

Harman International Industries, Inc.

RF TEST REPORT

Report Type:

FCC Part 15.247 RF report

Model:

AP72598V

REPORT NUMBER:

220201028SHA-007

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

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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..... 7

1.4 DESCRIPTION OF TEST FACILITY 8

2 TEST SPECIFICATIONS..... 9

2.1 STANDARDS OR SPECIFICATION 9

2.2 MODE OF OPERATION DURING THE TEST..... 9

2.3 TEST SOFTWARE LIST 10

2.4 TEST PERIPHERALS LIST 10

2.5 TEST ENVIRONMENT CONDITION:..... 10

2.6 INSTRUMENT LIST 11

2.7 MEASUREMENT UNCERTAINTY 12

3 RADIATED EMISSIONS IN RESTRICTED FREQUENCY BANDS..... 13

3.1 LIMIT 13

3.2 MEASUREMENT PROCEDURE 13

3.3 TEST CONFIGURATION 15

3.4 TEST RESULTS OF RADIATED EMISSIONS 17

4 POWER LINE CONDUCTED EMISSION..... 19

4.1 LIMIT 19

4.2 TEST CONFIGURATION 19

4.3 MEASUREMENT PROCEDURE 20

4.4 TEST RESULTS OF POWER LINE CONDUCTED EMISSION..... 21

5 ANTENNA REQUIREMENT..... 23

Revision History

Report No.	Version	Description	Issued Date
220201028SHA-007	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
Support Standards:	IEEE 802.11b, IEEE 802.11g, IEEE 802.11n-HT20
Type of Modulation:	IEEE 802.11b: DSSS (CCK, DQPSK, DBPSK) IEEE 802.11g: OFDM (64-QAM, 16-QAM, QPSK, BPSK) IEEE 802.11n-HT20: OFDM (64-QAM, 16-QAM, QPSK, BPSK)
Channel Number:	11 Channels for 802.11b, 802.11g and 802.11n(HT20)
Data Rate:	IEEE 802.11b: Up to 11 Mbps IEEE 802.11g: Up to 54 Mbps IEEE 802.11n-HT20: Up to MCS7
Channel Separation:	5 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.

Mode	Tx/Rx Function	Beamforming function	CDD function
802.11b	1Tx/1Rx	NO	NO
802.11g	2Tx/2Rx	NO	YES
802.11n(HT20)	2Tx/2Rx	NO	NO

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

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

Software name	Manufacturer	Version	Supplied by
SecureCRT.exe	Vandyke	6.5.0.380	Applicant

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

Frequency Band (MHz)	Mode	Lowest (MHz)	Middle (MHz)	Highest (MHz)
2400-2483.5	802.11b	2412	2437	2462
	802.11g	2412	2437	2462
	802.11n(HT20)	2412	2437	2462

Data rate VS Power:

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. After this pre-scan, we choose the following table of the data rata as the worst case.

Frequency Band (MHz)	Mode	Worst case data rate
2400-2483.5	802.11b	1Mbps
	802.11g	6Mbps
	802.11n(HT20)	MCS0

The EUT will use two types antenna, and there have the following test mode:

Radiated test mode:

Mode 1: EUT transmitted signal with internal antenna;

Conducted test mode:

Mode 2: EUT transmitted signal from PCBA RF port connected to SPA directly;

We have verified all test modes, and choose the worst mode 1 for radiated test and mode 2 for conducted test as representatively to list the results in this report.

2.3 Test software list

Test Items	Software	Manufacturer	Version
Conducted emission	e3	Audix	9 20151119i
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 SAC	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:**

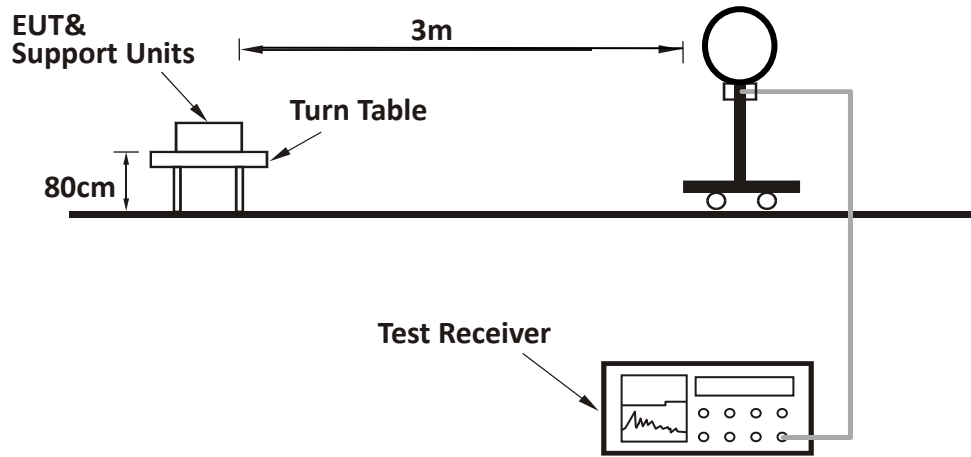
- a) The EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- b) The EUT was set 3 meters away from the interference-receiving 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:

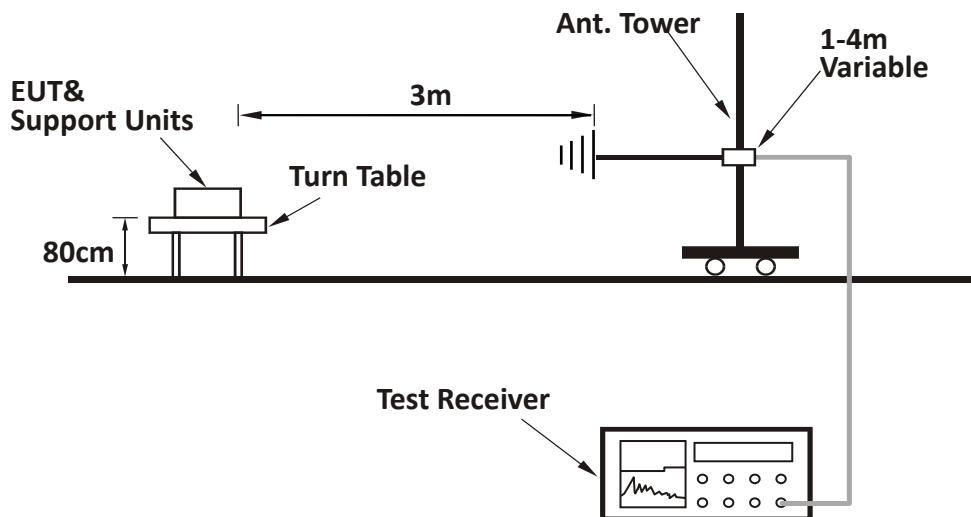
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
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 x 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

3.3 Test Configuration

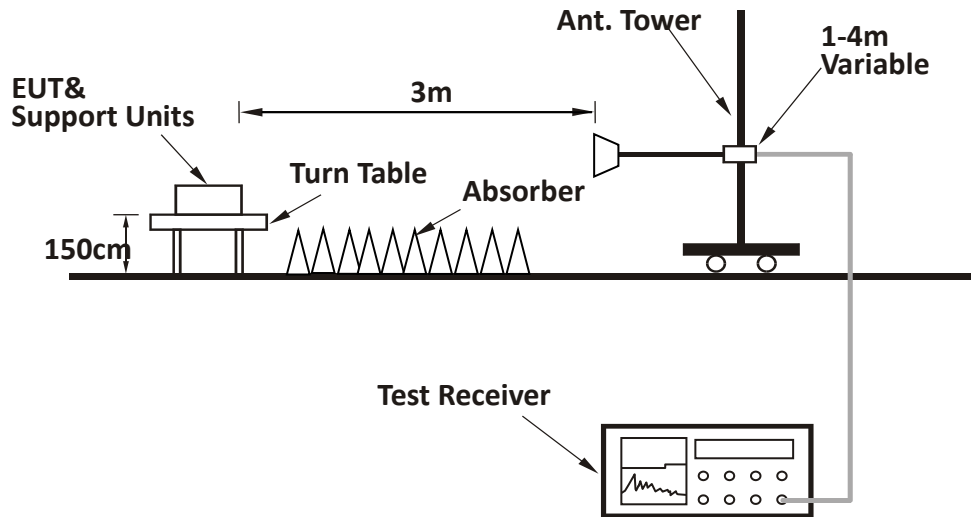
For Radiated emission below 30MHz:



For Radiated emission 30MHz to 1GHz:

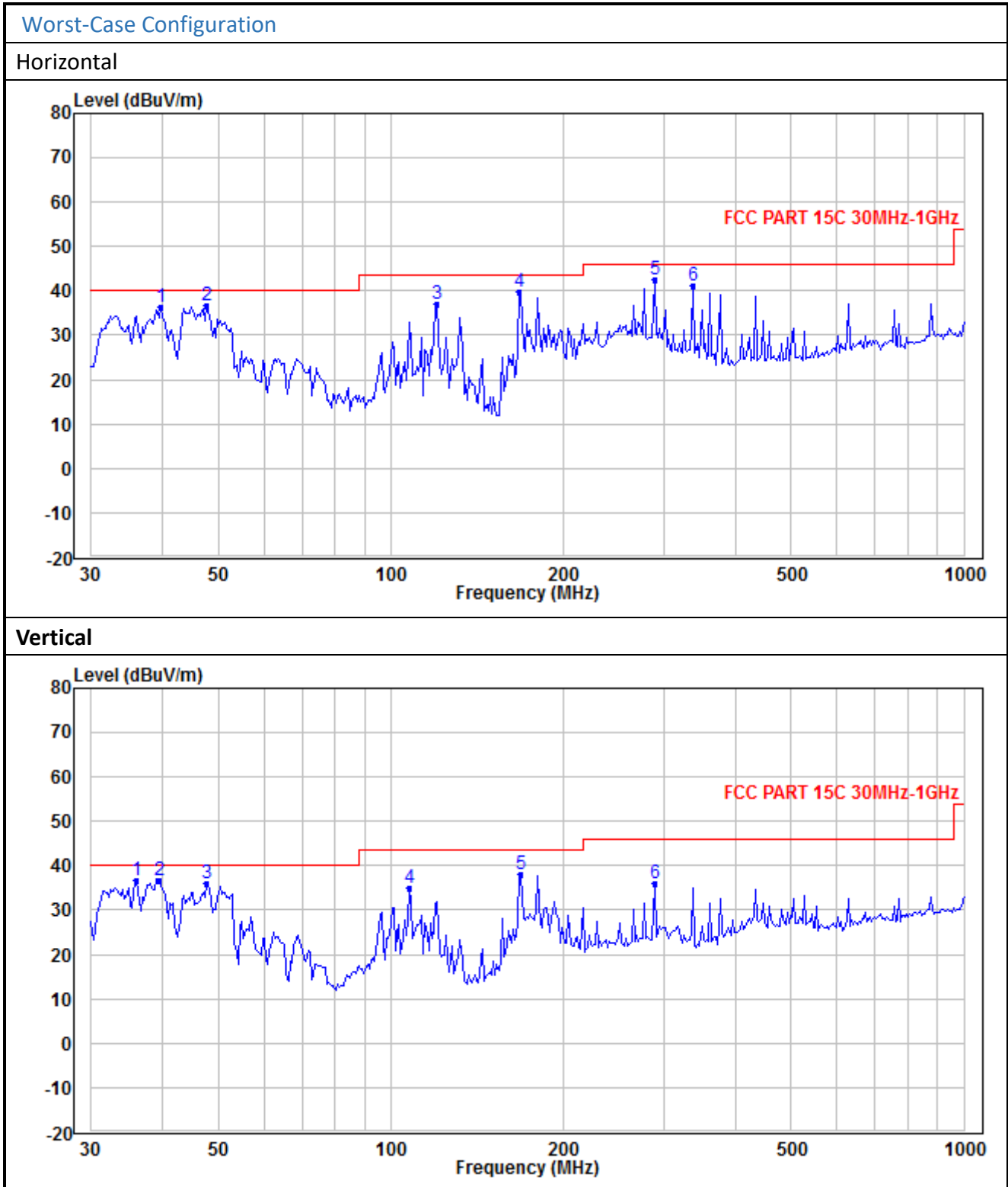


For Radiated emission above 1GHz:



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	39.737	36.35	-8.08	40.00	-3.65	QP
	47.703	36.78	-13.18	40.00	-3.22	QP
	120.612	36.94	-16.02	43.50	-6.56	QP
	167.814	39.81	-12.21	43.50	-3.69	QP
	288.284	42.70	-7.06	46.00	-3.30	QP
	336.482	41.26	-5.82	46.00	-4.74	QP
V	36.014	36.61	-5.63	40.00	-3.39	QP
	39.459	36.84	-7.94	40.00	-3.16	QP
	47.703	35.94	-13.18	40.00	-4.06	QP
	107.785	35.07	-16.17	43.50	-8.43	QP
	168.997	38.21	-11.95	43.50	-5.29	QP
	288.284	35.98	-7.06	46.00	-10.02	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

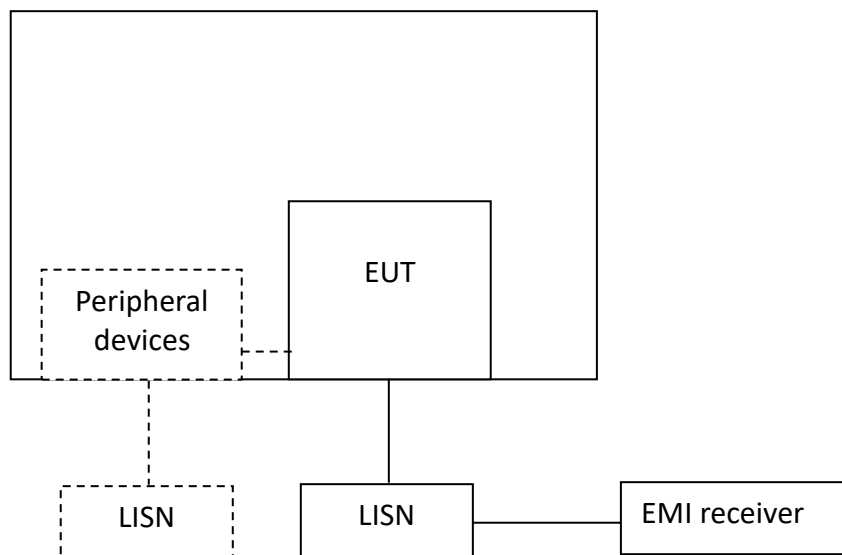
Test result: Pass

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.

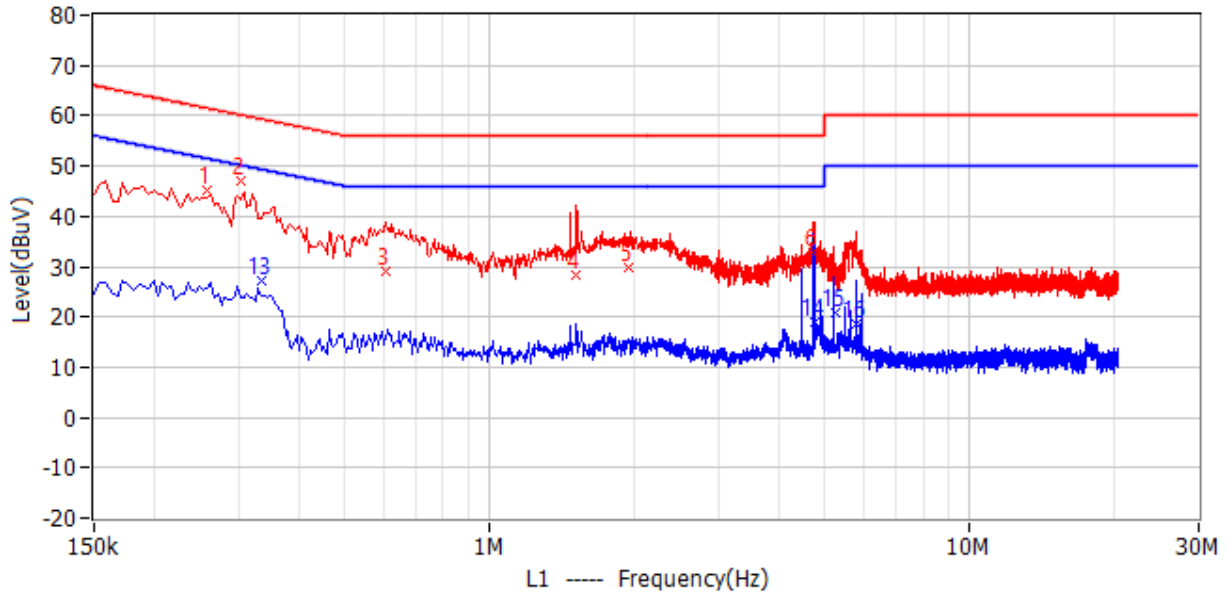
Tabletop devices shall be placed on a platform of nominal size 1 m by 1.5 m, raised 80 cm above the reference ground plane. The vertical conducting plane or wall of an RF-shielded (screened) room shall be located 40 cm to the rear of the EUT. Floor-standing devices shall be placed either directly on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

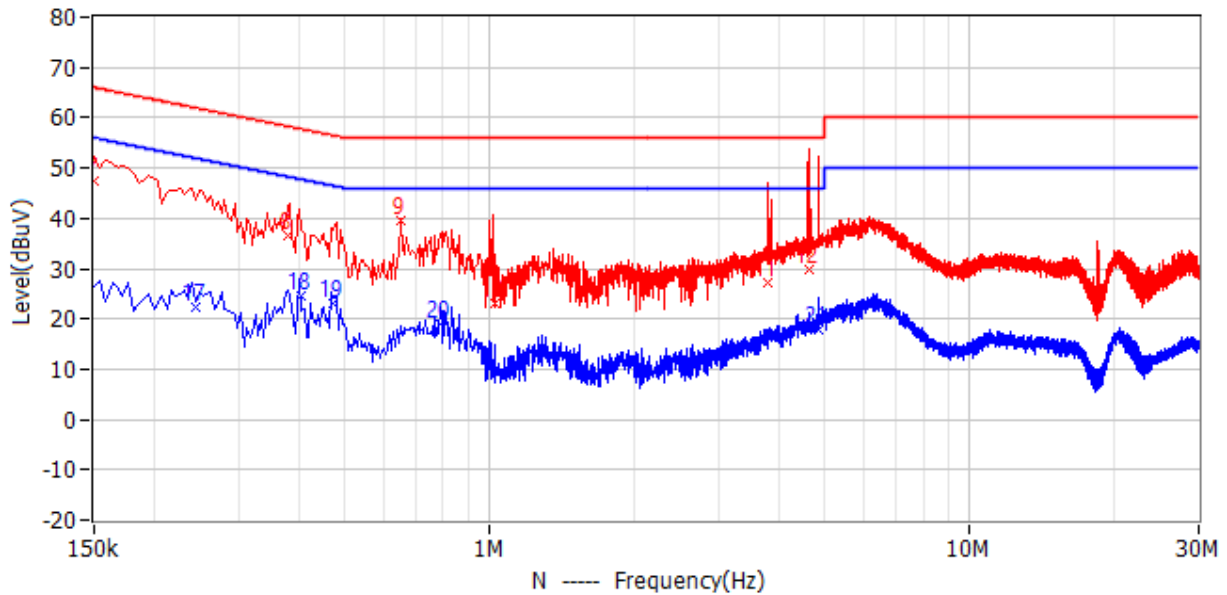
4.4 Test Results of Power line conducted emission

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

***** END *****