

CONTENTS

| | |
|--|----|
| FOREWORD | 4 |
| 1.0 PURPOSE, SCOPE, LIMITATION, and EXPERIENCE LEVEL REQUIRED | 9 |
| 1.1 Purpose | 9 |
| 1.2 Scope | 9 |
| 1.3 Limitation | 9 |
| 1.4 Experience Level Required | 9 |
| 2.0 ReferenceD PUBLICATIONS | 9 |
| 3.0 DEFINITIONS | 10 |
| 4.0 Personnel Safety | 10 |
| 5.0 Measurement Techniques FOR ESd Risk Assessment | 10 |
| 6.0 ESD Robustness of ESDS ITEMS used in Processes | 12 |
| 6.1 ESD Withstand Currents of Single Devices (Components) | 13 |
| 6.1.1 Human Body Model | 13 |
| 6.1.2 Discharge of Charged Conductors | 13 |
| 6.1.3 Charged Device Model | 14 |
| 6.2 ESD Withstand Currents of Electronic Assemblies | 14 |
| 6.2.1 Discharge of Charged Personnel | 14 |
| 6.2.2 Discharge of Charged Conductors | 14 |
| 6.2.3 Discharge of Boards/Systems | 15 |
| 7.0 Process Assessment Flow | 15 |
| 7.1 General Considerations | 15 |
| 7.2 Manual Handling Steps | 16 |
| 7.2.1 Introduction | 16 |
| 7.2.2 Parameter Limits for ESD Process Assessment in Manual Handling Steps | 16 |
| 7.2.3 Detailed ESD Risk Assessment Flow | 17 |
| 7.3 Conductors | 18 |
| 7.3.1 Introduction | 18 |
| 7.3.2 Parameter Limits for Process Assessment of Conductors | 19 |
| 7.3.3 Detailed ESD Risk Assessment Flow | 19 |
| 7.4 Charged ESDS Items | 20 |
| 7.4.1 Introduction | 20 |
| 7.4.2 Parameter Limits for Process Assessment of Charged ESDS Items | 20 |
| 7.4.3 Detailed ESD Risk Assessment Flow | 21 |
| 7.5 Risks Due to Process-Required Insulators | 23 |
| 7.5.1 Introduction | 23 |
| 7.5.2 Parameter Limits for Process Assessment of Process-Required Insulators | 23 |
| 7.5.3 Detailed ESD Risk Assessment Flow | 24 |
| 7.6 Process Assessment by ESD Event Detection | 25 |
| 7.6.1 Introduction | 25 |

| | | |
|---|--|----|
| 7.6.2 | General Procedure | 26 |
| 7.6.3 | Detailed ESD Risk Assessment Flow | 26 |
| ANNEX A (INFORMATIVE): Measurement TECHNIQUES And EQuipment | | 28 |
| A.1 | General Considerations..... | 28 |
| A.2 | Measurements of Grounding..... | 28 |
| A.3 | Measurements of Electrostatic Fields | 31 |
| A.4 | Measurements of Charges | 32 |
| A.5 | Measurements of Electrostatic Voltages | 33 |
| A.6 | Measurements of Discharge Events | 37 |
| A.7 | Measurements of Discharge Currents..... | 39 |
| ANNEX B (INFORMATIVE) – PREPARATION: WHAT IS NECESSARY TO | | |
| PREPARE AN EFFECTIVE PROCESS EVALUATION? | | 45 |
| B.1 | Measurement of Temperature, Humidity, and Basic Electrostatic Conditions | 45 |
| B.2 | Further Hints for Preparation | 45 |
| ANNEX C (INFORMATIVE) – Risk Assessment and Mitigation..... | | 46 |
| ANNEX D (INFORMATIVE) – ExampleS for defining limits in process assessment for | | |
| Risks Due to Charged Personnel | | 47 |
| ANNEX E (INFORMATIVE) – Example for CDM risk assessment in a | | |
| semiconductor manufacturing line | | 49 |
| ANNEX F (INFORMATIVE) – Bibliography | | 53 |
| ANNEX g (INFORMATIVE) – revision History for ANSI/ESD Sp17.1 | | 54 |
| Table 1 – Overview of Possible Measurement Equipment Used for Different Scenarios | | |
| to Assess ESD Risk..... | | 11 |
| Table 2 – Peak Current Ranges of CDM Discharges of Small and Large Verification Modules for | | |
| Oscilloscopes with a Bandwidth of 1 GHz and 6 GHz According to ANSI/ESDA/JEDEC JS-002..... | | 44 |
| Table 3 – Recommended Measurement Locations During Process Assessment in Assembly | | |
| (Pre-Assembly) of Devices | | 49 |
| Table 4 – Recommended Measurement Locations During Process Assessment in Device Testing . | | 50 |
| Figure 1 – Direct (Best Correlation) and Indirect (Least Correlation) Measurements | | |
| to Assess an ESD Risk..... | | 12 |
| Figure 2 – Flow to Assess ESD Risk Induced by Personnel..... | | 18 |
| Figure 3 – Flow to Assess the ESD Risk Induced by Conductors | | 20 |
| Figure 4 – Flow to Assess the ESD Risk Induced by Charged ESDS Items | | 22 |
| Figure 5 – Flow to Assess the ESD Risk Induced by Process-Required Insulators | | 25 |
| Figure 6 – Flow to Assess the ESD Risk by Detecting the Electromagnetic Radiation | | |
| Using ESD Event Detectors or Antennas and Oscilloscopes | | 27 |
| Figure 7 – Examples of Current Probes | | 40 |
| Figure 8 – Example of a 4-GHz Pellegrini Target | | 42 |
| Figure 9 – Commercially Available CDM Test Head Used for Discharge Current Measurements.... | | 43 |
| Figure 10 – Discharge Current Measured in the Field and During Device Qualification [8] | | 47 |
| Figure 11 – Examples of Measurements During Semiconductor Assembly and Testing | | 50 |
| Figure 12 – Schematic of Possible CDM-Like Scenarios During Device Testing | | 52 |