TEST REPORT

IEC 61683

Photovoltaic systems – Power conditioners – Procedure for measuring efficiency

Report reference number ..... :	**PV2105WDG0102-2**
Date of issue ..... ::	2021-06-10
Total number of pages ..... ::	35
Testing laboratory name ..... :	**Bureau Veritas Shenzhen Co., Ltd. Dongguan Branch**
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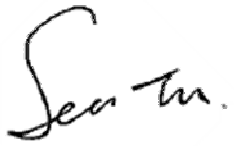
Accreditation ..... :	ilac-MRA A2LA ACCREDITED Certificate # 2951.01
Applicant's name ..... :	**AISWEI New Energy Technology(Jiangsu) Co.,Ltd**
Address ..... :	Building 9,No.198 Xiangyang Road,215011 Suzhou,P.R.China
Test specification	
Standard..... :	IEC 61683:1999
Test Report Form No. ..... :	IEC61683 VER.1
TRF Originator ..... :	Bureau Veritas Shenzhen Co., Ltd. Dongguan Branch
Master TRF ..... :	Dated 2020-03-11
Test item description ..... :	**PV inverter**
Trademark..... :	Solplanet
Model / Type ..... :	ASW5000-S, ASW4000-S, ASW3680-S, ASW3000-S

Ratings..... :	ASW3000-S	ASW3680-S	ASW4000-S	ASW5000-S
MPP DC input voltage [V] ..... :	80-550Vdc			
Input DC voltage range [V] ..... :	80-580Vdc			
Input DC current [A] ..... :	2 x 12A			
Output AC voltage [V] ..... :	220/230Vac, 50/60Hz			
Output AC current [A] ..... :	Max.15,0	Max.16,0	Max.20,0	Max.22,7
Initial short-current AC current $I_{k''}$[A] :	30,4	30,4	30,4	30,4
Nominal Output power [KW] ..... :	3,000	3,680	4,000	5,000*
Max.Output apparent power [KVA].. :	3,000	3,680	4,000	5,000*

Testing Location ..... :	**Bureau Veritas Shenzhen Co., Ltd. Dongguan Branch**
Address ..... :	No. 96, Guantai Road (Houjie Section), Houjie Town, Dongguan City, Guangdong Province, 523942, People's Republic of China
Tested by (name and signature) ..... :	Sean Tu 
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Manufacturer address ..... :	Building 9,No.198 Xiangyang Road,215011 Suzhou,P.R.China
Factory's name ..... :	**AISWEI New Energy Technology (Yangzhong) Co., Ltd**
Factory address	No.588 Gangxing Road,Yangzhong, Jiangsu P.R.Chna

Document History			
Date	**Internal reference**	**Modification / Change / Status**	**Revision**
2021-05-31	Sean Tu	Initial report was written	0
Supplementary information:			

Test items particulars	
Equipment mobility ..... :	Permanent connection
Operating condition ..... :	Continuous
Class of equipment ..... :	Class I
Protection against ingress of water .. :	IP65 according to EN 60529
Mass of equipment [kg] ..... :	12,0kg

Test case verdicts

Test case does not apply to the test object ..... :	N/A
Test item does meet the requirement ..... :	P(ass)
Test item does not meet the requirement ..... :	F(ail)

Testing

Date of receipt of test item ..... :	2021-05-11
Date(s) of performance of test ..... :	2021-05-11 to 2021-05-31

General remarks:

The test result presented in this report relate only to the object(s) tested.
This report must not be reproduced in part or in full, without the written approval of the issuing testing laboratory.

”(see Annex #)" refers to additional information appended to the report.
"(see appended table)" refers to a table appended to the report.

Throughout this report a point is used as the decimal separator.

This Test Report consists of the following documents:

1. Test Results
2. Annex No. 1 – Pictures of the unit
3. Annex No. 2 – Test equipment list

Copy of marking plate:

Solplanet

Model: ASW3000-S

Max. input voltage	d.c. 580V
MPP voltage range	d.c. 80-550V
Max. input current	d.c. 2×12A
Isc PV(absolute maximum)	d.c. 2×18A
Rated grid voltage	a.c. 220/230V
Rated grid frequency	50/60Hz
Max. AC output active power	3000W
Max. AC output apparent power	3000VA
Max. continuous output current	a.c. 15A
Adjustable cos(ϕ)	0.8ind...0.8cap
Operating temperature range	-25...+60°C
Ingress protection	IP65
Protective class	I
Overvoltage category	II(PV) III(MAINS)

Supported DRM0,DRM5,DRM6,DRM7,DRM8

5mins

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Made in China

Solplanet

Model: ASW3680-S

Max. input voltage	d.c. 580V
MPP voltage range	d.c. 80-550V
Max. input current	d.c. 2×12A
Isc PV(absolute maximum)	d.c. 2×18A
Rated grid voltage	a.c. 220/230V
Rated grid frequency	50/60Hz
Max. AC output active power	3680W
Max. AC output apparent power	3680VA
Max. continuous output current	a.c. 16A
Adjustable cos(ϕ)	0.8ind...0.8cap
Operating temperature range	-25...+60°C
Ingress protection	IP65
Protective class	I
Overvoltage category	II(PV) III(MAINS)

Supported DRM0,DRM5,DRM6,DRM7,DRM8

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Copy of marking plate:

Solplanet

Model: ASW4000-S

Max. input voltage	d.c. 580V
MPP voltage range	d.c. 80-550V
Max. input current	d.c. 2×12A
Isc PV(absolute maximum)	d.c. 2×18A
Rated grid voltage	a.c. 220/230V
Rated grid frequency	50/60Hz
Max. AC output active power	4000W
Max. AC output apparent power	4000VA
Max. continuous output current	a.c. 20A
Adjustable cos(ϕ)	0.8ind...0.8cap
Operating temperature range	-25...+60°C
Ingress protection	IP65
Protective class	I
Overvoltage category	II(PV) III(MAINS)

Supported DRM0,DRM5,DRM6,DRM7,DRM8

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Solplanet

Model: ASW5000-S

Max. input voltage	d.c. 580V
MPP voltage range	d.c. 80-550V
Max. input current	d.c. 2×12A
Isc PV(absolute maximum)	d.c. 2×18A
Rated grid voltage	a.c. 220/230V
Rated grid frequency	50/60Hz
Max. AC output active power	5000W *1
Max. AC output apparent power	5000VA *1
Max. continuous output current	a.c. 22.7A *2
Adjustable cos(ϕ)	0.8ind...0.8cap
Operating temperature range	-25...+60°C
Ingress protection	IP65
Protective class	I
Overvoltage category	II(PV) III(MAINS)

*1, For VDE AR-N 4105, Pac max=4600W, Sac max=4600VA
*2, For AS/NZS 4777.2:2015, Iac max=21.7A
Supported DRM0,DRM5,DRM6,DRM7,DRM8

5mins

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532-00432-00 Made in China

General product information:

The Solar converter converts DC voltage into AC voltage.
The DC input of Solar converter can be supplied from PV array only.
The Solar converter is a single-phase type.
The unit is providing EMC filtering at the output toward mains. The unit does not provide galvanic separation from 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 will also operate in case of one error.

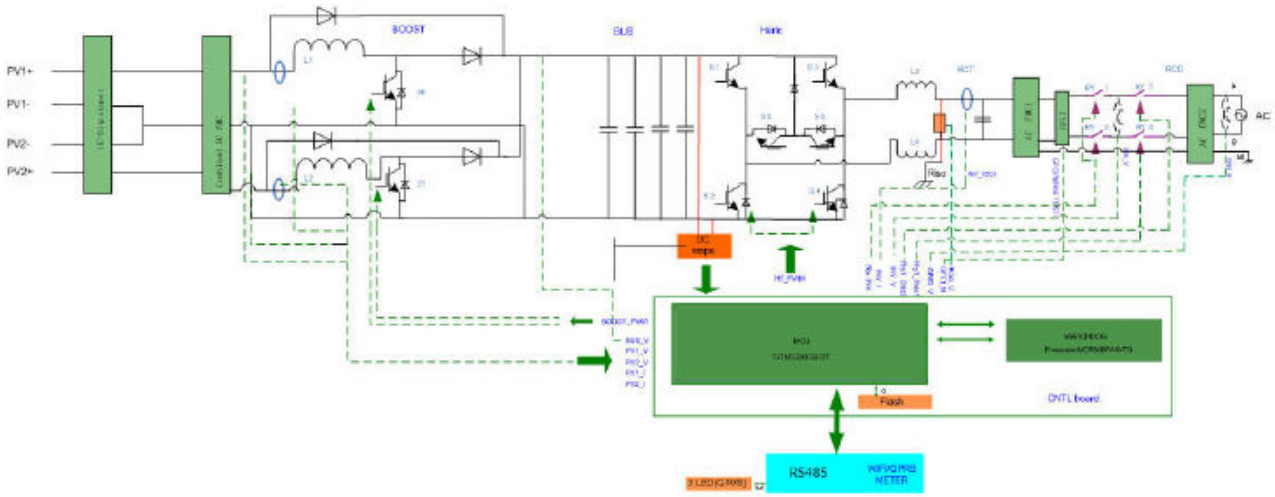

Figure 1-Block diagram

The internal control is redundant built. It consists of Microcontroller master DSP (U705) and slave DSP (U710).

The master DSP (U705) control the relays by switching signals; measures the PV voltage, PV current, Bus voltage, grid voltage, frequency, AC current with injected DC and the array insulation resistance to ground. In addition it tests the current sensors and the RCMU circuit before each start up.

The slave (U710) can be switch off the relays independently, and communicate with the master DSP (U705) each other to monitoring the master DSP (U705).

The current is measured by a current sensor. The AC current signal and the injected DC current signal are sent to the master DSP (U705). The master DSP (U705) tests and calibrates before each start up all current sensors.

The unit provides two relays in series in all output conductors. When single fault applied to one relay, alarm an error code in display panel, another redundant relay provides basic insulation maintained between the PV array and the mains. All the relays are tested before each start up.

The product was tested on:

Hardware version: V1.0

Software version: V1.0

Model difference:

The models ASW3000-S, ASW3680-S, ASW4000-S and ASW5000-S are identical in hardware and software, and the output power derated by software.

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Clause	Requirement + Test	Result - Remark	Verdict

4	**Efficiency measurement conditions**	Considered.	**P**
	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.	See below.	**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.	Photovoltaic array simulator used.	**P**
4.2	Temperature		**P**
	All measurements are to be made at an ambient temperature of 25 °C ± 2 °C.	25°C	**P**
	Other ambient temperatures may be allowed by mutual agreement. However, the temperature used must be clearly stated in all documentation.		**N/A**
4.3	Output voltage and frequency		**P**
	The output voltage and frequency are maintained at the manufacturer's stated nominal values.	230V, 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.	Input voltages: a) ASW3000-S: 140Vdc; ASW3680-S: 165Vdc; ASW4000-S: 180Vdc; ASW5000-S: 220Vdc; b) 360V; c) 522V;	**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.	The ripple of the input voltage had no influence on the measurements. (see appended table)	**P**
4.6	Resistive loads/utility grid		**P**

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Clause	Requirement + Test	Result - Remark	Verdict
	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.	The efficiency measurement was performed at 10 %, 25 %, 50 %, 75 % and 100 %, because the unit does not provide 120% of the inverter's rating overload function.	**P**
	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.	Grid-connected inverters.	**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.	Grid-connected inverters.	**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 ± 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.	Grid-connected inverters.	**N/A**
	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.		**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 ± 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.	Grid-connected inverters.	**N/A**
	The type of complex load is clearly stated in all documentation.		**N/A**
5.	**Efficiency calculations**	See below.	**P**
5.1	Rated output efficiency		**P**

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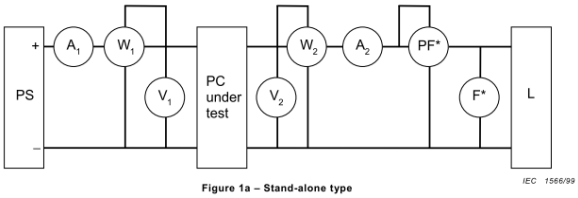
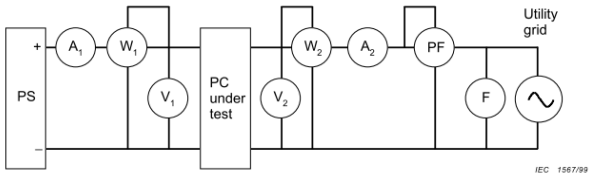
Clause	Requirement + Test	Result - Remark	Verdict
	Rated output efficiency shall be calculated from measured data as follows: $\eta_R = (P_o / P_i) \times 100$	Considered.	**P**
5.2	Partitial output efficiency		**N/A**
	Partial output efficiency shall be calculated from measured data as follows: $\eta_{par} = (P_{op} / P_{ip}) \times 100$	No derating during testing.	**N/A**
5.3	Energy efficiency		**P**
	Energy efficiency shall be calculated from measured data as follows: $\eta_E = (W_o / W_i) \times 100$	Considered.	**P**
5.4	Efficiency tolerances		**P**
	When an efficiency value has been guaranteed, the tolerance of this value shall be within: $-0,2(1-\eta)\eta$ (%)	Considered.	**P**
6.	**Efficiency test circuits**	See below.	**P**
6.1	Test circuits	Considered.	**P**
	Figure 1a is applied to standard-alone power conditioners	Figure 1b used.	**N/A**
	 Figure 1a – Stand-alone type		**N/A**
	Figure 1b is applied to utility-interactive power conditioners	Considered.	**P**
	 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		**P**
6.2	Measurement procedure	Considered.	**P**
	a) Efficiency is calculated with equation (1) or (2) using measured P_i, P_o or P_{ip}, P_{op}. DC input power P_i, P_{ip} can be measured by wattmeter W_1, or determined by multiplying the d.c. voltmeter V_1 and d.c. ammeter A_1 readings. Output power P_o, P_{op} is measured with wattmeter W_2.	Considered.	**P**

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	b) DC input voltage, which is measured by d.c. voltmeter V_1, shall be varied in the defined range where the output current, which is measured with a.c. ammeter A_2, is varied from low output to the rated output.	Considered.	**P**
	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 W_1 shall be a d.c. measuring type. The wattmeter W_2 shall be an a.c. or d.c. measuring type according to the output.	Considered.	**P**
	d) Power factor (PF in per cent) can be measured by a power factor meter PF, or calculated from the readings of V_2, A_2, W_2 and as follows: $PF = (W_2/(V_2 \times A_2)) \times 100$	Considered.	**P**
	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.	Digital measurement devices were used for testing. The accuracy of the measurement devices fulfills the requirements.	**P**
	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 less than 5 %, then averaging of readings is acceptable. The averaging period shall be 30 s or longer.	The dynamic MPPT was deactivated, the 60s average was used anyway.	**P**
7.	**Loss measurement**	See below.	**P**
7.1	No-load loss		**P**
	Stand-alone inverters: reading of d.c. input voltage, output voltage and frequency is given with meters V_1, V_2 and F respectively in figure 1a, and shall be adjusted to the rated values.	Grid-connected inverters.	**N/A**
	Utility-interactive inverters: reading of d.c. input voltmeter V_1, a.c. output voltmeter V_2 and frequency meter F in figure 1b shall be adjusted to meet the specified voltages and frequency.	See appended table.	**P**
7.2	Standby loss		**P**
	Stand-alone inverters: Consumption of utility power when the power conditioner is not operating but is under standby condition.	No such inverters.	**N/A**
	Utility-interactive inverters: consumption from the d.c. source when the power conditioner is not operating but is under standby condition.	See appended table.	**P**

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Clause	Requirement + Test	Result - Remark	Verdict

Annex A	**Power conditioner description (informative)**	See below.	**P**
	A power conditioner is defined in IEC 61277	Figure A.2	**P**

Annex B	**Power efficiency and conversion factor (informative)**	See below.	**P**
	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.	Power efficiency used.	**P**

Annex C	**Weighted-average energy efficiency (informative)**	See below.	**P**
	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	Considered.	**P**
C.1	η_{WT} of power conditioner for utility-interactive PV systems		**P**
	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.	Considered.	**P**
C.2	η_{WT} of power conditioner for stand-alone PV systems	Grid-connected inverters.	**N/A**
	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.		**N/A**
Annex D	**Derivation of efficiency tolerance in table 2 (informative)**	Considered.	**P**

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Clause	Requirement + Test	Result - Remark	Verdict

TABLE	**Efficiency recording and efficient calculation sheet**								
power conditioner type	**Grid-connected**								
Model:	ASW3000-S								
Parameters of power conditioner	Minimum rated input voltage: 140V Nominal voltage: 360V Maximum input voltage: 580V Rated output voltage: 230Vac Rated output frequency: 50Hz Rated output power: 3000VA								
PV input voltage	**a) Manufacturer's minimum rated input voltage (140Vdc)**								
Temperature (°C)	25								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	140,77	139,27	138,40	139,43	137,62	/	/	/
Input voltage ripple (V)	/	8,40	6,13	4,07	5,34	7,41	/	/	/
Input current (A)	/	2,475	6,256	12,543	18,610	25,046	/	/	/
Input current ripple (A)	/	0,186	0,269	0,362	0,729	1,301	/	/	/
Input power (Pi) (W)	/	314	784	1563	2335	3101	/	/	/
Output power (Po) (W)	/	288	741	1486	2221	2946	/	/	/
Output efficiency (%)	/	91,72	94,52	95,07	95,12	95,00	/	/	/
Input energy (Wi) (kWh)	/	5,233	13,067	26,050	38,917	51,683	/	/	/
Output energy (Wo) (kWh)	/	4,800	12,350	24,767	37,017	49,100	/	/	/
Energy efficiency (%)	/	91,72	94,52	95,07	95,12	95,00	/	/	/
PV input voltage	**b) The inverter's nominal voltage (360Vdc)**								
Temperature (°C)	25								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	367,99	361,64	360,45	359,07	359,35	/	/	/
Input voltage ripple (V)	/	9,06	10,63	13,31	9,67	8,19	/	/	/
Input current (A)	/	0,940	2,413	4,799	7,286	9,694	/	/	/

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Input current ripple (A)	/	0,066	0,090	0,203	0,201	0,222	/	/	/
Input power (Pi) (W)	/	311	786	1557	2355	3135	/	/	/
Output power (Po) (W)	/	296	758	1513	2285	3041	/	/	/
Output efficiency (%)	/	95,18	96,44	97,17	97,03	97,00	/	/	/
Input energy (Wi) (kWh)	/	5,183	13,100	25,950	39,250	52,250	/	/	/
Output energy (Wo) (kWh)	/	4,933	12,633	25,217	38,083	50,683	/	/	/
Energy efficiency (%)	/	95,18	96,44	97,17	97,03	97,00	/	/	/
PV input voltage	**c) The inverter's input voltage** (375Vdc)								
Temperature (°C)	25								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	386,54	377,14	377,41	378,63	379,84	/	/	/
Input voltage ripple (V)	/	15,24	15,01	10,02	16,07	8,29	/	/	/
Input current (A)	/	0,823	2,118	4,216	6,290	8,344	/	/	/
Input current ripple (A)	/	0,059	0,099	0,123	0,300	0,202	/	/	/
Input power (Pi) (W)	/	312	786	1571	2355	3135	/	/	/
Output power (Po) (W)	/	295	762	1533	2298	3059	/	/	/
Output efficiency (%)	/	94,55	96,95	97,58	97,58	97,58	/	/	/
Input energy (Wi) (kWh)	/	5,200	13,100	26,183	39,250	52,250	/	/	/
Output energy (Wo) (kWh)	/	4,917	12,700	25,550	38,300	50,983	/	/	/
Energy efficiency (%)	/	94,55	96,95	97,58	97,58	97,58	/	/	/
PV input voltage	**d) The inverter's input voltage** (464Vdc)								
Temperature (°C)	25								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	464,84	461,71	466,63	464,99	462,79	/	/	/
Input voltage ripple (V)	/	9,99	14,02	12,59	10,69	14,09	/	/	/
Input current (A)	/	0,744	1,887	3,707	5,630	7,537	/	/	/
Input current ripple (A)	/	0,050	0,106	0,121	0,151	0,227	/	/	/

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Clause	Requirement + Test	Result - Remark	Verdict

Input power (Pi) (W)	/	311	784	1557	2357	3140	/	/	/
Output power (Po) (W)	/	292	757	1514	2295	3057	/	/	/
Output efficiency (%)	/	93,89	96,56	97,24	97,37	97,36	/	/	/
Input energy (Wi) (kWh)	/	5,183	13,067	25,950	39,283	52,333	/	/	/
Output energy (Wo) (kWh)	/	4,867	12,617	25,233	38,250	50,950	/	/	/
Energy efficiency (%)	/	93,89	96,56	97,24	97,37	97,36	/	/	/
PV input voltage	**e) 90% of the inverter's maximum input voltage** (522Vdc)								
Temperature (°C)	25								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	522,14	521,82	520,55	519,68	519,53	/	/	/
Input voltage ripple (V)	/	5,57	11,89	9,37	8,88	8,08	/	/	/
Input current (A)	/	0,662	1,667	3,351	5,035	6,697	/	/	/
Input current ripple (A)	/	0,067	0,078	0,088	0,123	0,139	/	/	/
Input power (Pi) (W)	/	311	783	1571	2356	3132	/	/	/
Output power (Po) (W)	/	289	754	1524	2290	3046	/	/	/
Output efficiency (%)	/	92,93	96,30	97,01	97,20	97,25	/	/	/
Input energy (Wi) (kWh)	/	5,183	13,050	26,183	39,267	52,200	/	/	/
Output energy (Wo) (kWh)	/	4,817	12,567	25,400	38,167	50,767	/	/	/
Energy efficiency (%)	/	92,93	96,30	97,01	97,20	97,25	/	/	/

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			
Clause	Requirement + Test	Result - Remark	Verdict

TABLE	**Efficiency recording and efficient calculation sheet**								
power conditioner type	**Grid-connected**								
Model:	ASW3680-S								
Parameters of power conditioner	Minimum rated input voltage: 165V Nominal voltage: 360V Maximum input voltage: 580V Rated output voltage: 230Vac Rated output frequency: 50Hz Rated output power: 3680VA								
PV input voltage	**a) Manufacturer's minimum rated input voltage (165Vdc)**								
Temperature (°C)	25								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	165,51	165,43	165,08	162,83	163,48	/	/	/
Input voltage ripple (V)	/	4,12	7,36	4,92	4,03	2,21	/	/	/
Input current (A)	/	2,599	6,487	12,957	19,648	26,034	/	/	/
Input current ripple (A)	/	0,077	0,29	0,392	0,475	0,355	/	/	/
Input power (Pi) (W)	/	387	966	1925	2879	3829	/	/	/
Output power (Po) (W)	/	359	918	1839	2747	3648	/	/	/
Output efficiency (%)	/	92,76	95,03	95,53	95,42	95,27	/	/	/
Input energy (Wi) (kWh)	/	6,450	16,100	32,083	47,983	63,817	/	/	/
Output energy (Wo) (kWh)	/	5,983	15,300	30,650	45,783	60,800	/	/	/
Energy efficiency (%)	/	92,76	95,03	95,53	95,42	95,27	/	/	/
PV input voltage	**b) The inverter's nominal voltage (360Vdc)**								
Temperature (°C)	25								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	369,23	357,00	361,57	359,21	360,48	/	/	/
Input voltage ripple (V)	/	10,06	8,05	12,09	12,12	5,08	/	/	/
Input current (A)	/	1,151	3,012	5,944	8,962	11,891	/	/	/
Input current ripple (A)	/	0,084	0,080	0,223	0,308	0,179	/	/	/

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Input power (Pi) (W)	/	383	968	1935	2897	3857	/	/	/
Output power (Po) (W)	/	366	935	1878	2811	3741	/	/	/
Output efficiency (%)	/	95,56	96,59	97,05	97,03	96,99	/	/	/
Input energy (Wi) (kWh)	/	6,383	16,133	32,250	48,283	64,283	/	/	/
Output energy (Wo) (kWh)	/	6,100	15,583	31,300	46,850	62,350	/	/	/
Energy efficiency (%)	/	95,56	96,59	97,05	97,03	96,99	/	/	/
PV input voltage	**c) The inverter's input voltage** (375Vdc)								
Temperature (°C)	25								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	383,87	376,03	376,30	380,12	377,67	/	/	/
Input voltage ripple (V)	/	8,05	8,68	11,05	10,10	6,03	/	/	/
Input current (A)	/	0,998	2,560	5,093	7,547	10,121	/	/	/
Input current ripple (A)	/	0,040	0,070	0,176	0,230	0,175	/	/	/
Input power (Pi) (W)	/	376	948	1894	2838	3780	/	/	/
Output power (Po) (W)	/	358	921	1848	2769	3686	/	/	/
Output efficiency (%)	/	95,21	97,15	97,57	97,57	97,51	/	/	/
Input energy (Wi) (kWh)	/	6,267	15,800	31,567	47,300	63,000	/	/	/
Output energy (Wo) (kWh)	/	5,967	15,350	30,800	46,150	61,433	/	/	/
Energy efficiency (%)	/	95,21	97,15	97,57	97,57	97,51	/	/	/
PV input voltage	**d) The inverter's input voltage** (464Vdc)								
Temperature (°C)	25								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	467,66	465,14	464,89	464,73	462,94	/	/	/
Input voltage ripple (V)	/	9,08	12,97	11,01	11,11	7,53	/	/	/
Input current (A)	/	0,914	2,311	4,630	6,935	9,274	/	/	/
Input current ripple (A)	/	0,063	0,098	0,142	0,197	0,151	/	/	/
Input power (Pi) (W)	/	385	968	1938	2901	3864	/	/	/

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Output power (Po) (W)	/	364	937	1886	2825	3760	/	/	/
Output efficiency (%)	/	94,55	96,80	97,32	97,38	97,31	/	/	/
Input energy (Wi) (kWh)	/	6,417	16,133	32,300	48,350	64,400	/	/	/
Output energy (Wo) (kWh)	/	6,067	15,617	31,433	47,083	62,667	/	/	/
Energy efficiency (%)	/	94,55	96,80	97,32	97,38	97,31	/	/	/
PV input voltage	**e) 90% of the inverter's maximum input voltage** (522Vdc)								
Temperature (°C)	25								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	523,07	520,68	520,17	518,88	518,07	/	/	/
Input voltage ripple (V)	/	14,13	7,06	9,31	11,55	7,27	/	/	/
Input current (A)	/	0,7920	2,0100	4,0240	6,0380	8,0470	/	/	/
Input current ripple (A)	/	0,0880	0,0530	0,1070	0,2040	0,1290	/	/	/
Input power (Pi) (W)	/	373	942	1884	2821	3753	/	/	/
Output power (Po) (W)	/	350	909	1831	2743	3648	/	/	/
Output efficiency (%)	/	93,82	96,50	97,19	97,24	97,20	/	/	/
Input energy (Wi) (kWh)	/	6,217	15,700	31,400	47,017	62,550	/	/	/
Output energy (Wo) (kWh)	/	5,833	15,150	30,517	45,717	60,800	/	/	/
Energy efficiency (%)	/	93,82	96,50	97,19	97,24	97,20	/	/	/
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	Result - Remark	Verdict

TABLE	**Efficiency recording and efficient calculation sheet**								
power conditioner type	**Grid-connected**								
Model:	ASW4000-S								
Parameters of power conditioner	Minimum rated input voltage: 180V Nominal voltage: 360V Maximum input voltage: 580V Rated output voltage: 230Vac Rated output frequency: 50Hz Rated output power: 4000VA								
PV input voltage	**a) Manufacturer's minimum rated input voltage (180Vdc)**								
Temperature (°C)	25								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	179,43	179,71	179,09	178,26	178,32	/	/	/
Input voltage ripple (V)	/	4,61	7,22	4,99	6,09	2,47	/	/	/
Input current (A)	/	2,596	6,466	12,939	19,431	25,843	/	/	/
Input current ripple (A)	/	0,070	0,239	0,350	0,645	0,352	/	/	/
Input power (Pi) (W)	/	419	1046	2086	3117	4146	/	/	/
Output power (Po) (W)	/	391	997	1997	2980	3958	/	/	/
Output efficiency (%)	/	93,32	95,32	95,73	95,61	95,47	/	/	/
Input energy (Wi) (kWh)	/	6,983	17,433	34,767	51,950	69,100	/	/	/
Output energy (Wo) (kWh)	/	6,517	16,617	33,283	49,667	65,967	/	/	/
Energy efficiency (%)	/	93,32	95,32	95,73	95,61	95,47	/	/	/
PV input voltage	**b) The inverter's nominal voltage (360Vdc)**								
Temperature (°C)	25								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	363,56	361,06	361,22	359,35	359,93	/	/	/
Input voltage ripple (V)	/	7,05	10,40	10,20	8,19	10,06	/	/	/
Input current (A)	/	1,277	3,192	6,440	9,694	12,882	/	/	/
Input current ripple (A)	/	0,042	0,103	0,220	0,222	0,387	/	/	/

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Clause	Requirement + Test	Result - Remark	Verdict

Input power (Pi) (W)	/	418	1038	2094	3135	4171	/	/	/
Output power (Po) (W)	/	398	1005	2034	3041	4042	/	/	/
Output efficiency (%)	/	95,22	96,82	97,14	97,00	96,91	/	/	/
Input energy (Wi) (kWh)	/	6,967	17,300	34,900	52,250	69,517	/	/	/
Output energy (Wo) (kWh)	/	6,633	16,750	33,900	50,683	67,367	/	/	/
Energy efficiency (%)	/	95,22	96,82	97,14	97,00	96,91	/	/	/
PV input voltage	**c) The inverter's input voltage** (375Vdc)								
Temperature (°C)	25								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	378,98	378,50	379,46	376,62	375,34	/	/	/
Input voltage ripple (V)	/	12,49	12,02	13,51	8,67	6,03	/	/	/
Input current (A)	/	1,108	2,776	5,512	8,319	11,117	/	/	/
Input current ripple (A)	/	0,070	0,122	0,234	0,208	0,191	/	/	/
Input power (Pi) (W)	/	412	1036	2068	3099	4126	/	/	/
Output power (Po) (W)	/	394	1007	2018	3024	4022	/	/	/
Output efficiency (%)	/	95,63	97,20	97,58	97,58	97,48	/	/	/
Input energy (Wi) (kWh)	/	6,867	17,267	34,467	51,650	68,767	/	/	/
Output energy (Wo) (kWh)	/	6,567	16,783	33,633	50,400	67,033	/	/	/
Energy efficiency (%)	/	95,63	97,20	97,58	97,58	97,48	/	/	/
PV input voltage	**d) The inverter's input voltage** (464Vdc)								
Temperature (°C)	25								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	467,20	464,73	468,02	462,79	463,70	/	/	/
Input voltage ripple (V)	/	6,14	14,34	9,11	14,09	8,26	/	/	/
Input current (A)	/	0,992	2,479	4,972	7,537	10,018	/	/	/
Input current ripple (A)	/	0,055	0,089	0,142	0,227	0,183	/	/	/
Input power (Pi) (W)	/	417	1037	2095	3140	4181	/	/	/

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Clause	Requirement + Test	Result - Remark	Verdict

Output power (Po) (W)	/	397	1005	2039	3057	4067	/	/	/
Output efficiency (%)	/	95,20	96,91	97,33	97,36	97,27	/	/	/
Input energy (Wi) (kWh)	/	6,950	17,283	34,917	52,333	69,683	/	/	/
Output energy (Wo) (kWh)	/	6,617	16,750	33,983	50,950	67,783	/	/	/
Energy efficiency (%)	/	95,20	96,91	97,33	97,36	97,27	/	/	/
PV input voltage	**e) 90% of the inverter's maximum input voltage** (522Vdc)								
Temperature (°C)	25								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	521,91	520,43	519,83	517,90	518,63	/	/	/
Input voltage ripple (V)	/	9,36	13,14	10,46	9,79	6,87	/	/	/
Input current (A)	/	0,864	2,179	4,367	6,559	8,713	/	/	/
Input current ripple (A)	/	0,075	0,115	0,102	0,099	0,151	/	/	/
Input power (Pi) (W)	/	406	1021	2044	3058	4068	/	/	/
Output power (Po) (W)	/	383	987	1986	2973	3954	/	/	/
Output efficiency (%)	/	94,33	96,67	97,16	97,22	97,20	/	/	/
Input energy (Wi) (kWh)	/	6,767	17,017	34,067	50,967	67,800	/	/	/
Output energy (Wo) (kWh)	/	6,383	16,450	33,100	49,550	65,900	/	/	/
Energy efficiency (%)	/	94,33	96,67	97,16	97,22	97,20	/	/	/
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	Result - Remark	Verdict

TABLE	**Efficiency recording and efficient calculation sheet**								
power conditioner type	**Grid-connected**								
Model:	ASW5000-S								
Parameters of power conditioner	Minimum rated input voltage: 220V Nominal voltage: 360V Maximum input voltage: 580V Rated output voltage: 230Vac Rated output frequency: 50Hz Rated output power: 5000VA								
PV input voltage	**a) Manufacturer's minimum rated input voltage (220Vdc)**								
Temperature (°C)	25								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	221,04	219,65	219,29	218,33	217,91	/	/	/
Input voltage ripple (V)	/	12,21	5,08	4,11	6,11	3,10	/	/	/
Input current (A)	/	2,604	6,555	13,091	19,655	26,178	/	/	/
Input current ripple (A)	/	0,179	0,158	0,237	0,550	0,371	/	/	/
Input power (Pi) (W)	/	518	1296	2584	3861	5129	/	/	/
Output power (Po) (W)	/	489	1244	2484	3705	4909	/	/	/
Output efficiency (%)	/	94,40	95,99	96,13	95,96	95,71	/	/	/
Input energy (Wi) (kWh)	/	8,633	21,600	43,067	64,350	85,483	/	/	/
Output energy (Wo) (kWh)	/	8,150	20,733	41,400	61,750	81,817	/	/	/
Energy efficiency (%)	/	94,40	95,99	96,13	95,96	95,71	/	/	/
PV input voltage	**b) The inverter's nominal voltage (360Vdc)**								
Temperature (°C)	25								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	363,02	360,68	359,67	360,23	358,81	/	/	/
Input voltage ripple (V)	/	12,88	5,69	9,15	8,05	7,07	/	/	/
Input current (A)	/	1,582	3,998	8,003	11,961	15,976	/	/	/
Input current ripple (A)	/	0,089	0,067	0,212	0,301	0,324	/	/	/

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Clause	Requirement + Test	Result - Remark	Verdict

Input power (Pi) (W)	/	517	1298	2591	3877	5155	/	/	/
Output power (Po) (W)	/	497	1259	2516	3759	4989	/	/	/
Output efficiency (%)	/	95,95	97,15	97,37	97,36	97,27	/	/	/
Input energy (Wi) (kWh)	/	8,617	21,633	43,183	64,617	85,917	/	/	/
Output energy (Wo) (kWh)	/	8,283	20,983	41,933	62,650	83,150	/	/	/
Energy efficiency (%)	/	96,13	97,00	97,11	96,96	96,78	/	/	/
PV input voltage	**c) The inverter's input voltage** (375Vdc)								
Temperature (°C)	25								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	371,20	372,67	376,37	376,17	375,78	/	/	/
Input voltage ripple (V)	/	11,04	11,30	8,03	7,13	5,02	/	/	/
Input current (A)	/	1,402	3,498	6,894	10,324	13,764	/	/	/
Input current ripple (A)	/	0,095	0,104	0,162	0,215	0,202	/	/	/
Input power (Pi) (W)	/	511	1286	2566	3841	5111	/	/	/
Output power (Po) (W)	/	492	1253	2506	3746	4976	/	/	/
Output efficiency (%)	/	94,98	96,68	96,98	97,02	97,02	/	/	/
Input energy (Wi) (kWh)	/	8,517	21,433	42,767	64,017	85,183	/	/	/
Output energy (Wo) (kWh)	/	8,200	20,883	41,767	62,433	82,933	/	/	/
Energy efficiency (%)	/	96,28	97,43	97,66	97,53	97,36	/	/	/
PV input voltage	**d) The inverter's input voltage** (464Vdc)								
Temperature (°C)	25								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	474,46	467,40	465,40	465,26	465,28	/	/	/
Input voltage ripple (V)	/	14,09	7,27	9,20	8,83	0,45	/	/	/
Input current (A)	/	1,209	3,084	6,190	9,275	12,279	/	/	/
Input current ripple (A)	/	0,103	0,086	0,128	0,177	0,018	/	/	/
Input power (Pi) (W)	/	516	1298	2593	3884	5140	/	/	/

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Clause	Requirement + Test	Result - Remark	Verdict

Output power (Po) (W)	/	493	1260	2525	3778	4991	/	/	/
Output efficiency (%)	/	95,17	97,22	97,72	97,85	97,31	/	/	/
Input energy (Wi) (kWh)	/	8,600	21,633	43,217	64,733	85,667	/	/	/
Output energy (Wo) (kWh)	/	8,217	21,000	42,083	62,967	83,183	/	/	/
Energy efficiency (%)	/	95,54	97,07	97,38	97,27	97,10	/	/	/
PV input voltage	**e) 90% of the inverter's maximum input voltage** (522Vdc)								
Temperature (°C)	25								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	519,89	520,47	519,35	517,81	519,00	/	/	/
Input voltage ripple (V)	/	14,88	8,34	10,35	10,82	1,15	/	/	/
Input current (A)	/	1,103	2,766	5,536	8,306	11,008	/	/	/
Input current ripple (A)	/	0,090	0,093	0,123	0,142	0,040	/	/	/
Input power (Pi) (W)	/	516	1296	2588	3871	5142	/	/	/
Output power (Po) (W)	/	492	1256	2516	3761	4989	/	/	/
Output efficiency (%)	/	94,98	96,91	97,37	97,41	97,27	/	/	/
Input energy (Wi) (kWh)	/	8,600	21,600	43,133	64,517	85,700	/	/	/
Output energy (Wo) (kWh)	/	8,200	20,933	41,933	62,683	83,150	/	/	/
Energy efficiency (%)	/	95,35	96,91	97,22	97,16	97,02	/	/	/
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	Result - Remark	Verdict

TABLE	No load loss: ASW3680-S
power conditioner type	Utility-interactive
Measure input voltage (V)	360,22 Vdc
Measured input power(W)	5,642 W
Remark: No load loss is measured when the power conditioner works at rated input voltage and it's load is disconnected.	

TABLE	No load loss: ASW3000-S
power conditioner type	Utility-interactive
Measure input voltage (V)	360,22 Vdc
Measured input power(W)	5,642 W
Remark: No load loss is measured when the power conditioner works at rated input voltage and it's load is disconnected.	

TABLE	No load loss: ASW4000-S
power conditioner type	Utility-interactive
Measure input voltage (V)	360,22 Vdc
Measured input power(W)	5,642 W
Remark: No load loss is measured when the power conditioner works at rated input voltage and it's load is disconnected.	

TABLE	No load loss: ASW5000-S
power conditioner type	Utility-interactive
Measure input voltage (V)	360,22 Vdc
Measured input power(W)	5,642 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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Clause	Requirement + Test	Result - Remark	Verdict

TABLE	Standby loss: ASW3680-S
power conditioner type	Utility-interactive
Measure output voltage (V)	230,29 Vac
Measured output power(W)	2,044 W
Remark: Standby loss is measured when the power conditioner works at rated input voltage and in standby mode.	

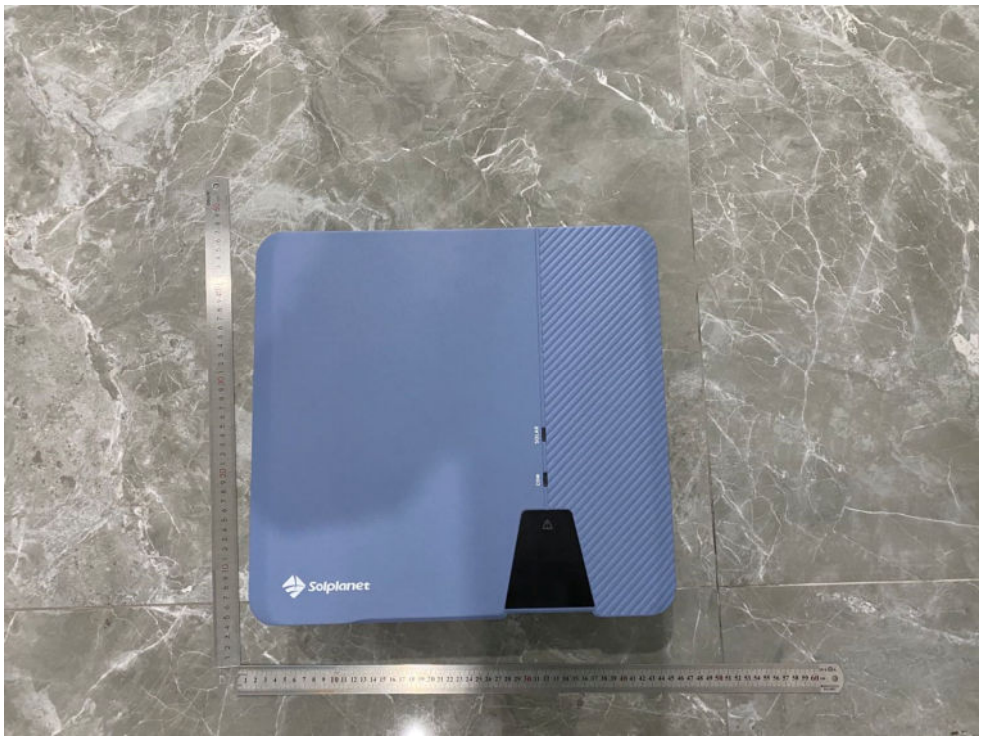
TABLE	Standby loss: ASW3000-S
power conditioner type	Utility-interactive
Measure output voltage (V)	230,27 Vac
Measured output power(W)	2,026 W
Remark: Standby loss is measured when the power conditioner works at rated input voltage and in standby mode.	

TABLE	Standby loss: ASW4000-S
power conditioner type	Utility-interactive
Measure output voltage (V)	230,33 Vac
Measured output power(W)	2,037 W
Remark: Standby loss is measured when the power conditioner works at rated input voltage and in standby mode.	

TABLE	Standby loss: ASW5000-S
power conditioner type	Utility-interactive
Measure output voltage (V)	230,33 Vac
Measured output power(W)	2,042 W
Remark: Standby loss is measured when the power conditioner works at rated input voltage and in standby mode.	

Annex 1
Pictures of the unit

Enclosure front view - 1



Enclosure front view - 2

Enclosure rear view

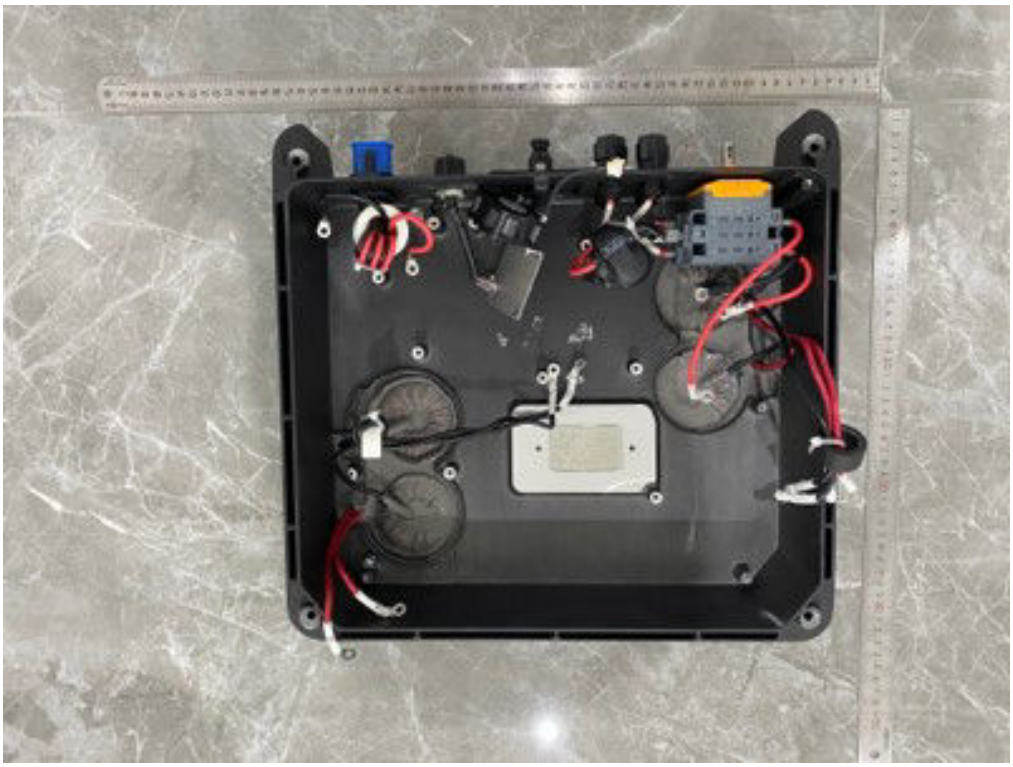
Enclosure Bottom view

Enclosure side view-1

Enclosure side view-2

Internal view 1

Internal view 2



Internal view 1

Main board -component side view

Main board-solder side view

Annex 2

Test equipment list

Date(s) of performance test: 2020-06-09 to 2020-08-21

Equipment	Internal No.	Manufacturer	Type	Serial No.	Last Calibration
Power analyser	C3RB17008E	YOKOGAWA	WT1800	//	May. 19, 2022
Oscilloscope	SE-559	YOKOGAWA	DLM2024	//	May. 19, 2022
	SCGT208	Agilent	DSO7014B	//	May. 19, 2022
AC Source	SCGJ250	CHROMA	61512	//	Monitored by Power analyser
DC Simulation Power supply	SCGJ390	CHROMA	62150H-1000S	//	
	SCGJ391	CHROMA	62150H-1000S	//	
RLC load	93V002581	Qunling	ACTL-3803H	//	
AC/DC Current probe	ZSCGJ0464	Tektronix	A622	//	May. 19, 2022
Differential probe	SCGJ359	Tektronix	P5200A	//	May. 19, 2022
Multi-meter	41620008	Fluke	287C	//	May. 19, 2022