



IEC 62899-301-2

Edition 1.0 2017-08

INTERNATIONAL STANDARD



**Printed electronics –
Part 301-2: Equipment – Contact printing – Rigid master – Measurement method
of plate master pattern dimension**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 19.080; 37.100.10

ISBN 978-2-8322-4768-6

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

| | |
|--|----|
| FOREWORD..... | 4 |
| INTRODUCTION..... | 6 |
| 1 Scope..... | 7 |
| 2 Normative references | 7 |
| 3 Terms and definitions | 7 |
| 4 Coordinate system [1]..... | 10 |
| 5 1-D qualification features [1]..... | 10 |
| 5.1 Measurement instrument..... | 10 |
| 5.2 Feature types..... | 10 |
| 5.3 Pattern edge detection method | 11 |
| 5.4 Feature width and pitch..... | 11 |
| 5.4.1 Procedure..... | 11 |
| 5.4.2 Report | 12 |
| 5.5 Line edge roughness (LER) and line width roughness (LWR)..... | 12 |
| 5.5.1 Procedure..... | 12 |
| 5.5.2 Report | 13 |
| 5.6 Discussion | 13 |
| 6 2-D qualification features [2]..... | 13 |
| 6.1 Measurement instrument..... | 13 |
| 6.2 Pattern edge detection method | 13 |
| 6.3 Image alignment | 14 |
| 6.4 Feature types..... | 14 |
| 6.5 Contact..... | 14 |
| 6.5.1 Procedure..... | 14 |
| 6.5.2 Report | 15 |
| 6.6 Corner rounding..... | 15 |
| 6.6.1 Procedure..... | 15 |
| 6.6.2 Report | 16 |
| 6.7 Line-end shortening | 16 |
| 6.7.1 Procedure..... | 16 |
| 6.7.2 Report | 17 |
| 6.8 Discussion | 17 |
| 7 Cross-sectional qualification features [3] | 19 |
| 7.1 Measurement instrument..... | 19 |
| 7.2 Feature types..... | 19 |
| 7.3 Cross-sectional area and feature height [3]..... | 19 |
| 7.3.1 Procedure..... | 19 |
| 7.3.2 Report | 21 |
| 7.4 Discussion | 21 |
| 8 Registration accuracy | 22 |
| 8.1 Measurement instrument..... | 22 |
| 8.2 Specification for registration marks for the plate master [4]..... | 22 |
| 8.2.1 Overview | 22 |
| 8.2.2 Guidelines for shape and sizes of registration mark | 22 |

| | | |
|-----|---|----|
| 8.3 | Algorithm for calculating the feature position from image | 24 |
| 8.4 | Procedure | 24 |
| 8.5 | Report..... | 25 |
| | Bibliography..... | 26 |
| | Figure 1 – Coordinate system for measuring patterns on the plate master | 10 |
| | Figure 2 – Evaluation example of feature width and pitch..... | 11 |
| | Figure 3 – 2-D qualification of contact hole or dot | 15 |
| | Figure 4 – 2-D qualification of corner rounding..... | 16 |
| | Figure 5 – 2D qualification of line-end shortening | 17 |
| | Figure 6 – Effect of 1-D parameter such as line width | 18 |
| | Figure 7 – Example of 1-D effect correction by reducing the line width..... | 18 |
| | Figure 8 – Example of 1-D effect correction by enlarging the line width..... | 18 |
| | Figure 9 – 3-D height distribution | 20 |
| | Figure 10 – Cross-sectional height profile | 20 |
| | Figure 11 – Trapezoidal feature model..... | 21 |
| | Figure 12 – Measurement of the relief pattern..... | 21 |
| | Figure 13 – Shape of registration mark (cross form)..... | 23 |
| | Figure 14 – Shape of registration mark (round form)..... | 23 |
| | Figure 15 – Measurement of registration accuracy | 25 |
| | Table 1 – Dimension of registration mark (cross form) | 23 |
| | Table 2 – Dimension of registration mark (round form)..... | 24 |
| | Table 3 – Example of report – Registration accuracy of reference marks relative to the reference edges..... | 25 |
| | Table 4 – Example of report – Registration accuracy of marks relative to the coordinate system of the plate master..... | 25 |

INTERNATIONAL ELECTROTECHNICAL COMMISSION

PRINTED ELECTRONICS –

**Part 301-2: Equipment – Contact printing – Rigid master –
Measurement method of plate master pattern dimension**

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 62903-2 has been prepared by IEC technical committee TC119: Printed electronics.

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

| FDIS | Report on voting |
|--------------|------------------|
| 119/178/FDIS | 119/187/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.

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 "<http://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.

A bilingual version of this publication may be issued at a later date.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

When dissecting the term "printed electronics", it can be easily understood that this industry involves electronic devices and products that are made using some fashion of printing technique. Printing methods have been widely used in textile and paper type substrates for centuries. In the past, the advent of mass producible printouts has brought huge impacts on how knowledge is stored, transferred and reproduced. At this stage of technological development, printing on either rigid or flexible substrates is considered to supplement or replace traditional electronic device manufacturing processes. The difference between media printing and printed electronics stems from the fact that media print is used to convey information for human to process using eyes while printed electronics requires machine to process electronic information; the level of required resolution and functionality make the differences. Some of the widely used functional materials for printed electronics are, but not limited to nano- or micro-size metal particles, semiconductive polymers, and dielectric materials. Due to the available and required readout resolution, small feature size below 20 μm needs to be printed. Layer thickness and registration accuracy of printed products are closely related to quality control of electronic devices, and ink materials require a high level of quality. Overall, printing tolerance is much smaller in printed electronics.

There are mainly two categories in printing process for the printed electronics. One is a non-contact printing process such as inkjet printing and electrostatic discharge (ESD) printing process. The other is a contact printing process such as gravure printing, gravure offset printing, reverse offset printing and screen printing. This document provides a proposal for measuring and assessing the printing master, therefore the scope is limited to the printing process using the printing master.

The quality of the printing master is important because the ink is transferred from the printing master to the substrate directly in these processes and it means that the quality of the results of the printed circuit depends on the quality of the printing master. For a mass production of the printed electronic devices, many companies such as device manufacturers, printing master manufacturers and printing master manufacturing equipment vendors are related to manufacturing and they need to use the printing master and the standardized measurement and assessment methods.

PRINTED ELECTRONICS –

Part 301-2: Equipment – Contact printing – Rigid master – Measurement method of plate master pattern dimension

1 Scope

This part of IEC 62899 defines measurement terms and methods related to the critical dimension of features and the registration accuracy of features on rigid plate masters.

General critical dimensions are defined to evaluate the shape accuracy of features on the plate master. To evaluate the registration accuracy of features on the plate master, the specification for the registration mark for the plate master is specified. Then, common metrology procedures to measure the critical dimensions and the registration accuracy of the plate master are established for device manufacturers, printing master manufacturers and printing master manufacturing equipment vendors. The measurement terms which are measured by agreement between the user and the supplier are measured using the measurement methods given in this document.

2 Normative references

There are no normative references in this document.