TEST REPORT

of

FCC Part 15 Subpart C §15.249

FCC ID: WU2SMRSMINISYNC

Equipment Under Test	:	Digital Radio Slave
Model Name	:	MINI SYNC
Applicant	:	SMDV
Manufacturer	:	SMDV
Date of Receipt	:	2018.05.31
Date of Test(s)	:	2018.07.06 ~ 2018.07.26
Date of Issue	:	2018.08.03

In the configuration tested, the EUT complied with the standards specified above.

Tested By:  **Date:** **2018.08.03**

Jinhyoung Cho

Technical Manager:  **Date:** **2018.08.03**

Harim Lee

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1. General information

1.1. Testing Laboratory

SGS Korea Co., Ltd. (Gunpo Laboratory)
- Wireless Div. 2FL, 10-2, 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 : SMDV
Address : 1532, Nakdongdae-Ro, Sasang-Gu, Busan, Korea, 46901
Contact Person : Kim, Jong-seok
Phone No. : +82 51 324 0788

1.3. Details of Manufacturer

Applicant : Same as applicant
Address : Same as applicant

1.4. Description of EUT

Kind of Product	Digital Radio Slave
Model Name	MINI SYNC
Power Supply	DC 3.0 V
Frequency Range	2 427 ㎒ ~ 2 457 ㎒
Modulation Technique	FSK
Number of Channels	16 channels
Antenna Type	PIFA antenna
Antenna Gain	1.16 ㏈i

1.5. Test Equipment List

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Interval	Cal. Due
Signal Generator	R&S	SMBV100A	259067	Jun. 15, 2018	Annual	Jun. 15, 2019
Signal Generator	Agilent	E8257D	MY51501169	Jul. 03, 2018	Annual	Jul. 03, 2019
Spectrum Analyzer	Agilent	N9020A	MY53421758	Sep. 25, 2017	Annual	Sep. 25, 2018
Spectrum Analyzer	R&S	FSV30	100768	Mar. 12, 2018	Annual	Mar. 12, 2019
High Pass Filter	Wainwright Instrument GmbH	WHK3.0/18G-6SS	4	Jun. 14, 2018	Annual	Jun. 14, 2019
High Pass Filter	Wainwright Instrument GmbH	WHNX7.5/26.5G-6SS	15	Jun. 11, 2018	Annual	Jun. 11, 2019
Low Pass Filter	Mini-Circuits	NLP-1200+	V8979400903-2	Feb. 22, 2018	Annual	Feb. 22, 2019
DC Power Supply	R&S	HMP2020	020089489	May 30, 2018	Annual	May 30, 2019
Preamplifier	H.P.	8447F	2944A03909	Aug. 11, 2017	Annual	Aug. 11, 2018
Signal Conditioning Unit	R&S	SCU-18	102244	Sep. 22, 2017	Annual	Sep. 22, 2018
Loop Antenna	Schwarzbeck Mess-Elektronik	FMZB 1519	1519-039	Aug. 23, 2017	Biennial	Aug. 23, 2019
Bilog Antenna	Schwarzbeck Mess-Elektronik	VULB 9163	01126	Mar. 26, 2018	Biennial	Mar. 26, 2020
Horn Antenna	R&S	HF906	100326	Feb. 14, 2018	Biennial	Feb. 14, 2020
Horn Antenna	Schwarzbeck Mess-Elektronik	BBHA 9170	9170-540	Jul. 17, 2017	Biennial	Jul. 17, 2019
Horn Antenna	Schwarzbeck Mess-Elektronik	BBHA 9170	BBHA9170223	Aug. 25, 2016	Biennial	Aug. 25, 2018
Turn Table	INN-CO systems	CONTROLLER CO3000	N/A	N. C. R	N/A	N. C. R
Antenna Master	INN-CO systems	MA4640-XP-ET	N/A	N. C. R	N/A	N. C. R
Test Receiver	R&S	ESU26	100109	Jan. 07, 2018	Annual	Jan. 07, 2019
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	Jul. 04, 2018	Semi-annual	Jan. 04, 2019
Coaxial Cable	SUCOFLEX	104 (10 m)	MY3145814	Jul. 04, 2018	Semi-annual	Jan. 04, 2019

1.6. Summary of Test Results

The EUT has been tested according to the following specifications:

Applied Standard: FCC Part15 Subpart C		
Section	**Test Item**	**Result**
15.205 15.209(a) 15.249(a) 15.249(c) 15.249(d)	Fundamental and Radiated Spurious emission	Complied
15.215(c)	20 dB Bandwidth	Complied

1.7. Test Procedure(s)

The measurement procedures described in the American National Standard of Procedure for Compliance Testing of unlicensed Wireless Devices (ANSI C63.10-2013) was used in the measurement of the DUT.

1.8. Sample Calculation

Where relevant, the following sample calculation is provided

1.8.1. Radiation Test

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

1.9. Measurement Uncertainty

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

Parameter	Uncertainty (dB)
Radiated Disturbance, 9 kHz to 30 MHz	±3.59
Radiated Disturbance, below 1 GHz	±5.88
Radiated Disturbance, above 1 GHz	±5.94

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-RTL012946	2018.08.03	Initial

1.11. Duty Cycle Correction Factor of EUT

According to 15.35 (c), as a "duty cycle correction factor"
Average Reading = Peak Reading (dBμV/m) + 20log (Duty Cycle)

In order to determine possible Maximum Modulation percentage, alternations are made to the EUT.
We measured;

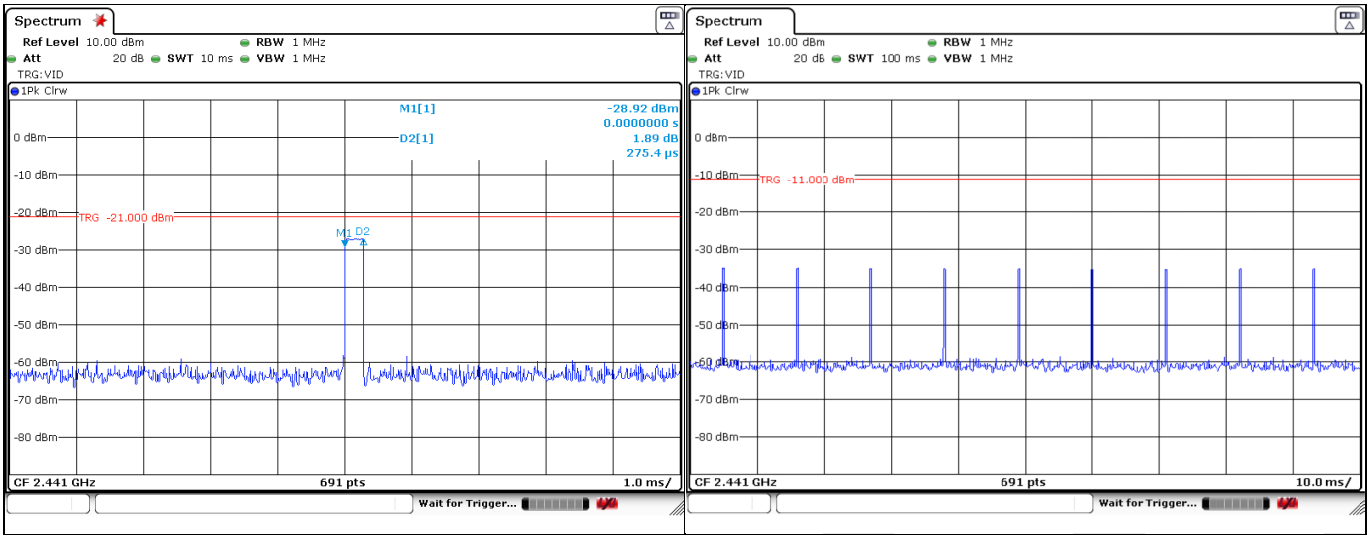
T_{on+off}	T_{on}	M % = (T_{on} / T_{on+off}) * 100 %	Duty Correction Factor
100 ㎳	2.479 ㎳	2.479	-32.11

T_{on+off} = 100 ㎳
T_{on} = 0.275 4 ㎳ x 9
2.479 ㎳
Duty Cycle = 20log (T_{on} / T_{on+off}) = 20log (2.479 / 100) = -32.11

Remark;

- T_{on+off} > 100 ㎳. Use 100 ㎳ for calculation

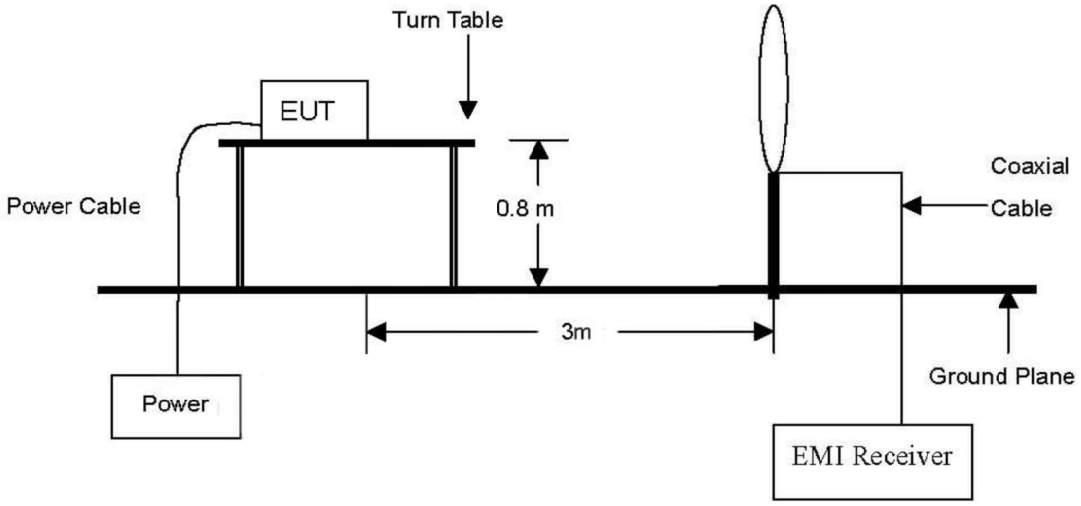
- Test plot



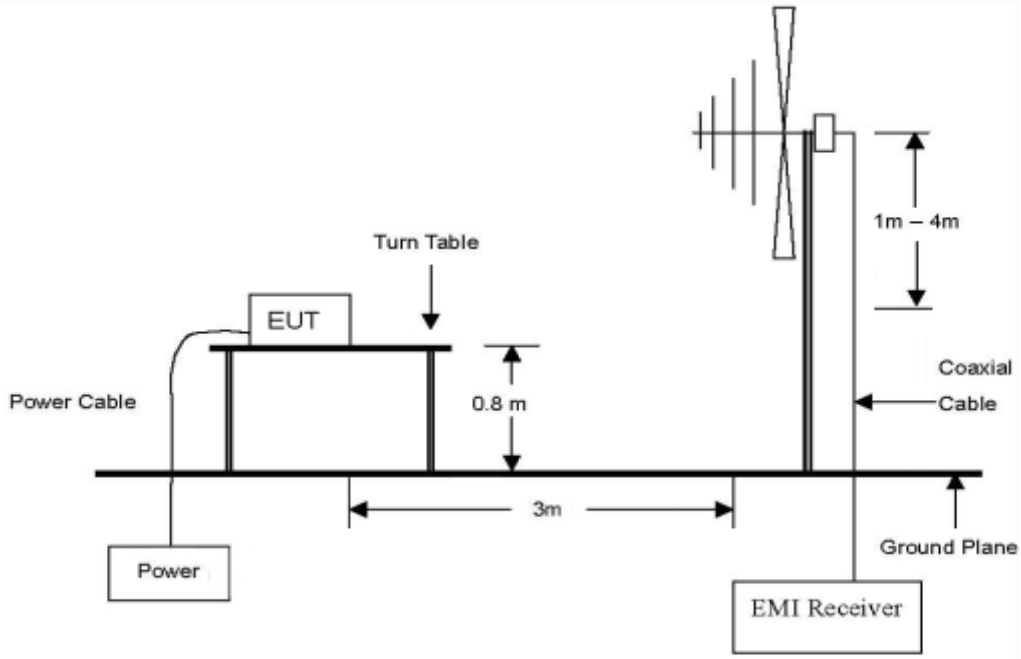
2. Fundamental and Radiated Spurious Emission

2.1. Test Setup

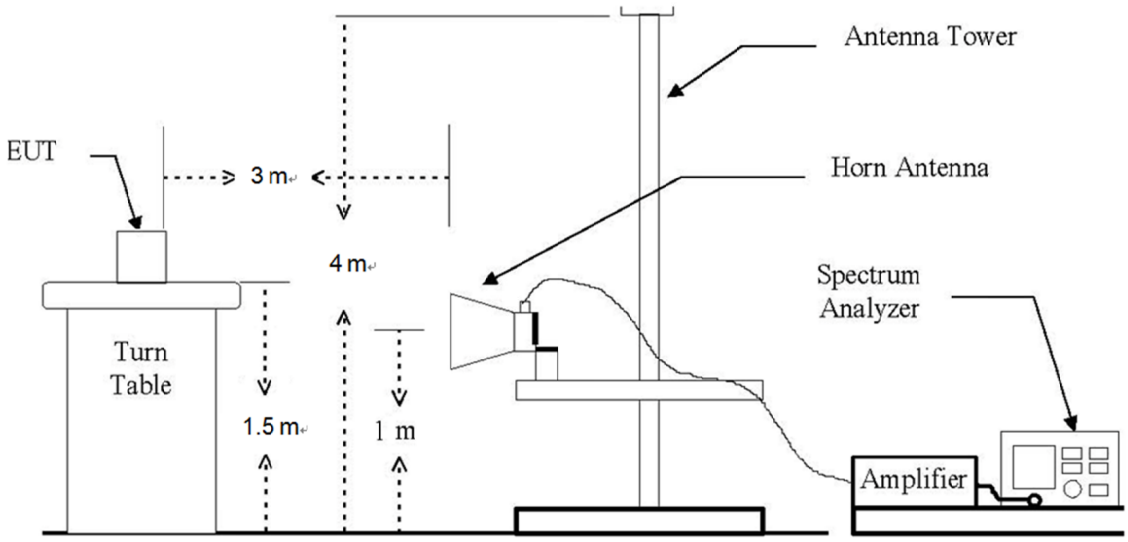
The diagram below shows the test setup that is utilized to make the measurements for emission from 9 ㎑ to 30 ㎒ Emissions.



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



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 10th harmonic of the highest fundamental frequency or 40 ㎓, whichever is lower.



2.2. Limit

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.

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 (㎶/m)**	**Measurement distance (Meters)**
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 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 average or quasi peak detect function and Specified Bandwidth with Maximum Hold Mode.

Note;

- Although these tests were performed other than open field test site, adequate comparison measurements were confirmed against 30 meter open field test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788 D01 Radiated Test Site v01r01.

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 below 1 ㎓ and 1.5 meters above the ground at a 3 meter anechoic chamber test site above 1 ㎓. 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. During performing radiated emission above 1 ㎓, the EUT was set 3 meter away from the interference-receiving antenna.
3. The antenna is a bi-log antenna, a horn 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. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
6. If the emission level of the EUT in peak mode was 10 ㏈ lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10 ㏈ margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

Note;

1. For frequency below 1 ㎓, set spectrum analyzer detector to peak, and resolution bandwidth is 100 ㎑ and video bandwidth is 300 ㎑.
2. For frequency above 1 ㎓, set spectrum analyzer detector to peak, and resolution bandwidth is 1 ㎒ and video bandwidth is 3 ㎒.
3. According to 15.35 (c), as a “duty cycle correction factor”, pulse averaging with 20 log (worst case dwell time / 100 ㎳) has to be used for average result.
4. To get a maximum emission level from the EUT, the EUT is manipulated through three orthogonal planes (X, Y, Z). Worst orthogonal plan of EUT is **Y – axis** during radiation test.

2.4. Test Result

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

2.4.1. Field Strength of Fundamental

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

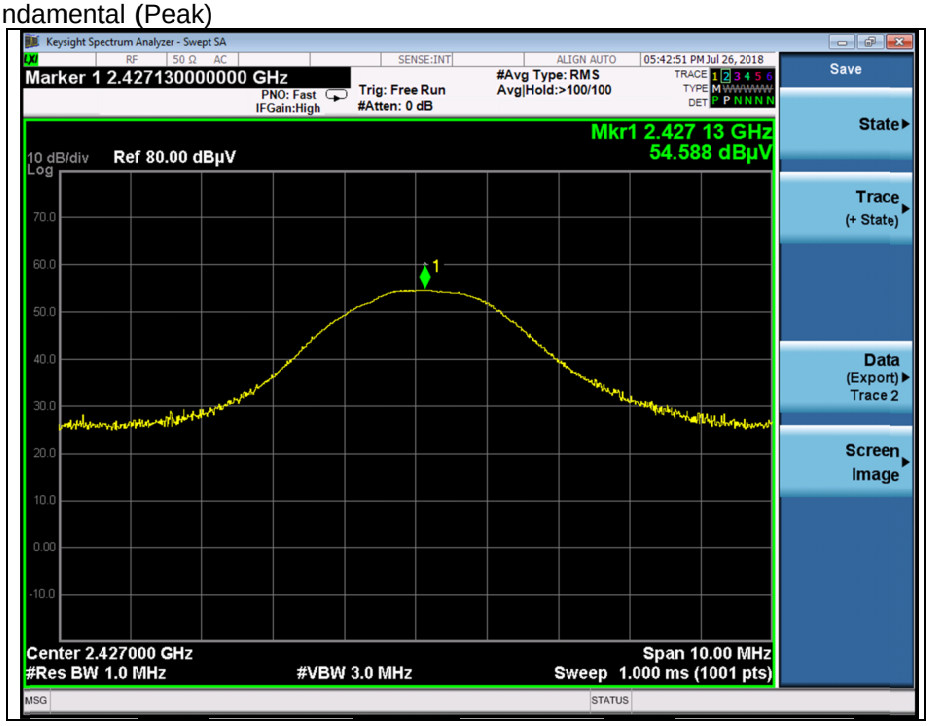
Frequency (㎒)	Detect Mode	Ant. Pol.	Reading (dB㎶)	AF (dB/m)	CL (dB)	Result (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
<Low channel 2 427 ㎒>								
2 427.13	Peak	H	54.59	28.00	7.78	90.37	114.00	23.63
2 427.13	Average	H	22.48	28.00	7.78	58.26	94.00	35.74
<Middle channel 2 441 ㎒>								
2 440.86	Peak	H	55.01	28.00	7.80	90.81	114.00	23.19
2 440.86	Average	H	22.90	28.00	7.80	58.70	94.00	35.30
<High channel 2 457 ㎒>								
2 456.94	Peak	H	52.15	28.00	7.81	87.96	114.00	26.04
2 456.94	Average	H	20.04	28.00	7.81	55.88	94.00	38.15

Remark;

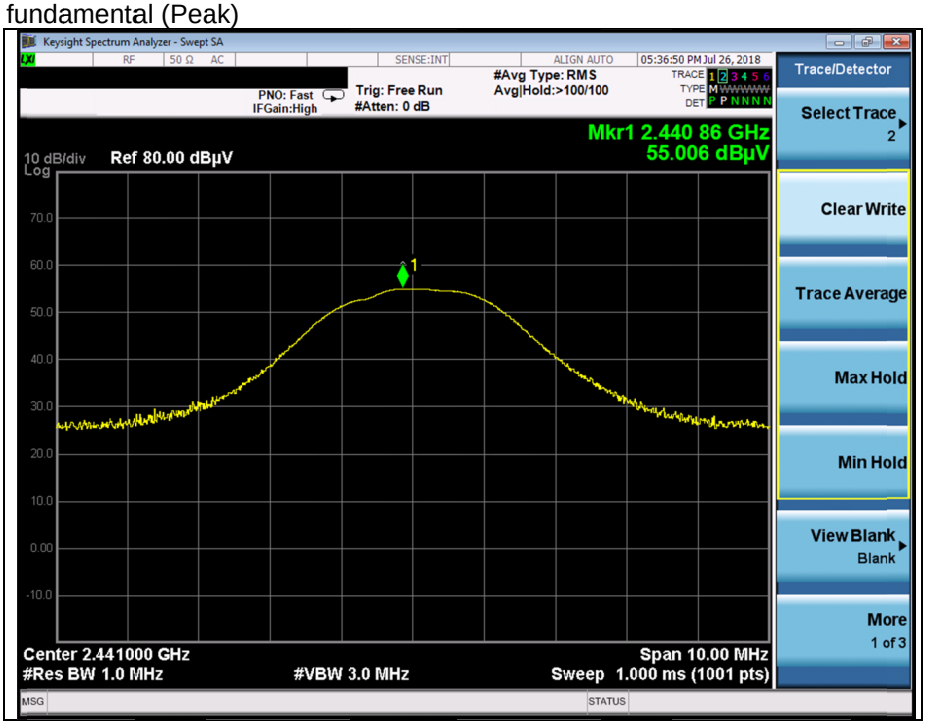
1. Result = Reading + AF + CL
2. Average Reading = Peak Reading + Duty Cycle Correction Factor
3. Duty Cycle Correction Factor: 20log(T_{on} / 100 ㎳) = 20log (2.479 / 100) = -32.11
   - T_{on} time = 2.479 ㎳

- Test plots

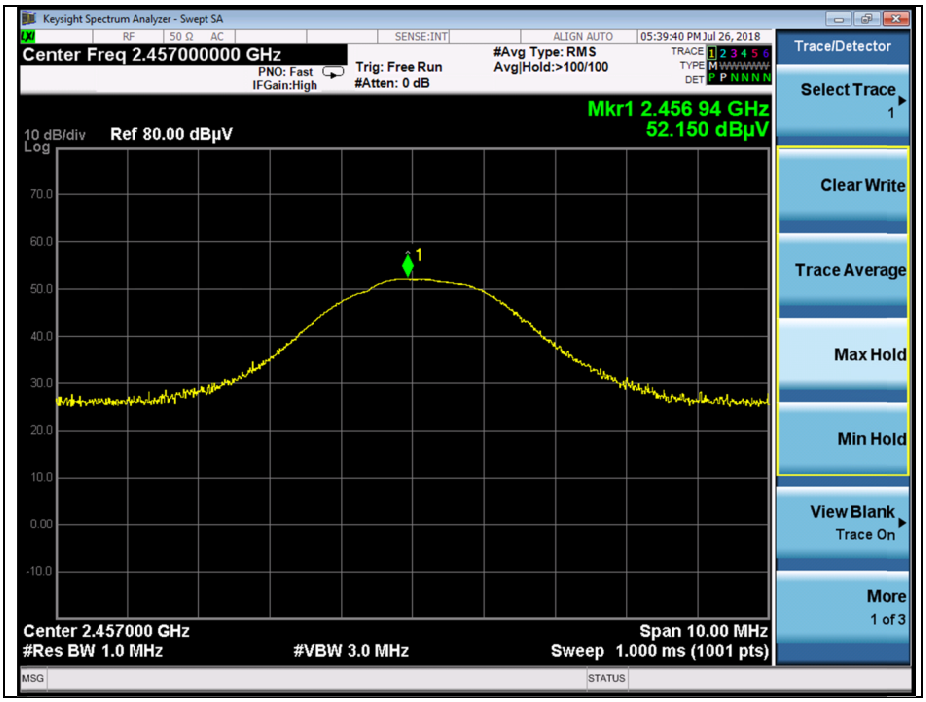
Low channel fundamental (Peak)



Middle channel fundamental (Peak)



High channel fundamental (Peak)



2.4.2. Radiated Spurious Emission below 1 000 ㎒

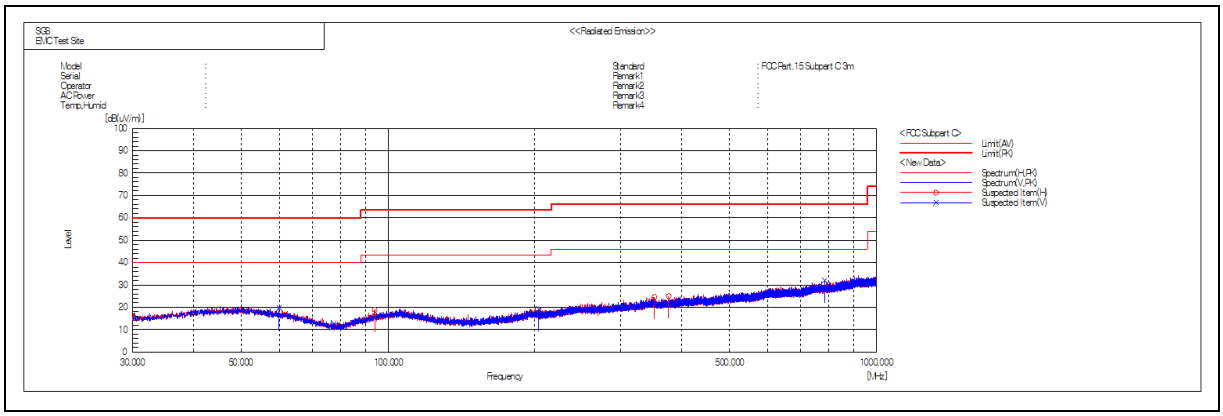
The frequency spectrum from 9 ㎑ to 1 000 ㎒ was investigated. All reading values are peak values.

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)
783.81	34.60	Peak	V	20.94	-23.67	31.87	46.00	14.13
Above 800.00	Not detected	-	-	-	-	-	-	-

Remark;

1. Spurious emissions for all channels were investigated and almost the same below 1 ㎓.
2. Reported spurious emissions are in **Middle channel** as worst case among other channels.
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



2.4.3. Radiated Spurious Emission above 1 000 ㎒

A. Low Channel (2 427 ㎒)

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Duty (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*2 310.00	25.05	Peak	H	27.82	7.54	-	60.41	74.00	13.59
*2 310.00	25.05	Average	H	27.82	7.54	-32.11	28.30	54.00	25.70
*2 385.73	27.58	Peak	H	27.97	7.68	-	63.23	74.00	10.77
*2 385.73	27.58	Average	H	27.97	7.68	-32.11	31.12	54.00	22.88
*2 390.00	25.53	Peak	H	27.98	7.69	-	61.20	74.00	12.80
*2 390.00	25.53	Average	H	27.98	7.69	-32.11	29.09	54.00	24.91

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

B. Middle Channel (2 441 ㎒)

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

C. High Channel (2 457 ㎒)

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Duty (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*2 483.50	25.76	Peak	H	28.00	7.84	-	61.60	74.00	12.40
*2 483.50	25.76	Average	H	28.00	7.84	-32.11	29.49	54.00	24.51
*2 495.44	28.12	Peak	H	28.00	7.86	-	63.98	74.00	10.02
*2 495.44	28.12	Average	H	28.00	7.86	-32.11	31.87	54.00	22.13
*2 500.00	26.41	Peak	H	28.00	7.87	-	62.28	74.00	11.72
*2 500.00	26.41	Average	H	28.00	7.87	-32.11	30.17	54.00	23.83

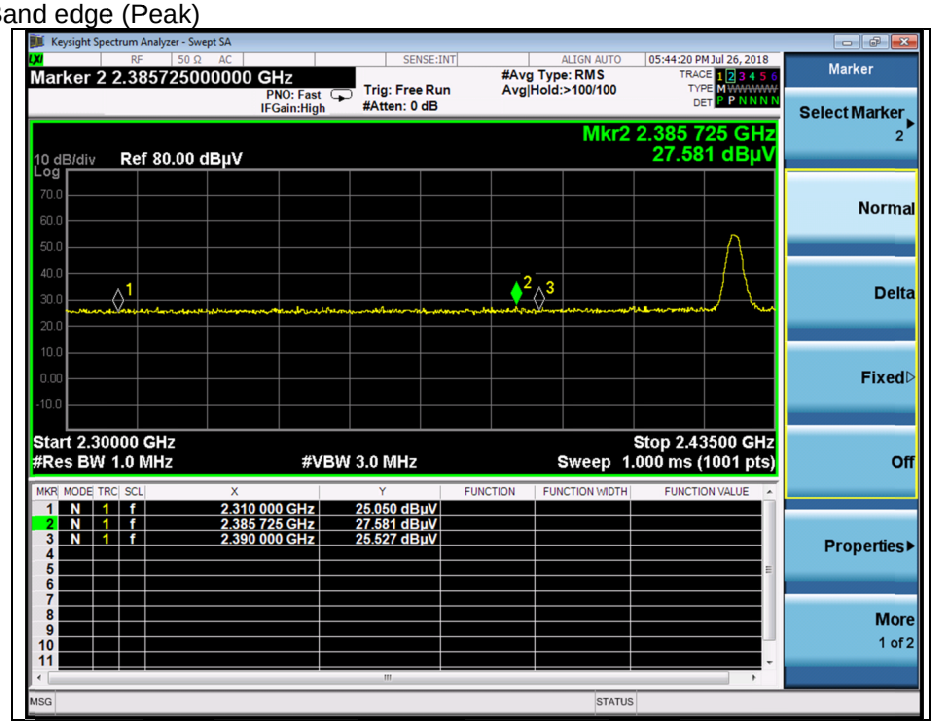
Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Duty (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-			-	-	-

Remarks;

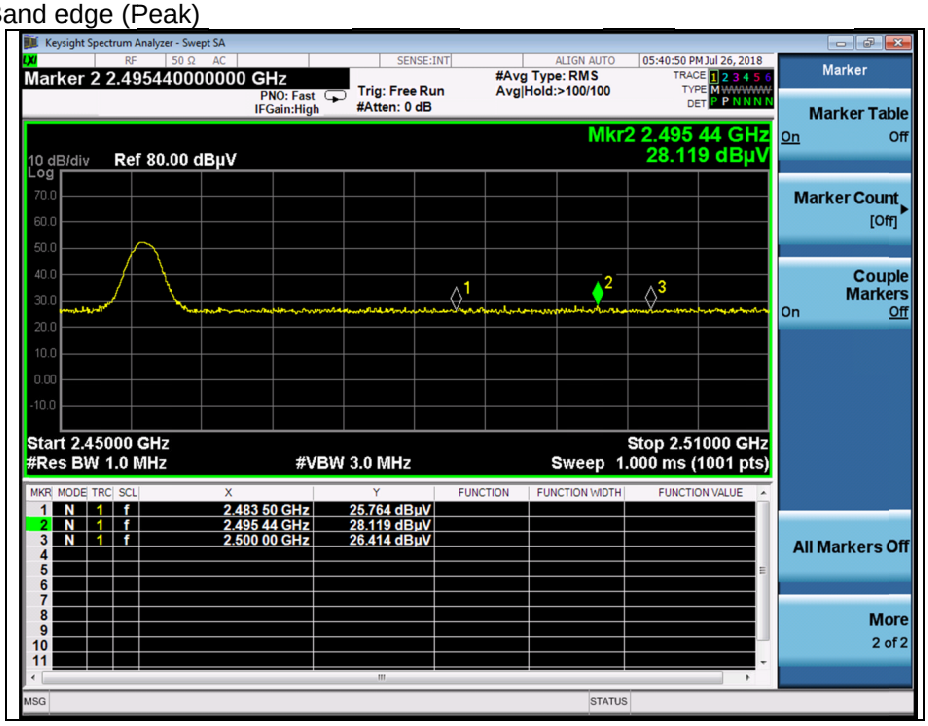
1. "*" means the restricted band.
2. Measuring frequencies from 1 ㎓ to the 10th harmonic of highest fundamental frequency.
3. Actual = Reading + AF + AMP + CL + (Duty) or Reading + AF + CL + (Duty).
4. Average Reading = Peak Reading + Duty Cycle Correction Factor
5. Duty Cycle Correction Factor: 20log (T_{on} / 100 ㎳) = 20log (2.479 / 100) = -32.11
   - T_{on} time = 2.479 ㎳
6. According to § 15.31(o), emission levels are not reported much lower than the limits by over 20 ㏈.

- Test plots

Low channel Band edge (Peak)



High channel Band edge (Peak)



3. 20 dB Bandwidth

3.1. Test Setup

3.2. Limit

Limit: Not Applicable

3.3. Test Procedure

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

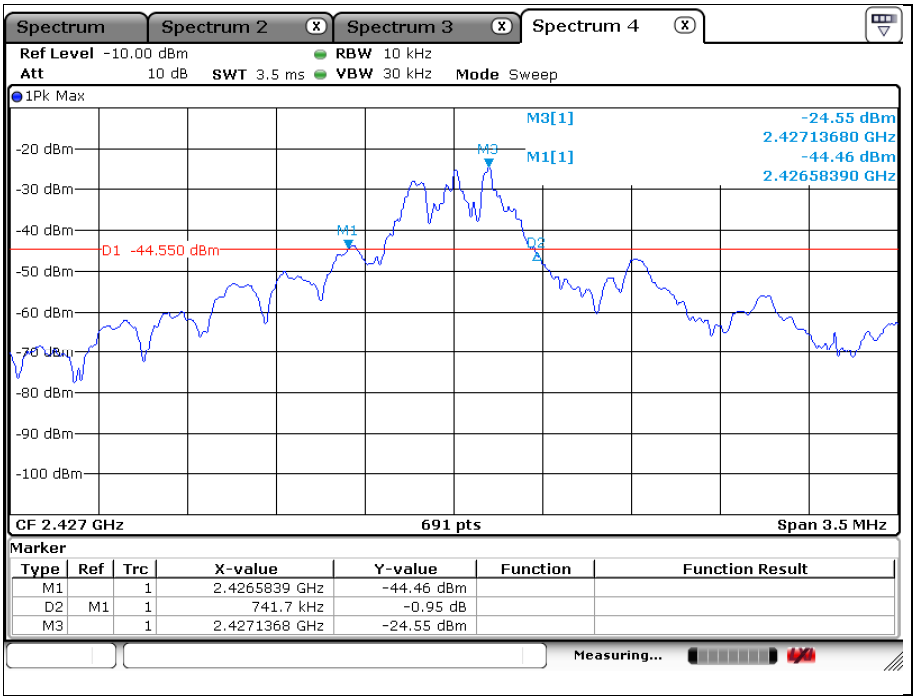
The marker-to-peak function to set the mark to the peak of the emission. Use the marker-delta function to measure 20 dB down one side of the emission. Reset the function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is 20 dB bandwidth of the emission.

3.4. Test Results

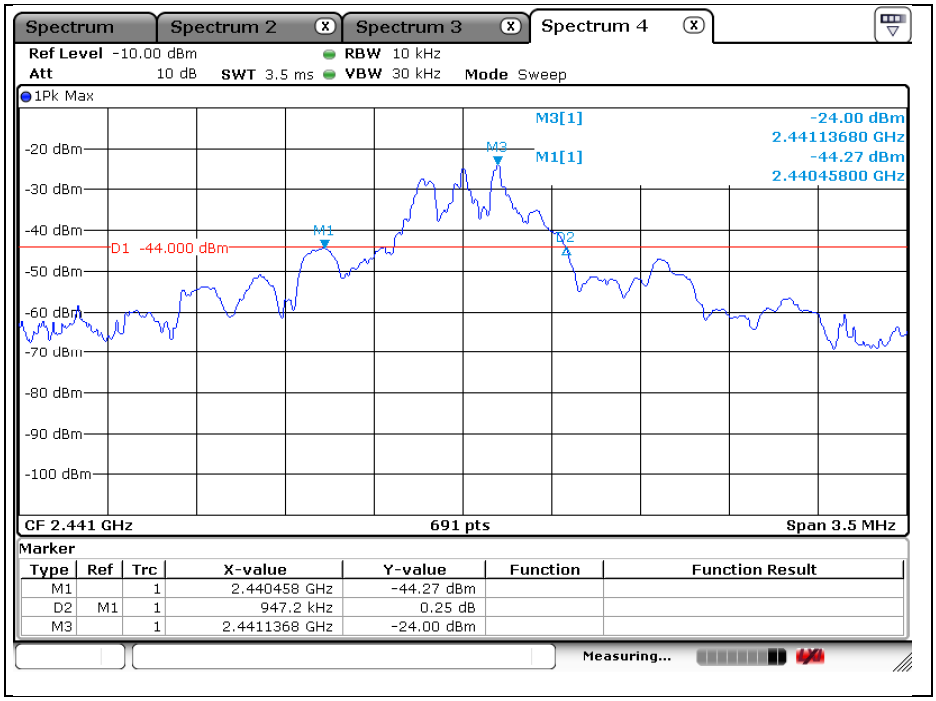
Ambient temperature : (23 ± 1) ℃
Relative humidity : 47 % R.H.

Channel	Frequency (㎒)	20 ㏈ Bandwidth (㎒)
Low	2 427	0.742
High	2 441	0.947
High	2 457	0.745

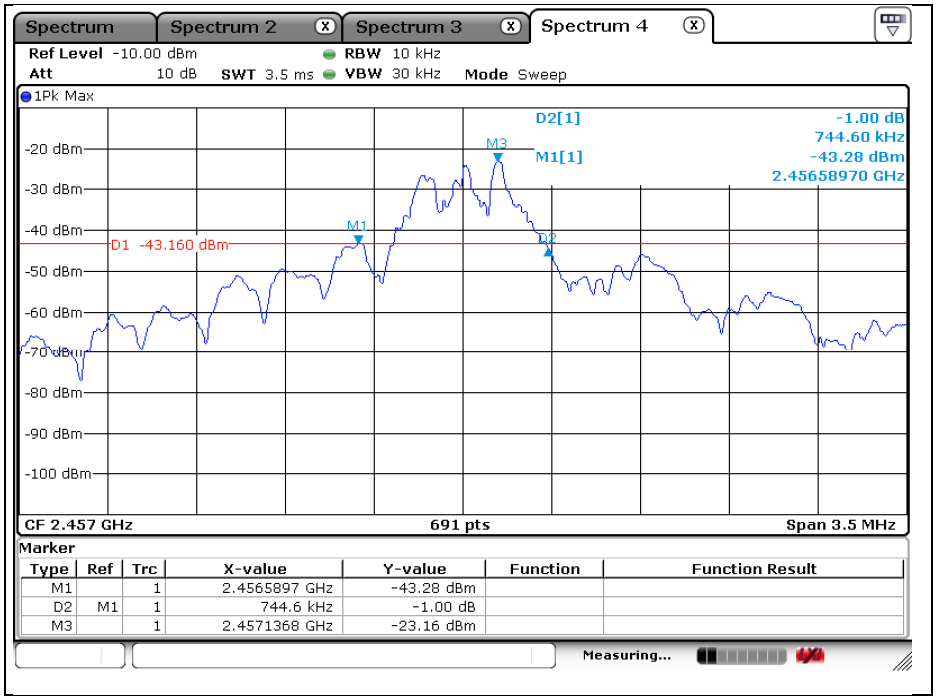
Low Channel



Middle Channel



High Channel



- End of the Test Report -