TEST REPORT

DT&C Co., Ltd. 42, Yurim-ro, 154Beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea Tel : 031-321-2664, Fax : 031-321-1664	Report No : DRTFCC1605-0075 Pages:(1) / (36) page	Dt&C

1. Customer
   - Name : SOLUM CO.,LTD.
   - Address : 150, Maeyeong-ro, Yeongtong-gu, Gyeonggi-do, Suwon-si, South Korea
2. Use of Report : FCC Original Grant
3. Product Name (FCC ID): ESL Graphic TAG (2AFWN-ST-GR2700N)
4. Date of Test : 2016-05-04 ~ 2016-05-11
5. Test Method Used: FCC Part 15 Subpart C.247
6. Testing Environment : See appended test report
7. Test Result : ☒ Pass ☐ Fail

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This Test Report cannot be reproduced, except in full.

Affirmation	Tested by Name : HoonPyo Lee (Signature)	Technical Manager Name : WonJung Lee (Signature)

2016. 05. 24

DT&C Co., Ltd.

* If this test report is required to confirmation of authenticity, please contact to report@dtnc.net

Test Report Version

Test Report No.	Date	Description
DRTICT1605-0075	May. 24, 2016	Initial issue

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1. General Information

1.1 Testing Laboratory

DT&C Co., Ltd.			
Standard		**Site number**	**Address**
FCC	☒	**165783**	42, Yurim-ro 154 beon-gil, Cheoin -gu, Yongin-si, Gyeonggi -do, South Korea 449-935
	☐	**804488**	42, Yurim-ro 154 beon-gil, Cheoin -gu, Yongin-si, Gyeonggi -do, South Korea 449-935
	☐	**596748**	42, Yurim-ro 154 beon-gil, Cheoin -gu, Yongin-si, Gyeonggi -do, South Korea 449-935
	☐	**678747**	683-3, Yubang-dong, Cheoin-gu, Yongin-si, Kyeonggi-do, Korea, 449-080
IC	☐	**5740A-3**	42, Yurim-ro 154 beon-gil, Cheoin -gu, Yongin-si, Gyeonggi -do, South Korea 449-935
	☐	**5740A-2**	683-3, Yubang-dong, Cheoin-gu, Yongin-si, Kyeonggi-do, Korea, 449-080
www.dtnc.net			
Telephone	:	+ 82-31-321-2664	
FAX	:	+ 82-31-321-1664	

1.2 Details of Applicant

Applicant	:	SOLUM CO.,LTD.
Address	:	150, Maeyeong-ro, Yeongtong-gu, Gyeonggi-do, Suwon-si, South Korea
Contact person	:	Ki Dong Lee

1.3 Description of EUT

EUT	ESL Graphic TAG
Model Name	ST-GR2700N
Add Model Name	N/A
Serial Number	Identical prototype
Power Supply	DC 3.0 V (Not rechargeable battery)
Frequency Range	2405 ~ 2480MHz (16 channels)
Max. RF Output Power	3.32 dBm
Modulation Technique	O-QPSK
Antenna Specification	Antenna Type: Internal Antenna Gain: -1.10 dBi(PK)

1.4 Declaration by the applicant / manufacturer

- N/A

1.5 Test Conditions

Ambient Condition	
▪ Temperature	+22 ℃ ~ +24 ℃
▪ Relative Humidity	43 % ~ 45 %

1.6 Test Equipment List

Type	Manufacturer	Model	Cal. Date (yy/mm/dd)	Next Cal. Date (yy/mm/dd)	S/N
MXA Signal Analyzer	Agilent Technologies	N9020A	16/01/06	17/01/06	MY48011146
MXA Signal Analyzer	Agilent Technologies	N9020A	16/01/06	17/01/06	MY46471096
Dynamic Measurement DC Source	Agilent Technologies	66332A	16/01/05	17/01/05	US37476998
Thermohygrometer	BODYCOM	BJ5478	16/04/22	17/04/22	120612-1
Signal Generator	Rohde Schwarz	SMF100A	15/06/29	16/06/29	102341
Multimeter	HP	34401A	16/02/25	17/02/25	3146A13475
Loop Antenna	Schwarzbeck	FMZB1513	16/04/22	18/04/22	1513-128
BILOG ANTENNA	Schwarzbeck	VULB9161	14/07/10	16/07/10	4070
Horn Antenna	ETS-LINDGREN	3115	15/02/09	17/02/09	9202-3820
Horn Antenna	A.H.Systems Inc.	SAS-574	15/04/30	17/04/30	154
Highpass Filter	Wainwright Instruments	WHKX12-2580-3000-18000-80SS	15/09/23	16/09/23	3
Highpass Filter	Wainwright Instruments	WHNX6-6320-8000-26500-40CC	15/09/23	16/09/23	1
PreAmplifier	Agilent	8449B	16/02/24	17/02/24	3008A00370
PreAmplifier	TSJ	MLA-010K01-B01-27	16/03/10	17/03/10	1844539
EMI Test Receiver	Rohde Schwarz	ESU	15/07/14	16/07/14	100469

1.7 Summary of Test Results

FCC Part	RSS Std.	Parameter	Limit	Test Condition	Status Note 1
15.247(a)	RSS-247 [5.2]	6 dB Bandwidth	> 500 kHz	Conducted	C
15.247(b)	RSS-247 [5.4]	Transmitter Output Power	< 1 Watt		C
15.247(d)	RSS-247 [5.5]	Out of Band Emissions / Band Edge	20 dBc in any 100 kHz BW		C
15.247(e)	RSS-247 [5.2]	Transmitter Power Spectral Density	< 8 dBm/3 kHz		C
-	RSS-Gen [6.6]	Occupied Bandwidth (99 %)	RSS-Gen(6.6)		NA
15.205 15.209	RSS-247 [5.5]	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	FCC 15.209 limits	Radiated	C
15.207	RSS-Gen [8.8]	AC Line Conducted Emissions	FCC 15.207 limits	AC Line Conducted	NA Note 2
15.203	RSS-Gen [8.3]	Antenna Requirements	FCC 15.203	-	C

Note 1: **C**=Comply **NC**=Not Comply **NT**=Not Tested **NA**=Not Applicable

Note 2: The supplying power of this device is batteries which are not rechargeable.

2. Test Methodology

Generally the tests were performed according to the KDB558074 D01 v03r05. And ANSI C63.10-2013 was used to reference appropriate EUT setup and maximizing procedures of radiated spurious emission and AC line conducted emission testing.

2.1 EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

2.2 EUT Exercise

The EUT was operated in the test mode to fix the TX frequency that was for the purpose of the measurements. According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C.

2.3 General Test Procedures

Conducted Emissions

The power-line conducted emission test procedure is not described on the KDB 558074.
So this test was fulfilled with the requirements in Section 6.2 of ANSI C63.10.
The EUT is placed on the wooden table, which is 0.8 m above ground plane and the conducted emissions from the EUT measured in the frequency range between 0.15MHz and 30MHz using CISPR Quasi-peak and Average detector.

Radiated Emissions

Basically the radiated tests were performed with KDB 558074. But some requirements and procedures like test site requirements, EUT setup and maximizing procedure were fulfilled with the requirements in Section 5 and 6 of the ANSI C63.10 as stated on section 12.1 of the KDB 558074.
The EUT is placed on a non-conductive table, which is above ground plane. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 1 or 3 m away from the receiving antenna, which varied from 1 m to 4 m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the highest emission, the relative positions of the EUT were rotated through three orthogonal axes.

2.4 Description of Test Modes

The EUT has been tested with the operating condition for maximizing the emission characteristics. A test program is used to control the EUT for staying in continuous transmitting. The lowest, middle and highest channels were tested and reported.

Test Mode [TM]		Test Frequency [MHz]		
		Lowest channel	Middle channel	Highest channel
TM 1	ZIGBEE	2405	2440	2480
TM 2	-	-	-	-
TM 3	-	-	-	-
TM 4	-	-	-	-

2.5 Instrument Calibration

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment, which is traceable to recognized national standards.

3. Test Result

3.1 Maximum Peak Conducted Output Power

▣ Test Requirements and limit, §15.247(b) & RSS-247 [5.4]

A transmitter antenna terminal of EUT is connected to the input of a spectrum analyzer.

Measurement is made while the EUT is operating in transmission mode at the appropriate frequencies.

The maximum permissible conducted output power is 1 Watt.

3.1.1 Test Setup

Refer to the APPENDIX I.

3.1.2 Test Procedures

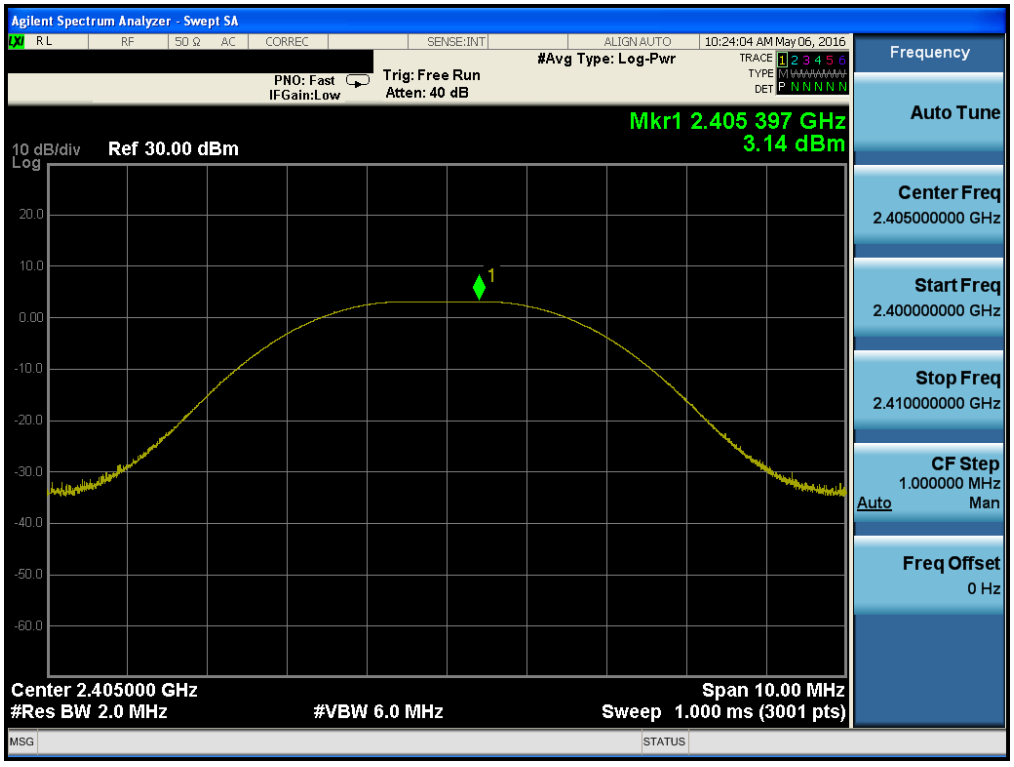
Maximum Peak Conducted Output Power is measured using Measurement Procedure Option 1 of **KDB558074**

1. Set the RBW ≥ DTS bandwidth. **Actual RBW = 2 MHz**
2. Set VBW ≥ 3 x RBW. **Actual VBW = 6 MHz**
3. Set span **≥ 3 x RBW**.
4. Sweep time = **auto couple**
5. Detector = **peak**
6. Trace mode = **max hold**
7. Allow trace to fully stabilize
8. Use peak marker function to determine the peak amplitude level.

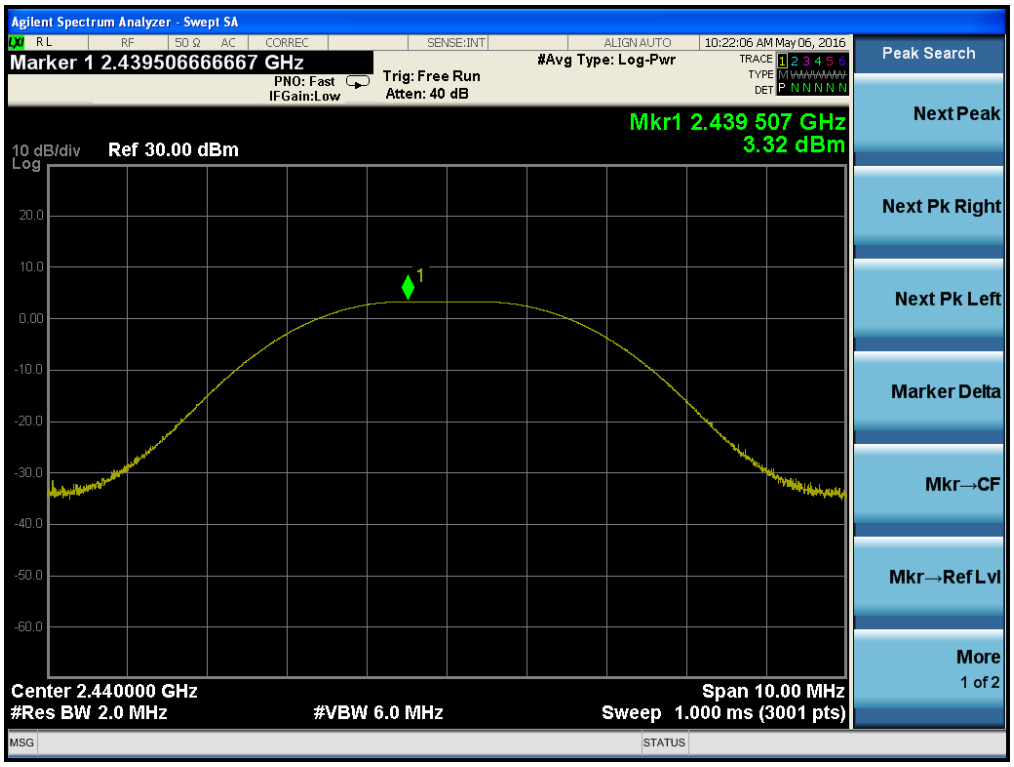
3.1.3 Test Results

Test Mode	Tested Channel	Test Results (dBm)
TM 1	Lowest	3.14
	Middle	**3.32**
	Highest	2.84

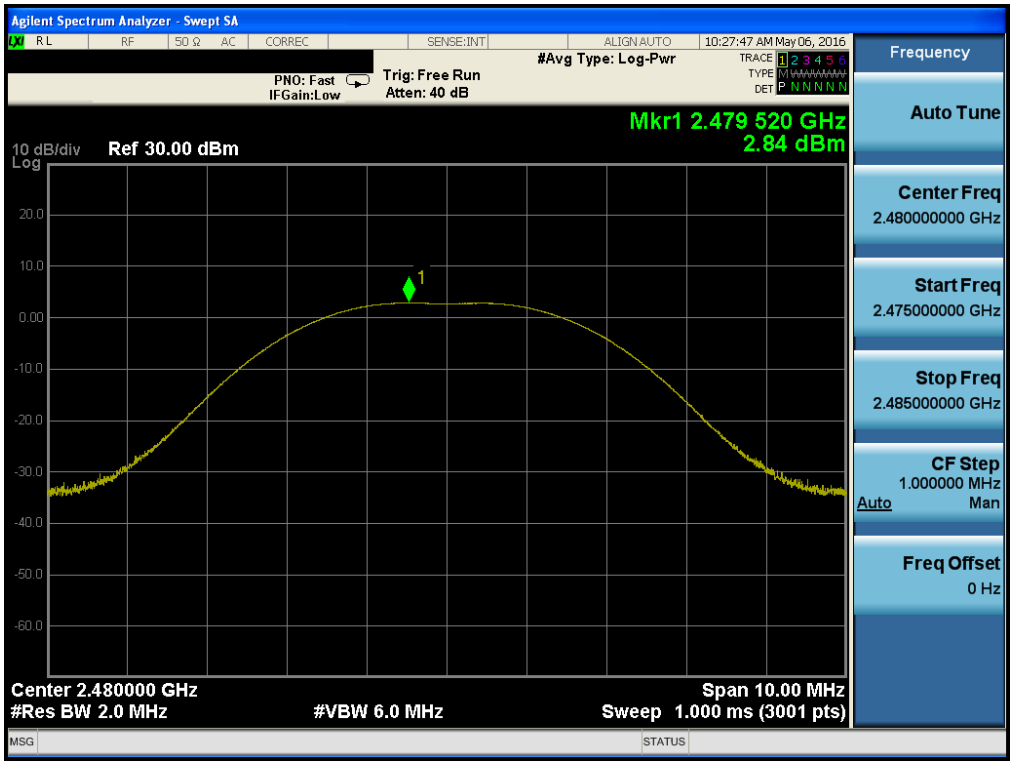
Peak Output Power Test Channel : Lowest



Peak Output Power Test Channel : Middle



Peak Output Power Test Channel : Highest



3.2 6 dB Bandwidth Measurement

▣ Test Requirements and limit, §15.247(a) & RSS-247 [5.2]

The bandwidth at 6 dB down from the highest in-band spectral density is measured with a spectrum analyzer connected to the EUT's antenna terminal while the EUT is operating in transmission mode at the appropriate frequencies.

The minimum permissible 6 dB bandwidth is 500 kHz.

3.2.1 Test Setup

Refer to the APPENDIX I.

3.2.2 Test Procedures

The transmitter output is connected to the Spectrum Analyzer and used following test procedure of **KDB558074.**

1. Set resolution bandwidth (RBW) = 100 kHz.
2. Set the video bandwidth (VBW) ≥ 3 x RBW.
   (RBW : 100 kHz / VBW : 300 kHz)
3. Detector = **Peak**.
4. Trace mode = **max hold**.
5. Sweep = **auto couple**.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

3.2.3 Test Results

Test Mode	Tested Channel	Test Results [MHz]
TM 1	Lowest	1.213
	Middle	**1.223**
	Highest	1.203

6 dB Bandwidth Test Channel : Lowest

6 dB Bandwidth Test Channel : Middle

6 dB Bandwidth

Test Channel : Highest

3.3 Maximum Power Spectral Density.

▣ Test requirements and limit, §15.247(e) & RSS-247 [5.2]

The peak power density is measured with a spectrum analyzer connected to the antenna terminal while the EUT is operating in transmission mode at the appropriate frequencies.

Minimum Standard

The power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission

3.3.1 Test Setup

Refer to the APPENDIX I.

3.3.2 Test Procedures

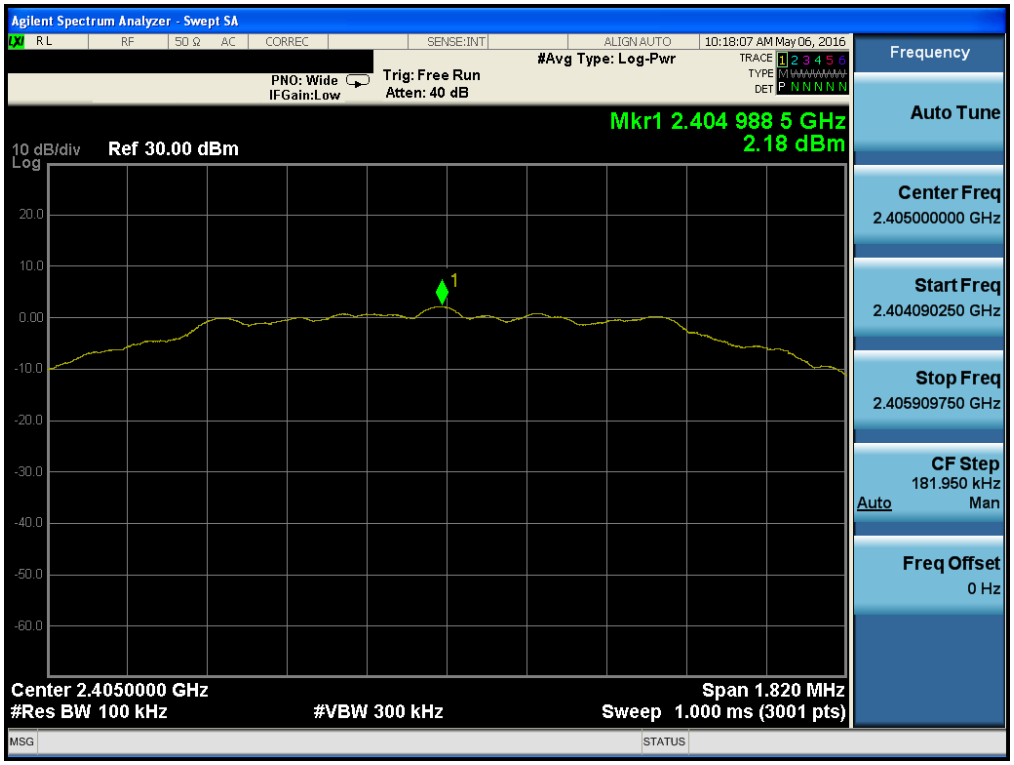
Method PKPSD of KDB558074 is used.

1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to **1.5 times** the DTS bandwidth.
3. Set the RBW : **3 kHz ≤ RBW ≤ 100 kHz**.
4. Set the VBW ≥ **3 x RBW.**
5. Detector = **peak.**
6. Sweep time = **auto couple.**
7. Trace mode = **max hold.**
8. Allow trace to fully stabilize.
9. Use the **peak marker function** to determine the maximum amplitude level within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

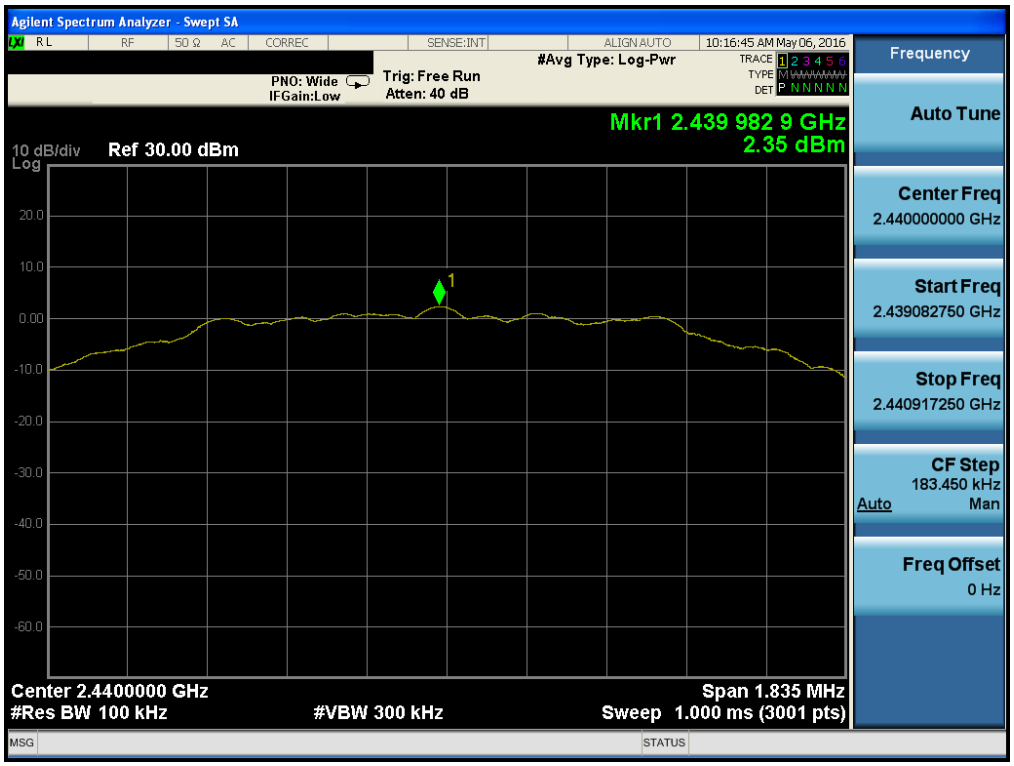
3.3.3 Test Results

Test Mode	Tested Channel	PKPSD [dBm]
TM 1	Lowest	2.18
	Middle	**2.35**
	Highest	1.83

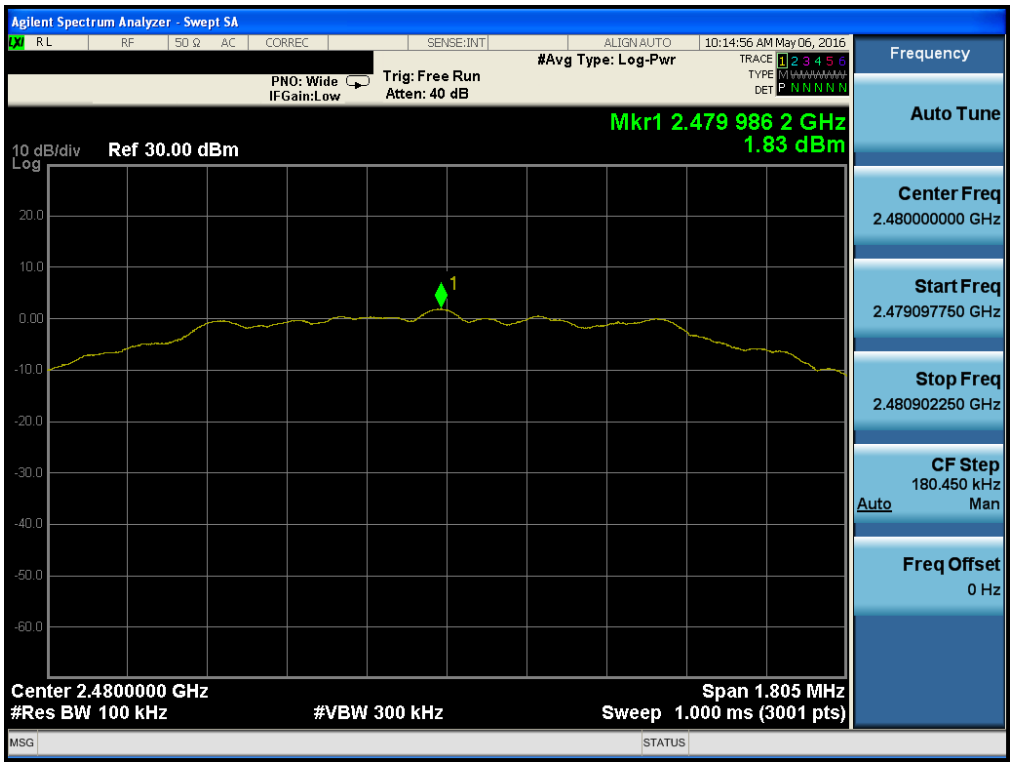
Maximum PKPSD Test Channel : Lowest



Maximum PKPSD Test Channel : Middle



Maximum PKPSD Test Channel : Highest



3.4 Unwanted Emissions (Conducted)

▣ **Test requirements and limit, §15.247(d) & RSS-247 [5.5]**

§15.247(d) specifies that in any 100 kHz bandwidth outside of the authorized frequency band, the power shall be attenuated according to the following conditions:

If **the peak output power procedure** is used to measure the fundamental emission power to demonstrate compliance to **15.247(b)(3)** requirements, then the peak conducted output power measured within any 100 kHz outside the authorized frequency band shall be attenuated **by at least 20 dB** relative to the maximum measured in-band peak PSD level.

If the average output power procedure is used to measure the fundamental emission power to demonstrate compliance to **15.247(b)(3)** requirements, then the power in any 100 kHz outside of the authorized frequency band shall be attenuated by at least 30 dB relative to the maximum measured in-band average PSD level.

In either case, attenuation to levels below the general emission limits specified in **§15.209(a)** is not required.

3.4.1 Test Setup

Refer to the APPENDIX I.

3.4.2 Test Procedures

The transmitter output is connected to a spectrum analyzer.

- Measurement Procedure 1 – Reference Level

1. Set instrument center frequency to DTS channel center frequency.
2. Set the span to ≥ 1.5 times the DTS bandwidth.
3. Set the RBW = 100 kHz.
4. Set the VBW ≥ 3 x RBW.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum PSD level
   LIMIT LINE = 20 dB below of the reference level.

- Measurement Procedure 2 - Unwanted Emissions

1. Set the center frequency and span to encompass frequency range to be measured.
2. Set the RBW = **100 kHz.(Actual 1 MHz , See below note)**
3. Set the VBW ≥ **3 x RBW.(Actual 3 MHz, See below note)**
4. Detector = **peak**.
5. Ensure that the number of measurement points ≥ span / RBW
6. Sweep time = **auto couple.**
7. Trace mode = **max hold.**
8. **Allow the trace to stabilize** (this may take some time, depending on the extent of the span).
9. Use the peak marker function to determine the maximum amplitude level.

Note : The conducted spurious emission was tested with below settings.

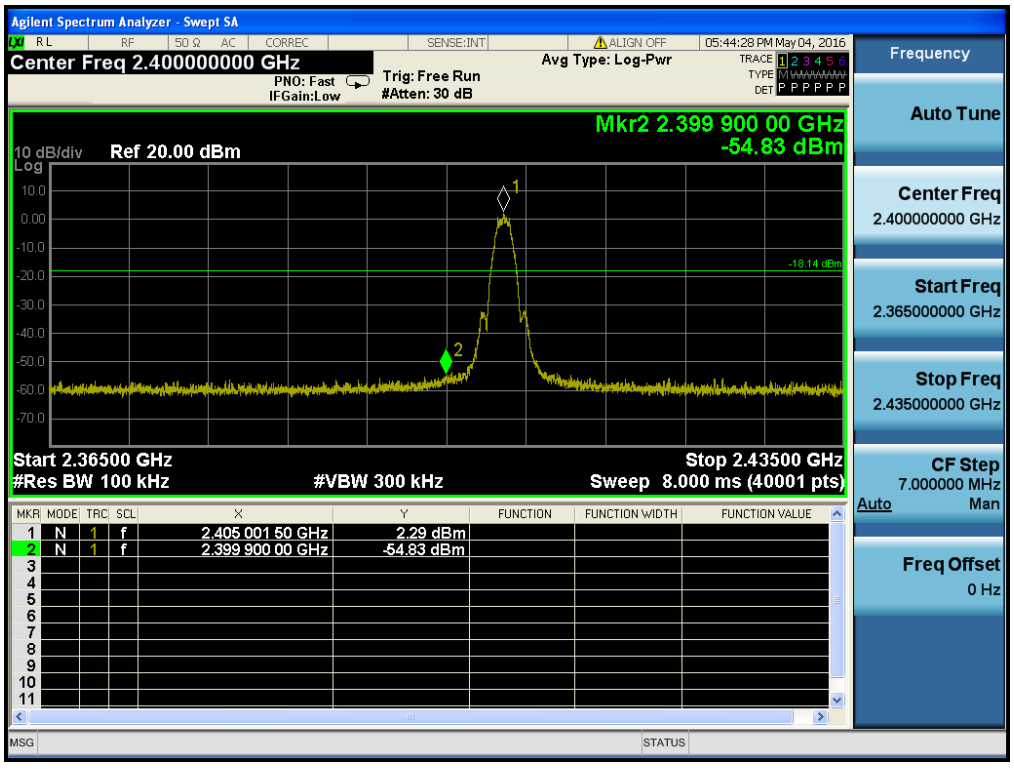
Frequency range	RBW	VBW	Detector	Trace	Sweep Point
9 kHz ~ 30 MHz	100 kHz	300 kHz	Peak	Max Hold	40001
30 MHz ~ 10 GHz	1 MHz	3 MHz			
10 GHz ~ 25 GHz	1 MHz	3 MHz			

If the emission level with above setting was close to the limit (ie, less than 3 dB margin) then zoom scan is required using RBW = 100 kHz, VBW = 300 kHz, SPAN = 100 MHz and BINS = 2001 to get accurate emission level within 100 kHz BW.

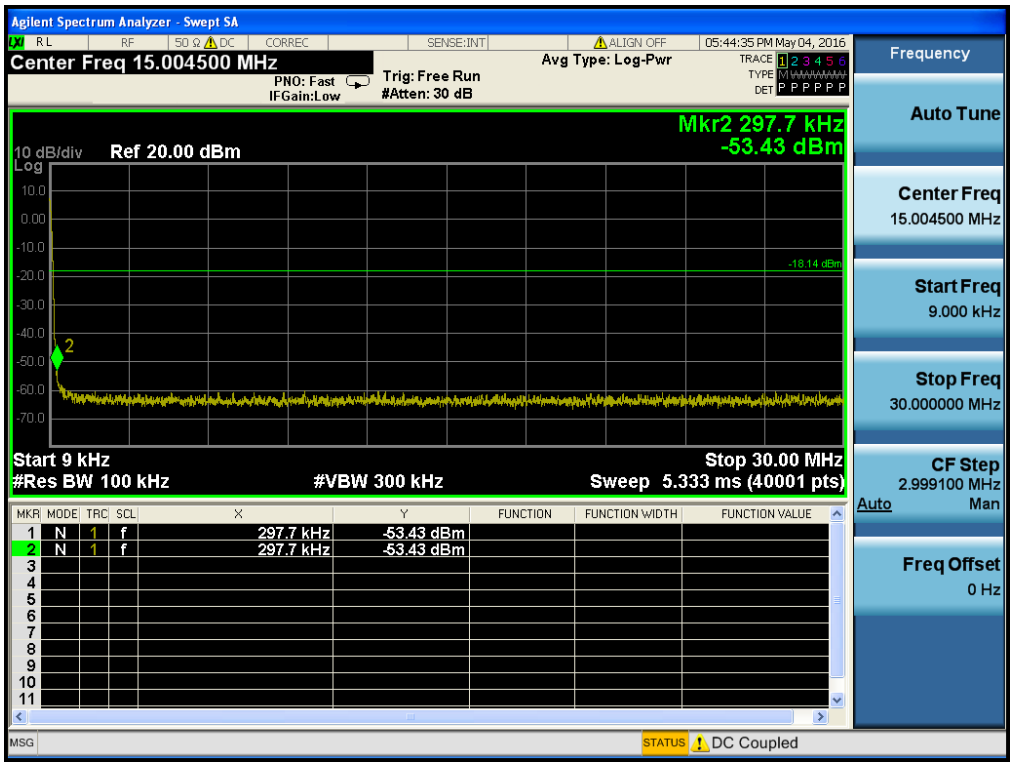
3.4.3 Test Results

Reference (Test Channel : Lowest)

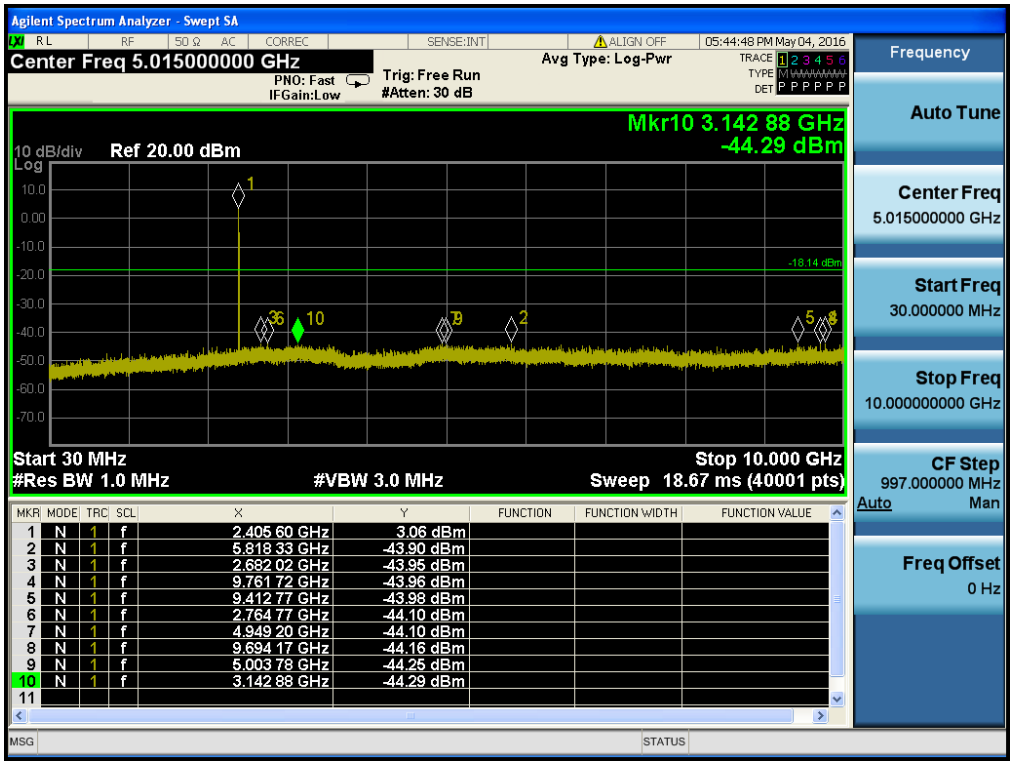
Low Band-edge



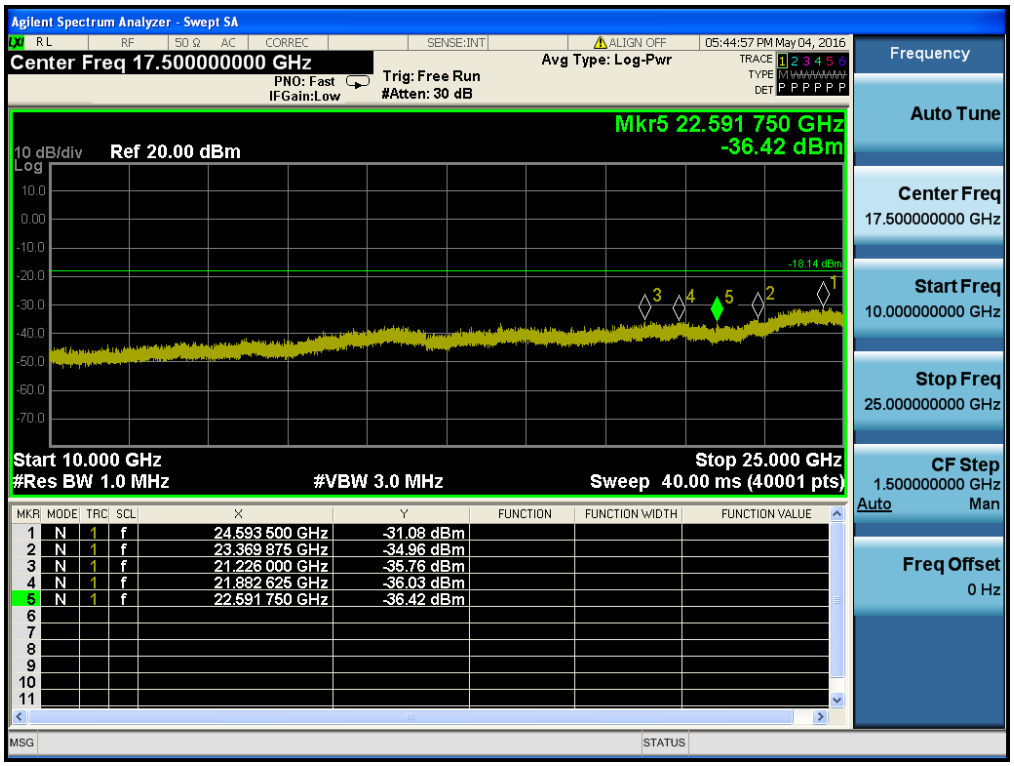
Conducted Spurious Emissions 1 (Test Channel : Lowest)



Conducted Spurious Emissions 2 (Test Channel : Lowest)

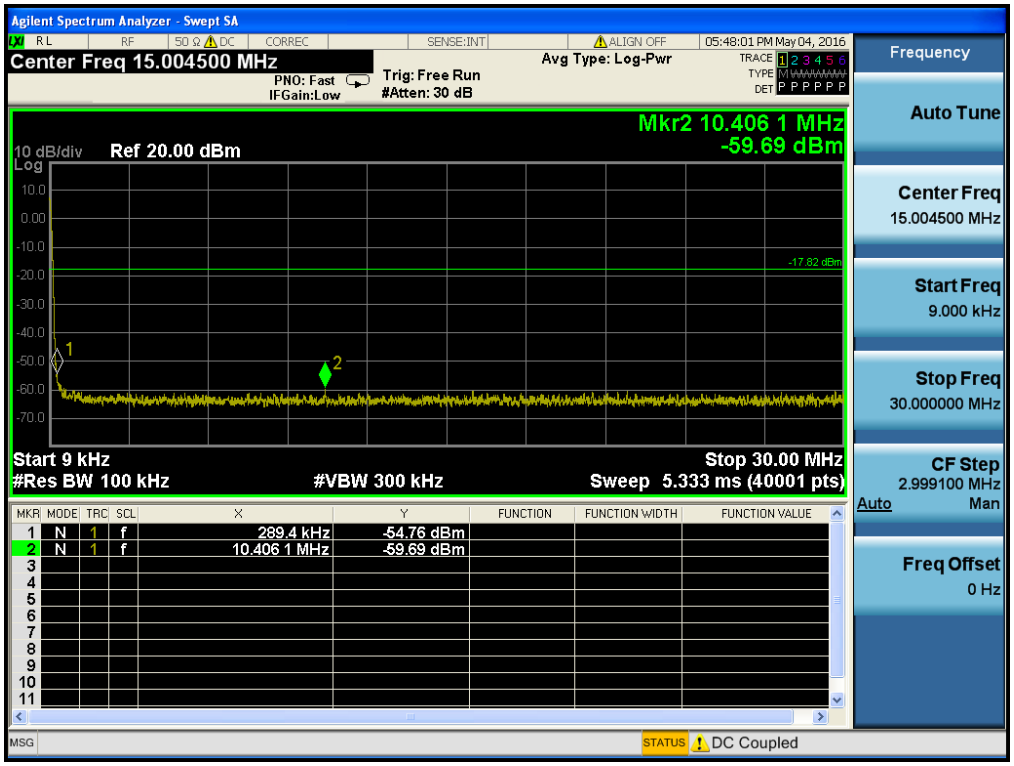


Conducted Spurious Emissions 3 (Test Channel : Lowest)

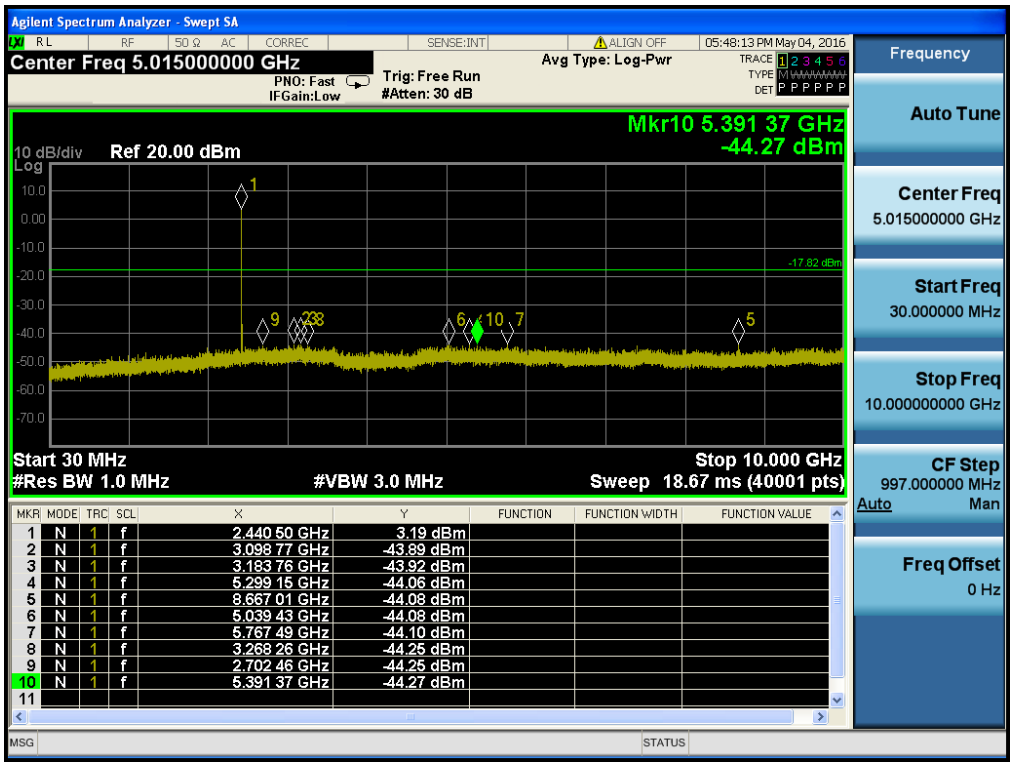


Reference (Test Channel : Middle)

Conducted Spurious Emissions 1 (Test Channel : Middle)



Conducted Spurious Emissions 2 (Test Channel : Middle)



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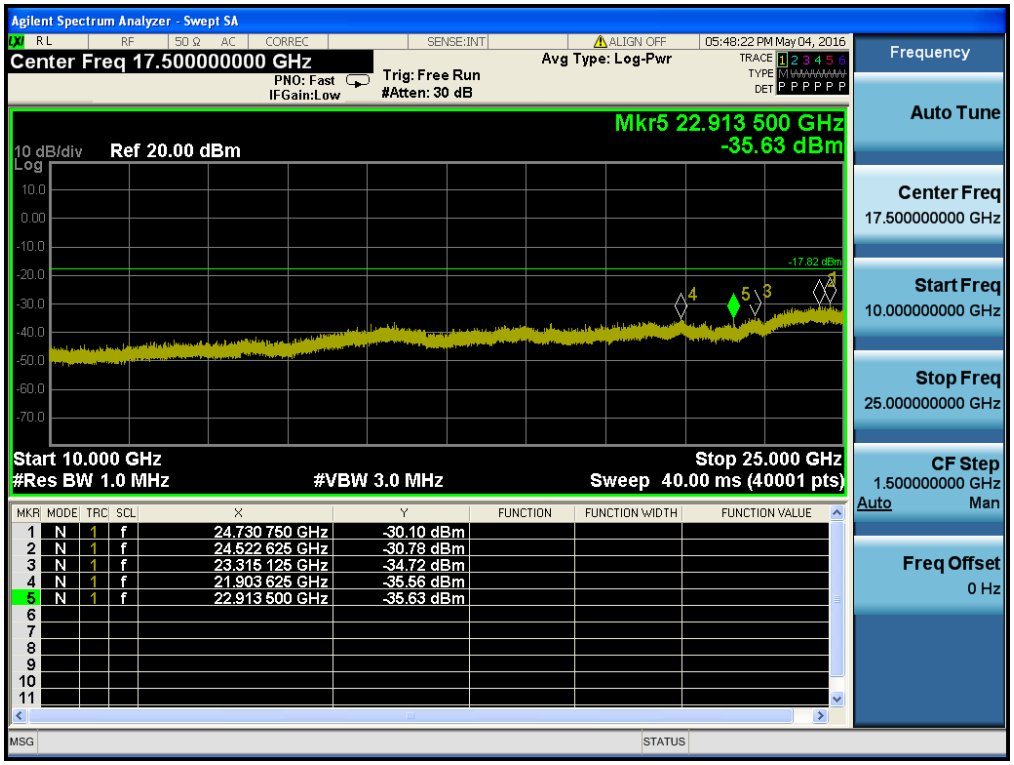
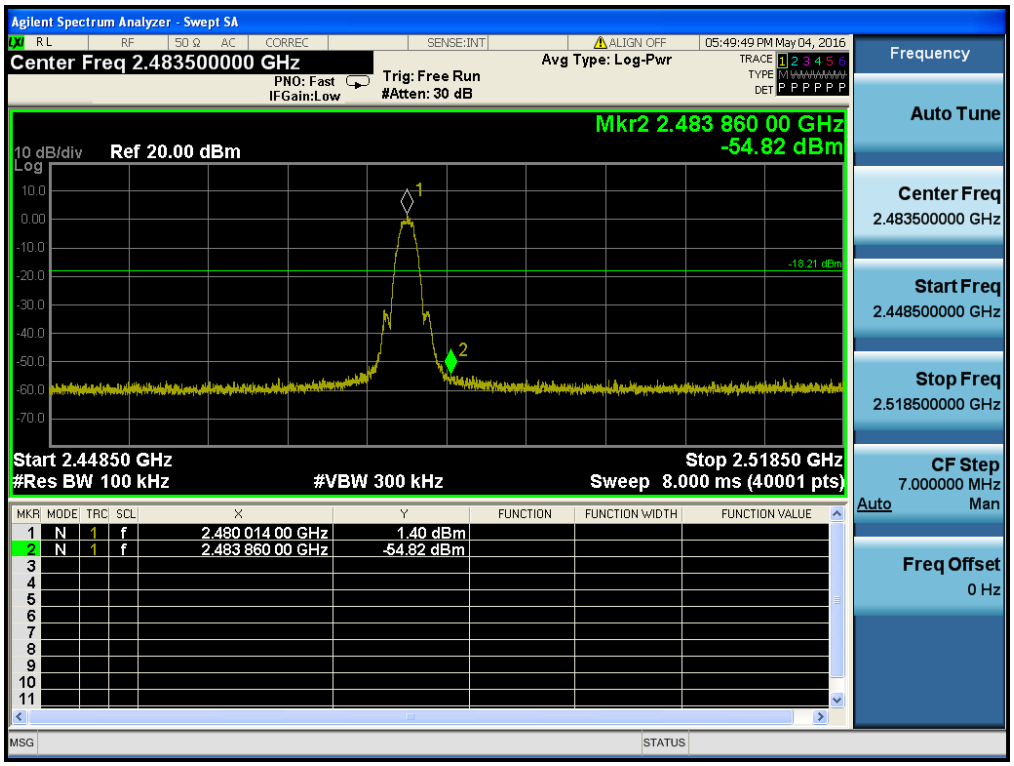
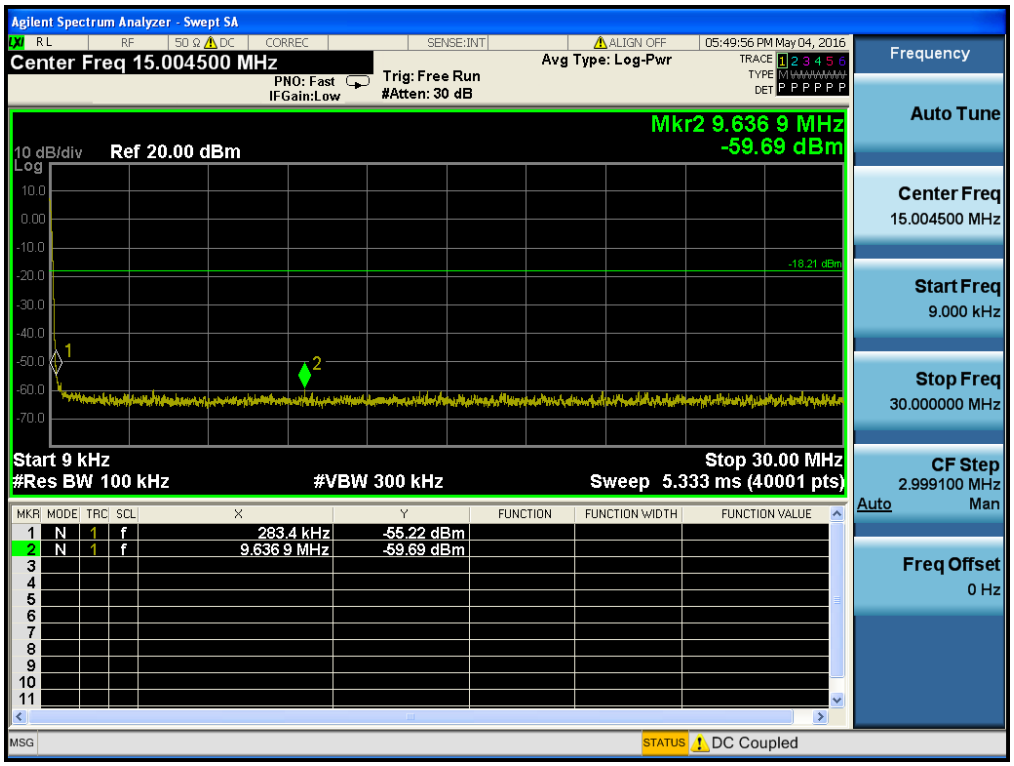


Reference (Test Channel : Highest)

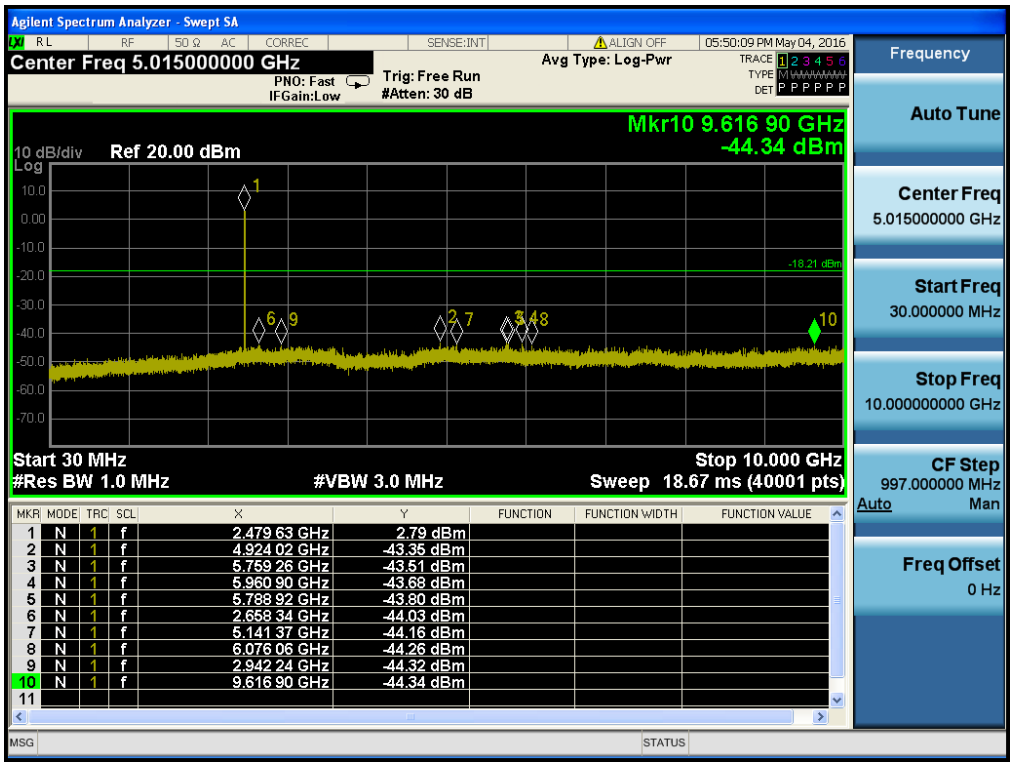
High Band-edge (Test Channel : Highest)



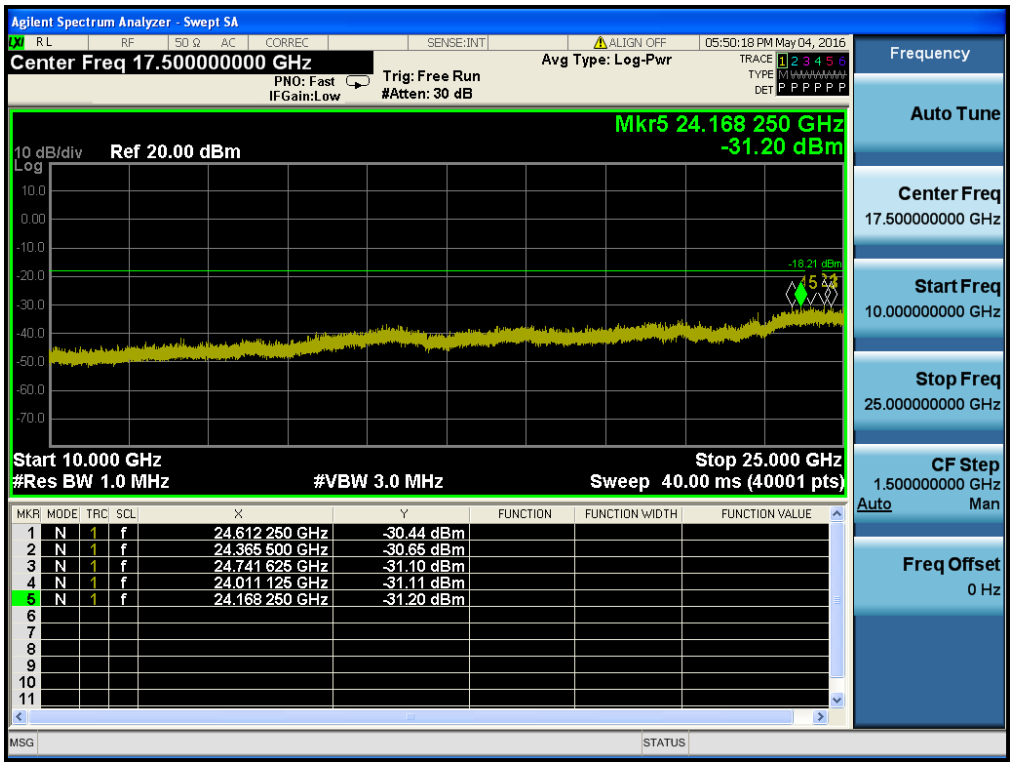
Conducted Spurious Emissions 1 (Test Channel : Highest)



Conducted Spurious Emissions 2 (Test Channel : Highest)



Conducted Spurious Emissions 3 (Test Channel : Highest)



3.5 Unwanted Emissions (Radiated)

▣ **Test Requirements and limit,**

§15.247(d), §15.205, §15.209 & RSS-247 [5.5], RSS-Gen [8.9], RSS-Gen [8.10]

In any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a) and (b), then the 15.209(a) limit in the table below has to be followed

▪ **FCC Part 15.209(a) and (b)**

Frequency (MHz)	Limit (uV/m)	Measurement Distance (meter)
0.009 ~ 0.490	2400/F (kHz)	300
0.490 ~ 1.705	24000/F (kHz)	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 15.209(g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54 ~ 72 MHz, 76 ~ 88 MHz, 174 ~ 216 MHz or 470 ~ 806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g. 15.231 and 15.241.

▪ **FCC Part 15.205 (a) :** Only spurious emissions are permitted in any of the frequency bands listed below :

MHz	MHz	MHz	MHz	GHz	GHz
0.009 ~ 0.110	8.41425 ~ 8.41475	108 ~ 121.94	1300 ~ 1427	4.5 ~ 5.15	14.47 ~ 14.5
0.495 ~ 0.505	12.29 ~ 12.293	123 ~ 138	1435 ~ 1626.5	5.35 ~ 5.46	15.35 ~ 16.2
2.1735 ~ 2.1905	12.51975 ~	149.9 ~ 150.05	1645.5 ~ 1646.5	7.25 ~ 7.75	17.7 ~ 21.4
4.125 ~ 4.128	12.52025	156.52475 ~	1660 ~ 1710	8.025 ~ 8.5	22.01 ~ 23.12
4.17725 ~ 4.17775	12.57675 ~	156.52525	1718.8 ~ 1722.2	9.0 ~ 9.2	23.6 ~ 24.0
4.20725 ~ 4.20775	12.57725	156.7 ~ 156.9	2200 ~ 2300	9.3 ~ 9.5	31.2 ~ 31.8
6.215 ~ 6.218	13.36 ~ 13.41	162.0125 ~ 167.17	2310 ~ 2390	10.6 ~ 12.7	36.43 ~ 36.5
6.26775 ~ 6.26825	16.42 ~ 16.423	167.72 ~ 173.2	2483.5 ~ 2500	13.25 ~ 13.4	Above 38.6
6.31175 ~ 6.31225	16.69475 ~	240 ~ 285	2655 ~ 2900		
8.291 ~ 8.294	16.69525	322 ~ 335.4	3260 ~ 3267		
8.362 ~ 8.366	16.80425 ~	399.90 ~ 410	3332 ~ 3339		
8.37625 ~ 8.38675	16.80475	608 ~ 614	3345.8 ~ 3358		
	25.5 ~ 25.67	960 ~ 1240	3600 ~ 4400		
	37.5 ~ 38.25				
	73 ~ 74.6				
	74.8 ~ 75.2				

▪ **FCC Part 15.205(b) :** The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in §15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in §15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in §15.35 apply to these measurements.

3.5.1 Test Setup

Refer to the APPENDIX I.

3.5.2 Test Procedures

1. The EUT is placed on a non-conductive table. For emission measurements at or below 1 GHz, the table height is 80 cm. For emission measurements above 1 GHz, the table height is 1.5 m.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 1 or 3 m away from the receiving antenna, which is varied from 1 m to 4 m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.

Note: Measurement Instrument Setting for Radiated Emission Measurements.

1. **Frequency Range: ≤ 1 GHz**

   RBW = 100 or 120 kHz, VBW = 3 x RBW, Detector = Peak or Quasi Peak

2. **Frequency Range: > 1 GHz**

   Peak Measurement

   RBW = 1 MHz, VBW = 3 MHz, Detector = Peak, Sweep time = Auto, Trace mode = Max Hold until the trace stabilizes

   Average Measurement

   The result of Average measurement is calculated using PK result and duty correction factor.

3.5.3 Test Results

Frequency Range : 9 kHz ~ 25 GHz

▪ Lowest Channel

Tested band	Frequency (MHz)	ANT Pol	The worst case EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
RB	2388.86	H	X	PK	47.86	-3.13	N/A	N/A	44.73	74.00	29.27
RB	2388.86	H	X	AV	47.86	-3.13	-28.18	N/A	16.55	54.00	37.45
RB	4810.08	V	Y	PK	46.57	5.90	N/A	N/A	52.47	74.00	21.53
RB	4810.08	V	Y	AV	46.57	5.90	-28.18	N/A	24.29	54.00	29.71
NRB	7213.57	V	Y	PK	45.24	11.04	N/A	N/A	56.28	76.11	19.83
F	2404.50	H	X	PK	99.22	-3.11	N/A	N/A	96.11	N/A	N/A

▪ Middle Channel

Tested band	Frequency (MHz)	ANT Pol	The worst case EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
RB	4879.95	H	Z	PK	45.10	5.63	N/A	N/A	50.73	74.00	23.27
RB	4879.95	H	Z	AV	45.10	5.63	-28.18	N/A	22.55	54.00	31.45
RB	7321.02	V	Y	PK	45.06	11.20	N/A	N/A	56.26	74.00	17.74
RB	7321.02	V	Y	AV	45.06	11.20	-28.18	N/A	28.08	54.00	25.92
F	2440.46	H	Z	PK	98.71	-3.06	N/A	N/A	95.65	N/A	N/A

▪ Highest Channel

Tested band	Frequency (MHz)	ANT Pol	The worst case EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
RB	2483.78	V	Z	PK	51.56	-3.01	N/A	N/A	48.55	74.00	25.45
RB	2483.78	V	Z	AV	51.56	-3.01	-28.18	N/A	20.37	54.00	33.63
RB	4960.01	V	X	PK	45.37	5.74	N/A	N/A	51.11	74.00	22.89
RB	4960.01	V	X	AV	45.37	5.74	-28.18	N/A	22.93	54.00	31.07
RB	7441.39	V	Y	PK	45.66	11.54	N/A	N/A	57.20	74.00	16.80
RB	7441.39	V	Y	AV	45.66	11.54	-28.18	N/A	29.02	54.00	24.98
F	2480.51	V	Z	PK	98.48	-3.02	N/A	N/A	95.46	N/A	N/A

▪ **Note.**

1. No other spurious and harmonic emissions were found greater than listed emissions on above table.
2. The limit is applied as below,
   Non-restricted band = Fundamental level – 20dB
   Restricted band = FCC Part15. 209
3. Description of tested band
   "F" = Fundamental signal / "NRB" = Emission in non-restricted band / "RB" = Emission in restricted Band
4. Information of Distance Factor
   For finding emissions, the test distance might be reduced from 3m to 1m. In this case, the distance factor(-9.54dB) is applied to the result.
   - Calculation of distance factor = 20 log(applied distance / required distance) = **20 log(1 m / 3 m)** = **-9.54 dB**
   When distance factor is "N/A", the distance is 3 m and distance factor is not applied.
5. Sample Calculation.
   Margin = Limit – Result / Result = Reading + T.F + D.C.F / T.F = AF + CL – AG
   Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain,
   D.C.F = Duty Cycle Correction Factor.
6. The AV result was calculated using a duty correction factor (D.C.F).
   And the Duty cycle information is declared by manufacturer.
   DCF = 20 log(t / 100 ms), t = Declared value of bursts on-time in 100 ms.
   20 log(3.9 ms / 100 ms) = -28.18 dB / AV result = PK result + DCF

3.6 Power line Conducted Emissions

▣ **Test Requirements and limit, §15.207 & RSS-Gen [8.8]**

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN).

Frequency Range (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15 ~ 0.5	66 to 56 *	56 to 46 *
0.5 ~ 5	56	46
5 ~ 30	60	50

* Decreases with the logarithm of the frequency

Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line (LINE and NEUTRAL) and ground at the power terminals.

3.6.1 Test Setup

See test photographs for the actual connections between EUT and support equipment.

3.6.2 Test Procedures

Conducted emissions from the EUT were measured according to the ANSI C63.10.

1. The test procedure is performed in a 6.5 m × 3.5 m × 3.5 m (L × W × H) shielded room. The EUT along with its peripherals were placed on a 1.0 m (W) × 1.5 m (L) and 0.8 m in height wooden table and the EUT was adjusted to maintain a 0.4 meter space from a vertical reference plane.
2. The EUT was connected to power mains through a line impedance stabilization network (LISN) which provides 50 ohm coupling impedance for measuring instrument and the chassis ground was bounded to the horizontal ground plane of shielded room.
3. All peripherals were connected to the second LISN and the chassis ground also bounded to the horizontal ground plane of shielded room.
4. The excess power cable between the EUT and the LISN was bundled. The power cables of peripherals were unbundled. All connecting cables of EUT and peripherals were moved to find the maximum emission.

3.6.3 Test Results

Not Applicable

3.7 Occupied Bandwidth

▣ **Test Requirements, RSS-Gen [6.6]**

When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99 % emission bandwidth, as calculated or measured.

3.7.1 Test Setup

Refer to the APPENDIX I.

3.7.2 Test Procedures

The 99 % power bandwidth was measured with a calibrated spectrum analyzer.
The resolution bandwidth (RBW) shall be in the range of 1 % to 5 % of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately 3 × RBW.
Spectrum analyzer plots are included on the following pages.

3.7.3 Test Results

Not Applicable

4. ANTENNA REQUIREMENTS

▣ **According to FCC 47 CFR §15.203 & RSS-Gen [8.3]**

"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section."

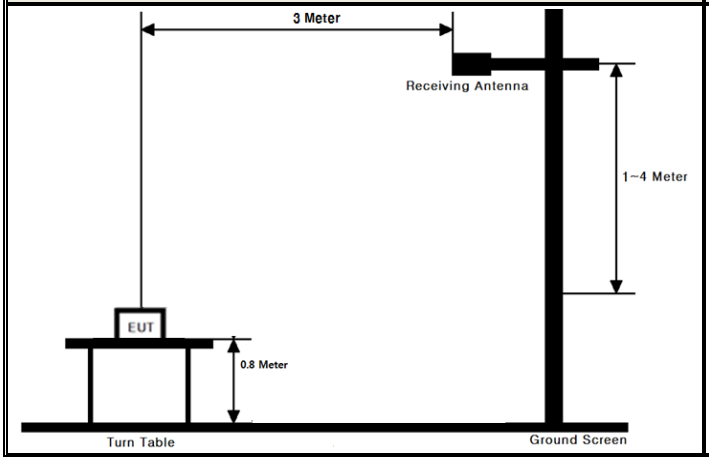
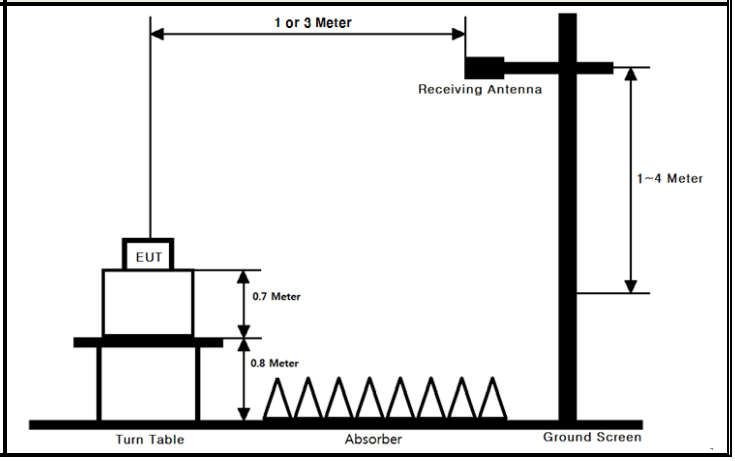
The antenna uses a unique coupling to this device. (Please refer to internal photo.)

Therefore this E.U.T Complies with the requirement of §15.203

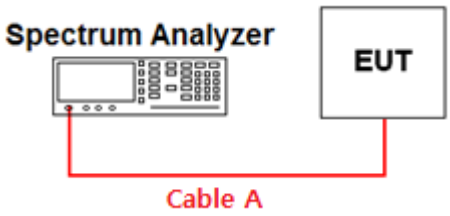
APPENDIX I

Test set up diagrams

- **Radiated Measurement**

Below 1GHz	Above 1GHz
	

- **Conducted Measurement**



Path loss information

Frequency (GHz)	Path Loss (dB)	Frequency (GHz)	Path Loss (dB)
0.03	0.27	15	4.24
1	1.14	20	5.16
2405 & 2440 & 2480	1.76	25	6.69
5	3.65	-	-
10	3.61	-	-

Note 1: The path loss from EUT to Spectrum analyzer was measured and used for test.
Path loss (S/A's correction factor) = Cable A (Attenuator, Applied only when it was used externally)

APPENDIX II

Duty cycle plots

- **Test Procedure**

Duty Cycle was measured using **section 6.0 b) of KDB558074 :**

The zero-span mode on a spectrum analyzer or EMI receiver if the response time and spacing between bins on the sweep are sufficient to permit accurate measurements of the on and off times of the transmitted signal. Set the center frequency of the instrument to the center frequency of the transmission. Set RBW ≥ OBW if possible; otherwise, set RBW to the largest available value. Set VBW ≥ RBW. Set detector = peak or average.

The zero-span measurement method shall not be used unless both RBW and VBW are > 50/T and the number of sweep points across duration T exceeds 100. (For example, if VBW and/or RBW are limited to 3 MHz, then the zero-span method of measuring duty cycle shall not be used if T ≤ 16.7 microseconds.)

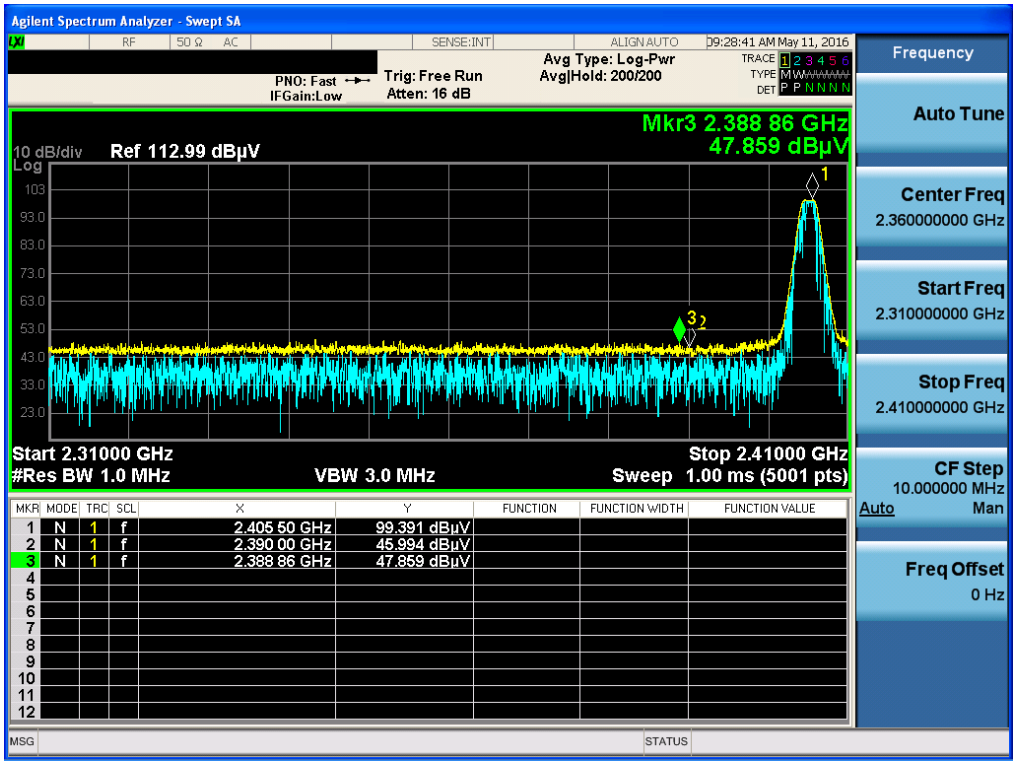
Duty Cycle **Test Channel : Middle**

Note : Measure Duty Cycle = T / 100 ms (T = sum of the individual on-time in 100 ms)
= (0.610 ms + 0.620 ms + 0.625 ms) / 100 ms = 1.86 %
Declared worst Duty Cycle = 3.9 %

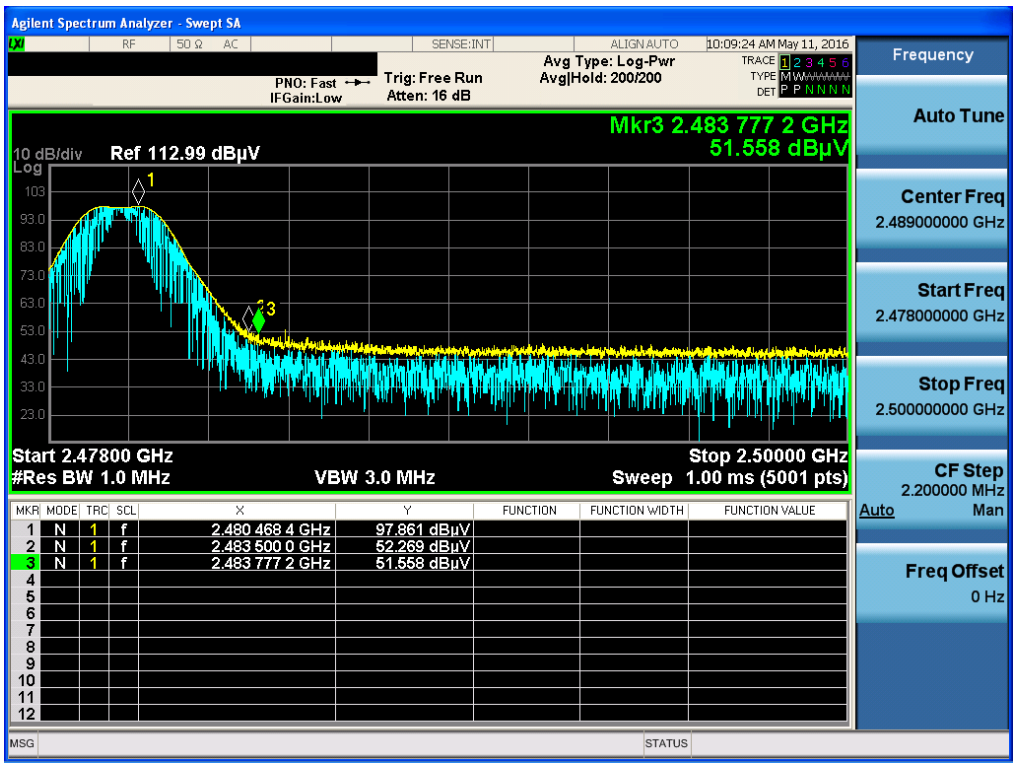
APPENDIX III

Unwanted Emissions (Radiated) Test Plot

Lowest & X axis & Hor Detector Mode : PK



Highest & Z axis & Ver Detector Mode : PK



Highest & Y axis & Ver **Detector Mode : PK**