

RF TEST REPORT

Test Equipment : HYDROGEN MINI
Model Name : DHW-9100A
Variant Model Name : -
FCC ID : 2ATF3DHW-9100A
Date of receipt : 2019.05.10
Test duration : 2019.08.13 ~ 2019.08.26
Date of issue : 2019.09.03

Applicant : Dagaga Co., Ltd.
510ho, 30 jeonpa-ro, Manan-gu, Anyang-si, Gyeonggi-do, South Korea

Test Laboratory : Lab-T, Inc.
2182-42 Baegok-daero, Mohyeon-myeon, Cheoin-gu, Yongin-si
Gyeonggi-do 17036, South Korea

Test specification : FCC CFR Title 47 Part 15 Subpart C 15.203
FCC CFR Title 47 Part 15 Subpart C 15.207
FCC CFR Title 47 Part 15 Subpart C 15.209
Test result : Pass

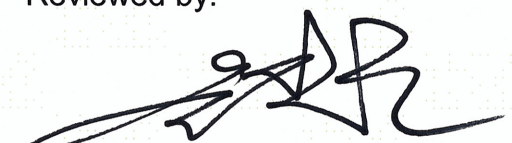
The above equipment was tested by Lab-T Testing Laboratory for compliance
with the requirements of FCC Rules and Regulations.
The test results presented in this test report are limited only to the sample supplied by applicant
and the use of this test report is inhibited other than its purpose.
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Tested by:



Engineer
Namhyoung Kwon

Reviewed by:



Technical Manager
SangHoon Yu

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1. Applicant Information

Applicant : Dagaga Co., Ltd.
Address : 510ho, 30 jeonpa-ro, Manan-gu, Anyang-si, Gyeonggi-do, South Korea
Telephone No. : +82-31-8068-5594
Person in charge : Dagaga_1@naver.com

Manufacturer : Dagaga Co., Ltd.
Address : 510ho, 30 jeonpa-ro, Manan-gu, Anyang-si, Gyeonggi-do, South Korea

2. Laboratory Information

Test Laboratory : Lab-T, Inc.
Address : 2182-42 Baegok-daero, Mohyeon-myeon, Cheoin-gu, Yongin-si
Gyeonggi-do 17036, South Korea
Telephone No. : +82 31-322-6767
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Certificate

Designation No. : KR0159
Registration No. : 133186

3. Information About Test Equipment

3.1 Equipment Information

Equipment type	HYDROGEN MINI
Equipment model name	DHW-9100A
Variant model name	-
Frequency range	110 kHz ~ 205 kHz
Modulation type	ASK
Power supply	DC 5.00 V

Note1: The above EUT information was declared by the manufacturer.

Note2: EUT has been tested with bottle as supporting equipment since the EUT has ability to charge only the specified tumbler.

3.2 Antenna Information

type	Inductive Loop Coil Antenna
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3.3 Tested Companion Device Information

Type	Manufacturer	Model	Note
Adapter	Dongguan Yingju Power Co., Ltd.	EP-TA20KBK	-

4. Test Report

4.1 Summary

FCC Part 15			
Reference	Parameter	Clause	Status
Transmitter Requirements			
2.1049	20 dB Bandwidth	4.4.5	C
15.209(a)	Radiated Emission	4.4.6	C
15.207(a)	Conducted Emissions	4.4.7	C
15.203	Antenna Requirements	4.4.8	C
NOTE 1 : C = Comply N/C = Not Comply N/T = Not Tested N/A = Not Applicable			

* The general test methods used to test this device is ANSI C63.10:2013

4.2 Measurement Uncertainty

Measurement items	Expanded Uncertainty
Radiated Spurious Emissions (1 GHz under)	± 4.67 dB (The confidence level is about 95 %, $k=2$)
Conducted emission	± 2.36 dB (The confidence level is about 95 %, $k=2$)

4.3 Test Report Version

Test Report No.	Date	Description
TRRFCC19-0029	19.09.03	Initial issue

4.4 Test Report

4.4.1 20 dB Bandwidth

4.4.1.1 Measurement Procedure

The 20 dB Bandwidth is measured with a spectrum analyzer connected via a receiving antenna placed near the EUT while the EUT is operating.

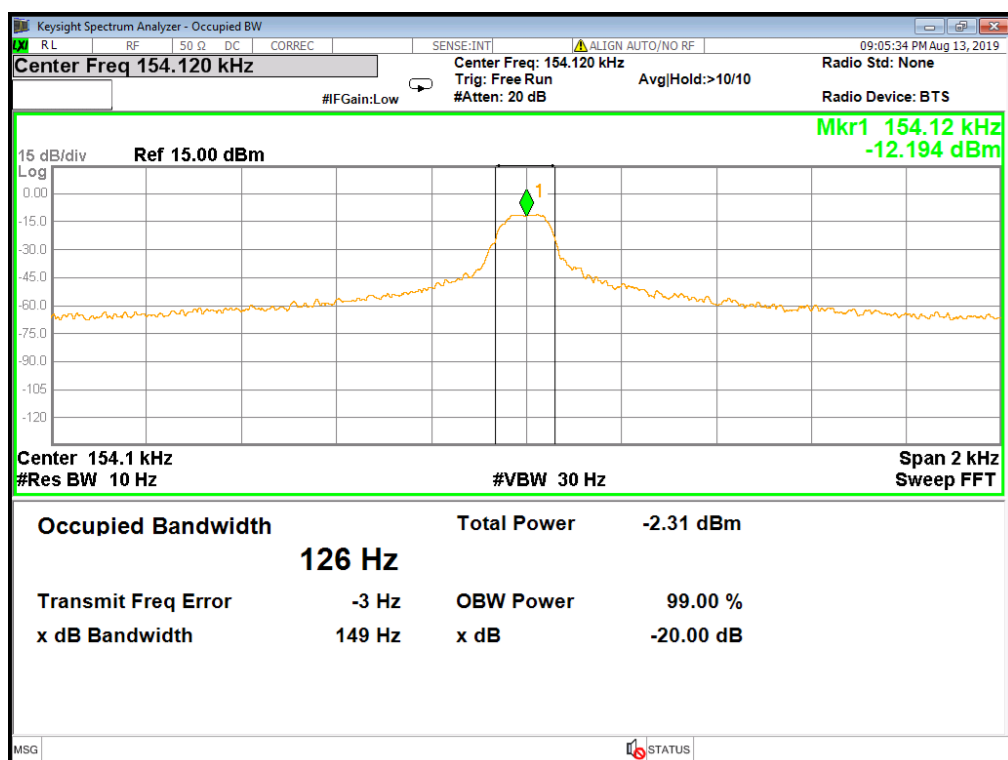
4.4.1.2 Result

Comply (measurement data : refer to below)

4.4.1.3 Measurement data

Test mode : 5 V Charging Mode

Tested Frequency(kHz)	Test Results(kHz)
154.1	0.149



4.4.2 Radiated Emission

4.4.2.1 Regulation

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(MHz)	Field strength(microvolts/meter)	Measurement distance(meters)
0.009 - 0.490	2 400/F(kHz)	300
0.490 - 1.705	24 000/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

**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 MHz, 76–88 MHz, 174–216 MHz or 470–806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241.

4.4.2.2 Measurement Procedure

- 1) The EUT was placed on a turn table which is 0.8m above ground plane.
- 2) Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0° to 360° to acquire the highest emissions from EUT
- 3) And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
- 4) Repeat above procedures until all frequency measurements have been completed.

4.4.2.3 Test mode

In order to check all kinds of possible configurations, EUT was evaluated with appropriate client and under each charging condition as below table.

EUT Voltage	Cal.Date
5 V Charging Mode	Battery less than 1% charged
	Battery less than 50% charged
	Battery 100% fully charged

4.4.2.4 Result

Comply (measurement data : refer to the next page)

4.4.2.5 Measurement data_Radiated Spurious Emissions

Test mode : 5 V Charging Mode_9 kHz ~ 30 MHz (Battery less than 1% charged)

Frequency (MHz)	Detector	Note 1	Pol. (V/H)	Reading (dBμV)	Ant Factor (dB)	Cable Loss (dB)	Result at 3m (dBμV/m)	Result at 300m (dBμV/m)	Limit at 300m (dBμV/m)	Margin (dB)
0.154	QP	F	H	55.80	11.00	0.10	66.90	-13.10	23.85	36.95
0.154	QP	F	V	51.00	11.00	0.10	62.10	-17.90	23.85	41.75

Frequency (MHz)	Detector	Note 1	Pol. (V/H)	Reading (dBμV)	Ant Factor (dB)	Cable Loss (dB)	Result at 3m (dBμV/m)	Result at 30m (dBμV/m)	Limit at 30m (dBμV/m)	Margin (dB)
Above 0.154	Not Detected	-	-	-	-	-	-	-	-	-

Note 1 : "F" : Fundamental, "S" : Spurious

Note 2 : Result : Reading + Ant Factor + Cable Loss

Note 3 : According to §15.31 (f)(2);

Result at 30m (dBμV/m) = Result at 3m(dBμV/m)-40log(30/3) (dBμV/m)

Result at 300m (dBμV/m) = Result at 3m(dBμV/m)-40log(300/3) (dBμV/m)

Note 4 : The radiation measurements are performed in X, Y, Z axis positioning. And worst case mode is recorded in the report.

Test mode : 5 V Charging Mode_9 kHz ~ 30 MHz (Battery less than 50% charged)

Frequency (MHz)	Detector	Note 1	Pol. (V/H)	Reading (dBμV)	Ant Factor (dB)	Cable Loss (dB)	Result at 3m (dBμV/m)	Result at 300m (dBμV/m)	Limit at 300m (dBμV/m)	Margin (dB)
0.154	QP	F	H	55.20	11.00	0.10	66.30	-13.70	23.85	37.55
0.154	QP	F	V	51.60	11.00	0.10	62.70	-17.30	23.85	41.15

Frequency (MHz)	Detector	Note 1	Pol. (V/H)	Reading (dBμV)	Ant Factor (dB)	Cable Loss (dB)	Result at 3m (dBμV/m)	Result at 30m (dBμV/m)	Limit at 30m (dBμV/m)	Margin (dB)
Above 0.154	Not Detected	-	-	-	-	-	-	-	-	-

Note 1 : "F" : Fundamental, "S" : Spurious

Note 2 : Result : Reading + Ant Factor + Cable Loss

Note 3 : According to §15.31 (f)(2);

Result at 30m (dBμV/m) = Result at 3m(dBμV/m)-40log(30/3) (dBμV/m)

Result at 300m (dBμV/m) = Result at 3m(dBμV/m)-40log(300/3) (dBμV/m)

Note 4 : The radiation measurements are performed in X, Y, Z axis positioning. And worst case mode is recorded in the report.

Test mode : 5 V Charging Mode_9 kHz ~ 30 MHz (Battery 100% fully charged)

Frequency (MHz)	Detector	Note 1	Pol. (V/H)	Reading (dBμV)	Ant Factor (dB)	Cable Loss (dB)	Result at 3m (dBμV/m)	Result at 300m (dBμV/m)	Limit at 300m (dBμV/m)	Margin (dB)
0.154	QP	F	H	55.50	11.00	0.10	66.60	-13.40	23.85	37.25
0.154	QP	F	V	50.50	11.00	0.10	61.60	-18.40	23.85	42.25

Frequency (MHz)	Detector	Note 1	Pol. (V/H)	Reading (dBμV)	Ant Factor (dB)	Cable Loss (dB)	Result at 3m (dBμV/m)	Result at 30m (dBμV/m)	Limit at 30m (dBμV/m)	Margin (dB)
Above 0.154	Not Detected	-	-	-	-	-	-	-	-	-

Note 1 : "F" : Fundamental, "S" : Spurious

Note 2 : Result : Reading + Ant Factor + Cable Loss

Note 3 : According to §15.31 (f)(2);

Result at 30m (dBμV/m) = Result at 3m(dBμV/m)-40log(30/3) (dBμV/m)

Result at 300m (dBμV/m) = Result at 3m(dBμV/m)-40log(300/3) (dBμV/m)

Note 4 : The radiation measurements are performed in X, Y, Z axis positioning. And worst case mode is recorded in the report.

Test mode : 5 V Charging Mode_30 MHz ~ 1 GHz (Worst Case : Battery 1% fully charged)

Frequency (MHz)	Detector	Note 1	Pol. (V/H)	Reading (dBμV)	Ant Factor (dB)	Loss (dB)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
38.973	QP	S	V	37.40	12.90	-23.40	26.90	40.00	13.10
50.249	QP	S	V	36.40	12.60	-23.20	25.80	40.00	14.20
86.623	QP	S	V	40.70	7.90	-22.70	25.90	40.00	14.10

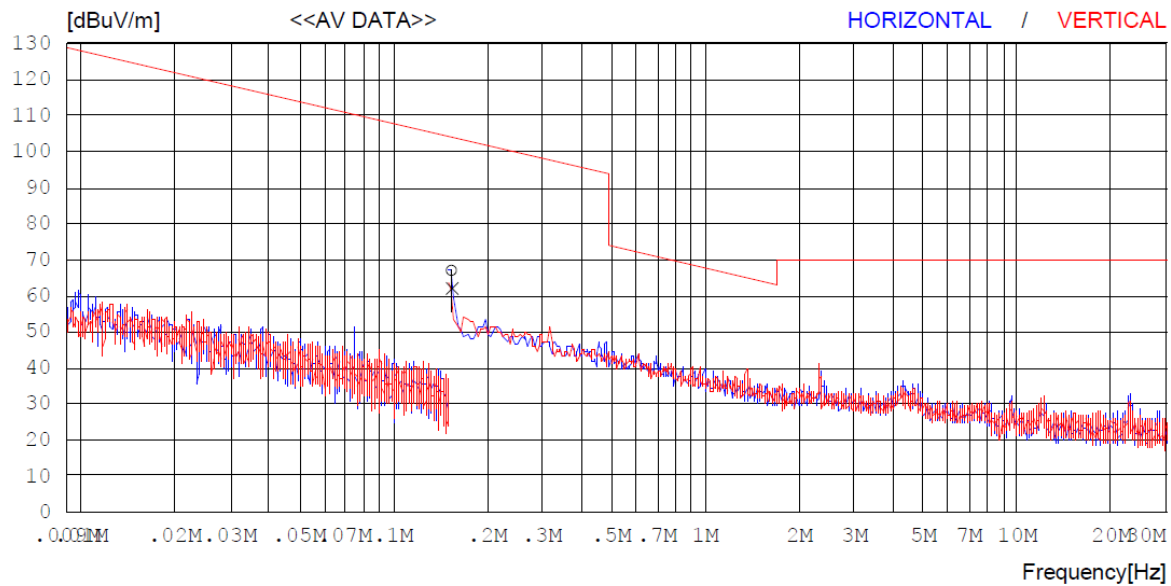
Note 1 : "F" : Fundamental, "S" : Spurious

Note 2 : Loss : Cable loss – Amp gain

Note 3 : Result : Reading + Ant Factor + Loss

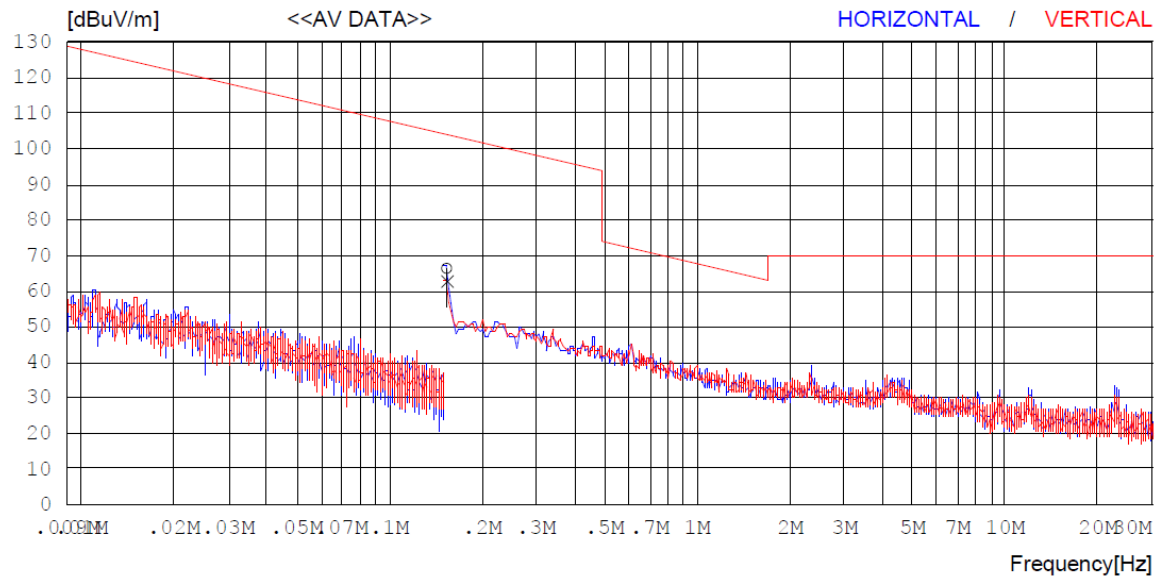
4.4.2.6 Measurement Plot

Test mode : 5 V Charging Mode_9 kHz ~ 30 MHz (Battery less than 1% charged)



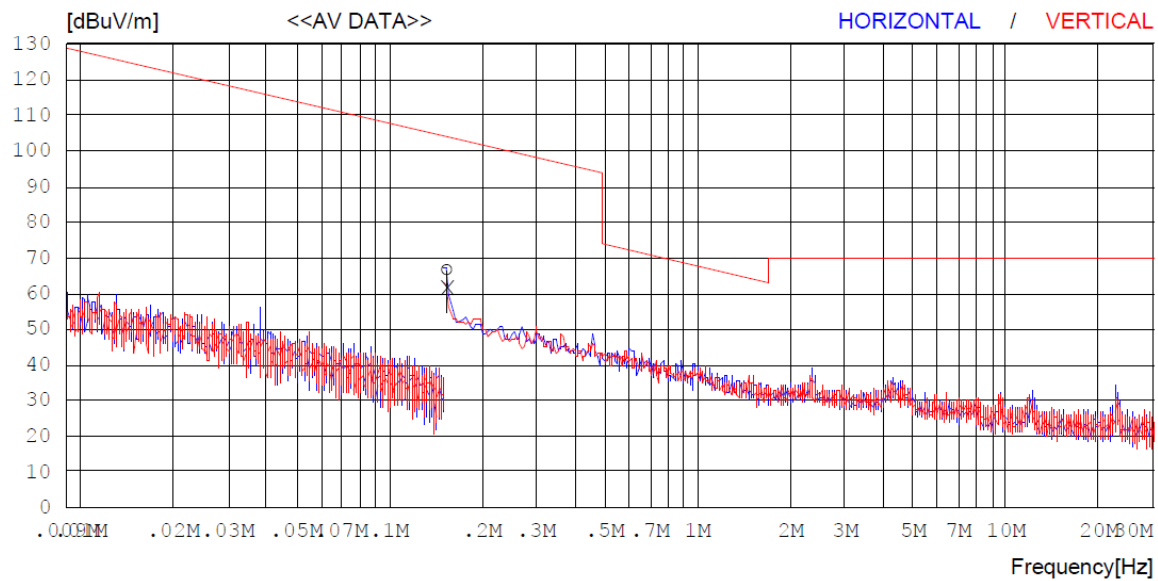
No.	FREQ [MHz]	READING CAV [dBuV]	ANT FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal -----										
1	0.154	55.8	11.0	0.1	0.0	66.9	103.9	37.0	100	117
----- Vertical -----										
2	0.154	51.0	11.0	0.1	0.0	62.1	103.9	41.8	100	147

Test mode : 5 V Charging Mode_9 kHz ~ 30 MHz (Battery less than 50% charged)



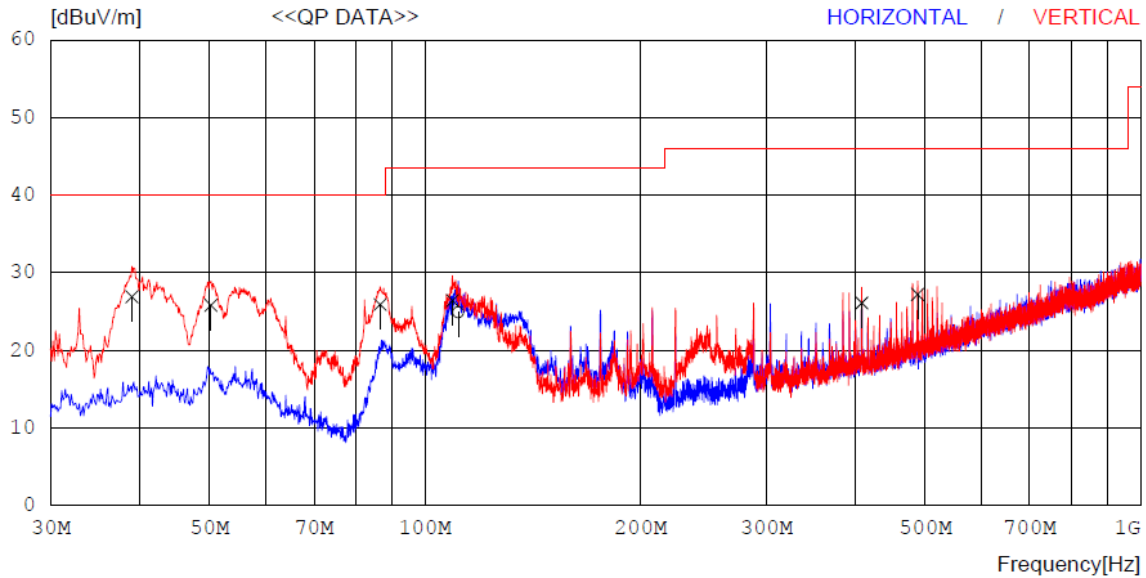
No.	FREQ [MHz]	READING CAV [dBuV]	ANT FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal -----										
1	0.154	55.2	11.0	0.1	0.0	66.3	103.9	37.6	100	84
----- Vertical -----										
2	0.154	51.6	11.0	0.1	0.0	62.7	103.9	41.2	100	152

Test mode : 5 V Charging Mode_9 kHz ~ 30 MHz (Battery 100% fully charged)



No.	FREQ [MHz]	READING CAV [dBuV]	ANT FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal -----										
1	0.154	55.5	11.0	0.1	0.0	66.6	103.9	37.3	100	359
----- Vertical -----										
2	0.154	50.5	11.0	0.1	0.0	61.6	103.9	42.3	100	359

Test mode : 5 V Charging Mode_30 MHz ~ 1 GHz (Worst Case : Battery less than 1% charged)



No.	FREQ [MHz]	READING QP [dBuV]	ANT FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal -----										
1	111.357	36.3	10.9	-22.3	0.0	24.9	43.5	18.6	300	1
----- Vertical -----										
2	38.973	37.4	12.9	-23.4	0.0	26.9	40.0	13.1	100	358
3	50.249	36.4	12.6	-23.2	0.0	25.8	40.0	14.2	100	358
4	86.623	40.7	7.9	-22.7	0.0	25.9	40.0	14.1	100	269
5	109.296	38.1	10.6	-22.3	0.0	26.4	43.5	17.1	100	358
6	407.805	30.7	16.0	-20.6	0.0	26.1	46.0	19.9	100	358
7	488.070	30.0	17.6	-20.4	0.0	27.2	46.0	18.8	100	237

4.4.3 Conducted Emission

4.4.3.1 Regulation

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 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μ H/50 Ω line impedance stabilization network (LISN).

Compliance with the provisions 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 (MHz)	Conducted limit (dB μ V)	
	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.

According to §15.107(a), for unintentional device, except for Class A digital devices, line conducted emission limits are the same as the above table.

4.4.3.2 Measurement Procedure

1) The EUT was placed on a wooden table of size, 1 m by 1.5 m, raised 80 cm in which is located 40 cm away from the vertical wall and 1.5 m away from the side wall of the shielded room.

2) Each current-carrying conductor of the EUT power cord was individually connected through a 50 Ω /50 μ H LISN, which is an input transducer to a Spectrum Analyzer or an EMI/Field Intensity Meter, to the input power source.

3) Exploratory measurements were made to identify the frequency of the emission that had the highest amplitude relative to the limit by operating the EUT in a range of typical modes of operation, cable position, and with a typical system equipment configuration and arrangement. Based on the exploratory tests of the EUT, the one EUT cable configuration and arrangement and mode of operation that had produced the emission with the highest amplitude relative to the limit was selected for the final measurement.

4) The final test on all current-carrying conductors of all of the power cords to the equipment that comprises the EUT (but not the cords associated with other non-EUT equipment in the system) was then performed over the frequency range of 0.15 MHz to 30 MHz.

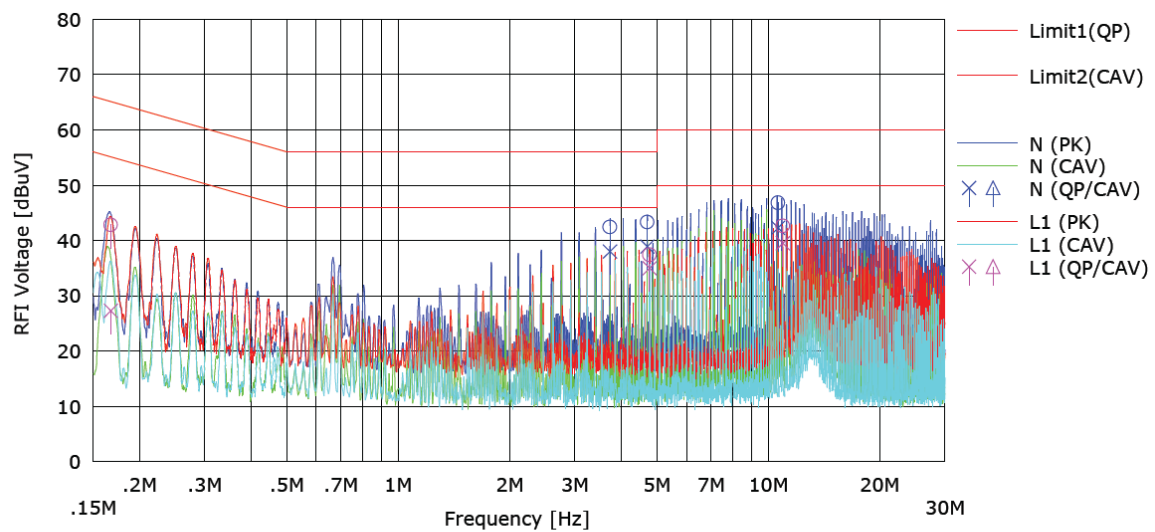
5) The measurements were made with the detector set to PEAK amplitude within a bandwidth of 10 kHz or to QUASIPEAK and AVERAGE within a bandwidth of 9 kHz. The EUT was in transmitting mode during the measurements.

4.4.3.3 Result

Test Condition : refer to the clause 4.4.2.3 test coditions

Comply (measurement data : refer to below)

Test mode : 5 V Charging Mode (Worst Case : Battery less than 1% charged)



NO	FREQ [MHz]	READING		C.FACTOR [dB]	RESULT		LIMIT		MARGIN		PHASE
		QP [dBuV]	CAV [dBuV]		QP [dBuV]	CAV [dBuV]	QP [dBuV]	CAV [dBuV]	QP [dBuV]	CAV [dBuV]	
1	3.73349	22.3	17.9	20.1	42.4	38.0	56.0	46.0	13.6	8.0	N
2	4.70750	23.2	18.8	20.1	43.3	38.9	56.0	46.0	12.7	7.1	N
3	10.62878	26.5	22.0	20.3	46.8	42.3	60.0	50.0	13.2	7.7	N
4	0.16724	22.4	6.9	20.4	42.8	27.3	65.1	55.1	22.3	27.8	L1
5	4.77800	17.2	14.8	20.2	37.4	35.0	56.0	46.0	18.6	11.0	L1
6	10.94195	22.3	19.2	20.3	42.6	39.5	60.0	50.0	17.4	10.5	L1

4.4.4 Antenna Requirements

4.4.4.1 Regulation

According to §15.203, 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.

4.4.4.2 Result

Comply (The antenna of this EUT is Inductive Loop Coil Antenna Type. Therefore the antenna is permanently attached. Please refer to the internal photo. Therefore this EUT Complies with the requirement of §15.203)

APPENDIX I

TEST EQUIPMENT USED FOR TESTS

To facilitate inclusion on each page of the test equipment used for related tests, each item of test equipment.

Equipment	Manufacturer	Model	Serial No.	Cal. Date (yy.mm.dd)	Next Cal.Date (yy.mm.dd)
PXA Signal Analyzer	KEYSIGHT	N9030A	MY54410264	2019-01-10	2020-01-10
AC POWER SUPPLY	PCR 500L	KIKUSUI	FE002647	2019-04-25	2020-04-25
HUMIDITY/TEMP DATA RECORDER	LUTRON	MHB-382SD	79735	2019-04-25	2020-04-25
Digital MultiMeter	HP	34401A	US36025428	2019-01-10	2020-01-10
Signal Generator	ROHDE&SCHWARZ	SMB100A	178384	2018-10-15	2019-10-15
EMI Test Receiver	ROHDE&SCHWARZ	ESU40	100445	2019-12-14	2019-12-14
BiLog Antenna	Schwarzbeck	VULB9160	3381	2019-04-09	2021-04-09
Preamplifier	TSJ	MLA-10k01-b01-27	1870369	2019-04-23	2020-04-23
Antenna Mast(10 m)	TOKIN	5977	-	-	-
Controller(10 m)	TOKIN	5909L	141909L-1	-	-
Turn Table(10 m)	TOKIN	5983-1.5	-	-	-
10 m Semi-Anechoic Chamber	SY CORPORATION	-	-	-	-
EMI Test Receiver	ROHDE&SCHWARZ	ESR7	101440	2018-12-14	2019-12-14
LISN	ROHDE&SCHWARZ	ENV216	101883	2019-04-24	2020-04-24
Pulse Limiter	Schwarzbeck	VTSD 9561-F	9561-F189	2019-04-23	2020-04-23
Active Loop H-Field	ETS	6502	00150598	2019-05-15	2020-05-15