

This is a preview of "BS IEC 62899-503-3:2021". [Click here to purchase the full version from the ANSI store.](#)



BSI Standards Publication

Printed electronics

Part 503-3: Quality assessment — Measuring method of contact resistance for the printed thin film transistor — Transfer length method

This is a preview of "BS IEC 62899-503-3:2021". [Click here to purchase the full version from the ANSI store.](#)

National foreword

This British Standard is the UK implementation of IEC 62899-503-3:2021.

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.

Contractual and legal considerations

This publication has been prepared in good faith, however no representation, warranty, assurance or undertaking (express or implied) is or will be made, and no responsibility or liability is or will be accepted by BSI in relation to the adequacy, accuracy, completeness or reasonableness of this publication. All and any such responsibility and liability is expressly disclaimed to the full extent permitted by the law.

This publication is provided as is, and is to be used at the recipient's own risk.

The recipient is advised to consider seeking professional guidance with respect to its use of this publication.

This publication is not intended to constitute a contract. Users are responsible for its correct application.

© The British Standards Institution 2021
Published by BSI Standards Limited 2021

ISBN 978 0 539 04325 9

ICS 29.045; 29.220.10; 29.220.30; 29.220.99; 31.080.30

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 September 2021.

Amendments/corrigenda issued since publication

Date	Text affected
------	---------------

This is a preview of "BS IEC 62899-503-3:2...". [Click here to purchase the full version from the ANSI store.](#)



Edition 1.0 2021-08

INTERNATIONAL STANDARD



**Printed electronics –
Part 503-3: Quality assessment – Measuring method of contact resistance for
the printed thin film transistor – Transfer length method**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 29.045; 31.080.30

ISBN 978-2-8322-1013-8

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

This is a preview of "BS IEC 62899-503-3:2...". [Click here to purchase the full version from the ANSI store.](#)

CONTENTS

FOREWORD.....	3
INTRODUCTION.....	5
1 Scope.....	6
2 Normative references	6
3 Terms and definitions	6
4 Symbols and abbreviated terms.....	7
5 Measuring method of contact resistance.....	8
5.1 General.....	8
5.2 Preparation of TEGs	8
5.3 Measuring apparatus	9
5.4 Environmental conditions and storage.....	9
5.5 Measuring procedure	9
5.6 Data analysis	10
5.6.1 Calculation procedure of normalized resistances for each TEG.....	10
5.6.2 Derivation procedure of contact resistance (R_C).....	10
5.7 Report	11
Annex A (informative) Examples of sets of source and drain electrodes layouts in a TEG.....	12
Bibliography.....	13
Figure 1 – Schematic structure of printed thin film transistors (TFTs).....	7
Figure 2 – Measurement configuration	8
Figure 3 – Example of plots of the total resistance R versus the distance between the source and drain electrode (channel length) L	10
Figure A.1 – Example of a set of source and drain electrodes in a TEG	12

This is a preview of "BS IEC 62899-503-3:2...". [Click here to purchase the full version from the ANSI store.](#)

INTERNATIONAL ELECTROTECHNICAL COMMISSION

PRINTED ELECTRONICS –

Part 503-3: Quality assessment – Measuring method of contact resistance for the printed thin film transistor – Transfer length method

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 62899-503-3 has been prepared by IEC technical committee 119: Printed Electronics.

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

FDIS	Report on voting
119/359/FDIS	119/368/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 is a preview of "BS IEC 62899-503-3:2...". [Click here to purchase the full version from the ANSI store.](#)

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/standardsdev/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.

IMPORTANT – The "colour inside" logo on the cover page of this document 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.

This is a preview of "BS IEC 62899-503-3:2...". [Click here to purchase the full version from the ANSI store.](#)

INTRODUCTION

In a thin film transistor (TFT), contact resistance occurs at the contacting interfaces at the gate, source and drain electrodes, and the TFT semiconductor layer. While contact resistance is negligible at the gate electrode, it reduces the effective voltage applied to the source and drain electrodes. Therefore, the evaluation of the contact resistance can provide important insights related to the performance characteristics of printed TFTs. Especially for printed electronics, the contact resistance varies with the employed materials, printing processes and the time series variation because the interface is made of simple contact obtained by additive manufacturing instead of a junction obtained by vacuum deposition and etching processes. Thus, the performance of printed TFTs is greatly influenced by the value of contact resistance. A change of the contact resistance is therefore considered to be a key factor for a proper interpretation of performance, lifetime, and reliability of a printed TFT.

To determine the contact resistance, several techniques, including but not limited to two-terminal contact method, four-terminal contact method, six-terminal contact method, transfer length method, and scanning probe potentiometer technique can be used. The transfer length method (TLM) in particular has a practical advantage because the supplier can test discrete devices, which have the same structure as the original printed TFT, on a common substrate simultaneously. Furthermore, the TLM is cost-effective because the user can measure the apparent contact resistance without using expensive equipment. Therefore, by using TLM, the supplier and the user can exchange the important parameter of the TFT that is contact resistance for reliability assessment as a part of their supply chain service.

PRINTED ELECTRONICS –

Part 503-3: Quality assessment – Measuring method of contact resistance for the printed thin film transistor – Transfer length method

1 Scope

This part of IEC 62899 specifies a measuring method of contact resistance for printed thin film transistors (TFTs) by the transfer length method (TLM). The method requires the fabrication of a test element group (TEG) with varying channel length (L) between source and drain electrodes. The method is intended for quality assessment of TFT electrode contacts and is suited for determining whether the contact resistance lies within a desired range.

2 Normative references

There are no normative references in this document.

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 contact resistance

R_c

<printed thin film transistor> resistance at the interface between an electrode and the semiconductor layer in a printed thin film transistor

Note 1 to entry: The resistance of the interface in this document involves not only the contacting area between the electrode and the semiconductor layer but also the semiconductor layer between the contacting area to electrode and the channel area for the "bottom-gate and top-contact" and "top-gate and bottom contact" devices shown in Figure 1, respectively.