

**Photovoltaic system performance
monitoring - Guidelines for
measurement, data exchange and
analysis**

EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

<p>Käesolev Eesti standard EVS-EN 61724:2002 sisaldab Euroopa standardi EN 61724:1998 ingliskeelset teksti.</p> <p>Käesolev dokument on jõustatud 18.12.2002 ja selle kohta on avaldatud teade Eesti standardiorganisatsiooni ametlikus väljaandes.</p> <p>Standard on kättesaadav Eesti standardiorganisatsioonist.</p>	<p>This Estonian standard EVS-EN 61724:2002 consists of the English text of the European standard EN 61724:1998.</p> <p>This document is endorsed on 18.12.2002 with the notification being published in the official publication of the Estonian national standardisation organisation.</p> <p>The standard is available from Estonian standardisation organisation.</p>
--	---

ICS 27.180

Standardite reprodutseerimis- ja levitamise õigus kuulub Eesti Standardikeskusele

Andmete paljundamine, taastekitamine, kopeerimine, salvestamine elektroonilisse süsteemi või edastamine ükskõik millises vormis või millisel teel on keelatud ilma Eesti Standardikeskuse poolt antud kirjaliku loata.

Kui Teil on küsimusi standardite autorikaitse kohta, palun võtke ühendust Eesti Standardikeskusega:
Aru 10 Tallinn 10317 Eesti; www.evs.ee; Telefon: 605 5050; E-post: info@evs.ee

Right to reproduce and distribute Estonian Standards belongs to the Estonian Centre for Standardisation

No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying, without permission in writing from Estonian Centre for Standardisation.

If you have any questions about standards copyright, please contact Estonian Centre for Standardisation:
Aru str 10 Tallinn 10317 Estonia; www.evs.ee; Phone: +372 605 5050; E-mail: info@evs.ee

English version

**Photovoltaic system performance monitoring
Guidelines for measurement, data exchange and analysis
(IEC 61724:1998)**

Surveillance des qualités de
fonctionnement des systèmes
photovoltaïques - Recommandations
pour la mesure, le transfert et l'analyse
des données
(CEI 61724:1998)

Überwachung des Betriebsverhaltens
photovoltaischer Systeme - Leitfaden für
Messen, Datenaustausch und Analyse
(IEC 61724:1998)

This European Standard was approved by CENELEC on 1998-08-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Annex ZA (normative)

**Normative references to international publications
with their corresponding European publications**

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

NOTE: When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60904-2 A1	1989 1998	Photovoltaic devices Part 2: Requirements for reference solar cells	EN 60904-2 A1	1993 1998
IEC 60904-6 A1	1994 1998	Part 6: Requirements for reference solar modules	EN 60904-6 A1	1994 1998
IEC 61194 (mod)	1992	Characteristic parameters of stand-alone photovoltaic (PV) systems	EN 61194	1995
IEC 61829	1995	Crystalline silicon photovoltaic (PV) array On-site measurement of I-V characteristics	EN 61829	1998

Foreword

The text of document 82/189/FDIS, future edition 1 of IEC 61724, prepared by IEC TC 82, Solar photovoltaic energy systems, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61724 on 1998-08-01.

The following dates were fixed:

- latest date by which the EN has to be implemented
at national level by publication of an identical
national standard or by endorsement (dop) 1999-05-01
- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2001-05-01

Annexes designated "normative" are part of the body of the standard.
Annexes designated "informative" are given for information only.
In this standard, annex ZA is normative and annex A is informative.
Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61724:1998 was approved by CENELEC as a European Standard without any modification.

INTERNATIONAL STANDARD

IEC
61724

First edition
1998-04

Photovoltaic system performance monitoring – Guidelines for measurement, data exchange and analysis

*Suivi des performances des systèmes photovoltaïques –
Recommandations pour les mesures, et le transfert
et l'analyse des données*



Reference number
IEC 61724:1998(E)

Numbering

As from 1 January 1997 all IEC publications are issued with a designation in the 60000 series.

Consolidated publications

Consolidated versions of some IEC publications including amendments are available. For example, edition numbers 1.0, 1.1 and 1.2 refer, respectively, to the base publication, the base publication incorporating amendment 1 and the base publication incorporating amendments 1 and 2.

Validity of this publication

The technical content of IEC publications is kept under constant review by the IEC, thus ensuring that the content reflects current technology.

Information relating to the date of the reconfirmation of the publication is available in the IEC catalogue.

Information on the subjects under consideration and work in progress undertaken by the technical committee which has prepared this publication, as well as the list of publications issued, is to be found at the following IEC sources:

- **IEC web site***
- **Catalogue of IEC publications**
Published yearly with regular updates
(On-line catalogue)*
- **IEC Bulletin**
Available both at the IEC web site* and as a printed periodical

Terminology, graphical and letter symbols

For general terminology, readers are referred to IEC 60050: *International Electrotechnical Vocabulary* (IEV).

For graphical symbols, and letter symbols and signs approved by the IEC for general use, readers are referred to publications IEC 60027: *Letter symbols to be used in electrical technology*, IEC 60417: *Graphical symbols for use on equipment. Index, survey and compilation of the single sheets* and IEC 60617: *Graphical symbols for diagrams*.

* See web site address on title page.

INTERNATIONAL STANDARD

IEC
61724

First edition
1998-04

Photovoltaic system performance monitoring – Guidelines for measurement, data exchange and analysis

*Suivi des performances des systèmes photovoltaïques –
Recommandations pour les mesures, et le transfert
et l'analyse des données*

© IEC 1998 — Copyright - all rights reserved

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 the publisher.

International Electrotechnical Commission

Telefax: +41 22 919 0300

3, rue de Varembé, Geneva, Switzerland

e-mail: inmail@iec.ch

IEC web site: <http://www.iec.ch>



Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

CONTENTS

	Page
FOREWORD	3
INTRODUCTION	4
Clause	
1 Scope	5
2 Normative references	5
3 Measured parameters	5
4 Monitoring method	7
4.1 Measurement of irradiance	7
4.2 Measurement of ambient air temperature	7
4.3 Measurement of wind speed	7
4.4 Measurement of module temperature	7
4.5 Measurement of voltage and current	8
4.6 Measurement of electrical power	8
4.7 Data acquisition system	8
4.8 Sampling interval	8
4.9 Data processing operation	8
4.10 Recording interval, τ_r (expressed in hours)	8
4.11 Monitoring period	9
5 Documentation	9
6 Data format	9
6.1 Separate header with multiple data records	9
6.2 Single record format	10
7 Check of data quality	10
8 Derived parameters	11
8.1 Global irradiation	11
8.2 Electrical energy quantities	12
8.3 BOS component performance	13
8.4 System performance indices	14
Annex A (informative) A suggested method of checking the data acquisition system	16
Figure 1 – Parameters to be measured in real time	7
Table 1 – Parameters to be measured in real time	6
Table 2 – Derived parameters	12

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**PHOTOVOLTAIC SYSTEM PERFORMANCE MONITORING –
GUIDELINES FOR MEASUREMENT, DATA EXCHANGE AND ANALYSIS**

FOREWORD

- 1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the 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, the IEC publishes International Standards. 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. The 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 the 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 National Committees.
- 3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical reports or guides and they are accepted by the National Committees in that sense.
- 4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.
- 5) The IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with one of its standards.
- 6) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 61724 has been prepared by IEC technical committee 82: Solar photovoltaic energy systems.

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

FDIS	Report on voting
82/189/FDIS	82/201/RVD

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

Annex A is for information only.

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

INTRODUCTION

This standard describes general guidelines for the monitoring and analysis of the electrical performance of photovoltaic (PV) systems. It does not describe the performance of discrete components, but concentrates on evaluating the performance of an array as part of a PV system.

The intent of the data analysis is to provide a performance summary suitable for comparing PV installations of different sizes, operating in different climates, and providing energy for different uses, in such a way that the relative merits of different designs or operating procedures become evident. Simpler methods might be more cost effective for small, solar home or domestic stand-alone systems.

Guidelines are also included which describe a file format to be used for the exchange of monitoring data between organizations.

The use of a microprocessor-based data acquisition system for monitoring is required.

PHOTOVOLTAIC SYSTEM PERFORMANCE MONITORING – GUIDELINES FOR MEASUREMENT, DATA EXCHANGE AND ANALYSIS

1 Scope

This International Standard recommends procedures for the monitoring of energy-related PV system characteristics such as in-plane irradiance, array output, storage input and output and power conditioner input and output; and for the exchange and analysis of monitored data. The purpose of these procedures is to assess the overall performance of PV systems configured as stand-alone or utility grid-connected, or as hybridised with non-PV power sources such as engine generators and wind turbines.

This standard may not be applicable to small stand-alone systems due to the relatively high cost of the measurement equipment.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60904-2:1989, *Photovoltaic devices – Part 2: Requirements for reference solar cells*
Amendment 1 (1998)

IEC 60904-6:1994, *Photovoltaic devices – Part 6: Requirements for reference solar modules*
Amendment 1 (1998)

IEC 61194:1992, *Characteristic parameters of stand-alone photovoltaic (PV) systems*

IEC 61829:1995, *Crystalline silicon photovoltaic (PV) array – On-site measurement of I-V characteristics*

3 Measured parameters

Parameters to be measured are shown in table 1 and figure 1. Other parameters can be calculated from the measured data in real time by the data acquisition system's software. Note that all blocks in figure 1 can represent multiple components. The measured parameters and array characteristics are defined in IEC 61194.

The parasitic power drawn by all ancillary systems shall be considered a power loss of the PV plant and shall not be considered a load. All monitoring systems not essential for the operation of the PV plant shall be considered part of the load. The monitoring equipment may present a major part of the overall power consumption, and the end user should be made aware that supplemental power may be required to satisfy the total load requirement.