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Ecovacs Robotics Co., Ltd.

EMC TEST REPORT

Report Type:
FCC Part 15B & ICES-003 EMC report

Model:
DEX11

REPORT NUMBER:
211000371SHA-004

ISSUE DATE:
December 19, 2021

DOCUMENT CONTROL NUMBER:
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Intertek Testing Services Shanghai
Building No.86, 1198 Qinzhou Road (North)
Caohejing Development Zone
Shanghai 200233, China

Telephone: 86 21 6127 8200
www.intertek.com

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TEST REPORT

Report no.: 211000371SHA-004

Applicant	:	**Ecovacs Robotics Co., Ltd.** **No.518 Songwei Road, Wusongjiang industry Park, Guoxiang Street, Wuzhong District, Suzhou, Jiangsu, China.**
Manufacturer	:	**Ecovacs Robotics Co., Ltd.** **No.518 Songwei Road, Wusongjiang industry Park, Guoxiang Street, Wuzhong District, Suzhou, Jiangsu, China.**
Factory	:	**Ecovacs Robotics Co., Ltd.** **No.518 Songwei Road, Wusongjiang industry Park, Guoxiang Street, Wuzhong District, Suzhou, Jiangsu, China.**
FCC ID	:	**2AZAT-DEX11**

SUMMARY:

The equipment complies with the requirements according to the following standard(s) or Specification:
47CFR Part 15 (2020): Radio Frequency Devices (Subpart B) **ANSI C63.4 (2014):** American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz **ICES-003 Issue 7 October 2020:** Information Technology Equipment (Including Digital Apparatus) —Limits and Methods of Measurement.

PREPARED BY:	**REVIEWED BY:**
Project Engineer Eric Li	Reviewer Wakeyou Wang

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Revision History

Report No.	Version	Description	Issued Date
211000371SHA-004	Rev. 01	Initial issue of report	December 19, 2021

Measurement result summary

TEST ITEM	FCC REFERENCE	IC REFERENCE	RESULT
Power line conducted emission	15.107	3.2.1	Pass
Radiated emission	15.109	3.2.2	Pass

Notes: 1: NA =Not Applicable
2: "" means this test is no need and not performed within this report, and the result can refer to the related base report(s).*

1 GENERAL INFORMATION

1.1 Description of Equipment Under Test (EUT)

Product name:	Floor Cleaning Robot
Type/Model:	DEX11
Description of EUT:	The EUT is a Floor Cleaning Robot, it supports WIFI functions, there is only one model, it can match with two charging station, we test it and list the worst results in this report.
Rating:	20V DC, 2A
Category of EUT:	Class B
EUT type:	☐ Table top ☒ Floor standing
Highest operating frequency	> 108MHz
Software Version:	0.2.7
Hardware Version:	0.9
Sample received date:	2021.12.07
Date of test:	2021.12.09~2021.12.16

1.2 Description of Test Facility

Name:	Intertek Testing Services Shanghai
Address:	Building 86, No. 1198 Qinzhou Road(North), Shanghai 200233, P.R. China
Telephone:	86 21 61278200
Telefax:	86 21 54262353

The test facility is recognized, certified, or accredited by these organizations:	CNAS Accreditation Lab Registration No. CNAS L0139
	FCC Accredited Lab Designation Number: CN1175
	IC Registration Lab Registration code No.: 2042B-1
	VCCI Registration Lab Registration No.: R-4243, G-845, C-4723, T-2252
	A2LA Accreditation Lab Certificate Number: 3309.02

2 TEST SPECIFICATIONS

2.1 Standards or specification

47CFR Part 15 (2020)
ANSI C63.10 (2014)
ICES-003 Issue 7 October 2020

2.2 Mode of operation during the test

Within this test report, EUT was tested under all available operation modes and tested under its rating voltage and frequency. Other voltage and frequency are specified if used.

2.3 Test software list

Test Items	Software	Manufacturer	Version
Conducted emission	ESxS-K1	R&S	V2.1.0
Radiated emission	ES-K1	R&S	V1.71

2.4 Test peripherals list

Item No.	Name	Brand and Model	Description
1	Charging Station	CH2108/CH2103	-

2.5 Test environment condition:

Test items	Temperature	Humidity
Power line conducted emission	23°C	51% RH
Radiated Emissions	24°C	52% RH

2.6 Instrument list

Conducted Emission					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
☑	Test Receiver	R&S	ESCS 30	EC 2107	2022-07-14
☑	A.M.N.	R&S	ESH2-Z5	EC 3119	2022-11-29
☑	Shielded room	Zhongyu	-	EC 2838	2022-01-13
Radiated Emission					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
☑	Test Receiver	R&S	ESIB 26	EC 3045	2022-09-12
☑	Bilog Antenna	TESEQ	CBL 6112D	EC 4206	2022-12-10
☑	Horn antenna	R&S	HF 906	EC 3049	2022-11-17
☑	Horn antenna	ETS	3117	EC 4792-1	2022-01-09
☑	Horn antenna	TOYO	HAP18-26W	EC 4792-3	2022-07-09
☑	Pre-amplifier	R&S	Pre-amp 18	EC5881	2022-06-11
☑	Semi-anechoic chamber	Albatross project	-	EC 3048	2022-09-15
Additional instrument					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
☑	Therom-Hygrograph	ZJ1-2A	S.M.I.F.	EC 3325	2022-04-07
☑	Pressure meter	YM3	Shanghai Mengde	EC 3320	2022-06-30

2.7 Measurement uncertainty

The measurement uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

Test item	Measurement uncertainty
Radiated Emissions in restricted frequency bands below 1GHz	± 4.90dB
Radiated Emissions in restricted frequency bands above 1GHz	± 5.02dB
Power line conducted emission	± 3.19dB

3 Radiated Emissions

Test result: **Pass**

3.1 Limit

3.1.1 Limits for radiated disturbance of class A device

FCC

Frequency (MHz)	**Permitted limit in dBμV/m (Quasi-peak) of Measurement Distance 10m**
30 – 88	39
88 – 216	43.5
216 – 960	46.4
Above 960	49.5
Note: for the measurement distance other than 3m and 10m, the limit is varied according to 20dB/10 decades.	

IC

Frequency (MHz)	Permitted limit in dBμV/m (Quasi-peak) of Measurement Distance 10m	Permitted limit in dBμV/m (Quasi-peak) of Measurement Distance 3m
30 ~ 88	40.0	50.0
88 ~ 216	43.5	54.0
216 ~ 230	46.4	56.9
230 ~ 960	47.0	57.0
960 ~ 1000	49.5	60.0
Note: The more stringent limit applies at transition frequencies.		

Frequency (GHz)	Permitted limit in dBμV/m (Peak) of Measurement Distance 3m	Permitted limit in dBμV/m (Average) of Measurement Distance 3m
1 ~ F_M	80.0	60.0
Note: These limit levels apply for a measurement distance of 3 m. If using a different measurement distance, the measured levels shall be extrapolated to the 3 m limit distance using a factor of 20 dB per decade of distance. The measurement distance shall place the measurement antenna in the far field of the ITE or digital apparatus under test.		

3.1.2 Limits for radiated disturbance of class B device

FCC

Frequency (MHz)	**Permitted limit in dBμV/m (Quasi-peak) of Measurement Distance 3m**
30 – 88	40.0
88 – 216	43.5
216 – 960	46.0
Above 960	54.0
Note: for the measurement distance other than 3m and 10m, the limit is varied according to 20dB/10 decades.	

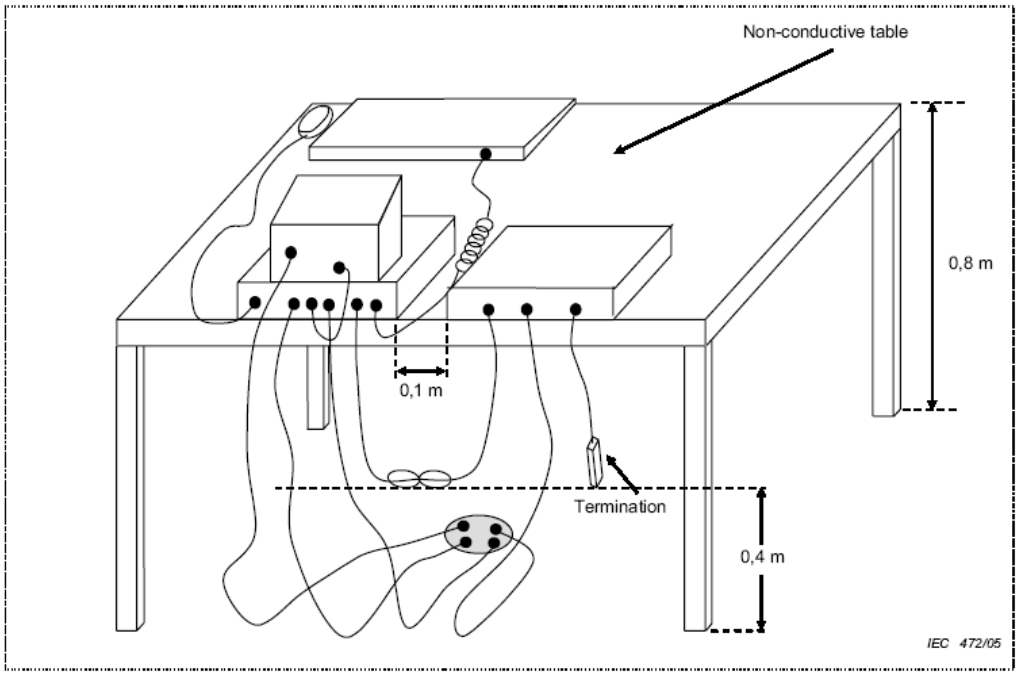
IC

Frequency (MHz)	Permitted limit in dBμV/m (Quasi-peak) of Measurement Distance 10m	Permitted limit in dBμV/m (Quasi-peak) of Measurement Distance 3m
30 ~ 88	30.0	40.0
88 ~ 216	33.1	43.5
216 ~ 230	35.6	46.0
230 ~ 960	37.0	47.0
960 ~ 1000	43.5	54.0
Note: The more stringent limit applies at transition frequencies.		

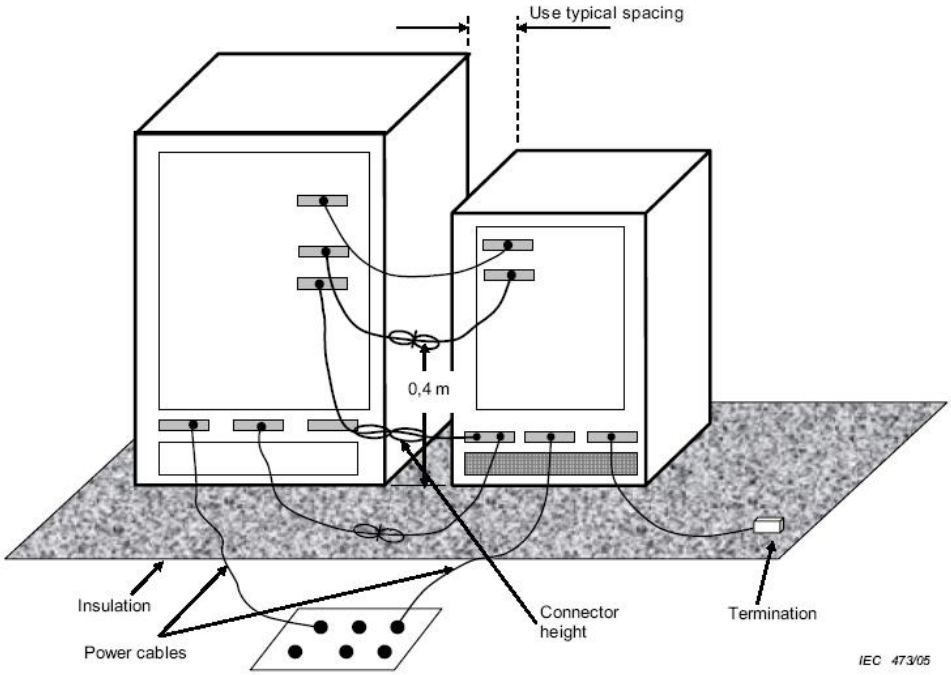
Frequency (GHz)	Permitted limit in dBμV/m (Peak) of Measurement Distance 3m	Permitted limit in dBμV/m (Average) of Measurement Distance 3m
1 ~ F_M	74.0	54.0
Note: These limit levels apply for a measurement distance of 3 m. If using a different measurement distance, the measured levels shall be extrapolated to the 3 m limit distance using a factor of 20 dB per decade of distance. The measurement distance shall place the measurement antenna in the far field of the ITE or digital apparatus under test.		

3.2 Block diagram and test set up

For table top equipment



For floor standing equipment



3.3 Measurement Procedure

The measurement was performed in a semi-anechoic chamber. While testing for spurious emission higher than 1GHz, the pre-amplifier (and high pass filter if necessary) is equipped just at the output terminal of the antenna.
The distance from EUT to receiving antenna is 3 meters.
Measurement was performed according to clause 4 and clause 5 of ANSI 63.4.
Test procedure was according to clause 8.3 of ANSI 63.4.
EUT arrangement and operate condition were according to clause 6 and clause 8 of ANSI 63.4.
The radiated emission was measured using the test receiver with the resolutions bandwidth set as:

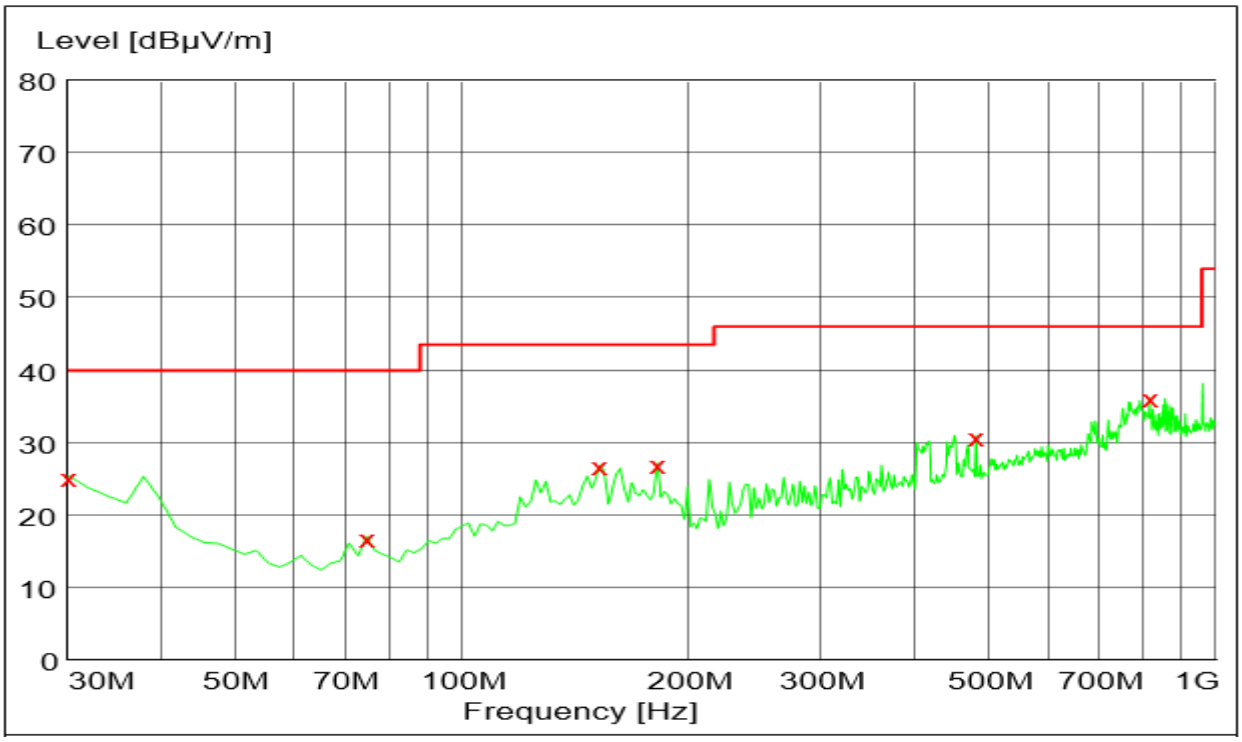
RBW = 100kHz, VBW = 300kHz (30MHz~1GHz)
RBW = 1MHz, VBW = 3MHz (>1GHz for PK)

Highest internal frequency (Fx)	Highest measured frequency F_M for radiated measurement	Measured Bandwidth
Fx ≤ 108 MHz	1 GHz	120kHz
108 MHz < Fx ≤ 500 MHz	2 GHz	1MHz
500 MHz < Fx ≤ 1 GHz	5 GHz	1MHz
Fx > 1 GHz	5 × Fx up to a maximum of 40 GHz	1MHz
Note: 1. Fx is the highest fundamental frequency generated and/or used in the ITE or digital apparatus under test.		

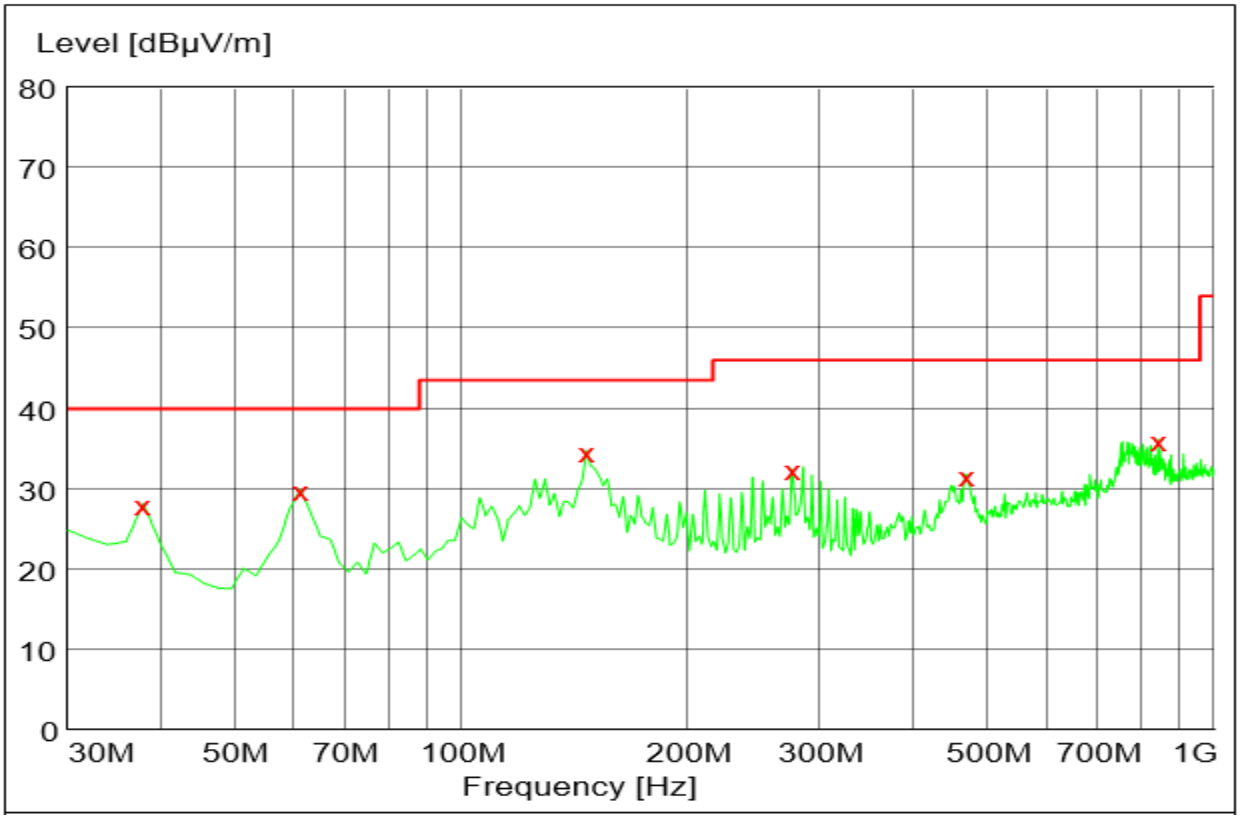
3.4 Test Results of Radiated Emissions

Test Curve of Charging with CH2103:

Horizontal



Vertical



Test data:

Polarization	Frequency (MHz)	Measured level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
H	30.00	25.50	40.00	14.50	PK
	74.71	17.10	40.00	22.90	PK
	152.46	26.90	43.50	16.60	PK
	181.62	27.20	43.50	16.30	PK
	480.98	31.00	46.00	15.00	PK
	817.27	36.30	46.00	9.70	PK
V	37.78	28.20	40.00	11.80	PK
	61.10	29.90	40.00	10.10	PK
	146.63	34.80	43.50	8.70	PK
	274.93	32.50	46.00	13.50	PK
	469.32	31.80	46.00	14.20	PK
	844.49	36.20	46.00	9.80	PK

Above 1GHz

Polarization	Frequency (MHz)	Emission level (dBuV/m)	Limits (dBuV/m)	Margin (dBuV/m)	Detector
Horizontal	1000.00	*	74.0	*	PK
	5000.00	*	74.0	*	PK
	10000.00	*	74.0	*	PK
	15000.00	*	74.0	*	PK
	20000.00	*	74.0	*	PK
	25000.00	*	74.0	*	PK
Vertical	1000.00	*	74.0	*	PK
	5000.00	*	74.0	*	PK
	10000.00	*	74.0	*	PK
	15000.00	*	74.0	*	PK
	20000.00	*	74.0	*	PK
	25000.00	*	74.0	*	PK

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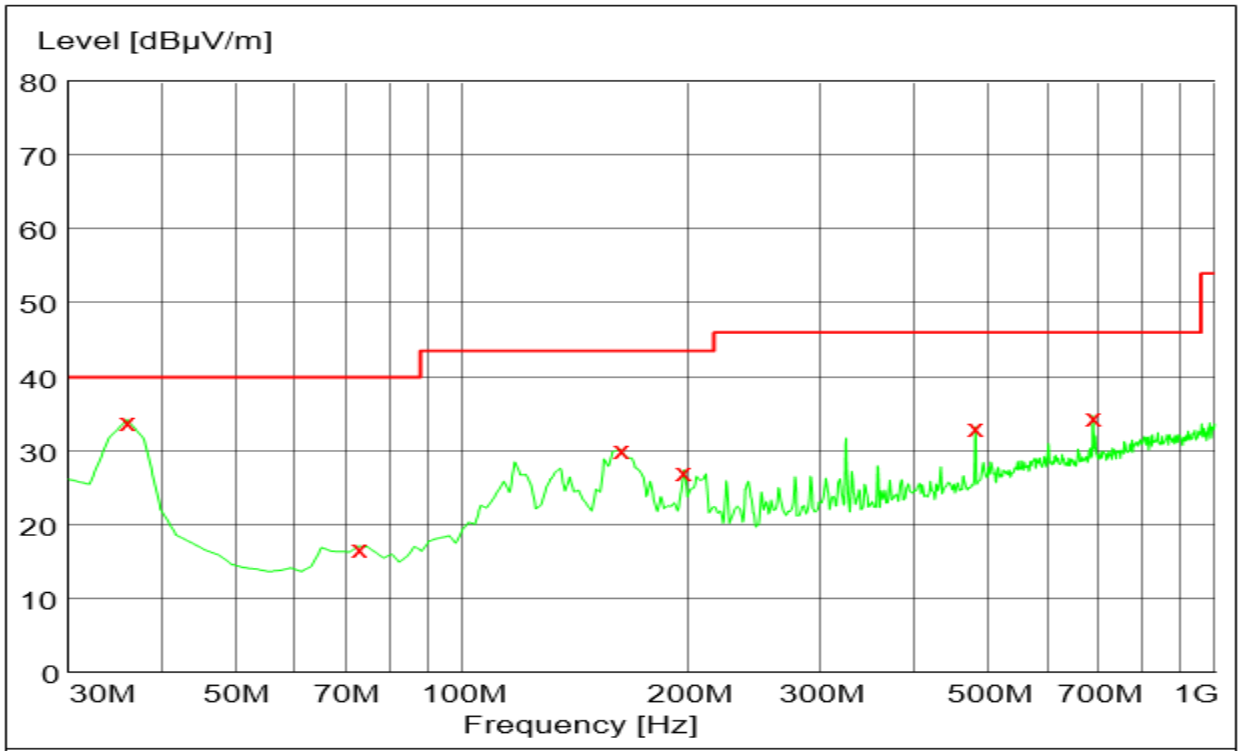
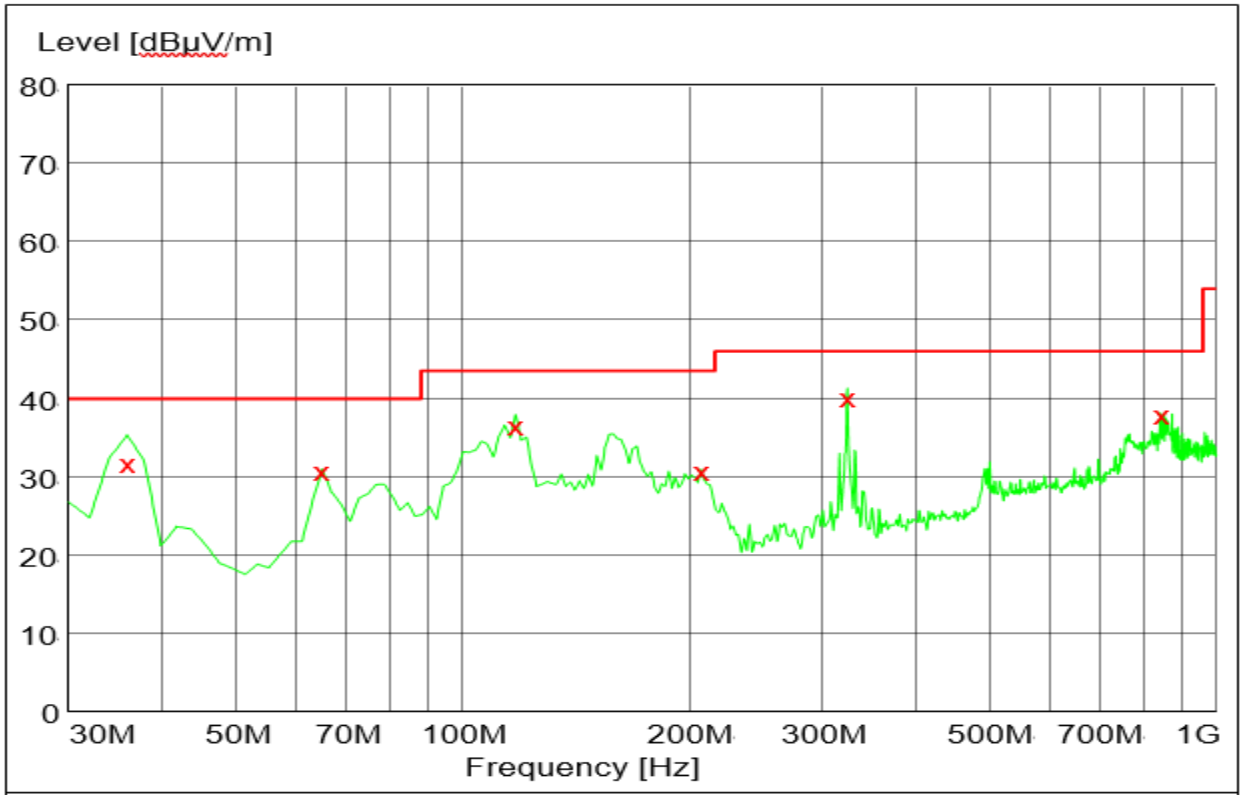
Test Curve of Charging with CH2108

Horizontal



Vertical



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Test data:

Polarization	Frequency (MHz)	Measured level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
H	35.83	33.80	40.00	6.20	PK
	72.77	17.10	40.00	22.90	PK
	162.18	30.30	43.50	13.20	PK
	197.17	27.40	43.50	16.10	PK
	480.98	33.30	46.00	12.70	PK
	688.98	34.80	46.00	11.20	PK
V	35.83	31.30	40.00	8.70	QP
	64.99	31.00	40.00	9.00	PK
	117.47	36.90	43.50	6.70	QP
	206.89	31.00	43.50	12.50	PK
	323.53	39.40	46.00	6.60	QP
	842.55	38.10	46.00	7.90	PK

Above 1GHz

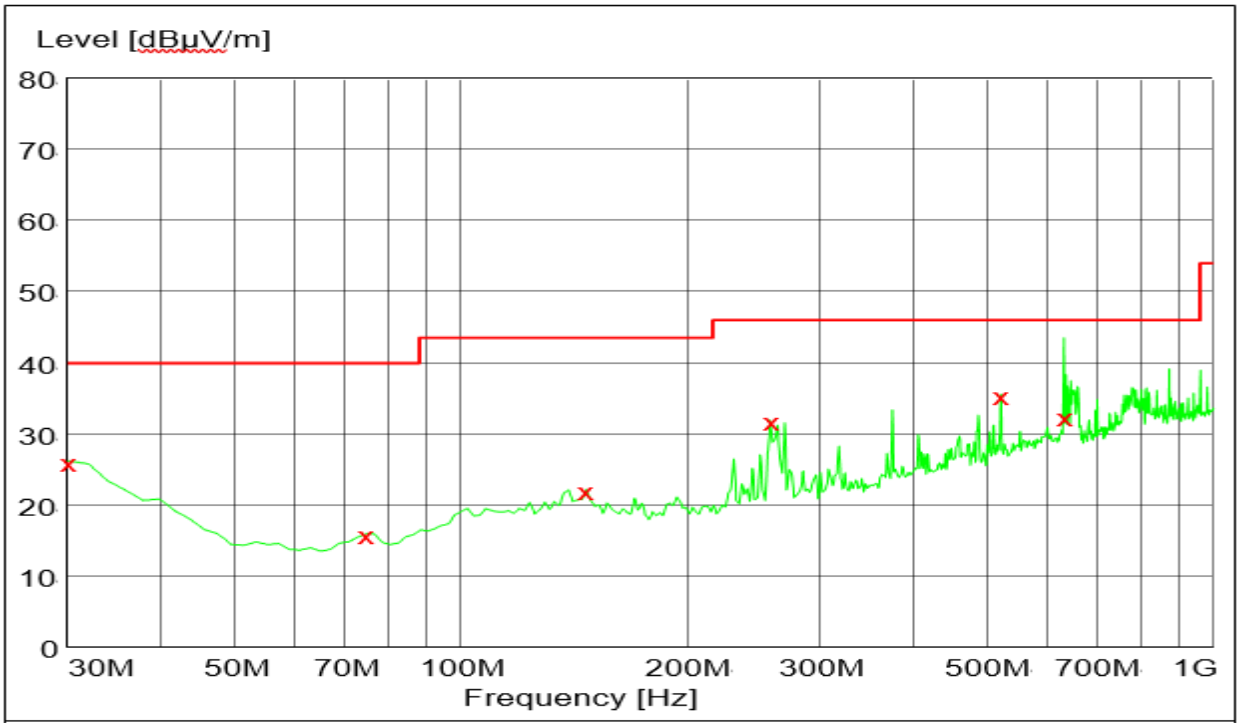
Polarization	Frequency (MHz)	Emission level (dBuV/m)	Limits (dBuV/m)	Margin (dBuV/m)	Detector
Horizontal	1000.00	*	74.0	*	PK
	5000.00	*	74.0	*	PK
	10000.00	*	74.0	*	PK
	15000.00	*	74.0	*	PK
	20000.00	*	74.0	*	PK
	25000.00	*	74.0	*	PK
Vertical	1000.00	*	74.0	*	PK
	5000.00	*	74.0	*	PK
	10000.00	*	74.0	*	PK
	15000.00	*	74.0	*	PK
	20000.00	*	74.0	*	PK
	25000.00	*	74.0	*	PK

Note: * means the emission level is 10dB or more lower than the relevant limit.

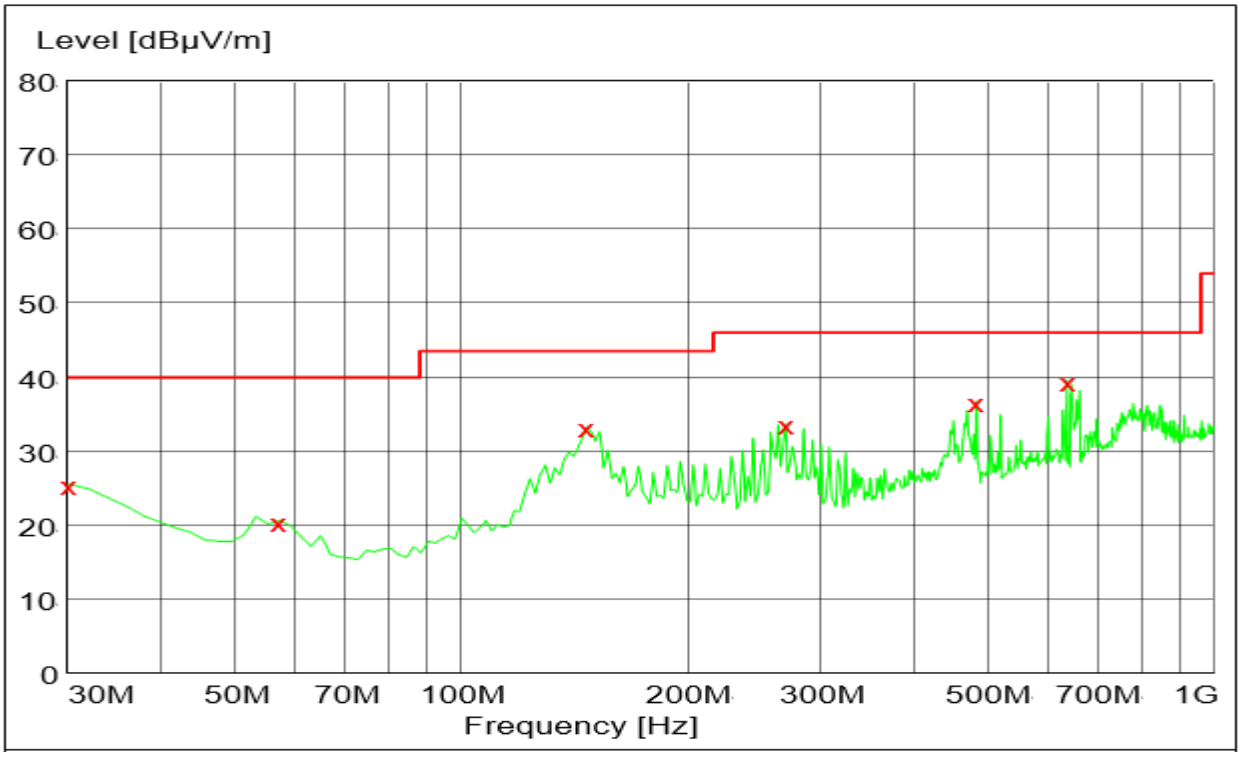
Remark:
1. Factor= Antenna Factor + Cable Loss (-Amplifier, is employed)
2. Measured level= Original Receiver Reading + Factor
3. Margin = Limit – Measured level
4. If the PK measured level is lower than AV limit, the AV test can be elided.

Test Curve of working mode:

Horizontal



Vertical



Test data below 1GHz

Antenna	Frequency (MHz)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
H	30.00	26.20	40.00	13.80	PK
H	74.71	16.00	40.00	24.00	PK
H	146.63	22.20	43.50	21.30	PK
H	257.43	32.00	46.00	14.00	PK
H	521.80	35.50	46.00	10.50	PK
H	632.61	32.50	46.00	13.50	QP
V	30.00	25.60	40.00	14.40	PK
V	57.21	20.60	40.00	19.40	PK
V	146.63	33.30	43.50	10.20	PK
V	269.10	33.80	46.00	12.20	PK
V	482.93	36.70	46.00	9.30	PK
V	636.49	39.64	46.00	6.36	PK

Above 1GHz

Polarization	Frequency (MHz)	Emission level (dBuV/m)	Limits (dBuV/m)	Margin (dBuV/m)	Detector
Horizontal	1000.00	*	74.0	*	PK
	5000.00	*	74.0	*	PK
	10000.00	*	74.0	*	PK
	15000.00	*	74.0	*	PK
	20000.00	*	74.0	*	PK
	25000.00	*	74.0	*	PK
Vertical	1000.00	*	74.0	*	PK
	5000.00	*	74.0	*	PK
	10000.00	*	74.0	*	PK
	15000.00	*	74.0	*	PK
	20000.00	*	74.0	*	PK
	25000.00	*	74.0	*	PK

Note: * means the emission level is 10dB or more lower than the relevant limit.

Remark:
1. Factor= Antenna Factor + Cable Loss (-Amplifier, is employed)
2. Measured level= Original Receiver Reading + Factor
3. Margin = Limit – Measured level
4. If the PK measured level is lower than AV limit, the AV test can be elided.

4 Power line conducted emission

Test result: **Pass**

4.1 Limit

4.1.1 Limits for conducted disturbance voltage at the mains ports of class A device

Frequency range (MHz)	Limits dB(μV)	
	Quasi-peak	Average
0.15 ~ 0.5	79	66
0.5 ~ 30	73	60

Note: If the limit for the measurement with the average detector is met when using a receiver with a quasi-peak detector, the equipment under test shall be deemed to meet both limits and the measurement using the receiver with an average detector need not be carried out.

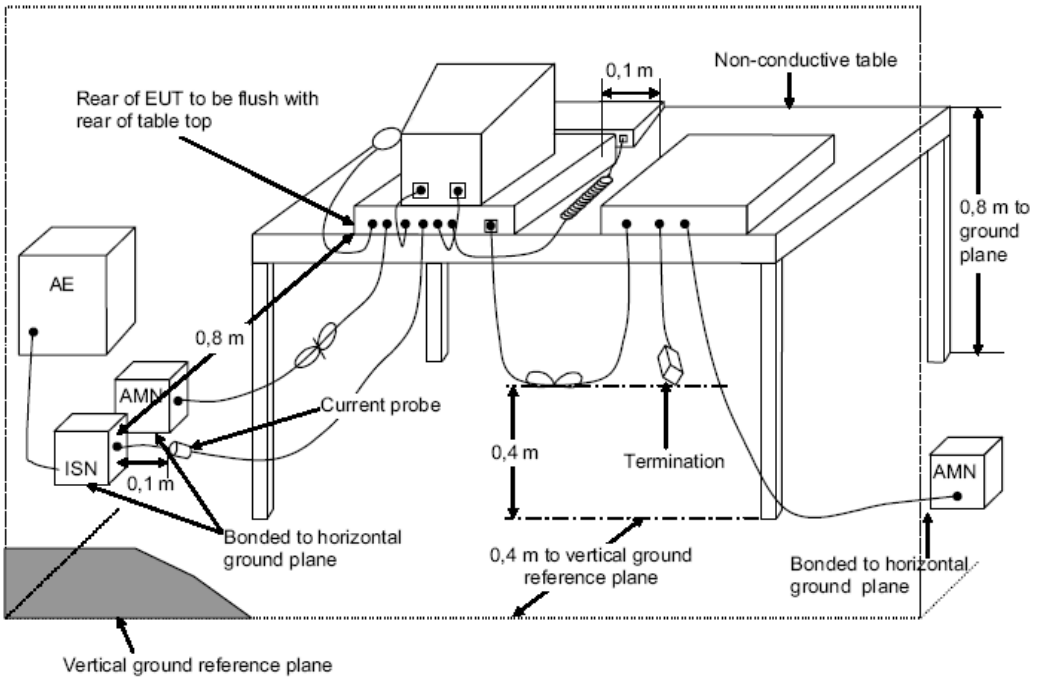
4.1.2 Limits for conducted disturbance voltage at the mains ports of class B device

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

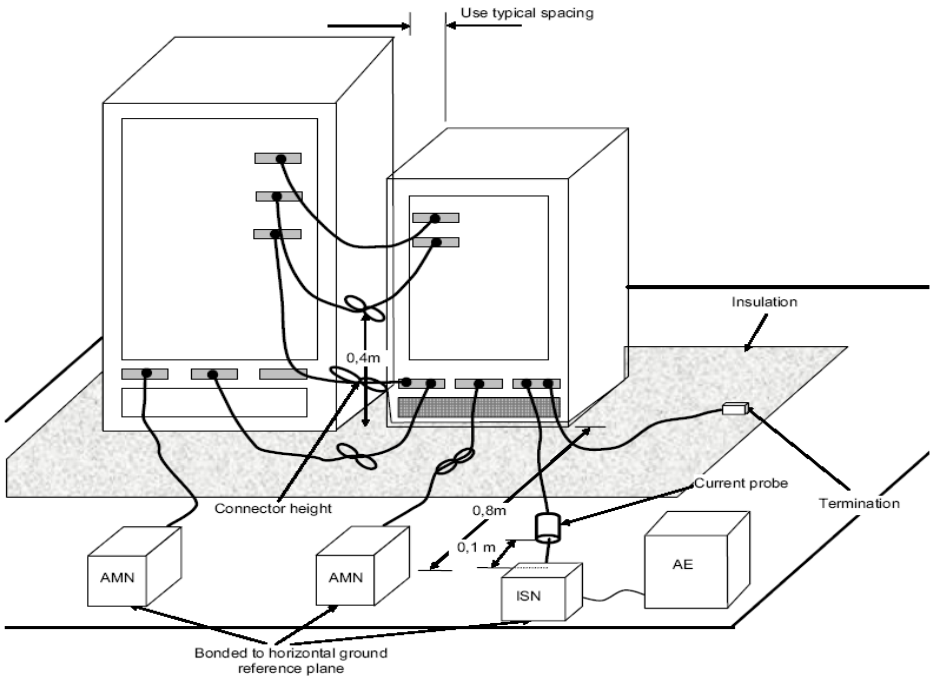
Note: 1. * Means the limit decreasing linearly with the logarithm of the frequency in the range 0.15MHz to 0.5MHz
2. If the limit for the measurement with the average detector is met when using a receiver with a quasi-peak detector, the equipment under test shall be deemed to meet both limits and the measurement using the receiver with an average detector need not be carried out.

4.2 Block diagram and test set up

For table top equipment



For floor standing equipment



4.3 Measurement Procedure

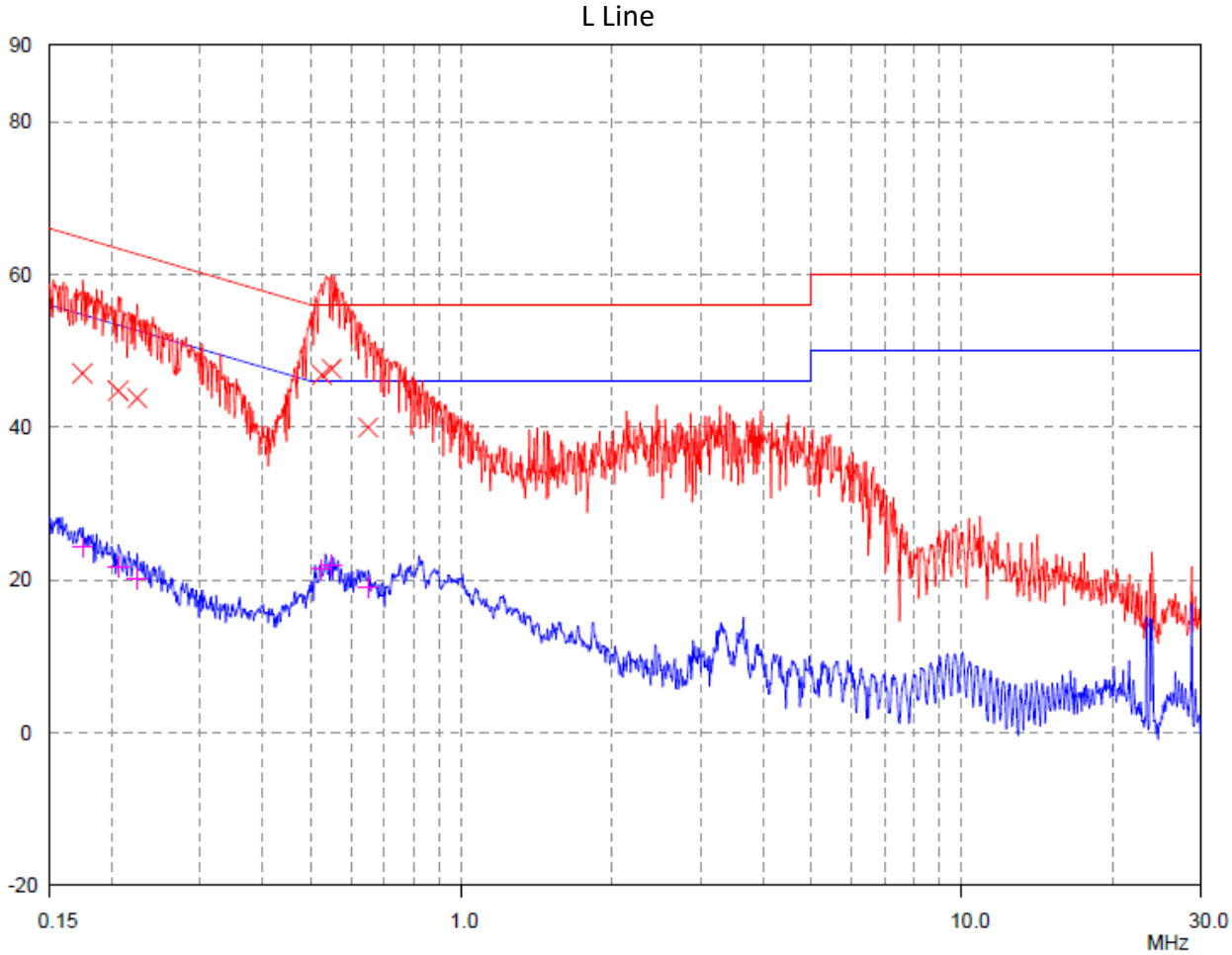
Measured levels of ac power-line conducted emission shall be the emission voltages from the voltage probe, where permitted, or across the 50 Ω LISN port (to which the EUT is connected), where permitted, terminated into a 50 Ω measuring instrument. All emission voltage and current measurements shall be made on each current-carrying conductor at the plug end of the EUT power cord by the use of mating plugs and receptacles on the LISN, if used. Equipment shall be tested with power cords that are normally supplied or recommended by the manufacturer and that have electrical and shielding characteristics that are the same as those cords normally supplied or recommended by the manufacturer. For those measurements using a LISN, the 50 Ω measuring port is terminated by a measuring instrument having 50 Ω input impedance. All other ports are terminated in 50 Ω loads.

Tabletop devices shall be placed on a platform of nominal size 1 m by 1.5 m, raised 80 cm above the reference ground plane. The vertical conducting plane or wall of an RF-shielded (screened) room shall be located 40 cm to the rear of the EUT. Floor-standing devices shall be placed either directly on the reference ground-plane or on insulating material as described in ANSI C63.4. All other surfaces of tabletop or floor-standing EUTs shall be at least 80 cm from any other grounded conducting surface, including the case or cases of one or more LISNs.

The bandwidth of the test receiver is set at 9 kHz.

4.4 Test Results of Power line conducted emission

Test Curve of charging with CH2103



Test Data:

Frequency (MHz)	Quasi-peak			Average		
	level dB(μV)	Limit dB(μV)	Margin (dB)	level dB(μV)	limit dB(μV)	Margin (dB)
0.17	47.05	64.74	17.69	24.30	54.74	30.44
0.21	44.79	63.38	18.59	21.70	53.38	31.68
0.22	43.81	62.65	18.84	20.13	52.65	32.52
0.53	46.87	56.00	9.13	21.42	46.00	24.58
0.55	47.64	56.00	8.36	21.98	46.00	24.02
0.65	39.96	56.00	16.04	19.01	46.00	26.99

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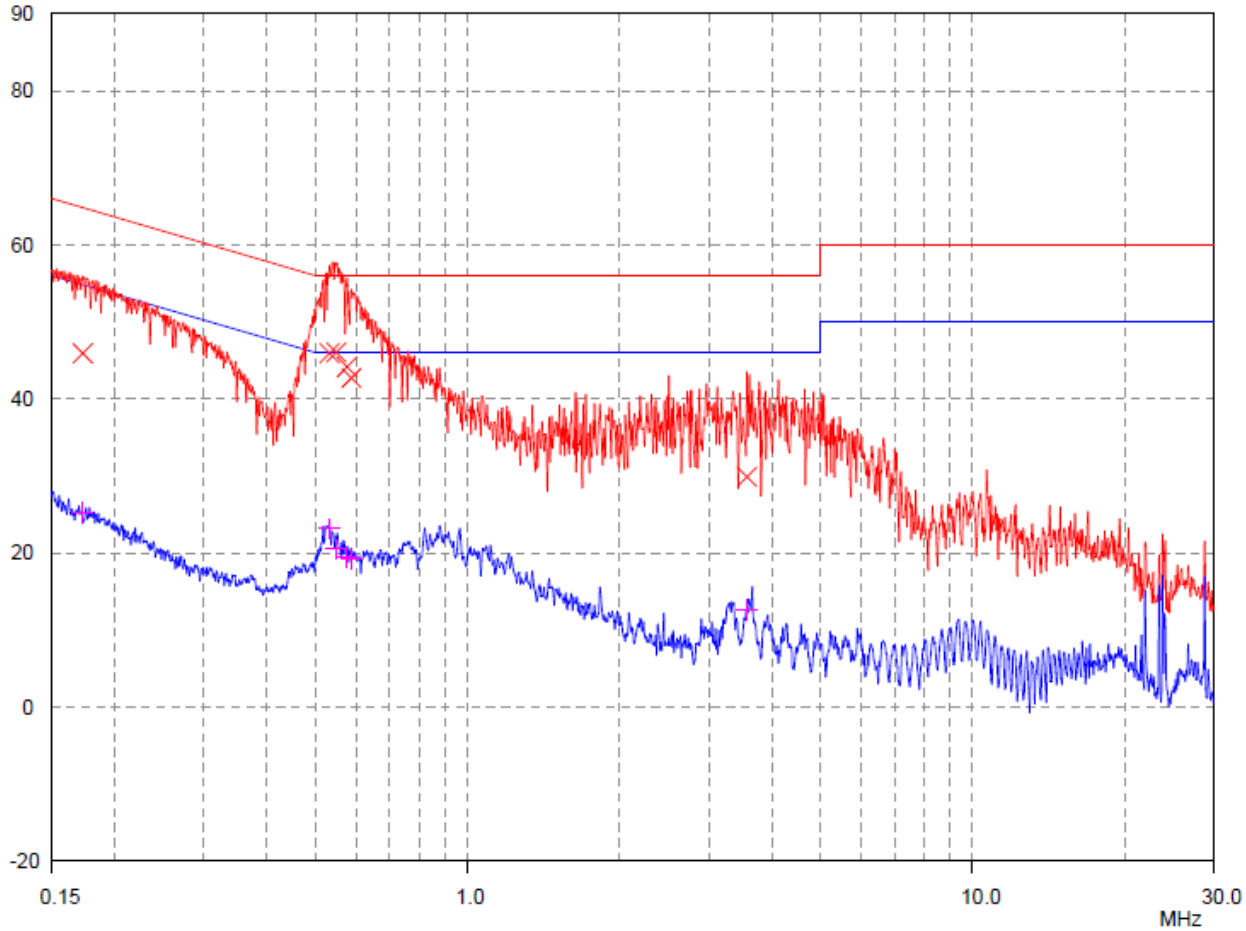
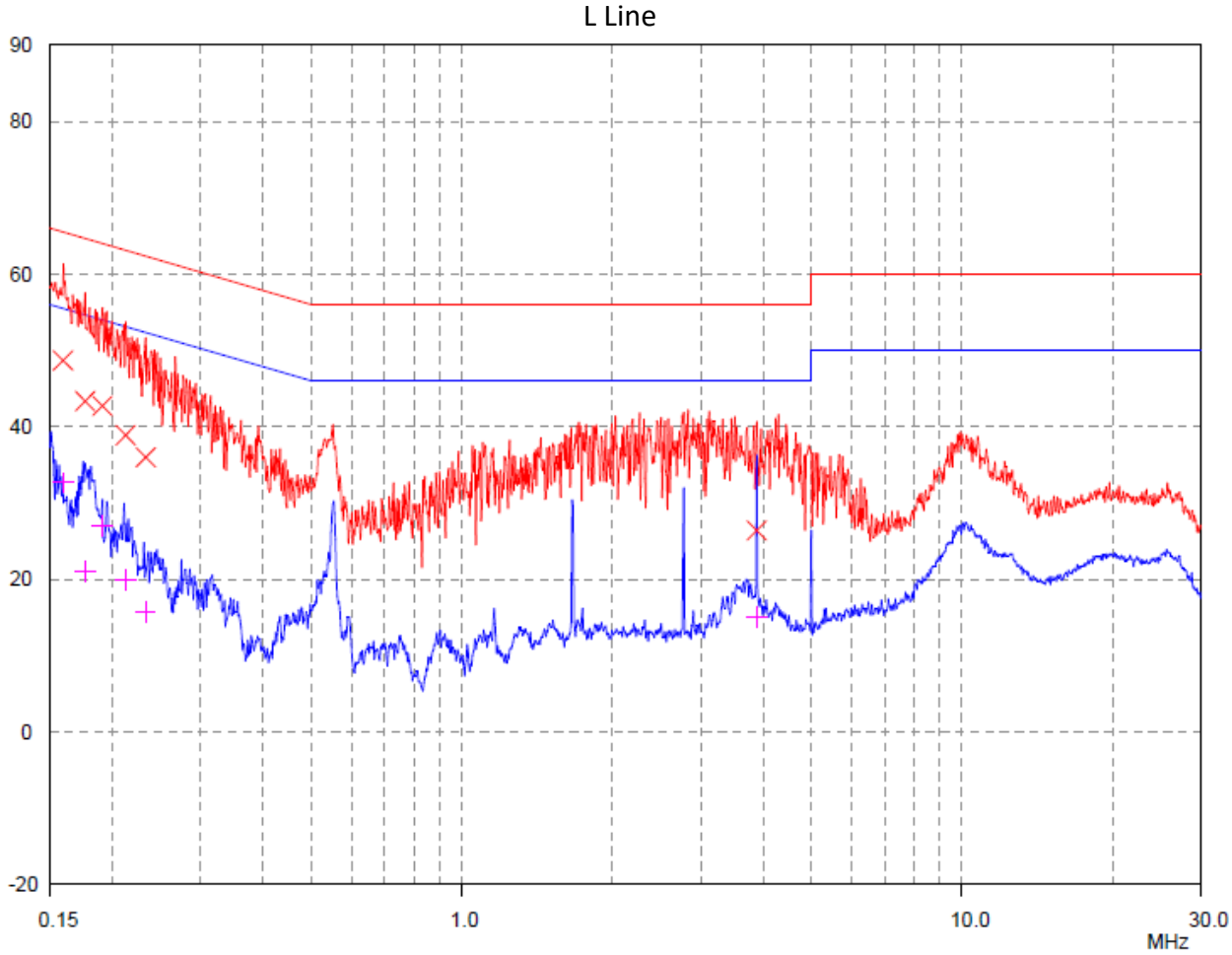
N Line



Test Data:

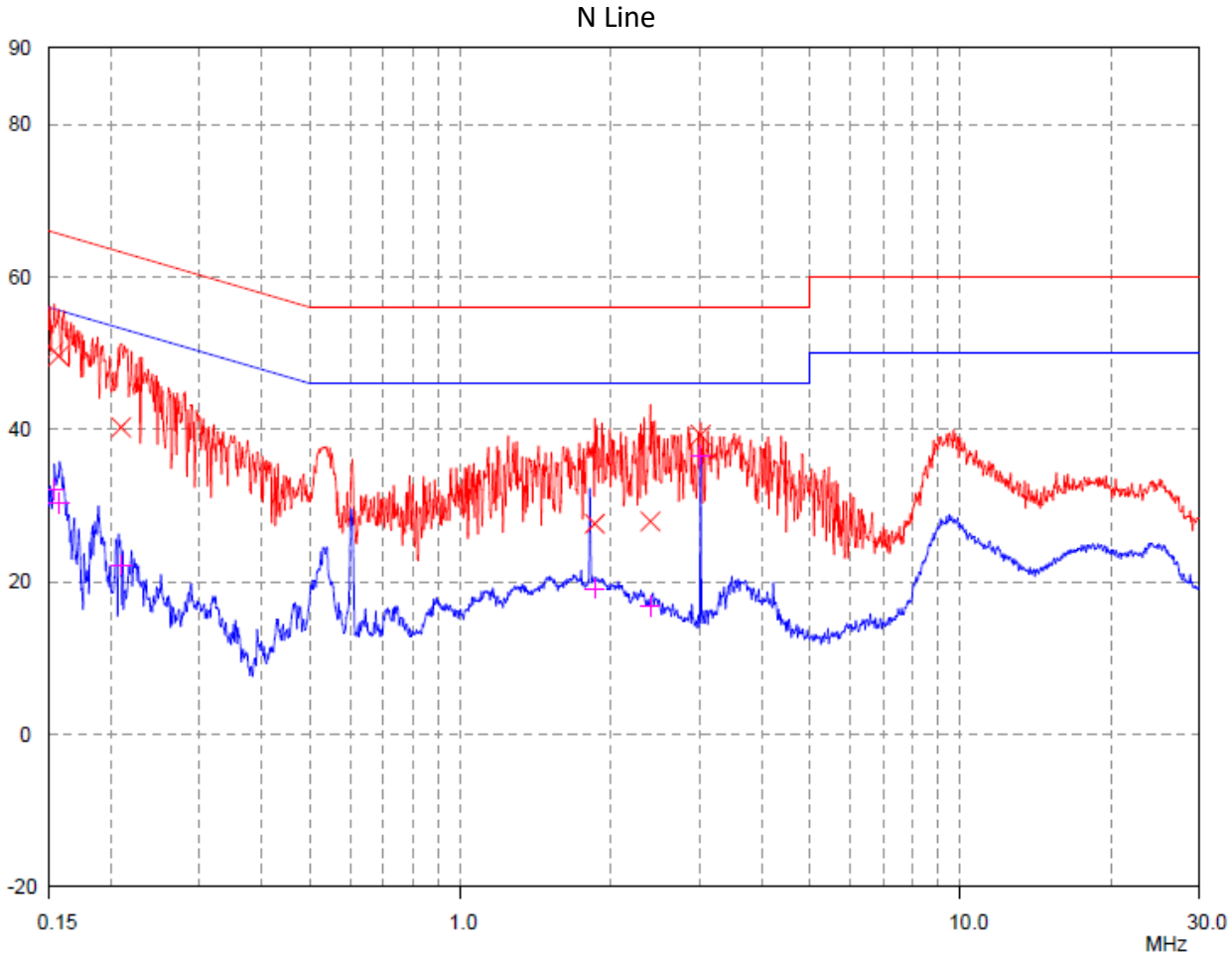
Frequency (MHz)	Quasi-peak			Average		
	level dB(µV)	Limit dB(µV)	Margin (dB)	level dB(µV)	limit dB(µV)	Margin (dB)
0.17	45.93	64.84	18.91	25.30	54.84	29.54
0.53	45.94	56.00	10.06	23.21	46.00	22.79
0.55	46.06	56.00	9.94	20.51	46.00	25.49
0.58	44.17	56.00	11.83	19.43	46.00	26.57
0.59	42.73	56.00	13.27	19.26	46.00	26.74
3.57	29.90	56.00	26.10	12.68	46.00	33.32

Test Curve of charging with CH2108



Test Data:

Frequency (MHz)	Quasi-peak			Average		
	level dB(μV)	Limit dB(μV)	Margin (dB)	level dB(μV)	limit dB(μV)	Margin (dB)
0.16	48.70	65.50	16.80	32.72	55.50	22.78
0.18	43.37	64.67	21.30	21.00	54.67	33.67
0.19	42.73	64.01	21.28	27.02	54.01	26.99
0.21	38.89	63.12	24.23	19.90	53.12	33.22
0.23	35.99	62.35	26.36	15.73	52.35	36.62
3.88	26.42	56.00	29.58	15.05	46.00	30.95



Test Data:

Frequency (MHz)	Quasi-peak			Average		
	level dB(μV)	Limit dB(μV)	Margin (dB)	level dB(μV)	limit dB(μV)	Margin (dB)
0.15	50.26	65.80	15.54	32.16	55.80	23.64
0.16	49.62	65.64	16.02	30.31	55.64	25.33
0.21	40.27	63.25	22.98	22.22	53.25	31.03
1.85	27.63	56.00	28.37	19.17	46.00	26.83
2.39	27.92	56.00	28.08	16.79	46.00	29.21
3.02	39.26	56.00	16.74	36.62	46.00	9.38

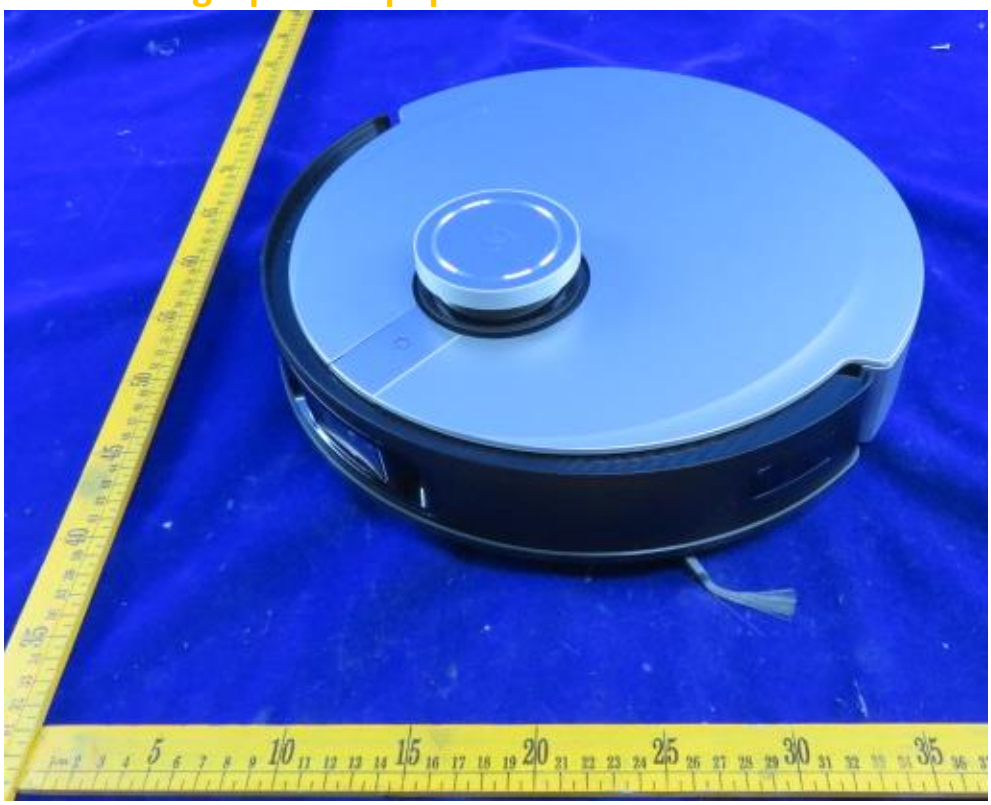
Remark: 1. Correct Factor = LISN Factor + Cable Loss, the value was added to Original Receiver Reading by the software automatically.

2. Corrected Reading = Original Receiver Reading + Correct Factor

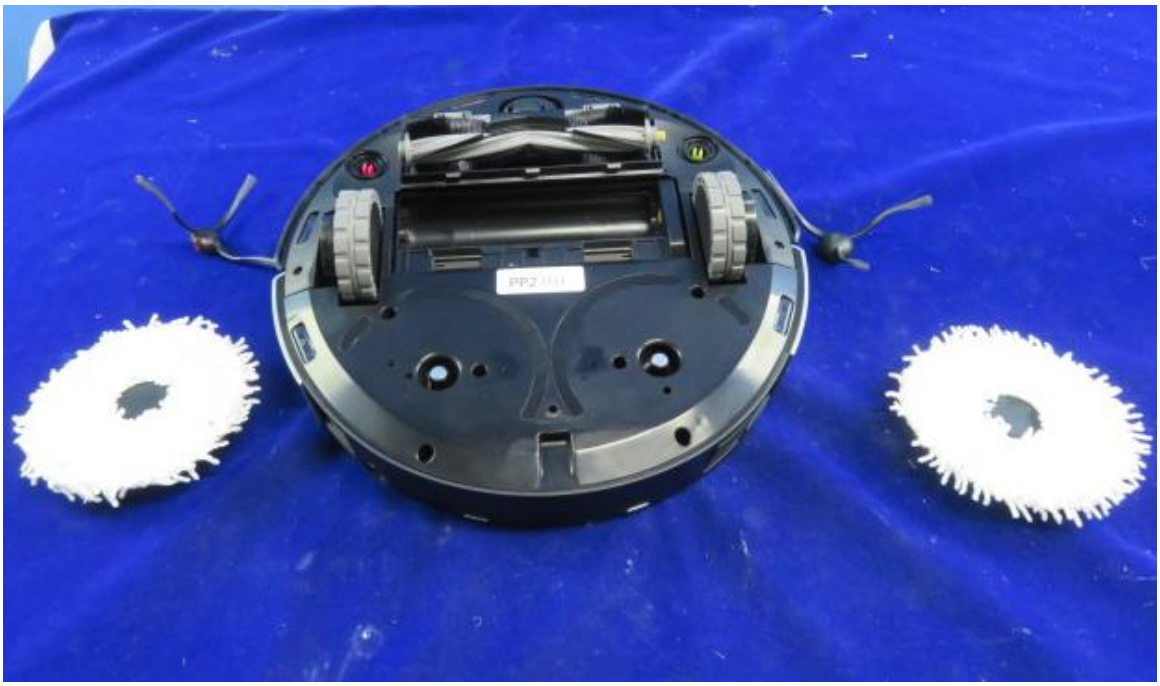
3. Margin = Limit - Corrected Reading

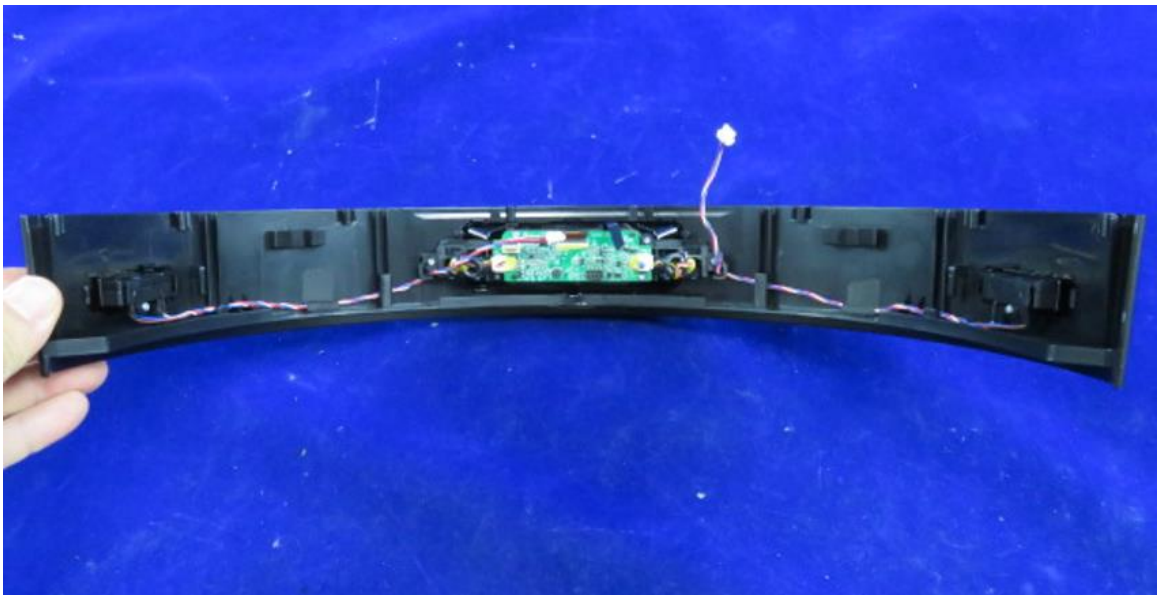
4. If the PK Corrected Reading is lower than AV limit, the AV test can be elided.

Appendix I: Photograph of equipment under test



AIVI 3D





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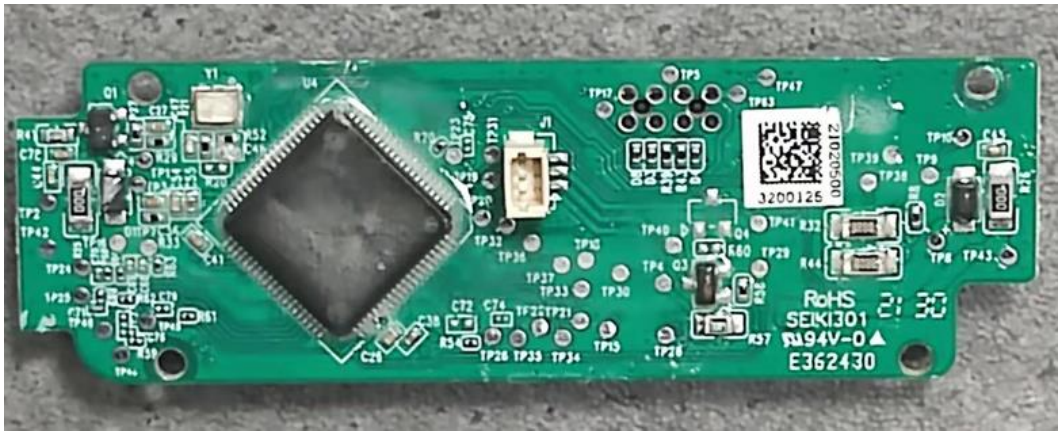
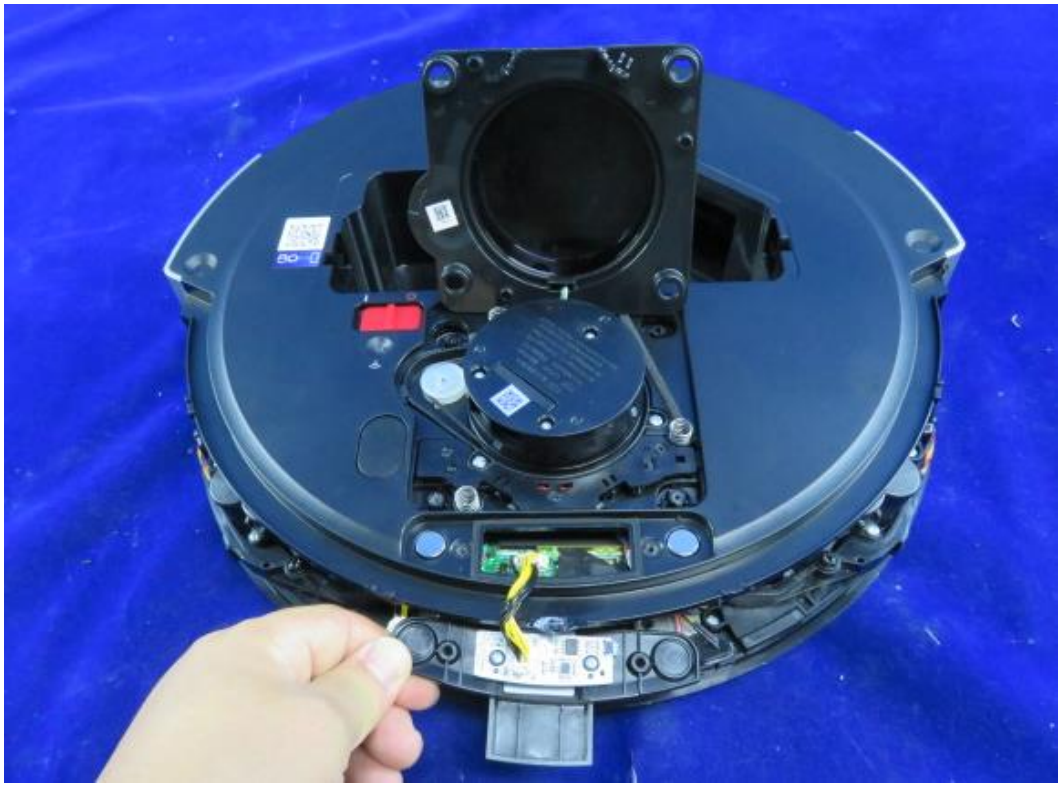
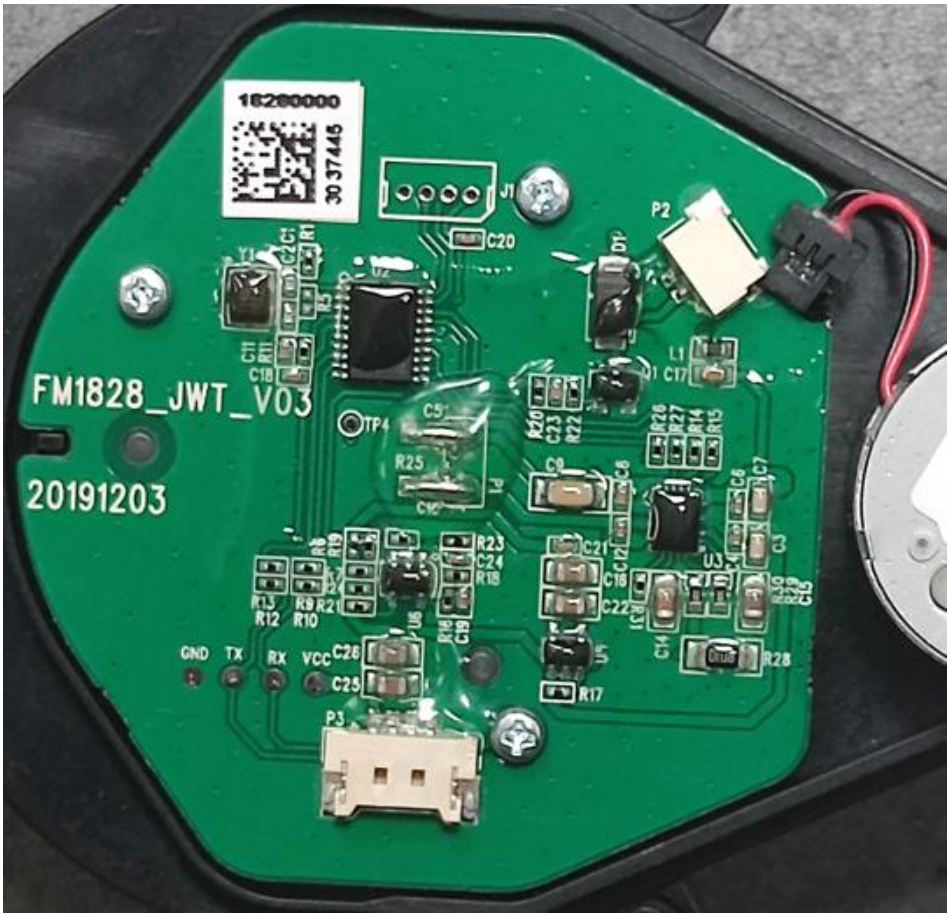
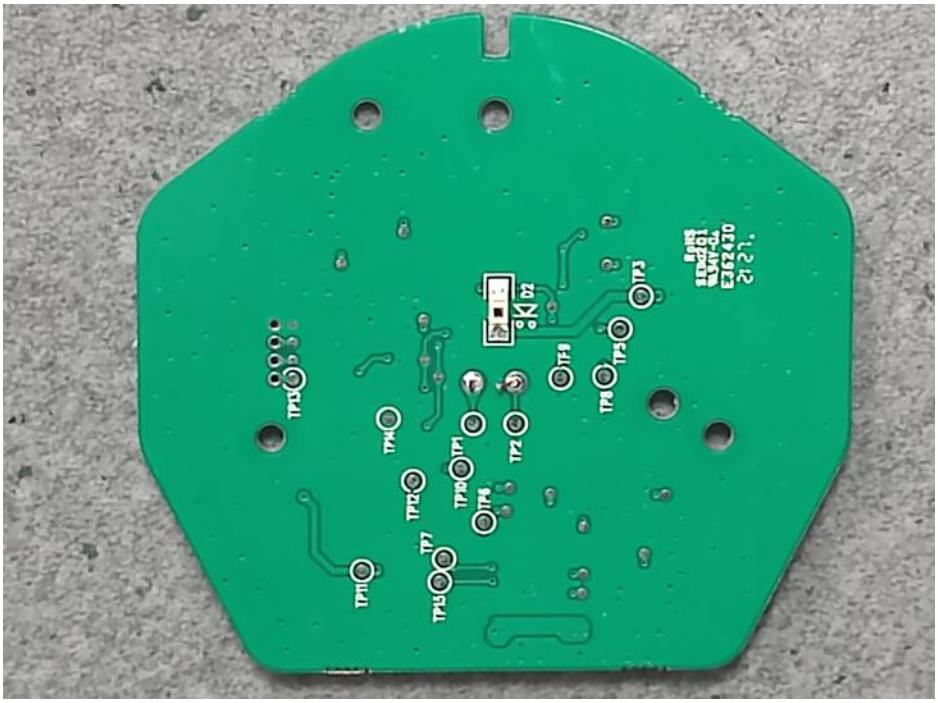
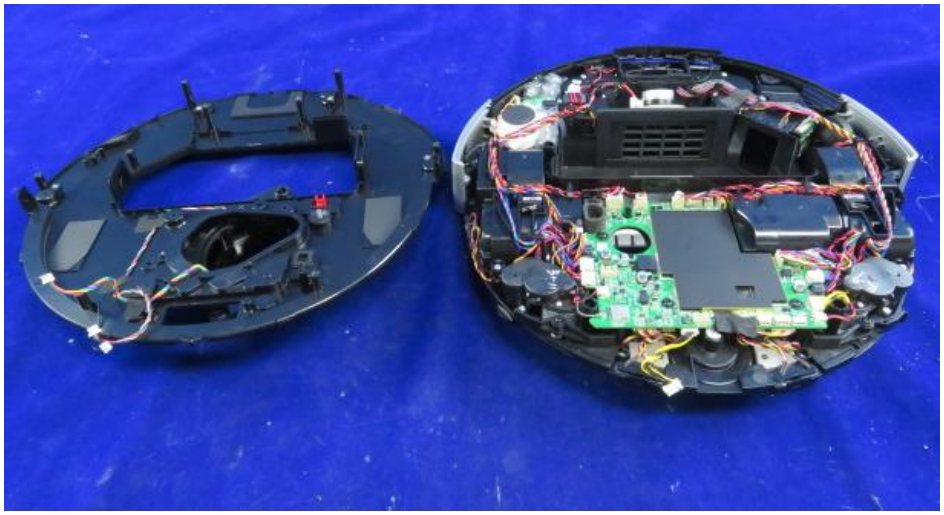

RoHS
SEIKI301
E362430

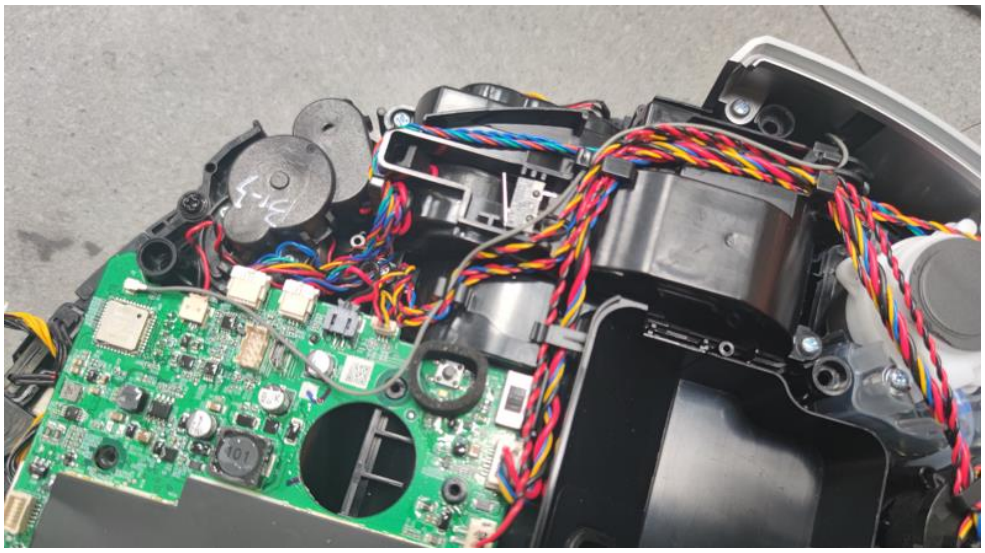


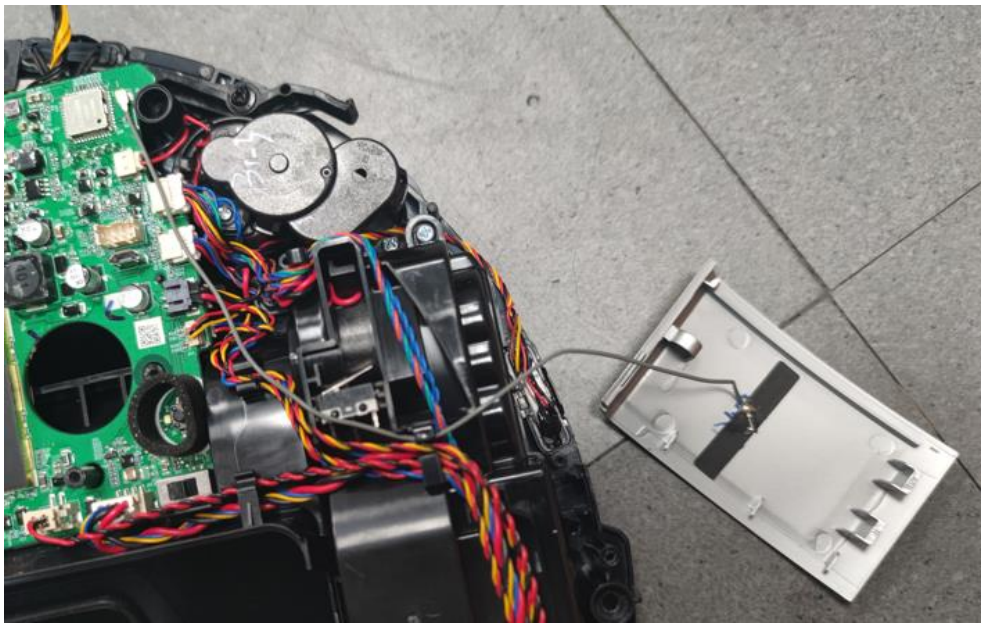

FM1828_JWT_V03
20191203
GND
TX
RX
VCC
P2
P3

TEST REPORT

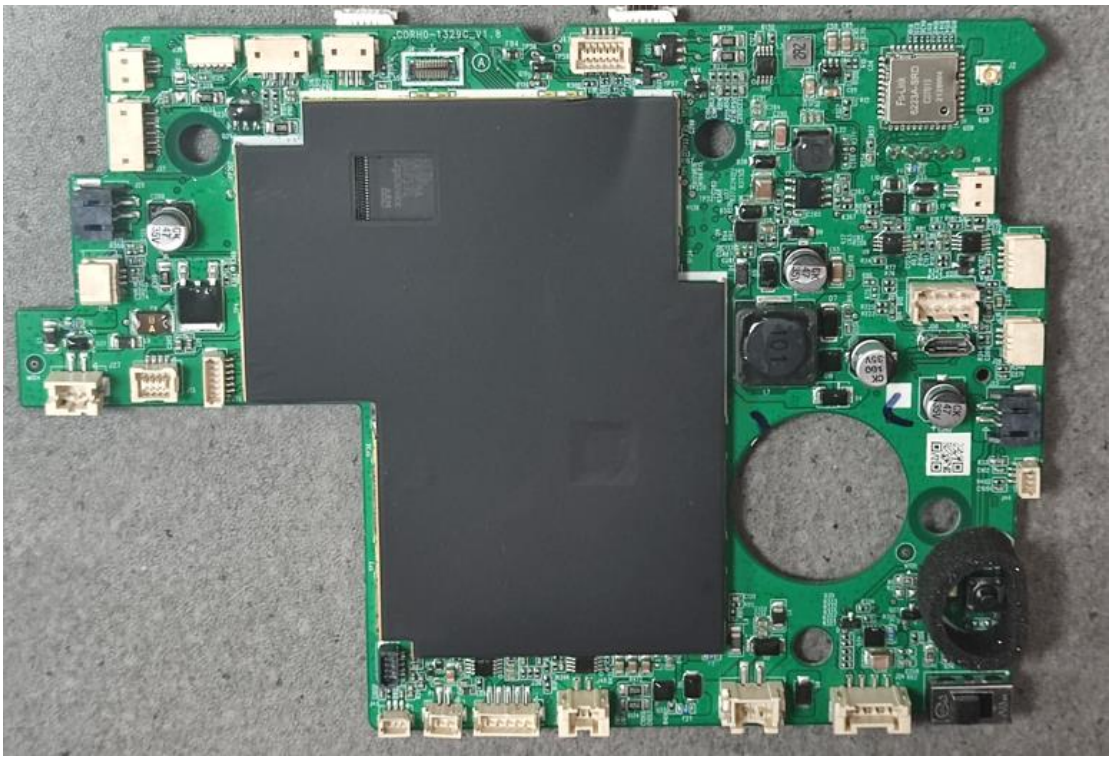


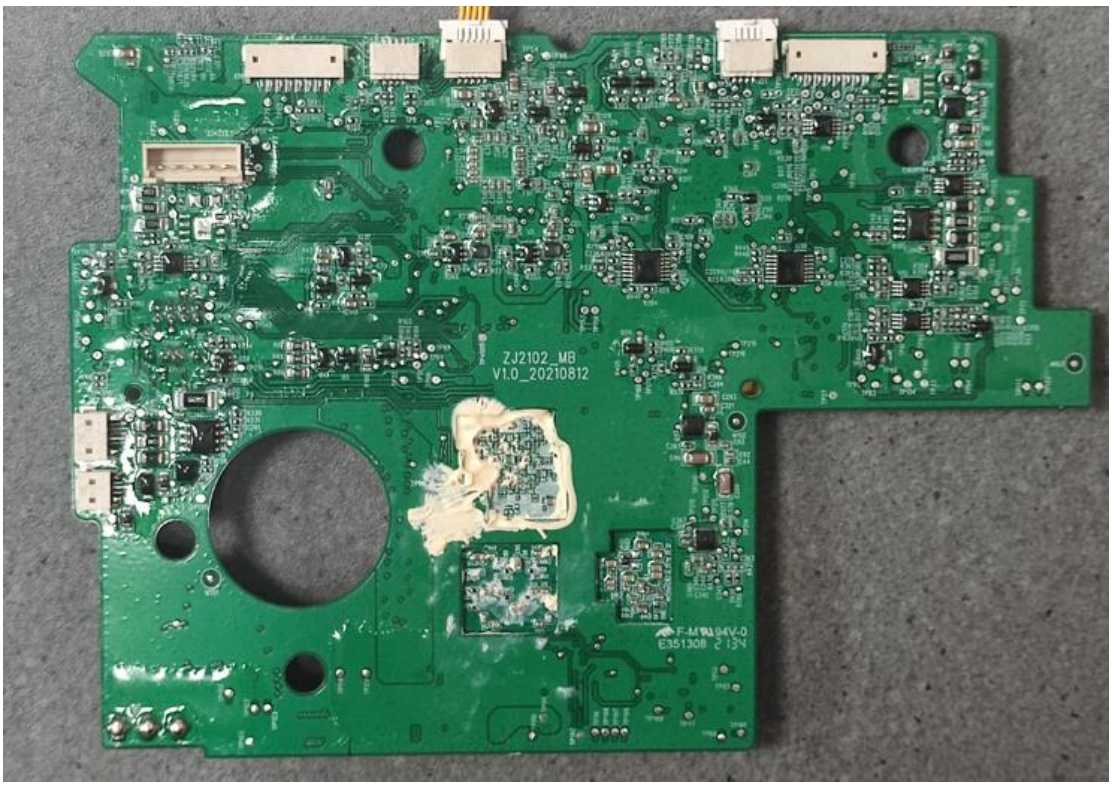






TEST REPORT





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