

# **Ecovacs Home Service Robotics Co., Ltd.**

# **EMC TEST REPORT**

# **Report Type:**

FCC Part 15B & ICES-003 EMC report

# Model:

DEX86

### **REPORT NUMBER:**

2308A1232SHA-001

### **ISSUE DATE:**

October 13, 2023

### **DOCUMENT CONTROL NUMBER:**

TTRF15b\_V1 © 2018 Intertek





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

Report no.: 2308A1232SHA-001

**Applicant:** Ecovacs Home Service Robotics Co., Ltd.

No.518 Songwei Road, Wusongjiang industry Park, Guoxiang Street,

Wuzhong District, Suzhou, Jiangsu, China.

Manufacturer: Ecovacs Home Service Robotics Co., Ltd.

No.518 Songwei Road, Wusongjiang industry Park, Guoxiang Street,

Wuzhong District, Suzhou, Jiangsu, China.

**Factory 1:** Ecovacs Robotics Co., Ltd.

No.518 Songwei Road, Wusongjiang industry Park, Guoxiang Street,

Wuzhong District, Suzhou, Jiangsu, China

**Factory 2:** Ecovacs Home Service Robotics Co., Ltd.

No.518 Songwei Road, Wusongjiang industry Park, Guoxiang Street,

Wuzhong District, Suzhou, Jiangsu, China.

**FCC ID:** 2A64B-DEX86 **IC:** 28593-DEX86

#### **SUMMARY:**

The equipment complies with the requirements according to the following standard(s) or Specification:

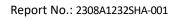
**47CFR Part 15 (2021):** Radio Frequency Devices (Subpart B)

**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:	
Zrie.li		
Project Engineer	Reviewer	
Eric Li	Wakeyou Wang	

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# **Content**

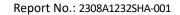
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# **Revision History**

Report No.	Version	Description	Issued Date
230302476SHA-005	Rev. 01	Initial issue of report	June 6, 2023
2308A1232SHA-001	Rev. 01	This report is based on the original report 230302476SHA-005 for amendment include the follow changes or/and additions: 1, added an alternative main PWB with heat dissipation copper sheet 2, Added an alternative construction that cancel pressure sensor PWB.  There is no change for RF part, after the evaluation, we test the conducted emission and radiated emission below 1GHz.	October 13, 2023



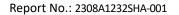


# **Measurement result summary**

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

<sup>2: &</sup>quot;\*" 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:	DEX86	
	The EUT is a Floor Cleaning Robot, it supports WIFI and Bluetooth	
Description of EUT:	functions, there is only one model. we test them and list the worst results in this report.	
Rating:	20V DC 2.0A	
Category of EUT:	Class B	
EUT type:	☐ Table top ☐ Floor standing	
Highest operating frequency	<mark>/</mark> < 2480MHz	
Software Version:	/	
Hardware Version:	/	
Sample Identification No.:	0230505-03-002	
Sample received date:	2023.09.15	
Date of test:	2023.09.18-2023.09.23	





# 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,	CNAS Accreditation Lab Registration No. CNAS L0139
certified, or accredited by these organizations:	FCC Accredited Lab Designation Number: CN0175
0 1111	IC Registration Lab CAB identifier.: CN0014
	VCCI Registration Lab Member No: 3598 (Registration No.: R-14243, G-10845, C-14723, T-12252)
	A2LA Accreditation Lab Certificate Number: 3309.02

Report No.: 2308A1232SHA-001



# **2 TEST SPECIFICATIONS**

# 2.1 Standards or specification

47CFR Part 15 (2021) 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

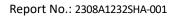
Test Items	Software	Manufacturer	Version
Conducted emission	ESxS-K1	R&S	V2.1.0
Radiated emission	ES-K1	R&S	V1.71

# 2.4 Test peripherals list

Item No.	Name	Brand and Model	Description
1	Docking Station	€cov∧cs CH2229	-

### 2.5 Test environment condition:

Test items	Temperature	Humidity
Power line conducted emission	24°C	54% RH
Radiated Emissions	25°C	53% RH





# 2.6 Instrument list

Conducted	Conducted Emission					
Used	Equipment	Manufacturer	Type	Internal no.	Due date	
$\boxtimes$	Test Receiver	R&S	ESCS 30	EC 2107	2024-07-09	
$\boxtimes$	A.M.N.	R&S	ESH2-Z5	EC 3119	2023-11-09	
	A.M.N.	R&S	ENV 216	EC 3393	2024-07-09	
	A.M.N.	R&S	ENV4200	EC 3558	2024-06-09	
Radiated E	mission					
Used	Equipment	Manufacturer	Type	Internal no.	Due date	
$\boxtimes$	Test Receiver	R&S	ESIB 26	EC 3045	2023-10-19	
$\boxtimes$	Bilog Antenna	TESEQ	CBL 6112D	EC 4206	2024-08-06	
	Pre-amplifier	R&S	AFS42- 00101800-25-S- 42	EC5262	2024-06-09	
$\boxtimes$	Horn antenna	ETS	3117	EC 4792-1	2024-03-26	
$\boxtimes$	Horn antenna	TOYO	HAP18-26W	EC 4792-3	2024-07-08	
	Active loop antenna	Schwarzbeck	FMZB1519	EC 5345	2024-04-23	
Tet Site						
Used	Equipment	Manufacturer	Туре	Internal no.	Due date	
$\boxtimes$	Shielded room	Zhongyu	-	EC 2838	2024-01-24	
	Shielded room	Zhongyu	-	EC 2839	2024-01-24	
	Semi-anechoic chamber	Albatross project	-	EC 3048	2024-08-22	
	Fully-anechoic chamber	Albatross project	-	EC 3047	2024-08-22	
Additional	instrument					
Used	Equipment	Manufacturer	Туре	Internal no.	Due date	
$\boxtimes$	Therom- Hygrograph	ZJ1-2A	S.M.I.F.	EC 3783	2024-03-23	
	Therom- Hygrograph	ZJ1-2A	S.M.I.F.	EC 5844	2024-03-08	
$\boxtimes$	Therom- Hygrograph	ZJ1-2A	S.M.I.F.	EC 3442	2024-01-04	
$\boxtimes$	Therom- Hygrograph	ZJ1-2A	S.M.I.F.	EC 5198	2024-03-08	
	Pressure meter	YM3	Shanghai Mengde	EC 3320	2024-07-22	

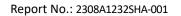




# 2.7 Measurement uncertainty

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

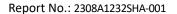
Note: for the measurement distance other than 3m and 10m, the limit is varied according to 20dB/10 decades.

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<br/>(Peak)<br/>of Measurement Distance 3mPermitted limit in dBμV/m<br/>(Average)<br/>of Measurement Distance 3m $1 \sim F_M$ 80.060.0

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	Permitted limit in dBμV/m			
	(Quasi-peak)	(Quasi-peak)			
	of Measurement Distance 10m	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  $dB\mu V/m$ (Peak)

of Measurement Distance 3m

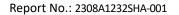
1 ~ F<sub>M</sub>

Permitted limit in  $dB\mu V/m$ (Average)

of Measurement Distance 3m

54.0

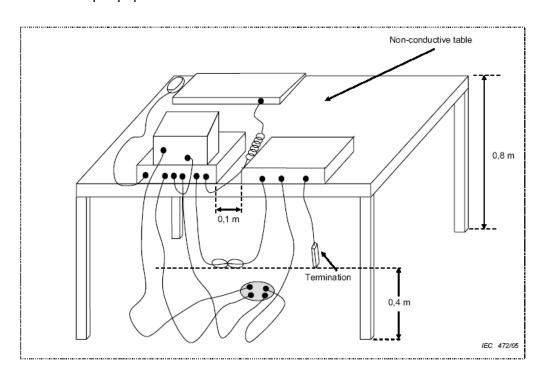
Note: These limit levels apply for a measurement distance of 3 m. If using a different measurement distance, the measured levels shall be extrapolated to the 3 m limit distance using a factor of 20 dB per decade of distance. The measurement distance shall place the measurement antenna in the far field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



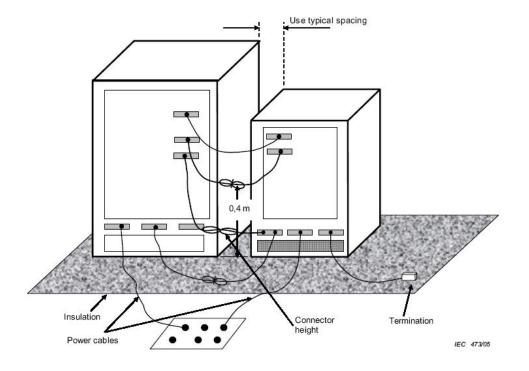


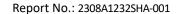
# 3.2 Block diagram and test set up

# 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	Highest measured frequency F <sub>M</sub> for	Measured Bandwidth
(Fx)	radiated measurement	
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	$5 \times Fx$ up to a maximum of 40 GHz	1MHz

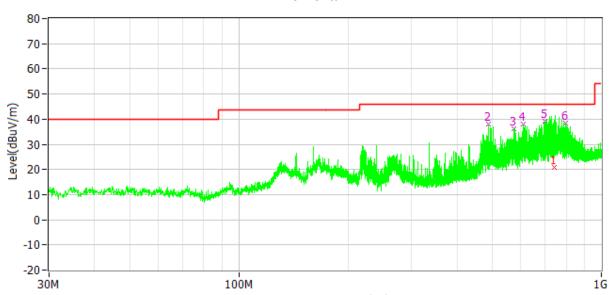
Note: 1. Fx is the highest fundamental frequency generated and/or used in the ITE or digital apparatus under test.



# 3.4 Test Results of Radiated Emissions

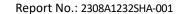
# **Test Curve of worst results with CH2229:**

### Horizontal

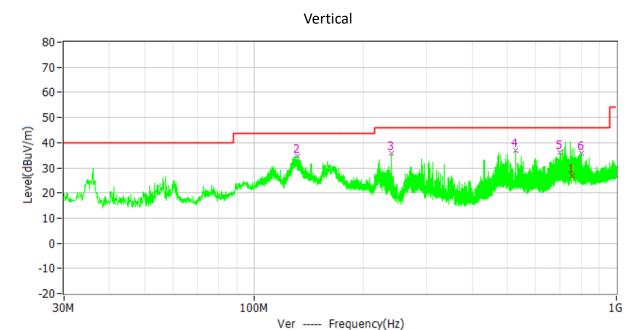


Hor ---- Frequency(Hz)

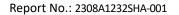
No.	Frequency	Limit dBuV/m	Level dBuV/m	Delta dB	Reading dBuV	Factor dB/m	Detector	Polar
1	744.000MHz	46.0	20.9	-25.1	-3.2	24.1	QP	Hor
2*	488.325MHz	46.0	38.2	-7.8	18.6	19.6	PK	Hor
3*	573.297MHz	46.0	36.1	-9.9	14.6	21.5	PK	Hor
4*	610.254MHz	46.0	38.2	-7.8	15.9	22.3	PK	Hor
5*	700.367MHz	46.0	39.1	-6.9	15.5	23.6	PK	Hor
6*	794.748MHz	46.0	38.4	-7.6	13.6	24.8	PK	Hor







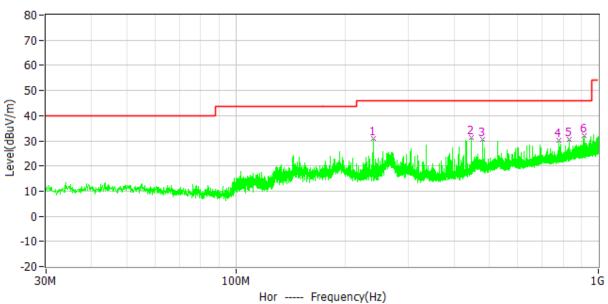
Limit Level Delta Reading Factor Polar No. Frequency Detector dBuV/m dBuV/m dB dBuV dB/m 1 753.351MHz 2.4 Ver 46.0 26.7 -19.3 24.3 QP 2\* 43.5 131.850MHz 34.7 -8.8 21.4 13.3 PΚ Ver 3\* 240.005MHz 46.0 35.9 -10.1 23.0 12.9 PK Ver 4\* 46.0 37.1 -8.9 PK 527.998MHz 16.6 20.5 Ver 5\* 46.0 -9.9 697.942MHz 36.1 12.5 23.6 PK Ver 6\* 46.0 35.8 -10.2 PK 799.307MHz 10.9 24.9 Ver



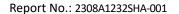


# **Test Curve of cleaning mode:**

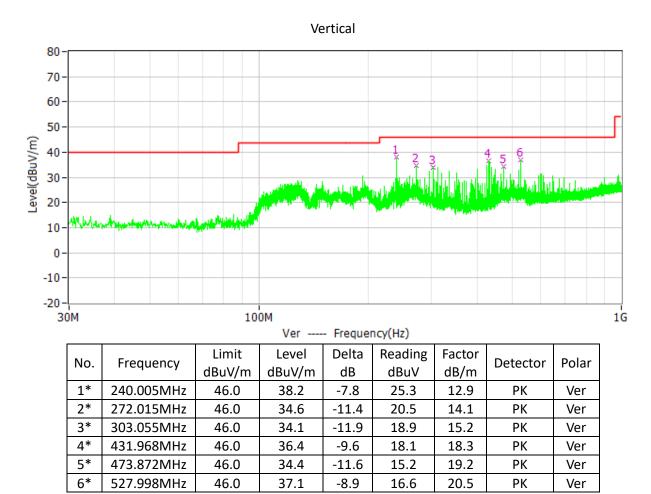




No	Fraguana	Limit	Level	Delta	Reading	Factor	Detector	Dolor
No.	Frequency	dBuV/m	dBuV/m	//m dB dBuV dB/m Dete		Detector	Polar	
1*	240.005MHz	46.0	31.0	-15.0	18.1	12.9	PK	Hor
2*	447.488MHz	46.0	31.2	-14.8	12.5	18.7	PK	Hor
3*	479.013MHz	46.0	30.6	-15.4	11.2	19.4	PK	Hor
4*	777.094MHz	46.0	30.2	-15.8	5.6	24.6	PK	Hor
5*	830.153MHz	46.0	30.4	-15.6	5.1	25.3	PK	Hor
6*	912.894MHz	46.0	32.2	-13.8	5.9	26.3	PK	Hor

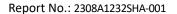






### Remark:

- 1. Factor = Antenna Factor + Cable Loss (-Amplifier, is employed)
- 2. Level= Original Receiver Reading + Factor
- 3. Delta = Level Limit
- 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	Limits dB(μV)		
(MHz)	Quasi-peak	Average	
0.15 ~ 0.5	79	66	
0.5 ~ 30	73	60	

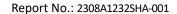
Note: If the limit for the measurement with the average detector is met when using a receiver with a quasi-peak detector, the equipment under test shall be deemed to meet both limits and the measurement using the receiver with an average detector need not be carried out.

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

Frequency range	Limits dB(μV)			
(MHz)	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

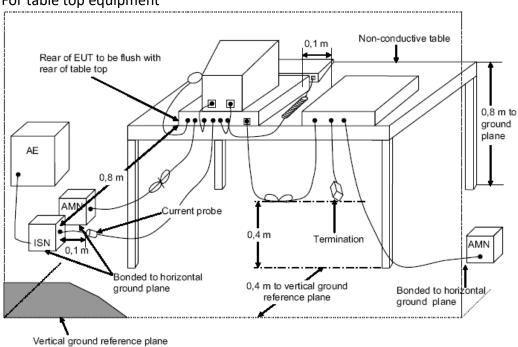
2. If the limit for the measurement with the average detector is met when using a receiver with a quasi-peak detector, the equipment under test shall be deemed to meet both limits and the measurement using the receiver with an average detector need not be carried out.



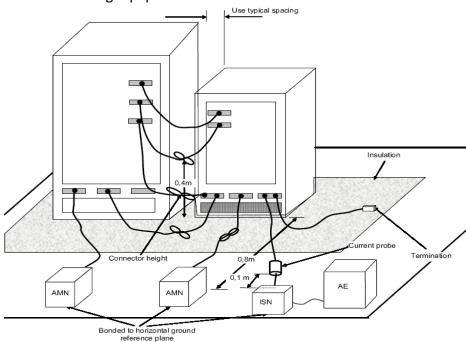


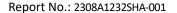
# 4.2 Block diagram and test set up

# 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  $\Omega$  LISN port (to which the EUT is connected), where permitted, terminated into a 50  $\Omega$  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  $\Omega$  measuring port is terminated by a measuring instrument having 50  $\Omega$  input impedance. All other ports are terminated in 50  $\Omega$  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.

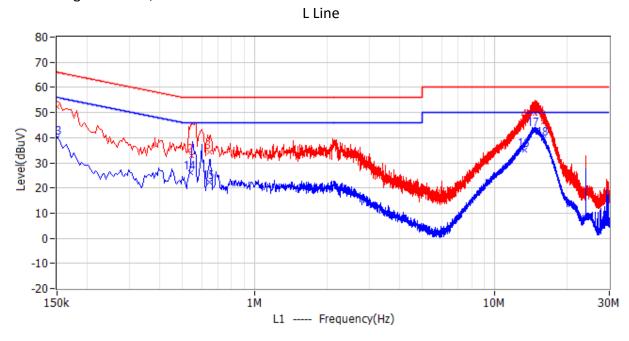


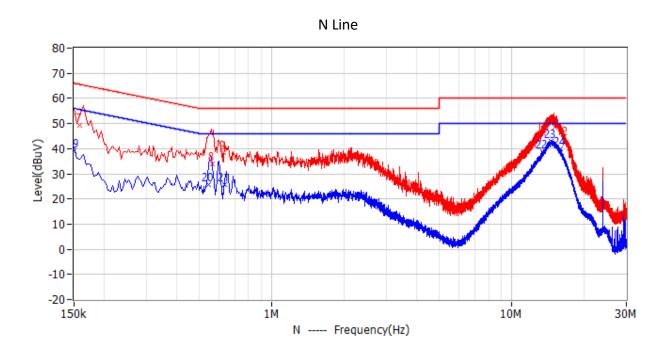


# 4.4 Test Results of Power line conducted emission

### **Test Curve:**

Test Voltage: AC 120V, 60Hz









### **Test Data:**

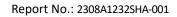
No	No. Frequency	Limit	Level	Delta	Reading	Factor	Dotostor	Dhaca
NO.	Frequency	dBuV	dBuV	dB	dBuV	dB	Detector	Phase
1	150.000kHz	66.0	52.1	-13.9	45.9	6.2	QP	L1
2	546.000kHz	56.0	32.7	-23.3	26.4	6.3	QP	L1
3	645.000kHz	56.0	34.3	-21.7	28.0	6.3	QP	L1
4	13.479MHz	60.0	46.6	-13.4	40.1	6.5	QP	L1
5	14.739MHz	60.0	49.7	-10.3	43.2	6.5	QP	L1
6	15.941MHz	60.0	46.2	-13.8	39.7	6.5	QP	L1
7	159.000kHz	65.5	49.4	-16.1	43.1	6.3	QP	Ν
8	564.000kHz	56.0	33.8	-22.2	27.6	6.2	QP	Ν
9	631.500kHz	56.0	38.4	-17.6	32.2	6.2	QP	N
10	13.587MHz	60.0	46.1	-13.9	39.7	6.4	QP	Ν
11	15.108MHz	60.0	48.7	-11.3	42.3	6.4	QP	Ν
12	16.359MHz	60.0	44.0	-16.0	37.6	6.4	QP	Ν
13	150.000kHz	56.0	40.1	-15.9	33.9	6.2	CAV	L1
14	541.500kHz	46.0	25.9	-20.1	19.6	6.3	CAV	L1
15	645.000kHz	46.0	22.5	-23.5	16.2	6.3	CAV	L1
16	13.313MHz	50.0	35.0	-15.0	28.5	6.5	CAV	L1
17	14.622MHz	50.0	43.3	-6.7	36.8	6.5	CAV	L1
18	16.013MHz	50.0	39.5	-10.5	33.0	6.5	CAV	L1
19	150.000kHz	56.0	39.2	-16.8	33.0	6.2	CAV	Ν
20	546.000kHz	46.0	25.6	-20.4	19.4	6.2	CAV	N
21	636.000kHz	46.0	25.6	-20.4	19.3	6.3	CAV	N
22	13.376MHz	50.0	38.9	-11.1	32.5	6.4	CAV	N
23	14.577MHz	50.0	43.0	-7.0	36.6	6.4	CAV	N
24	15.918MHz	50.0	39.9	-10.1	33.5	6.4	CAV	N

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

<sup>2.</sup> Level = Original Receiver Reading + Correct Factor

<sup>3.</sup> Delta = Level - Limit

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





Appendix I: Photograph of equipment under test
Refer to the documents for the External Photos and Internal Photos
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