

Harman International Industries, Inc.

RF TEST REPORT

Report Type:

FCC Part 15.247 & ISED RSS-247 RF report

Model:

AP72598V

REPORT NUMBER:

220201028SHA-009

ISSUE DATE:

June 10, 2022

DOCUMENT CONTROL NUMBER:

TTRF15.247-03_V1 © 2018 Intertek



Applicant: Harman International Industries, Inc.
8500 Balboa Blvd, Northridge, CA 91329, USA

Manufacturer: Dalian Golden Hualu Digital Technology Co., Ltd.
No.1 Hua Road, Qixianling, High-Tech Industrial Zone, Dalian, Liaoning, China

Manufacturing site: Dalian Golden Hualu Digital Technology Co., Ltd.
No.1 Hua Road, Qixianling, High-Tech Industrial Zone, Dalian, Liaoning, China

Product Name: WiFi & BT Platform Module

Type/Model: AP72598V

FCC ID: APIAP72598V

IC: 6132A-AP72598V

SUMMARY:

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

47CFR Part 15 (2020): Radio Frequency Devices (Subpart C)

ANSI C63.10 (2013): American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

RSS-247 Issue 2 (February 2017): Digital Transmission Systems (DTs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

RSS-Gen Issue 5 (February 2021) Amendment 2: General Requirements for Compliance of Radio Apparatus

PREPARED BY:

REVIEWED BY:



Project Engineer
Erick Liu

Reviewer
Wakeyou Wang

This report is for the exclusive use of Intertek's Client and is provided pursuant to the agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this report. Only the Client is authorized to permit copying or distribution of this report and then only in its entirety. Any use of the Intertek name or one of its marks for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test results in this report are relevant only to the sample tested. This report by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program.

TEST REPORT

Contents

- REVISION HISTORY..... 4**
- MEASUREMENT RESULT SUMMARY 5**
- 1 GENERAL INFORMATION 6**
 - 1.1 DESCRIPTION OF EQUIPMENT UNDER TEST (EUT) 6
 - 1.2 TECHNICAL SPECIFICATION 6
 - 1.3 ANTENNA INFORMATION..... 6
 - 1.4 DESCRIPTION OF TEST FACILITY 7
- 2 TEST SPECIFICATIONS..... 8**
 - 2.1 STANDARDS OR SPECIFICATION 8
 - 2.2 MODE OF OPERATION DURING THE TEST..... 8
 - 2.3 TEST SOFTWARE LIST 9
 - 2.4 TEST PERIPHERALS LIST 9
 - 2.5 TEST ENVIRONMENT CONDITION:..... 9
 - 2.6 INSTRUMENT LIST 10
 - 2.7 MEASUREMENT UNCERTAINTY 11
- 3 RADIATED EMISSIONS IN RESTRICTED FREQUENCY BANDS..... 12**
 - 3.1 LIMIT 12
 - 3.2 MEASUREMENT PROCEDURE 12
 - 3.3 TEST CONFIGURATION 14
 - 3.4 TEST RESULTS OF RADIATED EMISSIONS 16
- 4 POWER LINE CONDUCTED EMISSION..... 18**
 - 4.1 LIMIT 18
 - 4.2 TEST CONFIGURATION 18
 - 4.3 MEASUREMENT PROCEDURE 19
 - 4.4 TEST RESULTS OF POWER LINE CONDUCTED EMISSION..... 20
- 5 ANTENNA REQUIREMENT..... 22**

Revision History

Report No.	Version	Description	Issued Date
220201028SHA-009	Rev. 01	Initial issue of report	June 10, 2022

Measurement result summary

TEST ITEM	FCC REFERANCE	IC REFERANCE	RESULT
Minimum 6dB Bandwidth	15.247(a)(2)	RSS-247 Issue 2 Clause 5.2	NT
Maximum conducted output power and e.i.r.p.	15.247(b)(3)	RSS-247 Issue 2 Clause 5.4	NT
Power spectrum density	15.247(e)	RSS-247 Issue 2 Clause 5.2	NT
Emission outside the frequency band	15.247(d)	RSS-247 Issue 2 Clause 5.5	NT
Radiated Emissions in restricted frequency bands	15.247(d), 15.205&15.209	RSS-Gen Issue 5 Clause 8.9&8.10	Pass
Power line conducted emission	15.207(a)	RSS-Gen Issue 5 Clause 8.8	Pass
Occupied bandwidth	-	RSS-Gen Issue 5 Clause 6.6	NT
Antenna requirement	15.203	-	Pass

Notes: 1: NA =Not Applicable

2: Determination of the test conclusion is based on IEC Guide 115 in consideration of measurement uncertainty.

3: Additions, Deviations and Exclusions from Standards: None.

1 GENERAL INFORMATION

1.1 Description of Equipment Under Test (EUT)

Product name:	WiFi & BT Platform Module
Type/Model:	AP72598V
Description of EUT:	The EUT is wireless module with WiFi and Bluetooth function, it has only one model. This is C2PC report, three antennas has been added, after evaluation, we choose antenna 0&1 for all tests.
Rating:	4.5-5.5V DC
EUT type:	<input checked="" type="checkbox"/> Table top <input type="checkbox"/> Floor standing
Software Version:	/
Hardware Version:	/
Sample received date:	May 26, 2022
Date of test:	May 26, 2022 ~ June 10, 2022

1.2 Technical Specification

Frequency Band:	2400MHz ~ 2483.5MHz
Bluetooth Version:	Bluetooth LE
Type of Modulation:	GFSK
Channel Number:	40
Data Rate:	1 Mbps
Channel Separation:	2 MHz

1.3 Antenna information

Antenna information:			
No.	Antenna Type	Gain	Note
0	Pole antenna	2.53dBi	Pole antenna
1	Chip antenna	1.55dBi	Chip antenna
2	Pole antenna	1.83dBi	Pole antenna

Note: After technology evaluation, the max gain antenna 0 and 1 was choose for all tests.

TEST REPORT

1.4 Description of Test Facility

Power line conducted emission test was performed in the following test facilities:

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: CN0175
	IC Registration Lab CAB identifier.: CN0051
	VCCI Registration Lab Registration No.: R-14243, G-10845, C-14723, T-12252
	A2LA Accreditation Lab Certificate Number: 3309.02

Radiated Emissions in restricted frequency bands test was performed in the following test facilities:

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, China 518109
Telephone:	+86 (0) 755 2823 0888
Telefax:	+86 (0) 755 2823 0886

The test facility is recognized, certified, or accredited by these organizations:	CNAS Accreditation Lab Registration No. CNAS L9069
	FCC Accredited Lab Designation Number: CN1194
	IC Registration Lab CAB identifier.: CN0032
	A2LA Accreditation Lab Certificate Number: 4312.01

TEST REPORT

2 TEST SPECIFICATIONS

2.1 Standards or specification

47CFR Part 15 (2020)
 ANSI C63.10 (2013)
 RSS-247 Issue 2 (February 2017)
 RSS-Gen Issue 5 (February 2021) Amendment 2
 KDB 558074(v05r02)

2.2 Mode of operation during the test

Three axes (X, Y, Z) were observed while the test receiver worked as “max hold” continuously and the highest reading among the whole test procedure was recorded. Compare with the test results that X axis is the worst case.

The lowest, middle and highest channel were tested as representatives.

Frequency Band (MHz)				2402 ~ 2480			
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	10	2422	20	2442	30	2462
1	2404	11	2424	21	2444	31	2464
2	2406	12	2426	22	2446	32	2466
3	2408	13	2428	23	2448	33	2468
4	2410	14	2430	24	2450	34	2470
5	2412	15	2432	25	2452	35	2472
6	2414	16	2434	26	2454	36	2474
7	2416	17	2436	27	2456	37	2476
8	2418	18	2438	28	2458	38	2478
9	2420	19	2440	29	2460	39	2480

Data rate VS Power:

The test setting software is offered by the manufactory. The pre-scan for the conducted power with all rates in each modulation and bands was used, and the worst case was found and used in all test cases.

Test software and Power Setting parameter			
Test Software	Secure CRT		
Working Mode	BLE		
Test Channel	2402MHz	2440MHz	2480MHz
Power Setting	Default	Default	Default

TEST REPORT

While testing transmitting mode of EUT, the internal modulation and continuously transmission was applied.

Radiated test mode: EUT transmitted signal with BT antenna;

Conducted test mode: EUT transmitted signal from BT RF port connected to SPA directly;

2.3 Test software list

Test Items	Software	Manufacturer	Version
Conducted emission	e3	Audix	9.160323
Radiated emission	e3	Audix	9.160323

2.4 Test peripherals list

Item No.	Name	Band and Model	Description
1	Laptop computer	DELL 5480	-
2	RF cable	/	0.2m length; 0.5dB loss

2.5 Test environment condition:

Test items	Temperature	Humidity
Radiated Emissions in restricted frequency bands	24.7°C	52%RH
Power line conducted emission	25°C	53%RH

2.6 Instrument list

Shenzhen UnionTrust Quality and Technology Co., Ltd.

Radiated 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"/>	3M Chamber & Accessory Equipment	ETS-LINDGREN	3M	N/A	Jan. 22, 2021	Jan. 21, 2024
<input checked="" type="checkbox"/>	Receiver	R&S	ESIB26	100114	Nov. 05, 2021	Nov. 04, 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. 05, 2021	Nov. 04, 2022
<input checked="" type="checkbox"/>	Horn Antenna (Pre-amplifier)	ETS-LINDGREN	3117-PA	00201874	Apr. 30, 2021	Apr. 29, 2023
<input checked="" type="checkbox"/>	Horn Antenna (Pre-amplifier)	ETS-LINDGREN	3116C-PA	00202652	Nov. 14, 2020	Nov. 13, 2022
<input checked="" type="checkbox"/>	Multi device Controller	ETS-LINDGREN	7006-001	00160105	N/A	N/A
<input checked="" type="checkbox"/>	Test Software	Audix	e3	Software Version: 9.160323		

Intertek Testing Services Shanghai

Conducted Emission/Disturbance Power/Tri-loop Test/CDN method					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
<input checked="" type="checkbox"/>	Test Receiver	R&S	ESCS 30	EC 2107	2022-07-15
<input checked="" type="checkbox"/>	A.M.N.	R&S	ESH2-Z5	EC 3119	2022-12-07
<input type="checkbox"/>	A.M.N.	R&S	ENV 216	EC 3393	2022-07-04
<input type="checkbox"/>	A.M.N.	R&S	ENV4200	EC 3558	2022-06-10
<input type="checkbox"/>	Absorbing clamp	R&S	MDS 21	EC 2108	2022-06-19
<input type="checkbox"/>	CDN	Frankonia	CDN M2M316	EC 5969	2023-03-15
<input type="checkbox"/>	CDN	Schaffner	CDN M316	EC 2113-1	2022-07-16
<input type="checkbox"/>	Attenuator	Weinschel	68-6-44	EC 3043-9	2023-02-05
<input type="checkbox"/>	Tri-loop	Schwarzbeck	HXYZ 9170	EC 3384	2022-10-11
<input type="checkbox"/>	Voltage Probe	Schwarzbeck	TK9420	EC 4888	2022-09-11
<input type="checkbox"/>	Current probe	R&S	EZ-17	EC 3221	2023-03-15
<input type="checkbox"/>	I.S.N.	FCC	FCC-TLISN -T2-02	EC 3754	2023-02-05
<input type="checkbox"/>	I.S.N.	FCC	FCC-TLISN -T4-02	EC 3755	2023-02-05

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.

No.	Item	Measurement Uncertainty
1	Conducted emission 9kHz-150kHz	±3.2 dB
2	Conducted emission 150kHz-30MHz	±2.7 dB
3	Radiated emission 9kHz-30MHz	± 4.7 dB
4	Radiated emission 30MHz-1GHz	± 4.6 dB
5	Radiated emission 1GHz-18GHz	± 4.4 dB
6	Radiated emission 18GHz-26GHz	± 4.6 dB
7	Radiated emission 26GHz-40GHz	± 4.6 dB
8	RF Power, Conducted	± 0.9 dB
9	Transmission Time	± 0.19 %
10	Occupied Bandwidth	± 1.86 %
11	Power Spectral Density, conducted	± 0.6 dB
12	Radio Frequency	± 6.5 x 10 ⁻⁸
13	Conducted out of band emission	± 2.7 dB

TEST REPORT

3 Radiated Emissions in restricted frequency bands

Test result: Pass

3.1 Limit

The radiated emissions which fall in the restricted bands, must also comply with the radiated emission limits specified showed as below:

Frequencies (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 ~ 0.490	2400/F(kHz)	300
0.490 ~ 1.705	24000/F(kHz)	30
1.705 ~ 30.0	30	30
30 ~ 88	100	3
88 ~ 216	150	3
216 ~ 960	200	3
Above 960	500	3

3.2 Measurement Procedure

For Radiated emission below 30MHz:

- a) The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.
- b) The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c) Both X and Y axes of the antenna are set to make the measurement.
- d) For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e) The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

NOTE:

- 1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9kHz at frequency below 30MHz.

TEST REPORT**For Radiated emission above 30MHz:**

- a) The EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- b) The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c) The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d) For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e) The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.
- f) The test-receiver system was set to peak and average detect function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

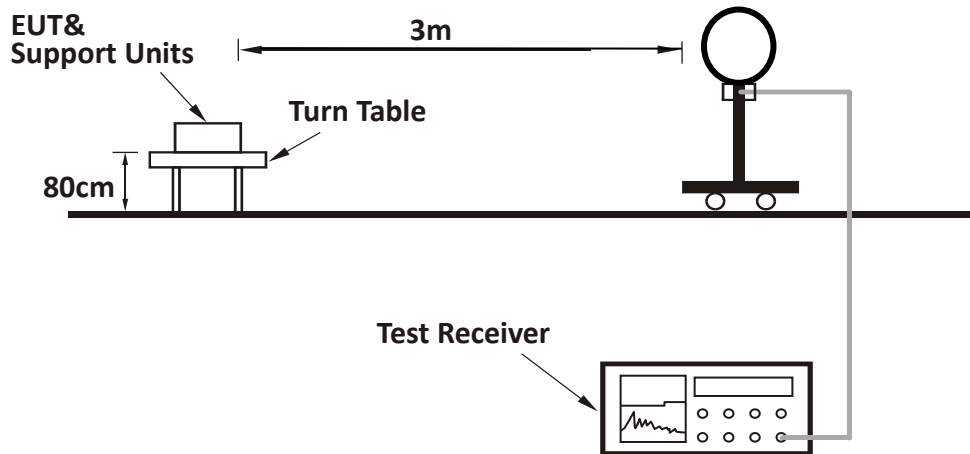
Note:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is $\geq 1/T$ (Duty cycle < 98%) or $3 \times \text{RBW}$ (Duty cycle $\geq 98\%$) for Average detection (AV) at frequency above 1GHz.
4. All modes of operation were investigated and the worst-case emissions are reported

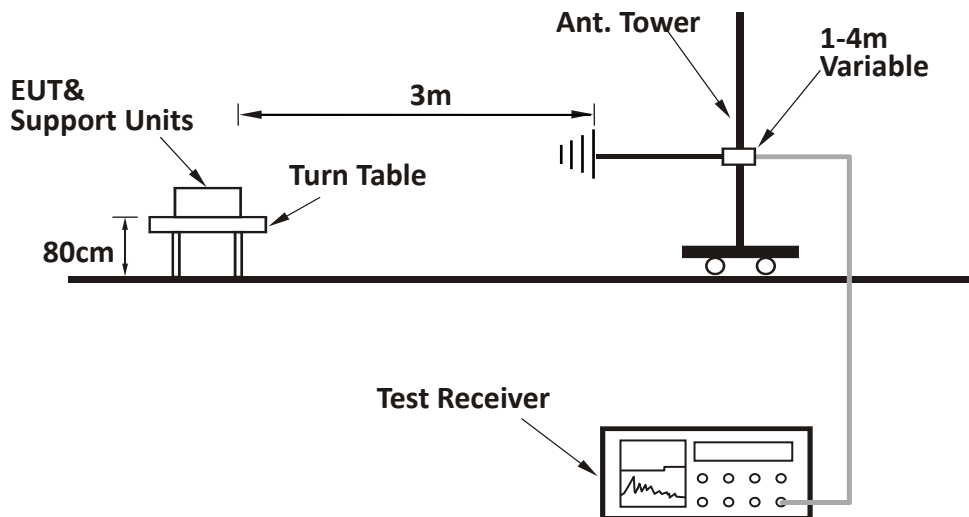
TEST REPORT

3.3 Test Configuration

For Radiated emission below 30MHz:

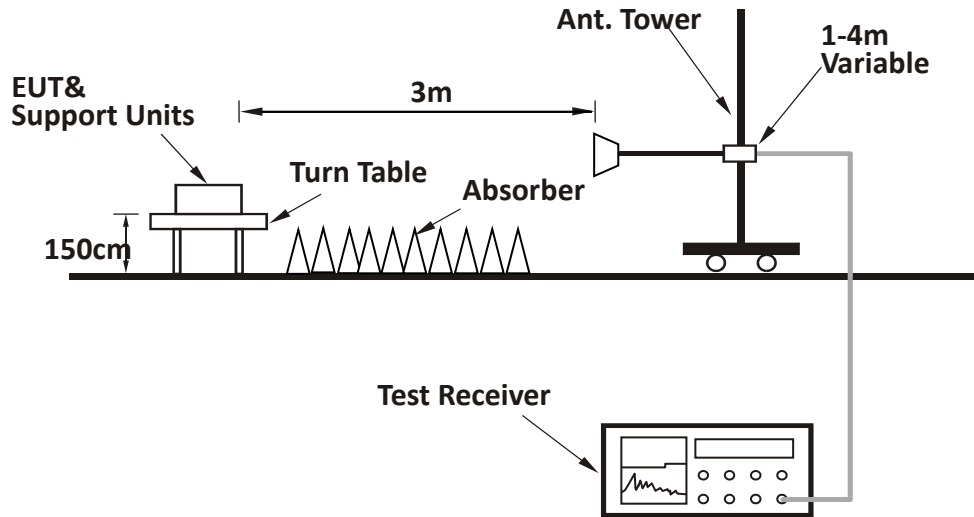


For Radiated emission 30MHz to 1GHz:



TEST REPORT

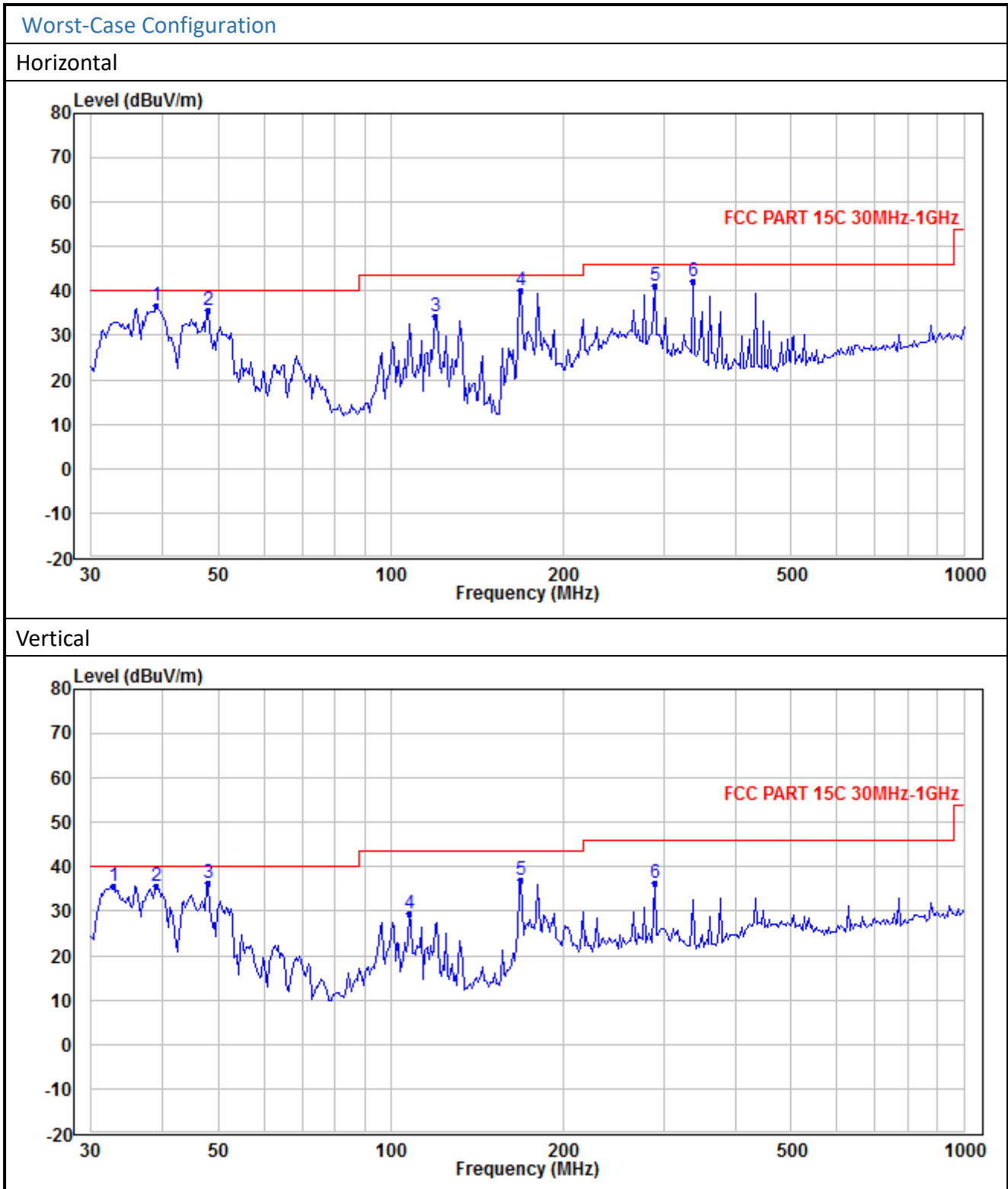
For Radiated emission above 1GHz:



TEST REPORT

3.4 Test Results of Radiated Emissions

Radiated Emission Test Data (Below 1GHz):



TEST REPORT

Polarization	Frequency (MHz)	Measured level (dB μ V/m)	Factor (dB/m)	Limits (dB μ V/m)	Margin (dB)	Detector
H	38.908	36.74	-7.64	40.00	-3.26	QP
	48.039	35.80	-13.52	40.00	-4.20	QP
	119.767	34.39	-15.88	43.50	-9.11	QP
	168.997	40.21	-11.95	43.50	-3.29	QP
	288.284	41.30	-7.06	46.00	-4.70	QP
	336.482	42.26	-5.82	46.00	-3.74	QP
V	32.870	35.72	-5.03	40.00	-4.28	QP
	38.908	35.81	-7.64	40.00	-4.19	QP
	48.039	36.52	-13.52	40.00	-3.48	QP
	107.785	29.56	-16.17	43.50	-13.94	QP
	168.997	37.14	-11.95	43.50	-6.36	QP
	288.284	36.33	-7.06	46.00	-9.67	QP

Remark:

1. Factor= Antenna Factor + Cable Loss (-Amplifier, is employed)
2. Measured level= Original Receiver Reading + Factor
3. Margin = Limit – Measured level
4. All possible modes of operation were investigated, only the worst-case emissions reported.
5. Pre-scan test indicated that QP level is less than Peak level about 5dB in same frequency and same Polarization direction, so not all data was recorded by QP detector.

Radiated Emission Test Data (Above 1GHz):

Please refer to Appendix A

4 Power line conducted emission

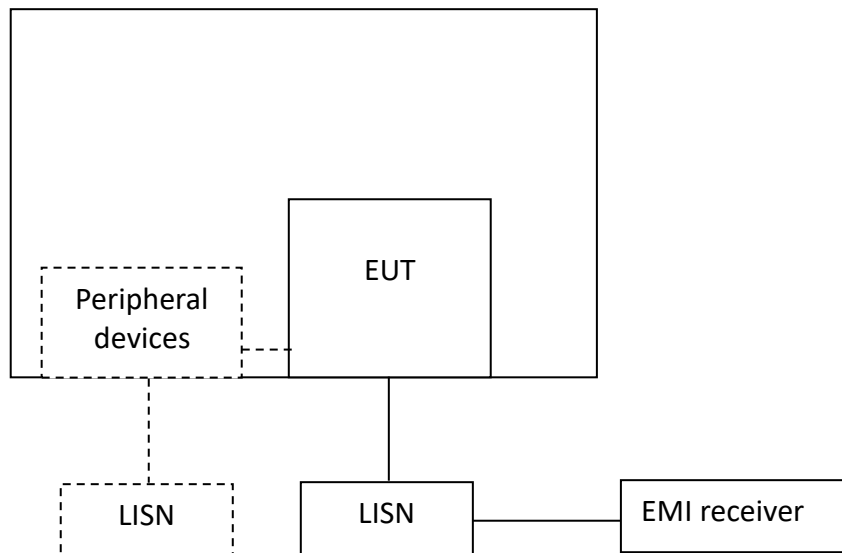
Test result: Pass

4.1 Limit

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	QP	AV
0.15-0.5	66 to 56*	56 to 46 *
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.

4.2 Test Configuration



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.

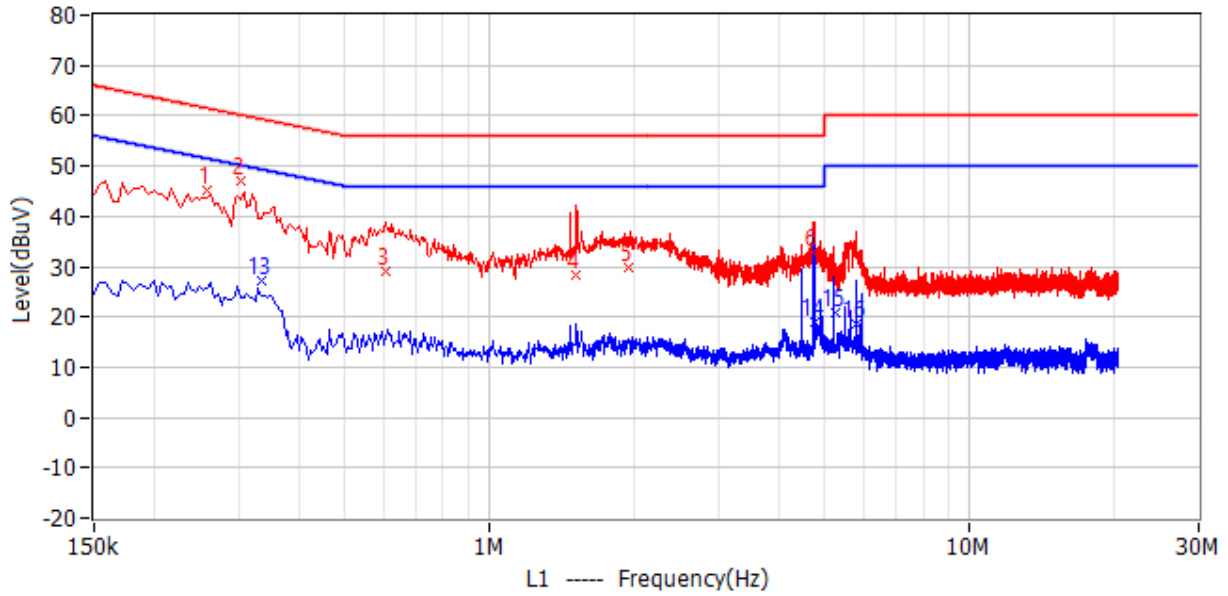
Tabletop devices shall be placed on a platform of nominal size 1 m by 1.5 m, raised 80 cm above the reference ground plane. The vertical conducting plane or wall of an RF-shielded (screened) room shall be located 40 cm to the rear of the EUT. Floor-standing devices shall be placed either directly on 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.

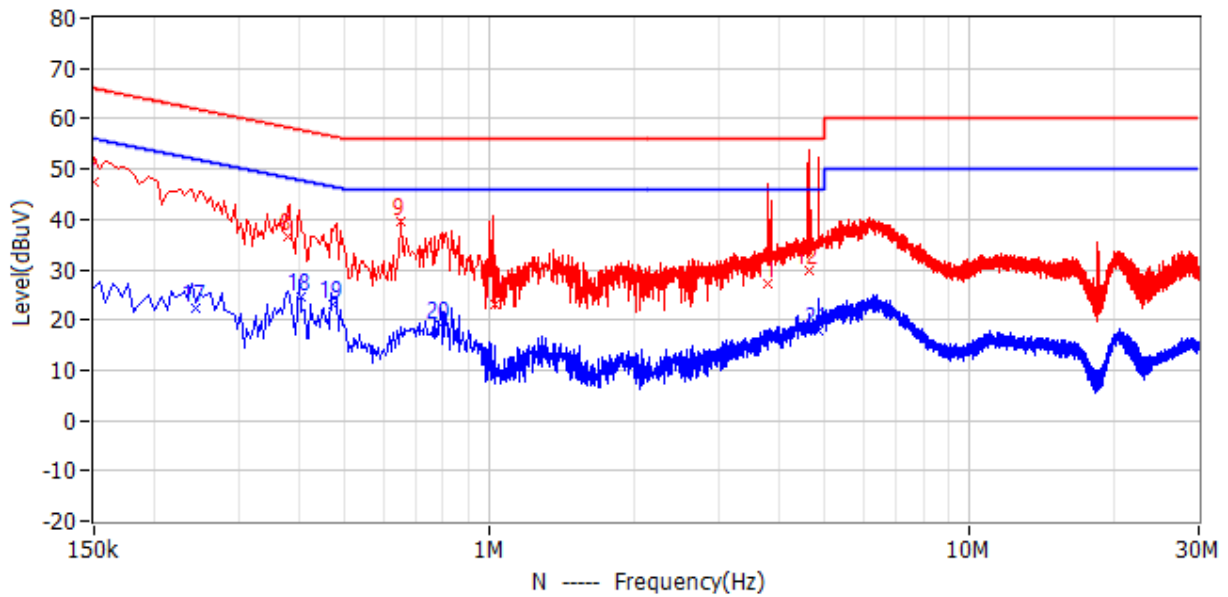
4.4 Test Results of Power line conducted emission

Test Curve:

L Line



N Line



TEST REPORT

Test Data:

No.	Frequency	Limit dBuV	Level dBuV	Delta dB	Reading dBuV	Factor dB	Detector	Phase
1	258.000kHz	61.5	45.2	-16.3	34.9	10.3	QP	L1
2	303.000kHz	60.2	47.2	-13.0	36.9	10.3	QP	L1
3	609.000kHz	56.0	29.2	-26.8	18.8	10.4	QP	L1
4	1.514MHz	56.0	28.5	-27.5	18.0	10.5	QP	L1
5	1.955MHz	56.0	29.9	-26.1	19.4	10.5	QP	L1
6	4.713MHz	56.0	32.8	-23.2	22.4	10.4	QP	L1
7	150.000kHz	66.0	47.5	-18.5	37.2	10.3	QP	N
8	379.500kHz	58.3	36.7	-21.6	26.4	10.3	QP	N
9	654.000kHz	56.0	39.7	-16.3	29.2	10.5	QP	N
10	1.028MHz	56.0	22.9	-33.1	12.3	10.6	QP	N
11	3.795MHz	56.0	27.2	-28.8	16.8	10.4	QP	N
12	4.623MHz	56.0	29.8	-26.2	19.4	10.4	QP	N
13	334.500kHz	49.3	27.1	-22.3	16.8	10.3	CAV	L1
14	4.772MHz	46.0	19.1	-26.9	8.7	10.4	CAV	L1
15	5.244MHz	50.0	20.7	-29.3	10.2	10.5	CAV	L1
16	5.780MHz	50.0	18.7	-31.3	8.2	10.5	CAV	L1
17	244.500kHz	51.9	22.4	-29.5	12.0	10.4	CAV	N
18	406.500kHz	47.7	24.4	-23.3	14.1	10.3	CAV	N
19	474.000kHz	46.4	23.1	-23.3	12.8	10.3	CAV	N
20	789.000kHz	46.0	19.1	-26.9	8.5	10.6	CAV	N
21	4.848MHz	46.0	17.8	-28.2	7.4	10.4	CAV	N

- Remark: 1. Factor = LISN Factor + Cable Loss, the value was added to Original Receiver Reading by the software automatically.
 2. Level = Original Receiver Reading + Factor
 3. Delta= Level - Limit
 4. If the PK Level is lower than AV limit, the AV test can be elided.

Example: Assuming LISN Factor = 10.00dB, Cable Loss = 2.00dB,
 Original Receiver Reading = 10.00dBuV, Limit = 66.00dBuV.
 Then Factor = 10.00 + 2.00 = 12.00dB;
 Level = 10dBuV + 12.00dB = 22.00dBuV;
 Delta = 22.00dBuV - 66.00dBuV = -44.00dB.

TEST REPORT

5 Antenna requirement

Requirement:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

Result:

EUT uses a unique coupling to the intentional radiator, so it can comply with the provisions of this section.

***** END *****