TEST REPORT

of

FCC Part 15 Subpart C §15.249

FCC ID: A3LAAMR1D9TG

Equipment Under Test	:	Wireless Mouse
Model Name	:	AA-MR1D9TG
Applicant	:	Samsung Electronics Co., Ltd.
Manufacturer	:	Samsung Electronics Co., Ltd.
Date of Receipt	:	2016.10.28
Date of Test(s)	:	2016.11.02 ~ 2016.11.23
Date of Issue	:	2016.11.23

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

Tested By:	**Inho Park**	**Date:**	**2016.11.23**
Technical Manager:	**Alvin Kim**	**Date:**	**2016.11.23**

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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 : Samsung Electronics Co., Ltd.
Address : 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Republic of Korea
Contact Person : Park, Eun-Bum
Phone No. : +82 31 277 5707

1.3. Description of EUT

Kind of Product	Wireless Mouse
Model Name	AA-MR1D9TG
Power Supply	DC 3.0 V
Frequency Range	2 403 ㎒ ~ 2 475 ㎒
Modulation Technique	GFSK
Number of Channels	73
Antenna Type	PCB antenna
Antenna Gain	1.78 ㏈i
H/W Version	03
S/W Version	0102

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1.4. Test equipment list

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Interval	Cal. Due
Signal Generator	R&S	SMBV100A	255834	Jun. 20, 2016	Annual	Jun. 20, 2017
Signal Generator	R&S	SMR40	100272	Jun. 18, 2016	Annual	Jun. 18, 2017
Spectrum Analyzer	Agilent	N9020A	MY53421758	Sep. 23, 2016	Annual	Sep. 23, 2017
Spectrum Analyzer	R&S	FSV30	103100	Jun. 24, 2016	Annual	Jun. 24, 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+	V9500401023-2	Jun. 15, 2016	Annual	Jun. 15, 2017
Attenuator	MCLI	FAS-12-10	1	Jun. 11, 2016	Annual	Jun. 11, 2017
Power Sensor	R&S	NRP-Z81	100253	Mar. 22, 2016	Annual	Mar. 22, 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. 04, 2015	Biennial	Sep. 04, 2017
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	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.

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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 of Procedure for Compliance Testing of 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. Conducted test

Offset value (dB) = Attenuator (dB) + Cable loss (dB)

1.7.2. 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-RTL010584	2016.11.23	Initial

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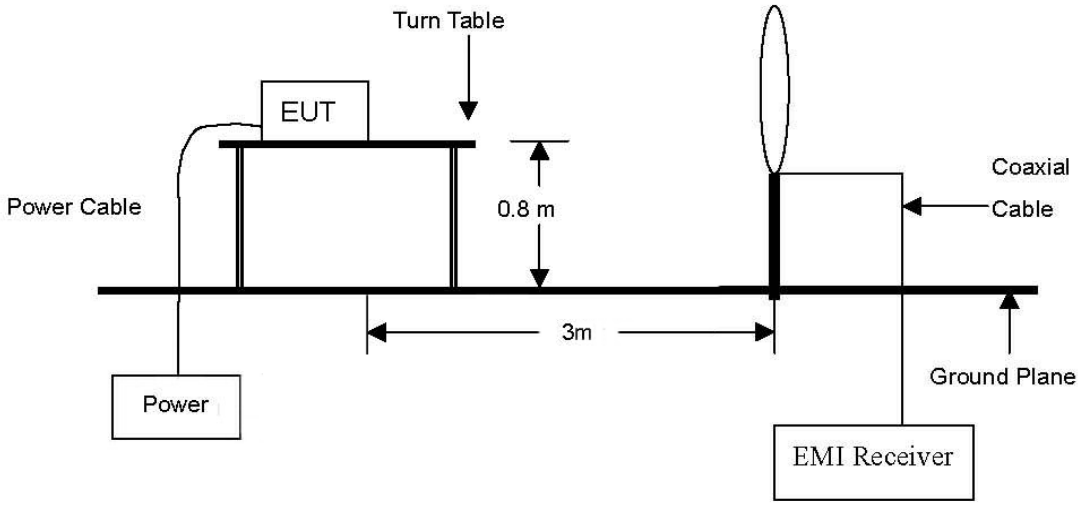
2. Fundamental and Radiated spurious emission

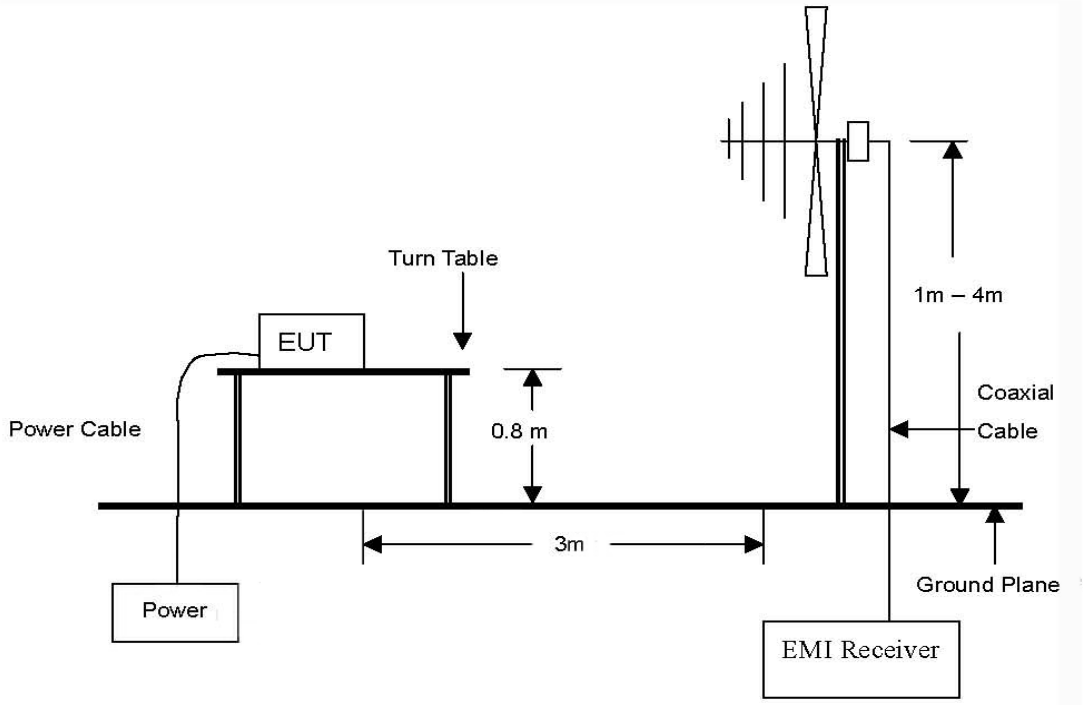
2.1. Test setup

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.



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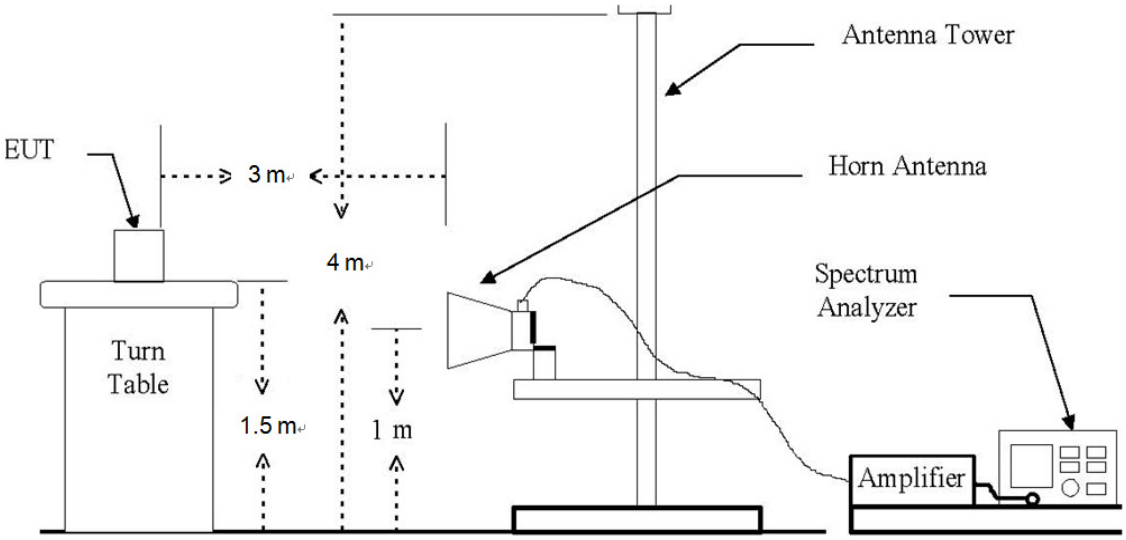
The diagram below shows the test setup that is utilized to make the measurements for emission. The spurious emissions were investigated form 1 ㎓ to the 10th harmonic of the highest fundamental frequency or 40 ㎓, whichever is lower.



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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 **Z – axis** during radiation test.

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2.3. Limits

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 (millivolts/meter)	Field strength of harmonics (microvolts/meter)
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 §15.249(e), as shown in §15.35(b), for frequencies above 1000 ㎒, the field strength limits in paragraphs (a) and (b) of this section are based on average limits However, the peak field strength of ant emission shall not exceed the maximum permitted average limits specified above by more than 30 ㏈ under any condition of modulation. For point to point operation under paragraph (b) of this section, the peak field strength shall not exceed 2 500 millivolts/meter at 3 meters along the antenna azimuth.

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 (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., Sections §15.231 and §15.241

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2.4. Test result

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

2.4.1. Field Strength of Fundamental

A. Low Channel (2 403 ㎒)

Fundamental level			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2 403.36	55.47	Peak	H	28.16	5.84	89.47	114.00	24.53
2 403.06	54.35	Average	H	28.16	5.85	88.36	94.00	5.64

B. Middle Channel (2 440 ㎒)

Fundamental level			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2 440.35	54.33	Peak	H	28.20	5.62	88.15	114.00	25.85
2 440.06	52.48	Average	H	28.20	5.62	86.30	94.00	7.70

C. High Channel (2 475 ㎒)

Fundamental level			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2 474.69	51.15	Peak	H	28.23	5.57	84.95	114.00	29.05
2 475.26	50.11	Average	H	28.23	5.57	83.91	94.00	10.09

1. Radiated emissions measured in frequency above 1 000 ㎒ were made with an instrument using peak/average detector mode.
2. Actual = Reading + AF + AMP + CL or Reading + AF + CL

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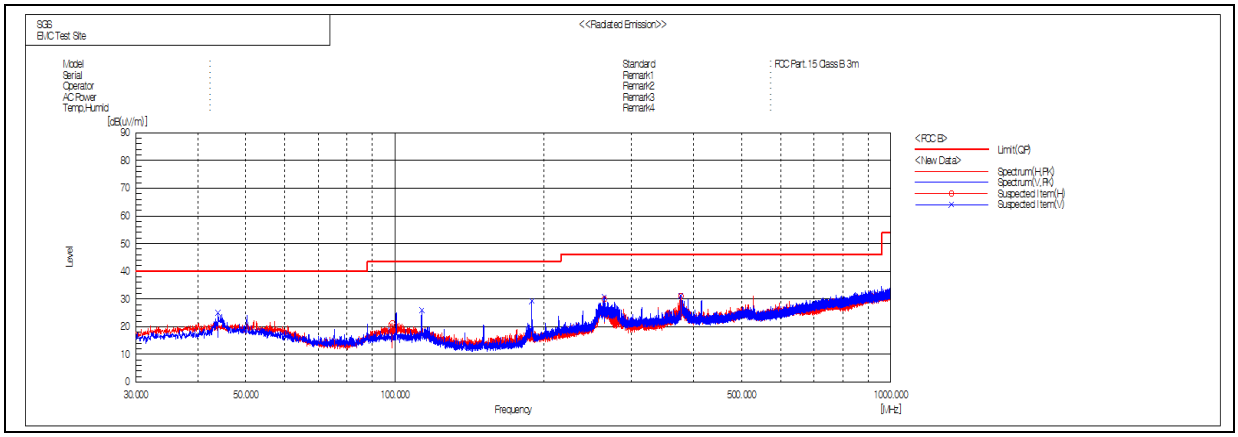
2.4.2. Radiated Spurious Emission below 1 000 ㎒

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

Radiated Emissions			Ant.	Correction Factors		Total	FCC Limit	
Frequency (㎒)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	AMP + CL (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
43.98	37.50	Peak	V	14.54	-27.13	24.91	40.00	15.09
113.26	41.40	Peak	V	10.76	-26.51	25.65	43.50	17.85
188.84	45.00	Peak	V	10.14	-25.82	29.32	43.50	14.18
264.30	41.80	Peak	V	14.34	-25.41	30.73	46.00	15.27
264.38	41.60	Peak	H	13.58	-25.41	29.77	46.00	16.23
377.26	39.90	Peak	V	16.61	-25.50	31.01	46.00	14.99
377.87	40.20	Peak	H	16.33	-25.50	31.03	46.00	14.97
Above 400.00	Not detected	-	-	-	-	-	-	-

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



2.4.3. Radiated Spurious Emission above 1 000 ㎒

A. Low Channel (2 403 ㎒)

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
*2 310.00	24.78	Peak	H	28.07	5.31	58.16	74.00	15.84
*2 310.00	15.44	Average	H	28.07	5.31	48.82	54.00	5.18
*2 382.53	27.93	Peak	H	28.14	5.75	61.82	74.00	12.18
*2 389.70	15.67	Average	H	28.15	5.80	49.62	54.00	4.38
*2 390.00	24.67	Peak	H	28.15	5.80	58.62	74.00	15.38
*2 390.00	15.66	Average	H	28.15	5.80	49.61	54.00	4.39
2 399.48	33.16	Peak	H	28.16	5.87	67.19	74.00	6.81
2 399.98	15.89	Average	H	28.16	5.87	49.92	54.00	4.08
2 400.00	25.82	Peak	H	28.16	5.87	59.85	74.00	14.15
2 400.00	15.91	Average	H	28.16	5.87	49.94	54.00	4.06

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
*4 806.65	44.23	Peak	H	32.66	-30.21	46.68	74.00	27.32
*4 806.72	39.07	Average	H	32.66	-30.21	41.52	54.00	12.48
7 210.11	42.91	Peak	V	35.60	-25.71	52.80	74.00	21.20
7 210.21	38.29	Average	V	35.60	-25.71	48.18	54.00	5.82
Above 7 300.00	Not detected	-	-	-	-	-	-	-

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B. Middle Channel (2 440 ㎒)

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
*4 880.69	45.05	Peak	H	32.86	-29.70	48.21	74.00	25.79
*4 880.61	40.03	Average	H	32.86	-29.70	43.19	54.00	10.81
*7 321.07	43.20	Peak	V	35.74	-25.06	53.88	74.00	20.12
*7 321.08	37.05	Average	V	35.74	-25.06	47.73	54.00	6.27
Above 7 400.00	Not detected	-	-	-	-	-	-	-

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C. High Channel (2 475 ㎒)

Radiated Emissions			Ant	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
*2 483.50	25.15	Peak	H	28.24	5.54	58.93	74.00	15.07
*2 483.50	16.14	Average	H	28.24	5.54	49.92	54.00	4.08
*2 484.85	27.41	Peak	H	28.24	5.54	61.19	74.00	12.81
*2 483.70	16.15	Average	H	28.24	5.54	49.93	54.00	4.07
*2 500.00	25.97	Peak	H	28.26	5.49	59.72	74.00	14.28
*2 500.00	16.14	Average	H	28.26	5.49	49.89	54.00	4.11

Radiated Emissions			Ant	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
*4 950.75	44.94	Peak	H	33.05	-29.48	48.51	74.00	25.49
*4 950.73	39.67	Average	H	33.05	-29.48	43.24	54.00	10.76
*7 425.94	40.88	Peak	V	35.88	-23.02	53.74	74.00	20.26
*7 425.96	36.01	Average	V	35.88	-23.02	48.87	54.00	5.13
Above 7 500.00	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 ㏈.

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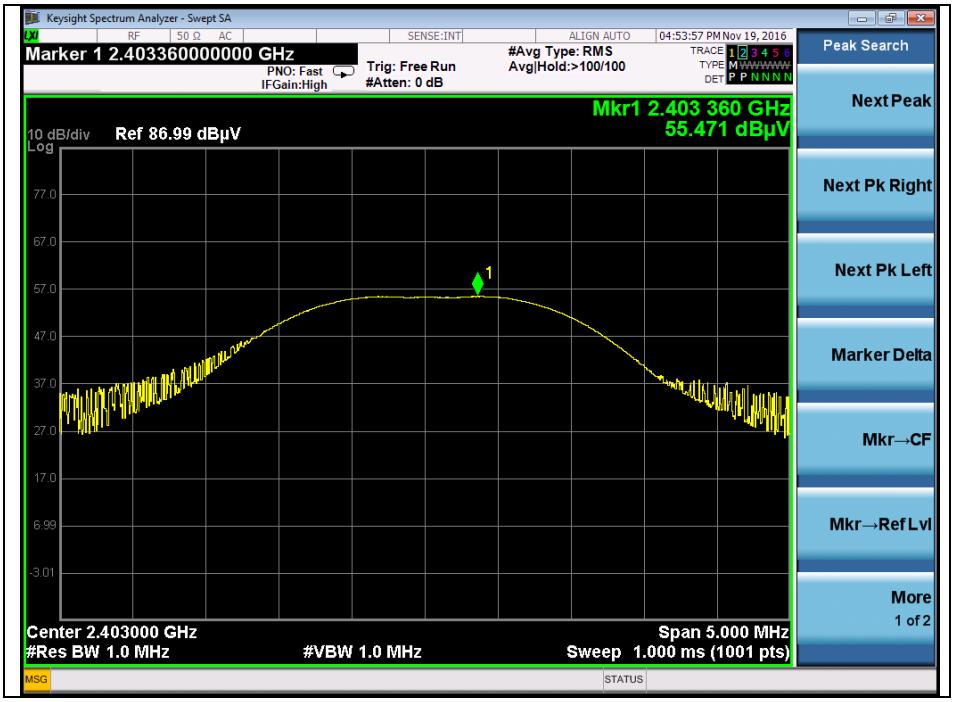
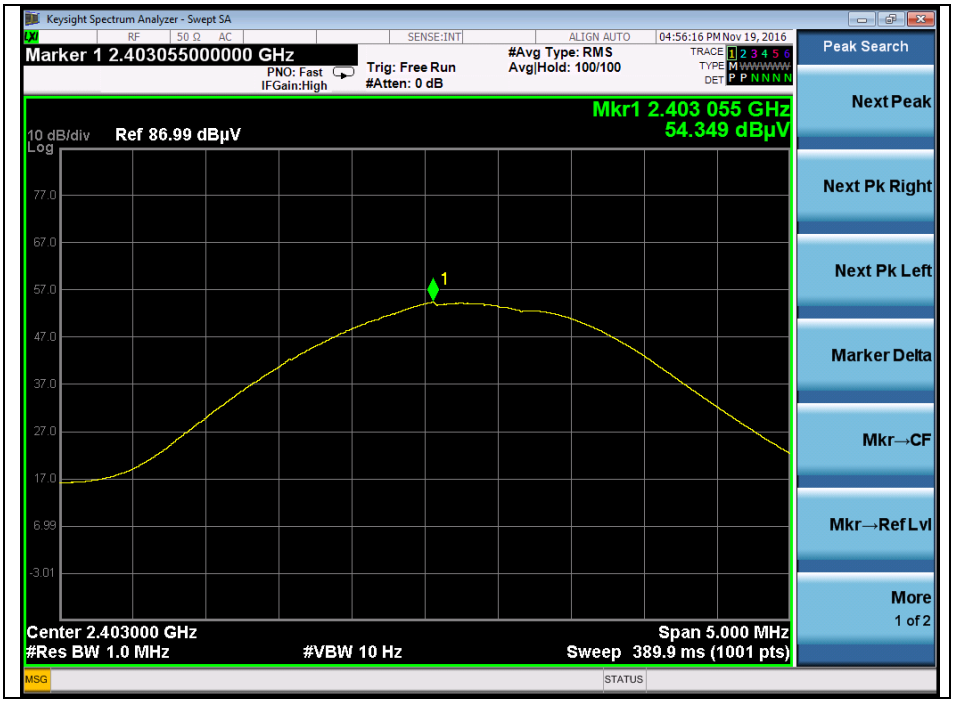
Plots of Field strength of fundamental

Low channel (Peak)



Low channel (Average)



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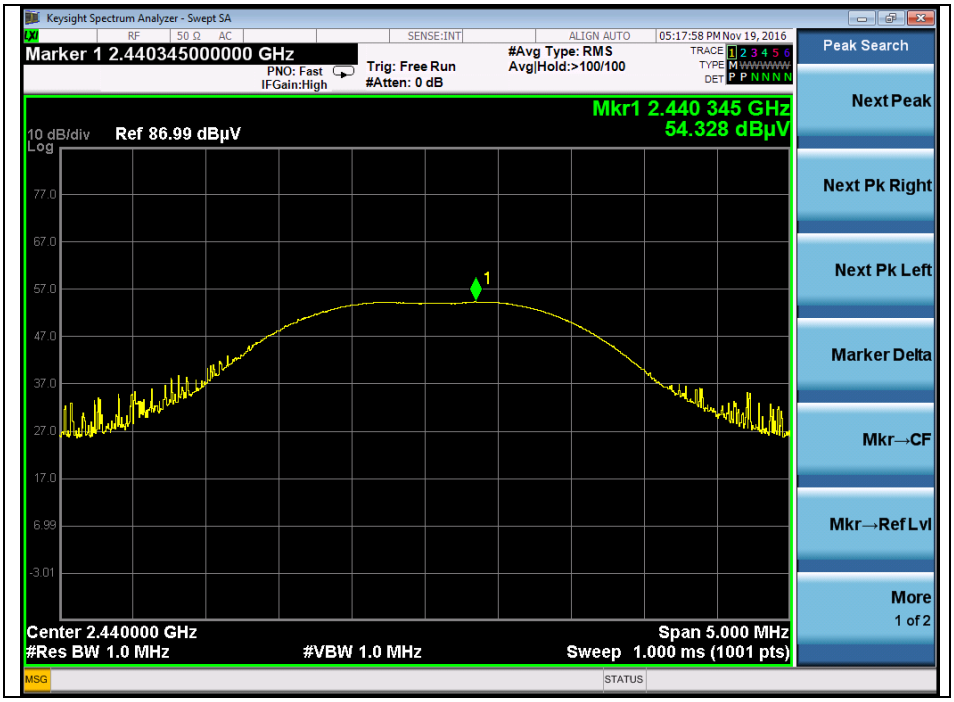
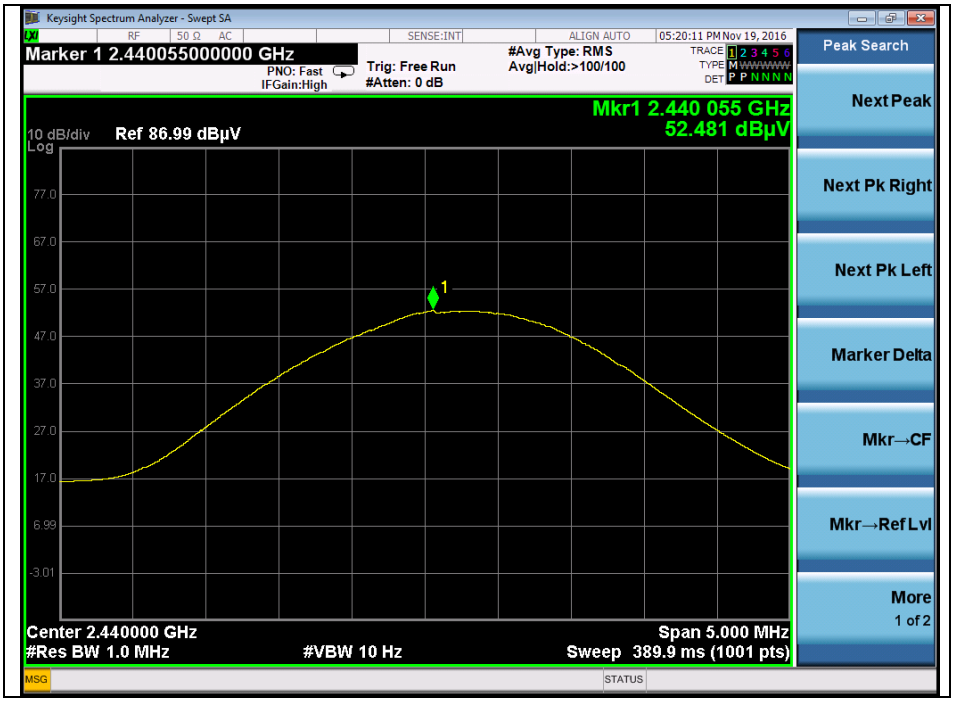
Middle channel (Peak)



Middle channel (Average)



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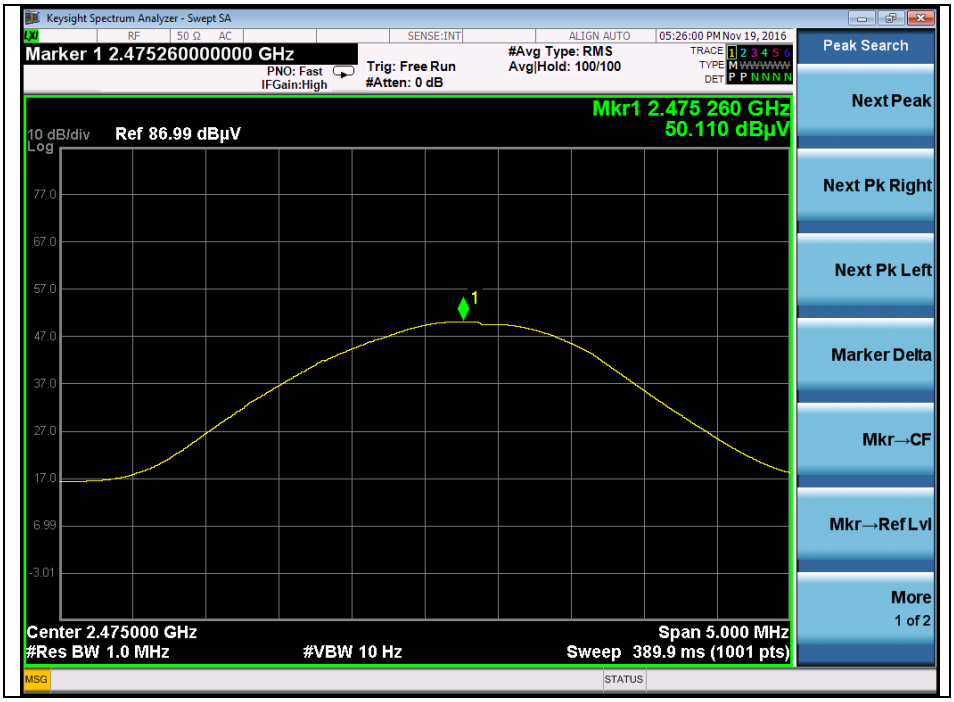
High channel (Peak)

High channel (Average)



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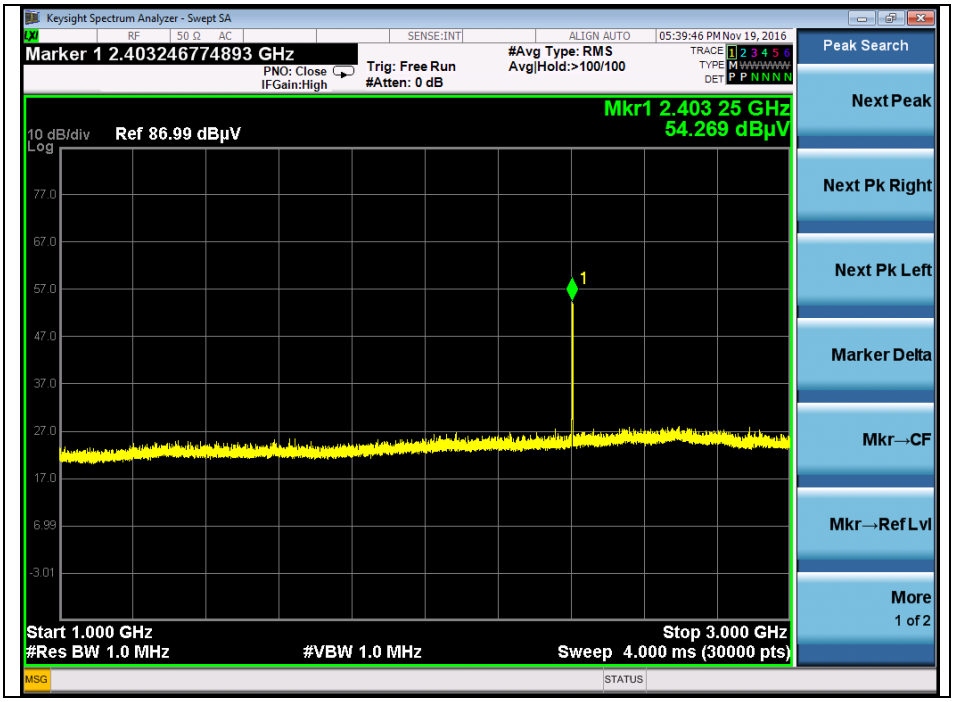
Plots of Pre-scan 1 ㎓ ~ 25 ㎓

Low channel

1 ㎓ ~ 3 ㎓



3 ㎓ ~ 18 ㎓

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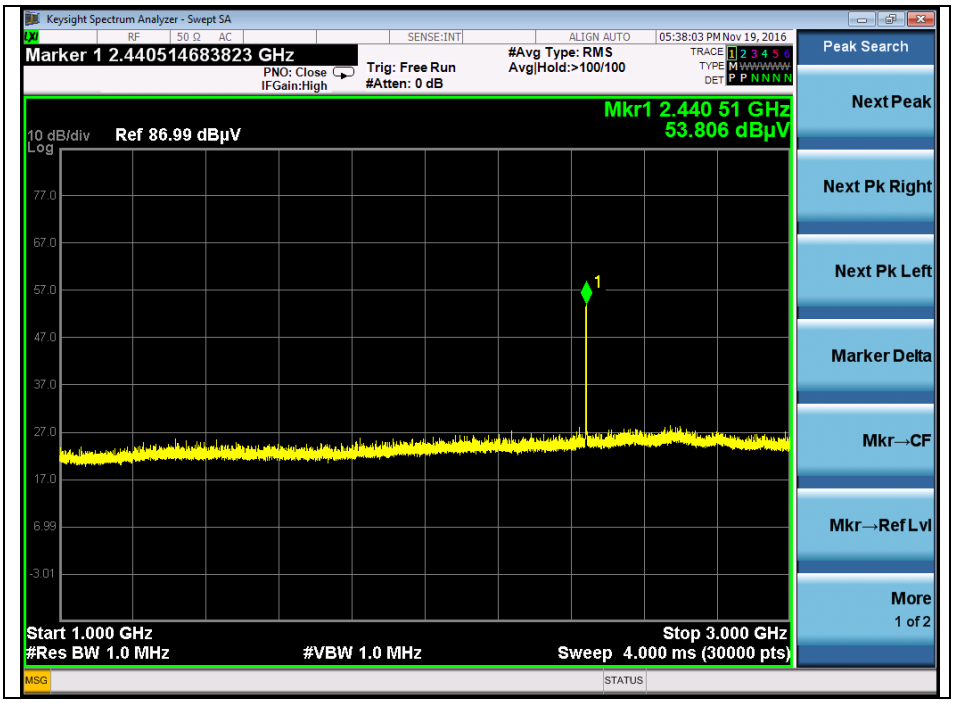
18 ㎓ ~ 25 ㎓

Keysight Spectrum Analyzer - Swept SA
Start Freq 18.000000000 GHz
PNO: Close
IFGain:High
Trig: Free Run
#Atten: 0 dB
#Avg Type: RMS
Avg|Hold:>100/100
07:51:47 PM Nov 19, 2016
10 dB/div
Log
Ref 86.99 dBµV
77.0
67.0
57.0
47.0
37.0
27.0
17.0
6.99
-3.01
Start 18.000 GHz
#Res BW 1.0 MHz
#VBW 1.0 MHz
Stop 25.000 GHz
Sweep 19.20 ms (32001 pts)
Frequency
Auto Tune
Center Freq
21.500000000 GHz
Start Freq
18.000000000 GHz
Stop Freq
25.000000000 GHz
CF Step
7.219490650 GHz
Auto
Man
Freq Offset
0 Hz

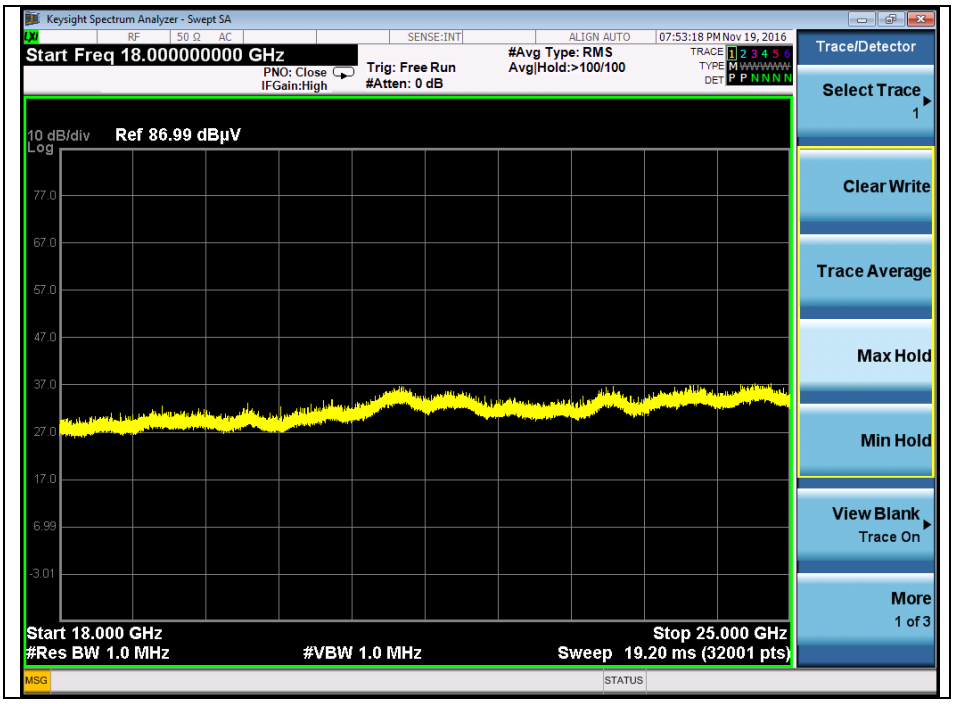
Middle channel

1 GHz ~ 3 GHz



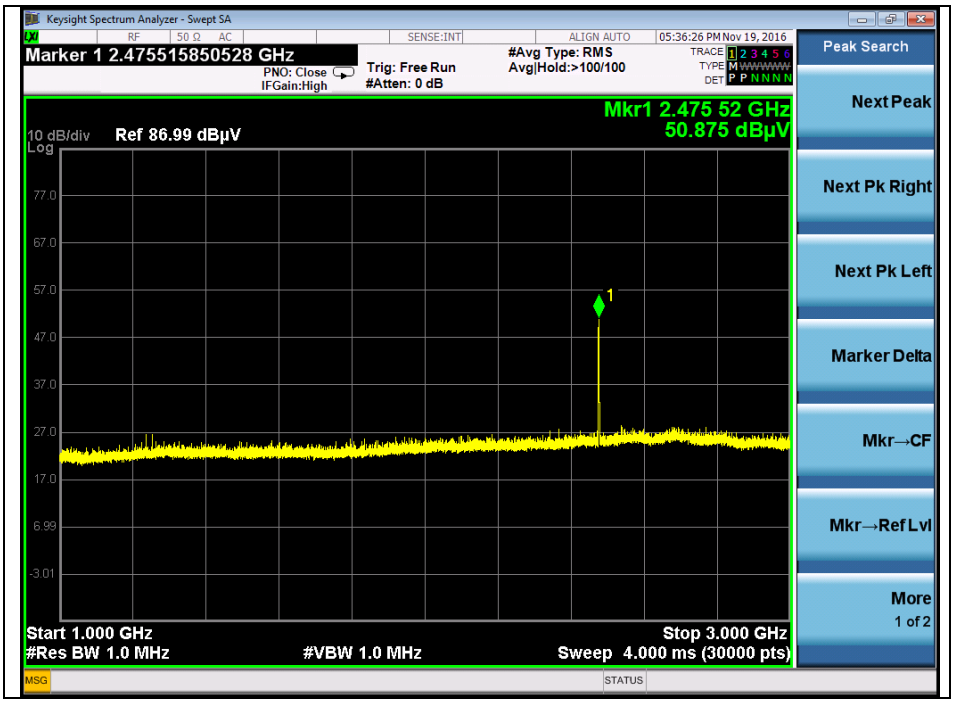
3 GHz ~ 18 GHz

18 ㎓ ~ 25 ㎓

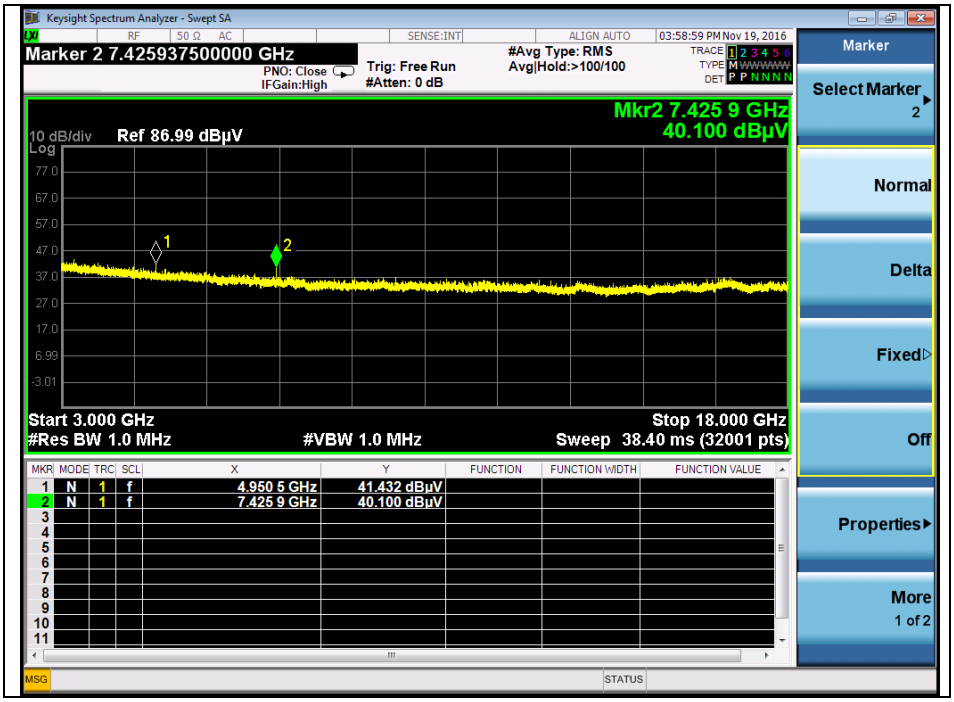

Keysight Spectrum Analyzer - Swept SA
Start Freq 18.000000000 GHz
PNO: Close
IFGain:High
Trig: Free Run
#Atten: 0 dB
#Avg Type: RMS
Avg|Hold:>100/100
07:53:18 PM Nov 19, 2016
10 dB/div
Log
Ref 86.99 dBµV
77.0
67.0
57.0
47.0
37.0
27.0
17.0
6.99
-3.01
Start 18.000 GHz
#Res BW 1.0 MHz
#VBW 1.0 MHz
Stop 25.000 GHz
Sweep 19.20 ms (32001 pts)
Trace/Detector
Select Trace
1
Clear Write
Trace Average
Max Hold
Min Hold
View Blank
Trace On
More
1 of 3

High channel

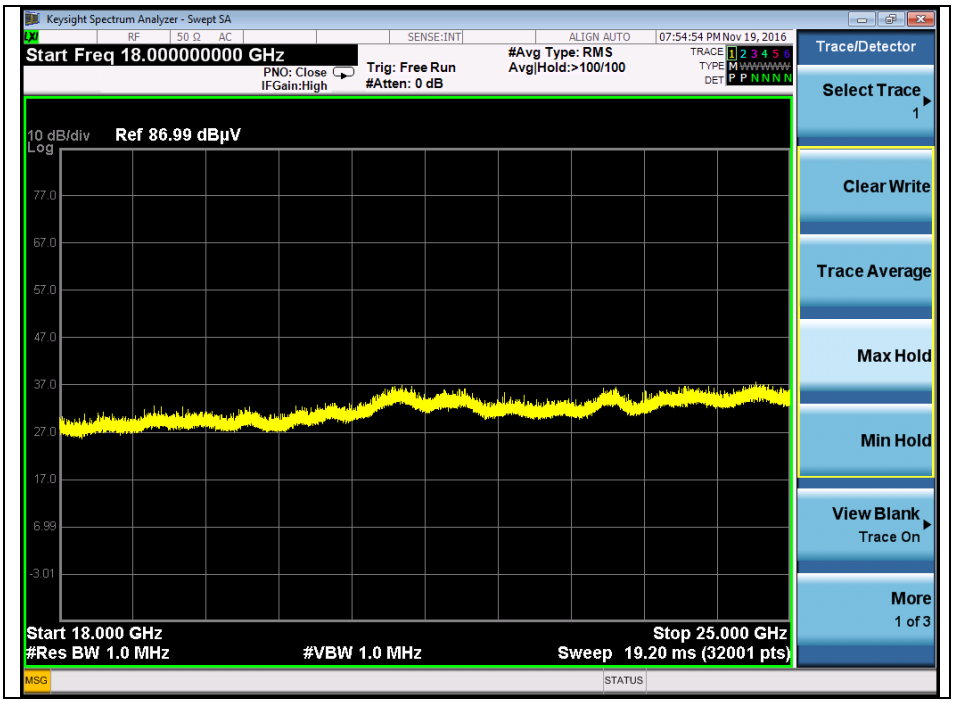
1 GHz ~ 3 GHz



3 GHz ~ 18 GHz

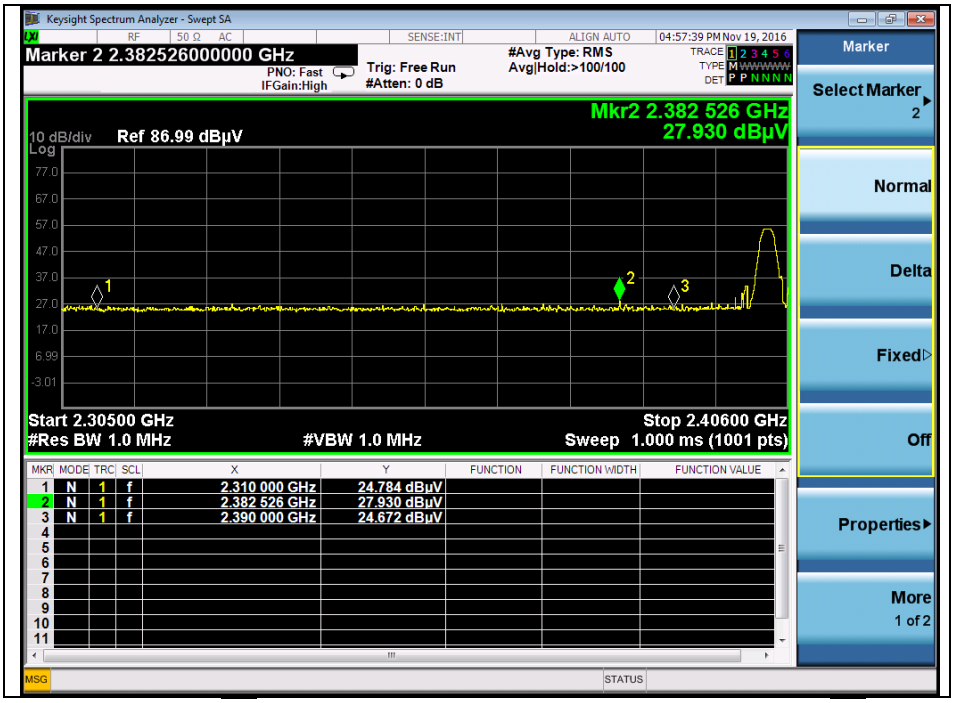


18 ㎓ ~ 25 ㎓

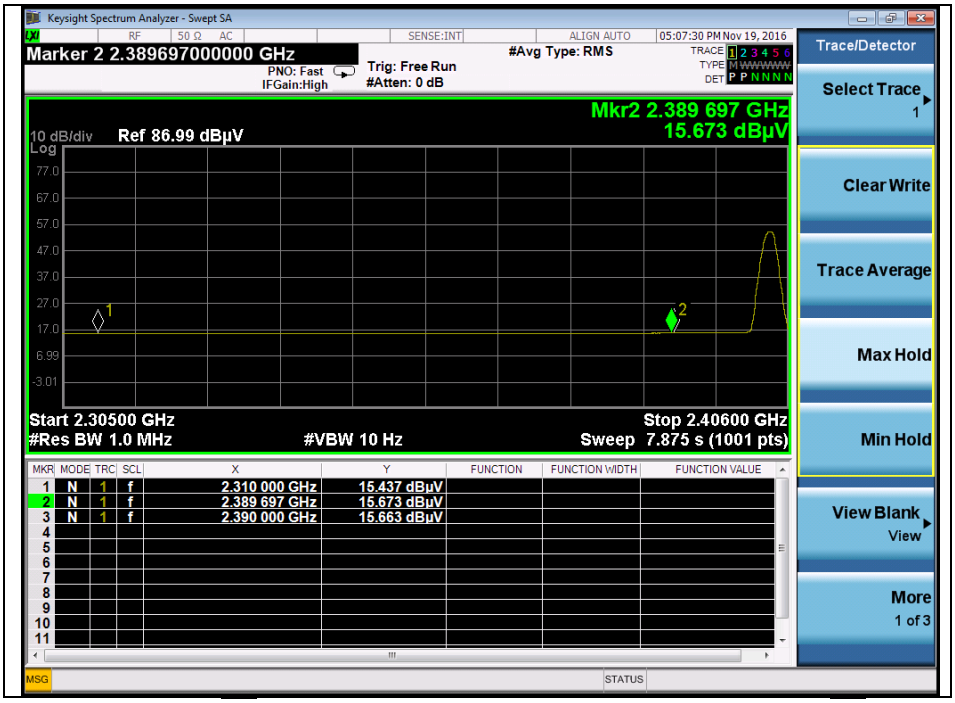

Keysight Spectrum Analyzer - Swept SA
Start Freq 18.000000000 GHz
PNO: Close
IFGain:High
Trig: Free Run
#Atten: 0 dB
#Avg Type: RMS
Avg|Hold:>100/100
10 dB/div
Log
Ref 86.99 dBµV
77.0
67.0
57.0
47.0
37.0
27.0
17.0
6.99
-3.01
Start 18.000 GHz
#Res BW 1.0 MHz
#VBW 1.0 MHz
Stop 25.000 GHz
Sweep 19.20 ms (32001 pts)
Trace/Detector
Select Trace
1
Clear Write
Trace Average
Max Hold
Min Hold
View Blank
Trace On
More
1 of 3

Plots of Radiated Spurious Emission above 1 000 MHz

Low channel band edge - Restricted band (Peak)

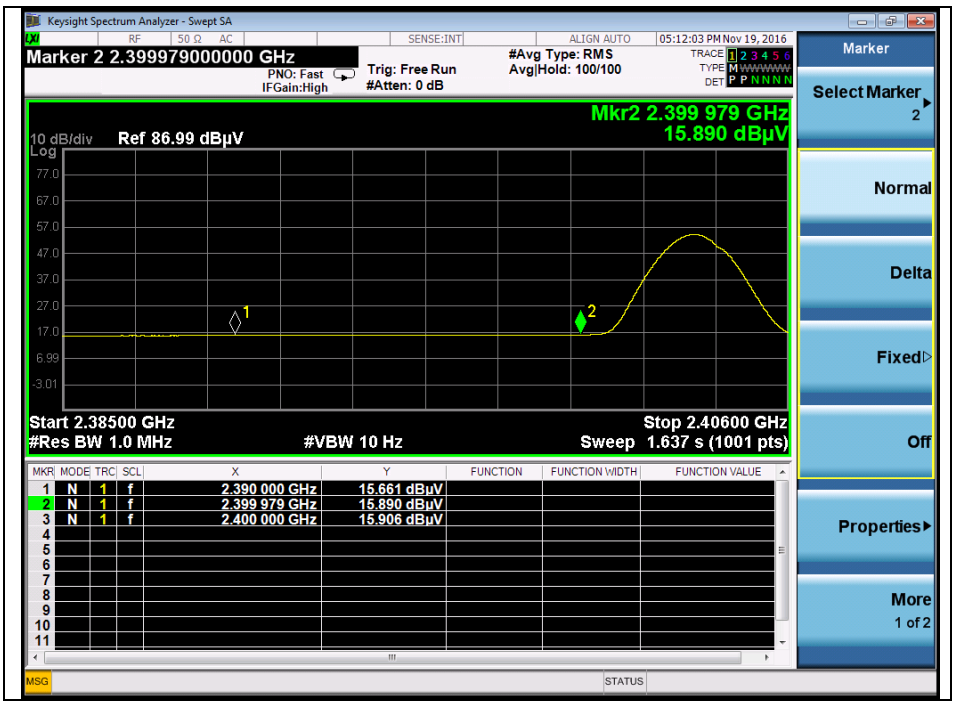


Low channel band edge - Restricted band (Average)

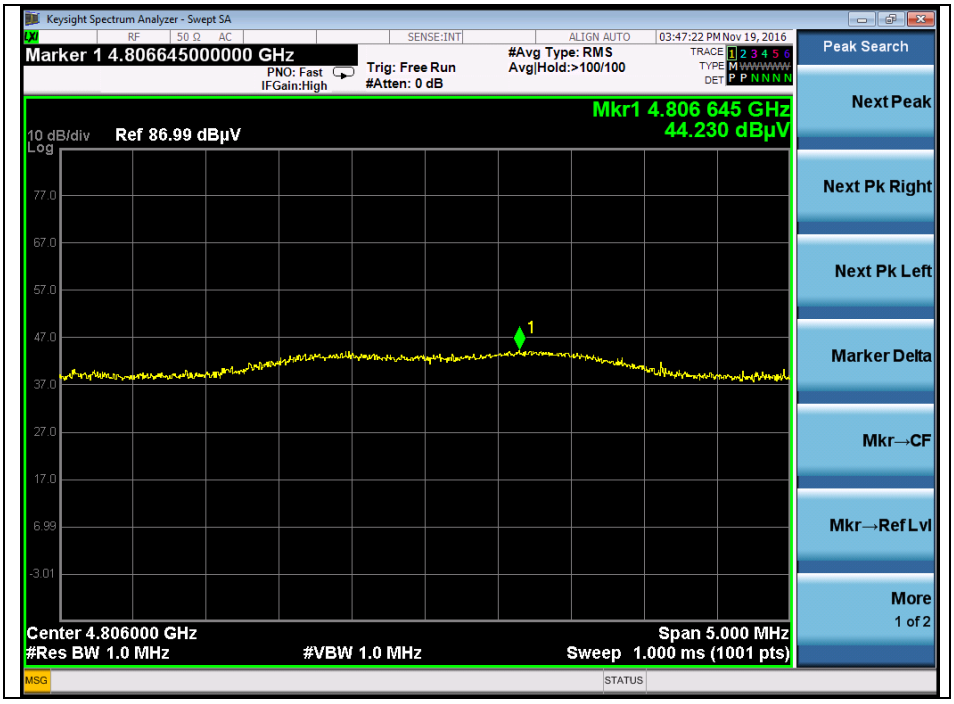


Low channel band edge – Non Restricted band (Peak)

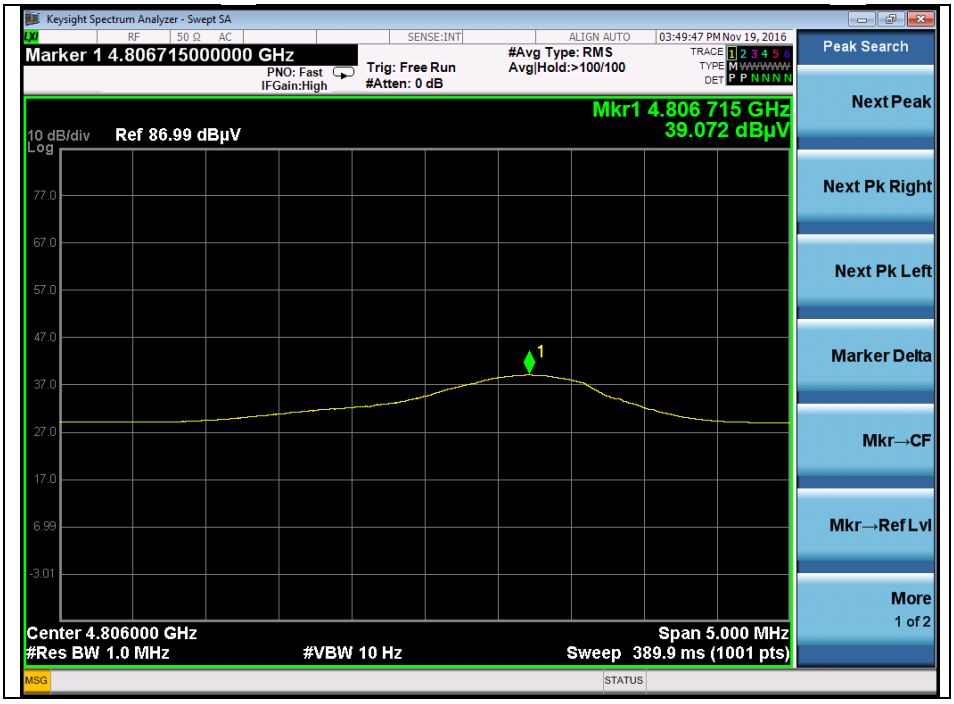
Low channel band edge – Non Restricted band (Average)



Low channel 2nd harmonic (Peak)



Low channel 2nd harmonic (Average)



Low channel 3rd harmonic (Peak)

Low channel 3rd harmonic (Average)

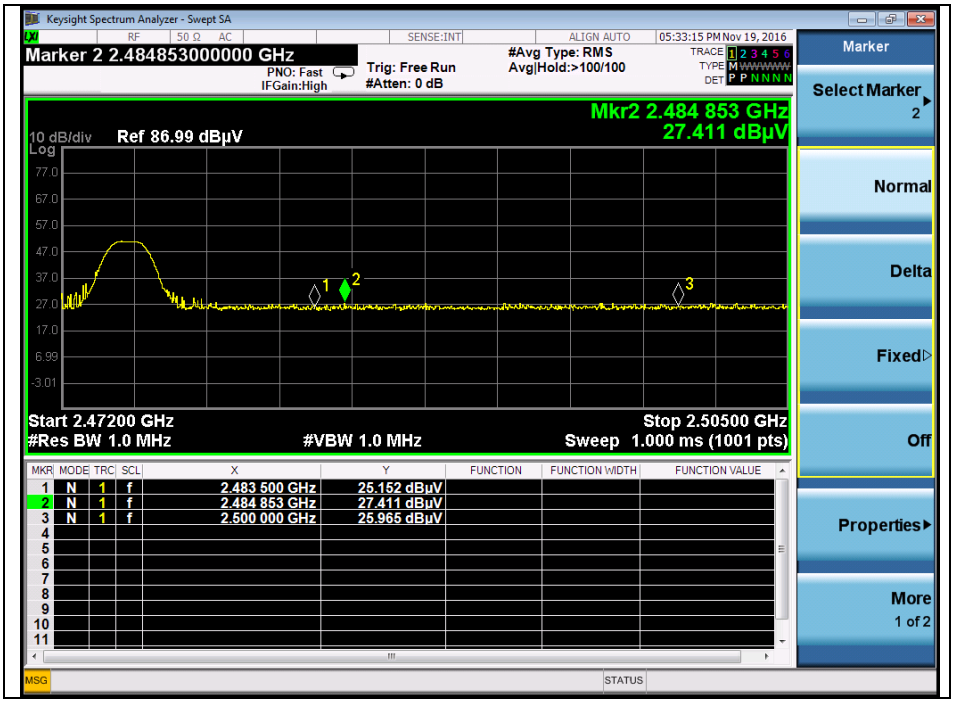
Middle channel 2nd harmonic (Peak)

Middle channel 2nd harmonic (Average)

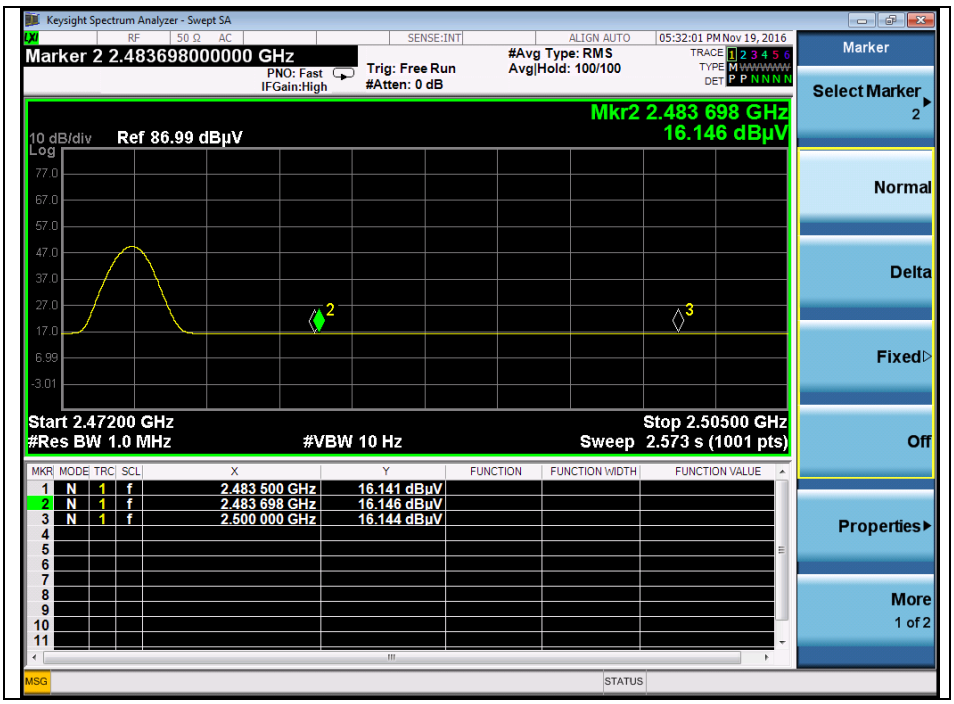
Middle channel 3rd harmonic (Peak)

Middle channel 3rd harmonic (Average)

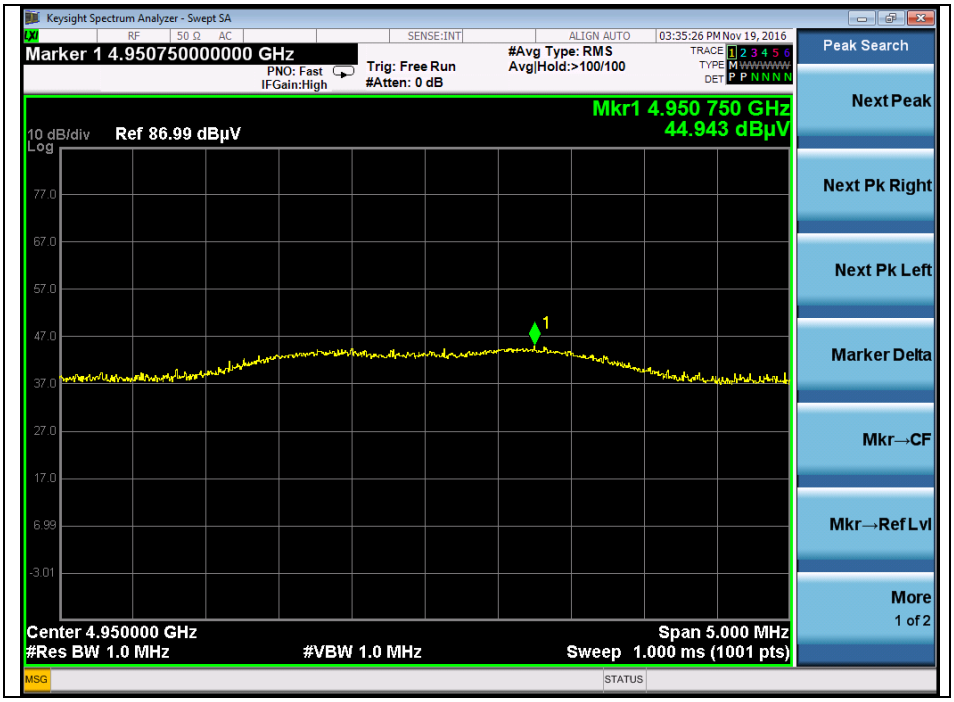
High channel band edge (Peak)



High channel band edge (Average)

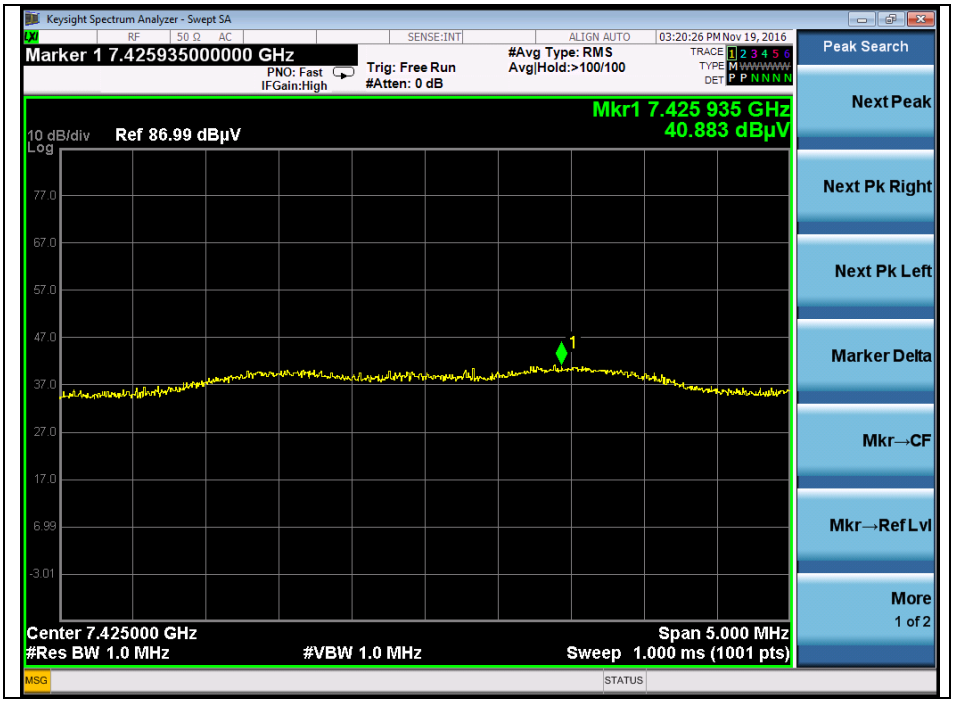


High channel 2nd harmonic (Peak)



High channel 2nd harmonic (Average)

High channel 3rd harmonic (Peak)



High channel 3rd harmonic (Average)

3. 20 ㎧ Bandwidth

3.1. Test Setup

3.2. Limit

Limit: Not Applicable

3.3. Test Procedure

20 ㎧ Bandwidth

a. Span = approximately 2 to 3 times the 20 ㎧ bandwidth, RBW = greater than 1 % of the 20 ㎧ bandwidth, VBW = RBW, Sweep = auto, Detector = peak, Trace = max hold.

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

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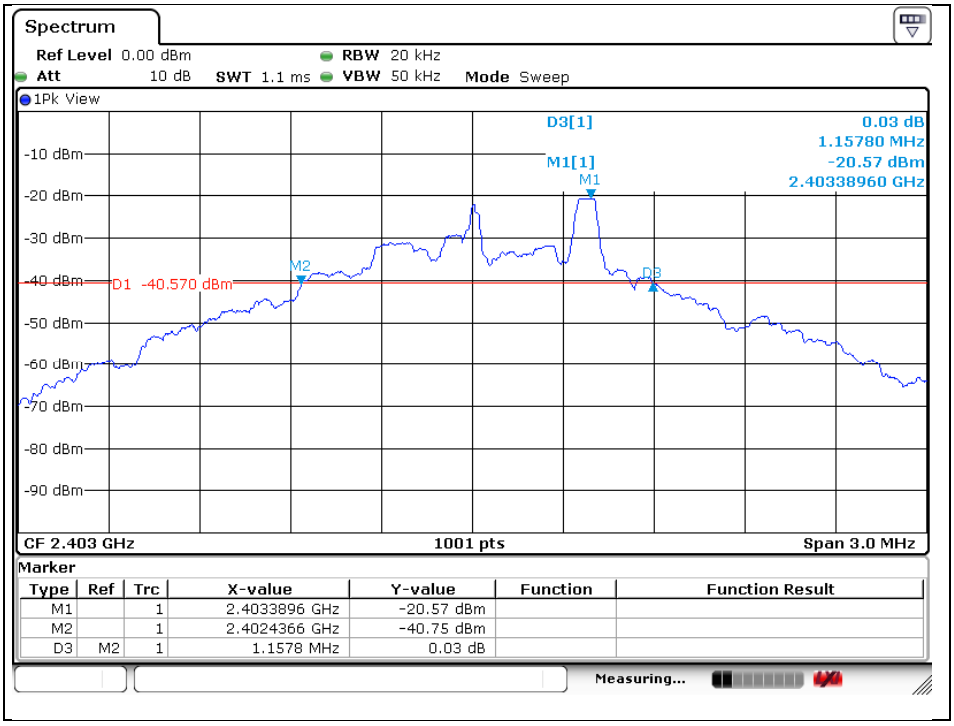
3.4. Test Results

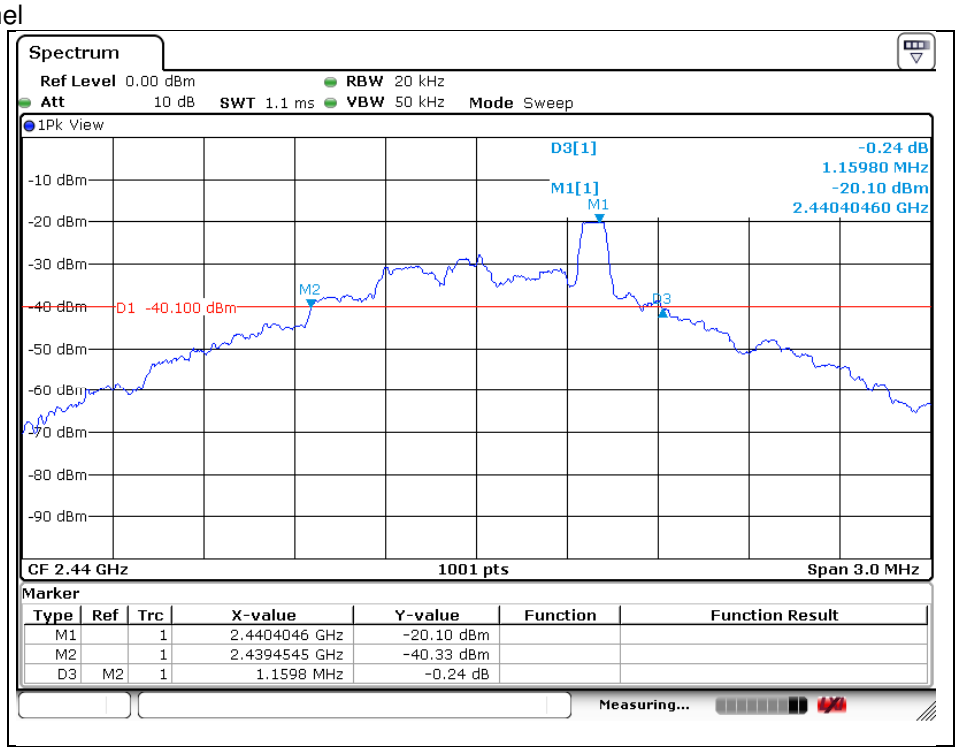
Ambient temperature : (23 ± 1) ℃
Relative humidity : 47 % R.H.

Channel	Frequency (MHz)	20 dB Bandwidth (MHz)
Low	2 403	1.158
Middle	2 440	1.160
High	2 475	1.136

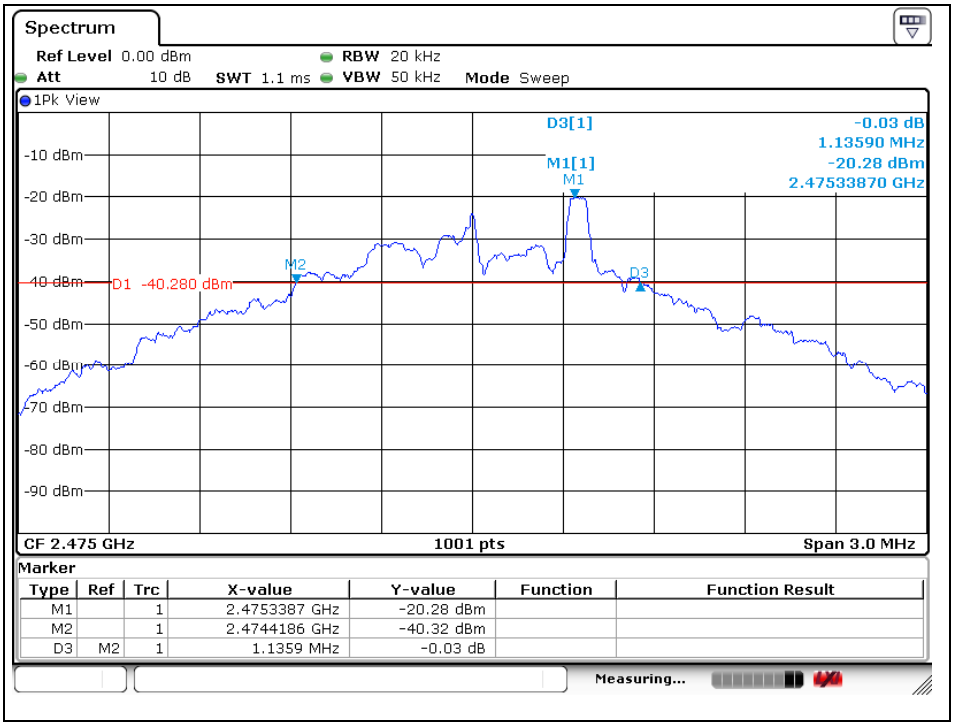
Low Channel



Middle Channel



High Channel



- End of the Test Report -

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