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TEST REPORT

of

FCC Part 15 Subpart C §15.249
IC RSS-210 Issue 10 and RSS-Gen Issue 5

FCC ID: WHBUTR2
IC Certification: 22539-UTR2

1. Equipment Under Test	:	UTR 2.0
2. Model Name	:	UTR 2.0
3. Variant Model Name(s)	:	Refer to page 3
4. Applicant	:	Mobile Appliance, Inc.
5. Manufacturer	:	Mobile Appliance, Inc.
6. Date of Receipt	:	2020.06.16
7. Date of Test(s)	:	2020.07.15 ~ 2020.07.23
8. Date of Issue	:	2020.07.24

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

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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.

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1.2. Details of Applicant

Applicant	:	Mobile Appliance, Inc.
Address	:	401, Simin-daero, Dongan-gu, #1701-1706, Daerung Techno Town 15, Gwangyang-dong, Anyang-si, Gyeonggi-do, Korea, 14057
Contact Person	:	Choi, Jin-oh
Phone No.	:	+82 31 421 8071

1.3. Details of Manufacturer

Company	:	Same as above
Address	:	Same as above

1.4. Description of EUT

Kind of Product	UTR 2.0
Model Name	UTR 2.0
Variant Model Name(s)	Porsche Dashcam, Universal Traffic Recorder 2
Model Serial Number	ASF200700003
Power Supply	DC 12 V
Frequency	24.22 ㎓ (24 ㎓ Radar)
Modulation Technique	FMCW
Number of Channels	1 channel
Antenna Type	Patch antenna
Antenna Gain	7 ㏈i
H/W Version	V1.0
S/W Version	V1.0

1.5. Test Equipment List

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Interval	Cal. Due
Signal Generator	R&S	SMBV100A	255834	Jun. 03, 2020	Annual	Jun. 03, 2021
Signal Generator	R&S	SMR40	100272	Jun. 18, 2020	Annual	Jun. 18, 2021
Signal Generator	Agilent	E8257D	MY51501169	Nov. 21, 2019	Annual	Nov. 21, 2020
Spectrum Analyzer	R&S	FSW67	103242	Feb. 11, 2020	Annual	Feb. 11, 2021
Spectrum Analyzer	R&S	FSV30	100768	Mar. 04, 2020	Annual	Mar. 04, 2021
Spectrum Analyzer	Agilent	N9030A	US51350132	Nov. 15, 2019	Annual	Nov. 15, 2020
Preamplifier	H.P.	8447F	2944A03909	Aug. 07, 2019	Annual	Aug. 07, 2020
Signal Conditioning Unit	R&S	SCU-18	10117	Jun. 10, 2020	Annual	Jun. 10, 2021
DC Power Supply	Agilent	U8002A	MY50060028	Mar. 03, 2020	Annual	Mar. 03, 2021
Low Pass Filter	Mini-Circuits	NLP-1200+	V 9500401023-3	Jun. 01, 2020	Annual	Jun. 01, 2021
Loop Antenna	Schwarzbeck Mess-Elektronik	FMZB 1519	1519-039	Aug. 22, 2019	Biennial	Aug. 22, 2021
Bilog Antenna	Schwarzbeck Mess-Elektronik	VULB9163	396	Mar. 21, 2019	Biennial	Mar. 21, 2021
Horn Antenna	R&S	HF906	100326	Feb. 14, 2020	Annual	Feb. 14, 2021
Horn Antenna	Schwarzbeck Mess-Elektronik	BBHA 9170	BBHA9170431	Sep. 10, 2018	Biennial	Sep. 10, 2020
Preamplifier	TESTEK	TK-PA1840H	130016	Jan. 06, 2020	Annual	Jan. 06, 2021
Horn Antenna	OML, Inc.	M22RH	180926-2	Sep. 26, 2018	Biennial	Sep. 26, 2020
Horn Antenna	OML, Inc.	M15RH	180926-2	Sep. 26, 2018	Biennial	Sep. 26, 2020
Horn Antenna	OML, Inc.	M10RH	180926-2	Sep. 26, 2018	Biennial	Sep. 26, 2020
Harmonic Mixer	OML, Inc.	M15HWD	180926-1	Nov. 06, 2019	Annual	Nov. 06, 2020
Harmonic Mixer	OML, Inc.	M10HWD	180926-2	Nov. 06, 2019	Annual	Nov. 06, 2020
Test Receiver	R&S	ESU26	100109	Feb. 18, 2020	Annual	Feb. 18, 2021
Controller	Innco systems GmbH	CONTROLLER CO3000-4P	CO3000/963/3833 0516/L	N.C.R.	N/A	N.C.R.
Turn Table	Innco systems GmbH	DS 1200 S	N/A	N.C.R.	N/A	N.C.R.
Turn Table	C&K Technologies, Inc.	mmTu-2x	MMT20181101	N.C.R.	N/A	N.C.R.
Antenna Master	Innco systems GmbH	MA4640-XP-ET	MA4640/536/3833 0516/L	N.C.R.	N/A	N.C.R.
Antenna Mast	C&K Technologies, Inc.	mmAm-2x	MMA20181101	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	RFONE	PL520-NMNM-4M (4 m)	20200324001	May 06, 2020	Semi-annual	Nov. 06, 2020
Coaxial Cable	RFONE	PL520-NMNM-10M (10 m)	20200324001	May 06, 2020	Semi-annual	Nov. 06, 2020
Coaxial Cable	Rosenberger	LA1-C006-1500	131014 01/20	Feb. 23, 2020	Semi-annual	Aug. 23, 2020

1.6. Summary of Test Results

The EUT has been tested according to the following specifications:

APPLIED STANDARD: FCC Part15 subpart C, IC RSS-210 Issue 10 and RSS-Gen Issue 5			
Section in FCC	**Section in IC**	**Test Item(s)**	**Result**
15.205 15.209(a) 15.249(a) 15.249(c) 15.249(d) 15.249(e)	RSS-210 Issue 10 A.1, Table A1 RSS-Gen Issue 5 8.9	Radiated emission, Spurious Emission and Field Strength of Fundamental	Complied
15.231(c)	RSS-210 Issue 10 A.1.3 RSS-Gen Issue 5 6.7	20 ㏈ Bandwidth & 99 % Bandwidth	Complied
15.207	RSS-Gen Issue 5 8.8	AC Power Line Conducted Emission	N/A[1)]

Note;

1) The AC power line test was not performed because the EUT use battery power for operation and which do not operate from the AC power lines.

1.7. Measurement Uncertainty

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

Parameter	Uncertainty
Occupied Bandwidth	± 9.66 ㎑
Radiated Emission, 9 ㎑ to 30 ㎒	± 3.59 ㏈
Radiated Emission, below 1 ㎓	± 5.88 ㏈
Radiated Emission, above 1 ㎓	± 5.94 ㏈

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

1.8. Test Report Revision

Revision	Report Number	Date of Issue	Description
0	F690501-RF-RTL001012	2020.07.24	Initial

1.9. Descriptions of Variant model(s)

Model Name		Description
Basic Model	UTR 2.0	- Basic model
Variant Models	Porsche Dashcam	- Same as basic model - The variant models' name are made for car type. (Porsche).
	Universal Traffic Recorder 2	- Same as basic model - The variant models' name are made for car type. (Volkswagen).

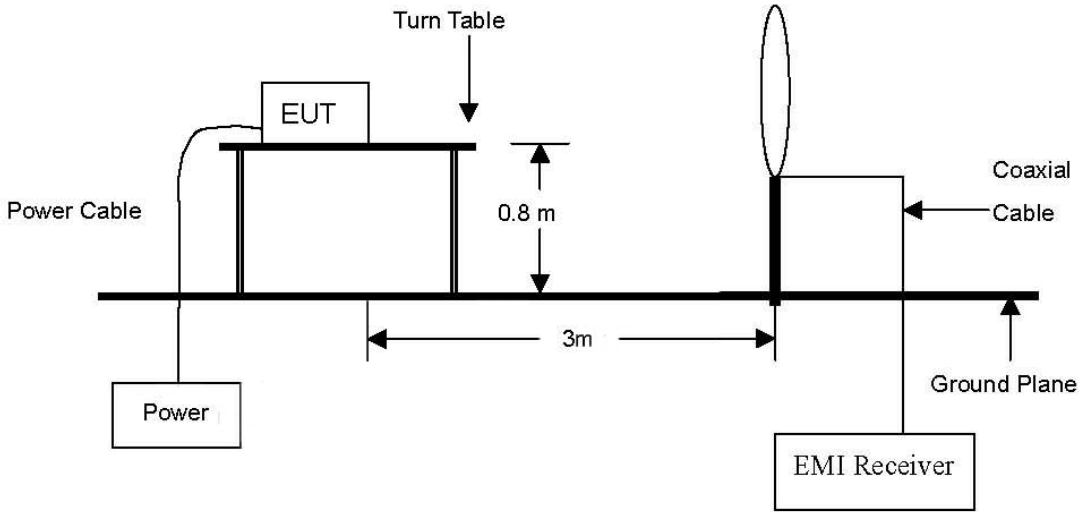
1.10. Information of Software for test

- Operating software of EUT has integrated test interface. No additional software was used.

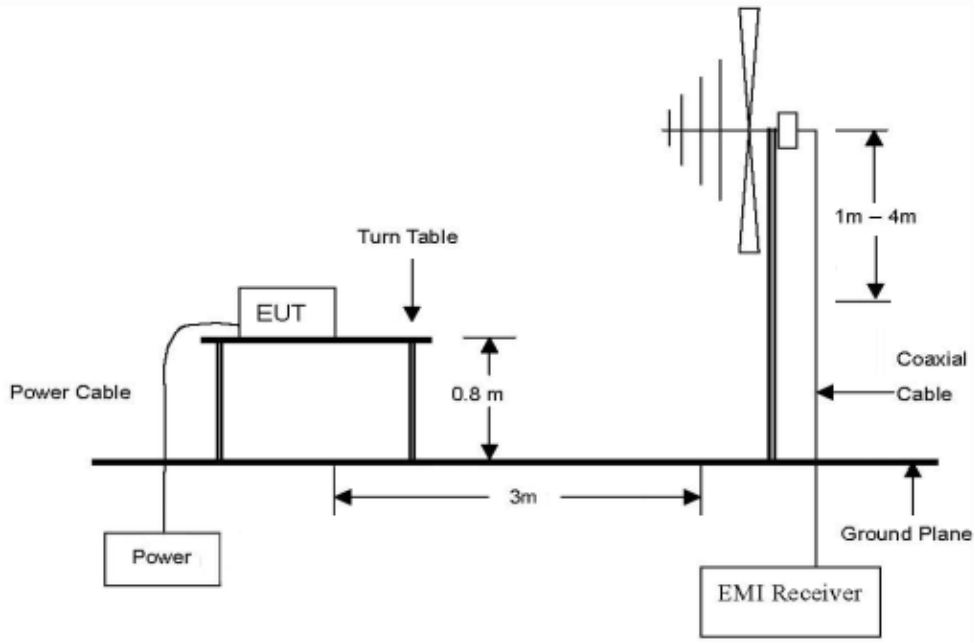
2. Field Strength of Fundamental and Spurious Emission

2.1. Test Setup

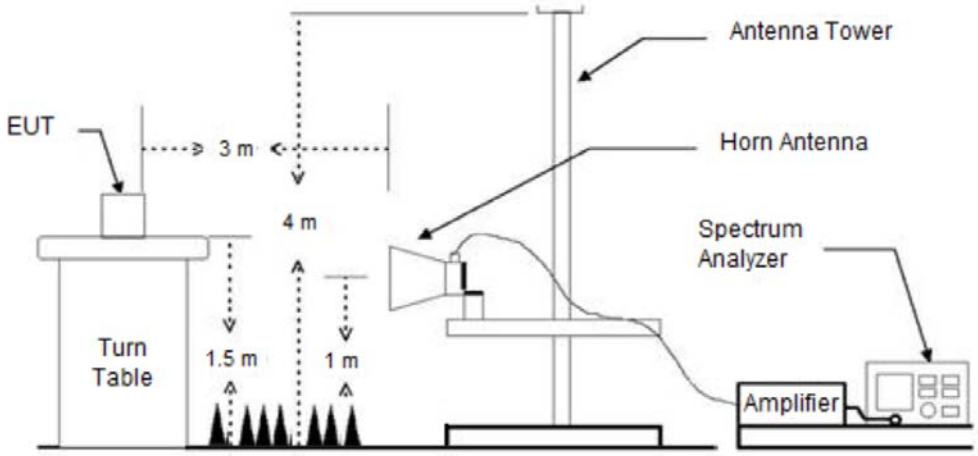
The diagram below shows the test setup that is utilized to make the measurements for emission below 30 ㎒.



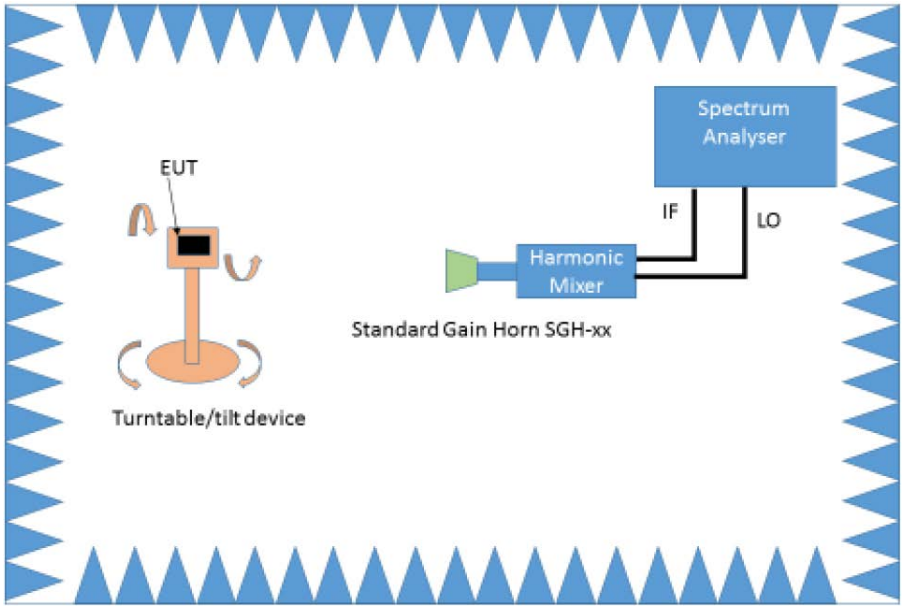
The diagram below shows the test setup that is utilized to make the measurements for emission from 30 ㎒ to 1 ㎓.



The diagram below shows the test setup that is utilized to make the measurements for emission. The spurious emissions were investigated form 1 ㎓ to the 40 ㎓.



The diagram below shows the test setup that is utilized to make the measurements for emission. The spurious emissions were investigated form 40 ㎓ to the 100 ㎓.



2.2. Limit

2.2.1. FCC

2.2.1.1. 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.

2.2.1.2. Operation within the bands 902-928 ㎒, 2 400-2 483.5 ㎒, 5 725-5 875 ㎒, and 24.0-24.25 ㎓

According to §15.249(a), Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency	Field strength of fundamental (㎷/m)	Field strength of harmonics (㎶/m)
902-928 ㎒	50	500
2 400-2 483.5 ㎒	50	500
5 725-5 875 ㎒	50	500
24.0-24.25 ㎓	250	2 500

According to §15.249(d), Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 ㏈ below the level of the fundamental or to the general radiated emission limits in §15.209, whichever the lesser attenuation.

2.2.2. IC

2.2.2.1. Transmitter Emission Limits

According to RSS-Gen Issue 5, 8.9.
Except where otherwise indicated in the applicable RSS, radiated emissions shall comply with the field strength limits shown in table 5 and table 6. Additionally, the level of any transmitter unwanted emission shall not exceed the level of the transmitter's fundamental emission.

Table 5 - General field strength limits at frequencies above 30 ㎒

Frequency (㎒)	Field Strength (㎶/m at 3 m)
30-88	100
88-216	150
216-960	200
Above 960	500

Table 6 - General field strength limits at frequencies below 30 ㎒

Frequency	Magnetic Field Strength (H-Field) (㎂/m)	Measurement Distance (m)
9-490 ㎑ [1]	6.37/F (F in ㎑)	300
490-1 705 ㎑	63.7/F (F in ㎑)	30
1.705-30 ㎒	0.08	30

Note 1: The emission limits for the ranges 9-90 ㎑ and 110-490 ㎑ are based on measurements employing a linear average detector.

2.2.2.2. Bands 902-928 ㎒, 2 400-2 483.5 ㎒, 5 725-5 875 ㎒, and 24.0-24.25 ㎓

According to B.10 of RSS-210 Issue 10.
Devices shall comply with the following requirements:
(a) The field strength of fundamental and harmonic emissions measured at 3 m shall not exceed the limits in table B2.

Table B2 - Field strength limits at various frequencies

Frequency bands (㎒)	Field Strength (㎷/m)	
	Fundamental emissions	Harmonic emissions
902-928	50	0.5
2 400-2 483.5	50	0.5
5 725-5 875	50	0.5
24 000-24 250	250	2.5

The field strength shall be measured using an average detector, except for the fundamental emission in the frequency band 902-928 ㎒, which is based on measurements using an International Special Committee on Radio Interference (CISPR) quasi-peak detector.

(b) Emissions radiated outside of the specified frequency bands, except for harmonic emissions, shall be attenuated by at least 50 ㏈ below the level of the fundamental emissions or to the general field strength limits listed in RSS-Gen, whichever is less stringent.

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 below 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 Peak 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.

2.3.3. Test Procedures for emission above 1 ㎓ to 40 ㎓

a. The EUT was placed on the top of a rotating table 1.5 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. The receiver/spectrum analyzer resolution bandwidth 1 ㎒ and video bandwidth is 3 ㎒ for Peak detection at frequency above 1 ㎓.
c. Above 18 ㎓ shall be extrapolated to the specified distance using an extrapolation factor of 20 ㏈/decade from 3m to 1m.

2.3.4. Test Procedures for emission above 40 ㎓ to 100 ㎓

a. The EUT was placed on the top of a rotating table 1.5 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. The receiver/spectrum analyzer resolution bandwidth 1 ㎒ and video bandwidth is 3 ㎒ for Peak detection at frequency above 1 ㎓.

2.4. Test Result

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

2.4.1. Field Strength of Fundamental and Band edge

All emissions tested both horizontal and vertical. The following table shows the highest levels of radiated emissions on the worst polarization.

- Fundamental

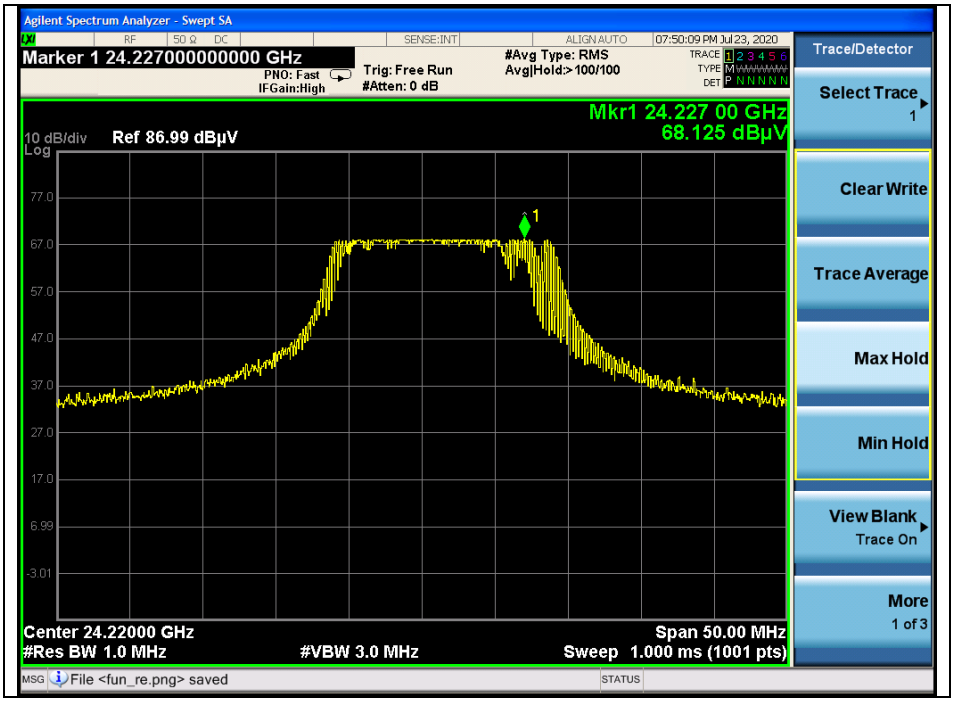
Fundamental Emission			Ant.	Correction Factors			Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Distance Factor (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
24 227.00	68.13	Peak	H	39.43	4.09	-9.54	102.11	127.96	25.85
24 227.00	68.13	Average	H	39.43	4.09	-9.54	102.11	107.96	5.85

Remark;

1. Actual (dB㎶/m)= Reading + AF + CL + Distance Factor.
2. Distance Factor = 20log (specific distance (3m) / measured distance (1m)
3. Average Result = Peak Reading + Duty Cycle Correction Factor
4. DF (Duty Cycle Correction Factor): 20log (T_{on} / 100 ㎳) = 20log (100 / 100) =0
   - T_{on} > 100 ㎳. Used 100 ㎳ for calculation.
   - T_{on+off} > 100 ㎳. Used 100 ㎳ for calculation.

- Test plots

Fundamental (Peak)



- Band edge

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Distance Factor (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
23 996.55	56.01	Peak	H	39.20	-45.53	-9.54	49.68	74.00	24.32
23 998.30	45.01	Average	H	39.20	-45.54	-9.54	38.67	54.00	15.33
24 250.00	69.53	Peak	H	39.45	-45.50	-9.54	63.48	74.00	10.52
24 250.00	57.23	Average	H	39.45	-45.50	-9.54	**51.18**	54.00	2.82

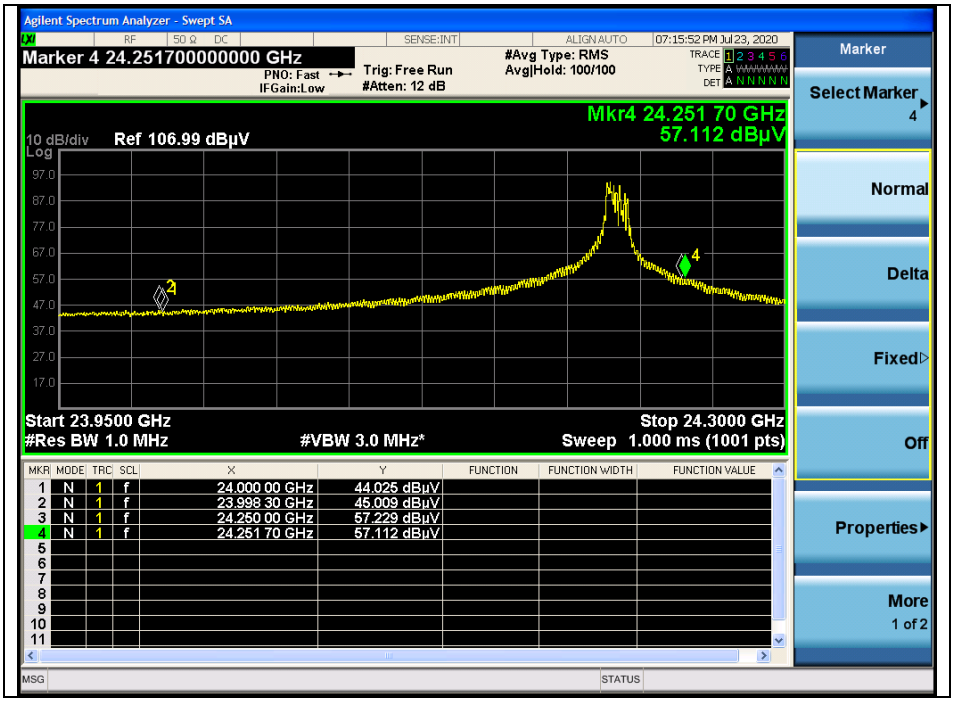
Remark;

1. Actual (dB㎶/m)= Reading + AF + AMP + L + Distance Factor.
2. Distance Factor = 20log (specific distance (3m) / measured distance (1m)
3. Average Result = Peak Reading + Duty Cycle Correction Factor

- Test plots

Band edge (Peak)

Band edge (Average)



2.4.2. Radiated Spurious Emission below 1 000 ㎒

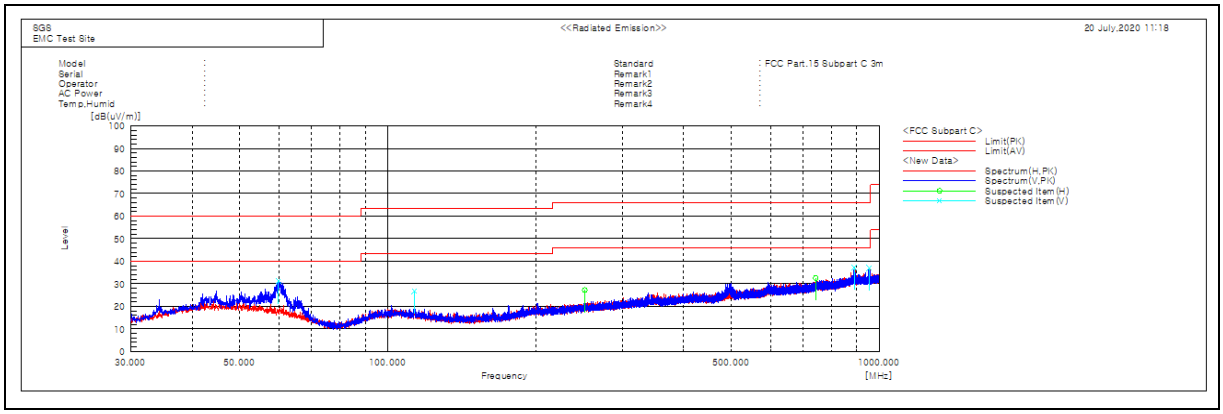
The frequency spectrum from 9 ㎑ to 1 000 ㎒ was investigated. All reading values are peak values.

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP + CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
59.95	40.30	Peak	V	18.11	-27.17	31.24	40.00	8.76
113.22	37.50	Peak	V	16.28	-26.57	27.21	43.50	16.29
251.65	34.70	Peak	H	18.27	-26.53	26.44	46.00	19.56
742.34	31.40	Peak	H	26.65	-25.02	33.03	46.00	12.97
889.78	34.30	Peak	V	27.90	-24.71	37.49	46.00	8.51
952.79	33.60	Peak	V	28.10	-24.41	37.29	46.00	8.71

Remark;

1. Spurious emissions for all channels were investigated and almost the same below 1 ㎓.
3. Radiated spurious emission measurement as below.
   (Actual = Reading + AF + Amp + CL)
4. According to §15.31(o), emission levels are not report much lower than the limits by over 20 ㏈.

- Test plot



2.4.2. Spurious Emission above 1 ㎓ to 40 ㎓

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Distance Factor (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-	-	-	-	-	-

Remarks;

1. Actual = Reading + AF + AMP + CL + (Distance Factor).
2. According to § 15.31(o), emission levels are not reported much lower than the limits by over 20 ㏈.
3. The maximized peak measured value complies with the average limit, to perform an average measurement is unnecessary.
4. Above 18 ㎓, measurement performed at 1m distance instead 3m.
5. Distance Factor = 20log (specific distance (3m) / measured distance (1m).

2.4.3. Spurious Emission above 40 ㎓ to 100 ㎓

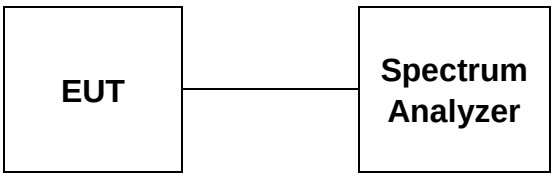
Radiated Emissions			Ant.	Correction Factors				Total	Limit	
Frequency (㎒)	Reading (dB㎷)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Mixer Loss (dB)	Conversion Factors (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
Above 40 000.00	Not detected	-	-	-	-	-	-	-	-	-

Remarks;

1. Actual = Reading + AF + CL + Conversion Factors
2. Conversion Factor = 20 log D - 104.8; where D is the measurement distance in meters (3m)
3. According to § 15.31(o), emission levels are not reported much lower than the limits by over 20 ㏈.
4. The maximized peak measured value complies with the average limit, to perform an average measurement is unnecessary.

3. 20 dB Bandwidth & 99 % Bandwidth

3.1. Test Setup



3.2. Limit

Limit: Not Applicable

3.3. Test Procedure

3.3.1. 20 dB Bandwidth

The test follows ANSI C63.10-2013.

The 20 dB bandwidth was measured with a spectrum analyzer connected to RF antenna connector (conducted measurement) while EUT was operating in transmit mode at the appropriate center frequency.

Use the following spectrum analyzer setting:

Span = approximately 2 to 5 times the 20 dB bandwidth.
RBW ≥ 1 % to 5 % of the 20 dB bandwidth.
VBW ≥ 3 x RBW
Sweep = auto
Detector = peak
Trace = max hold

The marker-to-peak function to set the mark to the peak of the emission. Use the marker-delta function to measure 20 dB 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 dB bandwidth of the emission.

3.3.2. 99 % Bandwidth

The following conditions shall be observed for measuring the occupied bandwidth and x dB bandwidth:

● The transmitter shall be operated at its maximum carrier power measured under normal test conditions.

● The span of the spectrum analyzer shall be set large enough to capture all products of the modulation process, including the emission skirts, around the carrier frequency, but small enough to avoid having other emissions (e.g. on adjacent channels) within the span.

● The detector of the spectrum analyzer shall be set to “Sample”. However, a peak, or peak hold, may be used in place of the sampling detector since this usually produces a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold (or “Max Hold”) may be necessary to determine the occupied / x dB bandwidth if the device is not transmitting continuously.

● The resolution bandwidth (RBW) shall be in the range of 1 % to 5 % of the actual occupied / x dB bandwidth and the video bandwidth (VBW) shall not be smaller than three times the RBW value. Video averaging is not permitted.

Note: It may be necessary to repeat the measurement a few times until the RBW and VBW are in compliance with the above requirement.

For the 99 % emission bandwidth, the trace data points are recovered and directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5 % of the total is reached, and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded. The difference between the two recorded frequencies is the occupied bandwidth (or the 99 % emission bandwidth).

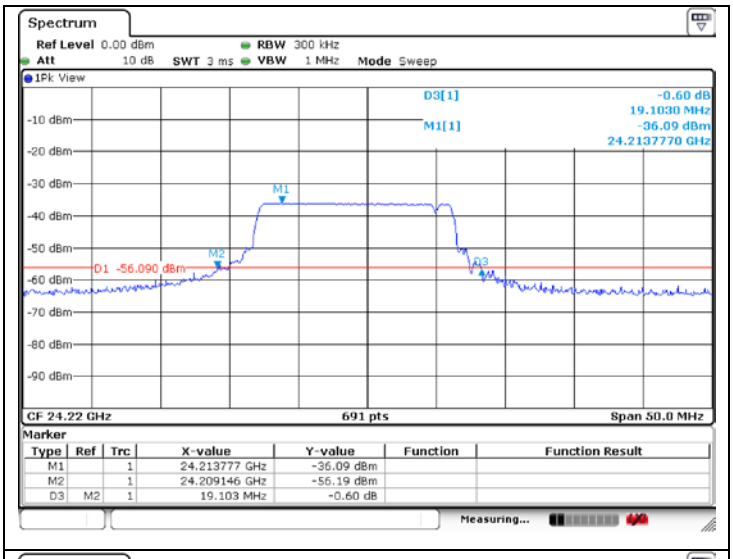
3.4. Test Result

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

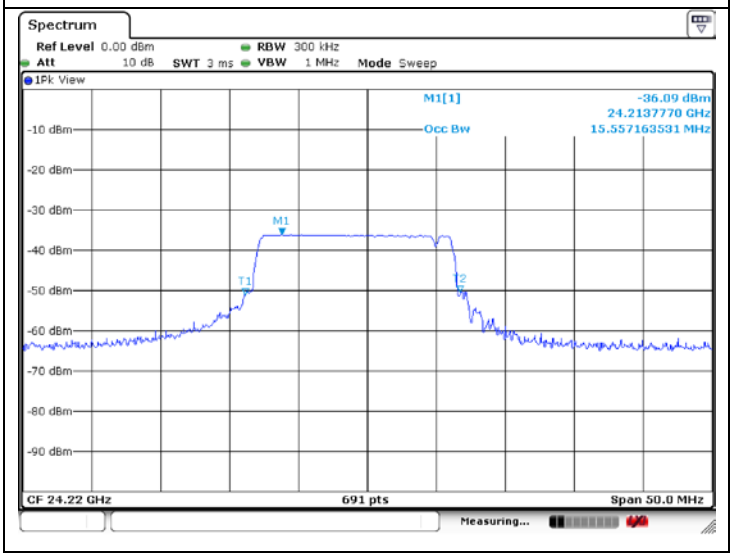
Frequency (㎓)	20 ㏈ Bandwidth (㎒)	99 % Bandwidth (㎒)
24.22	19.103	15.557

- Test plots

20 ㏈ Bandwidth



99 % Bandwidth



4. Antenna Requirement

4.1. Standard Applicable

For intentional device, according to FCC 47 CFR Section §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.

4.2. Antenna Connected Construction

Antenna used in this product is Patch Antenna with gain of 7 dBi.

- End of the Test Report -