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BSI Standards Publication

Printed electronics

Part 302-5: Equipment — Inkjet — Significant characteristics of inkjet printing

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National foreword

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The UK participation in its preparation was entrusted to Technical Committee AMT/9, Printed Electronics.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FOREWORD

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IEC TR 62899-302-5 has been prepared by IEC technical committee 119: Printed Electronics. It is a Technical Report.

The text of this Technical Report is based on the following documents:

Draft	Report on voting
119/421/DTR	119/439/RVDTR

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 Technical Report 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- withdrawn,
- replaced by a revised edition, or
- amended.

INTRODUCTION

Until recently, inkjet technologies were used only for imaging printing (conventional ‘graphic printing’). However, the recent development of inkjet technologies, such as technologies for inkjet print-head, functional ink, or print-head driving technologies, now makes it possible to apply these technologies for another area called functional printing, such as printed electronics.

Unlike conventional imaging printing, functional printing requires to have a very precise ink drop position so as to bring a functionality to what is produced. If the ink drop position is not exact, the expected function cannot be realized because the electronic connection secured by the ink drop position is vital for the electronic function of the final product. For example, when producing 2 000 imaging pixels by 1 000 imaging-pixels display, that display would have at least 2 000 × 1 000 = 2 000 000 active-matrix circuitries in order to show an image by that display. In addition, and because of the complexity of the above-mentioned circuitries, functional printing requires a higher resolution. Usually, an active-matrix circuitry consists of several active and passive electrical components, such as transistors and capacitors. Each component is usually made (or printed) using certain layers of different printed materials. Any printing defect in an active-matrix circuitry will be catastrophic for the performance of the printed device, such as shorted circuitry; when that display shows a uniform image, such as whole white or whole black image, that image shown by a display with a defect would be pretty obvious for a viewer because human eyes are very keen for a small number of detects in a uniform image. From that sense, a defect in a complex circuitry would be a big issue for an entire printed electronics device.

On the other hand, for imaging printing, a dropped ink position would not affect the image quality of that image as much as for functional printing, because usually a defect (for example, one dot does not have a dropped ink at all in the whole black image) will not be so obvious for human eyes.

Another important difference between functional printing and imaging printing by inkjet printing technologies is due to the fragmentation in the supply chain of the functional printing electronics markets. For imaging printing, until recently a vendor would provide inks, printing equipment including inkjet heads, and sometimes a printing substrate, paper. That means that the vendor could directly control the quality of all these elements. However, for functional printing, the functions come from inks, and inks usually come from ink vendors that are specialized for inks, and inkjet heads come from an inkjet head vendor that is specialized in inkjet heads. Sometimes, a printing equipment vendor makes their own printing equipment by using several inkjet heads. Obviously, a substrate is not always paper, but can consist of several kinds of film, such as plastic films, or metal foils or both. That means vendors cannot control the whole process of printing but have to work closely with other vendors. Thus, for inkjet printing especially for printed electronics, it is extremely useful to have certain ways of evaluating functions of each component that composes functional printing.

This document explores what kind of characteristics of inkjet printing will be considered to obtain functionable printed electronics device(s), for example detailed characteristics of inkjet head(s).

PRINTED ELECTRONICS –

Part 302-5: Equipment – Inkjet – Significant characteristics of inkjet printing

1 Scope

This part of IEC 62899 provides the significant characteristics, parameters and system properties that are relevant for functional inkjet printing for printed electronics. Where possible, existing measurement standards and specifications are cited.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

No terms and definitions are listed in this document.

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

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

4 Inkjet printing

4.1 General

Generally, the purpose of printing is to put some material onto other materials. In that sense, ”printing” is sometimes called ”deposition”.

For imaging purposes, ”printing” means putting pigments or dye, which can contain colour, onto a substrate. A pigment and dye can reflect or sometimes emit light to form an image.

For electrically functional printing, ”printing” means putting electrically functional material onto a substrate. A functional material can show function(s), somehow. For printed electronics, ”printing” means putting electrically functional material(s) onto a substrate; for example,

1) an organic material that emits light when a correct electric current is applied,
2) a passive layer that protects the material under that layer, and
3) an insulating layer that electrically insulates between other materials or layers, or both.

Material put onto a substrate can realize function(s). In order to have (a) proper function(s) by a printed material, the printed position of the material is very important