FCC Test Report
(Class II Permissive Change)

Product Name	Wireless Module
Model No.	WUSBMDL
FCC ID.	X3X-WUSBMDL

Applicant	ELMO COMPANY, LIMITED
Address	1-3-4, Shioya-cho, Minami-ku, Nagoya, 457-0078, JAPAN

Date of Receipt	Mar. 19, 2018
Issued Date	Apr. 12, 2018
Report No.	1830278R-RFUSP25V00
Report Version	V1.0

Testing Laboratory
3023

Test Report

Issued Date: Apr. 12, 2018
Report No.: 1830278R-RFUSP25V00

Product Name	Wireless Module
Applicant	ELMO COMPANY, LIMITED
Address	1-3-4, Shioya-cho, Minami-ku, Nagoya, 457-0078, JAPAN
Manufacturer	ELMO COMPANY, LIMITED
Model No.	WUSBMDL
FCC ID.	X3X-WUSBMDL
EUT Rated Voltage	DC 5V (Power by USB)
EUT Test Voltage	AC 120V/60Hz
Trade Name	ELMO
Applicable Standard	FCC CFR Title 47 Part 15 Subpart C: 2017 ANSI C63.4: 2014, ANSI C63.10: 2013 KDB 558074 D01 DTS Meas Guidance v04
Test Result	Complied

Documented By : Jinn Chen
(Senior Adm. Specialist / Jinn Chen)

Tested By : Nova Chu
(Engineer / Nova Chu)

Approved By :
(Director / Vincent Lin)

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1. GENERAL INFORMATION

1.1. EUT Description

Product Name	Wireless Module
Trade Name	ELMO
Model No.	WUSBMDL
FCC ID.	X3X-WUSBMDL
Frequency Range	2402 – 2480MHz
Channel Number	78CH
Type of Modulation	Limited Single Modular
Antenna Type	PCB Antenna
Channel Control	Auto
Antenna Gain	Refer to the table “Antenna List”
USB Cable	Non-shielded, 2.05m
Power Adapter	MFR: UNIFIVE, M/N:UBX310-0520 Input: AC 100-240V 50/60Hz, 0.3A Output:DC5V 2A

Antenna List

No.	Manufacturer	Part No.	Antenna Type	Peak Gain
1	CYPRESS	AN48610	PCB Antenna	1.16dBi for 2.4 GHz

Note: The antenna of EUT is conforming to FCC 15.203.

Center Frequency of Each Channel:

Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
Channel 01:	2402 MHz	Channel 21:	2422 MHz	Channel 41:	2442 MHz	Channel 61:	2462 MHz
Channel 02:	2403 MHz	Channel 22:	2423 MHz	Channel 42:	2443 MHz	Channel 62:	2463 MHz
Channel 03:	2404 MHz	Channel 23:	2424 MHz	Channel 43:	2444 MHz	Channel 63:	2464 MHz
Channel 04:	2405 MHz	Channel 24:	2425 MHz	Channel 44:	2445 MHz	Channel 64:	2465 MHz
Channel 05:	2406 MHz	Channel 25:	2426 MHz	Channel 45:	2446 MHz	Channel 65:	2466 MHz
Channel 06:	2407 MHz	Channel 26:	2427 MHz	Channel 46:	2447 MHz	Channel 66:	2467 MHz
Channel 07:	2408 MHz	Channel 27:	2428 MHz	Channel 47:	2448 MHz	Channel 67:	2468 MHz
Channel 08:	2409 MHz	Channel 28:	2429 MHz	Channel 48:	2449 MHz	Channel 68:	2469 MHz
Channel 09:	2410 MHz	Channel 29:	2430 MHz	Channel 49:	2450 MHz	Channel 69:	2470 MHz
Channel 10:	2411 MHz	Channel 30:	2431 MHz	Channel 50:	2451 MHz	Channel 70:	2471 MHz
Channel 11:	2412 MHz	Channel 31:	2432 MHz	Channel 51:	2452 MHz	Channel 71:	2472 MHz
Channel 12:	2413 MHz	Channel 32:	2433 MHz	Channel 52:	2453 MHz	Channel 72:	2473 MHz
Channel 13:	2414 MHz	Channel 33:	2434 MHz	Channel 53:	2454 MHz	Channel 73:	2474 MHz
Channel 14:	2415 MHz	Channel 34:	2435 MHz	Channel 54:	2455 MHz	Channel 74:	2475 MHz
Channel 15:	2416 MHz	Channel 35:	2436 MHz	Channel 55:	2456 MHz	Channel 75:	2476 MHz
Channel 16:	2417 MHz	Channel 36:	2437 MHz	Channel 56:	2457 MHz	Channel 76:	2477 MHz
Channel 17:	2418 MHz	Channel 37:	2438 MHz	Channel 57:	2458 MHz	Channel 77:	2478 MHz
Channel 18:	2419 MHz	Channel 38:	2439 MHz	Channel 58:	2459 MHz	Channel 78:	2479 MHz
Channel 19:	2420 MHz	Channel 39:	2440 MHz	Channel 59:	2460 MHz		
Channel 20:	2421 MHz	Channel 40:	2441 MHz	Channel 60:	2461 MHz		

Note:

1. The EUT is a Wireless Module with built-in 2.4G transceiver.
2. These tests were conducted on a sample for the purpose of demonstrating compliance of 2.4G transmitter with Part 15 Subpart C Paragraph 15.247 for spread spectrum devices.
3. Regarding to the operation frequency, the lowest, middle and highest frequency are selected to perform the test.
4. This is to request a Class II permissive change for FCC ID: X3X-WUSBMDL, originally granted on 11/02/2011.
   The major change filed under this application is:
   Change
   #1: Additional a new platform: ELMO/CRB-1W.
5. The radiation measurements are performed in X, Y, Z axis positioning. Only the worst case is shown in the report.

Test Mode	Mode 1: Transmit

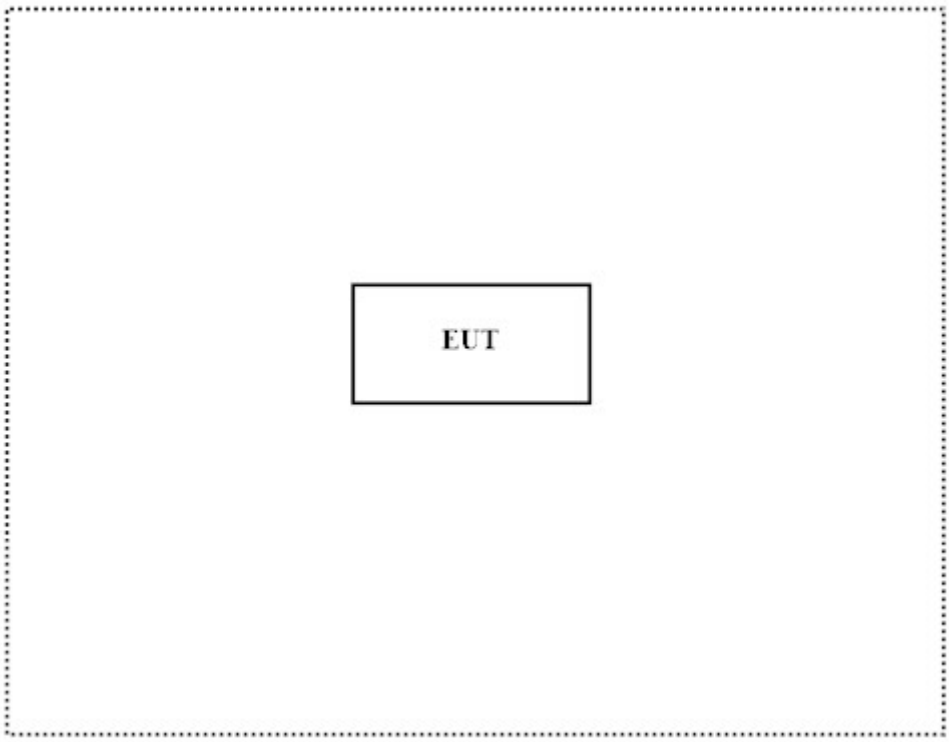
1.3. Tested System Details

The types for all equipment, plus descriptions of all cables used in the tested system (including inserted cards) are:

Product	Manufacturer	Model No.	Serial No.	Power Cord
N/A				

Signal Cable Type	Signal cable Description
N/A	

1.4. Configuration of Tested System



1.5. EUT Exercise Software

(1) Setup the EUT as shown in Section 1.4.

(2) Execute software “Usbhidioc1.0.0.1” on the Notebook PC.

(3) Configure the test mode, the test channel, and the data rate.

(4) Press “OK” to start the continuous Transmit.

(5) Verify that the EUT works properly.

1.6. Test Facility

Ambient conditions in the laboratory:

Items	Required (IEC 68-1)	Actual
Temperature (°C)	15-35	20-35
Humidity (%RH)	25-75	50-65
Barometric pressure (mbar)	860-1060	950-1000

The related certificate for our laboratories about the test site and management system can be downloaded from DEKRA Testing and Certification Co., Ltd. Web Site:
http://www.dekra.com.tw/english/about/certificates.aspx?bval=5
The address and introduction of DEKRA Testing and Certification Co., Ltd. laboratories can be founded in our Web site: http://www.dekra.com.tw/index_en

Site Description: Accredited by TAF
Accredited Number: 3023

Site Name: DEKRA Testing and Certification Co., Ltd.
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E-Mail : info.tw@dekra.com

FCC Accreditation Number: TW3023

1.7. List of Test Equipment

For Conduction measurements /ASR1

	Equipment	Manufacturer	Model No.	Serial No.	Cali. Data	Due. Data
X	EMI Test Receiver	R&S	ESR7	101601	2018.02.08	2019.02.07
X	Two-Line V-Network	R&S	ENV216	101306	2018.03.09	2019.03.08
X	Two-Line V-Network	R&S	ENV216	101307	2018.03.20	2019.03.19
X	Coaxial Cable	Quietek	RG400_BNC	RF001	2017.05.24	2018.05.23

Note:
1. All equipments are calibrated every one year.
2. The test instruments marked with "X" are used to measure the final test results.
3. Test Software version : QuieTek EMI 2.0 V2.1.113

For Conducted measurements /ASR4

	Equipment	Manufacturer	Model No.	Serial No.	Cali. Data	Due. Data
X	Spectrum Analyzer	R&S	FSV30	103464	2018.01.23	2019.01.22
X	Power Meter	Anritsu	ML2496A	1548003	2017.12.11	2018.12.10
X	Power Sensor	Anritsu	MA2411B	1531024	2017.12.11	2018.12.10
X	Power Sensor	Anritsu	MA2411B	1531025	2017.12.11	2018.12.10
	Bluetooth Tester	R&S	CBT	101238	2018.01.18	2019.01.17

Note:
1. All equipments are calibrated every one year.
2. The test instruments marked with "X" are used to measure the final test results.
3. Test Software version : QuieTek Conduction Test System V8.0.110

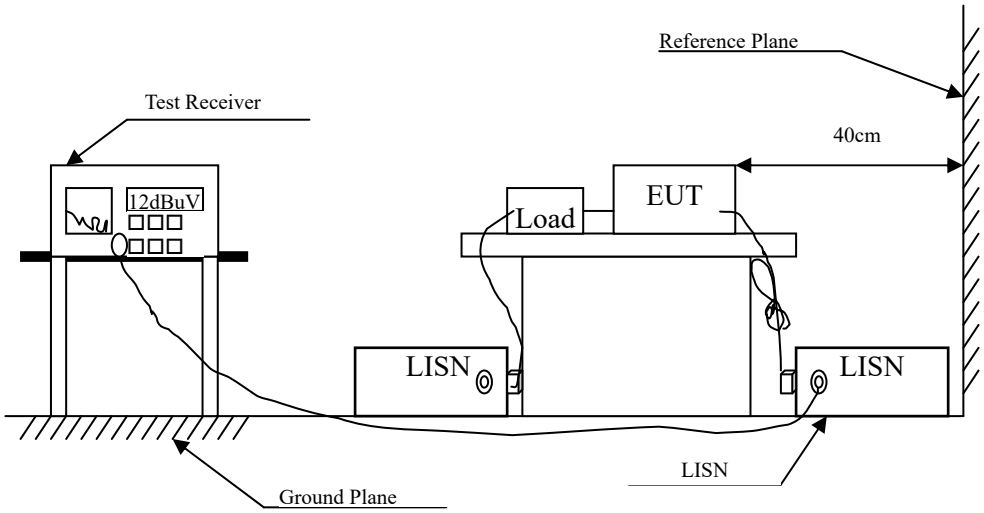
For Radiated measurements /ACB1

	Equipment	Manufacturer	Model No.	Serial No.	Cali. Data	Due. Data
X	Loop Antenna	AMETEK	HLA6121	49611	2018.01.26	2019.01.25
X	Bi-Log Antenna	SCHWARZBECK	VULB9168	9168-674	2018.04.02	2019.04.01
X	Horn Antenna	ETS-Lindgren	3117	00203800	2017.11.10	2018.11.09
X	Horn Antenna	Com-Power	AH-840	101087	2017.05.24	2018.05.23
X	Pre-Amplifier	EMCI	EMC001330	980316	2017.05.16	2018.05.15
X	Pre-Amplifier	EMCI	EMC051835SE	980311	2017.05.17	2018.05.16
X	Pre-Amplifier	EMCI	EMC05820SE	980310	2017.05.17	2018.05.16
X	Pre-Amplifier	EMCI	EMC184045SE	980314	2017.05.17	2018.05.16
X	Filter	MICRO TRONICS	BRM50702	G251	2017.08.30	2018.08.29
	Filter	MICRO TRONICS	BRM50716	G188	2017.08.30	2018.08.29
X	EMI Test Receiver	R&S	ESR7	101602	2017.12.11	2018.12.10
X	Spectrum Analyzer	R&S	FSV40	101148	2018.02.08	2019.02.07
X	Coaxial Cable	SUHNER	SUCOFLEX 106	RF002	2017.05.25	2018.05.24
X	Mircoflex Cable	HUBER SUHNER	SUCOFLEX 102	MY3381/2	2017.08.11	2018.08.10

Note:
1. Loop Antenna is calibrated every two year, the other equipments are calibrated every one year.
2. The test instruments marked with "X" are used to measure the final test results.
3. Test Software version : QuieTek EMI 2.0 V2.1.113

2. Conducted Emission

2.1. Test Setup



2.2. Limits

FCC Part 15 Subpart C Paragraph 15.207 (dBuV) Limit		
Frequency MHz	Limits	
	QP	AV
0.15 - 0.50	66-56	56-46
0.50-5.0	56	46
5.0 - 30	60	50

Remarks: In the above table, the tighter limit applies at the band edges.

2.3. Test Procedure

The EUT and Peripherals are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50 ohm /50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm /50uH coupling impedance with 50ohm termination. (Please refer to the block diagram of the test setup and photographs.)

Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all the interface cables must be changed according to ANSI C63.4: 2014 on conducted measurement.

Conducted emissions were invested over the frequency range from 0.15MHz to 30MHz using a receiver bandwidth of 9kHz.

The EUT was setup to ANSI C63.4, 2014; tested to DTS test procedure of FCC KDB-558074 for compliance to FCC 47CFR Subpart C requirements.

2.4. Uncertainty

±2.35dB

2.5. Test Result of Conducted Emission

Product : Wireless Module
Test Item : Conducted Emission Test
Power Line : Line 1
Test Mode : Mode 1: Transmit (2441MHz)
Test Date : 2018/04/02

Frequency	Correct Factor	Reading Level	Measurement Level	Margin	Limit
MHz	dB	dBuV	dBuV	dB	dBuV
LINE 1					
Quasi-Peak					
0.161	9.560	50.648	60.208	-5.478	65.686
0.188	9.560	49.676	59.236	-5.678	64.914
0.238	9.562	47.487	57.049	-6.437	63.486
0.328	9.568	47.851	57.419	-3.495	60.914
0.474	9.578	45.843	55.421	-1.322	56.743
0.699	9.580	39.371	48.951	-7.049	56.000
Average					
0.161	9.560	27.995	37.555	-18.131	55.686
0.188	9.560	29.119	38.679	-16.235	54.914
0.238	9.562	25.046	34.609	-18.877	53.486
0.328	9.568	25.010	34.578	-16.336	50.914
0.474	9.578	23.166	32.744	-13.999	46.743
0.699	9.580	17.572	27.152	-18.848	46.000

Note:

1. All Reading Levels are Quasi-Peak and average value.
2. " " means the worst emission level.
3. Measurement Level = Reading Level + Correct Factor

Product : Wireless Module
Test Item : Conducted Emission Test
Power Line : Line 2
Test Mode : Mode 1: Transmit (2441MHz)
Test Date : 2018/04/02

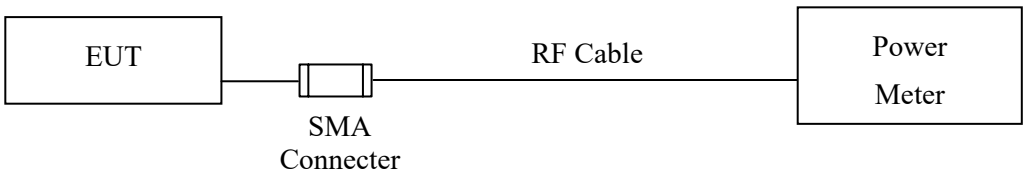
Frequency	Correct Factor	Reading Level	Measurement Level	Margin	Limit
MHz	dB	dBuV	dBuV	dB	dBuV
LINE 2					
Quasi-Peak					
0.161	9.861	50.885	60.745	-4.941	65.686
0.206	9.857	48.907	58.764	-5.636	64.400
0.242	9.827	47.294	57.120	-6.251	63.371
0.287	9.834	47.093	56.927	-5.159	62.086
0.465	9.864	46.865	56.729	-0.271	57.000
0.701	9.817	39.444	49.261	-6.739	56.000
Average					
0.161	9.861	28.219	38.079	-17.607	55.686
0.206	9.857	28.179	38.036	-16.364	54.400
0.242	9.827	25.602	35.429	-17.942	53.371
0.287	9.834	25.216	35.051	-17.035	52.086
0.465	9.864	24.420	34.284	-12.716	47.000
0.701	9.817	21.111	30.928	-15.072	46.000

Note:

1. All Reading Levels are Quasi-Peak and average value.
2. " " means the worst emission level.
3. Measurement Level = Reading Level + Correct Factor

3. Peak Power Output

3.1. Test Setup



3.2. Limit

The maximum peak power shall be less 1Watt.

3.3. Test Procedure

Tested according to DTS test procedure of KDB 558074 for compliance to FCC 47CFR 15.247 requirements. The maximum peak conducted output power using KDB 558074 section 9.1.3 PKPM1 Peak power meter method.

3.4. Uncertainty

±0.86 dB

3.5. Test Result of Peak Power Output

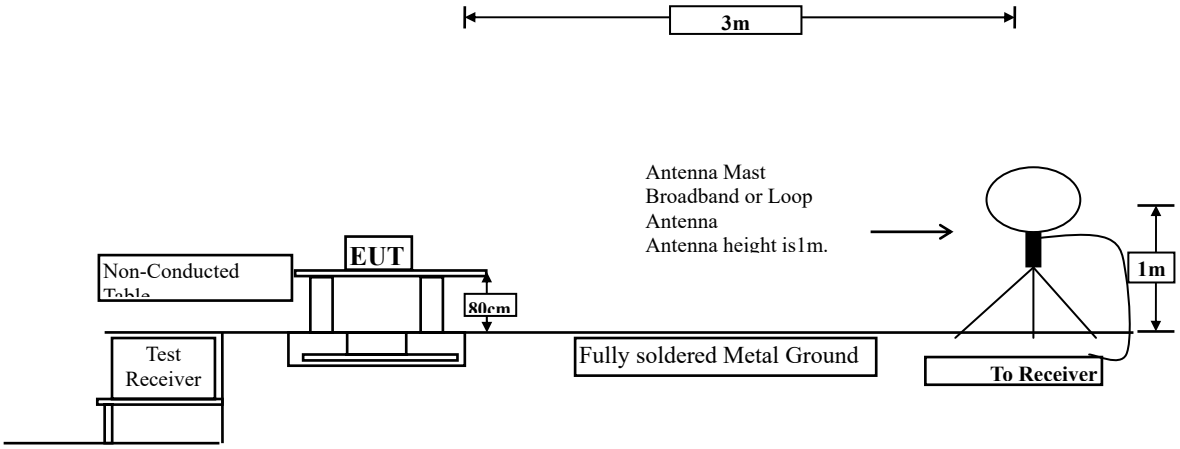
Product : Wireless Module
Test Item : Peak Power Output
Test Mode : Mode 1: Transmit
Test Date : 2018/04/03

Channel No.	Frequency (MHz)	Measurement (dBm)	Required Limit	Result
Channel 01	2402	-3.16	1 Watt= 30 dBm	Pass
Channel 40	2441	-3.59	1 Watt= 30 dBm	Pass
Channel 78	2479	-3.93	1 Watt= 30 dBm	Pass

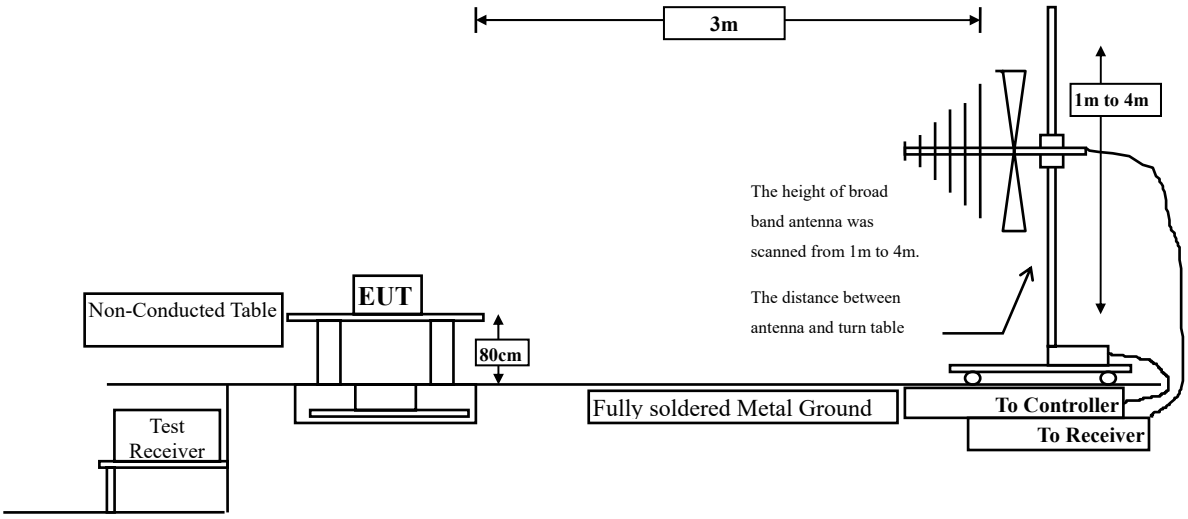
4. Radiated Emission

4.1. Test Setup

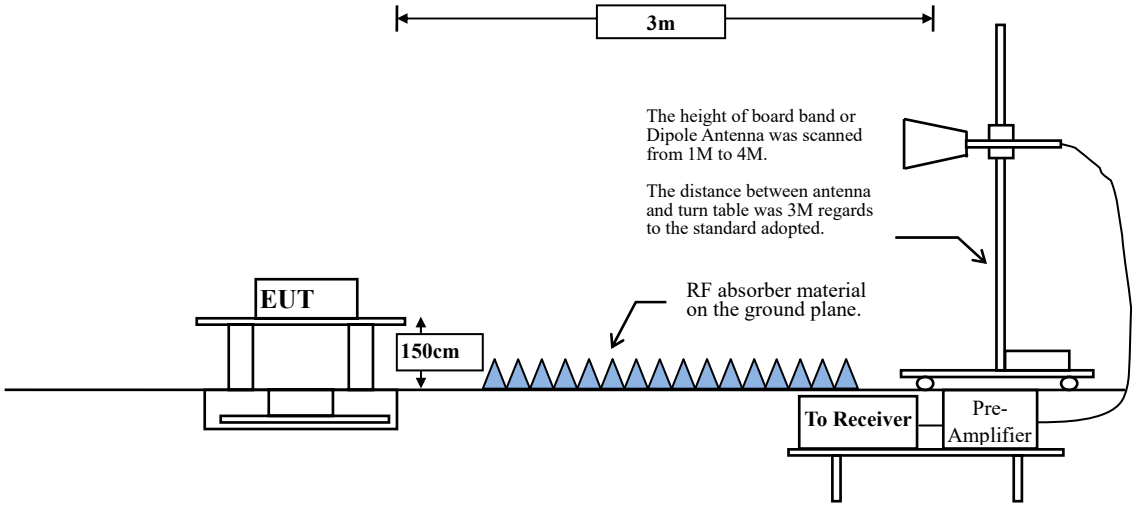
Radiated Emission Under 30MHz



Radiated Emission Below 1GHz



Radiated Emission Above 1GHz



4.2. Limits

➢ General Radiated Emission Limits

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 20dB below the level of the fundamental or to the general radiated emission limits in paragraph 15.209, whichever is the lesser attenuation.

FCC Part 15 Subpart C Paragraph 15.209 Limits		
Frequency MHz	Field strength (microvolts/meter)	Measurement distance (meter)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Remarks: 1. RF Voltage (dBuV) = 20 log RF Voltage (uV)
2. In the Above Table, the tighter limit applies at the band edges.
3. Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system.

4.3. Test Procedure

The EUT was setup according to ANSI C63.10: 2013 and tested according to DTS test procedure of KDB558074 for compliance to FCC 47CFR 15.247 requirements.

Measuring the frequency range below 1GHz, the EUT is placed on a turn table which is 0.8 meter above ground,when measuring the frequency range above 1GHz, the EUT is placed on a turn table which is 1.5 meter above ground.

The turn table is rotated 360 degrees to determine the position of the maximum emission level.

The EUT was positioned such that the distance from antenna to the EUT was 3 meters.

The antenna is scanned between 1 meter and 4 meters to find out the maximum emission level. This is repeated for both horizontal and vertical polarization of the antenna. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10: 2013 on radiated measurement.

The resolution bandwidth below 30MHz setting on the field strength meter is 9kHz and 30MHz~1GHz is 120kHz and above 1GHz is 1MHz.

Radiated emission measurements below 30MHz are made using Loop Antenna and 30MHz~1GHz are made using broadband Bilog antenna and above 1GHz are made using Horn Antennas.

The measurement is divided into the Preliminary Measurement and the Final Measurement.

The suspected frequencies are searched for in Preliminary Measurement with the measurement antenna kept pointed at the source of the emission both in azimuth and elevation, with the polarization of the antenna oriented for maximum response. The antenna is pointed at an angle towards the source of the emission, and the EUT is rotated in both height and polarization to maximize the measured emission. The emission is kept within the illumination area of the 3 dB bandwidth of the antenna.

The measurement frequency range form 9kHz - 10th Harmonic of fundamental was investigated.

RBW and VBW Parameter setting:

According to KDB 558074 section 12.2.4. Peak power measurement procedure

RBW = as specified in Table 1.

VBW ≥ 3 x RBW.

Table 1 —RBW as a function of frequency

Frequency	RBW
9-150 kHz	200-300 Hz
0.15-30 MHz	9-10 kHz
30-1000 MHz	100-120 kHz
> 1000 MHz	1 MHz

According to KDB 558074 section 12.2.5. Average power measurement procedure

RBW = 1MHz.

VBW = 10Hz, when duty cycle ≥ 98 %

VBW ≥ 1/T, when duty cycle < 98 %

(T refers to the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.)

2.4GHz band	Duty Cycle (%)	T (ms)	1/T (Hz)	VBW (Hz)
	75.89	2.1400	467	500

Note: Duty Cycle Refer to Section 9

4.4. Uncertainty

Horizontal polarization：

30-300MHz: ±4.08dB；300M-1GHz: ±3.86dB；1-18GHz: ±3.77dB；18-40GHz: ±3.98dB

Vertical polarization：

30-300MHz: ±4.81dB；300M-1GHz: ±3.87dB；1-18GHz：±3.83dB；18-40GHz: ±3.98dB

4.5. Test Result of Radiated Emission

Product : Wireless Module
Test Item : Harmonic Radiated Emission
Test Mode : Mode 1: Transmit (2402MHz)
Test Date : 2018/03/31

Frequency	Correct Factor	Reading Level	Measurement Level	Margin	Limit
MHz	dB	dBuV	dBuV/m	dB	dBuV/m
Horizontal					
Peak Detector:					
4804.000	-6.114	54.850	48.736	-25.264	74.000
7206.000	-3.112	51.330	48.218	-25.782	74.000
9608.000	-0.801	46.150	45.350	-28.650	74.000
Average					
Detector:					
--					54.000
Vertical					
Peak Detector:					
4804.000	-6.114	57.570	51.456	-22.544	74.000
7206.000	-3.112	52.370	49.258	-24.742	74.000
9608.000	-0.801	45.930	45.130	-28.870	74.000
Average					
Detector:					
--					54.000

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
4. The average measurement was not performed when the peak measured data under the limit of average detection.
5. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : Wireless Module
Test Item : Harmonic Radiated Emission
Test Mode : Mode 1: Transmit (2441MHz)
Test Date : 2018/03/31

Frequency	Correct Factor	Reading Level	Measurement Level	Margin	Limit
MHz	dB	dBuV	dBuV/m	dB	dBuV/m
Horizontal					
Peak Detector:					
4882.000	-6.066	55.490	49.424	-24.576	74.000
7323.000	-3.022	52.730	49.708	-24.292	74.000
9764.000	-0.522	46.700	46.177	-27.823	74.000
Average					
Detector:					
--					54.000
Vertical					
Peak Detector:					
4882.000	-6.066	57.600	51.534	-22.466	74.000
7323.000	-3.022	52.250	49.228	-24.772	74.000
9764.000	-0.522	46.780	46.257	-27.743	74.000
Average					
Detector:					
--					54.000

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
4. The average measurement was not performed when the peak measured data under the limit of average detection.
5. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : Wireless Module
Test Item : Harmonic Radiated Emission
Test Mode : Mode 1: Transmit (2479MHz)
Test Date : 2018/03/31

Frequency	Correct Factor	Reading Level	Measurement Level	Margin	Limit
MHz	dB	dBuV	dBuV/m	dB	dBuV/m
Horizontal					
Peak Detector:					
4958.000	-6.056	55.180	49.124	-24.876	74.000
7437.000	-2.870	53.860	50.990	-23.010	74.000
9916.000	-0.324	45.760	45.436	-28.564	74.000
Average					
Detector:					
--					54.000
Vertical					
Peak Detector:					
4958.000	-6.056	57.240	51.184	-22.816	74.000
7437.000	-2.870	52.530	49.660	-24.340	74.000
9916.000	-0.324	45.520	45.196	-28.804	74.000
Average					
Detector:					
--					54.000

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
4. The average measurement was not performed when the peak measured data under the limit of average detection.
5. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : Wireless Module
Test Item : General Radiated Emission
Test Mode : Mode 1: Transmit (2441MHz)
Test Date : 2018/03/31

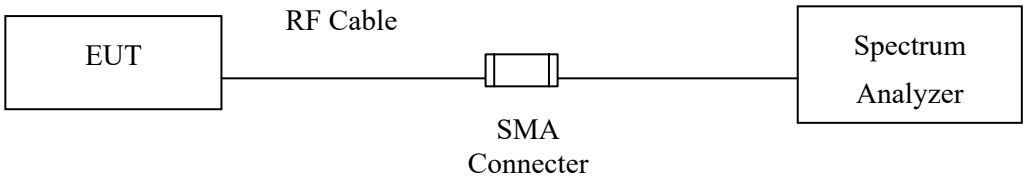
Frequency	Correct Factor	Reading Level	Measurement Level	Margin	Limit
MHz	dB	dBuV	dBuV/m	dB	dBuV/m
Horizontal					
136.841	-11.740	33.043	21.303	-22.197	43.500
368.797	-8.785	31.575	22.790	-23.210	46.000
519.217	-5.723	31.212	25.488	-20.512	46.000
659.797	-3.616	31.214	27.598	-18.402	46.000
827.087	-1.311	40.620	39.310	-6.690	46.000
988.754	0.723	31.128	31.851	-22.149	54.000
Vertical					
171.986	-11.484	31.827	20.342	-23.158	43.500
351.928	-9.165	30.308	21.143	-24.857	46.000
500.942	-6.009	30.084	24.075	-21.925	46.000
692.130	-3.161	31.213	28.052	-17.948	46.000
827.087	-1.311	35.809	34.499	-11.501	46.000
990.159	0.741	29.975	30.716	-23.284	54.000

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
4. The emission levels of other frequencies are very lower than the limit and not show in test report.
5. No emission found between lowest internal used/generated frequency to 30MHz.

5. RF Antenna Conducted Test

5.1. Test Setup



5.2. Limits

According to FCC Section 15.247(d). In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

5.3. Test Procedure

The EUT was tested according to DTS test procedure of KDB558074 for compliance to FCC 47CFR 15.247 requirements.
Set RBW = 100 kHz, Set VBW> RBW, scan up through 10th harmonic.

5.4. Uncertainty

±1.23dB

5.5. Test Result of RF Antenna Conducted Test

Product : Wireless Module
Test Item : RF Antenna Conducted Test
Test Mode : Mode 1: Transmit
Test Date : 2018/04/03

Figure Channel 01:

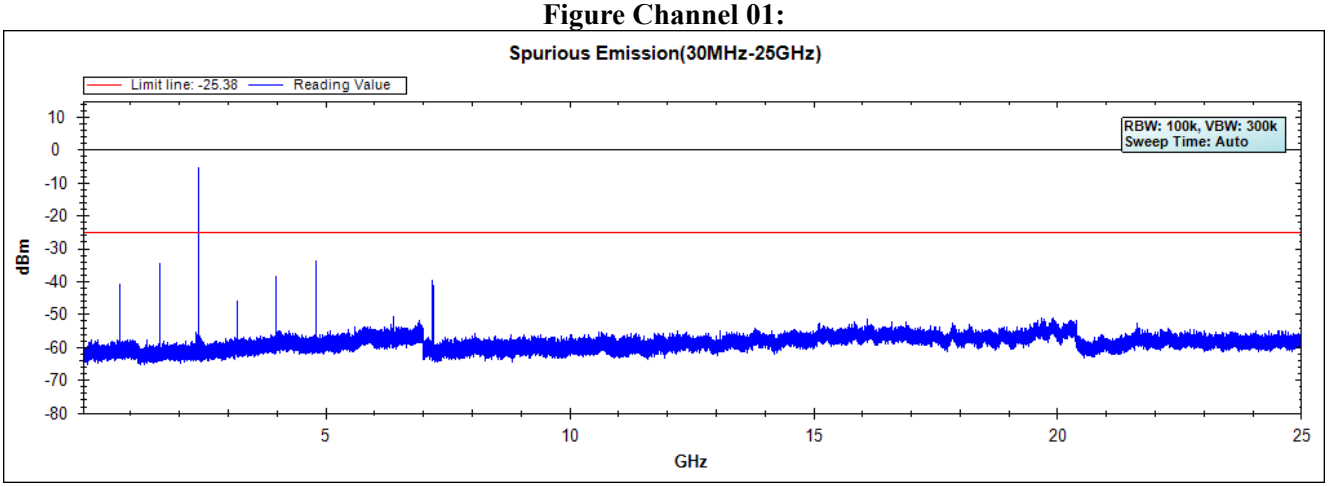


Figure Channel 40:

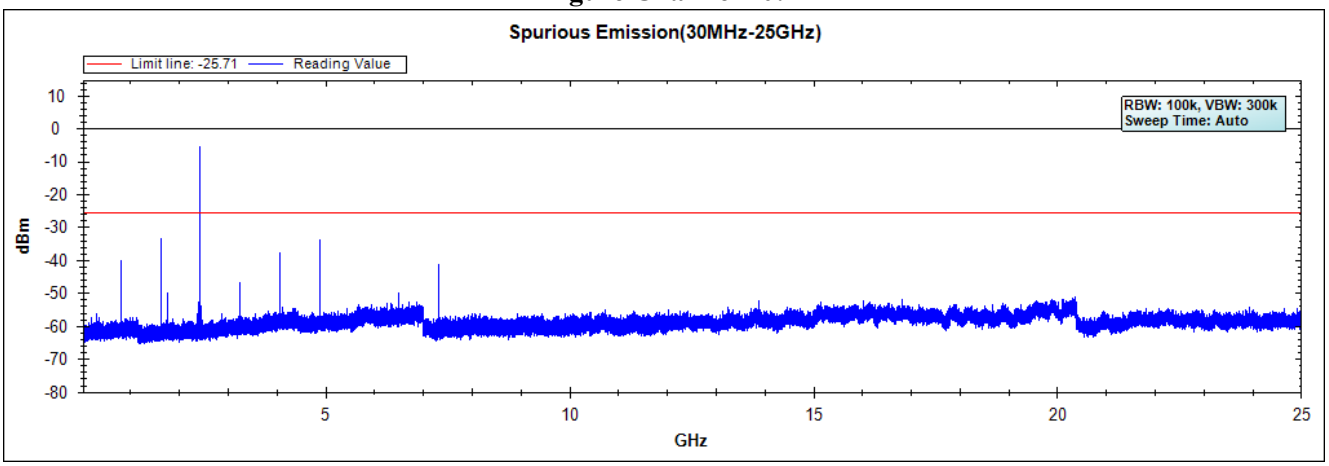
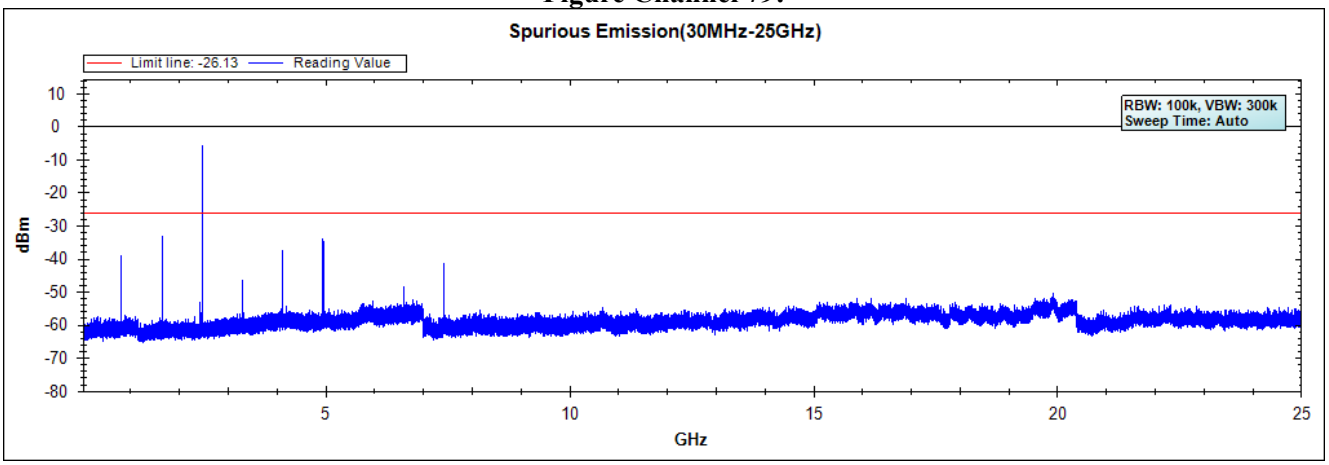


Figure Channel 79:

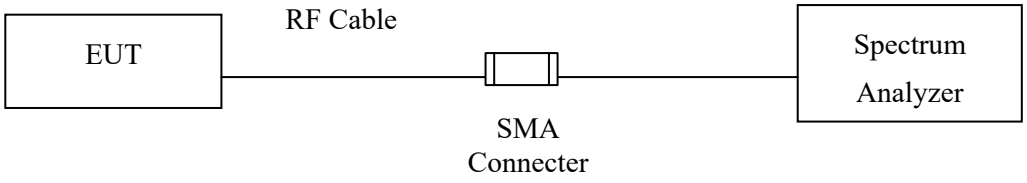


Note: The above test pattern is synthesized by multiple of the frequency range.

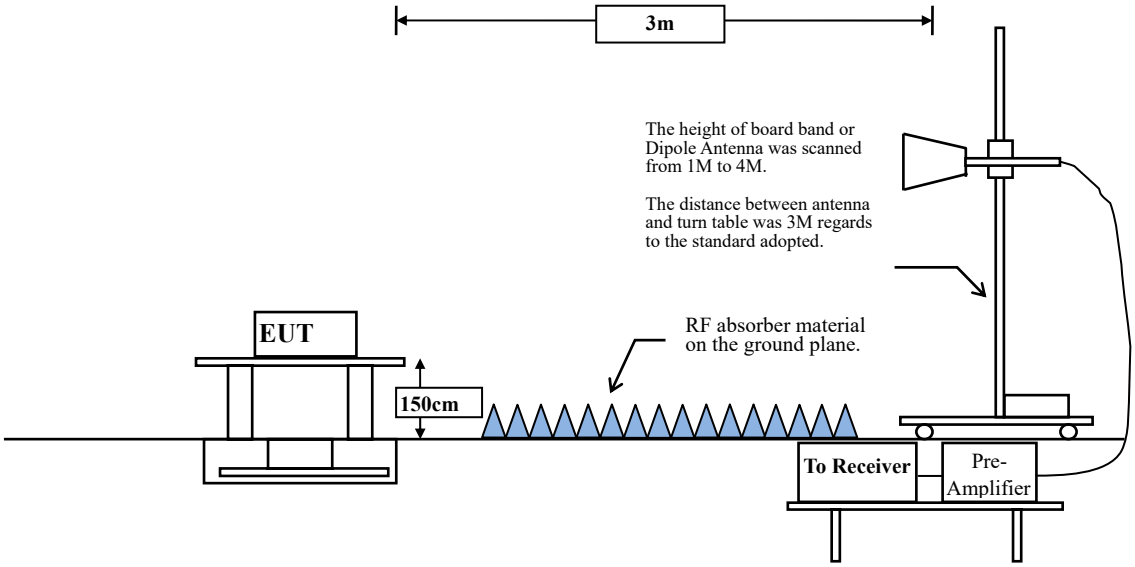
6. Band Edge

6.1. Test Setup

RF Conducted Measurement



RF Radiated Measurement:



6.2. Limit

According to FCC Section 15.247(d). In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

6.3. Test Procedure

The EUT was setup according to ANSI C63.10, 2013 and tested according to DTS test procedure of KDB558074 for compliance to FCC 47CFR 15.247 requirements.
The EUT is placed on a turn table which is 1.5 meter above ground. The turn table is rotated 360 degrees to determine the position of the maximum emission level. The EUT was positioned such that the distance from antenna to the EUT was 3 meters.
The antenna is scanned from 1 meter to 4 meters to find out the maximum emission level. This is repeated for both horizontal and vertical polarization of the antenna. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10:2013 on radiated measurement.

RBW and VBW Parameter setting:

According to KDB 558074 section 12.2.4. Peak power measurement procedure

RBW = as specified in Table 1.

VBW ≥ 3 x RBW.

Table 1 —RBW as a function of frequency

Frequency	RBW
9-150 kHz	200-300 Hz
0.15-30 MHz	9-10 kHz
30-1000 MHz	100-120 kHz
> 1000 MHz	1 MHz

According to KDB 558074 section 12.2.5. Average power measurement procedure

RBW = 1MHz.

VBW = 10Hz, when duty cycle ≥ 98 %

VBW ≥ 1/T, when duty cycle < 98 %

(T refers to the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.)

2.4GHz band	Duty Cycle (%)	T (ms)	1/T (Hz)	VBW (Hz)
	75.89	2.1400	467	500

Note: Duty Cycle Refer to Section 9

6.4. Uncertainty

Conducted: ±1.23dB

Radiated:

Horizontal polarization：1-18GHz: ±3.77dB

Vertical polarization：1-18GHz : ±3.83dB

6.5. Test Result of Band Edge

Product : Wireless Module
Test Item : Band Edge
Test Mode : Mode 1: Transmit
Test Date : 2018/03/31

RF Radiated Measurement (Horizontal):

Channel No.	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Emission Level (dBuV/m)	Peak Limit (dBuV/m)	Arerage Limit (dBuV/m)	Result
00 (Peak)	2390.000	10.262	42.718	52.980	74.00	54.00	Pass
00 (Peak)	2400.000	10.304	61.189	71.492	--	--	--
00 (Peak)	2402.319	10.312	77.526	87.839	--	--	--
00 (Average)	2352.029	10.106	22.152	32.257	74.00	54.00	Pass
00 (Average)	2390.000	10.262	18.353	28.615	74.00	54.00	Pass
00 (Average)	2400.000	10.304	36.992	47.295	--	--	--
00 (Average)	2402.029	10.312	76.846	87.158	--	--	--

Figure Channel 01: Horizontal (Peak)

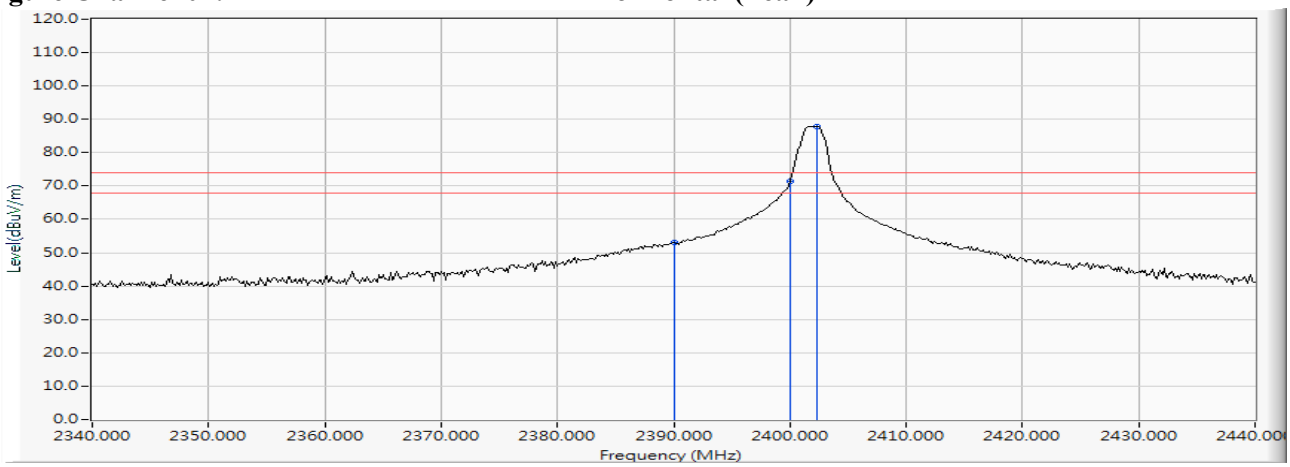
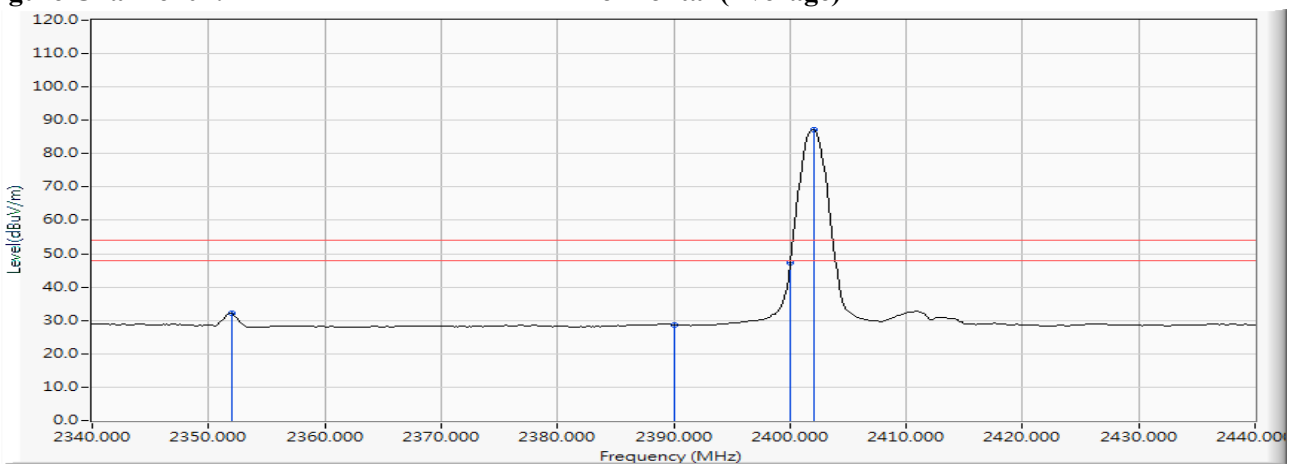


Figure Channel 01: Horizontal (Average)



Note:

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. The average measurement was not performed when the peak measured data under the limit of average detection.

Product : Wireless Module
Test Item : Band Edge
Test Mode : Mode 1: Transmit
Test Date : 2018/03/31

RF Radiated Measurement (Vertical):

Channel No.	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Emission Level (dBuV/m)	Peak Limit (dBuV/m)	Arerage Limit (dBuV/m)	Result
00 (Peak)	2389.275	10.260	49.497	59.756	74.00	54.00	Pass
00 (Peak)	2390.000	10.262	49.472	59.734	74.00	54.00	Pass
00 (Peak)	2400.000	10.304	68.121	78.424	--	--	--
00 (Peak)	2402.319	10.312	84.363	94.676	--	--	--
00 (Average)	2352.029	10.106	26.247	36.352	74.00	54.00	Pass
00 (Average)	2390.000	10.262	22.633	32.895	74.00	54.00	Pass
00 (Average)	2400.000	10.304	43.617	53.920	--	--	Pass
00 (Average)	2402.029	10.312	83.631	93.943	--	--	--

Figure Channel 01: Vertical (Peak)

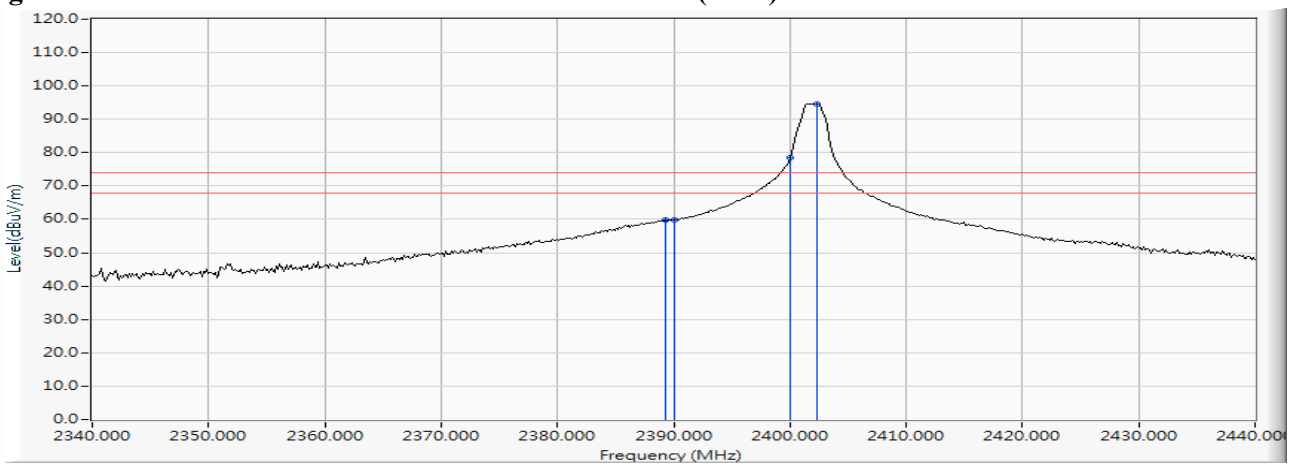
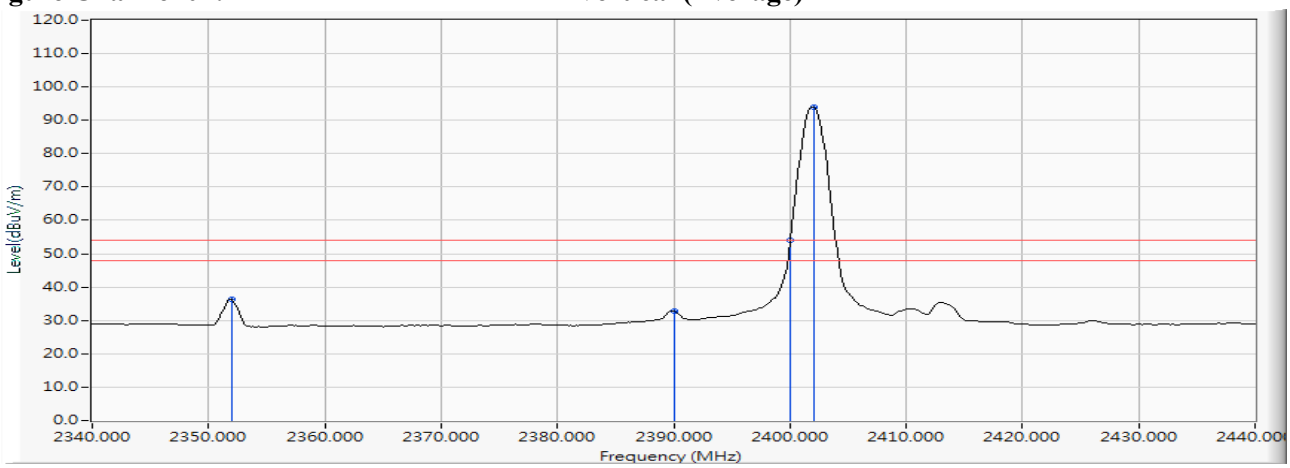


Figure Channel 01: Vertical (Average)



Note:

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. The average measurement was not performed when the peak measured data under the limit of average detection.

Product : Wireless Module
Test Item : Band Edge
Test Mode : Mode 1: Transmit
Test Date : 2018/03/31

RF Radiated Measurement (Horizontal):

Channel No.	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Emission Level (dBuV/m)	Peak Limit (dBuV/m)	Arerage Limit (dBuV/m)	Result
39 (Peak)	2478.572	10.623	76.340	86.962	--	--	--
39 (Peak)	2483.500	10.640	48.752	59.393	74.00	54.00	Pass
39 (Average)	2479.007	10.624	75.413	86.037	--	--	--
39 (Average)	2483.500	10.640	19.176	29.817	74.00	54.00	Pass

Figure Channel 78: Horizontal (Peak)

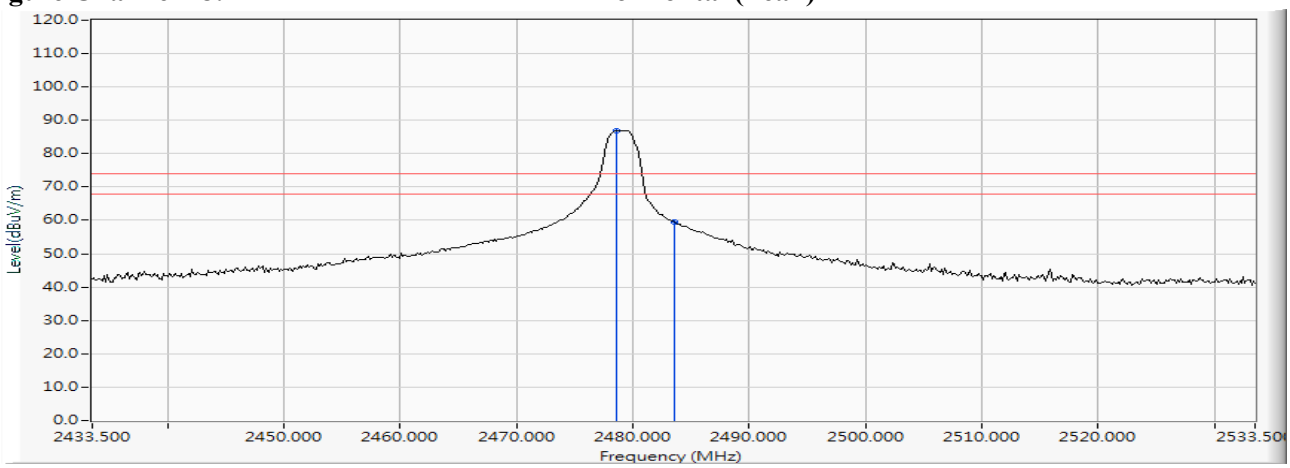
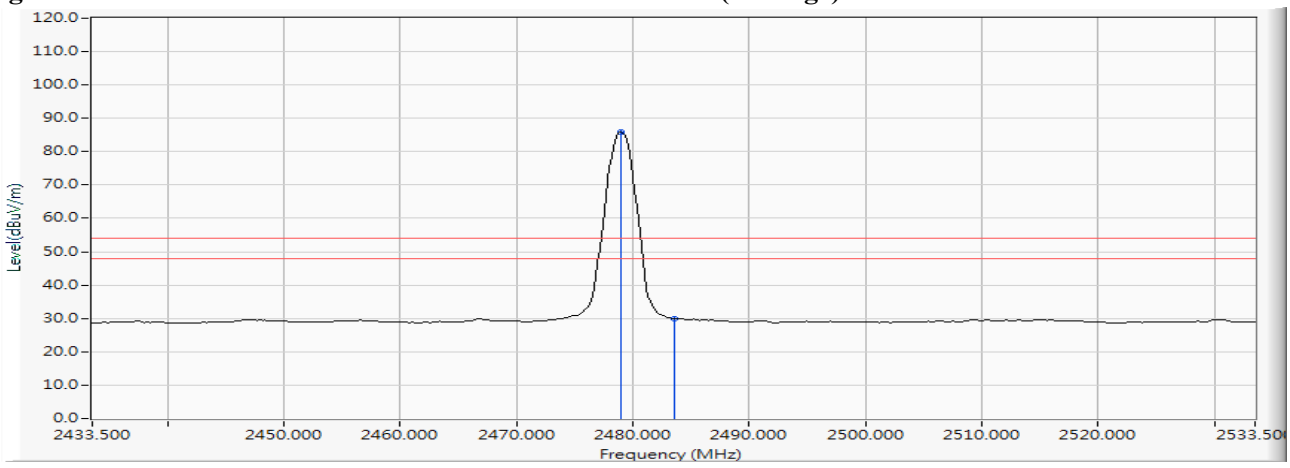


Figure Channel 78: Horizontal (Average)



Note:

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. The average measurement was not performed when the peak measured data under the limit of average detection.

Product : Wireless Module
Test Item : Band Edge
Test Mode : Mode 1: Transmit
Test Date : 2018/03/31

RF Radiated Measurement (Vertical):

Channel No.	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Emission Level (dBuV/m)	Peak Limit (dBuV/m)	Arerage Limit (dBuV/m)	Result
39 (Peak)	2478.572	10.623	81.783	92.405	--	--	--
39 (Peak)	2483.500	10.640	53.619	64.260	74.00	54.00	Pass
39 (Average)	2479.007	10.624	80.818	91.442	--	--	--
39 (Average)	2483.500	10.640	21.094	31.735	74.00	54.00	Pass

Figure Channel 78: Vertical (Peak)

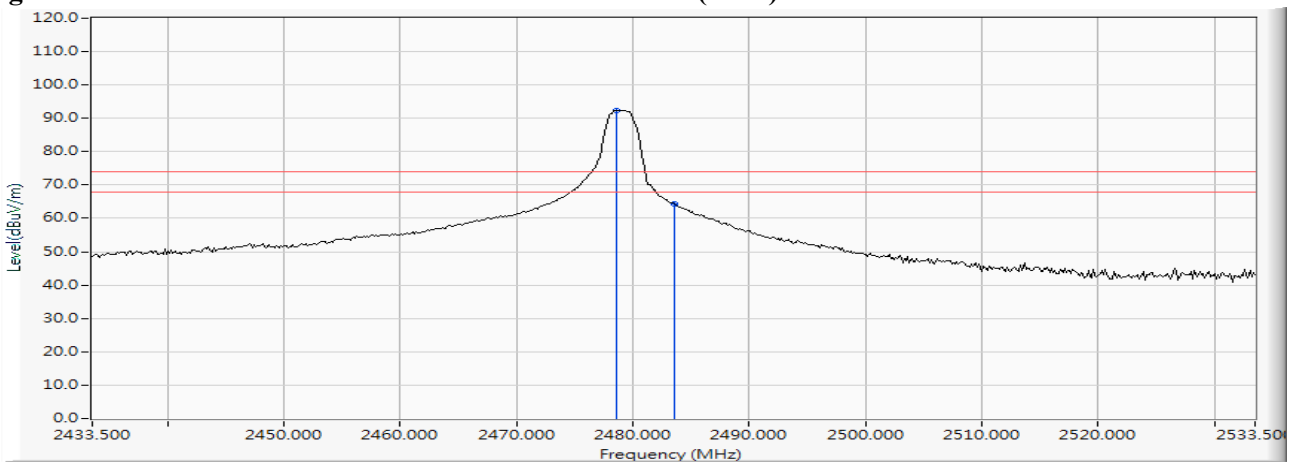
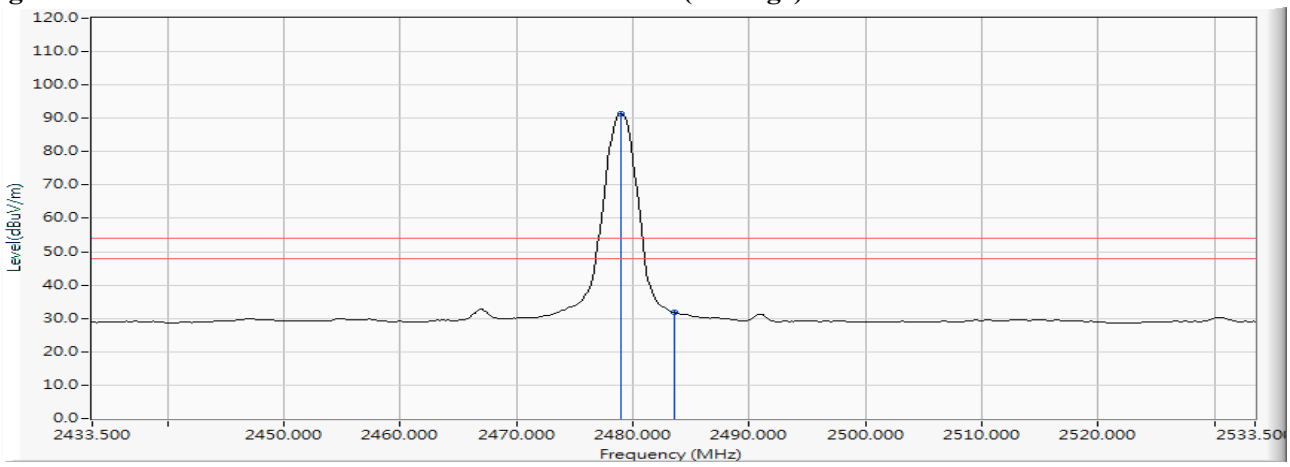


Figure Channel 78: Vertical (Average)

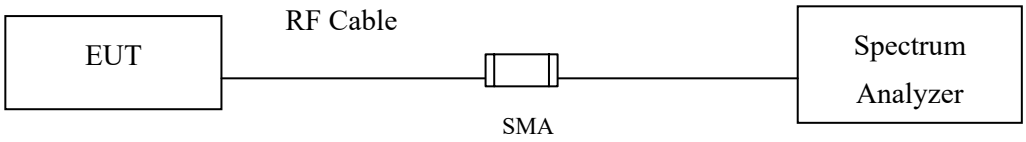


Note:

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. The average measurement was not performed when the peak measured data under the limit of average detection.

7. 6dB Bandwidth

7.1. Test Setup



7.2. Limits

The minimum bandwidth shall be at least 500 kHz.

7.3. Test Procedure

The EUT was setup according to ANSI C63.10 2013; tested according to DTS test procedure of KDB558074 for compliance to FCC 47CFR 15.247 requirements.
Set RBW = 1-5% of the emission bandwidth, VBW≥3*RBW

7.4. Uncertainty

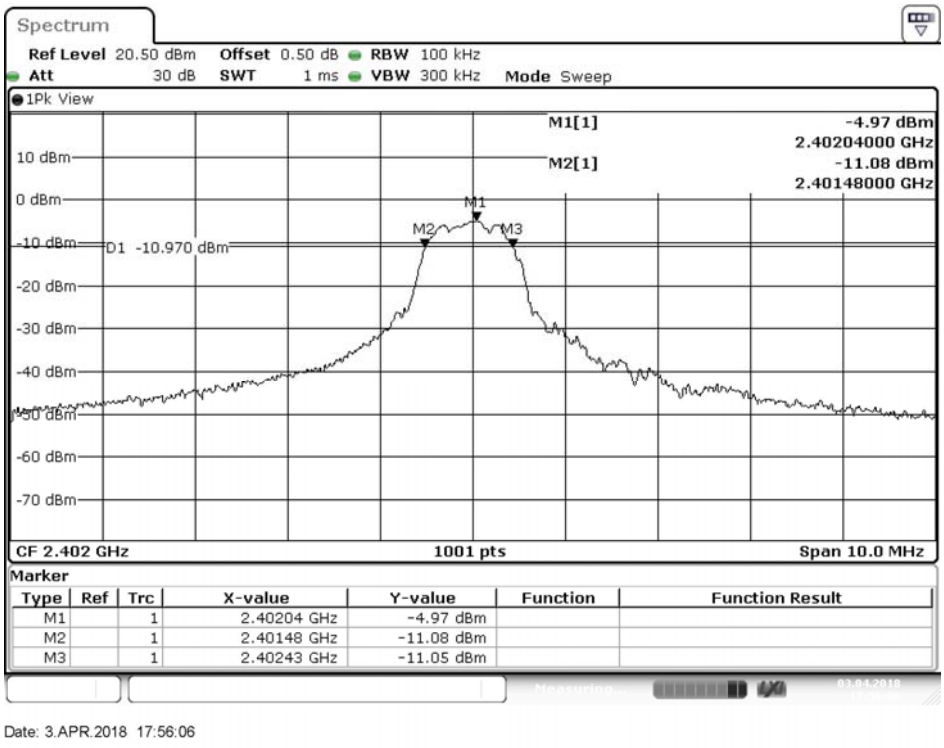
±279.2Hz

7.5. Test Result of 6dB Bandwidth

Product : Wireless Module
Test Item : 6dB Bandwidth Data
Test Mode : Mode 1: Transmit (2402MHz)

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
01	2402	950	>500	Pass

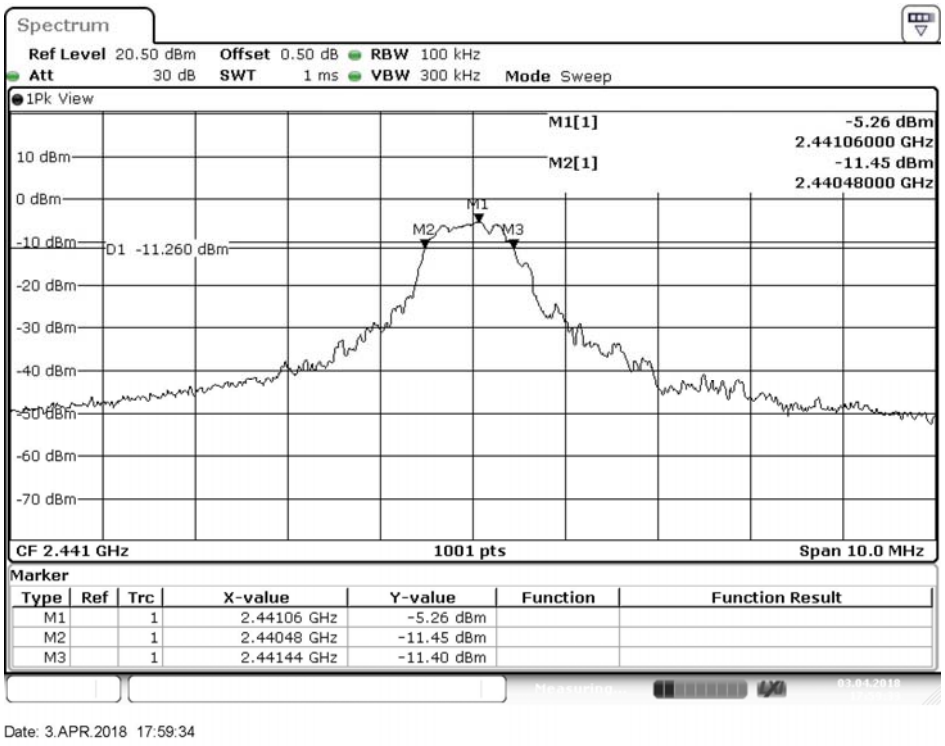
Figure Channel 01:



Product : Wireless Module
Test Item : 6dB Bandwidth Data
Test Mode : Mode 1: Transmit (2410MHz)

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
40	2441	960	>500	Pass

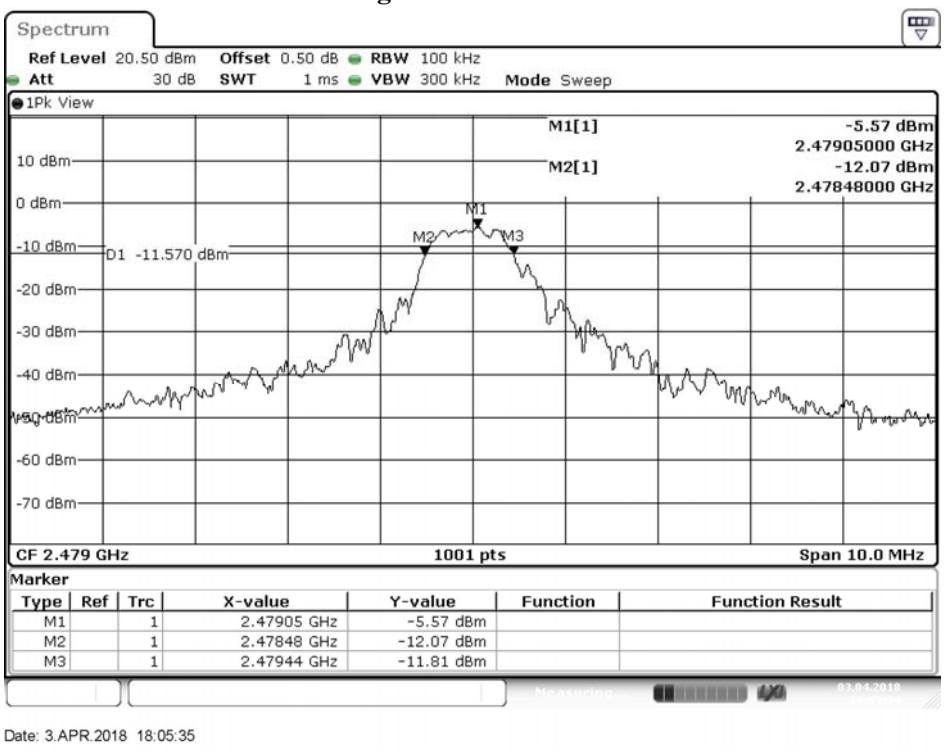
Figure Channel 40:



Product : Wireless Module
Test Item : 6dB Bandwidth Data
Test Mode : Mode 1: Transmit (2479MHz)

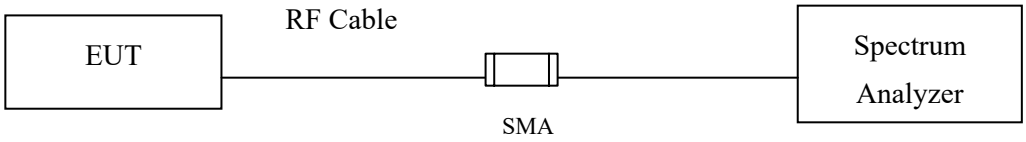
Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
78	2479	960	>500	Pass

Figure Channel 78:



8. Power Density

8.1. Test Setup



8.2. Limits

The transmitted power density averaged over any 1 second interval shall not be greater +8dBm in any 3kHz bandwidth.

8.3. Test Procedure

The EUT was setup according to ANSI C63.10: 2013, the maximum power spectral density using KDB 558074 section 10.2 PKPSD (peak PSD) method.

8.4. Uncertainty

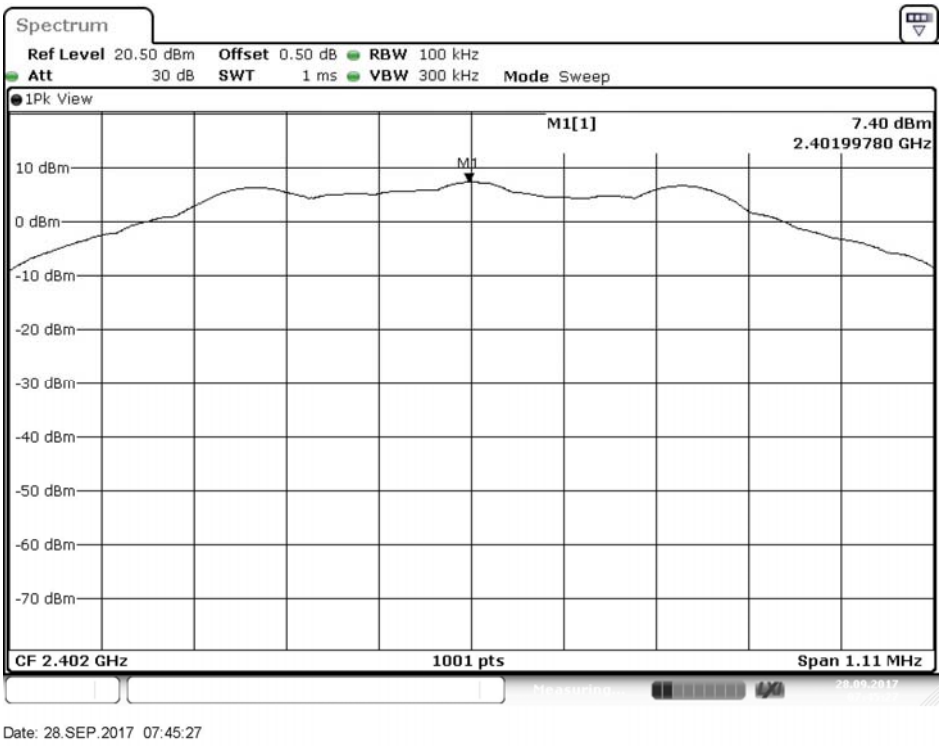
±1.23dB

8.5. Test Result of Power Density

Product : Wireless Module
Test Item : Power Density Data
Test Mode : Mode 1: Transmit (2402MHz)

Channel No.	Frequency (MHz)	Measure Level (dBm)	Limit (dBm)	Result
01	2402	-5.380	≦8dBm	Pass

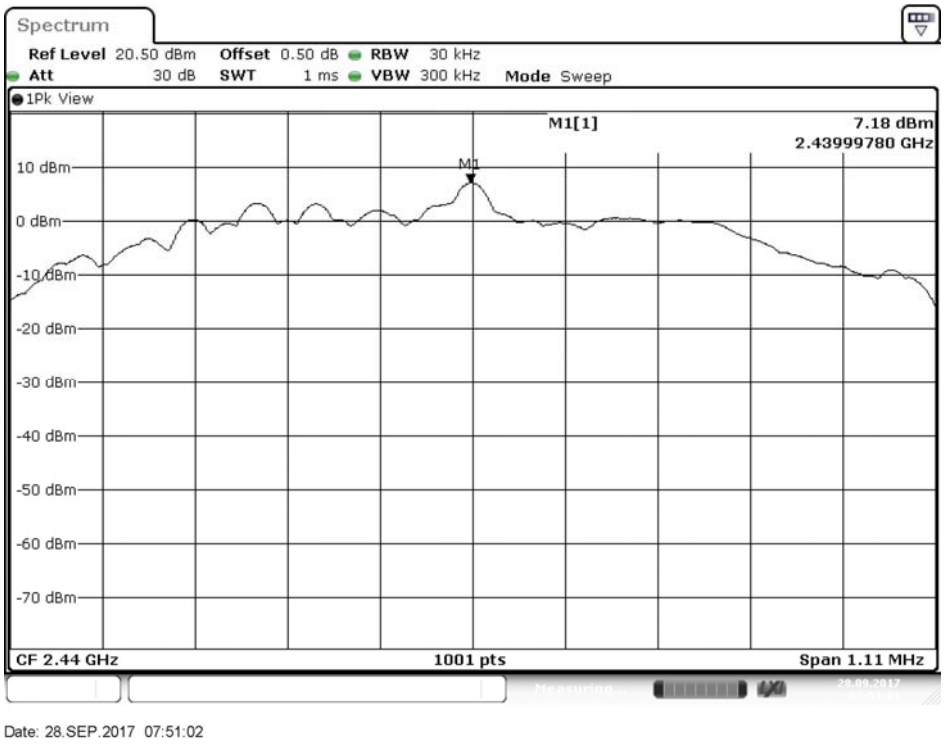
Figure Channel 01:



Product : Wireless Module
Test Item : Power Density Data
Test Mode : Mode 1: Transmit (2440MHz)

Channel No.	Frequency (MHz)	Measurement Level (dBm)	Required Limit (dBm)	Result
40	2441	-5.710	≦8dBm	Pass

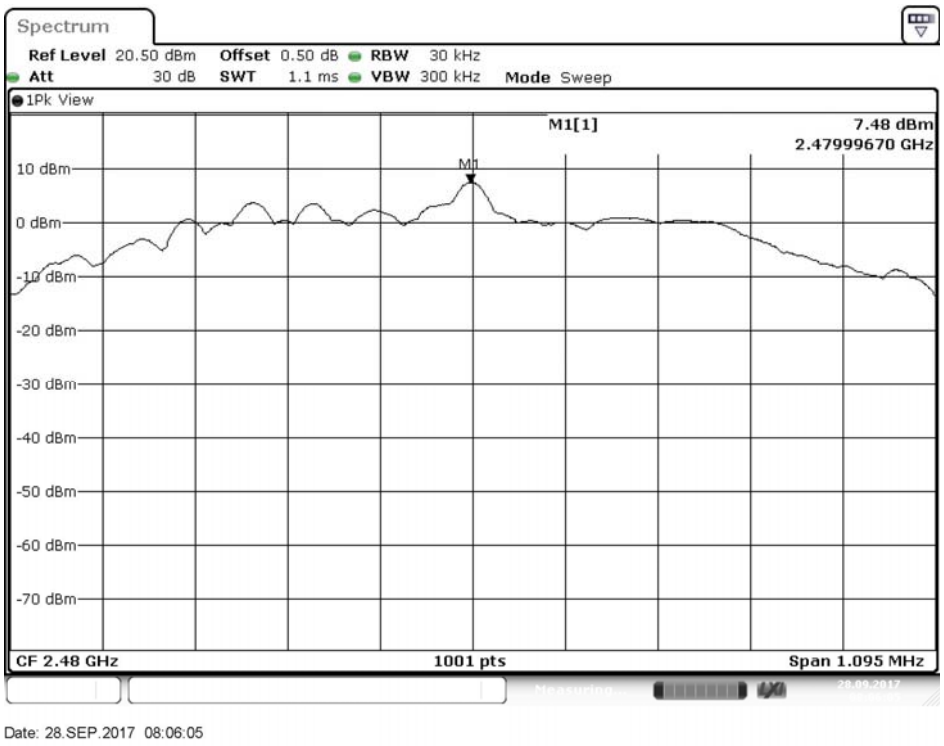
Figure Channel 40:



Product : Wireless Module
Test Item : Power Density Data
Test Mode : Mode 1: Transmit (2479MHz)

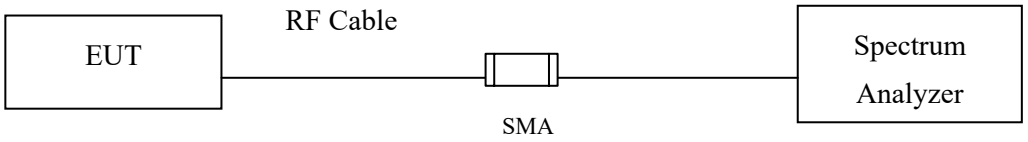
Channel No.	Frequency (MHz)	Measurement Level (dBm)	Required Limit (dBm)	Result
78	2479	-6.130	≦8dBm	Pass

Figure Channel 78:



9. Duty Cycle

9.1. Test Setup



9.2. Test Procedure

The EUT was setup according to ANSI C63.10 2013; tested according to DTS test procedure of KDB558074 for compliance to FCC 47CFR 15.247 requirements.

9.3. Uncertainty

± 2.31msec

9.4. Test Result of Duty Cycle

Product : Wireless Module
Test Item : Duty Cycle
Test Mode : Mode 1: Transmit

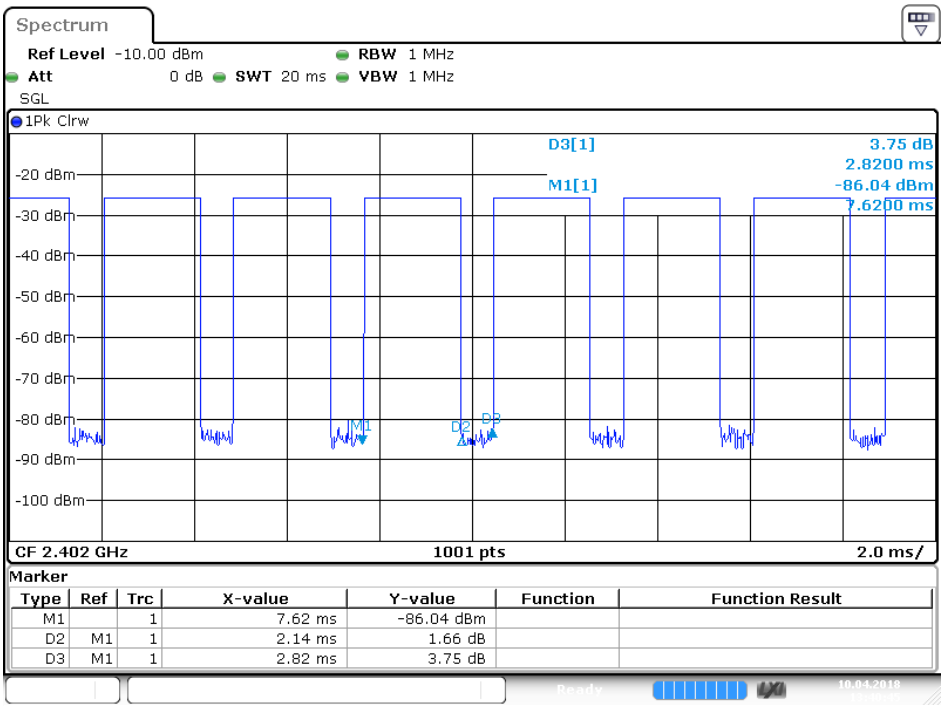
Duty Cycle Formula:

Duty Cycle = Ton / (Ton + Toff)

Duty Factor = 10 Log (1/Duty Cycle)

Results:

2.4GHz band	Ton (ms)	Ton + Toff (ms)	Duty Cycle (%)	Duty Factor (dB)
	2.1400	2.8200	75.89	1.20



10. EMI Reduction Method During Compliance Testing

No modification was made during testing.