ICS 31.080.01
CCS L 40

NATIONAL STANDARD OF THE PEOPLE'S REPUBLIC OF CHINA

GB/T 4937.17-2018

Semiconductor devices -- Mechanical and climatic test methods -- Part 17: Neutron irradiation

Issued on: September 17, 2018 **Implemented on: January 1, 2019**

Issued by: State Administration for Market Regulation, China National Standardization Administration

Table of Contents

Foreword

GB/T 4937 "Mechanical and Climatic Test Methods for Semiconductor Devices" consists of the following components.

--- Part 1. General;

--- Part 2. Low pressure;

--- Part 3. External visual inspection;

--- Part 4. Strongly accelerated steady-state damp heat test (HAST);

---Part 5. Steady-state temperature and humidity bias life test;

---Part 6. High temperature storage;

--- Part 7. Internal water vapor content test and other residual gas analysis;

--- Part 8. Sealing;

---Part 9. Logo durability;

--- Part 10. Mechanical shock;

--- Part 11. rapid temperature change double tank method;

--- Part 12. Sweeping vibration;

--- Part 13. Salt spray;

--- Part 14. Terminal strength (lead robustness);

---Part 15. Resistance to soldering of through-hole mounting devices;

--- Part 16. Particle collision noise detection (PIND);

---Part 17. Neutron irradiation;

---Part 18. Ionizing radiation (total dose);

---Part 19. Chip shear strength;

--- Part 20. The combined effects of moisture-resistant and soldering heat on plastic surface mount devices;

---Part 20-1. Operation, packaging, marking and transport of surface mount devices sensitive to the combined effects of moisture and soldering heat;

---Part 21. Solderability;

---Part 22. Bonding strength;

--- Part 23. High temperature working life;

--- Part 24. Accelerated moisture-resistant and non-biased strong accelerated stress test (HSAT);

---Part 25. Temperature cycling;

--- Part 26. Electrostatic discharge (ESD) sensitivity test human body model (HBM);

--- Part 27. Electrostatic discharge (ESD) sensitivity test mechanical model (MM);

--- Part 28. Electrostatic discharge (ESD) sensitivity test, charged device model (CDM), device level;

---Part 29. Latch test;

--- Part 30. Pre-treatment of unsealed surface mount devices prior to reliability testing;

--- Part 31. Flammability of plastic encapsulated devices (internal);

--- Part 32. Flammability of plastic encapsulated devices (external);

---Part 33. Accelerated moisture resistance without bias high pressure cooking;

--- Part 34. Power cycling;

--- Part 35. Acoustic scanning microscopy of plastic electronic components;

---Part 36. Constant acceleration;

--- Part 37. Plate-level drop test method using accelerometers;

--- Part 38. Soft error test methods for semiconductor memory devices;

--- Part 39. Measurement of moisture diffusivity and water dissolution rate of raw materials for semiconductor components;

--- Part 40. Plate-level drop test method using tension meter;

--- Part 41. Reliability test methods for non-volatile memory devices;

--- Part 42. Storage of temperature and humidity;

--- Part 43. Guide to the reliability identification scheme for integrated circuits (ICs);

--- Part 44. Test method for neutron beam irradiation single particle effect of semiconductor devices.

This part is the 17th part of GB/T 4937.

This part is drafted in accordance with the rules given in GB/T 1.1-2009.

This section uses the translation method equivalent to IEC 60749??17.2003 "Semiconductor device mechanical and climatic test methods Part 17.

Neutron irradiation.

1 Scope

This part of GB/T 4937 is intended to determine the sensitivity of semiconductor devices to performance degradation in neutron environments. This section applies to the set

Into circuit and semiconductor discrete devices. Neutron irradiation is primarily a military or space-related application and is a destructive test.

The test objectives are as follows.

a) detecting and measuring the relationship between degradation of critical parameters of semiconductor devices and neutron fluence;

b) determining whether the specified semiconductor device parameters are within the specified limits after receiving the specified level of neutron fluence radiation

(See Chapter 4).

2.1 Test equipment

The test instrument used in the radiation test shall be a standard laboratory electronic test instrument capable of measuring the required electrical parameters, such as power supply, digital power

Pressure gauges and picoammeters, etc.

2.2 Radiation source

The source of radiation used in the test should be a pulsed reactor.

2.3 Dosimetry equipment

a) fast neutron threshold activation foils, such as 32S, 54Fe and 58Ni;

b) thermoluminescence dosimeter (TLD) such as CaF2;

c) Applicable activated foil counting equipment and TLD reading equipment.

2.4.1 Neutron fluence

For device radiation, the total amount of radiation induced in simultaneously irradiated fast neutron activation foils such as 32S, 54Fe and 58Ni can be determined.

Neutron fluence.

The standard method for converting the amount of radiation measured in the activated foil to the neutron fluence is given by the relevant standard. Converted from the amount of foil to neutrons

For the fluence, it is necessary to determine the neutron spectrum incident on the foil. If you do not know the neutron spectrum, apply national standards or other equivalent methods to determine.

Once the neutron spectrum has been determined and an equivalent single energy fluence is calculated, the appropriate monitoring foil should be used in subsequent irradiation tests.

The neutron fluence is determined (eg 32S, 54Fe and 58Ni). Thus, the neutron fluence can be used to monitor the single-energy neutron fluence received on the foil.

Characterization. The single energy neutron fluence obtained with the monitoring foil is only effective when the energy spectrum remains unchanged.

2.4.2 Dose measurement

If it is required to check the gamma ray absorbed dose of the device during the test, a thermoluminescent dosimeter (TLD) or an equivalent method should be used to confirm

set. The use of thermoluminescent dosimeters should meet national standards or other equivalent methods.