TEST REPORT

of

FCC Part 15 Subpart C §15.249

FCC ID : WU2SMRSFLASHWAVE5

Equipment Under Test	:	FLASH WIRELESS CONTROL SYSTEM
Model Name	:	FLASHWAVE-5
Variant Model Names	:	FLASHWAVE-5 TX, FLASHWAVE-5 TTL, F5-TTL, F5-TTL TX, SWING-IV, POWERSYNC TTL, POWERSYNC 16-80 TTL, BRIHT TX, BRIHT TTL TX, TS-4
Applicant	:	SMDV
Manufacturer	:	SMDV
Date of Receipt	:	2016.02.23
Date of Test(s)	:	2016.03.02 ~ 2016.08.31
Date of Issue	:	2016.08.31

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

Tested By:  **Date:** **2016.08.31**

Jinhyoung Cho

Technical Manager:  **Date:** **2016.08.31**

Hyunchae You

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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

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.
Telephone : +82 31 688 0901
FAX : +82 31 688 0921

1.2 Details of applicant

Applicant : SMDV
Address : 1532 Nakdongdae-Ro, Sasang-Gu, Busan, Korea
Contact Person : Kim, Ji-Young
Phone No. : +82 51 324 0788

1.3. Description of EUT

Kind of Product	FLASH WIRELESS CONTROL SYSTEM
Model Name	FLASHWAVE-5
Variant Model Names	FLASHWAVE-5 TX, FLASHWAVE-5 TTL, F5-TTL, F5-TTL TX, SWING-IV, POWERSYNC TTL, POWERSYNC 16-80 TTL, BRIHT TX, BRIHT TTL TX, TS-4
Power Supply	DC 3.0 V
Frequency Range	2 402 ㎒ ~ 2 481 ㎒ (TX only)
Modulation Technique	GFSK
Number of Channels	80 Channels
Operation Temperature	-20 ℃ ~ 50 ℃
Antenna Type	PCB Antenna
Antenna Gain	0 ㏈i
H/W Version	1.0
S/W Version	1.0

1.4. Test equipment list

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Interval	Cal. Due
Signal Generator	R&S	SMBV100A	259067	Jun. 20, 2016	Annual	Jun. 20, 2017
Signal Generator	Agilent	E8257D	MY51501169	Jul. 07, 2016	Annual	Jul. 07, 2017
Spectrum Analyzer	Agilent	N9020A	MY53421758	Sep. 24, 2015	Annual	Sep. 24, 2016
Spectrum Analyzer	R&S	FSV30	100768	Mar. 30, 2016	Annual	Mar. 30, 2017
High Pass Filter	Wainwright Instrument GmbH	WHK3.0/18G-6SS	4	Jun. 18, 2016	Annual	Jun. 18, 2017
High Pass Filter	Wainwright Instrument GmbH	WHNX7.5/26.5G-6SS	15	Jun. 18, 2016	Annual	Jun. 18, 2017
Low Pass Filter	Mini-Circuits	NLP-1200+	V8979400903-2	Feb. 29, 2016	Annual	Feb. 29, 2017
Attenuator	Mini-Circuits	BW-N20W5+	0950-2	Jun. 18, 2016	Annual	Jun. 18, 2017
DC Power Supply	R&S	HMP2020	020089489	May 31, 2016	Annual	May 31, 2017
Preamplifier	H.P.	8447F	2944A03909	Aug. 11, 2016	Annual	Aug. 11, 2017
Preamplifier	R&S	SCU-18	10117	Apr. 07, 2016	Annual	Apr. 07, 2017
Preamplifier	MITEQ Inc.	JS44-18004000-35-8P	1546891	May 12, 2016	Annual	May 12, 2017
Loop Antenna	Schwarzbeck Mess-Elektronik	FMZB 1519	1519-039	Aug. 19, 2015	Biennial	Aug. 19, 2017
Bilog Antenna	Schwarzbeck Mess-Elektronik	VULB 9163	396	Jun. 18, 2015	Biennial	Jun. 18, 2017
Horn Antenna	R&S	HF906	100326	Feb. 01, 2016	Biennial	Feb. 01, 2018
Horn Antenna	Schwarzbeck Mess-Elektronik	BBHA 9170	9170-540	Sep. 01, 2015	Biennial	Sep. 04, 2017
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	Mar. 07, 2016	Annual	Mar. 07, 2017
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.

Note;
The equipment calibrated during the test period was used after finished the calibration.

1.5. Summary of test results

The EUT has been tested according to the following specifications:

Applied Standard : FCC Part15, Subpart C		
Standard 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

1.6. Test Procedure(s)

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

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 gain (dB)

1.8. Test report revision

Revision	Report number	Date of Issue	Description
0	F690501/RF-RTL010302	2016.08.31	Initial

1.9. Variant models

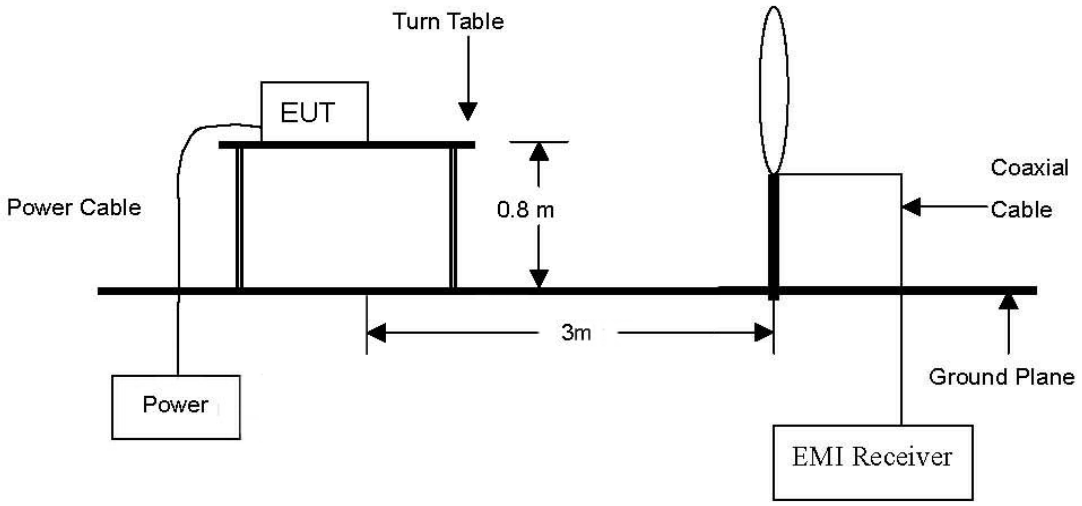
Model name	Information
FLASHWAVE-5	- Basic model.
FLASHWAVE-5 TX, FLASHWAVE-5 TTL, F5-TTL, F5-TTL TX, SWING-IV, POWERSYNC TTL, POWERSYNC 16-80 TTL, BRIHT TX, BRIHT TTL TX TS-4	- Same to basic model. - There are no difference electrical and electronic properties, circuits, components, features, appearance and structure.

2. Fundamental and Radiated Spurious emission

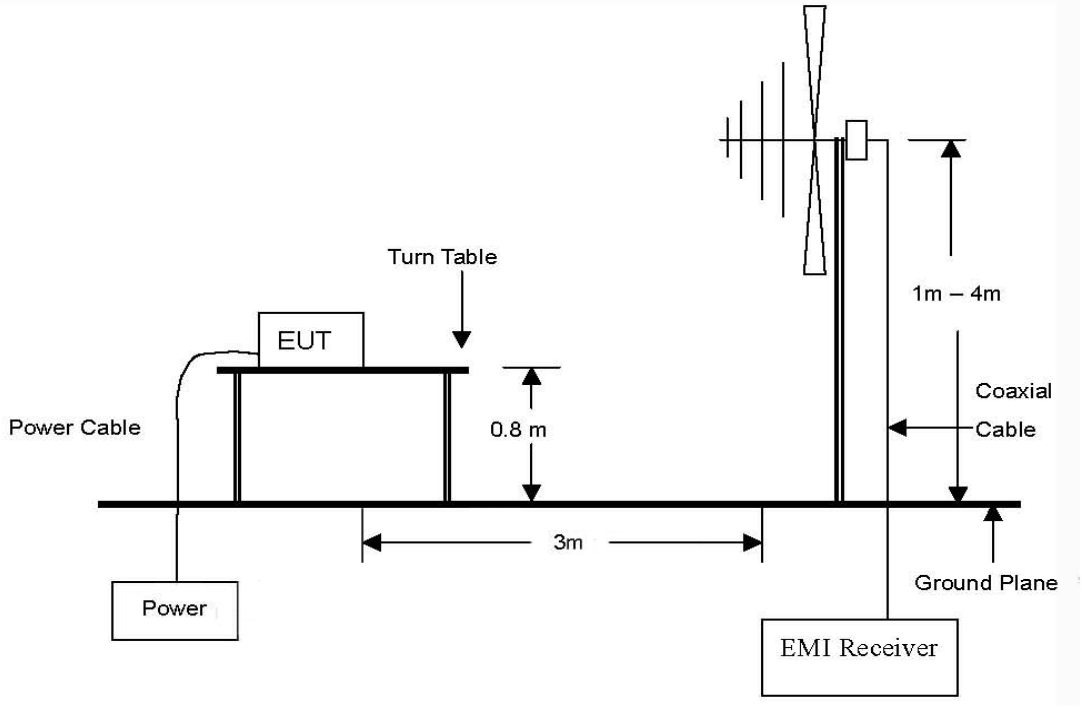
2.1. Test setup

2.1.1. Fundamental and Radiated Spurious Emissions

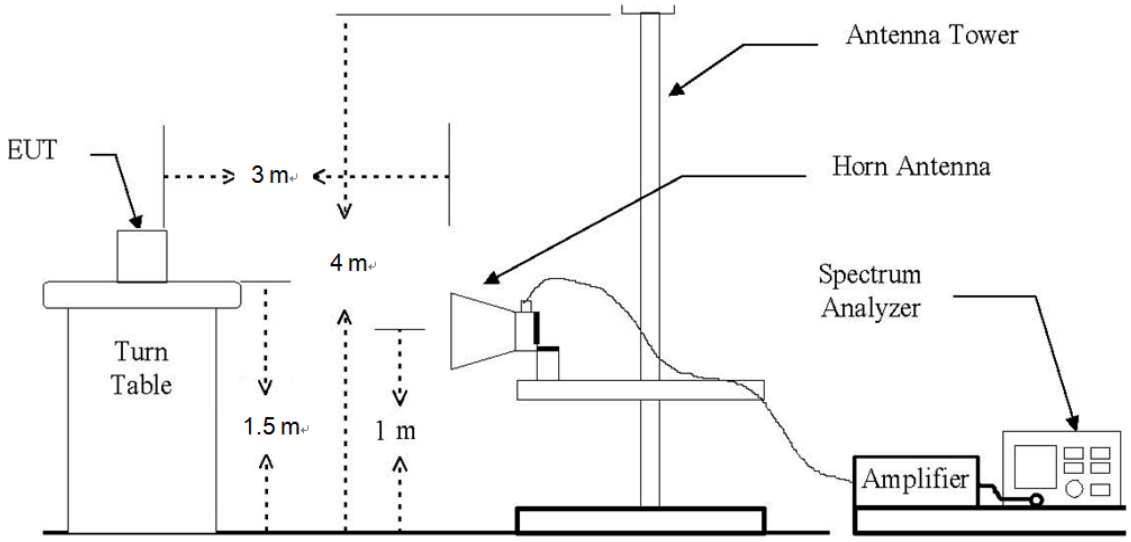
The diagram below shows the test setup that is utilized to make the measurements for emission from 9 ㎑ to 30 ㎒ Emissions.



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. Test procedures

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

2.2.1. 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 937606.

2.2.2. Test Procedures for emission from 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 trilog broadband 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. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 ㎑ for Peak detection (PK) and Quasi-peak detection (QP) at frequency below 1 ㎓.
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 ㎒ for Peak detection and frequency above 1 ㎓.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 ㎒ and the video bandwidth is 10 ㎐ for Average detection (AV) at frequency above 1 ㎓.
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 **X – axis** during radiation test.

2.3. 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 (㎒)	Distance (Meters)	Field Strength (㏈㎶/m)	Field Strength (㎶/m)
0.009 – 0.490	300	20 log (2 400/F(㎑))	2 400/F(㎑)
0.490 – 1.705	30	20 log (24 000/F(㎑))	24 000/F(㎑)
1.705 – 30.0	30	29.54	30
30 – 88	3	40.0	100
88 – 216	3	43.5	150
216 – 960	3	46.0	200
Above 960	3	54.0	500

Remark:
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., Sections 15.231 and 15.241.

2.4. Test result

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

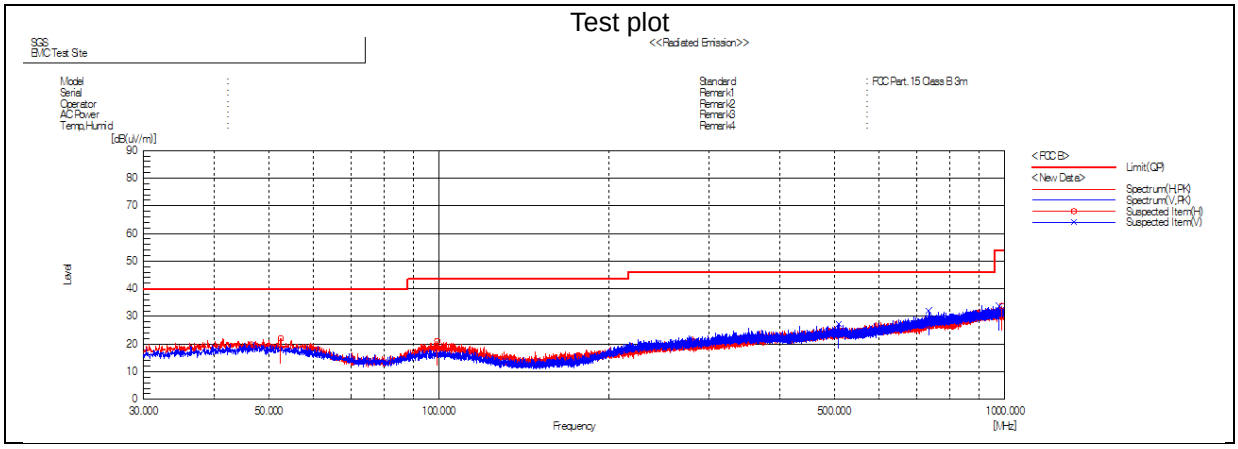
2.4.1. Radiated Spurious Emission below 1 000 ㎒

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

Radiated Emissions			Ant.	Correction Factors		Total	FCC Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP + CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
52.47	33.30	Peak	H	15.49	-26.96	21.83	40.00	18.17
508.82	34.20	Peak	V	18.68	-25.54	27.34	46.00	18.66
734.22	34.90	Peak	V	22.21	-25.23	31.88	46.00	14.12
988.40	34.00	Peak	H	23.48	-23.31	34.17	54.00	19.83

Remark
1. Spurious emissions for all channels were investigated and almost the same below 1 ㎓.
2. Reported spurious emissions are in **Low 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



2.4.2. Radiated Spurious Emission above 1 000 ㎒

A. Low Channel (2 402 ㎒)

Fundamental level			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
2 402.30	32.83	Peak	H	28.16	5.85	66.84	114.00	47.16
2 402.06	23.00	Average	H	28.16	5.85	57.01	94.00	36.99

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*2 310.00	24.58	Peak	H	28.07	5.31	58.16	74.00	15.84
*2 310.00	15.35	Average	H	28.07	5.31	48.74	54.00	5.26
*2 387.60	26.19	Peak	H	28.15	5.79	60.13	74.00	13.87
*2 388.90	15.57	Average	H	28.15	5.79	49.51	54.00	4.49
*2 390.00	25.14	Peak	H	28.15	5.80	59.24	74.00	14.76
*2 390.00	15.57	Average	H	28.15	5.80	49.54	54.00	4.46
2 400.00	24.94	Peak	H	28.16	5.87	58.97	74.00	15.03
2 400.00	15.76	Average	H	28.16	5.87	49.79	54.00	4.21

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)
*4 802.82	59.59	Peak	H	32.65	-30.28	61.96	74.00	12.04
*4 804.10	50.56	Average	H	32.65	-30.26	52.95	54.00	1.05
Above 4 900.00	Not detected	-	-	-	-	-	-	-

B. Middle Channel (2 441 ㎒)

Fundamental level			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
2 440.95	32.41	Peak	H	28.20	5.62	66.23	114.00	47.77
2 441.07	22.52	Average	H	28.20	5.62	56.34	94.00	37.66

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)
*4 880.92	59.00	Peak	H	32.86	-29.70	62.16	74.00	11.84
*4 882.12	49.10	Average	H	32.86	-29.69	52.27	54.00	1.73
Above 4 900.00	Not detected	-	-	-	-	-	-	-

C. High Channel (2 481 ㎒)

Fundamental level			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
2 481.34	31.90	Peak	H	28.24	5.55	65.69	114.00	48.31
2 481.06	21.91	Average	H	28.24	5.55	55.70	94.00	38.30

Radiated Emissions			Ant	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*2 483.50	25.38	Peak	H	28.24	5.54	59.16	74.00	14.84
*2 483.50	16.02	Average	H	28.24	5.54	49.80	54.00	4.20
*2 495.19	28.32	Peak	H	28.26	5.51	62.09	74.00	11.91
*2 484.76	16.03	Average	H	28.24	5.54	49.81	54.00	4.19
*2 500.00	25.94	Peak	H	28.26	5.49	59.69	74.00	14.31
*2 500.00	16.06	Average	H	28.26	5.49	49.81	54.00	4.19

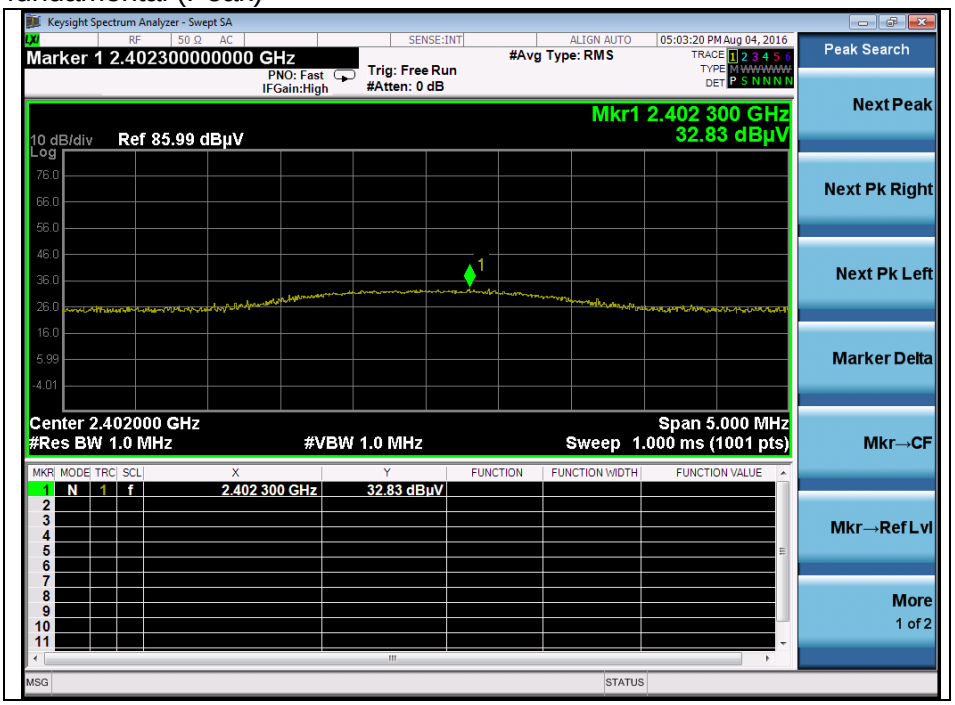
Radiated Emissions			Ant	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*4 961.59	56.78	Peak	H	33.08	-29.47	60.39	74.00	13.61
*4 962.09	46.11	Average	H	33.08	-29.47	49.72	54.00	4.28
Above 5 000.00	Not detected	-	-	-	-	-	-	-

Remarks;

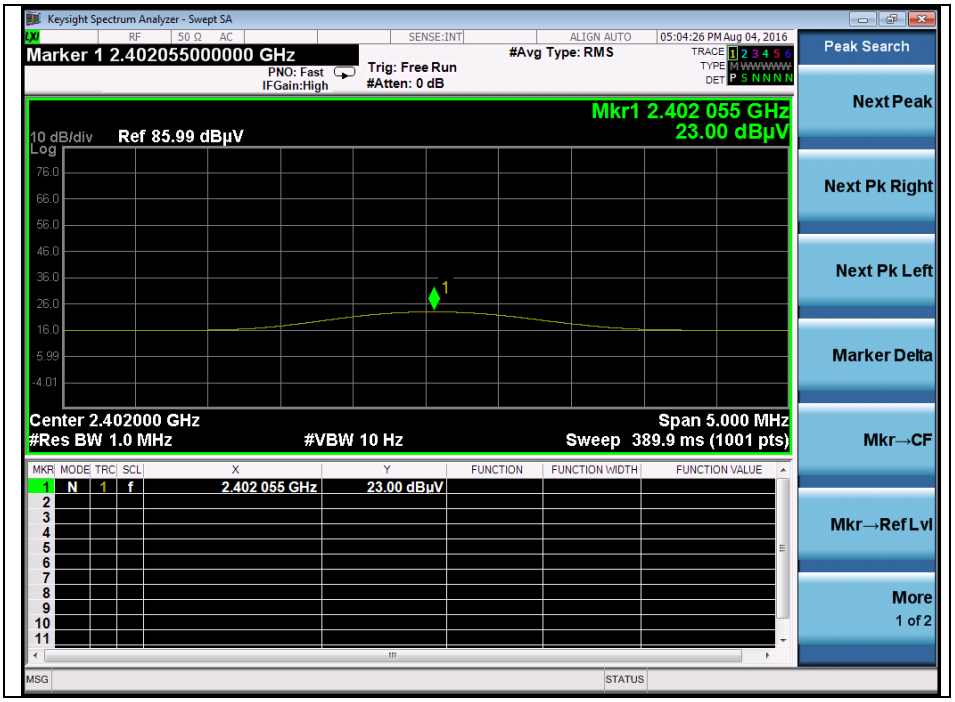
1. "*" means the restricted band.
2. Measuring frequencies from 1 ㎓ to the 10th harmonic of highest fundamental frequency.
3. Radiated emissions measured in frequency above 1 000 ㎒ were made with an instrument using peak/average detector mode.
4. Actual = Reading + AF + AMP + CL or Reading + AF + CL
5. According to §15.31(o), emission levels are not reported much lower than the limits by over 20 ㏈.
6. Emission was scanned up to 25 ㎓; No emissions were detected above the noise floor which was at least 20 ㏈ below the specification limit.

2.4.2. Radiated Spurious Emission above 1 000 ㎒

Low channel fundamental (Peak)

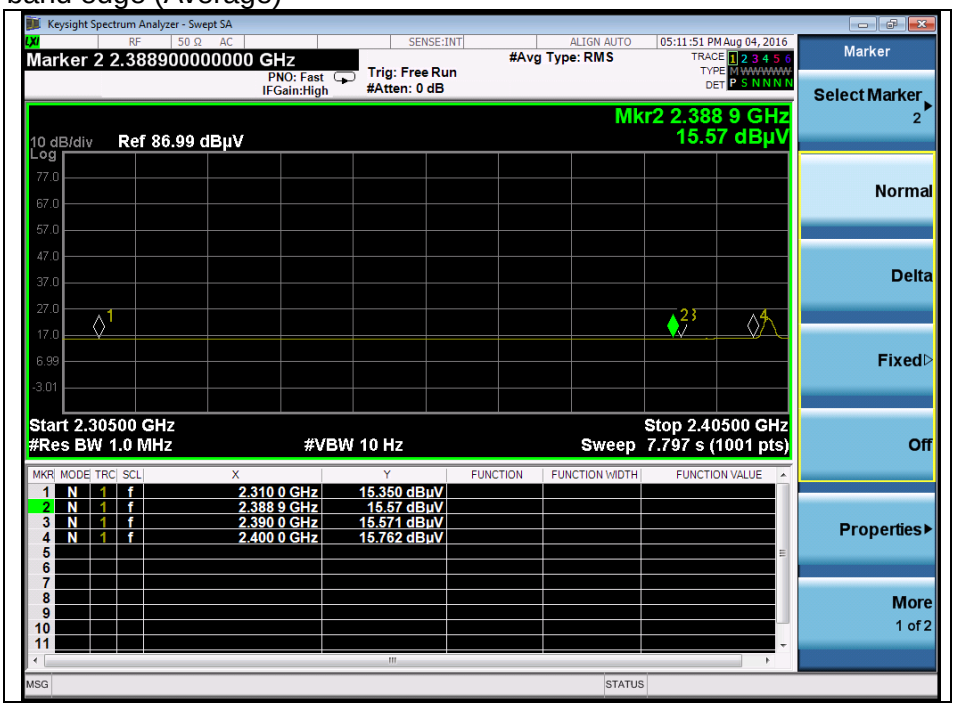


Low channel fundamental (Average)



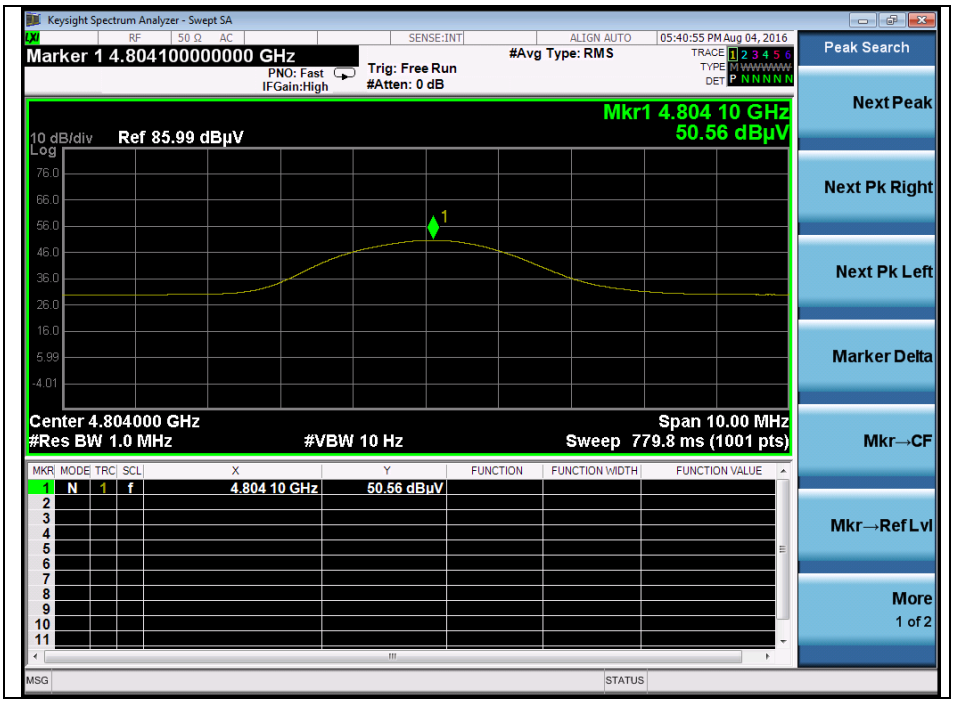
Low channel band edge (Peak)

Low channel band edge (Average)



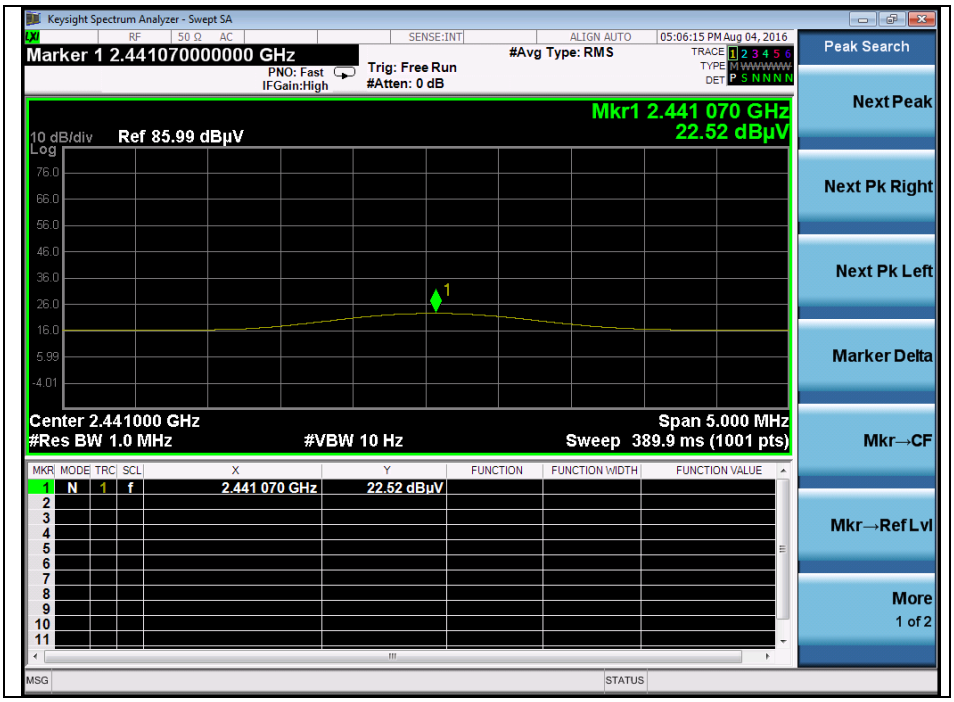
Low channel 2nd harmonic (Peak)

Low channel 2nd harmonic (Average)

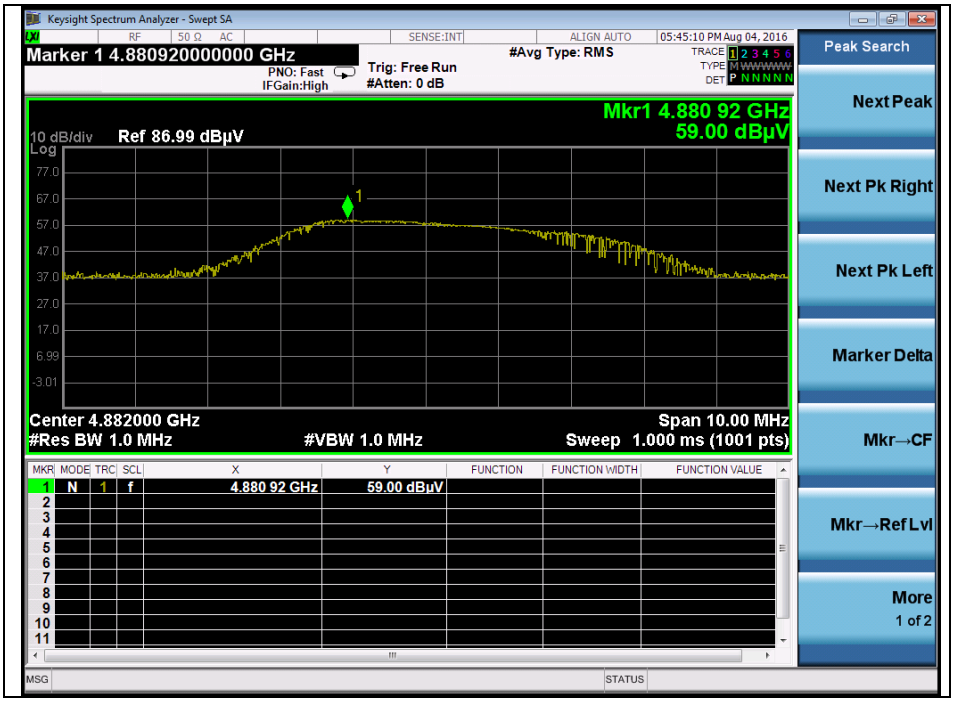


Middle channel fundamental (Peak)

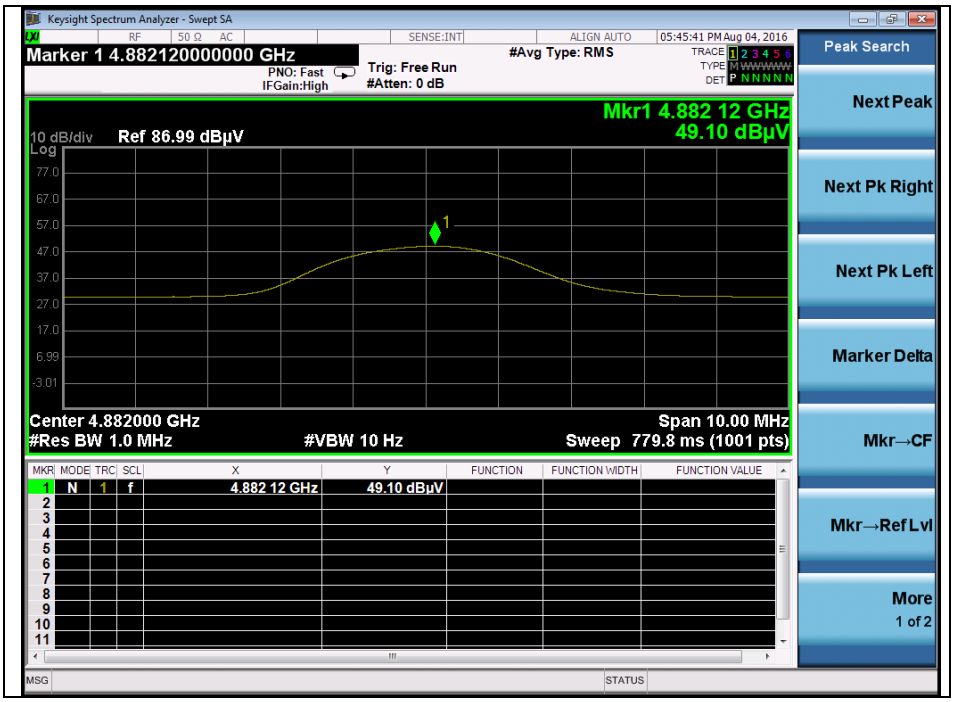
Middle channel fundamental (Average)



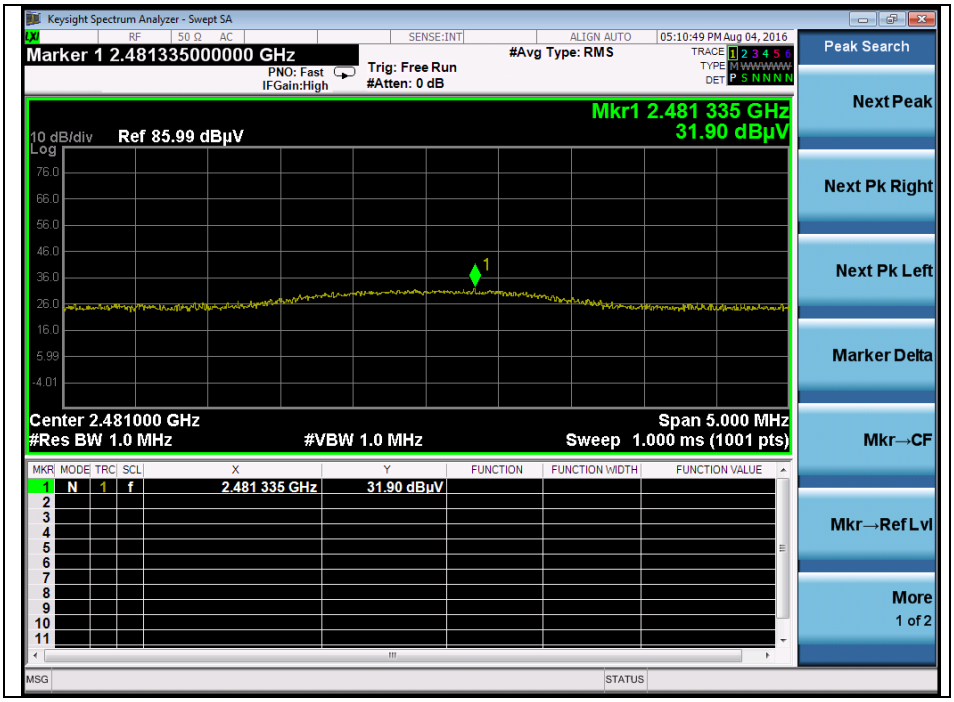
Middle channel 2nd harmonic (Peak)



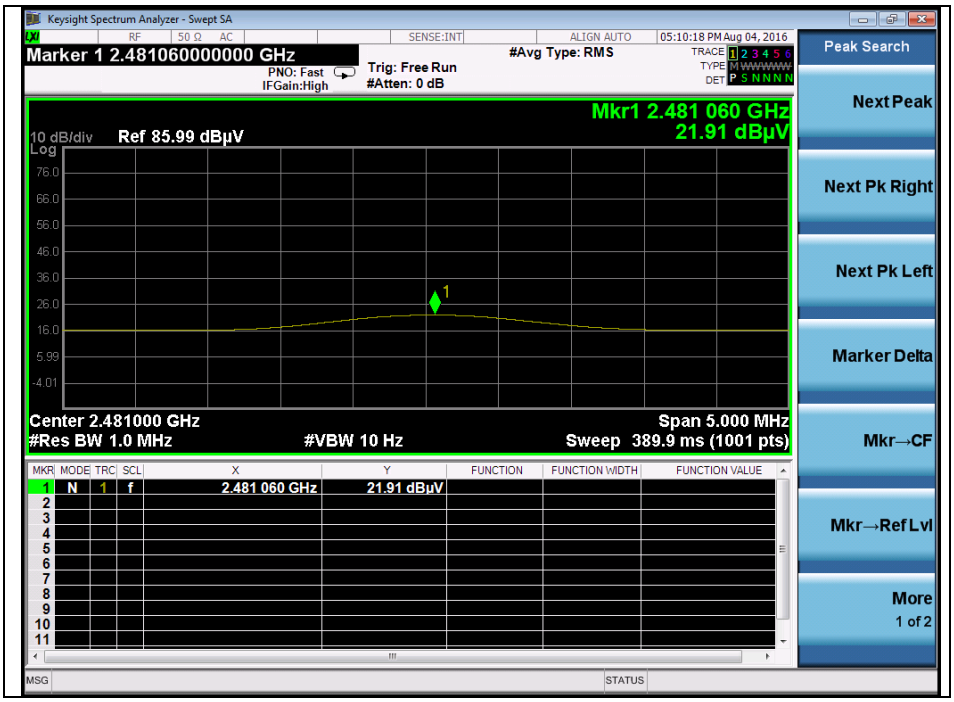
Middle channel 2nd harmonic (Average)



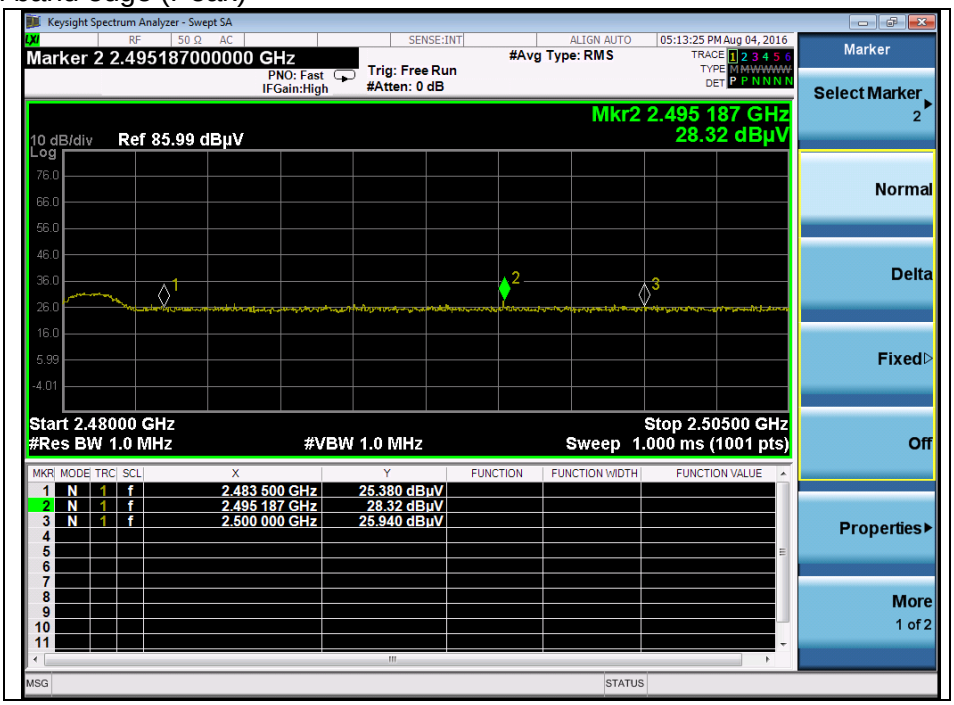
High channel fundamental (Peak)



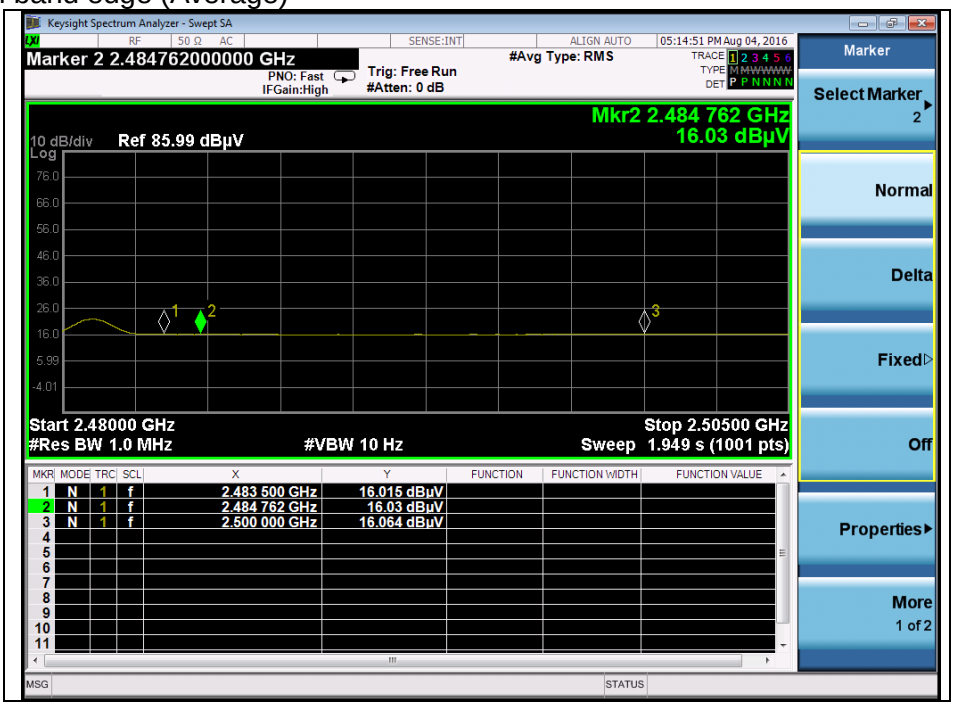
High channel fundamental (Average)



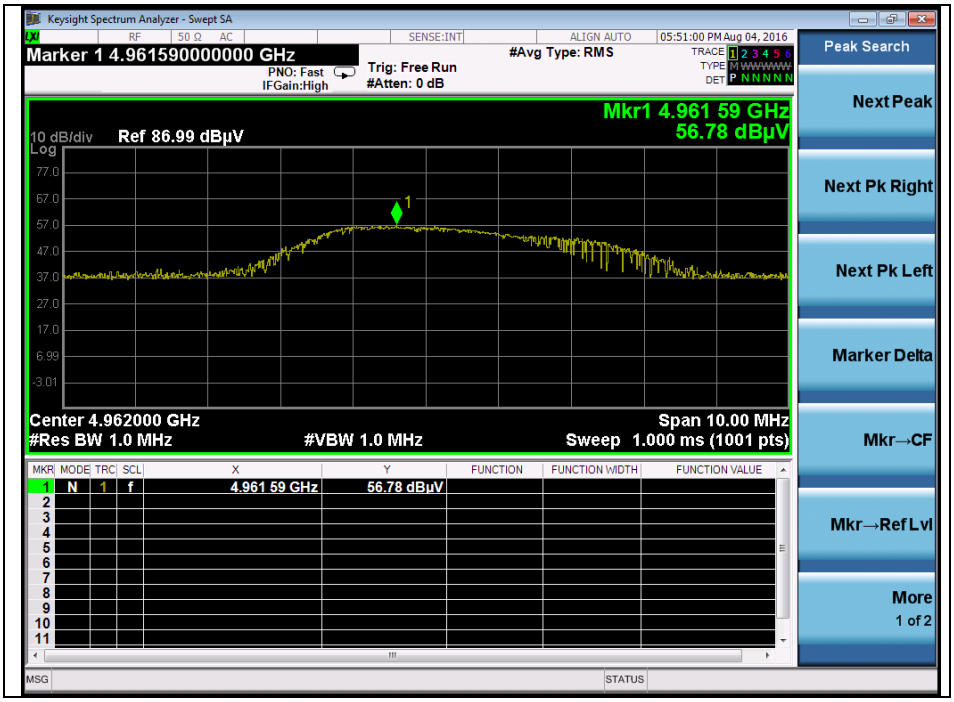
High channel band edge (Peak)



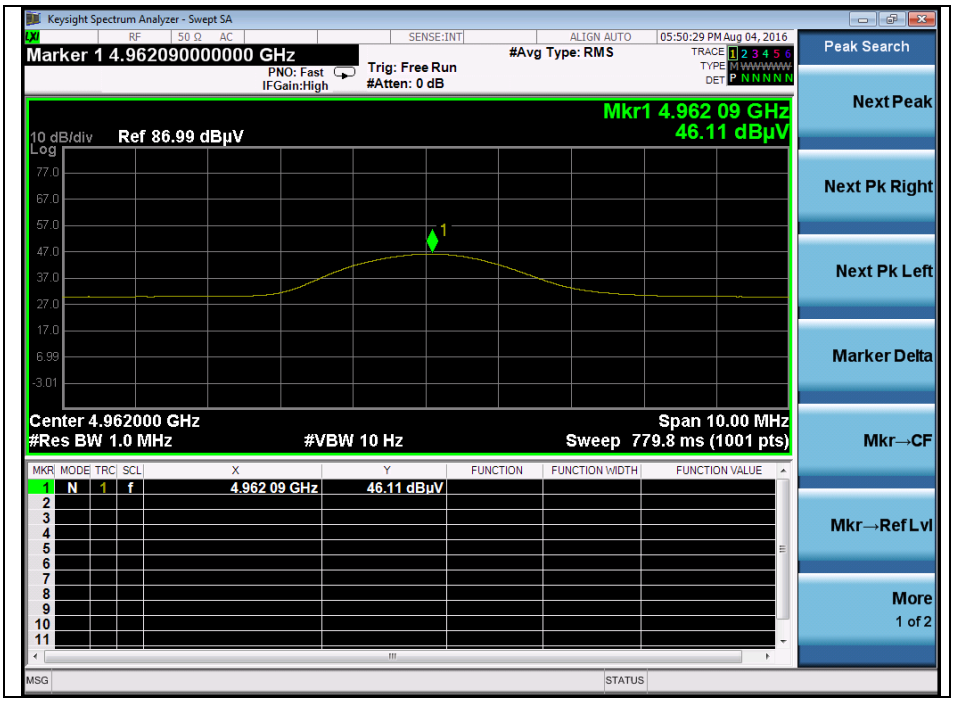
High channel band edge (Average)



High channel 2nd harmonic (Peak)

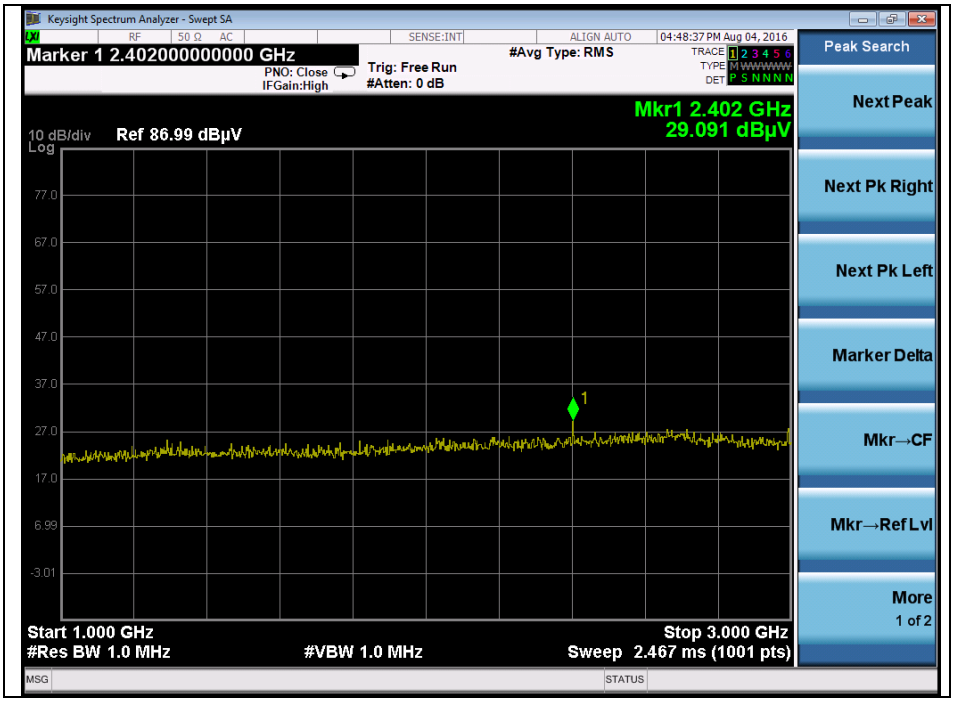


High channel 2nd harmonic (Average)



2.4.3. Pre-scan Test Plots

1 ㎓ ~ 3 ㎓



3 ㎓ ~ 18 ㎓

3. 20 dB Bandwidth

3.1. Test Setup

3.2. Limit

Limit: Not Applicable

3.3. Test Procedure

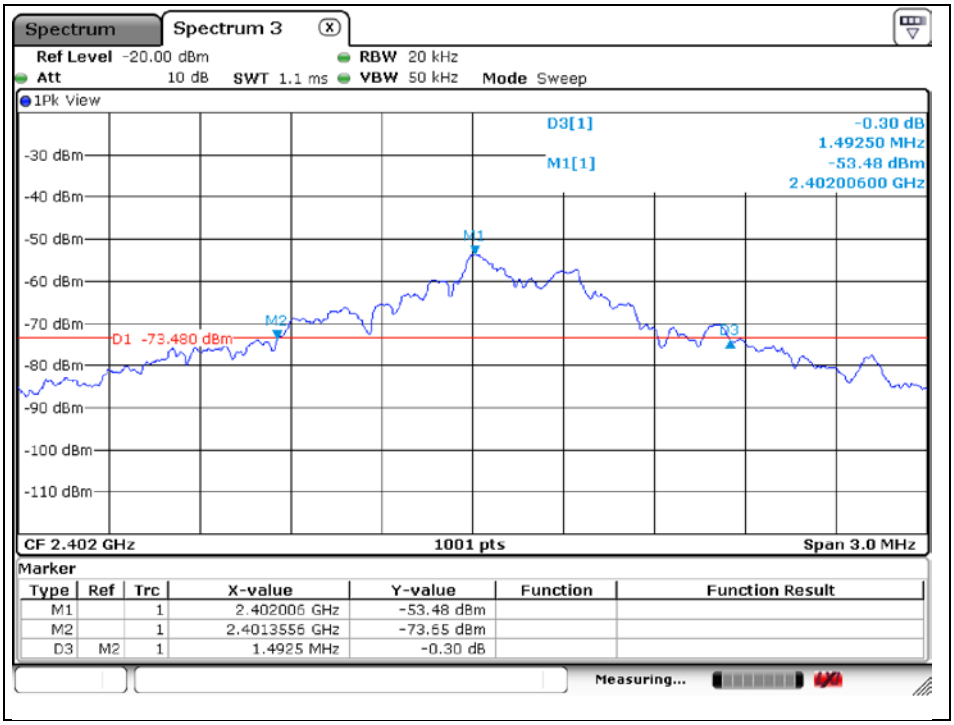
1. The transmitter output is connected to the spectrum analyzer.
2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using RBW=20 ㎑, VBW=50 ㎑ and Span=3 ㎒.

3.4. Test Results

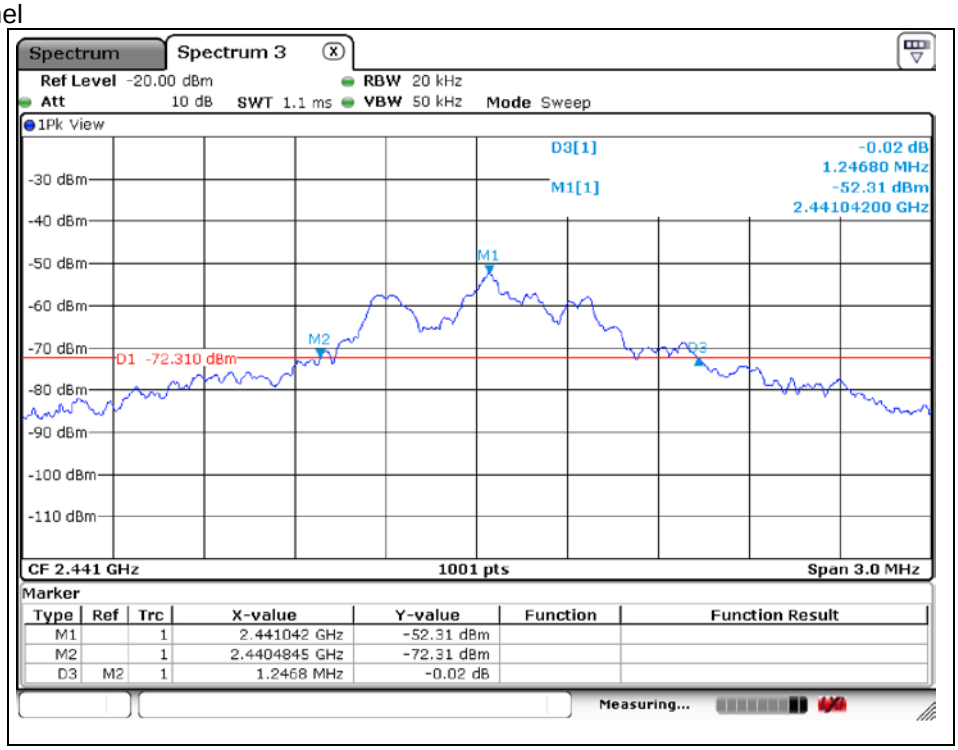
Ambient temperature : (23 ± 1) ℃
Relative humidity : 47 % R.H.

Channel	Frequency (㎒)	20 ㏈ Bandwidth (㎒)
Low	2 402	1.493
Middle	2 441	1.247
High	2 481	1.672

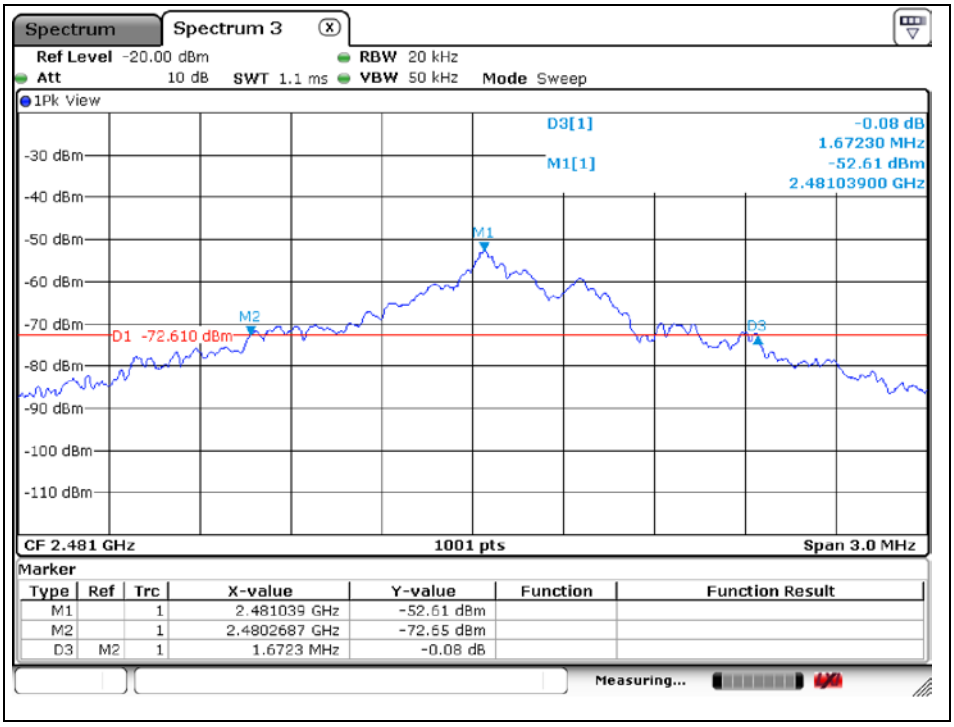
Low Channel



Middle Channel



High Channel



- End of the Test Report -