

# TEST REPORT

**Applicant name and address** : Shenzhen SOFARSOLAR Co., Ltd.  
3A-1, Huake Building, East Technology Park, Qiaoxiang Road, Nanshan District, Shenzhen, China.

**Manufacture name and address** : Shenzhen SOFARSOLAR Co., Ltd.  
3A-1, Huake Building, East Technology Park, Qiaoxiang Road, Nanshan District, Shenzhen, China.

**Report No** : 160408064GZU-002                      **Issue Date** : 29 Apr., 2016

**Total Pages** : 18

## Sample Description

**Name of Sample** : Solar Inverter

**Model Number** : Sofar 10000TL-Sx Series, Sofar 15000TL-Sx Series, Sofar 17000TL-Sx Series, Sofar 20000TL-Sx Series (x=2, 4, 5)

**Sample Condition** : Prototype

**Quantity of Sample(s)** : 4 pcs

**Date of Receiving** : 08 Apr., 2016

**Date of test Conducted** : 22 Apr., 2016 – 29 Apr., 2016

## Test

**Test Requested** : Power efficiency, loss measurement, Test A: clod, Test B: Dry heat, Test N: change of temperature, Test Db: Damp heat, cyclic

**Test Method** : Refer to IEC 60068-2-1:2007, IEC 60068-2-2:2007, IEC60068-2-14:2009, IEC60068-2-30:2005, IEC61683:1999

**Test Conclusion:** : Refer to test result

**Other information** : --

**Remark** :

- This test report is only for evaluation of the specified standard clauses listed in Test Requested.
- When determine the test result, measurement uncertainty has been considered.

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Tested by:



Tommy Zhong  
Assistant Technical Manager

Approved by:



Grady Ye  
Assistant Manager

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## TEST REPORT

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3. When determining of test conclusion, measurement uncertainty of test has been considered.

Electrical Rating:

Maximum d.c. input voltage: 1000 V

Input voltage rang: 250-960 V

MPPT voltage range with full power output: 430-850 V(for Sofar 20000TL-Sx); 420-850 V(for Sofar 17000TL-Sx); 370-850 V(for Sofar 15000TL-Sx); 350-850 V(for Sofar 10000TL-Sx)

Max. input current: 2×24 A (for Sofar 20000TL-Sx); 2×21 A (for Sofar 17000TL-Sx, Sofar 15000TL-Sx); 2×15 A (for Sofar 10000TL-Sx)

Max. PV Isc: 2×30 A (for Sofar 20000TL-Sx); 2×27 A (for Sofar 17000TL-Sx, Sofar 15000TL-Sx); 2×20 A (for Sofar 10000TL-Sx)

Nominal output voltage: 3/N/PE230V/400V

Max. output current: 3×29 A (for Sofar 20000TL-Sx); 3×25 A (for Sofar 17000TL-Sx); 3×22 A (for Sofar 15000TL-Sx); 3×15 A (for Sofar 10000TL-Sx)

Nominal frequency: 50 Hz

Max. output power: 20000 W (for Sofar 20000TL-Sx); 17000 W (for Sofar 17000TL-Sx); 15000 W (for Sofar 15000TL-Sx); 10000 W (for Sofar 10000TL-Sx)

Ingress protection: IP65

Operating temperature range: -25~60°C

All the models have identical mechanical and electrical construction except some components and some parameter of the software architecture in order to control the max output power. And refer to the following table for detail.

Model	DC surge arrester	AC surge arrester
Sofar 20000TL-S2		
Sofar 17000TL-S2		
Sofar 15000TL-S2		
Sofar 10000TL-S2		
Sofar 20000TL-S4		
Sofar 17000TL-S4	√	
Sofar 15000TL-S4		
Sofar 10000TL-S4		
Sofar 20000TL-S5		
Sofar 17000TL-S5	√	
Sofar 15000TL-S5		√
Sofar 10000TL-S5		
√ denote incorporating this component		

Unless other special note, the model Sofar 20000TL-S5 was selected as representative sample for testing in this report.

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## TEST REPORT

Test Results:

<u>Clause</u>	<u>Title/ Description</u>	<u>Pass</u>	<u>Fail</u>	<u>N.A.</u>	<u>Comment<sup>1</sup></u>
IEC 61683: 1999 (Cl.6)	Power efficiency	✓			
IEC 61683: 1999 (Cl.7)	Loss measurement	✓			
IEC 60068-2-1:2007 (Cl. 5.2)	Test A: Cold	✓			
IEC 60068-2-2:2007 (Cl. 5.2)	Test B: Dry heat	✓			
IEC 60068-2-14:2009 (Cl. 7)	Test N: Change of temperature	✓			
IEC 60068-2-30:2005 (Cl. 7)	Test Db: Damp heat, cyclic	✓			

**Remark:**

1. If there is special attention or condition needed to be pointed out, it can be written down in the column of "comment".

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## TEST REPORT

Test Results:

IEC 61683: 1999

Power efficiency (for Sofar 10000TL-Sx)

a) Test condition: Rated input voltage: 350 Vdc, Resistive load:

Power level	10%	25%	50%	75%	100%	120%
Input voltage (V)	350,010	350,860	350,040	350,640	348,150	--
Input current (A)	3,183	7,495	14,806	22,078	29,711	--
Input power (kW)	1,098	2,628	5,180	7,737	10,339	--
Output voltage (V)	231,346	231,225	231,108	230,525	230,691	--
Output current (A)	1,456	3,611	7,216	10,849	14,491	--
Output power (kW)	0,999	2,499	4,999	7,500	10,026	--
Efficiency (%)	90,985	95,102	96,513	96,928	96,981	--
Power factor	0,9882	0,9978	0,9993	0,9996	0,9998	--

b) Test condition: Rated input voltage: 600Vdc, Resistive load:

Power level	10%	25%	50%	75%	100%	120%
Input voltage (V)	600,450	600,090	600,430	599,760	600,790	--
Input current (A)	1,770	4,289	8,511	12,754	16,979	--
Input power (kW)	1,062	2,573	5,108	7,646	10,196	--
Output voltage (V)	230,087	230,229	230,282	230,470	230,675	--
Output current (A)	1,482	3,630	7,244	10,851	14,467	--
Output power (kW)	0,997	2,497	5,000	7,500	10,010	--
Efficiency (%)	93,832	97,081	97,881	98,091	98,173	--
Power factor	0,9743	0,9961	0,9991	0,9996	0,9998	--

c) Test condition: Rated input voltage: 765 Vdc, Resistive load:

Power level	10%	25%	50%	75%	100%	120%
Input voltage (V)	765,190	764,510	765,110	764,840	765,870	--
Input current (A)	1,427	3,416	6,735	10,061	13,384	--
Input power (kW)	1,092	2,610	5,150	7,692	10,245	--
Output voltage (V)	230,083	230,221	230,368	230,541	230,690	--
Output current (A)	1,534	3,654	7,255	10,856	14,466	--
Output power (kW)	1,000	2,500	5,002	7,501	10,006	--
Efficiency (%)	91,590	95,756	97,131	97,513	97,663	--
Power factor	0,9744	0,9904	0,9976	0,9990	0,9994	--

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## TEST REPORT

Test Results:

IEC 61683: 1999

Power efficiency (for Sofar 15000TL-Sx)

b) Test condition: Rated input voltage: 370 Vdc, Resistive load:

Power level	10%	25%	50%	75%	100%	120%
Input voltage (V)	370,300	370,520	370,700	369,640	369,850	--
Input current (A)	4,268	10,466	20,852	31,410	41,813	--
Input power (kW)	1,580	3,876	7,726	11,601	15,465	--
Output voltage (V)	228,003	227,985	228,014	228,390	228,545	--
Output current (A)	2,251	5,505	10,977	16,440	21,880	--
Output power (kW)	1,501	3,751	7,499	11,256	14,987	--
Efficiency (%)	95,015	96,774	97,067	97,021	96,912	--
Power factor	0,9747	0,9961	0,9988	0,9990	0,9990	--

b) Test condition: Rated input voltage: 610Vdc, Resistive load:

Power level	10%	25%	50%	75%	100%	120%
Input voltage (V)	609,440	610,580	610,130	609,970	610,120	--
Input current (A)	2,556	6,287	12,539	18,801	25,074	--
Input power (kW)	1,557	3,836	7,647	11,463	15,291	--
Output voltage (V)	227,592	227,772	228,555	228,289	228,605	--
Output current (A)	2,259	5,509	10,952	16,440	21,885	--
Output power (kW)	1,504	3,750	7,500	11,249	14,998	--
Efficiency (%)	96,594	97,741	98,081	98,134	98,086	--
Power factor	0,9749	0,9961	0,9988	0,9991	0,9993	--

c) Test condition: Rated input voltage: 765 Vdc, Resistive load:

Power level	10%	25%	50%	75%	100%	120%
Input voltage (V)	765,420	765,130	765,000	764,370	765,210	--
Input current (A)	2,063	5,053	10,051	15,073	20,018	--
Input power (kW)	1,578	3,864	7,685	11,516	15,310	--
Output voltage (V)	227,705	227,905	228,508	228,277	228,417	--
Output current (A)	2,275	5,512	10,961	16,446	21,850	--
Output power (kW)	1,499	3,752	7,503	11,252	14,961	--
Efficiency (%)	94,963	97,092	97,628	97,708	97,720	--
Power factor	0,9643	0,9948	0,9985	0,9990	0,9992	--

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## TEST REPORT

Test Results:

IEC 61683: 1999

Power efficiency (for Sofar 17000TL-Sx)

c) Test condition: Rated input voltage: 420 Vdc, Resistive load:

Power level	10%	25%	50%	75%	100%	120%
Input voltage (V)	419,230	420,020	420,210	420,38	419,95	--
Input current (A)	4,292	10,471	20,800	31,329	41,787	--
Input power (kW)	1,798	4,396	8,736	13,136	17,539	--
Output voltage (V)	228,435	228,234	228,068	228,514	228,729	--
Output current (A)	2,543	6,249	12,445	18,616	24,805	--
Output power (kW)	1,702	4,253	8,499	12,749	17,004	--
Efficiency (%)	94,643	96,754	97,284	97,054	96,948	--
Power factor	0,9768	0,9940	0,9981	0,9990	0,9991	--

b) Test condition: Rated input voltage: 635Vdc, Resistive load:

Power level	10%	25%	50%	75%	100%	120%
Input voltage (V)	635,590	635,550	635,340	634,470	634,270	--
Input current (A)	2,787	6,851	13,648	20,502	27,362	--
Input power (kW)	1,771	4,352	8,667	13,002	17,346	--
Output voltage (V)	228,153	228,467	228,642	228,993	229,032	--
Output current (A)	2,556	6,228	12,409	18,578	24,756	--
Output power (kW)	1,704	4,249	8,498	12,752	16,997	--
Efficiency (%)	96,206	97,621	98,049	98,078	97,987	--
Power factor	0,9738	0,9952	0,9984	0,9991	0,9992	--

c) Test condition: Rated input voltage: 765 Vdc, Resistive load:

Power level	10%	25%	50%	75%	100%	120%
Input voltage (V)	765,570	764,270	764,250	765,220	764,530	--
Input current (A)	2,344	5,741	11,412	17,067	22,781	--
Input power (kW)	1,793	4,385	8,717	13,054	17,408	--
Output voltage (V)	228,136	228,276	228,625	229,138	229,149	--
Output current (A)	2,574	6,239	12,416	18,565	24,749	--
Output power (kW)	1,698	4,251	8,503	12,751	17,001	--
Efficiency (%)	94,706	96,933	97,549	97,680	97,659	--
Power factor	0,9641	0,9949	0,9985	0,9991	0,9993	--

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## TEST REPORT

Test Results:

IEC 61683: 1999

Power efficiency (for Sofar 20000TL-Sx)

d) Test condition: Rated input voltage: 430 Vdc, Resistive load:

Power level	10%	25%	50%	75%	100%	120%
Input voltage (V)	429,330	430,910	430,280	430,075	430,065	--
Input current (A)	4,924	12,003	23,911	35,947	47,742	--
Input power (kW)	2,113	5,170	10,283	15,439	20,523	--
Output voltage (V)	231,268	231,697	231,777	228,709	229,325	--
Output current (A)	2,898	7,199	14,384	21,870	28,920	--
Output power (kW)	2,001	4,999	9,997	14,998	19,881	--
Efficiency (%)	94,684	96,700	97,218	97,148	96,874	--
Power factor	0,9949	0,9990	0,9996	0,9995	0,9992	--

b) Test condition: Rated input voltage: 640Vdc, Resistive load:

Power level	10%	25%	50%	75%	100%	120%
Input voltage (V)	640,380	640,500	640,040	640,280	640,121	--
Input current (A)	3,238	7,997	15,951	23,907	31,897	--
Input power (kW)	2,073	5,120	10,204	15,299	20,419	--
Output voltage (V)	231,071	231,430	231,791	231,938	231,956	--
Output current (A)	2,896	7,213	14,391	21,561	28,731	--
Output power (kW)	1,997	5,002	10,002	14,996	19,985	--
Efficiency (%)	96,344	97,710	98,022	98,019	97,875	--
Power factor	0,9948	0,9989	0,9996	0,9996	0,9996	--

c) Test condition: Rated input voltage: 765 Vdc, Resistive load:

Power level	10%	25%	50%	75%	100%	120%
Input voltage (V)	765,840	765,310	765,430	765,060	764,300	--
Input current (A)	2,775	6,732	13,372	20,020	26,813	--
Input power (kW)	2,139	5,149	10,230	15,309	20,483	--
Output voltage (V)	230,719	231,035	232,085	231,768	233,035	--
Output current (A)	2,969	7,234	14,368	21,530	28,626	--
Output power (kW)	2,039	5,006	9,998	14,964	20,003	--
Efficiency (%)	95,009	97,091	97,663	97,702	97,621	--
Power factor	0,9924	0,9985	0,9995	0,9995	0,9995	--

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## TEST REPORT

Test Results:

IEC 61683: 1999  
Power efficiency

7 Loss measurement (for Sofar 10000TL-Sx)

7.1 No-load loss

a) manufacturer's minimum rated input voltage: 350Vdc

Input voltage (V)	Input current (A)	Input power W1 (W)	Output voltage (V)	Frequency (Hz)	Output power W2 (W)
349,51	0,047	16,5	--	--	0

b) the inverter's nominal voltage or average of its rated input range: 600Vdc

Input voltage (V)	Input current (A)	Input power W1 (W)	Output voltage (V)	Frequency (Hz)	Output power W2 (W)
599,41	0,025	14,9	--	--	0

c) 90% of the inverter's maximum input voltage: 765Vdc

Input voltage (V)	Input current (A)	Input power W1 (W)	Output voltage (V)	Frequency (Hz)	Output power W2 (W)
764,35	0,021	15,9	--	--	0

7.2 Standby loss

Input voltage (V)	Input power W1 (W)	Output voltage (V)	Frequency (Hz)	Output current (A)	Output power W2 (W)
--	--	230,002	50,0	0,315	0,78

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## TEST REPORT

Test Results:

IEC 61683: 1999  
Power efficiency

7 Loss measurement (for Sofar 15000TL-Sx)

7.1 No-load loss

a) manufacturer's minimum rated input voltage: 370Vdc

Input voltage (V)	Input current (A)	Input power W1 (W)	Output voltage (V)	Frequency (Hz)	Output power W2 (W)
369,58	0,040	14,8	--	--	0

b) the inverter's nominal voltage or average of its rated input range: 610Vdc

Input voltage (V)	Input current (A)	Input power W1 (W)	Output voltage (V)	Frequency (Hz)	Output power W2 (W)
610,07	0,022	13,27	--	--	0

c) 90% of the inverter's maximum input voltage: 765Vdc

Input voltage (V)	Input current (A)	Input power W1 (W)	Output voltage (V)	Frequency (Hz)	Output power W2 (W)
765,02	0,018	13,51	--	--	0

7.2 Standby loss

Input voltage (V)	Input power W1 (W)	Output voltage (V)	Frequency (Hz)	Output current (A)	Output power W2 (W)
--	--	227,715	50,0	0,324	0,704

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## TEST REPORT

Test Results:

IEC 61683: 1999  
Power efficiency

7 Loss measurement (for Sofar 17000TL-Sx)

7.1 No-load loss

a) manufacturer's minimum rated input voltage: 420Vdc

Input voltage (V)	Input current (A)	Input power W1 (W)	Output voltage (V)	Frequency (Hz)	Output power W2 (W)
419,51	0,033	13,8	--	--	0

b) the inverter's nominal voltage or average of its rated input range: 635Vdc

Input voltage (V)	Input current (A)	Input power W1 (W)	Output voltage (V)	Frequency (Hz)	Output power W2 (W)
635,07	0,024	15,34	--	--	0

c) 90% of the inverter's maximum input voltage: 765Vdc

Input voltage (V)	Input current (A)	Input power W1 (W)	Output voltage (V)	Frequency (Hz)	Output power W2 (W)
765,00	0,020	15,26	--	--	0

7.2 Standby loss

Input voltage (V)	Input power W1 (W)	Output voltage (V)	Frequency (Hz)	Output current (A)	Output power W2 (W)
--	--	228,371	50,0	0,318	0,718

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## TEST REPORT

Test Results:

IEC 61683: 1999  
Power efficiency

7 Loss measurement (for Sofar 20000TL-Sx)

7.1 No-load loss

a) manufacturer's minimum rated input voltage: 430Vdc

Input voltage (V)	Input current (A)	Input power W1 (W)	Output voltage (V)	Frequency (Hz)	Output power W2 (W)
429,98	0,033	14,25	--	--	0

b) the inverter's nominal voltage or average of its rated input range: 640Vdc

Input voltage (V)	Input current (A)	Input power W1 (W)	Output voltage (V)	Frequency (Hz)	Output power W2 (W)
639,84	0,024	15,46	--	--	0

c) 90% of the inverter's maximum input voltage: 765Vdc

Input voltage (V)	Input current (A)	Input power W1 (W)	Output voltage (V)	Frequency (Hz)	Output power W2 (W)
765,10	0,023	17,04	--	--	0

7.2 Standby loss

Input voltage (V)	Input power W1 (W)	Output voltage (V)	Frequency (Hz)	Output current (A)	Output power W2 (W)
--	--	229,985	50,0	0,320	0,798

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## TEST REPORT

### Test Results:

#### **IEC 60068-2-1: 2007 Test A: Cold**

##### **Clause 5.2 Test Ab: Cold for non heat-dissipating specimens with gradual change of temperature**

The specimen is introduced into the chamber which is at the temperature of the laboratory. The temperature is then adjusted to the temperature appropriate to the degree of severity, as specified in the relevant specification. After temperature stability of the test specimen has been reached, the specimen is exposed to these conditions for the specified duration. For specimens that are required to be operational (even though they do not meet the requirements of being heat dissipating), power shall then be applied to the specimen and a functional test is performed as necessary. A further period of stabilization may be necessary and the specimen shall then be exposed to the low temperature conditions for a duration as specified in the relevant specification. Specimens under test are normally in non-operating conditions.

### Test condition:

Test Temperature : -25°C  
Test Duration : 16h

### Test result:

After the test, the specimens can operation normally.

#### **IEC 60068-2-2: 2007 Test B: Dry heat**

##### **Clause 5.2 Test Bb: Dry heat for non heat-dissipating specimens with gradual change of temperature**

The specimen is introduced into the chamber, which is at the temperature of the laboratory. The temperature is then adjusted to the temperature appropriate to the degree of severity as specified in the relevant specification. After temperature stability of the test specimen has been reached, the specimen is exposed to these conditions for the specified duration. For specimens that are required to be operational (even though they do not meet the requirements of being heat dissipating) power shall then be applied to the specimen and a functional test is performed as necessary. A further period of stabilization may be necessary and the specimen shall then be exposed to the high temperature conditions for a duration as specified in the relevant specification. Specimens under test are normally in non-operating conditions.

### Test condition:

Test Temperature : +60°C  
Test Duration : 16h

### Test result:

After the test, the specimens can operation normally.

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## TEST REPORT

Test Results:

**IEC 60068-2-14: 2009 Test N: Change of temperature**

**Clause 7 Test Na: Rapid change of temperature with prescribed time of transfer**

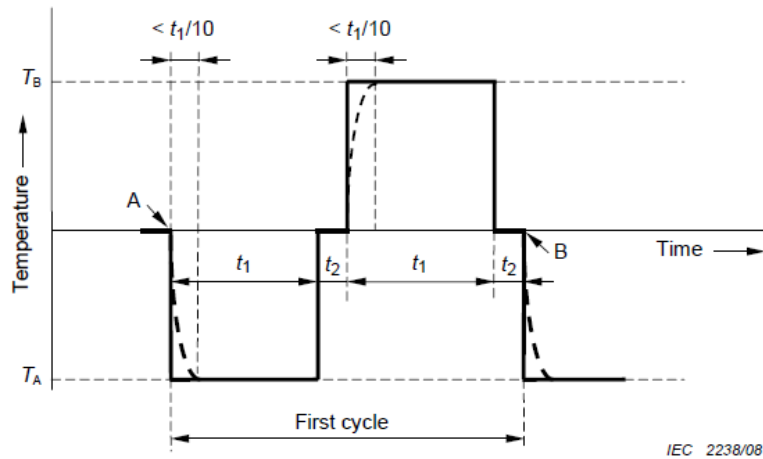
The severity of the test is defined by the combination of the two temperatures, the transfer time, the exposure time of the specimen and the number of cycles.

The lower temperature,  $T_A$ , shall be specified in the relevant specification and should be chosen from the test temperatures of IEC 60068-2-1 and IEC 60068-2-2.

The higher temperature,  $T_B$ , shall be specified in the relevant specification and should be chosen from the test temperatures of IEC 60068-2-1 and IEC 60068-2-2.

The exposure time,  $t_1$ , of each of the two temperatures depends upon the heat capacity of the specimen. It may be 3 h, 2 h, 1 h, 30 min or 10 min, or as specified in the relevant specification. Where no exposure period is specified in the relevant specification, it is understood to be 3 h.

The preferred number of test cycles is five, unless otherwise specified in the relevant specification.



**Key**

- A start of first cycle
- B end of first cycle and start of second cycle

NOTE The dotted curve is explained above.

**Figure 2 – Na test cycle**

Test condition:

Low temperature  $T_A$ : -25°C

High temperature  $T_B$ : +60°C

Duration of exposure time  $t_1$ : 3h

Duration of transfer time  $t_2$ : 3min

Number of cycles: 5

Recovery: 2h

Test result:

Initial measurements: Input: 640,38Vdc; 31,923A; 20,508kW      Output: 231,86Vac; 28,933A; 20,010kW

Final measurements: Input: 640,26Vdc; 31,868A; 20,366kW      Output: 231,78Vac; 28,892A; 19,988kW

After the test, the specimens can operation normally.

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## TEST REPORT

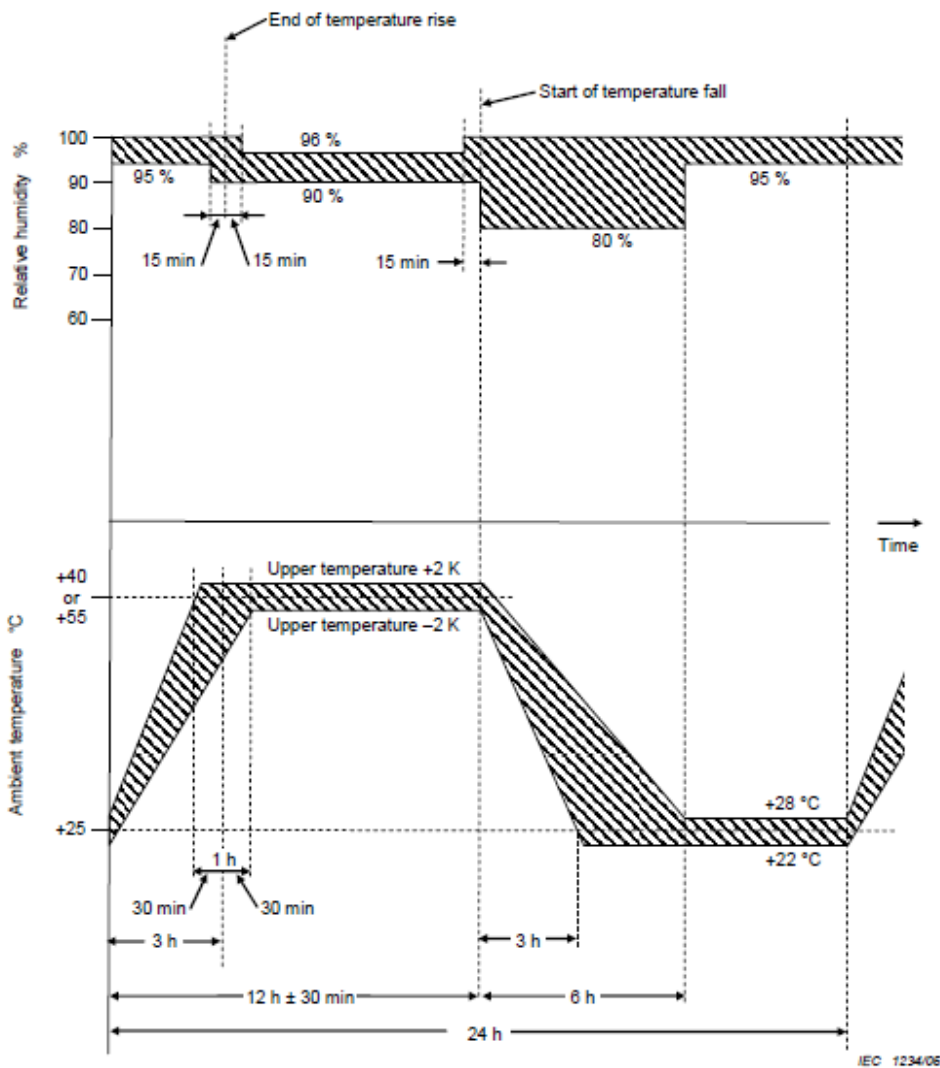
Test Results:

**IEC 60068-2-30: 2005 Test Db: Damp heat, cyclic**

**Clause 7 Test Na: Rapid change of temperature with prescribed time of transfer**

*Variant 2* (see Figure 2b)

The temperature shall be lowered to  $25\text{ °C} \pm 3\text{ K}$  within 3 h to 6 h, but without the additional requirement for the first hour and one half as in variant 1. The relative humidity shall be not less than 80 % RH.



**Figure 2b – Test Db – Test cycle – Variant 2**

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## TEST REPORT

Test Results:

Test condition:

Test Db, variant 2, b-cycle  
The humidity level shall be 95 %  $\pm$  5 %  
A minimum number of 3 cycles  
Lower temperature: 25°C  
Upper temperature: 40°C

Test result:

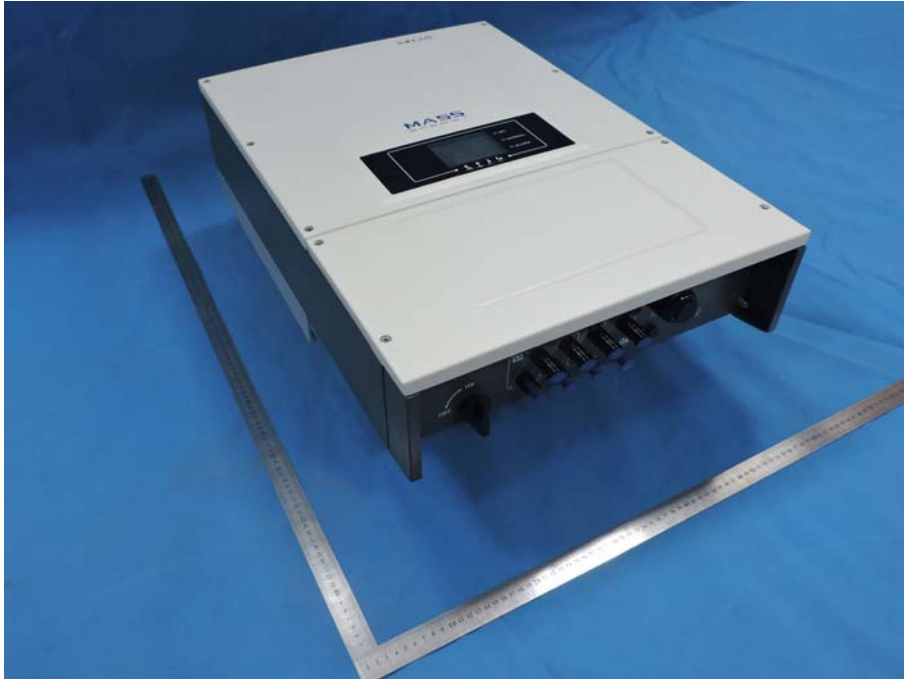
Initial measurements: Input: 640,26Vdc; 31,868A; 20,366kW      Output: 231,78Vac; 28,892A; 19,988kW  
Final measurements: Input: 640,56Vdc; 31,362A; 20,293kW      Output: 231,36Vac; 29,005A; 19,779kW

After the test, the specimens can operation normally.

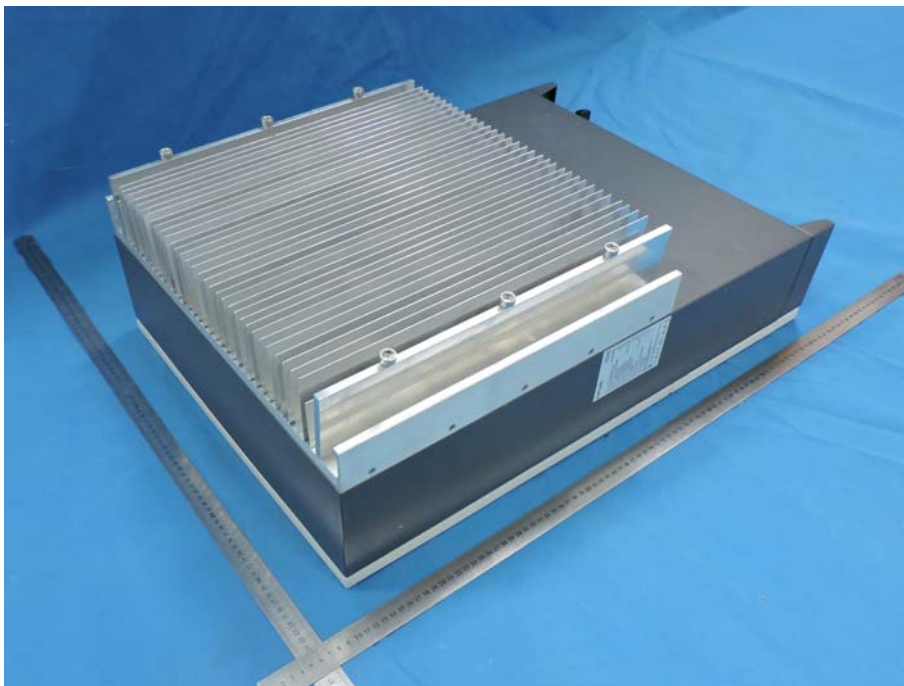
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**TEST REPORT**

Appendix 1: Photo document



Overall view



Backside view

\*\*\*\*\* End of Page\*\*\*\*\*



# TEST REPORT

Appendix 1: Photo document



Terminals view



Internal view

\*\*\*\*\* End of Page \*\*\*\*\*

# TEST REPORT

Appendix 1: Photo document



Internal view



Internal view

\*\*\*\*\*End of Report\*\*\*\*\*