

EMC TEST REPORT

The device described below is tested by Shenzhen NTC Co., Ltd. to determine the maximum emission levels emanating from the device, the severe levels which the device can endure and E.U.T.'s performance criterion. The test results are contained in this test report. Shenzhen NTC Co., Ltd. is assumed of full responsibility for the accuracy and completeness of these tests.

Applicant : SHENZHEN MUST ENERGY TECHNOLOGY CO.,LTD
Address : 5F, Building 11, Rundongsheng Industrial Park, Longzhu,Xixiang, Baoan District, Shenzhen, Guangdong, China
Manufacturer/ Factory : MUST (GUANGDONG) ENERGY TECHNOLOGY CO.,LTD
Address : 5FL, Building 8, No.115, zhangcha 1st road, South China power innovation Science Park, Foshan city, Guangdong, China
E.U.T. : HYBRID SOLAR INVERTER
Brand Name : MUST
Model No. : PH18-5048 PLUS, PH18-4048 PLUS, PH18-3048 PLUS, PH18-5048 VHM, PH18-4048 VHM, PH18-3048VHM
Measurement Standard : EN 61000-6-1: 2017/IEC 61000-6-1: 2016, EN 61000-6-3: 2007+A2:2016/IEC 61000-6-3:2006 IEC 61000-3-12: 2011/EN 61000-3-12: 2011, IEC 61000-3-11: 2017/EN 61000-3-11: 2000 (IEC 61000-4-2: 2008 / EN 61000-4-2: 2009, IEC 61000-4-3 : 2006 / EN 61000-4-3: 2006+A2: 2010, IEC 61000-4-4: 2012 / EN 61000-4-4: 2012, IEC 61000-4-5 :2014 / EN 61000-4-5: 2014+A1:2017, IEC 61000-4-6: 2013 / EN 61000-4-6: 2014+AC:2015, IEC 61000-4-8: 2009 / EN 61000-4-8: 2010, IEC 61000-4-11: 2004 / EN 61000-4-11: 2004+ A1:2017)
Date of Receiver : March 30, 2019
Date of Test : March 31, 2019 to June 18, 2019
Date of Report : June 20, 2019

This Test Report is Issued Under the Authority of :

Prepared by



Bowen Zhu / Engineer

Approved & Authorized Signer



Han Song / Authorized Signatory

This report shows that the E.U.T. is technically compliant with the IEC/EN 61000-6-3, IEC/EN 61000-3-2, IEC/EN 61000-3-3 and IEC/EN 61000-6-1. This report applies to above tested sample only and shall not be reproduced in part without written approval of Shenzhen NTC Co., Ltd.

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Appendix I (Photos of E.U.T.) (11 pages)

Revision History of This Test Report

Report Number	Description	Issued Date
NTC19031024EV00	Initial Issue	2019-06-20

1. SUMMARY OF TEST RESULTS

The E.U.T. has been tested according to the following specifications:

EMISSION			
Standard	Test Type	Result	Remarks
EN 61000-6-3: 2007+A2:2016/ IEC 61000-6-3:2006	Mains Terminal Disturbance Voltage test	PASS	Uncertainty: 2.7dB
	Radiated Emission Measurement	PASS	Uncertainty: 3.6dB
EN 61000-3-12: 2011/ IEC 61000-3-12: 2011	Harmonic Current Emission Measurement	PASS	Meets the requirements.
EN 61000-3-11: 2000 IEC 61000-3-11:2017	Voltage Fluctuations & Flicker Measurement	PASS	Meets the requirements.

IMMUNITY(EN 61000-6-1:2017/IEC 61000-6-1: 2016)			
Standard	Test Type	Result	Remarks
IEC 61000-4-2: 2008/ EN 61000-4-2: 2009	Electrostatic discharge immunity test	PASS	Meets the requirements of Performance Criterion B
IEC 61000-4-3: 2006/ EN 61000-4-3: 2006	Radiated, radio-frequency, electromagnetic field immunity test	PASS	Meets the requirements of Performance Criterion A
IEC 61000-4-4: 2012/ EN 61000-4-4: 2012	Electrical fast transient/ burst immunity test	PASS	Meets the requirements of Performance Criterion B
IEC 61000-4-5: 2014/ EN 61000-4-5: 2014	Surge immunity test	PASS	Meets the requirements of Performance Criterion B
IEC 61000-4-6: 2013/ EN 61000-4-6: 2014	Injected Currents immunity test	PASS	Meets the requirements of Performance Criterion A
IEC 61000-4-8: 2009/ EN 61000-4-8: 2010	Magnetic Field immunity test	PASS	Meets the requirements of Performance Criterion B
EN 61000-4-11: 2004+A1:2017/ IEC 61000-4-11: 2004	Voltage Dips and Interruptions test	PASS	Meets the requirements of Performance Criterion B&C


2. GENERAL INFORMATION

2.1 Details of E.U.T.


E.U.T.	: HYBRID SOLAR INVERTER
Model No.	: PH18-5048 PLUS, PH18-4048 PLUS, PH18-3048 PLUS, PH18-5048 VHM, PH18-4048 VHM, PH18-3048VHM(We Prepare PH18-5048 PLUS for EMC test.)
Brand Name	: MUST
Rating	: Please refer to the next page.
Operation Frequency	: Below 108MHz (Declaration by applicant)
Test Voltage	: AC 230V 50Hz, DC 48V (Battery), DC 72V
Cable	: None
Description of model difference	: The model name, input and output parameters are different, and the software performs the limit.
Remark	: None

Rating:


HYBRID SOLAR INVERTER
Model Name:PH18-5048 PLUS
Operating Temperature Range:-10°C~50°C
Protection Class:Class I
Protection Degree:IP 20
Off-grid Mode:
Rated Power:5000VA/5000W
DC Input:48VDC,118A
AC Output:230VAC,50/60Hz,22A,1 φ
Output Power Factor:1.0
On-grid Mode:
AC Output:230VAC,50/60Hz,22A,1 φ
AC Charger Mode:
AC Input:230VAC,50/60Hz,35A,1 φ
DC Output:54VDC,60A(max)
Solar Charger Mode:
Rated Current:80A
System Voltage:48VDC
MPPT Voltage Range:60~130VDC
Max.Solar Voltage(VOC):145VDC
Max.Charge Current:140A
ShenZhen MUST Energy Technology co.,LTD
5F, Building 11, Rundongsheng Industrial Park,
Longzhu, Xixiang, Baoan District, Shenzhen,
Guangdong, China




VPH184058201812060001
S/N.:VPH185048201812060001




HYBRID SOLAR INVERTER
Model Name:PH18-3048 PLUS
Operating Temperature Range:-10°C~50°C
Protection Class:Class I
Protection Degree:IP 20
Off-grid Mode:
Rated Power:3000VA/3000W
DC Input:48VDC,70A
AC Output:230VAC,50/60Hz,13A,1 φ
Output Power Factor:1.0
On-grid Mode:
AC Output:230VAC,50/60Hz,13A,1 φ
AC Charger Mode:
AC Input:230VAC,50/60Hz,26A,1 φ
DC Output:54VDC,60A(max)
Solar Charger Mode:
Rated Current:80A
System Voltage:48VDC
MPPT Voltage Range:60~130VDC
Max.Solar Voltage(VOC):145VDC
Max.Charge Current:140A
ShenZhen MUST Energy Technology co.,LTD
5F, Building 11, Rundongsheng Industrial Park,
Longzhu, Xixiang, Baoan District, Shenzhen,
Guangdong, China




VPH183048201812060001
S/N.:VPH183048201812060001




HYBRID SOLAR INVERTER
Model Name:PH18-4048 PLUS
Operating Temperature Range:-10°C~50°C
Protection Class:Class I
Protection Degree:IP 20
Off-grid Mode:
Rated Power:4000VA/4000W
DC Input:48VDC,93A
AC Output:230VAC,50/60Hz,17.4A,1 φ
Output Power Factor:1.0
On-grid Mode:
AC Output:230VAC,50/60Hz,17.4A,1 φ
AC Charger Mode:
AC Input:230VAC,50/60Hz,35A,1 φ
DC Output:54VDC,60A(max)
Solar Charger Mode:
Rated Current:80A
System Voltage:48VDC
MPPT Voltage Range:60~130VDC
Max.Solar Voltage(VOC):145VDC
Max.Charge Current:140A
ShenZhen MUST Energy Technology co.,LTD
5F, Building 11, Rundongsheng Industrial Park,
Longzhu, Xixiang, Baoan District, Shenzhen,
Guangdong, China




VPH184048201812060001
S/N.:VPH184048201812060001



HYBRID SOLAR INVERTER
Model Name:PH18-3048 VHM
Operating Temperature Range:-10°C~50°C
Protection Class:Class I
Protection Degree:IP 20
Off-grid Mode:
Rated Power:3000VA/3000W
DC Input:48VDC,70A
AC Output:230VAC,50/60Hz,13A,1 φ
Output Power Factor:1.0
On-grid Mode:
AC Output:230VAC,50/60Hz,13A,1 φ
AC Charger Mode:
AC Input:230VAC,50/60Hz,26A,1 φ
DC Output:54VDC,60A(max)
Solar Charger Mode:
Rated Current:80A
System Voltage:48VDC
MPPT Voltage Range:60~130VDC
Max.Solar Voltage(VOC):145VDC
Max.Charge Current:140A
ShenZhen MUST Energy Technology co.,LTD
5F, Building 11, Rundongsheng Industrial Park,
Longzhu, Xixiang, Baoan District, Shenzhen,
Guangdong, China



VPH183048201812060001
S/N.:VPH183048201812060001



HYBRID SOLAR INVERTER

Model Name:PH18-4048 VHM
Operating Temperature Range:-10°C~50°C
Protection Class:Class I
Protection Degree:IP 20

Off-grid Mode:

Rated Power:4000VA/4000W
DC Input:48VDC,93A
AC Output:230VAC,50/60Hz,17.4A,1 φ
Output Power Factor:1.0

On-grid Mode:

AC Output:230VAC,50/60Hz,17.4A,1 φ

AC Charger Mode:

AC Input:230VAC,50/60Hz,35A,1 φ
DC Output:54VDC,60A(max)

Solar Charger Mode:

Rated Current:80A
System Voltage:48VDC
MPPT Voltage Range:60~130VDC
Max.Solar Voltage(VOC):145VDC

Max.Charge Current:140A

ShenZhen MUST Energy Technology co.,LTD
5F, Building 11, Rundongsheng Industrial Park,
Longzhu, Xixiang, Baoan District, Shenzhen,
Guangdong, China



S/N.:VPH184048201812060001



HYBRID SOLAR INVERTER

Model Name:PH18-5048 VHM
Operating Temperature Range:-10°C~50°C
Protection Class:Class I
Protection Degree:IP 20

Off-grid Mode:

Rated Power:5000VA/5000W
DC Input:48VDC,118A
AC Output:230VAC,50/60Hz,22A,1 φ
Output Power Factor:1.0

On-grid Mode:

AC Output:230VAC,50/60Hz,22A,1 φ

AC Charger Mode:

AC Input:230VAC,50/60Hz,35A,1 φ
DC Output:54VDC,60A(max)

Solar Charger Mode:

Rated Current:80A
System Voltage:48VDC
MPPT Voltage Range:60~130VDC
Max.Solar Voltage(VOC):145VDC

Max.Charge Current:140A

ShenZhen MUST Energy Technology co.,LTD
5F, Building 11, Rundongsheng Industrial Park,
Longzhu, Xixiang, Baoan District, Shenzhen,
Guangdong, China



S/N.:VPH185048201812060001



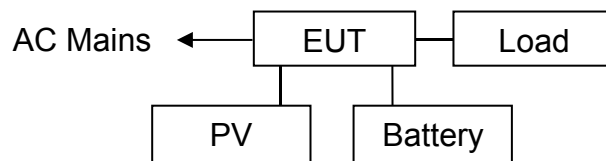
2.2 Description of Support Device

None

2.3 Block Diagram of Test Setup

Block diagram of connection between the E.U.T. and simulators.

2.3.1 AC Input & PV Mode



2.3.2 Inverter Mode



2.4 Test Facility

Site Description

EMC Lab : Listed by CNAS, May 18, 2018
The certificate is valid until May 17, 2024
The Laboratory has been assessed and proved to be in compliance with CNAS/CL01

Name of Firm 1 : The Certificate Registration Number is L11038.
Dongguan Nore Testing Center Co., Ltd.
(Dongguan NTC Co., Ltd.)

Site Location 1 : Building D, Gaosheng Science & Technology
Park, Zhouxi Longxi Road, Nancheng
District, Dongguan City, Guangdong Province, China

Name of Firm 2 : Shenzhen NTC Co., Ltd.

Site Location 2 : South, No. 1, Building 10, Maqueling Industrial
Zone, Nanshan Shenzhen, Guangdong, 518057,
China

2.5 Abnormalities from Standard Conditions

None

3. MEASURING DEVICES AND TEST EQUIPMENT

3.1 For Mains terminals Disturbance Voltage Test

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	Test Receiver	Rohde & Schwarz	ESCI	1142.8007.07	Mar. 24, 2019	1 Year
2.	L.I.S.N	Rohde & Schwarz	ESH3-Z5	100157	May 06, 2019	1 Year
3.	L.I.S.N	SCHWARZBECK	NNLK8129	8129-212	May 06, 2019	1 Year
4.	RF Switching Unit	Compliance Direction Systems Inc.	RSU-M2	RSUM2009	May 06, 2019	1 Year
5.	EMI Power Line Filter	JIANLI	DL-2*3282	N/A	N/A	N/A
6.	EMI Power Line Filter	JIANLI	DL-4*3282	N/A	N/A	N/A

3.2 For Radiated Emission Measurement

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	Test Receiver	Rohde & Schwarz	ESCI	100120	Mar. 24, 2019	1 Year
2.	Antenna	SCHAFFNER	CBL6112B	2625	May 26, 2019	1 Year
3.	Positioning Controller	MF	MF-7802	MF780208389	N/A	N/A
4.	Color Monitor	QUNXIN	ML-14C	MV0120	N/A	N/A
5.	EMI Power Line Filter	JIANLI	DL-2*3282	N/A	N/A	N/A
6.	EMI/RFI Filter	ETS	LRE-2030/PEN	00156629	N/A	N/A
7.	EMI Power Line Filter	JIANLI	DL-4*3282	N/A	N/A	N/A
8.	Cable	Huber+Suhner	CBL3-NN-9M	21490001	May 06, 2019	1 Year
9.	Cable	Huber+Suhner	RG223U	N/A	May 06, 2019	1 Year
10.	Power Amplifier	HP	HP 8447F	2443A01735	Mar. 27, 2019	1 Year

3.3 For Harmonic/Flicker Measurement

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	Power Frequency Test System	LAPLACE INSTRUMENTS LTD	AS 2000A	N/A	May 06, 2019	1 Year
2.	Software	Thurlby Thandar Instruments Ltd	HA-PC Link Plus v 3.01	N/A	N/A	N/A

3.4 For Electrostatic Discharge Immunity Test

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	ESD Tester	HAEFELY	ONYX16	1811981	Mar. 24, 2019	1 Year
2.	ESD Gun-1	HAEFELY	N/A	4700500/01	Mar. 24, 2019	1 Year
3.	ESD Gun-2	HAEFELY	N/A	4700525/00	Mar. 24, 2019	1 Year

3.5 For RF Electromagnetic Field Immunity Test

(Dongguan Nore Testing Center Co., Ltd.)

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	Signal Generator	Agilent	N5181A	MY47070160	Apr. 25, 2019	1 Year
2.	RF Switch	SKET	N/A	N/A	N/A	N/A
3.	Power Amplifier	SKET	HAP801000M 250W	N/A	N/A	N/A
4.	Power Amplifier	SKET	HAP0103G_75W	N/A	N/A	N/A
5.	Power Amplifier	SKET	HAP0306G_50W	N/A	N/A	N/A
6.	Power Meter	Agilent	E4419B	GB40201469	Apr.25,2019	1 Year
7.	Power Sensor	Agilent	E9300A	MY41498919	Apr.25,2019	1 Year
8.	Power Sensor	Agilent	E9300A	US39211259	Apr.25,2019	1 Year
9.	E-Field Probe	Narda	EP-601	N/A	Apr.24,2019	1 Year
10.	Antenna	Schwarzbeck	STLP 9129	00071	Apr.25,2019	2 Year
11.	Audio Analyzer	Rohde& Schwarz	UPV	100894	Mar.23,2019	1 Year
12.	Chamber	Chengyu	7*5*3.5m	N/A	Apr.25,2019	2 Year
13.	Test Software	SKET	SKET_RS	N/A	N/A	N/A

3.6 For Electrical Fast Transient /Burst Immunity Test

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	Burst Tester	HAEFELY	AXOS5	177723	Mar. 24, 2019	1 Year
2.	Coupling Clamp	HAEFELY	N/A	N/A	May 06, 2019	1 Year
3.	Test Soft	VNC	VNC Viewer 5.0.5	N/A	N/A	N/A

3.7 For Surge Immunity Test

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	Surge Tester	HAEFELY	AXOS5	177723	Mar. 24, 2019	1 Year
2.	Test Soft	VNC	VNC Viewer 5.0.5	N/A	N/A	N/A

3.8 For Injected Currents Immunity Test

(Dongguan Nore Testing Center Co., Ltd.)

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	Signal Generator	IFR	2023A	N/A	Mar. 14, 2019	1 Year
2.	Power Amplifier	SCHAFFNER	CBA9425	1022	Mar. 14, 2019	1 Year
3.	6dB 50Watt Attenuator	SCHAFFNER	ATN6025	N/A	Mar. 23, 2019	1 Year
4.	CDN	Lioncel	CDN-M3-16	0170703	Mar. 14, 2019	1 Year
5.	CDN	Lioncel	CDN-M2-16	0180501	Mar. 14, 2019	1 Year
6.	CDN	CDSI	CDN-M5/AF5	8105001	Mar. 14, 2019	1 Year
7.	EM Clamp	CDSI	EMCL-22	8192007	Mar. 14, 2019	1 Year
8.	Directional Coupler	SCHAFFNER	255	19184	Mar. 23, 2019	1 Year
9.	Dips Modulator	EM TEST	V4780S2	0111-11	Mar. 14, 2019	1 Year
10.	Audio Analyzer	Rohde & Schwarz	UPV	100894	Mar. 23, 2019	1 Year
11.	Test Software	SKET	SKET_RS	N/A	N/A	N/A

3.9 For Magnetic Field Immunity Test

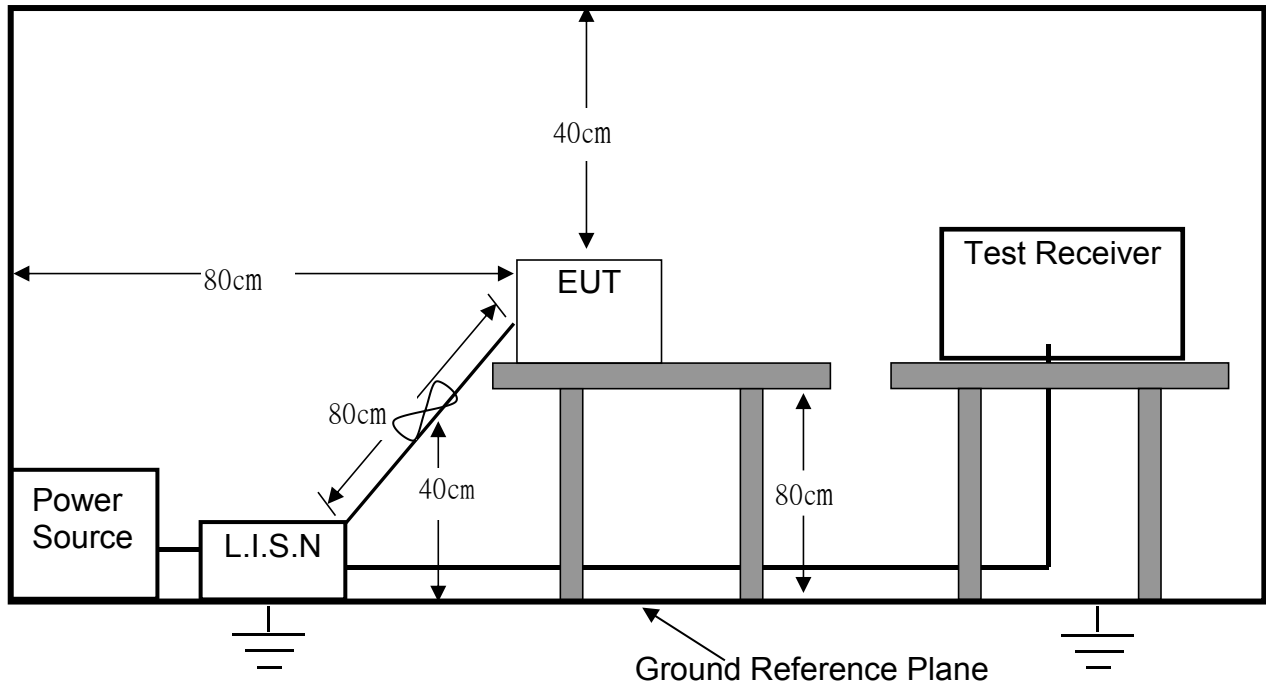
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	Magnetic Field Tester	N/A	MS-8000	N/A	Mar. 24, 2019	1 Year
2.	Test Software	N/A	N/A	N/A	N/A	N/A

3.10 For Voltage Dips and Interruptions Test

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	Dips Tester	HAEFELY	AXOS5	177723	Mar. 24, 2019	1 Year
2.	Test Soft	VNC	VNC Viewer 5.0.5	N/A	N/A	N/A
3.	Dips Modulator	N/A	N/A	N/A	N/A	N/A

4. MAINS TERMINAL DISTURBANCE VOLTAGE TEST

4.1 Block Diagram of Test Setup



4.2 Limit of Mains Terminal Disturbance Voltage Test

Test Standard: EN 61000-6-3: 2007+A2:2016/ IEC 61000-6-3: 2006

Limits for conducted disturbance at the mains port.

Frequency range (MHz)	Limits (dB(uV))	
	Quasi-peak	Average
0.15 to 0.5	66 to 56	56 to 46
0.5 to 5	56	46
5 to 30	60	50

- Note:
1. The lower limit shall apply at the transition frequencies.
 2. The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.5 MHz.

4.3 Test Procedure

The E.U.T. is put on the 0.8 m high table and connected to the AC mains through a Artificial Mains Network (AMN). This provided a 50ohm coupling impedance for the tested equipments. Both sides of AC line are checked to find out the maximum conducted emission levels according to the EN 61000-6-3 regulations during conducted emission test.

The bandwidth of the test receiver (R&S Test Receiver ESCI) is set at 9 KHz.

4.4 Operating Condition of E.U.T.

4.4.1 Setup the E.U.T. and simulators as shown in Section 2.3.

4.4.2 Turn on the power of all equipments.

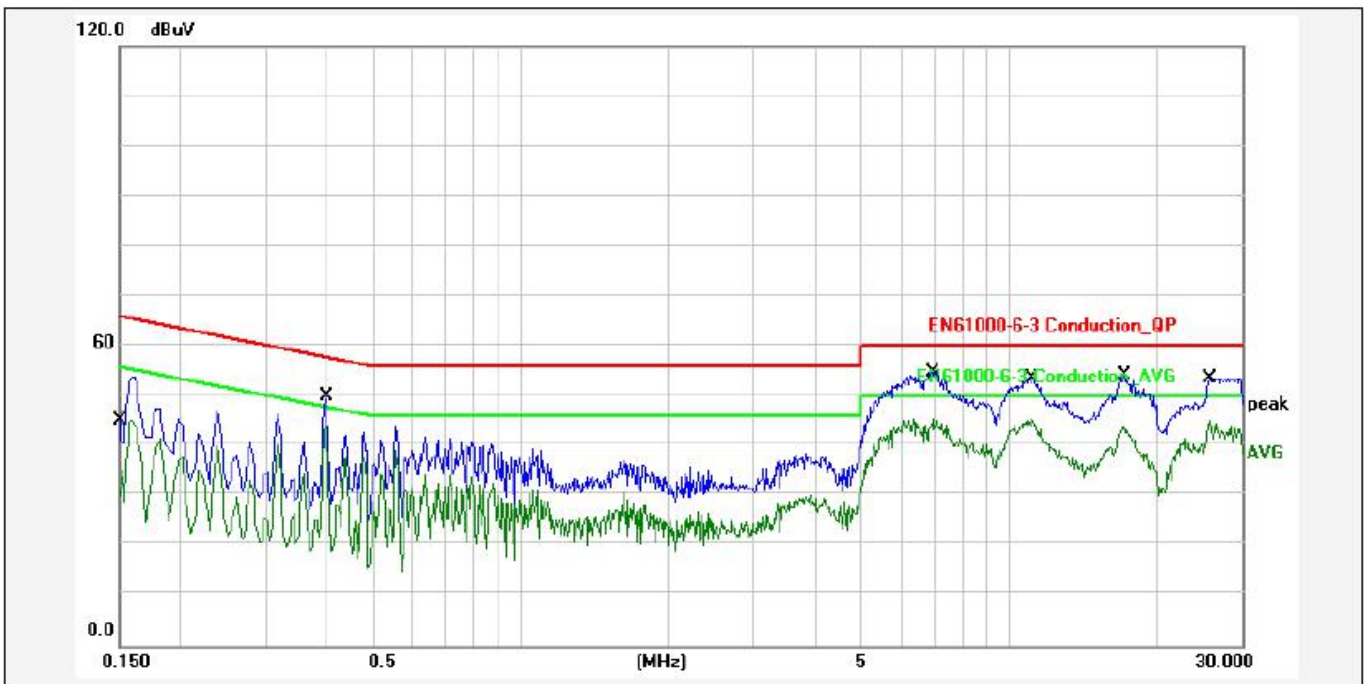
4.4.3 Let the E.U.T. work in test modes (AC Input Mode, Inverter Mode,PV Mode)
and test it.

4.5 Mains Terminal Disturbance Voltage Test Results

PASS.

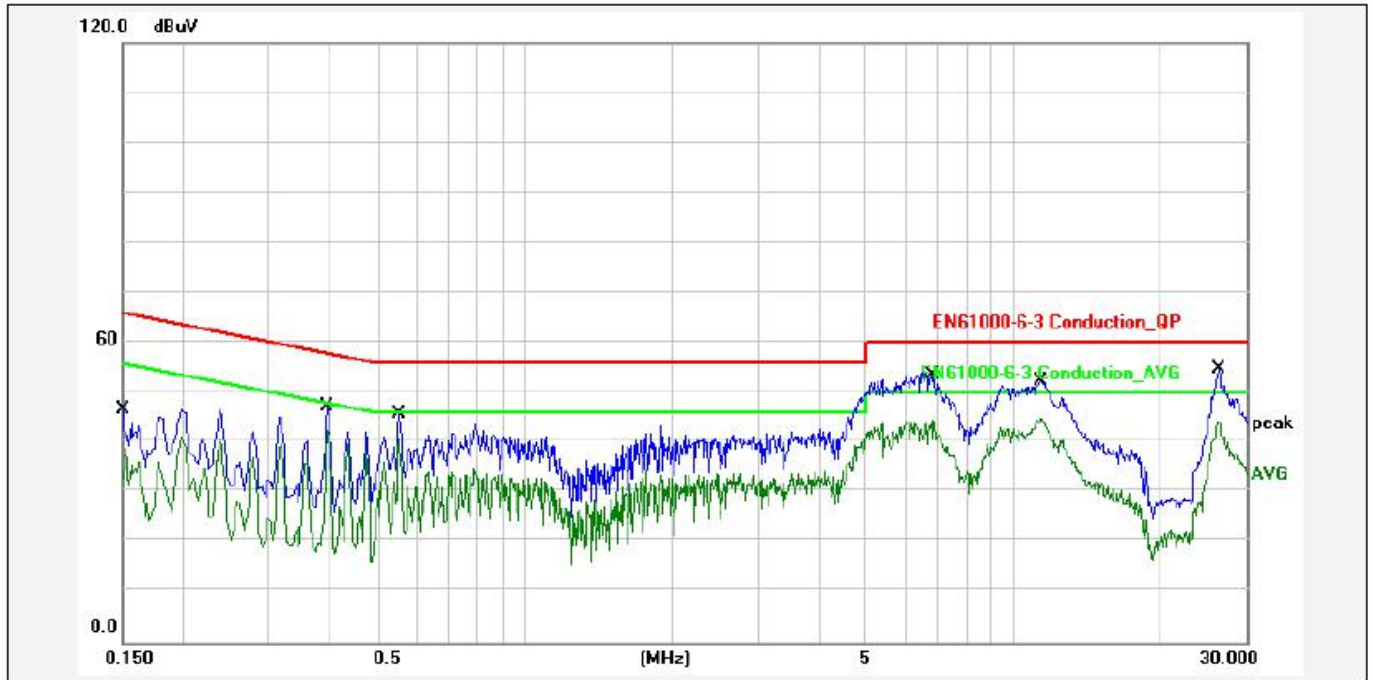
Please refer to the following pages.

E.U.T :	HYBRID SOLAR INVERTER	Model Name :	PH18-5048 PLUS
Temperature :	26°C	Relative Humidity :	55 %
Pressure :	1006 hPa	Test Voltage :	AC 230V/50Hz
Test Mode :	AC Input Mode	Phase:	Line



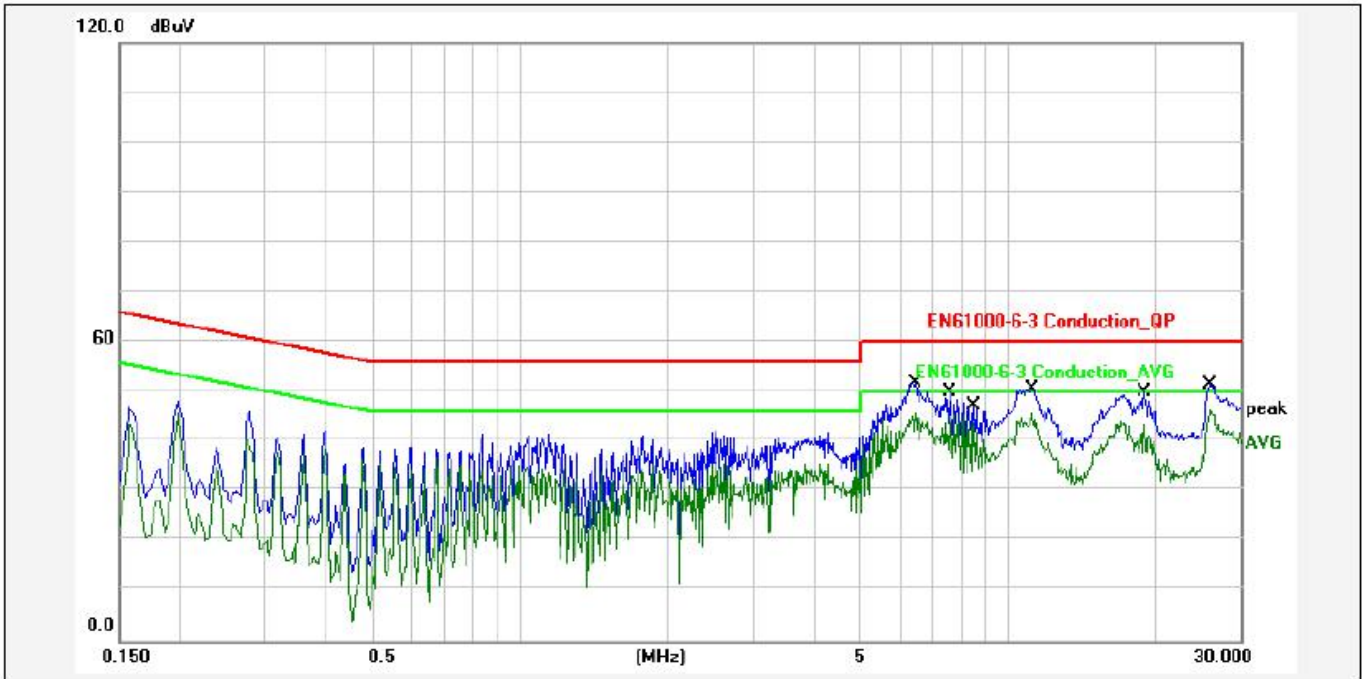
No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F	Remark
1	0.1501	6.60	30.90	37.50	65.99	-28.49	QP	P	
2	0.1501	6.60	21.90	28.50	55.99	-27.49	AVG	P	
3	0.3980	6.33	43.49	49.82	57.89	-8.07	QP	P	
4	0.3980	6.33	38.20	44.53	47.89	-3.36	AVG	P	
5	6.9739	6.34	49.01	55.35	60.00	-4.65	QP	P	
6	6.9739	6.34	39.22	45.56	50.00	-4.44	AVG	P	
7	11.1659	6.35	47.20	53.55	60.00	-6.45	QP	P	
8	11.1659	6.35	39.24	45.59	50.00	-4.41	AVG	P	
9	17.2777	6.36	47.83	54.19	60.00	-5.81	QP	P	
10	17.2777	6.36	37.69	44.05	50.00	-5.95	AVG	P	
11	25.8500	6.44	47.23	53.67	60.00	-6.33	QP	P	
12	25.8500	6.44	38.76	45.20	50.00	-4.80	AVG	P	

E.U.T :	HYBRID SOLAR INVERTER	Model Name :	PH18-5048 PLUS
Temperature :	26°C	Relative Humidity :	55 %
Pressure :	1006 hPa	Test Voltage :	AC 230V/50Hz
Test Mode :	AC Input Mode	Phase:	Neutral



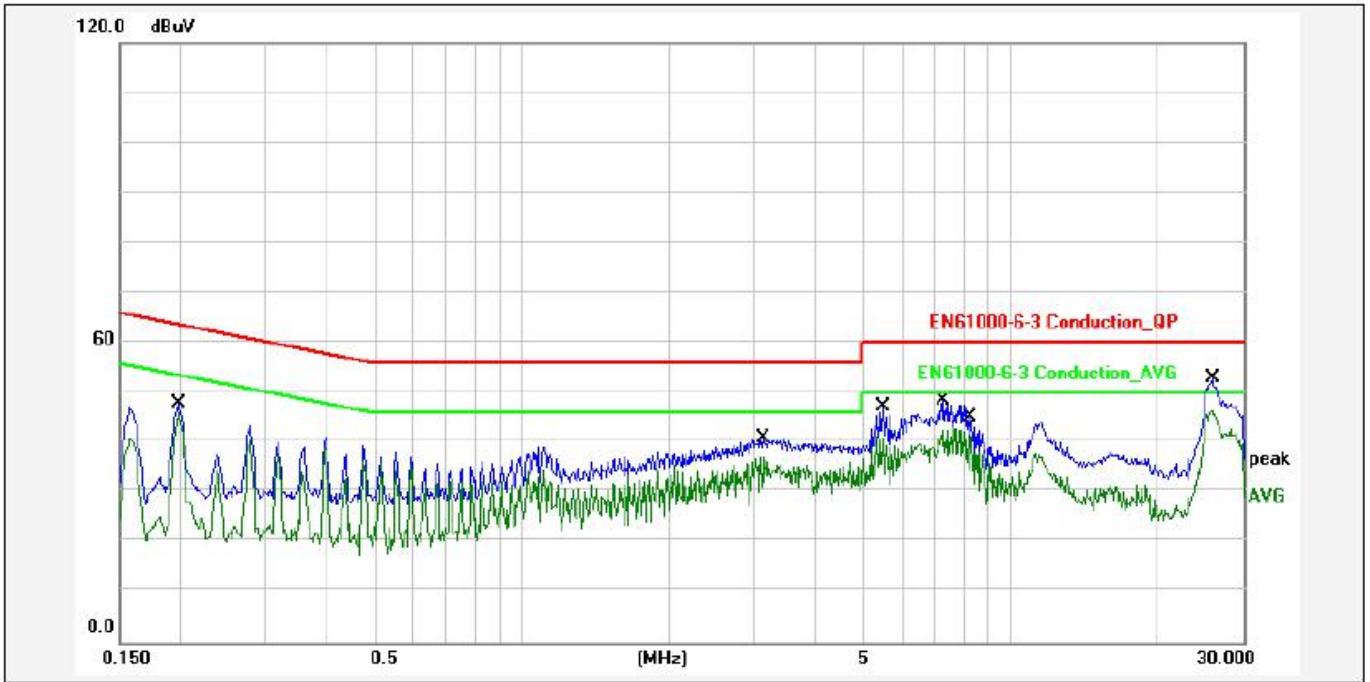
No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F	Remark
1	0.1501	6.60	29.00	35.60	65.99	-30.39	QP	P	
2	0.1501	6.60	22.70	29.30	55.99	-26.69	AVG	P	
3	0.3940	6.34	41.80	48.14	57.98	-9.84	QP	P	
4	0.3940	6.34	37.16	43.50	47.98	-4.48	AVG	P	
5	0.5540	6.23	41.01	47.24	56.00	-8.76	QP	P	
6	0.5540	6.23	36.11	42.34	46.00	-3.66	AVG	P	
7	6.8299	6.33	47.21	53.54	60.00	-6.46	QP	P	
8	6.8299	6.33	38.12	44.45	50.00	-5.55	AVG	P	
9	11.3899	6.35	46.04	52.39	60.00	-7.61	QP	P	
10	11.4938	6.35	38.45	44.80	50.00	-5.20	AVG	P	
11	26.2979	6.46	48.28	54.74	60.00	-5.26	QP	P	
12	26.2979	6.46	37.68	44.14	50.00	-5.86	AVG	P	

E.U.T :	HYBRID SOLAR INVERTER	Model Name :	PH18-5048 PLUS
Temperature :	26°C	Relative Humidity :	55 %
Pressure :	1006 hPa	Test Voltage :	DC 48V
Test Mode :	Inverter Mode	Phase:	Line



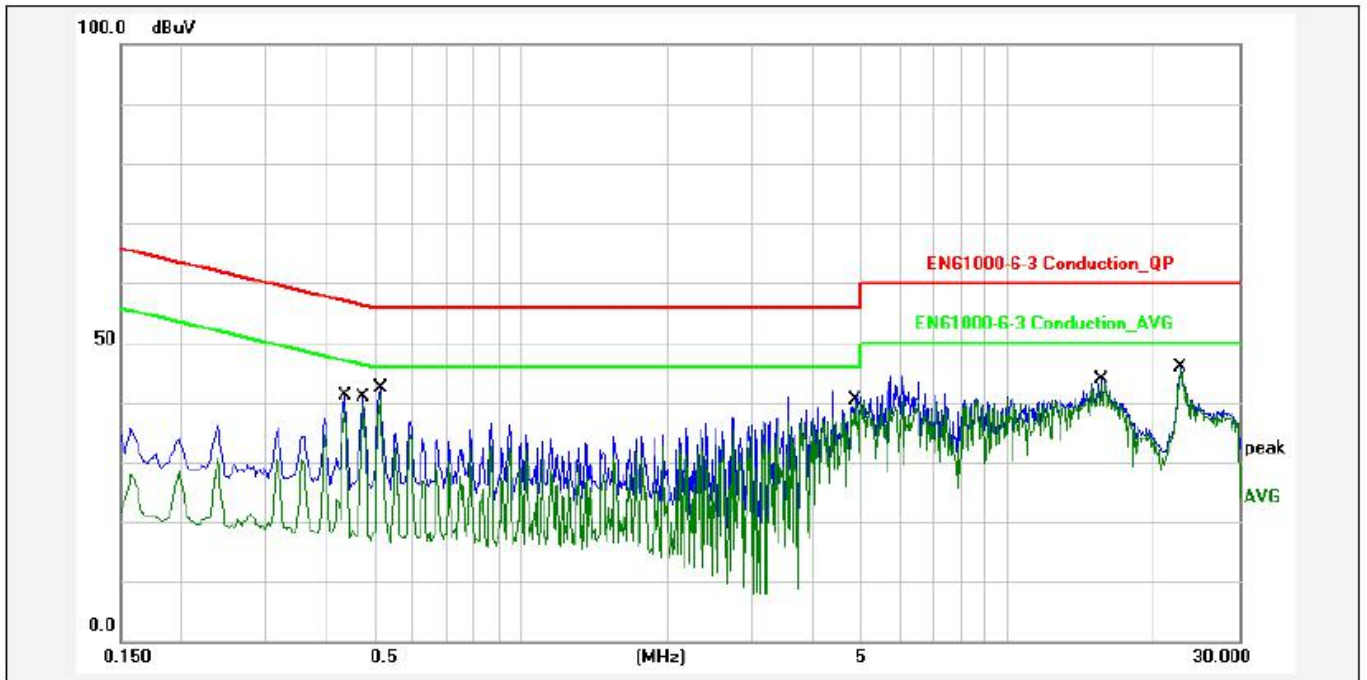
No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F	Remark
1	6.4818	6.34	45.56	51.90	60.00	-8.10	QP	P	
2	6.4818	6.34	39.41	45.75	50.00	-4.25	AVG	P	
3	7.6539	6.34	43.50	49.84	60.00	-10.16	QP	P	
4	7.6539	6.34	38.84	45.18	50.00	-4.82	AVG	P	
5	8.5219	6.35	40.10	46.45	60.00	-13.55	QP	P	
6	8.5219	6.35	37.25	43.60	50.00	-6.40	AVG	P	
7	11.2218	6.35	44.31	50.66	60.00	-9.34	QP	P	
8	11.2218	6.35	39.27	45.62	50.00	-4.38	AVG	P	
9	19.1178	6.54	43.29	49.83	60.00	-10.17	QP	P	
10	19.1178	6.54	36.91	43.45	50.00	-6.55	AVG	P	
11	26.0219	6.63	44.97	51.60	60.00	-8.40	QP	P	
12	26.0219	6.63	39.75	46.38	50.00	-3.62	AVG	P	

E.U.T :	HYBRID SOLAR INVERTER	Model Name :	PH18-5048 PLUS
Temperature :	26°C	Relative Humidity :	55 %
Pressure :	1006 hPa	Test Voltage :	DC 48V
Test Mode :	Inverter Mode	Phase:	Neutral



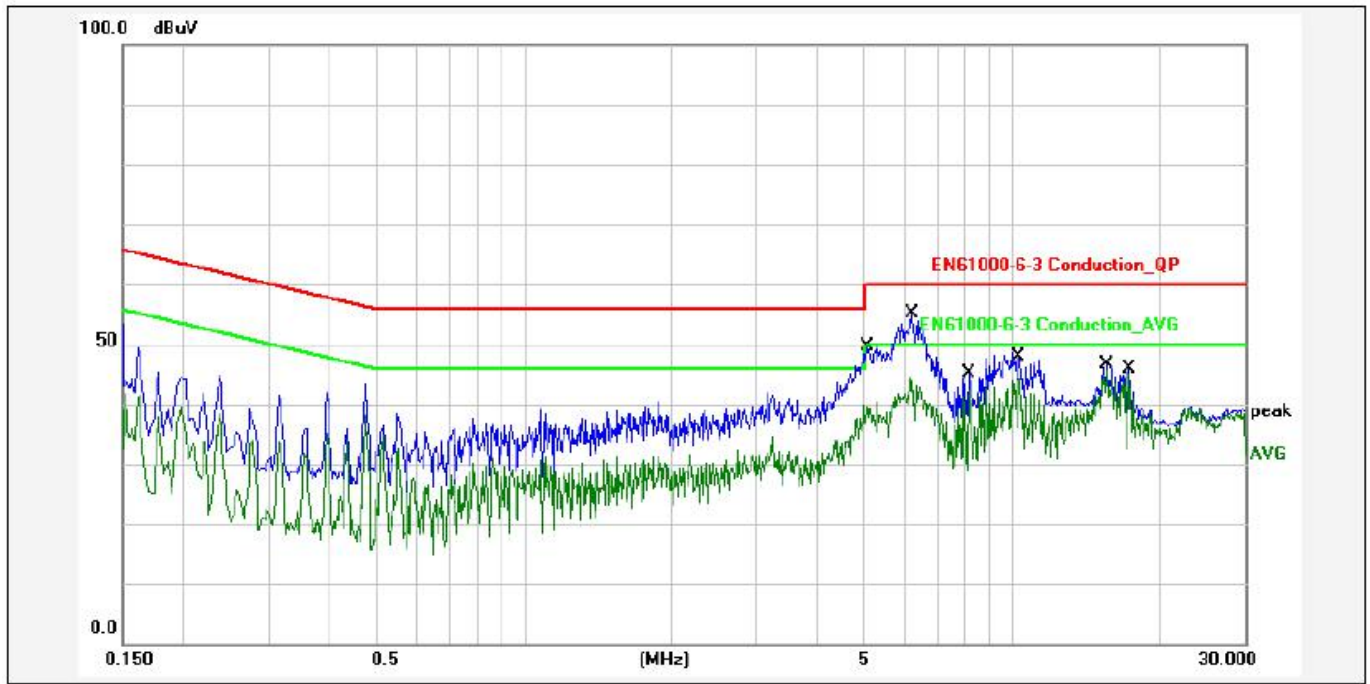
No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F	Remark
1	0.1980	6.42	41.56	47.98	63.69	-15.71	QP	P	
2	0.1980	6.42	39.71	46.13	53.69	-7.56	AVG	P	
3	3.0859	6.32	34.55	40.87	56.00	-15.13	QP	P	
4	3.0859	6.32	30.70	37.02	46.00	-8.98	AVG	P	
5	5.5019	6.34	40.94	47.28	60.00	-12.72	QP	P	
6	5.5019	6.34	34.57	40.91	50.00	-9.09	AVG	P	
7	7.3219	6.34	41.98	48.32	60.00	-11.68	QP	P	
8	7.3219	6.34	36.16	42.50	50.00	-7.50	AVG	P	
9	8.1936	6.34	38.17	44.51	60.00	-15.49	QP	P	
10	8.1936	6.34	35.33	41.67	50.00	-8.33	AVG	P	
11	25.9618	6.63	46.20	52.83	60.00	-7.17	QP	P	
12	25.9618	6.63	39.64	46.27	50.00	-3.73	AVG	P	

E.U.T :	HYBRID SOLAR INVERTER	Model Name :	PH18-5048 PLUS
Temperature :	26°C	Relative Humidity :	55 %
Pressure :	1006 hPa	Test Voltage :	DC 72V
Test Mode :	PV Mode	Phase:	Line



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F	Remark
1	0.4339	6.33	34.72	41.05	57.18	-16.13	QP	P	
2	0.4339	6.33	33.04	39.37	47.18	-7.81	AVG	P	
3	0.4737	6.33	34.59	40.92	56.45	-15.53	QP	P	
4	0.4737	6.33	33.24	39.57	46.45	-6.88	AVG	P	
5	0.5140	6.33	35.97	42.30	56.00	-13.70	QP	P	
6	0.5140	6.33	34.73	41.06	46.00	-4.94	AVG	P	
7	4.8539	6.34	34.95	41.29	56.00	-14.71	QP	P	
8	4.8539	6.34	33.49	39.83	46.00	-6.17	AVG	P	
9	15.8696	6.39	37.57	43.96	60.00	-16.04	QP	P	
10	15.8696	6.39	36.78	43.17	50.00	-6.83	AVG	P	
11	22.7457	6.60	39.31	45.91	60.00	-14.09	QP	P	
12	22.7457	6.60	38.90	45.50	50.00	-4.50	AVG	P	

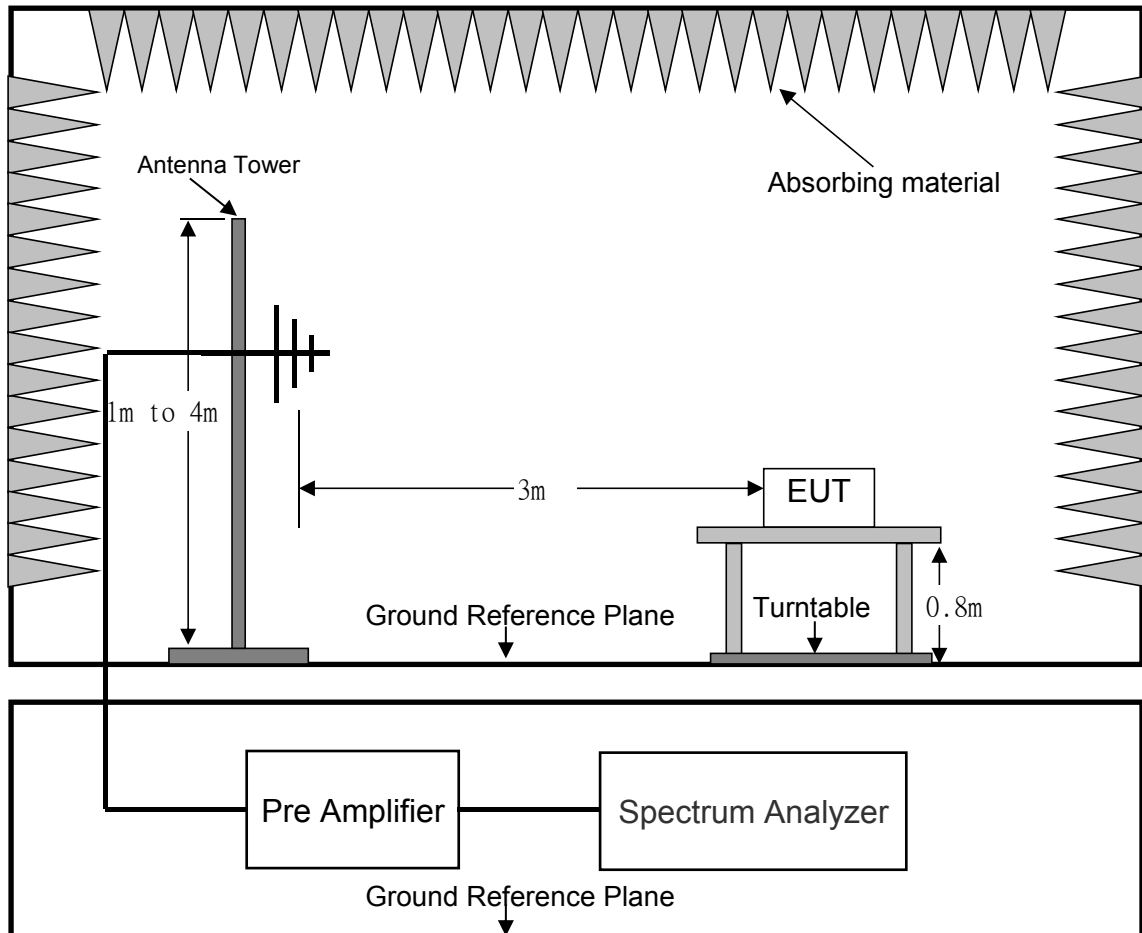
E.U.T :	HYBRID SOLAR INVERTER	Model Name :	PH18-5048 PLUS
Temperature :	26°C	Relative Humidity :	55 %
Pressure :	1006 hPa	Test Voltage :	DC 72V
Test Mode :	PV Mode	Phase:	Neutral



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F	Remark
1	4.9977	6.27	43.42	49.69	56.00	-6.31	QP	P	
2	4.9977	6.27	33.49	39.76	46.00	-6.24	AVG	P	
3	6.2339	6.31	48.76	55.07	60.00	-4.93	QP	P	
4	6.2339	6.31	38.05	44.36	50.00	-5.64	AVG	P	
5	8.1539	6.34	38.83	45.17	60.00	-14.83	QP	P	
6	8.1539	6.34	35.94	42.28	50.00	-7.72	AVG	P	
7	10.3139	6.35	41.46	47.81	60.00	-12.19	QP	P	
8	10.3139	6.35	37.82	44.17	50.00	-5.83	AVG	P	
9	15.6297	6.36	40.20	46.56	60.00	-13.44	QP	P	
10	15.6297	6.36	39.34	45.70	50.00	-4.30	AVG	P	
11	17.3097	6.36	39.58	45.94	60.00	-14.06	QP	P	
12	17.3097	6.36	38.80	45.16	50.00	-4.84	AVG	P	

5. RADIATED EMISSION MEASUREMENT

5.1 Block Diagram of Test



5.2 Limit of Radiated Emission Measurement

Test Standard: EN 61000-6-3: 2007+A2:2016/
IEC 61000-6-3: 2006

Limits for radiated disturbance at a measuring distance of 3m.

Frequency range MHz	Quasi-peak limits dB(uV/m)
30 to 230	40
230 to 1000	47

Note 1 The lower limit shall apply at the transition frequency.

Note 2 If the internal emission source is operating at a frequency below 9KHz, then measurements need only to be performed up to 230MHz

5.3 Test Procedure

E.U.T. and its simulators are placed on a turntable, which is 0.8 meter high above ground. The turntable can rotate 360 degrees to determine the position of the maximum emission level. E.U.T. is set 3.0 meters away from the receiving antenna, which is mounted on an antenna tower. The antenna can be moved up and down between 1.0 meter and 4 meters to find out the maximum emission level. Broadband antenna (calibrated bilog antenna) is used as receiving antenna. Both horizontal and vertical polarization of the antenna is set on measurement. In order to find the maximum emission levels, all of the interface cables must be manipulated according to EN 61000-6-3 on radiated emission measurement.

The bandwidth of the EMI test receiver (R&S ESCI) is set at 120 KHz.

The frequency range from 30 MHz to 1000 MHz is checked.

5.4 Operating Condition of E.U.T.

5.4.1 Setup the E.U.T. and simulators as shown in Section 2.3.

5.4.2 Turn on the power of all equipments.

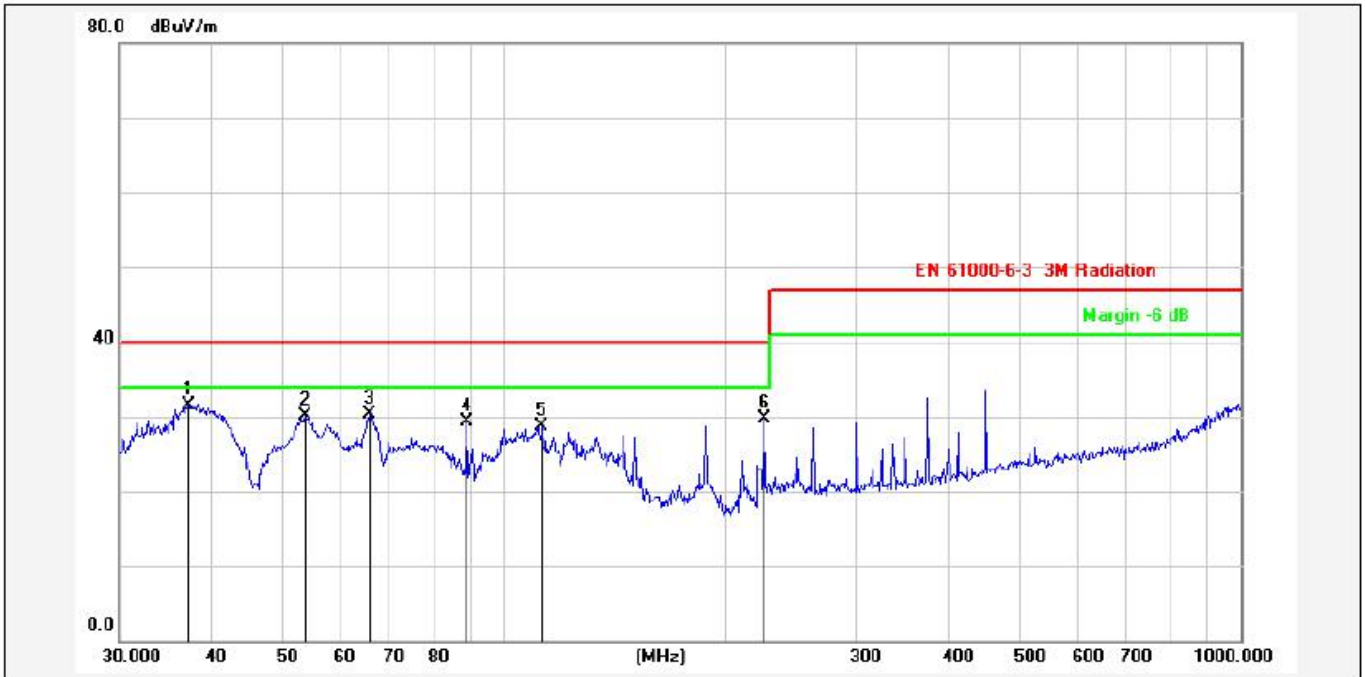
5.4.3 Let the E.U.T. work in test modes (AC Input Mode, Inverter Mode, PV Mode) and test it.

5.5 Radiated Emission Measurement Result

PASS.

Please refer to the following pages.

E.U.T :	HYBRID SOLAR INVERTER	Model Name :	PH18-5048 PLUS
Temperature :	26°C	Relative Humidity :	55 %
Pressure :	1006 hPa	Test Voltage :	AC 230V/50Hz
Test Mode :	AC Input Mode	Phase:	Horizontal



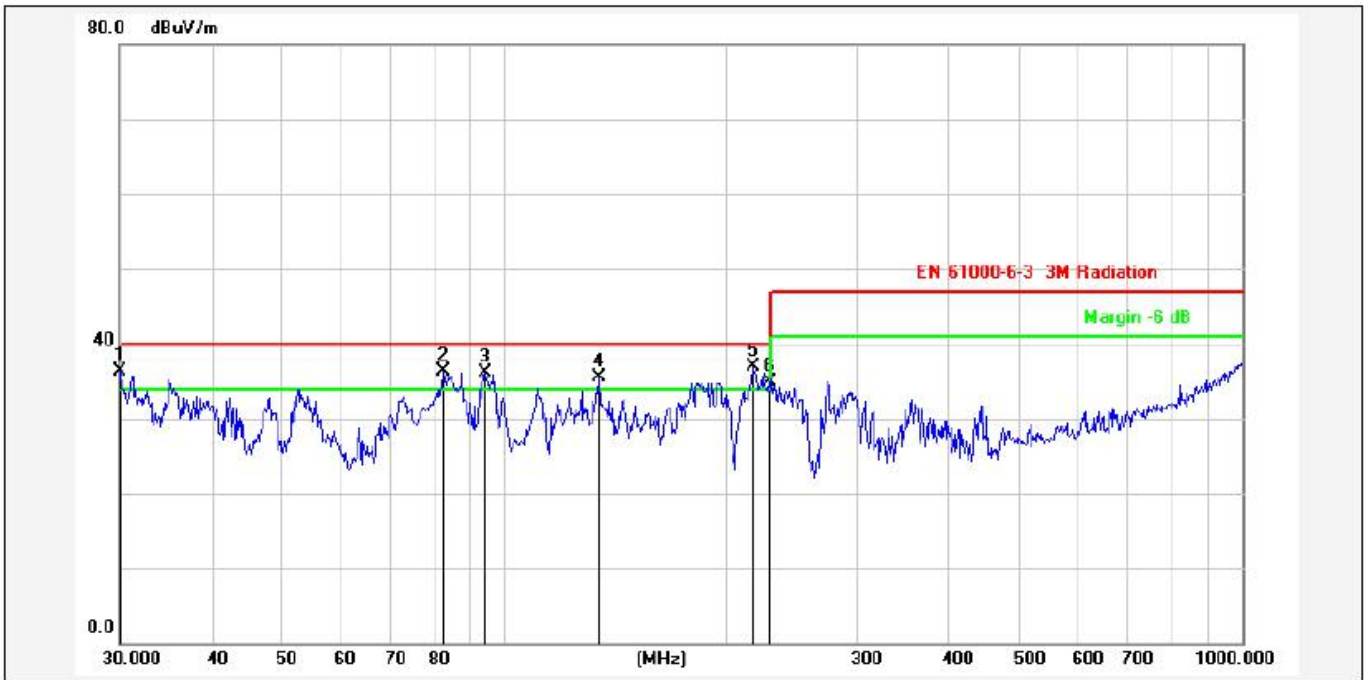
No.	Frequency (MHz)	Factor (dB/m)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1	37.2854	-8.09	39.69	31.60	40.00	-8.40	QP			P	
2	53.6931	-17.45	47.51	30.06	40.00	-9.94	QP			P	
3	65.5726	-17.32	47.68	30.36	40.00	-9.64	QP			P	
4	88.9637	-11.07	40.35	29.28	40.00	-10.72	QP			P	
5	112.5242	-8.30	37.09	28.79	40.00	-11.21	QP			P	
6	225.3078	-9.43	39.04	29.61	40.00	-10.39	QP			P	

E.U.T :	HYBRID SOLAR INVERTER	Model Name :	PH18-5048 PLUS
Temperature :	26°C	Relative Humidity :	55 %
Pressure :	1006 hPa	Test Voltage :	AC 230V/50Hz
Test Mode :	AC Input Mode	Phase:	Vertical



No.	Frequency (MHz)	Factor (dB/m)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1	37.5478	-11.11	46.92	35.81	40.00	-4.19	QP			P	
2	69.8448	-16.37	52.65	36.28	40.00	-3.72	QP			P	
3	150.0107	-8.86	35.14	26.28	40.00	-13.72	QP			P	
4	187.7529	-10.91	40.23	29.32	40.00	-10.68	QP			P	
5	225.3078	-9.43	42.60	33.17	40.00	-6.83	QP			P	
6	900.1473	2.40	34.60	37.00	47.00	-10.00	QP			P	

E.U.T :	HYBRID SOLAR INVERTER	Model Name :	PH18-5048 PLUS
Temperature :	26°C	Relative Humidity :	55 %
Pressure :	1006 hPa	Test Voltage :	DC 48V
Test Mode :	Inverter Mode	Phase:	Horizontal



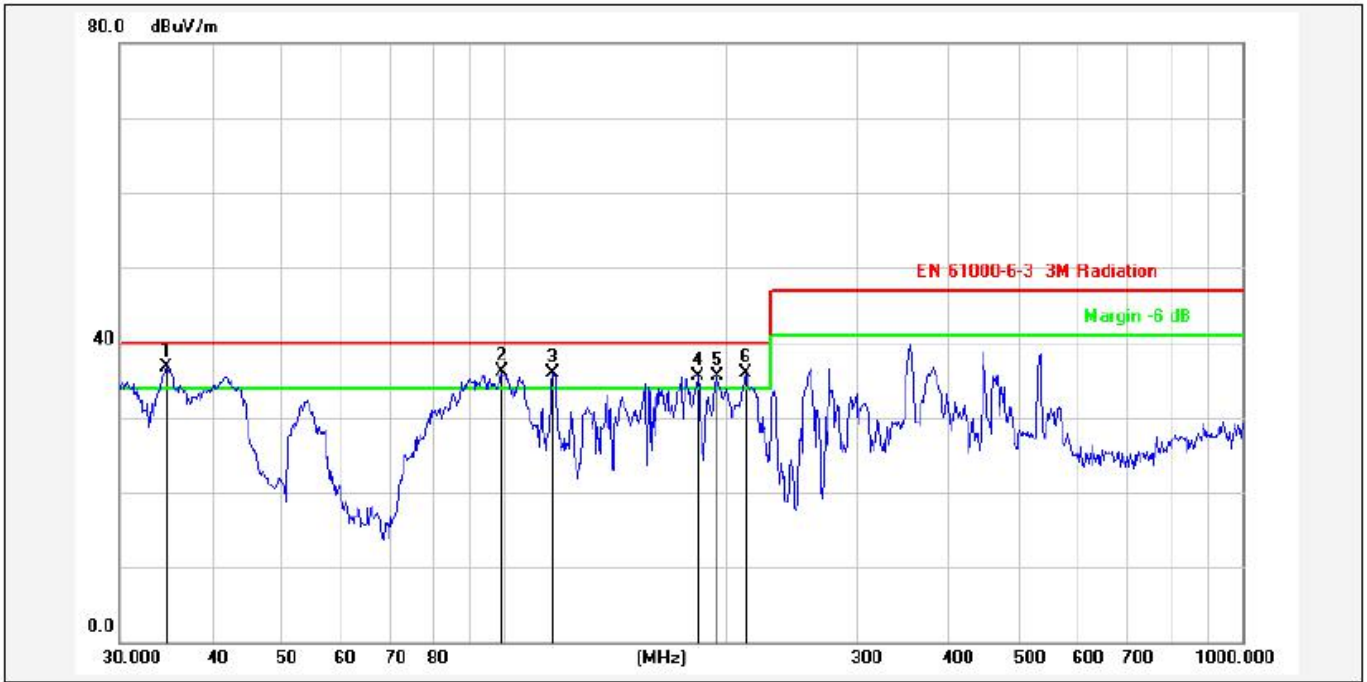
No.	Frequency (MHz)	Factor (dB/m)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1	30.1051	-5.83	42.18	36.35	40.00	-3.65	QP			P	
2	82.6478	-12.15	48.43	36.28	40.00	-3.72	QP			P	
3	94.0978	-10.00	46.17	36.17	40.00	-3.83	QP			P	
4	134.0878	-7.98	43.56	35.58	40.00	-4.42	QP			P	
5	216.7828	-10.13	46.98	36.85	40.00	-3.15	QP			P	
6	228.4901	-9.16	44.09	34.93	40.00	-5.07	QP			P	

E.U.T :	HYBRID SOLAR INVERTER	Model Name :	PH18-5048 PLUS
Temperature :	26°C	Relative Humidity :	55 %
Pressure :	1006 hPa	Test Voltage :	DC 48V
Test Mode :	Inverter Mode	Phase:	Vertical



No.	Frequency (MHz)	Factor (dB/m)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1	36.6372	-10.79	47.29	36.50	40.00	-3.50	QP			P	
2	54.8348	-17.66	53.73	36.07	40.00	-3.93	QP			P	
3	71.8319	-15.83	52.06	36.23	40.00	-3.77	QP			P	
4	95.4269	-9.71	45.72	36.01	40.00	-3.99	QP			P	
5	117.7724	-8.15	44.24	36.09	40.00	-3.91	QP			P	
6	150.0107	-8.86	44.28	35.42	40.00	-4.58	QP			P	

E.U.T :	HYBRID SOLAR INVERTER	Model Name :	PH18-5048 PLUS
Temperature :	26°C	Relative Humidity :	55 %
Pressure :	1006 hPa	Test Voltage :	DC 72V
Test Mode :	PV Mode	Phase:	Horizontal



No.	Frequency (MHz)	Factor (dB/m)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1	34.7601	-7.30	43.97	36.67	40.00	-3.33	QP			P	
2	98.8324	-8.96	45.06	36.10	40.00	-3.90	QP			P	
3	116.1320	-8.20	44.20	36.00	40.00	-4.00	QP			P	
4	182.5592	-10.67	46.14	35.47	40.00	-4.53	QP			P	
5	193.7726	-11.20	46.71	35.51	40.00	-4.49	QP			P	
6	212.2692	-10.50	46.42	35.92	40.00	-4.08	QP			P	

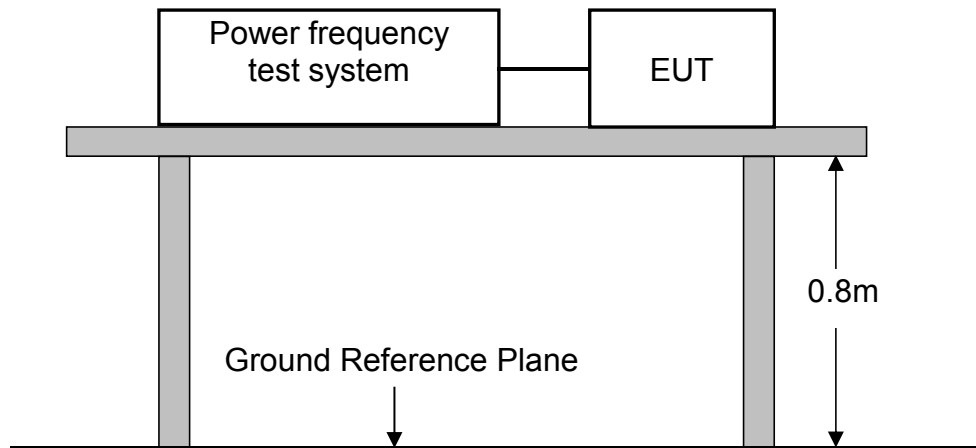
E.U.T :	HYBRID SOLAR INVERTER	Model Name :	PH18-5048 PLUS
Temperature :	26°C	Relative Humidity :	55 %
Pressure :	1006 hPa	Test Voltage :	DC 72V
Test Mode :	PV Mode	Phase:	Vertical



No.	Frequency (MHz)	Factor (dB/m)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1	35.3750	-10.35	47.30	36.95	40.00	-3.05	QP			P	
2	67.2021	-16.96	51.67	34.71	40.00	-5.29	QP			P	
3	97.4557	-9.26	45.76	36.50	40.00	-3.50	QP			P	
4	113.7142	-8.27	44.22	35.95	40.00	-4.05	QP			P	
5	166.6511	-9.80	46.38	36.58	40.00	-3.42	QP			P	
6	178.7582	-10.48	45.93	35.45	40.00	-4.55	QP			P	

6. HARMONIC CURRENT EMISSION MEASUREMENT

6.1 Block Diagram of Test Setup



6.2 Limits of Harmonics current measurement

Test Standard: EN 61000-3-12: 2011/ IEC 61000-3-12: 2011

Limits for Class A equipment		Limits for Class D equipment		
Harmonics Order n	Max. permissible harmonics current A	Harmonics Order n	Max. permissible harmonics current per watt mA/W	Max. permissible harmonics current A
Odd harmonics				
3	2.30	3	3.4	2.30
5	1.14	5	1.9	1.14
7	0.77	7	1.0	0.77
9	0.40	9	0.5	0.40
11	0.33	11	0.35	0.33
13	0.21	13	0.30	0.21
15 ≤ n ≤ 39	0.15 × 15/n	15 ≤ n ≤ 39	3.85/n	0.15 × 15/n
Even harmonics				
2	1.08			
4	0.43			
6	0.30			
8 ≤ n ≤ 40	0.23 × 8/n			

For the following categories of equipment limits are not specified in this edition of the standard.

Note 1: Equipment with a rated power of 75W or less, other than lighting equipment.

6.3 Test Procedure

The E.U.T. was put on the top of a wooden table 0.8m above the ground and operated to produce the maximum harmonic components under normal operating conditions for each successive harmonic component in turn.

The E.U.T. is classified as follows:

Class A:

Balanced three-phase equipment, Household appliances excluding equipment as Class D, Tools excluding portable tools, Dimmers for incandescent lamps, audio equipment, equipment not specified in one of the three other classes.

Class B:

Portable tools; Arc welding equipment which is not professional equipment.

Class C:

Lighting equipment.

Class D:

Equipment having a specified power less than or equal to 600W of the following types: Personal computers and personal computer monitors and television receivers.

6.4 Operating Condition of E.U.T.

6.4.1 Setup the E.U.T. and simulators as shown in Section 2.3.

6.4.2 Turn on the power of all equipments.

6.4.3 Let the E.U.T. work in test mode (AC Input Mode) and test it.

6.5 Test Results

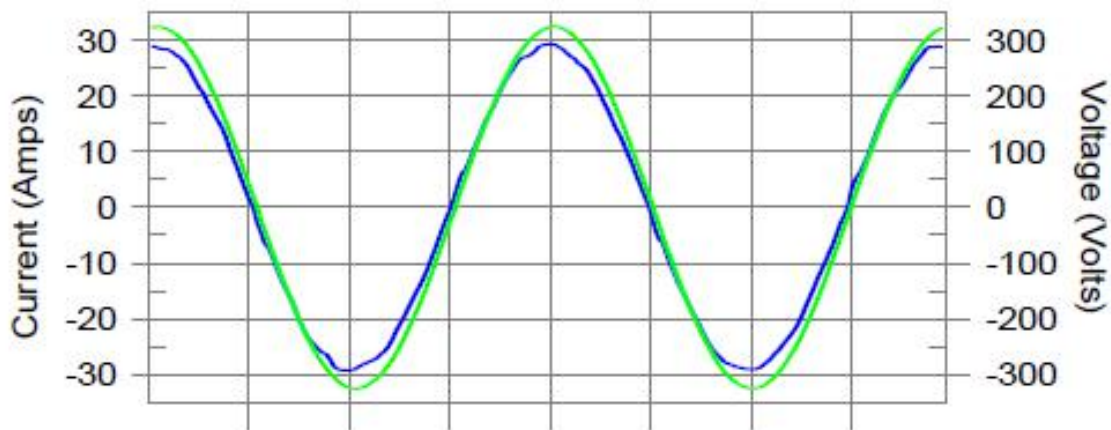
PASS.

Please refer to the following pages.

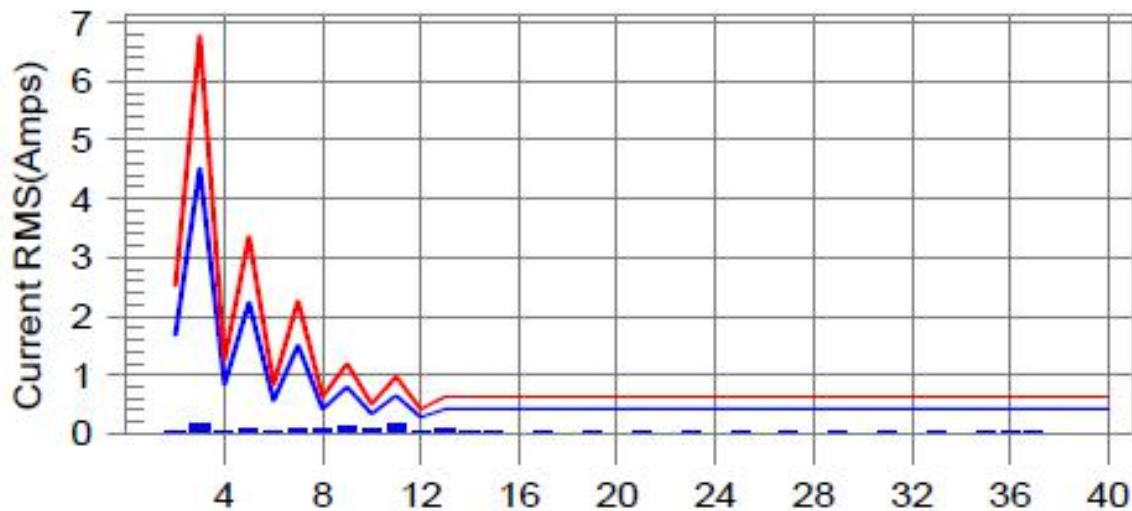
Harmonics – Class-A per Ed. 3.2 (2009)(Run time)

Report Number : NTC19031024EV00
Tested On : April 18, 2019 17:56 for 150 Seconds.
Equipment Under Test : HYBRID SOLAR INVERTER
Serial Number : PH18-5048 PLUS
Tested by : LOUIS

Current & voltage waveforms



Harmonics and Class A limit line European Limits



Test result: Pass

Current Test Result Summary (Run time)

Report Number : NTC19031024EV00
 Tested On : April 18, 2019 17:56 for 150 Seconds.
 Equipment Under Test : HYBRID SOLAR INVERTER
 Serial Number : PH18-5048 PLUS
 Tested by : LOUIS

Test Result: Pass Measured I-ref: 20.933 Amp rms Source: Normal
 I-THC(%): 1.8 Limit(%): 23.0 PWHC(%): 3.2 PWHC Limit(%): 23.0

Highest parameter values during test:

V_RMS (Volts): 229.56	Frequency(Hz): 50.00
I_Peak (Amps): 30.022	I_RMS (Amps): 21.192
I_Fund (Amps): 20.933	Crest Factor: 1.428
Power (Watts): 4850	Power Factor: 0.997

Harm#	Harms(avg)	100%Limit	%of Limit	Harms(max)	150%Limit	%of Limit	Status
2	0.023	1.675	1.4	0.059	2.512	2.3	Pass
3	0.160	4.522	3.5	0.224	6.783	3.3	Pass
4	0.036	0.837	4.3	0.063	1.256	5.0	Pass
5	0.090	2.240	4.0	0.125	3.360	3.7	Pass
6	0.040	0.558	7.1	0.061	0.837	7.3	Pass
7	0.090	1.507	6.0	0.102	2.261	4.5	Pass
8	0.083	0.419	19.9	0.099	0.628	15.7	Pass
9	0.142	0.796	17.8	0.150	1.193	12.6	Pass
10	0.076	0.335	22.6	0.089	0.502	17.8	Pass
11	0.152	0.649	23.3	0.161	0.974	16.6	Pass
12	0.041	0.279	14.6	0.055	0.419	13.2	Pass
13	0.076	0.419	18.1	0.081	0.628	13.0	Pass
14	0.020	N/A	N/A	0.026	N/A	N/A	N/A
15	0.060	N/A	N/A	0.063	N/A	N/A	N/A
16	0.018	N/A	N/A	0.024	N/A	N/A	N/A
17	0.058	N/A	N/A	0.060	N/A	N/A	N/A
18	0.017	N/A	N/A	0.020	N/A	N/A	N/A
19	0.052	N/A	N/A	0.055	N/A	N/A	N/A
20	0.016	N/A	N/A	0.018	N/A	N/A	N/A
21	0.048	N/A	N/A	0.051	N/A	N/A	N/A
22	0.014	N/A	N/A	0.017	N/A	N/A	N/A
23	0.040	N/A	N/A	0.045	N/A	N/A	N/A
24	0.014	N/A	N/A	0.021	N/A	N/A	N/A
25	0.036	N/A	N/A	0.040	N/A	N/A	N/A
26	0.012	N/A	N/A	0.018	N/A	N/A	N/A
27	0.032	N/A	N/A	0.035	N/A	N/A	N/A
28	0.011	N/A	N/A	0.017	N/A	N/A	N/A
29	0.027	N/A	N/A	0.031	N/A	N/A	N/A
30	0.010	N/A	N/A	0.015	N/A	N/A	N/A
31	0.024	N/A	N/A	0.027	N/A	N/A	N/A
32	0.010	N/A	N/A	0.014	N/A	N/A	N/A
33	0.020	N/A	N/A	0.024	N/A	N/A	N/A
34	0.009	N/A	N/A	0.013	N/A	N/A	N/A
35	0.019	N/A	N/A	0.033	N/A	N/A	N/A
36	0.020	N/A	N/A	0.030	N/A	N/A	N/A
37	0.024	N/A	N/A	0.032	N/A	N/A	N/A
38	0.016	N/A	N/A	0.026	N/A	N/A	N/A
39	0.017	N/A	N/A	0.029	N/A	N/A	N/A
40	0.009	N/A	N/A	0.022	N/A	N/A	N/A

Voltage Source Verification Data (Run time)

Report Number : NTC19031024EV00
 Tested On : April 18, 2019 17:56 for 150 Seconds.
 Equipment Under Test : HYBRID SOLAR INVERTER
 Serial Number : PH18-5048 PLUS
 Tested by : LOUIS

Test Result: Pass Source qualification: Normal
 Measured source distortion is within the requirements of the standards
 Measurements are compliant with IEC/EN61000-3-12 Ed.2 (2011) & IEC/EN61000-4-7

Highest parameter values during test:

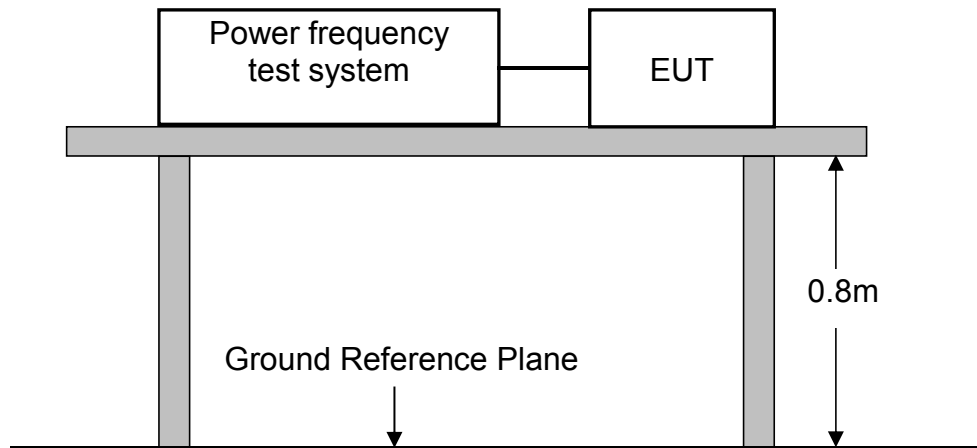
Voltage (Vrms):	229.56	Frequency(Hz):	50.00
I_Peak (Amps):	30.022	I_RMS (Amps):	21.192
I_Fund (Amps):	20.933	Crest Factor:	1.428
Power (Watts):	4850	Power Factor:	0.997

Harm#	Harmonics V-rms	Limit V-rms	% of Limit	Status
2	0.088	0.918	9.63	OK
3	0.194	2.868	6.75	OK
4	0.031	0.918	3.41	OK
5	0.097	3.443	2.82	OK
6	0.023	0.918	2.51	OK
7	0.165	2.869	5.75	OK
8	0.036	0.918	3.88	OK
9	0.180	1.377	13.07	OK
10	0.030	0.918	3.22	OK
11	0.199	1.607	12.39	OK
12	0.034	0.689	4.93	OK
13	0.172	1.377	12.50	OK
14	0.022	0.689	3.12	OK
15	0.181	0.688	26.26	OK
16	0.018	0.688	2.60	OK
17	0.164	0.689	23.78	OK
18	0.021	0.689	3.11	OK
19	0.149	0.689	21.59	OK
20	0.029	0.688	4.20	OK
21	0.142	0.688	20.60	OK
22	0.022	0.689	3.26	OK
23	0.124	0.689	17.97	OK
24	0.024	0.689	3.55	OK
25	0.113	0.689	16.48	OK
26	0.026	0.688	3.75	OK
27	0.108	0.689	15.74	OK
28	0.025	0.689	3.67	OK
29	0.097	0.689	14.06	OK
30	0.023	0.688	3.36	OK
31	0.092	0.689	13.41	OK
32	0.021	0.688	3.01	OK
33	0.085	0.689	12.28	OK
34	0.021	0.689	3.01	OK
35	0.094	0.689	13.59	OK
36	0.043	0.688	6.31	OK
37	0.091	0.688	13.26	OK
38	0.036	0.689	5.20	OK
39	0.088	0.688	12.73	OK
40	0.033	0.688	4.78	OK

Minimum Rsce required: Rsce = 7.693
 Phase A = 23.3% of tested Rsce = 33.000, Rsce = 7.693

7. VOLTAGE FLUCTUATIONS & FLICKER MEASUREMENT

7.1 Block Diagram of Test Setup



7.2 Limits of Voltage Fluctuations & Flicker Measurement

Test Standard: EN 61000-3-11: 2000 / IEC 61000-3-11: 2017

Test Item	Limit
P_{st} (Short-term flicker indicator.)	1.0
P_{lt} (Long-term flicker indicator.)	0.65
$T_{d(t)}$ (ms) (Maximum time that $d(t)$ exceeds 3.3%)	500
d_{max} (%) (Maximum relative voltage change.)	4
d_c (%) (Relative steady-state voltage change)	3.3

7.3 Test Procedure

The E.U.T. was put on the top of a wooden table 0.8m above the ground and operated to produce the most unfavorable sequence of voltage changes under normal operating conditions.

7.4 Operating Condition of E.U.T.

- 7.4.1 Setup the E.U.T. and simulators as shown in Section 2.3.
- 7.4.2 Turn on the power of all equipments.
- 7.4.3 Let the E.U.T. work in test mode (AC Input Mode) and test it.

7.5 Test Results

PASS.

Please refer to the following pages.

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

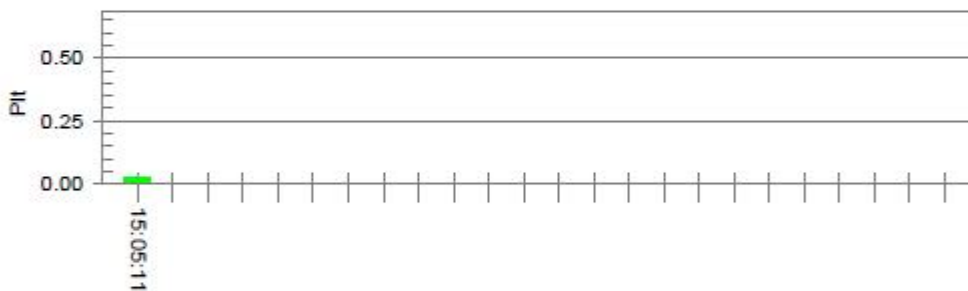
Report Number : NTC19031024EV00
Tested On : April 18, 2019 15:05 for 600 Seconds.
Equipment Under Test : HYBRID SOLAR INVERTER
Serial Number : PH18-5048 PLUS
Tested by : LOUIS

Test Result: Pass
 Status: Test Completed

Pst. and limit line



PIt and limit line



Parameter values recorded during the test:

Vrms at the end of test (Volt): 225.29

T-max (mS):	0.0	Test limit (mS):	500.0	Pass
Highest dc (%):	0.00	Test limit (%):	3.30	Pass
Highest dmax (%):	-0.11	Test limit (%):	4.00	Pass
Highest Pst (10 min. period):	0.064	Test limit:	1.000	Pass
Highest PIt (2 hr. period):	0.028	Test limit:	0.650	Pass

Calculated dmax(%): 0.000
 Calculated dc(%): 0.000

Calculated Pst : 0.064
 Calculated PIt : 0.028

The maximum permissible system impedance Zsys:

Z = 24.772 Ohm + j 15.482 Ohm (24.772 Ohm + 49282 ?H)

8. PERFORMANCE CRITERIA FOR IMMUNITY

The performance criteria are referred to the test standard: EN 61000-6-1/ IEC 61000-6-1

The variety and the diversity of the apparatus within the scope of this standard makes it difficult to define precise criteria for the evaluation of the immunity test results.

If, as a result of the application of the tests defined in this standard, the apparatus becomes dangerous or unsafe, the apparatus shall be deemed to have failed the test.

A functional description and a definition of performance criteria, during or as a consequence of the EMC testing, shall be provided by the manufacturer and noted in the test report.

Performance Criterion A:

The apparatus 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 apparatus is used as 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 reasonable expect from the apparatus if used as intended.

Performance Criterion B:

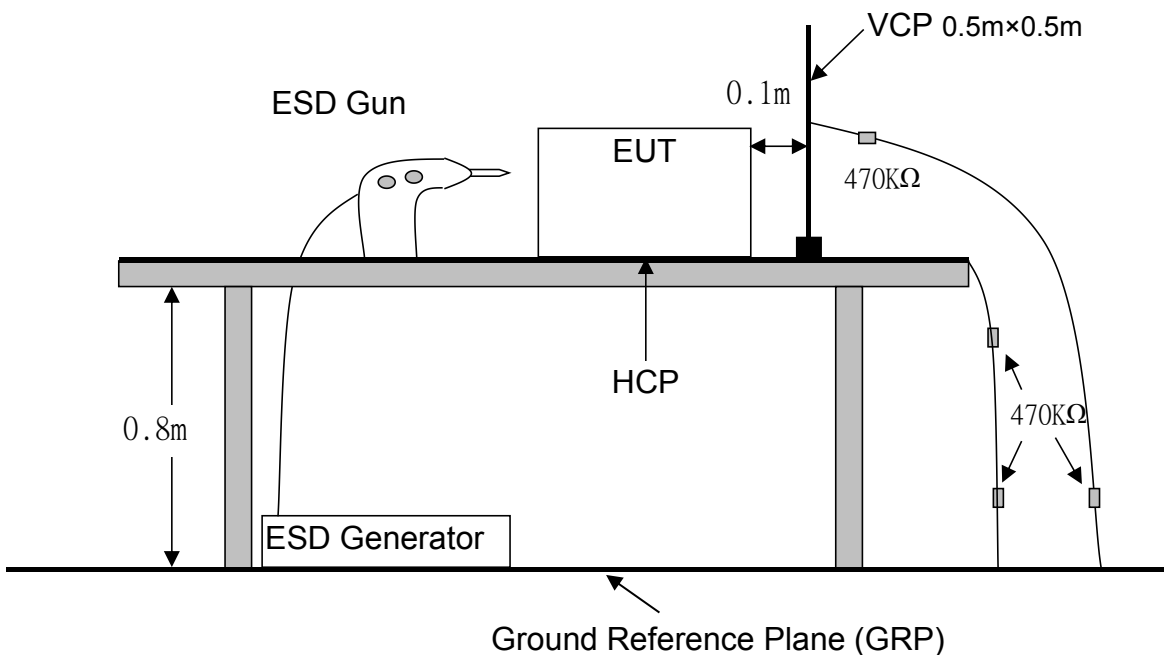
The apparatus shall continue to operate as intended after the test. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the apparatus is used as intended. The performance level may be replaced by a permissible loss of performance. During the test, degradation of performance is however allowed. No change of actual operation 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 apparatus if used as intended.

Performance Criteria C

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

9. ELECTROSTATIC DISCHARGE TEST

9.1 Block Diagram of Test Setup



9.2 Test Standard and Severity Levels

9.2.1 Test Standard:

EN 61000-6-1:2017,
(EN 61000-4-2:2009/IEC 61000-4-2:2008
Air Discharge: Severity Level: 3, $\pm 8\text{KV}$; Contact Discharge:
Level: 2, $\pm 4\text{KV}$)

9.2.2 Severity Levels:

Level	Test Voltage Contact Discharge (KV)	Test Voltage Air Discharge (KV)
1.	± 2	± 2
2.	± 4	± 4
3.	± 6	± 8
4.	± 8	± 15
X	Special	Special

9.3 Test Procedure

9.3.1 Air Discharge:

This test is done on a non-conductive surface. The round discharge tip of the discharge electrode shall be approached as fast as possible to touch the E.U.T.. After each discharge, the discharge electrode shall be removed from the E.U.T.. The generator is then re-triggered for a new single discharge and repeated 10 times for each pre-selected test point. This procedure shall be repeated until all the air discharge completed

9.3.2 Contact Discharge:

All the procedure shall be same as Section 9.3.1. except that the tip of the discharge electrode shall touch the E.U.T..

9.3.3 Indirect discharge for horizontal coupling plane

At least 10 single discharges (in the most sensitive polarity) shall be applied at the front edge of each HCP opposite the center point of each unit(if applicable) of the E.U.T. and 0.1m from the front of the E.U.T.. The long axis of the discharge electrode shall be in the plane of the HCP and perpendicular to its front edge during the discharge.

9.3.4 Indirect discharge for vertical coupling plane

At least 10 single discharge (in the most sensitive polarity) shall be applied to the center of one vertical edge of the coupling plane. The coupling plane, of dimensions 0.5m X 0.5m, is placed parallel to, and positioned at a distance of 0.1m from the E.U.T.. Discharges shall be applied to the coupling plane, with this plane in sufficient different positions that the four faces of the E.U.T. are completely illuminated.

9.4 Test Results

PASS.

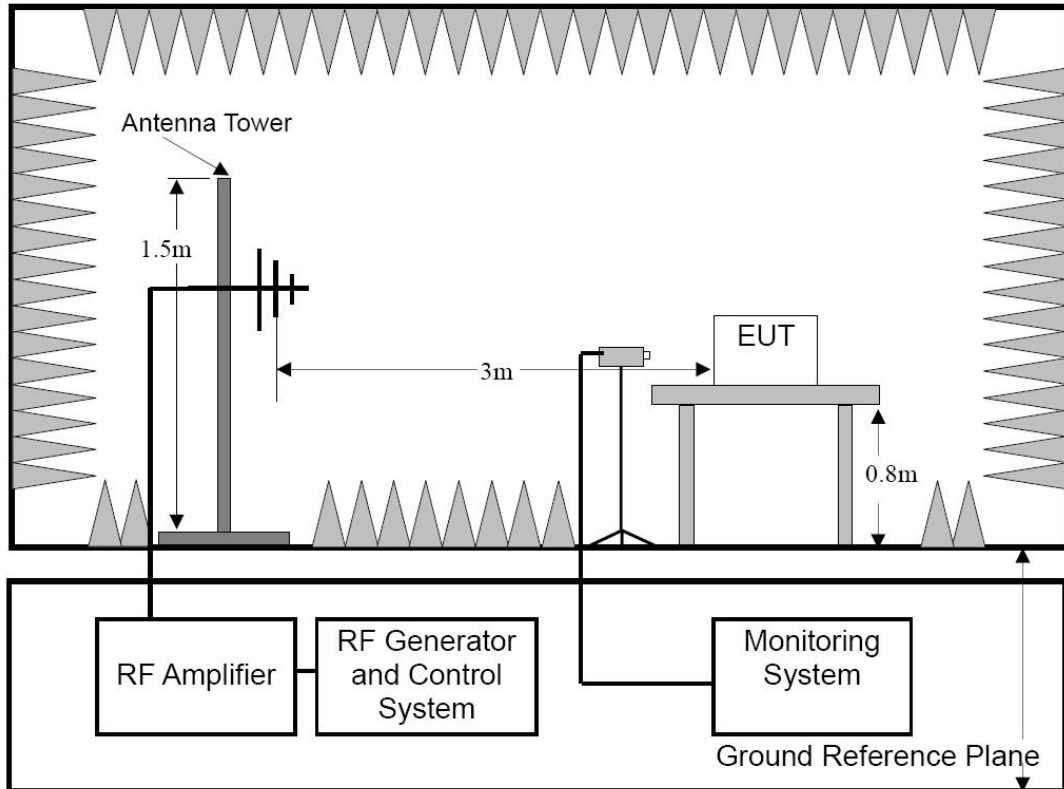
Please refer to the following page.

Electrostatic Discharge Test Results

Ambient Condition :	Temp. : 26 °C	R.H. : 50 %	Air Pressure : 101 kPa
Power Supply:	AC 230V/50Hz DC 48V/DC 72V	Required Performance Criterion : B	
Test Specifications:	± 2,4 kV Contact Discharge; ± 2,4,8 kV Air Discharge; For each point positive 10 times and negative 10 times.		
Tested mode:	AC Input Mode, Inverter Mode, PV Mode		
Test Point	Kind A-Air Discharge C-Contact Discharge	Result (Performance Criterion)	
Metal	C	A	
Screw	C	A	
Ports	C	A	
Slot of E.U.T.	A	A	
Screen	A	A	
Button	A	A	
Indirect Discharge (HCP)	C	A	
Indirect Discharge (VCP)	C	A	
Note:			
Test Equipment : ESD Tester (HAEFELY, ONYX16)		Test Engineer : Louis	

10. RF FIELD STRENGTH SUSCEPTIBILITY TEST

10.1 Block Diagram of Test Setup



10.2 Test Standard and Severity Levels

10.2.1 Test Standard

EN 61000-6-1:2017,
 (EN 61000-4-3:2006+A2:2010/ IEC 61000-4-3: 2010
 80 to 1000MHz Severity Level: 2, 3V/m;
 1.4 to 2.0GHz Severity Level: 2, 3V/m;
 2.0 to 2.7GHz Severity Level: 1, 1V/m)

10.2.2 Severity Levels

Level	Field Strength V/m
1	1
2	3
3	10
X	Special

10.3 Test Procedure

The E.U.T. and its simulators are placed on a turn table which is 0.8 meter above ground. E.U.T. is set 3 meter away from the transmitting antenna which is mounted on an antenna tower. Both horizontal and vertical polarization of the antenna are set on test. Each of the four sides of E.U.T. must be faced this transmitting antenna and measured individually.

All the scanning conditions are as follows :

Condition of Test	Remarks
1. Fielded Strength	80 to 1000MHz Severity Level: 3, 3V/m; 1.4 to 2.0GHz Severity Level: 2, 3V/m; 2.0 to 2.7GHz Severity Level: 1, 1V/m
2. Radiated Signal	Modulated
3. Dwell time of radiated	0.0015 decade/s
4. Waiting Time	1 Sec.

10.4 Test Results

PASS.

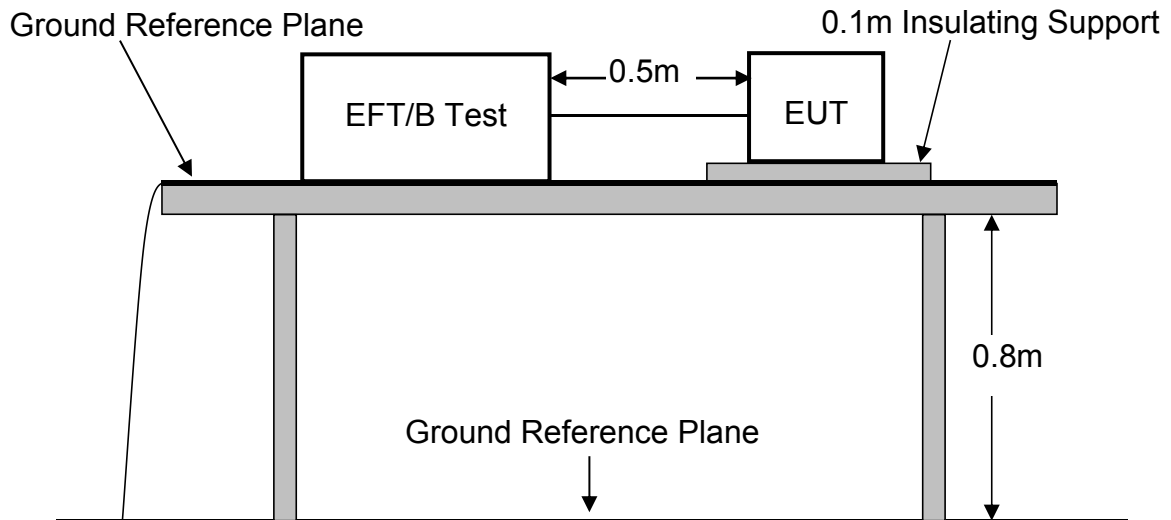
Please refer to the following page.

RF Field Strength Susceptibility Test Results

Ambient Condition:	Temp.: 26 °C	R.H.: 50 %	Air Pressure: 101 kPa	
Power Supply:	AC 230V/50Hz	Required Performance Criterion: A		
Test Specifications:	Modulation: 1kHz, 80%AM; Step Size: 1%; Dwell Time: 3s			
Tested mode:	AC Input Mode			
Frequency (MHz)	Level (V/m)	Antenna polarity	Side	Result (Performance Criterion)
80-1000	3	Horizontal/ Vertical	Front/ Left/ Right/ Back	A
1400-2000	3			A
2000-2700	1			A
Note:				
Test Equipment : 1. Signal Generator : (Agilent, N5181A) 2. Power Sensor : (Agilent, E4419B) 3. Antenna (Schwarzbeck, STLP 9129)				
				Test Engineer : Lecdon

11.ELECTRICAL FAST TRANSIENT/BURST TEST

11.1 Block Diagram of Test Setup



11.2 Test Standard and Severity Levels

11.2.1 Test Standard

EN 61000-6-1:2017,
(EN 61000-4-4: 2012/ IEC 61000-4-4: 2012
Severity Level, Level 2: 1KV)

11.2.2 Severity level

Open circuit output test voltage and repetition rate of the impulses				
Level	On power port, PE		On I/O (Input/Output) Signal data and control ports	
	Voltage peak KV	Repetition rate KHz	Voltage peak KV	Repetition rate KHz
1.	0.5	5 or 100	0.25	5 or 100
2.	1.0	5 or 100	0.5	5 or 100
3.	2.0	5 or 100	1.0	5 or 100
4.	4.0	5 or 100	2.0	5 or 100
X	Special	Special	Special	Special

Note 1 Use of 5 KHz repetition rates is traditional; however, 100 KHz is closer to reality. Product committees should determine which frequencies are relevant for specific products or product types.

Note 2 With some products, there may be no clear distinction, between power ports and I/O ports, in which case it is up to product committees to make this determination for test purposes.

Note 3 "X" is an open level. The level has to be specified in the dedicated equipment specification.

11.3 Test Procedure

The E.U.T. is put on the table which is 0.8 meter high above the ground. This reference ground plane shall project beyond the E.U.T. by at least 0.1m on all sides and the minimum distance between E.U.T. and all other conductive structure, except the ground plane beneath the E.U.T., shall be more than 0.5m.

11.3.1 For input and output AC power ports:

The E.U.T. is connected to the power mains by using a coupling device which couples the EFT interference signal to AC power lines. Both polarities of the test voltage should be applied during compliance test and the duration of the test is 2 minutes.

11.3.2 For signal lines ports:

It's unnecessary to test.

11.3.3 For DC ports:

It's unnecessary to test.

11.4 Test Result

PASS.

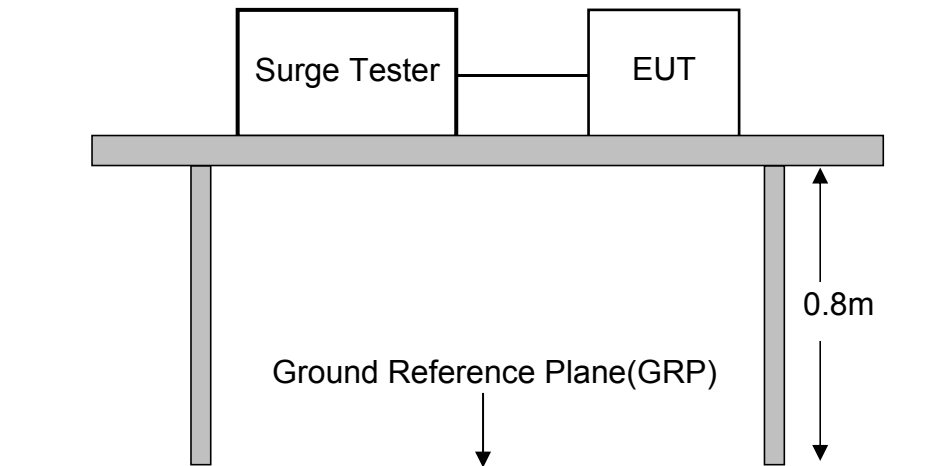
Please refer to the following page.

Electrical Fast Transient/Burst Test Results

Ambient Condition:	Temp.: 26 °C	R.H.: 50 %	Air Pressure: 101 kPa
Power Supply:	AC 230V/50Hz	Required Performance Criterion: B	
Test Specifications:	Repetition Frequency: 5kHz; Duration: 15ms; Period: 300ms		
Tested mode:	AC Input Mode		
Line : <input checked="" type="checkbox"/> AC Mains <input type="checkbox"/> Signal line <input type="checkbox"/> DC line Coupling : <input checked="" type="checkbox"/> Direct <input type="checkbox"/> Capacitive			
Line	Test Voltage	Result (Performance Criterion)	
L	± 1KV	A	
N	± 1KV	A	
PE	± 1KV	A	
L、N	± 1KV	A	
L、PE	± 1KV	A	
N、PE	± 1KV	A	
L、N、PE	± 1KV	A	
Signal line	--	--	
DC line	--	--	
Note :			
Test Equipment : Burst Tester(HAEFELY, AXOS5)		Test Engineer : Louis	

12. SURGE IMMUNITY TEST

12.1 Block Diagram of Test Setup



12.2 Test Standard and Severity Levels

12.2.1 Test Standard

EN 61000-6-1:2017,
 (EN 61000-4-5: 2014+A1:2017/IEC 61000-4-5: 2014
 Severity Level: Line To Line, Level 2: 1.0KV;
 Line To Earth, Level 3: 2.0KV)

12.2.2 Severity level

Severity Level	Open-Circuit Test Voltage KV
1	0.5
2	1.0
3	2.0
4	4.0
*	Special

12.3 Test Procedure

- 12.3.1 Set up the E.U.T. and test generator as shown on Section 12.1.
- 12.3.2 For line to line coupling mode, provide a 1.0KV 1.2/50us voltage surge (at open-circuit condition) and 8/20us current surge to E.U.T. selected points.
- 12.3.3 At least 5 positive and 5 negative (polarity) tests with a maximum 1/min repetition rate are conducted during test.
- 12.3.4 Different phase angles are done individually.
- 12.3.5 Record the E.U.T. operating situation during compliance test and decide the E.U.T. immunity criterion for above each test.

12.4 Test Result

PASS.

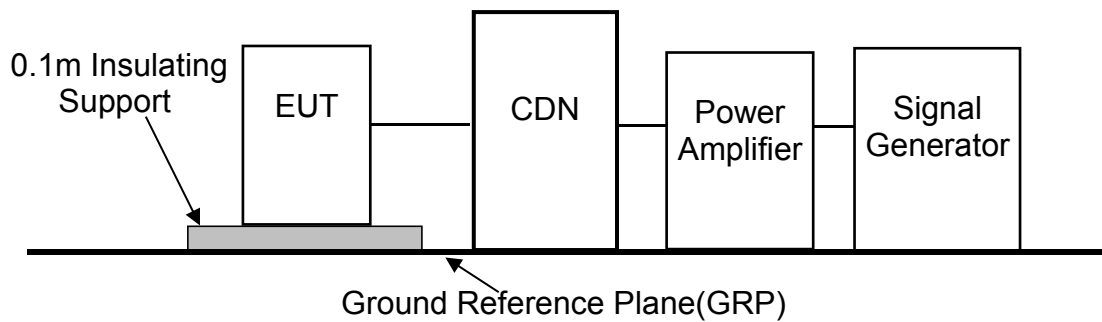
Please refer to the following page.

Surge Immunity Test Results

Ambient Condition:	Temp.: 26 °C	R.H.: 50 %	Air Pressure: 101 kPa
Power Supply:	AC 230V/50Hz	Required Performance Criterion: C	
Test Specifications:	Voltage surge 1.2/50 us, Current surge 8/20 us, Five positive pulses Line-to-neutral at 0°, 90°, 180°, 270° phase, Five negative pulses Line-to-neutral at 0°, 90°, 180°, 270° phase.		
Tested mode:	AC Input Mode		
Line (AC Input)	Phase Angle	Test Voltage	Result (Performance Criterion)
L-N	0°, 90°, 180°, 270°	±1KV	A
L-PE	0°, 90°, 180°, 270°	±2KV	A
N-PE	0°, 90°, 180°, 270°	±2KV	A
Signal line	--	--	--
DC line	--	--	--
Note :			
Test Equipment : Burst Tester(HAEFELY, AXOS5)		Test Engineer : Louis	

13. INJECTED CURRENTS SUSCEPTIBILITY TEST

13.1 Block Diagram of Test Setup



13.2 Test Standard and Severity Levels

13.2.1 Test Standard

EN 61000-6-1:2017,
 (EN 61000-4-6: 2014/IEC 61000-4-6 :2013,
 Severity Level 2: 3V (rms),0.15MHz ~ 80MHz)

13.2.2 Severity level

Level	Field Strength V
1	1
2	3
3	10
X	Special

13.3 Test Procedure

- 13.3.1 Set up the E.U.T., CDN and test generators as shown on Section 13.1.
- 13.3.2 Let the E.U.T. work in test mode and measure it.
- 13.3.3 The E.U.T. are placed on an insulating support 0.1m high above a ground reference plane. CDN (coupling and decoupling device) is placed on the ground plane about 0.3m from E.U.T.. Cables between CDN and E.U.T. are as short as possible, and their height above the ground reference plane shall be between 30 and 50 mm (where possible).
- 13.3.4 The disturbance signal described below is injected to E.U.T. through CDN.
- 13.3.5 The E.U.T. operates within its operational mode(s) under intended climatic conditions after power on.
- 13.3.6 The frequency range is swept from 150 KHz to 80 MHz using 10V signal level, and with the disturbance signal 80% amplitude modulated with a 1KHz sine wave.
- 13.3.7 The rate of sweep shall not exceed 1.5×10^{-3} decades/s. Where the frequency is swept incrementally, the step size shall not exceed 1% of the start and thereafter 1% of the preceding frequency value.
- 13.3.8 Recording the E.U.T. operating situation during compliance testing and decide the E.U.T. immunity criterion.

13.4 Test Result

PASS.

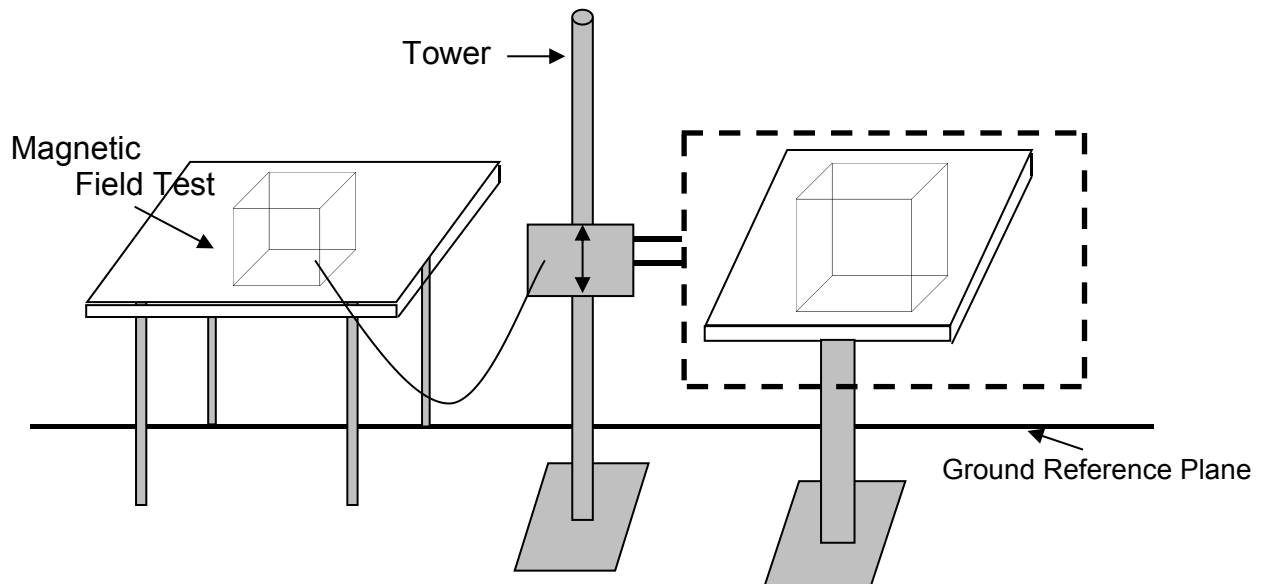
Please refer to the following page.

Injected Currents Susceptibility Test Results

Ambient Condition:	Temp.: 26 °C	R.H.: 50 %	Air Pressure: 101 kPa
Power Supply:	AC 230V/50Hz	Required Performance Criterion: A	
Test Specifications:	Modulation : 1KHz, 80%AM; Step Size : 1%; Dwell Time : 3s		
Tested mode:	AC Input Mode		
Test Port (AC Input)	Frequency (MHz)	Level(V)	Result (Performance Criterion)
AC Mains	0.15~80	3	A
Note :			
Test Equipment : Signal Generator(IFR,2023A)		Test Engineer : Lecdon	

14. MAGNETIC FIELD IMMUNITY TEST

14.1 Block Diagram of Test Setup



14.2 Test Standard and Severity Levels

14.2.1 Test Standard

EN 61000-6-1:2017,

(EN 61000-4-8: 2010/IEC 61000-4-8: 2009 Severity Level 2: 3A/m)

14.2.2 Severity level

Level	Magnetic Field Strength A/m
1	1
2	3
3	10
4	30
5	100
X	Special

Performance Criterion : **A**

14.3 Test Procedure

The E.U.T. is placed in the middle of a induction coil (1*1m), under which is a 1*1*0.8m (high)table, this small table is also placed on a larger table, 0.1 m above the ground. X, Y and Z polarization of the induction coil are set on test, so that each side of the E.U.T. is affected by the magnetic field. Also can reach the same aim by change the position of the E.U.T..

14.4 Test Result

PASS.

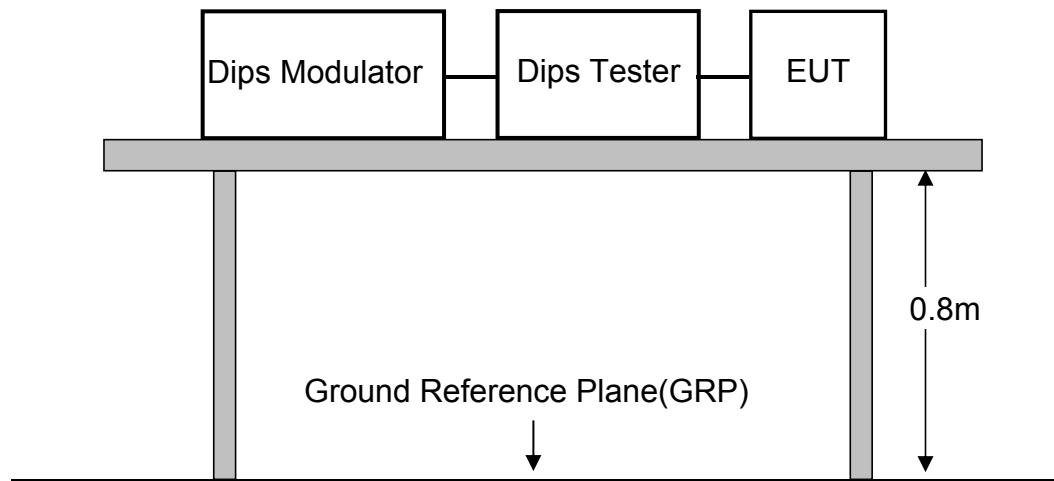
Please refer to the following page.

Magnetic Field Immunity Test Results

Ambient Condition:	Temp.: 22°C	R.H.: 58%	Air Pressure: 101 kPa
Power Supply:	AC 230V/50Hz	Required Performance Criterion: A	
Test Specifications:	3A/m		
Test mode:	AC Input Mode		
Test Level	Testing Duration	Coil Orientation	Result (Performance Criterion)
3A/m	5 mins	X	A
3A/m	5 mins	Y	A
3A/m	5 mins	Z	A
Note :			
Test Equipment : Magnetic field test(MS-8000)		Test Engineer : Louis	

15.VOLTAGE DIPS AND INTERRUPTIONS TEST

15.1 Block Diagram of Test Setup



15.2 Test Standard and Severity Levels

15.2.1 Test Standard

EN 61000-6-1:2017,
(EN 61000-4-11:2004+A1:2017/IEC 61000-4-11: 2004)

15.2.2 Severity level

Test Level $\%U_T$	Voltage dip and short interruptions $\%U_T$	Duration (in period)
0	100	0.5 1
40	60	5 10
70	30	25 50 *

15.3 Test Procedure

15.3.1 Set up the E.U.T. and test generator as shown on Section 15.1.

15.3.2 The interruptions is introduced at selected phase angles with specified duration.

15.3.3 Record any degradation of performance.

15.4 Test Result

PASS.

Please refer to the following page.

Voltage Dips And Interruptions Test Results

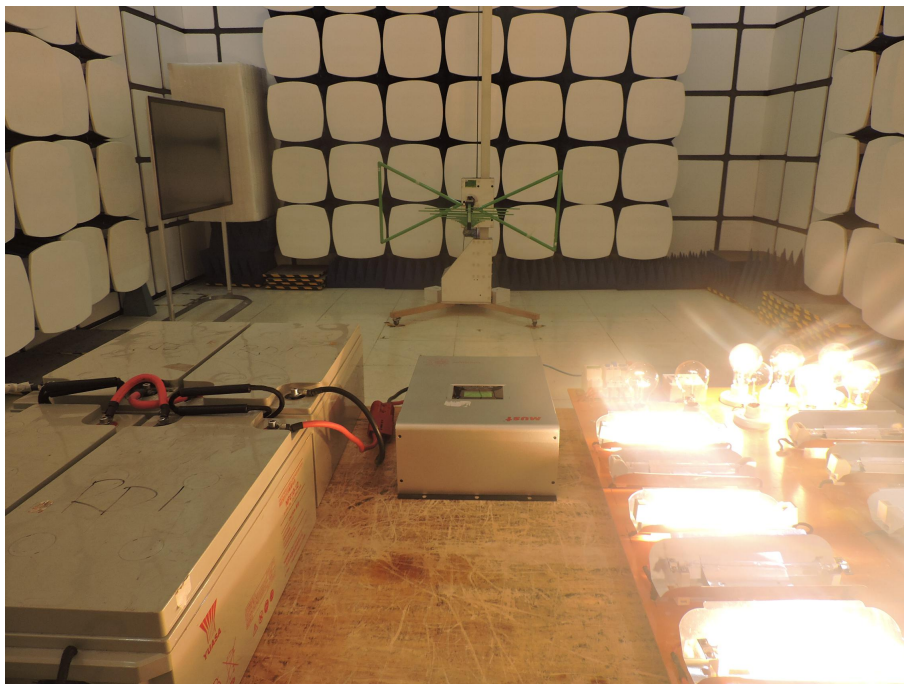
Ambient Condition:	Temp.: 26 °C	R.H.: 50 %	Air Pressure: 101 kPa
Power Supply:	AC 230V/50Hz	Required Performance Criterion: B&C	
Test Specifications:	0%U _T , 0.5Cycle; 0%U _T , 1Cycles ; 70%U _T , 25/30Cycles at 50/60Hz; 0%U _T , 250/300Cycles at 50/60Hz		
Tested mode:	AC Input Mode		
Test Level % UT	Duration (in period)		Result (Performance Criterion)
	50Hz	60Hz	
0	0.5	A	0
70	25	A	70
0	1	A	0
0	250	C	0
Note: The AC Input Mode changes to Inverter Mode during the test, but it can be resumed by itself after test.			
Test Equipment : Dips Tester (HAEFELY, AXOS5)		Test Engineer : Louis	

16.PHOTOGRAPH

16.1 Photo of Conducted Emission Measurement



16.2 Photo of Radiated Emission Measurement



16.3 Photo of Harmonic/Flicker Measurement



16.4 Photo of Electrostatic Discharge Immunity Test



16.5 Photo of Electrical Fast Transient/Surge /Voltage Dips Test



16.6 Photo of RF Electromagnetic Field Immunity Test



16.7 Photo of Injected Currents Immunity Test



16.8 Photo of Magnetic Field immunity Test



APPENDIX I (Photos of E.U.T.)

Figure 1
General Appearance of the E.U.T.



Figure 2
General Appearance of the E.U.T.



Figure 3
General Appearance of the E.U.T.

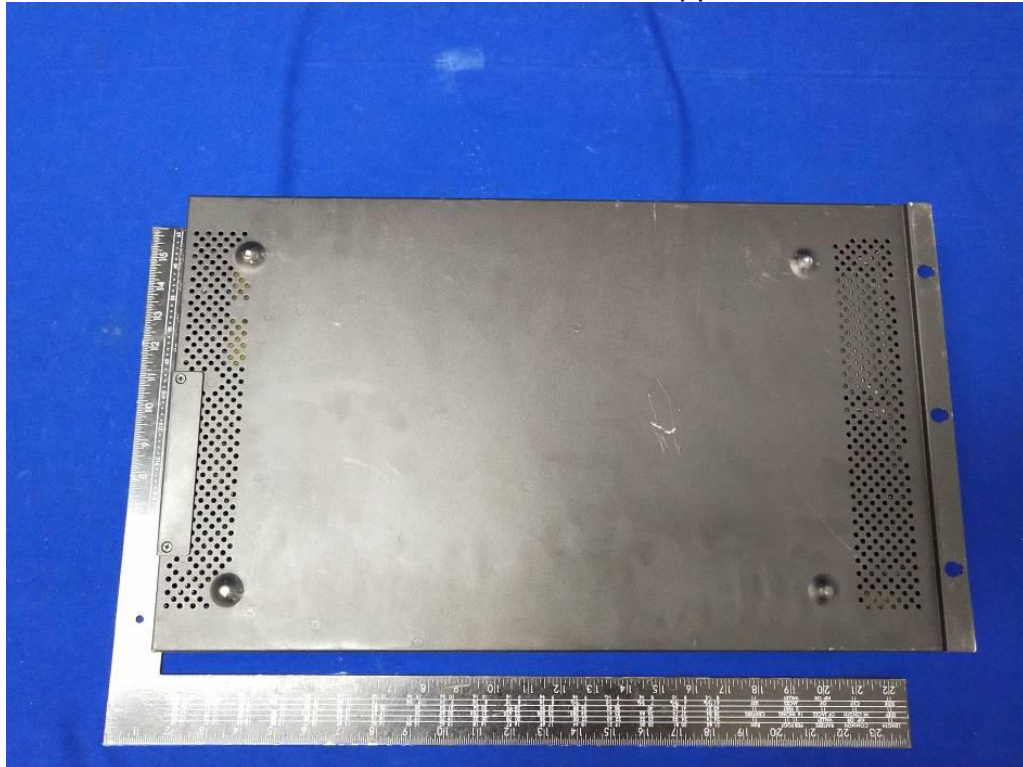


Figure 4
General Appearance of the E.U.T.



Figure 5
General Internal of the E.U.T.

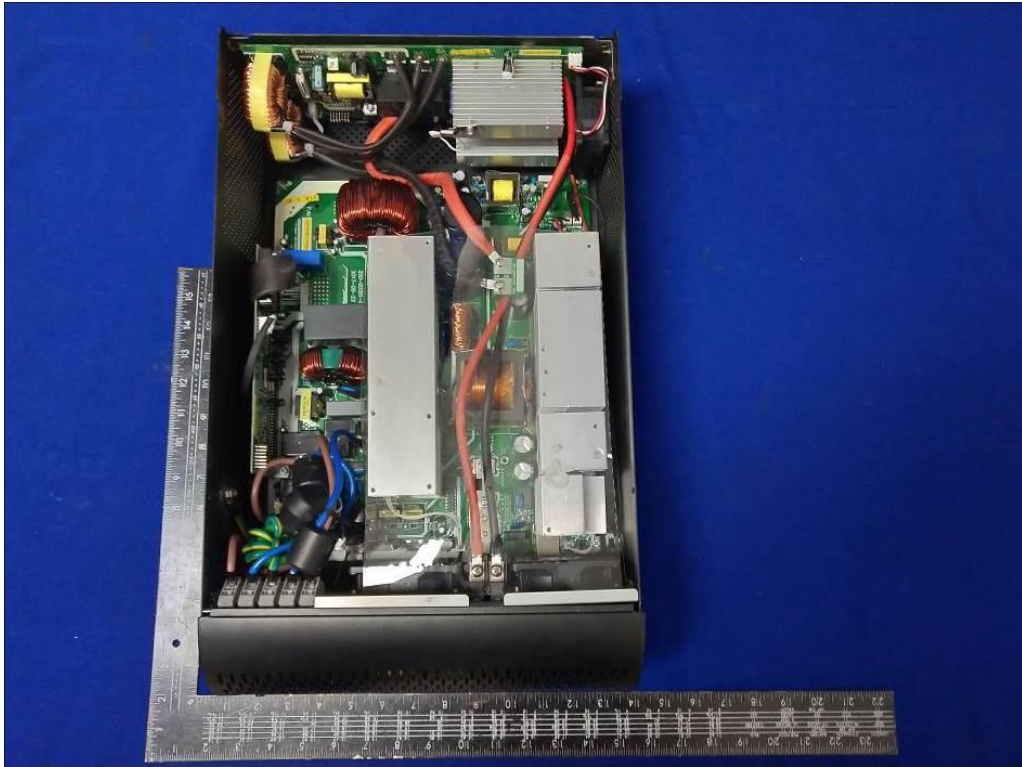


Figure 6
General Appearance of the PCB

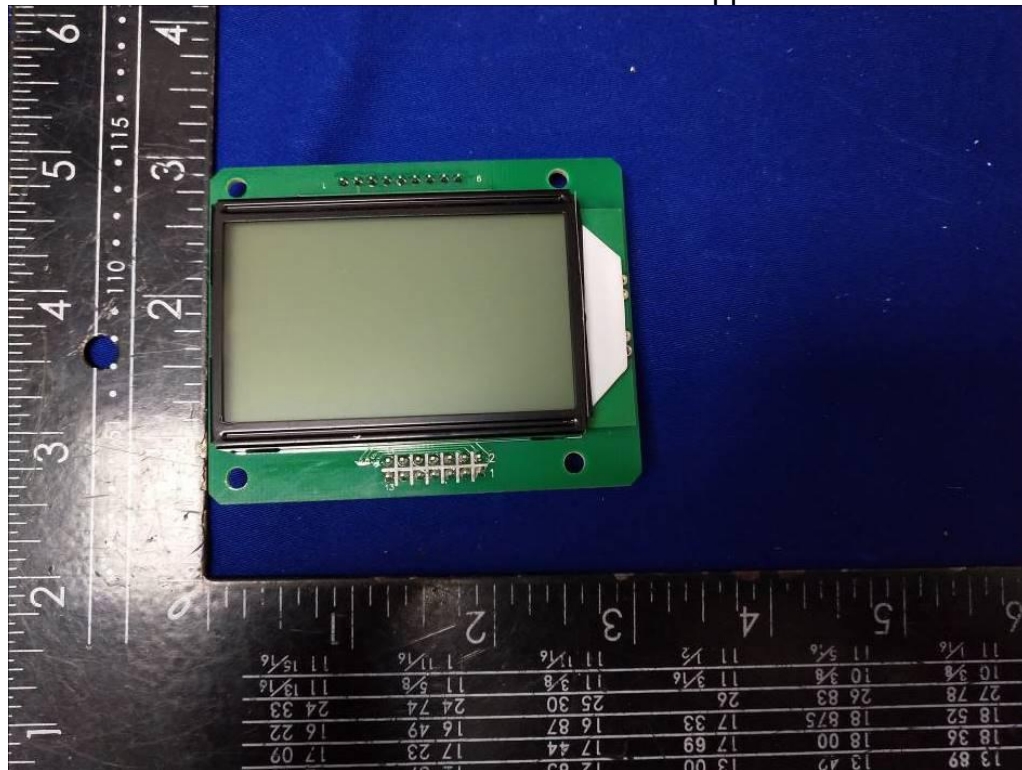


Figure 7
General Appearance of the PCB

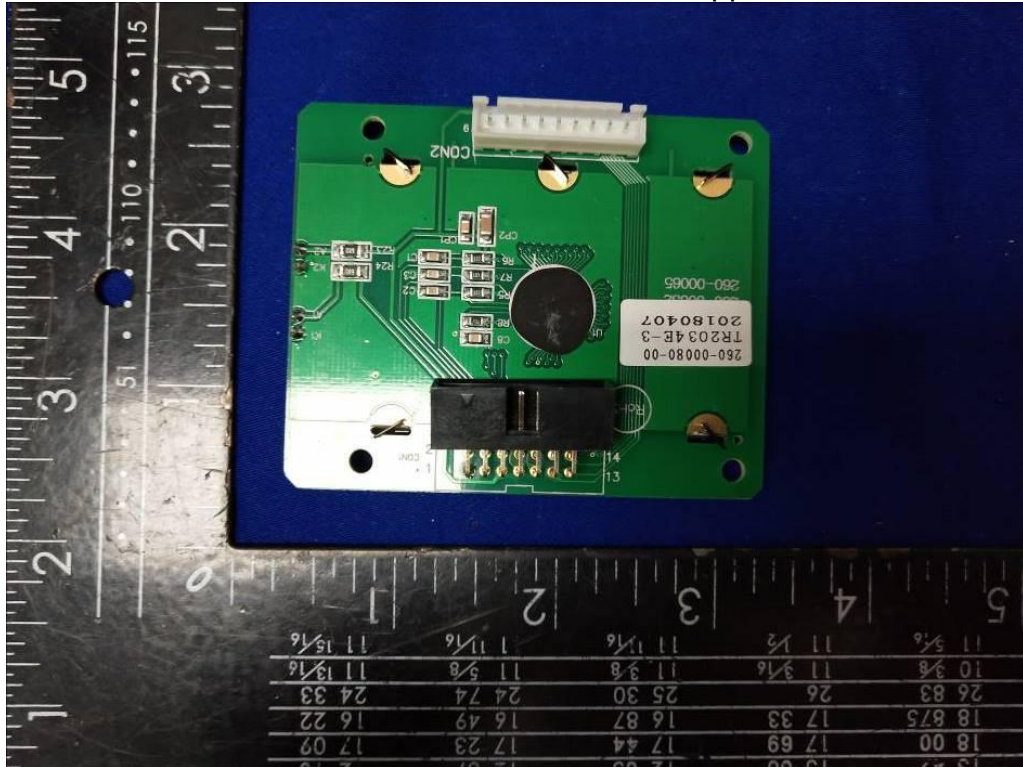


Figure 8
General Appearance of the PCB

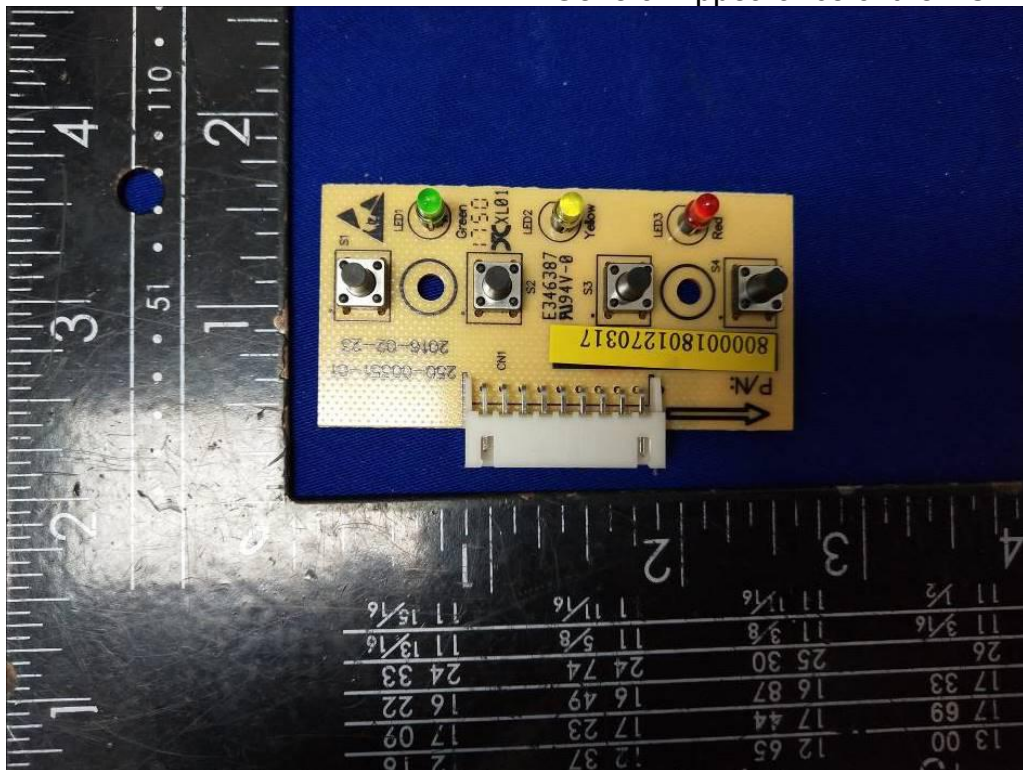


Figure 9
General Appearance of the PCB

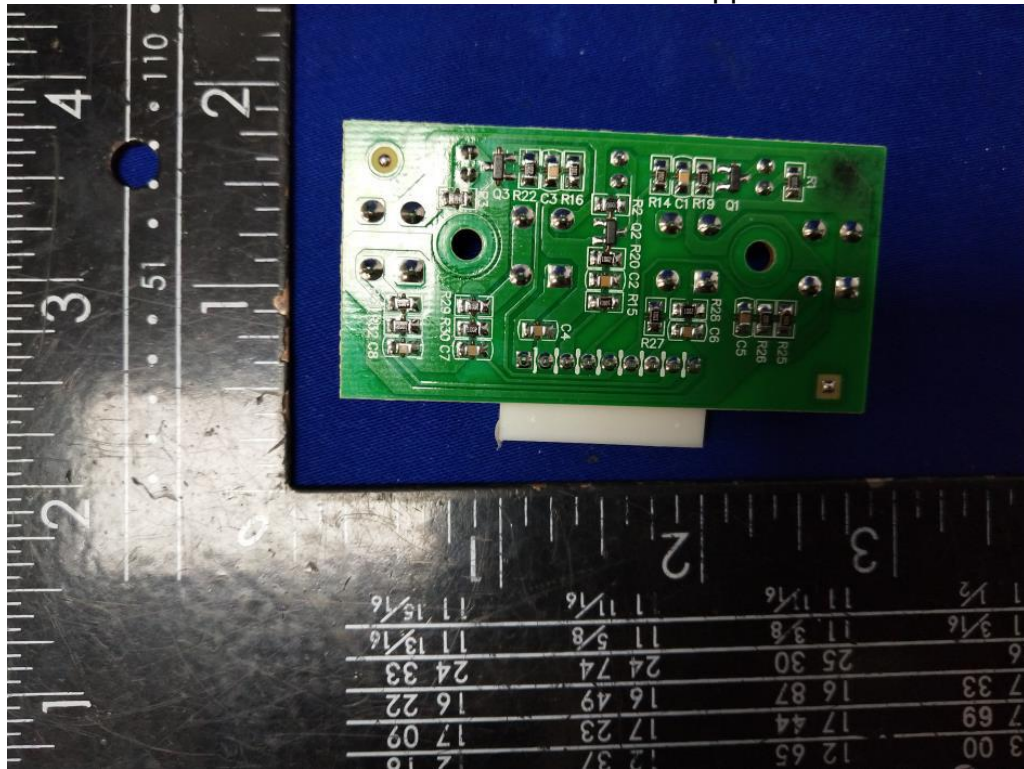


Figure 10
General Appearance of the PCB

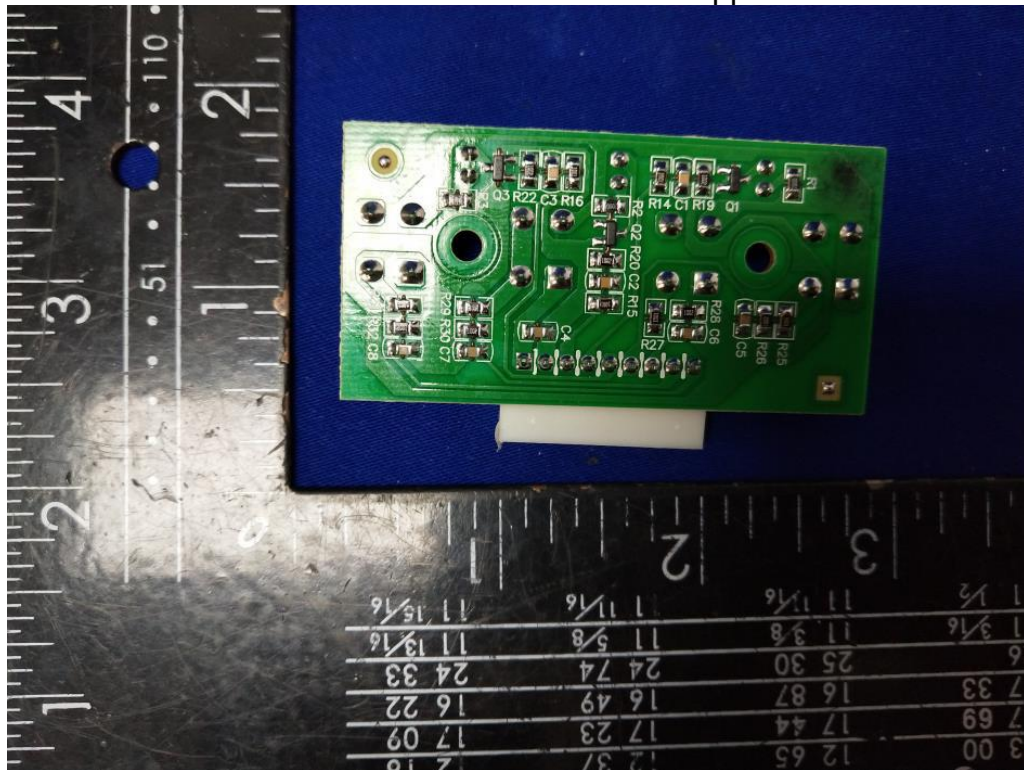


Figure 11
General Appearance of the PCB

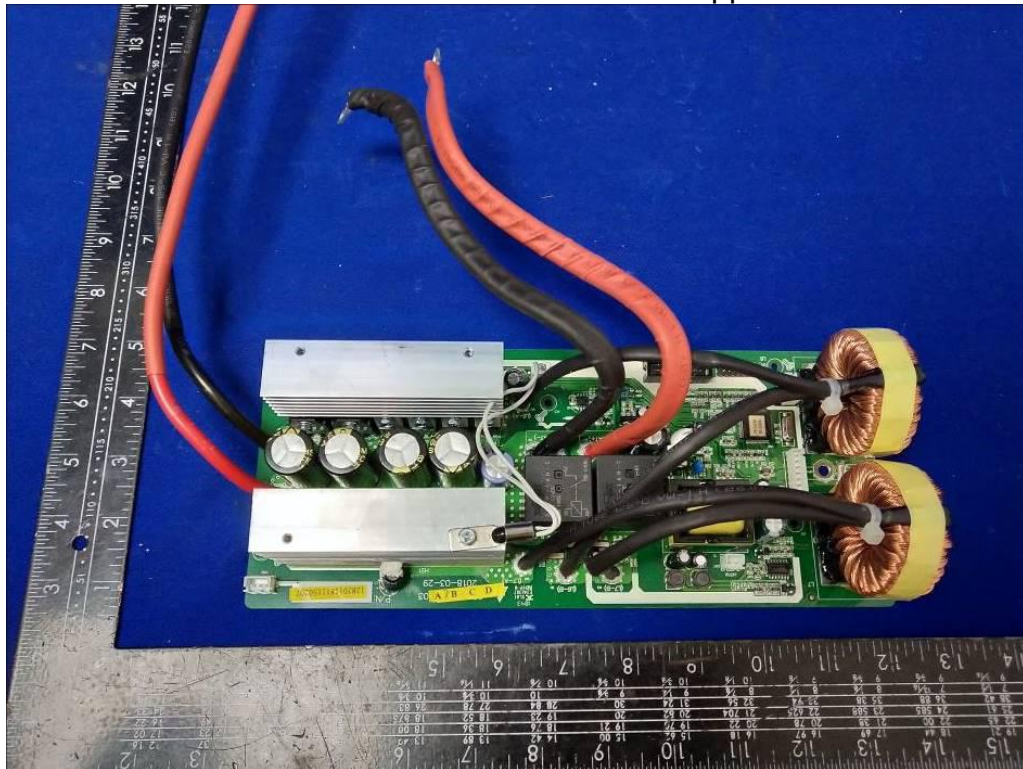


Figure 12
General Appearance of the PCB



Figure 13
General Appearance of the PCB

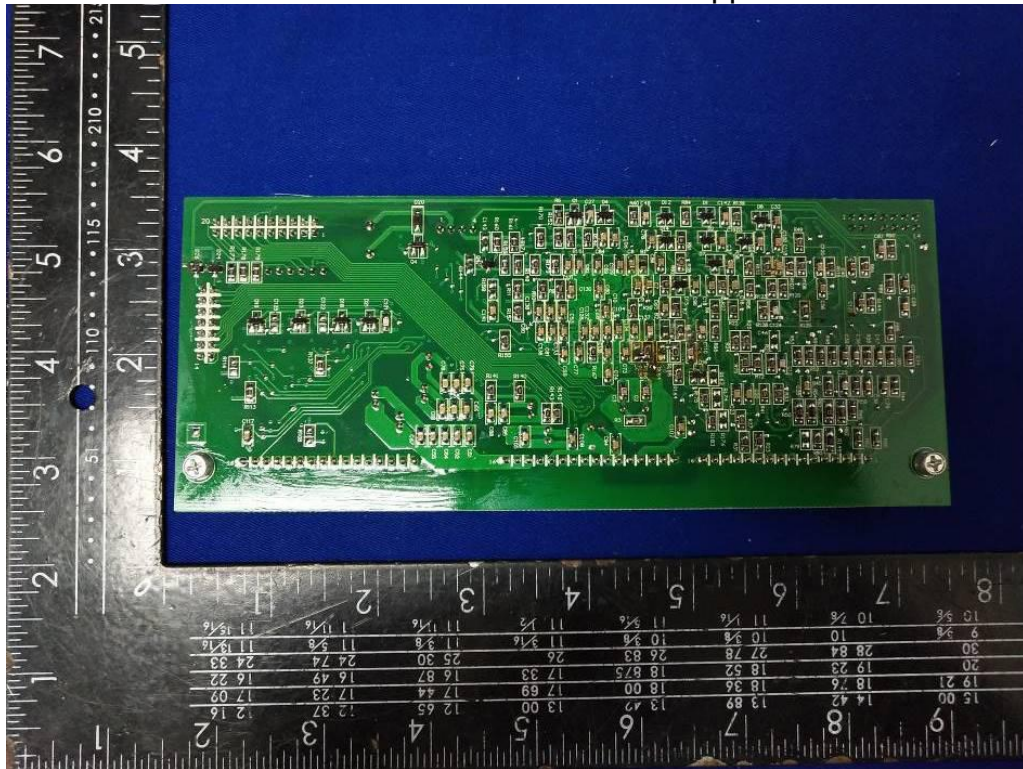


Figure 14
General Appearance of the PCB

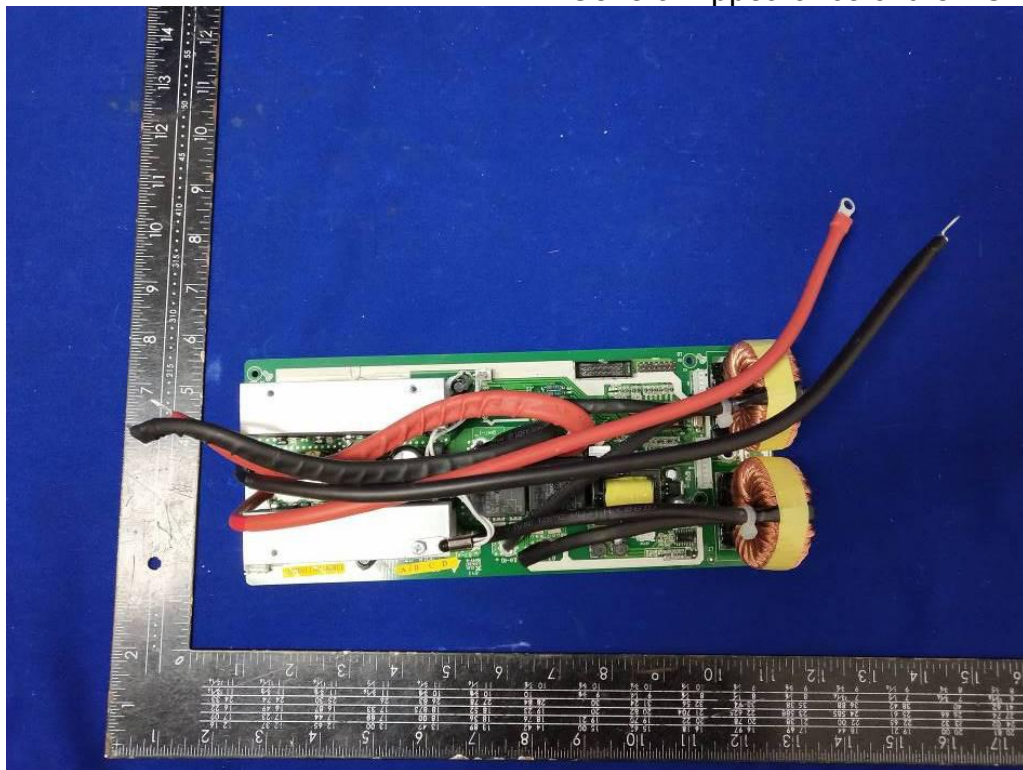


Figure 15
General Appearance of the PCB

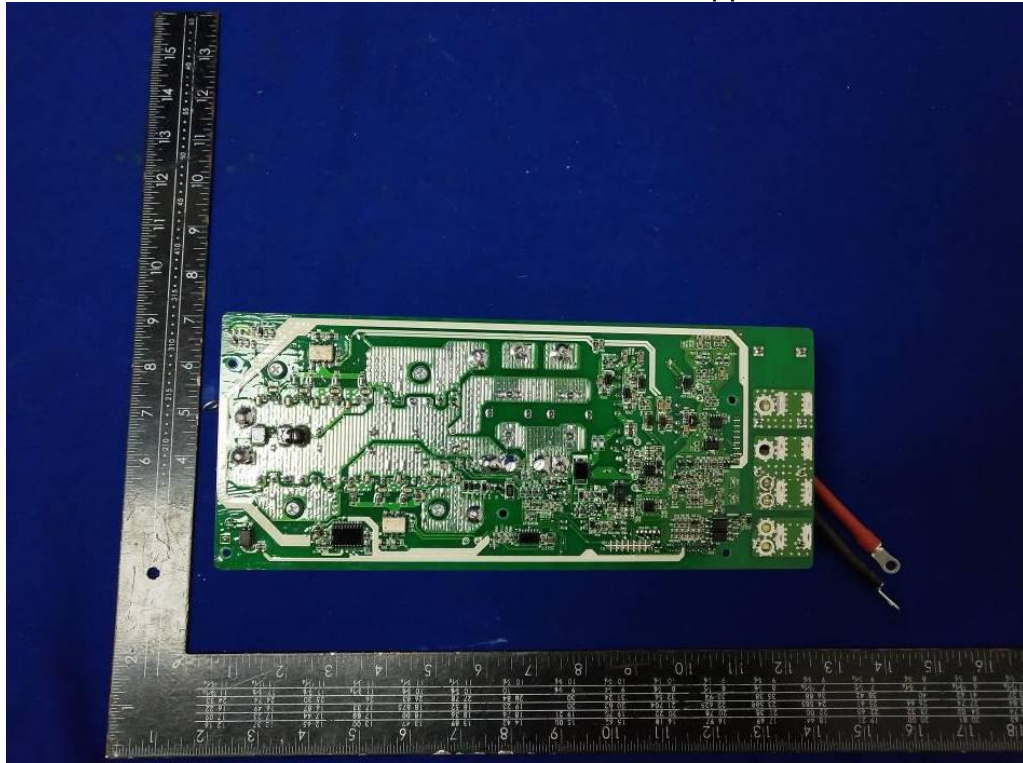


Figure 16
General Appearance of the PCB

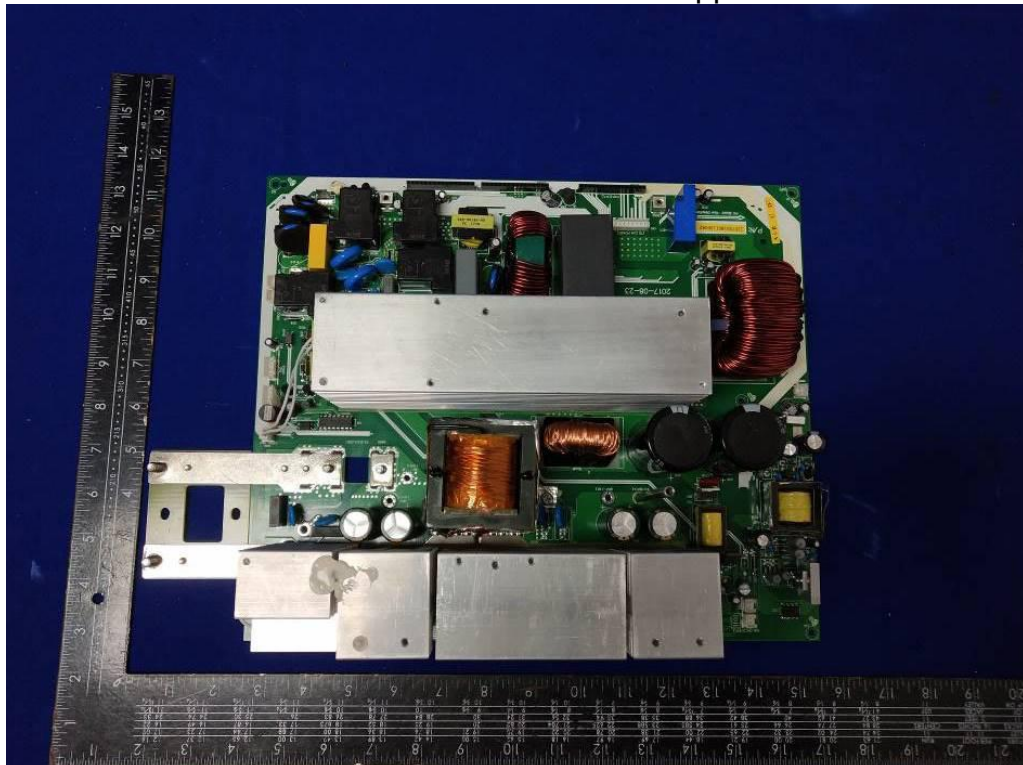


Figure 17
General Appearance of the PCB

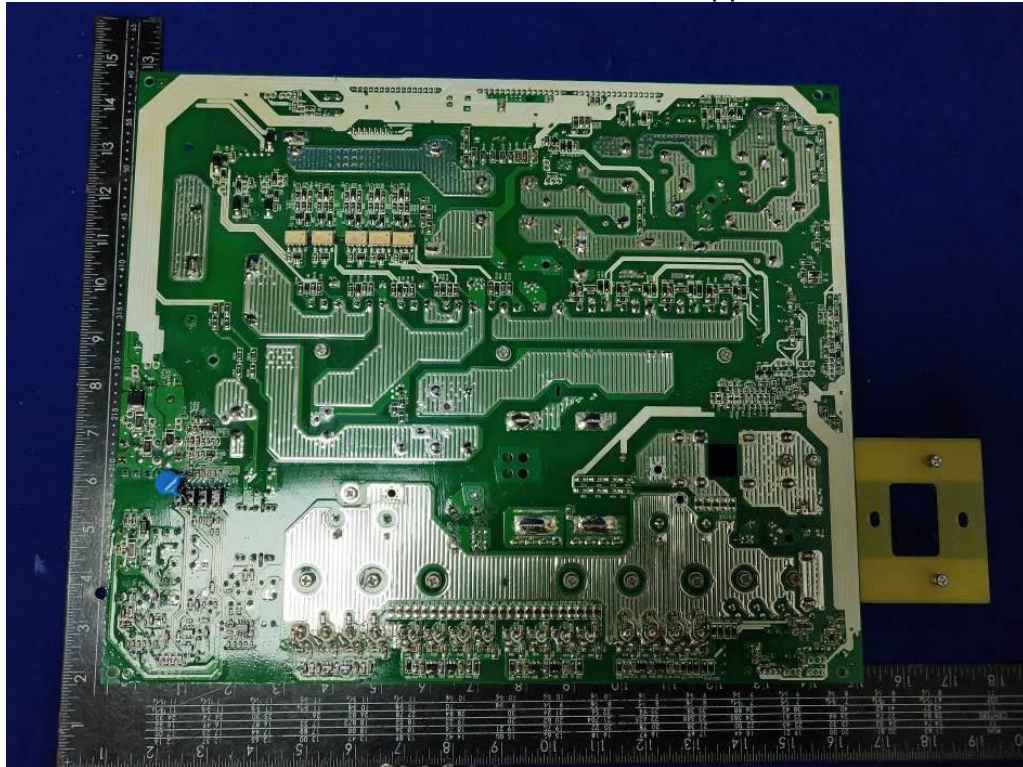


Figure 18
General Appearance of the PCB

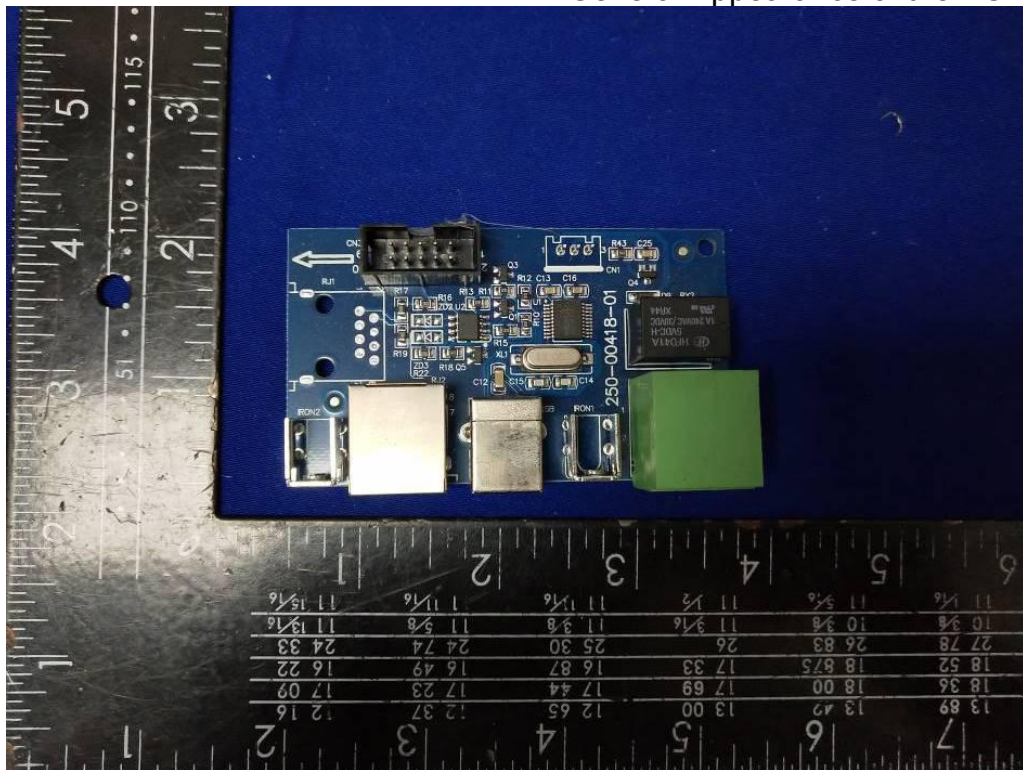


Figure 19
General Appearance of the PCB

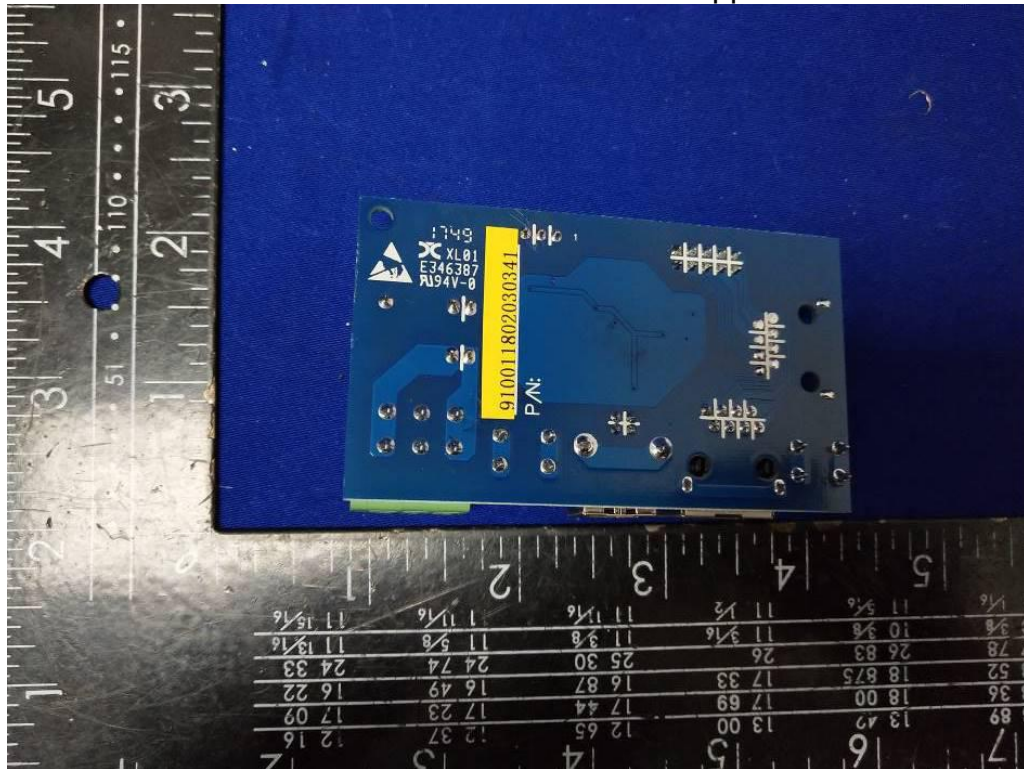


Figure 20
General Appearance of the PCB

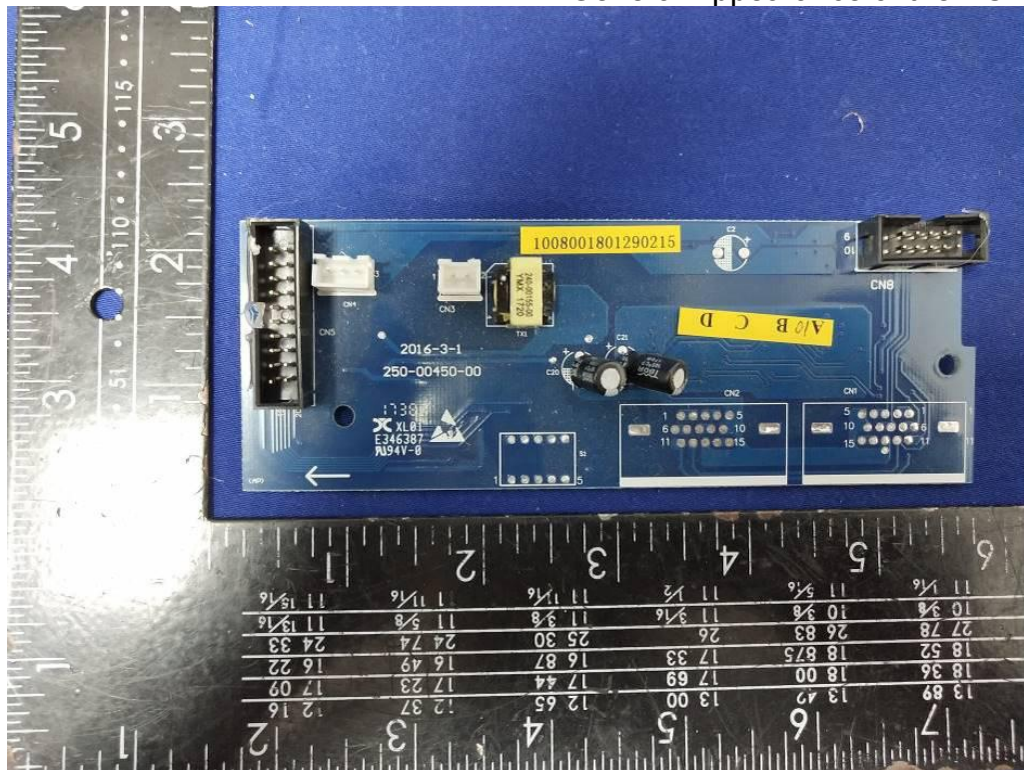
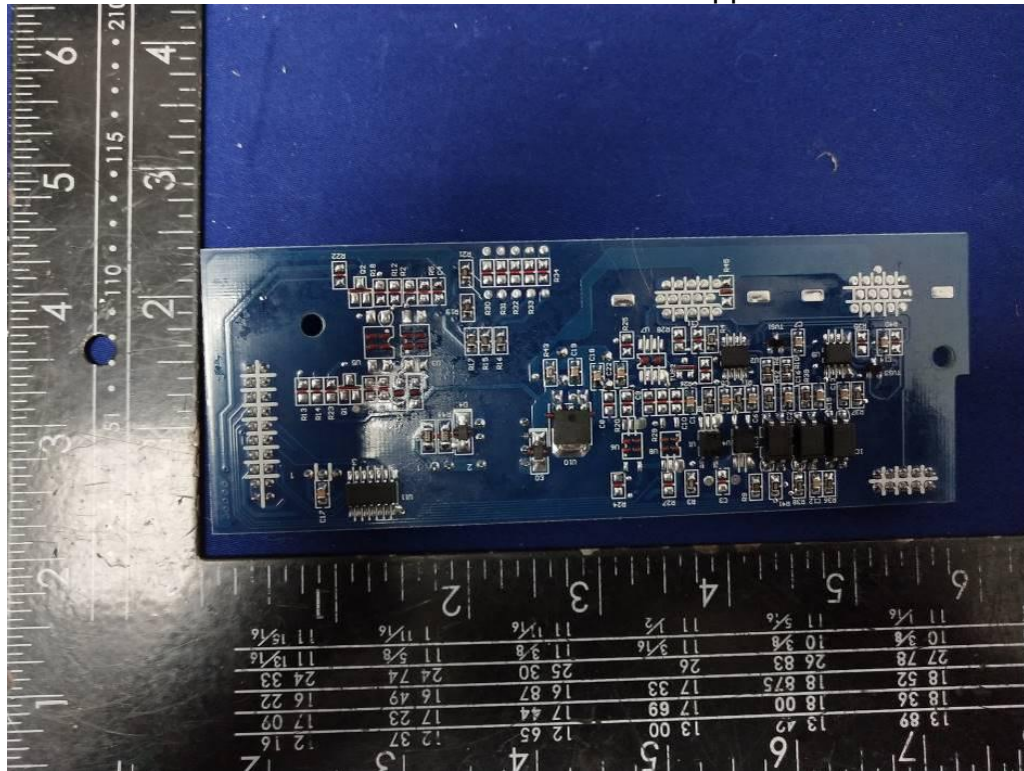


Figure 21
General Appearance of the PCB



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