TEST REPORT
IS/IEC 61683:1999
Photovoltaic systems-Power conditioners -Procedure for measuring efficiency

Report reference number.....: Date of issue.....: Total number of pages.....:
Testing laboratory name.....: Address.....: Accreditation.....:
Manufacture's name.....: Address.....:
Test specification Standard.....: IS/IEC 61683:1999
Test Report Form No.....: TRF Originator.....: Master TRF.....:
Test item description.....: Trademark.....: Model/Type.....:

Testing Location.....: Address.....:
Tested by (Name and signature).....: Approved by (Name and signature).....:
Manufacturer's name.....: Manufacturer address.....:

Test item particulars ..... : Photovoltaic systems-Power conditioners -Procedure for measuring efficiency Inverters
Equipment mobility .....: [ ] movable [ ] hand-held [ ] stationary [ ] fixed [ ] transportable [ ] for building-in
Connection to the mains .....: [ ] pluggable equipment [ ] direct plug-in [ ] permanent connection [ ] for building-in
Environmental category ..... : [ ] outdoor [ ] indoor unconditional [ ]indoor conditional
Over voltage category Mains .....: [ ] OVC I [ ] OVC II [ ] OVC III [ ] OVC IV
Over voltage category PV .....: [ ] OVC I [] OVC II [ ] OVC III [ ] OVC IV
Mains supply tolerance (%).....:
Tested for power system .....:
IT testing, phase-phase voltage (V) .....:
Class of equipment .....: [ ] Class I [ ] Class II [ ] Class III [ ] Not classified
Mass of equipment (kg) .....:
Pollution degree .....:
IP protection class .....:
Possible test case verdicts:
- test case does not apply to the test object ..... : N/A (Not Applicable)
- test object does meet the requirement ..... : P (Pass)
- test object was not evaluated for the requirement ..... : N/E
- test object does not meet the requirement ..... : F (Fail)
Testing
Date of receipt of test item.....:
Date(s) of performance of test.....:
General remarks:
The test results presented in this report relate only to the object tested.
This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory.

Copy of marking plate:

General product information:

Differences between the models:

Model tested with-in the family series:

IS/IEC 61683:1999			
Clause	Requirement + Test	Result-Remark	Verdict

4	**Efficiency measurement conditions**		
	Efficiency shall be measured under the matrix of conditions as described in the following clauses and table 1. Specific conditions may be excluded by mutual agreement when those conditions are outside the manufacturer's allowable operating range. The resulting data shall be presented in tabular form and may also be presented graphically.		
4.1	DC power source for testing		
	For power conditioners operating with fixed input voltage, the d.c. power source is a storage battery or constant voltage power source to maintain the input voltage.		
	For power conditioners that employ maximum power point tracking (MPPT) and shunt-type power conditioners, either a photovoltaic array or a photovoltaic array simulator is utilized.		
4.2	Temperature		
	All measurements are to be made at an ambient temperature of 25 °C ± 2 °C.		
	Other ambient temperatures may be allowed by mutual agreement. However, the temperature used must be clearly stated in all documentation.		
4.3	Output voltage and frequency		
	The Output voltage and frequency are maintained at the manufacturer's stated nominal values.		
4.4	Input voltage		
	Measurements performed in each of the following tests are repeated at three power conditioner input voltages: a) manufacturer's minimum rated input voltage; b) the inverter's nominal voltage or the average of its rated input range; c) 90% of the inverter's maximum input voltage.		
	In the case where a power conditioner is to be connected with a battery at its input terminals, only the nominal or rated input voltage maybe applied.		
4.5	Ripple and distortion		
	Record input voltage and current ripple for each measurement. Also record Output voltage and current distortion (if a.c.) or ripple (if d.c.).Ensure that these measurements remain within the manufacturer's specified values.		
4.6	Resistive loads/utility grid		

IS/IEC 61683:1999			
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	At unity power factor, or at the intrinsic power factor of grid-connected inverters without power factor adjustment, measure the efficiency for power levels of 10 %, 25 %, 50 %, 75 %, 100 % and 120 % of the inverter's rating.		
	Stand-alone inverters are also measured at a power level of 5% of rated. The power conditioner test is conducted with a specified resistive and reactive grid impedance.		
4.7	Reactive loads		
	For stand-alone inverters, measure the efficiency with a load which provides a power factor equal to the manufacturer's specified minimum level (or 0,25, whichever is greater) and at power levels of 25 %, 50 % and 100 % of rated VA.		
	Repeat for power factors of 0,5 and 0,75 (do not go below the manufacturer's specified minimum PF) and power levels of 25 %, 50 %, and 100 % of rated VA.		
4.8	Resistive plus non-linear loads		
	For stand-alone inverters, measure the efficiency with a fixed non-linear load (total harmonic distortion (THD)=(80±5) %) equal to (25±5)% of the inverter's rated VA plus sufficient resistive load in parallel to achieve a total load of 25 %, 50% and 100 %of rated VA.		
	Repeat the measurements with a fixed non-linear load equivalent to (50±5) % of the inverter’s rated VA plus sufficient resistive load in parallel to achieve a total load of 50% and 100% of rated VA.		
	The type of non-linear load must be clearly stated in all documentation.		
4.9	Complex loads		
	When a non-linear plus a sufficient reactive load condition is specified for stand-alone inverters, measure the efficiency with a fixed non-linear load (THD = (80 ± 5)%) equal to (50 ± 5)% of the inverter's rated VA plus a sufficient reactive load (PF = 0,5) in parallel to achieve a total load of 50% and 100 % of rated VA.		
	The type of complex load is clearly stated in all documentation.		
5.	**Efficiency calculations**		
5.1	Rated output efficiency		

IS/IEC 61683:1999			
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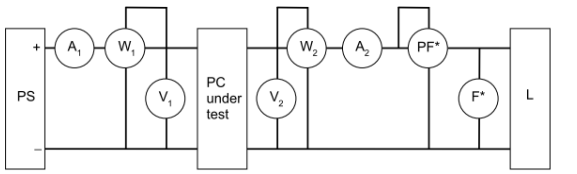
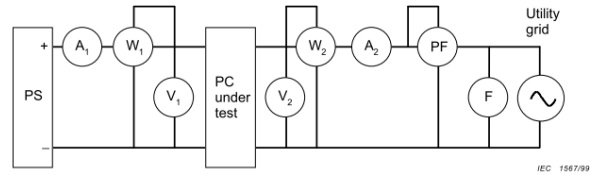
	Rated output efficiency shall be calculated from measured data as follows: R=(Po/Pi)×100		
5.2	Partial output efficiency		
	Partial output efficiency shall be calculated from measured data as follows: par= (Pop/Pip) ×100		
5.3	Energy efficiency		
	Energy efficiency shall be calculated from measured data as follows: ηE= (Wo/Wi)×100		
5.4	Efficiency tolerances		
	When an efficiency value has been guaranteed, the tolerance of this value shall be within: −0,2(1−η)η(%)		
6.	**Efficiency test circuits**		
6.1	Test circuits		
	Figure 1a is applied to standard-alone power conditioners		
	 **Figure 1a – Stand-alone type**		
	Figure 1b is applied to utility-interactive power conditioners		
	 **Figure 1b – Utility-interactive type** PC power conditioner PS variable voltage-current d.c. power supply A_1 DC ammeter A_2 AC or d.c. ammeter W_1 DC wattmeter W_2 AC or d.c. wattmeter L load F frequency meter V_1 DC voltmeter V_2 AC or d.c. voltmeter PF power factor meter		
6.2	Measurement procedure		
	a) Efficiency is calculated with equation (1) or (2) using measured Pi, Poor Pip, Pop. DC input power Pi, Pip can be measured by wattmeter W1, or determined by multiplying the d.c. voltmeter V1 and d.c. ammeter A1 readings. Output power Po, Pop is measured with wattmeter W2.		

IS/IEC 61683:1999			
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	b) DC input voltage, which is measured by d.c. voltmeter V1, shall be varied in the defined range where the output current, which is measured with a.c. ammeter A2,is varied from low output to the rated output.		
	c) An average indicating instrument shall be used for the d.c. voltmeter and d.c. ammeter. A true r.m.s. type of indicating instrument shall be used for the a.c. voltmeter and a.c. ammeter. The d.c. wattmeter W1 shall be a d.c. measuring type. The wattmeter W2 shall be an a.c. or d.c. measuring type according to the output.		
	d) Power factor (PF in per cent) can be measured by a power factor meter PF, or calculated from the readings of V2, A2, W2and as follows: PF=(W2/(V2×A2))×100		
	e) Each meter may be an analogue type or a digital type. The measurement accuracy shall be better than ± 0,5% of the full-scale value for each power measured. Digital power instruments for W1 and W2 are also recommended.		
	f) An MPPT dynamically adjusts the input voltage so as to maximize the output power. In principle, the monitoring equipment shall sample all of the electrical parameters, such as input voltage and current, output power and current, within the update period of the MPPT. If the MPPT and input source (PV array or PV array simulator) interact in such a way that the input voltage varies by than 5%, then averaging of readings is acceptable. The averaging period shall be 30s or longer.		
7.	**Loss measurement**		
7.1	No-load loss		
	Stand-alone inverters: reading of d.c. input voltage, Output voltage and frequency is given with meters V1, V2 and F respectively in figure 1a, and shall be adjusted to the rated values.		
	Utility-interactive inverters: reading of d.c. input voltmeter V1, a.c. output voltmeter V2 and frequency meter Fin figure 1b shall be adjusted to meet the specified voltages and frequency.		
7.2	Stand by loss		
	Stand-alone inverters: Consumption of utility power when the power conditioner is not operating but is under standby condition.		
	Utility-interactive inverters: consumption from the d.c. source when the power conditioner is not operating but is under standby condition.		

IS/IEC 61683:1999			
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Annex A	**Power conditioner description (informative)**		
	A power conditioner is defined in IEC61277		

Annex B	**Power efficiency and conversion factor (informative)**		
	There are two types of efficiencies shown in IEC 60146-2; one is a power efficiency, the other is a conversion factor. Power efficiency is defined as the ratio of active output power and active input power. Conversion factor is the ratio between output and input fundamental power levels.		
Annex C	**Weighted-average energy efficiency (informative)**		
	The energy of a power conditioner depends on both the irradiance profile and the load profile. The energy efficiency of a power conditioner shall be calculated by the ratio of the output to the input energy actually measured over a certain period		
C.1	ηWT of power conditioner for utility-interactive PV systems		
	Utility-interactive PV systems, which have no storage and for which reverse-power flow is accepted, are described. In this case, d.c. power generated by the PV array is supplied direct into the power conditioner (PC). Almost all of the input power to the PC is converted to a.c. power. A part of it is dissipated as the PC loss.		
C.2	ηWT of power conditioner for stand-alone PV systems		
	In stand-alone PV systems with a storage subsystem, power generated from the PV array is stored and stabilized by the batteries. DC power is converted into regulated d.c. power or constant- voltage and constant-frequency a.c. power by a power conditioner (PC) and supplied to the load. In this case, some fraction of the generated power is dissipated as a loss in the batteries and power conditioner.		
Annex D	**Derivation of efficiency tolerance in table 2 (informative)**		

IS/IEC 61683:1999			
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TABLE	**Efficiency recording and efficient calculation sheet**								
Power conditioner type									
Model:									
Parameters of power conditioner									
PV input voltage									
Temperature (°C)									
Operating period for energy measurement (min)									
Percentage of rated output (VA)									
Input voltage (V)									
Input voltage ripple (V)									
Input current (A)									
Input current ripple (A)									
Input power (Pi)(W)									
Output power(Po) (W)									
Output efficiency (%)									
Input energy (Wi) (kWh)									
Output energy (Wo) (kWh)									
Energy efficiency (%)									
PV input voltage									
Temperature(°C)									
Operating period for energy measurement (min)									
Percentage of rated output VA									
Input voltage(V)									
Input voltage ripple(V)									
Input current(A)									
Remarks:									

IS/IEC 61683:1999			
Clause	Requirement + Test	Result-Remark	Verdict

Input power(Pi)(W)									
Output power(Po) (W)									
Output efficiency(%)									
Input energy(Wi)(kWh)									
Output energy(Wo)(kWh)									
Energy efficiency(%)									

TABLE	**No load loss:**
Power conditioner type	Utility-interactive
Measure input voltage(V)	
Measured input power(W)	
Remark: No load loss is measured when the power conditioner works at rated input voltage and it’s load is disconnected.	

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Photographs of Equipment

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