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http://www.sgsgroup.kr

TEST REPORT

of

FCC Part 15 Subpart C §15.209

FCC ID: PPXAVADIN-1

1. Equipment Under Test	:	WIRELESS CHARGER
2. Model Name	:	AVAdin-1
3. Variant Model Name(s)	:	-
4. Applicant	:	RFTECH Co., Ltd.
5. Manufacturer	:	RFTECH Co., Ltd.
6. Date of Receipt	:	2020.02.21
7. Date of Test(s)	:	2020.02.25 ~ 2020.03.12
8. Date of Issue	:	2020.03.16

In the configuration tested, the EUT complied with the standards specified above. This test report does not assure KOLAS accreditation.

1) The results of this test report are effective only to the items tested.
2) The SGS Korea is not responsible for the sampling, the results of this test report apply to the sample as received.

Tested by: **Jinhyoung Cho**

Technical Manager: **Jungmin Yang**

SGS Korea Co., Ltd. Gunpo Laboratory

INDEX

Table of contents Page

1. General Information ---------- 3

2. Field Strength of Fundamental and Spurious Emission ---------- 7

3. 20 dB Bandwidth ---------- 20

4. AC Power Line Conducted Emission ---------- 23

1. General Information

1.1. Testing Laboratory

SGS Korea Co., Ltd. (Gunpo Laboratory)
- 10-2, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807
- 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807
- Designation number: KR0150

All SGS services are rendered in accordance with the applicable SGS conditions of service available on request and accessible at http://www.sgs.com/en/Terms-and-Conditions.aspx.

Phone No. : +82 31 688 0901
Fax No. : +82 31 688 0921

1.2. Details of Applicant

Applicant : RFTECH Co., Ltd.
Address : 60, Jugyangdaero 1763beon-gil, Wonsam-myeon, Cheoin-gu, Yongin-si, Gyeonggi-do, South Korea
Contact Person : Hwang, Dong-hyuk
Phone No. : +82 31 327 0346

1.3. Details of Manufacturer

Company : Same as applicant
Address : Same as applicant

1.4. Description of EUT

Kind of Product	WIRELESS CHARGER
Model Name	AVAdin-1
Power Supply	DC 5.0 V, DC 9.0 V
Operation Mode	5 W, 9 W
Frequency Range	110.1 ㎑ ~ 205 ㎑
Antenna Type	Loop coil antenna

1.5. Test Equipment List

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Interval	Cal. Due
Spectrum Analyzer	R&S	FSV30	103102	Jun. 05, 2019	Annual	Jun. 05, 2020
Signal Generator	R&S	SMBV100A	255834	Jun. 10, 2019	Annual	Jun. 10, 2020
Test Receiver	R&S	ESU26	100109	Feb. 18, 2020	Annual	Feb. 18, 2021
Loop Antenna	Schwarzbeck Mess-Elektronik	FMZB 1519	1519-039	Aug. 22 2019	Biennial	Aug. 22, 2021
Bilog Antenna	Schwarzbeck Mess-Elektronik	VULB 9163	396	Mar. 21, 2019	Biennial	Mar. 21, 2021
Turn Table	Innco systems GmbH	DS 1200 S	N/A	N.C.R.	N/A	N.C.R.
Controller	Innco systems GmbH	CONTROLLER CO3000-4P	CO3000/963/38330516/L	N.C.R.	N/A	N.C.R.
Anechoic Chamber	SY Corporation	L × W × H (9.6 m × 6.4 m × 6.6 m)	N/A	N.C.R.	N/A	N.C.R.
Coaxial Cable	SUCOFLEX	104 (3 m)	MY3258414	Jan. 28, 2020	Semi-annual	Jul. 28, 2020
Coaxial Cable	SUCOFLEX	104 (10 m)	MY3145814	Jan. 28, 2020	Semi-annual	Jul. 28, 2020
Test Receiver	R&S	ESCI 7	100911	Feb. 19, 2020	Annual	Feb. 19, 2021
Two-Line V-Network	R&S	ENV216	100190	May 14, 2019	Annual	May 14, 2020
Shield Room	SY Corporation	L × W × H (6.5 m × 3.5 m × 3.5 m)	N/A	N.C.R.	N/A	N.C.R.

▶ **Support Equipment**

Description	Manufacturer	Model	FCC ID
Samsung Mobile Phone	Samsung Electronics Co., Ltd.	SM-G950F	A3LSMG950F
C type USB Cable	RFTECH	EP-DR140AWE	-
TRAVEL ADAPTER	SOLUM VINA COMPANY LIMITED	EP-TA200	-

1.6. Sample Calculation

Where relevant, the following sample calculation is provided:
Field strength level (dBμV/m) = Measured level (dBμV) + Antenna factor (dB) + Cable loss (dB)

1.7. Worst Case of Test Configurations

Charging mode with client device	Mode		Description
Model: SM-G950F FCC ID: A3LSMG950F	5 W	9 W	1 % of battery 50 % of battery 99 % of battery

Note;

EUT was investigated with client device under normal charging condition as above then worst value was only reported.

1.8. Summary of Test Results

The EUT has been tested according to the following specifications:

APPLIED STANDARD: FCC Part 15 Subpart C		
Section	**Test Item**	**Result**
15.209	Radiated Emission, Spurious Emission and Field Strength of Fundamental	Complied
2.1049	20 ㏈ Bandwidth	Complied
15.207	AC Power Line Conducted Emission	Complied

Note;

Due to the frequency range of the device is less than 1 ㎒, so we perform Middle frequency according to 15.31 requirement.

1.9. Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

Parameter	Uncertainty
20 ㏈ Bandwidth	± 9.66 ㎑
AC Conducted Emission	± 3.30 ㏈
Radiated Disturbance, 9 ㎑ to 30 ㎒	± 3.59 ㏈
Radiated Disturbance, below 1 ㎓	± 5.88 ㏈

Uncertainty figures are valid to a confidence level of 95 %.

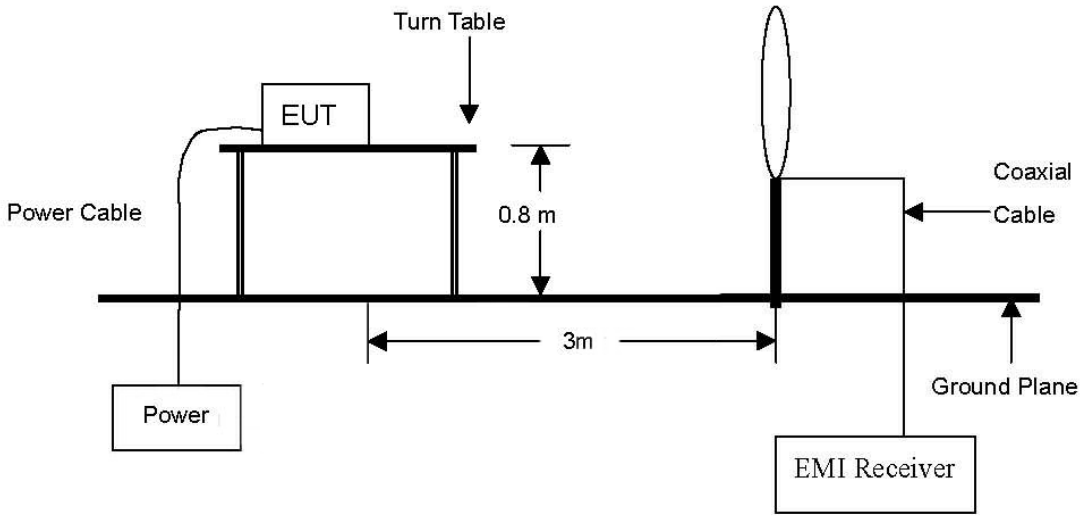
1.10. Test Report Revision

Revision	Report Number	Date of Issue	Description
0	F690501-RF-RTL000398	2020.03.16	Initial

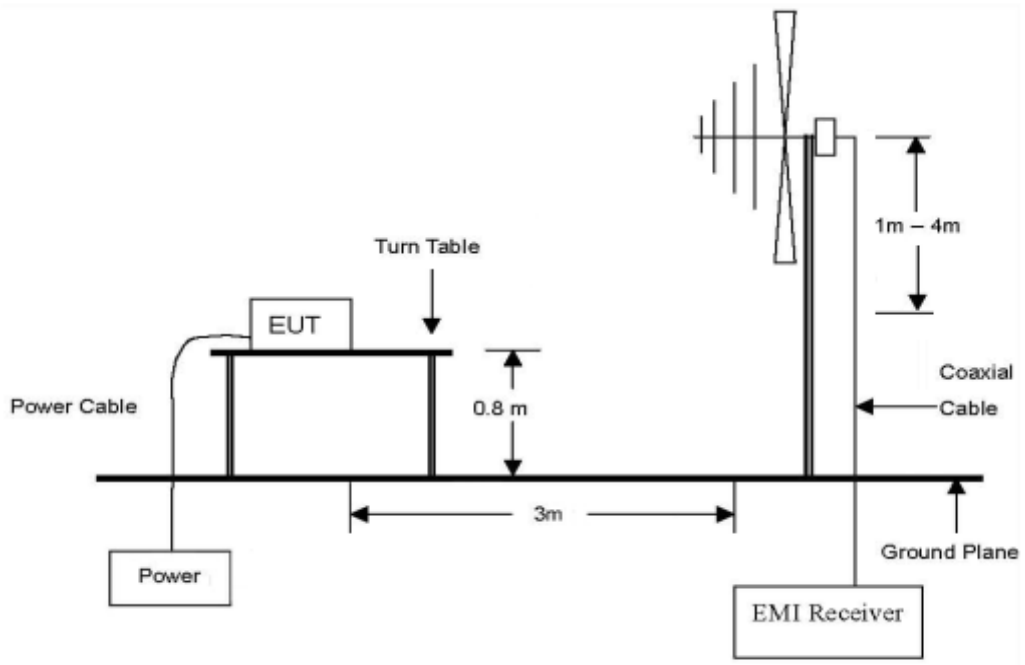
2. Field Strength of Fundamental and Spurious Emission

2.1. Test Setup

The diagram below shows the test setup that is utilized to make the measurements for emission from 9 ㎑ to 30 ㎒.



The diagram below shows the test setup that is utilized to make the measurements for emission from 30 ㎒ to 1 ㎓.



2.2. Limit

2.2.1. Radiated emission limits, general requirements

According to §15.209(a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (㎒)	Field Strength (microvolts/meter)	Measurement Distance (meter)
0.009-0.490	2 400/F(㎑)	300
0.490-1.705	24 000/F(㎑)	30
1.705-30.0	30	30
30-88	100**	3
88-216	150**	3
216-960	200**	3
Above 960	500	3

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 ㎒, 76-88 ㎒, 174-216 ㎒ or 470-806 ㎒. however, operation within these frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241

2.3. Test Procedures

Radiated emissions from the EUT were measured according to the dictates of ANSI C63.10:2013.

2.3.1. Test Procedures for emission from 9 ㎑ to 30 ㎒

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
b. Then antenna is a loop antenna is fixed at one meter above the ground to determine the maximum value of the field strength. Both parallel and perpendicular of the antenna are set to make the measurement.
c. For each suspected emission, the EUT was arranged to its worst case and then the table was turned from 0 degrees to 360 degrees to find the maximum reading.
d. The test-receiver system was set to Quasi Peak and Average Detect Function and Specified Bandwidth with Maximum Hold Mode.

2.3.2. Test Procedures for emission from 30 ㎒ to 1 000 ㎒

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
b. During performing radiated emission below 1 ㎓, the EUT was set 3 meters away from the interference receiving antenna, which was mounted on the top of a variable-height antenna tower. During performing radiated emission above 1 ㎓, the EUT was set 3 meter away from the interference-receiving antenna.
c. The antenna is a broadband antenna, and its height 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 table was turned from 0 degrees to 360 degrees to find the maximum reading.
e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

2.4. Field Strength of Fundamental Test Result

Ambient temperature : (23 ± 1) ℃
Relative humidity : 47 % R.H.

The following table shows the highest levels of radiated emissions on between polarizations of horizontal and vertical.

Test Condition: 5 W Operating mode with client device (1 % battery status of client device)

Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (㎒)	Reading (dBμV)	Detect Mode	Pol.	Ant. (dB/m)	Cable (dB)	Actual (dBμV/m) at 3 m	Actual (dBμV/m) at 300 m	Limit (dBμV/m) at 300 m	Margin (dB)
0.157	62.40	Average	H	17.80	0.09	80.29	0.29	23.69	23.40

Test Condition: 9 W Operating mode with client device (1 % battery status of client device)

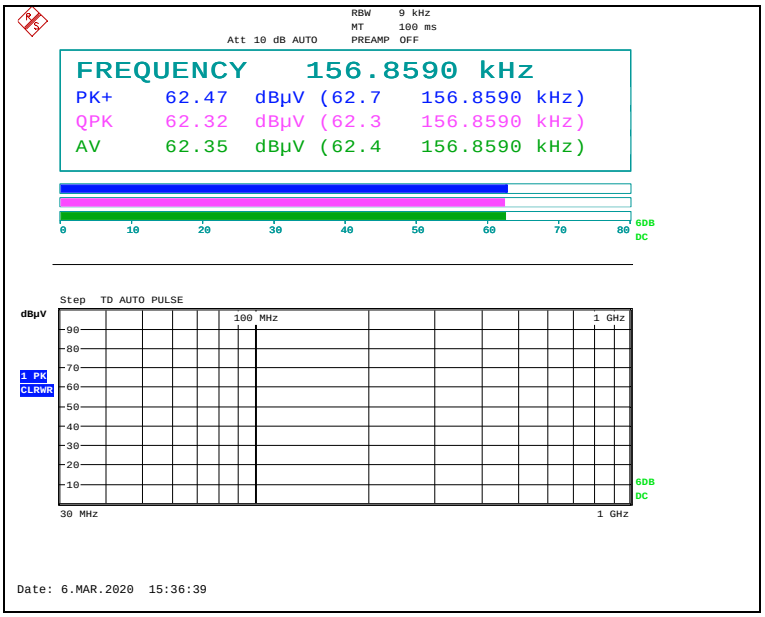
Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (㎒)	Reading (dBμV)	Detect Mode	Pol.	Ant. (dB/m)	Cable (dB)	Actual (dBμV/m) at 3 m	Actual (dBμV/m) at 300 m	Limit (dBμV/m) at 300 m	Margin (dB)
0.160	66.90	Average	H	17.80	0.09	84.79	4.79	23.52	18.73

Remark;

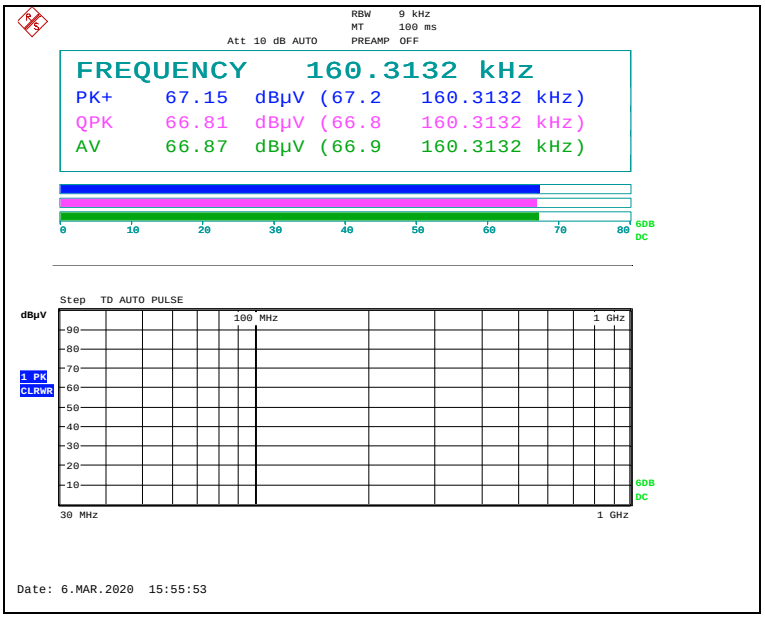
1. According to §15.31(f)(2),
   - 300 m Result (dBμV/m) = 3 m Result (dBμV/m) - 40log (300/3) (dBμV/m).
2. According to field strength table of general requirement in §15.209(a), field strength limits below 1.705 ㎒ were calculated as below.
   - 9 ㎑ to 490 ㎑: 20log (2 400 / F (㎑)) at 300 m (dBμV/m)
   - 490 ㎑ to 1.705 ㎒: 20log (24 000/F (㎑)) at 30 m (dBμV/m)
3. According to §15.209(d), the measurements were tested by using Quasi peak detector except for the frequency bands 9-90 ㎑, 110-490 ㎑ and above 1 ㎓ in these three bands on measurements employing an average detector.
4. The limit above was calculated based on table of §15.209(a).
5. Actual (dBμV/m) at 3 m = Reading (dBμV) + AF (dB/m) + CL (dB) or
   Reading (dBμV) + AF (dB/m) + AMP (dB) + CL (dB).

- Test plots

Test Condition: 5 W Operating mode with client device (1 % battery status of client device)



Test Condition: 9 W Operating mode with client device (1 % battery status of client device)



2.5. Spurious Emission Test Result

Ambient temperature : (23 ± 1) ℃
Relative humidity : 47 % R.H.

The following table shows the highest levels of radiated emissions on between polarizations of horizontal and vertical.

Test Condition: 5 W Operating mode with client device (1 % battery status of client device)

Below 30 ㎒

Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (㎒)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dBμV/m) at 3 m	Actual (dBμV/m) at 300 m or 30 m	Limit (dBμV/m) at 300 m or 30 m	Margin (dB)
0.021	25.30	Average	H	18.17	0.02	43.49	-36.51	41.16	77.67
0.056	23.60	Average	H	17.86	0.04	41.50	-38.50	32.64	71.14
0.469	39.80	Average	H	17.72	0.21	57.73	-22.27	14.18	36.45
0.786	28.42	Quasi-Peak	H	17.93	0.33	46.68	6.68	29.70	23.02

Above 30 ㎒

Radiated Emissions			Ant	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	AMP + CL (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
89.09	37.30	Peak	V	14.73	-25.24	26.79	43.50	16.71
95.88	32.90	Peak	V	16.49	-25.32	24.07	43.50	19.43
101.90	32.40	Peak	V	17.09	-25.39	24.10	43.50	19.40
Above 200.00	Not detected	-	-	-	-	-	-	-

Test Condition: 9 W Operating mode with client device (1 % battery status of client device)

Below 30 ㎒

Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (㎒)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dBμV/m) at 3 m	Actual (dBμV/m) at 300 m or 30 m	Limit (dBμV/m) at 300 m or 30 m	Margin (dB)
0.020	24.10	Average	H	18.20	0.02	42.32	-37.68	41.58	79.26
0.075	18.20	Average	H	17.84	0.05	36.09	-43.91	30.10	74.01
0.319	34.20	Average	H	17.79	0.15	52.14	-27.86	17.53	45.39
0.479	44.30	Average	H	17.71	0.21	62.22	-17.78	14.00	31.78
0.799	31.80	Quasi-Peak	H	17.94	0.33	50.07	10.07	29.55	19.48

Above 30 ㎒

Radiated Emissions			Ant	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	AMP + CL (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
89.09	36.30	Peak	V	14.73	-25.24	25.79	43.50	17.71
101.90	32.70	Peak	V	17.09	-25.39	24.40	43.50	19.10
423.38	41.40	Peak	H	22.00	-24.60	38.80	46.00	7.20
885.14	32.00	Peak	V	27.80	-22.19	37.61	46.00	8.39
Above 900.00	Not detected	-	-	-	-	-	-	-

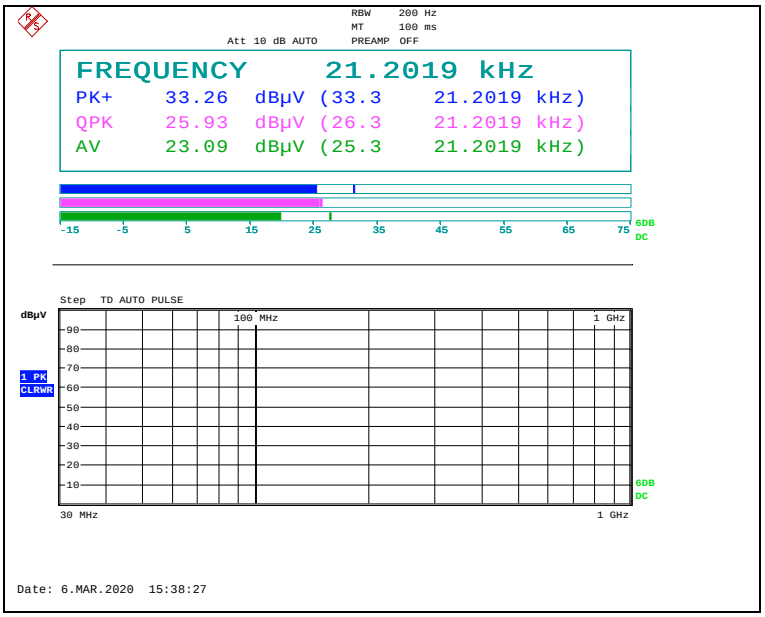
Remark;

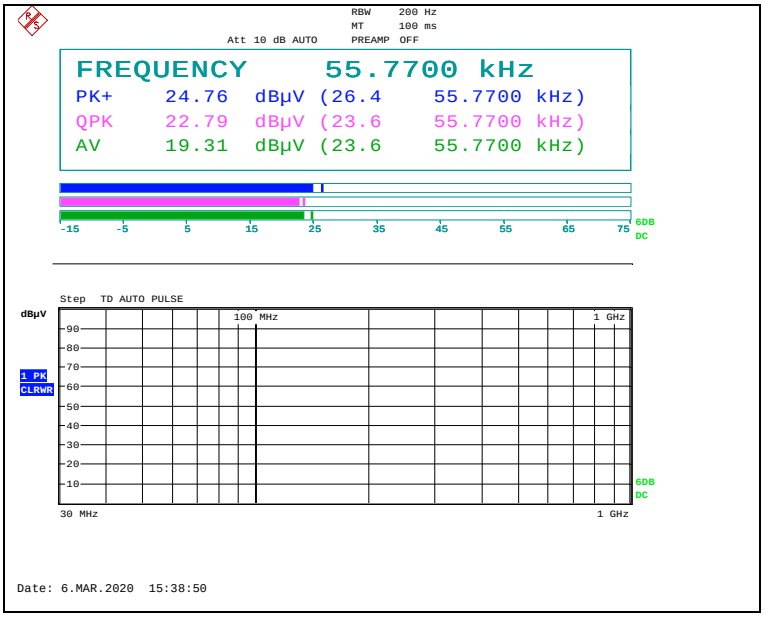
1. According to §15.31 (f)(2),
   - 300 m Result (dBμV/m) = 3 m Result (dBμV/m) - 40log (300/3) (dBμV/m)
   - 30 m Result (dBμV/m) = 3 m Result (dBμV/m) - 40log (30/3) (dBμV/m)
2. According to field strength table of general requirement in §15.209 (a), field strength limits below 1.705 ㎒ were calculated as below.
   - 9 ㎑ to 490 ㎑: 20log (2 400 / F (㎑)) at 300 m (dBμV/m)
   - 490 ㎑ to 1.705 ㎒: 20log (24 000 / F (㎑)) at 30 m (dBμV/m)
3. According to §15.209 (d), the measurements were tested by using Quasi peak detector except for the frequency bands 9-90 ㎑, 110-490 ㎑ and above 1 ㎓ in these three bands on measurements employing an average detector.
4. The limit above was calculated based on table of §15.209 (a).
5. Actual (dBμV/m) at 3 m = Reading (dBμV) + AF (dB/m) + CL (dB) or
   Reading (dBμV) + AF (dB/m) + AMP (dB) + CL (dB).
6. According to §15.31(o), emission levels are not report much lower than the limits by over 20 dB.

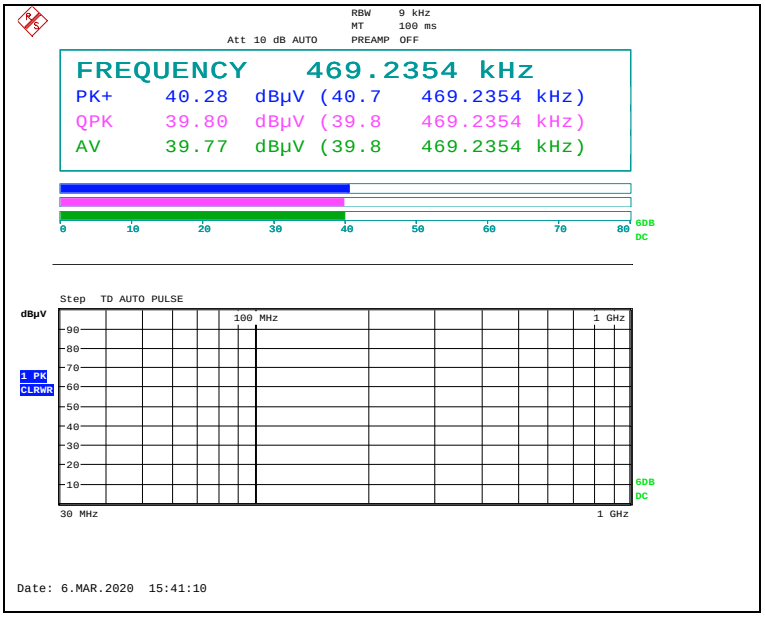
- Test plots

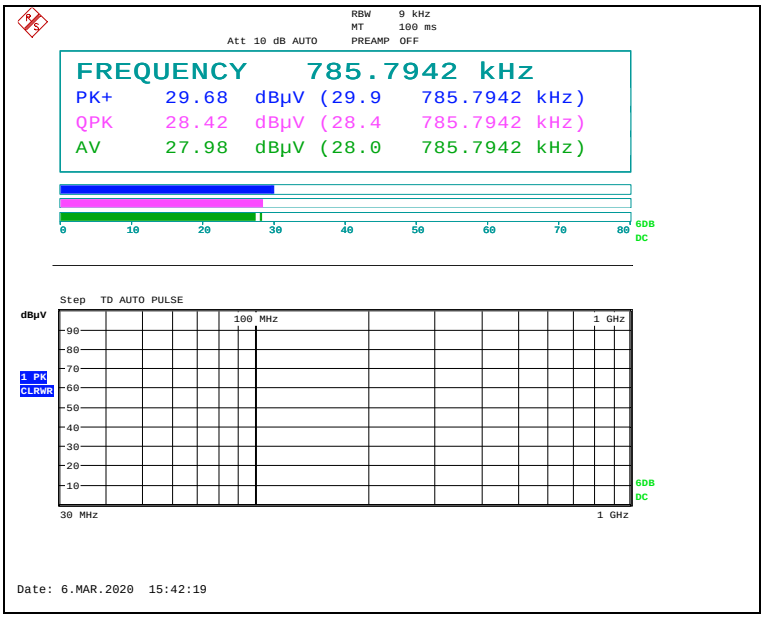
Test Condition: 5 W Operating mode with client device (1 % battery status of client device)

Below 30 ㎒

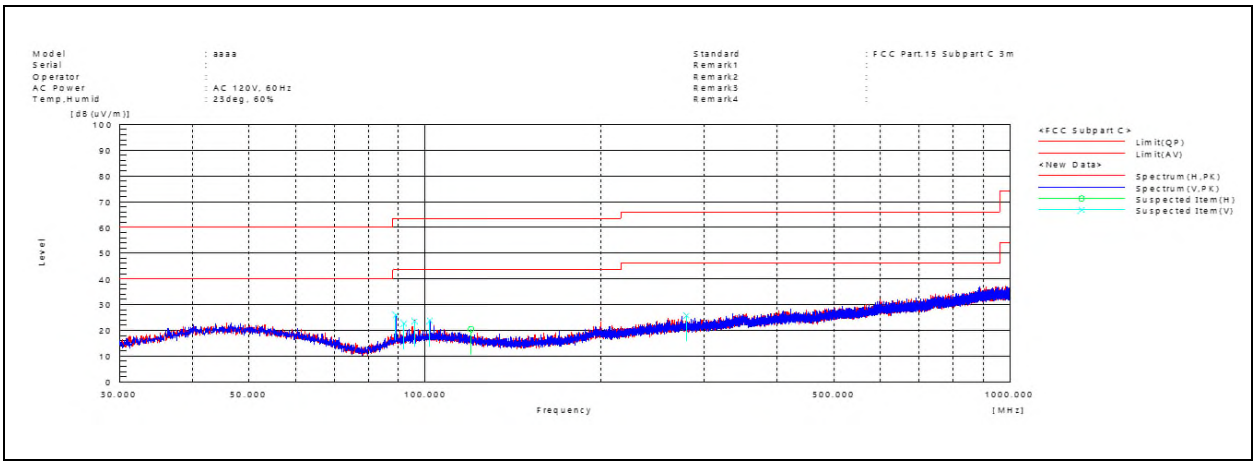





RBW 9 kHz
MT 100 ms
Att 10 dB AUTO PREAMP OFF
FREQUENCY 469.2354 kHz
PK+ 40.28 dBµV (40.7 469.2354 kHz)
QPK 39.80 dBµV (39.8 469.2354 kHz)
AV 39.77 dBµV (39.8 469.2354 kHz)
Step TD AUTO PULSE
dBµV
100 MHz
1 GHz
1 PK
CLRWR
30 MHz
1 GHz
Date: 6.MAR.2020 15:41:10


RBW 9 kHz
MT 100 ms
Att 10 dB AUTO PREAMP OFF
FREQUENCY 785.7942 kHz
PK+ 29.68 dBµV (29.9 785.7942 kHz)
QPK 28.42 dBµV (28.4 785.7942 kHz)
AV 27.98 dBµV (28.0 785.7942 kHz)
Step TD AUTO PULSE
dBµV
100 MHz
1 GHz
1 PK
CLRWR
30 MHz
1 GHz
Date: 6.MAR.2020 15:42:19

Above 30 ㎒

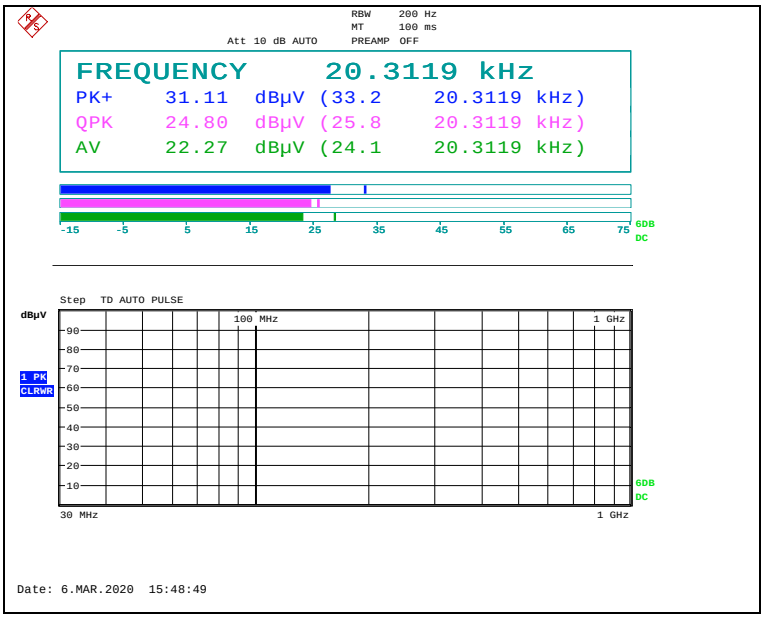


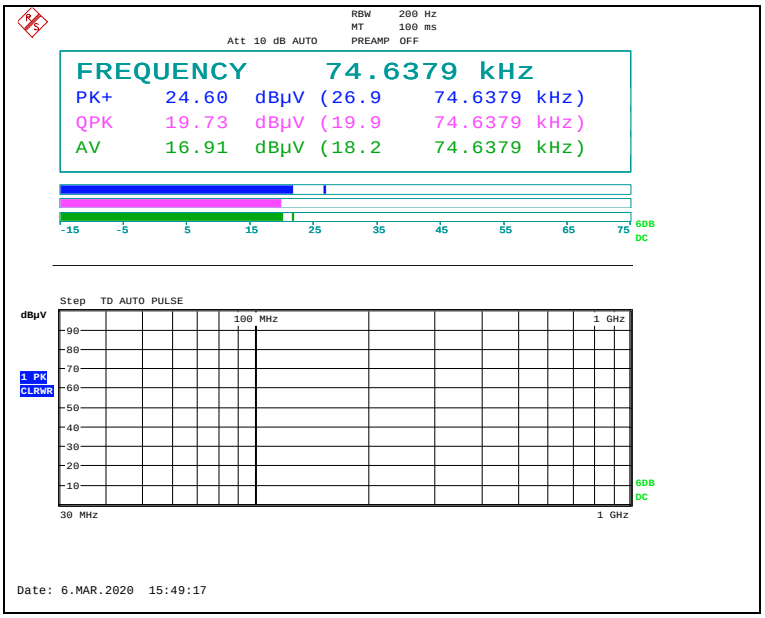
Remark;

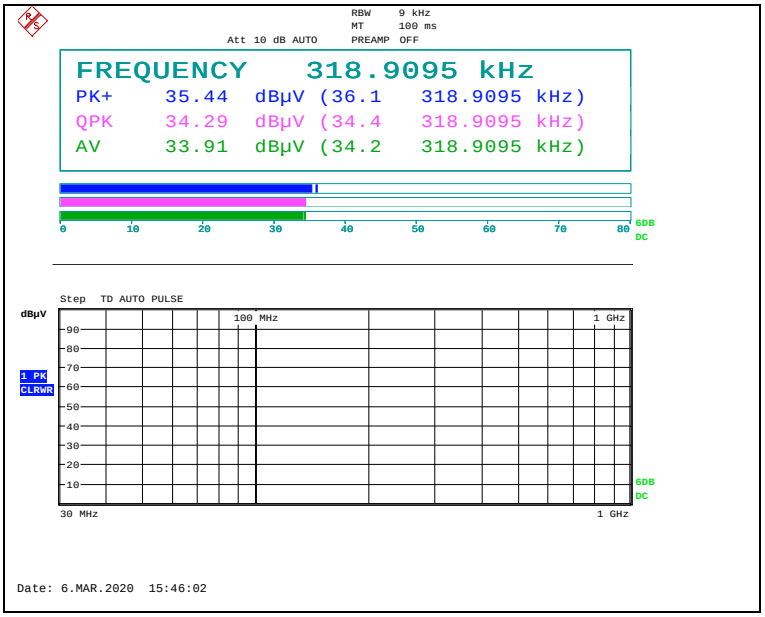
- Traces shown in the plot were made by using a peak detector.

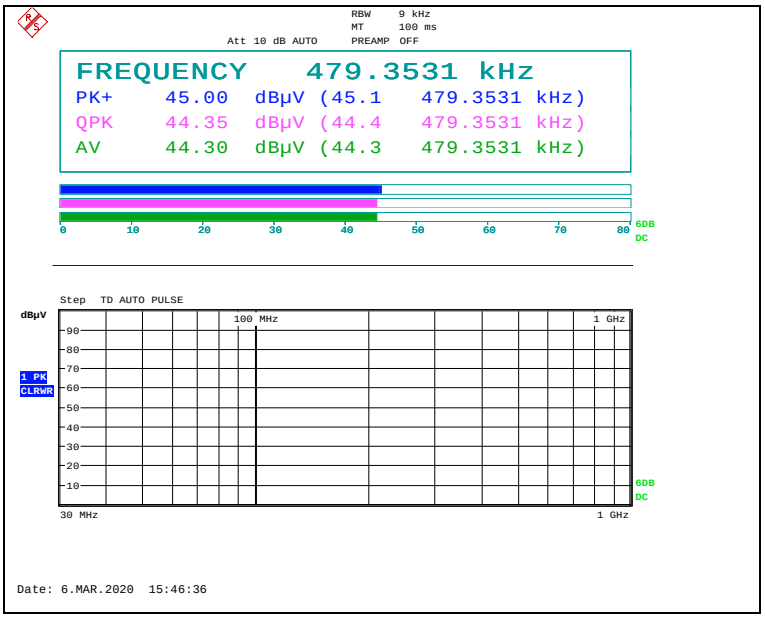
Test Condition: 9 W Operating mode with client device (1 % battery status of client device)

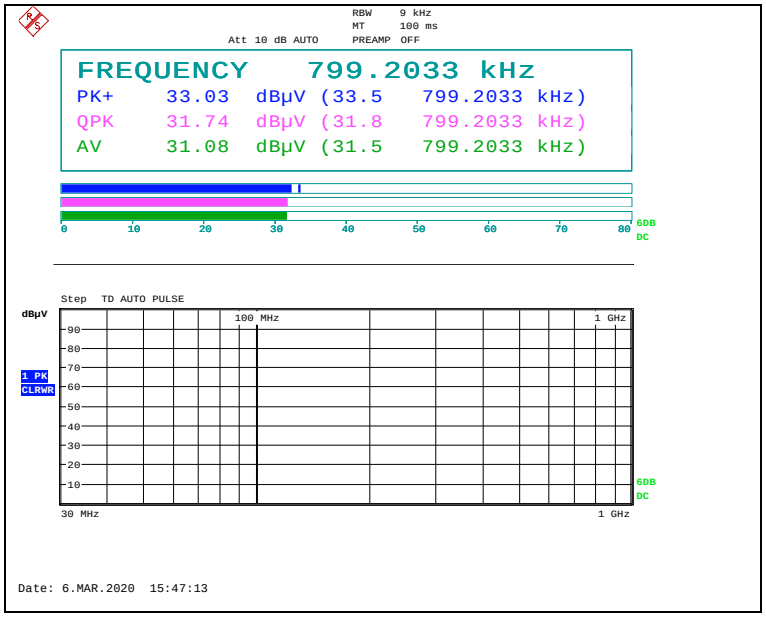
Below 30 ㎒



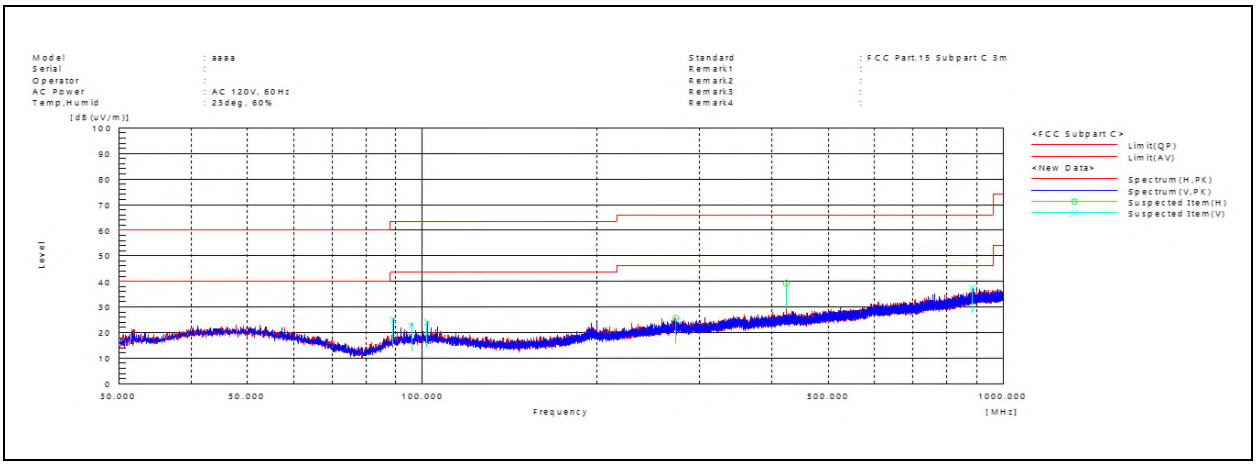



RBW 9 kHz
MT 100 ms
Att 10 dB AUTO PREAMP OFF
FREQUENCY 318.9095 kHz
PK+ 35.44 dBµV (36.1 318.9095 kHz)
QPK 34.29 dBµV (34.4 318.9095 kHz)
AV 33.91 dBµV (34.2 318.9095 kHz)
Step TD AUTO PULSE
dBµV
100 MHz
1 GHz
1 PK
CLRWR
30 MHz
1 GHz
Date: 6.MAR.2020 15:46:02


RBW 9 kHz
MT 100 ms
Att 10 dB AUTO PREAMP OFF
FREQUENCY 479.3531 kHz
PK+ 45.00 dBµV (45.1 479.3531 kHz)
QPK 44.35 dBµV (44.4 479.3531 kHz)
AV 44.30 dBµV (44.3 479.3531 kHz)
Step TD AUTO PULSE
dBµV
100 MHz
1 GHz
1 PK
CLRWR
30 MHz
1 GHz
Date: 6.MAR.2020 15:46:36



Above 30 ㎒

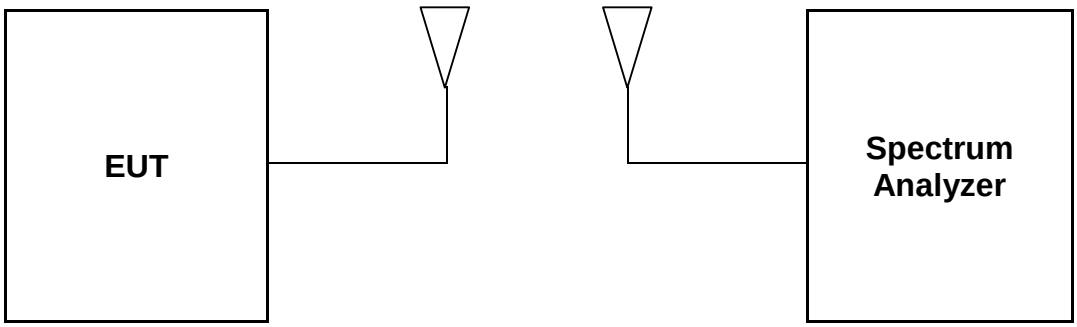


Remark;

- Traces shown in the plot were made by using a peak detector.

3. 20 ㏈ Bandwidth

3.1. Test Setup



3.2. Limit

None; for reporting purposed only

3.3. Test Procedure

a. Span = set to capture all products of the modulation process, including the emission skirts. RBW = 200 ㎐, VBW = 200 ㎐, Sweep = auto, Detector = peak, Trace = max hold.
b. The marker-to-peak function to set the mark to the peak of the emission. Use the marker-delta function to measure 20 ㏈ down one side of the emission. Reset the function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is 20 ㏈ bandwidth of the emission.

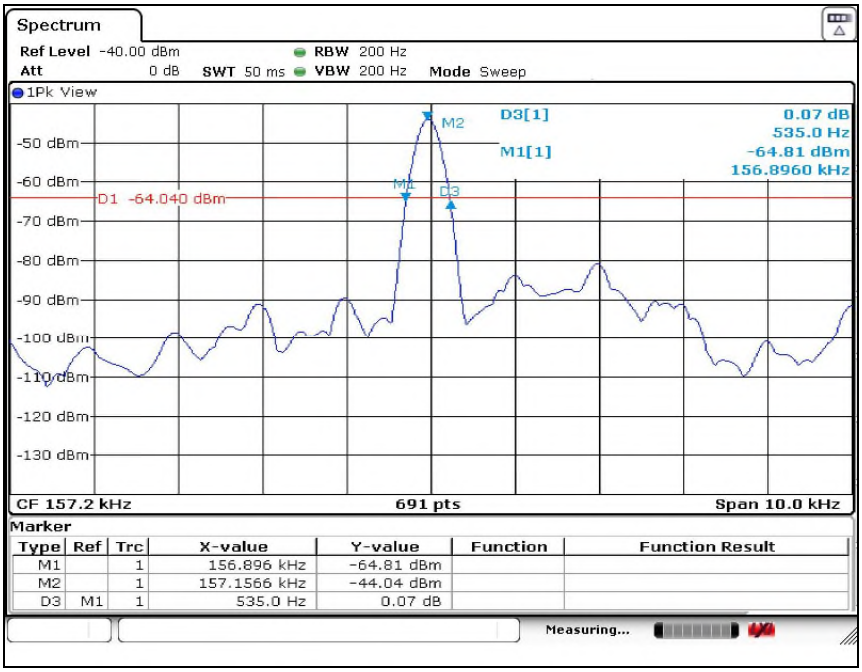
3.4. Test Result

Ambient temperature : (23 ± 1) ℃
Relative humidity : 47 % R.H.

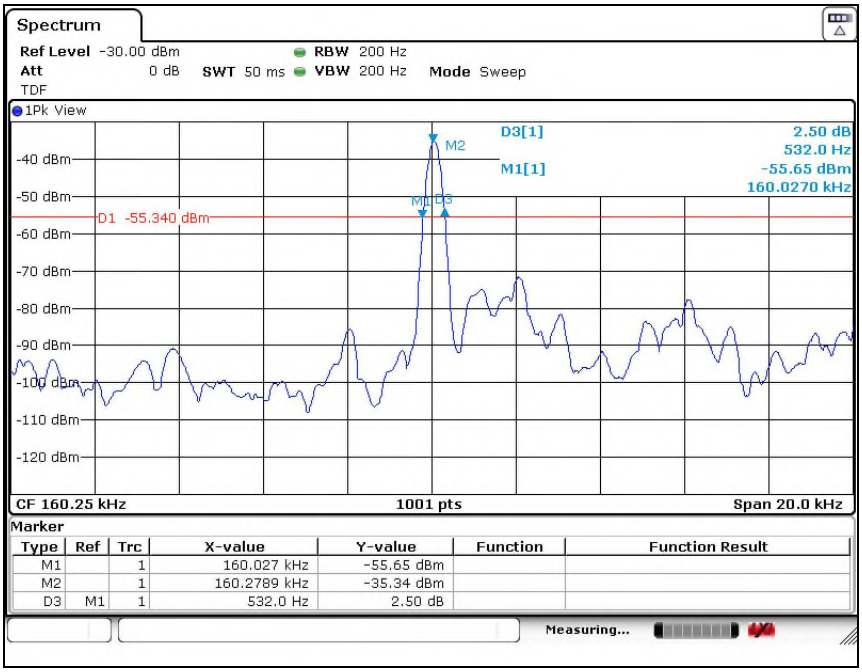
Test Condition	EUT Status	20 dB Bandwidth (㎑)	Limit
5 W	With client device (1 % battery status of client device)	0.535	Reporting proposed only
9 W		0.532	

- Test plots

Test Condition: 5 W Operating mode with client device (1 % battery status of client device)

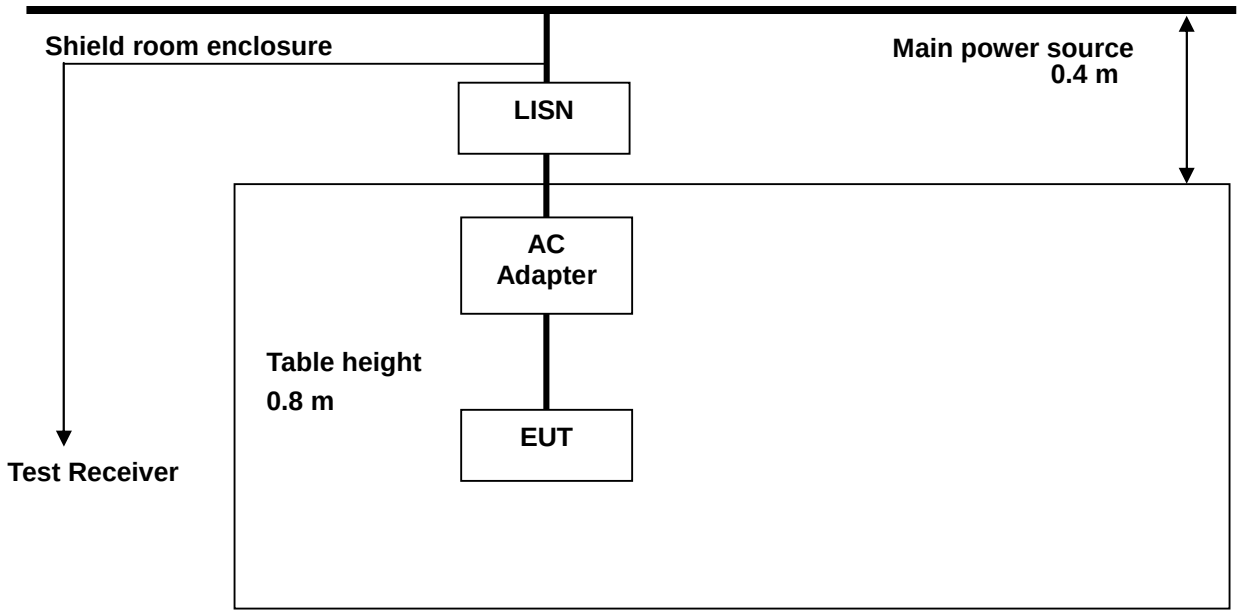


Test Condition: 9 W Operating mode with client device (1 % battery status of client device)



4. AC Power Line Conducted Emission

4.1. Test Setup



4.2. Limit

According to §15.207(a), for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 ㎑ to 30 ㎒, shall not exceed the limits in the following table, as measured using a 50 μH /50 ohms line impedance stabilization network (LISN).
Compliance with the provision of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of emission (㎒)	Conducted limit (㏈μV)	
	Quasi-peak	Average
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.

4.3. Test Procedures

AC conducted emissions from the EUT were measured according to the dictates of ANSI C63.10:2013

1. The test procedure is performed in a 6.5 m × 3.5 m × 3.5 m (L × W × H) shielded room. The EUT along with its peripherals were placed on a 1.0 m (W) × 1.5 m (L) and 0.8 m in height wooden table and the EUT was adjusted to maintain a 0.4 meter space from a vertical reference plane.
2. The EUT was connected to power mains through a line impedance stabilization network (LISN) which provides 50 ohm coupling impedance for measuring instrument and the chassis ground was bounded to the horizontal ground plane of shielded room.
3. All peripherals were connected to the second LISN and the chassis ground also bounded to the horizontal ground plane of shielded room.
4. The excess power cable between the EUT and the LISN was bundled. The power cables of peripherals were unbundled. All connecting cables of EUT and peripherals were moved to find the maximum emission.

4.4. Test Results

The following table shows the highest levels of conducted emissions on both phase of Hot and Neutral line.

Ambient temperature : (23 ± 1) ℃
Relative humidity : 47 % R.H.

Frequency range : 0.15 ㎒ – 30 ㎒
Measured Bandwidth : 9 ㎑

Test Condition: 5 W Operating mode with client device (1 % battery status of client device)

FREQ.	LEVEL (dBμV)		LINE	LIMIT (dBμV)		MARGIN (dB)	
(㎒)	Q-Peak	Average		Q-Peak	Average	Q-Peak	Average
0.36	28.50	27.20	N	58.73	48.73	30.23	21.53
0.61	36.80	32.50	N	56.00	46.00	19.20	13.50
1.09	37.90	34.20	N	56.00	46.00	18.10	11.80
2.07	30.10	27.00	N	56.00	46.00	25.90	19.00
3.29	27.80	25.30	N	56.00	46.00	28.20	20.70
11.62	27.10	19.60	N	60.00	50.00	32.90	30.40
0.19	43.50	24.90	H	64.04	54.04	20.54	29.14
0.23	39.00	19.80	H	62.45	52.45	23.45	32.65
3.03	32.90	29.30	H	56.00	46.00	23.10	16.70
6.99	31.60	28.80	H	60.00	50.00	28.40	21.20
12.00	27.60	21.40	H	60.00	50.00	32.40	28.60
15.71	15.80	8.80	H	60.00	50.00	44.20	41.20

Test Condition: 9 W Operating mode with client device (1 % battery status of client device)

FREQ.	LEVEL (dBμV)		LINE	LIMIT (dBμV)		MARGIN (dB)	
(MHz)	Q-Peak	Average		Q-Peak	Average	Q-Peak	Average
0.39	29.60	23.30	N	58.06	48.06	28.46	24.76
0.64	27.30	19.50	N	56.00	46.00	28.70	26.50
1.15	27.90	24.10	N	56.00	46.00	28.10	21.90
1.91	24.30	19.80	N	56.00	46.00	31.70	26.20
3.95	31.00	25.70	N	56.00	46.00	25.00	20.30
11.07	30.20	22.50	N	60.00	50.00	29.80	27.50
0.39	24.90	8.90	H	58.06	48.06	33.16	39.16
0.66	21.40	8.40	H	56.00	46.00	34.60	37.60
1.43	19.20	8.70	H	56.00	46.00	36.80	37.30
2.70	22.70	13.30	H	56.00	46.00	33.30	32.70
5.01	15.30	9.90	H	60.00	50.00	44.70	40.10
11.47	26.00	20.10	H	60.00	50.00	34.00	29.90

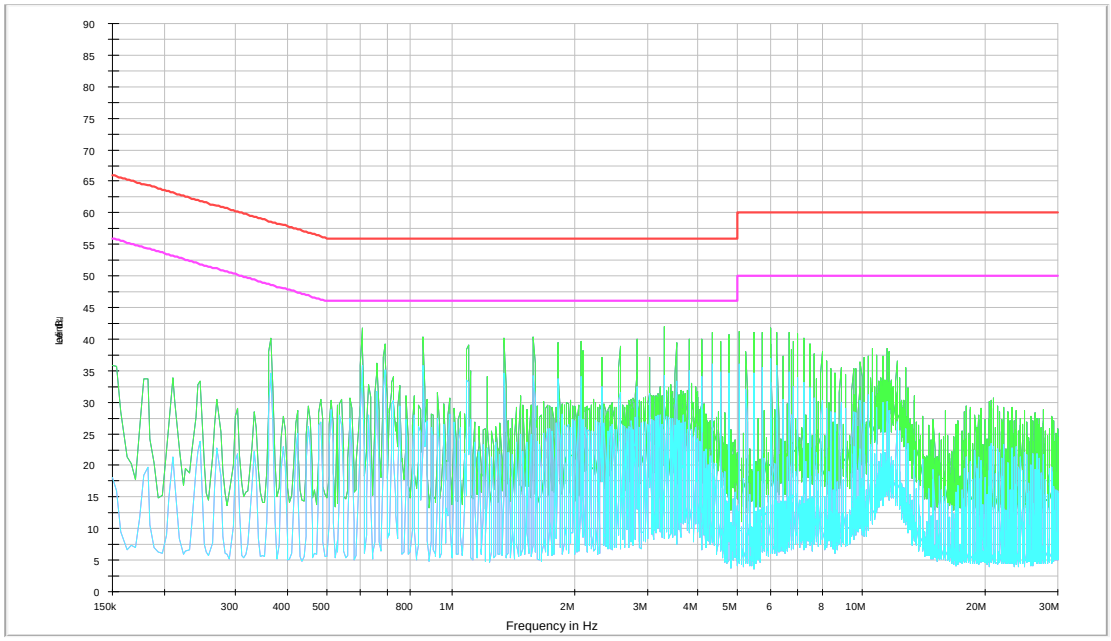
Remark;

1. Line (H): Hot, Line (N): Neutral
2. Each charging mode with client device (1 %, 50 % and 99 % of battery) was tested.
   As worst condition, charging mode with client device (1 %) is reported.
3. The limit for Class B device(s) from 150 ㎑ to 30 ㎒ are specified in section of the Title 47 CFR.
4. Traces shown in plot were made by using a peak detector and average detector.
5. Deviations to the Specifications: None.

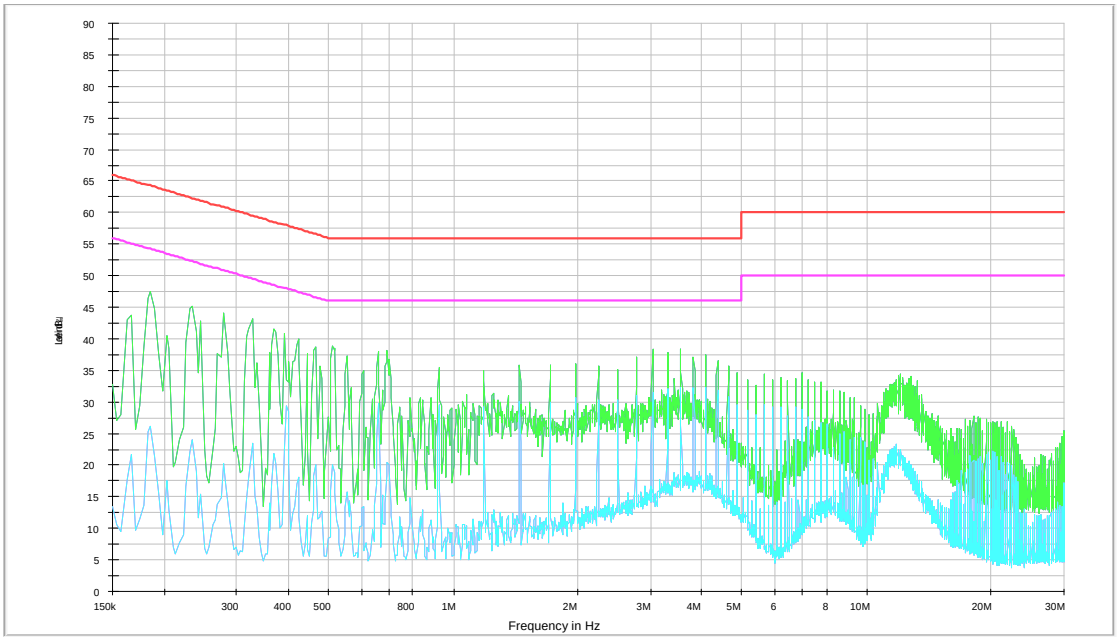
- Test plots

Test Condition: 5 W Operating mode with client device (1 % battery status of client device)

Test mode: (Neutral)

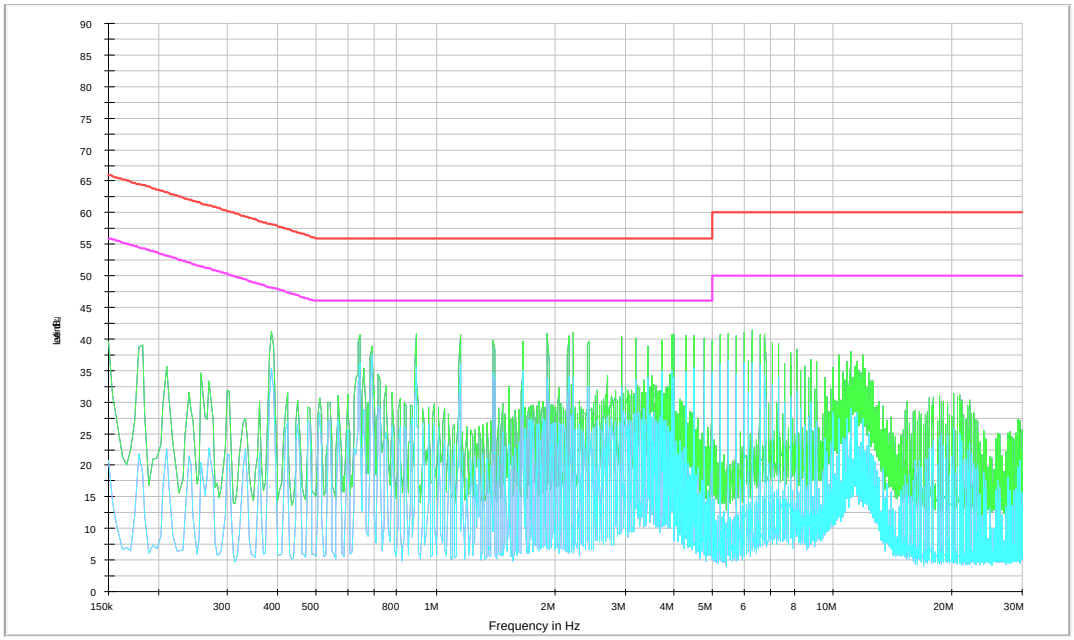


Test mode: (Hot)

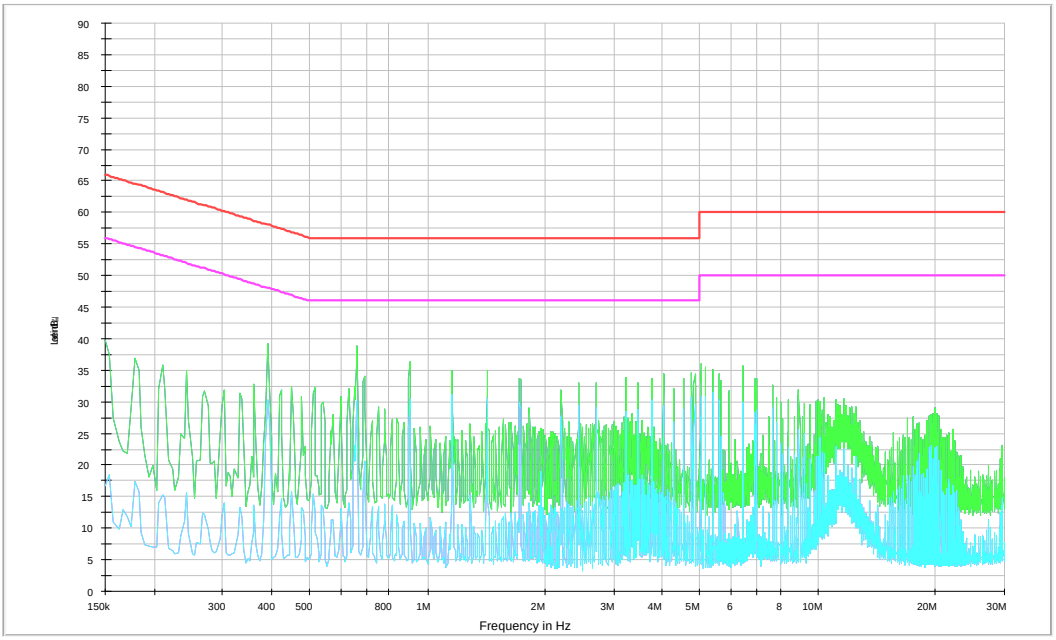


Test Condition: 9 W Operating mode with client device (1 % battery status of client device)

Test mode: (Neutral)



Test mode: (Hot)



- End of the Test Report -