TEST REPORT

DT&C Co., Ltd.
42, Yurim-ro, 154Beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea, 17042
Tel : 031-321-2664, Fax : 031-321-1664

1. Report No : DRTFCC1912-0318
2. Customer
   - Name (FCC): COMMAX Co., Ltd.
   - Name(IC) : Commax Co., Ltd
   - Address (FCC): 494 Dunchon-Daero, Jungwon-Gu, Sungnam-Si, Gyeonggi-Do, 13229, South Korea
   - Address (IC) : 513-11, Sangdaewon-dong, Jungwon-gu Seongnam-si, Gyeonggi-do 13229 Korea (Republic Of)
3. Use of Report : Class II Permissive Change
4. Product Name / Model Name : Zigbee Module / CMX-ZG03
   FCC ID : CCECMX-ZG03 / IC : 22254-CMXZG03
5. Test Method Used : KDB 558074 D01 v05, ANSI C63.10-2013
   Test Specification : FCC Part 15.247
   RSS-247 Issue 2, RSS-GEN Issue 5
6. Date of Test : 2019.12.03 ~ 2019.12.09
7. Testing Environment : See appended test report.
8. Test Result : Refer to the attached test result.

Affirmation	Tested by Name : InHee Bae (signature)	Reviewed by Name : JaeJin Lee (signature)

The test results presented in this test report are limited only to the sample supplied by applicant and the use of this test report is inhibited other than its purpose. This test report shall not be reproduced except in full, without the written approval of DT&C Co., Ltd.

2019 . 12 . 10 .

DT&C Co., Ltd.

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

Test Report Version

Test Report No.	Date	Description
DRTFCC1912-0318	Dec. 10, 2019	Initial issue

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1. General Information

1.1 Testing Laboratory

DT&C Co., Ltd.		
The 3 m test site and conducted measurement facility used to collect the radiated data are located at the 42, Yurim-ro, 154beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea 17042. The test site complies with the requirements of § 2.948 according to ANSI C63.4-2014. **- FCC MRA Accredited Test Firm No. : KR0034** **- IC Test site No. : 5740A**		
www.dtnc.net		
Telephone	:	+ 82-31-321-2664
FAX	:	+ 82-31-321-1664

1.2 Details of Applicant

Applicant(FCC)	:	COMMAX Co., Ltd.
Applicant(IC)	:	Commax Co., Ltd
Address(FCC)	:	494 Dunchon-Daero, Jungwon-Gu, Seongnam-si, Gyeonggi-do, 13229, South Korea
Address(IC)	:	513-11, Sangdaewon-dong, Jungwon-gu Seongnam-si, Gyeonggi-do 13229 Korea (Republic Of)
Contact person	:	Ji-Soo KIM

1.3 Description of EUT

EUT	Zigbee Module
Model Name	CMX-ZG03
Add Model Name	NA
HVIN	CMX-ZG03
FVIN	V1.0.0
Power Supply	DC 3.3 V
Frequency Range	2405 ~ 2480MHz (16 channels)
Modulation Technique	O-QPSK
Antenna Type	Intergral Antenna
Antenna Gain	PK: 1.70 dBi

1.4 Declaration by the applicant / manufacturer

- N/A

1.5 Test Conditions

Ambient Condition	
▪ Temperature	+22 ℃ ~ +26 ℃
▪ Relative Humidity	39 % ~ 41 %

1.6 Measurement Uncertainty

The measurement uncertainties shown below were calculated in accordance with requirements of ANSI C63.4-2014 and ANSI C63.10-2013. All measurement uncertainty values are shown with a coverage factor of *k* = 2 to indicate a 95 % level of confidence.

Test items	Measurement uncertainty
Transmitter Output Power	0.7 dB (The confidence level is about 95 %, k = 2)
Conducted spurious emission	0.9 dB (The confidence level is about 95 %, k = 2)
AC conducted emission	2.4 dB (The confidence level is about 95 %, k = 2)
Radiated spurious emission (1 GHz Below)	5.1 dB (The confidence level is about 95 %, k = 2)
Radiated spurious emission (1 GHz ~ 18 GHz)	5.4 dB (The confidence level is about 95 %, k = 2)
Radiated spurious emission (18 GHz Above)	5.3 dB (The confidence level is about 95 %, k = 2)

1.7 Support Equipment

Equipment	Manufacturer	Model No.	Serial No.	Note
-	-	-	-	-
-	-	-	-	-

Note: The above device was supported by manufacturer.

1.8 Test Equipment List

Type	Manufacturer	Model	Cal.Date (yy/mm/dd)	Next.Cal.Date (yy/mm/dd)	S/N
Spectrum Analyzer	Agilent Technologies	N9020A	18/12/19	19/12/19	MY49060056
Spectrum Analyzer	Agilent Technologies	N9020A	18/12/19	19/12/19	MY48011700
DC Power Supply	Agilent Technologies	66332A	19/06/25	20/06/25	MY43001173
DC Power Supply	SM techno	SDP30-5D	19/06/24	20/06/24	305DMG288
Multimeter	FLUKE	17B	18/12/18	19/12/18	26030065WS
Signal Generator	Rohde Schwarz	SMBV100A	18/12/19	19/12/19	255571
Signal Generator	ANRITSU	MG3695C	18/12/10	19/12/10	173501
Thermohygrometer	BODYCOM	BJ5478	18/12/27	19/12/27	120612-1
Thermohygrometer	BODYCOM	BJ5478	18/12/27	19/12/27	120612-2
HYGROMETER	TESTO	608-H1	19/01/31	20/01/31	34862883
Loop Antenna	ETS	6502	19/09/18	21/09/18	00226186
BILOG ANTENNA	Schwarzbeck	VULB 9160	19/04/23	21/04/23	9160-3362
HORN ANT	ETS	3117	18/05/10	20/05/10	00140394
HORN ANT	A.H.Systems	SAS-574	19/07/03	21/07/03	155
PreAmplifier	H.P	8447D	18/12/18	19/12/18	2944A07774
PreAmplifier	Agilent	8449B	19/06/27	20/06/27	3008A02108
High Pass Filter	Wainwright Instruments	WHKX10-2838-3300-18000-60SS	19/06/26	20/06/26	1
Attenuator	Cernexwave	CFADC2603U5	19/06/27	20/06/27	C11729
Power Meter & Wide Bandwidth Sensor	Anritsu	ML2495A MA2490A	19/06/27	20/06/27	1338003 1249304
LISN	SCHWARZBECK	NNLK 8121	19/05/23	20/05/23	06183
RECEIVER	ROHDE&SCHWARZ	ESCI7	19/01/30	20/01/30	100910
PULSE LIMITER	ROHDE&SCHWARZ	ESH3-Z2	19/09/17	20/09/17	101333
Cable	DT&C	Cable	19/01/16	20/01/16	RF-82
Cable	Radiall	TESTPRO3	19/01/16	20/01/16	M-01
Cable	DT&C	Cable	19/01/16	20/01/16	M-03
Cable	Junkosha	MWX315	19/01/16	20/01/16	M-05
Cable	Junkosha	MWX221	19/01/16	20/01/16	M-06
Cable	DT&C	Cable	19/01/14	20/01/14	RF-10
Test Software	tsj	Radiated Emission Measurement	NA	NA	Version 2.00.0177
Test Software	tsj	Noise Terminal Voltage Measurement	NA	NA	Version 2.00.0170

Note1: The measurement antennas were calibrated in accordance to the requirements of ANSI C63.5-2017
Note2: The cable is not a regular calibration item, so it has been calibrated by DT & C itself.

1.9 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 [6.7]	Occupied Bandwidth (99 %)	RSS-Gen(6.6)		C
15.247(d) 15.205 15.209	RSS-247 [5.5] RSS-Gen [8.9] RSS-Gen [8.10]	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	FCC 15.209 limits	Radiated	C Note3
15.207	RSS-Gen [8.8]	AC Line Conducted Emissions	FCC 15.207 limits	AC Line Conducted	C
15.203	-	Antenna Requirements	FCC 15.203	-	C

Note 1: **C**=Comply **NC**=Not Comply **NT**=Not Tested **NA**=Not Applicable
Note 2: For radiated emission tests below 30 MHz were performed on semi-anechoic chamber which is correlated with OATS.
Note 3: This test item was performed in each axis and the worst case data was reported.

2. Test Methodology

The measurement procedures described in the ANSI C63.10-2013 and the guidance provided in KDB558074 D01v05 were used in measurement of the EUT.

The EUT was tested per the guidance of KDB558074 D01v05. 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 KDB558074 D01v05.

So this test was fulfilled with the requirements in Section 6.2 of ANSI C63.10-2013.

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 0.15 MHz and 30 MHz using CISPR Quasi-peak and Average detector.

Radiated Emissions

Basically the radiated tests were performed with KDB558075 D01v05 and ANSI C63.10. 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.

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. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 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.

2.4 Description of Test Modes

The EUT has been tested with the highest operational duty cycle 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	Description	Test Frequency [MHz]			
TM 1	ZIGBEE	2405	2440	2475*Note1	2480

Note 1: The radiated test item were investigated a CH 15(2475MHz) as well as lowest/middle/highest channels.

Operation test setup for EUT

-Software: Teraterm 4.104

-Power setting

2405MHz: 4 / 2440MHz: 4 / 2475MHz: 4 / 2480MHz: 3

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

- **KDB558074 D01v05 - Section 8.3.1.1**
- **ANSI C63.10-2013 – Section 11.9.1.1**

BW ≥ DTS bandwidth

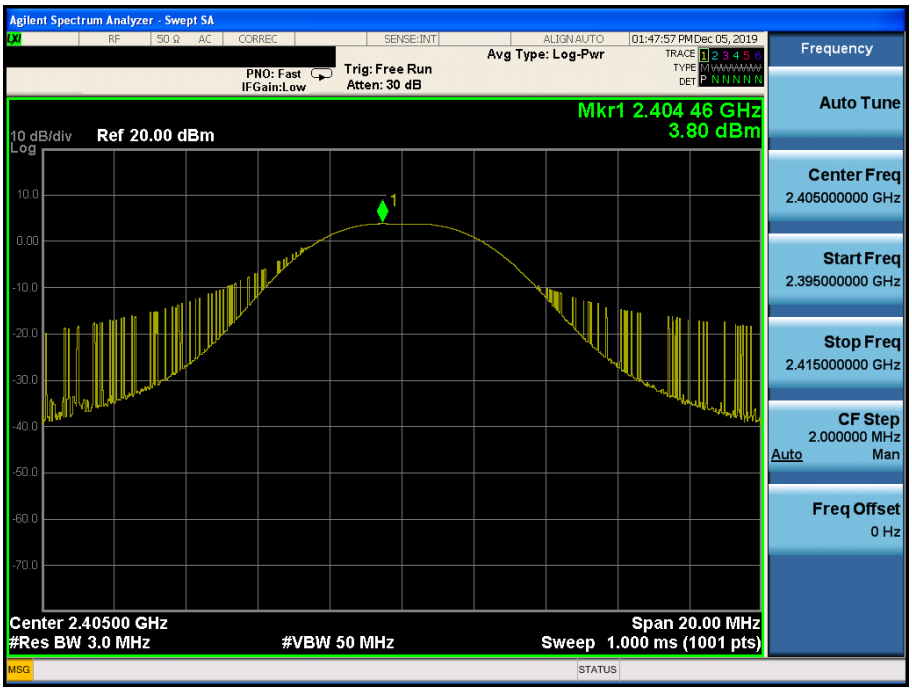
1. Set the RBW ≥ DTS bandwidth
2. Set VBW ≥ 3 x RBW.
3. Set span ≥ 3 x RBW.
4. Sweep time = Auto couple.
5. Detector = Peak.
6. Trace mode = Max hold.
7. Allow the trace to stabilize.

3.1.3 Test Results

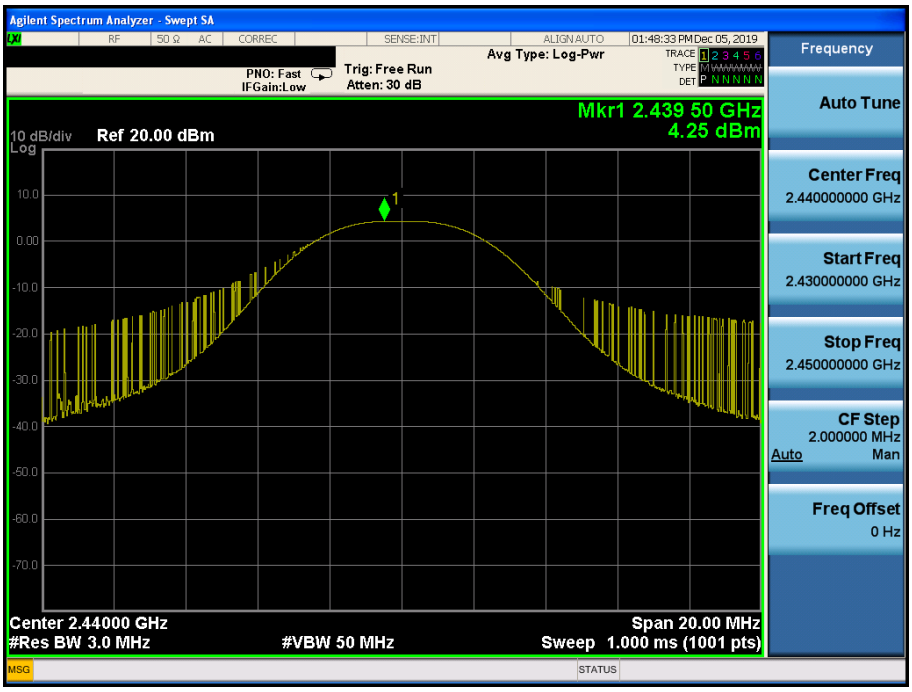
Test mode	Tested Channel	Burst Average Output Power		Peak Output Power	
		dBm	mW	dBm	mW
TM 1	2405 MHz	3.64	2.31	3.80	2.40
	2440 MHz	4.06	2.55	**4.25**	**2.66**
	2480 MHz	-6.78	0.21	-6.65	0.22

Note 1: See next pages for actual measured spectrum plots.

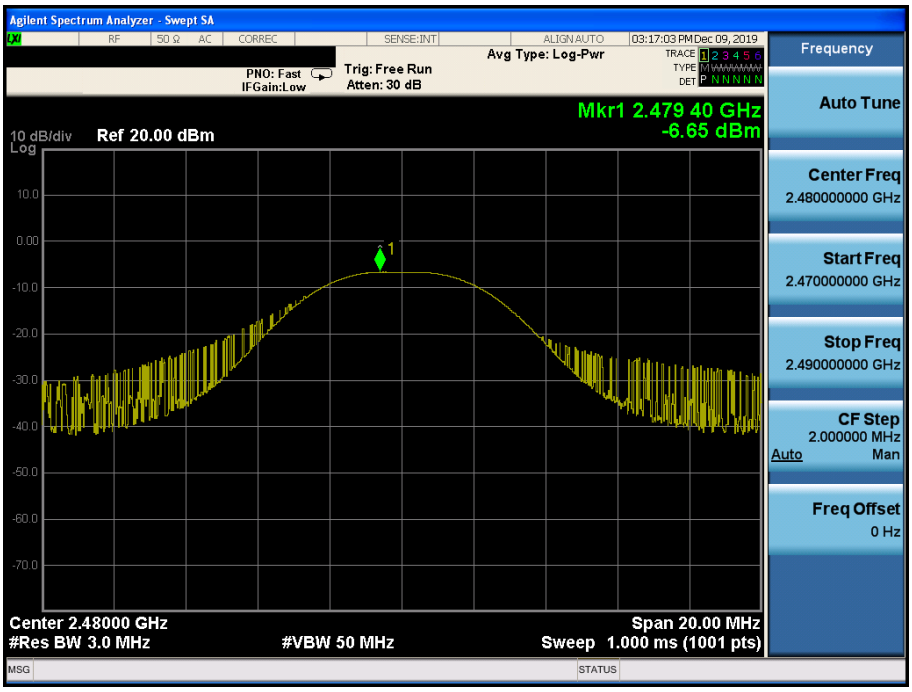
Peak Output Power Test Channel : 2405 MHz



Peak Output Power Test Channel : 2440 MHz



Peak Output Power Test Channel : 2480 MHz



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

- **KDB558074 D01v05 - Section 8.2**
- **ANSI C63.10-2013 – Section 11.8.2**

Option 2

1. Set resolution bandwidth (RBW) = 100 kHz.
2. Set the video bandwidth (VBW) ≥ 3 x RBW.
3. Detector = **Peak**.
4. Trace mode = **Max hold**.
5. Sweep = **Auto couple**.
6. Allow the trace to stabilize.

Note: The automatic bandwidth measurement capability of an instrument was used to perform the 6dB bandwidth measurement.

3.2.3 Test Results

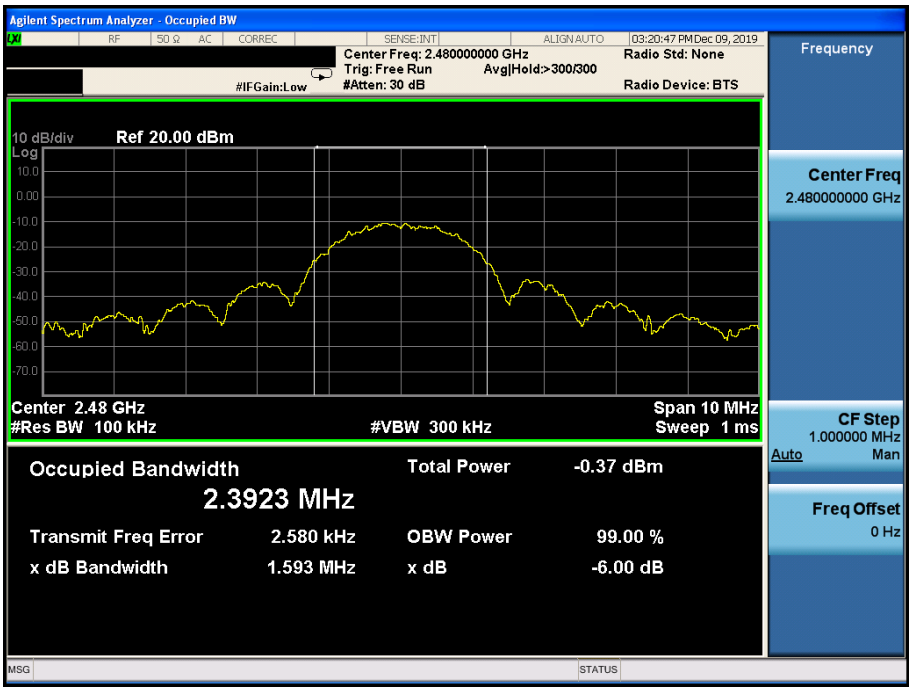
Test Mode	Tested Channel	Test Results [MHz]
TM 1	**2405 MHz**	1.481
	2440 MHz	1.592
	2480 MHz	**1.593**

6 dB Bandwidth Test Channel : 2405 MHz

6 dB Bandwidth Test Channel : 2440 MHz

6 dB Bandwidth

Test Channel : 2480 MHz



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

- **KDB558074 D01v05 - Section 8.4**
- **ANSI C63.10-2013 – Section 11.10.2**

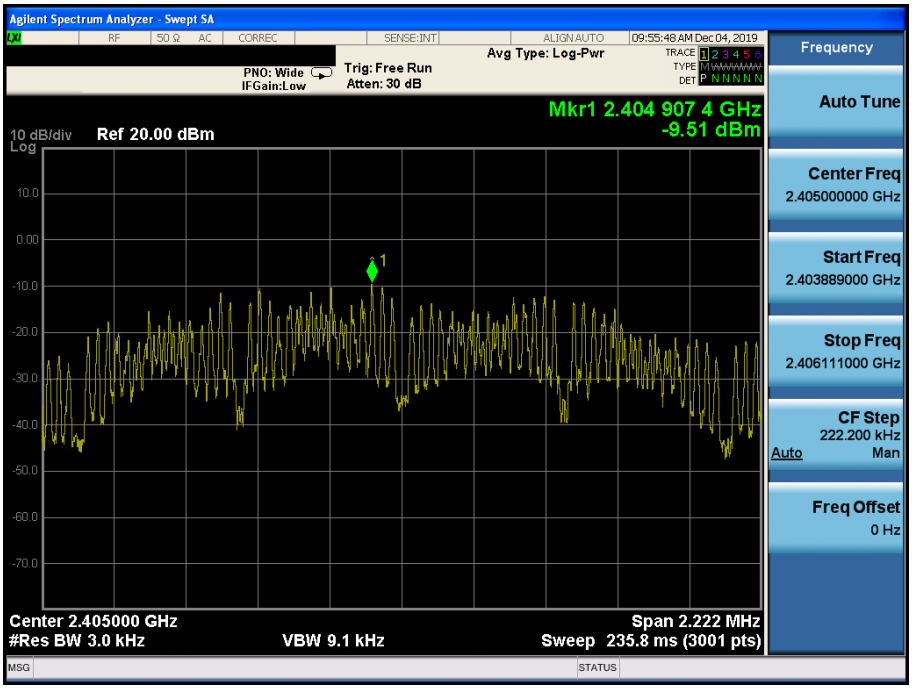
Method PKPSD (peak PSD)

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 to : **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.

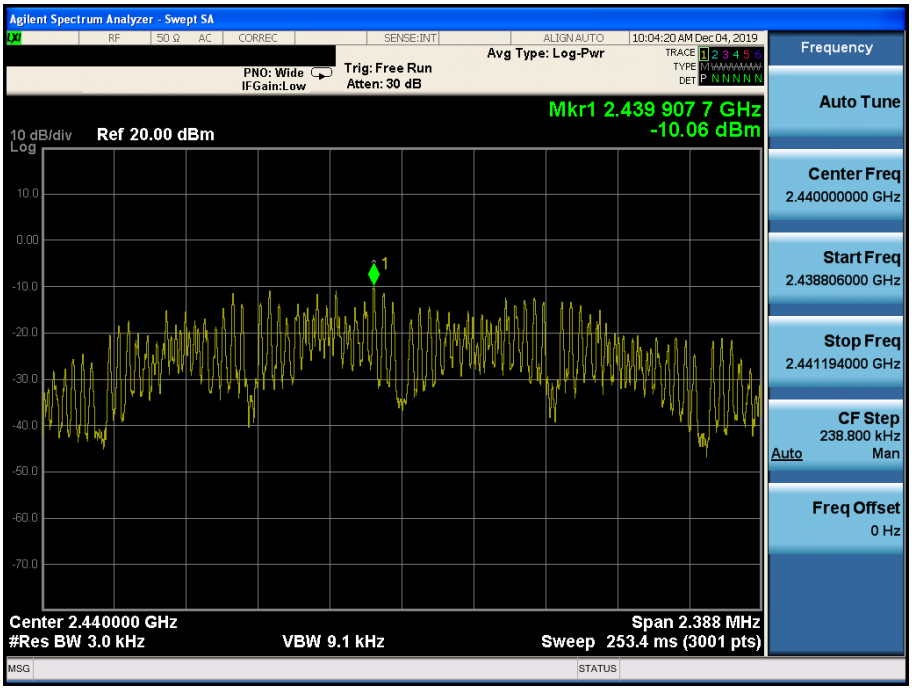
3.3.3 Test Results

Test Mode	Tested Channel	PKPSD [dBm]
TM 1	2405 MHz	-9.51
	2440 MHz	-10.06
	2480 MHz	-19.30

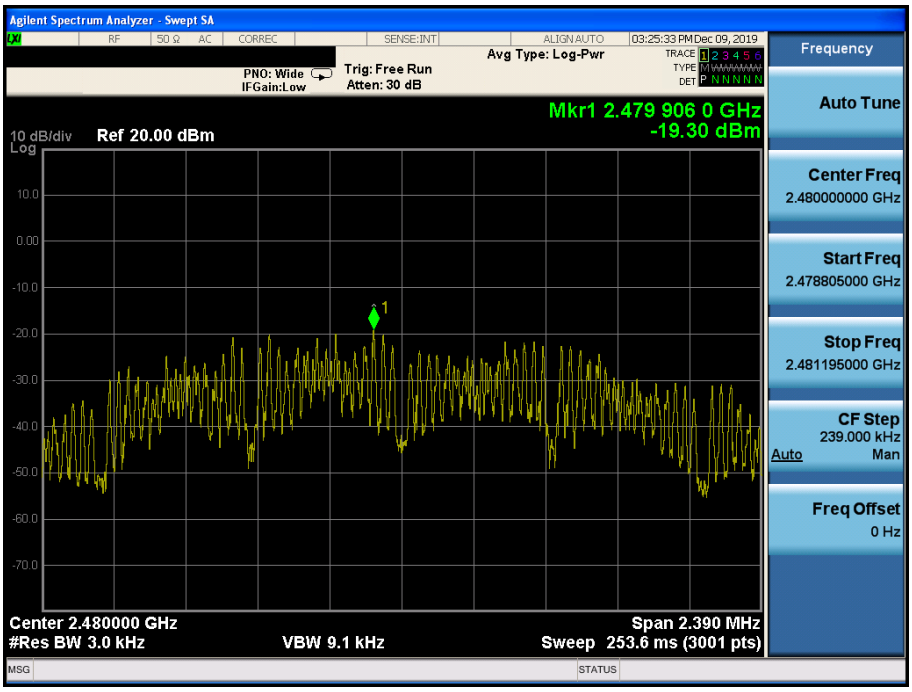
Power Spectral Density Test Channel : 2405 MHz



Power Spectral Density Test Channel : 2440 MHz



Power Spectral Density Test Channel : 2480 MHz



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 inband 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

- **KDB558074 D01v05 - Section 8.5**
- **ANSI C63.10-2013 – Section 11.11**

Reference level measurement

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.

Emission level measurement

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			

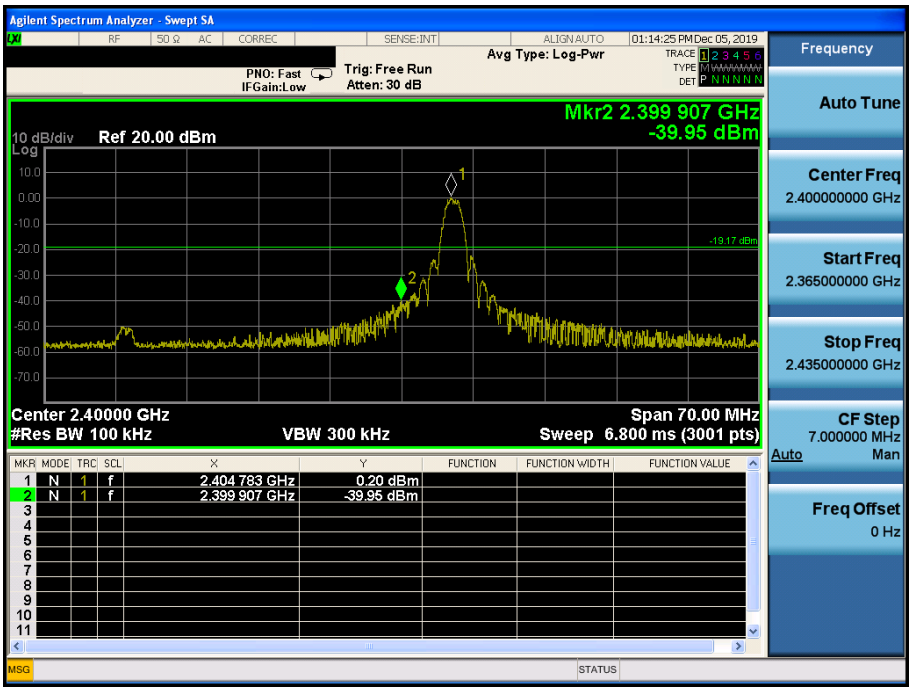
LIMIT LINE = 20 dB below of the reference level

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.

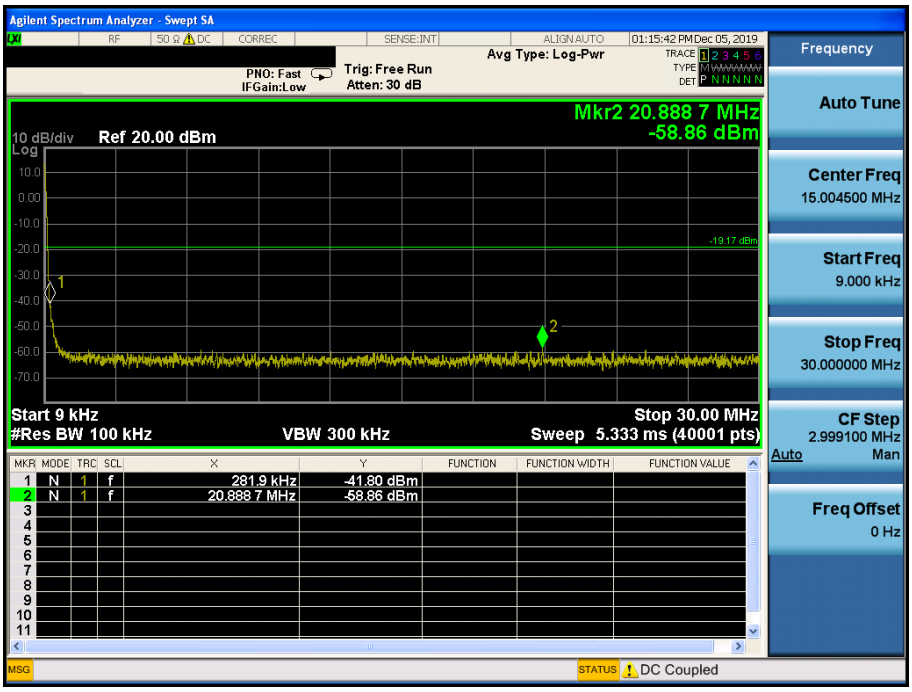
3.4.3 Test Results

Reference (Test Channel : 2405 MHz)

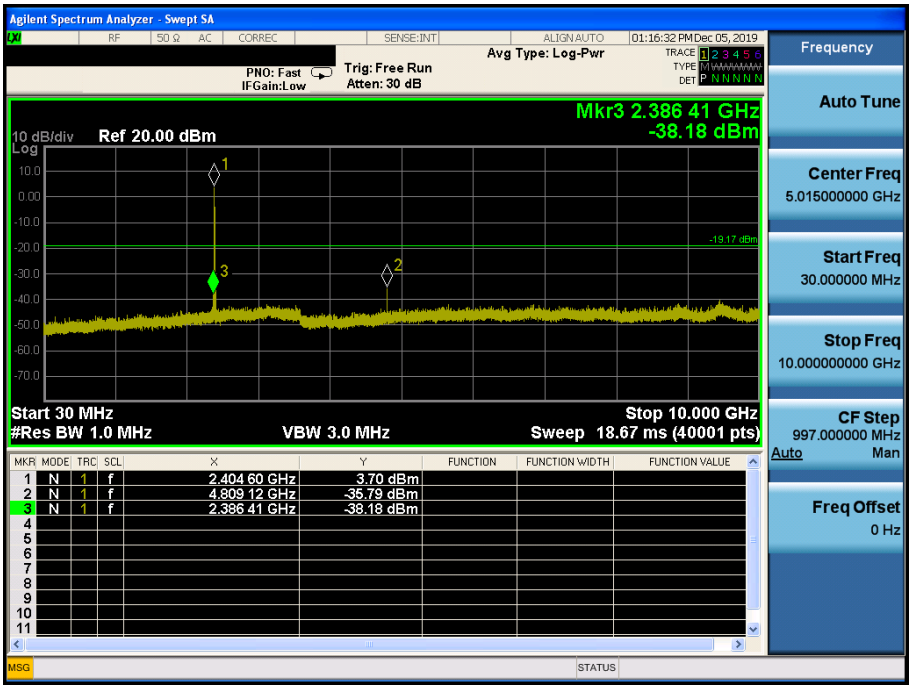
Low Band-edge



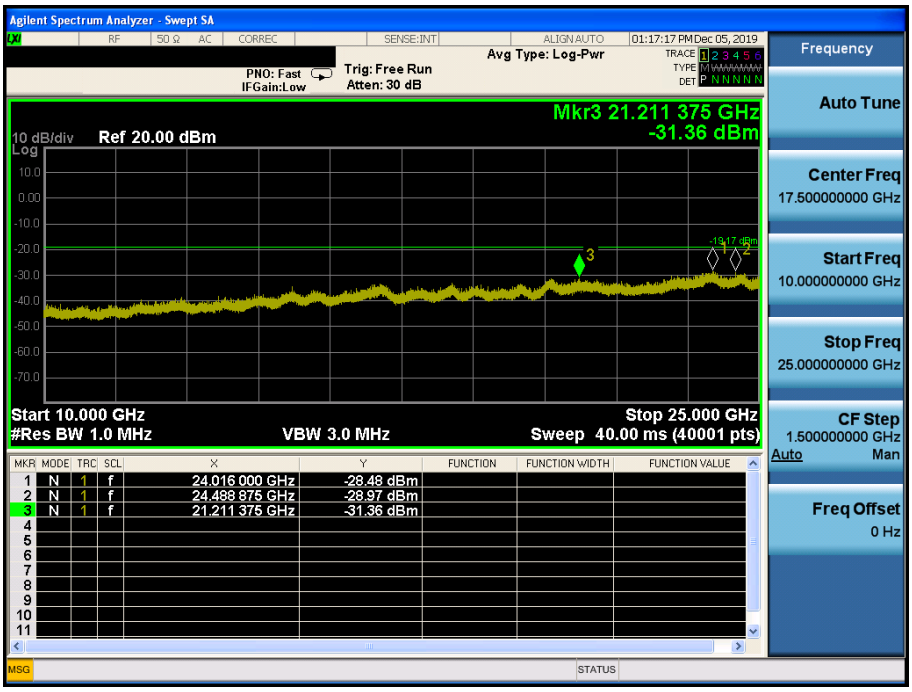
Conducted Spurious Emissions 1 (Test Channel : 2405 MHz)



Conducted Spurious Emissions 2 (Test Channel : 2405 MHz)

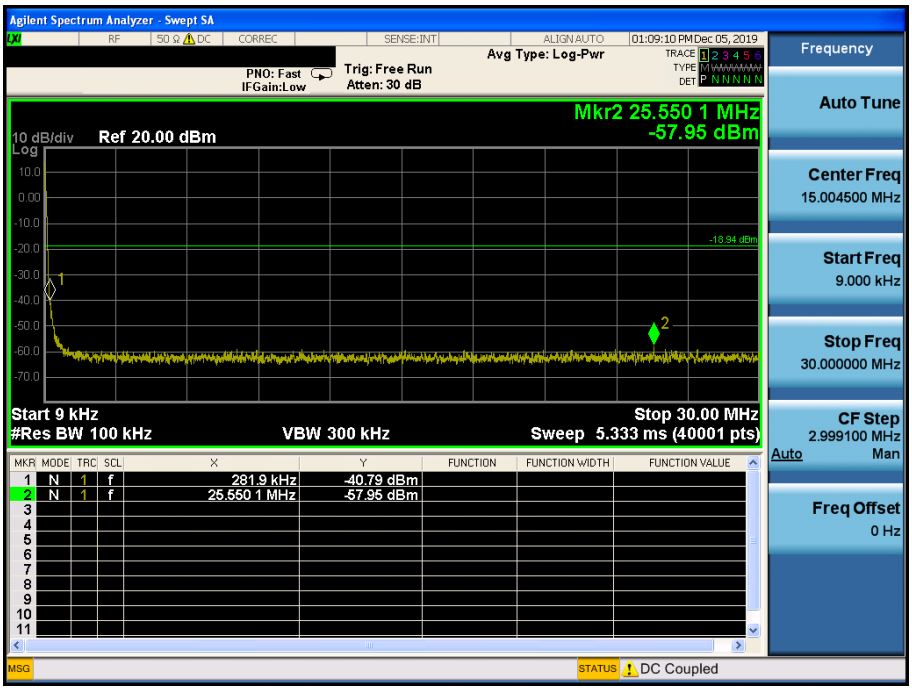


Conducted Spurious Emissions 3 (Test Channel : 2405 MHz)

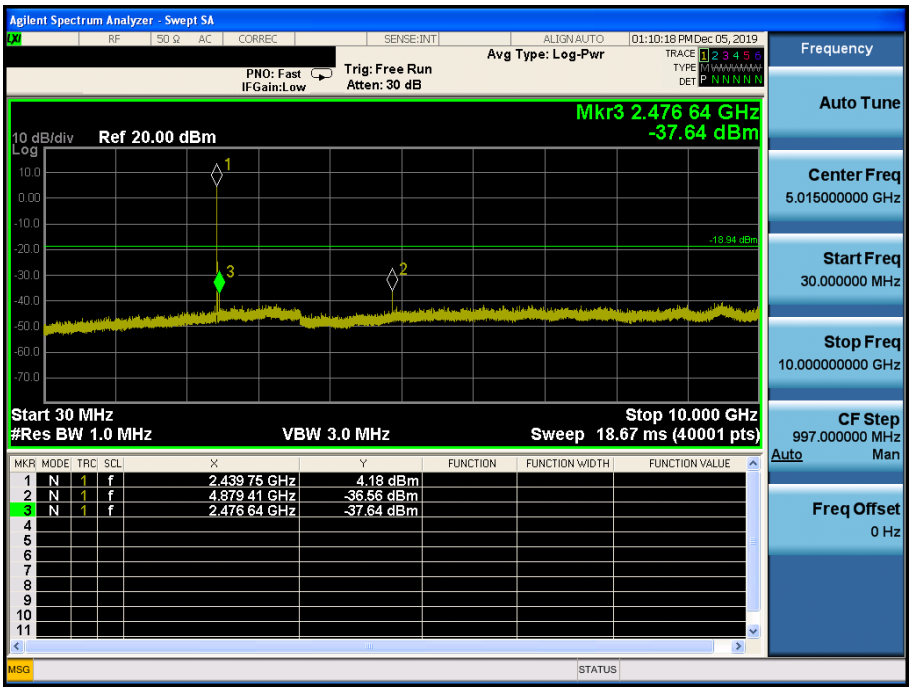


Reference (Test Channel : 2440 MHz)

Conducted Spurious Emissions 1 (Test Channel : 2440 MHz)



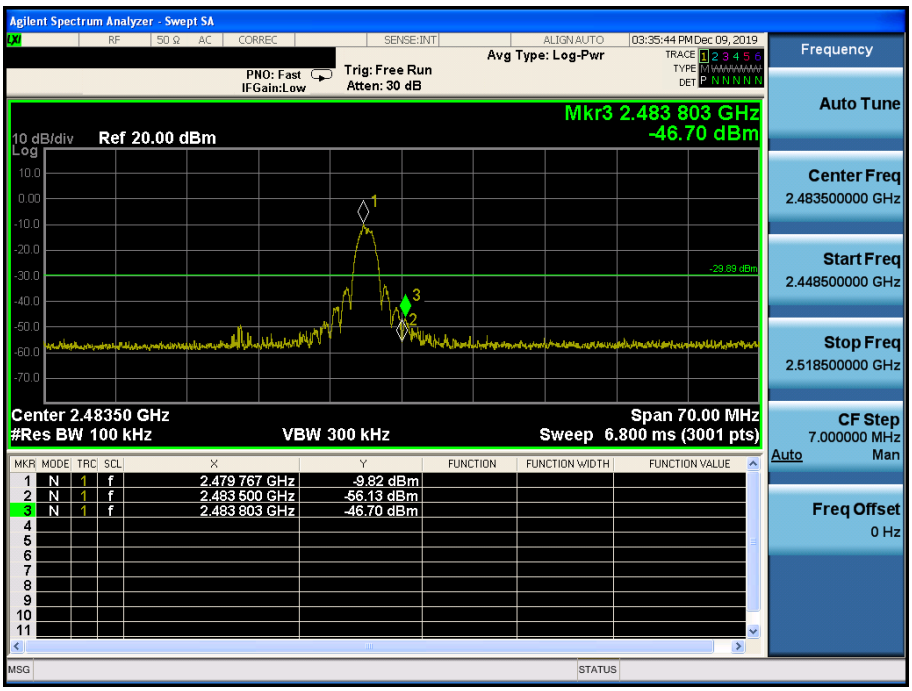
Conducted Spurious Emissions 2 (Test Channel : 2440 MHz)



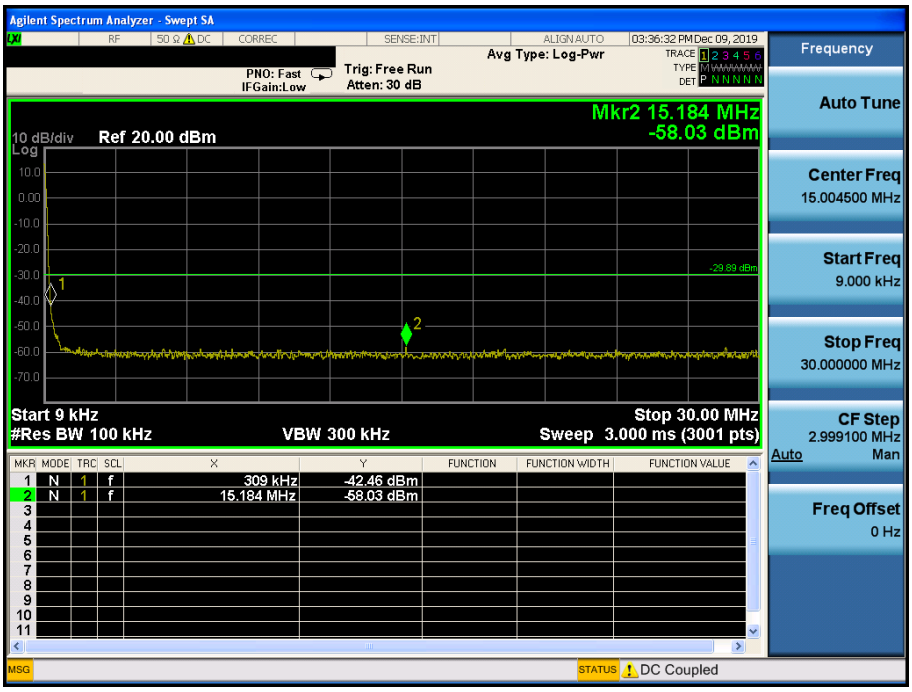
Conducted Spurious Emissions 3 (Test Channel : 2440 MHz)

Reference (Test Channel : 2480 MHz)

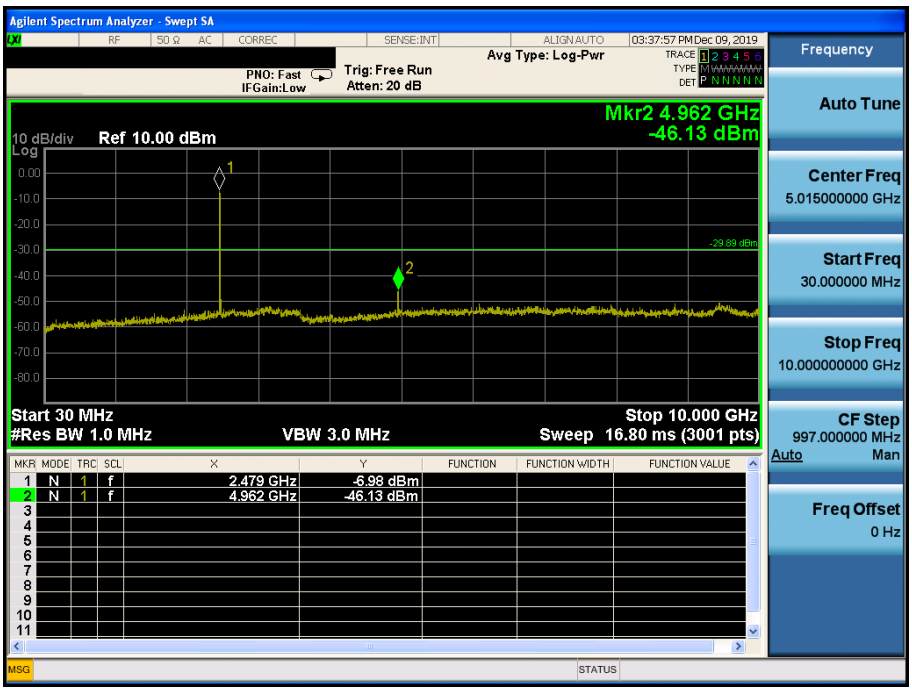
High Band-edge (Test Channel : 2480 MHz)



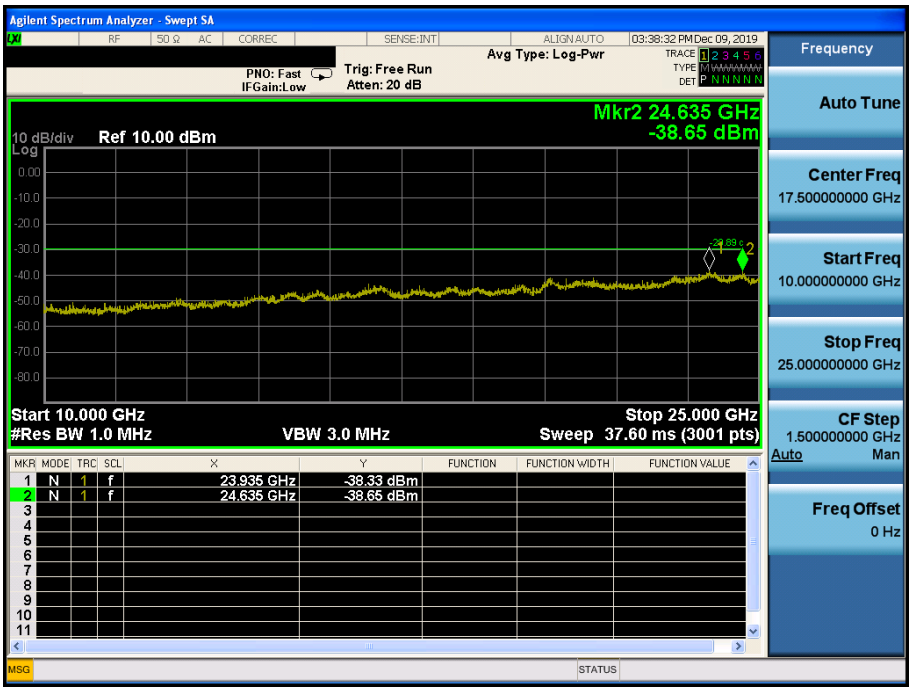
Conducted Spurious Emissions 1 (Test Channel : 2480 MHz)



Conducted Spurious Emissions 2 (Test Channel : 2480 MHz)



Conducted Spurious Emissions 3 (Test Channel : 2480 MHz)



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	GHz
0.009 ~ 0.110	16.42 ~ 16.423	399.90 ~ 410	4.5 ~ 5.15
0.495 ~ 0.505	16.69475 ~ 16.69525	608 ~ 614	5.35 ~ 5.46
2.1735 ~ 2.1905	16.80425 ~ 16.80475	960 ~ 1240	7.25 ~ 7.75
4.125 ~ 4.128	25.5 ~ 25.67	1300 ~ 1427	8.025 ~ 8.5
4.17725 ~ 4.17775	37.5 ~ 38.25	1435 ~ 1626.5	9.0 ~ 9.2
4.20725 ~ 4.20775	73 ~ 74.6	1645.5 ~ 1646.5	9.3 ~ 9.5
6.215 ~ 6.218	74.8 ~ 75.2	1660 ~ 1710	10.6 ~ 12.7
6.26775 ~ 6.26825	108 ~ 121.94	1718.8 ~ 1722.2	13.25 ~ 13.4
6.31175 ~ 6.31225	123 ~ 138	2200 ~ 2300	14.47 ~ 14.5
8.291 ~ 8.294	149.9 ~ 150.05	2310 ~ 2390	15.35 ~ 16.2
8.362 ~ 8.366	156.52475 ~ 156.52525	2483.5 ~ 2500	17.7 ~ 21.4
8.37625 ~ 8.38675	156.7 ~ 156.9	2690 ~ 2900	22.01 ~ 23.12
8.41425 ~ 8.41475	162.0125 ~ 167.17	3260 ~ 3267	23.6 ~ 24.0
12.29 ~ 12.293	167.72 ~ 173.2	3332 ~ 3339	31.2 ~ 31.8
12.51975 ~ 12.52025	240 ~ 285	3345.8 ~ 3358	36.43 ~ 36.5
12.57675 ~ 12.57725	322 ~ 335.4	3600 ~ 4400	Above 38.6
13.36 ~ 13.41			

▪ **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 Below 1 GHz**

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

2. **Frequency Range > 1 GHz**

   Peak Measurement > 1 GHz

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

   Average Measurement > 1GHz

   RBW = 1 MHz, VBW = 3 MHz, Detector = RMS, Averaging type= power(i.e., rms), Sweep time = Auto, Trace mode = perform a trace average of at least 100treaces.

   Note: The EUT has been tested with the highest operational duty cycle. Thus, the duty cycle correction was not applied.

3.5.3 Test Results

Frequency Range : 9 kHz ~ 25 GHz, TM 1

▪ 2405 MHz

Frequency (MHz)	ANT Pol	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)
2389.48	H	X	PK	56.04	2.43	N/A	N/A	58.47	74.00	15.53
2373.12	H	X	AV	39.46	2.38	N/A	N/A	41.84	54.00	12.17
4809.04	V	Z	PK	52.23	6.74	N/A	N/A	58.97	74.00	15.03
4809.11	V	Z	AV	41.04	6.74	N/A	N/A	47.78	54.00	6.22
7213.78	H	X	PK	50.85	9.12	N/A	N/A	59.97	74.00	14.03
7213.55	H	X	AV	39.82	9.12	N/A	N/A	48.94	54.00	5.06

▪ 2440 MHz

Frequency (MHz)	ANT Pol	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)
4879.02	V	Z	PK	51.16	6.88	N/A	N/A	58.04	74.00	15.96
4879.07	V	Z	AV	41.27	6.88	N/A	N/A	48.15	54.00	5.85
7318.94	H	X	PK	44.46	9.39	N/A	N/A	53.85	74.00	20.15
7318.51	H	X	AV	34.29	9.39	N/A	N/A	43.68	54.00	10.32

▪ 2475 MHz

Frequency (MHz)	ANT Pol	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)
2483.51	H	X	PK	65.87	1.79	N/A	N/A	67.66	74.00	6.34
2483.93	H	X	AV	42.20	1.80	N/A	N/A	44.00	54.00	10.00
4949.25	V	Z	PK	49.25	5.74	N/A	N/A	54.99	74.00	19.01
4949.05	V	Z	AV	38.42	5.74	N/A	N/A	44.16	54.00	9.84
7426.37	H	X	PK	52.66	7.89	N/A	N/A	60.55	74.00	13.45
7426.52	H	X	AV	41.82	7.89	N/A	N/A	49.71	54.00	4.29

▪ **Note.**

1. The radiated emissions were investigated up 25GHz. And no other spurious and harmonic emissions were found above listed frequencies.
2. Information of Distance Factor

   For finding emissions, the test distance might be reduced from 3 m to 1 m. In this case, the distance factor (-9.54 dB) 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.
3. 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,

   DCF = Duty Cycle Correction Factor.

   Duty cycle Correction factor = 20 x log (30ms/100ms) = -10.46 dB

Frequency Range : 9 kHz ~ 25 GHz, TM 1

▪ 2480 MHz

Frequency (MHz)	ANT Pol	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)
2483.60	H	X	PK	62.94	2.68	N/A	N/A	65.62	74.00	8.38
2483.52	H	X	AV	42.76	2.68	N/A	N/A	45.44	54.00	8.56
4961.10	V	Z	PK	45.78	6.98	N/A	N/A	52.76	74.00	21.24
4960.92	V	Z	AV	34.86	6.98	N/A	N/A	41.84	54.00	12.16
7438.17	H	X	PK	47.98	9.26	N/A	N/A	57.24	74.00	16.76
7438.66	H	X	AV	37.09	9.26	N/A	N/A	46.35	54.00	7.65

▪ **Note.**

1. The radiated emissions were investigated up 25GHz. And no other spurious and harmonic emissions were found above listed frequencies.
2. Information of Distance Factor

   For finding emissions, the test distance might be reduced from 3 m to 1 m. In this case, the distance factor (-9.54 dB) 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.
3. 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,

   DCF = Duty Cycle Correction Factor.

   Duty cycle Correction factor = 20 x log (30ms/100ms) = -10.46 dB

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

AC Line Conducted Emissions (Graph) : TM 1

Results of Conducted Emission

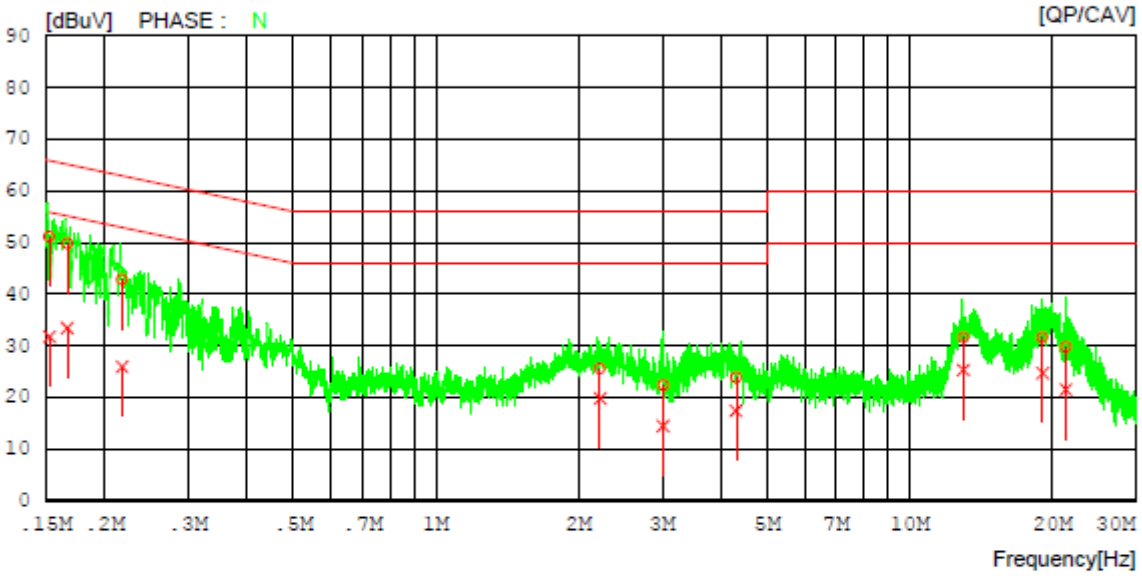
DTNC

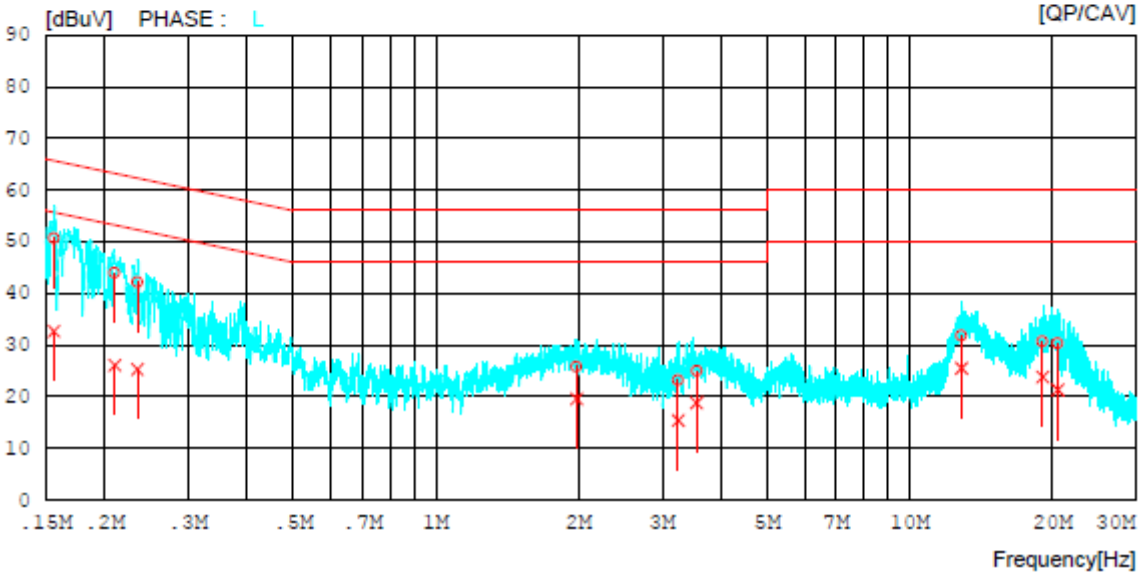
Date 2019-12-09

Order No.		Referrence No.	
Model No.	CMX-ZG03	Power Supply	120 V, 60 Hz
Serial No.		Temp/Humi.	24 'C / 39 %
Test Condition	Zigbee	Operator	InHee Bae

Memo

LIMIT : FCC P15.207 QP
FCC P15.207 AV





AC Line Conducted Emissions (List) : TM 1

Results of Conducted Emission

DTNC Date 2019-12-09

Order No.		Referrence No.	
Model No.	CMX-ZG03	Power Supply	120 V, 60 Hz
Serial No.		Temp/Humi.	24 'C / 38 %
Test Condition	Zigbee	Operator	InHee Bae

Memo

LIMIT : FCC P15.207 QP
FCC P15.207 AV

NO	FREQ [MHz]	READING QP [dBuV]	READING CAV [dBuV]	C.FACTOR [dB]	RESULT QP [dBuV]	RESULT CAV [dBuV]	LIMIT QP [dBuV]	LIMIT CAV [dBuV]	MARGIN QP [dBuV]	MARGIN CAV [dBuV]	PHASE
1	0.15277	41.21	21.81	9.94	51.15	31.75	65.85	55.85	14.70	24.10	N
2	0.16669	39.87	23.55	9.94	49.81	33.49	65.12	55.12	15.31	21.63	N
3	0.21745	32.87	16.00	9.94	42.81	25.94	62.92	52.92	20.11	26.98	N
4	2.21800	15.50	9.77	10.03	25.53	19.80	56.00	46.00	30.47	26.20	N
5	3.01800	12.27	4.39	10.07	22.34	14.46	56.00	46.00	33.66	31.54	N
6	4.29700	13.71	7.31	10.13	23.84	17.44	56.00	46.00	32.16	28.56	N
7	12.98740	21.22	14.92	10.43	31.65	25.35	60.00	50.00	28.35	24.65	N
8	19.06120	21.11	14.15	10.54	31.65	24.69	60.00	50.00	28.35	25.31	N
9	21.36000	19.19	10.93	10.58	29.77	21.51	60.00	50.00	30.23	28.49	N
10	0.15611	40.75	22.64	9.94	50.69	32.58	65.67	55.67	14.98	23.09	L
11	0.20963	34.05	16.13	9.94	43.99	26.07	63.22	53.22	19.23	27.15	L
12	0.23429	32.18	15.34	9.94	42.12	25.28	62.30	52.30	20.18	27.02	L
13	1.97980	15.69	9.53	10.03	25.72	19.56	56.00	46.00	30.28	26.44	L
14	3.24480	13.04	5.34	10.06	23.10	15.40	56.00	46.00	32.90	30.60	L
15	3.54720	14.82	8.64	10.09	24.91	18.73	56.00	46.00	31.09	27.27	L
16	12.85080	21.33	15.03	10.41	31.74	25.44	60.00	50.00	28.26	24.56	L
17	19.07200	20.17	13.28	10.52	30.69	23.80	60.00	50.00	29.31	26.20	L
18	20.53120	19.79	10.76	10.54	30.33	21.30	60.00	50.00	29.67	28.70	L

3.7 Occupied Bandwidth

▣ **Test Requirements, RSS-Gen [6.7]**

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

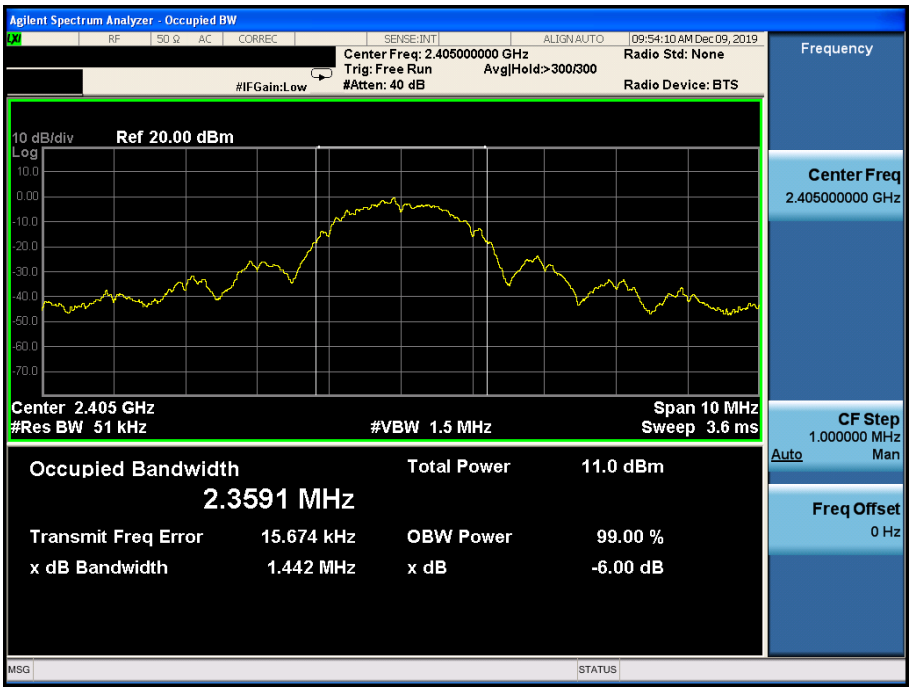
3.7.2 Test Procedures

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

Test Mode	Tested Channel	Test Results (MHz)
TM 1	**2405 MHz**	2.359
	2440 MHz	2.361
	2480 MHz	**2.420**

Occupied Bandwidth Test Channel : 2405 MHz



Occupied Bandwidth Test Channel : 2440 MHz

Occupied Bandwidth Test Channel : 2480 MHz

4. ANTENNA REQUIREMENTS

▣ **According to FCC 47 CFR §15.203**

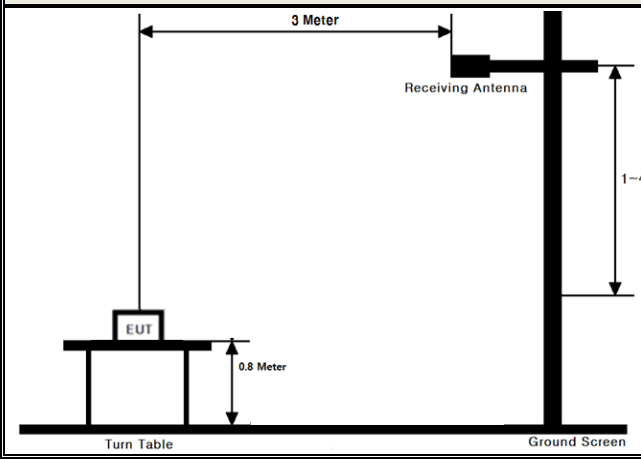
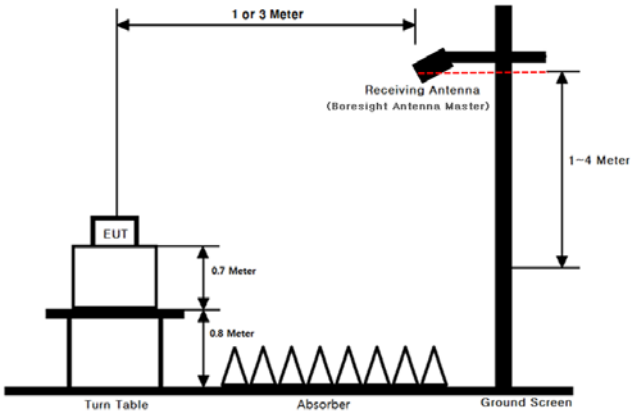
"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient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

The Antenna is permanently attached.
Therefore this E.U.T Complies with the requirement of §15.203

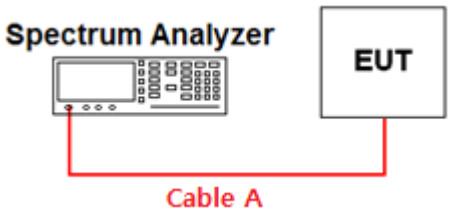
APPENDIX I

Test set up diagrams

- **Radiated Measurement**

Below 1GHz	Above 1GHz
	

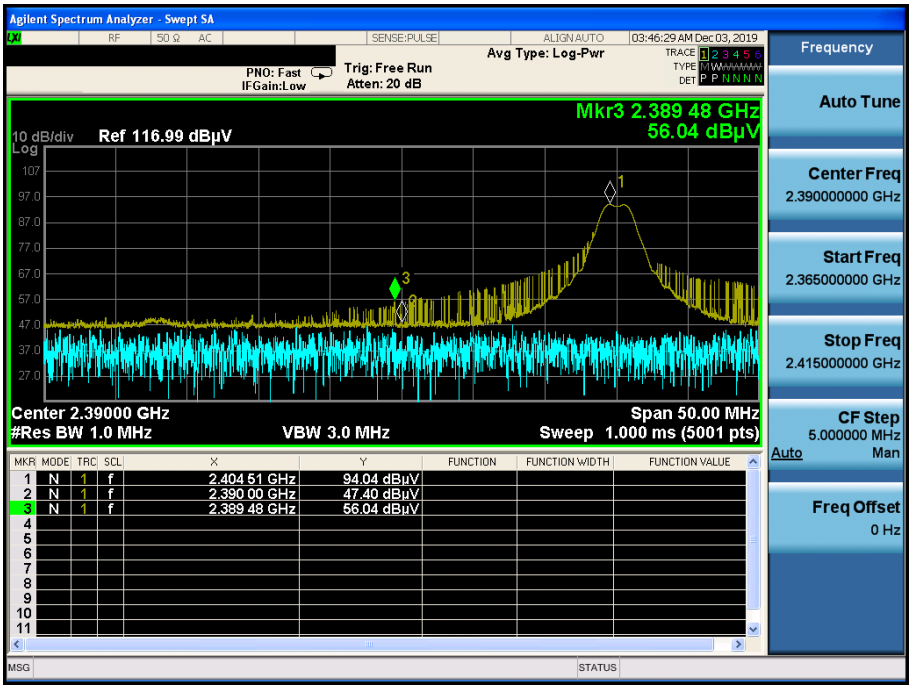
- **Conducted Measurement**



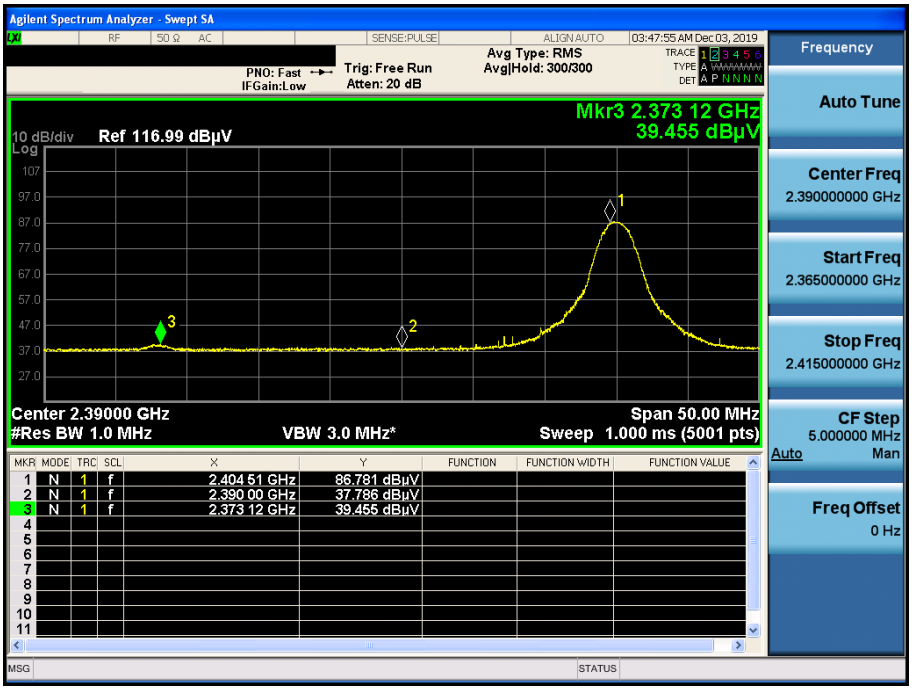
APPENDIX II

Unwanted Emissions (Radiated) Test Plot, TM 1

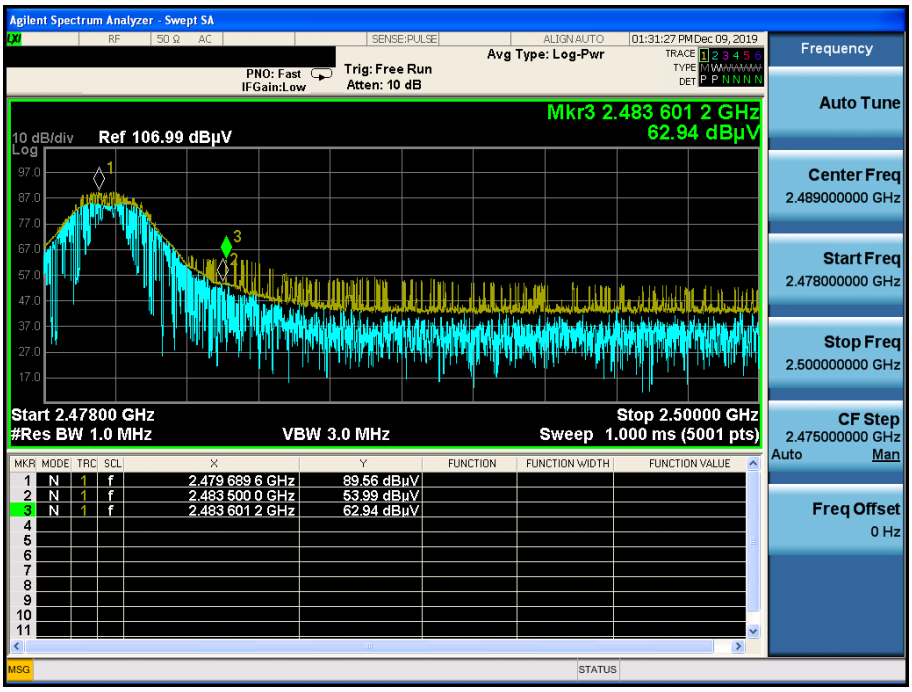
TM1 & 2405 MHz & X & Hor **Detector Mode : PK**



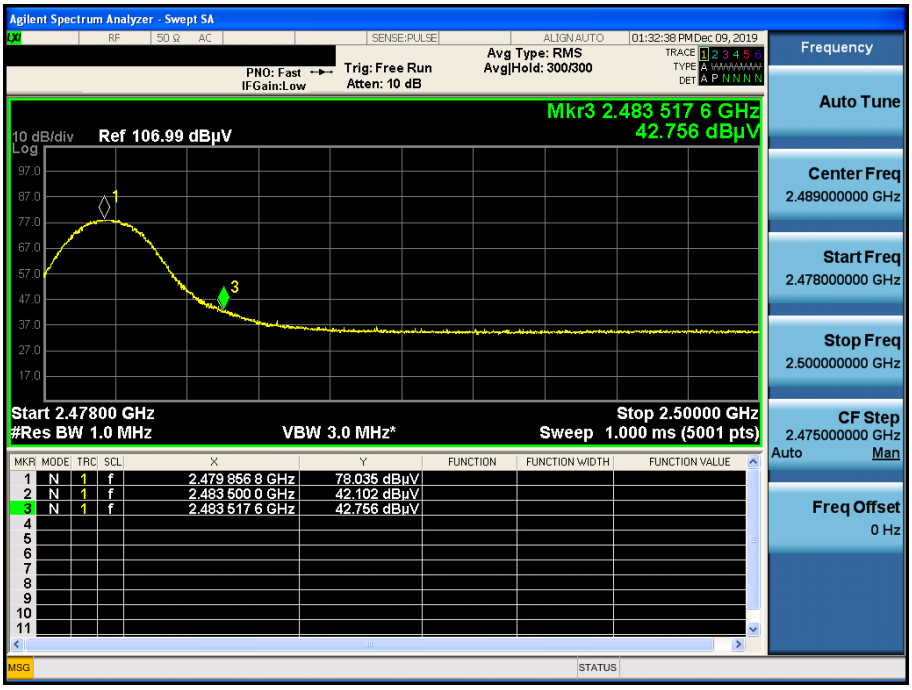
TM1 & 2405 MHz & X & Hor **Detector Mode : AV**



TM1 & 2480 MHz & X & Hor **Detector Mode : PK**



TM1 & 2480 MHz & X & Hor **Detector Mode : AV**



TM1 & 2475 MHz & X & Hor **Detector Mode : AV**