

Ecovacs Robotics Co., Ltd.

EMC TEST REPORT

Report Type:

FCC Part 15B & ICES-003 EMC report

Model:

DEX11

REPORT NUMBER:

211000371SHA-004+A1

ISSUE DATE:

June 2, 2022

DOCUMENT CONTROL NUMBER:

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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**

IC : **12253A-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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TEST REPORT

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Revision History

Report No.	Version	Description	Issued Date
211000371SHA-004+A1	Rev. 01	This report is based on the original report 211000374SHA-004 for amendment. The client adds an alternative 6L Diaphragm Pump CJVP28-AB12C12 and Diaphragm Pump motor RK-370CA-15320A in the docking station. There is no effect to the wireless part, only the EMC items of washing mode were conducted and the worst results were listed in this report.	June 2, 2022

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:	This report is based on the original report 211000374SHA-004 for amendment. The client adds an alternative 6L Diaphragm Pump CJVP28-AB12C12 and Diaphragm Pump motor RK-370CA-15320A in the docking station. There is no effect to the wireless part, only the EMC items of washing mode were conducted and the worst results were listed in this report.
Rating:	20V DC, 2A
Category of EUT:	Class B
EUT type:	<input type="checkbox"/> Table top <input checked="" type="checkbox"/> Floor standing
Highest operating frequency	> 108MHz
Software Version:	/
Hardware Version:	/
Sample received date:	2022.5.19
Date of test:	2022.5.20~2022.5.24

TEST REPORT

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

Subcontractor:	Name:	Shenzhen UnionTrust Quality and Technology Co., Ltd.
	Address:	Unit D/E of 9/F and 16/F, Block A, Building 6, Baoneng Science and Technology Park, Longhua District, Shenzhen, China
	Telephone:	+86 (0) 755 2823 0888
	Telefax:	+86 (0) 755 2823 0886
	FCC Accredited Lab Designation Number:	CN1194
	CNAS Accreditation Lab:	Registration No. CNAS L9069
	A2LA Accreditation Lab:	Certificate Number: 4312.01

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	-

TEST REPORT

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 Test Equipment List						
Used	Equipment	Manufacturer	Model No.	Serial Number	Cal. date (mm dd, yyyy)	Cal. Due date (mm dd, yyyy)
<input checked="" type="checkbox"/>	Receiver	R&S	ESR7	1316.3003K07-101181-K3	Nov. 05, 2021	Nov. 04, 2022
<input checked="" type="checkbox"/>	Pulse Limiter	R&S	ESH3-Z2	0357.8810.54	Nov. 05, 2021	Nov. 04, 2022
<input checked="" type="checkbox"/>	LISN	R&S	ESH2-Z5	860014/024	Nov. 05, 2021	Nov. 04, 2022

Radiated Emission Test - 3M Chamber						
Used	Equipment	Manufacturer	Model No.	Serial Number	Cal. date (mm dd, yyyy)	Cal. Due date (mm dd, yyyy)
<input checked="" type="checkbox"/>	3m SAC	ETS-LINDGREN	3m	N/A	Jan. 22, 2021	Jan. 21, 2024
<input checked="" type="checkbox"/>	Receiver	R&S	ESIB26	100114	Nov. 5, 2021	Nov. 4, 2022
<input checked="" type="checkbox"/>	Broadband Antenna	ETS-LINDGREN	3142E	00201566	Nov.11, 2021	Nov.10, 2023
<input checked="" type="checkbox"/>	6dB Attenuator	Talent	RA6A5-N-18	18103001	Nov.11, 2021	Nov.10, 2023
<input checked="" type="checkbox"/>	Preamplifier	HP	8447F	2805A02960	Nov. 5, 2021	Nov. 4, 2022
<input checked="" type="checkbox"/>	Multi device Controller	ETS-LINDGREN	7006-001	00160105	Nov. 17, 2020	Nov. 16, 2022

TEST REPORT**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 dB μ V/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 dB μ V/m (Quasi-peak) of Measurement Distance 10m	Permitted limit in dB μ V/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 dB μ V/m (Peak) of Measurement Distance 3m	Permitted limit in dB μ V/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.

TEST REPORT

3.1.2 Limits for radiated disturbance of class B device

FCC

Frequency (MHz)	Permitted limit in dB μ V/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 dB μ V/m (Quasi-peak) of Measurement Distance 10m	Permitted limit in dB μ V/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

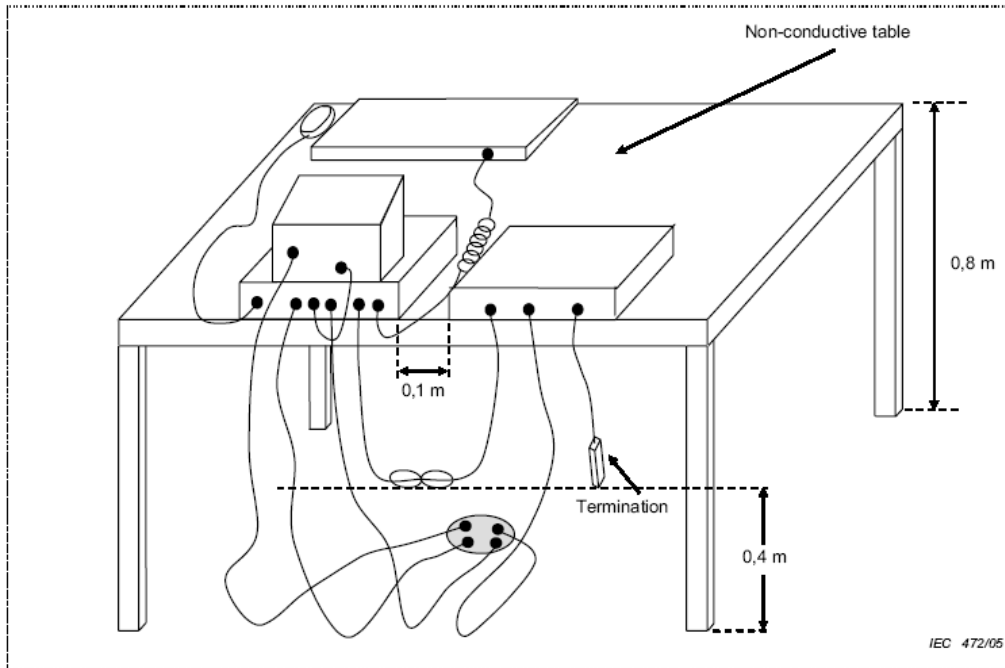
Note: The more stringent limit applies at transition frequencies.

Frequency (GHz)	Permitted limit in dB μ V/m (Peak) of Measurement Distance 3m	Permitted limit in dB μ V/m (Average) of Measurement Distance 3m
1 ~ F _M	74.0	54.0

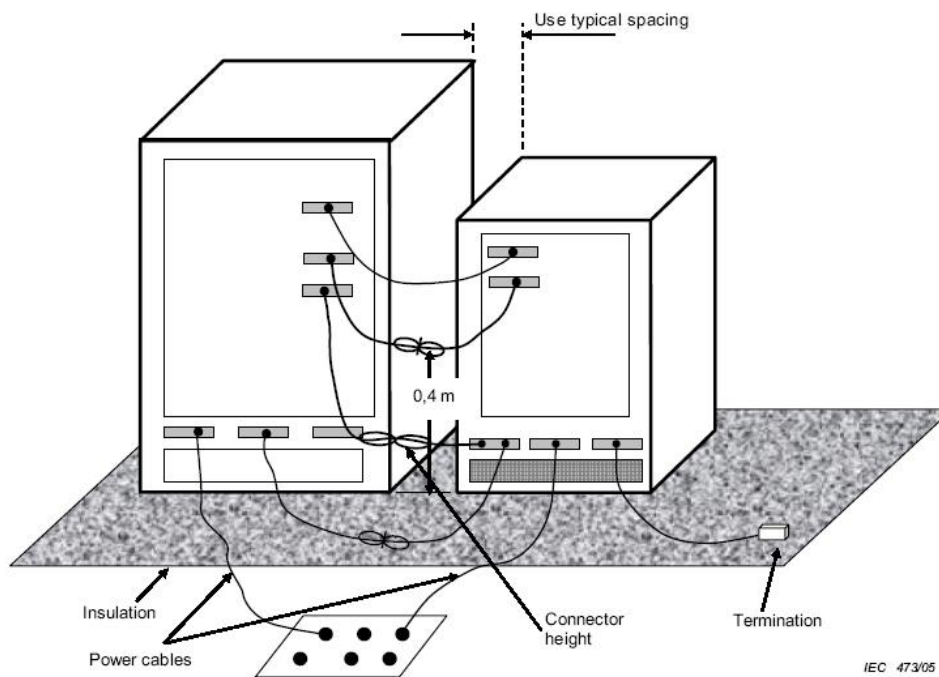
Note: These limit levels apply for a measurement distance of 3 m. If using a different measurement distance, the measured levels shall be extrapolated to the 3 m limit distance using a factor of 20 dB per decade of distance. The measurement distance shall place the measurement antenna in the far field 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)

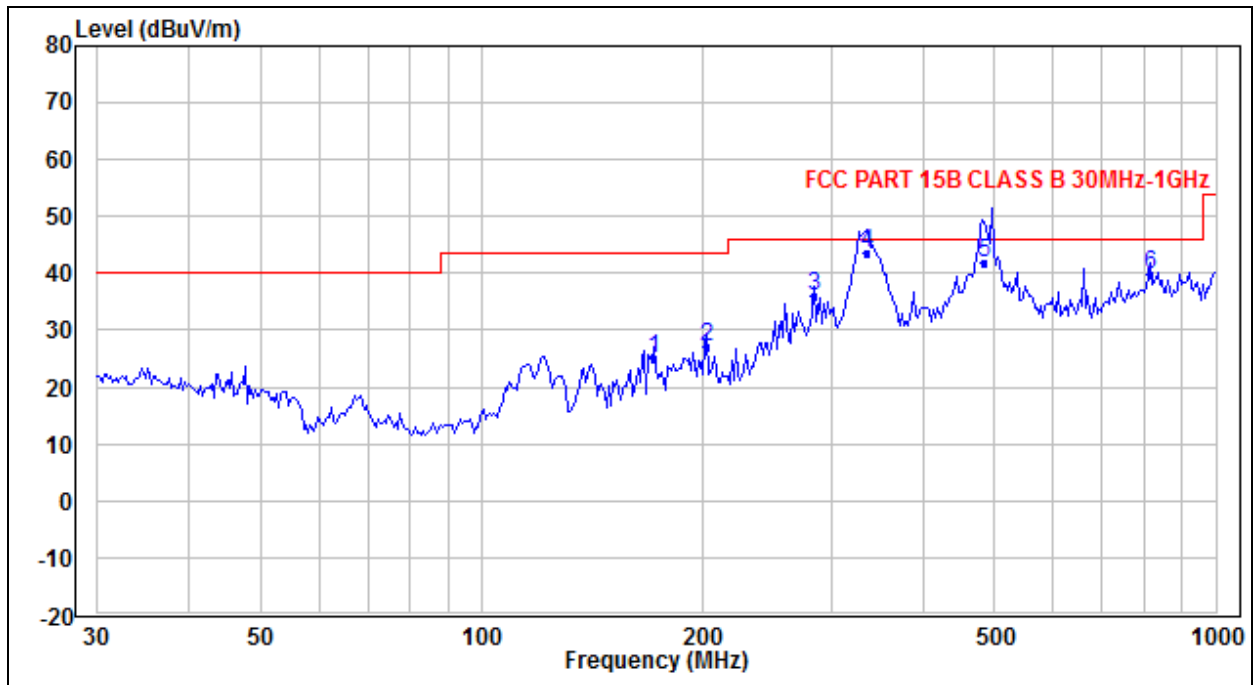
Highest internal frequency (F _x)	Highest measured frequency F _M for radiated measurement	Measured Bandwidth
F _x ≤ 108 MHz	1 GHz	120kHz
108 MHz < F _x ≤ 500 MHz	2 GHz	1MHz
500 MHz < F _x ≤ 1 GHz	5 GHz	1MHz
F _x > 1 GHz	5 × F _x up to a maximum of 40 GHz	1MHz
Note: 1. F _x is the highest fundamental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

TEST REPORT

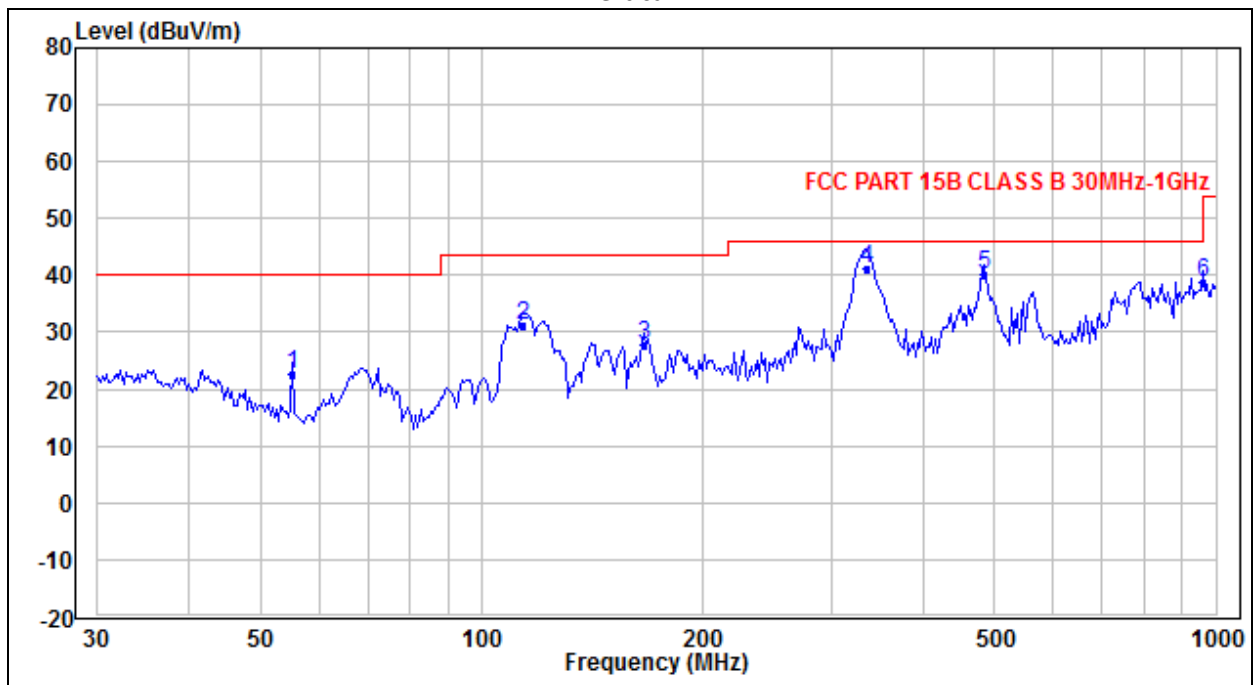
3.4 Test Results of Radiated Emissions

Test Curve of Charging with CH2103:

Horizontal



Vertical



TEST REPORT

Test data:

Polarization	Frequency (MHz)	Measured level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Detector
H	171.39	25.17	43.50	16.42	QP
	202.88	27.08	43.50	10.12	QP
	284.26	35.88	46.00	2.48	QP
	334.35	43.52	46.00	4.30	QP
	482.82	41.70	46.00	6.24	QP
	815.64	39.76	46.00	7.33	QP
V	55.29	22.74	40.00	17.26	QP
	114.02	31.37	43.50	12.13	QP
	166.64	27.66	46.00	15.84	QP
	334.13	41.31	46.00	4.69	QP
	484.91	39.98	46.00	6.02	QP
	958.71	38.67	46.00	7.33	QP

Above 1GHz

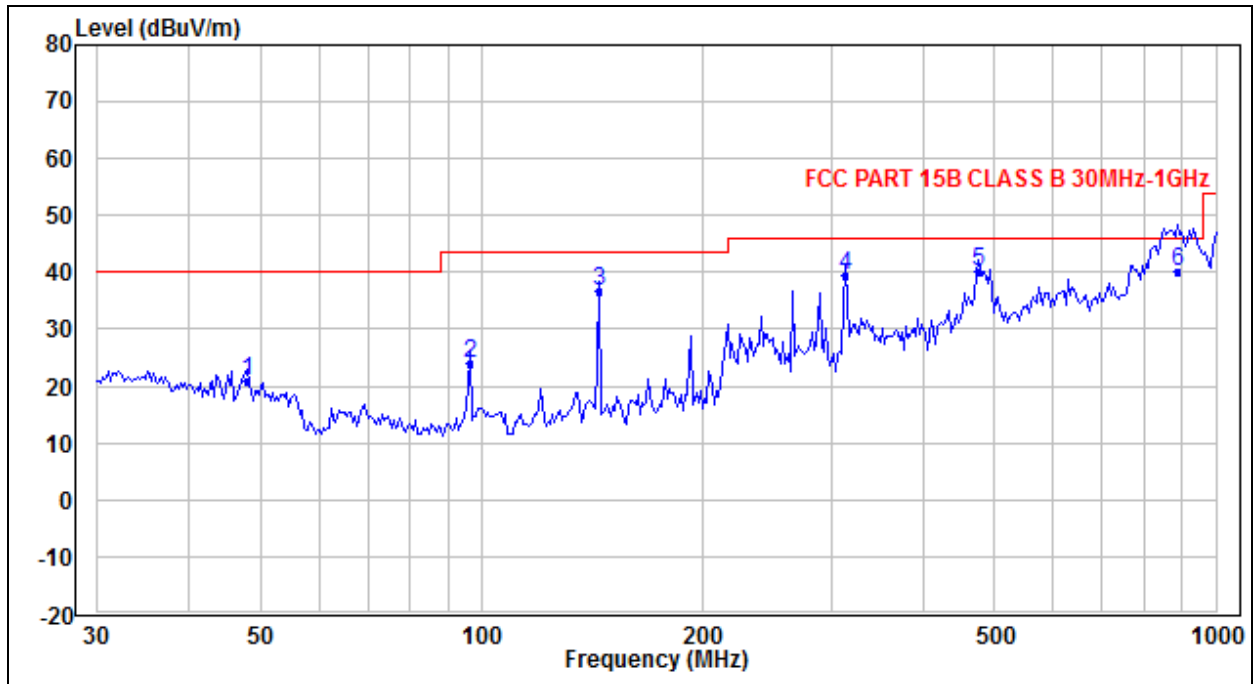
Polarization	Frequency (MHz)	Emission level (dBuV/m)	Limits (dBuV/m)	Margin (dBuV/m)	Detector
Horizontal	1000.00	*	74.0	*	PK
	5000.00	*	74.0	*	PK
	10000.00	*	74.0	*	PK
	15000.00	*	74.0	*	PK
	20000.00	*	74.0	*	PK
	25000.00	*	74.0	*	PK
Vertical	1000.00	*	74.0	*	PK
	5000.00	*	74.0	*	PK
	10000.00	*	74.0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

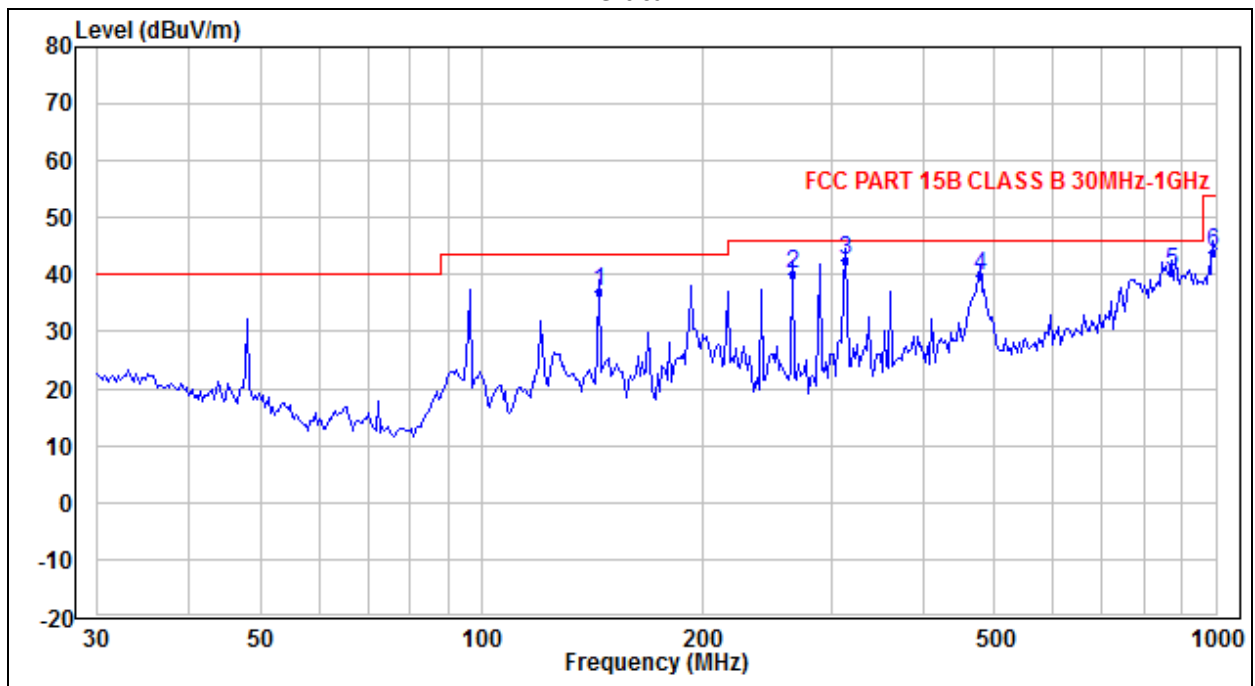
TEST REPORT

Test Curve of Charging with CH2108

Horizontal



Vertical



TEST REPORT

Test data:

Polarization	Frequency (MHz)	Measured level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Detector
H	48.04	20.85	40.00	19.15	QP
	96.32	24.07	43.50	19.43	QP
	144.79	36.58	43.50	6.92	QP
	313.65	39.28	46.00	6.72	QP
	474.79	40.29	46.00	5.71	QP
	887.40	40.12	46.00	5.88	QP
V	144.79	36.98	43.50	6.52	QP
	264.97	40.16	46.00	5.84	QP
	313.65	42.54	46.00	3.46	QP
	478.14	39.79	46.00	6.21	QP
	868.89	40.43	46.00	5.57	QP
	993.00	43.83	54.00	10.17	QP

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:

- Factor= Antenna Factor + Cable Loss (-Amplifier, is employed)
- Measured level= Original Receiver Reading + Factor
- Margin = Limit – Measured level
- 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.

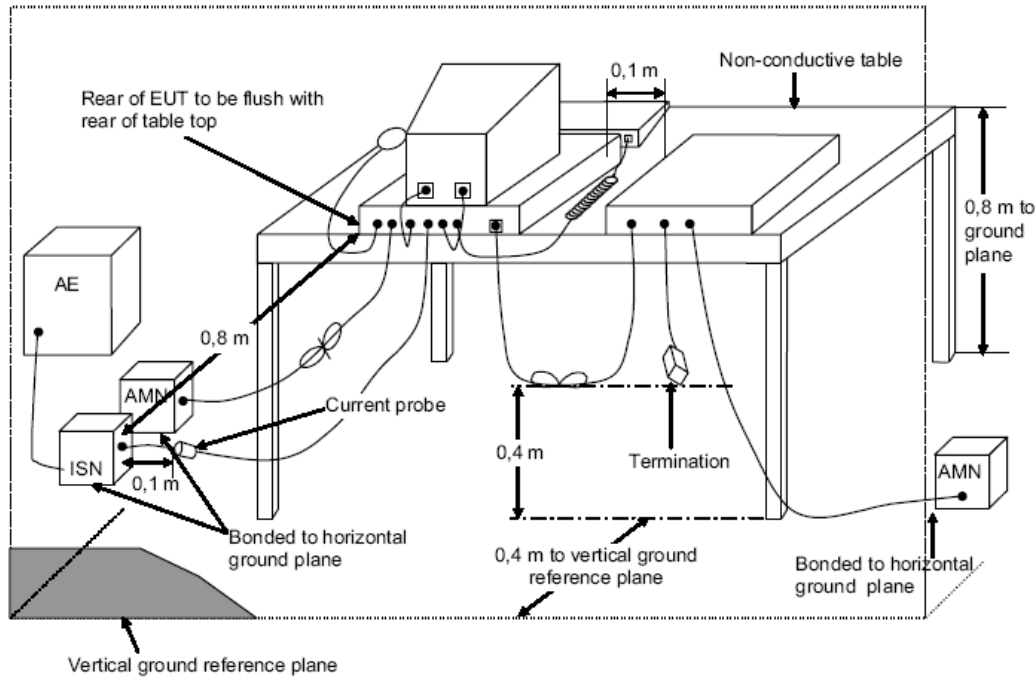
4.1.2 Limits for conducted disturbance voltage at the mains ports of class B device

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

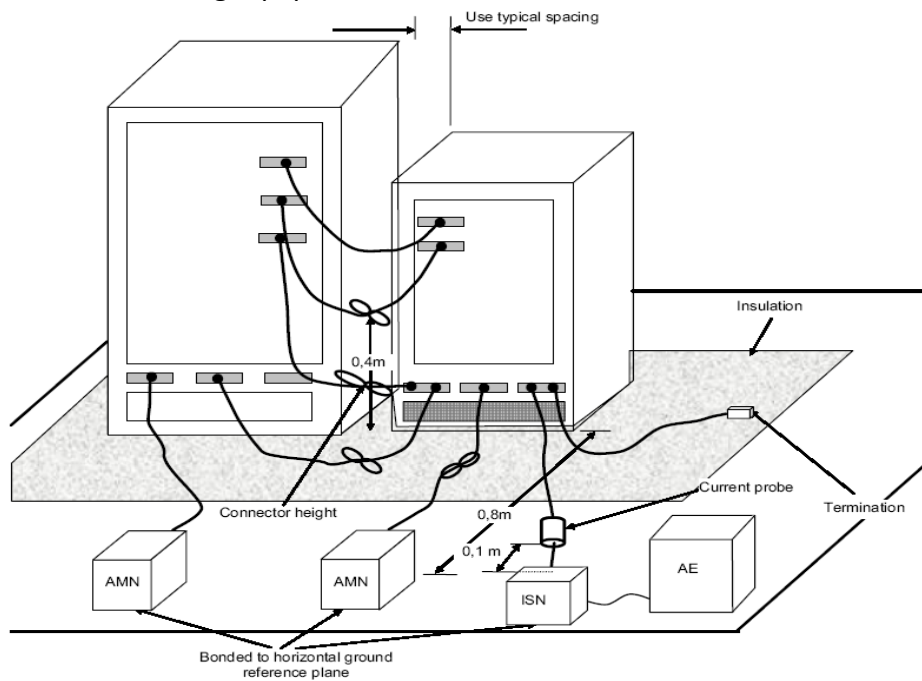
Note: 1. * Means the limit decreasing linearly with the logarithm of the frequency in the range 0.15MHz to 0.5MHz
 2. If the limit for the measurement with the average detector is met when using a receiver with a quasi-peak detector, the equipment under test shall be deemed to meet both limits and the 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



TEST REPORT**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.

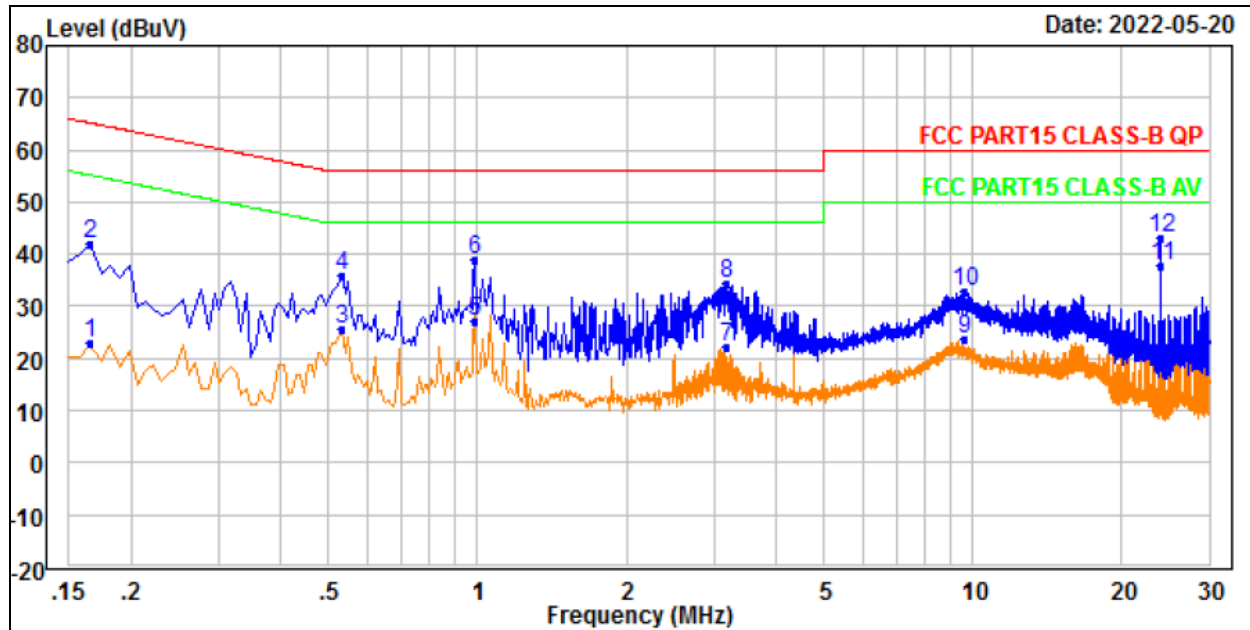
The bandwidth of the test receiver is set at 9 kHz.

TEST REPORT

4.4 Test Results of Power line conducted emission

Test Curve of charging with CH2103

L Line

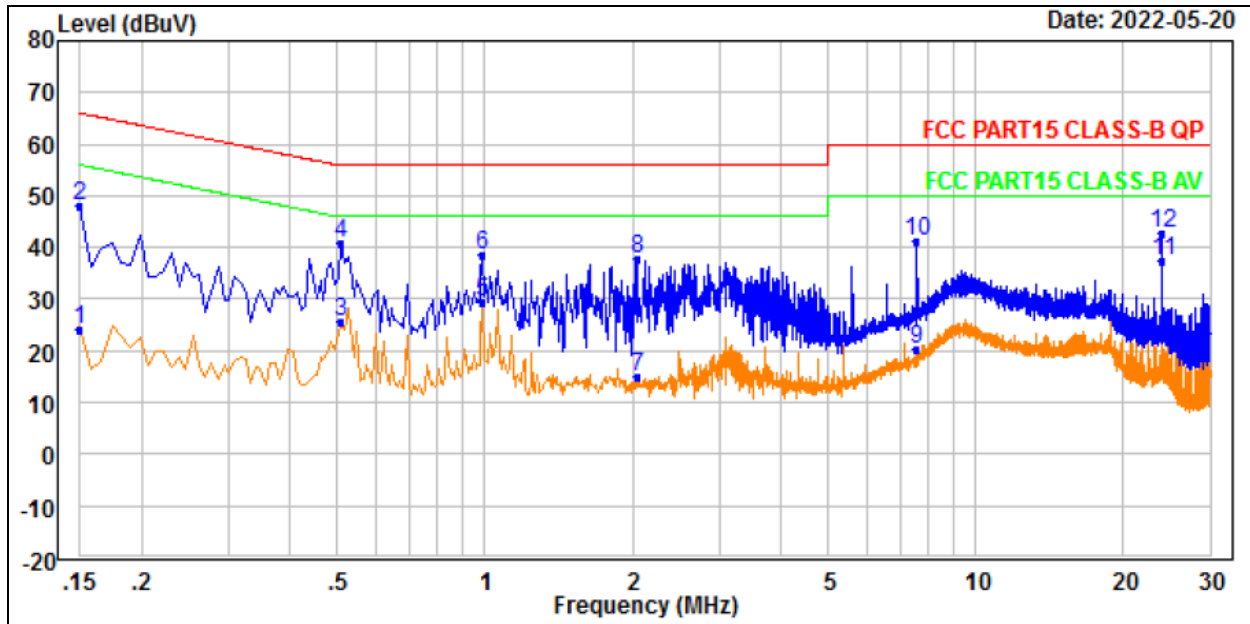


Test Data:

Freq	Read Level	LISN Factor	Cable Loss	Aux Factor	Level	Limit Line	Over Limit	Remark
MHz	dBuV	dB	dB	dB	dBuV	dBuV	dB	
0.166	13.01	0.25	0.01	9.87	23.14	55.16	-32.02	Average
0.166	32.01	0.25	0.01	9.87	42.14	65.16	-23.02	QP
0.534	15.58	0.30	0.00	9.86	25.74	46.00	-20.26	Average
0.534	25.58	0.30	0.00	9.86	35.74	56.00	-20.26	QP
0.990	16.88	0.36	0.00	9.86	27.10	46.00	-18.90	Average
0.990	28.88	0.36	0.00	9.86	39.10	56.00	-16.90	QP
3.173	12.04	0.38	0.06	9.82	22.30	46.00	-23.70	Average
3.173	24.04	0.38	0.06	9.82	34.30	56.00	-21.70	QP
9.636	13.22	0.60	0.08	9.88	23.78	50.00	-26.22	Average
9.636	22.22	0.60	0.08	9.88	32.78	60.00	-27.22	QP
24.001	27.01	0.88	0.08	9.98	37.95	50.00	-12.05	Average
24.001	32.01	0.88	0.08	9.98	42.95	60.00	-17.05	QP

TEST REPORT

N Line



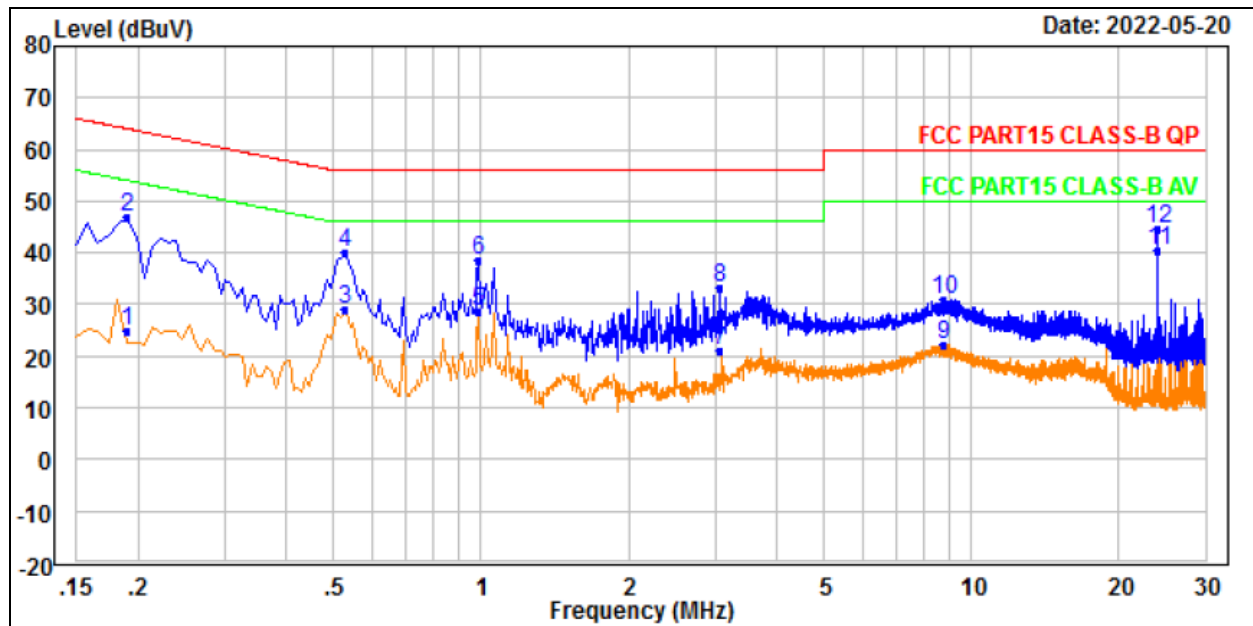
Test Data:

Freq	Read Level	LISN Factor	Cable Loss	Aux Factor	Level	Limit Line	Over Limit	Remark
MHz	dBuV	dB	dB	dB	dBuV	dBuV	dB	
0.150	13.95	0.24	0.01	9.86	24.06	56.00	-31.94	Average
0.150	37.95	0.24	0.01	9.86	48.06	66.00	-17.94	QP
0.510	15.63	0.27	0.00	9.86	25.76	46.00	-20.24	Average
0.510	30.63	0.27	0.00	9.86	40.76	56.00	-15.24	QP
0.990	19.36	0.29	0.00	9.86	29.51	46.00	-16.49	Average
0.990	28.36	0.29	0.00	9.86	38.51	56.00	-17.49	QP
2.046	4.68	0.31	0.03	9.84	14.86	46.00	-31.14	Average
2.046	27.68	0.31	0.03	9.84	37.86	56.00	-18.14	QP
7.597	9.65	0.56	0.09	9.85	20.15	50.00	-29.85	Average
7.597	30.65	0.56	0.09	9.85	41.15	60.00	-18.85	QP
24.001	26.67	0.87	0.08	9.98	37.60	50.00	-12.40	Average
24.001	31.67	0.87	0.08	9.98	42.60	60.00	-17.40	QP

TEST REPORT

Test Curve of charging with CH2108

L Line

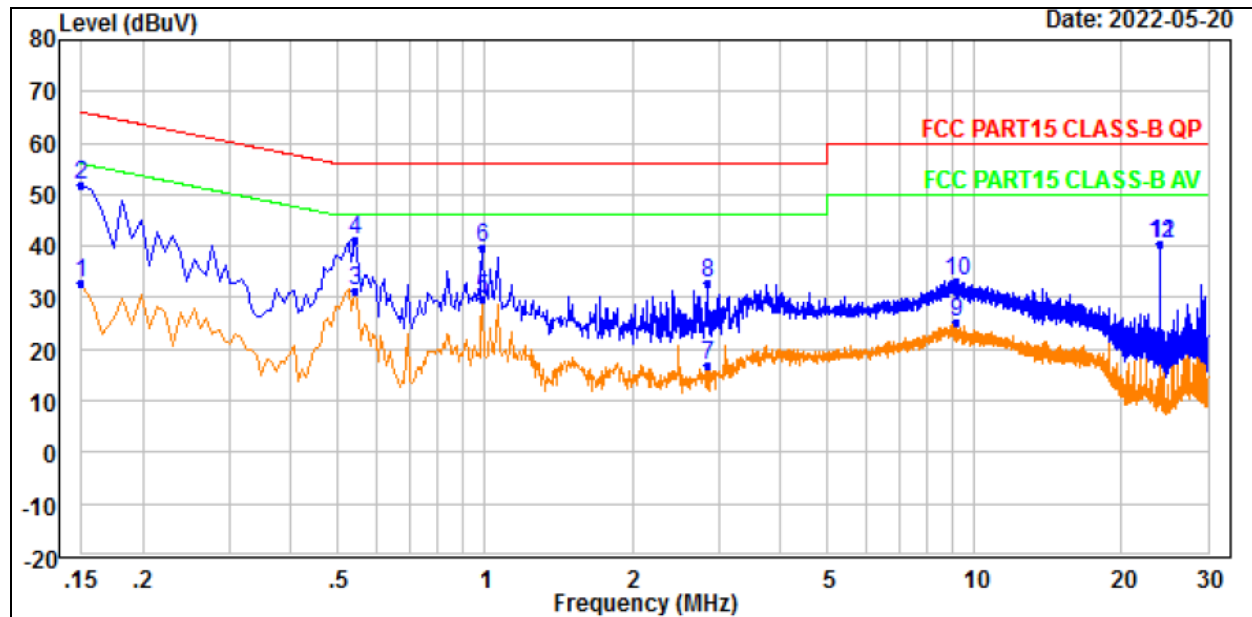


Test Data:

Freq	Read Level	LISN Factor	Cable Loss	Aux Factor	Level	Limit Line	Over Limit	Remark
MHz	dBuV	dB	dB	dB	dBuV	dBuV	dB	
0.190	14.64	0.25	0.00	9.87	24.76	54.04	-29.28	Average
0.190	36.64	0.25	0.00	9.87	46.76	64.04	-17.28	QP
0.526	19.03	0.30	0.00	9.86	29.19	46.00	-16.81	Average
0.526	30.03	0.30	0.00	9.86	40.19	56.00	-15.81	QP
0.990	18.50	0.36	0.00	9.86	28.72	46.00	-17.28	Average
0.990	28.50	0.36	0.00	9.86	38.72	56.00	-17.28	QP
3.077	10.97	0.38	0.06	9.83	21.24	46.00	-24.76	Average
3.077	22.97	0.38	0.06	9.83	33.24	56.00	-22.76	QP
8.740	11.57	0.58	0.09	9.87	22.11	50.00	-27.89	Average
8.740	20.57	0.58	0.09	9.87	31.11	60.00	-28.89	QP
24.001	29.52	0.88	0.08	9.98	40.46	50.00	-9.54	Average
24.001	33.52	0.88	0.08	9.98	44.46	60.00	-15.54	QP

TEST REPORT

N Line



Test Data:

Freq MHz	Read Level dBuV	LISN Factor dB	Cable Loss dB	Aux Factor dB	Level dBuV	Limit Line dBuV	Over Limit dB	Remark
0.150	22.75	0.24	0.01	9.86	32.86	56.00	-23.14	Average
0.150	41.75	0.24	0.01	9.86	51.86	66.00	-14.14	QP
0.542	21.23	0.27	0.00	9.86	31.36	46.00	-14.64	Average
0.542	31.23	0.27	0.00	9.86	41.36	56.00	-14.64	QP
0.990	19.58	0.29	0.00	9.86	29.73	46.00	-16.27	Average
0.990	29.58	0.29	0.00	9.86	39.73	56.00	-16.27	QP
2.861	6.71	0.38	0.05	9.83	16.97	46.00	-29.03	Average
2.861	22.71	0.38	0.05	9.83	32.97	56.00	-23.03	QP
9.196	14.79	0.62	0.08	9.88	25.37	50.00	-24.63	Average
9.196	22.79	0.62	0.08	9.88	33.37	60.00	-26.63	QP
24.001	29.61	0.87	0.08	9.98	40.54	50.00	-9.46	Average
24.001	29.61	0.87	0.08	9.98	40.54	60.00	-19.46	QP

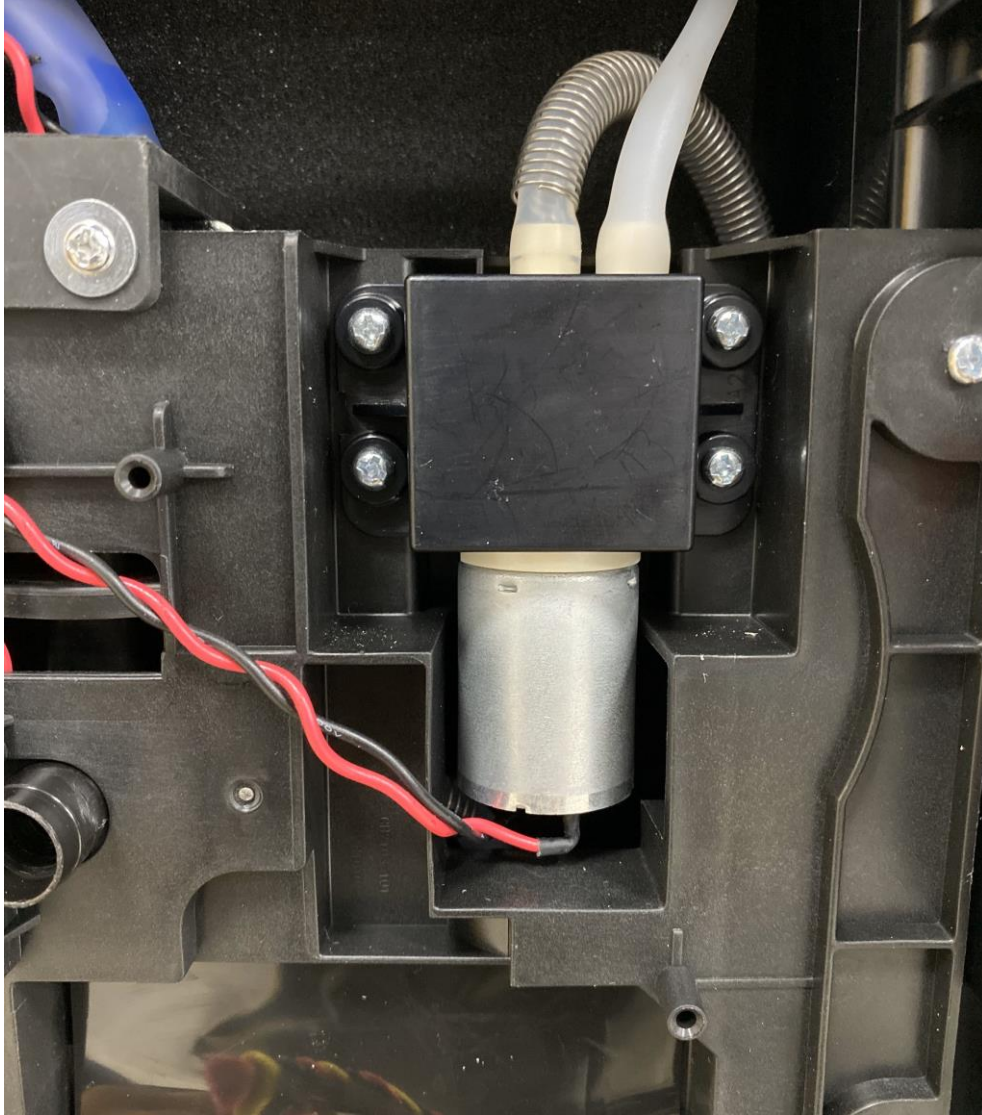
Remark: 1. Level = Read Level + LISN Factor + Cable Loss + Aux Factor.

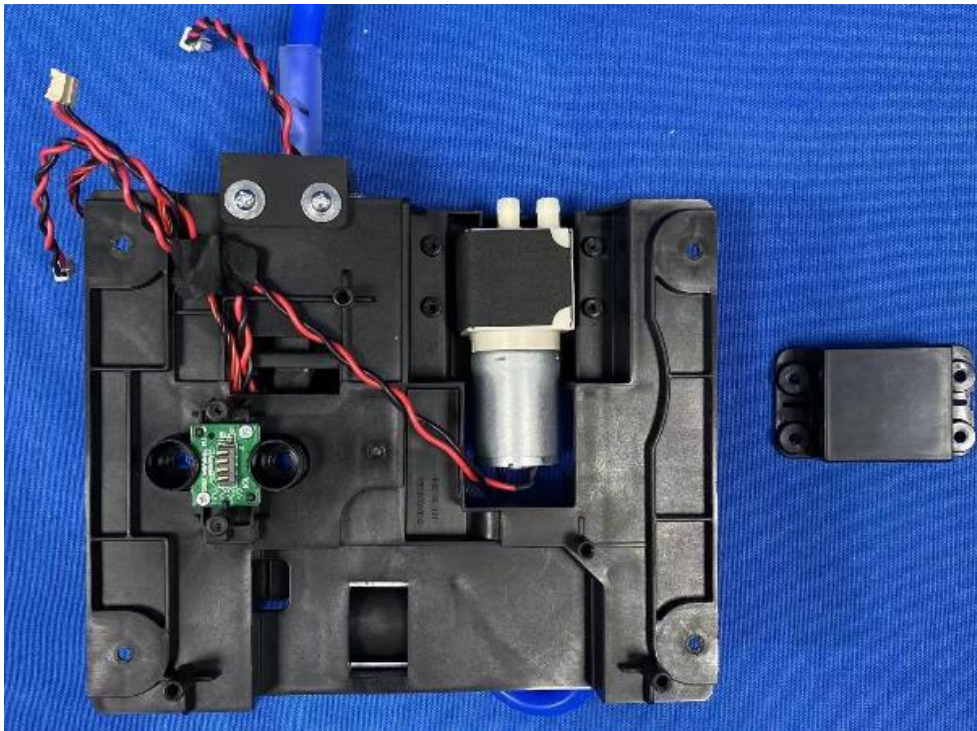
2. Over Limit = Limit Value – Level

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

Appendix I: Photograph of equipment under test

The alternative 6L Diaphragm Pump CJVP28-AB12C12
And Diaphragm Pump motor RK-370CA-15320A





***** END *****