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# INTERNATIONAL STANDARD

## Printed electronics – Part 202-11: Materials – Conductive ink – Measurement method of electrical resistance uniformity for large area printed conductive layer

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

| Draft | Report on voting |
|---|---|
| 119/537/FDIS | 119/540/RVD |

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 62899 series, published under the general title *Printed electronics*, can be found on the IEC website.

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

- reconfirmed,
- withdrawn, or
- revised.

# INTRODUCTION

The printing process is used for large area applications such as screen displays or digital signage for an outer wall of a building. It is also used to produce virtually transparent conductive films with uniform conductivity that can replace traditional thin film technologies. For fabrication of large area printed electronics, a conductive layer should be printed uniformly in the whole area. Some defects can occur during the printing process.

The most common method to measure the electrical resistivity of printed conductive layer is a four-point probe method which is very useful for obtaining sheet resistance of a conductive layer. However, the measurement area of the four-point probe method is relatively small compared to the whole area of large area devices. Therefore, it is useful to adopt a measurement method that can measure electrical resistance uniformity for a large area device. If the printed layer is very sensitive to the mechanical load of the contact probe, the contactless method (see IEC 62899-202-3) can be applicable. In case of nanomaterials such as carbon nanotube or graphene, in which mechanical damage can occur due to probe contact, the eddy current method can be used (see IEC TS 62607-6-9). This method is limited to the printed conductive layer which does not have mechanical damage during probe contact.

In this document, a method to measure the uniformity of resistances of large area printed conductive layers is described. Resistance in a conductive layer is periodically measured along the grid pattern and the values from the measurement points are compared. Sheet resistance cannot be obtained using this method. However, distribution of electrical resistance can be identified by resistance comparison and mapping. This method is similar to conventional electrical impedance tomography, but this document results from electrical resistance and potential drop measurements can be shown as a tomographic image.

This method is simple and cost-effective for screening line defects in large area printed layer. It is especially useful for a roll-to-roll printing process.

# PRINTED ELECTRONICS –

# Part 202-11: Materials – Conductive ink – Measurement method of electrical resistance uniformity for large area printed conductive layer

## 1 Scope

This part of IEC 62899 specifies a measurement method of electrical resistance uniformity for large area printed conductive layers. The purpose of this method is to measure resistance uniformity of planar large area printed layers. This method cannot measure sheet resistance. The methods measure electrical resistance or electrical potential drop and use direct contact.

## 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.

IEC 62899-202, *Printed electronics – Part 202: Materials – Conductive ink*