
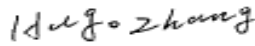







<p><b>TEST REPORT</b> <b>IEC 61683</b></p> <p><b>Photovoltaic systems – Power conditioners – Procedure for measuring efficiency</b></p>	
<b>Report Number</b> .....	2219 / 0019 - 5
<b>Date of issue</b> .....	23/05/2019
<b>Total number of pages</b> .....	22
<b>Applicant's name</b> .....	Shenzhen SOFAR SOLAR Co., Ltd.
<b>Address</b> .....	401, Building 4, AnTongDa Industrial Park, District 68, XingDong Community, XinAn Street, BaoAn District, Shenzhen City, Guangdong Province, P.R. China
<b>Test specification:</b>	
<b>Standard</b> .....	IEC 61683:1999 (First Edition)
<b>Test procedure</b> .....	Characteristic Examination
<b>Non-standard test method</b> .....	N/A
<b>Test Report Form No.</b> .....	IEC61683A
<b>Test Report Form(s) Originator</b> .....	TÜV SÜD Product Service GmbH
<b>Master TRF</b> .....	Dated 2014-10
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<b>General disclaimer:</b>	
<p>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 CB Testing Laboratory. The authenticity of this Test Report and its contents can be verified by contacting the NCB, responsible for this Test Report.</p>	

<b>Test item description</b> ..... :	Hybrid Inverter
<b>Trade Mark</b> ..... :	
<b>Manufacturer</b> ..... :	Shenzhen SOFAR SOLAR Co., Ltd.
<b>Model/Type reference</b> ..... :	HYD 6000-ES, HYD 5000-ES, HYD 4000-ES, HYD 3600-ES, HYD3000-ES
<b>Ratings</b> ..... :	<p>           HYD 6000-ES            DC input: 90-580V Max.2x15A            AC output: 230Vac, 50Hz, Max.27.3A, 6000VA         </p> <p>           HYD 5000-ES            DC input: 90-580V Max.2x15A            AC output: 230Vac, 50Hz, Max. 22.8A, 5000VA         </p> <p>           HYD 4000-ES            DC input: 90-580V Max.2x15A            AC output: 230Vac, 50Hz, Max.18.2A, 4000VA         </p> <p>           HYD 3600-ES            DC input: 90-580V Max.2x15A            AC output: 230Vac, 50Hz, Max.16A, 3680VA         </p> <p>           HYD 3000-ES            DC input: 90-580V Max.2x15A            AC output: 230Vac, 50Hz, Max.13.7A, 3000VA         </p> <p> <b>Serial Number:</b> SM1ES060JCS423  <b>Firmware version:</b> V1.60         </p>

<b>Testing procedure and testing location:</b>		
<input type="checkbox"/>	<del>CB Testing Laboratory:</del>	
<del>Testing location/ address.....:</del>		
<input type="checkbox"/>	<del>Associated CB Testing Laboratory:</del>	
<input checked="" type="checkbox"/>	<b>Testing procedure: TMP/CTF Stage 1:</b>	Shenzhen BALUN Technology Co.,Ltd.
<b>Testing location/ address.....:</b>		Block B, 1st FL, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province. P.R. China
<b>Tested by (name + signature).....:</b>	Hugo zhang (Project Engineer)	
	Roger Hu (Project Engineer)	
<b>Approved by (name + signature).....:</b>	Jacobo Tevar (Technical Reviewer)	
<input type="checkbox"/>	<del>Testing procedure: WMT/CTF Stage 2:</del>	
<input type="checkbox"/>	<del>Testing procedure: SMT/CTF Stage 3 or 4:</del>	

<b>List of Attachments (including a total number of pages in each attachment):</b>		
50Hz		
Attachment #	Description	Pages
Attachment I	Pictures of the EUT and Electrical Schemes	16pages
Attachment II	Testing Information	5 pages
<b>Summary of testing:</b>		
<p><b>Tests performed (name of test and test clause):</b></p> <p>The equipment has been tested according to the standard: IEC 61683:1999. Testing has been carried out at 50Hz.</p> <p>All applicable tests according to the above specified standard have been carried out.</p> <p>From the result of inspection and tests on the submitted sample, we conclude that it complies with the requirements of the standard.</p>	<p><b>Testing location:</b></p> <p>Shenzhen BALUN Technology Co.,Ltd. Block B, 1st FL, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province. P.R. China (All clauses)</p>	
<b>Summary of compliance with National Differences</b>		
<p><b>List of countries addressed</b></p> <p>No National Differences are addressed to this test report</p>		

**Copy of marking plate(representative):**

 Hybrid Inverter	
<b>Model No:</b>	<b>HYD 6000-ES</b>
Max. DC Input Voltage	600V
Operating MPPT Voltage Range	90V-580V
MAX.PV Isc	2x15A
Battery Type	Lead-acid, Lithium-ion
Battery Voltage Range	42-58V
Max. Charging Current	65A
Max. Discharging Current	70A
Max. Charging&Discharging Power	3000VA
Nominal Grid Voltage	230Vac
Nominal Output Voltage	230Vac
Max. Output Current	27.3A
Nominal Grid Frequency	50/60Hz
Power Factor	1(adjustable+/-0.8)
Nominal Output Power	6000VA
Backup Rated Current	13.2A
Backup Rated Apparent Power	3000VA
Ingress Protection	IP65
Operating Temperature Range	-25-+60°C
Protective Class	Class I
Manufacturer : Shenzhen SOFAR SOLAR Co., Ltd. Address : 401 , Building 4, An TongDa Industrial Park, District 68, Xing Dong Community, XinAn Street, BaoAn District, Shenzhen , China SAA183423 VDE0126-1-1, VDE-AR-N4105, G99, EN50438, AS4777, UTE C15-712-1	
	

**Note:**

1. The above markings are the minimum requirements required by the safety standard. For the final production samples, the additional markings which do not give rise to misunderstanding may be added.
2. Label is attached on the side surface of enclosure and visible after installation
3. Labels of other models are as the same wit HYD 6000-ES's except the parameters of rating.



<b>Test item particulars</b> ..... : Hybrid Inverter	
<b>Classification of installation and use</b> ..... : Fixed(permanent connection)	
<b>Supply Connection</b> ..... : DC; PV	
..... : AC; Grid connection	
<b>Possible test case verdicts:</b>	
- test case does not apply to the test object ..... : N/A	
- test object does meet the requirement..... : P (Pass)	
- test object does not meet the requirement ..... : F (Fail)	
<b>Testing</b> ..... : CTF Stage 1 procedure	
<b>Date of receipt of test item</b> ..... : N/A	
<b>Date (s) of performance of tests</b> ..... : From 24/04/2019 to 29/04/2019	
<b>General remarks:</b>	
<p>"(See Enclosure #)" refers to additional information appended to the report.          "(See appended table)" refers to a table appended to the report.</p> <p>This document is issued by the Company subject to its General Conditions of Service printed overleaf, available on request or accessible at <a href="http://www.sgs.com/terms_and_conditions.htm">www.sgs.com/terms_and_conditions.htm</a> and, for electronic format documents, subject to Terms and Conditions for Electronic Documents at <a href="http://www.sgs.com/terms_e-document.htm">www.sgs.com/terms_e-document.htm</a>. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. This document cannot be reproduced except in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated the results shown in this test report refer only to the sample(s) tested.</p> <p><b>Throughout this report a <input type="checkbox"/> comma / <input checked="" type="checkbox"/> point is used as the decimal separator.</b></p>	
<b>Manufacturer's Declaration per sub-clause 4.2.5 of IEC 61851-1:</b>	
The application for obtaining a CB Test Certificate includes more than one factory location and a declaration from the Manufacturer stating that the sample(s) submitted for evaluation is (are) representative of the products from each factory has been provided ..... :	<input type="checkbox"/> <b>Yes</b> <input checked="" type="checkbox"/> <b>Not applicable</b>
<b>When differences exist; they shall be identified in the General product information section.</b>	
<b>Name and address of factory (ies)</b> ..... : Dongguan SOFAR SOLAR Co.,Ltd. 1F - 6F, Building E, No. 1 JinQi Road, Bihu Industrial Park, Wulian Village, Fenggang Town, Dongguan City, Guangdong Province,P.R. China.	

**General product information:**

Product covered by this report is hybrid inverter for indoor or outdoor installation. The connection to the DC input and AC output are through connectors.

The input and output are protected by varistors to Earth. The unit is providing EMC filtering at the output toward mains. The unit does not provide galvanic separation from PV input to output (transformerless). The output is switched off redundant by the high power switching bridge and a two relays. This assures that the opening of the output circuit can operate in case of one error.

**Equipment Under Testing:**

- HYD 6000-ES
- HYD 5000-ES
- HYD 4000-ES
- HYD 3600-ES
- HYD 3000-ES

Model Number	HYD 6000-ES	HYD 5000-ES	HYD4000-ES	HYD 3600-ES	HYD 3000-ES
Max. input voltage	600Vd.c.				
Max. input current	2 x 15.0 A <sub>dc</sub>	2 x 15.0A <sub>dc</sub>	2 x 15.0 A <sub>dc</sub>	2 x 15.0 A <sub>dc</sub>	2 x 15.0 A <sub>dc</sub>
MPPT voltage range	90-580Vd.c.				
Rated grid voltage	230Va.c.				
Rated grid frequency	50Hz				
Rated output power	6kW	5kW	4kW	3.68kW	3kW
Max output current	27.3A <sub>ac</sub>	22.8A <sub>ac</sub>	18.2A <sub>ac</sub>	16A <sub>ac</sub>	13.7A <sub>ac</sub>
Power factor	0.8 leading to 0.8 lagging				
Ambient temperature	-25°C~60°C				
Ingress protection	IP65				
Protective class	Class I				

The variants models have been included in this test report without tests because the following features don't change regarding to the tested model:

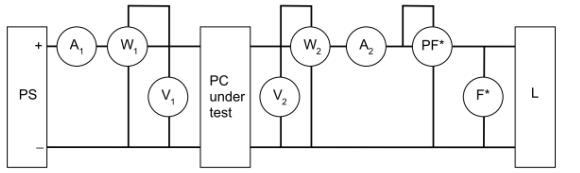
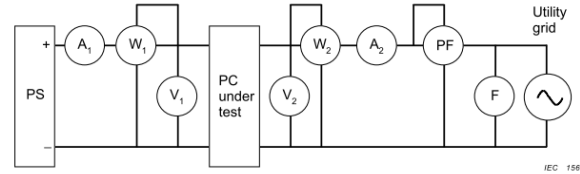
- Same connection system and hardware topology
- Same control algorithm.
- Output power within 2,5 and 2/3 of the EUT or Modular inverters.
- Same Firmware Version

IEC 61683: 1999			
Clause	Requirement – Test	Measuring result – Remark	Verdict
4	Efficiency measurement conditions		P
	Efficiency is measured under the conditions in the following clauses.		P
	Specific conditions may be excluded by mutual agreement when those conditions are outside the manufacturer's allowable operating range.		P
4.1	DC power source for testing		P
	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.		N/A
	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.		P
4.2	Temperature		P
	All measurements are to be made at an ambient temperature of $25\text{ °C} \pm 2\text{ °C}$ .		N/A
	Other ambient temperatures may be allowed by mutual agreement. However, the temperature used must be clearly stated in all documentation.	By mutual agreement all measurements at 50 Hz have been carried out at $25\text{°C} \pm 5\text{°C}$	P
4.3	Output voltage and frequency		P
	The output voltage and frequency are maintained at the manufacturer's stated nominal values.	L/N/PE 230Vac, 50Hz	P
4.4	Input voltage		P
	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.		P
	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 may be applied.		N/A
4.5	Ripple and distortion		P
	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.		P
4.6	Resistive loads/utility grid		P
	At unity power factor, or at the intrinsic power factor of grid-connected inverters without power		P



IEC 61683: 1999			
Clause	Requirement – Test	Measuring result – Remark	Verdict
	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.		N/A
4.7	Reactive loads		N/A
	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.		N/A
	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.		N/A
4.8	Resistive plus non-linear loads		N/A
	For stand-alone inverters, measure the efficiency with a fixed non-linear load (total harmonic distortion (THD) = $(80 \pm 5) \%$ ) equal to $(25 \pm 5) \%$ 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.		N/A
	Repeat the measurements with a fixed non-linear load equivalent to $(50 \pm 5) \%$ of the inverter's rated VA plus sufficient resistive load in parallel to achieve a total load of 50% and 100% of rated VA.		N/A
	The type of non-linear load must be clearly stated in all documentation.		N/A
4.9	Complex loads		N/A
	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 = $(80 \pm 5) \%$ ) equal to $(50 \pm 5) \%$ 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.		N/A
	The type of complex load is clearly stated in all documentation.		N/A
5	Efficiency calculations		P
5.1	Rated output efficiency		P
5.2	Partial output efficiency		P
5.3	Energy efficiency		P

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Clause	Requirement – Test	Measuring result – Remark	Verdict
5.4	Efficiency tolerances		P
6	Conditions of loading for output ports		P
6.1	Test circuit		P
	Figure 1a is applied to standard-alone power conditioners		N/A
	 <p>Figure 1a – Stand-alone type</p> <p>IEC 1566/99</p>		N/A
	Figure 1b is applied to utility-interactive power conditioners		P
	 <p>Figure 1b – Utility-interactive type</p> <p>IEC 1567/99</p> <p>PC power conditioner  PS variable voltage-current d.c. power supply  A<sub>1</sub> DC ammeter  A<sub>2</sub> AC or d.c. ammeter  W<sub>1</sub> DC wattmeter  W<sub>2</sub> AC or d.c. wattmeter  L load  F frequency meter  V<sub>1</sub> DC voltmeter  V<sub>2</sub> AC or d.c. voltmeter  PF power factor meter</p>		P
6.2	Measurement procedure		P
7	Loss measurement		P
7.1	No-load loss		P
7.2	Standby loss		P
Annex A	Power conditioner description		P
Annex B	Power efficiency and conversion factor		P
Annex C	Weighted-average energy efficiency		P
Annex D	Derivation of efficiency tolerance in table 2		P

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Clause	Requirement – Test	Measuring result – Remark	Verdict
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TABLE	Efficiency recording and efficient calculation sheet								
power conditioner type	Grid-connected								
Model:	HYD 6000-ES								
Parameters of power conditioner	Minimum full load input voltage:300V Nominal voltage:410V 90% of the inverter's maximum input voltage:520V Rated output voltage: 230Vac Rated output frequency:50Hz Rated output power: <b>6000W</b>								
PV input voltage	a) Manufacturer's minimum rated input voltage								
Temperature (°C)	25°C ± 5°C								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	314.0	313.0	307.0	298.1	299.3	/	/	/
Input voltage ripple (V)	/	0.5	1.6	0.3	0.2	0.6	/	/	/
Input current (A)	/	2.2	5.1	10.2	15.9	20.7	/	/	/
Input current ripple (A)	/	0.2	0.2	0.2	0.3	0.4	/	/	/
Input power (Pi) (W)	/	680	1594	3145	4743	6183	/	/	/
Output power (Po) (W)	/	640	1530	3022	4547	5917	/	/	/
Output efficiency(%)	/	94.12	95.99	96.09	95.87	95.69	/	/	/
Input energy (Wi) (Wh)	/	11.29	26.52	52.43	79.05	103.03	/	/	/
Output energy (Wo) (Wh)	/	10.64	25.42	50.39	75.77	98.61	/	/	/
Energy efficiency(%)	/	94.24	95.85	96.11	95.85	95.71	/	/	/
PV input voltage	b) The inverter's nominal voltage								
Temperature (°C)	25°C ± 5°C								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	417.3	407.7	417.1	412.5	423.3	/	/	/
Input voltage ripple (V)	/	0.5	1	2.2	3.2	4.3	/	/	/

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Clause	Requirement – Test				Measuring result – Remark				Verdict
Input current (A)	/	1.7	4	7.6	11.3	14.6	/	/	/
Input current ripple (A)	/	0.9	2	3.7	5.4	6.6	/	/	/
Input power (Pi) (W)	/	693	1623	3161	4657	6182	/	/	/
Output power (Po) (W)	/	662	1575	3070	4517	5983	/	/	/
Output efficiency(%)	/	95.53	97.04	97.12	96.98	96.78	/	/	/
Input energy (Wi) (Wh)	/	11.56	27.09	52.56	77.63	102.71	/	/	/
Output energy (Wo) (Wh)	/	11.08	26.28	51.04	75.25	99.29	/	/	/
Energy efficiency(%)	/	95.85	97.01	97.11	96.93	96.67	/	/	/
PV input voltage	c) 90% of the inverter's maximum input voltage								
Temperature (°C)	25°C ± 5°C								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	529.1	514	517.1	514.3	511.1	/	/	/
Input voltage ripple (V)		0.4	0.8	1.8	2.6	3.3	/	/	/
Input current (A)	/	1.2	3.1	6.1	9	12.1	/	/	/
Input current ripple (A)		0.8	1.67	2.94	4.23	5.6	/	/	/
Input power (Pi) (W)	/	637	1598	3147	4627	6162	/	/	/
Output power (Po) (W)	/	609	1546	3048	4477	5946	/	/	/
Output efficiency(%)	/	95.60	96.75	96.85	96.76	96.49	/	/	/
Input energy (Wi) (Wh)	/	10.75	26.73	52.49	77.22	102.67	/	/	/
Output energy (Wo) (Wh)	/	10.22	25.85	50.87	74.73	99.15	/	/	/
Energy efficiency(%)	/	95.07	96.71	96.91	96.78	96.57	/	/	/
Remark:	*If limited by design, inverter is not capable to operate with the 120% of rated output load, test under this condition is waived;								

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Clause	Requirement – Test	Measuring result – Remark	Verdict
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TABLE	Efficiency recording and efficient calculation sheet								
power conditioner type	Grid-connected								
Model:	HYD 5000-ES								
Parameters of power conditioner	Minimum full load input voltage:250V Nominal voltage:385V 90% of the inverter's maximum input voltage: 520V Rated output voltage: 230Vac Rated output frequency:50Hz Rated output power: <b>5000W</b>								
PV input voltage	a) Manufacturer's minimum rated input voltage								
Temperature (°C)	25°C ± 5°C								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	249.8	247.7	250.7	244.6	260.4	/	/	/
Input voltage ripple (V)	/	0.3	0.3	0.3	0.3	0.3	/	/	/
Input current (A)	/	2.4	5.3	10.6	16.1	19.9	/	/	/
Input current ripple (A)	/	1.0	0.2	0.3	0.4	0.4	/	/	/
Input power (Pi) (kW)	/	610	1322	2662	3945	5188	/	/	/
Output power (Po) (kW)	/	573	1261	2552	3781	4968	/	/	/
Output efficiency(%)	/	93.93	95.39	95.87	95.84	95.76	/	/	/
Input energy (Wi) (Wh)	/	10.09	22.01	44.50	65.81	86.27	/	/	/
Output energy (Wo) (Wh)	/	9.48	21.00	42.70	63.04	82.59	/	/	/
Energy efficiency(%)	/	93.95	95.41	95.96	95.79	95.73	/	/	/
PV input voltage	b) The inverter's nominal voltage								
Temperature (°C)	25°C ± 5°C								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	391.1	388.6	379.7	383	383.9	/	/	/

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Clause	Requirement – Test						Measuring result – Remark		Verdict
Input voltage ripple (V)	/	0.5	1.0	1.9	3.0	3.8	/	/	/
Input current (A)	/	1.6	3.4	6.9	10	13.7	/	/	/
Input current ripple (A)	/	0.9	2.3	3.5	5.0	6.0	/	/	/
Input power (Pi) (kW)	/	611	1336	2619	3824	5236	/	/	/
Output power (Po) (kW)	/	573	1294	2545	3715	5086	/	/	/
Output efficiency(%)	/	93.78	96.86	97.17	97.15	97.14	/	/	/
Input energy (Wi) (Wh)	/	10.26	22.26	43.57	63.62	87.2	/	/	/
Output energy (Wo) (Wh)	/	9.83	21.58	42.35	61.79	84.54	/	/	/
Energy efficiency(%)	/	95.81	96.95	97.2	97.12	96.95	/	/	/
PV input voltage	c) 90% of the inverter's maximum input voltage								
Temperature (°C)	25°C ± 5°C								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	537.6	528.8	516.9	516.8	511.3	/	/	/
Input voltage ripple (V)	/	0.4	0.7	2.6	2.2	2.9	/	/	/
Input current (A)	/	1.1	2.4	5.1	7.6	10	/	/	/
Input current ripple (A)	/	0.8	1.5	1.5	3.6	4.8	/	/	/
Input power (Pi) (kW)	/	610	1286	2642	3908	5134	/	/	/
Output power (Po) (kW)	/	575	1245	2560	3784	4969	/	/	/
Output efficiency(%)	/	94.26	96.81	96.90	96.83	96.79	/	/	/
Input energy (Wi) (Wh)	/	10.05	21.22	44.23	65.16	85.53	/	/	/
Output energy (Wo) (Wh)	/	9.53	20.46	42.87	63.12	82.73	/	/	/
Energy efficiency(%)	/	94.83	96.42	96.93	96.87	96.73	/	/	/
Remark:									
*If limited by design, inverter is not capable to operate with the 120% of rated output load, test under this condition is waived;									

## IEC 61683: 1999

Clause	Requirement – Test	Measuring result – Remark	Verdict
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TABLE	Efficiency recording and efficient calculation sheet								
power conditioner type	Grid-connected								
Model:	HYD 4000-ES								
Parameters of power conditioner	Minimum full load input voltage:200V Nominal voltage:360V 90% of the inverter's maximum input voltage: 520V Rated output voltage: 230Vac Rated output frequency:50Hz Rated output power: <b>4000W</b>								
PV input voltage	a) Manufacturer's minimum rated input voltage								
Temperature (°C)	25°C ± 5°C								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	193.3	197.4	197.7	184.3	209.8	/	/	/
Input voltage ripple (V)	/	0.2	0.1	0.2	0.1	0.2	/	/	/
Input current (A)	/	2.4	5.5	10.6	17.2	19.9	/	/	/
Input current ripple (A)	/	0.1	0.1	0.1	0.2	0.2	/	/	/
Input power (Pi) (kW)	/	458	1091	2089	3164	4172	/	/	/
Output power (Po) (kW)	/	424	1048	1995	3016	3985	/	/	/
Output efficiency(%)	/	92.58	96.06	95.50	95.32	95.52	/	/	/
Input energy (Wi) (Wh)	/	7.66	18.15	34.78	52.97	68.9	/	/	/
Output energy (Wo) (Wh)	/	7.06	17.2	33.21	50.5	65.82	/	/	/
Energy efficiency(%)	/	92.17	94.77	95.49	95.34	95.53	/	/	/
PV input voltage	b) The inverter's nominal voltage								
Temperature (°C)	25°C ± 5°C								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	366.1	361.3	357.8	362.6	358.4	/	/	/

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Clause	Requirement – Test						Measuring result – Remark		Verdict
Input voltage ripple (V)	/	0.6	1.6	0.2	0.3	0.9	/	/	/
Input current (A)	/	1.1	2.9	5.8	8.6	11.6	/	/	/
Input current ripple (A)	/	0.1	0.6	0.1	0.1	6.5	/	/	/
Input power (Pi) (kW)	/	421	1034	2083	3131	4169	/	/	/
Output power (Po) (kW)	/	398	1001	2008	3020	4059	/	/	/
Output efficiency(%)	/	94.54	96.81	96.40	96.45	97.36	/	/	/
Input energy (Wi) (Wh)	/	6.89	17.22	34.75	52.22	69.45	/	/	/
Output energy (Wo) (Wh)	/	6.53	16.66	33.48	50.38	67.47	/	/	/
Energy efficiency(%)	/	94.78	96.75	96.35	96.48	97.15	/	/	/
PV input voltage	c) 90% of the inverter's maximum input voltage								
Temperature (°C)	25°C ± 5°C								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	527.1	541.9	515.8	515.1	518.1	/	/	/
Input voltage ripple (V)	/	0.4	0.6	1.2	1.8	2.5	/	/	/
Input current (A)	/	0.9	2	4	6	8	/	/	/
Input current ripple (A)	/	0.5	1.3	2.2	2.9	3.8	/	/	/
Input power (Pi) (kW)	/	476	1061	2072	3111	4167	/	/	/
Output power (Po) (kW)	/	453	1019	2010	3019	4033	/	/	/
Output efficiency(%)	/	95.17	96.04	97.01	97.04	96.78	/	/	/
Input energy (Wi) (Wh)	/	7.54	17.5	34.62	51.75	69.39	/	/	/
Output energy (Wo) (Wh)	/	7.07	16.82	33.53	50.17	67.22	/	/	/
Energy efficiency(%)	/	93.77	96.11	96.85	96.95	96.87	/	/	/
Remark:									
*If limited by design, inverter is not capable to operate with the 120% of rated output load, test under this condition is waived;									



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Clause	Requirement – Test	Measuring result – Remark	Verdict
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TABLE	Efficiency recording and efficient calculation sheet								
power conditioner type	Grid-connected								
Model:	HYD 3600-ES								
Parameters of power conditioner	Minimum full load input voltage:180V Nominal voltage:350V 90% of the inverter's maximum input voltage: 520V Rated output voltage: 230Vac Rated output frequency:50Hz Rated output power: <b>3600W</b>								
PV input voltage	a) Manufacturer's minimum rated input voltage								
Temperature (°C)	25°C ± 5°C								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	175.3	175.3	181.4	174.5	203	/	/	/
Input voltage ripple (V)	/	0.4	0.2	0.2	0.3	0.4	/	/	/
Input current (A)	/	2.3	5.5	10.5	16.4	18.6	/	/	/
Input current ripple (A)	/	0.2	0.3	0.3	0.2	0.3	/	/	/
Input power (Pi) (kW)	/	399	968	1899	2855	3774	/	/	/
Output power (Po) (kW)	/	365	915	1801	2710	3590	/	/	/
Output efficiency(%)	/	91.48	94.52	94.84	94.92	95.12	/	/	/
Input energy (Wi) (Wh)	/	6.61	16.16	31,60	47.54	63.65	/	/	/
Output energy (Wo) (Wh)	/	6.01	15.2	29.99	45.09	60.52	/	/	/
Energy efficiency(%)	/	90.92	94.06	94.91	94.85	95.08	/	/	/
PV input voltage	b) The inverter's nominal voltage								
Temperature (°C)	25°C ± 5°C								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	354.1	349.9	346.7	352.6	344.5	/	/	/

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Clause	Requirement – Test						Measuring result – Remark		Verdict
Input voltage ripple (V)	/	0.6	0.2	0.2	0.3	0.3	/	/	/
Input current (A)	/	1.1	2.8	5.4	7.9	11	/	/	/
Input current ripple (A)	/	0.1	0.1	0.1	0.1	0.2	/	/	/
Input power (Pi) (kW)	/	384	985	1884	2781	3777	/	/	/
Output power (Po) (kW)	/	363	941	1814	2683	3638	/	/	/
Output efficiency(%)	/	94.53	95.53	96.28	96.48	96.32	/	/	/
Input energy (Wi) (Wh)	/	6.4	16.41	31.41	46.39	63.02	/	/	/
Output energy (Wo) (Wh)	/	6.04	15.66	30.23	44.74	60.75	/	/	/
Energy efficiency(%)	/	94.38	95.43	96.24	96.44	95.94	/	/	/
PV input voltage	c) 90% of the inverter's maximum input voltage								
Temperature (°C)	25°C ± 5°C								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	548.3	536.3	521.4	509.5	518.6	/	/	/
Input voltage ripple (V)	/	0.3	1.0	1.0	1.7	2.2	/	/	/
Input current (A)	/	0.7	1.8	3.6	5.5	7.2	/	/	/
Input current ripple (A)	/	0.5	0.6	1.9	2.6	3.4	/	/	/
Input power (Pi) (kW)	/	375	943	1867	2791	3716	/	/	/
Output power (Po) (kW)	/	347	908	1803	2710	3600	/	/	/
Output efficiency(%)	/	92.53	96.29	96.57	97.10	96.88	/	/	/
Input energy (Wi) (Wh)	/	6.17	15.7	31.38	46.56	62.14	/	/	/
Output energy (Wo) (Wh)	/	5.72	15.06	30.38	45.14	60.22	/	/	/
Energy efficiency(%)	/	92.71	95.92	96.81	96.95	96.91	/	/	/
Remark:									
*If limited by design, inverter is not capable to operate with the 120% of rated output load, test under this condition is waived;									

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Clause	Requirement – Test	Measuring result – Remark	Verdict
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TABLE	Efficiency recording and efficient calculation sheet								
power conditioner type	Grid-connected								
Model:	HYD 3000-ES								
Parameters of power conditioner	Minimum full load input voltage:160V Nominal voltage:340V 90% of the inverter's maximum input voltage: 520V Rated output voltage: 230Vac Rated output frequency:50Hz Rated output power: <b>3000W</b>								
PV input voltage	a) Manufacturer's minimum rated input voltage								
Temperature (°C)	25°C ± 5°C								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	150.9	159.9	157.0	157.2	167.3	/	/	/
Input voltage ripple (V)	/	0.3	0.3	0.3	0.38.	0.3	/	/	/
Input current (A)	/	2.2	5.1	10.1	15.1	19.7	/	/	/
Input current ripple (A)	/	0.1	0.1	0.2	0.2	0.2	/	/	/
Input power (Pi) (kW)	/	335	815	1587	2372	3118	/	/	/
Output power (Po) (kW)	/	302	765	1504	2253	3286	/	/	/
Output efficiency(%)	/	90.19	93.83	94.76	94.99	105.39	/	/	/
Input energy (Wi) (Wh)	/	5.59	13.63	26.5	39.43	54.07	/	/	/
Output energy (Wo) (Wh)	/	5.01	12.76	25.11	37.39	51.33	/	/	/
Energy efficiency(%)	/	89.62	93.62	94.75	94.83	94.93	/	/	/
PV input voltage	b) The inverter's nominal voltage								
Temperature (°C)	25°C ± 5°C								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	343.7	340.1	338.7	337.6	338.2	/	/	/

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Clause	Requirement – Test					Measuring result – Remark			Verdict
Input voltage ripple (V)	/	0.1	0.2	0.2	0.2	0.2	/	/	/
Input current (A)	/	1.0	2.3	4.7	6.9	9.1	/	/	/
Input current ripple (A)	/	0.1	0.1	0.1	0.1	0.1	/	/	/
Input power (Pi) (kW)	/	334	785	1586	2334	3086	/	/	/
Output power (Po) (kW)	/	303	745	1522	2250	2975	/	/	/
Output efficiency(%)	/	90.78	94.84	95.96	96.37	96.42	/	/	/
Input energy (Wi) (Wh)	/	5.57	13.06	26.25	38.9	51.6	/	/	/
Output energy (Wo) (Wh)	/	5.08	12.39	25.22	37.48	49.55	/	/	/
Energy efficiency(%)	/	91.2	94.87	96.08	96.35	96.03	/	/	/
PV input voltage	c) 90% of the inverter's maximum input voltage								
Temperature (°C)	25°C ± 5°C								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	523.8	524.9	524.5	507.1	516.8	/	/	/
Input voltage ripple (V)	/	0.3	0.5	0.8	1.3	1.8	/	/	/
Input current (A)	/	0.7	1.6	2.9	4.5	6.0	/	/	/
Input current ripple (A)	/	0.5	0.9	1.6	2.2	2.9	/	/	/
Input power (Pi) (kW)	/	347	819	1492	2289	3105	/	/	/
Output power (Po) (kW)	/	322	769	1543	2213	2995	/	/	/
Output efficiency(%)	/	0.93	0.94	1.03	0.97	0.96	/	/	/
Input energy (Wi) (Wh)	/	5.79	13.59	25.67	38.14	51.93	/	/	/
Output energy (Wo) (Wh)	/	5.36	13.01	24.82	36.97	50.35	/	/	/
Energy efficiency(%)	/	92.57	95.73	96.69	96.93	96.06	/	/	/
Remark:									
*If limited by design, inverter is not capable to operate with the 120% of rated output load, test under this condition is waived;									

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Clause	Requirement – Test	Measuring result – Remark	Verdict
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<b>TABLE</b>	No load loss	<b>P</b>
power conditioner type	Utility-interactive	
HYD 6000-ES		
Measure input voltage (V)	421.0	
Measured input power(W)	11.1	
HYD 5000-ES		
Measure input voltage (V)	395.1	
Measured input power(W)	8.7	
HYD 4000-ES		
Measure input voltage (V)	369.1	
Measured input power(W)	7.9	
HYD 3600-ES		
Measure input voltage (V)	358.9	
Measured input power(W)	8.4	
HYD 3000-ES		
Measure input voltage (V)	348.7	
Measured input power(W)	9.1	
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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Clause	Requirement – Test	Measuring result – Remark	Verdict
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TABLE	Standby loss	P
power conditioner type	Utility-interactive	
HYD 6000-ES		
Measure input voltage (V)	230.3	
Measured input power(W)	9.0	
HYD 5000-ES		
Measure input voltage (V)	230.3	
Measured input power(W)	8.8	
HYD 4000-ES		
Measure input voltage (V)	230.2	
Measured input power(W)	8.8	
HYD 3600-ES		
Measure input voltage (V)	230.1	
Measured input power(W)	8.9	
HYD 3000-ES		
Measure input voltage (V)	230	
Measured input power(W)	8.9	
Remark: Standby loss is measured when the power conditioner works at rated input voltage and in standby mode.		

--- End of test report---