IEC 62899-503-1

Edition 1.0 2020-05

INTERNATIONAL STANDARD

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Printed electronics –
Part 503-1: Quality assessment – Test method of displacement current measurement for printed thin-film transistor



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The text of this International Standard is based on the following documents:

FDIS	Report on voting
119/303/FDIS	119/307/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

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The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

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- replaced by a revised edition, or
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INTRODUCTION

There has been a need for a method to measure and evaluate performance and reliability that is appropriate for printed thin-film transistors (TFTs). In the case of printed TFTs, there is much larger parasitic capacitance than dielectric capacitance in the channel. Accordingly, there has been a need for a method to measure and evaluate the properties for printed TFTs. Carrier behavior is one such property, and mobility and threshold voltage (V_{th}) for TFTs are other properties. In the case of inorganic TFTs, for example complementary metal-oxide semiconductor (CMOS) TFTs, carriers are induced by the strong inversion at the semiconductor/dielectric interface. But in the case of organic or printed TFTs, carrier generation takes place in the accumulation mode. The total number of carriers in the organic semiconductor layer can often be insufficient to enrich the carrier concentration at the channel. There exists a carrier injection. The carrier injection occurs at the interface of the organic semiconductors' source/drain electrodes. There are three methods to investigate the carrier injection property, that is, Kelvin probe microscopy, four-terminal measurement, and displacement current measurement (DCM). Both Kelvin probe microscopy and four-terminal measurement are indirect methods, but DCM is a direct method to detect charge motion in semiconductors, molecular thin films, and nanoparticles. In this document, the DCM-based channel charge trapping and channel capacitance measurement method is proposed as a measuring method for the carrier properties of organic or printed TFTs.

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1 Scope

This part of IEC 62899 specifies a test method for displacement current measurement (DCM) for printed thin-film transistors (TFTs) or organic thin-film transistors (OTFTs).

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 291, *Plastics – Standard atmospheres for conditioning and testing*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
printed thin-film transistor
printed TFT
device of a field effect transistor whose components, that is, source-drain electrodes, semiconductor, gate electrode, and insulator, are formed by any kind of printing technologies

3.2
saturation region
operating region of a TFT in which, when the drain voltage with a magnitude greater than the difference in the applied drain-to-source voltages is applied, the drain current stays constant despite the increase in drain voltage

3.3
displacement current measurement
DCM
measurement method to measure carrier motion between the source/channel/drain and gate electrodes

3.4
charge trapping
phenomenon where the charge is trapped within (active layer and insulator layer) due to external and internal causes, when passing from the printed TFT's gate voltage through the forward scan (injection) and reverse scan (ejection)