TEST REPORT

IEC 61683

Photovoltaic systems – Power conditioners – Procedure for measuring efficiency

Report reference number ..... :	**PV200917N006-9**
Date of issue ..... ::	2021-01-28
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Accreditation ..... :	ilac-MRA A2LA ACCREDITED Certificate # 2951.01
Applicant's name ..... :	**Shenzhen SOFARSOLAR Co., Ltd.**
Address ..... :	401, Building 4, AnTongDa Industrial Park, District 68, XingDong Community, XinAn Street, BaoAn District, Shenzhen, 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..... :	**Hybrid Inverter**
Trademark..... :	SOFAR SOLAR
Model / Type ..... :	HYD 3000-EP,HYD 3680-EP,HYD 4000-EP HYD 4600-EP,HYD 5000-EP,HYD 5500-EP,HYD 6000-EP

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) ..... :	Lukes Lin 
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Manufacturer's name ..... :	**Shenzhen SOFARSOLAR Co., Ltd.**
Manufacturer address ..... :	401, Building 4, AnTongDa Industrial Park, District 68, XingDong Community, XinAn Street, BaoAn District, Shenzhen, China
Factory's name ..... :	**Dongguan SOFAR SOLAR Co.,Ltd.**
Factory address	1F - 6F, Building E, No. 1 JinQi Road, Bihu Industrial Park, Wulian Village, Fenggang Town, Dongguan City

Document History			
Date	**Internal reference**	**Modification / Change / Status**	**Revision**
2021-01-28	Lukes Lin	Initial report was written	0
Supplementary information:			

Ratings .....:	**HYD 3000-EP**	**HYD 3680-EP**	**HYD 4000-EP**
Full load MPP DC voltage range [V] :	160-520V	180-520V	200-520V
Input DC voltage range[V].....:	90-600V		
Input DC current [A].....:	Max. 13A/13A		
Output AC voltage [V].....:	L/N/PE, 220/230Vac, 50/60Hz		
Output AC current [A].....:	15,0	16,0	20,0
Output power [W] .....:	3000	3680	4000
Max. output power [VA].....:	3300	3680	4400
Output DC voltage range [V].....: [Battery charge]……:	42-58V		
Input/Output DC current [A].....: [Battery charge/discharge] ……:	Max. 75A	Max. 80A	Max. 85A
Charge and discharge power[W].....:	Max. 3750	Max. 4000	Max. 4250
Stand alone Output AC voltage [V] ..:	L/N/PE, 220/230Vac, 50Hz		
Max. Input/Output AC current [A].....: [Battery charge/discharge mode] …:	13,6	16,0	18,2
Max. Input/Output AC power [VA].....: [Battery charge/discharge mode] …:	3000	3680	4000
Ratings .....:	**HYD 4600-EP**	**HYD 5000-EP**	**HYD 5500-EP**
Full load MPP DC voltage range [V] :	230-520V	250-520V	250-520V
Input DC voltage range[V].....:	90-600V		
Input DC current [A].....:	Max. 13A/13A		
Output AC voltage [V].....:	L/N/PE, 220/230Vac, 50/60Hz		
Output AC current [A].....:	20,9	21,7	25,0
Output power [W] .....:	4600	5000	5000
Max. output power [VA].....:	4600	5000	5500
Output DC voltage range [V].....: [Battery charge]……:	42-58V		
Input/Output DC current [A].....: [Battery charge/discharge] ……:	Max. 100A		
Charge and discharge power[W].....:	Max. 5000		
Stand alone Output AC voltage [V] ..:	L/N/PE, 220/230Vac, 50Hz		
Max. Input/Output AC current [A].....: [Battery charge/discharge mode] …:	20,9	22,7	22,7
Max. Input/Output AC power [VA].....: [Battery charge/discharge mode] …:	4600	5000	5000

Ratings .....:	**HYD 6000-EP**
Full load MPP DC voltage range [V] :	300-520V
Input DC voltage range[V].....:	90-600V
Input DC current [A].....:	Max. 13A/13A
Output AC voltage [V].....:	L/N/PE, 220/230Vac, 50Hz/60Hz
Output AC current [A].....:	27,3
Output power [W] .....:	6000
Max. output power [VA].....:	6000
Output DC voltage range [V].....: [Battery charge]……:	42-58V
Input/Output DC current [A].....: [Battery charge/discharge] ……:	Max. 100A
Charge and discharge power[W].....:	Max. 5000
Stand alone Output AC voltage [V] ..:	L/N/PE, 220/230Vac, 50Hz
Max. Input/Output AC current [A].....: [Battery charge/discharge mode] …:	22,7
Max. Input/Output AC power [VA]....: [Battery charge/discharge mode] …:	5000

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] ..... :	Approx. 21,5

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 ..... :	2021-01-27
Date(s) of performance of test ..... :	2020-11-20 to 2021-01-27

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:

SOFAR SOLAR

Hybrid Inverter

Model No:	HYD 3000-EP
Max.DC Input Voltage	600V
Operating MPPT Voltage Range	90V~580V
MAX.PV Isc	2x18A
Battery Type	Lead-acid,Lithium-ion
Battery Voltage Range	42-58V
Max.Charging Current	75A
Max.Discharging Current	75A
Max.Charging&Discharging Power	3750W
Nominal Grid Voltage	220/230Vac
Nominal Output Voltage	230Vac
Max.Output Current	15.0A
Nominal Grid Frequency	50/60Hz
Power Factor	1(adjustable+/-0.8)
Nominal Output Power	3000W
Backup Rated Current	13.6A
Backup Rated Apparent Power	3000VA
Ingress Protection	IP65
Operating Temperature Range	-30-+60℃
Protective Class	Class I

Manufacturer : Shenzhen SOFARSOLAR Co., Ltd.
Address : 401, Building 4, AnTongDa Industrial Park, District 68, XingDong Community,XinAn Street, BaoAn District, Shenzhen, China
VDE0126-1-1,VDE-AR-N4105
G98,AS4777,UTE C15-712-1

SOFAR SOLAR

Hybrid Inverter

Model No:	HYD 3680-EP
Max.DC Input Voltage	600V
Operating MPPT Voltage Range	90V~580V
MAX.PV Isc	2x18A
Battery Type	Lead-acid,Lithium-ion
Battery Voltage Range	42-58V
Max.Charging Current	80A
Max.Discharging Current	80A
Max.Charging&Discharging Power	4000W
Nominal Grid Voltage	220/230Vac
Nominal Output Voltage	230Vac
Max.Output Current	16.0A
Nominal Grid Frequency	50/60Hz
Power Factor	1(adjustable+/-0.8)
Nominal Output Power	3680W
Backup Rated Current	16.0A
Backup Rated Apparent Power	3680VA
Ingress Protection	IP65
Operating Temperature Range	-30-+60℃
Protective Class	Class I

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SOFAR SOLAR

Hybrid Inverter

Model No:	HYD 4000-EP
Max.DC Input Voltage	600V
Operating MPPT Voltage Range	90V~580V
MAX.PV Isc	2x18A
Battery Type	Lead-acid,Lithium-ion
Battery Voltage Range	42-58V
Max.Charging Current	85A
Max.Discharging Current	85A
Max.Charging&Discharging Power	4250W
Nominal Grid Voltage	220/230Vac
Nominal Output Voltage	230Vac
Max.Output Current	20.0A
Nominal Grid Frequency	50/60Hz
Power Factor	1(adjustable+/-0.8)
Nominal Output Power	4000W
Backup Rated Current	18.2A
Backup Rated Apparent Power	4000VA
Ingress Protection	IP65
Operating Temperature Range	-30-+60℃
Protective Class	Class I

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SOFAR SOLAR

Hybrid Inverter

Model No:	HYD 4600-EP
Max.DC Input Voltage	600V
Operating MPPT Voltage Range	90V~580V
MAX.PV Isc	2x18A
Battery Type	Lead-acid,Lithium-ion
Battery Voltage Range	42-58V
Max.Charging Current	100A
Max.Discharging Current	100A
Max.Charging&Discharging Power	5000W
Nominal Grid Voltage	220/230Vac
Nominal Output Voltage	230Vac
Max.Output Current	20.9A
Nominal Grid Frequency	50/60Hz
Power Factor	1(adjustable+/-0.8)
Nominal Output Power	4600W
Backup Rated Current	20.9A
Backup Rated Apparent Power	4600VA
Ingress Protection	IP65
Operating Temperature Range	-30-+60℃
Protective Class	Class I

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SOFAR SOLAR

Hybrid Inverter

Model No:	HYD 5000-EP
Max.DC Input Voltage	600V
Operating MPPT Voltage Range	90V~580V
MAX.PV Isc	2x18A
Battery Type	Lead-acid,Lithium-ion
Battery Voltage Range	42-58V
Max.Charging Current	100A
Max.Discharging Current	100A
Max.Charging&Discharging Power	5000W
Nominal Grid Voltage	220/230Vac
Nominal Output Voltage	230Vac
Max.Output Current	21.7A
Nominal Grid Frequency	50/60Hz
Power Factor	1(adjustable+/-0.8)
Nominal Output Power	5000W
Backup Rated Current	22.7A
Backup Rated Apparent Power	5000VA
Ingress Protection	IP 65
Operating Temperature Range	-30-+60℃
Protective Class	Class I

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SOFAR SOLAR

Hybrid Inverter

Model No:	HYD 5500-EP
Max.DC Input Voltage	600V
Operating MPPT Voltage Range	90V~580V
MAX.PV Isc	2x18A
Battery Type	Lead-acid,Lithium-ion
Battery Voltage Range	42-58V
Max.Charging Current	100A
Max.Discharging Current	100A
Max.Charging&Discharging Power	5000W
Nominal Grid Voltage	220/230Vac
Nominal Output Voltage	230Vac
Max.Output Current	25.0A
Nominal Grid Frequency	50/60Hz
Power Factor	1(adjustable+/-0.8)
Nominal Output Power	5000W
Backup Rated Current	22.7A
Backup Rated Apparent Power	5000VA
Ingress Protection	IP 65
Operating Temperature Range	-30-+60℃
Protective Class	Class I

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SOFAR SOLAR

Hybrid Inverter

Model No:	HYD 6000-EP
Max.DC Input Voltage	600V
Operating MPPT Voltage Range	90V~580V
MAX.PV Isc	2x18A
Battery Type	Lead-acid,Lithium-ion
Battery Voltage Range	42-58V
Max.Charging Current	100A
Max.Discharging Current	100A
Max.Charging&Discharging Power	5000W
Nominal Grid Voltage	220/230Vac
Nominal Output Voltage	230Vac
Max.Output Current	27.3A
Nominal Grid Frequency	50/60Hz
Power Factor	1(adjustable+/-0.8)
Nominal Output Power	6000W
Backup Rated Current	22.7A
Backup Rated Apparent Power	5000VA
Ingress Protection	IP 65
Operating Temperature Range	-30-+60℃
Protective Class	Class I

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General product information:

The Hybrid inverter converts DC voltage into AC voltage.
The DC input of Hybrid inverter can be supplied from PV array and Batteries.
Battery management unit is integrated in External Energy storage.
The Hybrid inverter 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.

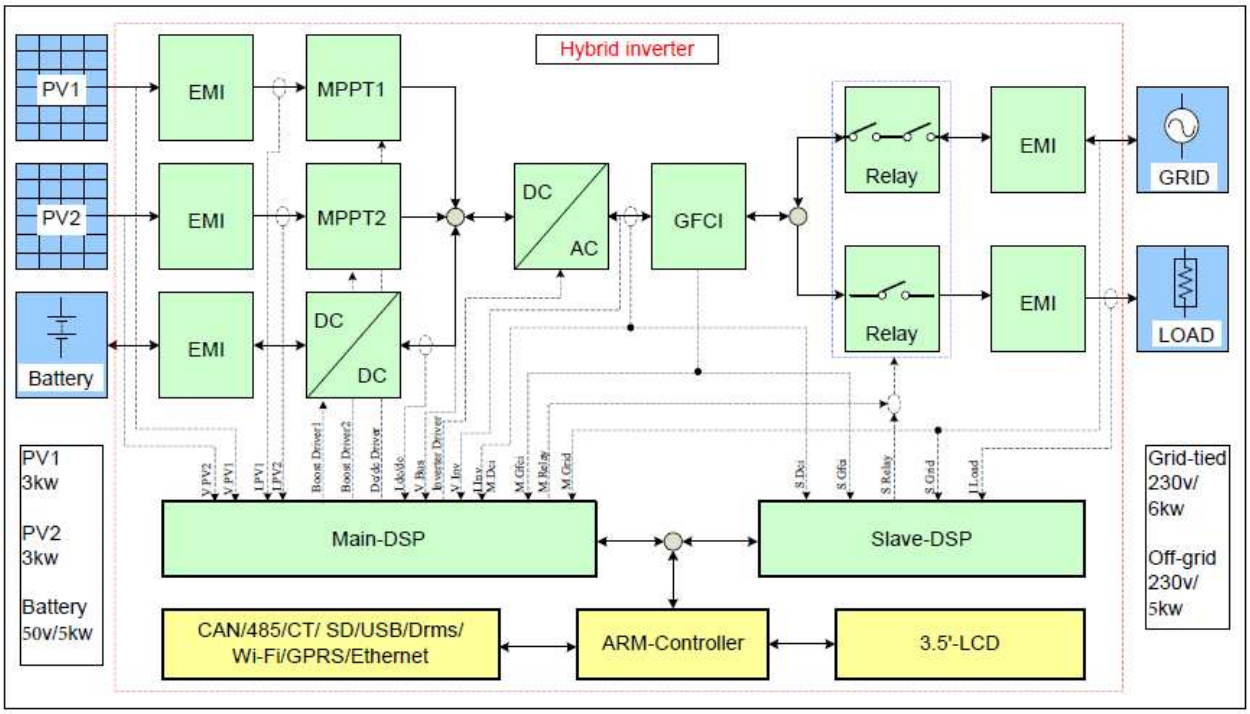

Figure 1-Block diagram

The internal control is redundant built. It consists of Main DSP(U4) and slave DSP(U43).

The Main DSP(U4)can control the relays, measures voltage, and frequency, AC current with injected DC, insulation resistance and residual current, In addition it tests the array insulation resistance and the RCMU circuit before each start up.

The slave DSP(U43) is using for detect residual current, also can open the relays independently and communicate with Main DSP(U4).

The unit provides two relays in series on Line 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 start up. Both controllers Main MCU(U4), slave MCU(U43) can open the relays.

The product was tested on:

Hardware version: V001

Software version: V02000

Model difference:

The models HYD 3000-EP,HYD 3680-EP,HYD 4000-EP,HYD 4600-EP,HYD 5000-EP,HYD5500-EP and HYD 6000-EP are almost identical in hardware except the shown in the following table and the output power derated by software.

	HYD 6000-EP	HYD 5500-EP	HYD 5000-EP	HYD 4600-EP	HYD 4000-EP	HYD 3680-EP	HYD 3000-EP
Mode resistance (R332,R334,R336)	(0Ω, NC, 0Ω)				(NC, 0Ω, NC)		
Number of BUS capacitance	8				6		
INV inductance	0.75mH				1.035mH		
The resistance of monitoring output current (R123,R132)	(1.5kΩ, 1.5kΩ)				(499Ω, 499Ω)		

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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.	220/230V, L/N/PE, 50/60Hz	**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) ; HYD 3000-EP: 160Vdc; HYD 3680-EP:180Vdc; HYD 4000-EP:200Vdc; HYD 4600-EP:230Vdc; HYD 5000-EP:250Vdc; HYD 5500-EP: 250Vdc; HYD 6000-EP:300Vdc; b); 360V c) .520V	**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.		**P**
4.5	Ripple and distortion		**P**

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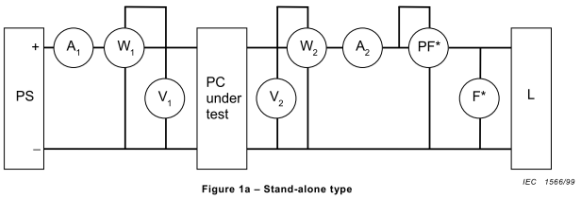
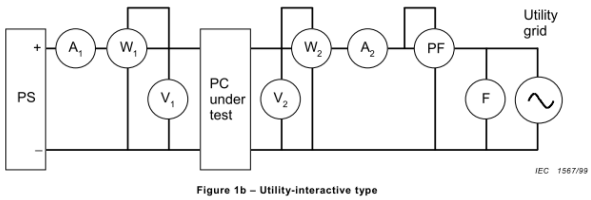
Clause	Requirement + Test	Result - Remark	Verdict
	Record input voltage and current ripple for each measurement. Also record output voltage and current distortion (if a.c.) or ripple (if d.c.). Ensure that these measurements remain within the manufacturer's specified values.	The ripple of the input voltage had no influence on the measurements. (see appended table)	**P**
4.6	Resistive loads/utility grid		**P**
	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.		**P**
4.7	Reactive loads		**P**
	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.		**P**
	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.		**P**
4.8	Resistive plus non-linear loads		**P**
	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.		**P**
	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.		**P**
	The type of non-linear load must be clearly stated in all documentation.		**P**
4.9	Complex loads		**P**
	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.		**P**
	The type of complex load is clearly stated in all documentation.		**P**

IEC 61683			
Clause	Requirement + Test	Result - Remark	Verdict

5.	**Efficiency calculations**	See below.	**P**
5.1	Rated output efficiency		**P**
	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	Considered.	**P**
	 Figure 1a – Stand-alone type		**P**
	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**

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Clause	Requirement + Test	Result - Remark	Verdict
	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**
	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.	See appended table.	**P**
	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**

IEC 61683			
Clause	Requirement + Test	Result - Remark	Verdict
	Stand-alone inverters: Consumption of utility power when the power conditioner is not operating but is under standby condition.	See appended table.	**P**
	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**
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	HYD 3000-EP: 97,09% HYD 3680-EP: 97,14% HYD 4000-EP: 97,13% HYD 4600-EP: 97,05% HYD 5000-EP,HYD 5500-EP: 97,07% HYD 6000-EP: 97,00%	**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	HYD 3000-EP: 92,84% HYD 3680-EP: 92,73% HYD 4000-EP: 92,66% HYD 4600-EP,HYD 5000-EP,HYD 5500-EP,HYD 6000-EP: 91,34%	**P**

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Clause	Requirement + Test	Result - Remark	Verdict
	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.		**P**
Annex D	**Derivation of efficiency tolerance in table 2 (informative)**	Considered.	**P**

IEC 61683			
Clause	Requirement + Test	Result - Remark	Verdict

TABLE	**Efficiency recording and efficient calculation sheet**								
power conditioner type	**Grid-connected**								
Model:	HYD 3000-EP								
Parameters of power conditioner	Minimum rated input voltage: 160V Nominal voltage: 360V Maximum input voltage: 520V Rated output voltage: 230V Rated output frequency: 50Hz Rated output power: 3,0kVA								
PV input voltage	**a) Manufacturer's minimum rated input voltage**								
Temperature (°C)	25								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	157,35	159,39	159,55	161,60	161,41	/	/	/
Input voltage ripple (V)	/	18,202	9,115	9,086	4,280	8,747	/	/	/
Input current (A)	/	2,039	5,018	9,981	14,757	19,648	/	/	/
Input current ripple (A)	/	0,149	0,277	0,575	0,530	1,195	/	/	/
Input power (Pi) (kW)	/	0,321	0,799	1,592	2,385	3,171	/	/	/
Output power (Po) (kW)	/	0,290	0,751	1,509	2,263	3,003	/	/	/
Output efficiency	/	90,53%	93,94%	94,78%	94,88%	94,70%	/	/	/
Input energy (Wi) (kWh)	/	0,321	0,799	1,592	2,385	3,171	/	/	/
Output energy (Wo) (kWh)	/	0,290	0,751	1,509	2,263	3,003	/	/	/
Energy efficiency	/	90,53%	93,94%	94,78%	94,88%	94,70%	/	/	/
PV input voltage	**b) The inverter's nominal voltage**								
Temperature (°C)	25								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	360,47	360,27	359,07	359,67	359,47	/	/	/
Input voltage ripple (V)	/	18,972	18,819	18,736	9,424	9,361	/	/	/
Input current (A)	/	0,907	2,173	4,376	6,494	8,618	/	/	/
Input current ripple (A)	/	0,053	0,125	0,251	0,174	0,235	/	/	/

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Input power (Pi) (kW)	/	0,327	0,782	1,570	2,334	3,095	/	/	/
Output power (Po) (kW)	/	0,309	0,756	1,526	2,270	3,009	/	/	/
Output efficiency	/	94,47%	96,70%	97,16%	97,27%	97,21%	/	/	/
Input energy (Wi) (kWh)	/	0,327	0,782	1,570	2,334	3,095	/	/	/
Output energy (Wo) (kWh)	/	0,309	0,756	1,526	2,270	3,009	/	/	/
Energy efficiency	/	94,47%	96,70%	97,16%	97,27%	97,21%	/	/	/
PV input voltage	**c) 90% of the inverter's maximum input voltage**(520V)								
Temperature (°C)	25								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	519,58	518,56	519,54	519,70	520,35	/	/	/
Input voltage ripple (V)	/	25,235	19,204	13,134	13,114	9,391	/	/	/
Input current (A)	/	0,635	1,563	3,074	4,501	5,996	/	/	/
Input current ripple (A)	/	0,039	0,047	0,080	0,118	0,135	/	/	/
Input power (Pi) (kW)	/	0,330	0,810	1,596	2,338	3,118	/	/	/
Output power (Po) (kW)	/	0,307	0,776	1,545	2,266	3,023	/	/	/
Output efficiency	/	93,13%	95,83%	96,76%	96,90%	96,93%	/	/	/
Input energy (Wi) (kWh)	/	0,330	0,810	1,596	2,338	3,118	/	/	/
Output energy (Wo) (kWh)	/	0,307	0,776	1,545	2,266	3,023	/	/	/
Energy efficiency	/	93,13%	95,83%	96,76%	96,90%	96,93%	/	/	/

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:	HYD 3680-EP								
Parameters of power conditioner	Minimum rated input voltage: 180V Nominal voltage: 360V Maximum input voltage: 520V Rated output voltage: 230V Rated output frequency: 50Hz Rated output power: 3,68kVA								
PV input voltage	**a) Manufacturer's minimum rated input voltage(180V)**								
Temperature (°C)	25								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	177,25	179,22	179,93	181,56	182,17	/	/	/
Input voltage ripple (V)	/	15,160	9,086	9,068	4,737	4,833	/	/	/
Input current (A)	/	2,265	5,415	10,739	16,046	21,327	/	/	/
Input current ripple (A)	/	0,197	0,277	0,577	0,552	0,794	/	/	/
Input power (Pi) (kW)	/	0,401	0,970	1,932	2,913	3,885	/	/	/
Output power (Po) (kW)	/	0,368	0,918	1,839	2,771	3,685	/	/	/
Output efficiency (%)	/	91,82%	94,60%	95,19%	95,11%	94,86%	/	/	/
Input energy (Wi) (kWh)	/	0,401	0,970	1,932	2,913	3,885	/	/	/
Output energy (Wo) (kWh)	/	0,368	0,918	1,839	2,771	3,685	/	/	/
Energy efficiency	/	91,82%	94,60%	95,19%	95,11%	94,86%	/	/	/
PV input voltage	**b) The inverter's nominal voltage （360V）**								
Temperature (°C)	25								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	359,41	359,50	360,19	358,63	359,43	/	/	/
Input voltage ripple (V)	/	18,951	18,784	15,469	9,387	9,112	/	/	/
Input current (A)	/	1,080	2,662	5,290	7,950	10,556	/	/	/

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Input current ripple (A)	/	0,058	0,143	0,254	0,200	0,267	/	/	/
Input power (Pi) (kW)	/	0,388	0,956	1,904	2,849	3,790	/	/	/
Output power (Po) (kW)	/	0,368	0,927	1,852	2,770	3,680	/	/	/
Output efficiency	/	95,02%	96,94%	97,28%	97,23%	97,10%	/	/	/
Input energy (Wi) (kWh)	/	0,388	0,956	1,904	2,849	3,790	/	/	/
Output energy (Wo) (kWh)	/	0,368	0,927	1,852	2,770	3,680	/	/	/
Energy efficiency	/	95,02%	96,94%	97,28%	97,23%	97,10%	/	/	/
PV input voltage	**c) 90% of the inverter's maximum input voltage**(520V)								
Temperature (°C)	25								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	519,88	519,84	518,86	518,88	518,37	/	/	/
Input voltage ripple (V)	/	19,313	19,073	12,505	9,525	9,548	/	/	/
Input current (A)	/	0,749	1,837	3,662	5,479	7,337	/	/	/
Input current ripple (A)	/	0,033	0,073	0,094	0,095	0,132	/	/	/
Input power (Pi) (kW)	/	0,389	0,955	1,899	2,841	3,801	/	/	/
Output power (Po) (kW)	/	0,366	0,919	1,840	2,754	3,681	/	/	/
Output efficiency	/	93,91%	96,26%	96,88%	96,95%	96,84%	/	/	/
Input energy (Wi) (kWh)	/	0,389	0,955	1,899	2,841	3,801	/	/	/
Output energy (Wo) (kWh)	/	0,366	0,919	1,840	2,754	3,681	/	/	/
Energy efficiency	/	93,91%	96,26%	96,88%	96,95%	96,84%	/	/	/
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:	HYD 4000-EP								
Parameters of power conditioner	Minimum rated input voltage: 200V Nominal voltage: 360V Maximum input voltage: 520V Rated output voltage: 230V Rated output frequency: 50Hz Rated output power: 4,00kVA								
PV input voltage	**a) Manufacturer's minimum rated input voltage(200V)**								
Temperature (°C)	25								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	198,15	199,58	199,03	200,31	201,23	/	/	/
Input voltage ripple (V)	/	12,346	9,122	9,111	5,116	5,817	/	/	/
Input current (A)	/	2,213	5,375	10,615	15,805	20,917	/	/	/
Input current ripple (A)	/	0,116	0,244	0,492	0,383	0,613	/	/	/
Input power (Pi) (kW)	/	0,438	1,072	2,112	3,166	4,208	/	/	/
Output power (Po) (kW)	/	0,405	1,018	2,016	3,018	4,000	/	/	/
Output efficiency (%)	/	92,46%	94,97%	95,43%	95,32%	95,05%	/	/	/
Input energy (Wi) (kWh)	/	0,438	1,072	2,112	3,166	4,208	/	/	/
Output energy (Wo) (kWh)	/	0,405	1,018	2,016	3,018	4,000	/	/	/
Energy efficiency	/	92,46%	94,97%	95,43%	95,32%	95,05%	/	/	/
PV input voltage	**b) The inverter's nominal voltage**								
Temperature (°C)	25								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	359,64	359,56	359,80	359,06	358,95	/	/	/
Input voltage ripple (V)	/	18,915	18,852	18,826	12,300	6,622	/	/	/
Input current (A)	/	1,235	2,959	5,852	8,740	11,666	/	/	/
Input current ripple (A)	/	0,061	0,148	0,299	0,295	0,219	/	/	/

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Clause	Requirement + Test	Result - Remark	Verdict

Input power (Pi) (kW)	/	0,444	1,063	2,104	3,136	4,183	/	/	/
Output power (Po) (kW)	/	0,423	1,032	2,046	3,048	4,058	/	/	/
Output efficiency (%)	/	95,26%	97,04%	97,26%	97,19%	97,02%	/	/	/
Input energy (Wi) (kWh)	/	0,444	1,063	2,104	3,136	4,183	/	/	/
Output energy (Wo) (kWh)	/	0,423	1,032	2,046	3,048	4,058	/	/	/
Energy efficiency	/	95,26%	97,04%	97,26%	97,19%	97,02%	/	/	/
PV input voltage	**c) 90% of the inverter's maximum input voltage**(520V)								
Temperature (°C)	25								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	517,72	520,57	519,96	519,10	518,68	/	/	/
Input voltage ripple (V)	/	19,267	12,555	12,457	9,470	9,497	/	/	/
Input current (A)	/	0,862	2,048	4,047	6,055	8,074	/	/	/
Input current ripple (A)	/	0,029	0,052	0,106	0,106	0,153	/	/	/
Input power (Pi) (kW)	/	0,446	1,066	2,103	3,142	4,185	/	/	/
Output power (Po) (kW)	/	0,421	1,028	2,037	3,045	4,051	/	/	/
Output efficiency (%)	/	94,38%	96,49%	96,87%	96,92%	96,80%	/	/	/
Input energy (Wi) (kWh)	/	0,446	1,066	2,103	3,142	4,185	/	/	/
Output energy (Wo) (kWh)	/	0,421	1,028	2,037	3,045	4,051	/	/	/
Energy efficiency	/	94,38%	96,49%	96,87%	96,92%	96,80%	/	/	/

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:	HYD 4600-EP								
Parameters of power conditioner	Minimum rated input voltage: 230V Nominal voltage: 360V Maximum input voltage: 520V Rated output voltage: 230V Rated output frequency: 50Hz Rated output power: 4,60kVA								
PV input voltage	**a) Manufacturer's minimum rated input voltage(230V)**								
Temperature (°C)	25								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	228,50	229,63	229,93	229,10	231,34	/	/	/
Input voltage ripple (V)	/	9,123	9,074	9,031	9,032	5,077	/	/	/
Input current (A)	/	2,142	5,295	10,542	15,831	20,874	/	/	/
Input current ripple (A)	/	0,076	0,195	0,397	0,614	0,458	/	/	/
Input power (Pi) (kW)	/	0,489	1,216	2,424	3,626	4,829	/	/	/
Output power (Po) (kW)	/	0,456	1,159	2,320	3,465	4,600	/	/	/
Output efficiency (%)	/	93,15%	95,37%	95,73%	95,56%	95,26%	/	/	/
Input energy (Wi) (kWh)	/	0,489	1,216	2,424	3,626	4,829	/	/	/
Output energy (Wo) (kWh)	/	0,456	1,159	2,320	3,465	4,600	/	/	/
Energy efficiency	/	93,15%	95,37%	95,73%	95,56%	95,26%	/	/	/
PV input voltage	**b) The inverter's nominal voltage (360V)**								
Temperature (°C)	25								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	359,97	360,05	360,29	359,56	358,70	/	/	/
Input voltage ripple (V)	/	24,800	18,855	18,523	9,598	9,077	/	/	/
Input current (A)	/	1,369	3,344	6,628	9,976	13,335	/	/	/
Input current ripple (A)	/	0,104	0,165	0,337	0,282	0,326	/	/	/

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Input power (Pi) (kW)	/	0,493	1,203	2,386	3,584	4,777	/	/	/
Output power (Po) (kW)	/	0,471	1,168	2,320	3,476	4,630	/	/	/
Output efficiency (%)	/	95,60%	97,06%	97,25%	96,98%	96,92%	/	/	/
Input energy (Wi) (kWh)	/	0,493	1,203	2,386	3,584	4,777	/	/	/
Output energy (Wo) (kWh)	/	0,471	1,168	2,320	3,476	4,630	/	/	/
Energy efficiency	/	95,60%	97,06%	97,25%	96,98%	96,92%	/	/	/
PV input voltage	**c) 90% of the inverter's maximum input voltage**(520V)								
Temperature (°C)	25								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	520,89	519,32	519,22	518,86	518,12	/	/	/
Input voltage ripple (V)	/	15,528	12,396	9,556	9,482	9,376	/	/	/
Input current (A)	/	0,951	2,287	4,591	6,925	9,259	/	/	/
Input current ripple (A)	/	0,037	0,060	0,081	0,130	0,185	/	/	/
Input power (Pi) (kW)	/	0,495	1,187	2,383	3,591	4,794	/	/	/
Output power (Po) (kW)	/	0,468	1,146	2,310	3,479	4,635	/	/	/
Output efficiency (%)	/	94,56%	96,57%	96,93%	96,86%	96,69%	/	/	/
Input energy (Wi) (kWh)	/	0,495	1,187	2,383	3,591	4,794	/	/	/
Output energy (Wo) (kWh)	/	0,468	1,146	2,310	3,479	4,635	/	/	/
Energy efficiency	/	94,56%	96,57%	96,93%	96,86%	96,69%	/	/	/
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:	HYD 5000-EP,HYD 5500-EP								
Parameters of power conditioner	Minimum rated input voltage: 250V Nominal voltage: 360V Maximum input voltage: 520V Rated output voltage: 230V Rated output frequency: 50Hz Rated output power: 5,0kVA								
PV input voltage	**a) Manufacturer's minimum rated input voltage(250V)**								
Temperature (°C)	25								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	248,71	249,63	248,90	248,98	251,06	/	/	/
Input voltage ripple (V)	/	12,128	9,083	9,039	6,018	6,105	/	/	/
Input current (A)	/	2,191	5,333	10,603	15,780	20,945	/	/	/
Input current ripple (A)	/	0,097	0,199	0,401	0,363	0,495	/	/	/
Input power (Pi) (kW)	/	0,545	1,331	2,639	3,929	5,258	/	/	/
Output power (Po) (kW)	/	0,510	1,272	2,531	3,761	5,016	/	/	/
Output efficiency (%)	/	93,68%	95,58%	95,92%	95,72%	95,41%	/	/	/
Input energy (Wi) (kWh)	/	0,545	1,331	2,639	3,929	5,258	/	/	/
Output energy (Wo) (kWh)	/	0,510	1,272	2,531	3,761	5,016	/	/	/
Energy efficiency	/	93,68%	95,58%	95,92%	95,72%	95,41%	/	/	/
PV input voltage	**b) The inverter's nominal voltage (360V)**								
Temperature (°C)	25								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	359,52	359,66	359,75	359,07	358,48	/	/	/
Input voltage ripple (V)	/	18,886	18,806	12,225	9,292	8,976	/	/	/
Input current (A)	/	1,482	3,591	7,232	10,829	14,546	/	/	/
Input current ripple (A)	/	0,079	0,196	0,259	0,286	0,393	/	/	/

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Input power (Pi) (kW)	/	0,532	1,291	2,600	3,884	5,206	/	/	/
Output power (Po) (kW)	/	0,510	1,253	2,528	3,771	5,042	/	/	/
Output efficiency (%)	/	95,88%	97,11%	97,25%	97,09%	96,84%	/	/	/
Input energy (Wi) (kWh)	/	0,532	1,291	2,600	3,884	5,206	/	/	/
Output energy (Wo) (kWh)	/	0,510	1,253	2,528	3,771	5,042	/	/	/
Energy efficiency	/	95,88%	97,11%	97,25%	97,09%	96,84%	/	/	/
PV input voltage	**c) 90% of the inverter's maximum input voltage**(520V)								
Temperature (°C)	25								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	520,55	518,25	518,45	518,65	517,92	/	/	/
Input voltage ripple (V)	/	19,137	13,199	13,166	13,053	9,408	/	/	/
Input current (A)	/	1,027	2,551	5,042	7,529	10,068	/	/	/
Input current ripple (A)	/	0,050	0,060	0,121	0,191	0,199	/	/	/
Input power (Pi) (kW)	/	0,535	1,321	2,613	3,902	5,135	/	/	/
Output power (Po) (kW)	/	0,507	1,277	2,534	3,779	5,035	/	/	/
Output efficiency (%)	/	94,89%	96,63%	96,99%	96,85%	96,63%	/	/	/
Input energy (Wi) (kWh)	/	0,535	1,321	2,613	3,902	5,135	/	/	/
Output energy (Wo) (kWh)	/	0,507	1,277	2,534	3,779	5,035	/	/	/
Energy efficiency	/	94,89%	96,63%	96,99%	96,85%	96,63%	/	/	/
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:	HYD 6000-EP								
Parameters of power conditioner	Minimum rated input voltage: 300V Nominal voltage: 360V Maximum input voltage: 520V Rated output voltage: 230V Rated output frequency: 50Hz Rated output power: 6.0kVA								
PV input voltage	**a) Manufacturer's minimum rated input voltage(300V)**								
Temperature (°C)	25								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	303,81	300,05	299,96	300,15	304,39	/	/	/
Input voltage ripple (V)	/	9,194	12,143	6,080	6,080	1,257	/	/	/
Input current (A)	/	2,072	5,326	10,421	15,596	20,579	/	/	/
Input current ripple (A)	/	0,082	0,219	0,215	0,328	0,119	/	/	/
Input power (Pi) (kW)	/	0,629	1,598	3,126	4,681	6,264	/	/	/
Output power (Po) (kW)	/	0,595	1,534	3,006	4,489	5,979	/	/	/
Output efficiency (%)	/	94,60%	96,02%	96,17%	95,90%	95,45%	/	/	/
Input energy (Wi) (kWh)	/	0,629	1,598	3,126	4,681	6,264	/	/	/
Output energy (Wo) (kWh)	/	0,595	1,534	3,006	4,489	5,979	/	/	/
Energy efficiency	/	94,60%	96,02%	96,17%	95,90%	95,45%	/	/	/
PV input voltage	**b) The inverter's nominal voltage (360V)**								
Temperature (°C)	25								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	360,11	359,82	358,78	358,04	357,53	/	/	/
Input voltage ripple (V)	/	9,455	9,423	12,336	9,416	9,052	/	/	/
Input current (A)	/	1,771	4,396	8,656	13,026	17,490	/	/	/
Input current ripple (A)	/	0,045	0,115	0,290	0,328	0,437	/	/	/

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Input power (Pi) (kW)	/	0,638	1,581	3,103	4,658	6,240	/	/	/
Output power (Po) (kW)	/	0,614	1,537	3,016	4,516	6,029	/	/	/
Output efficiency (%)	/	96,34%	97,20%	97,21%	96,95%	96,62%	/	/	/
Input energy (Wi) (kWh)	/	0,638	1,581	3,103	4,658	6,240	/	/	/
Output energy (Wo) (kWh)	/	0,614	1,537	3,016	4,516	6,029	/	/	/
Energy efficiency	/	96,34%	97,20%	97,21%	96,95%	96,62%	/	/	/
PV input voltage	**c) 90% of the inverter's maximum input voltage**(520V)								
Temperature (°C)	25								
Operating period for energy measurement (min)	1								
Percentage of rated output VA	/	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	/	518,57	520,60	519,39	518,57	516,94	/	/	/
Input voltage ripple (V)	/	12,477	9,576	12,448	9,590	9,461	/	/	/
Input current (A)	/	1,236	2,997	6,073	9,055	12,083	/	/	/
Input current ripple (A)	/	0,028	0,060	0,151	0,162	0,242	/	/	/
Input power (Pi) (kW)	/	0,640	1,560	3,153	4,693	6,241	/	/	/
Output power (Po) (kW)	/	0,610	1,510	3,057	4,539	6,019	/	/	/
Output efficiency (%)	/	95,30%	96,79%	96,95%	96,73%	96,44%	/	/	/
Input energy (Wi) (kWh)	/	0,640	1,560	3,153	4,693	6,241	/	/	/
Output energy (Wo) (kWh)	/	0,610	1,510	3,057	4,539	6,019	/	/	/
Energy efficiency	/	95,30%	96,79%	96,95%	96,73%	96,44%	/	/	/
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	**Stand-alone**								
Model:	HYD 3000-EP								
Parameters of power conditioner	Nominal battery voltage: 48V Rated output voltage: 230V Rated output frequency: 50Hz Rated input power: 3,75kW								
Battery input voltage	**48V**								
Temperature (°C)	25								
Operating period for energy measurement (min)	1								
Resistive load									
Percentage of rated output VA	5%	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	49,67	49,55	49,31	48,98	48,73	48,74	/	/	/
Input voltage ripple (V)	0,04	0,060	0,070	0,020	0,120	0,070	/	/	/
Input current (A)	3,779	7,549	19,061	38,288	57,683	76,832	/	/	/
Input current ripple (A)	0,020	0,020	0,030	0,030	0,060	0,080	/	/	/
Input power (Pi) (kW)	0,188	0,374	0,940	1,875	2,811	3,740	/	/	/
Output power (Po) (kW)	0,173	0,350	0,883	1,751	2,601	3,422	/	/	/
Output efficiency	92,10%	93,58%	93,94%	93,37%	92,53%	91,50%	/	/	/
Input energy (Wi) (kWh)	0,188	0,374	0,940	1,875	2,811	3,740	/	/	/
Output energy (Wo) (kWh)	0,173	0,350	0,883	1,751	2,601	3,422	/	/	/
Energy efficiency	92,10%	93,58%	93,94%	93,37%	92,53%	91,50%	/	/	/
Reactive load									
PF	0,8								
Percentage of rated output VA	25%			50%			100%		
Input voltage (V)	49,49			49,18			48,57		
Input voltage ripple (V)	0,010			0,030			0,060		
Input current (A)	15,110			30,448			62,120		
Input current ripple (A)	0,020			0,020			0,040		
Input power (Pi) (kW)	0,748			1,498			3,017		
Output power (Po) (kW)	0,703			1,400			2,771		
Output efficiency	93,98%			93,51%			91,82%		

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Clause	Requirement + Test	Result - Remark	Verdict

Input energy (Wi) (kWh)	0,748			1,498			3,017		
Output energy (Wo) (kWh)	0,703			1,400			2,771		
Energy efficiency	93,98%			93,51%			91,82%		
Non-linear load									
Non-linear load	25% of rated VA			50% of rated VA			/		
Percentage of rated output VA	25%	50%	100%	25%	50%	100%	/	/	/
Input voltage (V)	49,31	49,20	49,20	/	48,98	48,84	/	/	/
Input voltage ripple (V)	0,070	0,010	0,020	/	0,020	0,040	/	/	/
Input current (A)	19,061	19,039	19,170	/	38,288	38,281	/	/	/
Input current ripple (A)	0,030	0,010	0,050	/	0,030	0,060	/	/	/
Input power (Pi) (W)	0,940	0,937	0,943	/	1,875	1,869	/	/	/
Output power (Po) (W)	0,883	0,871	0,836	/	1,751	1,711	/	/	/
Output efficiency	93,94%	92,96%	88,66%	/	93,37%	91,53%	/	/	/
Input energy (Wi) (kWh)	0,940	0,937	0,943	/	1,875	1,869	/	/	/
Output energy (Wo) (kWh)	0,883	0,871	0,836	/	1,751	1,711	/	/	/
Energy efficiency	93,94%	92,96%	88,66%	/	93,37%	91,53%	/	/	/
Complex load									
Percentage of rated output VA	50%	100%	/	/	/	/	/	/	/
Input voltage (V)	49,20	48,84	/	/	/	/	/	/	/
Input voltage ripple (V)	0,010	0,040	/	/	/	/	/	/	/
Input current (A)	19,039	38,281	/	/	/	/	/	/	/
Input current ripple (A)	0,010	0,060	/	/	/	/	/	/	/
Input power (Pi) (W)	0,937	1,869	/	/	/	/	/	/	/
Output power (Po) (W)	0,871	1,711	/	/	/	/	/	/	/
Output efficiency	92,96%	91,53%	/	/	/	/	/	/	/
Input energy (Wi) (kWh)	0,937	1,869	/	/	/	/	/	/	/
Output energy (Wo) (kWh)	0,871	1,711	/	/	/	/	/	/	/
Energy efficiency	92,96%	91,53%	/	/	/	/	/	/	/

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	**Stand-alone**								
Model:	HYD 3680-EP								
Parameters of power conditioner	Nominal battery voltage: 48V Rated output voltage: 230V Rated output frequency: 50Hz Rated input power: 4,00kW								
Battery input voltage	**48V**								
Temperature (°C)	25								
Operating period for energy measurement (min)	1								
Resistive load									
Percentage of rated output VA	5%	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	49,91	49,83	49,63	49,33	49,05	48,96	/	/	/
Input voltage ripple (V)	0,02	0,040	0,060	0,060	0,010	0,370	/	/	/
Input current (A)	4,151	8,123	20,159	40,973	61,858	81,405	/	/	/
Input current ripple (A)	0,010	0,010	0,020	0,060	0,060	0,240	/	/	/
Input power (Pi) (kW)	0,207	0,405	1,000	2,021	3,034	3,984	/	/	/
Output power (Po) (kW)	0,192	0,379	0,940	1,885	2,798	3,644	/	/	/
Output efficiency	92,52%	93,58%	93,96%	93,24%	92,23%	91,47%	/	/	/
Input energy (Wi) (kWh)	0,207	0,405	1,000	2,021	3,034	3,984	/	/	/
Output energy (Wo) (kWh)	0,192	0,379	0,940	1,885	2,798	3,644	/	/	/
Energy efficiency	92,52%	93,58%	93,96%	93,24%	92,23%	91,47%	/	/	/
Reactive load									
PF	0,8								
Percentage of rated output VA	25%			50%			100%		
Input voltage (V)	49,74			49,49			49,00		
Input voltage ripple (V)	0,000			0,030			0,050		
Input current (A)	16,087			33,000			65,077		
Input current ripple (A)	0,010			0,030			0,090		
Input power (Pi) (kW)	0,800			1,633			3,189		
Output power (Po) (kW)	0,750			1,521			2,916		
Output efficiency	93,73%			93,14%			91,44%		

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Clause	Requirement + Test	Result - Remark	Verdict

Input energy (Wi) (kWh)	0,800			1,633			3,189		
Output energy (Wo) (kWh)	0,750			1,521			2,916		
Energy efficiency	93,73%			93,14%			91,44%		
Non-linear load									
Non-linear load	25% of rated VA			50% of rated VA			/		
Percentage of rated output VA	25%	50%	100%	25%	50%	100%	/	/	/
Input voltage (V)	49,63	49,63	49,64	/	49,63	49,64	/	/	/
Input voltage ripple (V)	0,060	0,010	0,010	/	0,010	0,010	/	/	/
Input current (A)	20,159	20,320	20,272	/	20,320	20,272	/	/	/
Input current ripple (A)	0,020	0,020	0,060	/	0,020	0,060	/	/	/
Input power (Pi) (W)	1,000	0,930	0,885	/	1,009	1,006	/	/	/
Output power (Po) (W)	0,940	1,009	1,006	/	0,930	0,885	/	/	/
Output efficiency	93,96%	92,22%	87,92%	/	92,22%	87,92%	/	/	/
Input energy (Wi) (kWh)	1,000	0,930	0,885	/	1,009	1,006	/	/	/
Output energy (Wo) (kWh)	0,940	1,009	1,006	/	0,930	0,885	/	/	/
Energy efficiency	93,96%	92,22%	87,92%	/	92,22%	87,92%	/	/	/
Complex load									
Percentage of rated output VA	50%	100%	/	/	/	/	/	/	/
Input voltage (V)	49,62	49,64	/	/	/	/	/	/	/
Input voltage ripple (V)	0,010	0,010	/	/	/	/	/	/	/
Input current (A)	20,137	20,272	/	/	/	/	/	/	/
Input current ripple (A)	0,030	0,060	/	/	/	/	/	/	/
Input power (Pi) (W)	0,999	1,006	/	/	/	/	/	/	/
Output power (Po) (W)	0,921	0,885	/	/	/	/	/	/	/
Output efficiency	92,18%	87,92%	/	/	/	/	/	/	/
Input energy (Wi) (kWh)	0,999	1,006	/	/	/	/	/	/	/
Output energy (Wo) (kWh)	0,921	0,885	/	/	/	/	/	/	/
Energy efficiency	92,18%	87,92%	/	/	/	/	/	/	/
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	**Stand-alone**								
Model:	HYD 4000-EP								
Parameters of power conditioner	Nominal battery voltage: 48V Rated output voltage: 230V Rated output frequency: 50Hz Rated input power: 4,25kW								
Battery input voltage	**48V**								
Temperature (°C)	25								
Operating period for energy measurement (min)	1								
Resistive load									
Percentage of rated output VA	5%	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	49,50	49,49	49,16	48,80	48,46	48,17	/	/	/
Input voltage ripple (V)	0,07	0,010	0,060	0,030	0,020	0,040	/	/	/
Input current (A)	4,260	8,642	21,819	43,436	65,802	87,961	/	/	/
Input current ripple (A)	0,020	0,010	0,040	0,040	0,080	0,430	/	/	/
Input power (Pi) (kW)	0,211	0,428	1,073	2,120	3,188	4,237	/	/	/
Output power (Po) (kW)	0,201	0,407	1,013	1,978	2,936	3,850	/	/	/
Output efficiency	95,09%	95,09%	94,39%	93,30%	92,07%	90,88%	/	/	/
Input energy (Wi) (kWh)	0,211	0,428	1,073	2,120	3,188	4,237	/	/	/
Output energy (Wo) (kWh)	0,201	0,407	1,013	1,978	2,936	3,850	/	/	/
Energy efficiency	95,09%	95,09%	94,39%	93,30%	92,07%	90,88%	/	/	/
Reactive load									
PF	0,8								
Percentage of rated output VA	25%			50%			100%		
Input voltage (V)	48,99			48,73			48,09		
Input voltage ripple (V)	0,020			0,040			0,020		
Input current (A)	17,324			34,925			70,492		
Input current ripple (A)	0,020			0,040			0,030		
Input power (Pi) (kW)	0,849			1,702			3,390		
Output power (Po) (kW)	0,790			1,579			3,088		
Output efficiency	93,03%			92,75%			91,10%		

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Clause	Requirement + Test	Result - Remark	Verdict

Input energy (Wi) (kWh)	0,849			1,702			3,390		
Output energy (Wo) (kWh)	0,790			1,579			3,088		
Energy efficiency	93,03%			92,75%			91,10%		
Non-linear load									
Non-linear load	25% of rated VA			50% of rated VA			/		
Percentage of rated output VA	25%	50%	100%	25%	50%	100%	/	/	/
Input voltage (V)	49,16	49,63	49,64	/	48,80	49,31	/	/	/
Input voltage ripple (V)	0,060	0,010	0,010	/	0,030	0,020	/	/	/
Input current (A)	21,819	20,320	20,272	/	43,436	41,251	/	/	/
Input current ripple (A)	0,040	0,020	0,060	/	0,040	0,040	/	/	/
Input power (Pi) (W)	1,073	1,009	1,006	/	2,120	2,034	/	/	/
Output power (Po) (W)	1,013	0,930	0,885	/	1,978	1,848	/	/	/
Output efficiency	94,39%	92,22%	87,92%	/	93,30%	90,84%	/	/	/
Input energy (Wi) (kWh)	1,073	1,009	1,006	/	2,120	2,034	/	/	/
Output energy (Wo) (kWh)	1,013	0,930	0,885	/	1,978	1,848	/	/	/
Energy efficiency	94,39%	92,22%	87,92%	/	93,30%	90,84%	/	/	/
Complex load									
Percentage of rated output VA	50%	100%	/	/	/	/	/	/	/
Input voltage (V)	49,62	48,80	/	/	/	/	/	/	/
Input voltage ripple (V)	0,010	0,030	/	/	/	/	/	/	/
Input current (A)	20,137	43,436	/	/	/	/	/	/	/
Input current ripple (A)	0,030	0,040	/	/	/	/	/	/	/
Input power (Pi) (W)	0,999	2,120	/	/	/	/	/	/	/
Output power (Po) (W)	0,921	1,978	/	/	/	/	/	/	/
Output efficiency	92,18%	93,30%	/	/	/	/	/	/	/
Input energy (Wi) (kWh)	0,999	2,120	/	/	/	/	/	/	/
Output energy (Wo) (kWh)	0,921	1,978	/	/	/	/	/	/	/
Energy efficiency	92,18%	93,30%	/	/	/	/	/	/	/
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	**Stand-alone**								
Model:	HYD 4600-EP,HYD 5000-EP,HYD 5500-EP,HYD 6000-EP								
Parameters of power conditioner	Nominal battery voltage: 48V Rated output voltage: 230V Rated output frequency: 50Hz Rated input power: 5kW								
Battery input voltage	**48V**								
Temperature (°C)	25								
Operating period for energy measurement (min)	1								
Resistive load									
Percentage of rated output VA	5%	10%	25%	50%	75%	100%	120%*	/	/
Input voltage (V)	49,72	49,66	49,69	48,95	48,84	48,19	/	/	/
Input voltage ripple (V)	0,03	0,030	0,120	0,050	0,160	0,210	/	/	/
Input current (A)	4,964	10,077	25,296	51,000	76,805	103,263	/	/	/
Input current ripple (A)	0,010	0,010	0,050	0,140	0,080	0,210	/	/	/
Input power (Pi) (kW)	0,250	0,500	1,260	2,497	3,751	4,977	/	/	/
Output power (Po) (kW)	0,207	0,449	1,160	2,302	3,411	4,487	/	/	/
Output efficiency	82,80%	89,80%	92,06%	92,21%	90,93%	90,16%	/	/	/
Input energy (Wi) (kWh)	0,250	0,500	1,260	2,497	3,751	4,977	/	/	/
Output energy (Wo) (kWh)	0,207	0,449	1,160	2,302	3,411	4,487	/	/	/
Energy efficiency	82,80%	89,80%	92,06%	92,21%	90,93%	90,16%	/	/	/
Reactive load									
PF	0,8								
Percentage of rated output VA	25%			50%			100%		
Input voltage (V)	49,67			49,42			48,72		
Input voltage ripple (V)	0,020			0,010			0,000		
Input current (A)	16,288			32,700			82,395		
Input current ripple (A)	0,010			0,010			0,020		
Input power (Pi) (kW)	0,809			1,616			4,014		

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Output power (Po) (kW)	0,759			1,507			3,639		
Output efficiency	93,82%			93,26%			90,65%		
Input energy (Wi) (kWh)	0,809			1,616			4,014		
Output energy (Wo) (kWh)	0,759			1,507			3,639		
Energy efficiency	93,82%			93,26%			90,65%		
Non-linear load									
Non-linear load	25% of rated VA			50% of rated VA			/		
Percentage of rated output VA	25%	50%	100%	25%	50%	100%	/	/	/
Input voltage (V)	49,69	49,45	49,46	/	48,95	49,02	/	/	/
Input voltage ripple (V)	0,120	0,010	0,000	/	0,050	0,020	/	/	/
Input current (A)	25,296	25,362	25,272	/	51,000	49,803	/	/	/
Input current ripple (A)	0,050	0,020	0,050	/	0,140	0,110	/	/	/
Input power (Pi) (W)	1,260	1,254	1,250	/	2,497	2,441	/	/	/
Output power (Po) (W)	1,160	1,160	1,097	/	2,302	2,210	/	/	/
Output efficiency	92,06%	92,52%	87,81%	/	92,21%	90,52%	/	/	/
Input energy (Wi) (kWh)	1,260	1,254	1,250	/	2,497	2,441	/	/	/
Output energy (Wo) (kWh)	1,160	1,160	1,097	/	2,302	2,210	/	/	/
Energy efficiency	92,06%	92,52%	87,81%	/	92,21%	90,52%	/	/	/
Complex load									
Percentage of rated output VA	50%	100%	/	/	/	/	/	/	/
Input voltage (V)	49,40	49,02	/	/	/	/	/	/	/
Input voltage ripple (V)	0,010	0,020	/	/	/	/	/	/	/
Input current (A)	49,40	49,803	/	/	/	/	/	/	/
Input current ripple (A)	0,010	0,110	/	/	/	/	/	/	/
Input power (Pi) (W)	1,249	2,441	/	/	/	/	/	/	/
Output power (Po) (W)	1,249	2,210	/	/	/	/	/	/	/
Output efficiency	92,55%	90,52%	/	/	/	/	/	/	/
Input energy (Wi) (kWh)	1,156	2,441	/	/	/	/	/	/	/
Output energy (Wo) (kWh)	1,249	2,210	/	/	/	/	/	/	/
Energy efficiency	92,55%	90,52%	/	/	/	/	/	/	/

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	No load loss: HYD 3000-EP
power conditioner type	Utility-interactive
Measure input voltage (V)	362,66
Measured input power(W)	8,28
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: HYD 3680-EP
power conditioner type	Utility-interactive
Measure input voltage (V)	359,20
Measured input power(W)	8,35
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: HYD 4000-EP
power conditioner type	Utility-interactive
Measure input voltage (V)	359,20
Measured input power(W)	8,35
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: HYD 4600-EP
power conditioner type	Utility-interactive
Measure input voltage (V)	360,32
Measured input power(W)	8,21
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: HYD 5000-EP,HYD 5500-EP
power conditioner type	Utility-interactive
Measure input voltage (V)	359,70
Measured input power(W)	8.08
Remark: No load loss is measured when the power conditioner works at rated input voltage and it's load is disconnected.	

IEC 61683			
Clause	Requirement + Test	Result - Remark	Verdict

TABLE	**No load loss: HYD 6000-EP**
power conditioner type	Utility-interactive
Measure input voltage (V)	360,31
Measured input power(W)	7,42
Remark: No load loss is measured when the power conditioner works at rated input voltage and it's load is disconnected.	

IEC 61683			
Clause	Requirement + Test	Result - Remark	Verdict

TABLE	Standby loss: HYD 3000-EP
power conditioner type	Utility-interactive
Measure output voltage (V)	230,08
Measured output power(W)	8
Remark: Standby loss is measured when the power conditioner works at rated input voltage and in standby mode.	

TABLE	Standby loss: HYD 3680-EP
power conditioner type	Utility-interactive
Measure output voltage (V)	229.07
Measured output power(W)	8
Remark: Standby loss is measured when the power conditioner works at rated input voltage and in standby mode.	

TABLE	Standby loss: HYD 4000-EP
power conditioner type	Utility-interactive
Measure output voltage (V)	229,04
Measured output power(W)	8
Remark: Standby loss is measured when the power conditioner works at rated input voltage and in standby mode.	

TABLE	Standby loss: HYD 4600-EP
power conditioner type	Utility-interactive
Measure output voltage (V)	230,56
Measured output power(W)	8
Remark: Standby loss is measured when the power conditioner works at rated input voltage and in standby mode.	

TABLE	Standby loss: HYD 5000-EP,HYD 5500-EP
power conditioner type	Utility-interactive
Measure output voltage (V)	229,04
Measured output power(W)	8
Remark: Standby loss is measured when the power conditioner works at rated input voltage and in standby mode.	

IEC 61683			
Clause	Requirement + Test	Result - Remark	Verdict

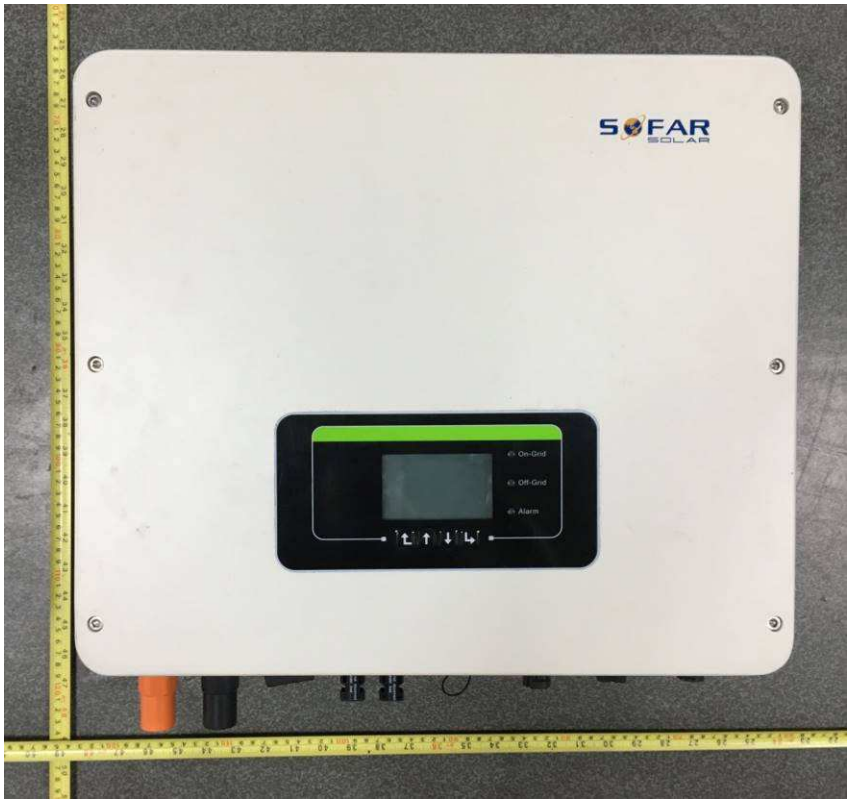
TABLE	Standby loss: HYD 6000-EP
power conditioner type	Utility-interactive
Measure output voltage (V)	229,04
Measured output power(W)	8
Remark: Standby loss is measured when the power conditioner works at rated input voltage and in standby mode.	

Annex 1

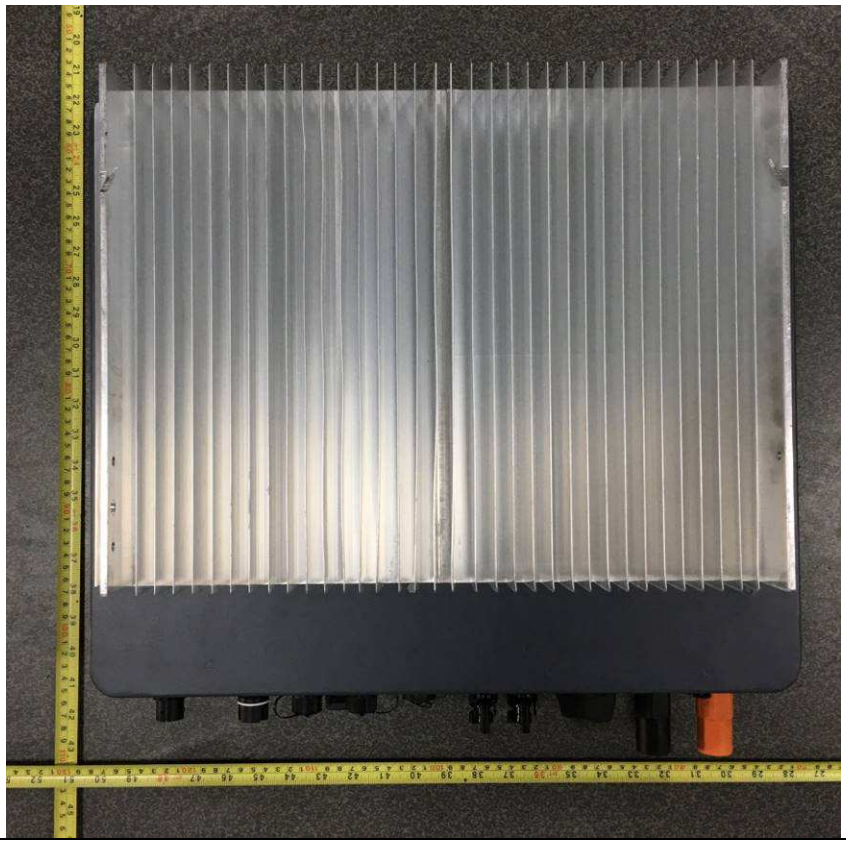
Pictures of the unit

EUT Photo

General view – 1 of Front



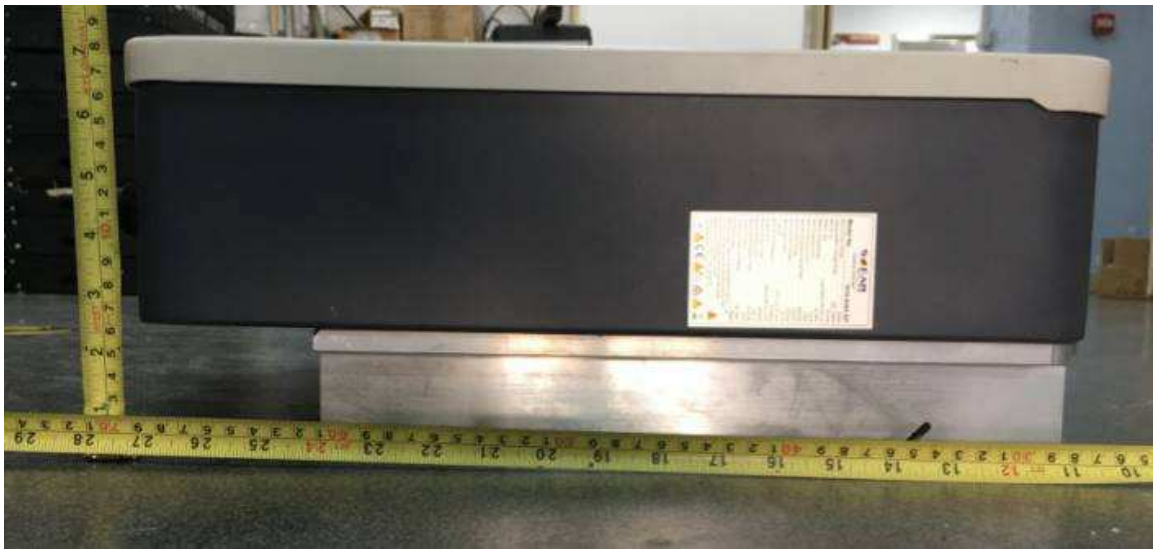
General view – 1 of Rear



EUT Photo

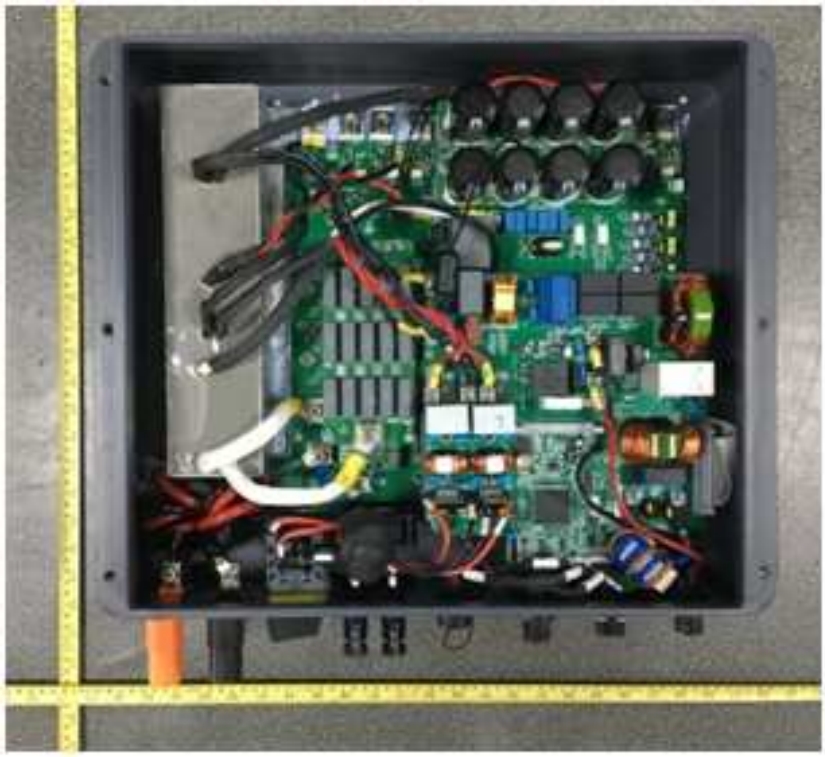
General view – 1 of Bottom

General view – 1 of Side

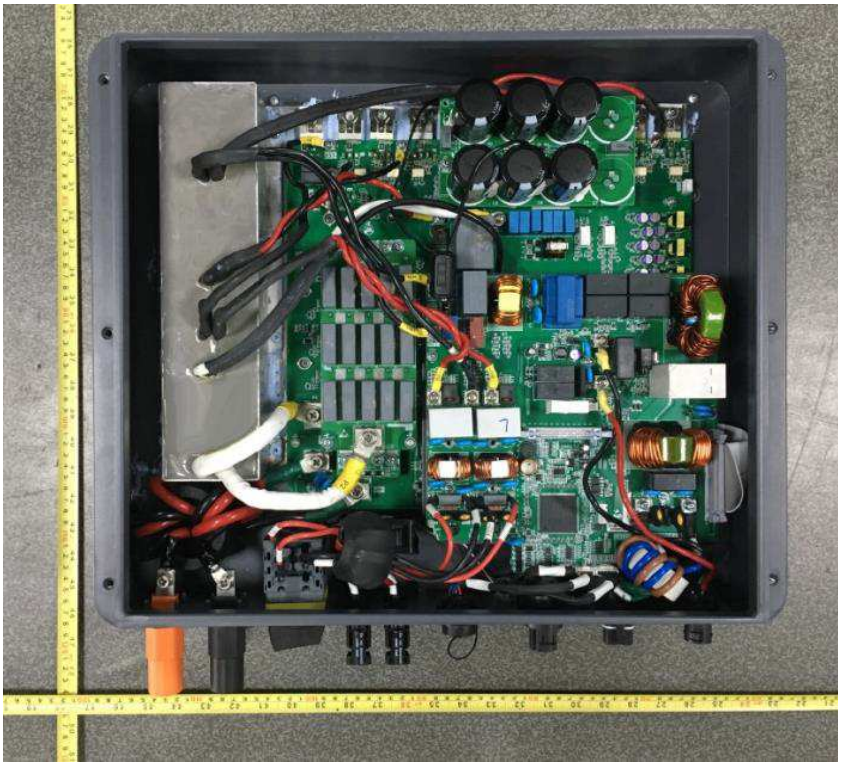


EUT Photo

Internal view – 1
(HYD 4600-EP, HYD 5000-EP, HYD 5500-EP,HYD 6000-EP)

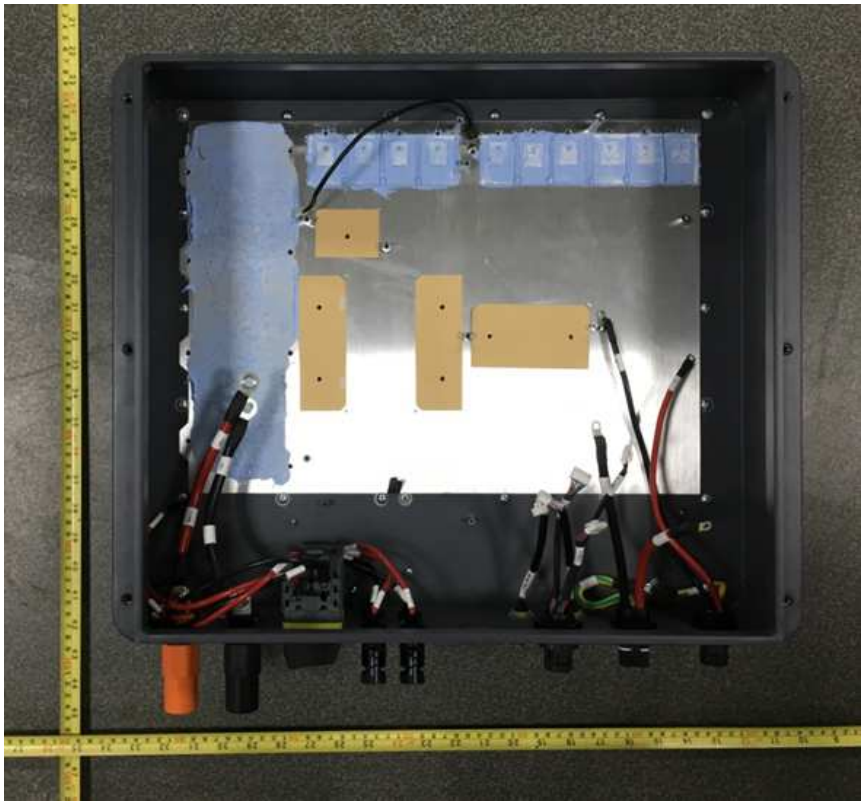


Internal view – 2
(HYD 3000-EP, HYD 3680-EP, HYD 4000-EP)

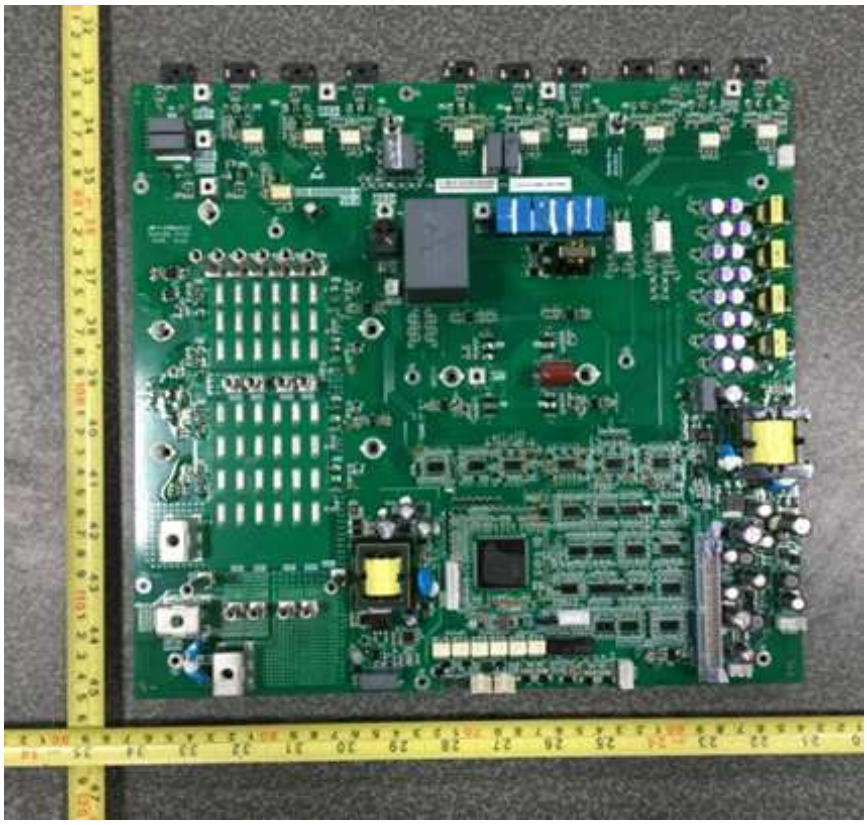


EUT Photo

Internal view - 3

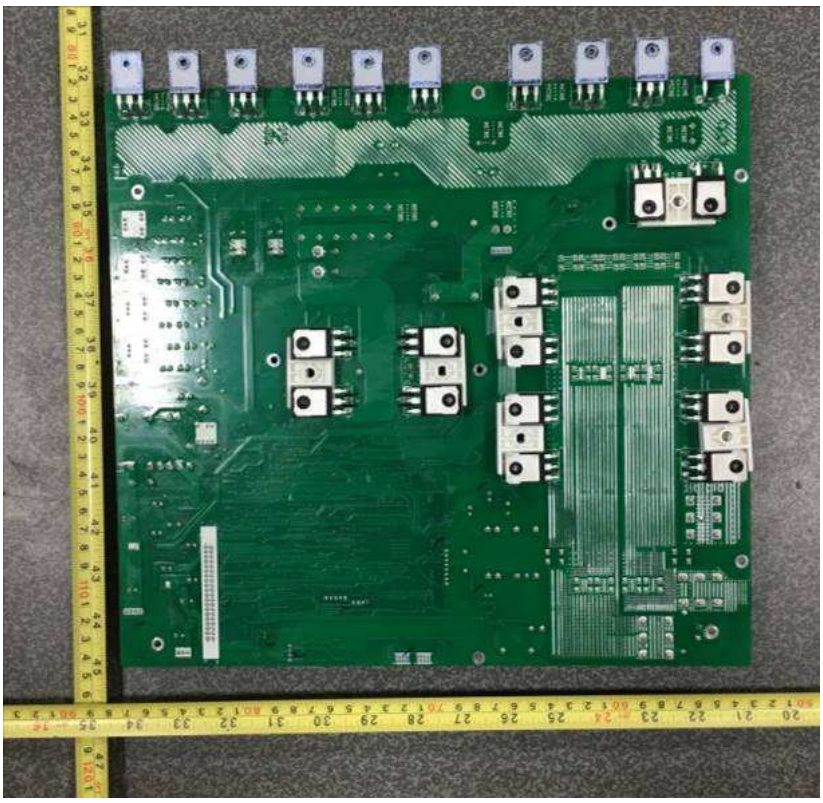


General view – 1 of Power board

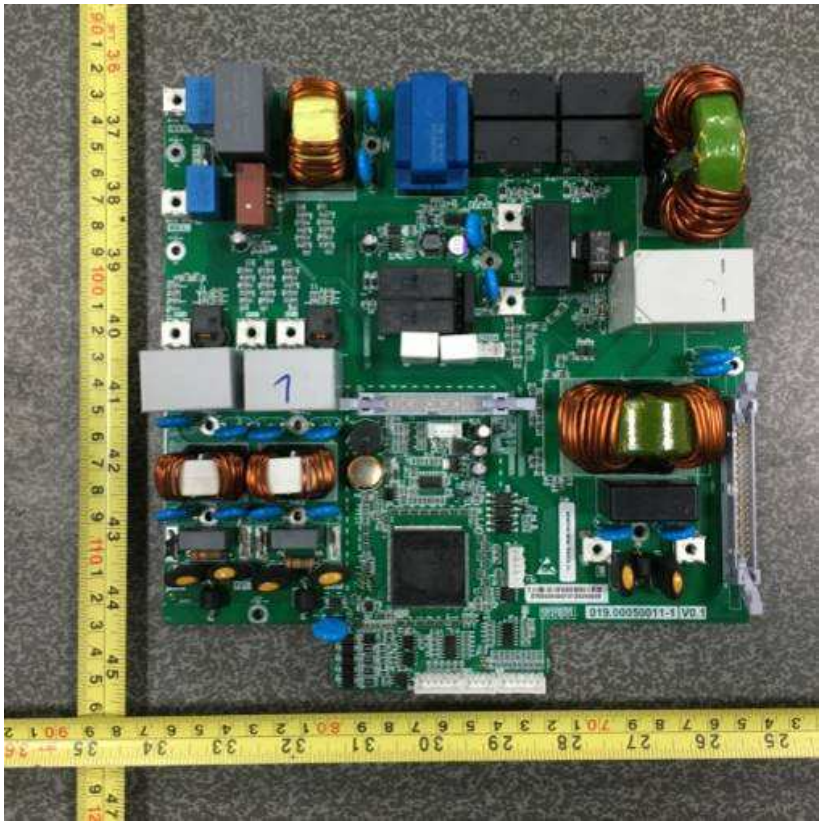


EUT Photo

General view – 2 of Power board

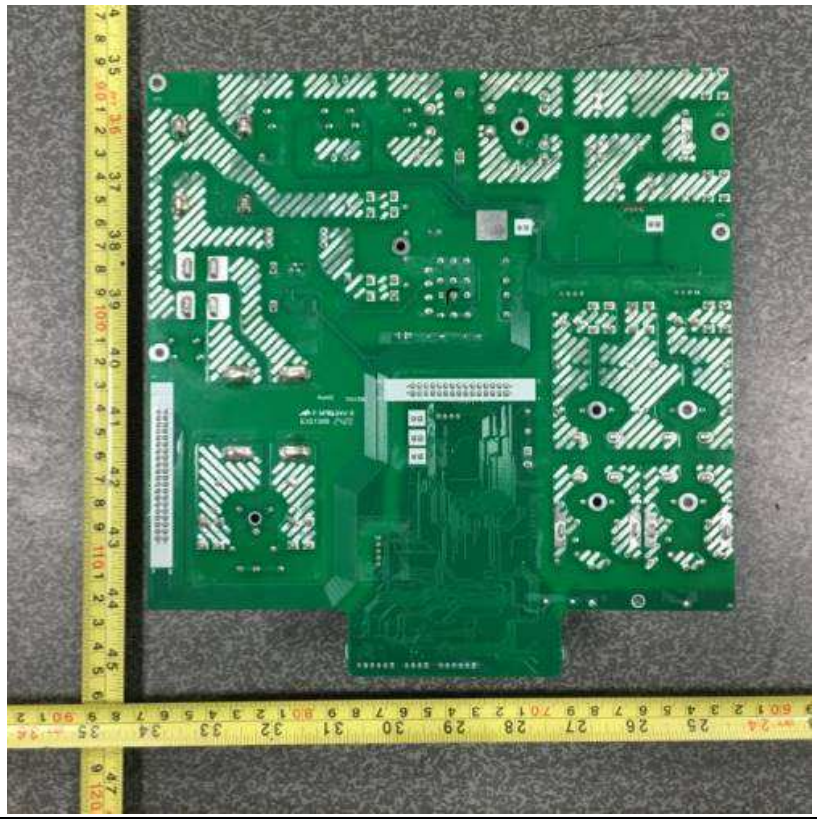


General view – 1 of Output board

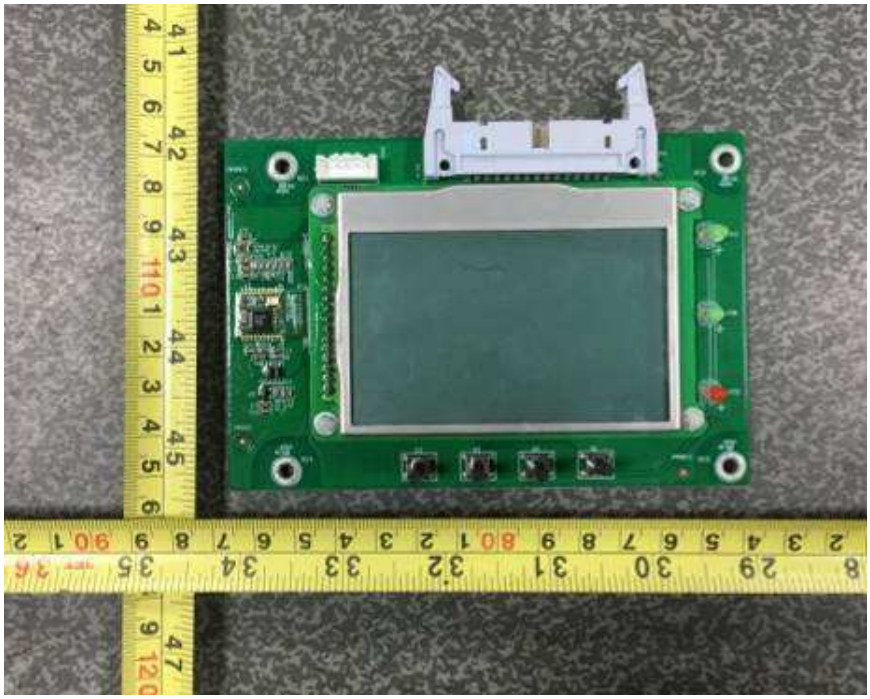


EUT Photo

General view – 2 of Output board

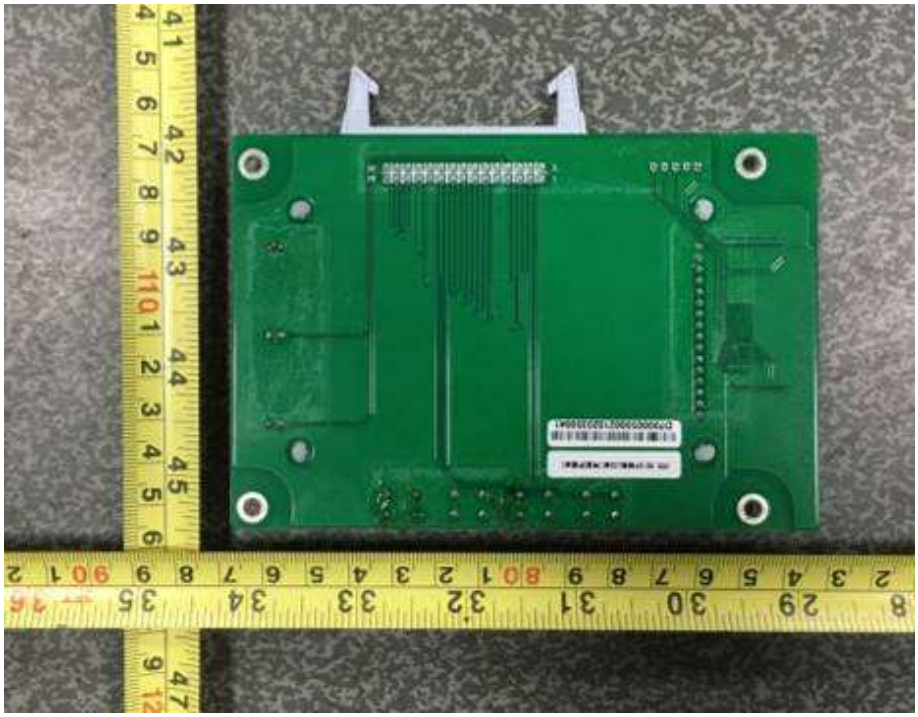


General view – 1 of LCD panel



EUT Photo

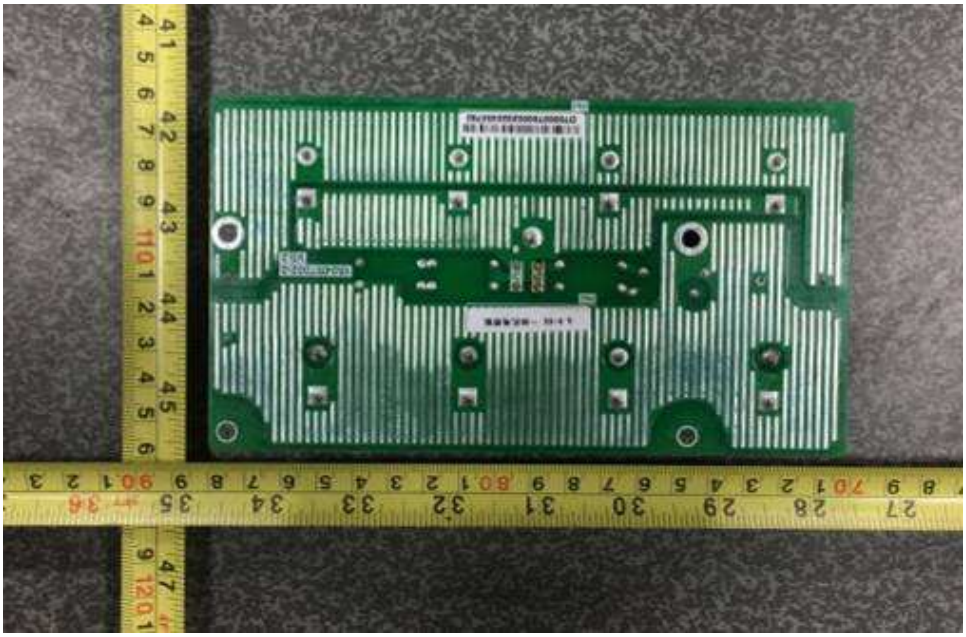
General view – 2 of LCD panel



General view - 1 of BUS board

EUT Photo

General view - 2 of BUS board



General view of Grouding point

Annex 2

Test equipment list

Test location: Bureau Veritas Shenzhen Co., Ltd. Dongguan Branch
Dates of performance test: 2020-11-20 to 2021-01-20

Equipment	Internal No.	Manufacturer	Type	Serial No.	Last Calibration
Power Analyzer	A4080002DG	YOKOGAWA	WT3000	91M210852	Jun. 17, 2020
AC Source	A7040019DG	Chroma	61512	61512000439	Monitored by Power Analyzer
	A7040020DG	Chroma	61512	61512000438	
DC Simulation Power Supply	A7040015DG	Chroma	62150H-1000S	62150EF00488	
	A7040016DG	Chroma	62150H-1000S	62150EF00490	
RLC Load	A7150027DG	Qunling	ACLT-3803H	93VOO2869	
Eight Channel Digital Phosphor Oscilloscope	A4089017DG	YOKOGAWA	DL850	91N726247	Sep. 23, 2020
Four Channel Digital Phosphor Oscilloscope	A4089003DG	Tektronix	DPO4104B	C010624	Mar. 06, 2020
	//	KEYSIGHT	DSOX3014T	MY59243036	Jan. 05, 2021
Oscilloscope probel	A1490009DG	YOKOGAWA	701901	//	Sep. 03, 2020
	A1490010DG	YOKOGAWA	701901	//	Sep. 03, 2020
	A1490011DG	YOKOGAWA	701901	//	Sep. 03, 2020
Current transducer	A1060008DG	YOKOGAWA	CT200	1130700017	Sep. 03, 2020
	A1060009DG	YOKOGAWA	CT200	1130700019	Sep. 03, 2020
	A1060009DG	YOKOGAWA	CT200	1130700019	Sep. 03, 2020