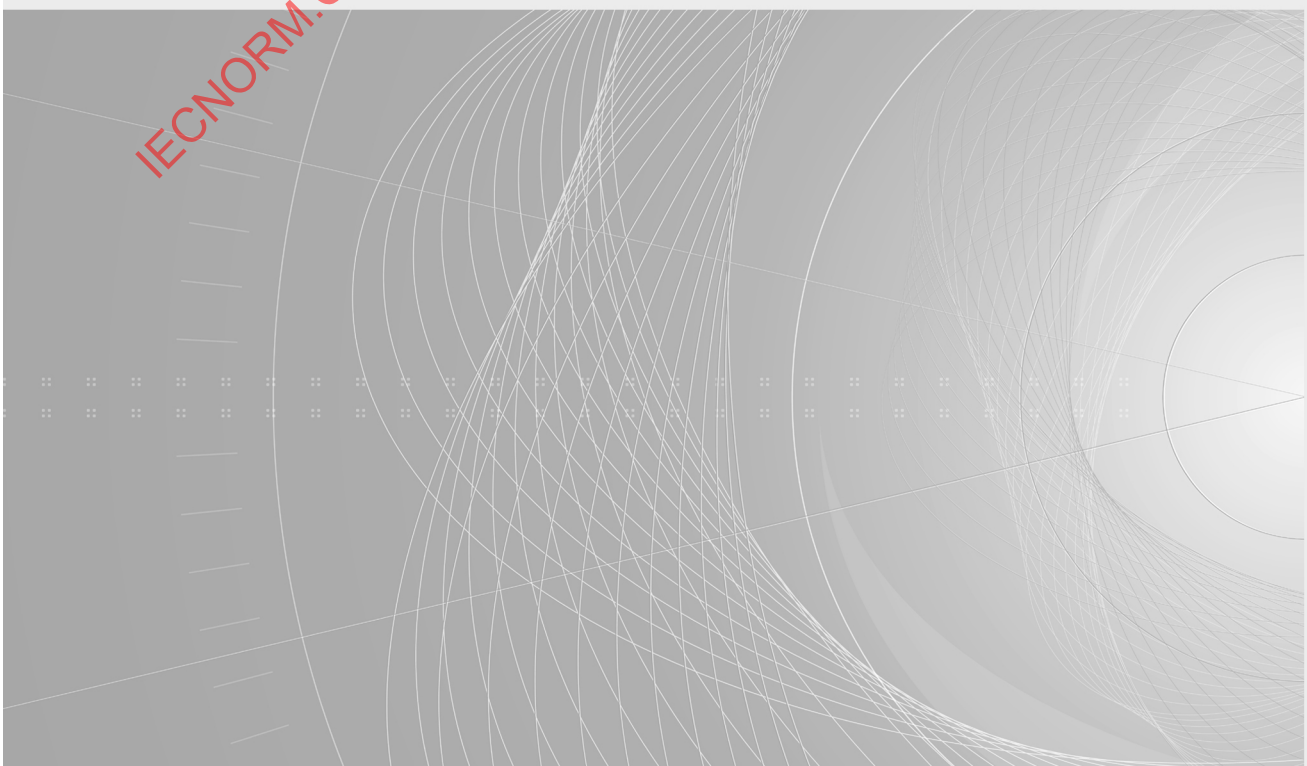
IEC 62899-402-1

Edition 1.0 2017-03

INTERNATIONAL STANDARD

colour inside

Printed electronics –
Part 402-1: Printability – Measurement of qualities – Pattern width



IEC 62899-402-1:2017-03(en)

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 31.180

ISBN 978-2-8322-3998-8

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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PRINTED ELECTRONICS –

Part 402-1: Printability – Measurement of qualities – Pattern width

FOREWORD

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International Standard IEC 62899-402-1 has been prepared by IEC technical committee 119: Printed electronics.

The text of this standard is based on the following documents:

FDIS	Report on voting
119/133/FDIS	119/143/RVD

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

This publication 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 publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication 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- withdrawn,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

This document contains fundamental information on the measurement of printed pattern width in printed electronics. This document includes measurement procedures as well as definitions of pattern width and related attributes such as variation properties of width, which are quite different from those in graphic art printing or the etching process. For example, in graphic art printing, the pattern width is generally more than several millimetres and the variation of width is relatively small and negligible. However, in printed electronics, the printed line patterns, through printing processes such as inkjet, gravure, flexography, etc., can have very narrow width of under several tens of micrometres, and the variation of pattern width can be large due to rough edges, which is hardly observed in the etching process. Therefore, it is difficult to define the line width exactly. The accurate information about pattern width can be very important for control and management of printability in the printing process and this can strongly affect the reliability and performance of printed electronics devices made of several sets of patterns.

This document excludes the standardization of the measurement system. It specifies the properties related to the width of the printed patterns obtained from the optical measurement system.

It is useful to use appropriate software that is capable of image processing, including image conversion, edge detection, calculation of the edge variation, etc., and should include information on the edge detection methods used.

PRINTED ELECTRONICS –

Part 402-1: Printability – Measurement of qualities – Pattern width

1 Scope

This part of IEC 62899 specifies the measurement methods of the widths of the printed patterns in printed electronics. These printed pattern widths are treated as two-dimensional on a substrate. When the patterns are definitely affected by three-dimensional configurations, these are specified in measurement methods for thickness in printed electronics.

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
stroke width
distance from edge to edge along a line normal to the vertical line of the captured image in the region of interest (ROI)

3.2
pattern width
distance from one edge to the other edge along a line normal to the pattern center line

3.3
pattern center line
approximate center line of two edges obtained from the centers of the stroke widths

3.4
mean pattern width
mean value of the pattern width

3.5
minimum pattern width
minimum value of the pattern width

3.6
maximum pattern width
maximum value of the pattern width

3.7
inner pattern width
distance between the inner edge lines which are drawn at the innermost points of the edges

3.8
outer pattern width
distance between the outer edge lines which are drawn at the outermost points of the edges

3.9
region of interest
ROI
area (inside defined boundaries) that the user wants to analyse

4 Atmospheric conditions for evaluation and conditioning

The standard atmosphere for evaluation (test and measurement) and storage of the specimen shall be a temperature of (23 ± 2) ˚C and relative humidity of (50 ± 10) %, conforming to standard atmosphere class 2 specified in ISO 291. For a test piece which is a substrate with printed patterns, the standard atmosphere for evaluation (test and measurement) and storage of the specimen shall be a temperature of (23 ± 1) ˚C and relative humidity of (50 ± 5) %, conforming to standard atmosphere class 1 specified in ISO 291.

If conditioning is necessary, the same standard atmosphere specified above shall apply.

5 Measuring methods and instruments

5.1 Measuring instrument

The measurement of pattern width shall be carried out with an instrument that can obtain the image of patterns. The repeatability and accuracy of the measuring instrument should be less than 10 % of the tolerance specification of the width. From the measurement system, the image of the pattern should be converted to an image file. The image should include the information of pixel size when converted to an image file.

5.2 Preparation of imaging (specimen)

The specimen for measuring pattern width contains the whole image of the pattern in the width direction. The measurer should report the size of the ROI and the resolution of the measurement system.

5.3 Measuring method

For the measurement of the width of the patterns, proper software that can recognize the two edges from patterns of the captured image and calculate the distance between two edges is required. Information on the two edges which border the width of the pattern is required. The required information on edges includes the position difference between two edges. The measurement steps are as follows:

1) Find a region of interest (ROI)

   The ROI shall contain the whole pattern in the width direction.

2) Locate the two edges by image capture

Using the proper software that can recognize the two edges in the ROI, edge images can be obtained.

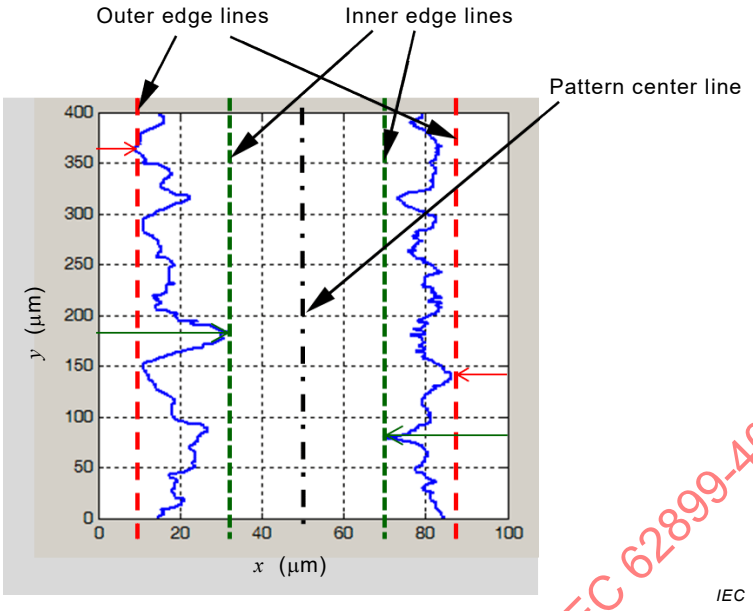

Figure 1 – Captured image of two edges of pattern and inner/outer edge lines

3) Specification of width

Draw inner edge lines and outer edge lines at each edge (Figure 1) and define the inner pattern width as the distance between the inner edge lines and the outer pattern width as the distance between the outer edge lines.

Capture the position difference between the two edges versus the coordinate perpendicular to the width direction and set this value as $f_E(y)$ (Figure 2). Therefore, $f_E(y)$ is the pattern width as a function of y, which is the coordinate in the length direction.

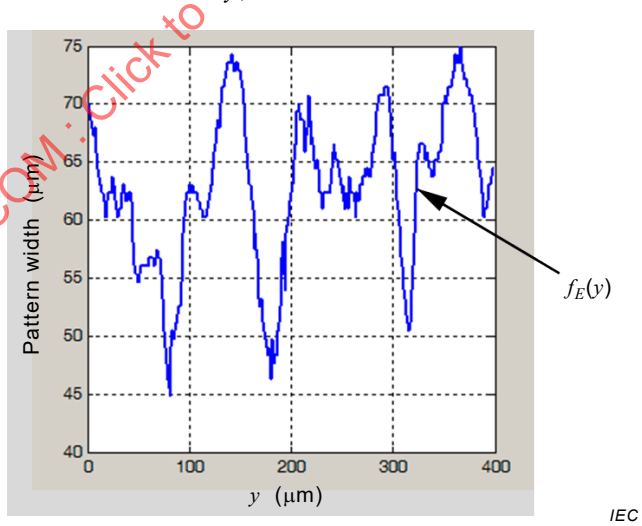

Figure 2 – Obtained position difference as a function of y

5.4 Obtaining width and related attributes

With the information obtained above, the width and related attributes can be obtained as follows:

a) W_0 (mean pattern width): mean value of $f_E(y)$

b) W_S (minimum pattern width): minimum value of $f_E(y)$

c) W_L (maximum pattern width): maximum value of $f_E(y)$

d) W_I (inner pattern width): distance between the inner edges lines

e) W_O (outer pattern width): distance between the outer edges lines

f) σ_W (variation of pattern width): $\sqrt{\frac{\sum[f_{E,i}(y_i) - W_0]^2}{n-1}}$

g) peak-to-peak to mean: $E_1 = \frac{W_L - W_S}{W_0}$

h) variation to mean: $E_2 = \frac{\sigma_W}{W_0}$

6 Report of results

6.1 Measurement identification information

The report shall include the date of the measurements, the identity of the operator, and the lot identifications.

6.2 Instrument system and its specification

The report shall include a description of the instrument system used with its specification, such as the type of instrumentation, resolution and ROI.

6.3 Measuring position

The report shall include the measuring position.

6.4 Results

The report shall include the items given in Table 1. The right side column of Table 1 is an example of the corresponding values of the items of the left side column of Table 1.

Table 1 – Example of reporting items

ORIGINATOR Test description Date of report Test operator	XYZ Printing Company Results of March 18, 2014 print set April 2, 2014 CHK
Atmospheric conditions Temperature Relative humidity	
INSTRUMENTATION Type Resolution ROI	XYZ Optical Company, Model XXX Confocal 2 μm 1 mm × 1 mm
CONFORMANCE TESTS Width Attributes Measurements	 Within the tolerance
SAMPLING POSITION	Indicate the position of the sample with the whole pattern design
PATTERN WIDTH ATTRIBUTES Mean pattern width	