

## CONTENTS

FOREWORD .....	5
1 Scope .....	7
2 Normative references .....	7
3 Terms and definitions .....	7
4 Apparatus and required equipment .....	10
4.1 Waveform verification equipment .....	10
4.2 Oscilloscope .....	11
4.3 Additional requirements for digital oscilloscopes .....	11
4.4 Current transducer (inductive current probe) .....	11
4.5 Evaluation loads .....	11
4.6 Human body model simulator .....	12
4.7 HBM test equipment parasitic properties .....	12
5 Stress test equipment qualification and routine verification .....	12
5.1 Overview of required HBM tester evaluations .....	12
5.2 Measurement procedures .....	13
5.2.1 Reference pin pair determination .....	13
5.2.2 Waveform capture with current probe .....	13
5.2.3 Determination of waveform parameters .....	14
5.2.4 High voltage discharge path test .....	17
5.3 HBM tester qualification .....	17
5.3.1 HBM ESD tester qualification requirements .....	17
5.3.2 HBM tester qualification procedure .....	17
5.4 Test fixture board qualification for socketed testers .....	18
5.5 Routine waveform check requirements .....	19
5.5.1 Standard routine waveform check description .....	19
5.5.2 Waveform check frequency .....	19
5.5.3 Alternate routine waveform capture procedure .....	20
5.6 High voltage discharge path check .....	20
5.6.1 Relay testers .....	20
5.6.2 Non-relay testers .....	20
5.7 Tester waveform records .....	20
5.7.1 Tester and test fixture board qualification records .....	20
5.7.2 Periodic waveform check records .....	20
5.8 Safety .....	21
5.8.1 Initial set-up .....	21
5.8.2 Training .....	21
5.8.3 Personnel safety .....	21
6 Classification procedure .....	21
6.1 Devices for classification .....	21
6.2 Parametric and functional testing .....	21
6.3 Device stressing .....	21
6.4 Pin categorization .....	22
6.4.1 General .....	22
6.4.2 No connect pins .....	22
6.4.3 Supply pins .....	23
6.4.4 Non-supply pins .....	23

6.5 Pin groupings .....	24
6.5.1 Supply pin groups .....	24
6.5.2 Shorted non-supply pin groups .....	24
6.6 Pin stress combinations .....	24
6.6.1 Pin stress combination categorization .....	24
6.6.2 Non-supply and supply to supply combinations (1, 2, ... N) .....	26
6.6.3 Non-supply to non-supply combinations .....	27
6.7 HBM stressing with a low-parasitic simulator .....	28
6.7.1 Low-parasitic HBM simulator .....	28
6.7.2 Requirements for low parasitics .....	28
6.8 Testing after stressing .....	28
7 Failure criteria .....	28
8 Component classification .....	28
Annex A (informative) HBM test method flow chart .....	30
Annex B (informative) HBM test equipment parasitic properties .....	33
B.1 Optional trailing pulse detection equipment / apparatus .....	33
B.2 Optional pre-pulse voltage rise test equipment .....	34
B.3 Open-relay tester capacitance parasitics .....	36
B.4 Test to determine if an HBM simulator is a low-parasitic simulator .....	36
Annex C (informative) Example of testing a product using Table 2, Table 3, or Table 2 with a two-pin HBM tester .....	38
C.1 General .....	38
C.2 Procedure A (following Table 2): .....	39
C.3 Alternative procedure B (following Table 3): .....	40
C.4 Alternative procedure C (following Table 2): .....	41
Annex D (informative) Examples of coupled non-supply pin pairs .....	43
Annex E (normative) Cloned non-supply (I/O) pin sampling test method .....	44
E.1 Purpose and overview .....	44
E.2 Pin sampling overview and statistical details .....	44
E.3 IC product selections .....	45
E.4 Randomly selecting and testing cloned I/O pins .....	46
E.5 Determining if sampling can be used with the supplied Excel spreadsheet .....	46
E.5.1 Using the supplied Excel spreadsheet .....	46
E.5.2 Without using the Excel spreadsheet .....	46
E.6 HBM testing with a sample of cloned I/O pins .....	46
E.7 Examples of testing with sampled cloned I/Os .....	47
Bibliography .....	50
Figure 1 – Simplified HBM simulator circuit with loads .....	12
Figure 2 – Current waveform through shorting wires .....	15
Figure 3 – Current waveform through a 500 Ω resistor .....	16
Figure 4 – Peak current short circuit ringing waveform .....	17
Figure A.1 – HBM test method flow chart (1 of 3) .....	30
Figure B.1 – Diagram of trailing pulse measurement setup .....	33
Figure B.2 – Positive stress at 4 000 V .....	34
Figure B.3 – Negative stress at 4 000 V .....	34

Figure B.4 – Illustration of measuring voltage before HBM pulse with a Zener diode or a device .....	35
Figure B.5 – Example of voltage rise before the HBM current pulse across a 9,4 V Zener diode .....	35
Figure B.6 – Diagram of a 10-pin shorting test device showing current probe .....	37
Figure C.1 – Example to demonstrate the idea of the partitioned test .....	38
Figure E.1 – SPL, V <sub>1</sub> , VM, and z with the Bell shape distribution pin failure curve .....	45
Figure E.2 – I/O sampling test method flow chart .....	49
Table 1 – Waveform specification .....	19
Table 2 – Preferred pin combinations sets .....	25
Table 3 – Alternative pin combinations sets .....	26
Table 4 – HBM ESD component classification levels .....	29
Table C.1 – Product testing in accordance with Table 2 .....	40
Table C.2 – Product testing in accordance with Table 3 .....	41
Table C.3 – Alternative product testing in accordance with Table 2 .....	42