



EMC Test Report

For



Applicant Name: Woteam New Energy (Guangdong) Co., Ltd.
Address: 2F, Zhi Rong Park, No. 33 Xiang Rong Rd Dalang Town, Dongguan, Guangdong, China
EUT Name: Lithium iron phosphate solar cells
Brand Name: N/A
Model Number: RAYS01

Issued By

Company Name: BTF Testing Lab (Shenzhen) Co., Ltd.
Address: F101, 201 and 301, Building 1, Block 2, Tantou Industrial Park, Tantou Community, Songgang Street, Bao'an District, Shenzhen, China

Report Number: BTF-SZ221031E-003
Test Standards: EN IEC 61000-6-3:2021
EN IEC 61000-6-1:2019

Test Conclusion: Pass
Test Date: 2022-10-31 to 2022-11-02
Date of Issue: 2022-11-02

Prepared By: 
Nightfall Wen / Project Engineer
Date: 2022-11-02
Approved By: 
Ryan.CJ / EMC Manager
Date: 2022-11-02



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Revision History		
Version	Issue Date	Revisions Content
R_V0	2022-11-02	Original

Note: Once the revision has been made, then previous versions reports are invalid.

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1 Introduction

1.1 Identification of Testing Laboratory

Company Name:	BTF Testing Lab (Shenzhen) Co., Ltd.
Address:	F101, 201 and 301, Building 1, Block 2, Tantou Industrial Park, Tantou Community, Songgang Street, Bao'an District, Shenzhen, China
Phone Number:	+86-0755-23146130
Fax Number:	+86-0755-23146130

1.2 Identification of the Responsible Testing Location

Company Name:	BTF Testing Lab (Shenzhen) Co., Ltd.
Address:	F101, 201 and 301, Building 1, Block 2, Tantou Industrial Park, Tantou Community, Songgang Street, Bao'an District, Shenzhen, China
Phone Number:	+86-0755-23146130
Fax Number:	+86-0755-23146130

1.3 Announcement

- (1) The test report reference to the report template version v0.
- (2) The test report is invalid if not marked with the signatures of the persons responsible for preparing, reviewing and approving the test report.
- (3) The test report is invalid if there is any evidence and/or falsification.
- (4) This document may not be altered or revised in any way unless done so by BTF and all revisions are duly noted in the revisions section.
- (5) Content of the test report, in part or in full, cannot be used for publicity and/or promotional purposes without prior written approval from the laboratory.
- (6) The laboratory is only responsible for the data released by the laboratory, except for the part provided by the applicant.

2 Product Information

2.1 Application Information

Company Name:	Woteam New Energy (Guangdong) Co., Ltd.
Address:	2F, Zhi Rong Park, No. 33 Xiang Rong RdDalang Town, Dongguan, Guangdong, China

2.2 Manufacturer Information

Company Name:	Woteam New Energy (Guangdong) Co., Ltd.
Address:	2F, Zhi Rong Park, No. 33 Xiang Rong RdDalang Town, Dongguan, Guangdong, China

2.3 Factory Information

Company Name:	Woteam New Energy (Guangdong) Co., Ltd.
Address:	2F, Zhi Rong Park, No. 33 Xiang Rong RdDalang Town, Dongguan, Guangdong, China

2.4 General Description of Equipment under Test (EUT)

EUT Name:	Lithium iron phosphate solar cells
Test Model Number:	RAYS01

2.5 Technical Information

Rating:	Rated voltage: 51.2V Rated capacity: 184Ah
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3 Summary of Test Results

3.1 Test Standards

The tests were performed according to following standards:

EN IEC 61000-6-3:2021: Electromagnetic compatibility (EMC) - Part 6-3: Generic standards - Emission standard for equipment in residential environments

EN IEC 61000-6-1:2019: Electromagnetic compatibility (EMC) - Part 6-1: Generic standards - Immunity standard for residential, commercial and light-industrial environments

3.2 Summary of Test Result

Item	Standard	Requirement	Result
Conducted disturbances from DC power port	EN IEC 61000-6-3:2021	Table 5	Pass
Radiation disturbance (30MHz-1GHz)	EN IEC 61000-6-3:2021	Table 3	Pass
Electrostatic discharge	EN IEC 61000-6-1:2019	Table 1.4	Pass
Radio-frequency electromagnetic field	EN IEC 61000-6-1:2019	Table 1.2 & 1.3	Pass
Fast transients on Input and output DC power ports	EN IEC 61000-6-1:2019	Table 3.3	Pass
Radio-frequency common mode on Input and output DC power ports	EN IEC 61000-6-1:2019	Table 3.1	Pass

4 Test Configuration

4.1 Test Equipment List

Conducted disturbances from DC power port					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
Pulse Limiter	SCHWARZBECK	VTSD 9561-F	00953	2021-11-25	2022-11-24
Coaxial Switcher	SCHWARZBECK	CX210	CX210	2021-11-27	2022-11-26
V-LISN	SCHWARZBECK	NSLK 8127	01073	2021-11-27	2022-11-26
LISN	AFJ	LS16/110VAC	16010020076	2021-11-27	2022-11-26
EMI Receiver	ROHDE&SCHWARZ	ESCI3	101422	2021-11-25	2022-11-24

Radiation disturbance (30MHz-1GHz)					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
Coaxial cable Multiflex 141	Schwarzbeck	N/SMA 0.5m	517386	2022-03-26	2023-03-25
Preamplifier	SCHWARZBECK	BBV9744	00246	2021-11-27	2022-11-26
RE Cable	REBES Talent	UF1-SMASMAM-10m	21101566	2021-11-29	2022-11-28
RE Cable	REBES Talent	UF2-NMNM-10m	21101570	2021-11-29	2022-11-28
RE Cable	REBES Talent	UF1-SMASMAM-1m	21101568	2021-11-29	2022-11-28
RE Cable	REBES Talent	UF2-NMNM-1m	21101576	2021-11-29	2022-11-28
RE Cable	REBES Talent	UF2-NMNM-2.5m	21101573	2021-11-29	2022-11-28
RE Cable	REBES Talent	UF1-SMASMAM-10m	21101566	2021-11-29	2022-11-28
RE Cable	REBES Talent	UF2-NMNM-10m	21101570	2021-11-29	2022-11-28
POSITIONAL CONTROLLER	SKET	PCI-GPIB	/	/	/
Horn Antenna	SCHWARZBECK	BBHA9170	01157	2021-11-28	2023-11-27
EMI TEST RECEIVER	ROHDE&SCHWARZ	ESCI7	101032	2021-11-25	2022-11-24
SIGNAL ANALYZER	ROHDE&SCHWARZ	FSQ40	100010	2021-11-27	2022-11-26
POSITIONAL CONTROLLER	SKET	PCI-GPIB	/	/	/
SIGNAL ANALYZER	ROHDE&SCHWARZ	FSQ40	100010	2021-11-27	2022-11-26
Broadband Preamplifier	SCHWARZBECK	BBV9718D	00008	2022-03-26	2023-03-25
Horn Antenna	SCHWARZBECK	BBHA9120D	2597	2022-05-22	2024-05-21
EZ EMC	Frad	FA-03A2 RE+	/	/	/
POSITIONAL CONTROLLER	SKET	PCI-GPIB	/	/	/
Preamplifier	SCHWARZBECK	BBV9744	00246	2021-11-27	2022-11-26
Log periodic antenna	SCHWARZBECK	VULB 9168	01328	2021-11-28	2023-11-27
EMI Receiver	ROHDE&SCHWARZ	ESCI7	101032	2021-11-25	2022-11-24

Electrostatic discharge					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
ESD Generator	Prima	PESD6030	PR210823683	2021-12-11	2022-12-10

Radio-frequency electromagnetic field					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
Antenna	SCHWARZBECK	STLP9128E-special	STLP 9149 #456	/	/
Antenna	SCHWARZBECK	STLP9128E-special	STLP9128E s#139	/	/
RF power Amplifier	Micotop	MPA-3000-6000-100	MPA1811348	2022-08-23	2023-08-22
RF power Amplifier	OPHIR	5273R	1018	2022-08-23	2023-08-22
RF power Amplifier	OPHIR	5225R	1045	2022-08-23	2023-08-22
Power Sensor	Agilent	E9300A	MY41496625s	2022-08-23	2023-08-22
Power meter	Agilent	E4419B	GB40202122	2022-08-23	2023-08-22
vector Signal Generator	Agilent	E4438C	US44271917	2022-08-23	2023-08-22

Fast transients on Input and output DC power ports					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
Coupling clamp	Prima	EFT-CLAMP	EFT-327	2021-11-27	2022-11-26
EFT Generator	Prima	PEFT6030-3816	PR210343256	2021-11-27	2022-11-26

Radio-frequency common mode on Input and output DC power ports					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
CDN coupling	Prima	CRF-CDN-M316	PR210881049	2021-11-25	2022-11-24
CDN coupling	Prima	CRF-CDN-M216	PR210881044	2021-11-25	2022-11-24
6DB ATTENUATOR	Prima	50W DC-3GHZ	T2A-50-6-3-N	2022-03-26	2023-03-25
Rf conduction immunity test system	Prima	CRF61006A	PR210681042	2021-11-27	2022-11-26

4.2 Test Auxiliary Equipment

The EUT was tested as an independent device.

4.3 Test Modes

No.	Test Modes	Description
TM1	discharging	/
TM2	charging	/
TM3	data transmission	data transmission by RS485

5 Emission Test Results (EMI)

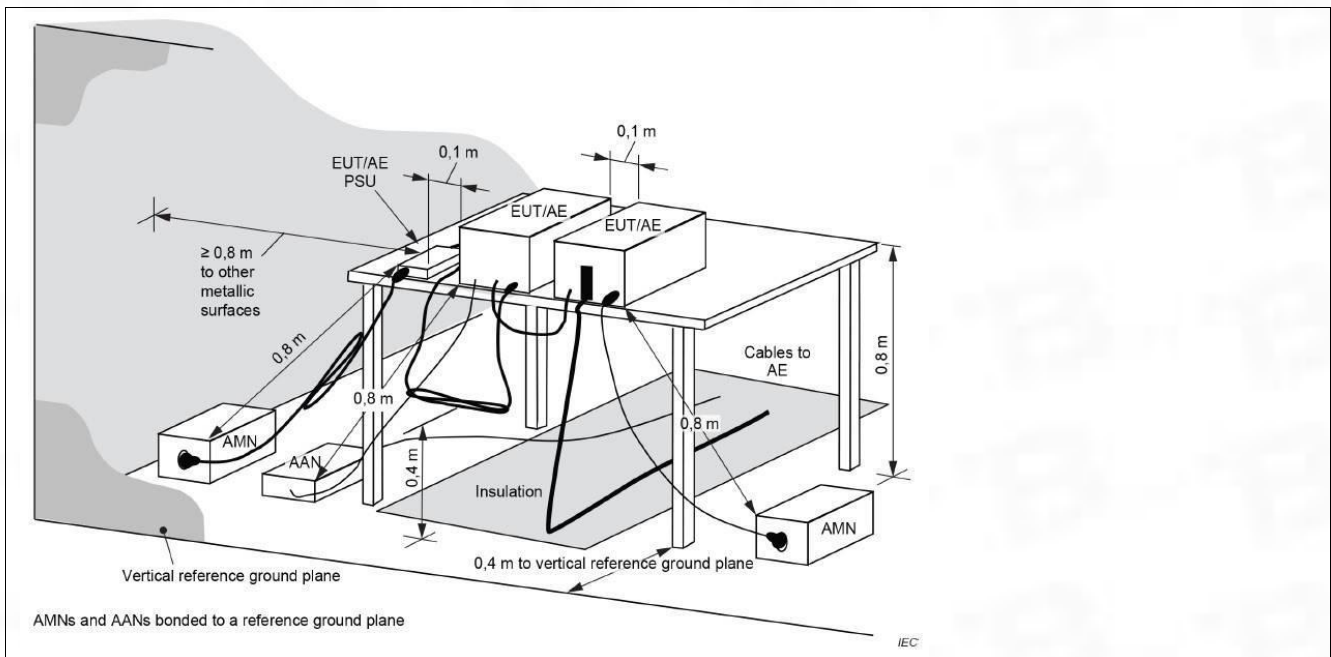
5.1 Conducted disturbances from DC power port

Test Requirement:	Table 5	
Test Method:	CISPR 16-2-1 Clause 7	
Test Limit:	Frequency range	Limits
	0,15 MHz to 0,5 MHz	79 dB(uV) quasi-peak 66 dB(uV) average
	0,5 MHz to 30 MHz	73 dB(uV) quasi-peak 60 dB(uV) average
	At transitional frequencies the lower limit applies.	
Procedure:	An initial pre-scan was performed with peak detector. Quasi-Peak or Average measurement were performed at the frequencies with maximized peak emission were detected.	

5.1.1 E.U.T. Operation:

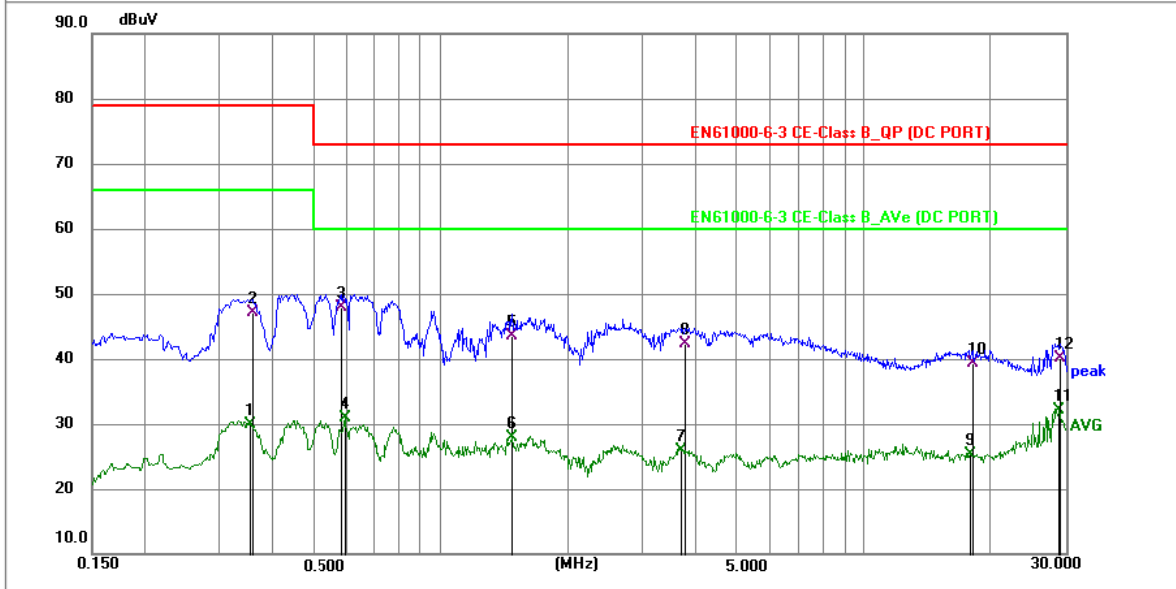
Operating Environment:	
Temperature:	22.5 °C
Humidity:	47.3 %
Atmospheric Pressure:	1010 mbar

5.1.2 Test Setup Diagram:



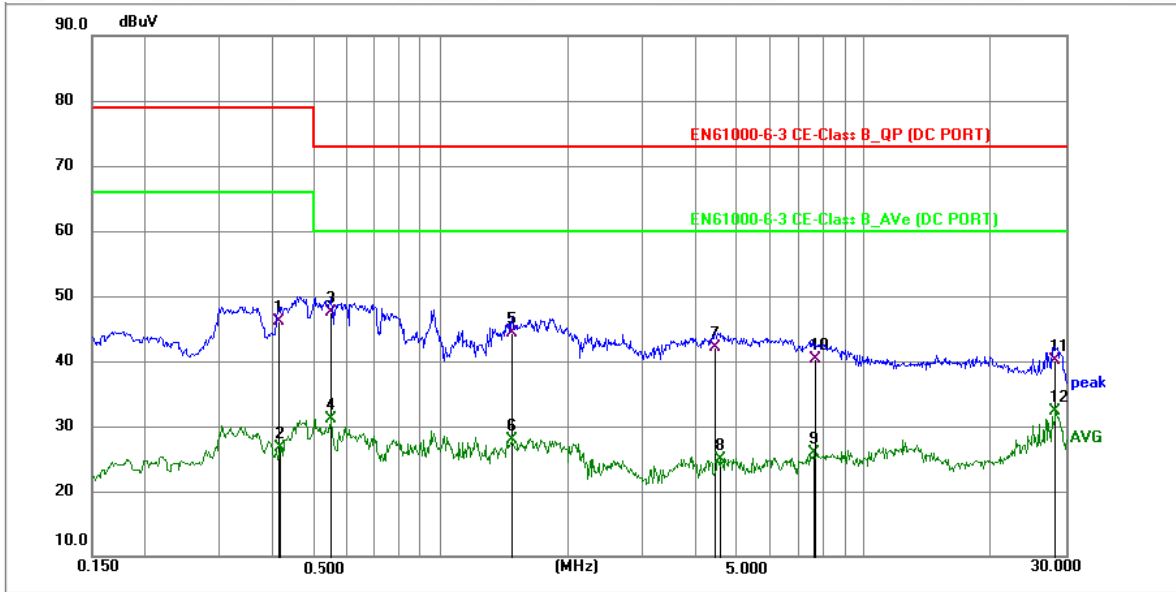
5.1.3 Test Data:

TM1 / Line: Line



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F	Remark
1	0.3523	19.60	10.22	29.82	66.00	-36.18	AVG	P	
2	0.3570	36.87	10.22	47.09	79.00	-31.91	QP	P	
3 *	0.5820	37.59	10.25	47.84	73.00	-25.16	QP	P	
4	0.5955	20.64	10.25	30.89	60.00	-29.11	AVG	P	
5	1.4775	33.27	10.25	43.52	73.00	-29.48	QP	P	
6	1.4775	17.56	10.25	27.81	60.00	-32.19	AVG	P	
7	3.7004	15.72	10.27	25.99	60.00	-34.01	AVG	P	
8	3.7905	32.04	10.26	42.30	73.00	-30.70	QP	P	
9	17.9070	15.39	9.88	25.27	60.00	-34.73	AVG	P	
10	18.0600	29.34	9.88	39.22	73.00	-33.78	QP	P	
11	28.9230	22.35	9.80	32.15	60.00	-27.85	AVG	P	
12	29.1615	30.23	9.80	40.03	73.00	-32.97	QP	P	

TM1 / Line: Neutral



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F	Remark
1	0.4110	35.89	10.25	46.14	79.00	-32.86	QP	P	
2	0.4148	16.40	10.25	26.65	66.00	-39.35	AVG	P	
3 *	0.5522	37.16	10.26	47.42	73.00	-25.58	QP	P	
4	0.5522	20.77	10.26	31.03	60.00	-28.97	AVG	P	
5	1.4775	33.98	10.25	44.23	73.00	-28.77	QP	P	
6	1.4775	17.56	10.25	27.81	60.00	-32.19	AVG	P	
7	4.4474	31.88	10.24	42.12	73.00	-30.88	QP	P	
8	4.5644	14.65	10.24	24.89	60.00	-35.11	AVG	P	
9	7.6333	15.56	10.30	25.86	60.00	-34.14	AVG	P	
10	7.6695	30.02	10.30	40.32	73.00	-32.68	QP	P	
11	28.3560	30.22	9.79	40.01	73.00	-32.99	QP	P	
12	28.3560	22.53	9.79	32.32	60.00	-27.68	AVG	P	

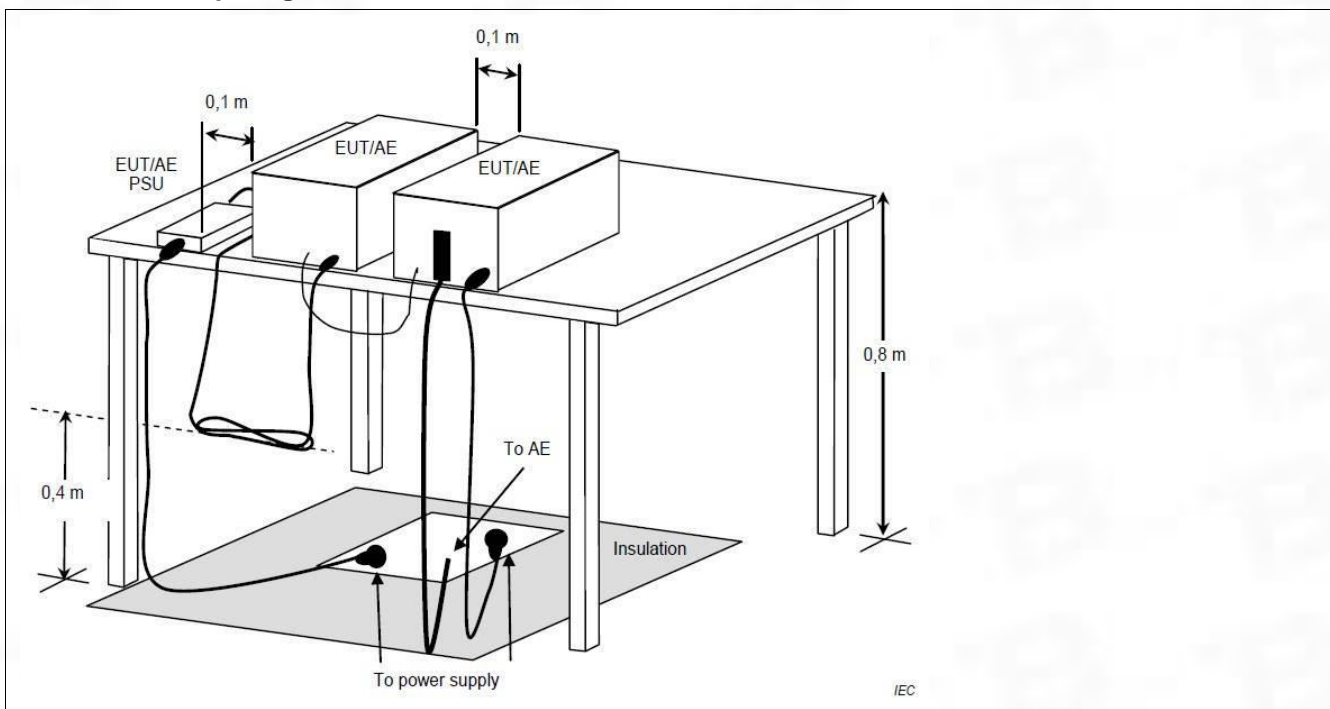
5.2 Radiation disturbance (30MHz-1GHz)

Test Requirement:	Table 3		
Test Method:	CISPR 16-2-3 Clause 7.3		
Test Limit:	Frequency range	Limits at 10m	Limits at 3m
	30 MHz to 230 MHz	30 dB(uV/m) quasi-peak	40 dB(uV/m) quasi-peak
	230 MHz to 1 000 MHz	37 dB(uV/m) quasi-peak	47 dB(uV/m) quasi-peak
	At transitional frequencies the lower limit applies.		
Procedure:	<p>An initial pre-scan was performed in the chamber using the spectrum analyser in peak detection mode. Quasi-peak measurements were conducted based on the peak sweep graph. The EUT was measured by BiConiLog antenna with 2 orthogonal polarities.</p> <p>Level=Read Level + Antenna Factor + Cable Loss - Preamp Factor</p>		

5.2.1 E.U.T. Operation:

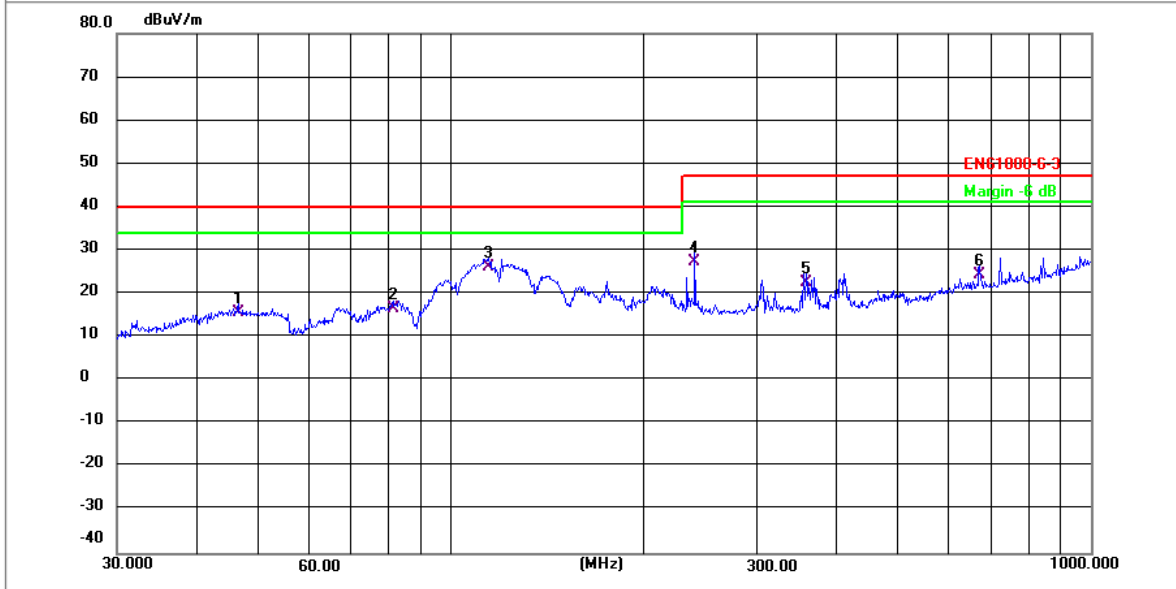
Operating Environment:	
Temperature:	24.8 °C
Humidity:	54.1 %
Atmospheric Pressure:	1010 mbar

5.2.2 Test Setup Diagram:



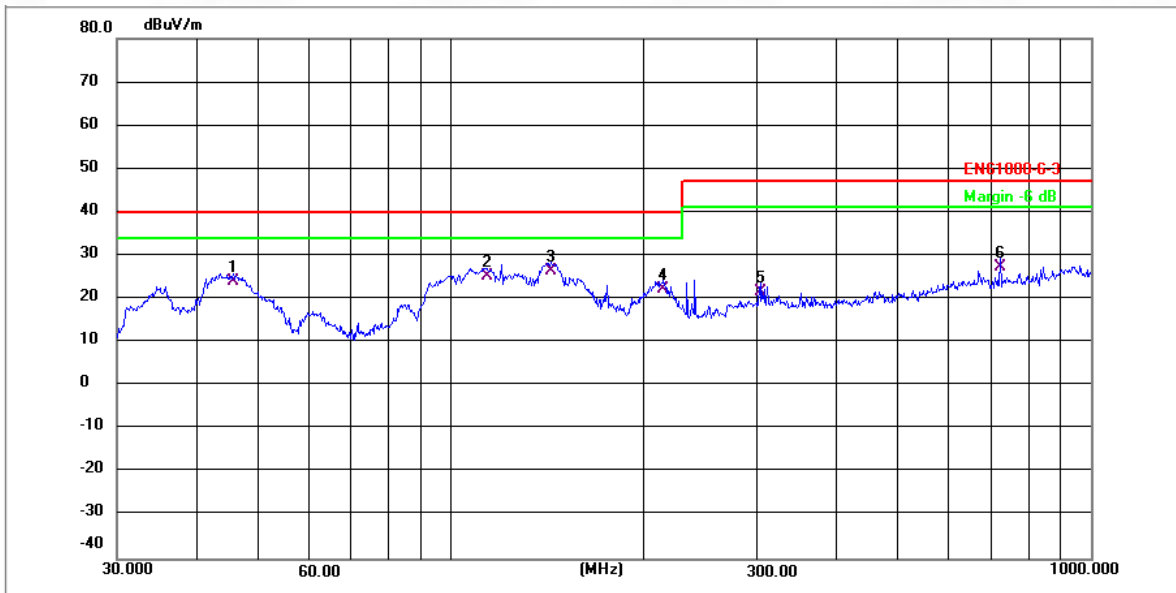
5.2.3 Test Data:

TM1 / Polarization: Horizontal



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F
1	46.3402	43.72	-28.08	15.64	40.00	-24.36	QP	P
2	81.2116	44.32	-27.87	16.45	40.00	-23.55	QP	P
3 *	114.5146	53.83	-27.57	26.26	40.00	-13.74	QP	P
4	239.9873	54.07	-26.77	27.30	47.00	-19.70	QP	P
5	357.9286	48.65	-26.09	22.56	47.00	-24.44	QP	P
6	670.4891	49.29	-24.89	24.40	47.00	-22.60	QP	P

TM1 / Polarization: Vertical



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F
1	45.5347	52.02	-28.09	23.93	40.00	-16.07	QP	P
2	114.1136	52.71	-27.57	25.14	40.00	-14.86	QP	P
3 *	143.3260	53.80	-27.28	26.52	40.00	-13.48	QP	P
4	214.5141	49.32	-26.92	22.40	40.00	-17.60	QP	P
5	304.6099	48.28	-26.54	21.74	47.00	-25.26	QP	P
6	721.7258	52.18	-24.88	27.30	47.00	-19.70	QP	P

6 Immunity Test Results (EMS)

Performance Criteria Description in EN IEC 61000-6-1 Performance Criteria

Performance Criterion A

The EUT shall continue to operate as intended during and after the test. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the EUT is used as intended. If the performance level is not specified by the manufacturer, this may be derived from the product description and documentation and what the user may reasonably expect from the equipment if used as intended.

Performance Criterion B

The EUT shall continue to operate as intended after the test. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the EUT is used as intended. The performance level may be replaced by a permissible loss of performance. However, during the test degradation of performance is allowed but 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, either of these may be derived from the product description and documentation and what the user may reasonably expect from the equipment if used as intended.

Performance Criterion C

Temporary loss of function is allowed during the test, provided the function is self-recoverable or can be restored by the operation of the controls.

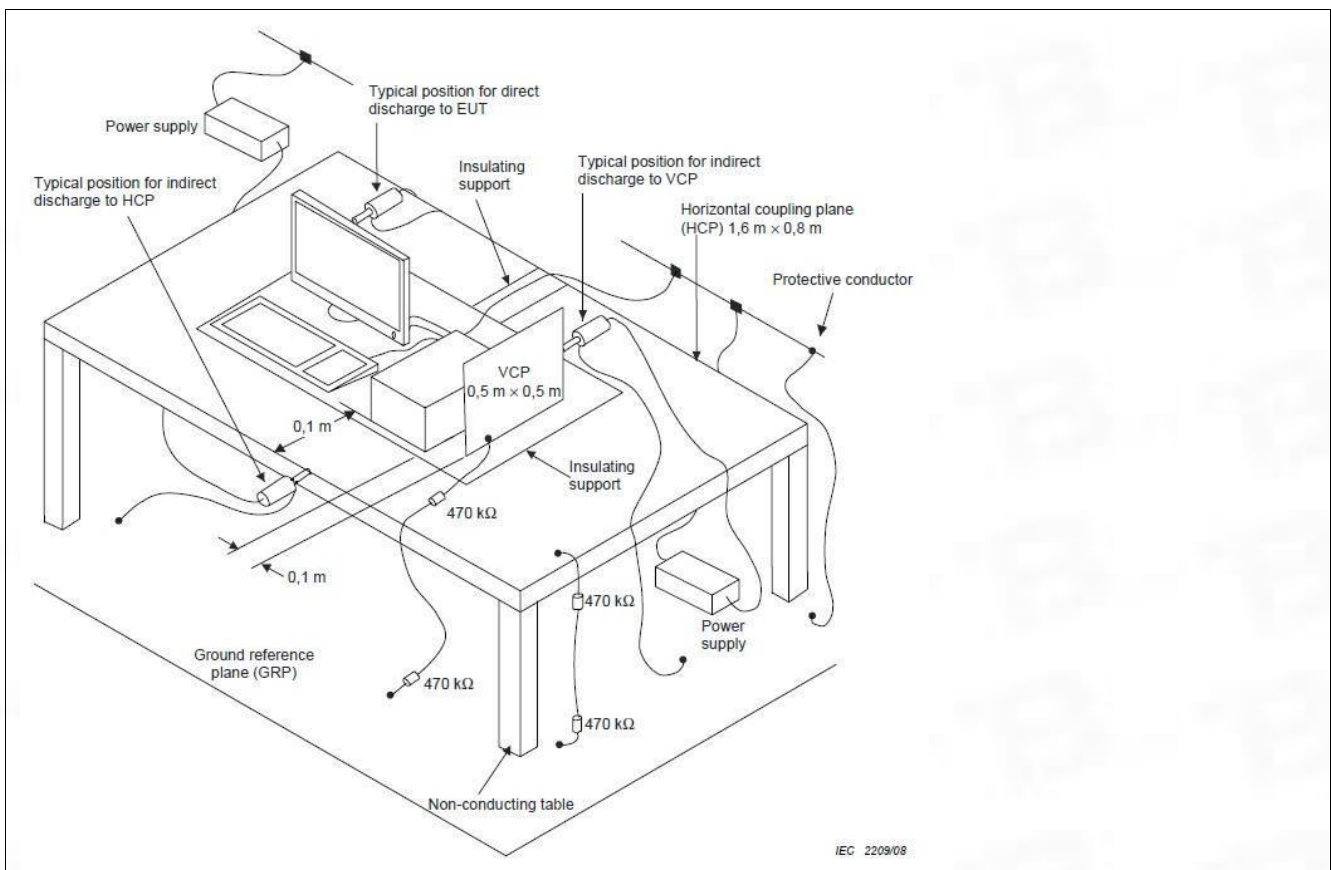
6.1 Electrostatic discharge

Test Requirement:	Table 1.4
Test Method:	EN 61000-4-2: 2009
Test Limit:	Performance criterion B
Procedure:	Discharge Impedance: 330 Ω / 150 pF Discharge Voltage: Air Discharge: 8 kV; Contact Discharge: 4 kV; VCP/HCP: 4 kV. Polarity: Positive & Negative Number of Discharge: Minimum 10 times at each test point Discharge Mode: Single Discharge Discharge Period: 1 second minimum
Performance Criteria:	B

6.1.1 E.U.T. Operation:

Operating Environment:	
Temperature:	25.4 °C
Humidity:	45.5 %
Atmospheric Pressure:	1010 mbar

6.1.2 Test Setup Diagram:



6.1.3 Test Data:

Discharge type	Volt (kV)	Polarity	Test Point	Result/ Observations
Air discharge	8	+	1	A
Air discharge	8	-	1	A
Contact discharge	4	+	2	A
Contact discharge	4	-	2	A
Horizontal Coupling	4	+	3	A
Horizontal Coupling	4	-	3	A
Vertical Coupling	4	+	3	A
Vertical Coupling	4	-	3	A

Note1:

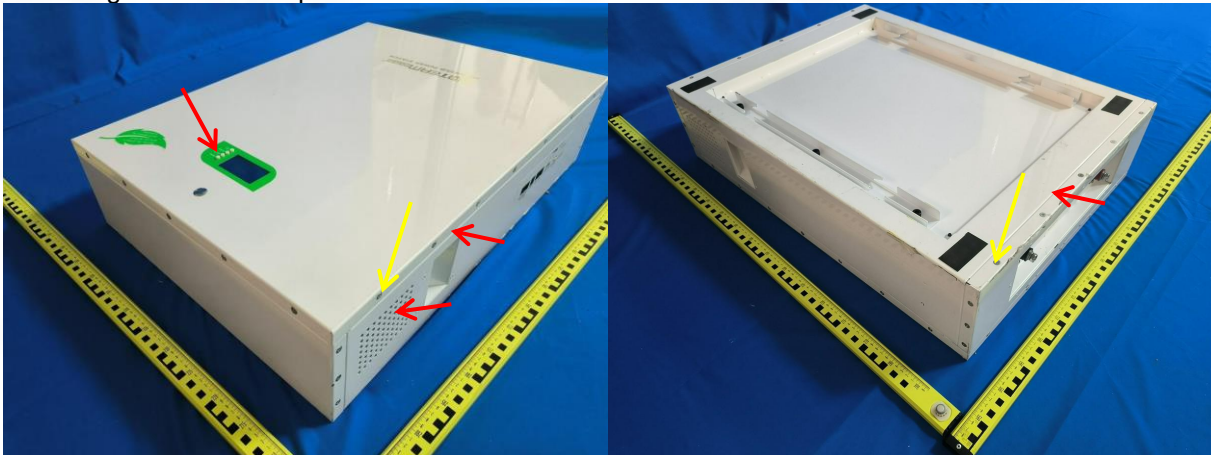
Test Points:

Air discharge: Red Arrow

Contact discharge: Yellow Arrow

Horizontal / Vertical Coupling: All sides

A: No degradation in the performance of the EUT was observed.



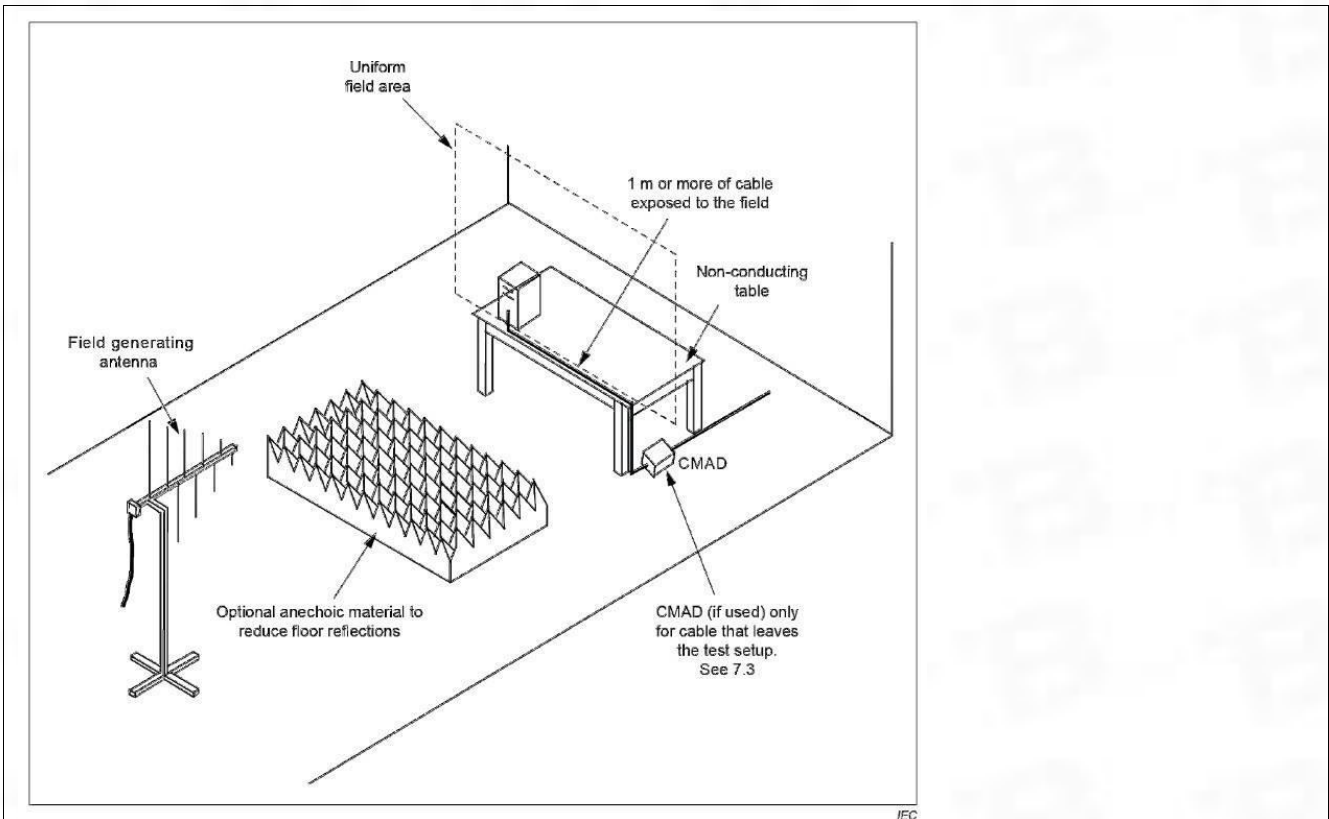
6.2 Radio-frequency electromagnetic field

Test Requirement:	Table 1.2 & 1.3
Test Method:	EN IEC 61000-4-3:2020
Test Limit:	Performance criterion A
Procedure:	Antenna Polarisation: Vertical and Horizontal Modulation: 1kHz,80% Amp. Mod,1% increment Frequency Range: 80MHz to 1GHz, 1.4GHz to 6GHz
Performance Criteria:	A

6.2.1 E.U.T. Operation:

Operating Environment:	
Temperature:	25.6 °C
Humidity:	47.6 %
Atmospheric Pressure:	1010 mbar

6.2.2 Test Setup Diagram:



6.2.3 Test Data:

Frequency	Field Strength (V/m)	EUT face	Dwell time	Result/ Observations
80MHz-1GHz	3	Front	2s	A
80MHz-1GHz	3	Back	2s	A
80MHz-1GHz	3	Left	2s	A
80MHz-1GHz	3	Right	2s	A
80MHz-1GHz	3	Top	2s	A
80MHz-1GHz	3	Bottom	2s	A
1.4GHz-6GHz	3	Front	2s	A
1.4GHz-6GHz	3	Back	2s	A
1.4GHz-6GHz	3	Left	2s	A
1.4GHz-6GHz	3	Right	2s	A
1.4GHz-6GHz	3	Top	2s	A
1.4GHz-6GHz	3	Bottom	2s	A

A: No degradation in the performance of the EUT was observed.

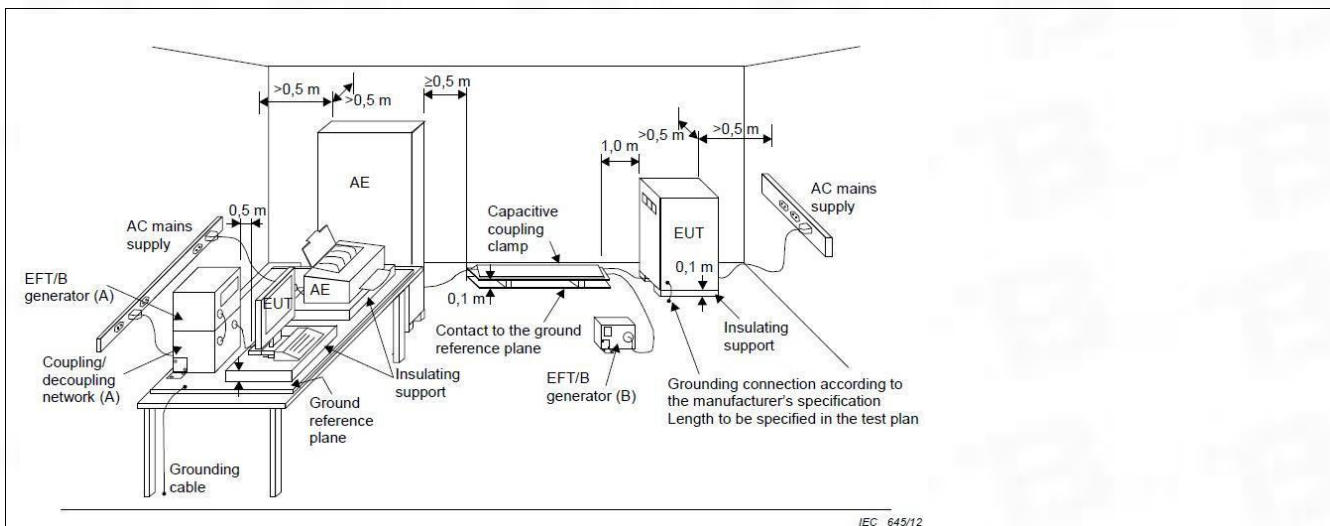
6.3 Fast transients on Input and output DC power ports

Test Requirement:	Table 3.3
Test Method:	EN 61000-4-4:2012
Test Limit:	Table 3.3
Procedure:	Repetition Frequency: 5kHz or 100kHz Burst Period: 300ms Test Duration: 2 minute per level & polarity Test Level: 0.5kV
Performance Criteria:	B

6.3.1 E.U.T. Operation:

Operating Environment:	
Temperature:	25.7 °C
Humidity:	51.7 %
Atmospheric Pressure:	1010 mbar

6.3.2 Test Setup Diagram:



6.3.3 Test Data:

Port	Votl (kV)	Polarity	CDN/ Clamp	Result/ Observations
DC power port	0.5	+	CDN	A
DC power port	0.5	-	CDN	A

A: No degradation in the performance of the EUT was observed.

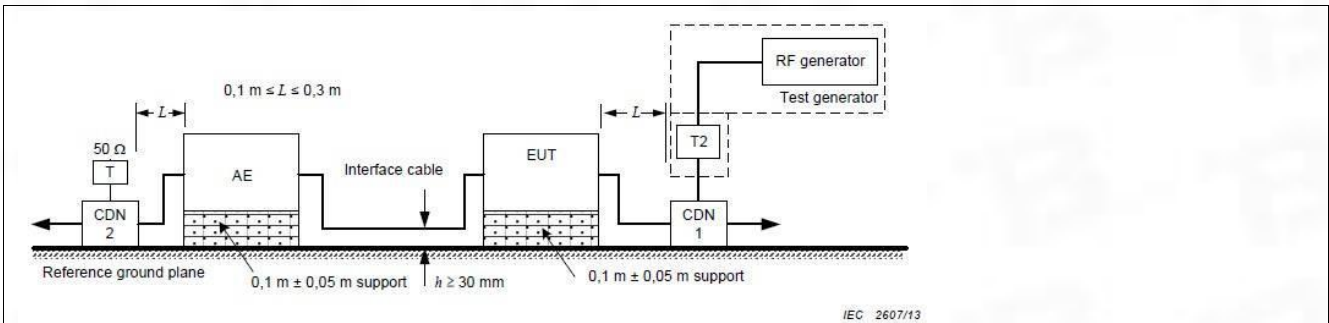
6.4 Radio-frequency common mode on Input and output DC power ports

Test Requirement:	Table 3.1
Test Method:	EN 61000-4-6:2014
Test Limit:	Performance criterion A
Procedure:	Frequency Range: 0.15MHz to 80MHz Modulation: 80%, 1kHz Amplitude Modulation Step Size 1%
Performance Criteria:	A

6.4.1 E.U.T. Operation:

Operating Environment:	
Temperature:	24 °C
Humidity:	49 %
Atmospheric Pressure:	1010 mbar

6.4.2 Test Setup Diagram:



6.4.3 Test Data:

Port	Strength (Vrms)	CDN/Clamp	Dwell Time	Result /Observation
DC power port	3	CDN	3s	A

A: No degradation in the performance of the EUT was observed.

7 Test Setup Photos

Conducted disturbances from DC power port



Radiation disturbance (30MHz-1GHz)



Electrostatic discharge

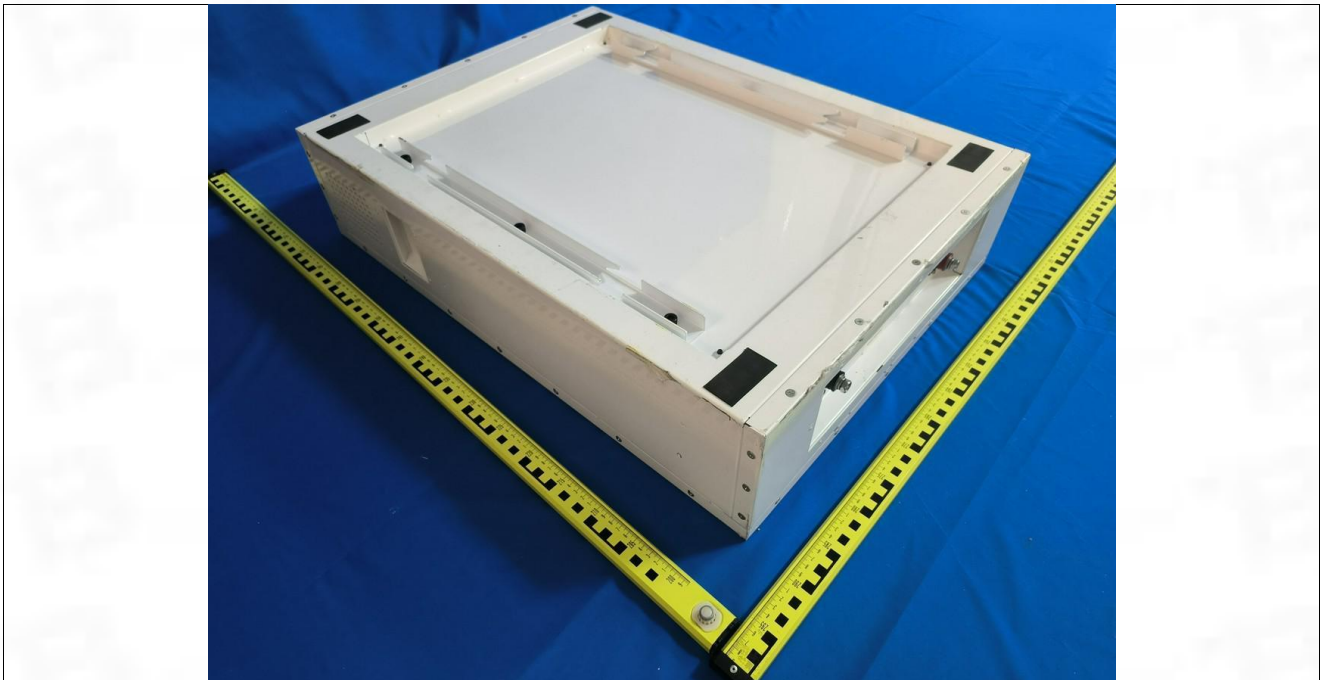
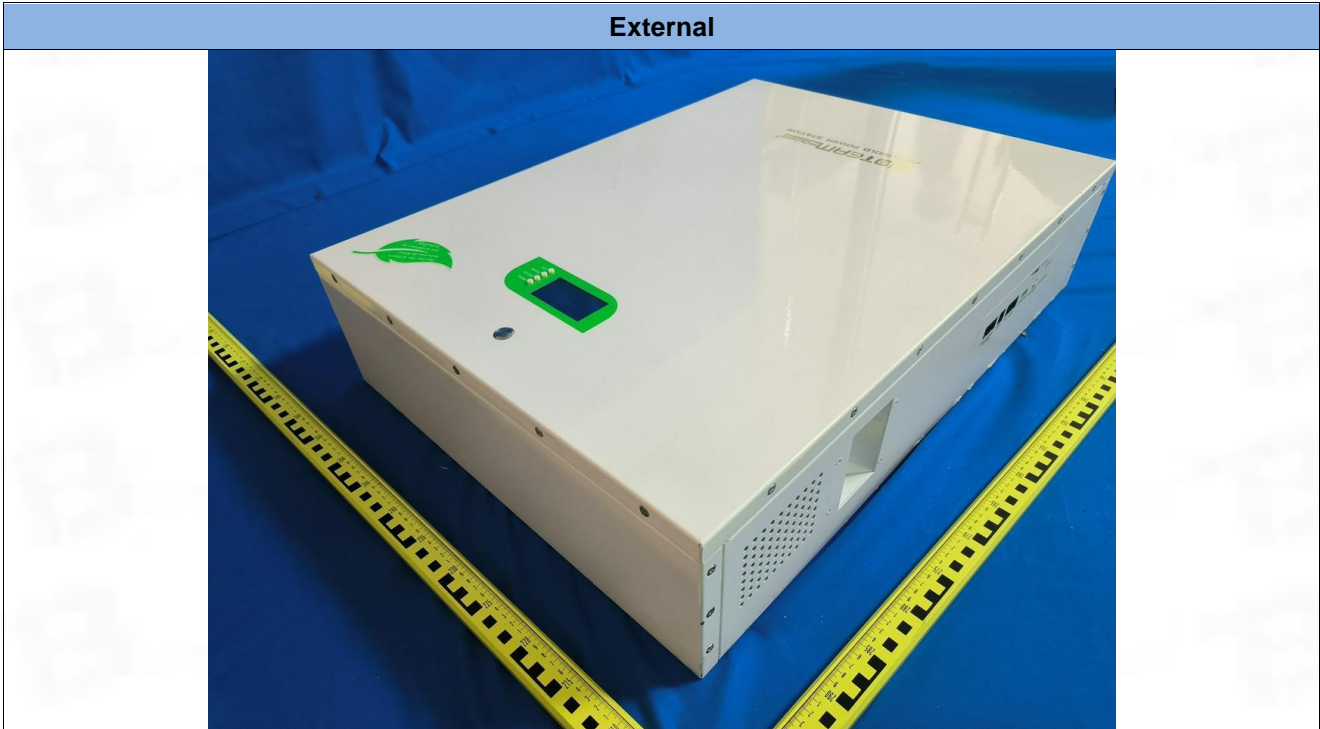


Fast transients on Input and output DC power ports

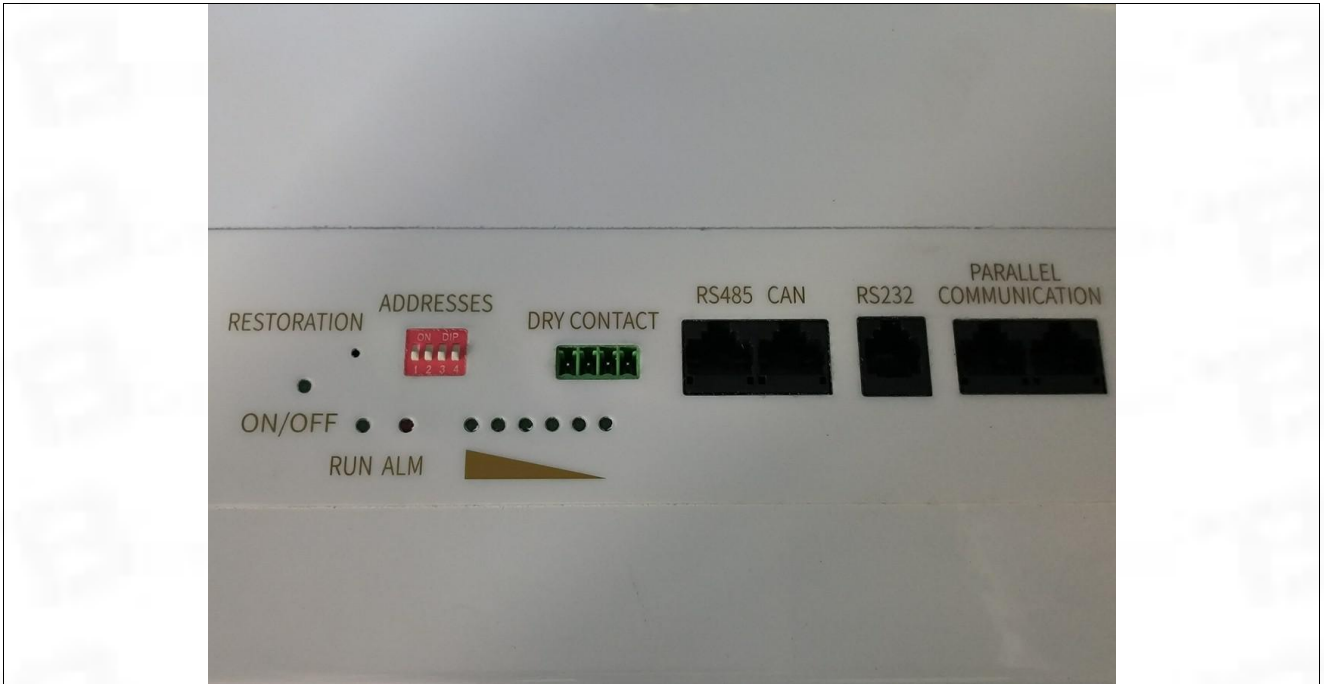


8 EUT Constructional Details (EUT Photos)

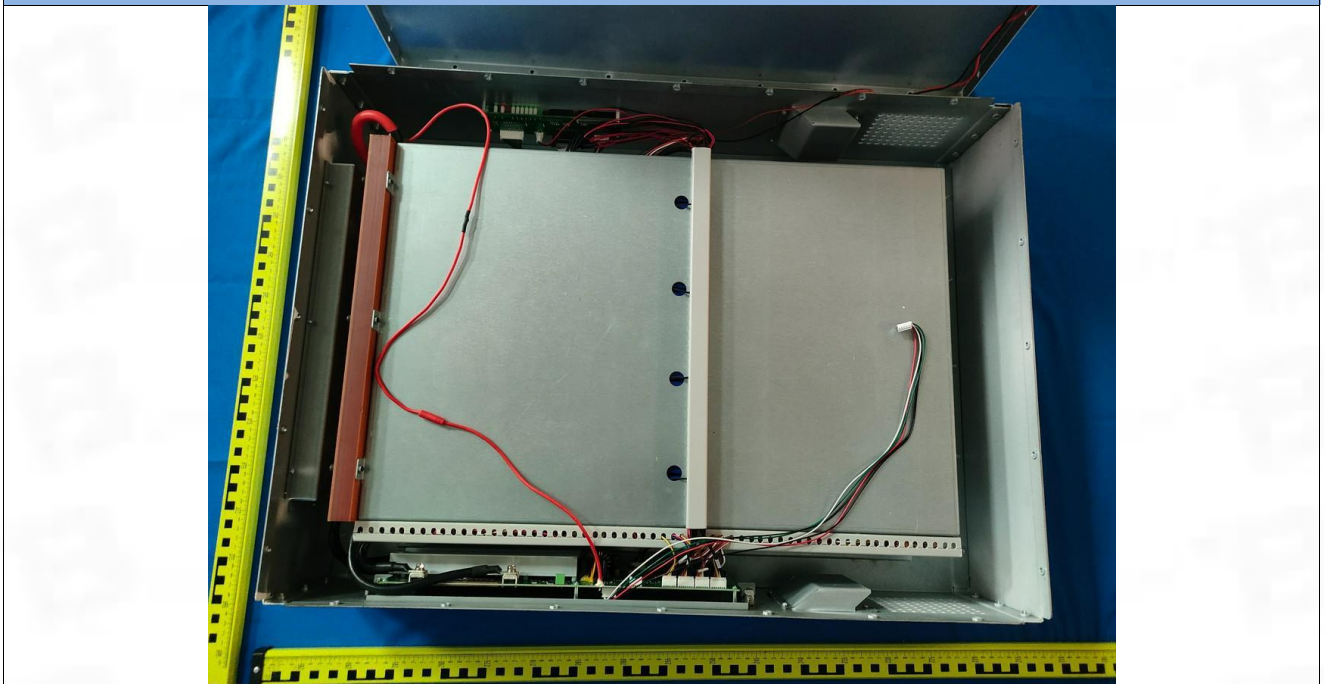
External

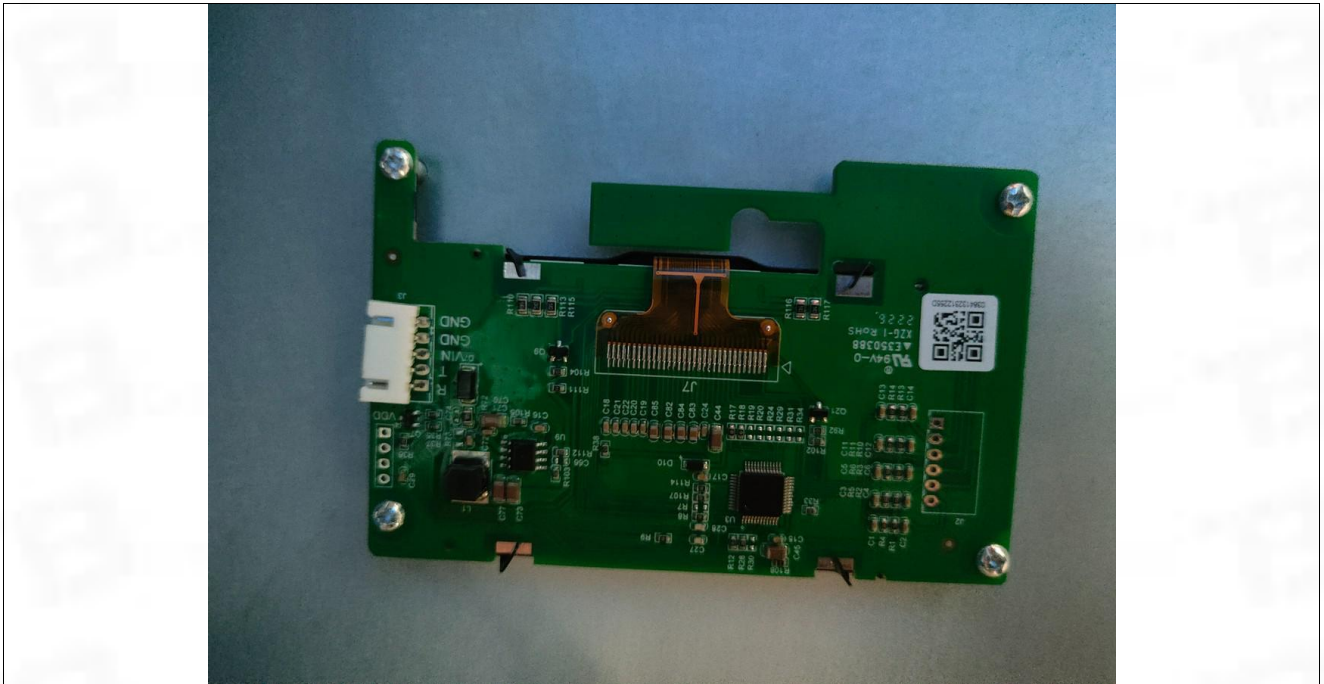






Internal







Test Report Number: BTF-SZ221031E-003



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