EMC Test Report

Report Number: UCSCE-1902-0011

Applicant

Bullsone
306th and 6th floors of Teheran-ro, Gangnam-gu, Seoul

Manufacturer

UIL
869-26, Bogwang-ro, Gwangtan-myeon, Paju-si, Gyenggi-do, 10952

Test information

Test product: **Air theraphy smartaction**

Test model name: **Bullsone air theraphy smartaction**

Received number: **UCS-R-2019-0121**

Test date: **2019.02.07 ~ 2019.02.08**

Issued Date: **2019.02.14**

Test standards

EN 55014-1:2006/A2:2011

EN 55014-2:2015

EN 61000-3-2:2014

EN 61000-3-3:2013

The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
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Tested by: J.H. Park **Approved by: I.Y. Jeong**

Office: #702, 268, Hagui-ro, Dongan-gu, Anyang-si, Gyeonggi-do, 14056, KOREA.
EMC Center: 161-8, Ansandong-gil, Hwaseong-si, Gyeonggi-do, Korea
EMC Test Site: 35-13, Hwalcho-gil, 109beon-gil, Hwaseong-si, Gyeonggi-do, 18278, Korea

Product information

Division	Main Specifications and Characteristics
Power	Adpater in : 230 V~, 50 Hz
Weight	545 g
Size	120 mm x 209 mm x 70 mm
Material	ABS/PC

Specifications: Refer to the manual

Contents

Revision History

Issued Report No.	Issued Date	Revisions	Effect Section
UCSCE-1902-0011	14-Feb-2019	Initial Issue	All

1. Testing laboratory

1.1 Location

UCS Co., Ltd.
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Tel: +82-1833-5681
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Laboratory Accreditations and Listings

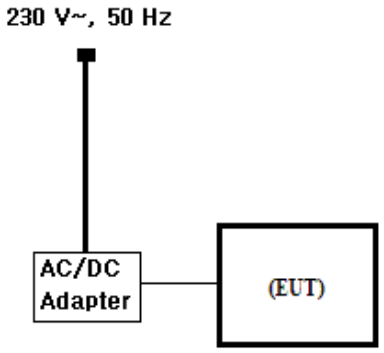
Country	Agency	Registration Number	Logo
USA	FCC	803225	
KOREA	RRA	KR0045	
KOREA	KOLAS	KT263	

2. Test Configuration and Condition

2.1 EUT operating condition

- Test the EUT continuously.
- Input power condition during the measurements was 230 V~, 50 Hz.

2.2 EUT test configuration diagra



2.3 Peripheral equipments list for test

Equipment Name	Model	Serial Number	Manufacturer
Air theraphy smartaction	Bullsone air theraphy smartaction	-	UIL
AC/DC Adapter	ANY12100C-1	18A402051	Wendeng ANY Electronics Co., Ltd.

2.4 Cable connections

Start		End		Cable	
Name	I/O Port	Name	I/O Port	Length (m)	Spec.
Air theraphy smartaction	DC-IN	AC/DC Adapter	DC-OUT	1.4	Unshielded

2.5 EUT modifications

- None

3. Summary of Test Results

3.1 Summary of test results

Standard	Test Item	Results
EN 55014-1:2006/A2:2011	Mains terminal continuous disturbance voltage	Met / PASS
	Mains terminal discontinuous disturbance voltage	Met / PASS
	Disturbance Power	Met / PASS
	Radiated disturbance	N/A (See note 1)
EN 61000-3-2:2014	Harmonics current emissions	Met Class A / Pass
EN 61000-3-3:2013	Voltage changes, Voltage fluctuations and flicker	Met / Pass
EN 55014-2:2015(Category II)	Electrostatic Discharge	A Met by Criterion / Pass
	Radiated RF electromagnetic field immunity	N/A (See note 2)
	Electrical Fast Transient/Burst Immunity	A Met by Criterion / Pass
	Surge Immunity	A Met by Criterion / Pass
	Conducted RF Field Immunity (Injected currents)	A Met by Criterion / Pass
	Voltage Dips, Short Interruptions Immunity	A Met by Criterion / Pass

* Note 1: This test is not performed because the EUT is tested to disturbance power. (The EUT meets the limit of the additional margin in the 200 MHz to 300 MHz band and it uses a clock frequency of less than 30 MHz.)
* Note 2: This test is not performed because the EUT is category II.

3.2 Performance of criteria

Performance criterion A

During and after the test the EUT shall continue to operate as intended without operator intervention. No degradation of performance or loss of function is allowed below a minimum 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. 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 by what the user may reasonably expect from the EUT if used as intended.

Performance criterion B

After the test, the EUT shall continue to operate as intended without operator intervention. No degradation of performance or loss of function is allowed, after the application of the phenomena 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. During the test, degradation of performance is allowed. However, no change of operating state or stored data is allowed to persist after the test. 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 by what the user may reasonably expect from the EUT if used as intended.

Performance criterion C

During and after testing, a temporary loss of function is allowed, provided the function is selfrecoverable, or can be restored by the operation of the controls or cycling of the power to the EUT by the user in accordance with the manufacturer's instructions. Functions, and/or information stored in non-volatile memory, or protected by a battery backup, shall not be lost.

4. Test Results

4.1 Mains terminal continuous disturbance voltage

Test Standard	EN 55014-1:2006/A2:2011		
Teat venue	Shield Room 2		
Tested Date	2019.02.07		
Input Ratings	230 V~, 50 Hz		
Temperature	18.6 ℃	**Humidity**	33.2 % R.H.
Test result	Met / Pass		

4.1.1 Limit

Frequency	**Mains terminals**		**Load and additional terminals**	
[MHz]	**Quasi-Peak [dBμV]**	**Average [dBμV]**	**Quasi-Peak [dBμV]**	**Average [dBμV]**
0.15 ~ 0.5	66 ~ 56*	59 ~ 46*	80	70
0.5 ~ 5	56	46	74	64
5 ~ 30	60	50	74	64

* The limit decreases linearly with the logarithm of frequency.

4.1.2 Test set-up and procedure

The mains terminal disturbance voltage was measured with the equipment under test (EUT) in a shield room.
The EUT was connected to an artificial mains network (LISN) placed on the floor.
The EUT was placed on non-metallic table 0.8 m above the metallic, grounded floor.
Amplitude measurements were performed with a quasi-peak detector and an average detector.

4.1.3 Test equipment used

Equipment	**Model**	**Serial No.**	**Vendor**	**Next Cal. Date**	**Use**
Test Receiver	ESR7	101120	ROHDE & SCHWARZ	2019.08.03	■
LISN	NSLK 8127	8127518	SCHWARZBECK	2019.08.03	□
Two-Line V-Network	ENV216	3560.6550.12-101874-Rq	ROHDE & SCHWARZ	2019.08.03	□
Two-Line V-Network	ENV216	3560.6550.12-102073-Ax	ROHDE & SCHWARZ	2019.08.03	■
Four-Line V-Network	ENV432	101284	ROHDE & SCHWARZ	2019.08.03	□
ARTFICIAL MAINS NETWORK	L3-32	1220X20311	PMM	-	□

4.1.4 Test data Test data

- Frequency Range : 150 kHz ~ 30 MHz
- Bandwidth : 9 kHz

[Quasi-Peak]

Frequency [MHz]	LISN [dB]	Cable Loss [dB]	Line [H/N]	Limit [dBµV]	Reading [dBµV]	Results [dBµV]	Margin [dB]
0.15	9.70	0.03	H	66.00	29.30	39.03	-26.97
0.26	9.60	0.01	N	61.43	25.21	34.82	-26.61
0.60	9.81	0.02	N	56.00	20.94	30.77	-25.23
1.05	9.69	0.03	N	56.00	21.52	31.24	-24.76
1.41	9.68	0.05	H	56.00	20.97	30.70	-25.30
1.98	9.63	0.07	N	56.00	20.01	29.71	-26.29
3.78	9.64	0.12	H	56.00	20.69	30.45	-25.55
5.79	9.63	0.16	N	60.00	16.92	26.71	-33.29
10.09	9.66	0.21	N	60.00	14.42	24.29	-35.71
23.41	9.68	0.32	N	60.00	16.79	26.79	-33.21
29.12	9.68	0.36	H	60.00	15.13	25.17	-34.83

[Average]

Frequency [MHz]	LISN [dB]	Cable Loss [dB]	Line [H/N]	Limit [dBµV]	Reading [dBµV]	Results [dBµV]	Margin [dB]
	* Average mode was not recorded, because Quasi-Peak values were under the Average limit.						

Conducted emission, quasi-peak detection: 2.2 dB
Conducted emission, average detection: 2.2 dB
Conducted emission, Telecom port: 1.8 dB
The measurement uncertainty is given with a confidence of 95 % with the coverage factor, $k = 2$.

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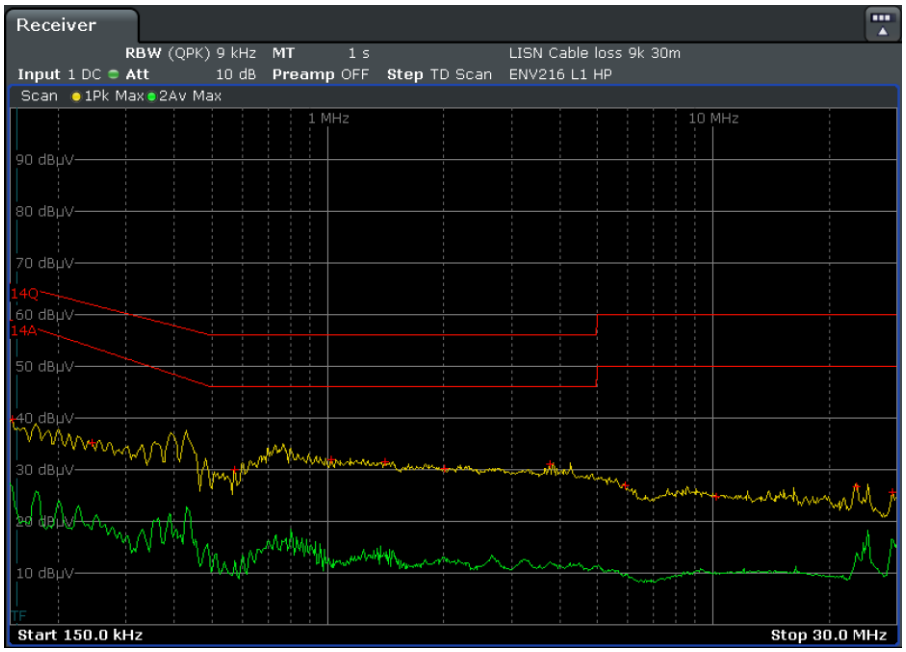
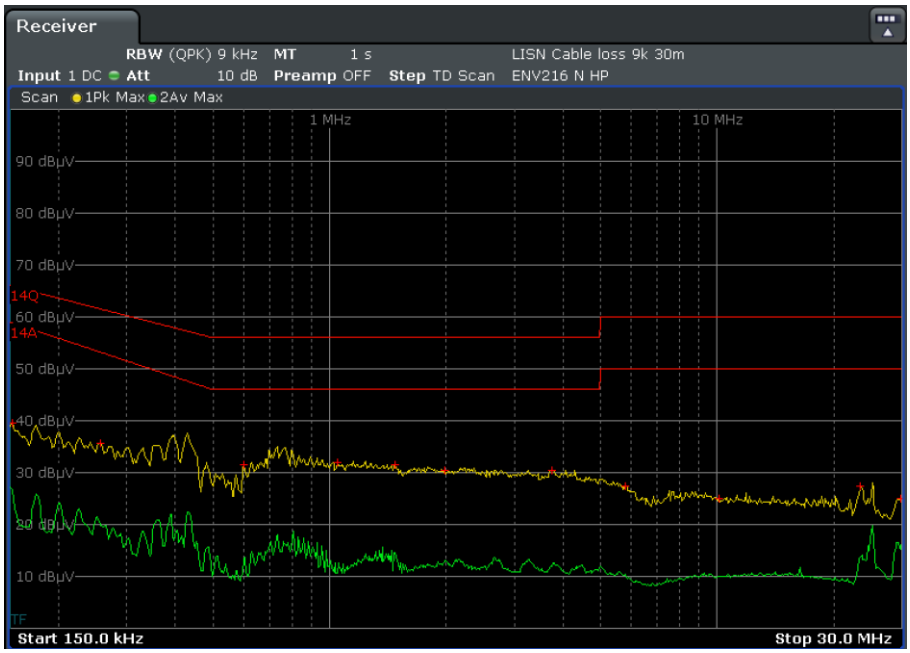
4.1.5 Test graph (AC mains power ports)

[Hot line]



* ——— : Quasi-Peak, ——— : Average

[Neutral line]



* ——— : Quasi-Peak, ——— : Average

4.2 Mains terminal discontinuous disturbance voltage

Test Standard	EN 55014-1:2006/A2:2011		
Teat venue	Shield Room 2		
Tested Date	2019.02.07		
Input Ratings	230 V~, 50 Hz		
Temperature	(19.3 ± 0.1) ℃	Humidity	(32.2 ± 0.1) % R.H.
Test result	Met / Pass		

4.2.1 Test set-up and procedure

The initial test was made to count discontinuous disturbance classified as clicks (n) over the Q-Peak limits of mains terminals disturbance voltage at each frequencies.

The test was observed for 120 min (T) for each measurement.

The click rate "N" was determined from the formula N = n * f/T.

The relevant click limit "Lq" for discontinuous disturbance was determined in according the formula given in EN 55014-1, Clause 4.2.2.2.

The second test run was made to determine how many clicks exceed the click limit "Lq" the time for this second run was the same as the time taken for initial test.

4.2.2 Test equipment used

Equipment	Model	Serial No.	Vendor	Next Cal. Date	Use
Test Receiver	ESPI3	101171	ROHDE & SCHWARZ	2019.08.03	□
Test Receiver	ESR7	101120	ROHDE & SCHWARZ	2019.08.03	□
EMI Receiver	9010	274WX90601	PMM	2019.08.03	■
LISN	NSLK 8127	8127518	SCHWARZBECK	2019.08.03	□
Two-Line V-Network	ENV216	3560.6550.12-101874-Rq	ROHDE & SCHWARZ	2019.08.03	□
Two-Line V-Network	ENV216	3560.6550.12-102073-Ax	ROHDE & SCHWARZ	2019.08.03	■
Four-Line V-Network	ENV432	101284	ROHDE & SCHWARZ	2019.08.03	□

4.2.3 Test data

- Observation time: 120 min

Frequency	150 kHz	500 kHz	1.4 MHz	30 MHz
Continuous Limit, L	66	56	56	60
Click rate, N	-	-	-	-
Click level*, Lc	-	-	-	-
Click limit, Lq = Lc + L	-	-	-	-
Counted clicks exceeding the click limit (Number)	-	-	-	-
Test result	Pass	Pass	Pass	Pass

* The discontinuous disturbance noise was not observed during the test.

The measurement uncertainty is 1.7 dB

The measurement uncertainty is given with a confidence of 95 % with the coverage factor, $k = 2$.

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4.3 Disturbance power

Test Standard	EN 55014-1:2006/A2:2011		
Test venue	Shield Room 2		
Tested Date	2019.02.07		
Input Ratings	230 V~, 50 Hz		
Temperature	18.9 ℃	Humidity	32.8 % R.H.
Test result	Met Class A / Pass		

4.3.1 Limit

	Household and similar appllances		**Tools**					
Frequency range			Rated motor power not exceeding 700 W		Rated motor power above 700 W and not exceeding 1 000 W		Rated motor power above 1 000 W	
(MHz)	dB(pW) Quasi-peak	dB(pW) Average	dB(pW) Quasi-peak	dB(pW) Average	dB(pW) Quasi-peak	dB(pW) Average	dB(pW) Quasi-peak	dB(pW) Average
30 ~ 300	45 ~ 55	35 ~ 45	45 ~ 55	35 ~ 45	49 ~ 59	39 ~ 49	55 ~ 65	45 ~ 55

4.3.2 Test set-up and procedure

EUT was placed on a wooden table 0.8 m above the floor and 0.8 m from any conductive structure except 0.4 m away from vertical reference plan when tested in shielded room.

EUT was placed as close as possible to the absorbing clamp's zero point (end of sideway) and the lead to be measured was extended to at 6 m length.

The lead was then led through the "absorbing clamp" which is a current probe followed by 0.5 m of highly absorptive ferrite.

A peak detector scan was conducted at the clamps zero-point in the frequency range 30 MHz to 300 MHz.

This overview scan with peak detector is presented in the report.

A "maximum search" was conducted to fine the maximum emitting point along the lead.

This was done by moving the clamp along the cable (from 0 m to 6 m) and constantly measures the emission.

The clamp was then moved to the maximum point where a quasi-peak and, if required, an average measurement was conducted.

This procedure was repeated for each single frequency found with the peak detector scan. The reading on the measurement receiver is observed for about 15 s for each measurement.

The highest readings were recorded with the exception of any isolated spike, which were ignored.

A test at about 50 MHz made over a range of 0.9 to 1.1 times the rated voltage in order to check whether the level of disturbance varies considerably with the supply voltage.

4.3.3 Test equipment used

Equipment	Model	Serial No.	Vendor	Next Cal. Date	Use
Test Receiver	ESPI3	101171	ROHDE & SCHWARZ	2019.08.03	□
Test Receiver	ESR7	101120	ROHDE & SCHWARZ	2019.08.03	■
Absorbing Clamp	MDS 21	80870	ROHDE & SCHWARZ	2019.08.06	■

4.3.4 Test data

- Frequency range : 30 MHz ~ 300 MHz
- Bandwidth : 120 kHz

[Quasi-Peak]

Frequency [MHz]	INSERTION LOSS [dB]	Limit [dB(pW)]	Reading [dB(pW)]	Results [dB(pW)]	Margin [dB]
32.13	24.62	45.08	-0.28	24.34	-20.74
49.80	22.06	45.73	3.89	25.95	-19.78
55.05	21.90	45.93	10.90	32.80	-13.13
65.04	21.63	46.30	1.15	22.78	-23.52
93.87	21.50	47.37	3.58	25.08	-22.29
149.76	20.93	49.44	-3.24	17.69	-31.75
177.24	20.45	50.45	1.88	22.33	-28.12
217.98	19.87	51.96	-2.61	17.26	-34.70
298.77	20.63	54.95	-10.62	10.01	-44.94

[Average]

Frequency [MHz]	INSERTION LOSS [dB]	Limit [dB(pW)]	Reading [dB(pW)]	Results [dB(pW)]	Margin [dB]

*** Results [dB(pW)]** = Reading [dB(pW)] + Insertion Loss [dB]

*** Margin [dB**] = Result [dB(pW)] – Limit [dB(pW)]

The measurement uncertainty is 2.9 dB
The measurement uncertainty is given with a confidence of 95 % with the coverage factor, k = 2.

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4.4 Harmonics current emissions

Test Standard	EN 61000-3-2:2014		
Test venue	EMS 1		
Tested Date	2019.02.07		
Input Ratings	230 V~, 50 Hz		
Temperature	19.5 ℃	Humidity	32.1 % R.H.
Test result	Met Class A / Pass		

4.4.1 Test setup and procedure

The equipment is supplied in series with shunt(s) Rms or current transformer(s) from a source having the same Nominal voltage and frequency as the rated supply voltage and frequency of the Measurements shall be made under Normal load, or conditions for adequate heat discharge, and underequipment.
Normal operating conditions. User's operation controls or automatic programmers shall be set to produce the maximum harmonic component, for each successive harmonic component in turn. For the purpose of harmonic current limitation, equipment is classified as follows:

Class A : Equipment not specified in one of the three other Classes shall be considered as Class A equipment.
- Balanced three-phase equipment;
- Household appliances, excluding equipment identified as class D;
- Tools, excluding portable tools;
- Dimmers for incandescent lamps;
- Audio equipment.

Class B:
- portable tools;
- arc welding equipment which is not professional equipment.

Class C:
- lighting equipment.

Class D: Equipment having a specified power according to 6.2.2 less than or equal to 600 W, of the following types:
- personal computers and personal computer monitors;
- television receivers.
- refrigerators and freezers having one or more variable-speed drives to control compressor motor(s).

4.4.2 Test equipment used

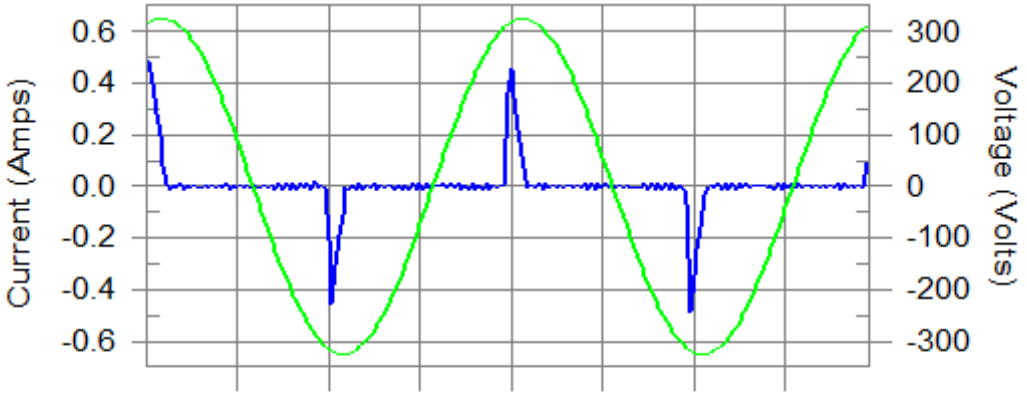
Equipment	Model	Serial No.	Vendor	Next Cal. Date	Use
5 k VA AC Power Source	5001iX	California Instruments	S59160	2019.08.08	■

4.4.3 Test data

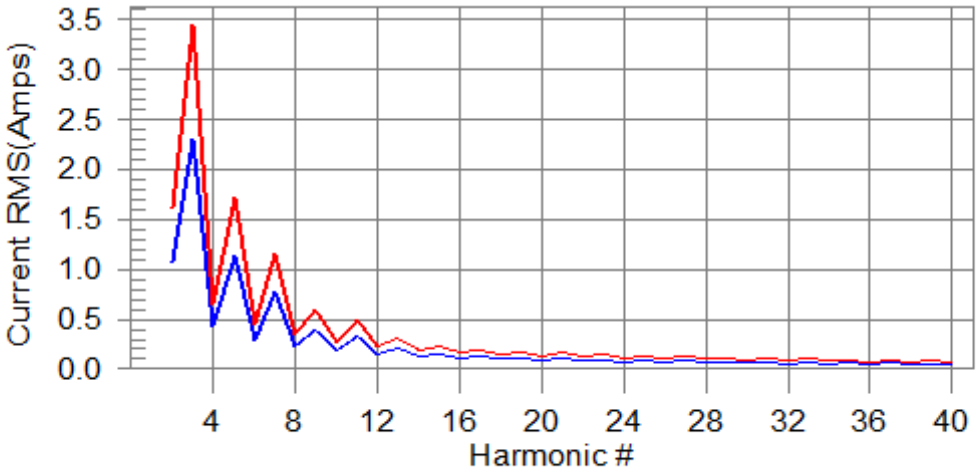
Harmonics – Class-A per Ed. 4.0 (2014)(Run time)

Test Result: Pass **Source qualification: Normal**

Current & voltage waveforms



Harmonics and Class A limit line European Limits



Test result: Pass Worst harmonics H17-5.9% of 150% limit, H21-8.3% of 100% limit

Current Test Result Summary (Run time)

Test Result: Pass Source qualification: Normal
THC(A): 0.044 I-THD(%): 218.1 POHC(A): 0.018 POHC Limit(A): 0.251

Highest parameter values during test:

V_RMS (Volts):	229.94	Frequency(Hz):	50.00
I_Peak (Amps):	0.533	I_RMS (Amps):	0.089
I_Fund (Amps):	0.020	Crest Factor:	8.987
Power (Watts):	4.5	Power Factor:	0.386

Harm#	Harms(avg)	100%Limit	%of Limit	Harms(max)	150%Limit	%of Limit	Status
2	0.001	1.080	N/A	0.001	1.620	N/A	Pass
3	0.015	2.300	0.7	0.020	3.450	0.6	Pass
4	0.001	0.430	N/A	0.001	0.645	N/A	Pass
5	0.015	1.140	1.3	0.019	1.710	1.1	Pass
6	0.001	0.300	N/A	0.001	0.450	N/A	Pass
7	0.015	0.770	1.9	0.018	1.155	1.6	Pass
8	0.001	0.230	N/A	0.001	0.345	N/A	Pass
9	0.014	0.400	3.5	0.017	0.600	2.9	Pass
10	0.001	0.184	N/A	0.001	0.276	N/A	Pass
11	0.013	0.330	4.0	0.016	0.495	3.2	Pass
12	0.001	0.153	N/A	0.001	0.230	N/A	Pass
13	0.013	0.210	6.0	0.015	0.315	4.6	Pass
14	0.001	0.131	N/A	0.001	0.197	N/A	Pass
15	0.012	0.150	7.8	0.013	0.225	5.8	Pass
16	0.001	0.115	N/A	0.001	0.173	N/A	Pass
17	0.011	0.132	8.2	0.012	0.198	5.9	Pass
18	0.001	0.102	N/A	0.001	0.153	N/A	Pass
19	0.010	0.118	8.3	0.010	0.178	5.8	Pass
20	0.001	0.092	N/A	0.001	0.138	N/A	Pass
21	0.009	0.107	8.3	0.009	0.161	5.6	Pass
22	0.001	0.084	N/A	0.001	0.125	N/A	Pass
23	0.008	0.098	8.1	0.008	0.147	5.5	Pass
24	0.001	0.077	N/A	0.001	0.115	N/A	Pass
25	0.007	0.090	7.8	0.007	0.135	5.3	Pass
26	0.001	0.071	N/A	0.001	0.107	N/A	Pass
27	0.006	0.083	7.5	0.006	0.125	5.1	Pass
28	0.001	0.066	N/A	0.001	0.099	N/A	Pass
29	0.005	0.078	7.0	0.006	0.116	4.8	Pass
30	0.001	0.061	N/A	0.001	0.092	N/A	Pass
31	0.005	0.073	N/A	0.005	0.109	N/A	Pass
32	0.001	0.058	N/A	0.001	0.086	N/A	Pass
33	0.004	0.068	N/A	0.005	0.102	N/A	Pass
34	0.001	0.054	N/A	0.001	0.081	N/A	Pass
35	0.004	0.064	N/A	0.004	0.096	N/A	Pass
36	0.001	0.051	N/A	0.001	0.077	N/A	Pass
37	0.003	0.061	N/A	0.004	0.091	N/A	Pass
38	0.001	0.048	N/A	0.001	0.073	N/A	Pass
39	0.003	0.058	N/A	0.004	0.087	N/A	Pass
40	0.001	0.046	N/A	0.001	0.069	N/A	Pass

Voltage Source Verification Data (Run time)

Test Result: Pass **Source qualification: Normal**

Highest parameter values during test:

Voltage (Vrms):	229.94	Frequency(Hz):	50.00
I_Peak (Amps):	0.533	I_RMS (Amps):	0.089
I_Fund (Amps):	0.020	Crest Factor:	8.987
Power (Watts):	4.5	Power Factor:	0.386

Harm#	Harmonics V-rms	Limit V-rms	% of Limit	Status
2	0.020	0.460	4.35	OK
3	0.446	2.069	21.57	OK
4	0.018	0.460	3.84	OK
5	0.011	0.920	1.15	OK
6	0.018	0.460	3.84	OK
7	0.040	0.690	5.80	OK
8	0.007	0.460	1.42	OK
9	0.116	0.460	25.14	OK
10	0.006	0.460	1.22	OK
11	0.068	0.230	29.45	OK
12	0.014	0.230	6.18	OK
13	0.035	0.230	15.30	OK
14	0.004	0.230	1.62	OK
15	0.015	0.230	6.68	OK
16	0.011	0.230	4.57	OK
17	0.007	0.230	2.96	OK
18	0.014	0.230	5.99	OK
19	0.014	0.230	6.17	OK
20	0.012	0.230	5.21	OK
21	0.012	0.230	5.21	OK
22	0.004	0.230	1.83	OK
23	0.009	0.230	4.07	OK
24	0.002	0.230	0.89	OK
25	0.008	0.230	3.54	OK
26	0.003	0.230	1.34	OK
27	0.009	0.230	3.92	OK
28	0.003	0.230	1.13	OK
29	0.008	0.230	3.29	OK
30	0.003	0.230	1.33	OK
31	0.007	0.230	3.10	OK
32	0.002	0.230	0.76	OK
33	0.007	0.230	2.95	OK
34	0.002	0.230	1.08	OK
35	0.007	0.230	3.14	OK
36	0.002	0.230	0.86	OK
37	0.008	0.230	3.65	OK
38	0.002	0.230	1.03	OK
39	0.009	0.230	3.96	OK
40	0.004	0.230	1.94	OK

The uncertainty of our equipment for flicker measurement is 5 %.
The measurement uncertainty is given with a confidence of 95 % with the coverage factor, k = 2.

4.5 Voltage changes, Voltage fluctuations and flicker

Test Standard	EN 61000-3-3:2013		
Test venue	EMS 1		
Tested Date	2019.02.07		
Input Ratings	230 V~, 50 Hz		
Temperature	19.5 ℃	Humidity	32.1 % R.H.
Test result	Met / Pass		

4.5.1 Test set-up and procedure

EUT was connected to the power analyzer system.
Measurement was performed to obtain the desired flicker parameters.
The measuring time depends on which parameters are to be measured.

Plt = 2 h

Pst = 10 min

Controls and automatic programs shall be set to produce the most unfavorable sequence of voltage changes, using only those combinations of controls and programs are mentioned by the manufacturer in the instruction manual.

4.5.2 Test equipment used

Equipment	Model	Serial No.	Vendor	Next Cal. Date	Use
Hamonics/Flicker	5001IX-208-150/300	S59160	C.I.	2019.08.08	■
Precision Power Analyzer	LMG670	01621511	ZES ZIMMER	2019.02.06	□
Reference Impedance	NI2415	NI2415-3	ZES ZIMMER	-	□
AC Power Source	360-AMX	1774	PACIFIC POWER SOURCE	-	□

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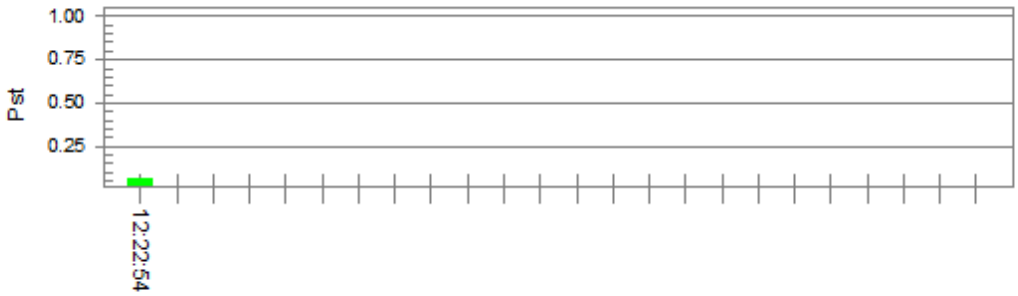
EMC Center: 161-8, Ansandong-gil, Hwaseong-si, Gyeonggi-do, Korea
EMC Test Site: 35-13, Hwalcho-gil, 109beon-gil, Hwaseong-si, Gyeonggi-do, 18278, Korea

4.5.3 Test data

Flicker Test Summary per EN/IEC61000-3-3 Ed. 3.0 (2013) (Run time)

Test Result: Pass **Status: Test Completed**

Pst and limit line **European Limits**



Plt and limit line

Parameter values recorded during the test:

Vrms at the end of test (Volt):	229.86			
T-max (mS):	0	Test limit (mS):	500.0	Pass
Highest dc (%):	0.00	Test limit (%):	3.30	Pass
Highest dmax (%):	0.00	Test limit (%):	4.00	Pass
Highest Pst (10 min. period):	0.064	Test limit:	1.000	Pass
Highest Plt (2 hr. period):	0.028	Test limit:	0.650	Pass

The uncertainty of our equipment for flicker measurement is 5 %.
The measurement uncertainty is given with a confidence of 95 % with the coverage factor, k = 2.

4.6 Electrostatic discharge

Test Standard	EN 61000-4-2:2009, Criteria: B		
Test venue	EMS 2		
Test Level	HCP/VCP/Contact: ± 4 kV Air: ± 8 kV		
Discharge Impedance	330 Ω / 150 pF		
Test Time	at least 10 times for each adapting point		
Tested Date	2019.02.08		
Input Ratings	230 V~, 50 Hz		
Temperature	18.1 ℃	**Humidity**	35.1 % R.H.
Atmospheric pressure	101.1 kPa		
Test Result	A Met by Criterion / Pass		

4.6.1 Test set-up and procedure

A ground reference plane was located on the floor, and connected to earth via a low Impedance connection.

The return cable of the ESD generator was connected to the reference plane.

In case of floor standing equipment, EUT was placed on the reference plane on 0.1 m of insulating Support.

In case of table top equipment, EUT was placed on a wooden table 0.8 m above the reference grounded floor.

A horizontal coupling plane (HCP) was placed on the table, and Connected to the reference plane via a 470 kohm resistor located in each end (0.5 mm insulating support between EUT and HCP).

In both cases a vertical coupling plane (VCP) of 0.5 m x 0.5 m was located 0.1 m from the EUT's sides.

The VCP was connected to the reference plane in the same matter as the HCP.

4.6.2 Test equipment used

Equipment	Model	Serial No.	Vendor	Next Cal. Date	Use
ESD Simulator	ESS-2000	4010C63927	NoiseKen	2019.08.08	□
HAEFELY TEST AG	ONYX 16	177897	HAEFELY TECHNOLOGY	2020.02.11	■
HCP	-	-	-	-	■
VCP	-	-	-	-	■

4.6.3 Test data

Location	Applied Level (±)	Criteria	Results
VCP	4 kV	B	A
HCP	4 kV	B	A

* There was no deviation from normal operation condition.

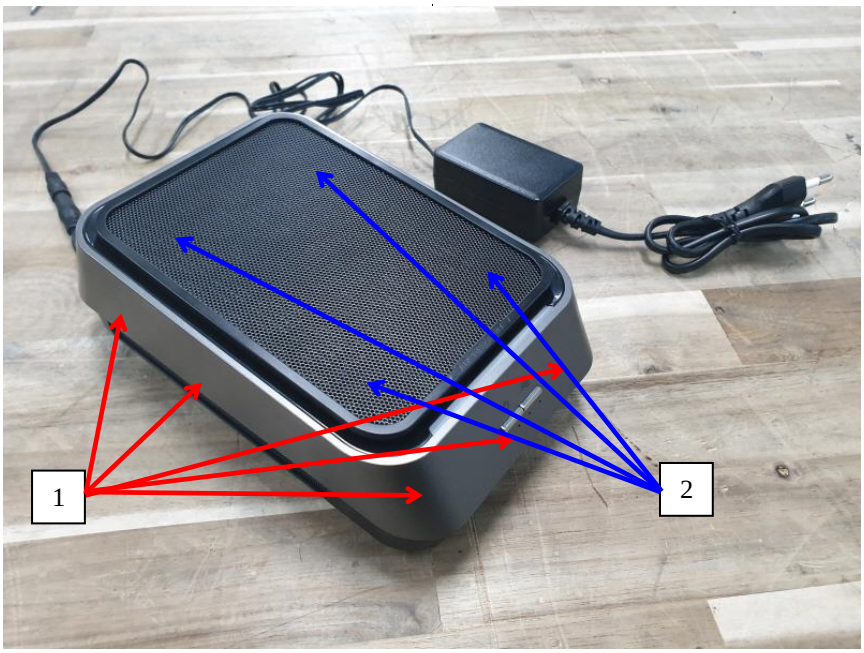
Location (EUT)	Applied Level (±)	Method	Criteria	Results
(1) Cove part	8 kV	Air	B	A
(2) Metal cove, screw part	4 kV	Contact	B	A

* There was no deviation from normal operation condition.

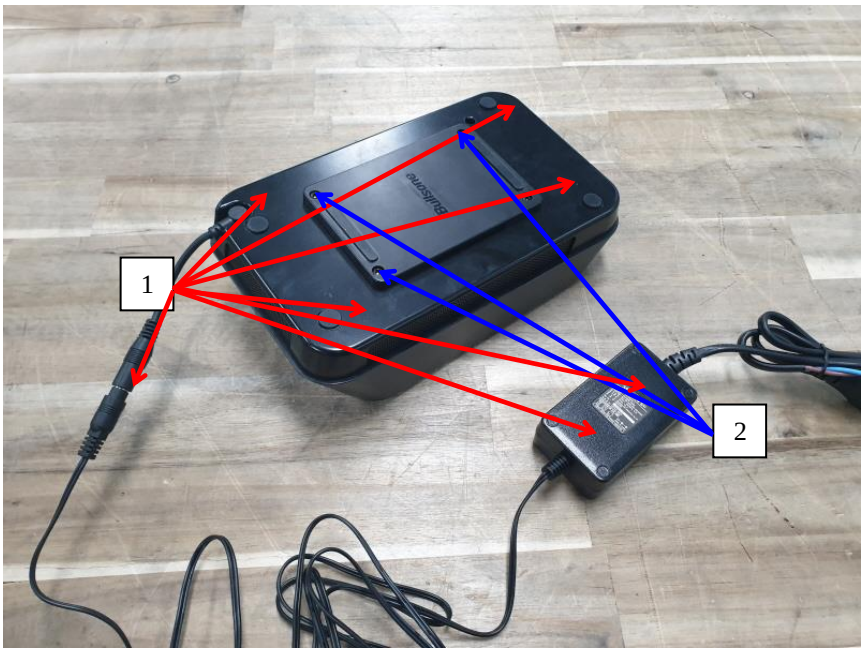
It has been demonstrated that the ESD generator meets the specified requirements in the standard with at least a 95 % confidence.

4.6.4 ESD points

[ESD points 1]



[ESD points 2]



4.7 Electric fast transient/burst immunity

Test Standard	EN 61000-4-4:2012, Criteria: B		
Test venue	EMS 2		
Coupling	Mains port - Coupling Decoupling Network, Signal port - Capacitive Coupling Clamp		
Test Level	AC Mains: ± 1 kV Peak		
Repetition Freq.	5 kHz, Tr / Th = 5 / 50 ns		
Coupling Time	120 s		
Tested Date	2019.02.08		
Input Ratings	230 V~, 50 Hz		
Temperature	18.3 ℃	**Humidity**	35.1 % R.H.
Atmospheric pressure	101.1 kPa		
Test Result	A Met by Criterion / Pass		

4.7.1 Test set-up and procedure

A ground reference plane was located on the floor.
EFT generator was connected to reference ground plane via low impedance connection.
For floor standing equipment, EUT was placed on a 0.1 m wooden table.
For tabletop equipment, EUT was placed on a 0.1 m above the ground reference plane.
Test generator and coupling/decoupling network was placed on, and bounded to, the ground reference plane.
When using the coupling clamp, the minimum distance between the coupling plates and all other conductive surfaces, except the ground reference plane beneath the coupling clamp, Shall be 0.5 m.

4.7.2 Test equipment used

Equipment	Model	Serial No.	Vendor	Next Cal. Date	Use
EMC IMMUNITY TEST	EMCPRO PLUS	0906221	ThermoFisher Scientific	2019.08.03	□
Capacitive Clamp	CCL	0904227	ThermoFisher Scientific	2019.08.03	□
COMPACT IMMUNITY TEST SYSTEM	AXOS5	180998	HAEFELY EMC TECHNOLOGY	2020.01.31	■
THREE PHASES EXTERNAL CDN	FP-COMB32	181211	HAEFELY EMC TECHNOLOGY	2020.02.01	□
Capacitive Coupling Clamp	IP4B	181514	HAEFELY EMC TECHNOLOGY	2020.02.01	□

4.7.3 Test data

EFT Coupling Point	Level (±)	Criteria	Results
L - N	1 kV	B	A

* There was no deviation from normal operation condition.

It has been demonstrated that the EFT/Burst generator meets the specified requirements in the standard with at least a 95 % confidence.

4.8 Surge immunity

Test Standard	EN 61000-4-5:2014, Criteria: B		
Test venue	EMS 2		
Coupling	Coupling Decoupling Network		
Test Level	AC Mains (Line to Line): ± 1 kV		
Number of surge/time	1 time / 60 s, total 5 times		
Angles	90˚, 270˚		
Tested Date	2019.02.08		
Input Ratings	230 V~, 50 Hz		
Temperature	(18.25 ± 0.05) ℃	**Humidity**	(35.05 ± 0.05) % R.H.
Atmospheric pressure	101.1 kPa		
Test Result	A Met by Criterion / Pass		

4.8.1 Test set-up and procedure

A ground reference plane was located on the floor. SURGE generator was connected to reference ground plane via low impedance connection. For floor standing equipment, EUT was placed on a 0.1 m wooden table.

For table top equipment, EUT was placed on a wooden table (0.1 m) above the reference plane.

4.8.2 Test equipment used

Equipment	Model	Serial No.	Vendor	Next Cal. Date	Use
EMC IMMUNITY TEST	EMCPRO PLUS	0906221	ThermoFisher Scientific	2019.08.03	□
I/O Lin Coupler/Decoupler	CM-I/OCD	0906226	ThermoFisher Scientific	-	□
Telecom coupler/Decoupler	CM-TELCD	0905226	ThermoFisher Scientific	-	□
COMPACT IMMUNITY TEST SYSTEM	AXOS5	180998	HAEFELY EMC TECHNOLOGY	2020.01.31	■
THREE PHASES EXTERNAL CDN	FP-COMB32	181211	HAEFELY EMC TECHNOLOGY	2020.02.01	□

4.8.3 Test data

Coupling Point	Level (±)	Criteria	Results
L to N	1 kV	B	A

* There was no deviation from normal operation condition.
* The EUT does not have the signal ports that may connect directly to outdoor cables.

It has been demonstrated that the surge tester meets the specified requirements in the standard with at least a 95 % confidence.

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EMC Test Site: 35-13, Hwalcho-gil, 109beon-gil, Hwaseong-si, Gyeonggi-do, 18278, Korea

4.9 Conducted disturbance induced by RF fields immunity

Test Standard	EN 61000-4-6:2014, Criteria: A		
Test venue	EMS 2		
Tested Frequency	150 kHz ~ 230 MHz		
Test Level/Modulation	3 V (AM 80 %, 1 kHz)		
Coupling Method	AC Mains: M2		
Dwell Time	1 s		
Step Size	log 1 % step		
Tested Date	2019.02.08		
Input Ratings	230 V~, 50 Hz		
Temperature	(18.3 ± 0.1) ℃	**Humidity**	(34.9 ± 0.1) % R.H.
Atmospheric pressure	101.1 kPa		
Test Result	A Met by Criterion / Pass		

4.9.1 Test set-up and procedure

A ground reference plane was located on the floor.
The test was performed on a ground reference plane on a 0.1 m wooden table.
This test were performed using CDN for mains, clamp for signal and injection probe.
The frequency range was swept from 150 kHz to 230 MHz. This frequency range was modulated with 1 kHz sine wave at 80 %.
The signal generators provided the modulated frequency at a 1 % step size.
The power and all network cable, I/O cables longer than 3 m length were tested.

4.9.2 Test equipment used

Equipment	Model	Serial No.	Vendor	Next Cal. Date	Use
CDN M2	FCC-801-M2-16A	091165	FCC	2019.08.03	■
CDN M3	FCC-801-M3-16A	091994	FCC	2019.08.03	□
EM INJECTION CLAMP	F-203I-23mm	091199	FCC	2019.08.06	□
Continuous Wave Simulator	CWS 500N1	P1247105423	EM Test	2020.02.01	■
Coaxial Fixed Attenuator	ATT6/75	P1306112966	EM Test	2020.02.01	■

4.9.3 Test data

Coupling Point	Coupling Method	Criteria	Results
AC Mains	CDN (M2)	A	A

* There was no deviation from normal operation condition.

The measurement uncertainty is 2.2 dB
The measurement uncertainty is given with a confidence of 95 % with the coverage factor, $k = 2$.

4.10 Voltage dips and short interruptions

Test Standard	EN 61000-4-11:2004, Criterion : C		
Test venue	EMS 2		
Number of reduction	3		
Duration	10 s		
Tested Date	2019.02.08		
Input Ratings	230 V~, 50 Hz		
Temperature	18.2 ℃	**Humidity**	35.0 % R.H.
Atmospheric pressure	101.1 kPa		
Test result	A Met by Criterion / Pass		

4.10.1 Test set-up and procedure

The dips/interruption test is only applicable to AC mains.

The dips/interruptions were applied at zero crossing.

4.10.2 Test equipment used

Equipment	Model	Serial No.	Vendor	Next Cal. Date	Use
EMC IMMUNITY TEST	EMCPRO PLUS	0906221	ThermoFisher Scientific	2019.08.03	□
COMPACT IMMUNITY TEST SYSTEM	AXOS5 & DIP 116	180998	HAEFELY EMC TECHNOLOGY	2020.01.31	■

4.10.3 Test data

Test	Test Level (% U_T)	Periods	Criteria	Results
Voltage dips	100 %	0.5	C	A
	60 %	10	C	A
	30 %	25	C	A

* There was no deviation from normal operation condition.

It has been demonstrated that the voltage dips and interruptions generator meets the specified requirements in the standard with at least a 95 % confidence.

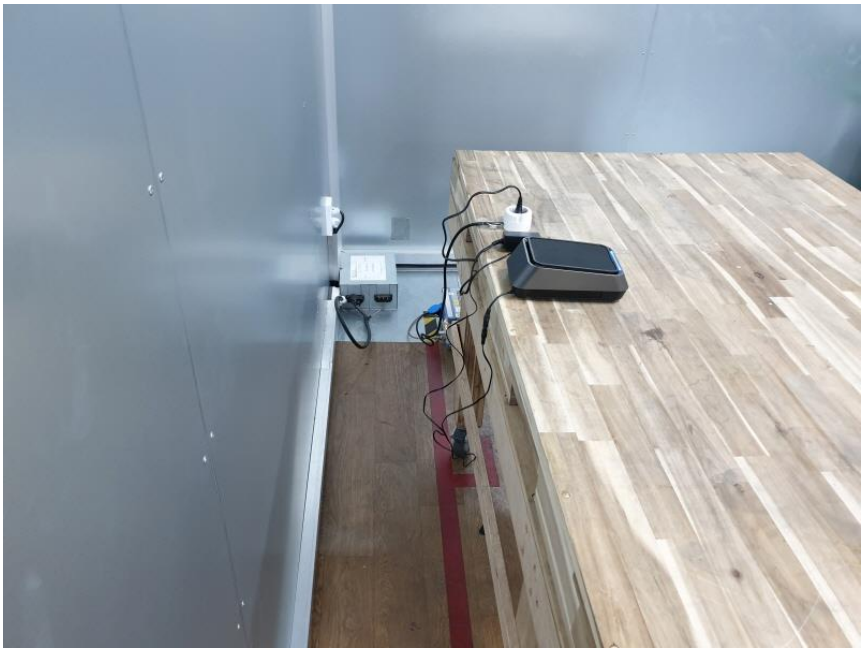
5. EUT Photos

5.1 Test Setup Photographs

5.1.1 Conducted disturbance (AC mains power ports)

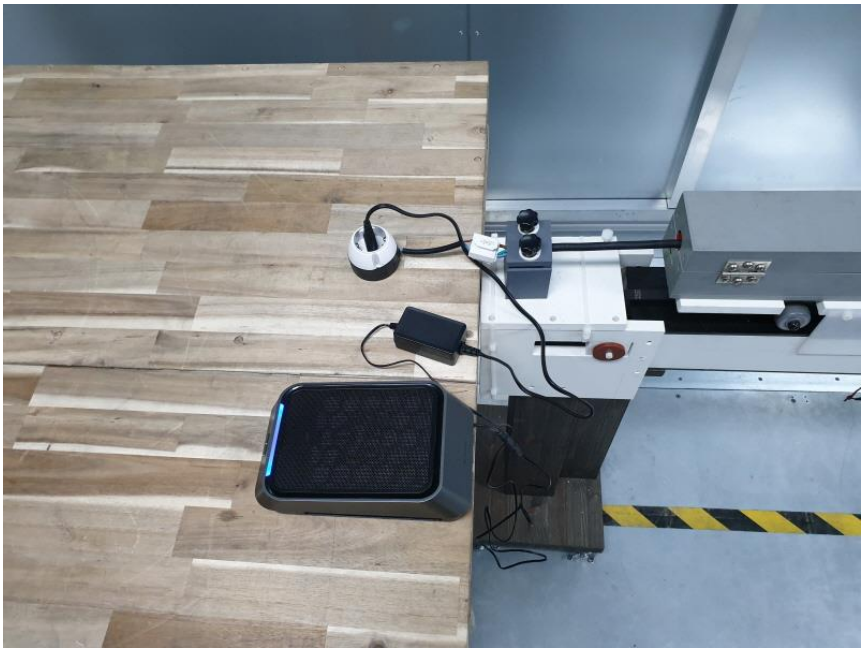
[Front view]

[Rear view]



5.1.2 Mains terminal discontinuous disturbance voltage

5.1.3 Disturbance power

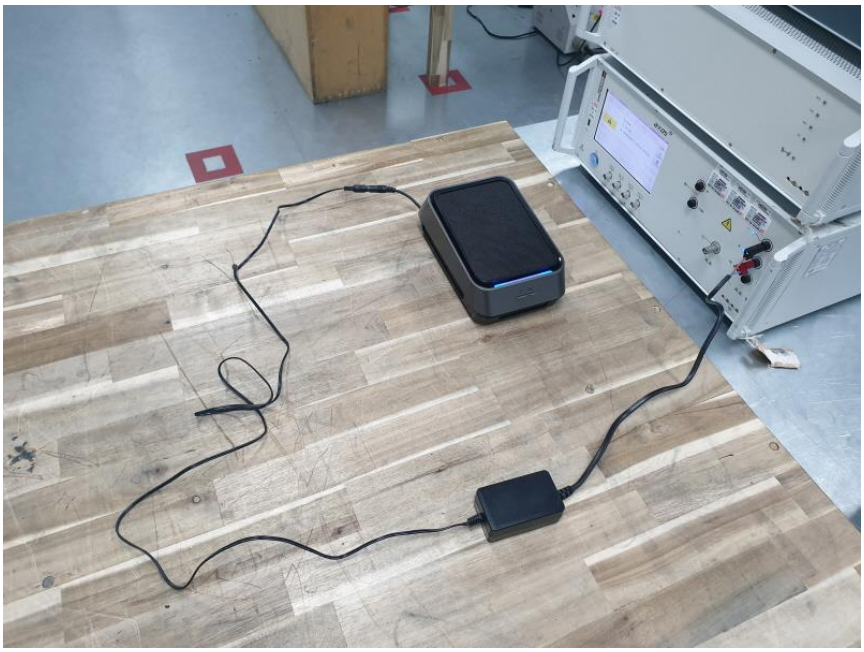


5.1.4 Harmonics current emissions

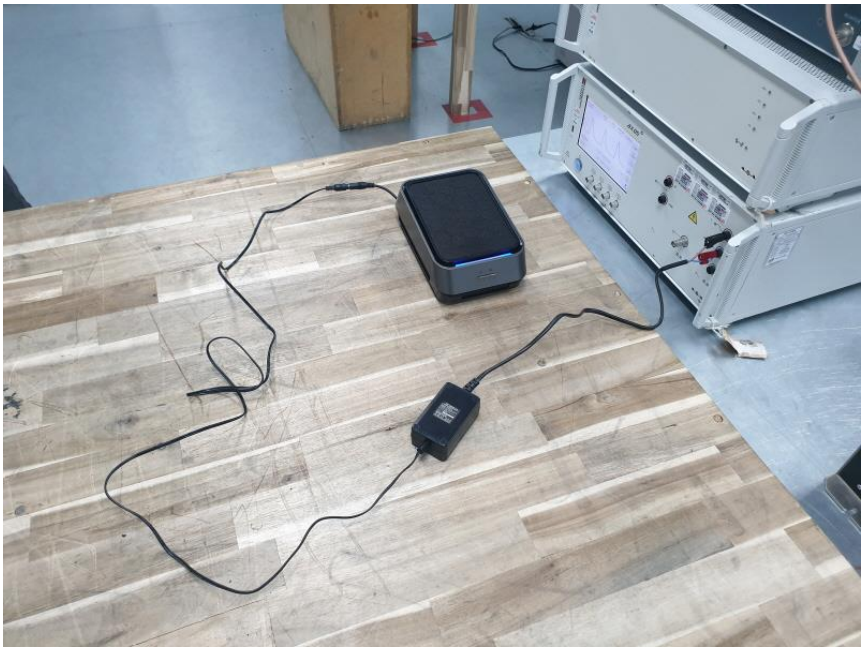
5.1.5 Voltage changes, Voltage fluctuations and flicker

5.1.6 Electrostatic discharge

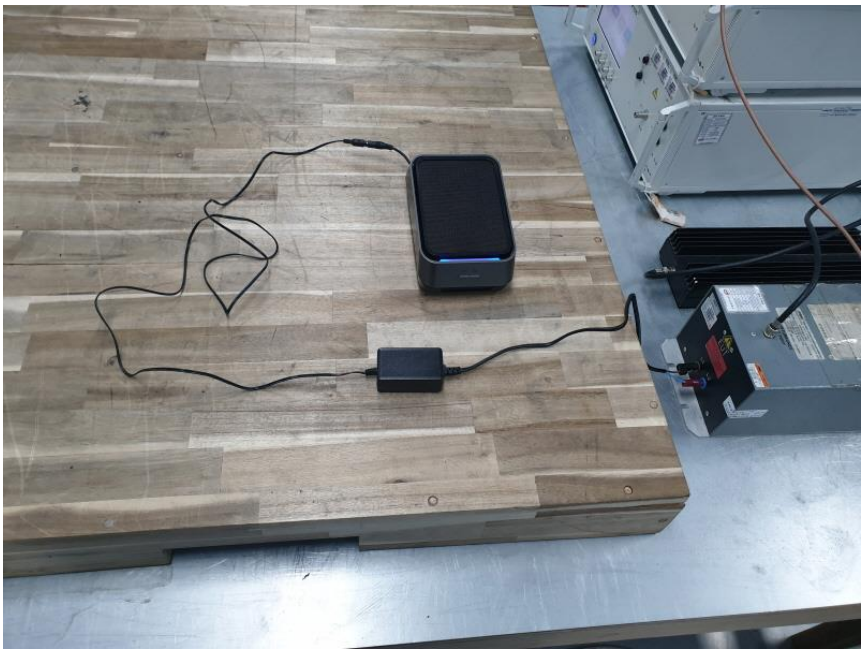
5.1.7 Electric fast transient/burst immunity



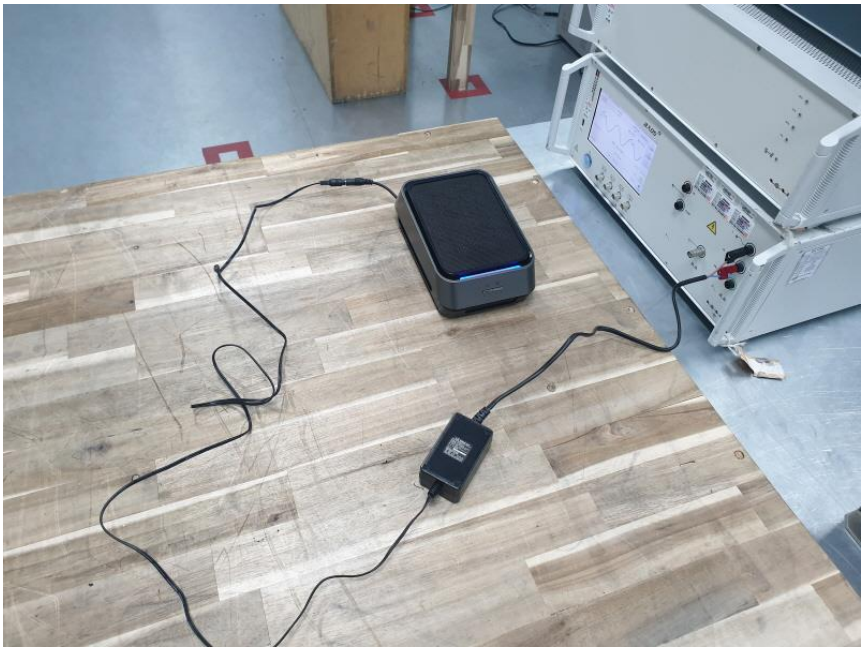
5.1.8 Surge immunity



5.1.9 Conducted disturbance induced by RF fields immunity



5.1.10 Voltage dips and short interruptions



5.2 External Photographs of EUT

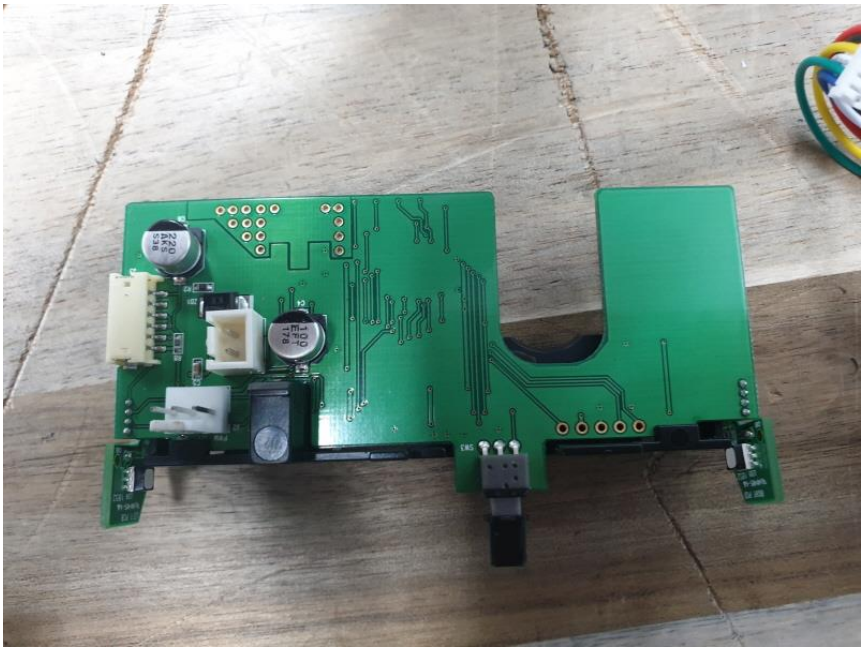
[Front view]

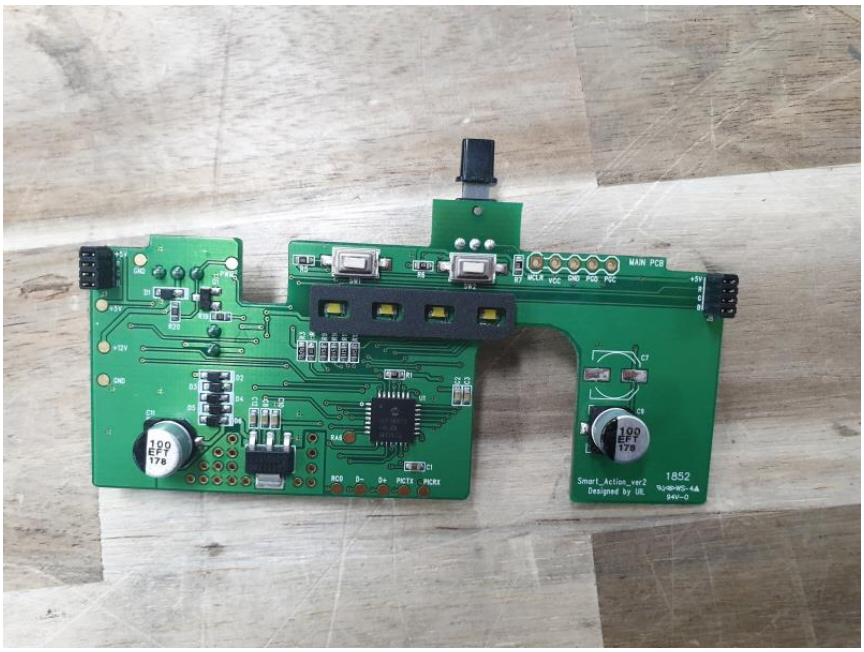
[Rear view]

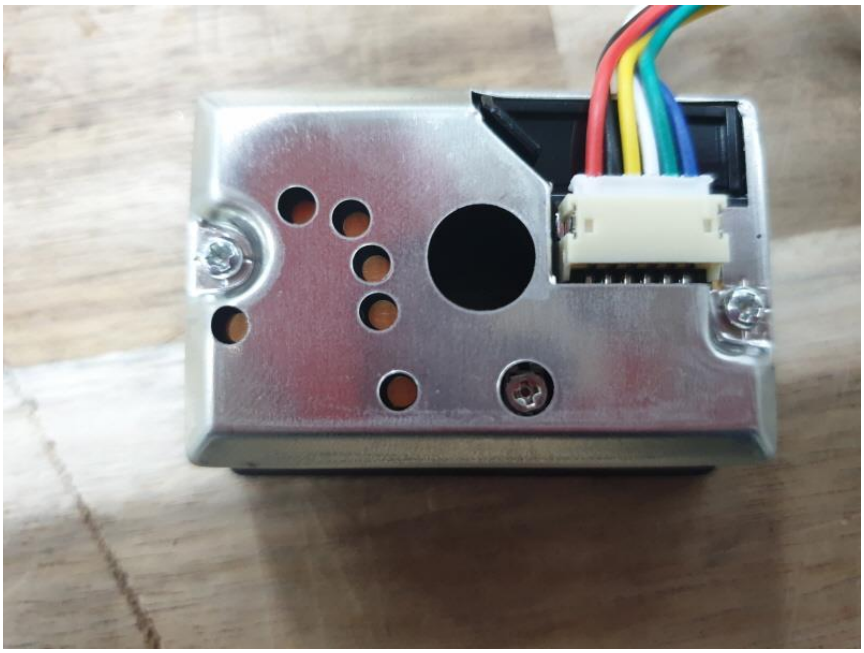
5.3 Internal Photographs of EUT

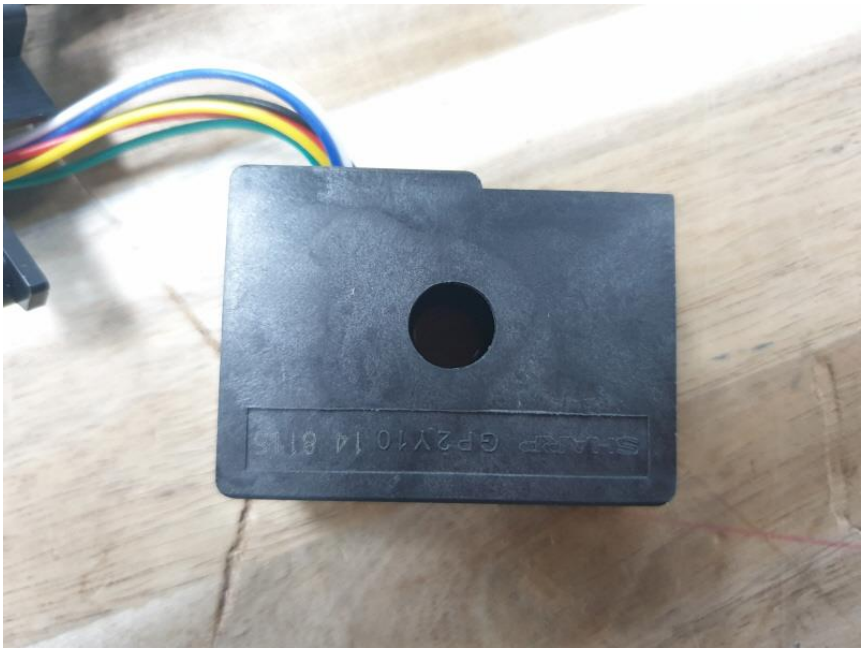
5.3.1 Internal view

5.3.2 Internal board view










DC FAN
BALL BEARING
12V-DC
DC BRUSHLESS FAN MOTOR
MADE IN CHINA

Manufacturer / Approval Declaration

The following identical model(s):

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