Report No.: 130918055GZU-001
Issued: 24 January 2014

TEST REPORT

Applicant Name & Address	:	Shenzhen SOFARSOLAR Co., Ltd. 3A-1, Huake Building, East Technology Park, Qiaoxiang Road, Nanshan District, Shenzhen, China
Manufacturing Site	:	Suga Networks Equipment (Shenzhen) Co., Ltd. Floor 1 East & Floor 2 of Building B(Manufacturing Site), Floor 3 & 4 of Building A(Office Site), Block 12, Xi Cheng Industrial Park, Xi Xiang Street, BaoAn District, Shenzhen City, China
Sample Description		
Product	:	Grid-connected PV inverter
Model No.	:	Sofar 20000TL-Sx, Sofar 17000TL-Sx, Sofar 15000TL-Sx, Sofar 10000TL-Sx (x=0-6)
Electrical Rating	:	Maximum d.c. input voltage: 1000 V Input voltage rang: 250-960 V Operating temperature range: -25～60℃ (See page 5 for details)
Date Received	:	18 September 2013
Date Test Conducted	:	23 November 2013-26 November 2013
Test standards	:	**EN 61000-6-3: 2007+A1: 2011** **EN 61000-6-1: 2007**
Test Result	:	Pass
Conclusion	:	The submitted samples complied with the above EMC standards.
Remark	:	None.

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

Prepared and Checked By:

Ivan Zhou
Project Engineer
Intertek Guangzhou

Approved By:

Helen Ma ***Signature***
Helen Ma
Sr. Project Engineer
Intertek Guangzhou
24 January 2014 ***Date***

Intertek Testing Services Shenzhen Ltd. Guangzhou Branch
Block E, No.7-2 Guang Dong Software Science Park, Caipin Road, Guangzhou Science City, GETDD Guangzhou, China
Tel / Fax: 86-20-8213 9688/86-20-3205 7538

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1 TEST RESULTS SUMMARY

Test Item	Standard	Result
Continuous conducted disturbance voltage	EN 61000-6-3:2007+A1: 2011 Reference: EN 55022: 2010	Pass
Discontinuous conducted disturbance voltage	EN 61000-6-3:2007+A1: 2011 Reference: EN 55014-1: 2006+A1: 2009	Pass
Emission at Telecommunications/ network Ports	EN 61000-6-3:2007+A1: 2011 Reference: EN 55022: 2010	N/A
Radiated emission (30 MHz–1000 MHz)	EN 61000-6-3:2007+A1: 2011 Reference: EN 55022: 2010	Pass
Radiated emission (1 GHz–6 GHz)	EN 61000-6-3:2007+A1: 2011 Reference: EN 55022: 2010	N/A
Harmonic of current	EN 61000-6-3:2007+A1: 2011 Reference: EN 61000-3-12:2011	Pass
Flicker	EN 61000-6-3:2007+A1: 2011 Reference: EN 61000-3-11:2000	Pass
ESD immunity	EN 61000-6-1:2007 Reference: EN 61000-4-2: 1995+A1: 1998+A2: 2001	Pass
Radiated EM field immunity	EN 61000-6-1:2007 Reference: EN 61000-4-3: 2006	Pass
EFT immunity	EN 61000-6-1:2007 Reference: EN 61000-4-4: 2004	Pass
Surge immunity	EN 61000-6-1:2007 Reference: EN 61000-4-5: 2006	Pass
Inject current immunity	EN 61000-6-1:2007 Reference: EN 61000-4-6: 2009	Pass
Power frequency magnetic field immunity	EN 61000-6-1:2007 Reference: EN 61000-4-8: 1993+A1: 2001	Pass
Voltage dips and interruption immunity	EN 61000-6-1:2007 Reference: EN 61000-4-11: 2004	N/A

Remark:

1. **The symbol "N/A" in above table means Not Applicable.**
2. **When determining the test results, measurement uncertainty of tests has been considered.**

2 EMC Results Conclusion

(with Justification)

RE: EMC Testing Pursuant to EMC Directive 2004/108/EC Performed On the Grid-connected PV inverter, Models: Sofar 20000TL-Sx, Sofar 17000TL-Sx, Sofar 15000TL-Sx, Sofar 10000TL-Sx (x=0-6).

We tested the Grid-connected PV inverter, Model: Sofar 20000TL-S6, to determine if it was in compliance with the relevant EN standards as marked on the Test Results Summary. We found that the unit met the requirement of EN 61000-6-3, EN 61000-6-1 (EN 61000-4-2), EN 61000-6-1 (EN 61000-4-4), EN 61000-6-1 (EN 61000-4-6), EN 61000-6-1 (EN 61000-4-5), EN 61000-6-1 (EN 61000-4-3), EN 61000-6-1 (EN 61000-4-8) &EN 61000-6-1(EN 61000-4-11) standards when tested as received. The worst case's test data was presented in this test report.

Electrical Rating:

Maximum d.c. input voltage: 1000 V

Input voltage rang: 250-960 V

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℃

General product information:

Product covered by this report is grid-connected PV inverter for indoor or outdoor installation. The connection to the DC input and AC output are through connectors. The structure of the unit complied with the IP 65 requirement.

The inverters intended to operate at ambient temperature -25℃ - +60℃ and 250-960 Vdc input, which will be specified in the user manual, the inverters will output full power when operated at 45℃. If operated at higher than 45℃ temperature, the output power derating.

For all models, if the DC input voltage is higher than 850 Vdc the output power will be derating. For model Sofar 20000TL-Sx, if the DC input voltage is lower than 430 Vdc, the output power will be derating.

For model Sofar 17000TL-Sx, if the DC input voltage is lower than 420 Vdc, the output power will be derating.
For model Sofar 15000TL-Sx, if the DC input voltage is lower than 370 Vdc, the output power will be derating.
For model Sofar 10000TL-Sx, if the DC input voltage is lower than 350 Vdc, the output power will be derating.

For all models, if the AC output voltage is lower than 230 Vac the output current will be limited to not higher than rated output current.

All the models have identical mechanical and electrical construction except some componnents and some parameter of the software architecture in order to control the max output power.

Other than special notice, the model Sofar 20000TL-S6 is as the representative test models in this report

The production units are required to conform to the initial sample as received when the units are placed on the market.

3 LABORATORY MEASUREMENTS

Configuration Information

Equipment Under Test (EUT):	Grid-connected PV inverter
Model:	Sofar 20000TL-S6
Serial No.	Not Labeled
Support Equipment:	AC-DC source provided by client
Rated Voltage:	Input: 720VDC; Output: 400V, 50Hz, 3phases
Condition of Environment:	Temperature : 22~28°C Relative Humidity: 35~60% Atmosphere Pressure 86~106kPa

Notes:
1. The EMI measurements had been made in the operating mode producing the largest emission in the frequency band being investigated consistent with normal applications.
An attempt had be made to maximize the emission by varying the configuration of the EUT.

2. The EMS measurements had been made in the frequency bands being investigated, with the EUT in the most susceptible operating mode consistent with normal applications. The configuration of the test sample had been varied to achieve maximum susceptibility.

4 EMI TEST

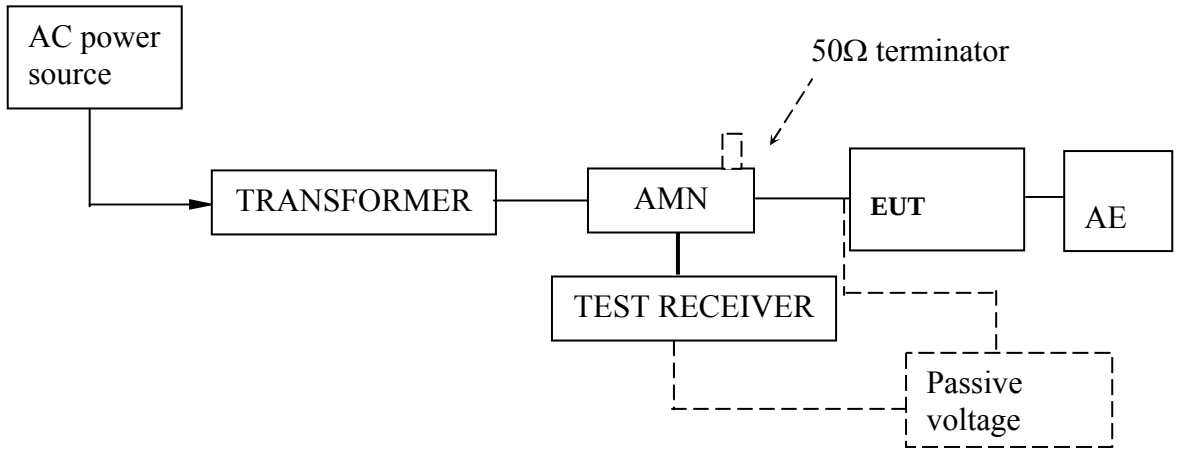
4.1 Emission- Low voltage AC mains port (continuous disturbance)

Test Result: Pass

4.1.1 Used Test Equipment

Equipment No.	Equipment	Model	Manufacturer
828985/018	Test Receiver	ESCS30	Rohde & Schwarz
8129-203	L.I.S.N.	NNLK8129	Schwarzbeck
M20531	50Ω Coaxial Switch	MP59B	Anritsu
100006	Pulse Limiter	ESH3-Z2	Rohde & Schwarz

4.1.2 Block Diagram of Test Setup



4.1.3 Test Setup and Procedure

The EUT was set to achieve the maximum emission level. The mains terminal disturbance voltage was measured with the EUT in a shielded room. The EUT was connected to AC power source through an Artificial Mains Network which provides a 50Ω linear impedance Artificial hand is used if appropriate (for handheld apparatus). The load/control terminal disturbance voltage was measured with passive voltage probe if appropriate.

The EUT was placed on a 0.8m high non-metallic table above a metallic plane, and 0.4m from wall of shielded room which is considered as Ground Reference Plane (GRP) (For floor standing EUT, was placed on a 0.1m high non-metallic supported on GRP) The EUT keeps a distance of at least 0.8m from any other of the metallic surface. The Artificial Mains Network is situated at a distance of 0.8m from the EUT.

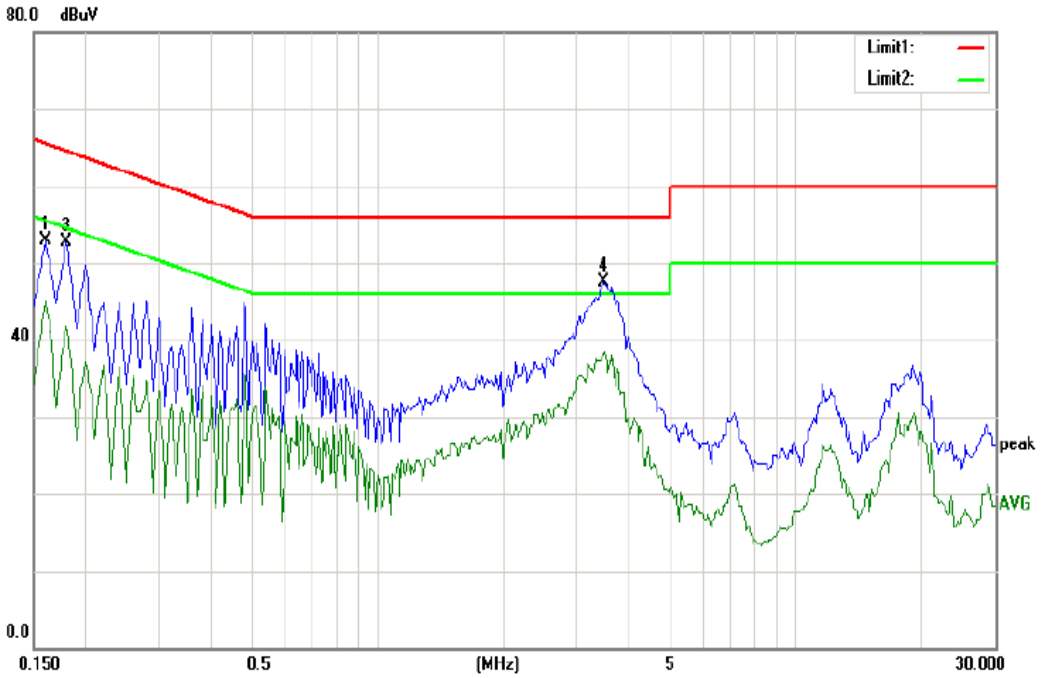
During the test, mains lead of EUT excess 0.8m was folded back and forth parallel to the lead so as to form a horizontal bundle with a length between 0.3m and 0.4m.

The bandwidth of test receiver was set at 9 kHz. The frequency range from 150 kHz to 30MHz was checked.

4.1.4 Emission Curve & Test Data

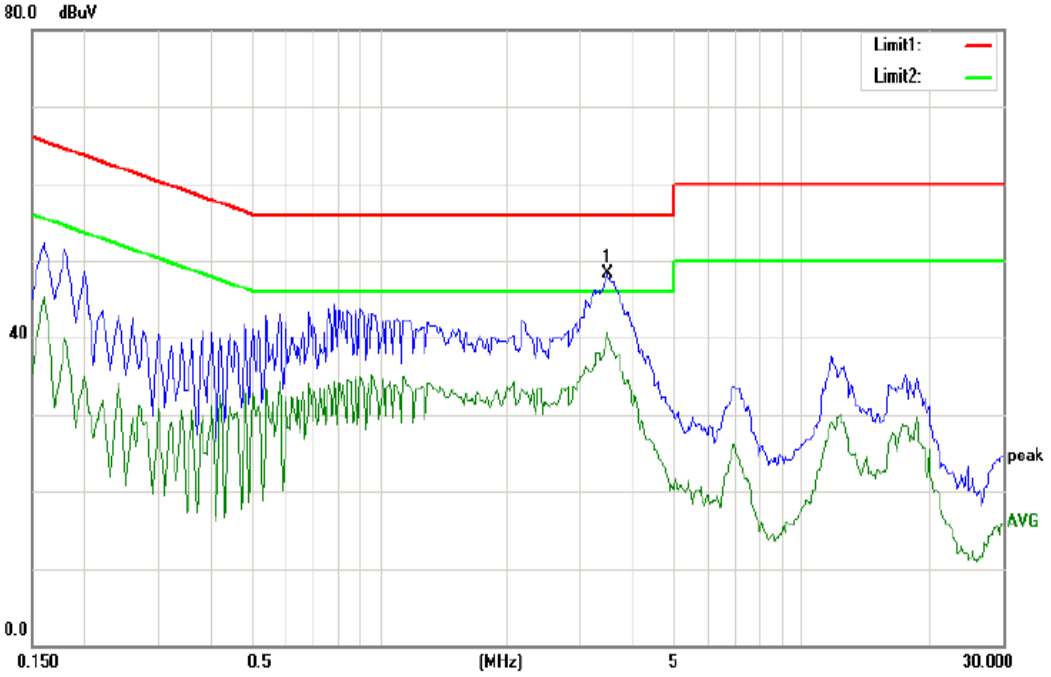
At mains terminal:

Tested Wire: L1 **Operation mode: EUT on, full load**



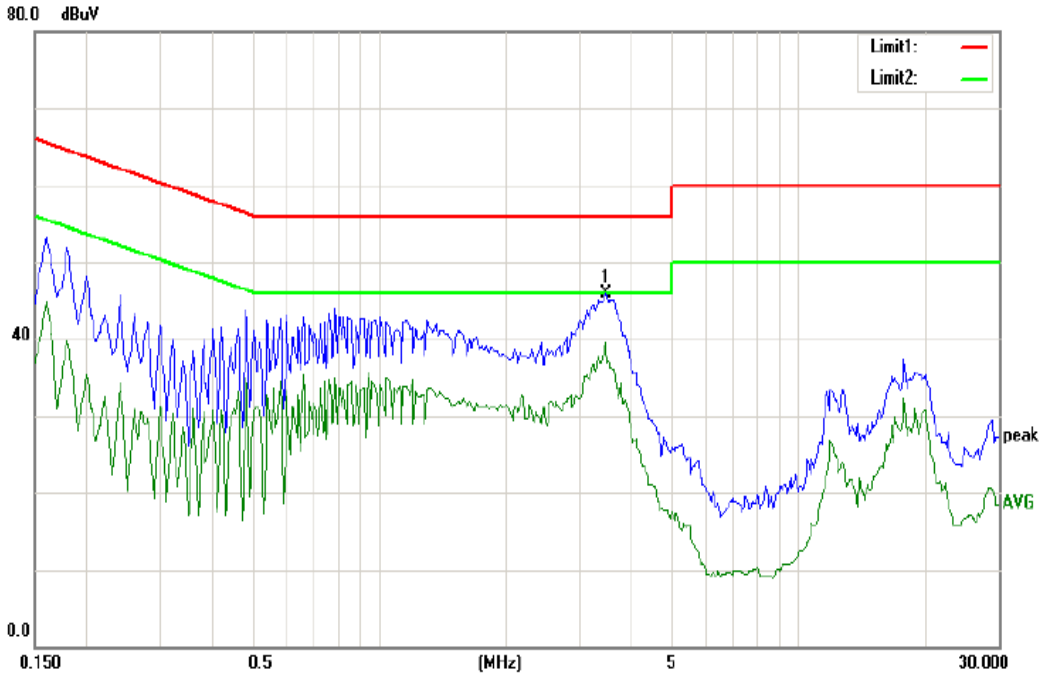
No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector
1		0.1600	52.92	0.00	52.92	65.46	-12.54	peak
2		0.1600	45.19	0.00	45.19	55.46	-10.27	AVG
3		0.1800	52.73	0.00	52.73	64.49	-11.76	peak
4		3.4600	47.41	0.00	47.41	56.00	-8.59	peak
5	*	3.5000	38.41	0.00	38.41	46.00	-7.59	AVG

Tested Wire: L2 **Operation mode: EUT on, full load**



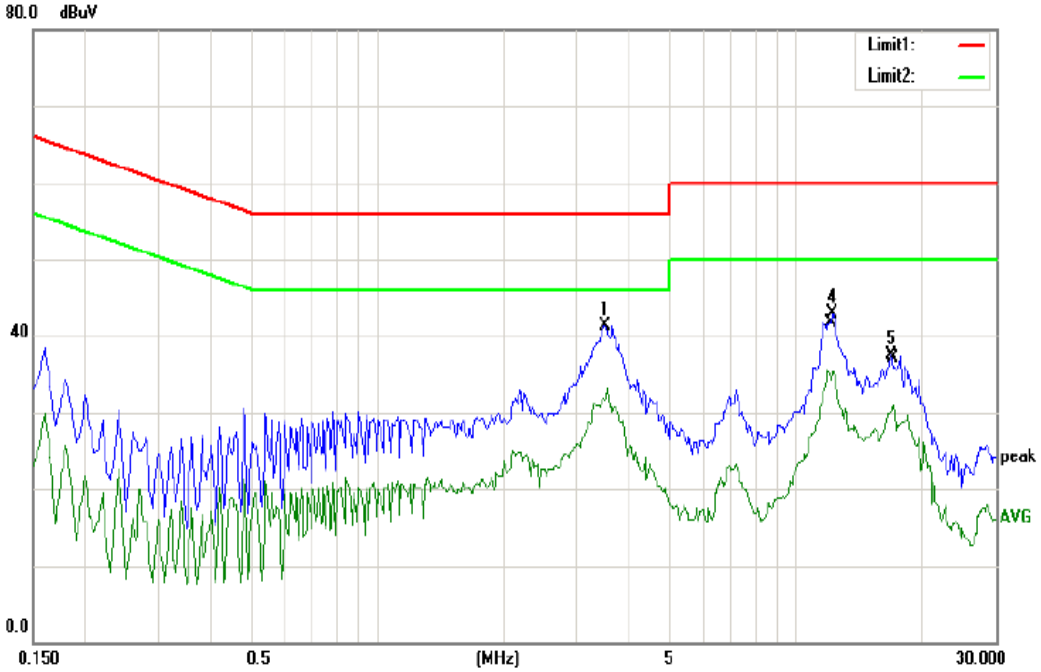
No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector
1		3.4600	48.34	0.00	48.34	56.00	-7.66	peak
2	*	3.4600	40.65	0.00	40.65	46.00	-5.35	AVG

Tested Wire: L3 **Operation mode: EUT on, full load**



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector
1		3.4600	45.82	0.00	45.82	56.00	-10.18	peak
2	*	3.4600	39.46	0.00	39.46	46.00	-6.54	AVG

Tested Wire: Neutral **Operation mode: EUT on, full load**



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector
1		3.5000	41.38	0.00	41.38	56.00	-14.62	peak
2	*	3.5400	33.04	0.00	33.04	46.00	-12.96	AVG
3		11.9000	35.48	0.00	35.48	50.00	-14.52	AVG
4		12.2500	42.85	0.00	42.85	60.00	-17.15	peak
5		16.8750	37.41	0.00	37.41	60.00	-22.59	peak
6		17.1250	30.85	0.00	30.85	50.00	-19.15	AVG

4.1.5 Measurement Uncertainty

The measurement uncertainty describes the overall uncertainty of the given measured value during the operation of the EUT.
Measurement uncertainty is calculated in accordance with CISPR 16-4-2:2003.
Measurement uncertainty of mains terminal disturbance voltage in CISPR band B: 2.6dB.
The measurement uncertainty is given with a confidence of 95%, k=2.

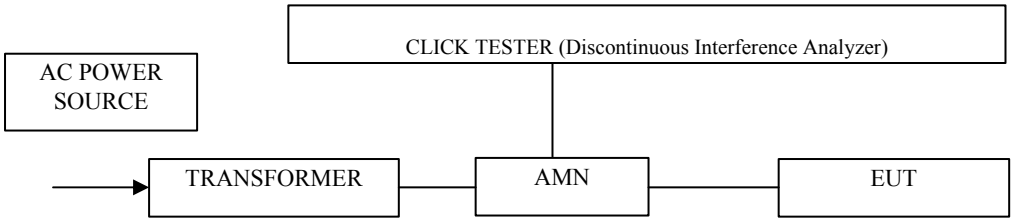
4.2 Emission- Low voltage AC mains port (discontinuous disturbance)

Test Result: Pass

4.2.1 Used Test Equipment

Equipment No.	Equipment	Model	Manufacturer
828985/018	Test Receiver	ESCS30	Rohde & Schwarz
8129-203	L.I.S.N.	NNLK8129	Schwarzbeck
M20531	50Ω Coaxial Switch	MP59B	Anritsu
100006	Pulse Limiter	ESH3-Z2	Rohde & Schwarz

4.2.2 Block Diagram of Test Setup



4.2.3 Test Setup and Procedure

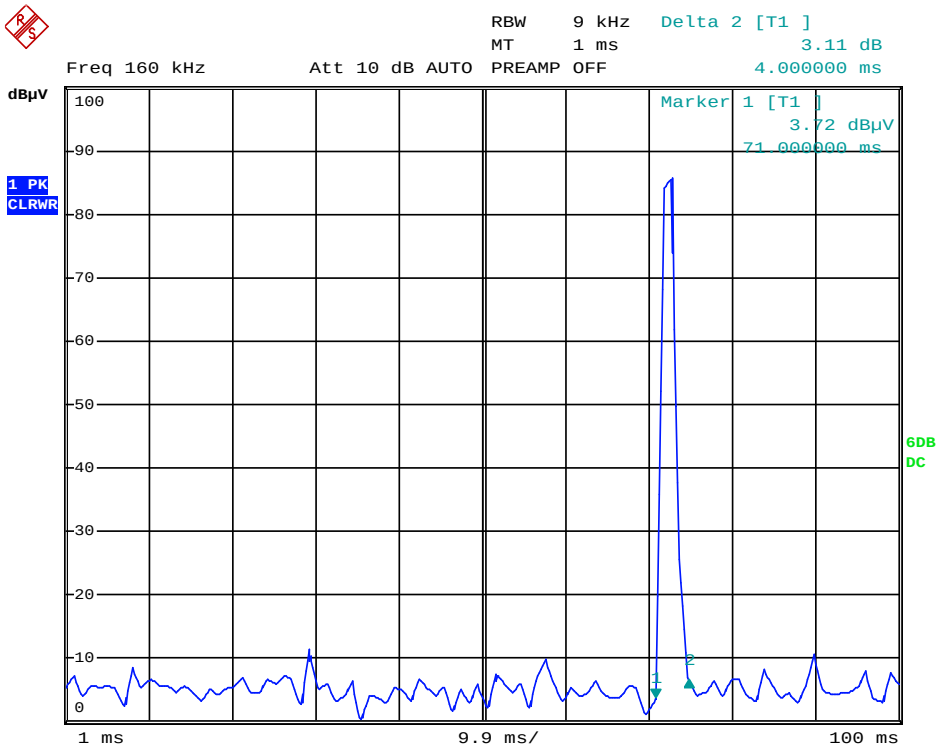
The EUT was placed on a 0.8m high non-metallic table in shielded room, the wall of shielded room used as Ground Reference Plane (GRP),and keeps a distance of at least 0.8m from any of the other metallic surface.

The EUT was connected to an artificial mains network and at a distance of 0.8m from it, the excess lead of EUT was bundled with a length of 0.3m to 0.4m parallel to the main lead.

The number of counted clicks above the permitted limit for continuous interference and their duration, spacing and rate were measured during the observation time. When relevant, a permitted (relaxed) limit for clicks were calculated and a second measurement was performed.

Determination of compliance with the permitted limit according to the upper quartile method was applied. The frequency 150kHz, 500kHz, 1.4MHz and 30MHz was checked.

4.2.4 Test Data



The appliance was deemed to comply with the limits if fulfilling the three conditions below:
– the click rate is not more than 5.
– none of the caused clicks has a duration longer than 20 ms.
– 90 % of the caused clicks have a duration less than 10 ms.

4.2.5 Measurement Uncertainty

The measurement uncertainty for click test is under consideration according to CISPR 16-4-2:2003.

4.3 Emission- DC power port

Test Result: Not Applicable

Remark: These DC ports of appliance are only intended for connection to solar battery modules.

4.4 Emission- Telecommunications/network port

Test Result: Not Applicable

Remark: The test only apply to balanced telecommunication ports intended for connection to unscreened balanced pairs

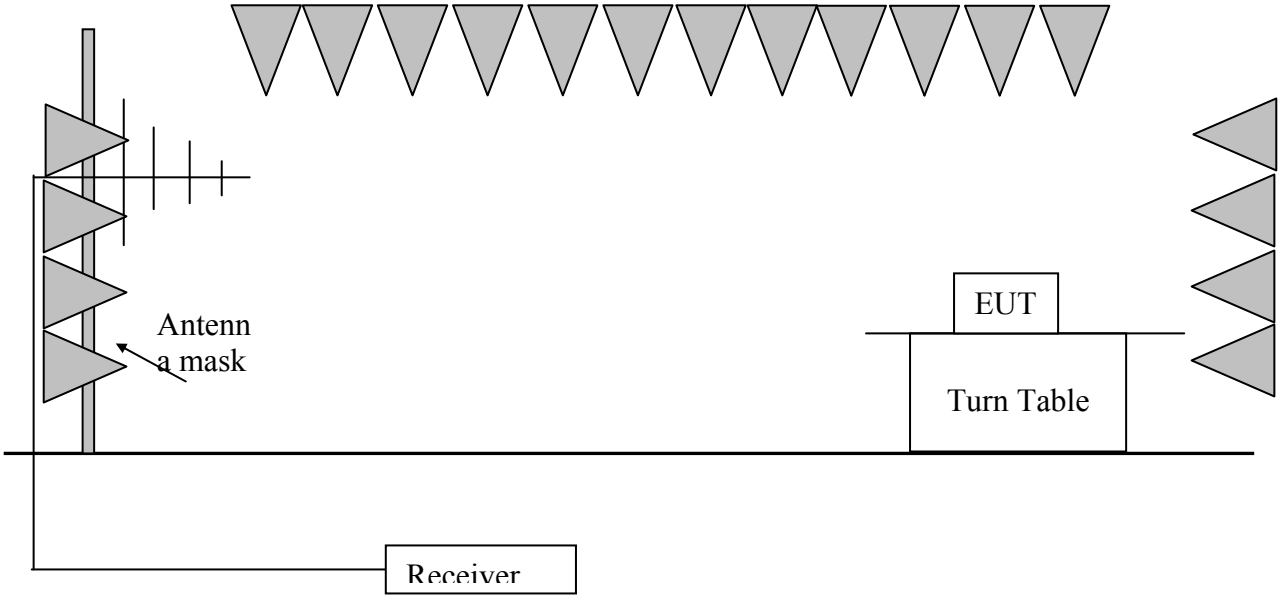
4.5 Emission- Enclosure port

Test Result: Pass

4.5.1 Used Test Equipment

Equip. No.	Equipment	Model	Manufacturer
101045	EMI Test Receiver	ESCI	Rohde & Schwarz
22013	Pre-Amplifier	PAP-0203	CD
141	Bilog Antenna	VULB9163	Schwarzbeck

4.5.2 Block Diagram of Test Setup



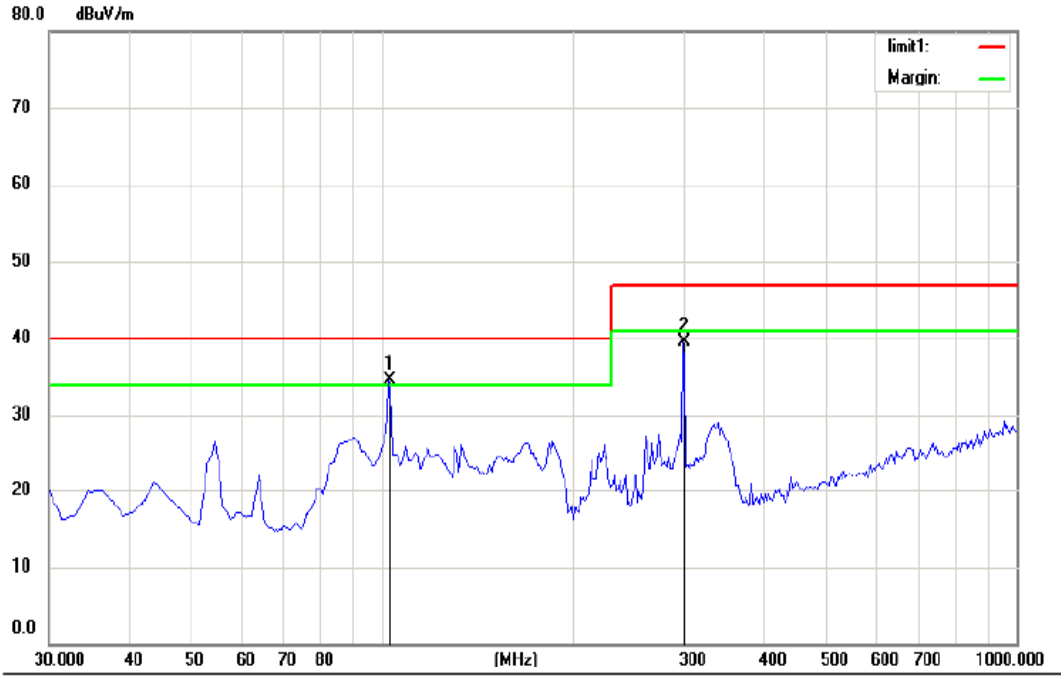
4.5.3 Test Setup and Procedure

The measurement was applied in a semi-anechoic chamber. The EUT and simulators were placed on a 0.8m high wooden turntable above the horizontal metal ground plane. The turn table rotated 360 degrees to determine the position of the maximum emission level. The EUT was set 3 meters away from the receiving antenna which was mounted on an antenna mask. The antenna moved up and down between from 1meter to 4 meters to find out the maximum emission level.
Broadband antenna was used as receiving antenna. Both horizontal and vertical polarization of the antenna was set on measurement. In order to find the maximum emission, all of the interface cables were manipulated according to EN55022 requirement during radiated test.
The bandwidth setting on R&S Test Receiver was 120 kHz.
The frequency range from 30MHz to 1000MHz was checked

4.5.4 Test Curve & Test Data

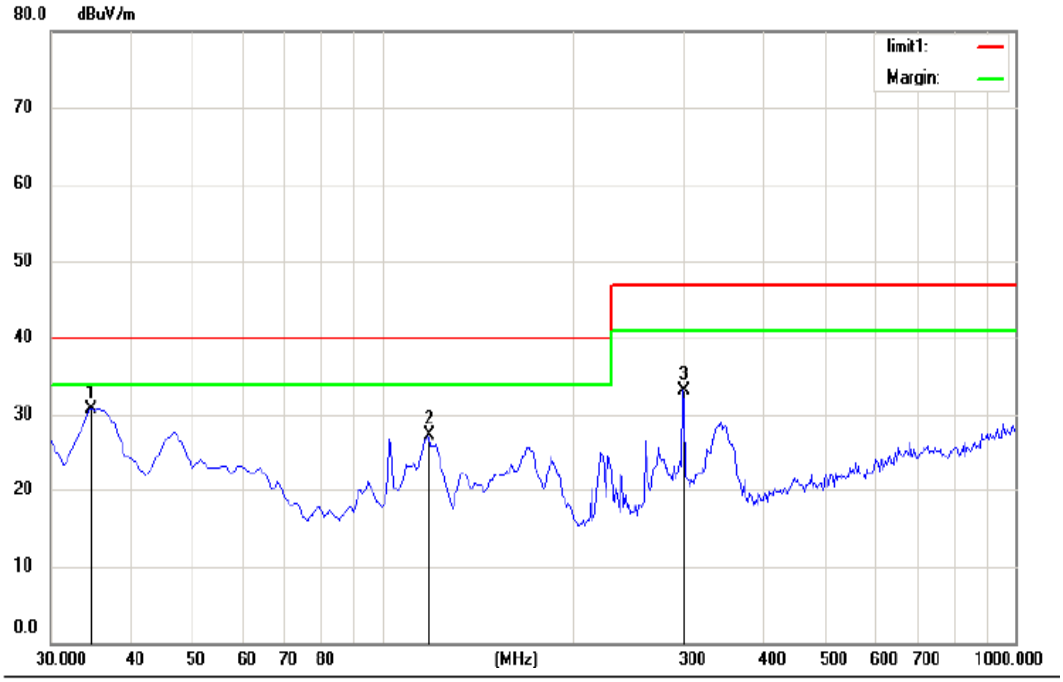
Operation mode: EUT on, full load

Horizontal



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector
1	*	103.0610	20.53	14.06	34.59	40.00	-5.41	peak
2		298.9263	23.15	16.29	39.44	47.00	-7.56	peak

Vertical



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector
1	*	34.6634	17.95	12.71	30.66	40.00	-9.34	peak
2		118.6058	14.47	12.85	27.32	40.00	-12.68	peak
3		298.9263	16.79	16.28	33.07	47.00	-13.93	peak

4.5.5 Measurement uncertainty

The measurement uncertainty describes the overall uncertainty of the given measured value during the operation of the EUT.
Measurement uncertainty is calculated in accordance with CISPR 16-4-2:2003.
Measurement uncertainty of radiated emission: 3.3 dB.
The measurement uncertainty is given with a confidence of 95%, k=2.

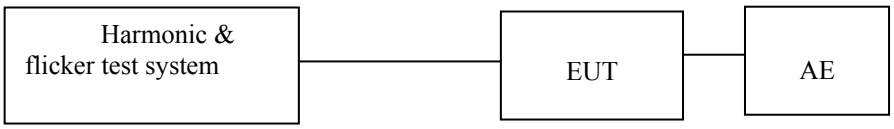
4.6 Harmonic of Current

Test Result: Pass

4.6.1 Used Test Equipment

Equip. No.	Equipment	Model	Manufacturer
1305A02873	45KVA AC Power source	NSG 1007-45/45KVA	Teseq
1305A02873	Signal conditioning Unit	CCN 1000-3	Teseq
1305A02873	Three phase impedance network	INA2197/37A	Teseq
1305A02874	Three phase impedance network	INA 2196/75A	Teseq
A22714	Profline 2100 AC Switching Unit	NSG2200-3	Teseq

4.6.2 Block Diagram of Test Setup



4.6.3 Test Setup and Procedure

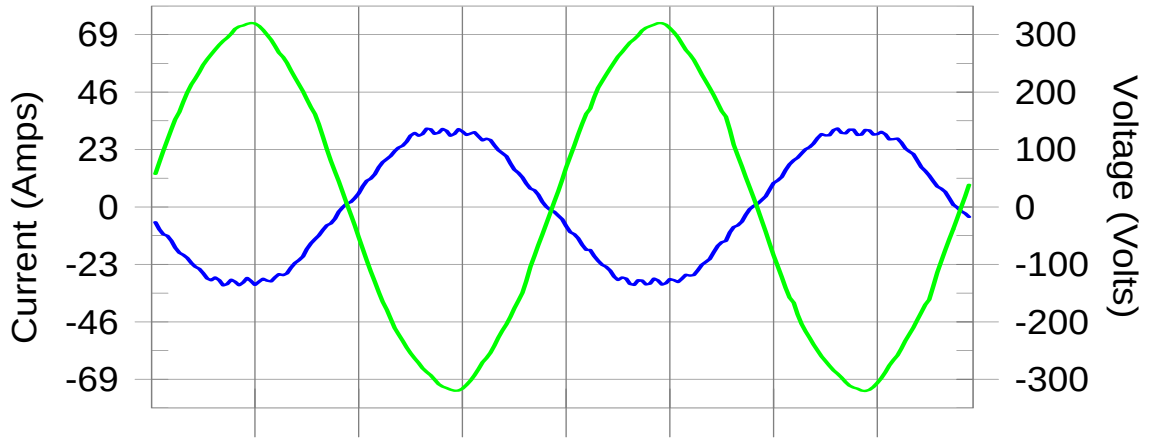
Harmonics of the fundamental current were measured up to 40 order harmonics using a digital power meter with an analogue output and frequency analyser which was integrated in the harmonic & flicker test system. The measurements were carried out under steady conditions.

☐ This product is not defined as lighting equipment, and has rated power less than 75W, therefore, no limit apply according to EN 61000-3-2.

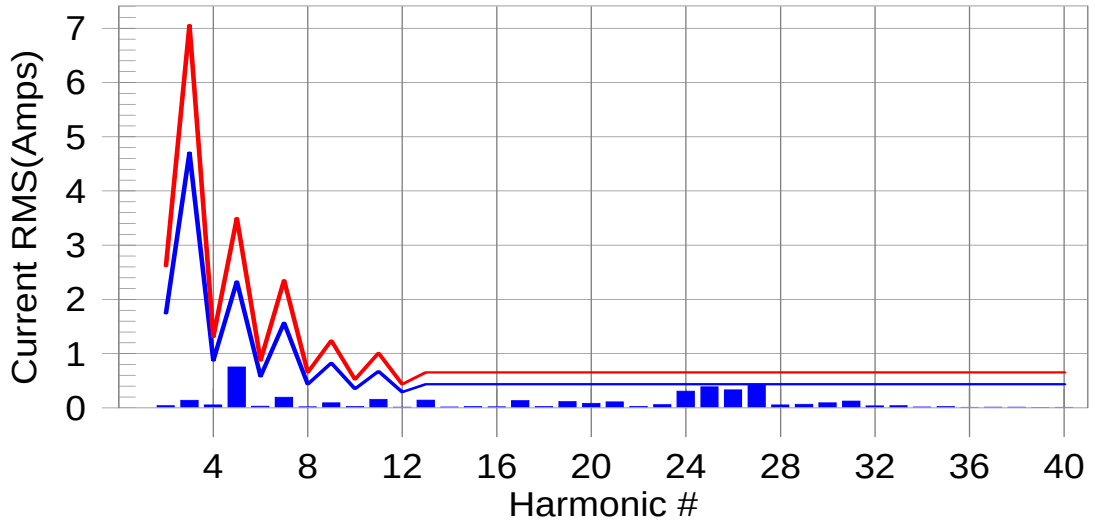
4.6.4 Test Data

Harmonics – Per EN/IEC61000-3-12(Phase A-Run time)

Current & voltage waveforms



Harmonics and Class 2 limit line **European Limits**



Test result: Pass **Worst harmonic was #5 with 32.35 % of the limit.**

Current Test Result Summary (Phase A-Run time)

I-THD(%): 4.602 **Limit(%): 23.000** **PWHD(%): 13.753** **PWHD Limit(%): 23.000**

Highest parameter values during test:

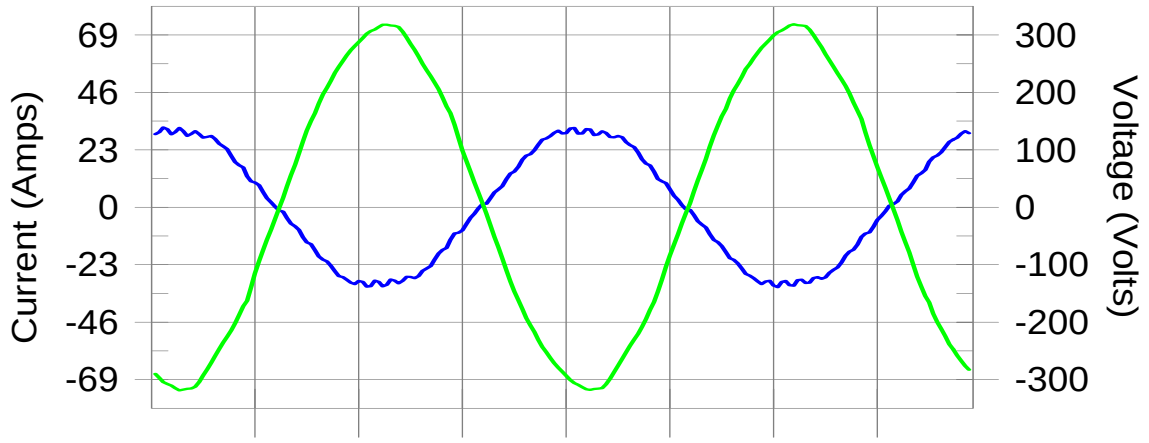
V_RMS (Volts):	222.70	Frequency(Hz):	49.99
I_Peak (Amps):	32.982	I_RMS (Amps):	22.373
I_1-Ref (Amps):	21.836	Crest Factor:	1.480
Power (Watts):	-4940	Power Factor:	-0.998

Harm#	Harms(avg)	100%Limit	%of Limit	Harms(max)	150%Limit	%of Limit	Status
2	0.027	1.744	1.5	0.040	2.616	1.52	Pass
3	0.130	4.708	2.8	0.140	7.062	1.99	Pass
4	0.047	0.872	5.4	0.056	1.308	4.24	Pass
5	0.745	2.332	31.9	0.756	3.498	21.62	Pass
6	0.024	0.581	4.1	0.032	0.872	3.68	Pass
7	0.185	1.569	11.8	0.197	2.354	8.36	Pass
8	0.016	0.436	3.7	0.020	0.654	3.11	Pass
9	0.083	0.828	10.0	0.094	1.242	7.60	Pass
10	0.021	0.349	5.9	0.023	0.523	4.49	Pass
11	0.139	0.676	20.5	0.159	1.014	15.71	Pass
12	0.011	0.291	3.6	0.014	0.436	3.21	Pass
13	0.129	0.436	29.5	0.143	0.654	21.84	Pass
14	0.015	N/A	N/A	0.018	N/A	N/A	N/A
15	0.021	N/A	N/A	0.025	N/A	N/A	N/A
16	0.016	N/A	N/A	0.019	N/A	N/A	N/A
17	0.124	N/A	N/A	0.134	N/A	N/A	N/A
18	0.014	N/A	N/A	0.026	N/A	N/A	N/A
19	0.111	N/A	N/A	0.119	N/A	N/A	N/A
20	0.038	N/A	N/A	0.085	N/A	N/A	N/A
21	0.097	N/A	N/A	0.112	N/A	N/A	N/A
22	0.020	N/A	N/A	0.029	N/A	N/A	N/A
23	0.052	N/A	N/A	0.060	N/A	N/A	N/A
24	0.115	N/A	N/A	0.309	N/A	N/A	N/A
25	0.342	N/A	N/A	0.388	N/A	N/A	N/A
26	0.129	N/A	N/A	0.333	N/A	N/A	N/A
27	0.377	N/A	N/A	0.429	N/A	N/A	N/A
28	0.032	N/A	N/A	0.054	N/A	N/A	N/A
29	0.061	N/A	N/A	0.066	N/A	N/A	N/A
30	0.038	N/A	N/A	0.094	N/A	N/A	N/A
31	0.111	N/A	N/A	0.127	N/A	N/A	N/A
32	0.021	N/A	N/A	0.038	N/A	N/A	N/A
33	0.037	N/A	N/A	0.042	N/A	N/A	N/A
34	0.014	N/A	N/A	0.017	N/A	N/A	N/A
35	0.021	N/A	N/A	0.024	N/A	N/A	N/A
36	0.007	N/A	N/A	0.011	N/A	N/A	N/A
37	0.012	N/A	N/A	0.014	N/A	N/A	N/A
38	0.013	N/A	N/A	0.014	N/A	N/A	N/A
39	0.006	N/A	N/A	0.009	N/A	N/A	N/A
40	0.007	N/A	N/A	0.012	N/A	N/A	N/A

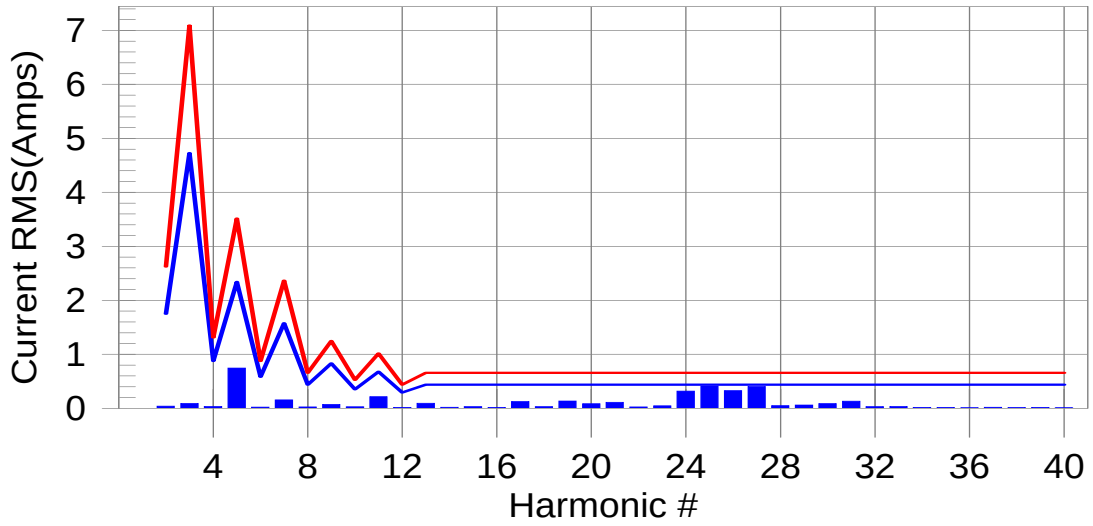
Note: Measured reference fundamental current limits were applied for this test.

Harmonics – Per EN/IEC61000-3-12(Phase B-Run time)

Current & voltage waveforms



Harmonics and Class 2 limit line **European Limits**



Test result: Pass **Worst harmonic was #5 with 31.78 % of the limit.**

Current Test Result Summary (Phase B-Run time)

I-THD(%): 4.497 **Limit(%): 23.000** **PWHD(%): 13.689** **PWHD Limit(%): 23.000**

Highest parameter values during test:

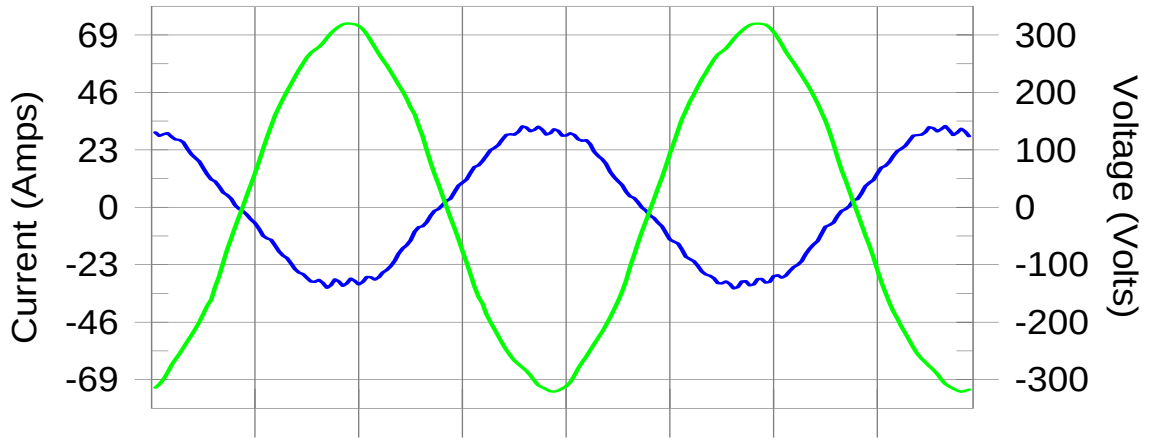
V_RMS (Volts):	222.45	Frequency(Hz):	49.99
I_Peak (Amps):	33.647	I_RMS (Amps):	22.451
I_1-Ref (Amps):	21.921	Crest Factor:	1.504
Power (Watts):	-4964	Power Factor:	-0.998

Harm#	Harms(avg)	100%Limit	%of Limit	Harms(max)	150%Limit	%of Limit	Status
2	0.024	1.751	1.4	0.039	2.627	1.49	Pass
3	0.083	4.728	1.7	0.091	7.093	1.29	Pass
4	0.025	0.876	2.9	0.035	1.313	2.68	Pass
5	0.733	2.342	31.3	0.747	3.513	21.26	Pass
6	0.015	0.584	2.5	0.023	0.876	2.66	Pass
7	0.139	1.576	8.8	0.156	2.364	6.60	Pass
8	0.021	0.438	4.8	0.026	0.657	3.97	Pass
9	0.062	0.832	7.4	0.073	1.248	5.87	Pass
10	0.024	0.350	7.0	0.028	0.525	5.36	Pass
11	0.195	0.679	28.7	0.216	1.018	21.23	Pass
12	0.012	0.292	4.2	0.015	0.438	3.49	Pass
13	0.078	0.438	17.9	0.095	0.657	14.49	Pass
14	0.018	N/A	N/A	0.021	N/A	N/A	N/A
15	0.029	N/A	N/A	0.033	N/A	N/A	N/A
16	0.013	N/A	N/A	0.017	N/A	N/A	N/A
17	0.123	N/A	N/A	0.126	N/A	N/A	N/A
18	0.015	N/A	N/A	0.030	N/A	N/A	N/A
19	0.124	N/A	N/A	0.136	N/A	N/A	N/A
20	0.036	N/A	N/A	0.086	N/A	N/A	N/A
21	0.099	N/A	N/A	0.113	N/A	N/A	N/A
22	0.018	N/A	N/A	0.026	N/A	N/A	N/A
23	0.038	N/A	N/A	0.048	N/A	N/A	N/A
24	0.124	N/A	N/A	0.319	N/A	N/A	N/A
25	0.363	N/A	N/A	0.414	N/A	N/A	N/A
26	0.126	N/A	N/A	0.328	N/A	N/A	N/A
27	0.356	N/A	N/A	0.405	N/A	N/A	N/A
28	0.031	N/A	N/A	0.050	N/A	N/A	N/A
29	0.056	N/A	N/A	0.063	N/A	N/A	N/A
30	0.038	N/A	N/A	0.089	N/A	N/A	N/A
31	0.115	N/A	N/A	0.131	N/A	N/A	N/A
32	0.017	N/A	N/A	0.030	N/A	N/A	N/A
33	0.029	N/A	N/A	0.034	N/A	N/A	N/A
34	0.012	N/A	N/A	0.015	N/A	N/A	N/A
35	0.016	N/A	N/A	0.019	N/A	N/A	N/A
36	0.009	N/A	N/A	0.012	N/A	N/A	N/A
37	0.015	N/A	N/A	0.019	N/A	N/A	N/A
38	0.012	N/A	N/A	0.014	N/A	N/A	N/A
39	0.012	N/A	N/A	0.015	N/A	N/A	N/A
40	0.009	N/A	N/A	0.011	N/A	N/A	N/A

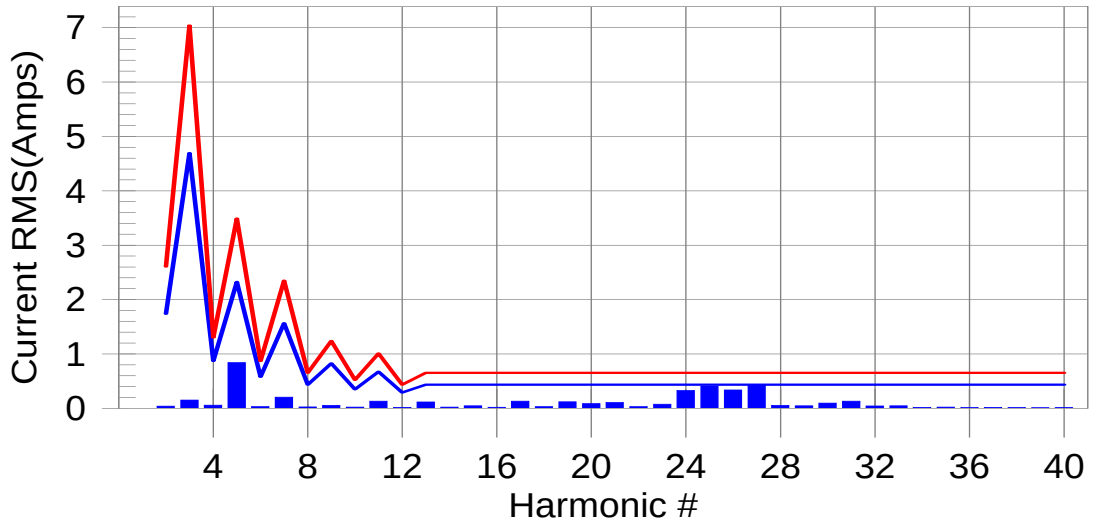
Note: Measured reference fundamental current limits were applied for this test.

Harmonics – Per EN/IEC61000-3-12(Phase C-Run time)

Current & voltage waveforms



Harmonics and Class 2 limit line **European Limits**



Test result: Pass **Worst harmonic was #5 with 35.82 % of the limit.**

Current Test Result Summary (Phase C-Run time)

I-THD(%): 4.914 Limit(%): 23.000 PWHD(%): 14.352 PWHD Limit(%): 23.000

Highest parameter values during test:

V_RMS (Volts):	225.21	Frequency(Hz):	49.99
I_Peak (Amps):	33.100	I_RMS (Amps):	22.300
I_1-Ref (Amps):	21.766	Crest Factor:	1.487
Power (Watts):	-4976	Power Factor:	-0.997

Harm#	Harms(avg)	100%Limit	%of Limit	Harms(max)	150%Limit	%of Limit	Status
2	0.025	1.739	1.5	0.040	2.608	1.52	Pass
3	0.143	4.694	3.0	0.151	7.041	2.15	Pass
4	0.047	0.869	5.5	0.059	1.304	4.50	Pass
5	0.819	2.325	35.2	0.839	3.488	24.06	Pass
6	0.024	0.580	4.1	0.033	0.869	3.77	Pass
7	0.195	1.565	12.5	0.207	2.347	8.81	Pass
8	0.023	0.435	5.2	0.027	0.652	4.12	Pass
9	0.041	0.826	5.0	0.053	1.239	4.28	Pass
10	0.019	0.348	5.4	0.023	0.522	4.33	Pass
11	0.100	0.674	14.9	0.131	1.011	12.95	Pass
12	0.012	0.290	4.2	0.015	0.435	3.45	Pass
13	0.108	0.435	24.9	0.118	0.652	18.04	Pass
14	0.018	N/A	N/A	0.022	N/A	N/A	N/A
15	0.044	N/A	N/A	0.048	N/A	N/A	N/A
16	0.016	N/A	N/A	0.019	N/A	N/A	N/A
17	0.122	N/A	N/A	0.131	N/A	N/A	N/A
18	0.016	N/A	N/A	0.032	N/A	N/A	N/A
19	0.111	N/A	N/A	0.119	N/A	N/A	N/A
20	0.037	N/A	N/A	0.088	N/A	N/A	N/A
21	0.096	N/A	N/A	0.109	N/A	N/A	N/A
22	0.020	N/A	N/A	0.030	N/A	N/A	N/A
23	0.065	N/A	N/A	0.076	N/A	N/A	N/A
24	0.123	N/A	N/A	0.330	N/A	N/A	N/A
25	0.363	N/A	N/A	0.412	N/A	N/A	N/A
26	0.135	N/A	N/A	0.339	N/A	N/A	N/A
27	0.389	N/A	N/A	0.440	N/A	N/A	N/A
28	0.034	N/A	N/A	0.053	N/A	N/A	N/A
29	0.038	N/A	N/A	0.047	N/A	N/A	N/A
30	0.038	N/A	N/A	0.096	N/A	N/A	N/A
31	0.117	N/A	N/A	0.133	N/A	N/A	N/A
32	0.020	N/A	N/A	0.044	N/A	N/A	N/A
33	0.040	N/A	N/A	0.048	N/A	N/A	N/A
34	0.015	N/A	N/A	0.019	N/A	N/A	N/A
35	0.018	N/A	N/A	0.021	N/A	N/A	N/A
36	0.010	N/A	N/A	0.014	N/A	N/A	N/A
37	0.016	N/A	N/A	0.019	N/A	N/A	N/A
38	0.011	N/A	N/A	0.014	N/A	N/A	N/A
39	0.010	N/A	N/A	0.012	N/A	N/A	N/A
40	0.009	N/A	N/A	0.014	N/A	N/A	N/A

Note: Measured reference fundamental current limits were applied for this test.

4.6.5 Measurement Uncertainty

The measurement uncertainty for harmonic test is under consideration according to CISPR 16-4-2:2003.

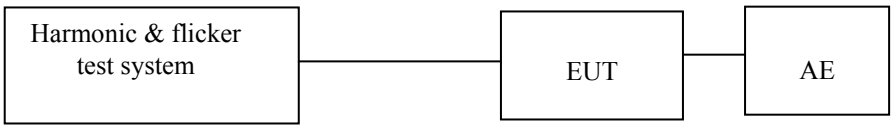
4.7 Flicker

Test Result: Pass

4.7.1 Used Test Equipment

Equip. No.	Equipment	Model	Manufacturer
1305A02873	45KVA AC Power source	NSG 1007-45/45KVA	Teseq
1305A02873	Signal conditioning Unit	CCN 1000-3	Teseq
1305A02873	Three phase impedance network	INA2197/37A	Teseq
1305A02874	Three phase impedance network	INA 2196/75A	Teseq
A22714	Profline 2100 AC Switching Unit	NSG2200-3	Teseq

4.7.2 Block Diagram of Test Setup



4.7.3 Test Setup and Procedure

4.7.3.1 Definition

Flicker: impression of unsteadiness of visual sensation induced by a lighting stimulus whose luminance or spectral distribution fluctuates with time.

Pst: Short-term flicker indicator The flicker severity evaluated over a short period (in minutes); Pst=1 is the conventional threshold of irritability

Plt: long-term flicker indicator; the flicker severity evaluated over a long period (a few hous). Using successive Pst valuse.

dc: the relative steady-state voltage change

dmax: the maximum relative voltage change

d(t): the value during a voltage change

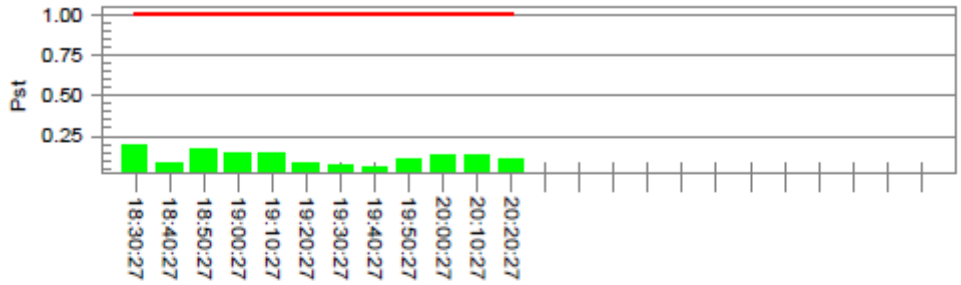
4.7.3.2 Test condition

The EUT was set to produce the most unfavourable sequence of voltage changes.

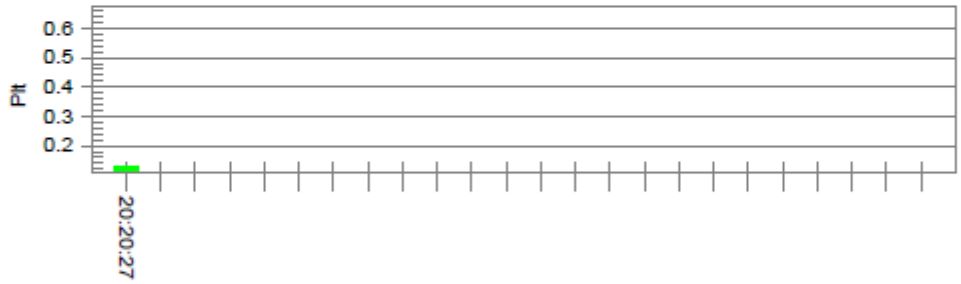
4.7.4 Test Data

Flicker Test Summary per EN/IEC61000-3-11 (Phase A-Run time)

Pst, and limit line European Limits



Plt and limit line

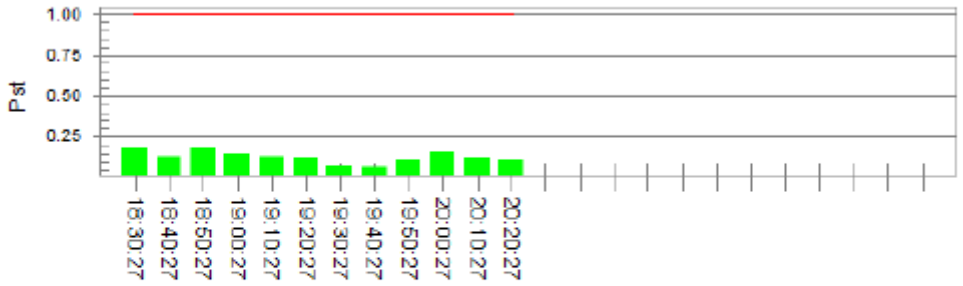


Parameter values recorded during the test:

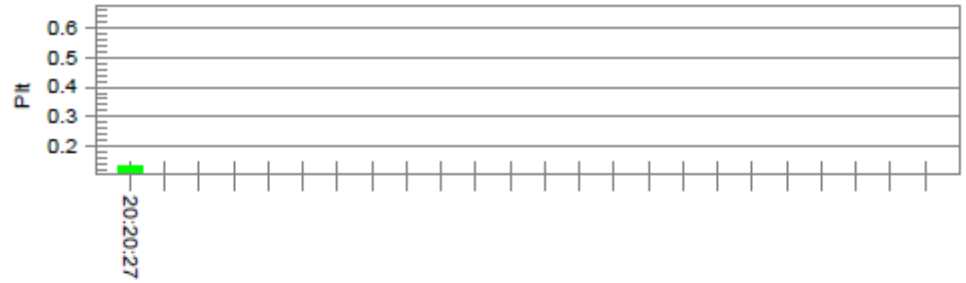
Vrms at the end of test (Volt):	228.80			
Highest dt (%):	0.96	Test limit (%):	3.30	Pass
Time(mS) > dt:	0.0	Test limit (mS):	500.0	Pass
Highest dc (%):	0.75	Test limit (%):	3.30	Pass
Highest dmax (%):	0.95	Test limit (%):	6.00	Pass
Highest Pst (10 min. period):	0.192	Test limit:	1.000	Pass
Highest Plt (2 hr. period):	0.132	Test limit:	0.650	Pass

Flicker Test Summary per EN/IEC61000-3-11 (Phase B-Run time)

Pst_t and limit line **European Limits**



Plt and limit line

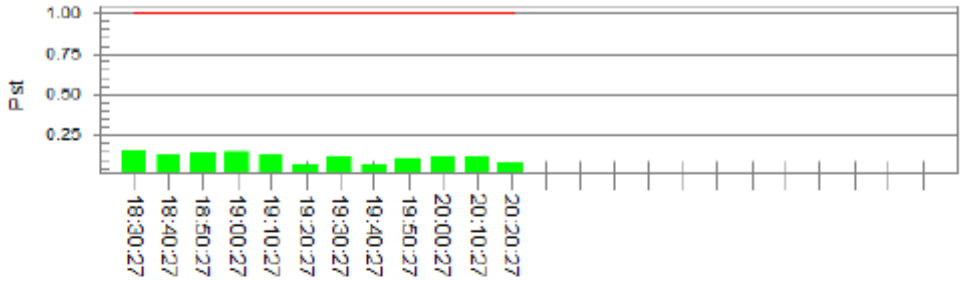


Parameter values recorded during the test:

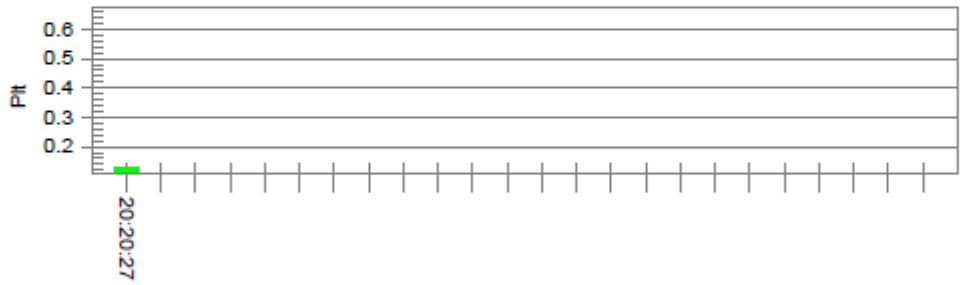
Vrms at the end of test (Volt):	229.75			
Highest dt (%):	0.98	Test limit (%):	3.30	Pass
Time(mS) > dt:	0.0	Test limit (mS):	500.0	Pass
Highest dc (%):	0.75	Test limit (%):	3.30	Pass
Highest dmax (%):	1.01	Test limit (%):	6.00	Pass
Highest Pst (10 min. period):	0.193	Test limit:	1.000	Pass
Highest Plt (2 hr. period):	0.134	Test limit:	0.650	Pass

Flicker Test Summary per EN/IEC61000-3-11 (Phase C-Run time)

Pst, and limit line European Limits



Plt and limit line



Parameter values recorded during the test:

Vrms at the end of test (Volt):	230.11			
Highest dt (%):	0.88	Test limit (%):	3.30	Pass
Time(mS) > dt:	0.0	Test limit (mS):	500.0	Pass
Highest dc (%):	0.72	Test limit (%):	3.30	Pass
Highest dmax (%):	0.91	Test limit (%):	6.00	Pass
Highest Pst (10 min. period):	0.188	Test limit:	1.000	Pass
Highest Plt (2 hr. period):	0.130	Test limit:	0.650	Pass

4.7.5 Measurement Uncertainty

Measurement uncertainty for voltage fluctuation and flicker is under consideration according to CISPR 16-4-2:2003.

5 EMS TEST

Performance Criteria:

Criterion A:	The apparatus shall continue to operate as intended during the test. No degradation of performance or loss of function is allowed below a performance level (or permission loss of performance) specified by the manufacturer, when the apparatus is used as intended. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be derived from the product description and documentation and from what the user may reasonably expect from the apparatus if used as intended.
Criterion B:	The apparatus shall continue to operate as intended after the test. No degradation of performance or loss of function is allowed below a performance level (or permission loss of performance) specified by the manufacturer, when the apparatus is used as intended. During the test, degradation of performance is allowed, however, no change of actual operating state or stored data is allowed. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be derived from the product description, and documentation, and from what the user may reasonably expect from the apparatus if used as intended.
Criterion C:	Temporary loss of function is allowed, provided the function is self-recoverable or can be restored by the operation of the controls, or by any operation specified in the instruction for use.

Measurement Uncertainty
According to CISPR 16-4-2:2003, measurement uncertainty to immunity test is under consideration.

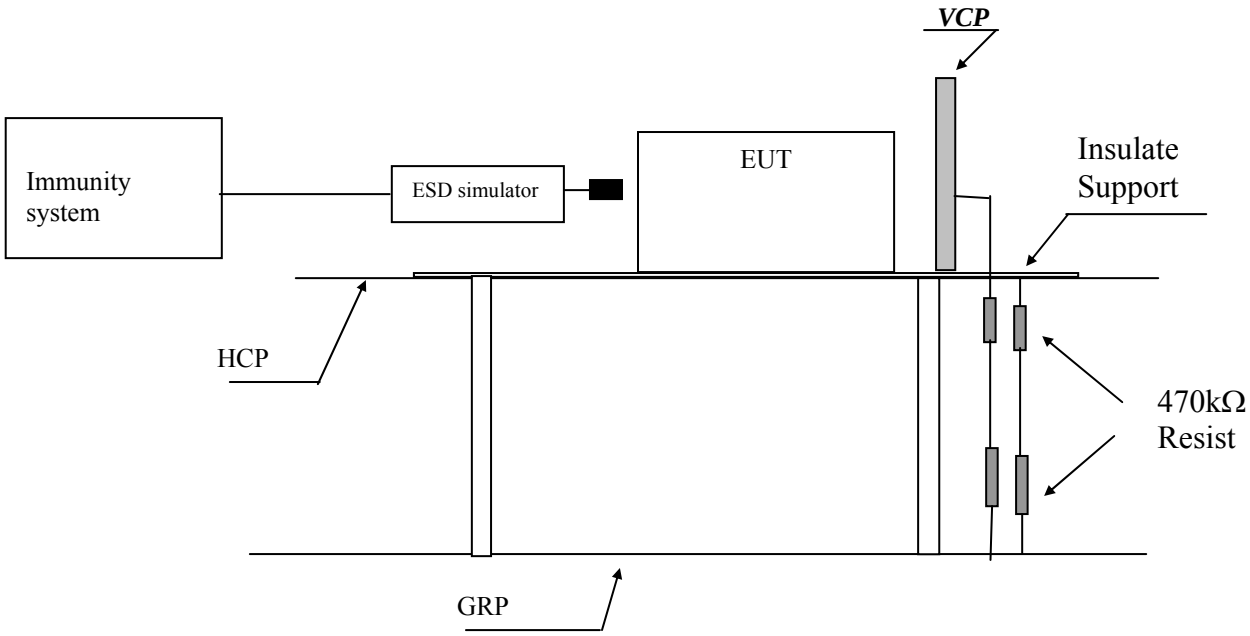
5.1 Electrostatic Discharge Immunity

Tested Port: Enclosure
Performance criterion: B
Test Result: Pass

5.1.1 Used Test Equipment

Equip. No.	Equipment	Model	Manufacturer
130	ESD Tester	NSG 438A	TESEQ AG
403-550/1712	Impulse Module	INA 4380-150pF/330Ohm	TESEQ AG

5.1.2 Block Diagram of Test Setup



Note: HCP means Horizontal Coupling Plane,
VCP means Vertical Coupling Plane
GRP means Ground Reference Plane

5.1.3 Test Setup and Procedure

The EUT was put on a 0.8m high wooden tabel/0.1m high for floor standing equipment standing on the ground reference plane(GRP) 3m by 2m in size, made by iron 1.0 mm thick.

A horizontal coupling plane(HCP) 1.6m by 0.8m in size was placed on the table, and the EUT with its cables were isolated from the HCP by an insulating support thick than 0.5mm. The VCP 0.5m by 0.5m in size & HCP were constructed from the same material type & thinkmess as that of the GRP, and connected to the GRP via a 470kΩ resistor at each end.

The distance between EUT and any of the other metallic surface excepted the GRP, HCP & VCP was greater than 1m.

The EUT was arranged and connected according to its functional requirements.
The EUT was arranged and connected according to its functional requirements

Direct static electricity discharges was applied only to those points and surface which are accessible to personnel during normal usage.

Test voltage was increased from the minimum to the selected test level and with single discharge.

On each preselected points 10 times of each polarity single discharge were applied The time interval between successive single discharges is 1s.

The ESD generator was held perpendicular to the surface to which the discharge is applied. The discharge return cable of the generator was kept at a distance of 0.2m whilst the discharge is being applied. During the contact discharges, the tip of the discharge electrode was touch the EUT before the discharge switch is operated. During the air discharges, the round discharge tip of the discharge electrode was approached as fast as possible to touch the EUT.

Indirect discharge was conducted to objects placed near the EUT, simulated by applying the dischares of the ESD generator to a coupling plane, in the contact discharge mode.

After each discharge, the ESD generator was removed from the EUT, the generator is then retriggered for a new single discharge. For ungrounded product, a grounded carbon fibre brush with bleeder resistors (2×470 kΩ) in the grounding cable was used after each discharge to remove remnant electrostatic voltage.

10 times of each polarity single discharge were applied to HCP and VCP. The detail selected points are listed in the following table.

5.1.4 Test Result

Direct Application of ESD

Direct Contact Discharge

Applied Voltage (kV)	No. of Discharge for each point	Discharged Points	Result
4	20	Accessible metal parts of the EUT Conductive substrate with coating which is not declared to be insulating	Pass

Direct Air Discharge

Applied Voltage (kV)	No. of Discharge for each point	Discharged Points	Result
8	20	All accessible points where contact discharge cannot be applied such as Displays, Indicators light, Keyboard, Button, Switch, Knob, Air gap, Slots, Hole and so on	Pass

Indirect Application of ESD

Horizontal Coupling Plane under the EUT

Applied Voltage (kV)	No. of Discharge for each point	Discharged Point	Result
4	20	At the front edge of each HCP opposite the centre point of each unit of the EUT	Pass

Vertical Coupling Plane beside the EUT

Applied Voltage (kV)	No. of Discharge for each point	Discharged Point	Result
4	20	The centre of the vertical edge of the coupling plane	Pass

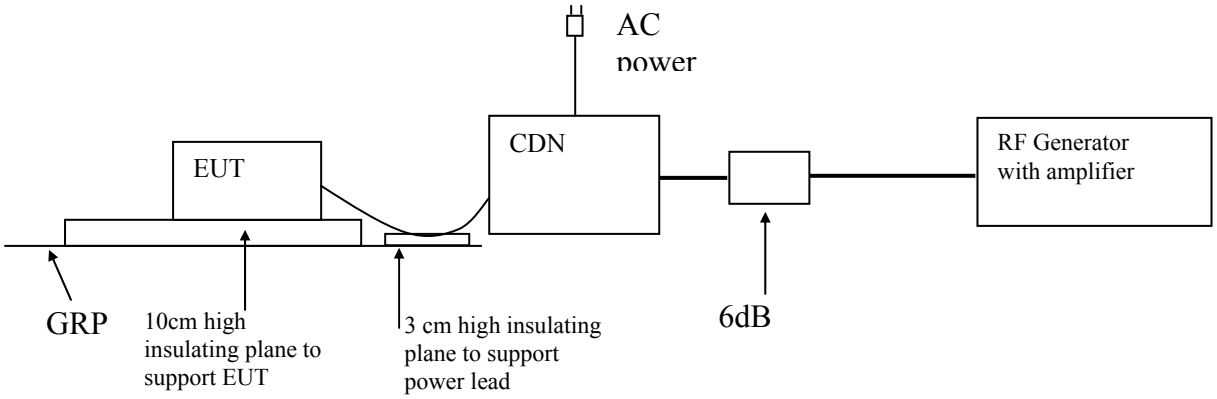
5.2 Injected Current (0.15 MHz to 80 MHz)

Tested Port: ☒ AC power ☒ DC power ☐Signal/Control
Performance criterion: A
Test Result: Pass

5.2.1 Used Test Equipment

Equip. No.	Equipment	Model	Manufacturer
0900-12	Simulator	CWS500C	EMTEST
33799	CDN	CDN M532S	TESEQ AG
368	Injection Clamp	F-2031-23MM	EMTEST
0010222A	Attenuator	ATT6	EMTEST
Ec3043-4	CDN	CDN T4	EM TEST

5.2.2 Block Diagram of Test Setup



5.2.3 Test Setup and Procedure

The EUT was placed on an insulating support of 0.1m height above a ground reference Plane, arranged and connected to satisfy its functional requirement.
All relevant cables were provided with the appropriate coupling and decoupling devices at a distance between 0.1m and 0.3m from the projected geometry of the EUT on an insulating support of 0.03m height above the ground reference plane.
Test voltage was verified before each testing though power meter combined in the RF generator with AMP.
Dwell time was set to 3s and step was set as 1% to keep sufficient response time for EUT. The frequency from 0.15MHz to 80MHz was checked.

5.2.4 Test Result

Port	Frequency (MHz)	Level	Result
A.C. Power Lines	0.15 to 80	3V (r.m.s.)	Pass
D.C. Power Lines	0.15 to 80	3V (r.m.s.)	Pass
Signal/Control Lines	0.15 to 80	3V (r.m.s.)	N/A

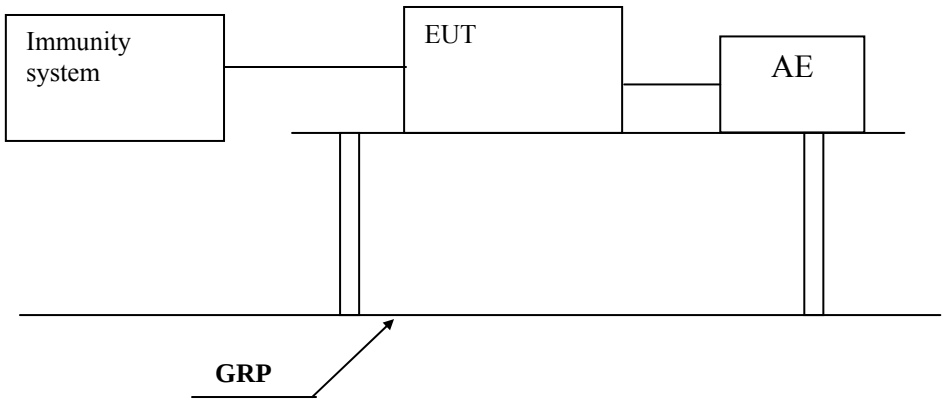
5.3 Electrical Fast Transient/Burst

Tested Port: ☒ AC power ☒ DC power ☐Signal/Control
Performance criterion: B
Test Result: Pass

5.3.1 Used Test Equipment

Equip. No.	Equipment	Model	Manufacturer
080981-16	Burst Tester	PEFT4010	HAEFELY
147147	Coupling Clamp	IP-4A	HAEFELY

5.3.2 Block Diagram of Test Setup



5.3.3 Test Setup and Procedure

The EUT was placed on a 0.1m high wooden table, standing on the ground reference plane 3m by 2m in size, made by steel 1mm thick.

The distance between the EUT and any other of the metallic surface except the GRP is greater than 0.5m.

The mains lead excess than 0.5m is folded to avoid a flat coil and situated at a distance of 0.1m above the ground reference plane to insure the distance between the coupling device and the EUT were 0.5m.

The EUT was arranged and connected to satisfy its functional requirement and supplied by the coupling-decoupling network.

5.3.4 Test Result

Port	Level	Result
A.C. Power Lines	1kV(Repetition frequency=5KHz, Tr/Th=5ns/50ns)	Pass
D.C. Power Lines	0.5kV(Repetition frequency=5KHz, Tr/Th=5ns/50ns)	Pass
Signal/Control Lines	0.5kV(Repetition frequency=5KHz, Tr/Th=5ns/50ns)	N/A

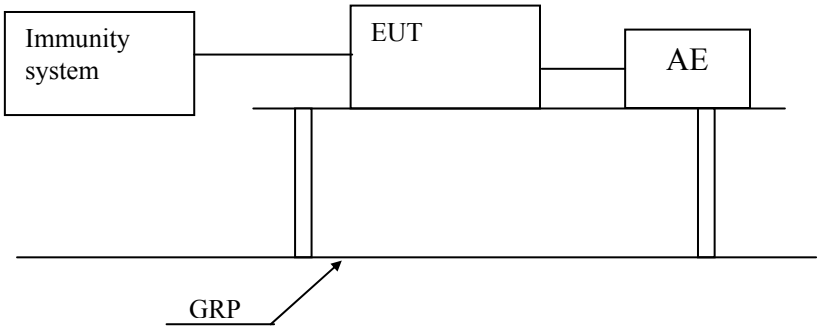
5.4 Surge Immunity

Tested Port: ☒ AC power ☐ DC power
Performance criterion: B
Test Result: Pass

5.4.1 Used Test Equipment

Equip. No.	Equipment	Model	Manufacturer
174031	Surge Controller	Psurge 8000	HAEFELY
174124	Impulse Module	PIM 100	HAEFELY
172181	Coupling Decoupling Filter	PCD 130	HAEFELY

5.4.2 Block Diagram of Test Setup



5.4.3 Test Setup and Procedure

The surge is to be applied to the EUT power supply terminals via the capacitive coupling network.

Decoupling networks are required in order to avoid possible adverse effects on equipment not under test that may be powered by the same lines and to provide sufficient decoupling impedance to the surge wave so that the specified wave may be developed on the lines under test.

The EUT was arranged and connected according to its functional requirements
The EUT was placed on a 0.1m high wooden support above the GRP, supplied by the coupling-decoupling network, and arranged and connected to satisfy its functional requirement and the power cord between the EUT and the coupling/decoupling network was less than 2 meters.

Surge is applied to the EUT power supply terminals.

5.4.4 Test Result

Tested Port	Level	Result
AC power	Line to line ±1 kV (Tr/Th= 8μs/20μs)	Pass
AC power	Line to earth ±2kV (Tr/Th= 1.2μs/50μs)	Pass
DC power	Line to line ±0.5kV (Tr/Th= 8μs/20μs)	N/A
DC power	Line to earth ±0.5kV (Tr/Th= 1.2μs/50μs)	N/A

5.5 Voltage Dips and Interruptions

Tested Port: AC power
Performance criterion: B (for test level of 0%Ut with 0.5/1 cycles), C (for test level of 70%Ut or 0%Ut with 25 cycles at 50Hz, as well as 30 cycles at 60Hz)
Test Result: Not Applicable
Remark: The rated current is greater than 16A/phase.

5.6 Radiated Electromagnetic Field Immunity

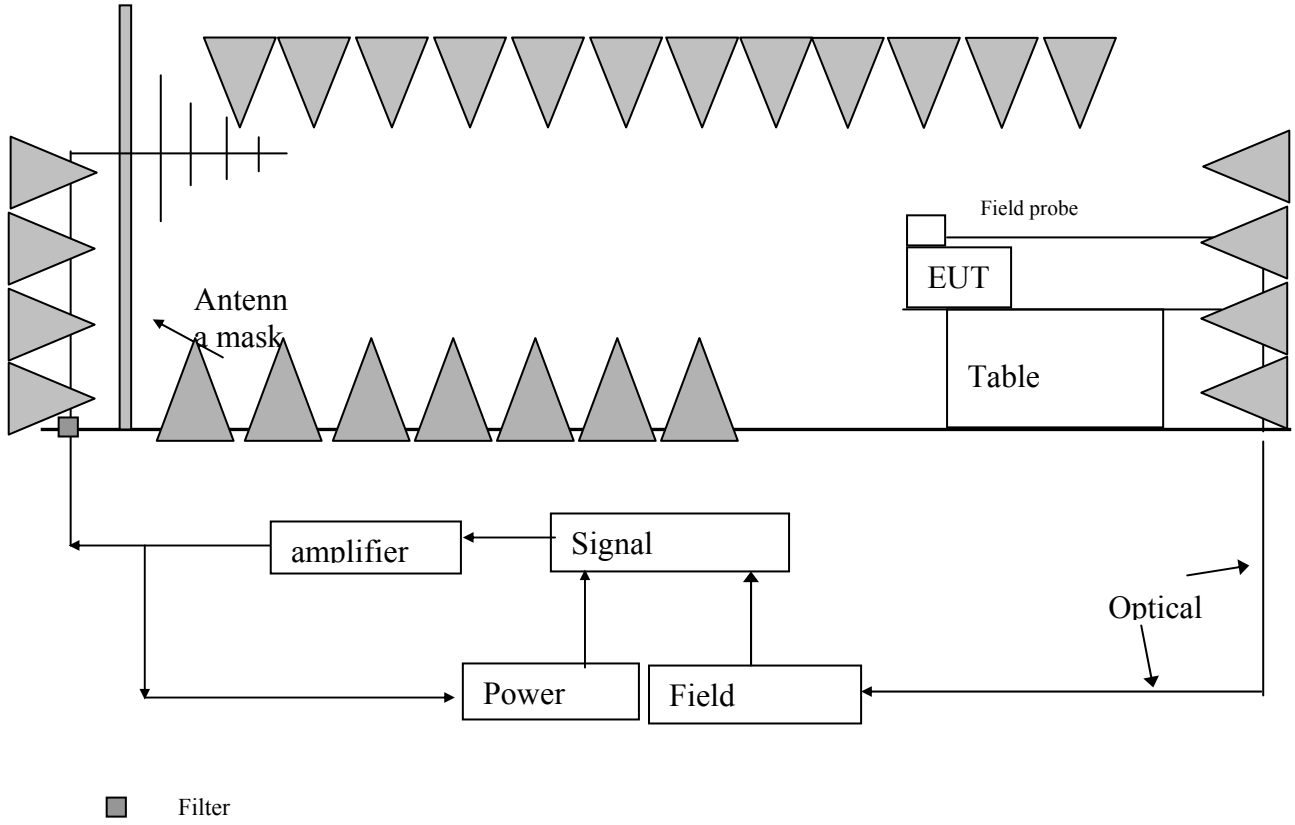
Tested Port: Enclosure
Performance criterion: A
Test Result: Pass

5.6.1 Used Test Equipment

Equipment No.	Equipment	Model	Manufacturer
10539	RF Power Meter. Dual Channel	4232A	BOONTON
34236/34238	50ohm Diode Power Sensor	51011EMC	BOONTON
332	Broad-Band Horn Antenna	BBHA 9120 L3F	SCHWARZBECK

N/A	Power Amplifier	AP32MT215	PRANA
N/A	Power Amplifier	AS0102-55	MILMEGA
N/A	Signal Generator	2023B	AEROFLEX
N/A	Log.-Per. Antenna	VULP 9118E	SCHWARZBECK

5.6.2 Block Diagram of Test Setup



5.6.3 Test Setup and Procedure

The test was conducted in an fully anechoic chamber to maintain a uniform field of sufficient dimensions with respect to the EUT, and also in order to comply with various national and international laws prohibiting interference to radio communications.
The equipment is placed in the test facility on a non-conducting table 0.8m high (for floor standing EUT, is placed on a non-conducting support 0.1m height).
The EUT was placed on the uniform calibrated plane which is 10V/m, 3V/m and 1V/m EM field.
For all ports connected to EUT, manufacturer specified cable type and length was used, for those cables no specification, unshielded cable applied.
Wire is left exposed to the electromagnetic field for a distance of 1m from the EUT.
The EUT was arranged and connected according to its functional requirements
Before testing, the intensity of the established field strength have been checked by placing the field sensor at a calibration grid point, and with the field generating antenna and cables in the

same positions as used for the calibration, the forward power needed to give the calibrated field strength was measured.
Spot checks was made at a number of calibration grid points over the frequency range 80 to 1000MHz and 1.4 to 2.7 GHz, both polarizations was checked.
After calibration, the EUT is initially placed with one face coincident with the calibration plane. The frequency range is swept from 80 to 1000MHz and 1.4 to 2.7 GH, with the signal 80% amplitude modulated with a 1 kHz sinewave, pausing to adjust the r.f. signal level.
The dwell time at each frequency was 3s so as that the EUT to be exercised and be able to respond.
The step size was 1% of the fundamental with linear interpolation between calibrated points.
Test was performed with the generating antenna facing each of the four sides of the EUT.

5.6.4 Test Result

Frequency (MHz)	Exposed Side	Field Strength (V/m)	Result
80 to 1000	Front	3V/m (r.m.s.)	Pass
80 to 1000	Left	3V/m (r.m.s.)	Pass
80 to 1000	Rear	3V/m (r.m.s.)	Pass
80 to 1000	Right	3V/m (r.m.s.)	Pass

Frequency (GHz)	Exposed Side	Field Strength (V/m)	Result
1.4 to 2.0	Front	3V/m (r.m.s.)	Pass
1.4 to 2.0	Left	3V/m (r.m.s.)	Pass
1.4 to 2.0	Rear	3V/m (r.m.s.)	Pass
1.4 to 2.0	Right	3V/m (r.m.s.)	Pass

Frequency (GHz)	Exposed Side	Field Strength (V/m)	Result
2.0 to 2.7	Front	1V/m (r.m.s.)	Pass
2.0 to 2.7	Left	1V/m (r.m.s.)	Pass
2.0 to 2.7	Rear	1V/m (r.m.s.)	Pass
2.0 to 2.7	Right	1V/m (r.m.s.)	Pass

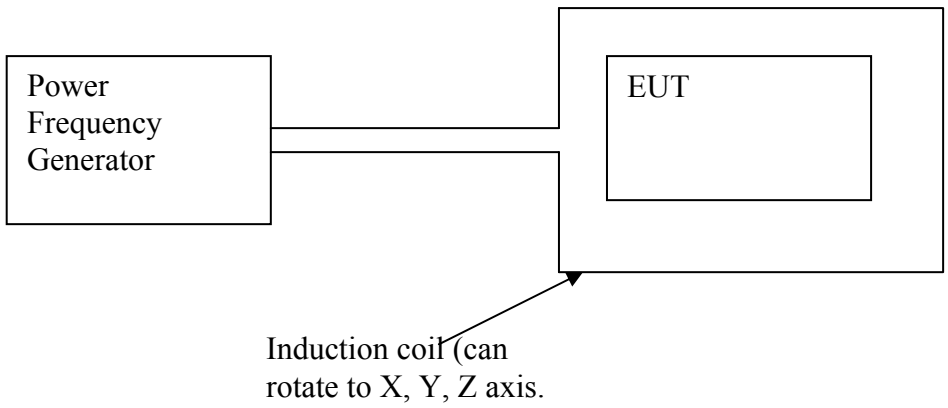
5.7 Power Frequency Magnetic Field Immunity

Tested Port: Enclosure
Performance criterion: A
Test Result: Pass

5.7.1 Used Test Equipment

Equipment No.	Equipment	Model	Manufacturer
250040.1	Magnetic Field Tester	MAG100	HAEFELY

5.7.2 Block Diagram of Test Setup



5.7.3 Test Setup and Procedure

Put EUT into center of induction coil(with suitable dimensions) in the testing.
For tabletop equipment:
The EUT was placed on a big enough wooden desk with height of 0.8m and operating as intended.
The equipment shall be subjected to the test magnetic field by using the induction coil of standards(1m*1m).
The induction coil shall be rotated by 90^0in order to expose the EUT to the test field with different orientations.
For Floor-standing equipment:
The EUT was placed on big enough wooden desk with height of 0.1m and operating as intended.
The equipment shall be subjected to the test magnetic field by using induction coils of suitable dimensions ; the test shall be repeated by moving and shifting the induction coils, in order to test the whole volume of the EUT for each orthogonal direction. The test shall be repeated with the coil shifted to different position along the side of the EUT, in steps corresponding to 50% of the shortest side of the coil.
The induction coil shall then be rotated by 90^0 in order to expose the EUT to the test field with different orientations and the same procedure followed.

5.7.4 Test Result

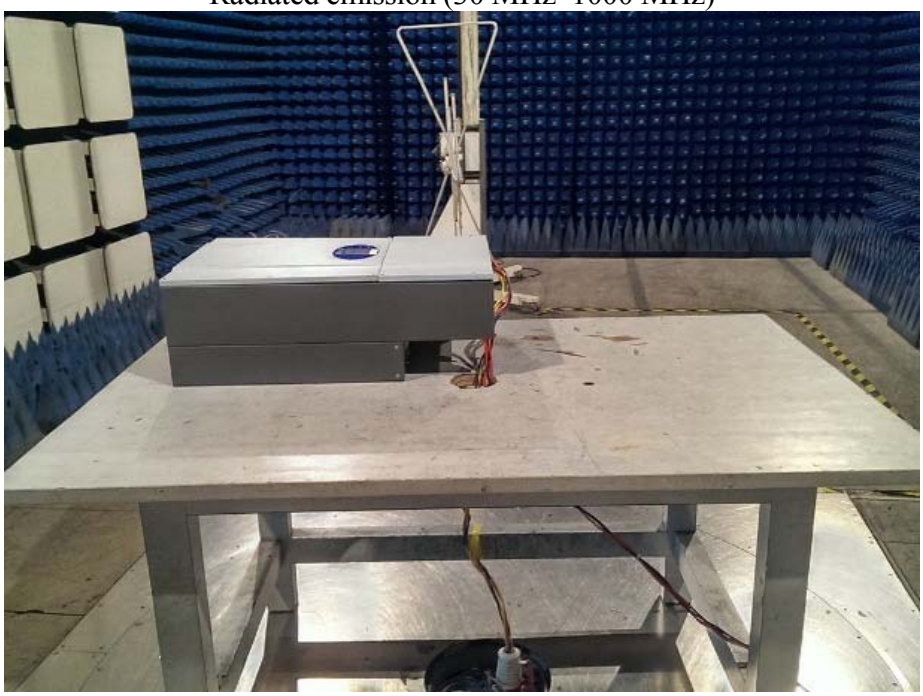
Mains frequency: ☒ 50Hz ☐ 60Hz

Orientations of induction coil	Magnetic Field Strength (A/m)	Result
X	3A/m	Pass
Y	3A/m	Pass
Z	3A/m	Pass

6 Appendix I - Photos of test setup

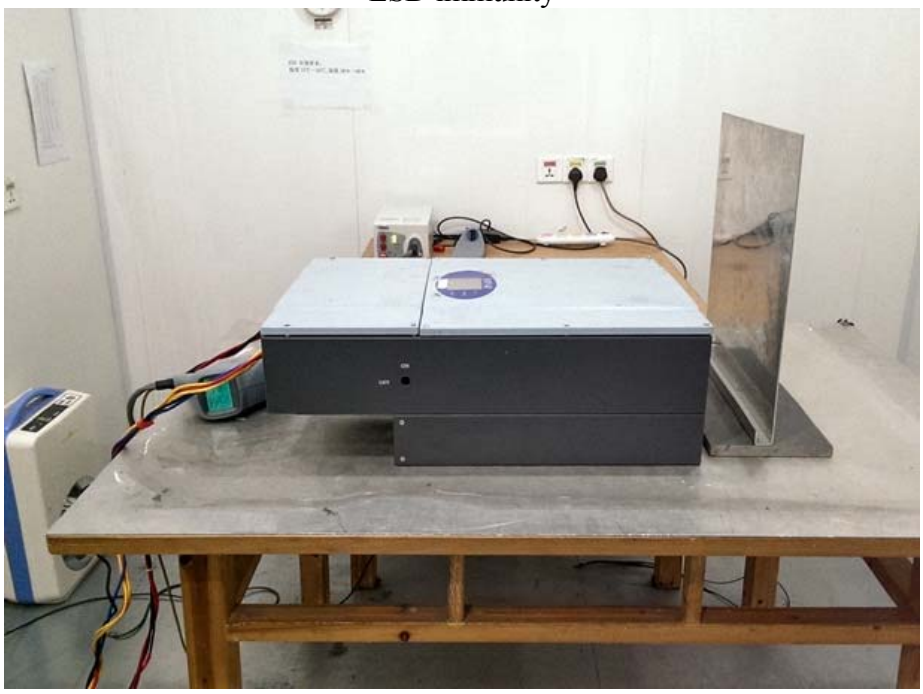
Continuous/Discontinuous conducted disturbance voltage

Radiated emission (30 MHz–1000 MHz)

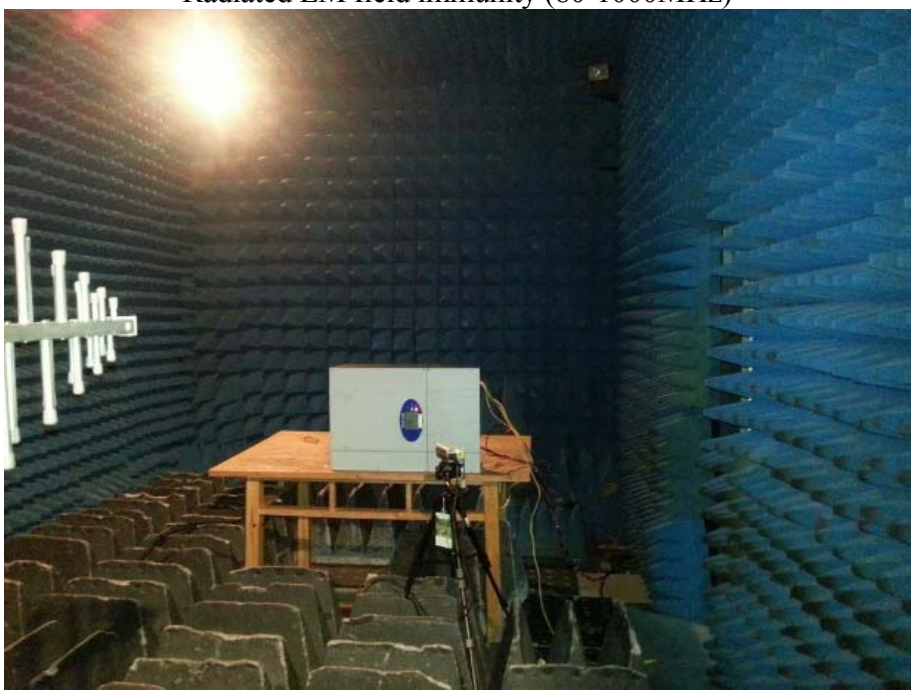


Harmonic of current & Flicker

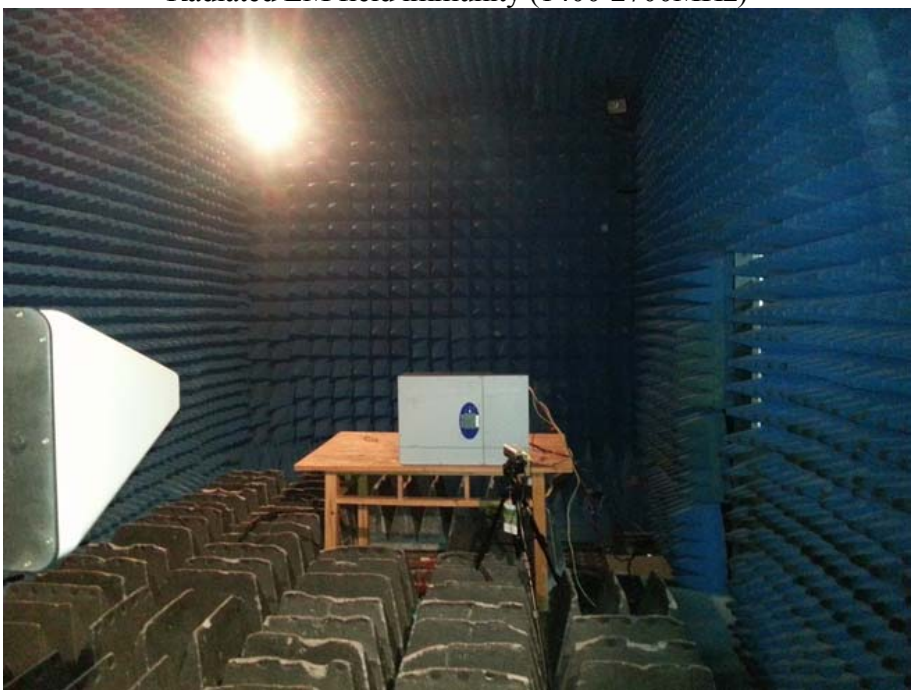
ESD immunity



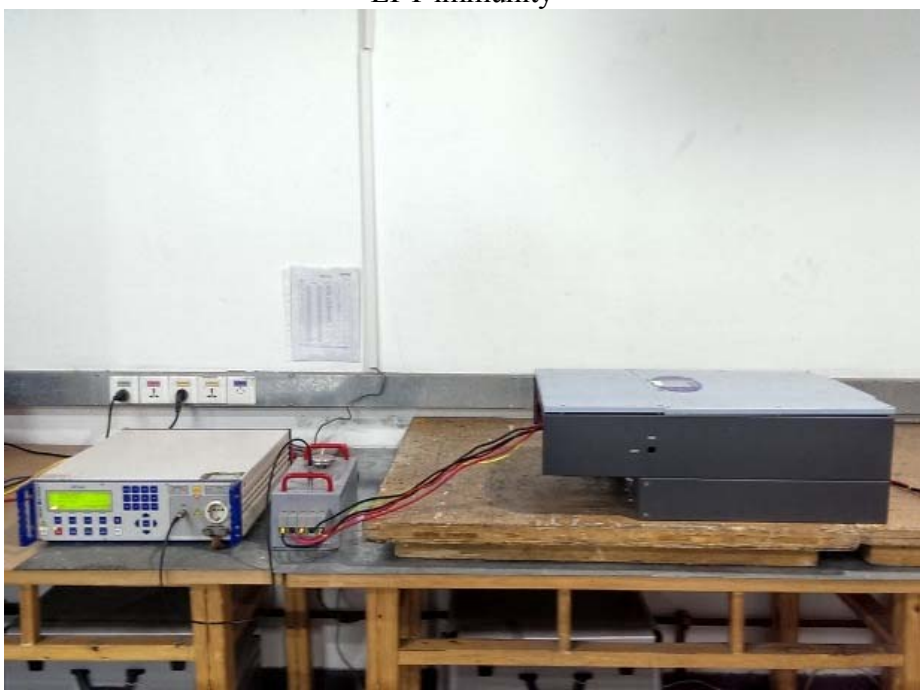
Radiated EM field immunity (80-1000MHz)

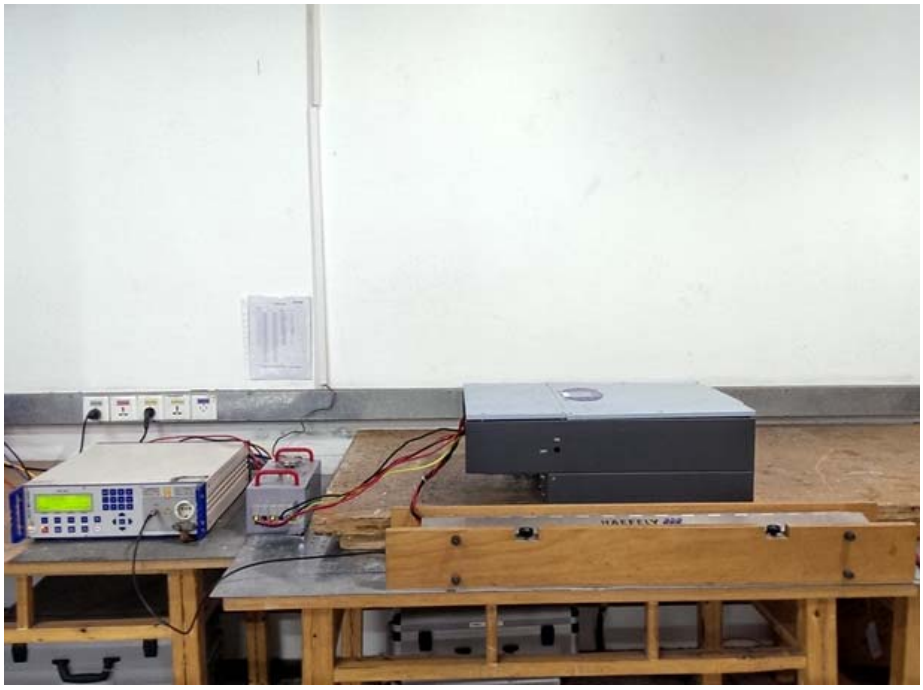


Radiated EM field immunity (1400-2700MHz)

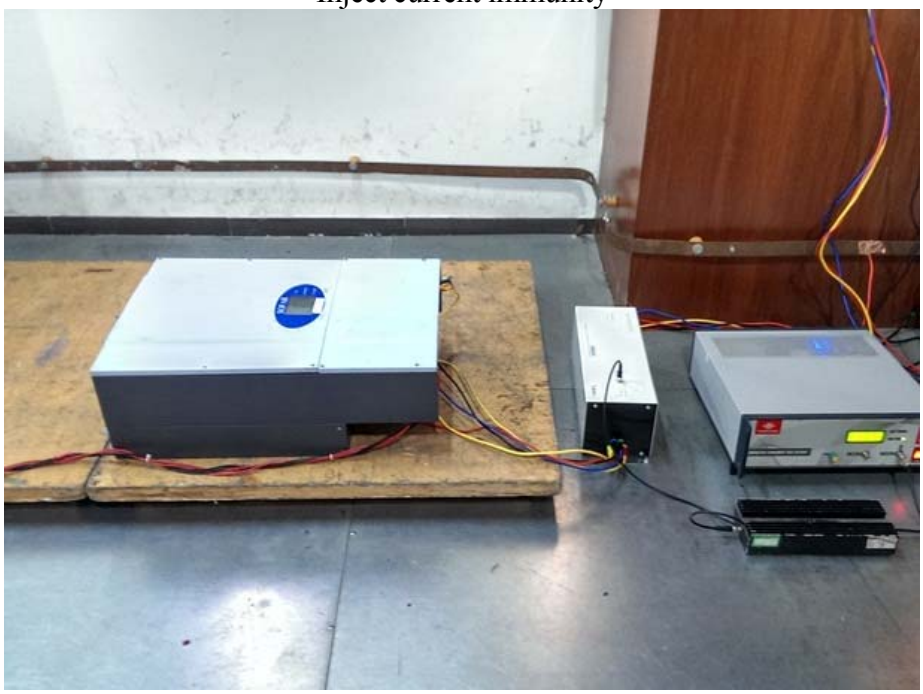


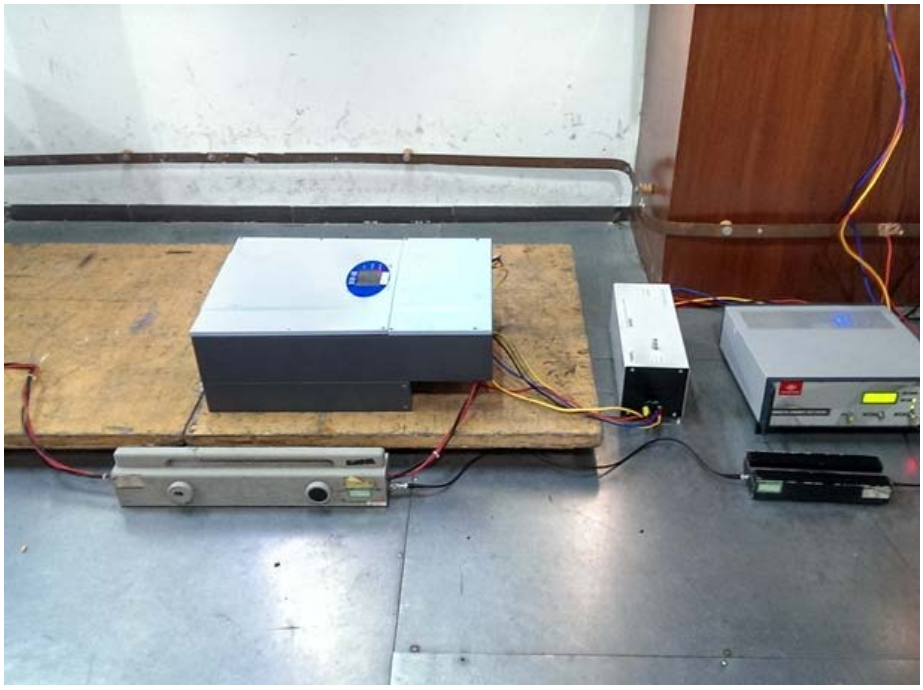
EFT immunity





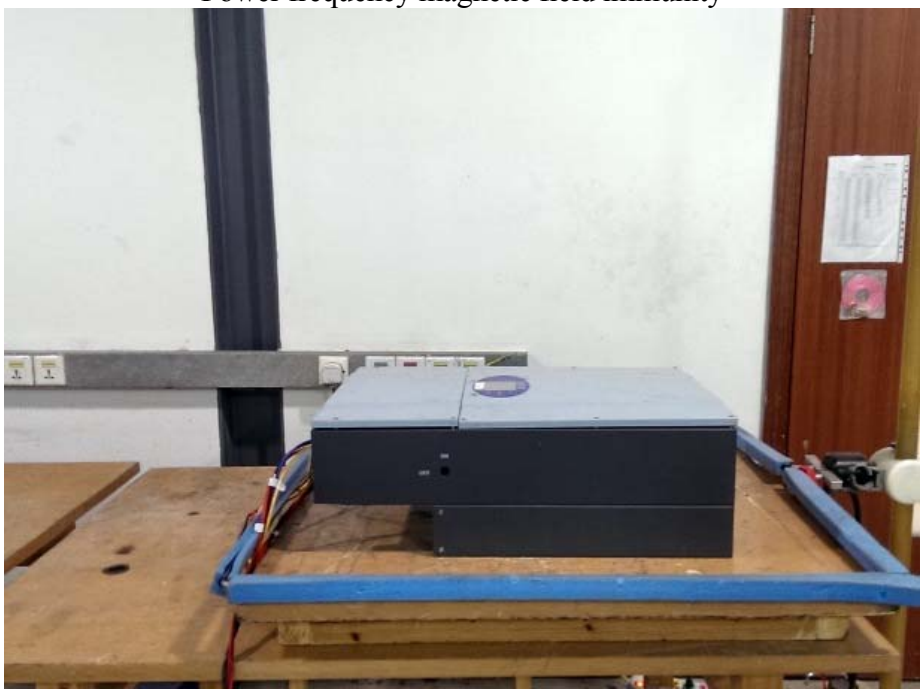
Inject current immunity





SURGE immunity

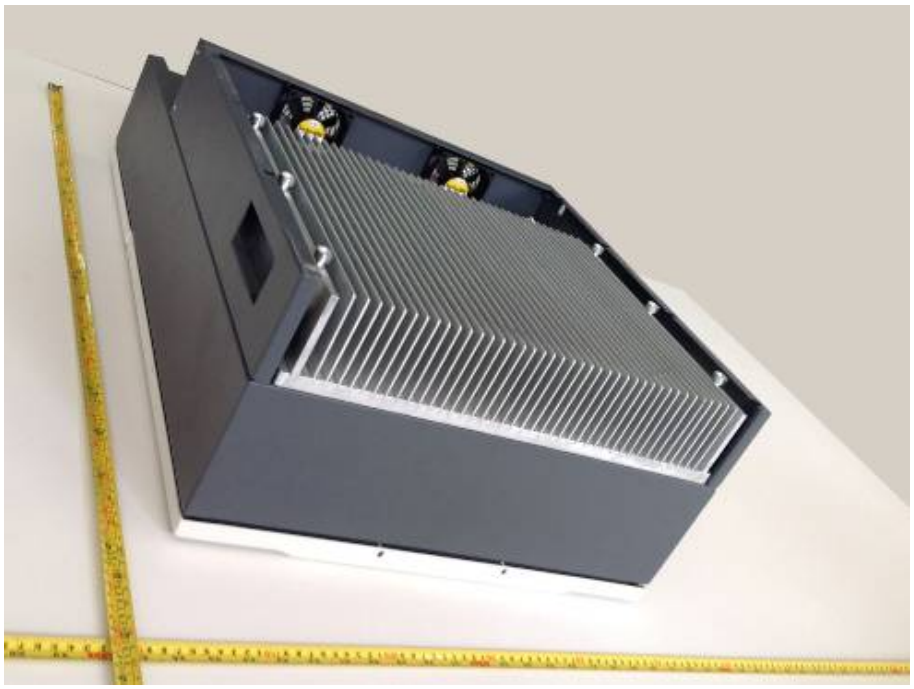
Power frequency magnetic field immunity



7 Appendix II- Photos of EUT

Overall view of the unit

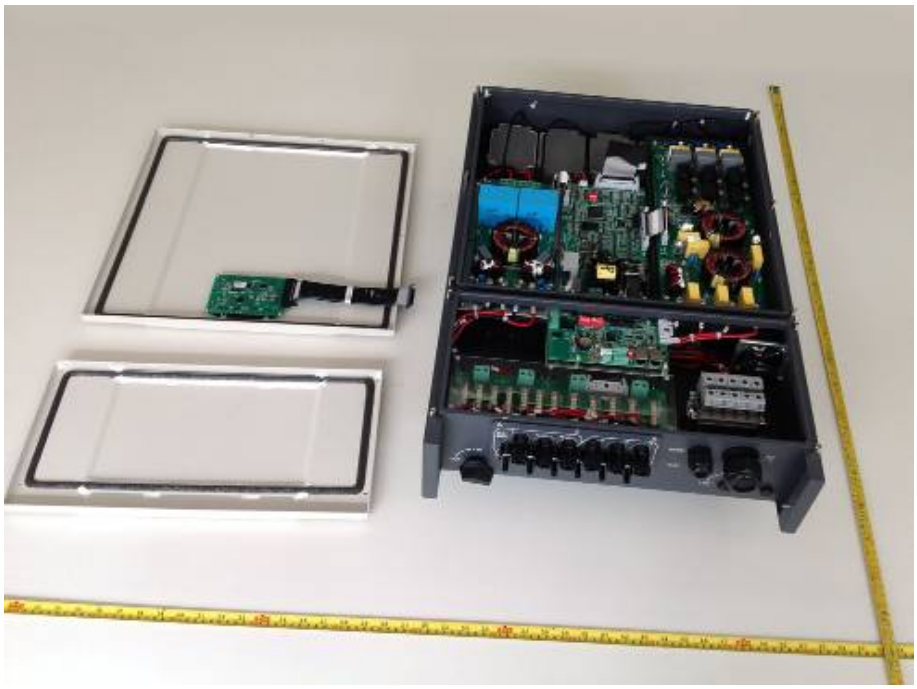
Bottom view of the unit



Terminals view of the unit (for models “-S2” to “-S6”)
PV connector (Sofar 20000TL-Sx and Sofar 17000TL-Sx has 3×2 pairs)
(Sofar 15000TL-Sx and Sofar 10000TL-Sx has 2×2 pairs)

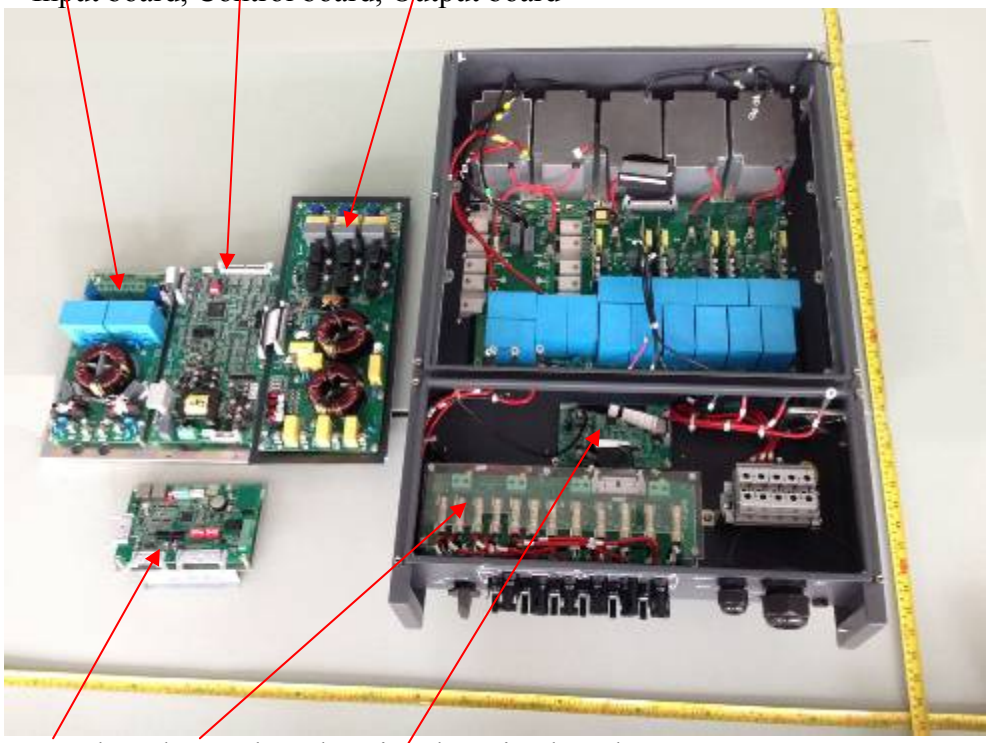
Terminals view of the unit (for models “-S0” to “-S1”)
DC Cable Gland

Internal view of the unit



Internal view of the unit

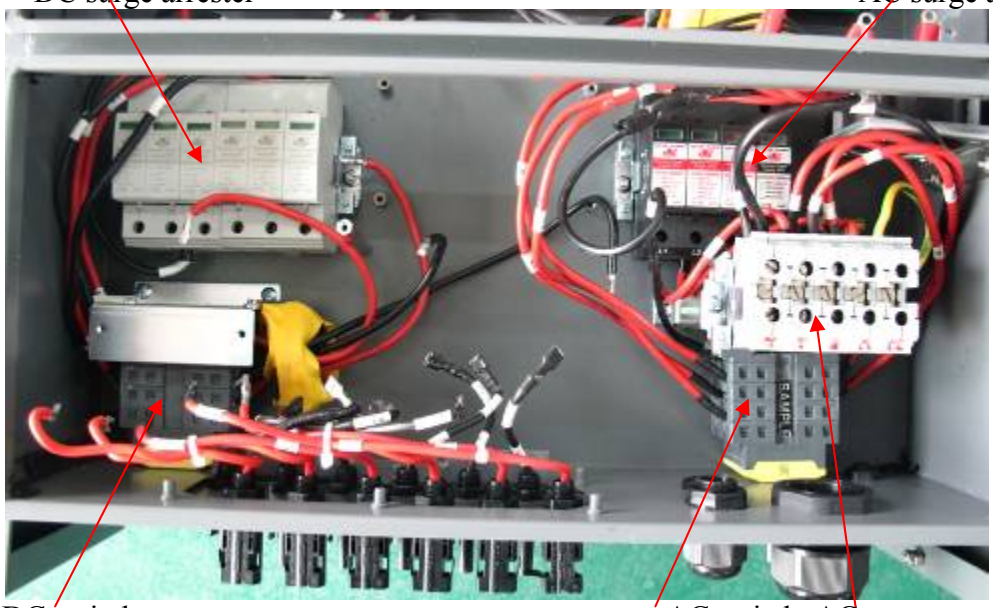
Input board, Control board, Output board



COM board, Fuse board, String detection board

DC surge arrester

AC surge arrester



DC switch

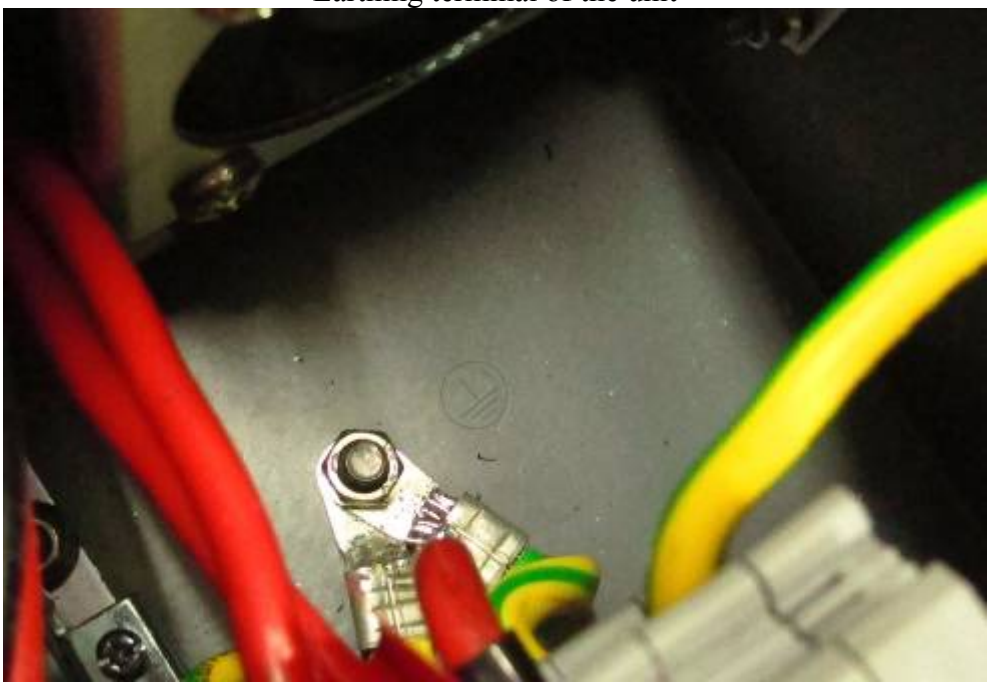
AC switch, AC output connector

Internal view of the unit

DC inside connector

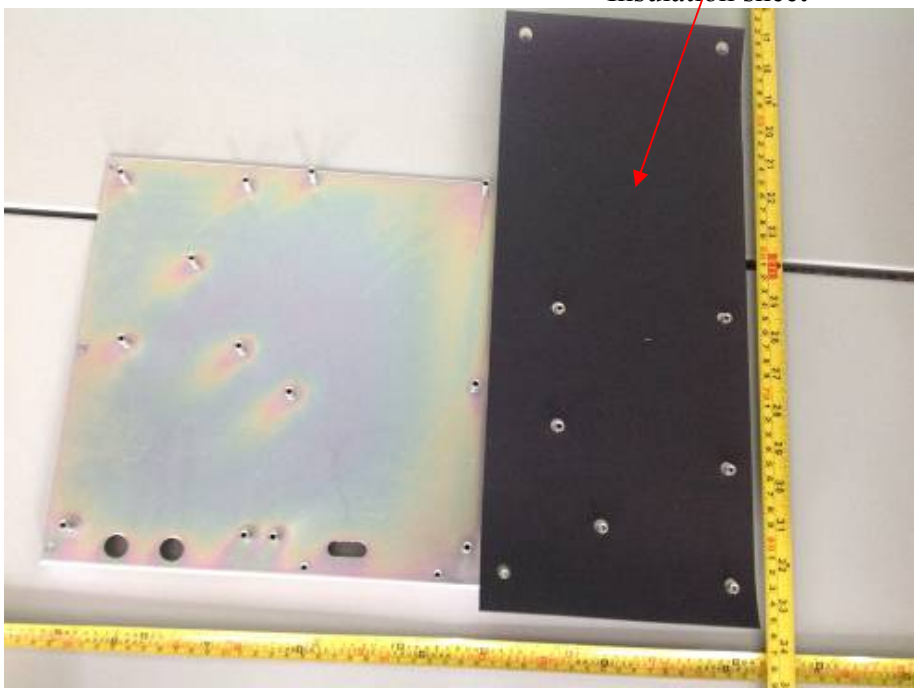
AC output connector

Earthing terminal of the unit

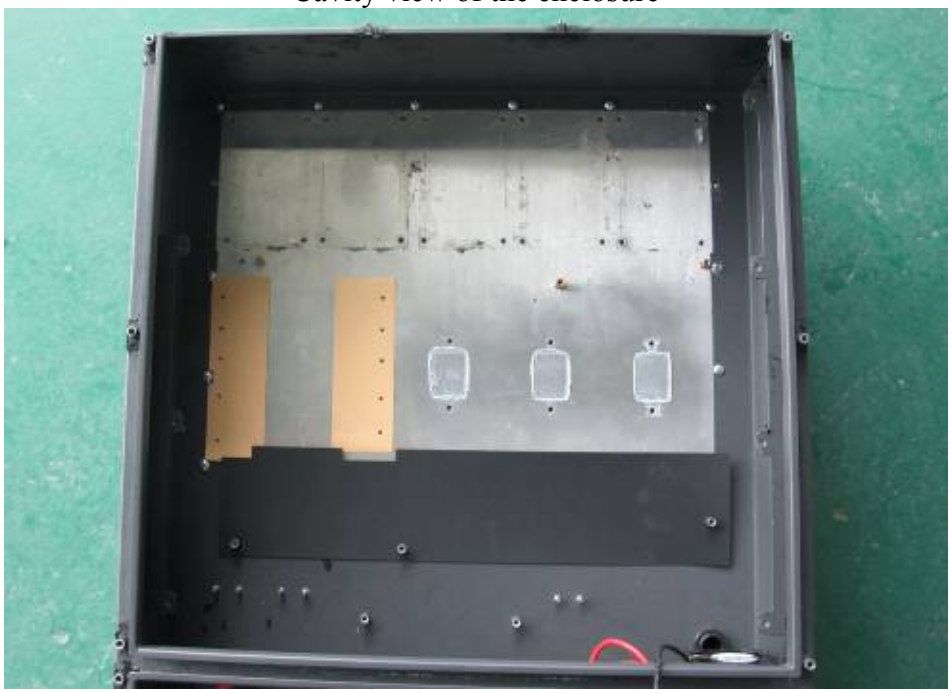


Support board for the PCBs

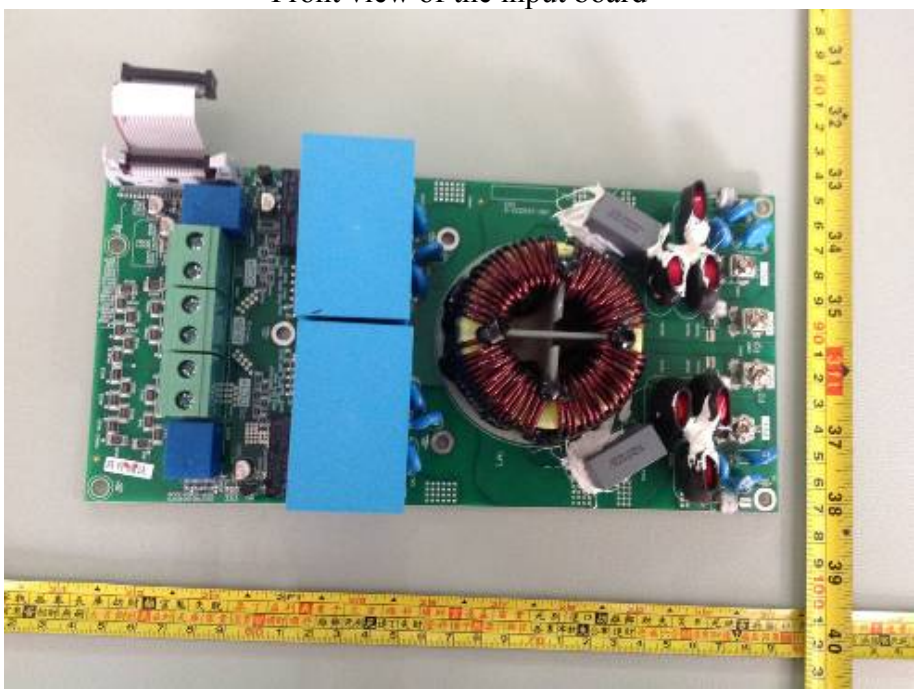
Insulation sheet



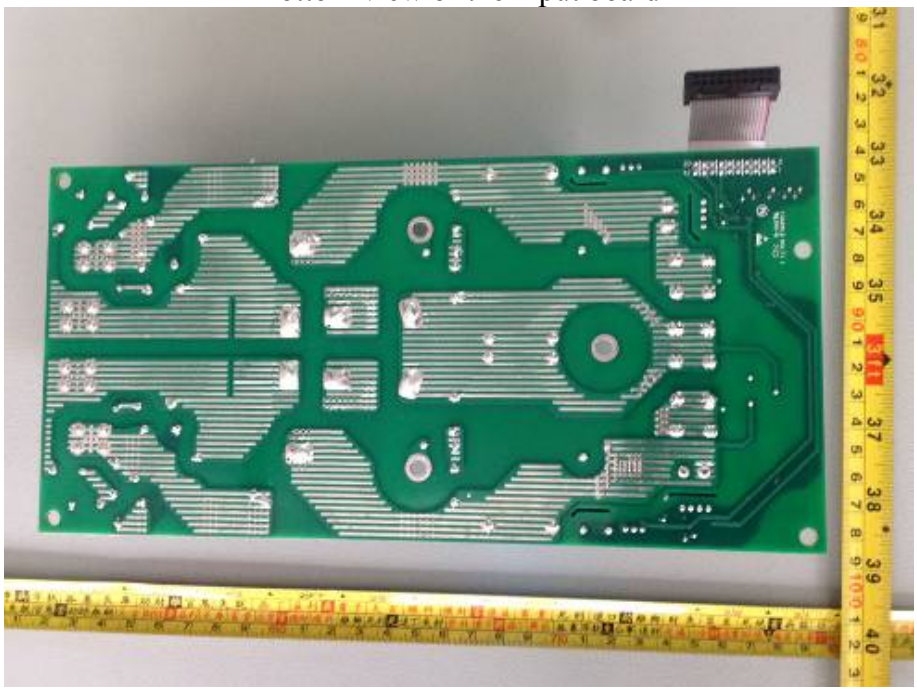
Cavity view of the enclosure



Front view of the input board

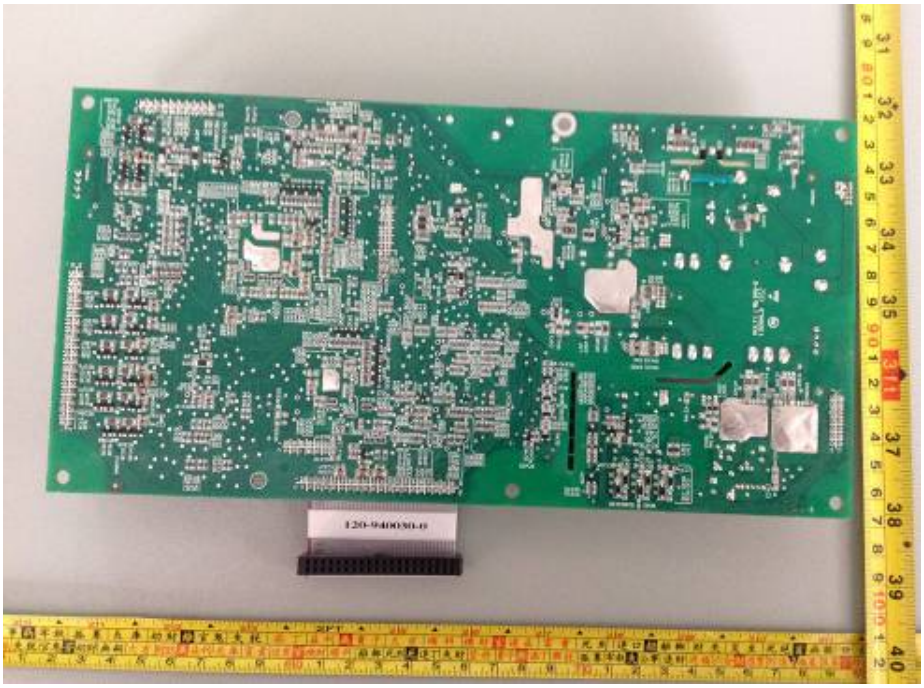


Bottom view of the input board

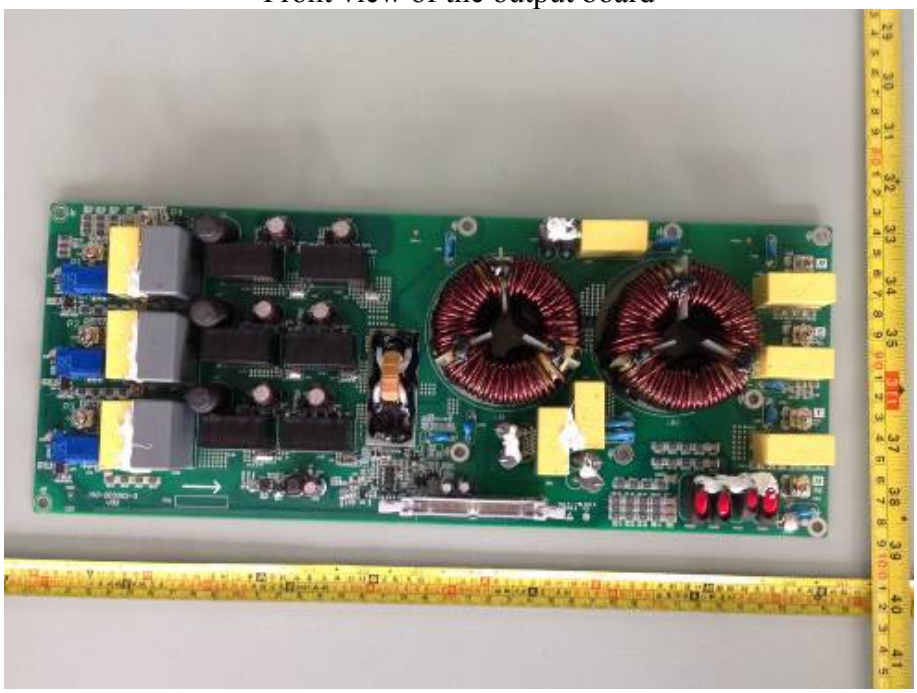


Front view of the control board

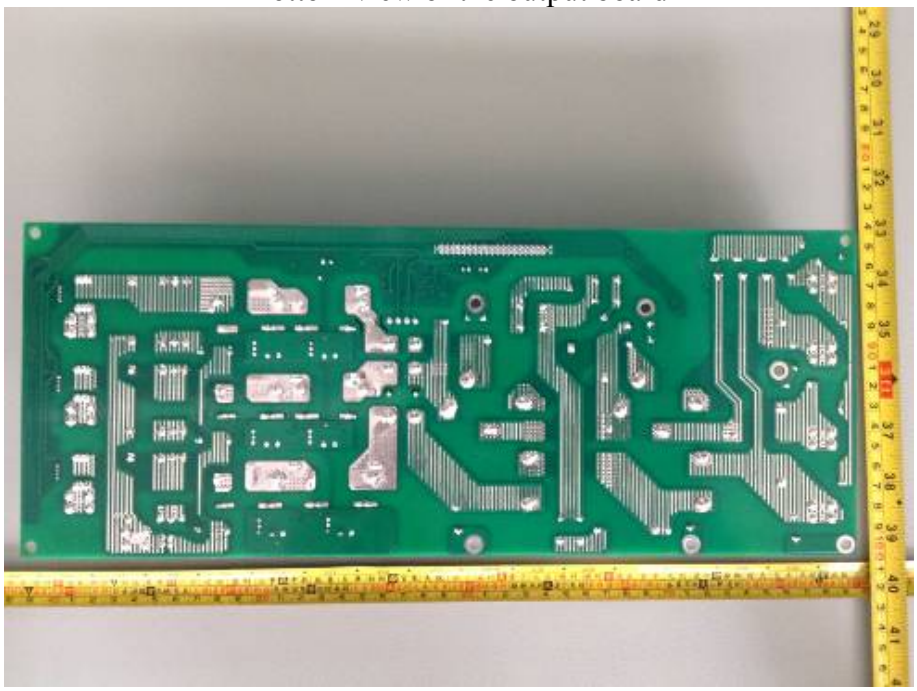
Bottom view of the control board



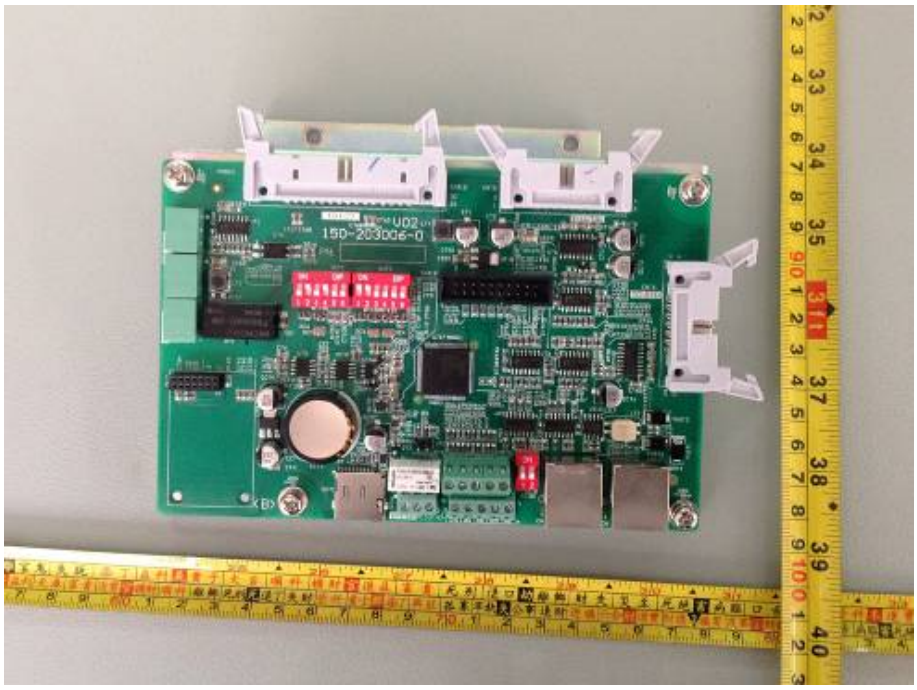
Front view of the output board



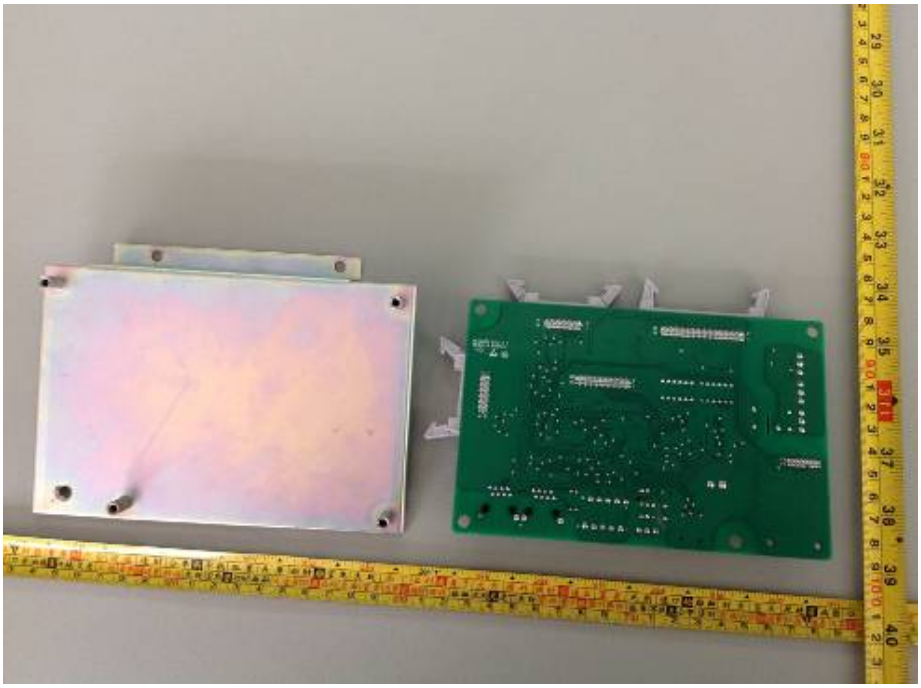
Bottom view of the output board



Front view of the COM board

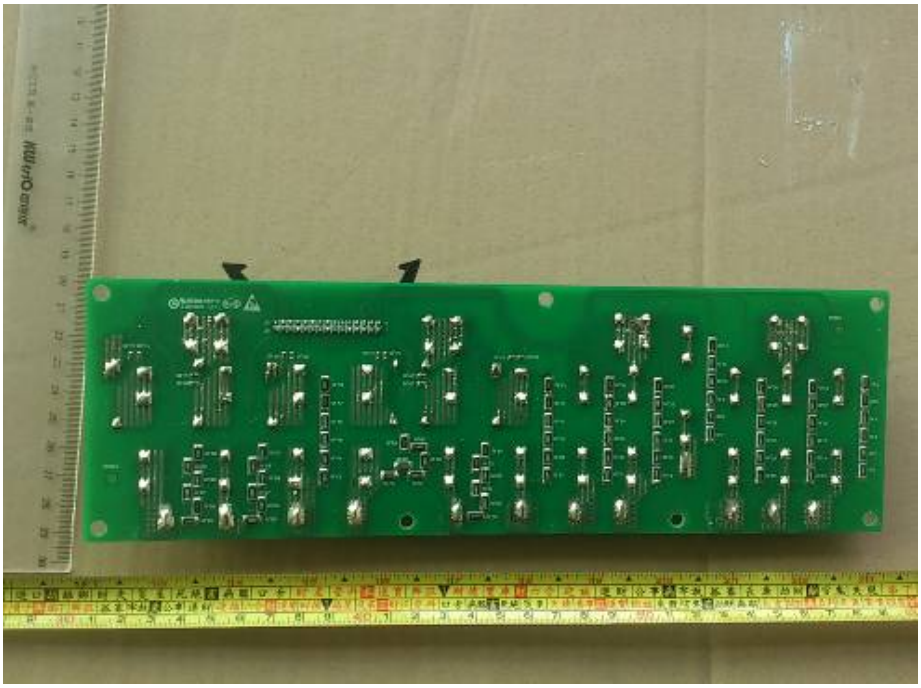


Bottom view of the COM board

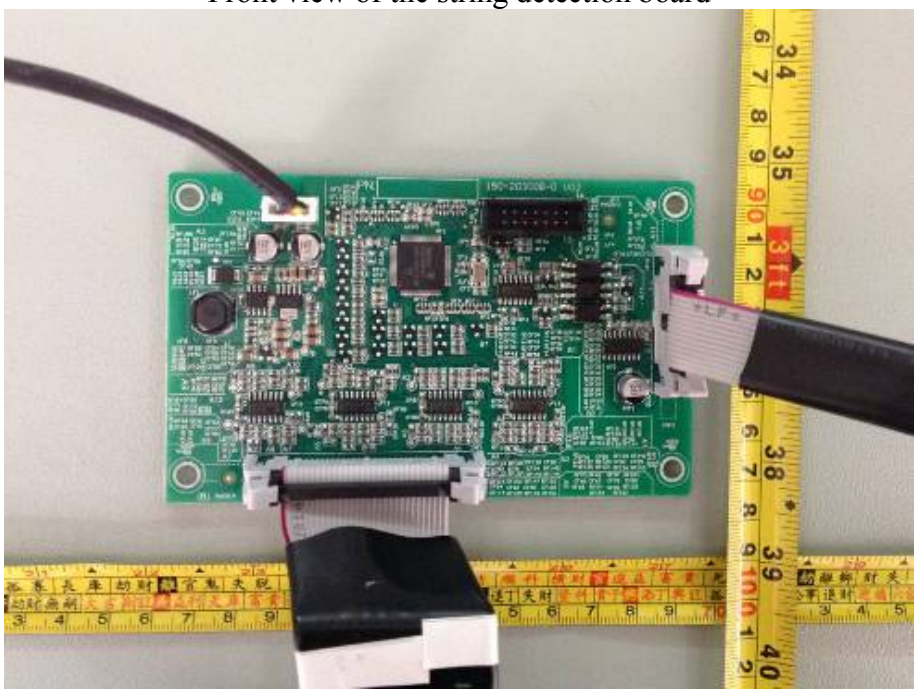


Front view of the fuse board

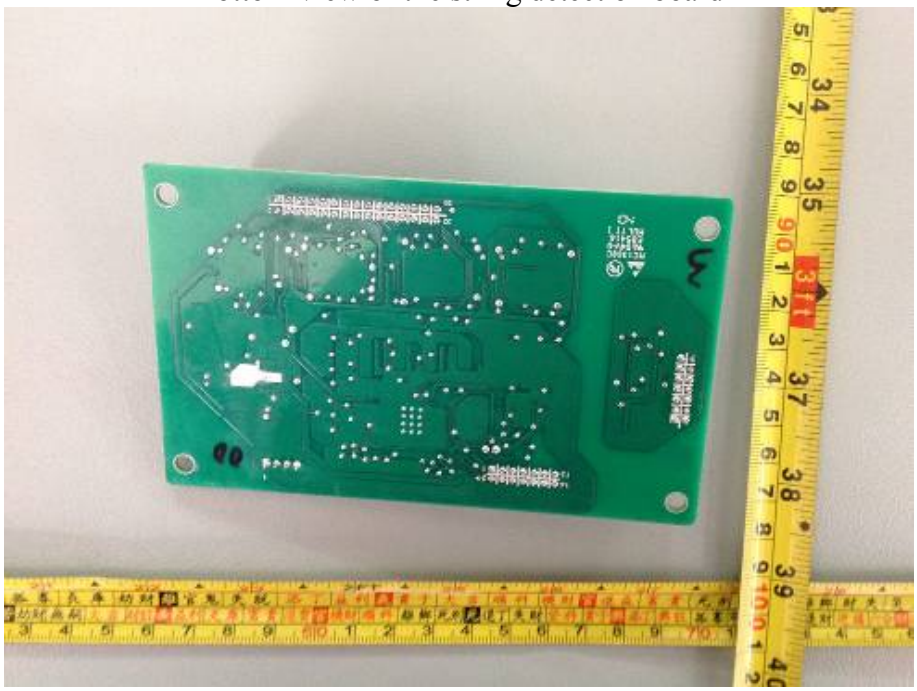
Bottom view of the fuse board



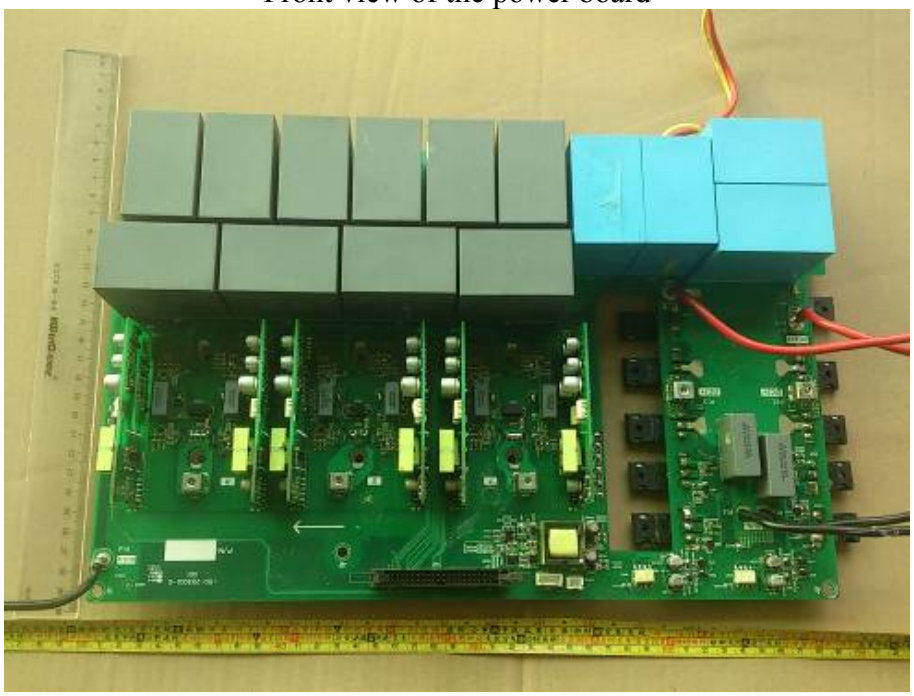
Front view of the string detection board



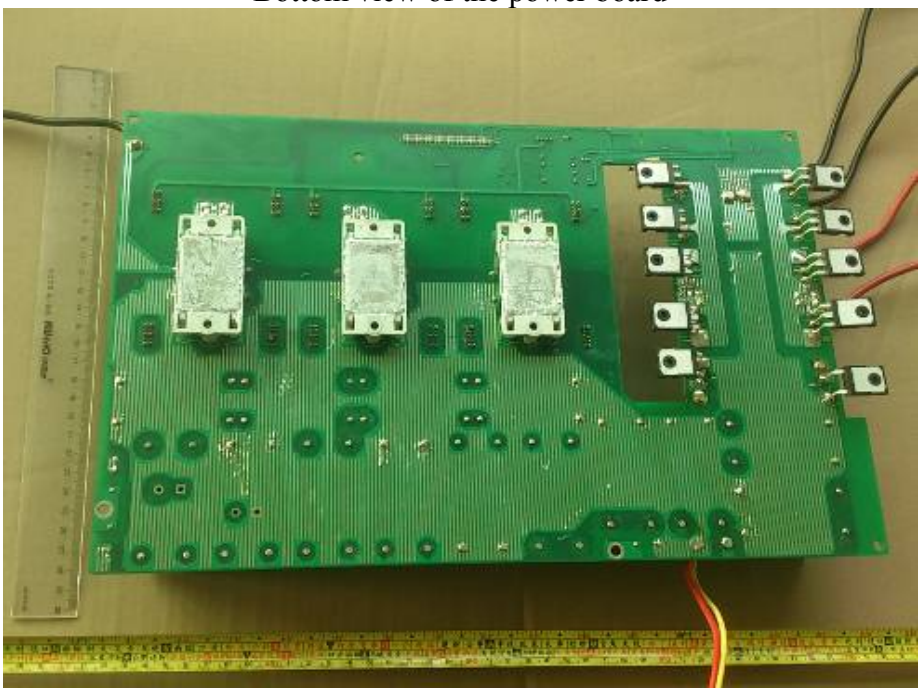
Bottom view of the string detection board



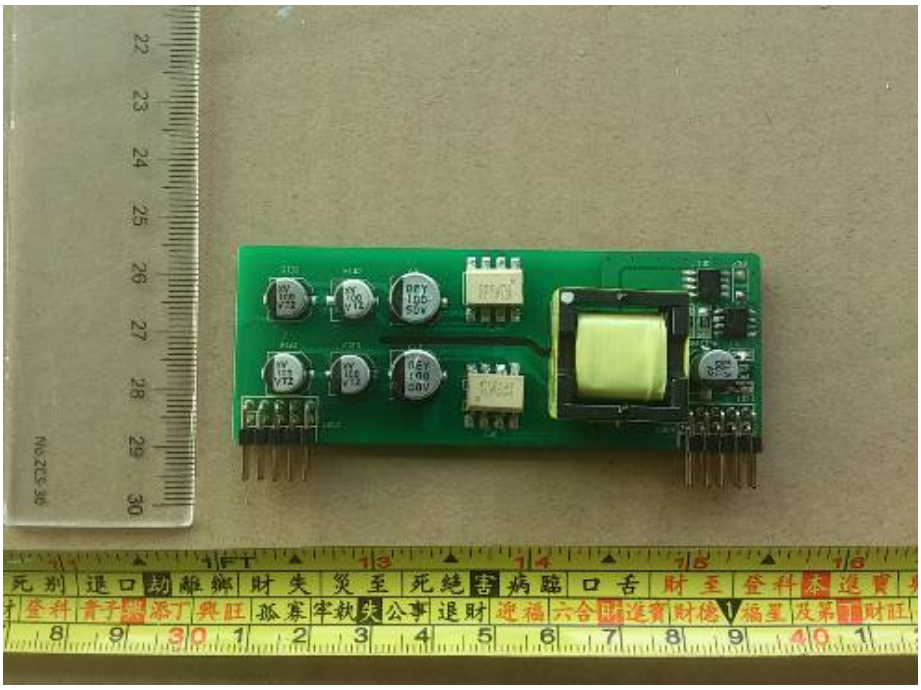
Front view of the power board



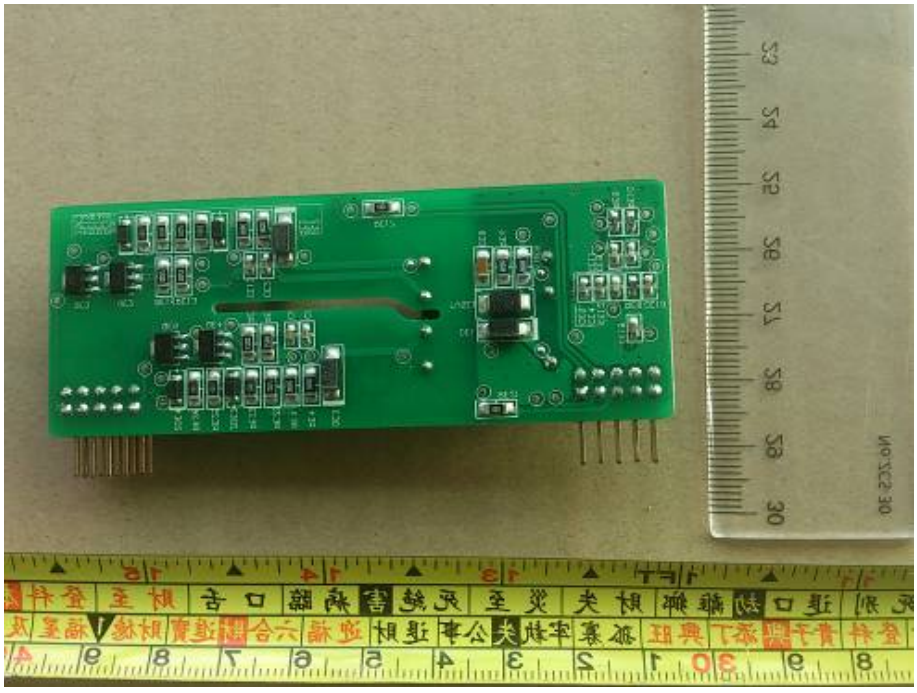
Bottom view of the power board



Front view of the driver board



Bottom view of the driver board



Front view of the display board

Bottom view of the display board