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TEST REPORT

of

FCC Part 15 Subpart C §15.225

FCC ID: NYOMBECNWPC2307

Equipment Under Test	:	UNIT ASSY-WIRELESS CHARGING NFC
Model Name	:	MBECNWPC2307
Variant Model Name(s)	:	-
Applicant	:	MOBASE ELECTRONICS CO., LTD.
Manufacturer	:	MOBASE ELECTRONICS CO., LTD.
Date of Receipt	:	2023.03.01
Date of Test(s)	:	2023.03.02 ~ 2023.06.28
Date of Issue	:	2023.06.28

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.
3) This test report cannot be reproduced, except in full, without prior written permission of the Company.
4) The data marked ※ in this report was provided by the customer and may affect the validity of the test results. We are responsible for all the information of this test report except for the data(※) provided by the customer.

Tested by: Murphy Kim

Technical Manager: Jinhyoung Cho

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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

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Phone No. : +82 31 688 0901
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1.2. Details of Applicant

Applicant : MOBASE ELECTRONICS CO., LTD.
Address : 100, Saneop-ro 156beon-gil, Gwonseon-gu, Suwon-si, Gyeonggi-do, South Korea, 16648
Contact Person : Ryu, Hee-tack
Phone No. : +82 31 8090 2611

1.3. Details of manufacturer

Company : Same as applicant
Address : Same as applicant

1.4. Description of EUT

Kind of Product	UNIT ASSY-WIRELESS CHARGING NFC
Model Name	MBECNWPC2307
Serial Number	001
Power Supply	DC 12 V
Frequency Range	13.56 ㎒ (NFC)
Modulation Technique	ASK
Number of Channels	1 channel
Antenna Type	PCB pattern antenna
Antenna Part Number	N/A
H/W Version	1.0
S/W Version	1.0

1.5. Test Equipment List

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Interval	Cal. Due
Spectrum Analyzer	Agilent	N9020A	MY53421758	Aug. 26, 2022	Annual	Aug. 26, 2023
DC Power Supply	Agilent	U8002A	MY50020026	Nov. 30, 2022	Annual	Nov. 30, 2023
Temperature Chamber	ESPEC CORP.	SH-662	93000533	Jun. 01, 2023	Annual	Jun. 01, 2024
Spectrum Analyzer	R&S	FSV30	103210	Dec. 07, 2022	Annual	Dec. 07, 2023
Signal Generator	R&S	SMBV100A	259067	Jun. 15, 2023	Annual	Jun. 15, 2024
Amplifier	H.P.	8447F	2944A03909	Aug. 04, 2022	Annual	Aug. 04, 2023
Loop Antenna	Schwarzbeck Mess-Elektronik	FMZB 1519	1519-039	Aug. 23, 2021	Biennial	Aug. 23, 2023
Bilog Antenna	Schwarzbeck Mess-Elektronik	VULB9163	01126	Feb. 09, 2023	Annual	Feb. 09, 2024
Test Receiver	R&S	ESU26	100109	Jan. 18, 2023	Annual	Jan. 18, 2024
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	CO3000/963/38 330516/L	N.C.R.	N/A	N.C.R.
Antenna Mast	Innco systems GmbH	MA4640-XP-ET	MA4640/536/38 330516/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	RFONE	PL360P-292M292M-1.5 M-A	20200324002	Apr. 14, 2023	Semi-Annual	Oct. 14, 2023
Coaxial Cable	RFONE	MWX221-NMSNMS (4 m)	J1023142	Apr. 04, 2023	Semi-Annual	Oct. 04, 2023
Coaxial Cable	Qualwave Inc.	QA500-18-NN-10 (10 m)	22200114	Apr. 04, 2023	Semi-Annual	Oct. 04, 2023

Note;

- For equipment listed above that has a calibration date or calibration due date that falls within the test date range, care was taken to ensure that this equipment was used after the calibration date and before the calibration due date.

1.6. Summary of Test Results

The EUT has been tested according to the following specifications:

Applied standard : FCC Part 15 subpart C		
Section	**Test item(s)**	**Result**
15.225(a)(b)(c)(d) 15.209	Radiated Emission, Spurious Emission and Field Strength of Fundamental	Complied
15.225(e)	Frequency Stability	Complied
15.215(c)	20 dB Bandwidth	Complied
15.207	AC Power Line Conducted Emissions	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. Sample calculation

Where relevant, the following sample calculation is provided:

1.7.1. Radiation test

Field strength level (dBμV/m) = Measured level (dBμV) + Antenna factor (dB) + Cable loss (dB) - amplifier (dB)

1.8. Information of software for test.

Using the software of Internal to testing of EUT.

1.9. Measurement Uncertainty

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

Parameter	Uncertainty	
20 dB Bandwidth	0.04 kHz	
Radiated Emission, 9 kHz to 30 MHz	H	3.40 dB
	V	3.40 dB
Radiated Emission, below 1 GHz	H	4.50 dB
	V	5.10 dB

All measurement uncertainty values are shown with a coverage factor *k* = 2 to indicate a 95 % level of confidence.

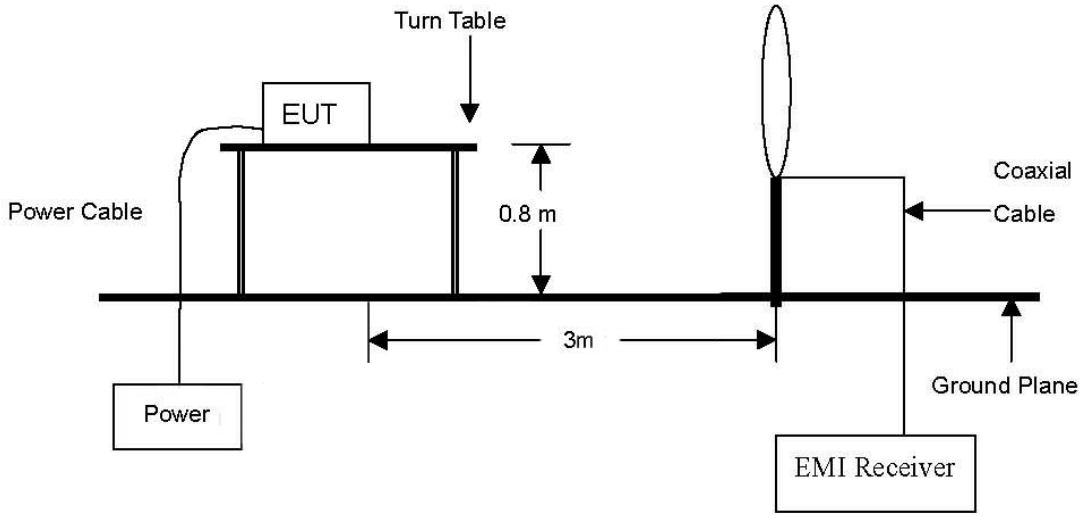
1.10. Test report revision

Revision	Report number	Date of Issue	Description
0	F690501-RF-RTL004187	2023.06.28	Initial

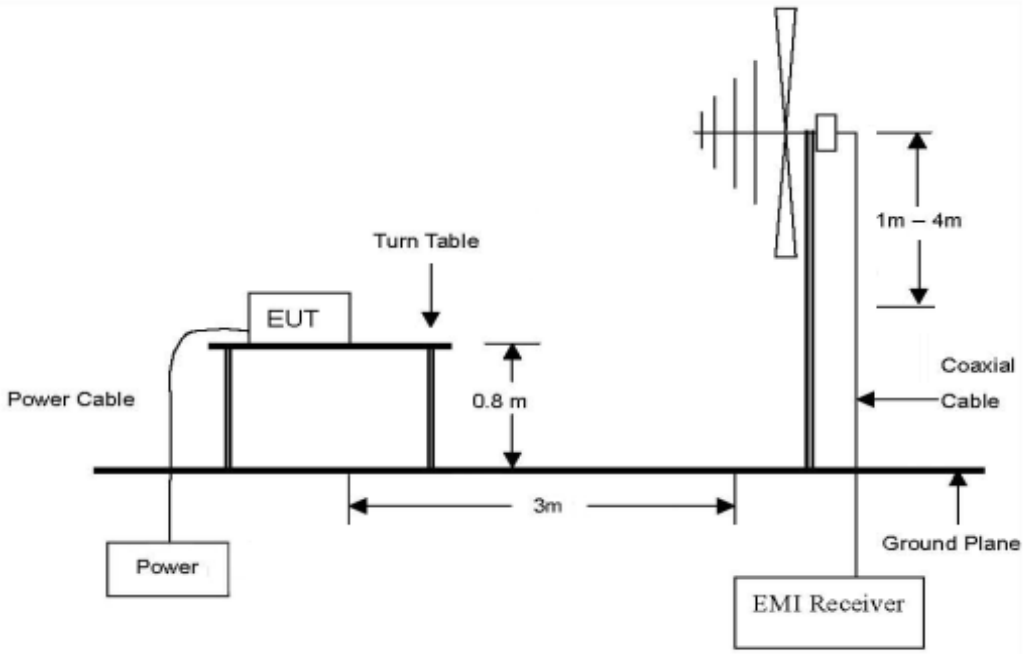
2. Radiated Emissions

2.1. Test Setup

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



The diagram below shows the test setup that is utilized to make the measurements for emission from 30 ㎒ to 1 000 ㎒ Emissions.



2.2. Limit

According to §15.225,
(a) The field strength of any emissions within the band 13.553-13.567 ㎒ shall not exceed 15 848 microvolts/meter at 30 meters.
(b) Within the bands 13.410-13.553 ㎒ and 13.567-13.710 ㎒, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.
(c) Within the bands 13.110-13.410 ㎒ and 13.710-14.010 ㎒ the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.
(d) The field strength of any emissions appearing outside of the 13.110-14.010 ㎒ band shall not exceed the general radiated emission limits in §15.209.

According to §15.209,
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	2400/F(㎑)	300
0.490-1.705	24000/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 below 30 ㎒

1. 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.
2. 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.
3. 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.
4. The test-receiver system was set to Quasi peak Detect Function with Maximum Hold Mode.

2.3.2. Test Procedures for emission above 30 ㎒

1. 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.
2. 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.
3. The antenna is a bi-log 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.
4. 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.
5. For measurements below 1 ㎓ resolution bandwidth is set to 100 ㎑ for peak detection measurements or 120 ㎑ for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

Note;

The radiation test of the EUT was investigated in three orthogonal orientations X, Y, and Z, and the worst case data is reported.

2.4. Test Result

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

The following table shows the highest levels of radiated emissions.

- Fundamental within the band 13.553 ㎒ - 13.567 ㎒

Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	Ant. Factor (dB/m)	Cable loss (dB)	Actual (dB㎶/m) at 3 m	Actual (dB㎶/m) at 30 m	Limit (dB㎶/m) at 30 m	Margin (dB)
13.560	59.19	Peak	H	19.00	0.27	78.46	38.46	84.00	45.54

- Spurious emission within the bands 13.410 ㎒ - 13.553 ㎒ and 13.567 ㎒ - 13.710 ㎒

Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	Ant. Factor (dB/m)	Cable loss (dB)	Actual (dB㎶/m) at 3 m	Actual (dB㎶/m) at 30 m	Limit (dB㎶/m) at 30 m	Margin (dB)
13.553	51.49	Peak	H	19.00	0.27	70.76	30.76	50.47	19.71
13.567	53.82	Peak	H	19.00	0.27	73.09	33.09	50.47	17.38

- Spurious emission within the bands 13.110 ㎒ - 13.410 ㎒ and 13.710 ㎒ - 14.010 ㎒

Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	Ant. Factor (dB/m)	Cable loss (dB)	Actual (dB㎶/m) at 3 m	Actual (dB㎶/m) at 30 m	Limit (dB㎶/m) at 30 m	Margin (dB)
13.384	20.75	Peak	H	19.00	0.26	40.01	0.01	40.51	40.50
13.410	23.70	Peak	H	19.00	0.26	42.96	2.96	29.54	26.58
13.983	18.16	Peak	H	19.00	0.30	37.46	-2.54	40.51	43.05

- Spurious emission within the bands 9 ㎑ - 13.110 ㎒

Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	Ant. Factor (dB/m)	Cable loss (dB)	Actual (dB㎶/m) at 3 m	Actual (dB㎶/m) at 30 or 300 m	Limit (dB㎶/m) at 30 or 300 m	Margin (dB)
13.032	35.27	Peak	H	19.00	0.24	54.51	14.51	29.54	15.03
Above 14.000	Not detected								

- Spurious emission within the bands 14.010 ㎒ - 30 ㎒

Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	Ant. Factor (dB/m)	Cable loss (dB)	Actual (dB㎶/m) at 3 m	Actual (dB㎶/m) at 30 m	Limit (dB㎶/m) at 30 m	Margin (dB)
14.473	9.53	Peak	H	19.00	0.34	28.87	-11.13	29.54	40.67
16.421	7.24	Peak	H	19.23	0.42	26.89	-13.11	29.54	42.65
25.509	7.17	Peak	H	19.20	0.56	26.93	-13.07	29.54	42.61
Above 26.000	Not detected	-	-	-	-	-	-	-	-

Remark;

1. Fundamental limit (㎶/m) = 20 log(15 848) = 84.00 dB㎶/m.
2. 30 m distance compensation = 40 log(3/30) = -40 dB㎶/m.
3. 300 m distance compensation = 40 log(3/300) = -80 dB㎶/m.
4. "*" means the restricted band.
5. If the spurious emissions are in the restricted band, the limit complied with §15.209.
6. All data were recorded using a spectrum analyzer employing a peak detector.
   If PK results were meet Quasi-peak limit, Quasi-peak measurements were omitted.
7. Radiated spurious emission measurement as below 30 ㎒.
   (Actual (dB㎂/m) at 3m = Reading (dB㎶) + AF (dB/m) + CL (dB))

- Spurious emission above 30 ㎒

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Freq. (㎒)	**Reading (dB㎶)**	**Detect Mode**	**Pol.**	**Ant. Factor (dB/m)**	**AMP + CL (dB)**	**Actual (dB㎶/m) at 3 m**	**Limit (dB㎶/m) at 3 m**	**Margin (dB)**
40.67	46.50	Peak	H	18.60	-27.45	37.65	40.00	2.35
54.25	45.60	Peak	H	19.35	-27.26	37.69	40.00	2.31
75.51	47.40	Peak	H	13.10	-27.04	33.46	40.00	6.54
108.45	40.90	Peak	H	17.41	-26.82	31.49	43.50	12.01
216.97	43.00	Peak	H	16.85	-25.90	33.95	46.00	12.05
325.45	43.90	Peak	H	19.67	-25.32	38.25	46.00	7.75
Above 400.00	Not detected	-	-	-	-	-	-	-

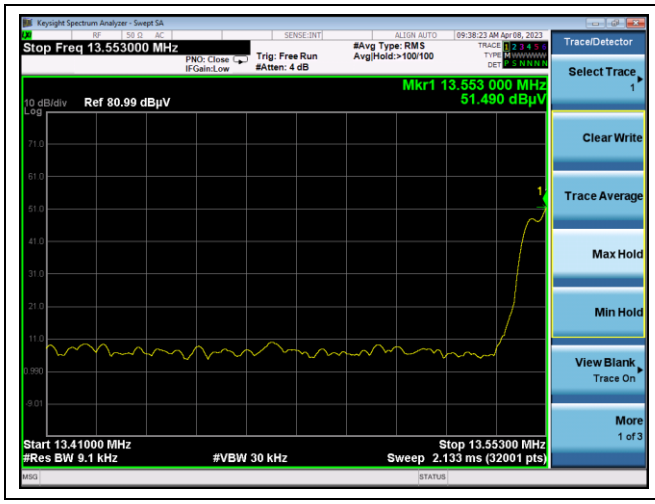
Remark;

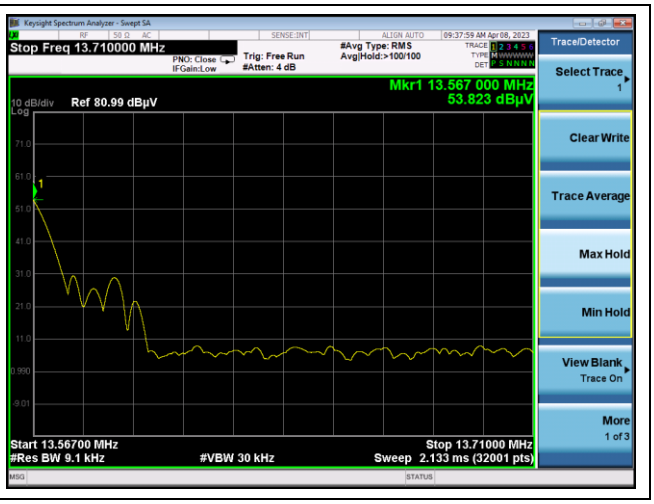
1. Radiated spurious emission measurement as below.
   (Actual = Reading + Antenna Factor + Amp + CL)
2. According to §15.31(o), emission levels are not report much lower than the limits by over 20 dB.
3. Radiated spurious emission measurement as above 30 ㎒.
   (Actual (dB㎂/m) = Reading (dB㎶) + AF (dB/m) + CL (dB) + AMP (dB))

Test plots

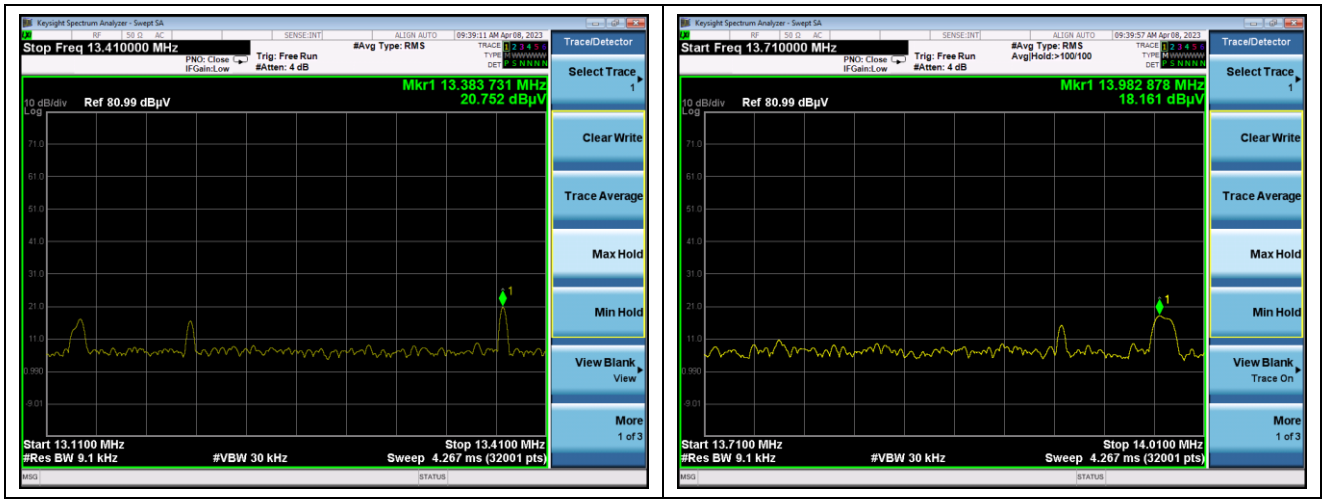
- Fundamental within the band 13.553 ㎒ - 13.567 ㎒

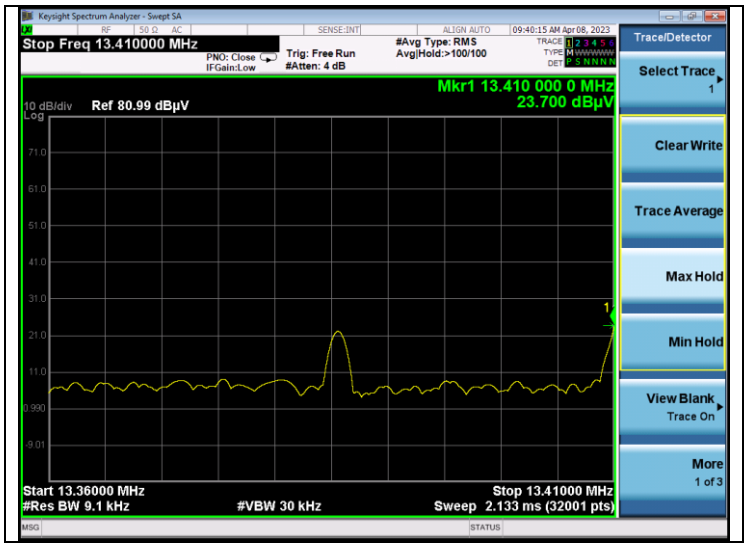
- Spurious emission within the bands 13.410 ㎒ - 13.553 ㎒ and 13.567 ㎒ - 13.710 ㎒



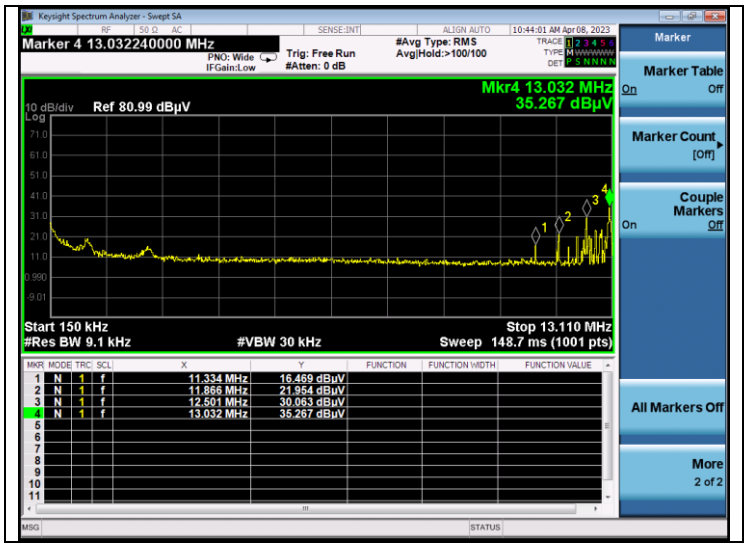


- Spurious emission within the bands 13.110 ㎒ - 13.410 ㎒ and 13.710 ㎒ - 14.010 ㎒

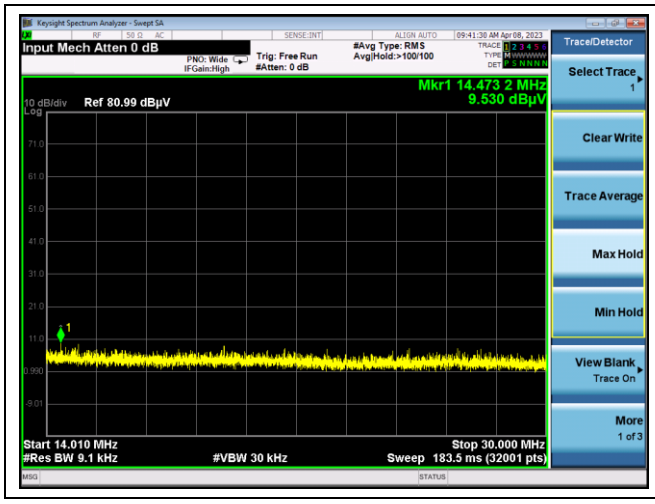


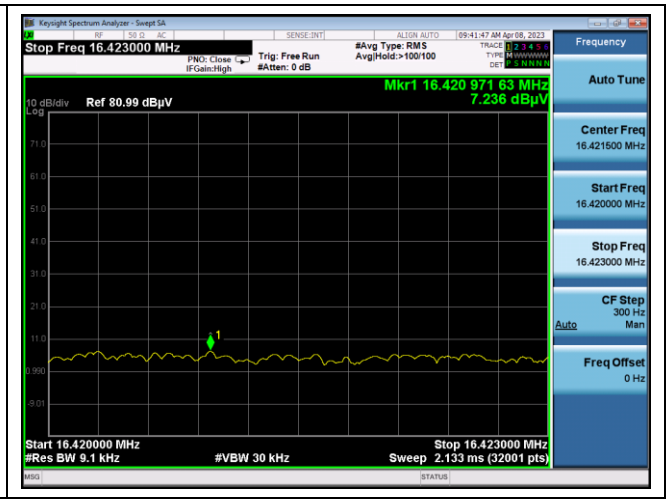


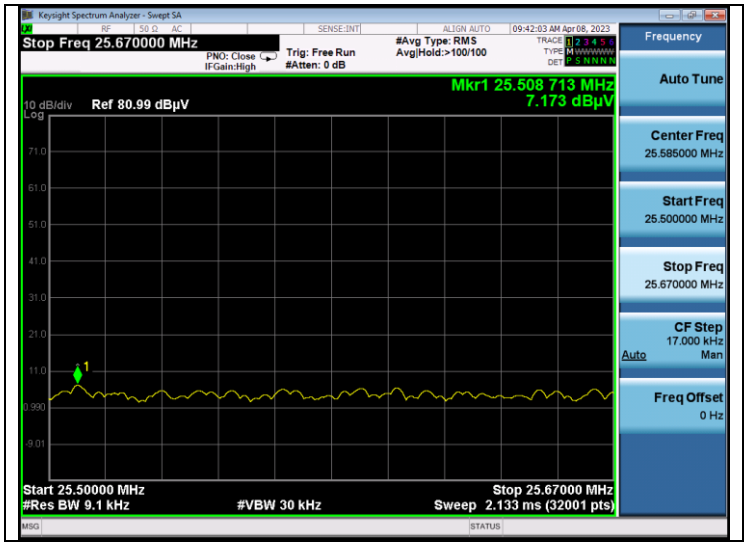
- Spurious emission within the bands 9 ㎑ – 13.110 ㎒



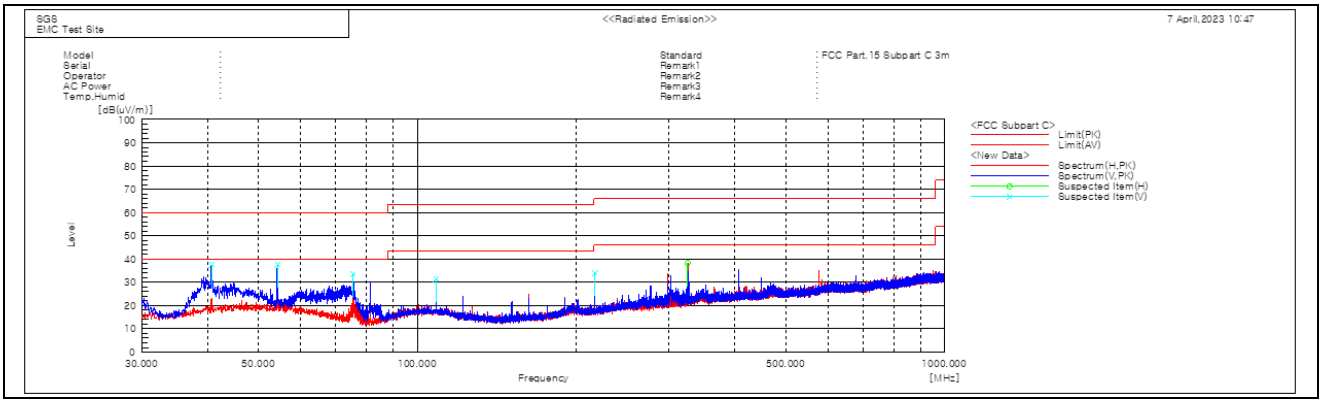
- Spurious emission within the bands 14.010 ㎒ – 30 ㎒





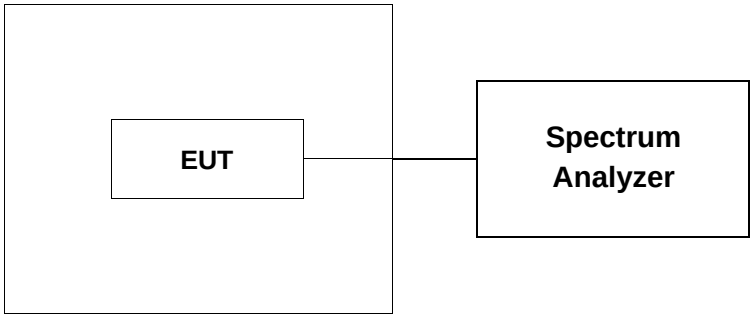


- Spurious emission above 30 ㎒



3. Frequency Stability

3.1. Test Setup



3.2. Limit

According to §15.225(e), the frequency tolerance of the carrier signal shall be maintained within ± 0.01 % of the operating frequency over a temperature variation of -20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85 % to 115 % of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

3.3. Test Procedures

1. Place the EUT on the table and set it in the transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set the environment into appropriate environment.
4. Set the spectrum analyzer as RBW = 100 ㎐, VBW = 100 ㎐, Span = 10 ㎑, Sweep time = auto.
5. Mark the peak frequency and measure the frequency tolerance using frequency counter function.
6. Repeat until all the results are investigated.

3.4. Test Result

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

Startup

Temperature Variations

Power ($V_{d.c}$)	Temperature (℃)	Frequency (㎐)	Freq. Dev. (㎐)	Deviation (%)
12	-20	13 560 859	336	0.000 025
	-10	13 560 813	290	0.000 021
	0	13 560 739	216	0.000 016
	+10	13 560 729	206	0.000 015
	+20(Ref.)	13 560 523	-	-
	+30	13 560 481	-42	-0.000 003
	+40	13 560 493	-30	-0.000 002
	+50	13 560 469	-54	-0.000 004

Voltage Variations

Power ($V_{d.c}$)	Temperature (℃)	Frequency (㎐)	Freq. Dev. (㎐)	Deviation (%)
115 % (13.80)	+20	13 560 633	110	0.000 008
85 % (10.20)	+20	13 560 639	116	0.000 009

2 minutes

Temperature Variations

Power ($V_{d.c}$)	Temperature (℃)	Frequency (㎐)	Freq. Dev. (㎐)	Deviation (%)
12	-20	13 560 869	139	0.000 010
	-10	13 560 809	79	0.000 006
	0	13 560 797	67	0.000 005
	+10	13 560 679	-51	-0.000 004
	+20(Ref.)	13 560 730	-	-
	+30	13 560 505	-225	-0.000 017
	+40	13 560 455	-275	-0.000 020
	+50	13 560 387	-343	-0.000 025

Voltage Variations

Power ($V_{d.c}$)	Temperature (℃)	Frequency (㎐)	Freq. Dev. (㎐)	Deviation (%)
115 % (13.80)	+20	13 560 635	-95	-0.000 007
85 % (10.20)	+20	13 560 637	-93	-0.000 007

5 minutes

Temperature Variations

Power ($V_{d.c}$)	Temperature (℃)	Frequency (㎐)	Freq. Dev. (㎐)	Deviation (%)
12	-20	13 560 877	224	0.000 017
	-10	13 560 805	152	0.000 011
	0	13 560 769	116	0.000 009
	+10	13 560 661	8	0.000 001
	+20(Ref.)	13 560 653	-	-
	+30	13 560 485	-168	-0.000 012
	+40	13 560 435	-218	-0.000 016
	+50	13 560 377	-276	-0.000 020

Voltage Variations

Power ($V_{d.c}$)	Temperature (℃)	Frequency (㎐)	Freq. Dev. (㎐)	Deviation (%)
115 % (13.80)	+20	13 560 635	-18	-0.000 001
85 % (10.20)	+20	13 560 637	-16	-0.000 001

10 minutes

Temperature Variations

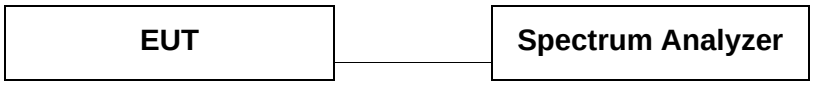
Power ($V_{d.c}$)	Temperature (℃)	Frequency (㎐)	Freq. Dev. (㎐)	Deviation (%)
12	-20	13 560 879	326	0.000 024
	-10	13 560 819	266	0.000 020
	0	13 560 749	196	0.000 014
	+10	13 560 641	88	0.000 006
	+20(Ref.)	13 560 553	-	-
	+30	13 560 485	-68	-0.000 005
	+40	13 560 425	-128	-0.000 009
	+50	13 560 371	-182	-0.000 013

Voltage Variations

Power ($V_{d.c}$)	Temperature (℃)	Frequency (㎐)	Freq. Dev. (㎐)	Deviation (%)
115 % (13.80)	+20	13 560 633	80	0.000 006
85 % (10.20)	+20	13 560 637	84	0.000 006

4. 20 dB Bandwidth

4.1. Test Setup



4.2. Limit

None; for reporting purposes only.

4.3. Test Procedures

1. Span = set to capture all products of the modulation process, including the emission skirts. RBW = 200 Hz, VBW = 200 Hz, Sweep = auto, Detector = peak, Trace = max hold.
2. 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.

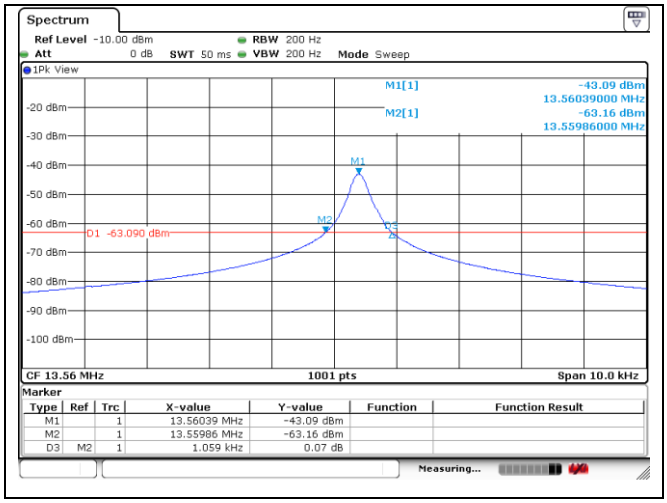
4.3. Test Result

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

Frequency (㎒)	20 ㏈ Bandwidth (㎑)
13.560	1.059

-Test plot

20 ㏈ Bandwidth



-End of the Test report-