

# TECHNICAL SPECIFICATION

---

**Recommendations for renewable energy and hybrid systems for rural  
electrification –  
Part 7-4: Generators – Integration of solar with other forms of power generation  
within hybrid power systems**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

---

ICS 27.160

ISBN 978-2-8322-6823-0

**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 .....	6
4 Overview .....	6
5 Types of hybrid systems .....	7
5.1 General .....	7
5.2 Multi-master rotating machine dominated mini-grid .....	7
5.2.1 General .....	7
5.2.2 Design .....	8
5.2.3 Design and selection of diesel generators .....	8
5.2.4 Design and selection of renewable energy component .....	9
5.2.5 Design and selection of batteries .....	9
5.2.6 Control system .....	9
5.3 Single switched master mini-grid .....	10
5.3.1 General .....	10
5.3.2 Design .....	11
5.3.3 Design and selection of diesel generators .....	12
5.3.4 Design and selection of renewable energy component .....	12
5.3.5 5.2.4 Design and selection of batteries .....	12
5.3.6 System control .....	13
5.4 Multi-master inverter dominated mini-grid .....	14
5.4.1 General .....	14
5.4.2 Design .....	15
5.4.3 Design and selection of diesel generators .....	15
5.4.4 Design and selection of renewable energy component .....	15
5.4.5 Design and selection of batteries .....	15
5.4.6 Control .....	15
Figure 1 – Typical multi-master rotating machine dominated mini-grid architecture .....	8
Figure 2 – Single switched master mini-grid architecture .....	11
Figure 3 – Multi-master inverter dominated mini-grid architecture .....	14

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**RECOMMENDATIONS FOR RENEWABLE ENERGY  
AND HYBRID SYSTEMS FOR RURAL ELECTRIFICATION –****Part 7-4: Generators – Integration of solar with other forms  
of power generation within hybrid power 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. In exceptional circumstances, a technical committee may propose the publication of a Technical Specification when

- the required support cannot be obtained for the publication of an International Standard, despite repeated efforts, or
- the subject is still under technical development or where, for any other reason, there is the future but no immediate possibility of an agreement on an International Standard.

Technical Specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC TS 62257-7-4, which is a Technical Specification, has been prepared by IEC technical committee 82: Solar photovoltaic energy systems.

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

Draft TS	Report on voting
82/1477/DTS	82/1545A/RVDTS

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

This part of IEC 62257 is to be used in conjunction with IEC 62257 (all parts).

A list of all parts in the IEC 62257 series, published under the general title *Recommendations for renewable energy and hybrid systems for rural electrification*, can be found on the IEC website.

Future standards in this series will carry the new general title as cited above. Titles of existing standards in this series will be updated at the time of the next edition.

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

- transformed into an International standard,
- reconfirmed,
- withdrawn,
- replaced by a revised edition, or amended.

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

## RECOMMENDATIONS FOR RENEWABLE ENERGY AND HYBRID SYSTEMS FOR RURAL ELECTRIFICATION –

### Part 7-4: Generators – Integration of solar with other forms of power generation within hybrid power systems

#### 1 Scope

This part of IEC 62257, which is a technical specification, specifies the design and implementation of hybrid off-grid solar systems, where solar energy provides energy to a load in conjunction with other sources of energy. Such systems may or may not include an energy storage system. There are a variety of different system architectures and applications, and many ways in which these energy sources can be combined. This document distinguishes between different sorts of hybrid system applications and gives guidance on the design and integration of these systems.

It applies to single-phase and three-phase applications, and it covers situations where grid is available as an additional source of power for charging batteries and maintaining system reliability, but this document does not cover situations in which energy is fed back into a utility grid, although such systems may incidentally possess this function.

#### 2 Normative references

The following documents are referred to in the text in such a way the 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.

IEC TS 61836, *Solar photovoltaic energy systems – Terms, definitions and symbols*

IEC TS 62257-7-2, *Recommendations for renewable energy and hybrid systems for rural electrification – Part 7-2: Generator set – Off-grid wind turbines*<sup>1</sup>

IEC TS 62257-7-3, *Recommendations for renewable energy and hybrid systems for rural electrification – Part 7-3: Generator set – Selection of generator sets for rural electrification systems*

IEC TS 62257-9-7, *Recommendations for renewable energy and hybrid systems for rural electrification – Part 9-7: Selection of inverters*

IEC 62509, *Battery charge controllers for photovoltaic systems – Performance and functioning*

IEC 62548, *Photovoltaic (PV) arrays – Design requirements*

IEC TS 62738, *Ground-mounted photovoltaic power plants – Design guidelines and recommendations*

---

<sup>1</sup> To be published.