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**NATIONAL STANDARD OF THE  
PEOPLE'S REPUBLIC OF CHINA**

**GB/T 47239.3-2026**

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**Semiconductor devices - Flexible and stretchable  
semiconductor devices - Part 3: Evaluation of thin film  
transistor characteristics on flexible substrates under bulging  
(English Translation)**

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## Foreword

This document complies with the provisions of GB/T 1.1-2020 "Standardization Work Guidelines Part 1: Structure and Drafting Rules of Standardization Documents".

Drafting.

This document is Part 3 of GB/T 47239 "Semiconductor Devices - Flexible and Stretchable Semiconductor Devices". GB/T 47239 has been issued.

The following parts were laid out.

---Part 1: Bending Test Methods for Conductive Thin Films on Flexible Substrates;

---Part 2: Evaluation methods for electron mobility, subthreshold swing, and threshold voltage of flexible devices;

---Part 4: Fatigue evaluation of flexible conductive films on flexible semiconductor device substrates;

---Part 5: Test methods for thermal properties of flexible materials;

---Part 6: Thin-film resistance testing methods for flexible conductive films;

---Part 7: Test methods for barrier properties of flexible organic semiconductor packaging films;

---Part 8: Test methods for the ductility, flexibility and stability of flexible resistive memory;

---Part 9: Performance testing method for one-transistor-one-resistor (1T1R) memory cell.

This document is equivalent to IEC 62951-3:2018 "Semiconductor devices - Flexible and stretchable semiconductor devices - Part 3: Flexible substrates in..." Performance evaluation of thin-film transistors in bulging state.

The following minimal editorial changes have been made to this document.

---The URLs for the ISO and IEC terminology databases have been removed from the terminology and definitions section.

Please note that some content in this document may involve patents. The issuing organization of this document assumes no responsibility for identifying patents.

This document was proposed by the Ministry of Industry and Information Technology of the People's Republic of China.

This document is under the jurisdiction of the National Semiconductor Device Standardization Technical Committee (SAC/TC78).

## Introduction

Flexible and stretchable semiconductor devices possess characteristics such as stretchability, bendability, deformability, light weight, and variable shape, and can be used in robotic skin, etc.

Applications include wearable devices, optoelectronic products, and energy storage products. This is driven by advancements in semiconductor device technology and the development of flexible, stretchable semiconductor devices.

The widespread application of semiconductors has placed higher demands on product quality and reliability. GB/T 47239 "Flexible and Stretchable Semiconductor Devices" the "Semiconductor Devices" standard is a fundamental standard for testing and experimenting with flexible and stretchable semiconductor devices, and is essential for evaluating the performance of these devices.

It plays an important role in energy, stability, and reliability. It is planned to consist of 9 parts.

---Part 1: Bending Test Methods for Conductive Thin Films on Flexible Substrates. The purpose is to specify the bending test methods for conductive thin films on flexible semiconductor substrates.

Curved test method.

---Part 2: Evaluation Methods for Electron Mobility, Subthreshold Swing, and Threshold Voltage of Flexible Devices. The aim is to define the evaluation methods for flexible devices under bending conditions.

Evaluation methods for electrical parameters such as mobility, subthreshold swing, and threshold voltage of flexible thin-film transistor devices.

---Part 3: Performance Evaluation of Thin Film Transistors on Flexible Substrates in a Raised State. The aim is to define the performance of flexible substrates in a raised state.

Evaluation methods for thin-film transistor characteristics.

---Part 4: Fatigue Evaluation of Flexible Conductive Thin Films on Flexible Semiconductor Device Substrates. The aim is to specify the requirements for flexible semiconductor device substrates.

A fatigue evaluation method for flexible conductive films on a board.

---Part 5: Test methods for thermal properties of flexible materials. The purpose is to specify the test methods for the thermal properties of flexible materials.

---Part 6: Methods for testing the sheet resistance of flexible conductive films. The purpose is to specify the methods for testing the sheet resistance of flexible conductive films.

method.

---Part 7: Test Methods for Barrier Properties of Flexible Organic Semiconductor Packaging Films. The purpose is to specify the barrier properties of flexible organic semiconductor packaging films.

Test methods for membrane barrier properties.

Terminology and definitions, as well as testing equipment and procedures for ductility, flexibility and stability.

---Part 9: Performance Test Methods for One-Transistor-One-Resistor (1T1R) Resistive Storage Cells. The purpose is to specify the performance test methods for one-transistor-one-resistor storage cells.

Terminology and definitions for resistive (1T1R) memory cells, as well as test apparatus and test stimuli for the performance parameters of resistive memory cells.

and testing process.

GB/T 47239 (all parts) corresponds to IEC 62951 (all parts), unifying the testing of flexible and stretchable semiconductor devices.

And testing methods to support the development of the flexible semiconductor device industry.

Flexible and stretchable semiconductor devices Part 3: Flexible substrates in a raised state Thin Film Transistor Performance Evaluation

## 1 Scope

This document describes a method for evaluating the performance of thin-film transistors fabricated on flexible substrates in a bulging state.

The thin-film transistors described in this document are fabricated using materials including polyethylene terephthalate (PET), polyimide (PI), and synthetic rubber.

The stress loading method in the performance evaluation process involves applying uniform stress to the flexible substrate using external equipment.

Uniform pressure.

## 2 Normative references

The contents of the following documents, through normative references within the text, constitute essential provisions of this document. Dated citations are not included.

For references to documents, only the version corresponding to that date applies to this document; for undated references, the latest version (including all amendments) applies.

This document.

Discretedevices-Part 8: Field-effecttransistors)

## 3 Terms and Definitions

The terms and definitions defined in IEC 60747-8 and IEC 62047-17, as well as the following terms and definitions, apply to this document.

flexible substrate

Flexible thin-film substrates used to fabricate thin-film transistors.

**Note:** A high-reliability, high-quality flexible substrate made from materials such as polyimide or polyester.