

TECHNICAL REPORT

Incompatibility of connectors for DC-application in photovoltaic systems
(standards.iteh.ai)

IEC TR 63225:2019

<https://standards.iteh.ai/catalog/standards/sist/d5fb8a77-bea5-4cf5-b7cf-3fe5035d2568/iec-tr-63225-2019>



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2019 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 000 terminological entries in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

67 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

[IEC TR 63225:2019](#)

<https://standards.iec.ai/catalog/standards/sist/d5fb8a77-bea5-4cf5-b7cf-3fe5035d2568/iec-tr-63225-2019>

TECHNICAL REPORT

Incompatibility of connectors for DC-application in photovoltaic systems
(standards.iteh.ai)

[IEC TR 63225:2019](https://standards.iteh.ai/catalog/standards/sist/d5fb8a77-bea5-4cf5-b7cf-3fe5035d2568/iec-tr-63225-2019)

<https://standards.iteh.ai/catalog/standards/sist/d5fb8a77-bea5-4cf5-b7cf-3fe5035d2568/iec-tr-63225-2019>

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 27.160

ISBN 978-2-8322-7534-4

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

CONTENTS

FOREWORD	3
1 Scope	5
2 Normative references	5
3 Terms and definitions	5
4 Background	5
5 Observations	7
6 Affected stakeholders	7
7 Proposed course of action	8
7.1 General.....	8
7.2 Long-term aim.....	8
7.3 Interim measures	8
8 Conclusion	9
Bibliography.....	10

iTeh STANDARD PREVIEW **(standards.iteh.ai)**

[IEC TR 63225:2019](https://standards.iteh.ai/catalog/standards/sist/d5fb8a77-bea5-4cf5-b7cf-3fe5035d2568/iec-tr-63225-2019)

<https://standards.iteh.ai/catalog/standards/sist/d5fb8a77-bea5-4cf5-b7cf-3fe5035d2568/iec-tr-63225-2019>

INTERNATIONAL ELECTROTECHNICAL COMMISSION

INCOMPATIBILITY OF CONNECTORS FOR DC-APPLICATION IN PHOTOVOLTAIC SYSTEMS

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.

The main task of IEC technical committees is to prepare International Standards. However, a technical committee may propose the publication of a Technical Report when it has collected data of a different kind from that which is normally published as an International Standard, for example "state of the art".

IEC TR 63225, which is a Technical Report, has been prepared by IEC technical committee 82: Solar photovoltaic energy systems.

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

Draft TR	Report on voting
82/1499/DTR	82/1552A/RVDTR

Full information on the voting for the approval of this Technical Report 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.

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.

iTeh STANDARD PREVIEW (standards.iteh.ai)

[IEC TR 63225:2019](#)

<https://standards.iteh.ai/catalog/standards/sist/d5fb8a77-bea5-4cf5-b7cf-3fe5035d2568/iec-tr-63225-2019>

INCOMPATIBILITY OF CONNECTORS FOR DC-APPLICATION IN PHOTOVOLTAIC SYSTEMS

1 Scope

This document highlights the problem of incompatibility of connectors for DC-application in photovoltaic systems (DC connectors) produced by different manufacturers. It addresses four particular issues in that context:

- background information on incompatibility of DC connectors from different manufacturers;
- observations and challenges concerning the handling of DC connectors from different manufacturers;
- stakeholders concerned by the incompatibility of DC connectors;
- recommendations for long-term standardization and interim measures to address incompatibility of DC connectors.

2 Normative references

IEC 62852, *Connectors for DC-application in photovoltaic systems – Safety requirements and tests*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62852 and the following 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

DC connector

connector designed for use in DC circuits of photovoltaic systems, as defined in IEC 62852.

Note 1 to entry: This document generally refers to connectors of type MC4 or similar, and particularly products that are often referred to as "MC4-compatible".

3.2

compatible DC connectors

interoperable DC connectors

intermateable DC connectors

<connector pair> components which terminate conductors for the purpose of providing connection to and disconnection from a suitable mating component under supervision of one quality management system

4 Background

In the early years of terrestrial photovoltaics, a range of different DC connectors were available on the market. They were of distinctly different designs and could not be connected between

each other. In the early 2000s the connector type MC4¹ became more and more popular. Manufacturers started to adapt their connectors to the MC4 type. However, no international or consortia-based interface technical specifications for this connector type are available. IEC 62852, often referred to in this context, is a product safety standard and is not intended to test intermateability.

Several countries report that problems with DC connectors are a major cause for failure such as fire hazards in PV systems. Reports from different testing laboratories have shown that DC connectors from different manufacturers may not be safe to interconnect. Even if they meet basic quality requirements in the short term, they may derate when connected to products from different manufacturers.

Disregarding these circumstances, DC connectors are often declared by manufacturers as being compatible with each other. This claim of compatibility is potentially misleading as it suggests a safe interoperability of DC connectors from different manufacturers.

The reasons for the incompatibility of DC connectors from different manufacturers over the intended lifetime of the connectors are as follows.

- Different metal alloys are used. This results in a high risk of increased resistance between the DC connectors, for example because of contact corrosion and/or thermal expansion differences.
- Different contact designs are used. This results in a high risk of increased resistance.
- Mechanical tolerances are not specified. This can lead to both material stress and loose contacts risking an increased resistance between the DC connectors. This increased resistance can also result from products under the same quality management system over the intended lifetime of the connectors if the tolerances are not sufficiently defined by the manufacturer.
- The material used for the polymeric parts of the DC connector is not specified. This creates a risk of chemical incompatibility and different thermal expansion behaviour resulting in accelerated ageing of the components and increased resistance, and exacerbating the points previously mentioned during long-term implementation on a PV installation. In addition, degradation and corrosion of the polymeric parts from external factors is a risk that could lead to ingress of dust and water.
- Even if a pair of connectors from different manufacturers have been declared compatible at one point in time, the quality management system or materials used by one brand might change in the interim, meaning that later batches of the same connector are in fact no longer compatible.

IEC 61730-1 tackles the safe electrical operation of PV modules, but does not tackle the topic of connecting DC connectors from different manufacturers. However, IEC 62548 and IEC 60364-7-712:2017 are installation standards and they explicitly do not allow the connection of DC connectors from different manufacturers. IEC 62852 is not intended to be used for DC connectors produced by different manufacturers and does not guarantee long-term reliability of components from different quality management systems.

Despite the explicit prohibitions in these International Standards, even installers aware of the dangers of using connectors from different manufacturers continue to do so since there are often insufficient available alternatives.

¹ Manufactured by Multi-Contact AG (since 1 January 2017 named Stäubli Electrical Connectors AG). This information is given for the convenience of users of this document and does not constitute an endorsement by IEC of this product.

5 Observations

Despite the knowledge of incompatibility of DC connectors from different manufacturers, many installers combine DC connectors from different manufacturers. The reasons include the following.

- The manufacturer of the DC connector attached to the PV module is not known;
- The manufacturer of the DC connector attached to the PV module is known but the installer has no access to the supply chain of this manufacturer.
- The installer would lose the module warranty if he or she cuts the DC connector to attach two connectors from the same manufacturer.
- The installer rejects field crimping of DC connectors because he or she sees poor field crimping quality as a bigger safety risk than the connection of DC connectors from different manufacturers.
- Adapter cables (with two connector types) meeting interoperability requirements are sometimes available, but they are expensive, difficult to find and introduce additional points of potential failure by increasing the quantity of crimps and connectors in the system.

These reasons often give the installer or system owner few choices but to assume the risks of mating connectors from different manufacturers and as a result several fire hazards caused by non-compatible DC connectors have been reported. Although a burnt connector leaves little evidence to ascertain the initiating root cause, connectors from different manufacturers are found to be a common factor.

iTeh STANDARD PREVIEW

These observations are not new and multiple agencies have reported the problem. For several years, test laboratories have been reporting insufficient connection quality and reliability if DC connectors from different manufacturers are connected, and it can be assumed that the continuing connection between incompatible connectors will lead to an increasing number of fire hazards in future. Nevertheless, no satisfactory solution has been found yet to the problem of needing to use connectors from the same manufacturer, but not having easy supply of all connectors currently available on the market for use in the field.

6 Affected stakeholders

Several stakeholders are affected by the observations in Clause 5. The most affected are the following.

- Owners of PV systems and residents of buildings with PV systems can face reduced electricity production, financial losses and safety risks due to hazards occurring in the PV system.
- Module, inverter and cable manufacturers are restricted in the choice of DC connectors and are expected to include connectors in their product warranty, even though connector manufacturers are part of a value chain which does not fully manage to supply truly long-term compatible DC connectors.
- Different connector manufacturers need to be able to sell their product, and so they need to have a way of guaranteeing long-term compatibility with other manufacturers, which will avoid safety issues associated with the number of different manufacturers available.
- PV installers often end up taking responsibility for the quality issues caused by not having access to connectors from the same manufacturer.
- Insurance companies insure PV power plants which may have latent technical risks due to the long-term incompatibility of connectors, and therefore they face financial long-term risks which are not properly addressed today.