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Keysight Technologies ESD Control Manual

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1.2	Updated training sections to include links to Meidas Level 1 & 2 training. Added Page numbers and a reference to the on-line link for this document. Optional annual conformance verification	Mark Nanakdewa	Rick Chapman	27-Oct-2016

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Note

This manual contains web links to internal reference documents that are restricted to Keysight personnel. Those links may not work if accessing this document from an external public network.

Document on-line location

<http://sharedoc.collaboration.is.keysight.com/sites/EMG-Quality/SD/EMG-BMS/ESD%20Control%20Docs/Keysight%20ESD%20Control%20Manual.pdf>

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1.0 Purpose

The purpose of this manual is to provide the requirements necessary to design, establish, implement and maintain an Electrostatic Discharge (ESD) control program where Electrostatic Discharge Sensitive (ESDS) components or subassemblies are handled.

This manual has been written to comply with industry ESD standard [ANSI/ESD S20.20-2014](#). **Note:** [ANSI/ESD S20.20](#) is technically equivalent to IEC 61340-5-1-2016. Contract Manufacturers that comply with the IEC standard meet the requirements of [ANSI/ESD S20.20-2014](#).

The fundamental ESD control principles that form the basis of this document are as follows:

- Transfer of electrostatic charge cannot occur between charged objects that are at the same electrostatic potential.
- Dissipative materials are **recommended** for first contact to any ESDS components and/or subassemblies that are at different electrostatic potentials. Dissipative materials allow electrostatic charge to transfer from one object to the other slowly and safely.
- All conductors in the environment, including personnel, shall be bonded electrically to either earth ground or another conducting body that provides an equipotential balance between all items and personnel.
- Charged insulators may potentially damage ESDS components or subassemblies through a process called "induction" which occurs when an ESD sensitive device is grounded in the presence of an electrostatic field. Ionization or other charge reduction techniques may be required if the measured static field exceeds the limits established in this manual.
- Transportation of ESDS components or subassemblies outside of an Electrostatic Protected Area (EPA) requires that the ESD sensitive device be protected from damage through either the use of ESD protective packaging or specially designed mobile equipment.

For the purposes of this manual, it shall be assumed that all unprotected components or subassemblies are ESDS devices.

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2.0 Scope

This manual applies to all Keysight locations and operations where unprotected ESD Sensitive Devices (ESDS) are handled. This manual also applies to all Contract Manufacturers that assemble products for Keysight.

Keysight suppliers are encouraged to adopt ANSI/ESD S20.20. However, at a minimum, the supplier shall have an ESD control program that includes:

- A documented ESD procedure
- Training (initial and periodic) for anyone that handles ESD sensitive parts
- Periodic verification of the installed ESD controls
- Grounding for personnel as well as the installed ESD control items. For a list of ESD control items see Table 3.
- Defined ESD Protected Areas
- ESD Sensitivity Information for the components supplied to Keysight. At a minimum there should be Human Body Model (HBM) and Charged Device Model (CDM) data available upon request.

Operations may include, but are not limited to: Design, New Product Introduction (NPI), Manufacturing Engineering, test, inspection, servicing, procurement, receiving and storage of materials, manufacturing, processing, assembly, installation and packaging.

The limits for the various ESD technical elements have been selected to ensure that ESDS that are susceptible to discharges greater than or equal to 100 volts Human Body Model (HBM), 200 volts Charged Device Model (CDM) or 35 volts on isolated charged conductors (referred to as Machine Model) will not be damaged. Any Keysight location, Supplier or Contract Manufacturer that follows ANSI/ESD S20.20-2014 or this manual can claim that their installed process will allow them to safely handle ESDS with these ESD sensitivities or higher. Operations that handle ESDS with sensitivity values that are lower than the above many require additional ESD controls or modified limits. The Keysight site ESD coordinator should be contacted to determine if program modifications are required.

Each Keysight location will develop a site ESD program document that reflects the specific ESD controls used at that location.

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3.0 Referenced Publications

Unless otherwise specified, the following documents of the latest issue, revision or amendment form a part of this manual to the extent specified herein:

- [ESD ADV1.0](#), ESD Association's Glossary of Terms
- [ANSI/ESD S1.1](#), Wrist Straps
- [ANSI/ESD STM 2.1](#), Garments
- [ANSI/ESD STM3.1](#), Ionization
- [ANSI/ESD SP3.3](#), Periodic Verification of Air Ionizers
- [ANSI/ESD S4.1](#), Worksurfaces – Resistive Measurements
- [ANSI/ESD STM4.2](#), ESD Protective Worksurfaces – Charge Dissipation Characteristics
- [ANSI/ESD S6.1](#), Grounding
- [ANSI/ESD STM7.1](#), Floor Materials – Characterization of Materials
- [ANSI/ESD S8.1](#), Symbols – ESD Awareness
- [ANSI/ESD STM9.1](#), Footwear – Resistive Characterization
- [ESD SP9.2](#), Footwear – Foot Grounders Resistive Characterization
- [ANSI/ESD STM12.1](#), Seating – Resistive Measurement
- [ANSI/ESD S13.1](#), Electrical Soldering/Desoldering Hand Tools
- [ESD TR53](#), Compliance Verification of ESD Protective Equipment and Materials
- [ANSI/ESD STM97.1](#), Floor Materials and Footwear – Resistance Measurement in Combination with a Person
- [ANSI/ESD STM97.2](#), Floor Materials and Footwear – Voltage Measurement in Combination with a Person
- [ANSI/ESD S541](#), Packaging Materials for ESD Sensitive Items
- [ANSI/ESD S11.4](#), Static Control Bags
- [ANSI/ESD S20.20-2014](#), Development of an ESD Control Program....
- [ANSI/ESD S20.20-2014 - French](#), Development of an ESD Control Program....
- [ANSI/ESD S20.20-2014 - Polish](#), Development of an ESD Control Program....
- [ANSI/ESD S20.20-2014 – Simplified Chinese](#), Development of an ESD Control Program....
- [ANSI/ESD S20.20-2014 – Traditional Chinese](#), Development of an ESD Control Program....
- [ANSI/ESD TR20.20](#) – Handbook for the development of an ESD Control Program...

Access to full text of the [ESDA ESD Standards](#)

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4.0 Definitions

The terms used in this document are in accordance with the definitions found in the ESD Association's Glossary of Terms entitled ESD ADV1.0. Additional definitions:

- Suppliers are organizations that provide products to Keysight, where the products are not designed by Keysight.
- Contract Manufacturers (CM's) are organizations that make products under contract for Keysight where the products are designed by Keysight. Assembly processes are outsourced to a CM.

5.0 Personnel Safety

The procedures and equipment described in this manual may expose personnel to hazardous electrical conditions. Users of this manual are responsible for selecting equipment that complies with applicable laws, regulatory codes and both external and internal policies. This document does not replace or supersede any requirements for personnel safety.

Ground fault circuit interrupters (GFCI) and other safety precautions should be considered wherever personnel might be exposed to hazardous electrical sources. Electrical hazard reduction practices should be exercised and proper grounding instructions for equipment shall be followed.

Any operations where personnel are exposed to operating line voltages should be reviewed and approved by the local Keysight safety authority. Safety decisions concerning the limiting of AC or DC current using the built-in resistance of an ESD control item should not be made with the current limited resistance meters used to measure those items.

6.0 ESD Control Program

6.1 ESD Control Program Requirements

Each Keysight Technology location, where unprotected ESD sensitive devices are handled, shall prepare a local ESD control program that addresses each of the Administrative Requirements (see Section 7.0) as well as the Technical Requirements (see section 8.0) of this manual. The local ESD Control Program Plan is the principle document for implementing and verifying local compliance with this manual.

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6.2 Site ESD Coordinator

A Site ESD Coordinator shall be assigned to implement and verify compliance of the local ESD program to this manual. In addition, the site ESD Coordinator's responsibilities may include, but are not limited to:

- Development and implementation of the local ESD Program Plan and Procedures
- Coordination of compliance verification audits and report preparation
- Acting as a local consultant for ESD related issues.
- Technical content of the ESD training used at their sites.
- Conducting training sessions, where needed
- Providing regular program status reports to management and the Corporate ESD Program Manager

It is recommended that Keysight sites (especially those organizations with large facilities) create ESD Control committees to help in the management of the local program. These committees shall be led by the site ESD Coordinator.

6.3 Tailoring

Tailoring is accomplished by evaluating the applicability of each Technical Requirement (see Section 8) for a specific process or application. Upon completion of the evaluation, technical requirements may be modified or eliminated from the requirements of this manual with the approval of the Keysight Corporate ESD Program Manager. Requests for tailoring should include the reason for the request as well as the technical justification for the change. If approved, the tailoring decision shall be documented in the local ESD program plan.

7.0 ESD Control Program Administrative Requirements

7.1 ESD Control Program Plan

Each site shall prepare a local ESD program plan that addresses each of the required elements of this manual. These requirements include:

- Training
- Qualification of ESD Control Products and Materials
- Compliance Verification (auditing)
- ESD Program Grounding
- Personnel Grounding
- ESD Protected Area (EPA) Requirements
- Packaging Requirements
- Marking

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The ESD Control Program Plan shall apply to all activities at the site where unprotected ESD sensitive devices are handled.

7.2 Training Plan

Initial and recurrent ESD awareness training shall be provided, at a minimum, to all personnel that handle or come into contact with ESD sensitive devices as well as all persons who need unescorted access to the ESD Protected Area. This would include new hires, transfers, contract and temporary (part-time) personnel as well as Engineers and Managers.

7.2.1 Initial Training and Certification

Initial training shall be provided before personnel handle unprotected ESD sensitive devices. Anyone entering the ESD protected area unescorted is required to take the "[Level 1: ESD Basics Training and Recertification](#)" on-line course in Meidas.

Personnel are considered to be certified once the following requirements have been completed:

- Completion of the Initial ESD Training Course
- A correct score of 90% or greater on a test administered by the trainer or on-line test.
- The recording of the names of the certified individuals in their training records

7.2.1.2 Temporary Orientation

If a new employee starts employment and a regularly scheduled initial training class is not available, it is permitted to issue a temporary certification for a period not to exceed 30 days. The temporary certification orientation must be developed and approved by the site ESD coordinator. At a minimum the orientation shall include:

- A description and demonstration on how to put on and use the personnel grounding equipment used by the site
- A description and demonstration on how to test the personnel grounding equipment used by the site
- A description and demonstration on how to handle ESD sensitive products and how to safely protect them for movement between ESD protected areas.

The supervisor for the person receiving temporary certification shall have a record of the training session that will be used as a training record until the initial training class is attended and completed.

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7.2.2 Re-certification Requirements

Re-certification is required of all ESD certified individuals at least once per year. Re-certification may also be required after any significant job change or transfer to a department or facility where the ESD control program is different. The decision for re-certification in this situation is at the discretion of the local site ESD coordinator.

Re-certification requires the completion of the following:

- A correct score of 90% or greater on the re-certification test
- The recording of the names of re-certified individuals in their training records

Repeating the certification class and test (or more frequent re-certification) is at the discretion of the ESD coordinator and/or area management.

7.2.3 ESD Coordinator Requirements

Every facility is required to provide training for ESD Coordinators. ESD Coordinator certification requires the following:

- Completion of “[Level 2: ESD Coordinator/Auditor Training](#)” that teaches the ESD Coordinator how to make compliance verification measurements based on ESD Association Technical Report [\(TR\) 53](#).
- Successful completion of a practical test using the monthly audit checklist (previous ESD-Self-Audit checklist)
- The recording of the successful coordinator’s names in their training records

ESD Coordinators do not have to re-certify as long as they perform at least two monthly audits per year from their date of certification. If certification expires the Coordinator will have to repeat the steps in this section.

7.3 Product Qualification Plan

A Product Qualification Plan must be established at each facility to ensure that the products and materials selected for use in the ESD Control Program meet the technical requirements for that item. The test methods and the required limits are located in the product qualification columns in Tables 2 and 3. Product Qualification shall be conducted during the initial selection process for the item being considered for purchase. Any of the following methods can be used as evidence of product qualification:

- Product Specification sheet review (*)
- Independent third party laboratory evaluation

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- Keysight Internal Laboratory evaluation

(*) If this method is used for product qualification, it is important that the site ESD coordinator perform, at a minimum, product qualification tests for that item at ambient temperature and relative humidity conditions prior to approval. The testing must be documented and archived.

The product qualification process described above shall be initiated from the date that this draft manual is approved for Keysight use. Product Qualification data shall be maintained by the Site ESD Coordinator.

ESD products and materials that are in use on the date that this draft manual is first approved can be considered “locally qualified” if the following conditions are met:

- The ESD Control item must meet the technical requirements for that item as found in Tables 2 and 3.
- The site has measurement data for a 12-month period showing that the ESD control item functions at the lowest possible relative humidity experience by the facility.

Note: Locally qualified materials that have NOT been completely tested to the required ESD Association test method cannot be placed on the Approved Corporate Product and Material listing.

7.4 Compliance Verification Plan

Each Keysight facility shall establish a Compliance Verification Plan. The purpose of the plan is to ensure that the site is compliant with the requirements of the local ESD program, the Corporate ESD Control Manual and ANSI/ESD S20.20-2014.

The Compliance Verification Plan shall consist of monthly area self-audits and an optional annual ESD audit conducted by a different group. Each ESD Control Item used by the site to control static electricity must be listed in the ESD Control Program. The Compliance Verification Plan must list the ESD Control Items used, the technical limits for each item and the frequency at which the verifications must occur. The ESD program must document the procedures used by the ESD Auditors to make the Compliance Verification measurements. Each site procedure shall use ESD Association [Technical Report \(TR\) 53](#) as the basis for all Compliance Verification measurements. Monthly ESD Audit, and Daily ESD wrist strap and footwear self-checks are required.

ESD Audit findings shall be documented and all corrective actions verified. The ESD Audit reports shall be issued to local management as well as the Site ESD Coordinator. The Site ESD Coordinator shall collect and combine the various ESD

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audit results into a summary report for the facility that shall be sent to the Corporate ESD program manager.

8.0 ESD Control Plan Technical Requirements

The following sections provide information regarding the Technical Requirements used in the development of an ESD control program. For the ESD control items selected for use in the local ESD program plan, the required limits and the test methods from this Corporate manual are mandatory.

8.1 Grounding / Bonding Systems

Grounding / Bonding Systems shall be used to ensure that ESD sensitive devices, personnel and any other conductors that come into contact with ESDS are at the same electrical potential.

Keysight Technologies follows the ESD Association requirements for ESD related grounding as specified in [ANSI/ESD S6.1](#). The ESD Controls must be connected to either AC (electrical/safety) ground or a separate ESD ground called an Auxiliary Ground in the ANSI standard.

Where allowed by local or national electrical codes, AC or equipment ground is the preferred ground connection for the installed ESD control items. **If a separate Auxiliary ground is used it must be bonded to AC (equipment ground) at the main service panel. The DC resistance between AC (equipment ground) and Auxiliary ground must be less than 25 ohms.**

Where multiple ESD Control items are used together, (i.e. wrist strap, work surface) the common point ground system described in [ANSI/ESD S6.1](#) shall be used.

In the event that AC (equipment ground) or Auxiliary Ground is not available it is permissible to establish an ESD safe environment by bonding all of the ESD control items together (work surface, personnel, packaged ESDS product) to a common point defined as a **common connection point** in [ANSI/ESD S6.1](#). This action is called Equipotential Bonding and will ensure that the ESD control items and the ESDS are at the same electrical potential.

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The technical requirements for grounding / equipotential bonding can be found in Table 1.

Technical Requirement	Implementing Process	Test Method	Required Limit(s)	Keysight Required Item?
Grounding / Bonding System	Equipment Grounding Conductor	ANSI/ESD S6.1	< 1.0 ohm impedance	Yes – Choose at least one but both can be present in a facility
	Auxiliary Ground	ANSI/ESD S6.1	< 25 ohms to the Equipment Grounding Conductor	
	Equipotential Bonding	ANSI/ESD S6.1	< 1.0 x 10 ⁹ ohms ⁽¹⁾	Yes (When used)

(1) The maximum resistance between any ESD control item and the common connection point.

Table 1: Grounding / Equipotential Bonding Requirement

8.2 Personnel Grounding

All personnel that handle ESD sensitive products must be connected to the grounding / bonding system via a wrist strap and/or through a footwear/flooring system.

Personnel handling ESD sensitive devices while seated must be connected to ground via a wrist strap system.

The product qualification requirements for the personnel grounding options can be found in Table 2.

Technical Requirement	Product Qualification		Compliance Verification		Keysight Required Item?
	Test Method(s)	Required Limit(s)	Test Method(s)	Required Limit(s)	
Wrist Strap System	ANSI/ESD S1.1 (Section 6.11)	< 3.5 x 10 ⁷ ohms	ESD TR53 Wrist Strap Section	< 3.5 x 10 ⁷ ohms	Yes
Footwear / Flooring System – (Both limits must be met)	ANSI/ESD STM97.1	< 3.5 x 10 ⁷ ohms	ESD TR53 Footwear Section	< 3.5 x 10 ⁷ ohms	Yes
	ANSI/ESD STM97.2	< 100 volts Peak	ESD TR53 Flooring Section	< 1.0 x 10 ⁶ ohms	Yes

Table 2: Personnel Grounding Requirement

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8.3 ESD Protected Areas

An ESD Protected Area (EPA) shall be established wherever unprotected ESD sensitive products are handled. The following requirements apply to ESD Protected Areas:

- The boundaries of the EPA shall be clearly identified.
- Unescorted access to the EPA is limited to individuals who are ESD certified.

8.3.1 Insulators

Insulators typically have a high surface and volume resistance and are easily charged through handling or contact with other items. All non-essential insulators shall be removed from the EPA. Examples of non-essential insulators are Styrofoam coffee cups, food wrappers as well as personal items.

Process required insulators are materials that are required for that process step. These materials can also be easily charged through handling or contact with other items in the process. The following requirements apply to process required insulators:

- The electrostatic field on process required insulators located closer than 1 foot (30 cm) from unprotected ESD Sensitive devices must be less than 100 volts/inch.
- Process required insulators with a measured electrostatic field of greater than or equal to 100 volts/inch must be either:
 - Moved a minimum of 12 inches (30 cm) away from unprotected ESD sensitive devices or
 - Exposed to air ionization to reduce the field on the process required insulator to less than 100 volts/inch

Note: Anti-static treatments are not recommended. Their effectiveness is not permanent and require frequent re-application. In addition, most of these chemicals require the presence of moisture in the air in order for the anti-stat to work. Anti-static chemicals may not function in ambient relative humidity environments of less than 25%.

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8.3.2 Isolated Conductors

Isolated conductors are, by definition, conductive items that are not typically grounded in the ESD control process. An example of an isolated conductor would be the conductive components in a test fixture. These conductors can become charged through charge sharing if the isolated conductor comes into contact with a charged conductor. These conductors can also become charged by air ionizers. If the air ionizer balance is greater than zero the isolated conductor will charge to the offset voltage of the ionizer. If the charged conductor then comes into contact with unprotected ESDS an ESD event will occur possibly damaging the device.

During the initial development of an ESD control program (or before a process is released to production) each process step where unprotected ESDS will be handled must be checked for isolated conductors. The voltage on these conductors must be less than 35 volts as measured with an electrostatic voltmeter (contact voltmeter is preferred). Note: This requirement in [ANSI/ESD S20.20-2014](#) only applies to isolated conductors that come into direct contact with ESDS.

There are many different ways to establish an effective ESD control program. Table 3 below lists the optional ESD controls that are commonly used. When selected for use the required limits and the referenced test methods for both product qualification and compliance verification becomes mandatory.

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Technical Requirement	ESD Control Item	Product Qualification ⁽¹⁾		Compliance Verification		Keysight Required Item?
		Test Method	Required Limit(s) ⁽²⁾	Test Method	Required Limit(s)	
EPA	Worksurface ^(3,4)	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	Yes
	Wrist Strap	ANSI/ESD S1.1	0.8 x 10 ⁶ to 1.2 x 10 ⁶ ohms	For compliance verification of a Wrist Strap System, see Table 2.		Yes
	Wristband	ANSI/ESD S1.1	Interior < 1 x 10 ⁵ 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	Yes
	Footwear	ANSI/ESD STM9.1	Point to Groundable Point < 1 x 10 ⁹ ohms	For compliance verification of Footwear / Flooring System, see Table 2.		Yes – Footwear is the required method.
	Foot Grounders	ESD SP9.2	Point to Groundable Point < 1 x 10 ⁹ ohms			Foot Grounders may be used when footwear is not possible (ex. Guests in the EPA)
	Flooring	ANSI/ESD STM7.1	Point to Point < 1 x 10 ⁶ ohms Point to Groundable Point < 1 x 10 ⁶ ohms			Yes
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	Yes – When ESD flooring or floor mats are used/installed	

Table 3: EPA ESD Control Items

¹ Product qualification is normally conducted during the initial selection of ESD control products and materials. Any of the following methods can be used: product specification review, independent laboratory evaluation or internal laboratory evaluation.

² For standards that have multiple resistance test methods, these limits apply to all methods.

³ Worksurfaces are defined as any surface on which an unprotected ESDS item is placed.

⁴ Due to a wide variety of applications for worksurfaces, specific requirements that could be broadly applied are difficult to determine. If there is a concern for CDM failures, then a lower limit of 1x10⁶ ohms for point to point and point to groundable point should be considered.

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Technical Requirement	ESD Control Item	Product Qualification (7)		Compliance Verification		Keysight Required Item?
		Test Method	Required Limit(s) (8)	Test Method	Required Limit(s)	
EPA	Ionization	ANSI/ESD STM3.1	Discharge Time 1,000 to 100 volts < 10 seconds Offset Voltage -35 < V _{offset} < 35	ESD TR53 ⁽⁵⁾ Ionization Section	Discharge Time 1,000 to 100 volts < 10 seconds Offset Voltage -35 < V _{offset} < 35	Optional
	Shelving (When used to store unprotected ESDS)	ANSI/ESD S4.1	Point to Point < 1 x 10 ⁹ ohms	ESD TR53 Worksurface Section	Point to Ground < 1 x 10 ⁹ ohms	Yes – If unprotected ESDS are stored on them
			Point to Groundable Point < 1 x 10 ⁹ ohms			
	Mobile Equipment (Working Surfaces)	ANSI/ESD S4.1	Point to Point < 1 x 10 ⁹ ohms	ESD TR53 Worksurface Section	Point to Ground < 1 x 10 ⁹ ohms	Yes - When used in the EPA for transporting unprotected ESDS
			Point to Groundable Point < 1 x 10 ⁹ ohms			
	Electrical Soldering / Desoldering Hand Tools	ANSI/ESD S13.1	Tip to Ground < 2.0 ohms	ESD TR53 Soldering Iron Section Or ANSI/ESD S13.1 Section 6.1	Tip to Ground < 10 ohms	Yes
			Tip < 20 millivolts			
Tip Leakage < 10 milliamps						
Continuous Monitors	Resistive Monitors Only	Operator Resistance to Ground < 3.5x10 ⁷ ohms	Manufacturer's Documented Testing Procedure	Operator Resistance to Ground < 3.5x10 ⁷ ohms	Optional	
Groundable Static Control Garment	ANSI/ESD STM2.1	Point to Point AND Point to Groundable Point < 1 x 10 ⁹ ohms	ESD TR53 Garments Section	Resistance Point to Point AND Resistance to Groundable Point < 1 x 10 ⁹ ohms	Yes	
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	Optional	

Table 3: EPA ESD Control Items (continued)

⁵ For additional information on periodic testing of ionizers, see ANSI/ESD SP3.3.

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8.4 Packaging

Keysight Technologies follows the packaging requirements specified in [ANSI/ESD S541](#) when packaging products that are ESD sensitive. ESD protective materials shall be qualified using the standards referenced in this manual.

The following requirements are specific to the packaging of Keysight products:

- Suppliers and Contract Manufacturers shall use Keysight approved packaging materials. Non Keysight qualified materials may only be used if the supplier has test reports showing that the packaging material was tested using the test methods and technical limits as required by [ANSI/ESD S541](#). Note: These materials must be tested at 12% ± 3% relative humidity and at a temperature of 23° C ± 3° C.
- Flexible films that are converted into ESD protective bags shall meet the physical and electrical requirements of [ANSI/ESD S11.4](#) – Static Control Bags
- Within a large EPA (formerly known as an SSWA) that utilizes ESD flooring AND employees are grounded with approved ESD footwear ESD sensitive products may be stored in one of the following:
 - Static dissipative packaging
 - Conductive containers
 - Static shielding or moisture barrier bags
- ESD sensitive items must be protected when moved between EPA's, SSWs or outside SSWA. Products must be stored in either:
 - Open products must be covered by product enclosure or ESD garment cover
 - Conductive Containers
 - Static shielding or moisture barrier bags
 - Specially designed protective carts or other mobile equipment

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8.4 Protective Package Marking

ESD Protective packaging shall be marked with the ESD Protective Symbol (see Figure 1) as found in [ANSI/ESD S8.1](#) – Symbols – ESD Awareness. This symbol can also be used on any item designed to provide ESD protection for ESD sensitive devices.



Figure 1 – ESD Protective Symbol

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1.2	Updated training sections to include links to Meidas Level 1 & 2 training. Added Page numbers and a reference to the on-line link for this document. Optional annual conformance verification	Mark Nanakdewa	Rick Chapman	27-Oct-2016
1.1	Updated "Keysight Required Items" for grounding and footwear	Mark Nanakdewa	Rick Chapman	7-June-2016
1.0	Initial release of the new Keysight ESD Control Manual based on ANSI/ESD S20.20	Mark Nanakdewa	Rick Chapman	1-June-2016

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