TEST ACCORDING TO
EN 50530:2010/A1:2013
OVERALL EFFICIENCY OF GRID CONNECTED PHOTOVOLTAIC INVERTERS

Test Report Number	:	**GZES210101087801**
Tested Model	:	**HYD 10KTL-3PH, HYD 5000-EP, HYD 3680-EP**
Variant Model	:	**N/A**

APPLICANT

Name	:	Shenzhen SOFARSOLAR Co., Ltd.
Address	:	401, Building 4, AnTongDa Industrial Park, District 68, XingDong Community, XinAn Street, BaoAn District, Shenzhen City, Guangdong Province, P.R. China

TESTING LABORATORY

Name	:	SGS-CSTC Standards Technical Services Co., Ltd. Guangzhou Branch
Address	:	198 Kezhu Road, Science City, Economic & Technology Development Area, Guangzhou, Guangdong, China
Conducted (tested) by	:	Hugo Zhang (Project Engineer)
Reviewed & Approved by	:	Roger Hu (Technical Reviewer)

Date of issue	:	**04/02/2021**
Number of pages	:	**26**

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Test Report Historical Revision:

Test Report Version	Date	Resume
GZES210101087801	04/02/2021	First Issuance

INDEX

1 SCOPE

SGS-CSTC Standards Technical Services Co., Ltd. Guangzhou Branch has been contract by Shenzhen SOFARSOLAR Co., Ltd., in order to perform the testing according to following standards:
:

- **EN 50530:2010/A1:2013**. Overall efficiency of grid connected photovoltaic inverters.

2 GENERAL INFORMATION

2.1 Testing Period and Climatic conditions

The necessary testing has been performed between the 17th of Jan. and the 31th of Jan. of 2021.

All the tests and checks have been performed in accordance with the reference Standard (the tests are done at 25 ± 5ºC, 96 kPa ± 10 kPa and 50% RH ± 10% RH).

SITE TEST

Name ..... : Shenzhen SOFARSOLAR Co., Ltd.
Address ..... : 401, Building 4, AnTongDa Industrial Park, District 68, XingDong Community, XinAn Street, BaoAn District, Shenzhen City, Guangdong Province, P.R. China

2.2 Equipment under Testing

Test Item

Apparatus type/ Installation ..... : Solar Grid-tied Inverter
Manufacturer/ Supplier/ Installer ..... : **Shenzhen SOFARSOLAR Co., Ltd.**

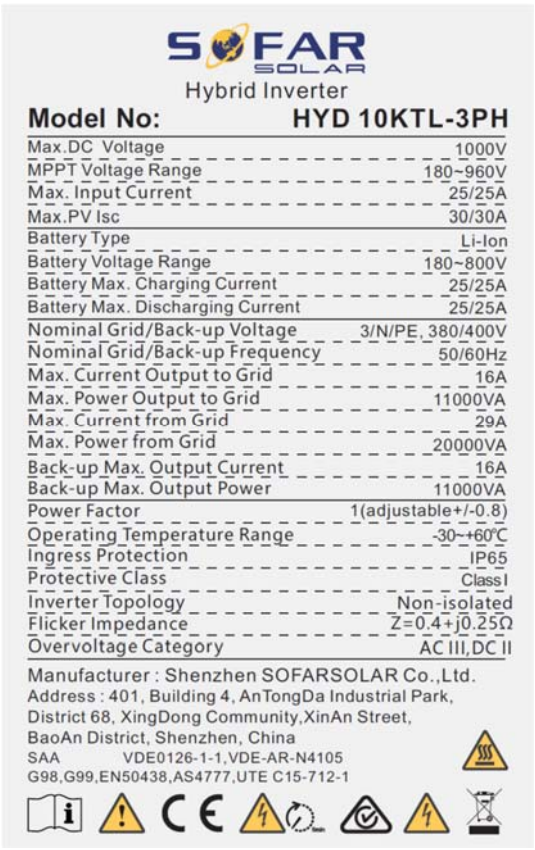
Trade mark ..... :

Type ..... : HYD
Model ..... : HYD 10KTL-3PH, HYD 5000-EP, HYD 3680-EP

Serial Number ..... : --
Software Version ..... : --
Rated Characteristics ..... : See page 7
Date of manufacturing: 2020

Test item particulars
Input ..... DC
Output ..... AC
Class of protection against electric shock ..... Class I
Degree of protection against moisture ..... IP 65
Type of connection to the main supply ..... Fixed installation
Cooling group ..... Heat sink
Modular ..... No
Internal Transformer ..... No

Rating Plate:



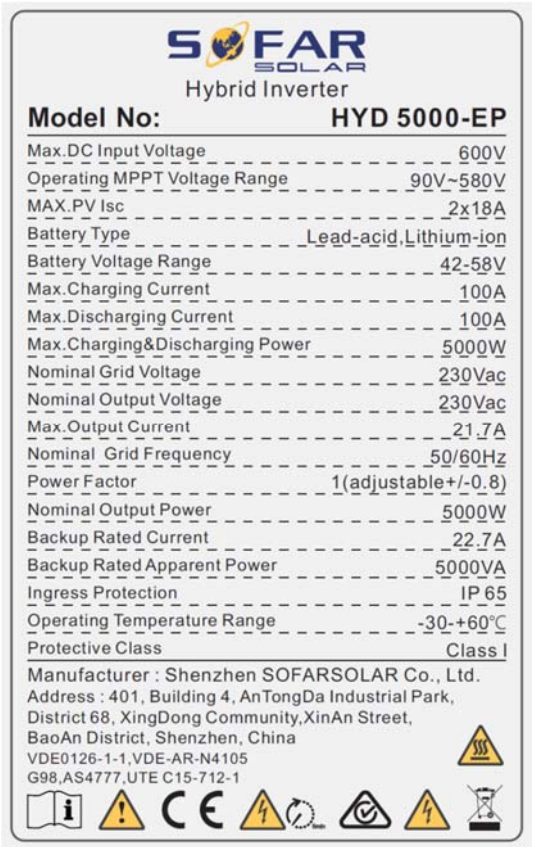
SOFAR SOLAR

Hybrid Inverter

Model No: HYD 10KTL-3PH

Max.DC Voltage	1000V
MPPT Voltage Range	180~960V
Max. Input Current	25/25A
Max.PV Isc	30/30A
Battery Type	Li-Ion
Battery Voltage Range	180~800V
Battery Max. Charging Current	25/25A
Battery Max. Discharging Current	25/25A
Nominal Grid/Back-up Voltage	3/N/PE, 380/400V
Nominal Grid/Back-up Frequency	50/60Hz
Max. Current Output to Grid	16A
Max. Power Output to Grid	11000VA
Max. Current from Grid	29A
Max. Power from Grid	20000VA
Back-up Max. Output Current	16A
Back-up Max. Output Power	11000VA
Power Factor	1(adjustable+/-0.8)
Operating Temperature Range	-30~+60℃
Ingress Protection	IP65
Protective Class	ClassI
Inverter Topology	Non-isolated
Flicker Impedance	Z=0.4+j0.25Ω
Overvoltage Category	AC III,DC II

Manufacturer : Shenzhen SOFARSOLAR Co.,Ltd.
Address : 401, Building 4, AnTongDa Industrial Park,
District 68, XingDong Community,XinAn Street,
BaoAn District, Shenzhen, China
SAA VDE0126-1-1,VDE-AR-N4105
G98,G99,EN50438,AS4777,UTE C15-712-1



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	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

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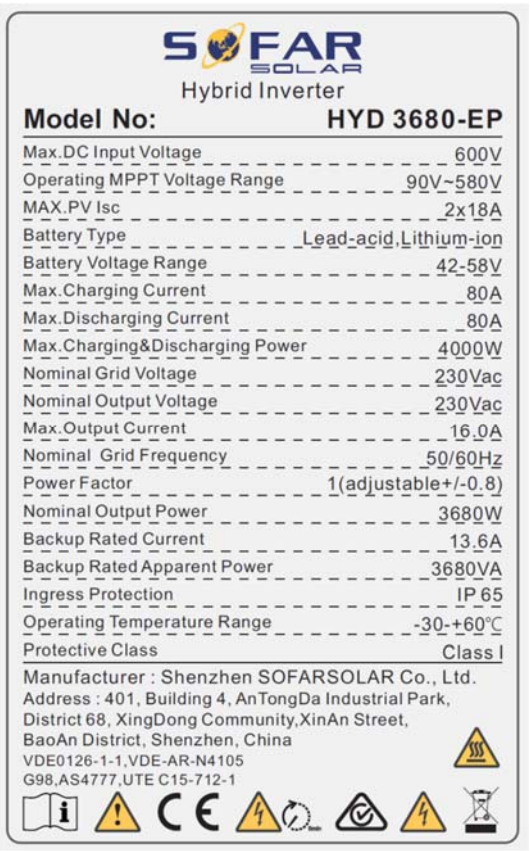
G98,AS4777,UTE C15-712-1



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	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	13.6A
Backup Rated Apparent Power	3680VA
Ingress Protection	IP 65
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

Model fully tested:

- **HYD 10KTL-3PH,**
- **HYD 5000-EP,**
- **HYD 3680-EP**

The results obtained apply only to the particular sample tested that is the subject of the present test report. The most unfavorable result values of the verifications and tests performed are contained herein.
Throughout this report a comma (point) is used as the decimal separator.

Model Number	**HYD 10KTL-3PH**	**HYD 5000-EP**	**HYD 3680-EP**
PV Side			
Max. DC Input Voltage	1000Vd.c.	600Vd.c.	600Vd.c.
Operating MPPT Voltage Range	180-960Vd.c.	90-580Vd.c.	90-580Vd.c.
Full load MPP DC voltage range	300-800Vd.c.	260-480Vd.c.	200-480Vd.c.
Max. PV Isc	30A/30A	18A/18A	18A/18A
Battery Side			
Battery Type	Li-Ion	Li-Ion	Li-Ion
Battery Voltage Range	180-800Vd.c.	42-58Vd.c.	42-58Vd.c.
Battery Max. Charging Current	25A/25A	100A	80A
Battery Max. Discharging Current	25A/25A	100A	80A
AC Side			
Nominal Grid Voltage	3P/N/PE 230/400Vac	230Vac	230Vac
Max. Output Current	16A	21.7A	16.0A
Rated grid frequency	50Hz	50Hz	50HZ
Rated output power	11000VA	5000VA	3680VA
Power Factor	1(adjustable+/-0.8)	1(adjustable+/-0.8)	1(adjustable+/-0.8)
Ingress Protection	IP65	IP65	IP65
Protective Class	I	I	I

2.3 Manufacturer and Factory information

Manufacturer Name ..... : **Shenzhen SOFARSOLAR Co., Ltd.**

Manufacturer Address ..... : 401, Building 4, AnTongDa Industrial Park, District 68, XingDong Community, XinAn Street, BaoAn District, Shenzhen City, Guangdong Province, P.R. China.

Factory 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, Guangdong Province,P.R. China.

2.4 Test Equipment List

From	No.	Equipment Name	Model No.	Equipment No.	Calibration Date	Equipment calibration due date
Sofar Solar	1	Voltage probe	SanHua / SI-9110	111539	2021/01/05	2022/01/04
	2	Voltage probe	SanHua / SI-9110	111134	2021/01/05	2022/01/04
	3	Power analyzer	ZLG / PA3000	C820200565180922 0002	2021/01/05	2022/01/04
	4	Current probe	CYBERTEK / CP1000A	C181000922	2021/01/05	2022/01/04
	5	Current probe	CYBERTEK / CP1000A	C181000929	2021/01/05	2022/01/04
	6	Voltage probe	SanHua / SI-9110	152655	2021/01/05	2022/01/04
	7	Current probe	CYBERTEK / CP1000A	C191000141	2021/01/05	2022/01/04
SGS	8	True RMS Multimeter	Fluke / 187	22930028 (GZE012-53)	2020/02/21	2021/02/20

2.5 Measurement Uncertainty

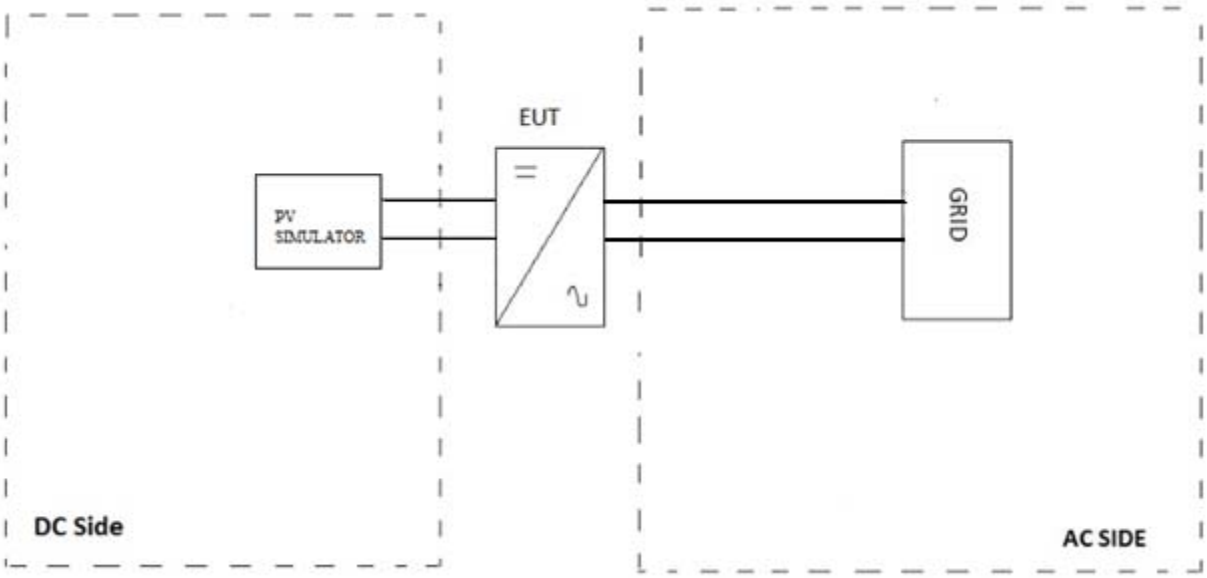
Voltage measurement uncertainty	±1.5 %
Current measurement uncertainty	±2.0 %
Frequency measurement uncertainty	±0.2 %
Time measurement uncertainty	±0.2 %
Power measurement uncertainty	±2.5 %
Phase Angle	±1º
cosφ	±0.01
Note: The measurement uncertainties associated with other parameters measured during the tests are in the laboratory at disposal of the solicitant.	

2.6 Definitions

EUT	Equipment Under Testing	Qn	Nominal Reactive Power
$I_{DC,I}$	Sampled value of the inverter's input current	S_n	Nominal Apparent Power (Inverter)
		T_M	Overall measuring period
I_n	Nominal Current (Inverter)	$U_{DC,I}$	Sampled value of the inverter's input voltage
p.u	Per unit		
P_{DC}	Measured input power of the device under test	U_n	Nominal Voltage
		ΔT	Period between two subsequent sample values
$P_{MPP,PVS}$	MPP power provided by the PV simulator	η	Efficiency
P_n	Nominal Active Power (Inverter)		

2.7 TEST SET UP OF THE DIFFERENT STANDARDS.

Below is the simplified construction of the test set up.



Different equipment has been used to take measures as it shows in chapter 2.3. Current and voltage clamps have been connected to the inverter output for all the tests.

All the tests described in the following pages have used this specified test setup.

The test bench used includes:

EQUIPMENT	MARK / MODEL	RATED CHARACTERISTICS	OWNER / ID.CODE
AC source	Kewell / KACM-75-33	Voltage: 0-600 V 75kVA	Sofarsolar/BZ-EP-L001
PV source(*)	Kewell / IVS-60KW	Voltage: 0 - 1000 V 60kW	Sofarsolar /BZ-EP-L002
Programmable ac load	QUNLING / ACLT-3820	Voltage: 0-600 V 60kVA	Sofarsolar /BZ-EP-L003

(*) Validation by SGS. The report of verification is in the laboratory at disposal of the requestor.

3 RESUME OF TEST RESULTS

INTERPRETATION KEYS

Test object does meet the requirement ..... **P** Pass

Test object does not meet the requirement ..... **F** Fails

Test case does not apply to the test object ..... **N/A** Not applicable

To make a reference to a table or an annex..... See additional sheet

To indicate that the test has not been realized..... **N/R** Not realized

STANDARD SECTION	STANDARD REQUIREMENTS EN 50530:2010/A1:2013	
4.3	**Static MPPT efficiency**	**P**
4.3.1	Test conditions for the Static MPPT efficiency	P
4.3.2	Measurement procedure	P
4.3.3	Evaluation – Calculation of static MPPT efficiency	P
4.5	**Static power conversion efficiency**	**P**
4.5.1	Test conditions for the static power conversion efficiency	P
4.5.2	Measurement procedure	P
4.5.3	Evaluation – Calculation of the static conversion efficiency	P
5	**Calculation of the overall efficiency**	**P**

4 TEST RESULTS

4.1 STATIC MPPT EFFICIENCY TEST

Static MPPT efficiency test has been performed according to point 4.3 of the standard.

The MPPT efficiency describes the accuracy of an inverter to set the maximum power point on the characteristic curve of a PV generator. It is determined from the sampled instantaneous values of voltage and current at the input.

$$\eta_{MPPTstat} = \frac{1}{P_{MPP,PVS} \cdot T_M} \sum_i U_{DC,i} \cdot I_{DC,i} \cdot \Delta T$$

See point 2.5 (Definitions) of this report. The following table shows the results of this test:

Model: HYD 10KTL-3PH									
MPP voltage of the simulated *I/V*-characteristic	Simulated I/V characteristic	MPP power of the simulated *I/V* characteristic normal-ised to rated DC power, $P_{MPP,PVS}/P_{DC,}(\%)$							
		0.05	0.10	0.20	0.25	0.30	0.50	0.75	1.00
U min 300 Vdc	c-Si	99.05	99.11	99.86	99.86	99.58	99.55	99.50	99.63
U nom 600 Vdc		99.70	99.82	99.84	99.94	99.94	99.95	99.96	99.96
U max 800 Vdc		99.74	99.84	99.86	99.86	99.89	99.96	99.97	99.97
Model: HYD 5000-EP									
MPP voltage of the simulated *I/V*-characteristic	Simulated I/V characteristic	MPP power of the simulated *I/V* characteristic normal-ised to rated DC power, $P_{MPP,PVS}/P_{DC,}(\%)$							
		0.05	0.10	0.20	0.25	0.30	0.50	0.75	1.00
U min 260 Vdc	c-Si	99.70	99.89	99.92	99.92	99.93	99.96	99.93	99.94
U nom 360 Vdc		99.80	99.93	99.94	99.95	99.95	99.96	99.96	99.95
U max 480 Vdc		99.53	99.88	99.92	99.93	99.92	99.94	99.92	99.89
Model: HYD 3680-EP									
MPP voltage of the simulated *I/V*-characteristic	Simulated I/V characteristic	MPP power of the simulated *I/V* characteristic normal-ised to rated DC power, $P_{MPP,PVS}/P_{DC,}(\%)$							
		0.05	0.10	0.20	0.25	0.30	0.50	0.75	1.00
U min 200 Vdc	c-Si	99.15	99.54	99.86	99.87	99.88	99.93	99.80	99.80
U nom 360 Vdc		99.71	99.79	99.83	99.82	99.84	99.95	99.96	99.96
U max 480 Vdc		99.62	99.72	99.90	99.89	99.88	99.93	99.93	99.94

4.2 DYNAMIC MPPT EFFICIENCY TEST

Test for the dynamic MPPT efficiency are to be performed with the following sequences. The percentage specification of the radiation intensity is related to standard test conditions (STC). 100 % corresponds to 1 000 W/m² at 25 °C.

4.2.1 Test sequence with ramps 10 % - 50 % P_{DCn}

The test has been performed according to point Annex B.2 of the standard.

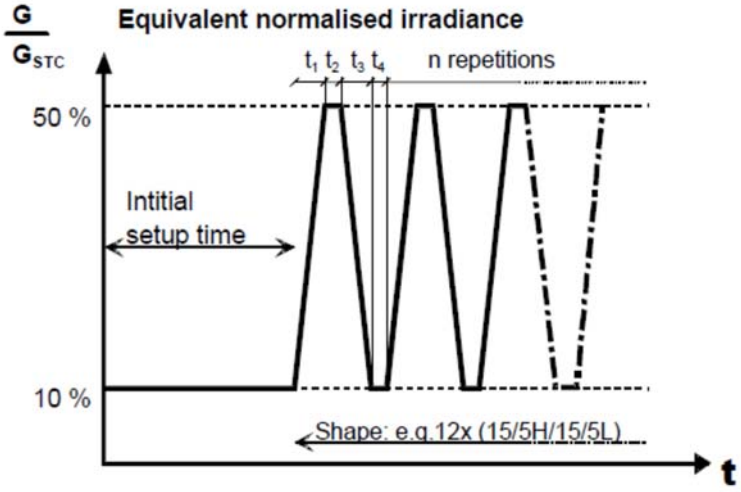


Figure B.1 – Test sequence for fluctuations between small and medium irradiation intensities

Model: HYD 10KTL-3PH							
From-to W/m²	Delta W/m²					Waiting time setting s	
100-500	400					300	
# Number	Slope W/m²/s	Ramp UP s	Dwell time s	Ramp DN s	Dwell time s	Duration s	Efficiency (%)
2	0.5	800	10	800	10	3540	99.93
2	1	400	10	400	10	1940	99.94
3	2	200	10	200	10	1560	99.94
4	3	133	10	133	10	1447	99.94
6	5	80	10	80	10	1300	99.93
8	7	57	10	57	10	1374	99.92
10	10	40	10	40	10	1700	99.75
10	14	29	10	29	10	1071	99.59
10	20	20	10	20	10	900	99.41
10	30	13	10	13	10	767	99.21
10	50	8	10	8	10	660	99.22

Model: HYD 5000-EP							
From-to W/m²	Delta W/m²					Waiting time setting s	
100-500	400					300	
# Number	Slope W/m²/s	Ramp UP s	Dwell time s	Ramp DN s	Dwell time s	Duration s	Efficiency (%)
2	0.5	800	10	800	10	3540	99.92
2	1	400	10	400	10	1940	99.92
3	2	200	10	200	10	1560	99.89
4	3	133	10	133	10	1447	99.85
6	5	80	10	80	10	1300	99.67
8	7	57	10	57	10	1374	99.50
10	10	40	10	40	10	1700	99.39
10	14	29	10	29	10	1071	99.30
10	20	20	10	20	10	900	99.30
10	30	13	10	13	10	767	99.24
10	50	8	10	8	10	660	98.83

Model: HYD 3680-EP							
From-to W/m²	Delta W/m²					Waiting time setting s	
100-500	400					300	
# Number	Slope W/m²/s	Ramp UP s	Dwell time s	Ramp DN s	Dwell time s	Duration s	Efficiency (%)
2	0.5	800	10	800	10	3540	99.88
2	1	400	10	400	10	1940	99.87
3	2	200	10	200	10	1560	99.85
4	3	133	10	133	10	1447	99.80
6	5	80	10	80	10	1300	99.61
8	7	57	10	57	10	1374	99.43
10	10	40	10	40	10	1700	99.46
10	14	29	10	29	10	1071	99.30
10	20	20	10	20	10	900	99.22
10	30	13	10	13	10	767	99.13
10	50	8	10	8	10	660	99.09

4.2.2 Test sequence with ramps 30 % - 100 % P_{DCn}

The test has been performed according to point Annex B.3 of the standard.

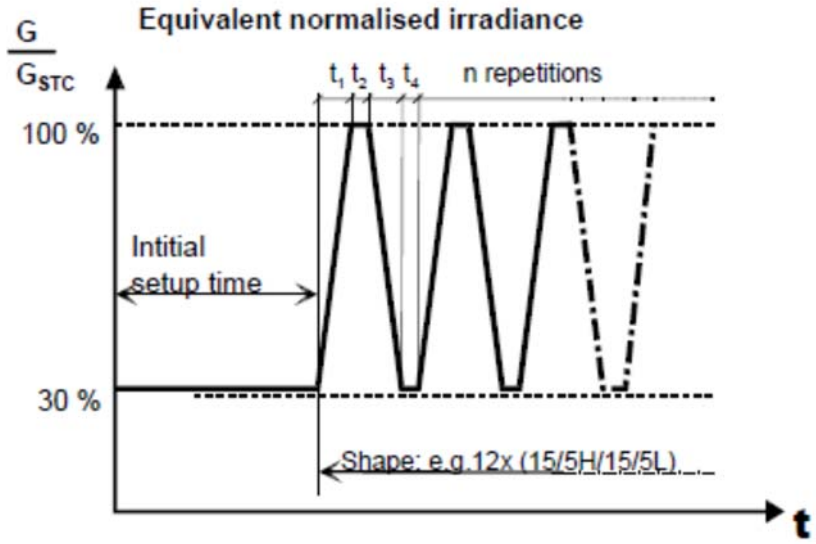


Figure B.2 – Test sequence for fluctuations between medium and high irradiation intensities

Model: HYD 10KTL-3PH							
From-to W/m²	Delta W/m²					Waiting time setting s	
300-1000	700					300	
# Number	Slope W/m²/s	Ramp UP s	Dwell time s	Ramp DN s	Dwell time s	Duration s	Efficiency (%)
10	10	70	10	70	10	1900	99.96
10	14	50	10	50	10	1500	99.96
10	20	35	10	35	10	1200	99.94
10	30	23	10	23	10	967	99.92
10	50	14	10	14	10	780	99.88
10	100	7	10	7	10	640	99.82

Model: HYD 5000-EP							
From-to W/m²	Delta W/m²					Waiting time setting s	
300-1000	700					300	
# Number	Slope W/m²/s	Ramp UP s	Dwell time s	Ramp DN s	Dwell time s	Duration s	Efficiency (%)
10	10	70	10	70	10	1900	99.96
10	14	50	10	50	10	1500	99.93
10	20	35	10	35	10	1200	99.93
10	30	23	10	23	10	967	99.89
10	50	14	10	14	10	780	99.85
10	100	7	10	7	10	640	99.80

Model: HYD 3680-EP							
From-to W/m²	Delta W/m²					Waiting time setting s	
300-1000	700					300	
# Number	Slope W/m²/s	Ramp UP s	Dwell time s	Ramp DN s	Dwell time s	Duration s	Efficiency (%)
10	10	70	10	70	10	1900	99.95
10	14	50	10	50	10	1500	99.91
10	20	35	10	35	10	1200	99.92
10	30	23	10	23	10	967	99.90
10	50	14	10	14	10	780	99.78
10	100	7	10	7	10	640	99.72

4.2.3 Start-up and shut-down test with slow ramps

The test has been performed according to point Annex B.4 of the standard.

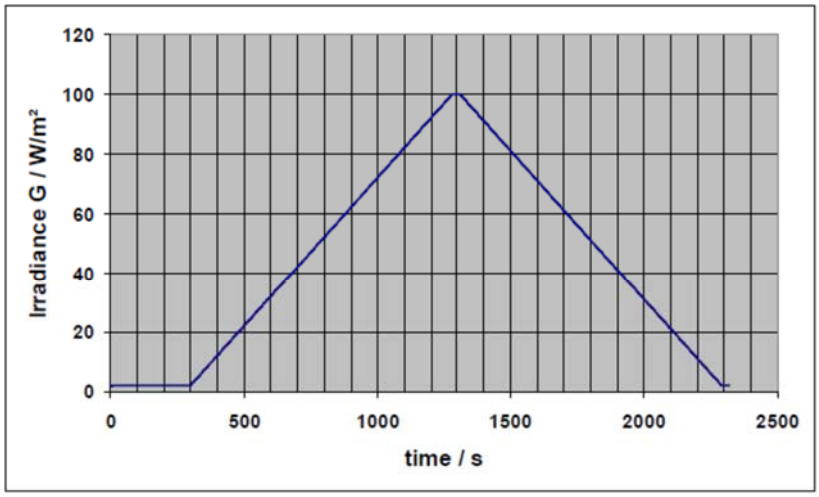


Figure B.3 – Test sequence for the start-up and shut-down test of grid connected inverters

Model: HYD 10KTL-3PH							
From-to W/m²	Delta W/m²		Dwell time setting s			Waiting time setting s	
10-100	90		30			300	
# Number	Slope W/m²/s	Ramp UP s	Dwell time s	Ramp DN s	Dwell time s	Duration s	Efficiency (%)
1	0.1	980	30	980	30	2320	99.69

Model: HYD 5000-EP							
From-to W/m²	Delta W/m²		Dwell time setting s			Waiting time setting s	
10-100	90		30			300	
# Number	Slope W/m²/s	Ramp UP s	Dwell time s	Ramp DN s	Dwell time s	Duration s	Efficiency (%)
1	0.1	980	30	980	30	2320	97.90

Model: HYD 3680-EP							
From-to W/m²	Delta W/m²		Dwell time setting s			Waiting time setting s	
10-100	90		30			300	
# Number	Slope W/m²/s	Ramp UP s	Dwell time s	Ramp DN s	Dwell time s	Duration s	Efficiency (%)
1	0.1	980	30	980	30	2320	89.52

4.3 STATIC POWER CONVERSION EFFICIENCY

Static power conversion efficiency test has been performed according to point 4.5 of the standard.
Rated output efficiency shall be calculated from measured data as follows:

$$\eta_R = (P_o / P_i) \times 100$$

where
η_R is the rated output efficiency (%);
P_o is the rated output power from power conditioner (kW);
P_i is the input power to power conditioner at rated output (kW).

The following table shows the results of this test:

Model: HYD 10KTL-3PH									
MPP voltage of the simulated *I/V*-characteristic	Simulated I/V characteristic	Power conversion efficiency (%)							
		0.05	0.10	0.20	0.25	0.30	0.50	0.75	1.00
U min 300 Vdc	c-Si	95.17	96.26	97.33	97.61	97.83	97.87	97.31	97.14
U nom 600 Vdc		96.60	98.02	98.06	98.02	98.07	98.31	98.20	98.19
U max 800 Vdc		95.44	97.39	97.57	97.75	97.97	98.09	97.95	97.79
Model: HYD 5000-EP									
MPP voltage of the simulated *I/V*-characteristic	Simulated I/V characteristic	Power conversion efficiency (%)							
		0.05	0.10	0.20	0.25	0.30	0.50	0.75	1.00
U min 260 Vdc	c-Si	95.07	96.34	96.81	97.07	97.22	97.35	97.16	96.79
U nom 360 Vdc		95.61	97.14	97.28	97.44	97.54	97.87	97.76	97.67
U max 480 Vdc		95.20	96.85	97.12	97.21	97.40	97.78	97.41	97.25
Model: HYD 3680-EP									
MPP voltage of the simulated *I/V*-characteristic	Simulated I/V characteristic	Power conversion efficiency (%)							
		0.05	0.10	0.20	0.25	0.30	0.50	0.75	1.00
U min 200 Vdc	c-Si	94.99	96.26	96.73	96.97	97.15	97.27	97.15	96.73
U nom 360 Vdc		95.57	97.07	97.20	97.40	97.52	97.64	97.58	97.53
U max 480 Vdc		95.21	96.80	96.95	97.14	97.34	97.59	97.34	97.21

4.4 OVERALL EFFICIENCY

Overall efficiency test has been performed according to point 5 of the standard.

The overall efficiency has been calculated according the following equation:

$$\eta_t = \eta_{conv} \cdot \eta_{MPPTstat} = \frac{P_{AC}}{P_{MPP,PVS}}$$

The following table shows the results of this test:

Model: HYD 10KTL-3PH									
MPP voltage of the simulated *I/V*-characteristic	Simulated I/V characteristic	Overall efficiency (%)							
		0.05	0.10	0.20	0.25	0.30	0.50	0.75	1.00
U min 300 Vdc	c-Si	94.27	95.40	97.19	97.47	97.42	97.43	96.82	96.78
U nom 600 Vdc		96.31	97.84	97.90	97.96	98.01	98.26	98.16	98.15
U max 800 Vdc		95.19	97.23	97.43	97.61	97.86	98.05	97.92	97.76
Model: HYD 5000-EP									
MPP voltage of the simulated *I/V*-characteristic	Simulated I/V characteristic	Overall efficiency (%)							
		0.05	0.10	0.20	0.25	0.30	0.50	0.75	1.00
U min 260 Vdc	c-Si	94.78	96.23	96.73	96.99	97.15	97.31	97.09	96.73
U nom 360 Vdc		95.42	97.07	97.22	97.39	97.49	97.83	97.72	97.62
U max 480 Vdc		94.75	96.73	97.04	97.14	97.32	97.72	97.33	97.14
Model: HYD 3680-EP									
MPP voltage of the simulated *I/V*-characteristic	Simulated I/V characteristic	Overall efficiency (%)							
		0.05	0.10	0.20	0.25	0.30	0.50	0.75	1.00
U min 200 Vdc	c-Si	94.18	95.82	96.59	96.84	97.03	97.20	96.96	96.54
U nom 360 Vdc		95.29	96.87	97.03	97.22	97.36	97.59	97.54	97.49
U max 480 Vdc		94.85	96.53	96.85	97.03	97.22	97.52	97.27	97.15

4.5 EUROPEAN EFFICIENCY

European efficiency test has been performed according to point annex D.1 of the standard.

For the calculation of a weighted European MPPT and conversion efficiency the following formula and factors are to be applied:

$$\eta_{MPPTstat,EUR} = a_{EU\_1} \cdot \eta_{MPP\_1} + a_{EU\_2} \cdot \eta_{MPP\_2} + a_{EU\_3} \cdot \eta_{MPP\_3} + a_{EU\_4} \cdot \eta_{MPP\_4} + a_{EU\_5} \cdot \eta_{MPP\_5} + a_{EU\_6} \cdot \eta_{MPP\_6} \quad \text{(D.1)}$$

a_{EU_i} weighting factor

η_{MPP_i} static MPPT efficiency at partial MPP power MPP_i

Table D.1 – Weighting factors and partial MPP power levels for the calculation of the European efficiency

Weighting Factor	a_{EU_1}	a_{EU_2}	a_{EU_3}	a_{EU_4}	a_{EU_5}	a_{EU_6}
	0.03	0.06	0.13	0.1	0.48	0.2
Partial MPP power $P_{MPP,PVS}/P_{DC,r}$	MPP_1	MPP_2	MPP_3	MPP_4	MPP_5	MPP_6
	0.05	0.1	0.2	0.3	0.5	1

Model: HYD 10KTL-3PH

$$\eta_{MPPTstat,EUR(c\text{-}si)} = 97.63\%$$

Model: HYD 5000-EP

$$\eta_{MPPTstat,EUR(c\text{-}si)} = 97.28\%$$

Model: HYD 3680-EP

$$\eta_{MPPTstat,EUR(c\text{-}si)} = 97.11\%$$

4.6 CEC EFFICIENCY

European efficiency test has been performed according to point annex D.2 of the standard.

For the calculation of a weighted CEC MPPT and conversion efficiency the following formula and factors are to be applied:

$$\eta_{MPPTstat,CEC} = a_{CEC\_1} \cdot \eta_{MPP\_1} + a_{CEC\_2} \cdot \eta_{MPP\_2} + a_{CEC\_3} \cdot \eta_{MPP\_3} + a_{CEC\_4} \cdot \eta_{MPP\_4} + a_{CEC\_5} \cdot \eta_{MPP\_5} + a_{CEC\_6} \cdot \eta_{MPP\_6} \quad \text{(D.2)}$$

a_{CEC_i} weighting factor

η_{MPP_i} static MPPT efficiency at partial MPP power MPP_i

Table D.2 – Weighting factors and partial MPP power levels for the calculation of the CEC efficiency (California Energy Commission)

Weighting Factor	a_{CEC_1}	a_{CEC_2}	a_{CEC_3}	a_{CEC_4}	a_{CEC_5}	a_{CEC_6}
	0.04	0.05	0.12	0.21	0.53	0.05
Partial MPP power $P_{MPP,PVS}/P_{DC,r}$	MPP_1	MPP_2	MPP_3	MPP_4	MPP_5	MPP_6
	0.1	0.2	0.3	0.5	0.75	1

Model: HYD 10KTL-3PH

$$\eta_{MPPTstat,CEC(c\text{-}si)} = 97.67\%$$

Model: HYD 5000-EP

$$\eta_{MPPTstat,CEC(c\text{-}si)} = 97.37\%$$

Model: HYD 3680-EP

$$\eta_{MPPTstat,CEC(c\text{-}si)} = 97.22\%$$

5 PICTURES

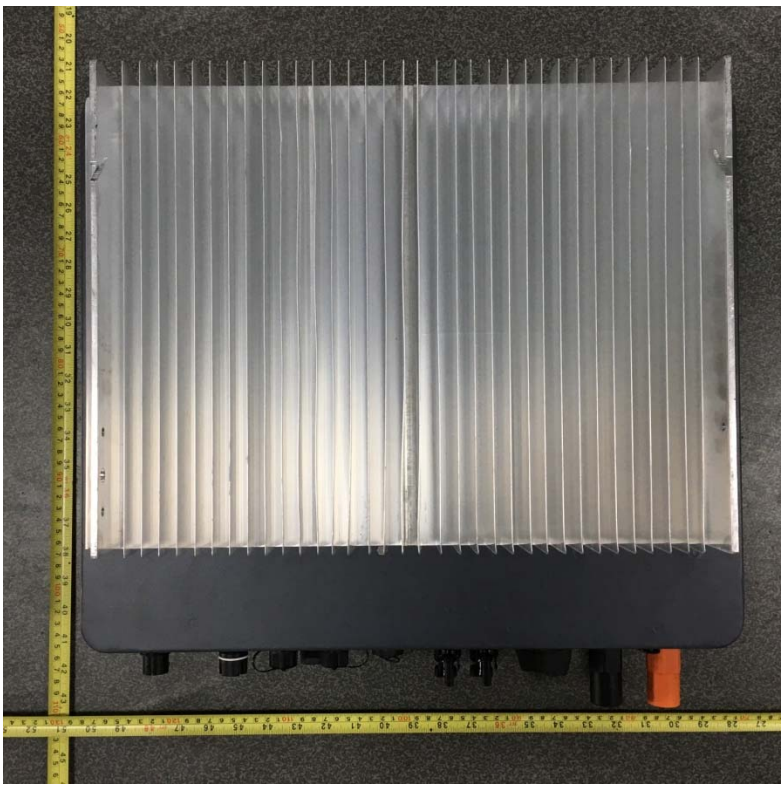
General view of HYD 10KTL-3PH

Back view of HYD 10KTL-3PH


Internal view of HYD 10KTL-3PH

Connection interface of HYD 10KTL-3PH

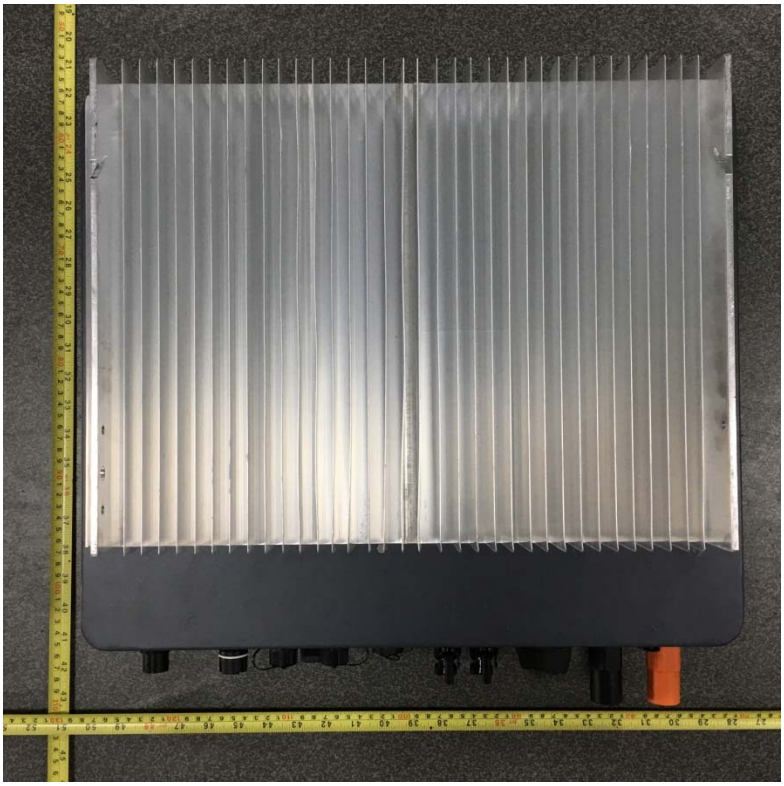
General view of HYD 5000-EP

Back view of HYD 5000-EP


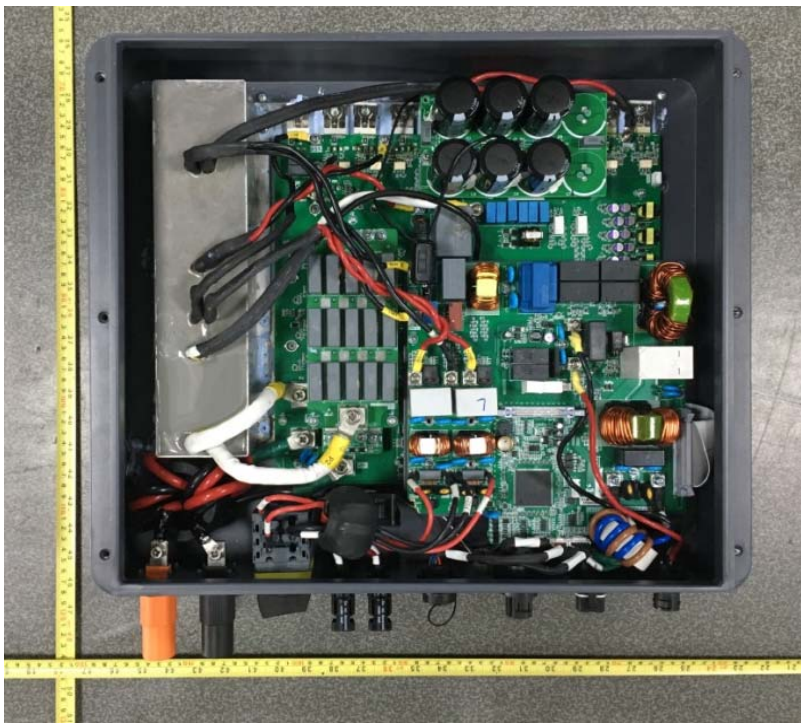
Internal view of HYD 5000-EP

Connection interface of HYD 5000-EP

General view of HYD 3680-EP

Back View of HYD 3680-EP


Invernal View of HYD 3680-EP



Connection interface of HYD 3680-EP

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