source of electrostatic discharge.
  - (2) Taking active antistatic measures.
  - (9) Basic reason (the entruster)
  - In receiving and transmitting circuit board, failed device is close to connector, easy to be touched;
  - In terms of antistatic work, precautions and management are incomplete, some workers do not wear antistatic wrist strap.

CEPREI 21

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2. Microwave Device and Circuit ESD Damage Case

- Case 2
  - Sample and failure background
    - Model AS169 NC SPDT microwave switch (PHEMT GaAs IC SPDT Switch) , with logo of Skyworks Company, was used by the entruster in receiving and transmitting circuit board. Test of the board after assembly found fall of the board's transmitting power by 3dB at least. Check found poor AS169 insertion loss and isolation; test with digital meter identified no prong breakdown.
  - Comparison of performance parameter tests
    - Of the failed samples, 7 switches had function failure, 2 failed samples had port I-V characteristics abnormal and radiofrequency parameter overrun tolerance.
  - ESD resistance testing
    - 250V and 300V
  - Conclusion
    - Electrostatic discharge occurred between the device's control end (6 prongs) and radiofrequency port, making device port characteristic abnormal and radiofrequency function failed.

CEPREI 22

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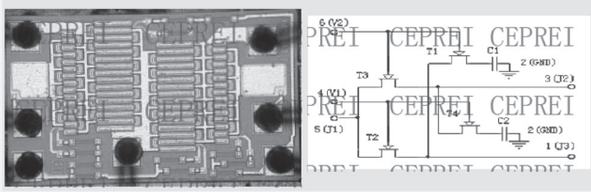
2. Microwave Device and Circuit ESD Damage Case

- Case 2 (Continued 1)
  - Microscopic examination and observation and analysis
    - The same as Alpha-logo sample circuit principle, with layout different slightly;
    - Failed product and ESD tests all found gate-source breakdown and metallized fusion, but no capacitor breakdown.



CEPREI 23

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Microwave Device and Circuit ESD Damage Case Analysis

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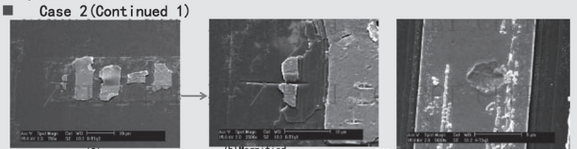
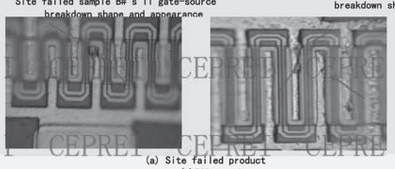
2. Microwave Device and Circuit ESD Damage Case

■ Case 2(Continued 1)



(a) Site failed sample B#'s T1 gate-source breakdown shape and appearance

(b) Magnified ESD failure sample B#'s T1 gate-source breakdown shape and appearance



(a) Site failed product (b) ESD sample source-drain metallized fusion

CEPREI 24

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2. Microwave Device and Circuit ESD Damage Case

■ Case 3
- Sample and failure background
  - Model PD09-12 two-way microwave power divider was used by the entruster in a monolithic processor. Under normal temperature, fault occurred upon power on for test of the assembled board, presenting super-high PD09-12 insertion loss, which should be 3.5dB under normal situations, but the failed product had roughly-measured insertion loss of 12~15dB. Of the 300 pieces of monolithic processors, 33 reported PD09-12 fault, making a failure proportion of 11%.
- Parameter test
  - Multiple prongs had short circuit
- ESD test
  - 250V-300V, belonging to a device very sensitive to static electricity

CEPREI 25

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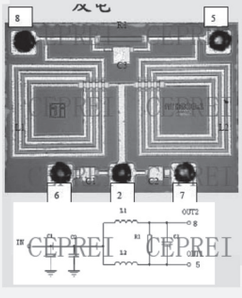
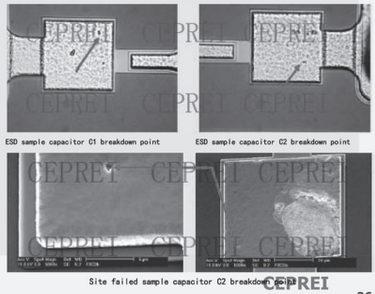
2. Microwave Device and Circuit ESD Damage Case

Case 3(Continued 1)
- Microscopic examination and analysis: all failed samples and ESD samples had capacitor breakdown and XXXXX





ESD sample capacitor C1 breakdown point ESD sample capacitor C2 breakdown point

Site failed sample capacitor C2 breakdown point

CEPREI 26

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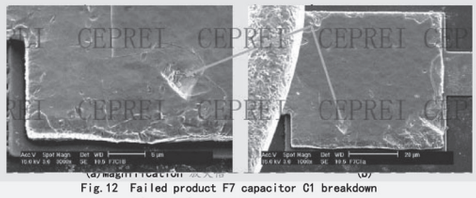
2. Microwave Device and Circuit ESD Damage Case

■ Case 3(Continued 2)
- Conclusion:
  - Main reason for PD09-12two-way microwave power divider failure: electrostatic discharge occurred between the device's radiofrequency input port and grounding port, causing short circuit and radiofrequency function failure due to the device port's direct-to-ground capacitor breakdown.



(a) Magnification (b)

Fig.12 Failed product F7 capacitor C1 breakdown shape and appearance

CEPREI 27

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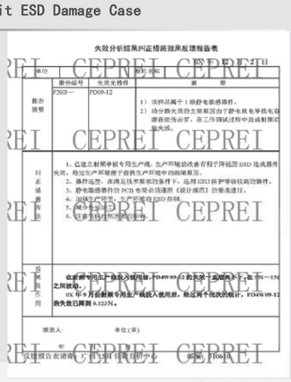
2. Microwave Device and Circuit ESD Damage Case

■ Case 3(Continued)
- Improvement feedback (failure analysis result and remedy effect feedback report)
- (1)Report summary
  - 1)The sample is a Level 1 element for electrostatic sensitivity.
  - 2)Main reason for power divider failure is potential damage and breakdown of capacitor due to electrostatic discharge, causing radiofrequency function failure in adjustment.



CEPREI 28

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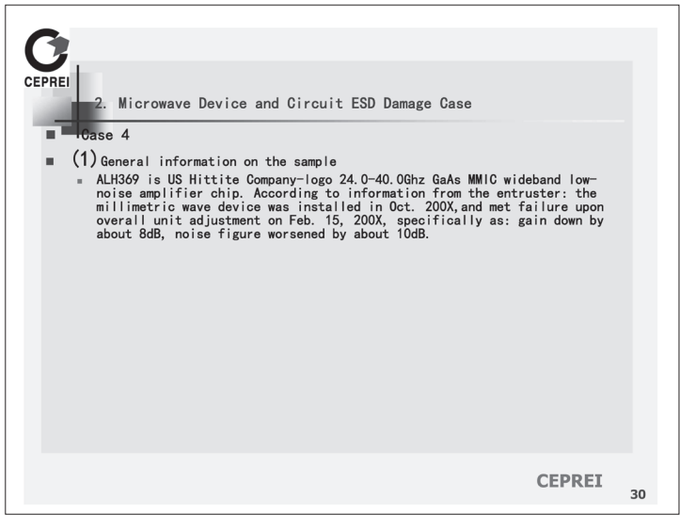
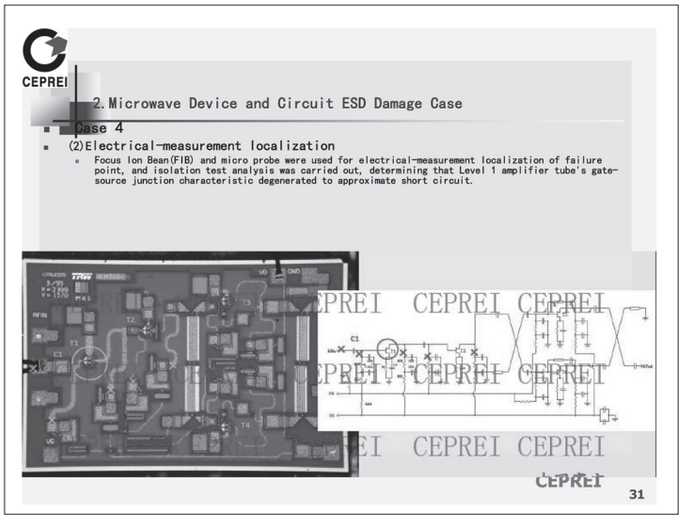
2. Microwave Device and Circuit ESD Damage Case

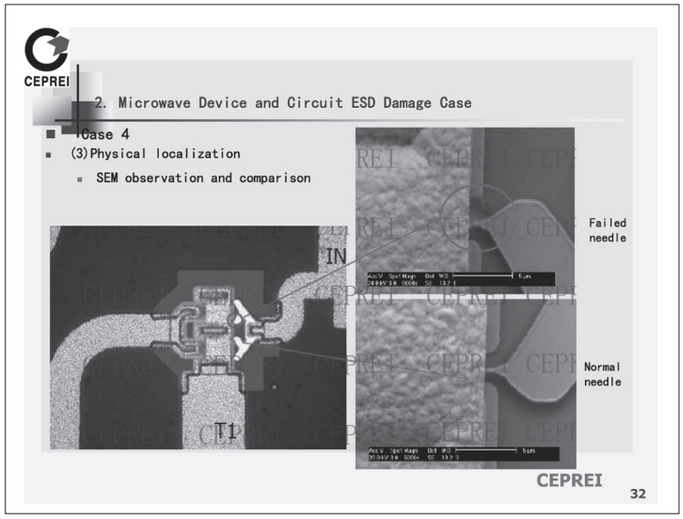
■ Case 3(Continued)-improvement feedback
- (2) Improvement measures
  - 1)Special radiofrequency monolithic processor production line has been established. Improved production environment is beneficial to reducing ESD-caused device failure, and stable production environment is convenient for troubleshooting in the environment.
  - 2)Device model, on the premise of meeting technical requirements, should be that with higher ESD protection level.
  - 3)PCB layout of element for electrostatic sensitivity must be in line with requirements of the Design Specifications.
  - 4)Enhancing ESD control in production links and environment.
  - 5)Reducing outsourcing.
  - 6)Paying attention to influence of climate and other natural factors.
- 3)Effect and action
  - Before the special radiofrequency production line was used, PD4W09-12's failure remained at high level, varying between 9% and 1%.
  - After the special radiofrequency production line was put into use in Sept.04, PD4W09-12's failure has decreased to 0.123% according to 2-batch statistics.

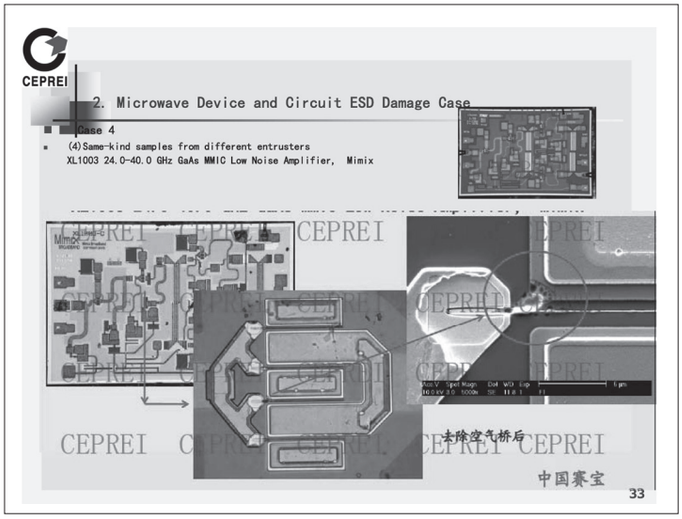
CEPREI 29

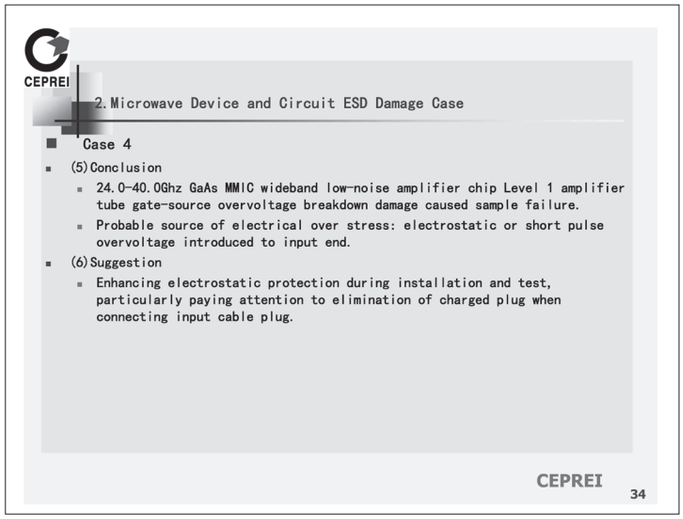
AA2 微波器件和电路ESD损伤案例分析
Microwave Device and Circuit ESD Damage Case Analysis

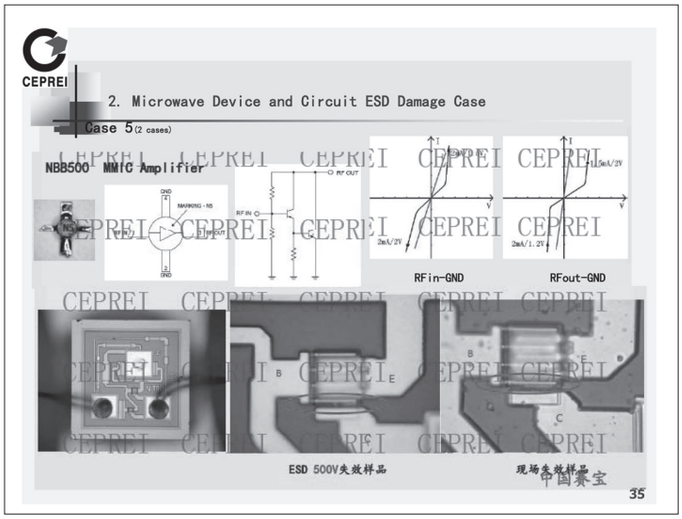












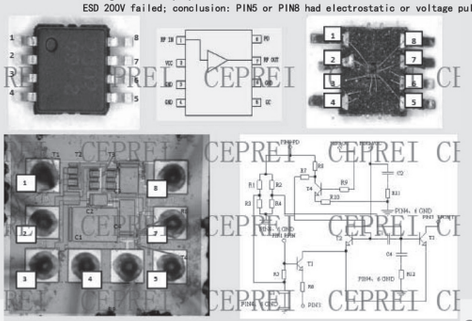
AA2 微波器件和电路ESD损伤案例分析
Microwave Device and Circuit ESD Damage Case Analysis

CEPREI

2. Microwave Device and Circuit ESD Damage Case

Case 6

Of the 50 RF2302 wideband linear variable gain amplifiers installed for use, 4 failed, making a failure proportion of about 8%.
ESD 200V failed; conclusion: PIN5 or PIN8 had electrostatic or voltage pulse introduced.



CEPREI 36

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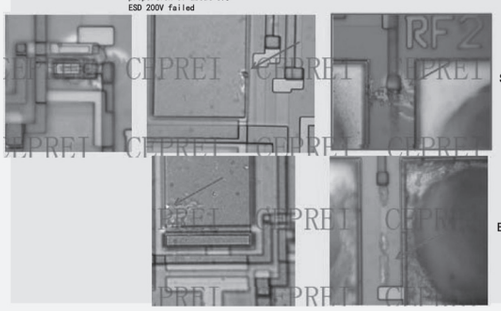
2. Microwave Device and Circuit ESD Damage Case

Case 6

Of the 50 RF2302 wideband linear variable gain amplifiers installed for use, 4 failed, making a failure proportion of about 8%
ESD 200V failed



CEPREI 37

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3. Brief Summary of ESD Damage Case Analysis

- 3.1 Main procedures for ESD failure analysis
- 3.2 Common analysis equipment

CEPREI 38

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3.1 Main Procedures for ESD Failure Analysis

- (1)Understanding failure background information
  - For example: failure discovering link, previous process, whether failure is in manner of batch? failure proportion? seasonal or not?
- (2)Failed sample data collection and understanding
  - Product specifications(data sheet), ESD sensitivity level, requirements for circuit application, etc;
- (3)Failed sample, failure mode confirmation, failure lead localization
  - Function test, radiofrequency test, DC characteristic test, I-V characteristics test ;
  - Comparison is very important!

CEPREI 39

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3.1 Main Procedures for ESD Failure Analysis

- (4)Analysis of microscopic examination after breaking the seal
  - Some damage points can be observed directly;
  - Some can be observed after surface delayering;
  - Some complicated circuits need electrical-measurement localization and analysis before specific observation
- (5)Qualified products ESD analogue validation
  - Carrying out corresponding lead ESD test to confirm sensitivity;
  - Breaking the seal of ESD failed sample for microscopic examination, comparing it with site failed sample
- (6)Making comprehensive analysis, drawing conclusions

CEPREI 40

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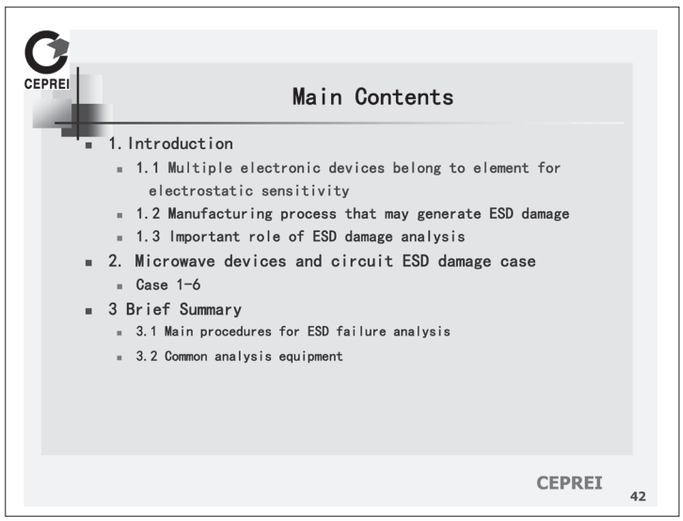
3.2 Common Analysis Equipment

- (1)Electric test equipment
  - Including DC and microwave test equipment, and test board or test fixture making, micro probe table, etc
- (2)ESD test equipment
  - For ESD analogue validation test of qualified products (and for I-V characteristics test)
- (3)Microscopic observation equipment
  - Optical microscope
  - Scanning electron microscope(SEM)
  - Photo-Emission Electron Microscope(PEM)
- (4)Sample making equipment
  - Delayering analysis: chemical corrosion, plasma etching, etc
  - Microscopic isolation and sample making: focus ion bean(FIB)

CEPREI 41

AA2 微波器件和电路ESD损伤案例分析
Microwave Device and Circuit ESD Damage Case Analysis



B1 美国异常敏感设备的静电放电控制技术
ESD Control Techniques for Very Sensitive Devices in the US

第三届静电防护与标准化年会

美国异常敏感设备的静电放电控制技术

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大纲

1. “异常敏感”是什么意思？—阈值和分类
2. 基本考虑
   a. 高级控制基本原理
   b. 高级测量技术
   c. 高级应对措施
   d. 标准控制技术限制
   e. 增强审计
3. 结论

p2

*静电放电元件充电模式分类

类别	电压范围 (V)
0B	125 至 < 250
1A	250 至 < 500
1B	500 至 < 1000
1C	≥1000

*JEDEC JESD22 – C101

0A类 = 异常敏感

0A类设备特点（以下一种或多种）

- 通常非常有限的或者没有内置静电放电防护设备
- 人体放电模式或元件充电模式承受阈值**< 125V**
- 介电击穿可能是一个问题
- 在采用所有传统静电放电控制技术后，静电放电问题仍然存在。

p4

0A类静电放电控制基本原理

- **SME (**行业专家**)**
- 定制要求
- 强化训练
- 静电耗散材料（软着陆）
- 软着陆不可能时所采取的电压测量和控制
- 恒定显示器和金属腕带

p5

0A类静电放电控制基本原理

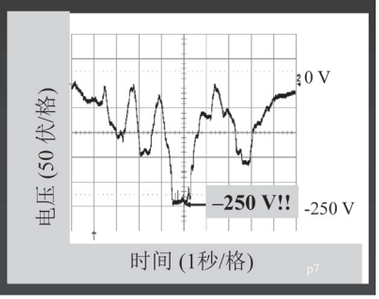
- 高级测量
  - 事件检测
  - 接触电压
  - 放电电流
  - 表面电阻
- 最大电场下限
- 更严格的离子发生器平衡要求
- 最重要时刻的消磨时间
  - 注意细节
  - 注重设备以及触控设备的工具
  - 其次是控制周围环境
- 每天进行严格的符合性认证是非常重要的。

p6

B1 美国异常敏感设备的静电放电控制技术
ESD Control Techniques for Very Sensitive Devices in the US

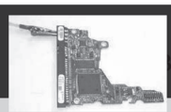
浮线电缆放电事件（CDE）的摩擦充电

光手搓塑料线涂层会导致线上产生－250伏以上的电压。
这是由于Q和C是不断变化的。

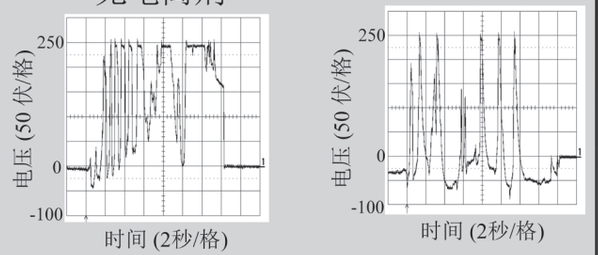


p7

PCB （印刷电路板）+ 腈手套



穿戴手套来处理浮式PCB



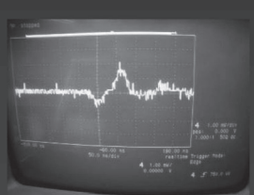
- 电离剂打开：峰值电压仍为250伏
- 不要依赖于0A类设备的电离剂！

p8

丝线电流探针测量

丝线尖端的CT-6

连续接触



WB #1 楔形测量
最大电流: 0.3微安
水平: 50毫微秒/格
垂直: 1毫伏/div
触发: 750微伏

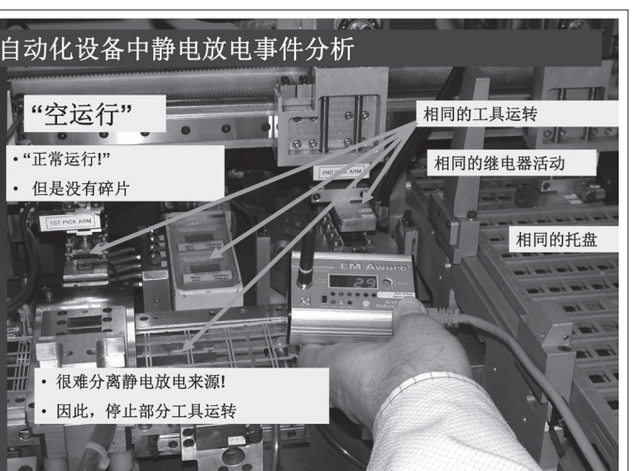
p9

静电放电事件检测优异连续测量

- 所依据的原理为每一个静电放电事件都会产生射频讯号。
- 用于审计/监测、故障排除和工艺鉴定的非接触法。
- 通常采用户外设施远程实施非侵入测量。
- 有可能确定时间、强度和地点。

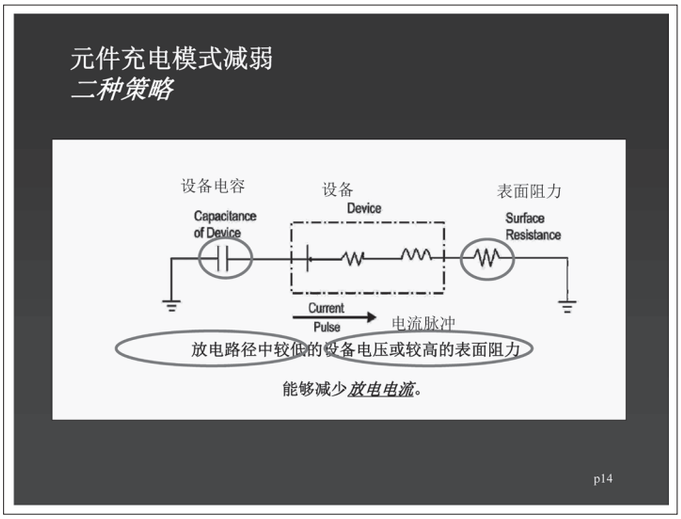
p10

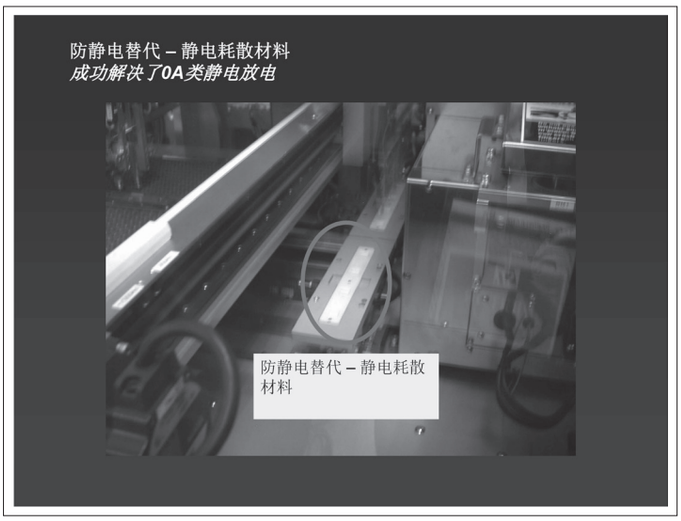
自动化设备中静电放电事件分析

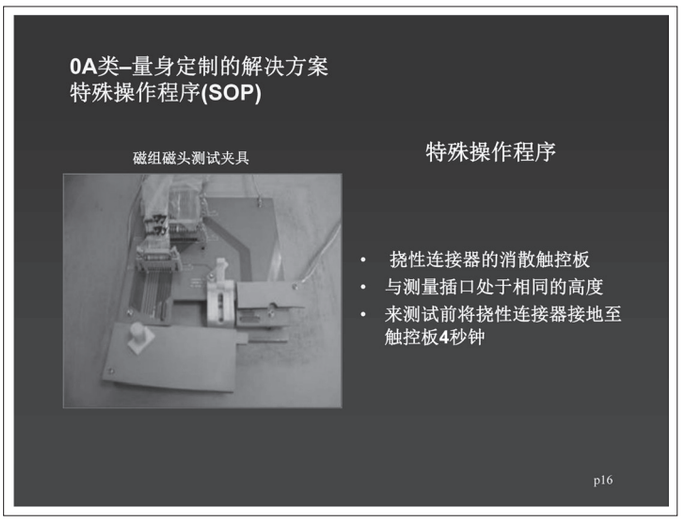


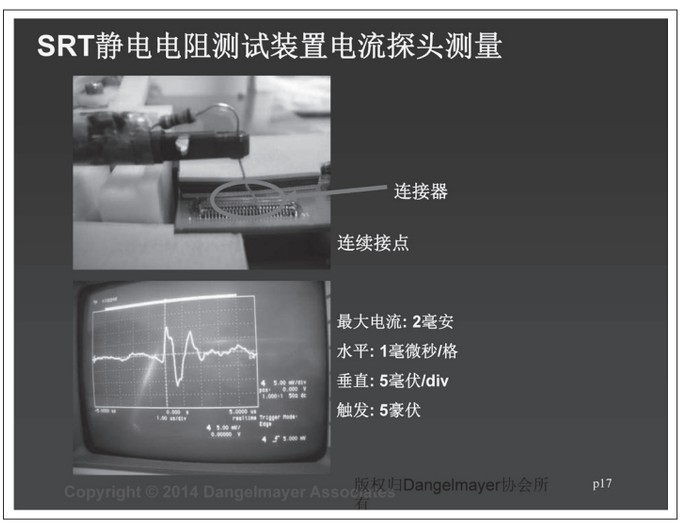
设备上200伏电压
以事件检测来估风险

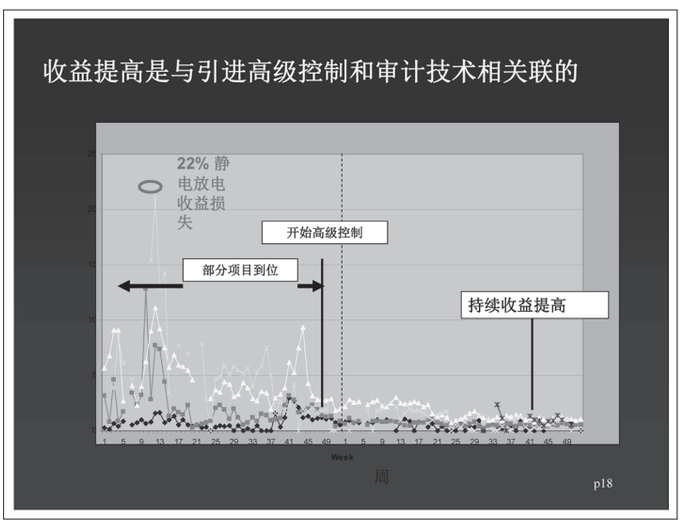
B1 美国异常敏感设备的静电放电控制技术
ESD Control Techniques for Very Sensitive Devices in the US











B1 美国异常敏感设备的静电放电控制技术
ESD Control Techniques for Very Sensitive Devices in the US

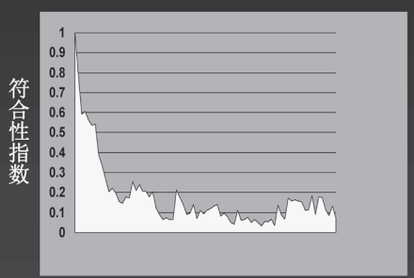
符合性验证
四个管理层次

1. 年度技术评估
   - 第三方审计
   - 基准
2. 质量保证内部审计
   - 定期审计(由公司确定)
   - **TR53** 符合性验证*
   - 材料和过程的直观验证
   - 项目管理验证
   - 质量责任
3. 统计过程控制
   - 基础统计过程控制
   - 日常工艺验证
   - 有利于所有**0**类敏感性装置
   - 是**0A**类和**000**类所需要的
4. 员工自检

注意：只有带* 的项目需要**S20.20**符合性验证

p19

质量保证内部审计
改善追踪度量事例
93%符合性改善



p20

0A类的其他关键问题：

- 需要设备信息(特别是行业内极缺乏的元件充电模式)
- 有关新产品引入的预先获得信息
- 更严格的工艺分析
- 了解控制策略的限制(比如电离)

新的控制技术并不是解决对策：需要更多地关注细节、更好的测量、更严格的要求以及严谨的符合性

p21

问题

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3rd Annual Conference on Electrostatic Protection and Standardization

ESD Control Techniques for Very Sensitive Devices in the US

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Outline

1. What is “very sensitive”? – Thresholds and Classifications
2. Basic considerations
   a. Advanced Control Fundamentals
   b. Advanced measurement techniques
   c. Advanced countermeasures
   d. Limits of Standard Control Techniques
   e. Enhanced Auditing
3. Conclusions

p2

B1 美国异常敏感设备的静电放电控制技术
ESD Control Techniques for Very Sensitive Devices in the US

ESD CDM Classification*

Class	Voltage Range (V)
1A	250 to < 500
1B	500 to < 1000
1C	≥1000

*JEDEC JESD22 – C101

Class 0A = Very Sensitive

Class 0A Devices Characteristics
(One Or More Of The Following)

- Often Very Limited or No Built-in ESD Protection Device
- HBM or CDM Withstand Threshold < 125V
- Dielectric Breakdown Can be an Issue
- ESD Problems Persist After Applying All Traditional ESD Control Measures

p4

Class 0A ESD Control Fundamentals

- SME (Subject Matter Expert)
- Customized Requirements
- Enhanced Training
- Dissipative Materials (soft landings)
- Voltage measurement and control where soft landing not possible
- Constant Monitors & Metal Wrist Bands

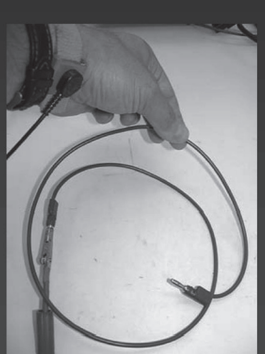
p5

Class 0A ESD Control Fundamentals

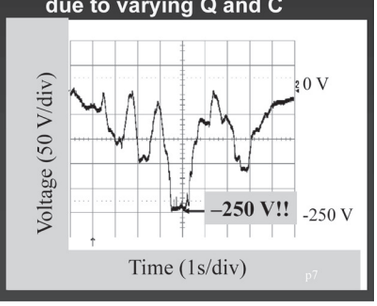
- Advanced measurements
  - Event detection
  - Contact voltage
  - Discharge current
  - Surface Resistance
- Lower Maximum Electric Field Limits
- More Stringent Ionizer Balance Requirements
- Spend Time Where It Counts Most
  - Pay Attention to Details
  - Focus On Device And Tools That Touch Devices
  - Control Of Surrounding Environment Is Secondary
- Robust Daily Compliance Verification is Critically Important

p6

Tribocharging Of A Floating Wire Cable Discharge Event (CDE)

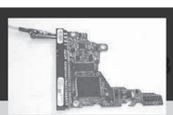


Plastic wire coating rubbed by bare, grounded fingers results in over –250 V on wire!
due to varying Q and C

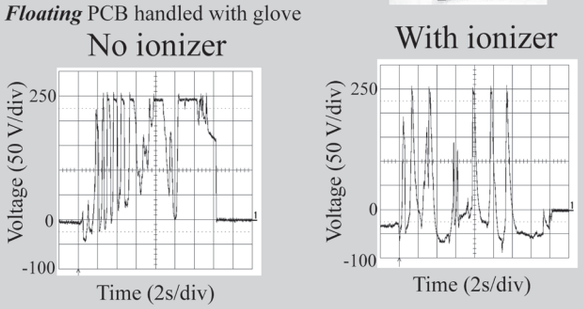


p7

PCB + Nitrile Glove



Floating PCB handled with glove



•Ionizer ON: Peak voltage still 250V!
•Don't depend on ionizers for Class 0A devices!

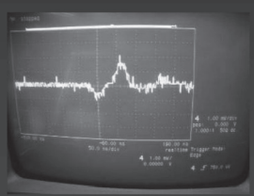
p8

B1 美国异常敏感设备的静电放电控制技术
ESD Control Techniques for Very Sensitive Devices in the US

Wire Bond Current Probe Measurement

CT-6 on Wire Bond Tip

Continuous Contact



WB #1 Wedge Measurement
Maximum Current: 0.3ma
Horizontal: 50ns/div
Vertical: 1mv/div
Trigger: 750uv

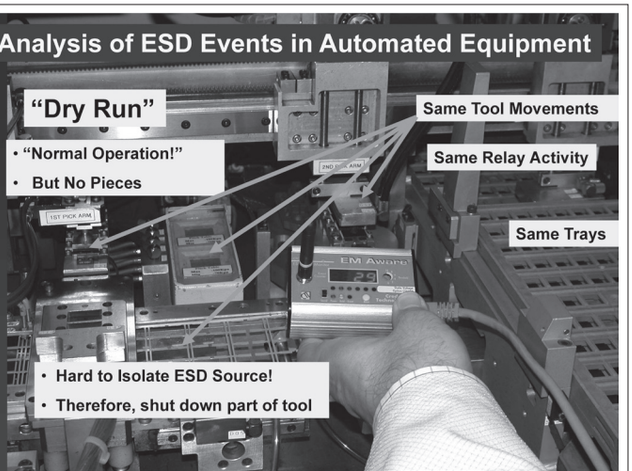
p9

ESD Event Detection
Excellent Continuous Measurement

- Based On Principle That Every ESD Event Produces An RF Signal
- Non-contact Method For Audit/Surveillance, Troubleshooting And Process Qualification
- Non-invasive Measurement Can Be Done Remotely Often Outside Equipment
- Possible To Determine Time, Strength And Location

p10

Analysis of ESD Events in Automated Equipment



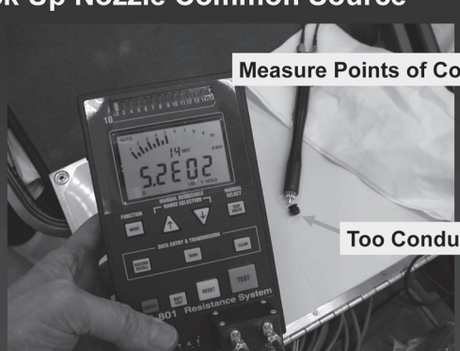
"Dry Run"
- "Normal Operation!"
- But No Pieces

Same Tool Movements
Same Relay Activity
Same Trays

- Hard to Isolate ESD Source!
- Therefore, shut down part of tool

200 Volts on Device
Evaluate Risk With Event Detection

SMT ESD Events
Pick Up Nozzle Common Source

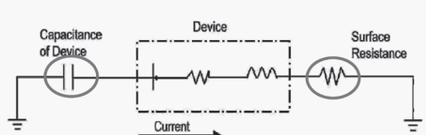


Measure Points of Contact

Too Conductive!

p13

CDM Mitigation
Two Strategies

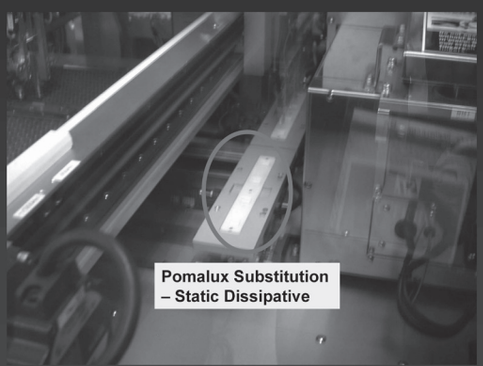


Lower device voltage or higher surface resistance in the discharge path can ***reduce discharge current***.

p14

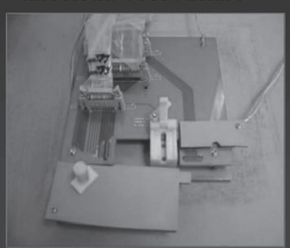
B1 美国异常敏感设备的静电放电控制技术
ESD Control Techniques for Very Sensitive Devices in the US

Pomalux Substitution – Static Dissipative
Successful Solution for Class 0A



Class 0A – Customized Solution
Special Operating Procedure (SOP)

MR Head Test Fixture

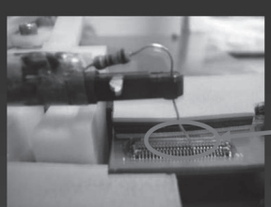


SOP

- Dissipative Touch Pad For Flex Connector
- At Same Elevation As Test Socket
- Ground Flex Connector To Touch Pad For 4 Sec. Prior To Test

p16

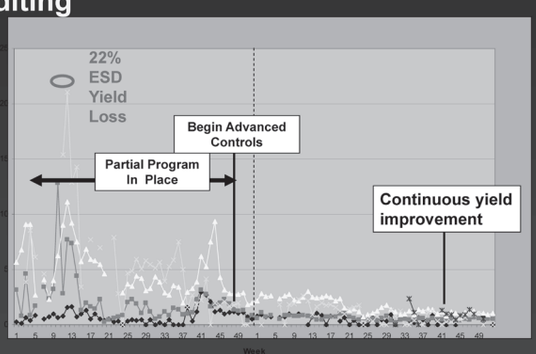
SRT Test Set Current Probe Measurement



Maximum current: 2mA
Horizontal: 1us/div
Vertical: 5mV/div
Trigger: 5mV

p17

Yield Improvements Correlate With Introduction of Advanced Controls and Auditing



p18

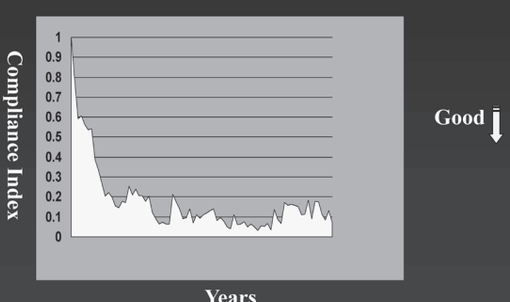
Compliance Verification
Four Administrative Levels

1. Annual Technical Assessment
   - 3rd Party Audit
   - Benchmarking
2. QA Internal Audit
   - Periodic (determined by company)
   - TR53 Compliance Verification*
   - Visual Verification of Materials and Procedure
   - Program Administration Verification
   - Quality Responsibility
3. Statistical Process Control
   - Rudimentary SPC
   - Daily Process Verification
   - Beneficial For All Class 0 Sensitivities
   - Required for Class 0A & 000
4. Employee Self-Checks

Note: * Only Item required for S20.20 Compliance Verification

p19

QA Internal Audit
Improvement Tracking Metric Example
93% Compliance Improvement



p20

B1 美国异常敏感设备的静电放电控制技术
ESD Control Techniques for Very Sensitive Devices in the US

Additional Critical Issues for Class 0A:

- Need for Device Information (especially CDM which is sorely lacking in industry)
- Advance information on New Product Introduction
- More rigorous process analysis
- Understand limits of control strategies (e.g., ionization)

New Control Technologies are not the answer: Need more attention to detail, better measurement, more stringent requirements, rigorous compliance

p21

Questions

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B2 环境湿度对防静电产品静电性能的影响
Influence of Environmental Humidity on Anti-static Property of Anti-static Products

HI-CLEAN 佰洁静电检测技术中心 Hi-Clean Static Test Technology Center

上海防静电工业协会唯一指定检测机构
ESD防护体系咨询、辅导、检测、培训

环境湿度对防静电产品静电性能的影响

ESD ONLINE 防静电在线
防静电在线QQ群： 282987584
技术支持热线电话： 400-820-8910

HI-CLEAN 佰洁静电检测技术中心 Hi-Clean Static Test Technology Center

索引

- 湿度与静电的关系
- 产品的防静电性能及实现方式
- 各类防静电产品在不同湿度条件下的表现
- 湿度因素可能引发的静电问题
- 如何应对环境湿度对防静电性能的影响

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湿度与静电的关系

- 有关湿度的概念
  - 相对湿度（单位：%RH）
    - JJF 1012：湿气中水蒸气的摩尔分数与相同温度和压力条件下饱和水蒸气的摩尔分数之百分比，或者湿气中水蒸气的分压值与相同温度下饱和水蒸气压的比值
    - 不同温度的空气对于水分的容纳程度不同
    - 相同温度下，相对湿度高的环境，空气中水分的饱和度越高
  - 我国不同季节不同地域的相对湿度
    - 南方（润湿）＞北方（干燥）、夏季（潮湿）＞冬季（干燥）

2013年7月1日			2014年1月1日		
北京	上海	广州	北京	上海	广州
86%RH	75%RH	81%RH	19%RH	40%RH	51%RH

■以上气象数据来自网络

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湿度与静电的关系

- 生活当中的静电现象

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湿度与静电的关系

- 湿度影响静电产生的机理
  - 材料能通过吸湿来降低表面电阻率
  - 材料表面因吸湿而形成的“水膜”有一定的润滑作用
- 较高的相对湿度能够显著降低静电的产生

人的活动	可产生的静电电压（V）	
	湿度10~20%RH	湿度65~90%RH
在地毯上走动	35,000	1,500
在聚乙烯地板上走动	12,000	250
在工作台上工作	6,000	100
拿聚乙烯纤维包	7,000	600
从工作台拿起普通塑料袋	20,000	1,200
坐在填有聚氟脂的椅子上	18,000	1,500

■摘自：IEST-RP-CC022.2 洁净室及相关受控环境的静电电荷

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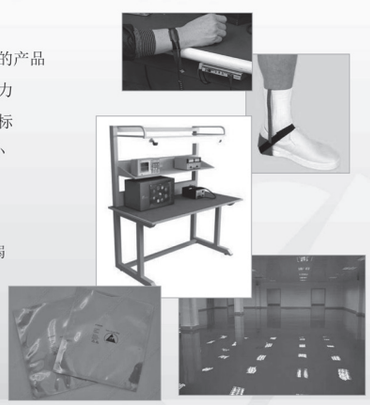
产品的防静电性能及其实现方式

- 产品的防静电性能
  - 用于避免或减少静电问题的产品
  - 对静电的控制（减少）能力
  - 衡量产品防静电性能的指标
    - 产品本身产生静电的大小
      - 静电电荷量
      - 静电电位
      - 静电场强
    - 产品耗散静电能力的强弱
      - 各类电阻
      - 静电衰减时间

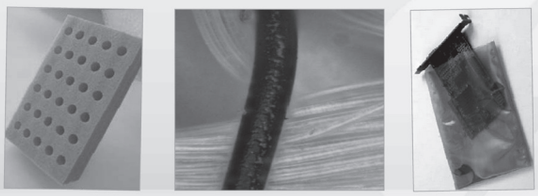


B2 环境湿度对防静电产品静电性能的影响
Influence of Environmental Humidity on Anti-static Property of Anti-static Products

HI-CLEAN 佰洁静电检测技术中心 Hi-Clean Static Test Technology Center

产品的防静电性能及其实现方式

- 产品防静电性能的实现方式
  - 使用可以导静电或静电耗散材料
  - 降低高分子材料表面的绝缘性
    - 使用亲水性抗静电剂对材料表面或材料本身进行处理（湿度依赖型）
    - 使用导电物质对材料进行填充或涂布（永久型）
    - 使用本征导电材料代替传统的高分子绝缘材料（永久型）



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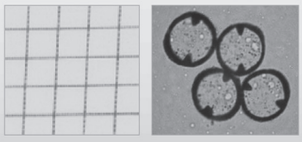
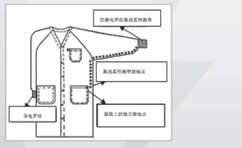
不同湿度下的产品防静电性能

- 永久型防静电织物
  - 主要用于制作防静电服装
    - 减少人员与服装摩擦产生的静电
    - 充当人员接地的通路或补充
  - 应用场所广泛
  - 原理及构造
    - 嵌织防静电纤维





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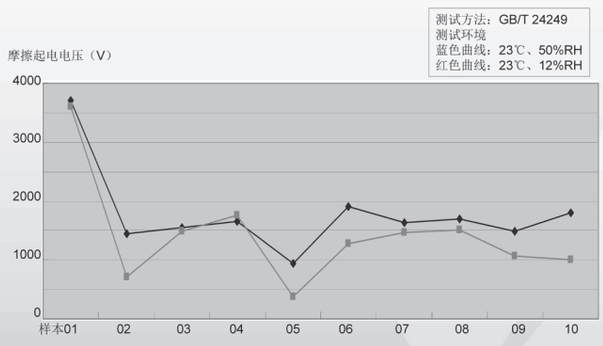
不同湿度下的产品防静电性能

- 永久性防静电织物起电电压在不同湿度下的表现



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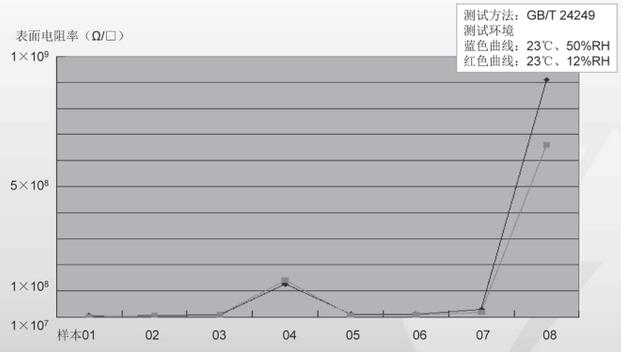
不同湿度下的产品防静电性能

- 永久性防静电织物表面电阻率在不同湿度下的表现



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不同湿度下的产品防静电性能

- 薄膜状材料静电衰减时间在不同湿度下的表现

测试方法：MIL-STD-3010B、MIL-PRF-81705D　　单位：秒（衰减到起始电压的10%）

测试环境		23℃/50%RH		23℃/12%RH	
起始电压		+ 5 kV	- 5 kV	+ 5 kV	- 5 kV
样本规格	防静电TC面料	0.19	0.20	7.99	7.26
	普通涤纶面料	60.20	78.12	无法加至要求的起始电压	
	尼丝纺（助剂）	0.03	0.01	0.48	0.41
	防静电Polo衫（条）	0.03	0.01	0.04	0.01
	防静电菱形针织面料	0.03	0.01	0.03	0.01
	防静电Polo衫（格）	0.03	0.01	0.03	0.02
	5mm格状导电绸	0.03	＜0.01	0.02	0.01
	屏蔽膜	0.03	0.01	0.04	0.02
	三层防潮膜	0.03	0.01	0.04	0.01
	四层防潮膜	0.02	0.01	0.03	0.02
	非织造布1#（薄）	2.98	2.88	50.66	68.77
	非织造布2#（厚）	0.08	0.04	0.55	0.46

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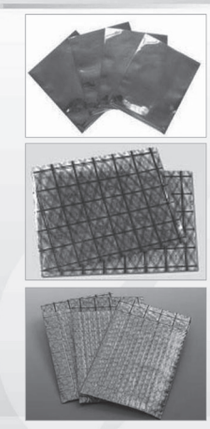
不同湿度下的产品防静电性能

- 防静电包装袋
  - 主要用于ESDS元器件移动中的防护
    - EPA内低起电、静电耗散
    - EPA外低起电、静电耗散、静电屏蔽
  - 完整ESD防护体系中的必须要素
  - 分类
    - 按结构
      - 单层、双层、多层、气泡垫膜
    - 按材料
      - PE袋、铝箔袋、网格袋
    - 按作用机理
      - 表面涂覆亲水性材料
      - 本征导电材料



B2 环境湿度对防静电产品静电性能的影响
Influence of Environmental Humidity on Anti-static Property of Anti-static Products

HI-CLEAN 佑洁静电检测技术中心 Hi-Clean Static Test Technology Center

不同湿度下的产品防静电性能

- 各类型包装材料表面电阻率在不同相对湿度下的表现

测试方法：ANSI/ESD STM11.1、ANSI/ESD STM11.2　　单位：Ω

样本规格	表面电阻		体积电阻	
	23℃/50%RH	23℃/12%RH	23℃/50%RH	23℃/12%RH
防静电防锈材料	3.0×10^{5}	2.0×10^{5}	1.5×10^{8}	2.9×10^{10}
永久性防静电IC保护带	4.8×10^{8}	3.7×10^{9}	1.5×10^{8}	6.9×10^{8}
普通防静电屏蔽袋	4.6×10^{9}	1.7×10^{10}	1.1×10^{10}	2.7×10^{11}
永久性防静电屏蔽袋	8.5×10^{8}	3.6×10^{9}	1.4×10^{10}	5.9×10^{10}
普通防静电PE袋	1.3×10^{10}	2.2×10^{11}	9.2×10^{10}	1.4×10^{12}
永久性防静电PE袋（单面防静电）	7.2×10^{8}	3.7×10^{9}	3.2×10^{11}	3.1×10^{12}

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不同湿度下的产品防静电性能

- 防静电鞋及人/鞋/地系统
  - 人员接地的重要途径和补充
  - 类型多样
  - ANSI/ESD S20.20中的变化

Flooring / Footwear System – Method 1	ANSI/ESD STM97.1	< 3.5×10^{7} ohms
Flooring / Footwear System – Method 2 (both required)	ANSI/ESD STM97.1	< 10^{9} ohms
	ANSI/ESD STM97.2	< 100 volts
Footwear / Flooring System[5] – (Both limits must be met)	ANSI/ESD STM97.1	< 1.0×10^{9} ohms
	ANSI/ESD STM97.2	< 100 volts Peak



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不同湿度下的产品防静电性能

- 防静电鞋在不同湿度条件下的表现

测试方法：ANSI/ESD STM9.1　　单位：Ω

样本规格	PVC底防静电鞋	PU底防静电鞋	灰色导电鞋
23℃ 50%RH	4.1×10^{7}	1.2×10^{7}	7.8×10^{5}
23℃ 12%RH	1.2×10^{8}	7.3×10^{7}	2.4×10^{6}

- 人/鞋/地系统在不同湿度条件下的表现

测试方法：ANSI/ESD STM97.1、ANSI/ESD STM97.2

样本	组合1		组合2		组合3		组合4	
项目	电阻Ω	电压V	电阻Ω	电压V	电阻Ω	电压V	电阻Ω	电压V
23℃ 50%RH	$4.9\times10_{7}$	-14~69	$5.9\times10_{7}$	2~95	$9.6\times10_{7}$	-11~45	$1.6\times10_{7}$	-2~84
23℃ 12%RH	$4.9\times10_{8}$	-19~112	$7.4\times10_{8}$	-31~190	$5.2\times10_{8}$	-32~142	$6.9\times10_{8}$	-4~177

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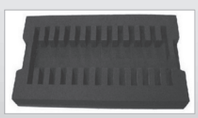
湿度因素可能带来的静电问题

- 不同地域的环境湿度可能改变产品的防静电性能
  - 案例介绍
    - **事件描述**：某深圳电子企业代加工一种ESDS器件，使用在国内经过验证的防静电泡棉进行保装保护，并发往位于北欧的用户，客户收到后反应ESD失效情况非常严重
    - **测量结果**：经测试，该泡绵在50%RH湿度时电阻为20GΩ，而在12%RH湿度时电阻为500GΩ
    - **原因分析**：该包装材料在天气潮湿的深圳使用时，表面电阻＜10^{11}Ω，符合有关要求，而发往北欧后，由于北欧的湿度较低，表面电阻显著增加，在12%RH时已经超过限值，因此无法为产品提供有效防护

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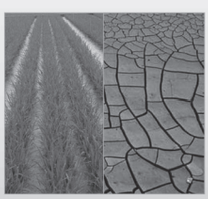
湿度因素可能带来的静电问题

- 不同季节的湿度环境可能改变产品的防静电性能
  - 防静电工作台电阻随季节变化的问题
    - 湿度依赖型工作表面在不同季节有明显差异
  - 干燥季节无法通过防静电门禁的问题
    - 季节干燥引起人体皮肤、服装、鞋子的变化

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- 总结与讨论-应对环境湿度对防静电性能的影响
  - 环境湿度对产品防静电性能有重大影响
  - 湿度依赖型的静电防护可能存在一定静电风险
  - 本征导电材料对于湿度的依赖性相对较弱
  - 产品防静电性能测试时因考虑低湿度条件
  - 离子化系统有辅助的防静电作用

ESD 在线 防静电在线　防静电在线QQ群：282987584　技术支持热线电话：400-820-8910

B2 环境湿度对防静电产品静电性能的影响
Influence of Environmental Humidity on Anti-static Property of Anti-static Products

HI-CLEAN 佰洁静电检测技术中心 Hi-Clean Static Test Technology Center

The only testing organization designated by Shanghai Electrostatic Protective Industrial Association
ESD protective system consulting, coaching, testing and training

Influence of Environmental Humidity on Anti-static Property of Anti-static Products

ESD ONLINE 防静电在线
Anti-static online QQ 282987584
Technical support hotline : 400-820-8910

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Index

- The relationship between humidity and electrostatic
- Anti-static performance and realization methods of product
- The performance of all kinds of anti electrostatic products in different humidity conditions
- Possible electrostatic problems due to humidity factors
- How to respond to the influence of environmental humidity on the anti-static performance

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The relationship between humidity and electrostatic

- Concepts related to humidity
  - Relative humidity (unit: %RH)
    - JJF 1012: percentage of the mole fraction of the water vapor in the moisture to that of the saturated water vapor under the same temperature and pressure conditions, or the ratio of the partial pressure value of the water vapor in the moisture to that of the saturated water vapor under the same temperature condition
    - Different moisture accomodation degree by the air of different temperature
    - At the same temperature, the higher the relative humidity in the environment, the higher the degree of saturation in the air
  - Relative humidity in different seasons in different regions of China
    - South (wet) > north (dry), summer (humid) > winter (dry)

July 1, 2013			Jan 1, 2014		
Beijing	Shanghai	Guangzhou	Beijing	Shanghai	Guangzhou
86%RH	75%RH	81%RH	19%RH	40%RH	51%RH

■Above meteorological data is from the network

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The relationship between humidity and electrostatic

- Electrostatic phenomena in life

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The relationship between humidity and electrostatic

- The mechanism of humidity affecting generation of electrostatic
  - The surface resistivity of materials can be reduced through moisture absorption
  - The surface of materials has a certain lubricating effect due to the 'water film' formed by moisture absorption
- A higher relative humidity can significantly reduce the generation of static electricity

Human activities	Electrostatic voltage can be generated (V)	
	Humidity 10~20%RH	Humidity 65~90%RH
Walking on the carpet	35,000	1,500
Walking on the polyethylene floor	12,000	250
Working on the workbench	6,000	100
Taking polyethylene fiber bag	7,000	600
Picking up an ordinary plastic bag from the workbench	20,000	1,200
Sitting on the chair filled with olyvinyl fluoride resin	18,000	1,500

■Extracted from: IEST-RP-CC022.2 Electrostatic Charge in Cleanroom and Associated Controlled Environments

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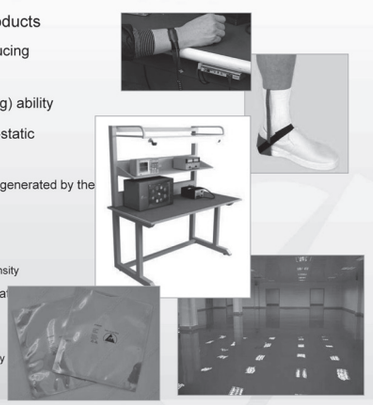
Anti-static performance and realization methods of product

- Anti-static performance of products
  - Products for avoiding or reducing electrostatic problems
  - Electrostatic control (reducing) ability
  - Indicators measuring anti-static performance of products
    - The size of static electricity generated by the product itself
      - Electrostatic charge
      - Electrostatic potential
      - Static electricity field intensity
    - The strength of static dissipa products
      - All kinds of resistance
      - Electrostatic charge decay



B2 环境湿度对防静电产品静电性能的影响
Influence of Environmental Humidity on Anti-static Property of Anti-static Products

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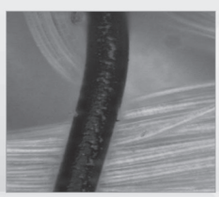
Anti-static performance and realization methods of product

- Realization methods of anti-static performance of products
  - Use static conductive or static dissipative materials
  - Reduce the insulativity on the surface of polymer materials
    - Use hydrophilic anstatic agent to treat the material surface or material itself (humidity dependent type)
    - Fill or coat the material with an electrically conductive substance (permanent type)
    - Use intrinsic conduction material to substitute traditional insulating polymeric materials (permanent type)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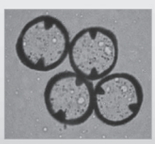
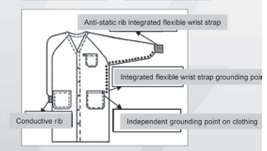
The performance of anti-electrostatic products in different humidity conditions

- Permanent antistatic fabric
  - Mainly for the production of anti-static clothing
    - Reduce electrostatic generated by friction betweeen personnel and clothing
    - Act as a pathway or supplement of personnel grounding
  - A wide range of application areas
  - Principle and structure
    - Insertion weaving of antistatic fiber



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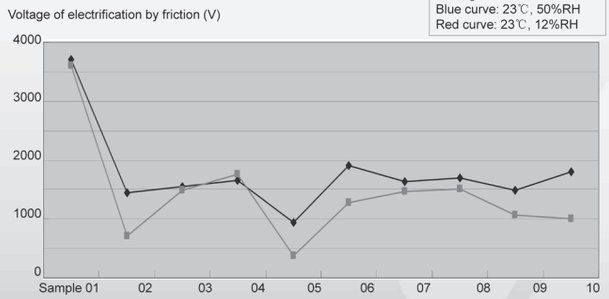
The performance of anti-electrostatic products in different humidity conditions

- Performance of electrification voltage of permanent anti-static fabric under different humidity

Testing method: GB/T 24249
Testing environment
Blue curve: 23℃, 50%RH
Red curve: 23℃, 12%RH

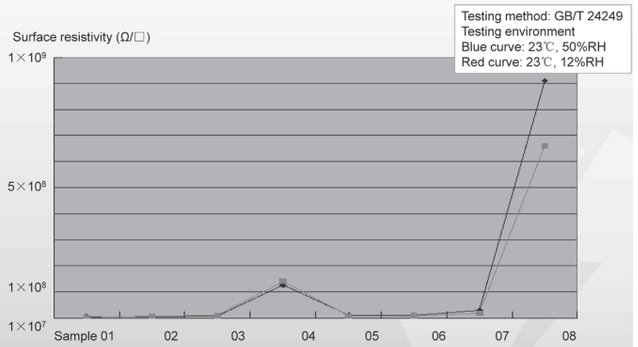


HI-CLEAN 佰洁静电检测技术中心 Hi-Clean Static Test Technology Center

The performance of anti-electrostatic products in different humidity conditions

- Performance of surface resistivity of permanent anti-static fabric under different humidity

Testing method: GB/T 24249
Testing environment
Blue curve: 23℃, 50%RH
Red curve: 23℃, 12%RH



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The performance of anti-electrostatic products in different humidity conditions

- Performance of electrostatic charge decay time of film-like materials under different humidity

Testing method: MIL-STD-3010B, MIL-PRF-81705D Unit: sec (decay to 10% of starting voltage)

Testing environment		23℃/50%RH		23℃/12%RH	
Starting voltage		+ 5 k	- 5 kV	+ 5 kV	- 5 kV
Sample spec.	Anti-static TC fabric	0.19	0.20	7.99	7.26
	Ordinary polyester fabric	60.20	78.12	Unable to add to the required starting voltage	
	Nylon taffeta (auxiliary)	0.03	0.01	0.48	0.41
	Anti-static Polo shirt (strip)	0.03	0.01	0.04	0.01
	Anti-static diamond knitted fabrics	0.03	0.01	0.03	0.01
	Anti-static Polo shirt (checked)	0.03	0.01	0.03	0.02
	5mm checked conductive silk	0.03	<0.01	0.02	0.01
	Shielding film	0.03	0.01	0.04	0.02
	Three-layer moisture-proof membrane	0.03	0.01	0.04	0.01
	Four-layer moisture-proof membrane	0.02	0.01	0.03	0.02
	Nonwoven fabric 1# (thin)	2.98	2.88	50.66	68.77

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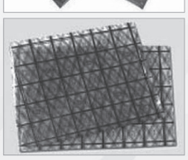
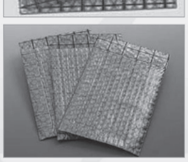
The performance of anti-electrostatic products in different humidity conditions

- Anti-static bag
  - Mainly used for protection of ESDS components on the move
    - Low electrification and electrostatic dissipation within EPA
    - Low electrification, electrostatic dissipation and electrostatic shielding outside EPA
  - Necessary factors in complete ESD protection system
  - Classification
    - By structures
      - Single-layer, double-layer, multi-layer and bubble mat film
    - By materials
      - PE bag, aluminum foil bag, mesh bag
    - By mechanism of action
      - Surface coated with hydrophilic material
      - Intrinsic conduction material

B2 环境湿度对防静电产品静电性能的影响
Influence of Environmental Humidity on Anti-static Property of Anti-static Products

HI-CLEAN 佰洁静电检测技术中心 Hi-Clean Static Test Technology Center

The performance of anti-electrostatic products in different humidity conditions

- Performance of surface resistivity of all kinds of packaging materials under different humidity

Testing method: ANSI/ESD STM11.1, ANSI/ESD STM11.2 Unit: Ω

Sample spec.	Surface resistance		Volume resistivity	
	23℃/50%RH	23℃/12%RH	23℃/50%RH	23℃/12%RH
Anti-static anti-rust material	3.0×10^{5}	2.0×10^{5}	1.5×10^{8}	2.9×10^{10}
Permanent anti-static IC protective tape	4.8×10^{8}	3.7×10^{9}	1.5×10^{8}	6.9×10^{8}
Common antistatic shielding bag	4.6×10^{9}	1.7×10^{10}	1.1×10^{10}	2.7×10^{11}
Permanent antistatic shielding bag	8.5×10^{8}	3.6×10^{9}	1.4×10^{10}	5.9×10^{10}
Common antistatic PE bag	1.3×10^{10}	2.2×10^{11}	9.2×10^{10}	1.4×10^{12}
Permanent antistatic PE bag (single-side anti-static)	7.2×10^{8}	3.7×10^{9}	3.2×10^{11}	3.1×10^{12}

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The performance of anti-electrostatic products in different humidity conditions

- Anti-static shoes and people/shoes/ground system
  - The important way and supplement of personnel grounding
  - Diverse types
  - Change in ANSI/ESD S20.20

Flooring / Footwear System – Method 1	ANSI/ESD STM97.1	< 3.5×10^{7} ohms
Flooring / Footwear System – Method 2 (both required)	ANSI/ESD STM97.1	< 10^{9} ohms
	ANSI/ESD STM97.2	< 100 volts
Footwear / Flooring System[5] – (Both limits must be met)	ANSI/ESD STM97.1	< 1.0×10^{9} ohms
	ANSI/ESD STM97.2	< 100 volts Peak



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The performance of anti-electrostatic products in different humidity conditions

- Performance of anti-static shoes under different humidity

Testing method: ANSI/ESD STM9.1 Unit:Ω

Sample spec.	PVC sole anti-static shoes	PU sole anti-static shoes	Grey conductive shoes
23℃ 50%RH	4.1×10^{7}	1.2×10^{7}	7.8×10^{5}
23℃ 12%RH	1.2×10^{8}	7.3×10^{7}	2.4×10^{6}

- Performance of people/shoes/ground system under different humidity

Testing method: ANSI/ESD STM97.1, ANSI/ESD STM97.2

Sample	Combination 1		Combination 2		Combination 3		Combination 4	
Item	Resistance Ω	Voltage V	Resistance Ω	Voltage V	Resistance Ω	Voltage V	Resistance Ω	Voltage V
23℃ 50%RH	$4.9\times10_{7}$	-14~69	$5.9\times10_{7}$	2~95	$9.6\times10_{7}$	-11~45	$1.6\times10_{7}$	-2~84
23℃ 12%RH	$4.9\times10_{8}$	-19~112	$7.4\times10_{8}$	-31~190	$5.2\times10_{8}$	-32~142	$6.9\times10_{8}$	-4~177

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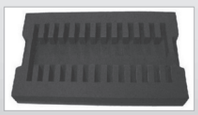
Possible electrostatic problems due to humidity factors

- Ambient humidity of different regions may change the anti-static properties of products
  - Case introduction
    - Event description: A Shenzhen electronics company processes an ESDS device, and uses the proven domestic anti-static foam to package it for protection, and sends to the user located in Northern Europe. The customer receives the product and finds out that the ESD failure is very serious.
    - Measuring result: through testing, the foam's resistance at 50%RH humidity is 20G Ω, and 500G Ω at 12%RH humidity.
    - Cause analysis: When the packaging material is used in wet weather in Shenzhen, the surface resistance is <1011 Ω, which complies with the relevant requirements. After sent to the Northern Europe where the humidity is low, the surface resistance increases significantly, and exceeds the limit at 12% RH. Therefore it can not provide effective protection for the product.

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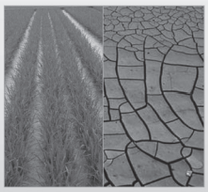
Possible electrostatic problems due to humidity factors

- Humidity environment of different seasons may change the anti-static properties of products
  - The problem of anti-static workbench resitance changing with the seaso
    - Humidity-dependent work surface has significant differences in different seasc
  - The problem of failure to pass through the anti-static access in dry seas
    - Dry season causes change of body skin, clothing and shoes

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- Summary and discussion - respond to the influence of environmental humidity on the anti-static performance
  - Ambient humidity have a significant impact on product's antistatic performance
  - Humidity-dependent electrostatic protection may have some electrostatic risks
  - Intrinsically conductive material is relatively weakly dependent on humidity
  - During anti-static performance test, consider the low humidity conditions
  - Ionization system has assisted anti-static effect

ESD NLINE 防静电在线 Anti-static online QQ 282987584
Technical support hotline : 400-820-8910

B3 本征静电耗散材料的应用对集成电路封装所用包材的重要意义
Significance of Intrinsic Electrostatic Dissipative Material Application in Packing Materials for Integrated Circuit Package

本征静电耗散材料的应用对集成电路封装所用包装材料的重要意义

2014-09-13 SSC-Pak 三创包装 1

防静电材料的分类

- 表面电阻率：Ω/□
- 10^3----------10^6--------10^9--------10^{11}---10^{12}及以上
- 分类：← 导静电材料→←---------- -静电耗散材料------→←绝缘材料→
- 传统实现方式：碳基　　抗静电剂
- 传统方式缺陷：不适用CDM静电放电模式，有碳粉末析出，对器件有影响　　需要环境湿度，非永久　真空条件下不起作用，表面有析出，有污染
- 本文推介方式：　　本征静电耗散材料

2014-9-13 SSC-Pak 三创包装 2

本征静电耗散包装材料的构成机理及特性

- 防静电机理

大家知道，由于大部分塑料和聚合物在本质上都是绝缘体，只有少数聚合物是导电或离子导电的。主要分为：

A）本征导电聚合物 (ICPs-Intrinsically Conducting Polymers)，如聚苯胺(polyaniline)，聚吡咯啉 (polypyrroline)，聚噻吩(polythiophene)等。该类材料一般呈现热固性性质，粘性低，似油墨状，通常用于涂覆工艺。

B)本征耗散聚合物 (IDPs-Inherently Dissipative Polymers)，如聚醚嵌段聚合物(polyether blockpolymers)，聚醚聚氨酯(polyether based polyurethanes)离子导电。是一种具有特殊的聚醚链段基于聚酰胺基础上合成的永久静电耗散物质。

2014-9-13 SSC-Pak 三创包装 3

本征静电耗散包装材料的构成机理及特性

- 防静电特性

1，本征耗散聚合物是热塑性，可用PA, ABS. ABS/PC, HIPS, PVC, PET, PE, PP等各种塑料材料加工，几乎涵盖了用于制造的塑料种类和加工工艺。

2，本征静电耗散材料防静电性能不依赖温湿度；无析出，渗出，无污染，洁净室兼容；不依靠使用条件和方式；可以根据需要加颜色。

2014-9-13 SSC-Pak 三创包装 4

表一：本征静电耗散材料VS抗静电剂产品

性能/功效	本征静电耗散材料	迁移型防静电添加剂（含涂层技术）
防静电功能时效性	永久性	短，有限，一般只在 3-6 个月内有效
制品起效对使用环境依赖程度	完全不依赖	依赖，在低湿度环境下失效
防静电功能响应性	生产后立即起效，不影响正常生产进度	不是立即起效，需待放置时日，吸湿后才起防静电功能
对制品外观/表面的影响	制品表面洁净	制品表面有粘物感
对制品可印刷性的影响	制品印刷性不受影响	制品印刷受限
对包装产品污染性	不会对所包装的产品造成污染	有腐蚀性，会损害包装的产品

2014-9-13 SSC-Pak 三创包装 5

表二：本征静电耗散材料VS炭黑等填充剂

性能/功效	本征静电耗散材料	导电填充剂
防静电功能可靠安全性，	适用于所有有源和无源器件	不适用于cdm模式器件
防静电效果的均匀性	均匀	不均匀
对制品外观的影响	制品表面洁净	会有碳分子松脱造成污染
着色性	制品可着色	制品只能是黑色
对包装产品污染性	不会对所包装的产品造成污染	会污染包装的产品，碳分子松脱会损害内包装器件。

2014-9-13 SSC-Pak 三创包装 6

B3 本征静电耗散材料的应用对集成电路封装所用包材的重要意义
Significance of Intrinsic Electrostatic Dissipative Material Application in Packing Materials for Integrated Circuit Package

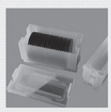
集成电路封装所用系列包材主要产品形态对静电防护的基本要求

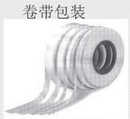
IC封装所用包材的主要产品形态

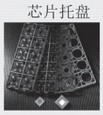
卷带包装

芯片托盘

电子器件工程联合会和定制集成电路装运盘








包装套管

集成电路封装所用系列包材主要产品形态对静电防护的基本要求

一，相关标准里对防静电包材的规定

对包装材料而言，CDM器件失效模式是当今MOSFET和IC等静电敏感器件失效的主要考量模式。所以，在IEC-61340和ANSI S2020标准中，规定见下：

IEC 61340-5-1

用IDP(本征耗散聚合物)做成的耗散产品可以用于防静电工作区与静电敏感器件、动力和非动力组件亲密接触的所有包装材料(SR IE5至1E11欧姆)。

至于产品资质，进行测试的环境条件必须是湿度为12%且温度为23度(IEC 61340-2-3, 测试方法)。

根据静电放电，如果有要求时，包装可以定义为在保护区域内、保护区域之间、工地、外勤服务和到达客户之间所有的材料移动。

集成电路封装所用系列包材主要产品形态对静电防护的基本要求

ANSI S20.20 (2007)

用于包材的ANSI S541 (2003)

- 防静电工作区内部所使用的包装(满足ANSI/ESD S20.20最低要求)应为：
- 1. 低静电形成。
- 2. 亲密接触的耗散或导电材料
- 根据应用和项目计划要求，对<100 伏特人体模型敏感的物品可能需要额外的保护。

用IDP(本征耗散聚合物)做成的耗散产品可以用于防静电工作区与静电敏感器件、动力和非动力组件亲密接触的所有包装材料(SR IE4至1E11欧姆)。

集成电路封装所用系列包材主要产品形态对静电防护的基本要求

IC封装包装材料的技术要求

IC封装包装材料选用原则:
★ 普通防静电，有存命，有析出污染，依赖环境湿度。
★ 直接接触器件，无污染，要求无污染和静电耗散型产品。
★ 符合IEC10694-SN20.20 要求。

要求 / 产品	使用过程及环境	是否直接接触产品	防静电指标要求	是否接受析出污染	是否需要以耐电压标	结论
卷盘	抽真空,洗涤<10^3Ω/□	否	导电或静电耗散材料，不依赖湿度	*	有	* 只能用本征静电耗散材料
料带 载带	抽真空,洗涤<10^3Ω/□	是	静电耗散材料，不依赖湿度	不能		只能用本征静电耗散材料
料带 盖带	抽真空,洗涤<10^3Ω/□	是	静电耗散材料，不依赖湿度	不能		只能用本征静电耗散材料
芯片托盘	可高温,抽真空,洗涤<10^3Ω/□	是	静电耗散材料，不依赖湿度	不能	有	只能用本征静电耗散材料
IC管	洗涤<10^3Ω/□	是	最低高衬静电耗散材料，不依赖湿度	不能	有	只能用本征静电耗散材料
特制袋	抽真空,内表面为洗涤<10^3Ω/□	否	内表面导电或静电耗散材料，不依赖湿度	*		只能用本征静电耗散材料
屏蔽袋及其他	内表面表层高衬洗涤<10^3Ω/□	否	最低高衬内表面导电或静电耗散材料，不依赖湿度	*		只能用本征静电耗散材料
硅片盒	洁净室,抽真空,洗涤<10^3Ω/□	是	静电耗散材料，不依赖湿度	不能	有	只能用本征静电耗散材料

* 对碳污染析出不敏感特殊件可以用碳基导电材料。

Significance of Intrinsic Electrostatic Dissipative Material Application in Packing Materials for Integrated Circuit Package

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Classification of Anti-static Materials

Surface resistivity: Ω/□

- 10^3----------10^6--------10^9--------10^{11}---10^{12} and above
- Class: ← Electrostatic conductive materials→←---------- -electrostatic dissipative materials ------→←insulating materials→
- Traditional implementation model: carbon base Antistatic agent
- Defects of traditional way: not applicable to ESD CDM, requiring ambient humidity and impermanent

Discharge mode, precipitation of carbon powder, no effect under vacuum condition, influences on the devices, precipitation on the surface and pollution. Promotion method in the text: Intrinsic Electrostatic Dissipative Material

B3 本征静电耗散材料的应用对集成电路封装所用包材的重要意义 Significance of Intrinsic Electrostatic Dissipative Material Application in Packing Materials for Integrated Circuit Package

Constitution Mechanism and Characteristics of Intrinsic Electrostatic Dissipative Packing Materials

- Anti-static Mechanism

We all know that most plastics and polymers are insulators in essence and only a minority of polymers are conductive or ion conductive, which are divided into:

A) Intrinsically Conducting Polymers (ICPs), such as polyaniline, polypyrroline, polythiophene and so on. This kind of materials usually demonstrate thermosetting property, low viscosity and printing ink, which are often used in coating process.

B) Inherently Dissipative Polymers (IDPs), such as polyether blockpolymers and polyether based polyurethanes, which are ion conductive. They are a kind of permanent electrostatic dissipative materials with special polyether chain segments synthesized on the basis of polyamide

Constitution Mechanism and Characteristics of Intrinsic Electrostatic Dissipative Packing Materials

- Anti-static characteristics

1. IDPs are thermoplastic, which can be processed with PA, ABS, ABS/PC, HIPS, PVC, PET, PE, PP and various plastic materials, covering nearly all plastic types and processing techniques used for manufacturing.
2. The antistatic property of intrinsic electrostatic dissipative materials is independent of temperature and humidity; there is no precipitation, exudation and pollution; they are compatible with cleaning room and independent of operating conditions and methods; and the color can be added as required.

Table I: Intrinsic Electrostatic Dissipative Materials VS Antistatic Agents

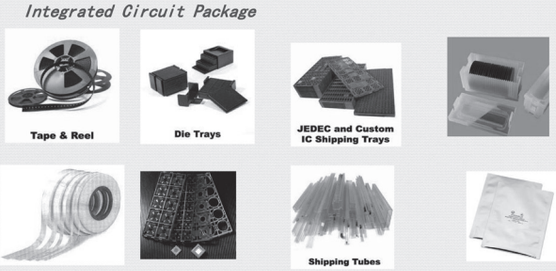
Performance / Effect	Intrinsic Electrostatic Disspative Materials	Migration-type Antistatic Additives (including coating technology)
Antistatic function timeliness	Permanency	Short, limited and usually effective within 3-6 months
Dependency on the operating environment when the products work	Total independence	Dependent and ineffective under low humidity environment
Antistatic function responsiveness	They work immediately after the production and won't influence normal production process.	They won't work immediately and the antistatic function will take effect after moisture absorption for a period of time.
Influences on article appearance / surface	The product surface is clean	The product surface is viscous.
Influences on product printability	No influences on the product printability	The product printability is limited
Pollute packed products	No influences on packed products	Corrode and damage the packed products

Table II: Intrinsic Electrostatic Dissipative Materials VS Carbon Black and Other Fillers

Performance / Effect	Intrinsic Electrostatic Disspative Materials	Conductive Filler
The antistatic function is reliable and safe	Apply to all active and passive devices	Not apply to CDM devices.
Uniformity of antistatic effect	Uniform	Nonuniform
Influences on product appearance	The product surface is clean	The loosening of carbon molecules will lead to pollution
Stainability	The product is colorable	The product can only be black.
Pollute packed products	Not pollute packed products	It will pollute packed products and the loosening of carbon molecules will damage devices in the package.

Basic Requirements of Main Product Forms of Series Packing Materials for Integrated Circuit Package in Terms of Electrostatic Protection

Main Product Forms of Packing Materials for Integrated Circuit Package



Basic Requirements of Main Product Forms of Series Packing Materials for Integrated Circuit Package in Terms of Electrostatic Protection

I. Regulations on antistatic packing materials in relevant standards

As far as packing materials are concerned, the failure mode of CDM devices is the main consideration mode for the failure of MOSFET and IC electrostatic sensitive devices. Therefore, the regulations in IEC-61340 and ANSIS2020 standards are as follows:

IEC 61340-5-1

Dissipative products made with IDP can be used in EPA for all packaging materials with intimate contact to ESDS, powered and non-powered components (SR 1E5 to 1E11 ohms)

For product qualification, the environmental conditions for testing must be 12 % RH and 23 degreés (IEC 61340-2-3, testing methods)

Packaging, when required, shall be defined for all material movement within protected areas, between protected areas, between job sites, field service operations and to the customer according to the ESD

B3 本征静电耗散材料的应用对集成电路封装所用包材的重要意义
Significance of Intrinsic Electrostatic Dissipative Material Application in Packing Materials for Integrated Circuit Package

Basic Requirements of Main Product Forms of Series Packing Materials for Integrated Circuit Package in Terms of Electrostatic Protection

ANSI S20.20 (2007)

ANSI S541 (2003) for packaging materials

- Packaging used within an EPA (that satisfies the minimum requirements of ANSI/ESD S20.20) shall be:
- 1. Low charge generation.
- 2. Dissipative or conductive materials for intimate contact.
- Items sensitive to <100 Volts Human Body Model may need additional protection depending on application and program plan requirements.

Dissipative products made with IDP can be used in EPA for all packaging materials with intimate contact to ESDS, powered and non-powered components (SR 1E4 to 1E11 ohms)

SSC-Pak Sanchuang Packaging

2014-9-13

9

Basic Requirements of Main Product Forms of Series Packing Materials for Integrated Circuit Package in Terms of Electrostatic Protection

Technical Requirements of Packing Materials for IC Package

Selection Principles of Packing Materials for IC Package
★ Normal antistatic property, life span, precipitation pollution and dependence on ambient humidity.
★ Direct-contact devices, no pollution and request for pollution-free and electrostatic dissipative products.
★ Conform to IEC10694-SN20.20.

Requirements / Products	Use process and environment	Direct-contact products or not	Antistatic index requirements	Accept precipitation pollution or not	Require color difference or not	Conclusion
Spool	Vacuum pumping and low humidity <10%RH	No	Conductive or electrostatic dissipative materials and independence on humidity	*	Yes	*Only intrinsic electrostatic dissipative materials can be used
Strip Carrier Tape	Vacuum pumping and low humidity <10%RH	Yes	Electrostatic dissipative materials and independence on humidity	No		Only intrinsic electrostatic dissipative materials can be used
Cover tape	Vacuum pumping and low humidity <10%RH	Yes	Electrostatic dissipative materials and independence on humidity	No		Only intrinsic electrostatic dissipative materials can be used
Chip tray	High temperature resistance, vacuum pumping and low humidity <10%RH	Yes	Electrostatic dissipative materials and independence on humidity	No	Yes	Only intrinsic electrostatic dissipative materials can be used
JC tube	low humidity <10%RH	Yes	Electrostatic dissipative materials when the requirement is high and independence on humidity	No	Yes	Only intrinsic electrostatic dissipative materials can be used
Damp-proof bag	Vacuum pumping and low humidity of inner surface <10%RH	No	Conductive or electrostatic dissipative materials of inner surface and independence on humidity	*		Only intrinsic electrostatic dissipative materials can be used
Shielding bag and others	low humidity <10%RH when the inner surface requirement is high	No	Conductive or electrostatic dissipative materials of inner surface and independence on humidity when the requirement is high	*		Only intrinsic electrostatic dissipative materials can be used
Silicon wafer box	Cleaning room, vacuum pumping and low humidity <10%RH	Yes	Electrostatic dissipative materials and independence on humidity	No	Yes	Only intrinsic electrostatic dissipative materials can be used

B4 防静电工作服和防静电标准
Antistatic Work Clothes and Antistatic Standards

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防静电工作服和防静电标准(JIS)

2014.10.14

KURARAY 繊維素材企画開発部
顧問 松尾 義輝

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はじめに

- 日本很早就对工作服的静电评价做了研讨。
- (把静电放电的安全性作为主要课题，与国家劳动部共同开发防止静电的安全工作服)

洁净服的静电评价标准是以IEC 61340-5-1的电阻值测定为基础，10E+5Ω值来决定的。

电阻的被重视的最大理由是任何地方，任何人都可以测定，随之洁净服带电问题也逐渐被人理解。

日本的防止带电标准并非考虑电阻值，而是从除静电这个层面引申的带电电荷量。

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日本不带电工作服标准(JIS化)

- 1960年以后，可能由于化纤工作服带电原因所引发多起事故，后来发现木棉的工作服虽然不起静电，但是如果在低湿度的状态依然会产生静电。
- 1970年～ SWS提唱 安全工作流程
- 1978年劳动部发布静电安全指南(防止静电工作服的性能要求等)
- 1980～1983年 带电性试验法的JIS化(JIS-L1094)、防静电工作服的JIS化(JIS-T8118)
- 1995年1月劳动安全卫生规则改定 1996年4月开始静电对策的强制执行 ･･･→ 称成为成熟化的功能商品

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防静电的变迁

- 第1阶段 (1969～) 用后整理防静电"防静电衬衫"

USA(1965～)根据ECF 地毯的防静电

- 第2阶段 (1973～) 根据注入式ECF来防静电"里料"
- 第3阶段 (1975～) 复合导电纤维的开发，以及使用导电纤维的"防静电服"と"防尘服"
- 第4阶段(1980～) 导电纤维的防静电机能被认，随后制定

JIS标准(1983年)

- 第5阶段(1995～) "防静电工作服"

1995年1月劳动安全卫生规则的改定

1996年4月对防静电进行强制执行

"防尘衣:洁净室服"1995年10月IEC TC101(静电)设立

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关于IEC TC101(静电)

- IEC(International Electrotechnical Commission:国际电子会议)在1904年在セントルイス召开的国际电子会议上被提案、1906年成立。 地点设在日内瓦。
- 目的是关于电子和电子技术的标准化、各国进行意见交流疏通并制定国际性规则。
- TC101的发展历史是首先用TC15(绝缘材料)属下的SC15D(静电)开始进行的、但是这个主题与防静电的要求是有算偏离的，所以在1995年10举行的德班会议上被定义为独立的新课题。

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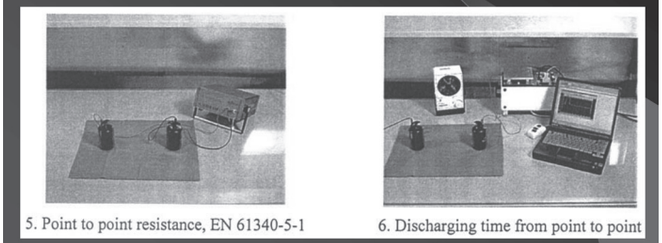
各国評価法と基準について

- IEC 6130-5-1
- BS-EN-1149-1,2(欧州)
- DIN-54345-6(独)
- AATCC 76(美)

- 着眼于防止从导体释放的静电(ESD)所制定的洁净服静电评判方法和基准是根据IEC 61340-5-1的静电检测法决定基准值为10E+12Ω，但欧美则把10E+5Ω定为主流值。
- 电阻值也成为一个标准的理由是"任何地方，任何人都可以随意测定"，之后洁净服存在静电问题也被逐渐理解。

B4　防静电工作服和防静电标准
Antistatic Work Clothes and Antistatic Standards

IEC 61340-5-1 面料的电阻测试方法



5. Point to point resistance, EN 61340-5-1　　6. Discharging time from point to point

Photo　IEC 61340－5－1规定的面料的表面电阻测试方法

IEC 61340-5-1 工作服的电阻测试方法

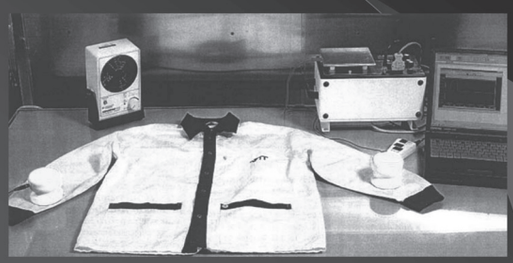


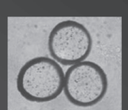
Photo　IEC 61340－5－1规定的服装的表面电阻测试方法

对应ESD的导电纤维的现状

- 电子产业工作服(ESD对应洁净服)的规格(TC-101 10E+12Ω以下 → 欧美要求10E+5Ω)来对应。
- Shakespeare纱(使用尼龙6的单丝黏附导电颗粒做成的 20dr-1f)是主流、随后是KB-SEIREN　9R1(把导电颗粒复合成条状 的20dr-3f　等)。

ESD的对应导电纤维

Shakespeare(原BASF)



9R1 (KB-SEIREN)

KC-782R

把导电层去暴露在表面是一个很大的缺点，因为这样容易被酸腐化。

日本の帯電防止基準(JIS規格)と帯電評価法

·JIS T-8118、JIS L-1094

・经编织物:摩擦带电电荷量(防爆标准7μC/m²)

・工作服:滚筒测试法(防爆标准0．6μC/着)

防静电处理方法

		内容	特徴
使用防静电剂	A.后加工法	亲水性聚合物,界面活性剂表面差(电荷的分散・扩散)	○容易加工 ×持久性 ×湿度影响大
	B.混合法	混合亲水性聚合物(电荷的分散・扩散)	○持久性 ×湿度影响大 ×均匀性差
使用导电丝		与导电碳纤维混织	○耐久性 ○与湿度无关 ○均匀性好

从「静电产品的构造标准」来看其实是从持久性，稳定性的角度所衍生的用导电纤维来防止静电产生的方法。

除電原理模式図(コロナ放電)

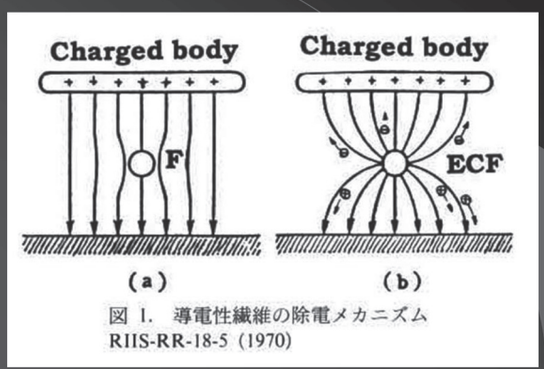
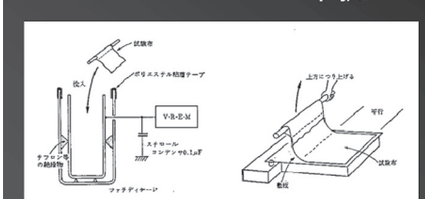


図 1.　導電性繊維の除電メカニズム
RIIS-RR-18-5 (1970)

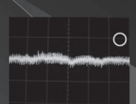
布の帯電量測定法

測定環境:温度20±5℃、湿度40%以下

- JIS-L-1094に準拠

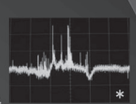


Pd:放電判定



○ ナシ

× 感じる



×× 著しい

＊ 不快

帯電電荷密度測定法

样品尺寸:250mm×350mm　摩擦布:腈纶和尼龙
摩擦:5次　单位:μC/m²

B4 防静电工作服和防静电标准
Antistatic Work Clothes and Antistatic Standards

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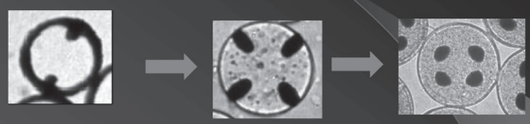
对防静电服(洁净服)最适合的导电纤维



由于酸化所产生的裂变和发尘问题得以消除。

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总结

·关于防静电工作服的安全管理、我们认为从凌驾于电阻值的除电这个角度、考虑用带电电荷量来进行管理是正确的。

·关于在JIS里的带电电荷量、特别是关于工作服的尺寸，规格的不同会产生差异，考虑到这点后对性能的管理就显得尤为重要。

·静电是一种容易出现差异的现象，为了得到稳定的测试结，测试环境，测试仪器的准备以及测试人员对静电现象，测试方法的熟知也非常重要。

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Antistatic Work Clothes and Antistatic Standards(JIS)

2014.10.14

KURARAY Fiber Material Planning & Development Dept. Consultant 松尾 義輝

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はじめに

- Japan explored evaluation on static electricity with work clothes long ago.
- (Taking ESD safety as main topic, to develop antistatic safe work clothes jointly with the Ministry of Labor)

Standard for electrostatic evaluation on clean clothes is based on IEC 61340-5-1 resistance determination and decided by 10E+5Ω value.

The biggest reason for importance to resistance is it can be determined everywhere by anyone, so the issue of charge with clean clothes is gradually understood by people.

Japanese standards for electrostatic protection do not consider resistance value but electric charge volume extended from static electricity removal view.

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Japanese Standard for Electrostatic-free Work Clothes(JIS Standardization)

- After 1960, multiple accidents were caused maybe by static electricity with chemical fiber work clothes. Later, people found that cotton work clothes do not generate static electricity, but excluding in low-humidity state.
- 1970～ SWS advocated safe work flow
- 1978, the Ministry of Labor issued guide to electrostatic safety(antistatic work clothes performance requirements, etc)
- 1980～1983 JIS standardization of hot-line test method(JIS-L1094), and JIS standardization of antistatic work clothes(JIS-T8118)
- In Jan.1995, rules for labor safety and health was promulgated; in April 1996, antistatic standard became compulsory ・・・→ called mature functional commodity

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Transition of Antistatic History

- Stage 1 (1969～) Using finishing antistatic process to make "antistatic shirt"
  USA(1965～) ECF carpet antistatic standard
- Stage 2 (1973～) Following injection ECF to make antistatic "lining"
- Stage 3 (1975～) Development of composite conductive fiber; conductive fiber made "antistatic clothes"と"anti-dust clothes"
- Stage4(1980～) Antistatic function of conductive fiber was recognized and JIS standard was formulated subsequently (1983)
- Stage5(1995～) "Antistatic work clothes"
  In Jan.1995, rule for labor safety and health was promulgated; in April 1996, antistatic standard became compulsory ・・・→ called mature functional commodity

"Anti-dust clothes:Cleanroom Clothes" was specified in IEC TC101(Electrostatic) Standard in Oct. 1995

B4 防静电工作服和防静电标准
Antistatic Work Clothes and Antistatic Standards

AboutIEC TC101（Static Electricity）

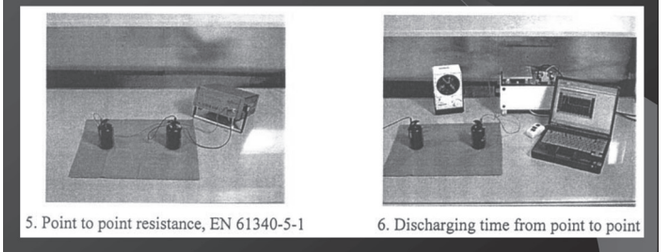
- IEC（International Electrotechnical Commission: International Electronics Conference）was proposed in the international electronics conference held in セントルイスin 1904 and established in Geneva in1906.
- The purpose is for standardization of electronics and electronic technology, exchanges among countries and formulation of international rules.
- History of TC101development started from SC15D（Static Electricity）under TC15（Insulating Materials）. But the theme deviated from antistatic requirements. So it was defined as an independent new topic in the Durban Conference held in Oct. 1995.

Reference for Evaluation of Different Countries

- IEC 6130-5-1
- BS-EN-1149-1,2（Europe）
- DIN-54345-6（独Germany）
- AATCC 76（US）

- Clean clothes static electricity judgment method and reference based on preventing ESD generated by conductor determine the base value as 1 0E＋12Ω according to IEC 61340-5-1 electrostatic testing method, but Europe and US take 10E＋5Ω as mainstream value.
- The reason for resistance value as a standard is that "it can be determined everywhere by anyone", so the issue of static electricity with clean clothes is gradually understood by people.

IEC 61340-5-1
Shell Resistance Testing Method



5. Point to point resistance, EN 61340-5-1　　6. Discharging time from point to point

Photo IEC 61340－5－1 specified shell surface resistance testing method

IEC 61340-5-1
Work Clothes Resistance Testing Method

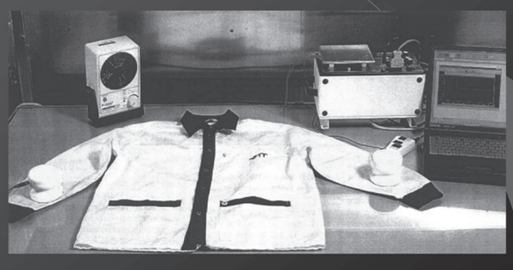
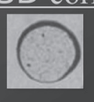


Photo IEC 61340－5－1 specified clothes surface resistance testing method

Current Situations of Corresponding ESD Conductive Fiber

- Specification of work clothes for electronic industry（ESD-corresponding clean clothes）(Under TC-101 10E+12Ω → Europe and US require 10E+5Ω).
- SHAKESPEARE yarn（20dr-1f made of Nylon 6 single fiber stuck with conductive grain）was the mainstream, later it was KB-SEIREN 9R1 (Compounding conductive grain into strip 20dr-3f, etc).

ESD corresponding conductive fiber



SHAKESPEARE
(Predecessor of BASF)

9R1 (KB－SEIREN)

KC-782R

Making conductive layer exposed to surface is a big shortcoming, as the layer is liable to be acid-corroded

Japanese Electrostatic Protection Standard（JIS）and Electrostatic Evaluation Method

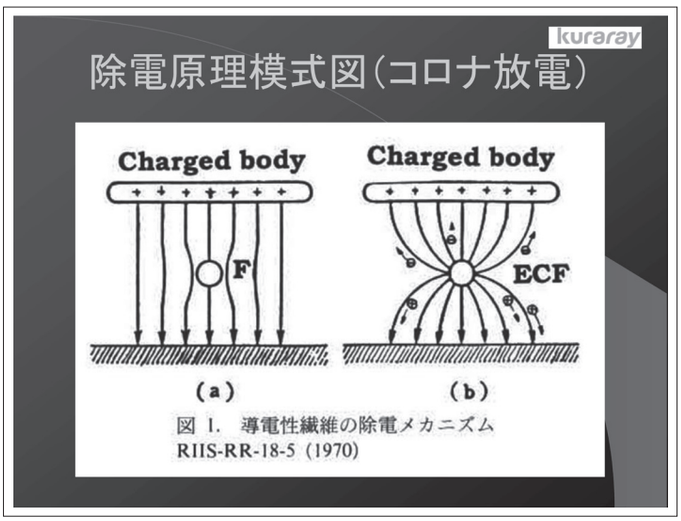
- JIS T-8118、JIS L-1094
  - Mesh fabric：electric charge volume from friction（explosive standard:7μC/m²）
  - Work clothes：tumble test method（explosive standard: 0．6μC/piece）

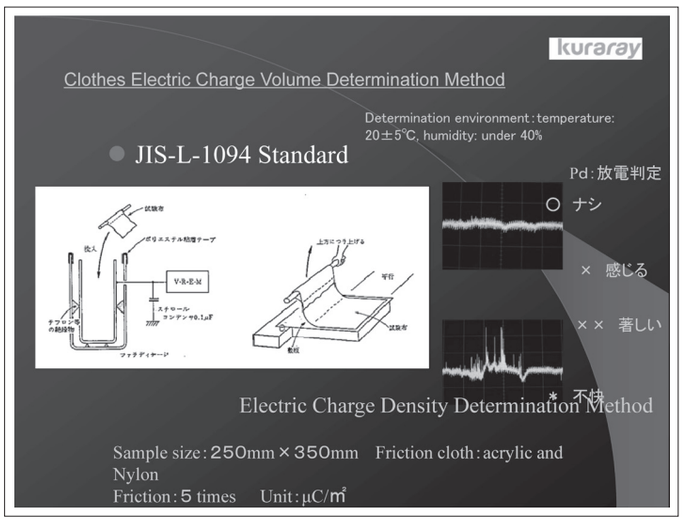
Antistatic treatment method

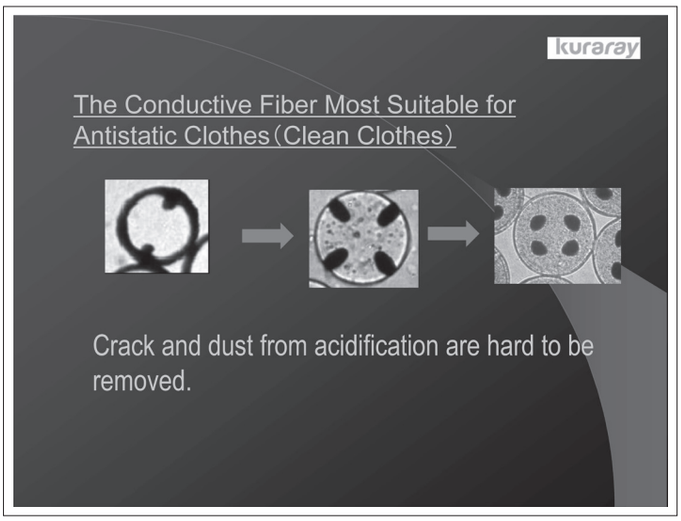
		Description	Characteristics
Using antistatic agent	A.Finishing process	Hydrophilic polymer, surfacant, poor surface (Charge scattering, ・diffusing)	○Easy processing ×Durability ×High humidity influence
	B. Mixing process	Mixed hydrophilic polymerレント (Charge scattering, ・diffusing)	○Durability ×High humidity influence ×Poor evenness
Using conductive fiber		Interwoven with conductive carbon fiber	○Durability ○Irrelevant with humidity ○Good evenness

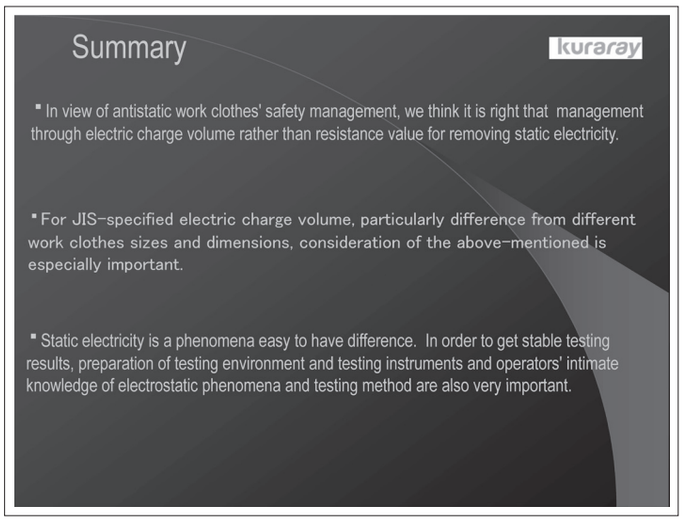
In view of「Static Production Structure Standard」, it is in fact a method for preventing static electricity from generating with conductive fiber on the basis of durability and stability.

B4 防静电工作服和防静电标准
Antistatic Work Clothes and Antistatic Standards

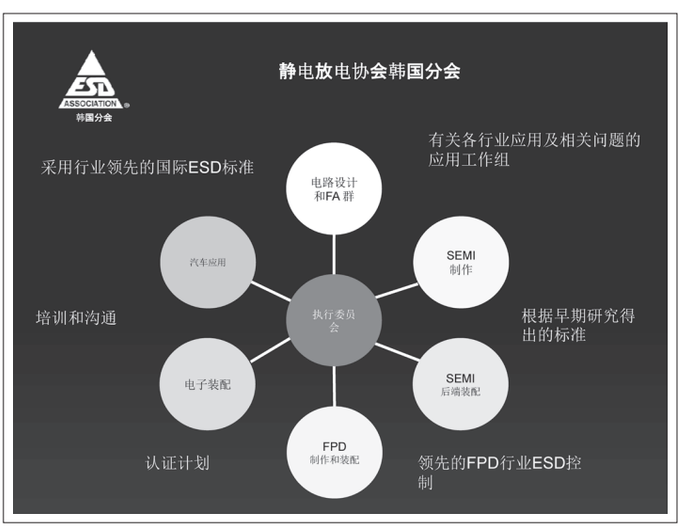








B5 韩国静电标准及产业情况
South Korea electrostatic standards and industry situation



B5 韩国静电标准及产业情况
South Korea electrostatic standards and industry situation

静电放电协会韩国分会

2014 区域指导计划
ESD 基础、离子化和净化室

静电放电协会韩国分会

2014 区域指导计划
ESD地方专题研究组

静电放电协会韩国分会

韩国、中国、台湾和日本ESD组织
新日程

平板显示器
ESD 问题

尚无平板应力测试模型的行业标准

尚无工厂控制准则

对FPD ESD损伤机理只有很低程度的研究

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KOREA CHAPTER OF
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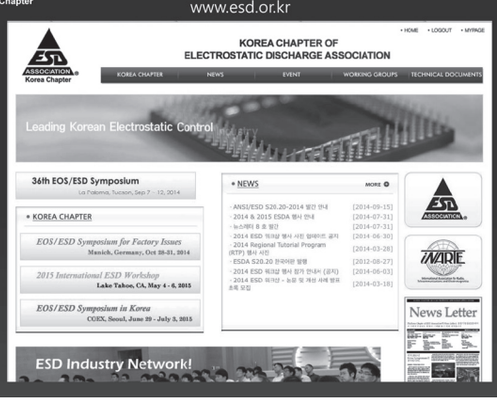
Korea Chapter

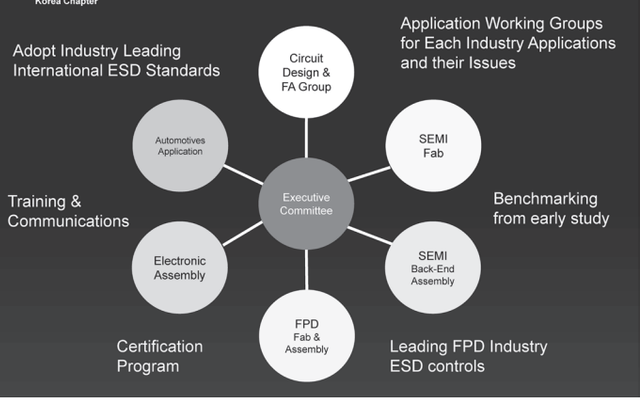
has founded in Sep 2011 as Local Chapter of ESD Association with small number of peoples and growing 161 official members. Hosting annual local events and running Regional Tutorial Programs of ESD Association.

KOREA CHAPTER OF
ELECTROSTATIC DISCHARGE ASSOCIATION

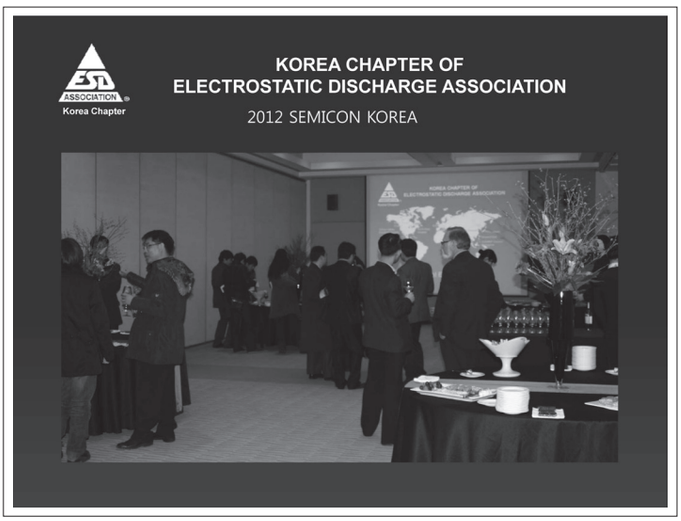
www.esd.or.kr

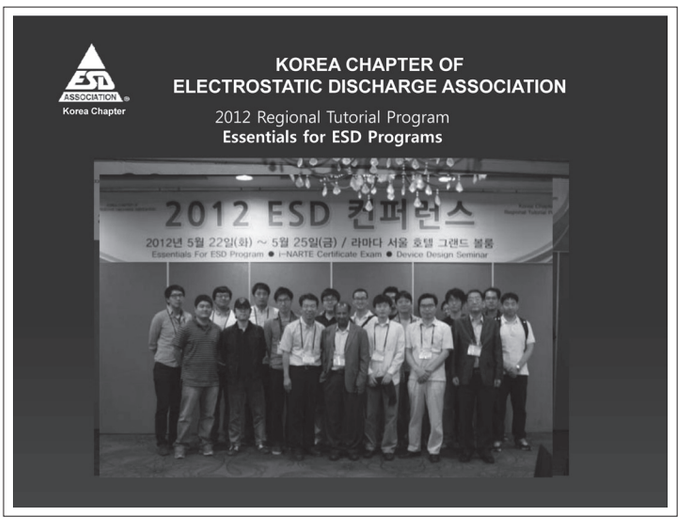


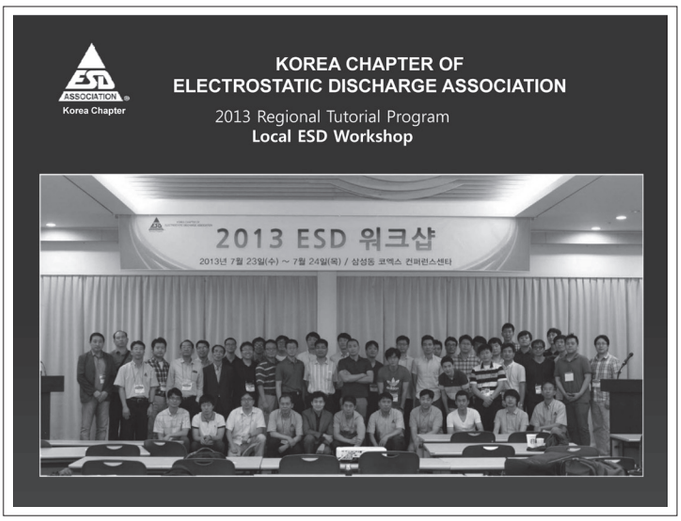
KOREA CHAPTER OF
ELECTROSTATIC DISCHARGE ASSOCIATION

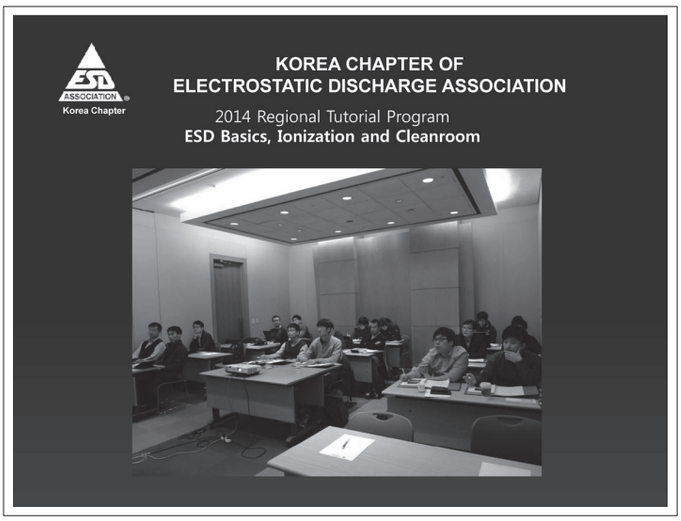


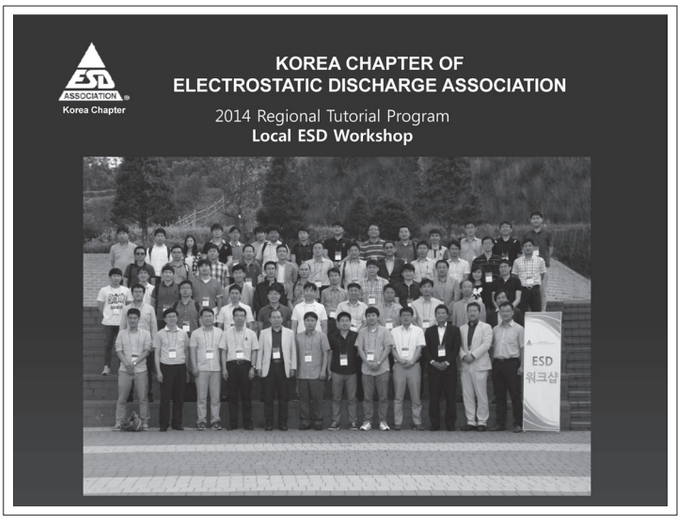
B5 韩国静电标准及产业情况
South Korea electrostatic standards and industry situation











B6 防静电工作区检验标准使用中的几个问题——使用ANSI/ESD S20.20和IEC61340-5-1的几点体会
Questions in the Use of Inspection Standards for Antistatic Work Areas —— Experience from Using IEC61340-5-1 and ANSI/ESD S20.20

NASTC

防静电工作区检验标准使用中的几个问题——使用IEC61340-5-1和ANSI/ESD S20.20的几点体会

主讲 廖志坚
信息产业防静电产品质量监督检验中心

www.cnastc.com

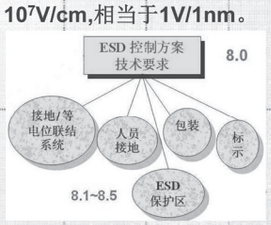
1 防静电工作区(EPA)内 ANSI/ESD S20.20和IEC61340-5-1的关系

1.1 防静电工作区（EPA）在静电防护中的重要位置

1.2 防静电管理体系对防静电工作区（EPA）建设的重要性

数据来自国标GJB/Z 105-1998《电子产品防静电放电控制手册》二氧化硅的绝缘强度是1厘米承受10的7次方伏特，击穿电场强度1×10^7V/cm,相当于1V/1nm。

1.3 IEC 61340-5-1和ANSI/ESD S20.20对防静电工作区（EPA）的要求



2 防静电工作区(EPA)防静电接地系统

2.1 ANSI/ESD S20.20的防静电接地系统

ANSI/ESD S20.20 表格1：接地及等电位连接之要求

技术要求	实施方案	测试方法	强制限定
接地 / 等电位相连接系统	设备接地导体	ANSI/ESD S6.1	<1.0 欧姆阻抗
	辅助接地	ANSI/ESD S6.1	<25 欧姆到设备接地导体
	等电位相连接	ANSI/ESD S6.1	$<1.0\times10^9$欧姆

[1]任何静电放电技术单元与公共接地点之间的最大电阻。

Deamer Wu (吴振忠) MKS, Ion Systems / Dr. Guan Wei (管伟博士) MKS, Ion Systems//文件下载网址：http://www.esda.org/keydownloads.html

2.2 IEC 61340-5-1中关于防静电接地系统的表述

IEC 61340-5-1表1接地/等电位连接要求

技术要求	接地方法	测试方法/标准	要求的限值
接地/等电位连接系统	保护接地	国家电力系统标准	国家电力规范限值
	功能接地	国家电力系统标准	国家电力规范限值
	等电位连接	见表2和表3中适用的实施过程	见表2和表3中每一个ESD控制项目的限值

[1]在图1中要求功能接地和保护接地同时存在时，两者要连接在一起。

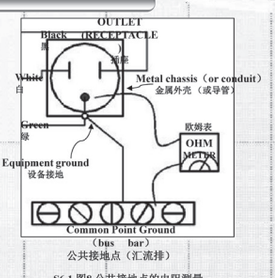
2 防静电工作区(EPA)防静电接地系统

2.3 两者在使用中的差别

2.3.1 ANSI/ESD S20.20的检测依据ANSI/ESD S6.1

2.3.2 IEC61340-5-1的检测依据国家电力系统标准

1. GB50169-2006《电气装置安装工程接地装置施工及验收规范》第3.9.2条：设计无要求时，接地电阻R≤4Ω。



S6.1 图8 公共接地点的电阻测量

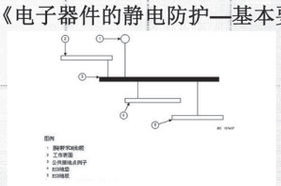
2. GB/T 16895.23-2012《低压电气装置 第6部分 检验》测试方法“三极测量法”(两极和地极的距离分别为20m、40m或按照仪器规定的距离)。测试时移动辅助测试极，读取三次数值，以算术平均值为测量结果。

2 防静电工作区(EPA)防静电接地系统

2.4 IEC 61340-5-1和ANSI/ESD S20.20的共同点

2.4.1 IEC 61340-5-1：2007《电子器件的静电防护—基本要求》

IEC 61340-5-1图1 带参考接地点的EPA接地原理图



IEC 61340-5-1图2等电位连接系统原理图

2.4.2 ANSI/ESD S20.20 8.1 接地 / 等电位相连系统：接地 / 等电位相连接系统应被使用，以保证静电放电敏感物件、人员和所有其它导电体(如移动设备)，处在同样的电位。

3 防静电工作区(EPA)电阻类指标的现场检测

3.1 电阻类指标检测基本要素

3.1.1电极组件

表1 两种标准体系中电极组件差异的对比

标准 / 项目	国际电工技术委员会标准		美国国家标准协会标准	
	参数和指标	标准代号	参数和指标	标准代号
①点对点电阻、系统电阻测试电极	柱状电极重量：2.5±0.25kg；直径φ63.5±1mm;金属板上10V测试两电极间电阻＜1KΩ	IEC61340-2-3 IEC61340-4-1	柱状电极重量：2.27±0.06kg(5 lb±2 oz)；直径φ63.5±0.25mm(2.5±0.1 inches)；金属板上10V测试两电极间电阻＜1KΩ	ANSI/ESD S4.1 ANSI/ESD S7.1 ESD TR53-01-06
②表面电阻、体积电阻测试电极	同心环电极重量：2.5±0.25kg；内柱电极直径φ30.5±1mm，外环电极内径φ57±1mm；金属板上10V测试两电极间电阻＜1KΩ	IEC61340-2-3	同心环电极重量：2.27±0.06kg(5 lb±2 oz)；内柱电极直径30.48±0.64mm（1.2±0.025 inches），外环电极内径φ57.15±0.64mm(2.25±0.025 inches)；金属板上10V测试两电极间电阻＜1KΩ	ANSI/ESD STM11.11 ANSI/ESD STM11.12
③鞋电极	鞋电极重量：12.5±2.5kg（由直径φ≤3mm钢珠组成）上部由钢珠布袋和铝条组成，下部不锈钢板，钢板下垫绝缘板，鞋电极系统电阻＜500Ω	IEC61340-4-3	鞋电极重量：25 lb(11.35kg)上部由钢珠布袋和铝条组成，下部不锈钢板，要求对地绝缘，大于1×10E13Ω	ANSI/ESD STM 9.1
其他电极	5.0±0.25kg用于其他软地面	IEC61340-4-1		

B6 防静电工作区检验标准使用中的几个问题——使用ANSI/ESD S20.20和IEC61340-5-1的几点体会
Questions in the Use of Inspection Standards for Antistatic Work Areas —— Experience from Using IEC61340-5-1 and ANSI/ESD S20.20

3 防静电工作区(EPA)电阻类指标的现场检测

【结论】（一）表1中两种标准体系的电极组件差异影响很小， IEC标准只在其他软地面测试上有一个补充。所以，两种标准体系在测量中由电极重量的影响可以不考虑。

【结论】（二）总体而言，两种标准体系对压力的要求很严格，说明了压力在测试中的重要性。①用2.5kg或5 lb的电极来代替人手的测量，统一了测量的压力；②对于人体的压力用了重量12.5kg或25 lb的电极。这里标准没有使用人体的重量作压力，也说明了这时增加重量对接触电阻的影响已可以忽略。

3.1.2 测试时间的影响

GJB2605-1996《可热封柔韧性防静电阻隔材料规范》规定初始电压±5000伏，衰减到±50V，时间不大于2秒。C仪器 =20pF，静电泄漏电阻：R20pF =2.17×10E10Ω。

①如果此时电容C人体 =200pF，R200pF（2.17×10E10Ω）的充电时间需要20s。

②如果电容C地面 =2000pF，Rg=1×10E9Ω,保证90%的测试电压（精度）ln(100/10) =2.30，T充电=RCln(Uo /Uc（t）) =4.6s

3 防静电工作区(EPA)电阻类指标的现场检测

【结论】（三）在情况①少于20s的时间对于测量肯定是有影响的。此时测试电压（等效加在电容上）不够高，对应的电流值肯定小，所以读数会比实际值小。在情况②的地面测试中，如果没有达到4.6s，也会产生10%以上的误差。其结果会将不合格的产品判定为合格。

3.1.3 测试条件和要求

表2 两种标准体系测试电压和环境要求对比

项目 \ 标准	国际电工技术委员会标准		美国国家标准协会标准	
	参数和指标	标准代号	参数和指标	标准代号
测试电压	100V±5%，（≥1×10E6Ω）；10V±5%（<1×10E6Ω），15s；500V±5%，（≥1×10E11Ω）对绝缘材料：500V，1min。	IEC61340-2-3 IEC61340-4-1 IEC61340-4-3	100V±5%（≥1×10E6Ω）；10V±5%（<1×10E6Ω）	ANSI/ESD STM11.11 ANSI/ESD STM11.12 ANSI/ESD S4.1 ANSI/ESD S7.1 ANSI/ESD STM9.1 ESD TR53-01-06
测试环境	一 级 ： 2 3 ℃ ± 2 ℃ 12%RH±3%RH(稳定96+10h)；二 级 ： 2 3 ℃ ± 2 ℃ 25%RH±3%RH(稳定96+10h)；三 级 ： 2 3 ℃ ± 2 ℃ 50%RH±3%RH(稳定48+10h)。	IEC61340-2-3 IEC61340-4-3	低湿度条件：12%RH±3%RH，23℃（±1℃ S4.1/±3℃S7.1）（稳定至少48 h，不超过72h）；中等湿度条件：50%RH（±5%RH S4.1/±2%RH S7.1），23℃（±1℃ S4.1/±3℃S7.1）（稳定至少48 h，不超过72h）。	ANSI/ESD STM11.11 ANSI/ESD STM11.12 ANSI/ESD S4.1 ANSI/ESD S7.1 ANSI/ESD STM9.1 ESD TR53-01-06
测试时间	15s后读数		5次充电时间平均值加5s	

3 防静电工作区(EPA)电阻类指标的现场检测

【结论】（四）两类标准中值得注意的共同点是对环境条件的要求，它是影响电阻类指标测试结果的重要因素。实际测量中低湿度条件和中等湿度条件下测试的结果可以相差一个数量级。所以，同一材料进行低湿度条件和中等湿度条件（两种湿度条件）的性能测试，来反映湿度对材料电阻性能影响和防静电特性更精确、更全面。

3.2 电阻类指标与静电防护的关系

3.2.1 防静电系统认证标准中电阻类指标

【结论】（五）防静电工作区的防护级别应根据敏感器件的等级而定。对于100V不能满足要求的情况，采取相应的加严措施对地电阻应高于指标Rg＜3.5×10E7Ω。采用导静电材料，例如Rg＜1×10E6Ω，要求人体静电＜10V。

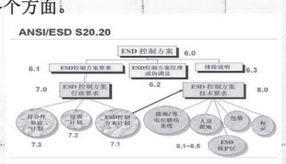
3.2.2 对地电阻与静电防护关系

【结论】（六）人体静电的曲线说明了在防静电工作区内也会有瞬间的产生静电高峰，瞬间消失，存在着潜在的危害。操作静电敏感器件，静置时间很重要。静电防护一般原则要求，控制静电电压小于静电敏感器件静电放电敏感电压阈值的-6dB(即1/2电压)。

4 结束语

一个全面、有效防静电体系要求建立在企业全面质量管理体系的基础上。

以ANSI/ESD S20.20为例，标准对工厂的ESD体系的建立、EPA的建立、敏感器件的包装、生产各环节的处理、人员培训和考核、内审制度的建立和检查、检测手段等各方面都作了明确的规定。涉及到采购、计量、过程控制、不合格品、管理职责和文件控制等各个方面。



随着微电子行业纳米技术的发展，越来越高，对防静电工作区和防静电系统的要求也越来越高。静电电压100V已不能满足要求，芯片的静电放电敏感电压阈值越来越低，对静电防护提出了更高的要求。

5. 参考文献

5.1 ANSI/ESD S20.20-2007《静电放电之控制方案》

5.2 ANSI/ESD S6.1-2005《静电放电敏感元件的防护接地》

5.3 ESD TR20.20-2000 ESD协会技术报告《静电放电之控制方案—手册》

5.4 NFPA 70-2011《国家电力规范》

5.5 IEEE Std142-2007《工业和商业电力系统接地的推荐做法》

5.6 IEC61340-5-1 2007《电子器件的静电防护—基本要求》

5.7 IEC TR61340-5-2 2007《电子器件的静电防护—用户指南》

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Questions in the Use of Inspection Standards for Antistatic Work Areas — Experience from Using IEC61340-5-1 and ANSI/ESD S20.20

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B6 防静电工作区检验标准使用中的几个问题——使用ANSI/ESD S20.20和IEC61340-5-1的几点体会
Questions in the Use of Inspection Standards for Antistatic Work Areas —— Experience from Using IEC61340-5-1 and ANSI/ESD S20.20

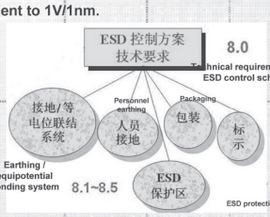
1 Relationship between ANSI/ESD S20.20 and IEC61340-5-1 within EPA

1.1 Important role of EPA in electrostatic protection

1.2 Significance of antistatic management system in EPA construction

The data comes from International GJB/Z 105-1998 Electrostatic Discharge Control Manual for Protection of Electronic Products. The insulation strength of silicon dioxide shall be 10^7V/cm and the breakdown field strength is 1×10^7V/cm, equivalent to 1V/1nm.

1.3 Requirements on EPA in IEC 61340-5-1 and ANSI/ESD S20.20



2 Antistatic earthing system of EPA

2.1 Antistatic Earthing System of ANSI/ESD S20.20

ANSI/ESD S20.20 Table 1: Earthing and Equipotential Bonding Requirements

Technical requirements	Implementation plan	Testing method	Compulsory limitation
Earthing / equipotential bondingsystem	Equipment earthing conductor	ANSI/ESD S6.1	<1.0 ohmage
	Auxiliary earthing	ANSI/ESD S6.1	<25 ohm to equipment earthing conductor
	Equipotential phase bonding	ANSI/ESD S6.1	<1.0x10^{9}ohm

¹Maximum resistance between any electrostatic discharge technical unit and common ground point.
Deamer Wu MKS, Ion Systems / Dr. Guan Wei MKS, Ion Systems // file download website: http://www.esda.org/keydownloads.html

2.2 Description of Antistatic Earthing System in IEC 61340-5-1

IEC 61340-5-1 Table 1 Earthing / Equipotential Bonding Requirements

Technical requirements	Earthing method	Testing method/ standard	Required limit
Earthing / equipotential bonding system	Protective earthing	State Electric Power System Standards	State power specification limit
	Functional earthing	State Electric Power System Standards	State power specification limit
	Equipotential bonding	See applicable implementation process in Table 2 and 3	See the limit of each ESD control item in Table 2 and 3

When the functional earthing and protection earthing are required simultaneously in Figure 1, both of them shall be connected together.

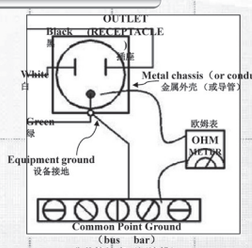
2 Antistatic Earthing System of EPA

2.3 Differences in use

2.3.1 The testing basis of ANSI/ESD S20.20 is ANSI/ESD S6.1

2.3.2 The testing basis of IEC61340-5-1 is the State Electric Power System Standards

1. Article 3.9.2 of GB50169-2006 Code for Construction and Acceptance of Grounding Connection Electric Equipment Installation Engineering: the earthing resistance R≤4Ω when there is no design requirements.



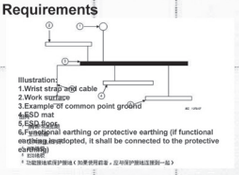
S6.1
Figure 8 Resistance Measurement of Common Point Ground

2. The testing method "three-pole measurement method" (the distance between two poles and earth poles is 20m and 40m respectively or as stipulated by the instrument) in GB/T 16895.23-2012 Low-voltage Electrical Installations - Part 6: Verification. Move the auxiliary testing pole, read the numerical values for three times and have the arithmetic mean value as the measurement results.

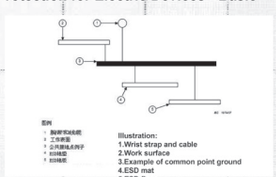
2 Antistatic Earthing System of EPA

2.4 Common Points between IEC 61340-5-1 and ANSI/ESD S20.20

2.4.1 IEC 61340-5-1：2007 Electrostatic Protection for Electric Devices - Basic Requirements



IEC 61340-5-1 Figure 1 EPA Earthing Schematic Diagram with Reference Earthing Point



IEC 61340-5-1 Figure 2 Schematic Diagram of Equipotential Bonding System

2.4.2 ANSI/ESD S20.20 8.1 Earthing / Equipotential Bonding System: the earthing / equipotential bonding system shall be applied to ensure ESDS, personnel and all other electrical conductors (such as mobile devices) are at the same electric potential.

3 Field Inspection of Resistance Indexes within EPA

3.1 Basic factors of resistance index detection

3.1.1 Electrode assembly

Table 1 Comparison on Electrode Assembly Differences in Two Standard Systems

Standard / Item	IEC		ANSI	
	Parameter and index	Standard code	Parameter and index	Standard code
①Point to point resistance, system resistance and test electrode	Cylindrical electrode weight: 2.5±0.25kg; diameter Φ63.5±1mm;10V on metal plate, testing resistance between two electrodes <1KΩ	IEC61340-2-3 IEC61340-4-1	Cylindrical electrode weight: 2.27±0.06kg(5 lb±2 oz); diameter Φ63.5±0.25mm(2.5±0.1 inches) ; 10V on metal plate, testing resistance between two electrodes <1KΩ	ANSI/ESD S4.1 ANSI/ESD S7.1 ESD TR53-01-06
②Surface resistance, volume resistance and test electrode	Concentric electrode weight: 2.5±0.25kg; interior column electrode diameter Φ30.5±1mm ; inner diameter of outer ring electrode Φ57±1mm; 10V on metal plate, testing resistance between two electrodes <1KΩ	IEC61340-2-3	Concentric electrode weight: 2.27±0.06kg(5 lb±2 oz); interior column electrode diameter 30.48±0.64mm (1.2±0.025 inches) ; inner diameter of outer ring electrode Φ57.15±0.64mm(2.25±0.025 inches) ; 10V on metal plate, testing resistance between two electrodes <1KΩ	ANSI/ESD STM11.11 ANSI/ESD STM11.12
③Shoe electrode	Shoe electrode weight: 12.5±2.5kg (composed of steel balls whose diameter is ≥ ≤3mm), the upper part is made up of steel ball cloth bag and aluminum strips and the lower part is composed of stainless steel plates, with insulating boards underneath. Shoe electrode system resistance<500Ω.	IEC61340-4-3	Shoe electrode weight: 25 lb(11.35kg) 上部由80根布袋和铝条组成，下部不锈钢板，要求对地绝缘，大于1×10E13Ω The upper part is composed of 80 steel ball cloth bags and aluminum strips and the lower part is made up of stainless steel plates, which shall have grounding insulation, greater than 1×10E13Ω.	ANSI/ESD STM 9.1
Other electrodes	5.0±0.25kg is used for other soft grounds	IEC61340-4-1		

3 Field Inspection of Resistance Indexes within EPA

[Conclusion] (I) The influence of the electrode assembly difference of the two standard systems in Table 1 is very small and IEC standard only has the supplementation in terms of other soft grounds. therefore, the influence of the electrode weight in the two standard systems on the measurement shall not not taken into account.

[Conclusion] (II) Generally speaking, the two standard systems have strict requirements on the pressure, which illustrates the importance of the pressure in the test. ① Use 2.5kg or 5 lb electrode to replace manual measurement, so as to unify the measured pressure; ② Use 12.5kg or 25 lb electrode for human body pressure. The standards don't use human body weight as the pressure here, which illustrates that the influence of weight increase on contact resistance can be ignored.

3.1.2 Influences of testing time

GJB2605-1996 Specifications for Hot Sealing, Flexible, Antistatic Barrier Materials stipulate that the time for initial voltage ±5000v decaying to ±50V shall not be greater than 2 seconds. C instrument = 20pF and electrostatically leakage resistance: R20pF =2.17×10E10Ω.

① If the capacitance C of human bodies is 200pF, the charging interval of R200pF（2.17×10E10Ω）shall be 20 seconds.

② If the capacitance C of the ground is 2000pF, Rg=1×10E9Ω, 90% testing voltage (precision) ln(100/10) =2.30 shall be guaranteed and T charging = RCln(Uo /Uc（t）) =4.6s.

B6 防静电工作区检验标准使用中的几个问题——使用ANSI/ESD S20.20和IEC61340-5-1的几点体会
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3 Field Inspection of Resistance Indexes within EPA

[Conclusion] (III) the measurement less than 20 seconds in ① will definitely produces influences, when the testing voltage (equivalence is added on the capacitance) is not high enough, the corresponding current value will be definitely small and then the readings will be lower than actual value. In the ground test in ②, the measurement less than 4.6 seconds will also produce more than 10% error, which will judge nonconforming products to be conforming.

3.1.3 Testing conditions and requirements

Table 2 Comparison on Testing Voltage and Environment Requirements in Two Standard Systems

Standard / Item	IEC		ANSI	
	Parameter and index	Standard code	Parameter and index	Standard code
Testing voltage	100V±5%, (≥1×10E6Ω); 10V±5% (<1×10E6Ω), 15s; 500V±5%, (≥1×10E11Ω) for insulation materials:500V, 1min.	IEC61340-2-3 IEC61340-4-1 IEC61340-4-3	100V±5% (≥1×10E6Ω); 10V±5%(<1×10E6Ω)	ANSI/ESD STM11.11 ANSI/ESD STM11.12 ANSI/ESD S4.1 ANSI/ESD S7.1 ANSI/ESD STM9.1 ESD TR53-01-06
Testing environment	First level: 23℃±2℃ 12%RH±3%RH(stable 96+10h); Second level:23℃±2℃ 25%RH±3%RH(stable 96+10h); Third level: 23℃±2℃ 50%RH±3%RH(stable 48+10h).	IEC61340-2-3 IEC61340-4-3	Low Humidity condition: 12%RH±3%RH, 23℃ (±1℃ S4.1/±3℃S7.1) (being stable for at least 48 h and not exceeding 72h); Medium humidity condition: 50%RH (±5%RH S4.1/±2%RH S7.1), 23℃ (±1℃ S4.1/±3℃S7.1) (being stable for at least 48h and not exceeding 72h).	ANSI/ESD STM11.11 ANSI/ESD STM11.12 ANSI/ESD S4.1 ANSI/ESD S7.1 ANSI/ESD STM9.1 ESD TR53-01-06
Testing time	Read the number in 15 seconds		The mean charging time for five times shall have 5 seconds added	

3 Field Inspection of Resistance Indexes within EPA

[Conclusion] (IV) The notable common ground between the two standards is the requirement on environment condition, which is the important factor influencing resistance index testing results. The testing results under medium and low humidity conditions and under moderate humidity conditions can differ in one order of magnitude. therefore, the performance test of the same materials under low humidity condition and moderate humidity condition (two humidity conditions) can demonstrate the influence of humidity on resistance performance of the materials and more accurate and comprehensive antistatic properties.

3.2 Relationship between resistance index and electrostatic protection

3.2.1 Resistance indexes in antistatic system certification standard

[Conclusion] (V) the protection level of electrostatic protection area shall be determined according to the level of sensitive devices. In such conditions where 100V can't meet the requirements, corresponding tightened measures shall be adopted and the ground resistance shall be higher than Rg<3.5×10E7Ω. Static conductive materials shall be used, such as Rg<1×10E6Ω, and human body static electricity is required to be <10V.

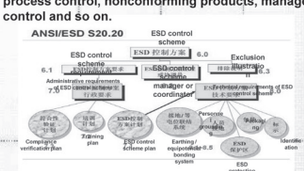
3.2.2 Relationship between ground resistance and electrostatic protection

[Conclusion] (VI) Human body electrostatic curve illustrates that there is instant electrostatic peak within EPA, which will disappear transiently, and there is potential harm. The standing time is quite important for operating ESDS. The general principle for electrostatic protection requires that the control electrostatic voltage shall be smaller than -6dB of electrostatic discharge sensitive voltage threshold of ESDS (namely 1/2 voltage).

4 Conclusion

A comprehensive and effective electrostatic protection system shall be established on the basis of the total quality control.

Take ANSI/ESD S20.20 as an example. The standard clearly defines ESD system establishment, EPA establishment, handling of sensitive device packaging, production and other links, personnel training and check, internal audit system establishment and check, detection methods and other aspects, which involve procurement, metering, process control, nonconforming products, management responsibilities, document control and so on.



With the development of nanometer technology in microelectronic industry, the requirements on EPA and antistatic system become higher and higher. Electrostatic voltage 100V can't meet the requirements and the electrostatic discharge sensitive voltage threshold of the chips is lower and lower, which proposes higher requirements on electrostatic protection.

5. References

5.1 ANSI/ESD S20.20-2007 Electrostatic Discharge Control Scheme

5.2 ANSI/ESD S6.1-2005 Protective Grounding for Electrostatic Discharge Sensitive Device

5.3 ESD TR20.20-2000 ESD Technical Report of the Association Electrostatic Discharge Control Scheme - Manual

5.4 NFPA 70-2011 National Electric Code

5.5 IEEE Std142-2007 Recommended Practice for Industrial and Commercial Electric System Grounding

5.6 IEC61340-5-1 2007 Electrostatic Protection for Electric Devices - Basic Requirements

5.7 IEC TR61340-5-2 2007 Electrostatic Protection for Electric Devices - User Guide

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B7 卫星充放电效应评价与防护技术研究现状
Evaluation of Satellite Charging/Discharging Effects And Related Protection Techniques

卫星充放电效应评价与防护技术研究现状

原青云

电磁环境效应国家重点实验室

2014.10.14 上海

汇报主要内容

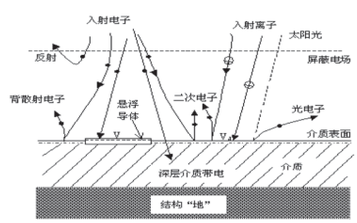
1 引 言

2 研究进展

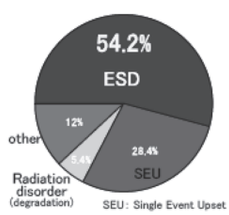
3 发展设想

一、引言

卫星充放电效应，是指卫星在空间轨道运行时，与空间等离子体、高能电子和太阳辐射等环境相互作用而发生的静电电荷积累及泄放过程，又被称为卫星带电。分为：表面带电效应和内带电效应。



一、引言



我国多颗卫星在轨运行期间，由于充放电效应造成了多次故障，因此，开展卫星充放电效应评价与防护方法研究对于保障我国卫星的研制和在轨安全具有重要的现实意义。

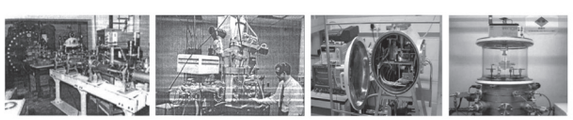
二、研究进展

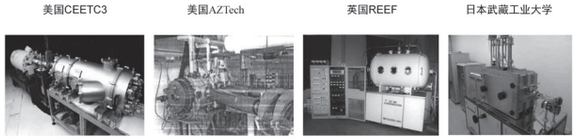
1. 评价方法

MIL-STD-1541A: ***Electromagnetic Compatibility Requirements for Space Systems***
NASA-HDBK-4001: ***Electrical Grounding Architecture for Unmanned Spacecraft***
NASA-HDBK-4002A: ***Mitigating In-Space Charging Effects: A Guideline***
NASA TP-2361: ***Design Guidelines for Assessing and Controlling Spacecraft Charging Effects***

二、研究进展

1. 评价方法—空间带电环境模拟系统





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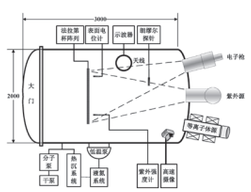
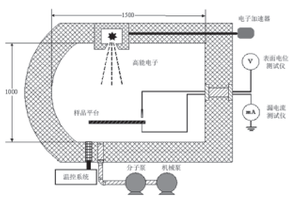
Evaluation of Satellite Charging/Discharging Effects And Related Protection Techniques

二、研究进展

1. 评价方法—空间带电环境模拟系统



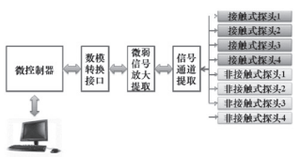
空间装备表面带电综合实验系统



空间介质内带电实验系统

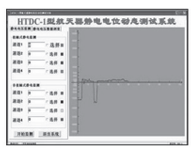
二、研究进展

1. 评价方法—航天器静电电位动态测试系统



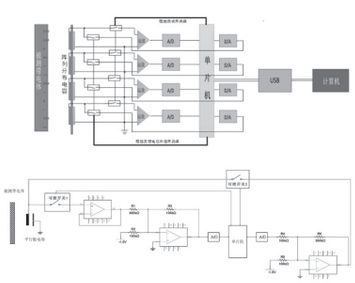
航天器静电电位动态测试系统结构示意图

响应带宽：直流~1 kHz



二、研究进展

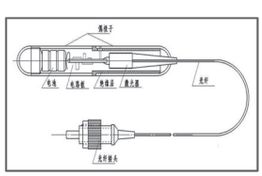
1. 评价方法—航天器静电电位动态测试系统



非接触式阵列式电位补偿静电测试仪原理示意图

二、研究进展

1. 评价方法—航天器静电放电脉冲测试装置



静电放电测试带宽：1 GHz

二、研究进展

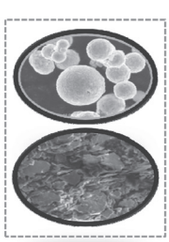
2. 防护技术

被动防护

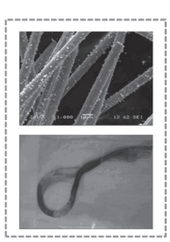
主动防护

二、研究进展

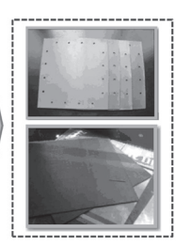
2. 防护技术—被动防护



银包铁核壳复合粒子



镀镍碳纤维



导电导磁双性抗静电复合材料

获2013年军队科技进步一等奖

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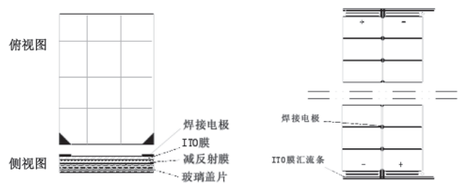
Evaluation of Satellite Charging/Discharging Effects And Related Protection Techniques

二、研究进展

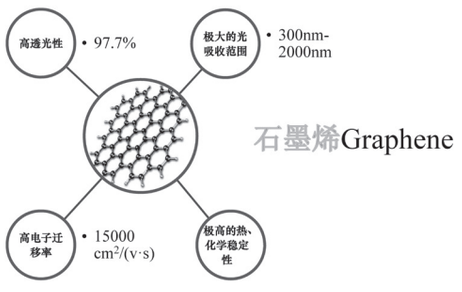
2. 防护技术—被动防护



网格式ITO膜防护方法

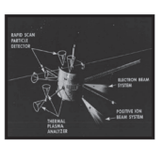
二、研究进展

2. 防护技术—被动防护

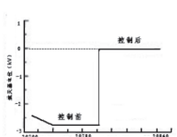


二、研究进展

2. 防护技术—主动防护



SCATHA/P78-2卫星电位主动控制试验



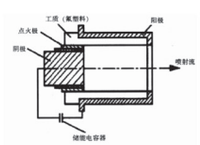
Xe等离子体电位控制效果

SHIELD实物图

功率	30 W(最大工作功率50 W，60 s 冷启动时间)
总线电压	28 ± 6 V DC
气体工质	Xenon，流量控制 0.03 mg/s
离子电流	最大到10 mA
电子电流	最大到1000 mA
离子能量	10 - 20 eV
电子能量	≤ 1 eV
工作寿命	15,000 hours
开/关次数	10,000
重量	6.3kg(包括1.8kg的 Xenon)
尺寸	17.8cm × 27.9cm × 12.7cm

二、研究进展

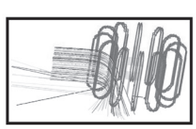
2. 防护技术—主动防护



脉冲等离子体源（PPS）结构示意图

四喷口PPS原理样机

磁鞘的一种设计方案

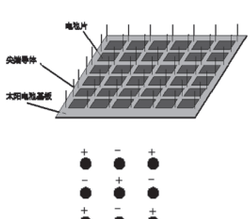


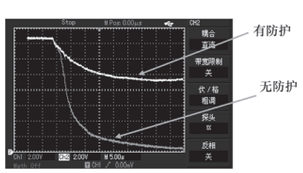
0.15MeV 左右的电子在磁鞘中的偏转情况

二、研究进展

2. 防护技术—主动防护

基于强电场的主动防护技术，即利用强电场改变带电粒子飞行方向。





三、发展设想

1. 卫星材料空间环境效应评价技术方法体系
2. 卫星带电效应仿真分析技术
3. 卫星充电电位主动控制技术
4. 空间带电环境模拟试验的新技术、新方法

B7 卫星充放电效应评价与防护技术研究现状
Evaluation of Satellite Charging/Discharging Effects And Related Protection Techniques

汇报结束！

谢谢！

Evaluation of Satellite Charging/Discharging Effects And Related Protection Techniques

Yuan Qingyun

Electromagnetic Environmental Effects State Key Laboratory

2014.10 Shanghai

Content

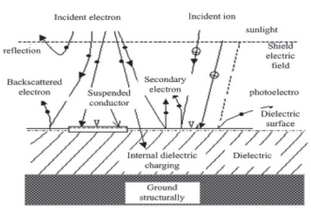
1 Introduction

2 Research Progress

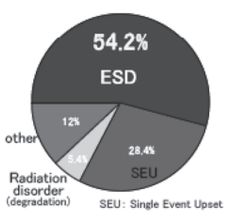
3 Development Vision

一、Introduction

Satellite charging/discharging effects, defined as the buildup and release of electrostatic charge in and on Satellite interacting with space plasma, high-energy electrons, solar radiation and other environment factors when it is in orbit. It is divided into surface charging effects and internal charging effects.



一、Introduction

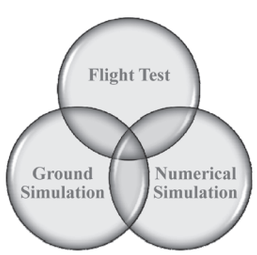


Our several satellites have been repeated failures caused by charging /discharging effects in orbit. Therefore, it's significant to carry out research on the evaluation method of satellite charging/discharging effects and related protection techniques for our satellites run safely in orbit.

二、Research Progress

1. Evaluation Method

MIL-STD-1541A: *Electromagnetic Compatibility Requirements for Space Systems*
NASA-HDBK-4001: *Electrical Grounding Architecture for Unmanned Spacecraft*
NASA-HDBK-4002A: *Mitigating In-Space Charging Effects: A Guideline*
NASA TP-2361: *Design Guidelines for Assessing and Controlling Spacecraft Charging Effects*

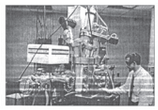


B7 卫星充放电效应评价与防护技术研究现状
Evaluation of Satellite Charging/Discharging Effects And Related Protection Techniques

二、Research Progress

1. Evaluation Method–Space Charged Environment Simulation System

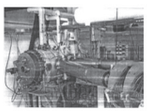

CEETC3 USA


AZTech USA


REEF UK


Musashi University Japan


SIRENE France

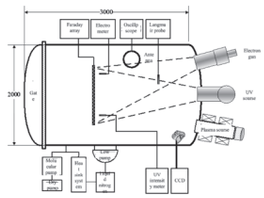

SEMIRAMIS France


Lanzhou institute of physics China

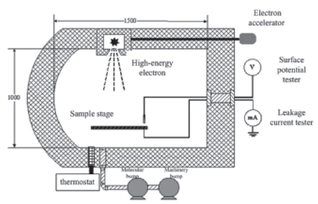

Chinese Academy of Sciences China

二、Research Progress

1. Evaluation Method–Space Charged Environment Simulation System



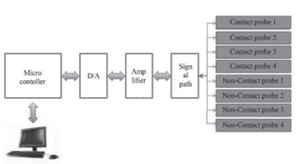
Space Equipments Surface Charging Comprehensive Experimental System



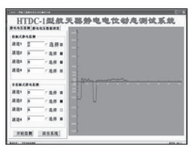
Space Dielectic Internal Charging Experiment System

二、Research Progress

1. Evaluation Method–Spacecraft Electrostatic Potential Dynamic Testing System



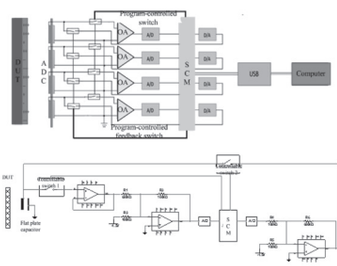
Spacecraft Electrostatic Potential Dynamic Testing System



Response Bandwidth： DC~1 kHz

二、Research Progress

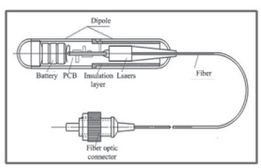
1. Evaluation Method–Spacecraft Electrostatic Potential Dynamic Testing System

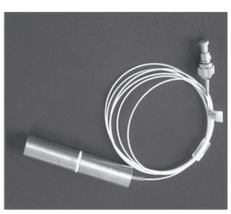



Schematic of Non-contact Array Potential Compensation Static Tester

二、Research Progress

1. Evaluation Method–Spacecraft ESD Pulse Test Device





ESD test bandwidth： 1 GHz

二、Research Progress

2. Protection Techniques

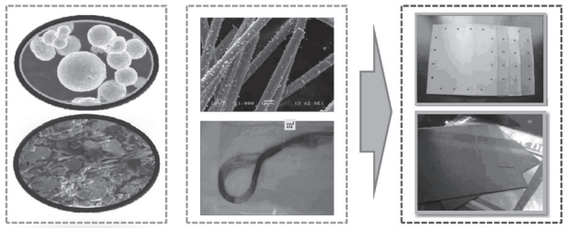
Passive Protection

Active Protection

B7 卫星充放电效应评价与防护技术研究现状
Evaluation of Satellite Charging/Discharging Effects And Related Protection Techniques

二、Research Progress

2. Protection Techniques–Passive Protection

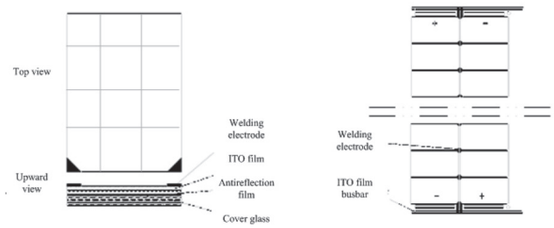


Wallets Iron Core-shell Composite Particles | Nickel-plated Carbon Fiber | Antistatic Conductive Magnetic Pairs Of Composite Materials

The 2013 Military Scientific And Technological Progress Award

二、Research Progress

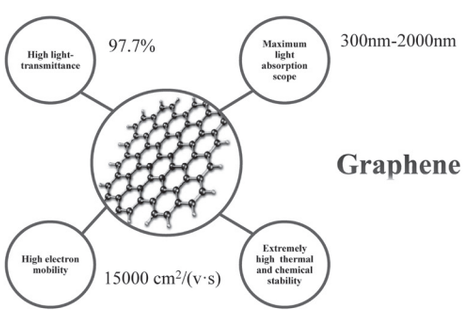
2. Protection Techniques–Passive Protection



Grid ITO Film Protection Methods

二、Research Progress

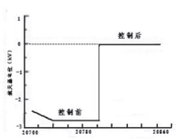
2. Protection Techniques–Passive Protection



二、Research Progress

2. Protection Techniques– Active Protection

SCATHA/P78-2 Satellite Potential Active Control Test



Xe Plasma Potential Control Effect

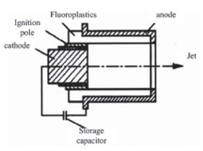
plasma sourse | shield sell | work status

SHIELD

Power	30 W(maximum Operating Power 50 W 60 S)
Bus Voltage	28 + 6 V Dc
Refrigerant Gas	Xenon
Ion Current	Up To 10 Ma
Electron Current	Up To 1000 Ma
Ion Energy	10 - 20 Ev
Electron Energy	≤ 1 Ev
Working Life	15,000 Hours
ON / OFF Times	10,000
Weight	6.3kg(including 1.8kg Of Xenon)
Size	17.8cm27.9cm12.7cm

二、Research Progress

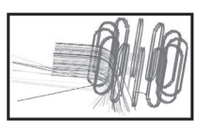
2. Protection Techniques– Active Protection



Schematic Diagram of Pulsed Plasma Source (PPS)

Four Vents PPS Prototype

A Design of The Magnetic Sheath

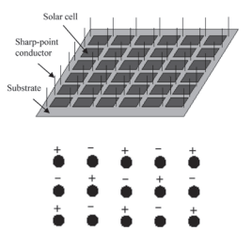


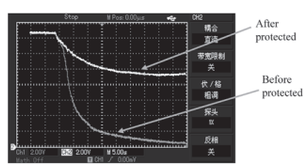
The Deflection of 0.15mev Electrons Around In The Magnetic Sheath

二、Research Progress

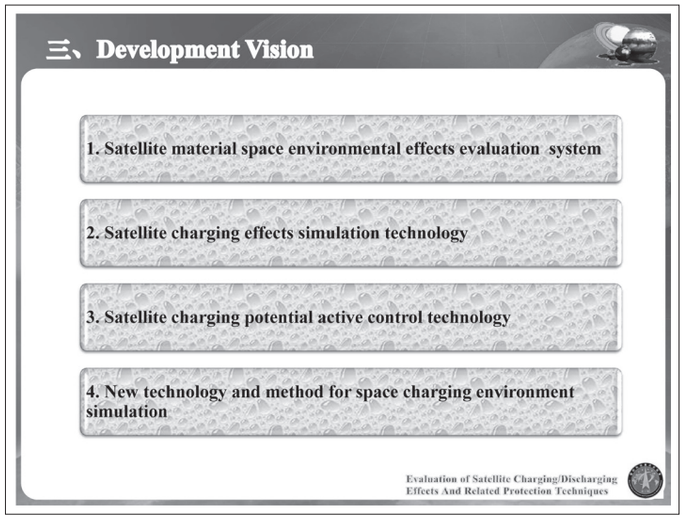
2. Protection Techniques– Active Protection

The active protective technology based on the strong electric field changing the flight direction of the charged particles .





B7 卫星充放电效应评价与防护技术研究现状
Evaluation of Satellite Charging/Discharging Effects And Related Protection Techniques



B8 新版ANSI/JEDEC/ESDA JS-002 CDM 标准
The New ANSI/JEDEC/ESDA JS-002 CDM Standard

第3届静电防护和标准化年会

ANSI/JEDEC/ESDA JS-002 CDM 标准

Nathaniel Peachey，博士
ESDA 标准业务部经理

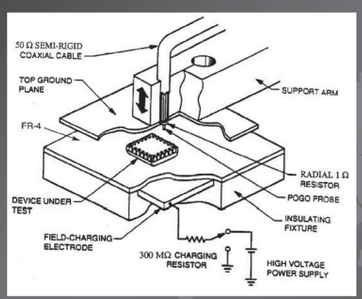
ESD协会
美国纽约Rome Turin 路7900号3栋， 13440-2069
电话： +1 315-339-6937 传真： +1 315-339-6793
email： info@esda.org 网址： www.esda.org

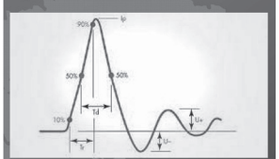
目标

- 提供CDM装置测试提要。
- 讨论其与组装过程中坚固性的关联性。
- 说明新接点 CDM文件ANSI/JEDEC/ESDA JS-002中的重大问题。

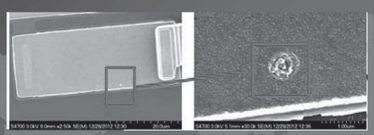
2

CDM测试





CDM测试



- CDM 故障是典型的过电压，会损坏栅氧化层或电容器氧化层。
- 这类ESD故障在HBM以外的工厂更为常见。
- CDM的坚固性被认为是工厂中装置坚固性的一个可靠的预示变量。

JEDEC和ESDA CMD 标准

- 在相当的一段时间内，JEDEC和ESDA各有它们自己的CDM 标准。
- 大多数公司选用JEDEC标准。该标准被认为是更易通过。
- 数年前人们开始将这两个不同的标准结合成一个。
- 今年已发布了新的ANSI/JEDEC/ESDA JS-002 文件。

ANSI/JEDEC/ESDA JS-002

新标准的指导原则：

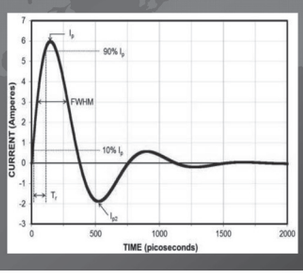
“结合有本联合文件中所用原则的关键是使用电流而非电压来定义测试条件。在仍报告有CDM电压存在的情况下，初始测试装置验证方法使用来自JEDEC校验模块的放电电流。这是一个关键的特征，允许将前面的二种方法结合成一个，同时保持到绝大多数CDM 阈值数据的连接。”

B8 新版ANSI/JEDEC/ESDA JS-002 CDM 标准
The New ANSI/JEDEC/ESDA JS-002 CDM Standard

ANSI/JEDEC/ESDA JS-002

变化内容提要

- 硬件（测试头）改变导致波形调整



ANSI/JEDEC/ESDA JS-002

变化内容提要

- 用电流测量而不是电压测量进行鉴定。
- 用测试条件（TC）而不是电压进行装置的鉴定与分类。
- TC一般与以前标准的电压测量相适应。
- *迄今为止已进行了有效的尝试以确保用新标准的测试结果会非常接近用JEDEC的电压（测试）结果。*

3rd Annual Conference on Electrostatic Protection and Standardization

ANSI/JEDEC/ESDA JS-002 CDM Standard

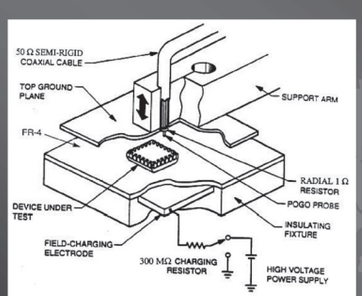
Nathaniel Peachey, PhD
ESDA Standards Business Unit Manager

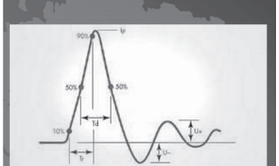
ESD ASSOCIATION
7900 Turin Road, Building 3
Rome, NY 13440-2069 USA
Ph: +1 315-339-6937 Fax: +1 315-339-6793
email: info@esda.org Website: www.esda.org

Objectives

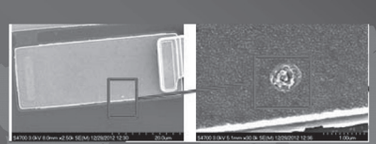
- Provide a summary of the CDM device test.
- Discuss its relevance to the robustness in assembly processes.
- Describe the important issues in the new joint CDM document ANSI/JEDEC/ESDA JS-002.

The CDM Test





The CDM Test



- CDM failures are typically overvoltage that damages gate or capacitor oxides.
- These types of ESD failures are more common in the factory than HBM.
- CDM robustness is seen as a reliable predictor of device robustness in the factory.

B8 新版ANSI/JEDEC/ESDA JS-002 CDM 标准
The New ANSI/JEDEC/ESDA JS-002 CDM Standard

The JEDEC and ESDA CMD Standards

- For quite some time JEDEC and ESDA have each had their own CDM Standard.
- Most companies chose to use the JEDEC Standard. It is considered to be easier to pass.
- Several years ago an effort was started to combine the two different Standards into one.
- The new ANSI/JEDEC/ESDA JS-002 document has been released this year.

ANSI/JEDEC/ESDA JS-002

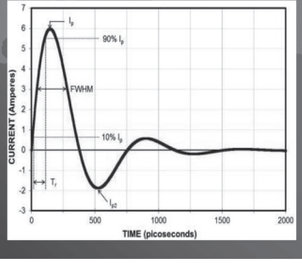
Guiding Principles of the New Standard:

"The key combining principle employed in this joint document is the use of current instead of voltage to define test conditions. While CDM voltages will still be reported, the underlying tester verification method uses discharge currents from the JEDEC calibration modules. This is the critical feature that allows the combination of the two former methods into one while maintaining connection to the vast majority of legacy CDM threshold data."

ANSI/JEDEC/ESDA JS-002

Summary of Changes

- Hardware (test head) changes result in waveform adjustments



ANSI/JEDEC/ESDA JS-002

Summary of Changes

- Qualification is now done using current measurements rather than voltage.
- Test Condition (TC) is used instead of voltage for qualification and classification of devices.
- TC generally corresponds to the voltage measurement in the previous Standard.
- *There has been an significant attempt to ensure that the test results using the new standard will be very close to the voltage results from JEDEC*

B9 TLP测试与静电放电敏感度HBM、MM、CDM测试对比分析
Tests Comparison between TLP and HBM/MM/CDM ESD Sensitivity

TLP 测试与静电放电敏感度 HBM、MM、CDM测试对比分析

黄久生 博士
北京华晶汇(HJH)科技有限公司 高级工程师
美国EsdEmc公司中国区技术支持 工程师

ESD敏感度HBM/MM/CDM测试

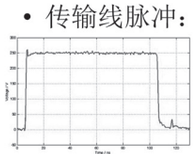
S20.20认证中最重要的依据：
制定静电放电控制方案的科学依据
(ANSI ESD S20.20-2014)
HBM: 100V
CDM: 200V
MM: 35V (孤立导体)
测试设备：HBM/MM/CDM通常
EST883A (0～±20kV)

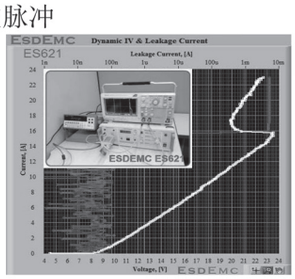
EST883 ESD Tester
HBM: 0～±20kV
MM: 0～±2000V
CDM: 0 ～±2000V

- **缺点：**
  - 敏感度测试获得信息量少（只有判断损坏或不坏），
  - 只能为被动ESD防护提供非常有限的数据，很难为主动防护设计者ESD提供多少有益的信息 。
  - 敏感度试验的电压V、电流I波形难以测量
  - 不能测试触发电压Vsnakbak，电流及失效的漏电流等参数

什么是TLP

- 传输线脉冲：方波脉冲





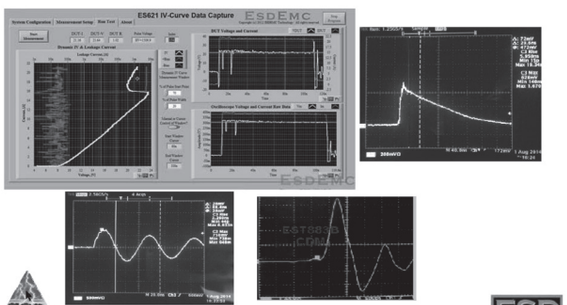
TLP有什么优点？

动态I-V曲线大量数据便于分析

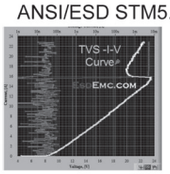
转折电压的测试和正负漏电流测试，便于ESD防护设计

ESD设计最有用的测试工具

TLP 测试与静电放电敏感度HBM、MM、CDM测试对比



TLP sim. ANSI/ESD STM5.5.1



HBM (Human Body Model)

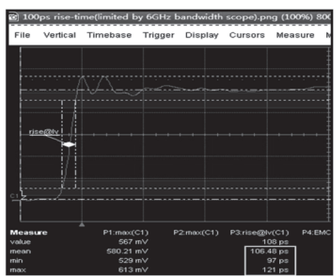
ANSI/ESDA/JEDEC JS-001-2014 or STM5.1

EsdEmc ES621 TLP 动态电流电压曲线测试系统
ES621 Series Dynamic IV-Curve Test System

VF-TLP sim. CDM

ANSI/ESD SP5.5.2 **ANSI/ESD S5.3.1**

- 模拟高速的带电器件模型 **CDM**
- 上升时间最快达**100ps** **(CDM<400ps)**
- 上升时间可模块化设置为**4X**和**7X**
- 脉冲宽度可定**1ns**到**2000ns**
- 脉冲电压电脑控制步长 **±0.1V steps**



B9 TLP测试与静电放电敏感度HBM、MM、CDM测试对比分析
Tests Comparison between TLP and HBM/MM/CDM ESD Sensitivity

TLP-HMM (Human Metal Model)

ANSI/ESD SP5. 6-2009

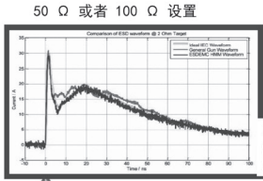
HMM 技术参数：

达8kV IEC 模型电流注入

30A 峰值电流，16A(30ns)，8A（60nA）

第一峰上升时间700～1000ps

50 Ω 或者 100 Ω 设置



The 100 Ohm HMM default, matches th ideal IEC Waveform rising and falling cur

高级ESD测试/调试/分析解决方案

ES613 ESD Simulator

ES613 ESD 模拟器

(IEC61000-4-2 & ISO10605)

人体工程学设计的放电枪

ESD 放电枪电流探头

测试和调试设定记忆功能

高精度高压电源功能

继电器寿命监控功能

可配置DUT报错检测模块

可捕获RC模块和上升沿模块

新功能可通过固件升级

ESD TR14.0-02-13
System Level or
IEC61000-4-2（2008）

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TLP - CDE (电缆放电)

ESDEMC

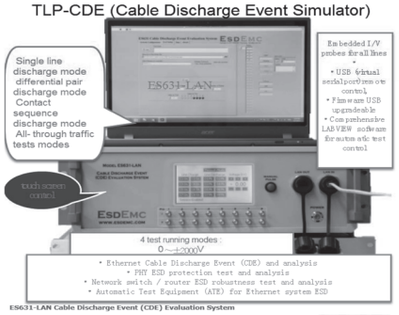
世界上第一台商用CDE

模拟网线对网络设备电子器件的放电

•应用：

- 电缆放电测试与分析
- PHY ESD 防护测试与分析
- •网络开关/路由抗ESD能力测试与分析
- •网络系统ESD自动测试设备

TLP-CDE (Cable Discharge Event Simulator)



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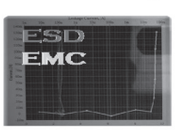
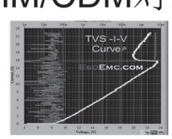
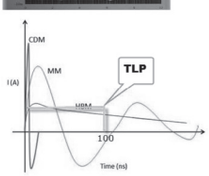
TLP I-V 与HBM/MM/CDM对比







ANSI ESD S20.20-2014:
HBM: 100V
CDM: 200V
MM: 35V (孤立导体)

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Tests Comparison between TLP and HBM/MM/CDM ESD Sensitivity

Dr. Js Huang

Beijiing HJH S&T, ESD Engineer
ESDEMC App. & Support Engineer

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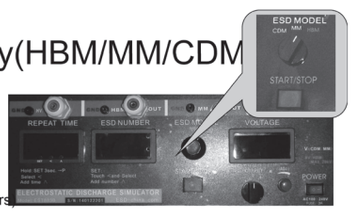
ESD Sensitivity(HBM/MM/CDM

Applications:
ESD sensitivity is the most important data for establish ESD S20.20-2014 program
HBM: 100V
CDM: 200V
MM: 35V (isolated conductors)



EST883 ESD Tester
HBM: 0～±20kV
MM: 0～±2000V
CDM: 0～±2000V

- **Disadvantages of ESD Sensitivity tests**
  - Fewer data for ESD current and voltage applied to DUT
  - Fewer data for ESD protection design
  - DUT voltage and current is not recording
  - No snapback voltage, current leakage data

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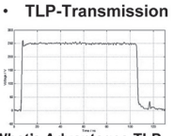
What is TLP

- **TLP-Transmission Line Pulse, or square-wave pulse**

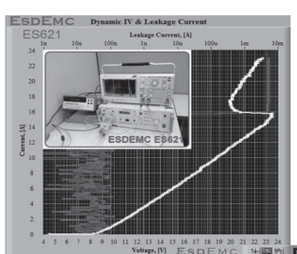


What's Advantages TLP I-V system

•Dynamic I-V test of DUT

•Vsnapback voltage, ±Icurrent leakage data

•Most important tools for ESD design and analysis



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B9 TLP测试与静电放电敏感度HBM、MM、CDM测试对比分析
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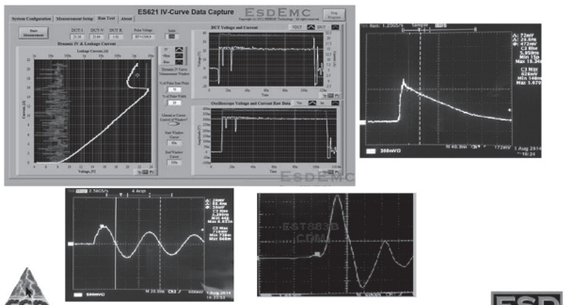
Test Comparison between TLP and HBM/MM/CDM ESD Sensitivity



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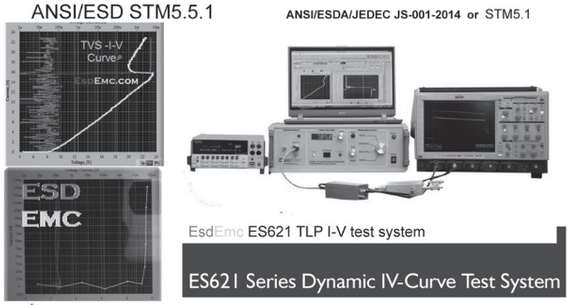
TLP sim. ANSI/ESD STM5.5.1 HBM (Human Body Model) ANSI/ESDA/JEDEC JS-001-2014 or STM5.1



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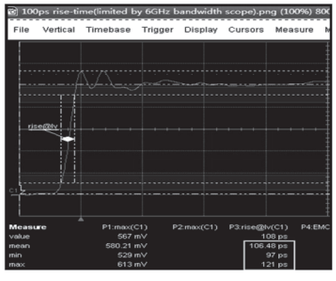
VF-TLP sim. CDM

ANSI/ESD SP5.5.2 **ANSI/ESD S5.3.1**

- **Simulate the CDM high speed ESD event**
- **100ps rise time & Programmable Rise- Time Module**
  X4 (CDM)
  X7 (HMM / IEC)
- **Pulse Width Adjustable Range**
  1ns～2000ns
- **Pulse Voltage Control**
  ±0.1V steps



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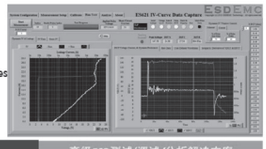
TLP-HMM (Human Metal Model)

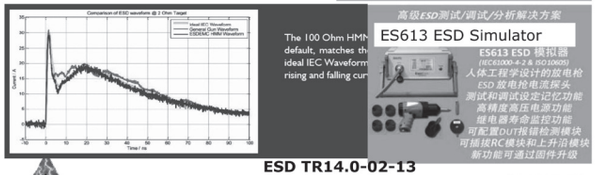
ANSI/ESD SP5. 6-2009

HMM Specifications

Standard Models

- Up to 8kV IEC model current injection for low Ohm devices
- 30A first peak, 16 A at 30ns, 8A at 60ns
- First peak rise-time 700 to 1000 ps
- Option of 50 Ohm or 100 Ohm test setups





ESD TR14.0-02-13 System Level or IEC61000-4-2

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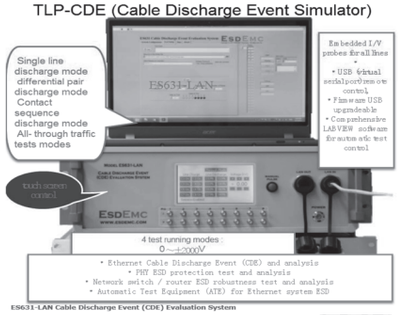
TLP-CDE (Cable Discharge Event)

First World Commercial CDE

Simulate the Ethernet cable discharge to any Ethernet based network system or device.

•Applications:
- Ethernet Cable Discharge Event (CDE) and analysis
- PHY ESD protection test and analysis
- Network switch / router ESD robustness test and analysis
- Automatic Test Equipment (ATE) for Ethernet system ESD

TLP-CDE (Cable Discharge Event Simulator)



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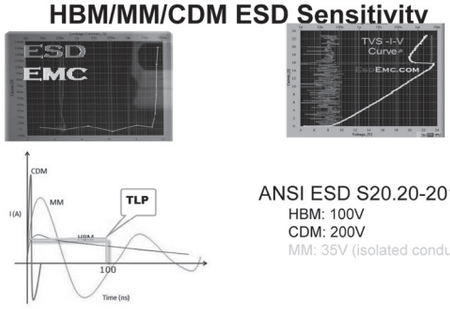
Comparison between TLP and HBM/MM/CDM ESD Sensitivity



ANSI ESD S20.20-2014:
HBM: 100V
CDM: 200V
MM: 35V (isolated conductors)

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B10 EOS/ESD传导引发失效的控制
EOS/ESD Conduction Failure Causing Control

上海防静电工业协会
上海航天电子有限公司

EOS/ESD传导引发失效的

现场控制

张明

引言

思考

ESD防护：建立了管理体系，按标准操作，为什么还有发生器件过电气应力的伤害事件？

ESD防护为消除静电积累，要求EPA内所有设备接地。如标准 GJB3007 4.1 a) 提出“ EPA内所有金属导体、 仪器设备、防静电装备、人员应接地”。Q/QJA119 5.3.1提出“ 使用交流电的工具：防静电工作区内使用交流电的工具应接地”。

当所有设备接地后,接地线就构成环路，因地线的导体或大地存在阻抗，地线上任意两点存在电位差，地线上的任一点的干扰会通过地线环路，对连接到地线上的所有设备产生干扰。

这些噪声形成的EOS导致电磁干扰（EMI）的发生：

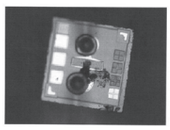
* *电气过应力，直接烧毁设备或隐性失效（在用户的使用中彻底失效）*
* *设备失灵， 造成误码或误动作*

EOS事件典型案例

中国航天

2013年6月，上海某航天企业，生产某卫星电子产品在单板调试过中，发现高频放大电路HE364B无放大特性，产品失效，送厂家（13所）进行可靠性分析。

故障定位: 将失效电路开帽检测，发现第一级 微波 放大管失效，且用高倍显微镜观察，芯片表面严重烧毁。



Source: 中电十三所

故障分析: 初步判断是输入端引入了大信号造成

* 输入端引入了大的直流信号；
* 输入端引入了大的交流信号；
* 输入端引入了EOS。

故障验证： 采用模拟失效的方法，分别在输入端加入上述信号，与实际失效电路比对得出失效模式,即采用一个接地不良,带有几十伏的零地电压的电烙铁多次触碰电路的输入端,引入的EOS导致电路失效模式与实际的电路失效一致。

结论: 电气过电压(EOS) 是导致HE364B电路失效的原因。

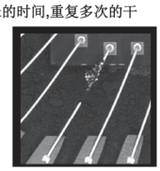
EOS失效类型与危害

中国航天

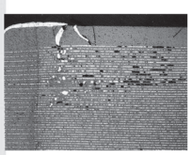
突发性失效：EOS释放的大量干扰信号能量（相对于ESD较长的时间,重复多次的干扰冲击），直接导致 操作设备的即刻失效；

造成 * 直接损失 * 闩锁效应

参数变化：与ESD损伤一样，也会使设备性能的参数指标变化 漂移、退化。



EOS damage Source: SEM Labs



EOS Damage of CaPa citor
Source: Assurance Technology

隐性失效: 最为严重的问题 是，损坏危机已经发生，但未检测发现，在后续的使用中彻底失效。

危害: EOS可以对由简单的组部件构成的设备系统，也可以对高精密的大规模集成电路造成损害。 可以影响电容和晶体管

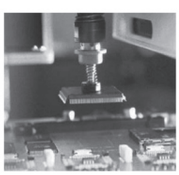
导致EOS的原因与场合

中国航天

* 雷暴、磁暴、核暴

* 设备：自动化取放器、高低温试验箱、BPCB表贴机；
* 伺服电机；
* 开关电源；
* 节能灯

* 工具：电烙铁、吸锡器、动手持工具、吸烟器；



场合: 设备的PBC装配、调试过程所经历的电应力

* 焊接 * 板级调试 * 系统调试

生产现场EOS的量值？

中国航天

现场操作EOS(瞬间）零地电压测试

项目	操作	Vp-p	RMS	备注
电吹风机	开启（1）	121 V	43.0 V	不同功率档次
	开启（2）	45 V	15.9 V	
	关闭（2）	42 V	14.8 V	
离子风机	开启	15 V	5.3 V	
	运行	3.5 V	1.23 V	
	关闭	29.8 V	10.53 V	
高低温试验箱（CIP710F）	开启	110.8 V	39.16 V	
	运行	6.37 VV	2.25 V	
	关闭	9.68	3.42 V	

B10 EOS/ESD传导引发失效的控制
EOS/ESD Conduction Failure Causing Control

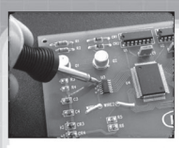
EOS接触的安全指标

敏感器件（焊接）EOS安全耐受电压

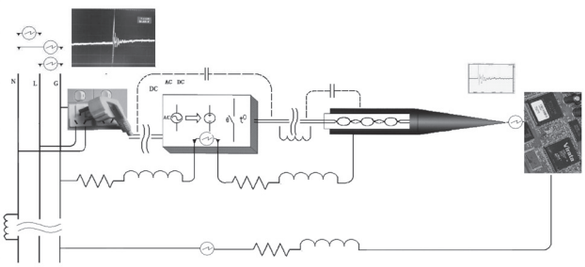
标准/组织	电压	电流	备注
MESDA STM13.1-2000	20 mV	10 mA	
MIL-STD-2000	2mV		RMS(有效值)
IPC-TM-650 Sec.2.5.33.2	2 V		Peak(峰值)
IPC-TM-650 Sec.2.5.33.2		1μA	RMS
IPC-A-610-E	0.5 V/0.3 V		Peak
GB50174-2008 《电子信息系统机房设计规范》	2 V		
航天五院	2 V		RMS(有效值)

国内这方面的研究刚起步，尚未建立敏感器件（焊接）EOS安全耐受电压的标准指标。

EOS传递的路径

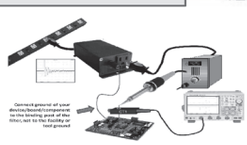


EOS 导致EMI传递到敏感器件的路径



抑制EOS的方法

电源滤波：根据使用的場合，按被保护设备的电流、电压的额定值和漏电流规定值的实际情况，选用不同的电源线 波器。

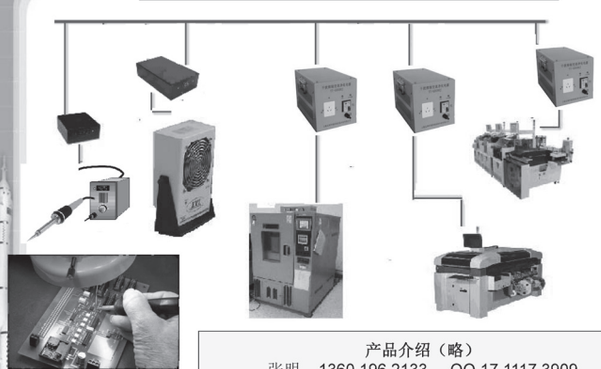


屏蔽隔离：隔离变压器实现电路与电路之间的电气隔离，超级隔离变压器可以抑制从低频段到高频段的所有共模干扰可达**140dB**以上，对高次谐波以外的所有差模干扰亦有抑制作用。

接地：地也可以作为一种防止干扰电流影响的措施，接地的谨慎隔离，能使接地自身的阻抗和它向敏感体转移阻抗最小。

小系统采用共地连接，如果在系统之间混接，对测量仪器、设备（产品联试），构成接地回路（公共地阻抗），地阻抗的变化，拾取的各种干扰形成地电 流，相互干扰敏感的仪器设备。

电子工厂EOS的系统控制



产品介绍（略）
张明　1360 196 2133　QQ 17 1117 3909

Shanghai electrostatic protection industry association
Shanghai Aerospace Electronics Co., Ltd.

EOS/ESD conduction failure causing control

Zhangming

Introduction

ESD protection in order to eliminate the accumulation of static electricity, the requirements of the EPA of all the equipment grounding.
Such as the standard GJB3007 4.1 A) put forward "all metal conductor, instrument EPA Equipment, anti-static equipment, personnel should be grounded". Q/QJA119 5.3.1 "The use of alternating current tools: Using AC electrostatic prevention in the work area.Tools should be grounded".
When all the equipment grounding, grounding wire constitutes loop, because the ground conductor or the earth impedance, Any two points on the ground potential difference exists at any point, interference of ground go through the ground loop, on Interference all devices connected to the ground.
The noise forming EOS cause electromagnetic interference (EMI) occurs:
* electrical over stress, direct burning equipment or latent failure (complete failure in the user's use)
* equipment failure, caused by error or malfunction

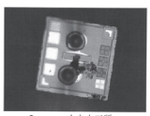
Question

ESD protection: the establishment of management system, according to the standard operation, why are generating device electrical stress injuries?

B10 EOS/ESD传导引发失效的控制
EOS/ESD Conduction Failure Causing Control

EOS accident case

In 2013 June, a Shanghai aerospace enterprise, the production of a satellite electronic products in the debugging process, found that the high-frequency amplification circuit HE364B without amplification characteristics, product failure, send factory (13) reliability analysis.
Fault location: failure detection circuit open cap, find the first grade microwave amplifier tube failure, and with high magnification Microscope observation, the chip surface badly burnt.


Source: 中电十三所

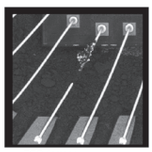
Fault analysis: preliminary judgement is introduced by large signal input
* input into the large DC signal;
* input into the large AC signal;
* input into EOS.

The fault verification: a method to simulate the failure, the signal at the input end respectively, and the actual failure circuit matching the failure mode, which uses a poor grounding, input electric iron zero with tens of volts of repeatedly touched circuit, the introduction of EOS guide circuit to circuit failure mode and the actual failure consistent.

Conclusion: electrical voltage (EOS) is a leading cause of HE364B circuit failure.

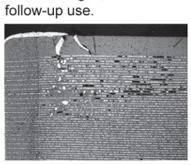
EOS failure types and hazard

Sudden failure: a lot of interference signal energy of EOS release (with respect to ESD long time, repeated impact of interference), directly lead to immediate operation equipment failure; cause direct loss of latch up effect


EOS damage
Source: SEM Labs

Parameters: as with ESD damage, also can make the parameters of the equipment performance index change of drift, degradation.

The hidden failure: the most serious problem is, the crisis has been damaged, but not detected, complete failure in the follow-up use.


EOS Damage of CaPa citor
Source: Assurance Technology

Hazard: the EOS of equipment system composed of simple components, can also cause damage to the large scale integrated circuit of high precision. Can affect the capacitor and transistor.

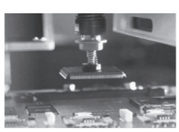
The cause and situation of EOS

Understorm, Storms, Nuclear bursts

* equipment: automatic fetching device, high low temperature test box, BPCB surface mount machine;

* tools: electric iron, tin suctioner, hand tools, smoking device;

* the servo motor;
* switch power supply;
* Energy saving light



Setting: the experienced PBC assembly, the debugging process equipment of electrical stress .
welding board、 level debugging、 system debugging

The production site EOS value

Site operation EOS (moment) zero voltage test

Project	Operation	Vp-p	RMS	Remarks
Hair dryer	Open (1)	121 V	43.0 V	 Different power grade
	Open (2)	45 V	15.9 V	
	Close (2)	42 V	14.8 V	
Ion Fan	Open	15 V	5.3 V	
	Function	3.5 V	1.23 V	
	Close	29.8 V	10.53 V	
High low temperature test box (CIP710F)	Open	110.8 V	39.16 V	
	Function	6.37 VV	2.25 V	
	Close	9.68	3.42 V	

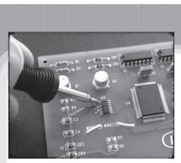
Safety index EOS contact

Sensitive device (welding) EOS safety voltage tolerance

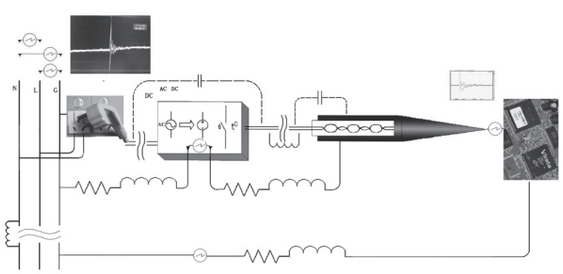
Standard / Organization	Voltage	Electricity	Remarks
MESDA STM13.1-2000	20 mV	10 mA	
MIL-STD-2000	2mV		RMS)
IPC-TM-650 Sec.2.5.33.2	2 V		Peak
IPC-TM-650 Sec.2.5.33.2		1 μA	RMS
IPC-A-610-E	0.5 V/0.3 V		Peak
GB50174 《Code for design of electronic information system room》	2 V		
航天五院	2 V		Peak

The domestic research in this area has just started, has not yet been established sensitive device (welding), the standard EOS safety voltage.

The path to the EOS transmission



EOS causes EMI to transfer to the path sensitive devices



B10 EOS/ESD传导引发失效的控制
EOS/ESD Conduction Failure Causing Control