SLOVENSKI STANDARD
SIST EN 50530:2011/A1:2013

01-april-2013

Celovita učinkovitost fotonapetostnih razsmernikov - Dopolnilo AA

Overall efficiency of grid connected photovoltaic inverters

Gesamtwirkungsgrad von Photovoltaik-Wechselrichtern

Efficacité globale des onduleurs photovoltaïques raccordés au réseau

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Ta slovenski standard je istoveten z: **EN 50530:2010/A1:2013**

ICS:

27.160	Sončna energija	Solar energy engineering

SIST EN 50530:2011/A1:2013   **en,fr,de**

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 50530/A1

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ICS 27.160

English version

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photovoltaïques raccordés au réseau

Gesamtwirkungsgrad von Photovoltaik-
Wechselrichtern

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CENELEC

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

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Foreword

This document (EN 50530:2010/A1:2013) has been prepared by CLC/TC 82 "Solar photovoltaic energy systems".

The following dates are fixed:

- latest date by which this document has to be implemented   (dop)   2013-12-24
  at national level by publication of an identical national
  standard or by endorsement

- latest date by which the national standards conflicting with   (dow)   2015-12-24
  this document have to be withdrawn

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2 Normative references

Delete the following reference:

EN 61683, *Photovoltaic systems – Power conditioners – Procedure for measuring efficiency (IEC 61683)*

3 Terms and definitions

In 3.1.6, **replace** *the note by the following:*

If this value is not specified by the manufacturer, it can be defined as $P_{DC,r} = P_{AC,r} / \eta_{conv,r}$, in which $\eta_{conv,r}$ is the conversion efficiency at rated DC voltage. If the rated conversion efficiency is not specified, it shall be measured.

4 MPPT and conversion efficiencies

4.1 General description

In the 1st paragraph, **replace** *the two first sentences by the following:*

The MPPT efficiency describes the accuracy of an inverter to set its operating conditions to match the maximum power point on the characteristic curve of a PV generator. The MPPT efficiency is divided into the static and dynamic conditions.

As with inverters with poor MPPT performance, the resulting DC input voltage is different from MPP voltage and conversion efficiency depends on DC input voltage, measurements of static MPPT efficiency and static power conversion efficiency according to 4.3 shall be performed simultaneously (detailed explanation in the informative Annex F).

4.2 Test set-up

Replace *Figure 1 by the following:*

U$_{MPP, PVS}$ *I*$_{MPP, PVS}$
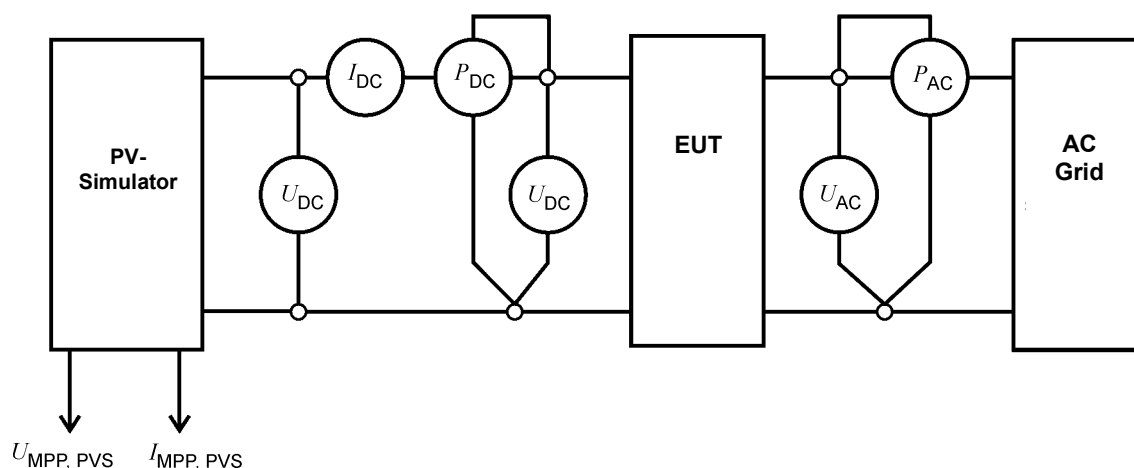
Replace *the note by the following:*

For the conversion efficiency, the DC and AC voltages shall be measured as close as possible to the inverter terminals. For MPPT efficiency, the DC voltage shall be measured as close as possible to the PV simulator. For combined conversion and MPPT efficiency measurements, two voltage

measurements will be required at the output of the PVS and the DC input of the EUT, in order to avoid measurement errors resulting from the voltage drop between the PVS and the EUT.

4.3 Static MPPT efficiency

Replace the title of 4.3 by the following:

4.3 Conversion and static MPPT efficiency

4.3.1 Test conditions for the static MPPT efficiency

Replace the title of 4.3.1 by the following:

4.3.1 Test conditions

Replace the 1st paragraph by the following:

The measurement of the conversion and static MPPT efficiency shall be performed simultaneously with test specifications as defined in Table 1.

Delete the note.

Replace the title of Table 1 by the following

Table 1 – Test specifications for the conversion and static MPPT efficiency

In Table 1, **add** the following row before the table footnotes:

The MPP voltages at the different test conditions (U_{MPPmax}, $U_{DC,r}$, U_{MPPmin}) shall be kept constant during the test for each power level.

Replace the last paragraph by the following:

The measurement should be performed at an ambient temperature of 25 °C ± 5 °C. Other ambient temperatures can be mutually agreed. The actual ambient temperature shall be specified in the test report.

4.3.2 Measurement procedure

Replace the text between NOTE 2 and NOTE 3 by the following:

The measuring time for each test condition as specified in Table 1 amounts to 10 min. For the first power level of each MPP voltage setting, the stabilisation of the MPPT-tracker has to be awaited. If a stabilisation cannot be observed a stabilisation time of at least 5 min is defined.

After a change of the power level a general stabilisation period of 2 min should be used. Data recorded during the stabilisation periods are not to be considered for the calculation of the static MPPT and conversion efficiency.

After the stabilisation of the MPP tracking the following parameters have to be logged:

– $P_{MPP,PVS}$;

– P_{DC};

– $U_{MPP,PVS}$;

– $I_{MPP,PVS}$;

– I_{DC};

– P_{AC}.

Replace "NOTE 3" and "NOTE 4" by "NOTE 2" and "NOTE 3" respectively.

4.3.3 Evaluation – Calculation of static MPPT efficiency

Replace the title of 4.3.3 by the following:

4.3.3 Evaluation – Calculation of conversion and static MPPT efficiency

Replace the first paragraph by the following:

For each measured power level according to Table 1, the conversion η_{conv} and static MPPT efficiency η_{MPPT} shall be calculated as energetic averages according to the definitions 3.4.2 and 3.4.1. The results shall be documented in the measuring report for each test condition according to Table 1.

4.4.1 Test conditions for the dynamic MPPT efficiency

Replace the title of 4.4.1 by the following:

4.4.1 Dynamic MPPT efficiency

Add the following after the first sentence:

The dynamics of the test sequences are generated by changes in solar irradiance. Measurements shall be performed with c-Si PV model as a basis and can additionally be made with TF model (see Table C.1). The chosen model (PV technology) shall be documented in the report.

Replace the last paragraph by the following:

The measurement should be performed at an ambient temperature of 25 °C ± 5 °C. Other ambient temperatures can be mutually agreed. The actual ambient temperature shall be specified in the test report.

4.5 Static power conversion efficiency

Delete this subclause.

5 Calculation of the overall efficiency

Add the following after Formula (8):

Formula (8) is to be applied for each power and voltage level of Table 1. By the application of weighting factors of EUR and CEC according to D.1 and D.2, the efficiencies can summarised for each voltage level (U_{MPPmax}, $U_{\mathrm{DC,r}}$, U_{MPPmin}). As a result, the weighted overall efficiencies $\eta_{\mathrm{t,EUR}}$ and $\eta_{\mathrm{t,CEC}}$ are obtained.

Annex B (normative)   Test conditions for dynamic MPPT efficiency

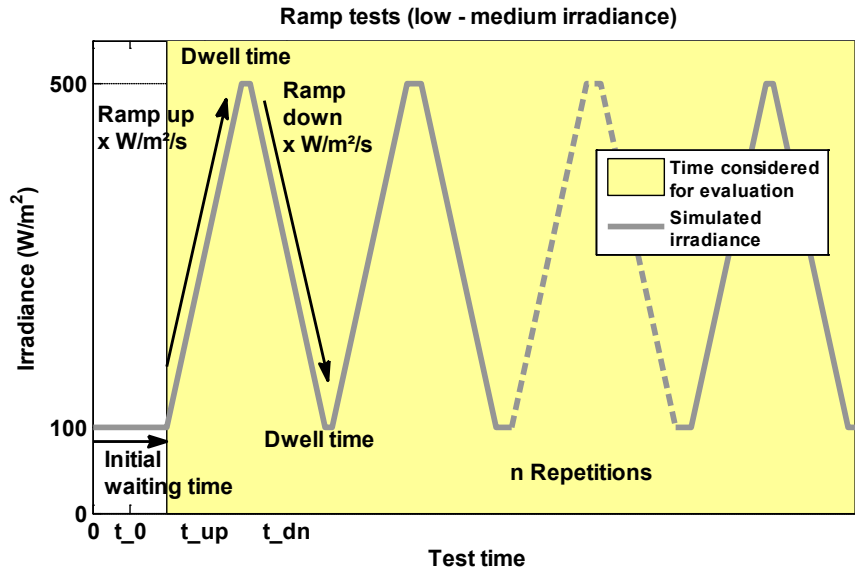### B.1 Test profiles

Replace *Figures B.1 and B.2 by the following:*

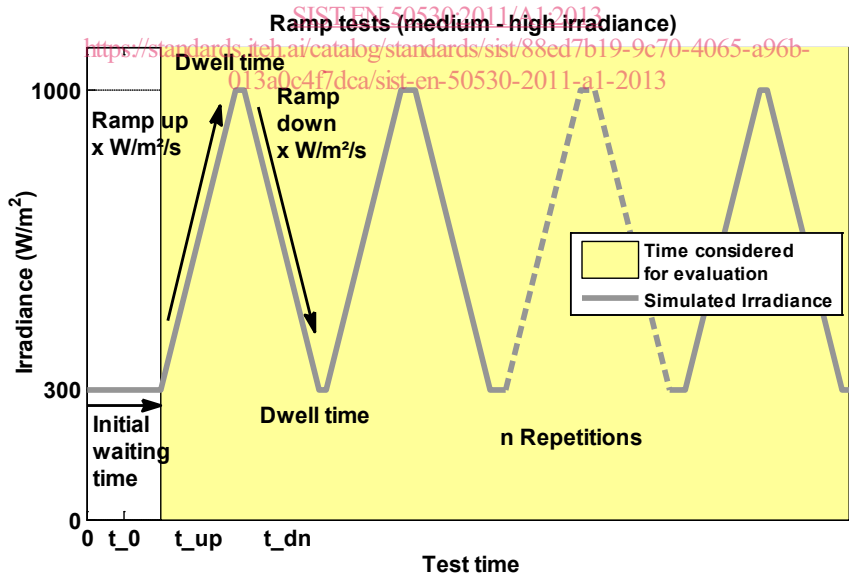**Figure B.1 – Test sequence for fluctuations between low and medium irradiance**

Figure B.2 – Test sequence for fluctuations between medium and high irradiance

B.2 Test sequence with ramps 10 % - 50 % P_{DCn}

Replace the title by the following:

B.2 Test sequence with ramps 10 % - 50 % G_{STC}

Replace Table B.1 by the following:

Table B.1 – Dynamic MPPT-Test 10 % $\rightarrow$ 50 % G_{STC} (valid for the evaluation of $\eta_{MPPTdyn}$)

From-to W/m²	Delta W/m²		Dwell time setting s			Waiting time setting s
100-500	400					300
# Number	Slope W/m²/s	Ramp UP s	Dwell time s	Ramp DN s	Dwell time s	Duration s
2	0,5	800	10	800	10	3 540
2	1	400	10	400	10	1 940
3	2	200	10	200	10	1 560
4	3	133	10	133	10	1 444
6	5	80	10	80	10	1 380
8	7	57	10	57	10	1 372
10	10	40	10	40	10	1 300
10	14	29	10	29	10	1 080
10	20	20	10	20	10	900
10	30	13	10	13	10	760
10	50	8	10	8	10	660
					Total	15 936
						04:25:36
NOTE Ramp and dwell times are given as rounded values.						

B.3 Test sequence with ramps 30 % - 100 % P_{DCn}

Replace the title by the following:

B.3 Test sequence with ramps 30 % - 100 % G_{STC}