TEST REPORT

Application No.:	HKEM1804000205IT
Applicant:	OnTel Products Corporation
FCC ID:	2AOXK18004
Product Name:	Micro Mechanic
Product Description:	Micro Mechanic
Model No.:	18002
Country of Origin:	China
Country of Destination:	USA
Standards:	47 CFR Part 15, Subpart C 15.247
Date of Receipt:	2018-04-16
Date of Test:	2018-04-17 to 2018-04-20
Date of Issue:	2018-04-20
Test Result :	**Pass***

* In the configuration tested, the EUT detailed in this report complied with the standards specified above. Please refer to section 3 of this report for further detail.

Authorized Signature:

CHEN Jian-feng, Jeffrey

The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report. If the product in this report is used in any configuration other than that detailed in the report, the manufacturer must ensure the new system complies with all relevant standards. Any mention of SGS International Electrical Approvals or testing done by SGS International Electrical Approvals in connection with, distribution or use of the product described in this report must be approved by SGS International Electrical Approvals in writing.
The report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government. All test results in this report can be traceable to National or International Standards.

2 Test Summary

Test	Test Requirement	Test method	Result
Antenna Requirement	FCC PART 15 C section 15.247 (c) and Section 15.203	FCC PART 15 C section 15.247 (c) and Section 15.203	PASS
Occupied Bandwidth	FCC PART 15 C section 15.247 (a)(1)	ANSI C63.10: Clause 6.9.1	PASS
Carrier Frequencies Separated	FCC PART 15 C section 15.247(a)(1)	ANSI C63.10: Clause 7.8.2	PASS
Hopping Channel Number	FCC PART 15 C section 15.247(a)(1)(iii)	ANSI C63.10: Clause 7.8.3	PASS
Dwell Time	FCC PART 15 C section 15.247(a)(1)(iii)	ANSI C63.10: Clause 7.8.4	PASS
Pseudorandom Frequency Hopping Sequence	FCC PART 15 C section 15.247(a)(1)	ANSI C63.10: Clause 7.7.5	PASS
Maximum Peak Output Power	FCC PART 15 C section 15.247(b)(1)	ANSI C63.10: Clause 7.8.5	PASS
Conducted Spurious Emission	FCC PART 15 C section 15.247(d)	ANSI C63.10: Clause 7.8.8	PASS
Radiated Spurious Emission	FCC PART 15 C section 15.247(d)	ANSI C63.10: Clause 6.10.4	PASS
Band Edges Measurement	FCC PART 15 C section 15.247 (d) &15.205	ANSI C63.10: clause 7.8.6	PASS

3 Contents

4 General Information

4.1 Client Information

Applicant:	OnTel Products Corporation
Address of Applicant:	21 Law Drive Fairlield, NJ 07004

4.2 General Description of E.U.T.

Product Name:	Micro Mechanic
Model No.:	18002

4.3 Details of E.U.T.

Operating Frequency	2402 MHz to 2480 MHz
Type of Modulation:	GFSK, π/4DQPSK, 8DPSK
Number of Channels	79 Channels
Channel Separation:	1 MHz
Dwell time	Per channel is less than 0.4s.
Antenna Type	Integral
Antenna gain:	0.55 dBi
Speciality:	V4.0 dual mode This test report is for classic mode
Function:	Bluetooth
Power Supply:	DC 12V for EUT USB power DC 5V for BT test board
Adapter:	Notebook Supplied by SGS
Power cord:	0.8m x 2 wires unscreened USB cable

Remark: The device meets the requirements stated within Parts 15.247(g) & (h) in that they were developed under the Bluetooth protocol and operate as a true frequency hopping system.The device does not have the ability to be coordinated with other FHSS systems in an effort to avoid the simultaneous occupancy of individual hopping frequencies by multiple transmitters.

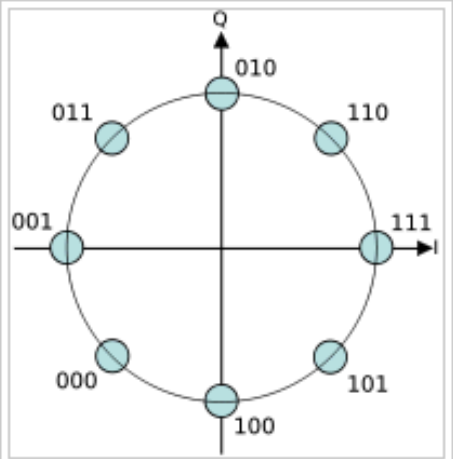
4.4 Modulation configure

Modulation	Packet	Packet Type	Packet Size
GFSK	DH1	4	24
	DH3	11	183
	DH5	15	339
(π/4)DQPSK	2DH1	20	54
	2DH3	26	367
	2DH5	30	379
8DPSK	3DH1	24	83
	3DH3	27	552
	3DH5	31	1021

Remark:

Modulation 8-DPSK

The modulation 8 PSK works with 8 phases between 0 and 2*pi (0 and 360 degrees), it can be seeing bellow in the circle.



Constellation diagram for 8-PSK with Gray coding.

Normal mode: the Bluetooth has been tested on the Modulation of GFSK;

EDR mode: the Bluetooth has been tested on the Modulation of (π/4)DQPSK and 8DPSK, compliance test and record the worst case on 8DPSK.

4.5 Description of Support Units

The EUT has been tested as an independent unit for fixed frequency by testing lab.

The EUT has been tested with corresponding accessories as below:

Supplied by SGS:

Description	Manufacturer	Model No.	SN/Certificate NO
NoteBook	Lenovo	L430	--
BT test board	--	2015-018	--

4.6 Deviation from Standards

Biconical and log periodic antennas were used instead of dipole antennas.

4.7 Abnormalities from Standard Conditions

None.

4.8 Other Information Requested by the Customer

None.

4.9 Test Location

All tests were performed at:

SGS IECC Limited (Member of the SGS Group (SGS SA))

No. 16-B, Yip Wo Street, On Lok Tsuen, Fanling, N.T., Hong Kong

Tel: +852 2305 2570 Fax: +852 2756 4480.

No tests were sub-contracted.

4.10 Test Facility

The test facility is recognized or accredited by the following organizations:

- **HOKLAS (Lab Code: 125)**

  SGS IECC Limited has been accepted by HKAS Executive, on the recommendation of the Accreditation Advisory Board, as a HOKLAS Accredited Laboratory, this laboratory meets the requirements of ISO/IEC 17025:2005 an it has been accredited for performing specific test as listed in the scope of accreditation within the test category of Electrical and Electronic Products.

- **FCC Recognized Accredited Test Firm(CAB Registration No.: 446297)**

  SGS IECC Limited has been accredited and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Designation Number: HK0010, Test Firm Registration Number: 446297.

- **Industry Canada (Registration No.: 5193A-2)**

  The 3m Alternative Semi-anechoic chamber of SGS IECC Limited has been registered by Certification and Engineering of Industry Canada for radio equipment testing with Registration No. **5193A-2**.

4.11 Measurement Uncertainty (95% confidence levels, k=2)

No.	Item	Measurement Uncertainty
1	Radio frequency	7.25×10^{-8}
2	RF power (conducted)	0.75dB
3	Radiated Spurious emission	4.5dB (30MHz-1GHz)
		4.8dB (1GHz-25GHz)
4	Temperature test	1°C
5	Humidity test	3%
6	DC and low frequency voltages test	0.5%

5 Equipment Used during Test

Equipment	Manufacturer	Model / Serial No.	Cal. Due Date
EMI Test Receiver 9kHz to 3.6GHz	Rohde & Schwarz	ESR3 / 102326	2018/08/15
Antenna	Schaffner	CBL6111C / 2791	2018/10/26
Loop Antenna	Rohde & Schwarz	HFH2-Z2 / 871336/48	2019/01/22
Antenna	Schwarzbeck	BBA9106 / TE039A	2020/01/29
Antenna	Schwarzbeck	UHALP9107 / TE039B	2020/01/29
Millivoltmeter	Rohde & Schwarz	URV5 / 846254/013	2018/06/28
100V insertion Unit	Rohde & Schwarz	URV5-Z4 / 100138	2018/06/28
Amplifier	TESEQ	CBAIG-070 / T43859	--
Antenna Mast System	Schwarzbeck	AM9104 / -	--
Turntable with Controller	Drehtisch	DT312 / -	--
Spectrum Analyzer	Rohde & Schwarz	FSP30 / 101474	2018/05/30
Horn Antenna	Schwarzbeck	BBHA9120D / 9120D-1070	2020/01/29
Horn Antenna	Schwarzbeck	BBHA9170 / 9170-492	2019/10/16
Preamplifier	Schwarzbeck	BBV9718 / 9718-223	2019/01/28
Preamplifier	Schwarzbeck	BBV9719 / 9719-019	2018/12/20
Highpass Filter	Wainwright	WHNX3.5/26.5G-6SS / nil	2018/12/18
Band Reject Filter	Wainwright	WRCJV 2400/2500-2100/2800-40/3SS / nil	2018/12/18
RF cable	HUBER+SUHNER	SF104-26.5/2	2018/12/26

6 Test Results

6.1 E.U.T. test conditions

Test Voltage:	USB DC5V
Temperature:	20.0 -25.0 °C
Humidity:	38-50 % RH
Atmospheric Pressure:	1000 -1010 mbar
Requirements:	**15.31(e):** For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery. **15.32:** Power supplies and CPU boards used with personal computers and for which separate authorizations are required to be obtained shall be tested as follows: Testing shall be in accordance with the procedures specified in Section 15.31 of this part.
Test frequencies and frequency range:	According to the 15.31(m) Measurements on intentional radiators or receivers, other than TV broadcast receivers, shall be performed and, if required, reported for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in the following table: According to the 15.33 (a) For an intentional radiator, the spectrum shall be investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to at least the frequency shown in the following table:

Number of fundamental frequencies to be tested in EUT transmit band

Frequency range in which device operates	Number of frequencies	Location in frequency range of operation
1 MHz or less	1	Middle
1 MHz to 10 MHz	2	1 near top and 1 near bottom
More than 10 MHz	3	1 near top, 1 near middle and 1 near bottom

Frequency range of radiated emission measurements

Lowest frequency generated in the device	Upper frequency range of measurement
9 kHz to below 10 GHz	10th harmonic of highest fundamental frequency or to 40 GHz, whichever is lower
At or above 10 GHz to below 30 GHz	5th harmonic of highest fundamental frequency or to 100 GHz, whichever is lower
At or above 30 GHz	5th harmonic of highest fundamental frequency or to 200 GHz, whichever is lower, unless otherwise specified

EUT channels and frequencies list:

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	27	2429	54	2456
1	2403	28	2430	55	2457
2	2404	29	2431	56	2458
3	2405	30	2432	57	2459
4	2406	31	2433	58	2460
5	2407	32	2434	59	2461
6	2408	33	2435	60	2462
7	2409	34	2436	61	2463
8	2410	35	2437	62	2464
9	2411	36	2438	63	2465
10	2412	37	2439	64	2466
11	2413	38	2440	65	2467
12	2414	39	2441	66	2468
13	2415	40	2442	67	2469
14	2416	41	2443	68	2470
15	2417	42	2444	69	2471
16	2418	43	2445	70	2472
17	2419	44	2446	71	2473
18	2420	45	2447	72	2474
19	2421	46	2448	73	2475
20	2422	47	2449	74	2476
21	2423	48	2450	75	2477
22	2424	49	2451	76	2478
23	2425	50	2452	77	2479
24	2426	51	2453	78	2480
25	2427	52	2454	/	/
26	2428	53	2455	/	/

Test frequencies are the lowest channel: 0 channel(2402 MHz), middle channel: 38 channel(2440 MHz) and highest channel: 78 channel(2480 MHz)

6.2 Antenna Requirement

Standard requirement

15.203 requirement:

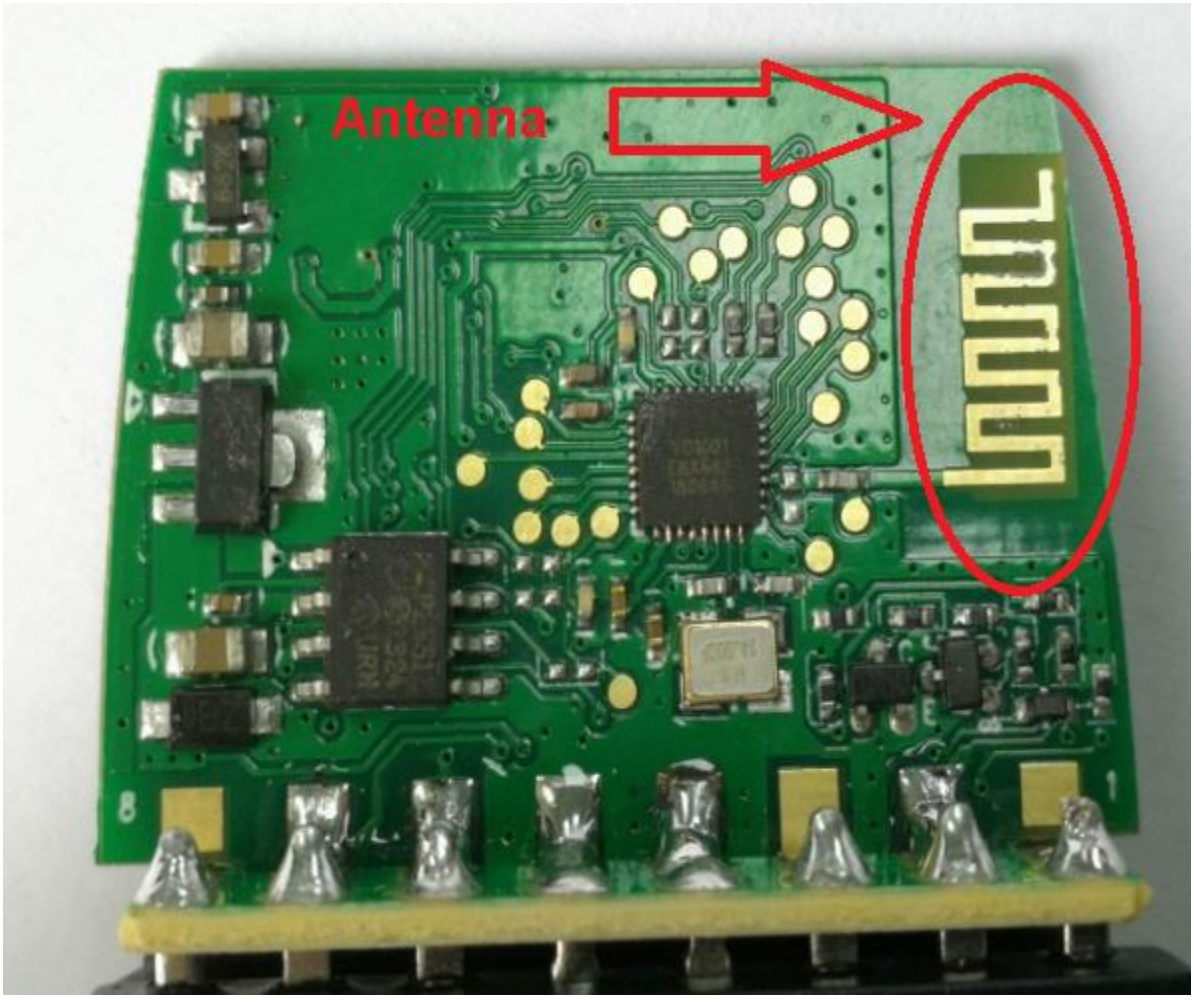
For intentional device. According to 15.203. an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

15.247(c) (1)(i) requirement:

(i) Systems operating in the 2400-2483.5 MHz bands that are used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

EUT Antenna

The antenna is integrated on the main PCB and no consideration of replacement. The maximum gain of the antenna is 0.55 dBi.



Test result: The unit does meet the FCC requirements.

6.3 Occupied Bandwidth

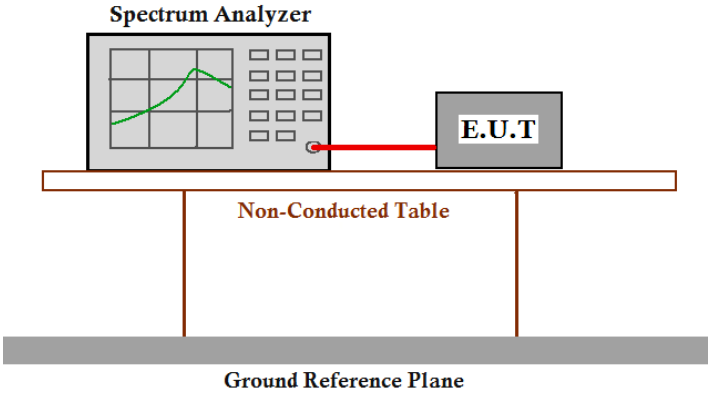
Test Requirement: FCC Part 15 C section 15.247

(a)(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

Test Method: ANSI C63.10: Clause 6.9.1

Test Status: Pre-test the EUT in continuous transmitting mode at the lowest (2402 MHz), middle (2440 MHz) and highest (2480 MHz) channel with different data package. Compliance test in normal mode (DH5) and EDR mode (3DH5) as the worst case was found.

Test Configuration:



Test Procedure:

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: Span = approximately 2 to 3 times the 20Db bandwidth, centring on a hopping channel;
3. Set the spectrum analyzer: RBW >= 1% of the 20dB bandwidth VBW >= RBW. Sweep = auto; Detector Function = Peak. Trace = Max Hold.
4. Mark the peak frequency and -20 dB points bandwidth.

Test result:

Normal mode:

Test Channel	Bandwidth(MHz)	2/3 bandwidth (MHz)
Lowest	1.15	0.767
Middle	1.16	0.773
Highest	1.18	0.787

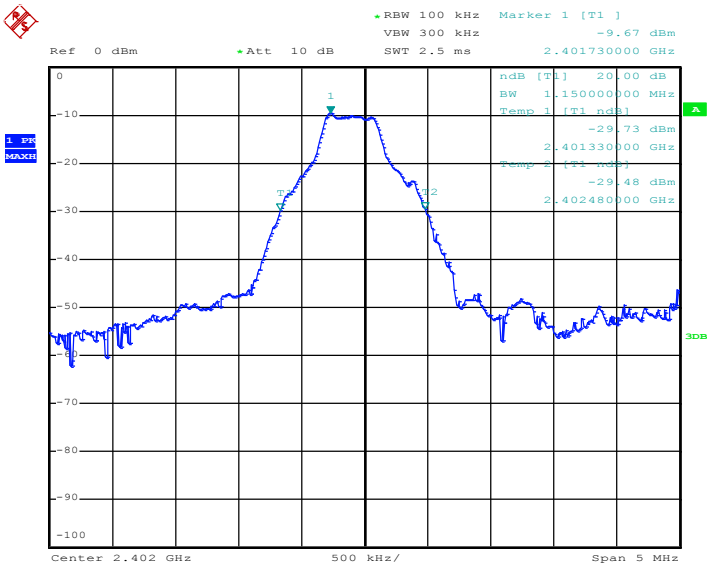
EDR mode:

Test Channel	Bandwidth (MHz)	2/3 bandwidth (MHz)
Lowest	1.39	0.927
Middle	1.39	0.927
Highest	1.39	0.927

Result plot as follows:

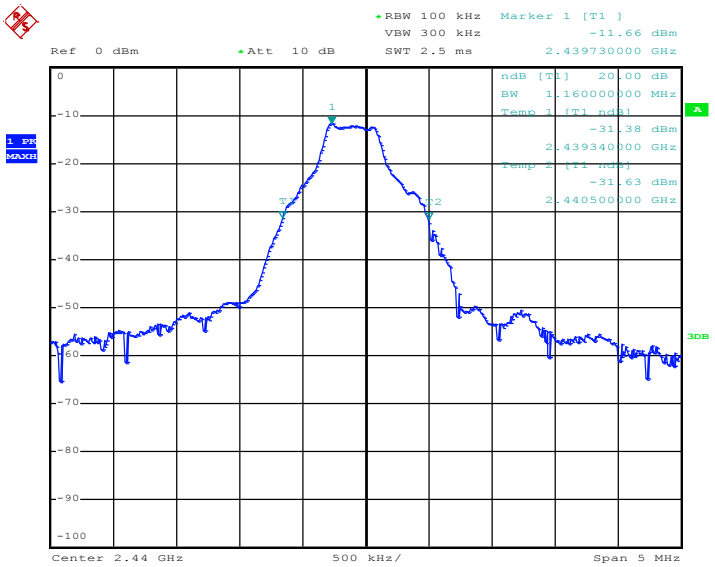
Normal mode (DH5):

Lowest Channel(2.402 GHz):



Date: 19.APR.2018 17:36:19

Middle Channel(2.440 GHz):



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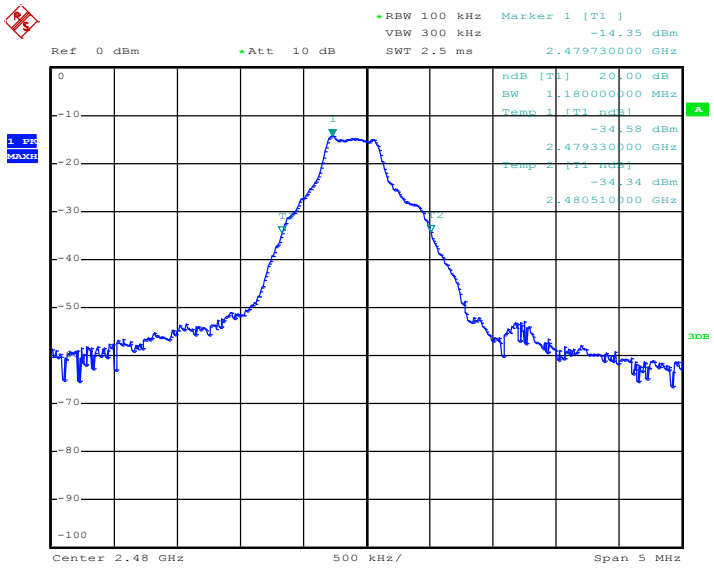
Highest Channel(2.480 GHz):



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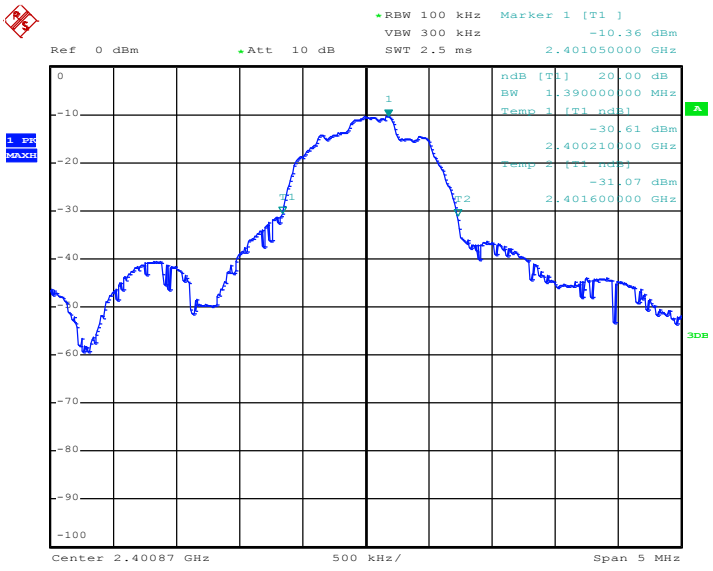
EDR mode (3DH5):

Lowest channel(2.402 GHz):



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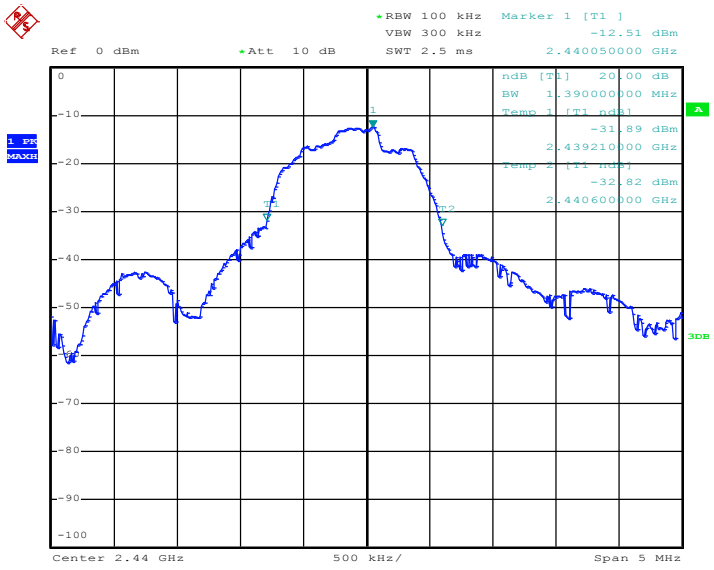
Middle channel(2.440 GHz):



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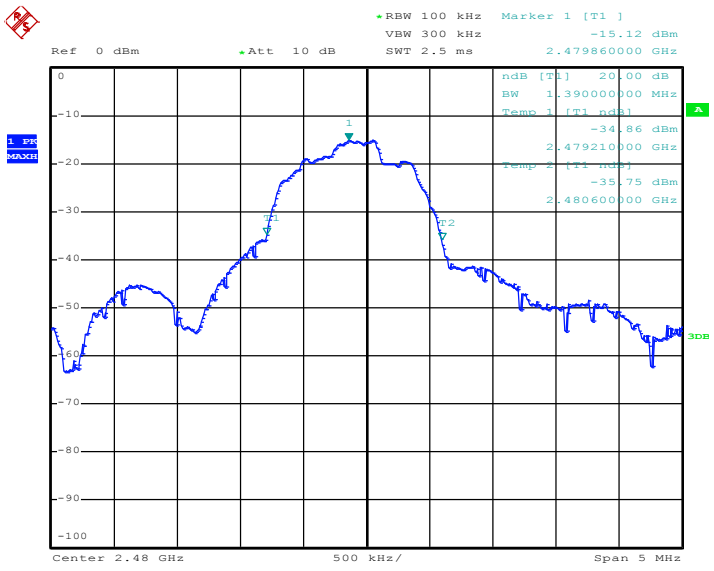
Highest channel(2.480 GHz):



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6.4 Carrier Frequencies Separated

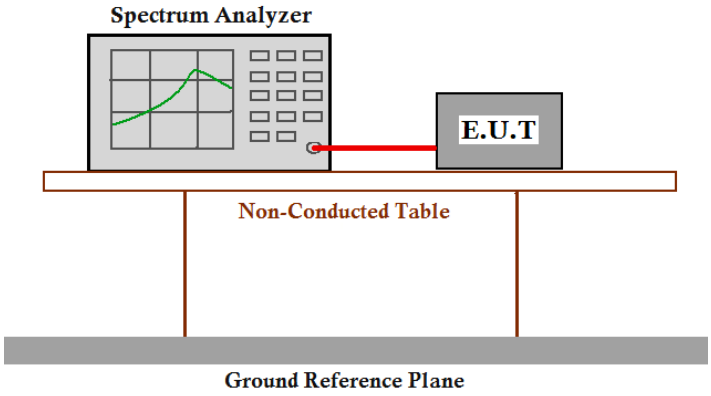
Test Requirement: FCC Part 15 C section 15.247

(a),(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

Test Method: ANSI C63.10: Clause 7.7.2

Test Status: Pre-test the EUT in hopping mode with different data packet. Compliance test in hopping with EDR mode (3DH5) as the worst case was found.

Test Configuration:



Test Procedure:

1. Remove the antenna from the EUT and then connect a low attenuation RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW >= 1% of the span, VBW >= RBW. Sweep = auto; Detector Function = Peak. Trace = Max, hold.
3. Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section. Submit this plot.

Test result:

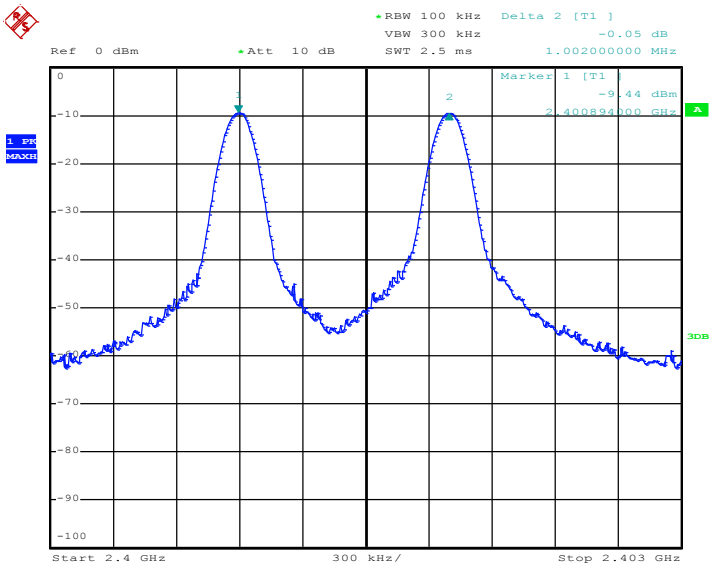
Test Channel	Carrier Frequencies Separated	Limit①	Pass/Fail
Lower Channels (channel 0 and channel 1)	1.002MHz	0.927	Pass
Middle Channels (channel 39 and channel 40)	1.002MHz	0.927	Pass
Upper Channels (channel 77 and channel 78)	1.002MHz	0.927	Pass

Remark:

① The limit is two-thirds of the 20 dB bandwidth with EDR(3DH5) mode.

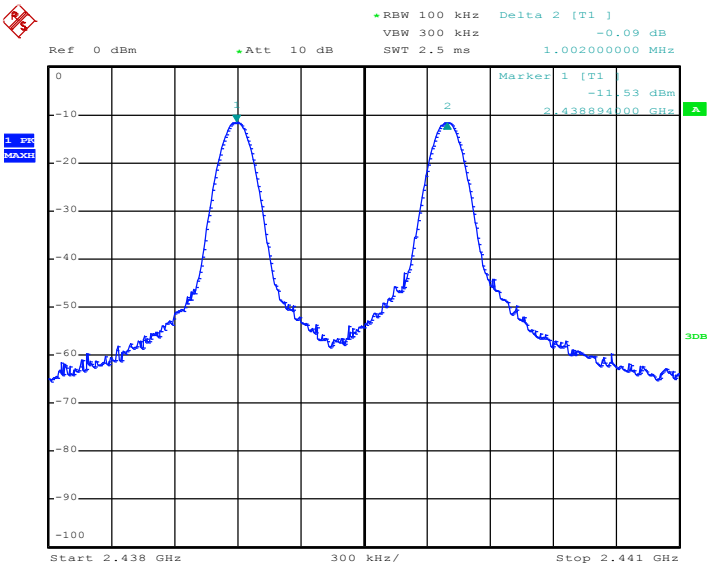
Result plot as follows:

Lowest Channels: **Carrier Frequencies Separated**



Date: 19.APR.2018 17:47:49

Middle Channels: **Carrier Frequencies Separated**



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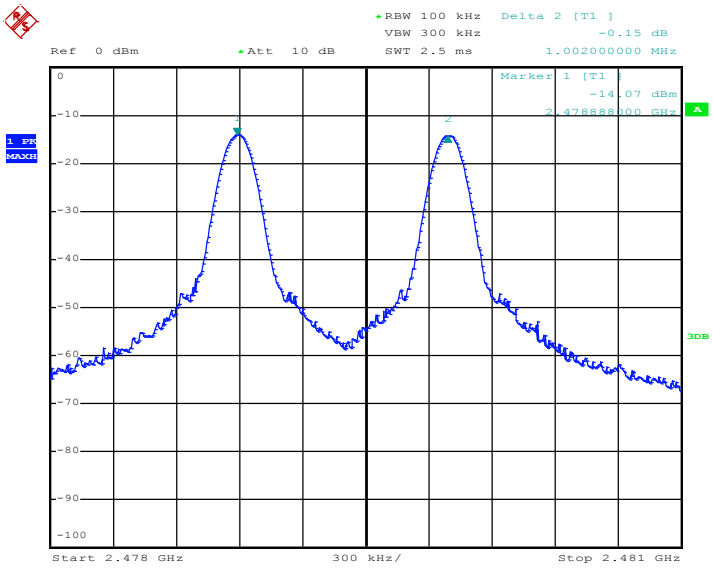
Highest Channels: **Carrier Frequencies Separated**



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Test result: The unit does meet the FCC requirements.

6.5 Hopping Channel Number

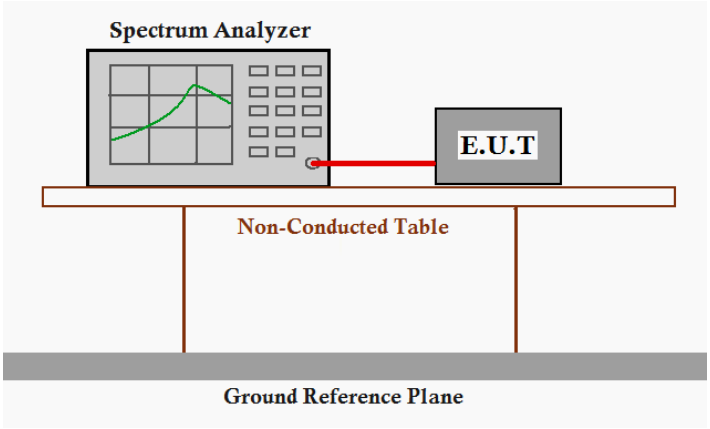
Test Requirement: FCC Part15 C section 15.247

(a)(1)(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

Test Method: ANSI C63.10: Clause 7.7.3

Test Status: Pre-test the EUT in hopping mode with different data packet. Compliance test in hopping with EDR mode (3DH5) as the worst case was found.

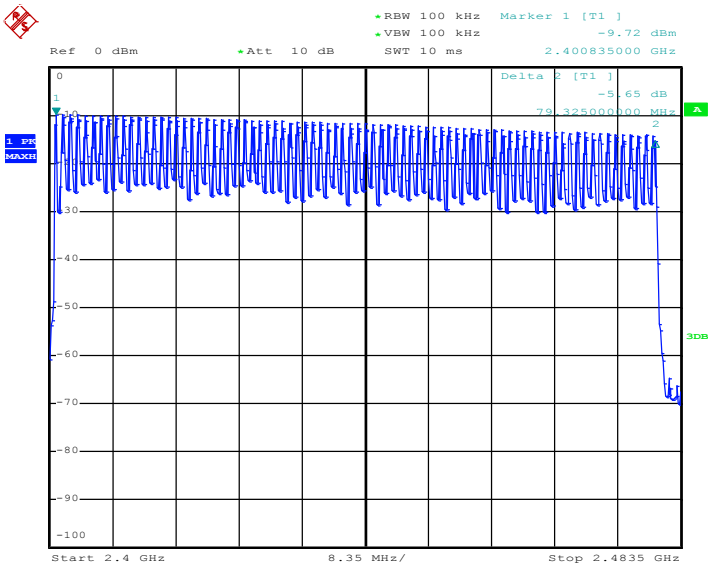
Test Configuration:



Test Procedure:

1. Remove the antenna from the EUT and then connect a low attenuation RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 100 kHz. VBW = 100 kHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.
3. Allow the trace to stabilize. It may prove necessary to break the span up to sections. in order to clearly show all of the hopping frequencies. The limit is specified in one of the subparagraphs of this Section.
4. Set the spectrum analyzer: start frequency = 2400 MHz. stop frequency = 2483.5 MHz. Submit the test result graph.

Test result: Total channels are 79 channels.



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Test result: The unit does meet the FCC requirements.

6.6 Dwell Time

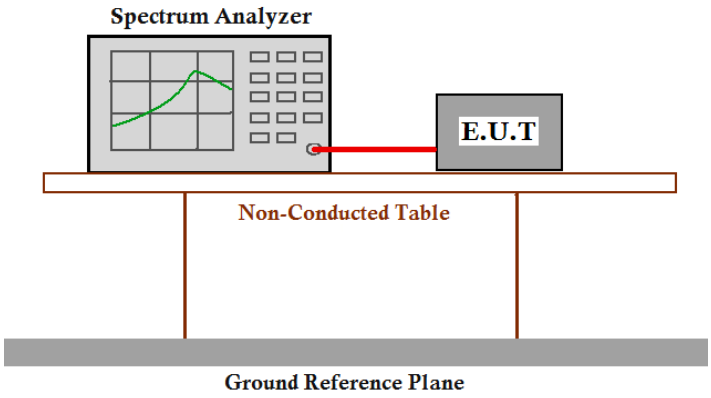
Test Requirement: FCC Part 15 C section 15.247

(a)(1)(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

Test Method: ANSI C63.10: Clause 7.7.4

Test Status: Test the EUT in hopping mode at the lowest (2402 MHz), middle (2440 MHz) and highest (2480 MHz) channel with different data packet. Compliance test in hopping mode with EDR mode (3DH1, 3DH3 and 3DH5) as the worst case was found.

Test Configuration:



Test Procedure:

1. Remove the antenna from the EUT and then connect a low attenuation RF cable from the antenna port to the spectrum.
2. Set spectrum analyzer span = 0. centered on a hopping channel;
3. Set RBW = 1 MHz and VBW = 1 MHz. Sweep = as necessary to capture the entire dwell time per hopping channel. Detector Function = Peak. Trace = Max hold;
4. Use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g. data rate. modulation format. etc.). Repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s). An oscilloscope may be used instead of a spectrum analyzer.

Test Result:

The test period: T= 0.4 Second/Channel x 79 Channel = 31.6 s

1. Channel 0: 2.402GHz											
3DH1 time slot	=	0.400	(ms)	*	20	*	(31.6/3.16)	=	80.000	ms
3DH3 time slot	=	1.660	(ms)	*	14	*	(31.6/3.16)	=	232.400	ms
3DH5 time slot	=	2.760	(ms)	*	13	*	(31.6/3.16)	=	358.800	ms
2. Channel 39: 2.440GHz											
3DH1 time slot	=	0.400	(ms)	*	19	*	(31.6/3.16)	=	76.000	ms
3DH3 time slot	=	1.660	(ms)	*	16	*	(31.6/3.16)	=	265.600	ms
3DH5 time slot	=	2.760	(ms)	*	12	*	(31.6/3.16)	=	Updating	ms
3. Channel 78: 2.480GHz											
3DH1 time slot	=	0.400	(ms)	*	18	*	(31.6/3.16)	=	Updating	ms
3DH3 time slot	=	1.660	(ms)	*	14	*	(31.6/3.16)	=	232.400	ms
3DH5 time slot	=	2.760	(ms)	*	11	*	(31.6/3.16)	=	303.600	ms

The average time of occupancy in the specified 31.6 second period is equal to pulse width*(# of pulse in observation period)*(test period / observation period)

The results are not greater than 0.4 seconds.

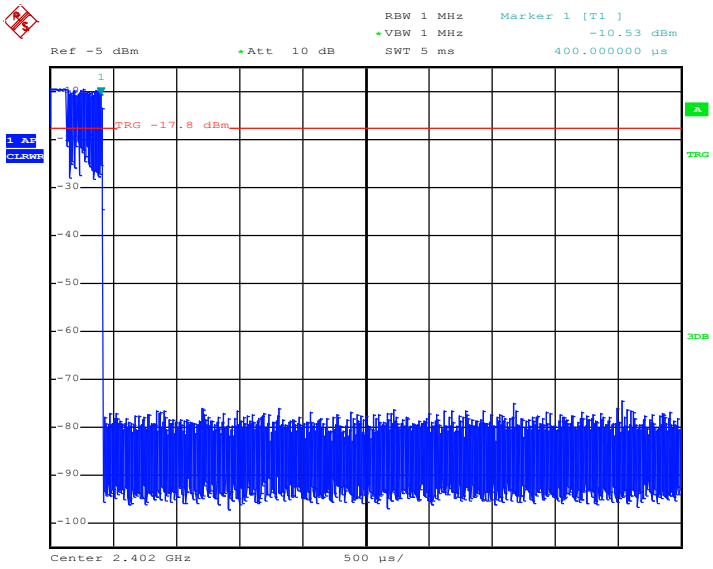
The unit does meet the FCC requirements.

Result plot as follows:

1. Lowest channel (2.402 GHz):

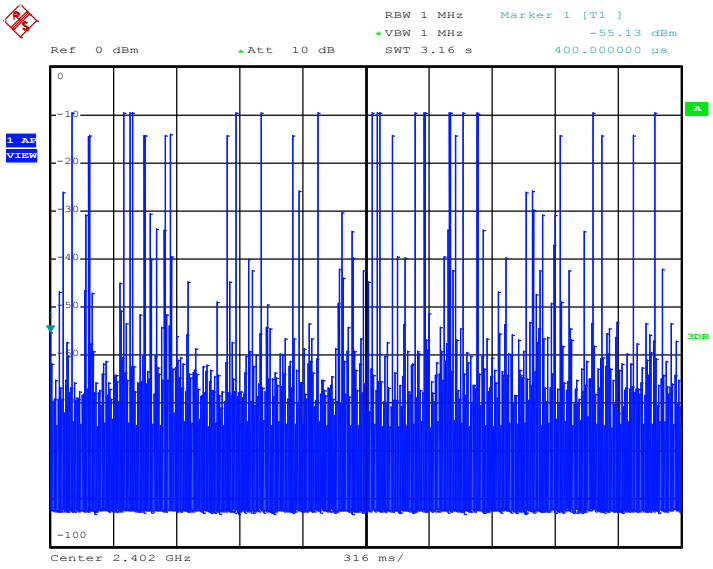
(1). 3DH1

Pulse Width:



Date: 19.APR.2018 18:20:20

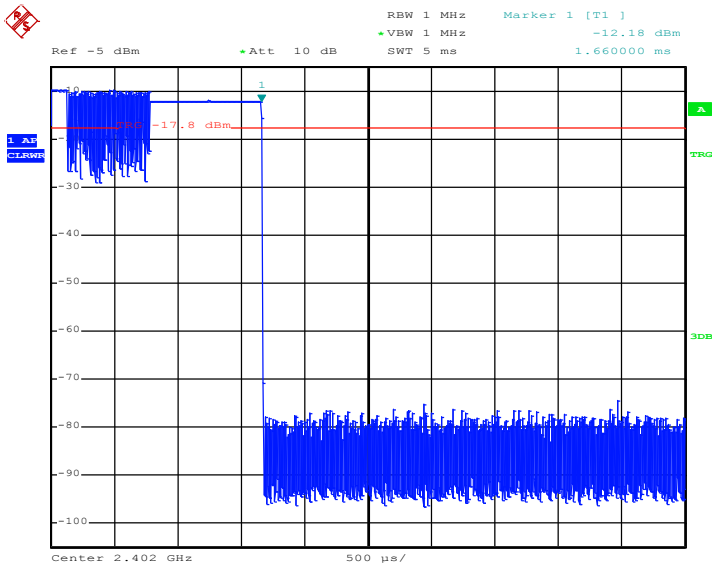
Number of Pulses in 3.16 S observation period:



Date: 19.APR.2018 18:28:06

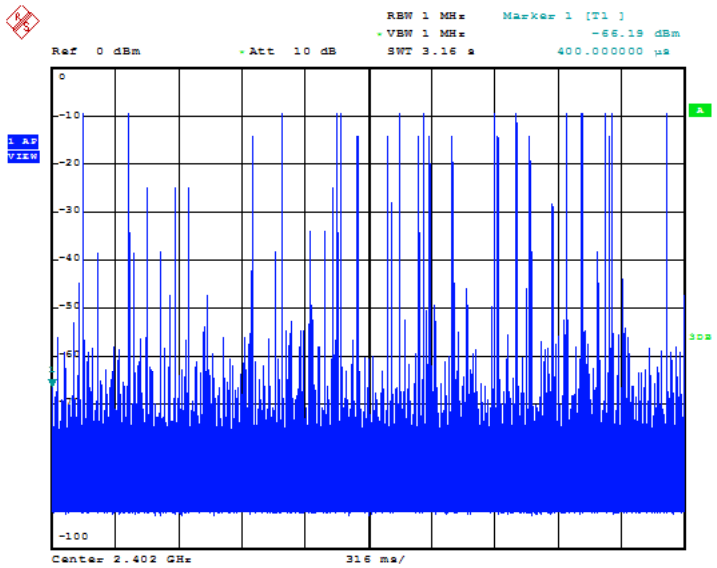
(2) 3DH3

Pulse Width:



Date: 19.APR.2018 18:19:51

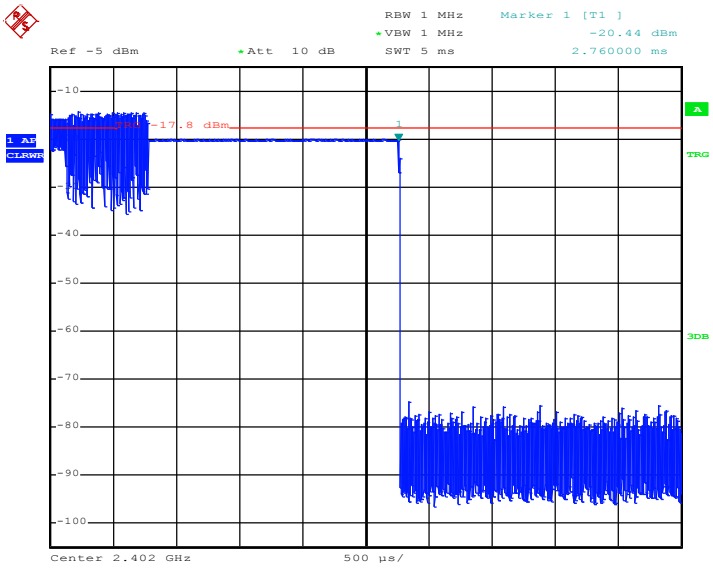
Number of Pulses in 3.16 S observation period:



Date: 19.APR.2018 18:33:02

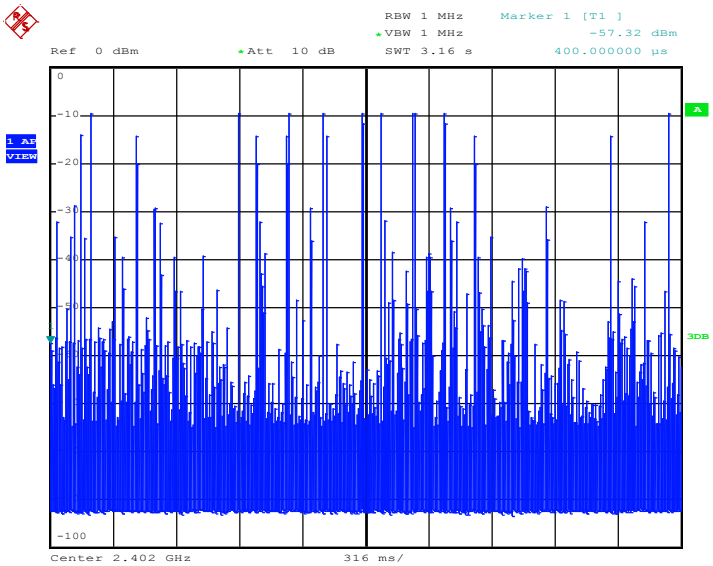
(3) 3DH5

Pulse Width:



Date: 19.APR.2018 18:19:26

Number of Pulses in 3.16 S observation period:

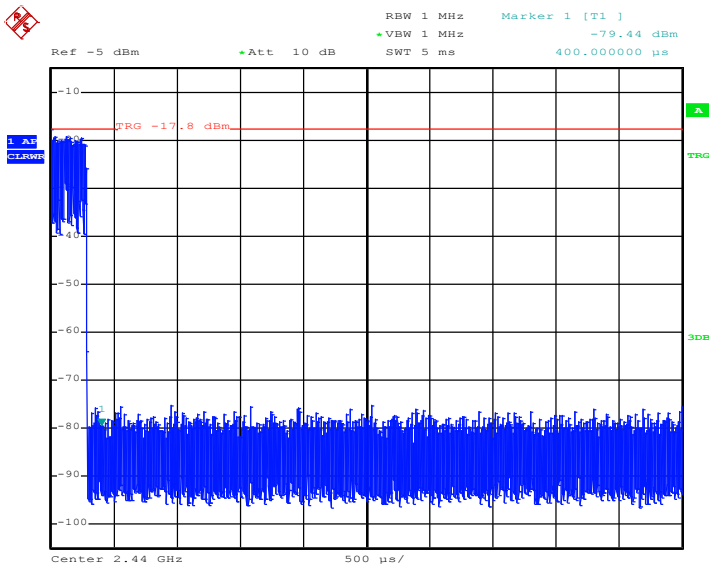


Date: 19.APR.2018 18:36:01

2. Middle Channel (2.440 GHz):

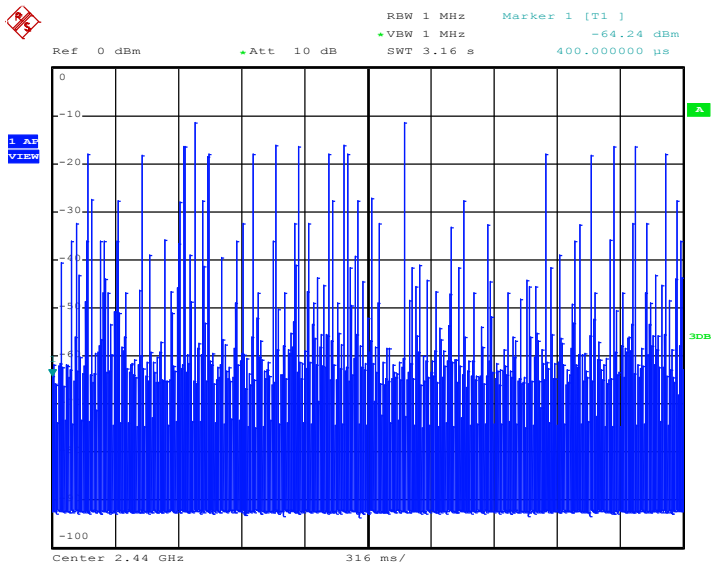
(1). 3DH1

Pulse Width:



Date: 19.APR.2018 18:20:50

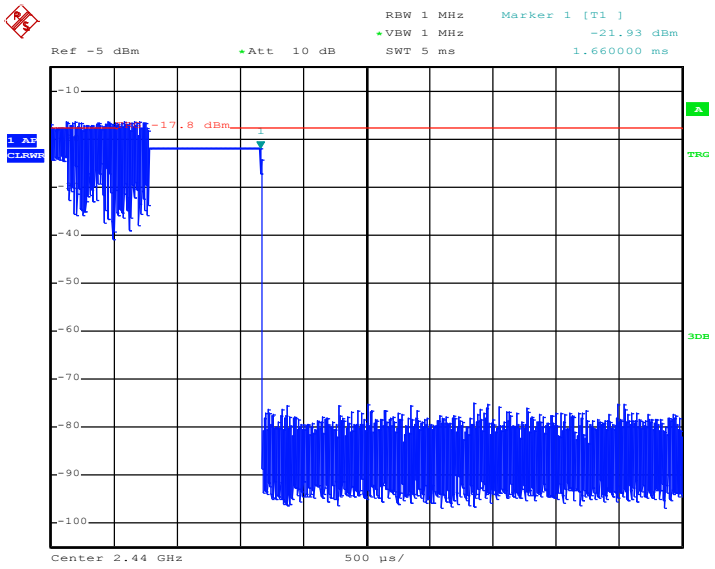
Number of Pulses in 3.16 S observation period:



Date: 19.APR.2018 18:29:10

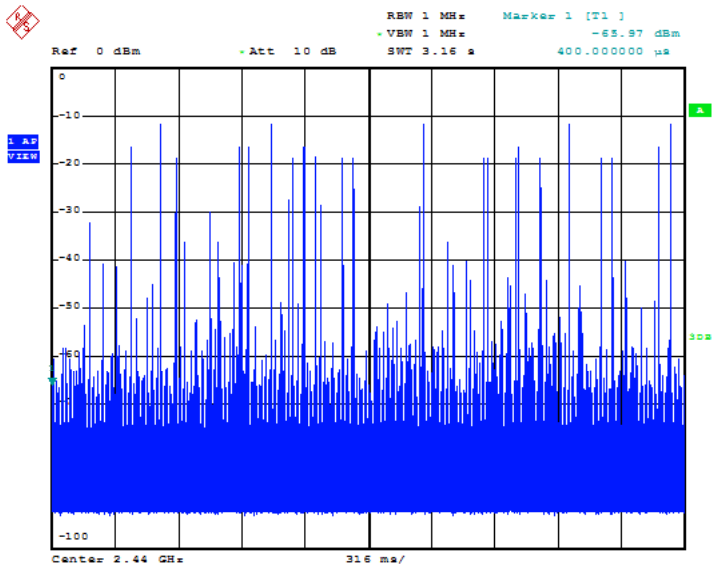
(2) 3DH3

Pulse Width:



Date: 19.APR.2018 18:21:17

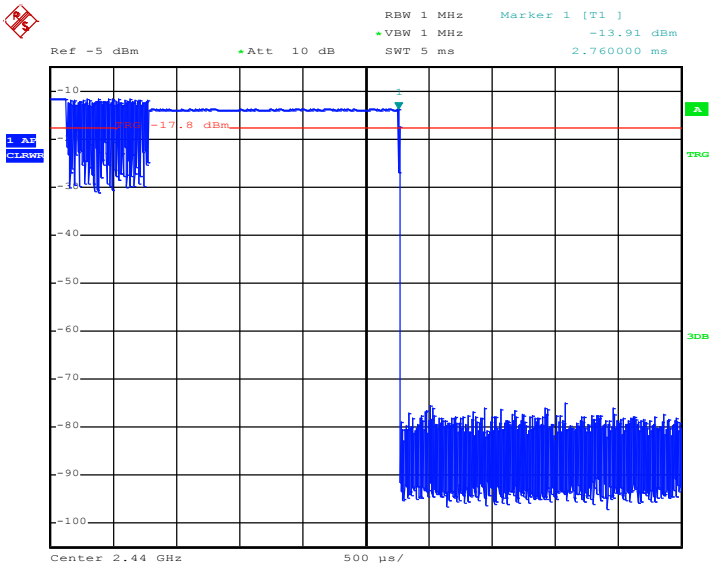
Number of Pulses in 3.16 S observation period:



Date: 19.APR.2018 18:33:47

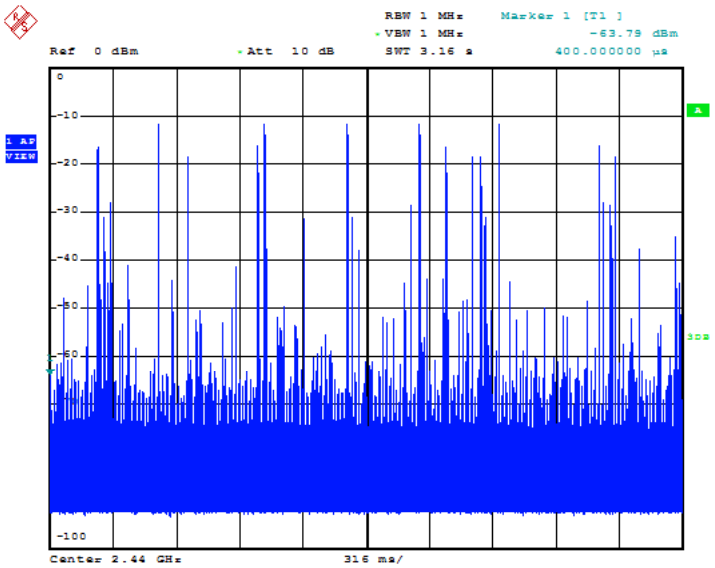
(3) 3DH5

Pulse Width:



Date: 19.APR.2018 18:21:48

Number of Pulses in 3.16 S observation period:

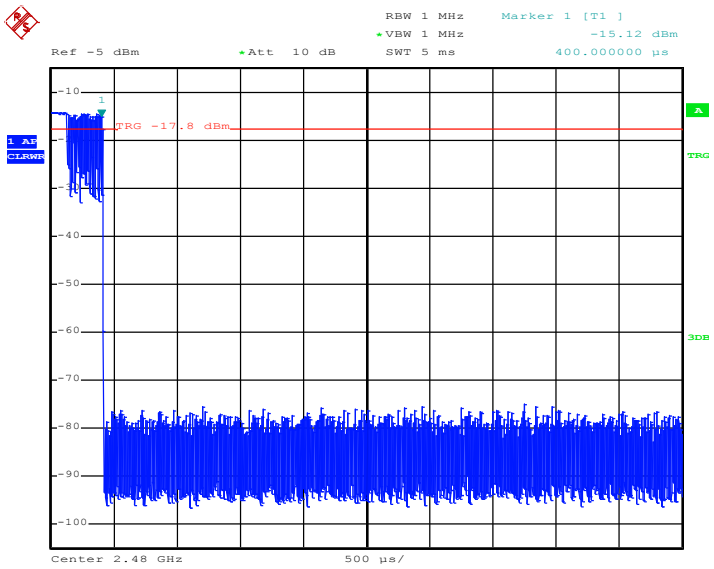


Date: 19.APR.2018 18:36:38

3. Highest Channel (2.480 GHz):

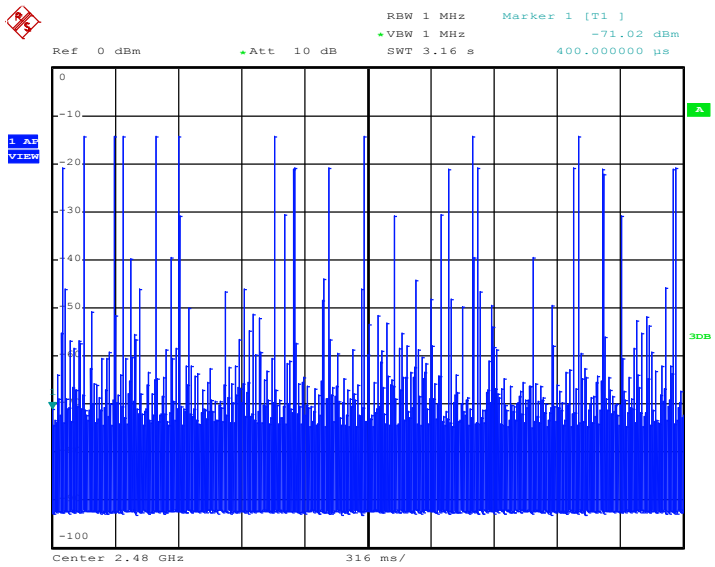
(1). 3DH1

Pulse Width:



Date: 19.APR.2018 18:23:01

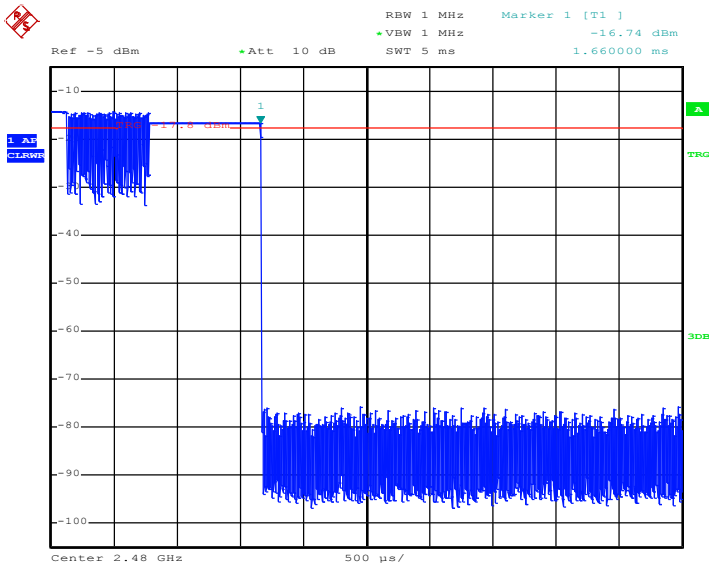
Number of Pulses in 3.16 S observation period:



Date: 19.APR.2018 18:31:45

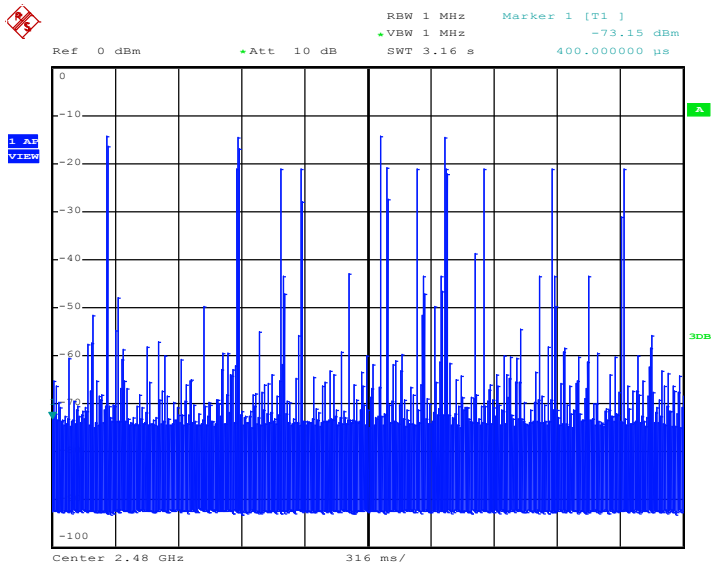
(2) 3DH3

Pulse Width:



Date: 19.APR.2018 18:22:35

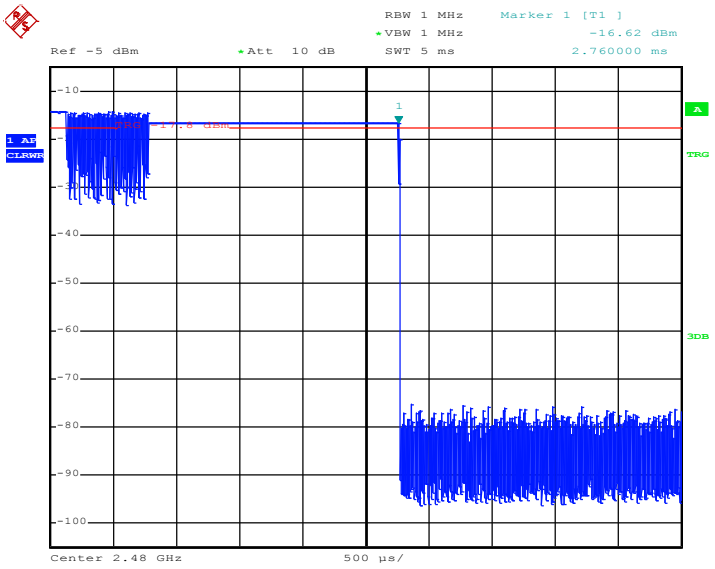
Number of Pulses in 3.16 S observation period:



Date: 19.APR.2018 18:35:06

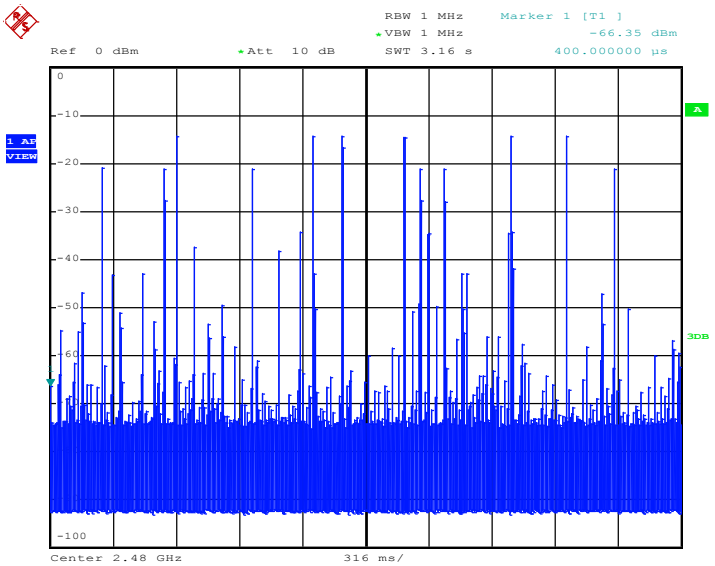
(3) 3DH5

Pulse Width:



Date: 19.APR.2018 18:22:12

Number of Pulses in 3.16 S observation period:



Date: 19.APR.2018 18:37:46

6.7 Pseudorandom Frequency Hopping Sequence

6.7.1 Standard requirement

15.247(a)(1) requirement:

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

Alternatively. Frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a Pseudorandom ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

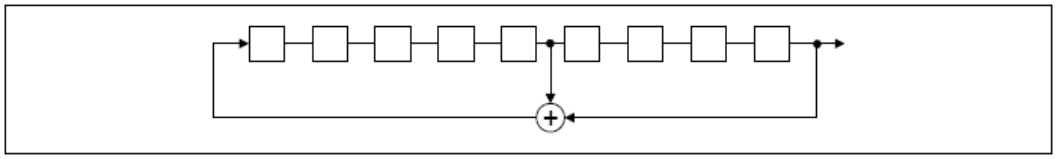
6.7.2 EUT Pseudorandom Frequency Hopping Sequence

The pseudorandom sequence may be generated in a nine-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first ONE of 9 consecutive ONEs; i.e. the shift register is initialized with nine ones.

• Number of shift register stages: 9

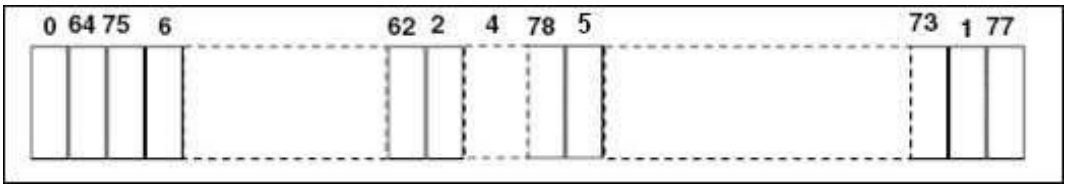
• Length of pseudo-random sequence: 2^9 -1 = 511 bits

• Longest sequence of zeros: 8 (non-inverted signal)



Linear Feedback Shift Register for Generation of the PRBS sequence

An example of Pseudorandom Frequency Hopping Sequence as follow:



Each frequency used equally on the average by each transmitter.

The system receivers have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchronization with the transmitted signals.

6.8 Maximum Peak Output Power

Test Requirement: FCC Part 15 C section 15.247

(b)(1)For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

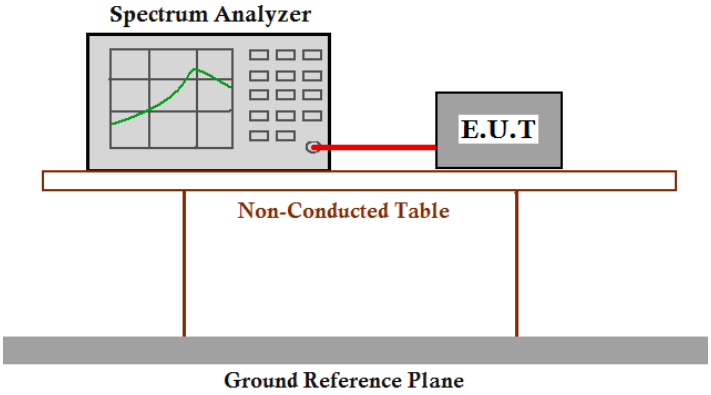
Refer to the result “Hopping channel number” of this document. The 1 watt (30.0 dBm) limit applies.

Test Method: ANSI C63.10: Clause 6.10.1

Test Limit:

Test mode: Pre-test the EUT in continuous transmitting mode at the lowest (2402 MHz), middle (2440 MHz) and highest (2480 MHz) channel with different data packet. Compliance test in continuous transmitting mode with normal (DH5) and EDR mode (3DH5) as the worst case was found.

Test Configuration:



Test Procedure:

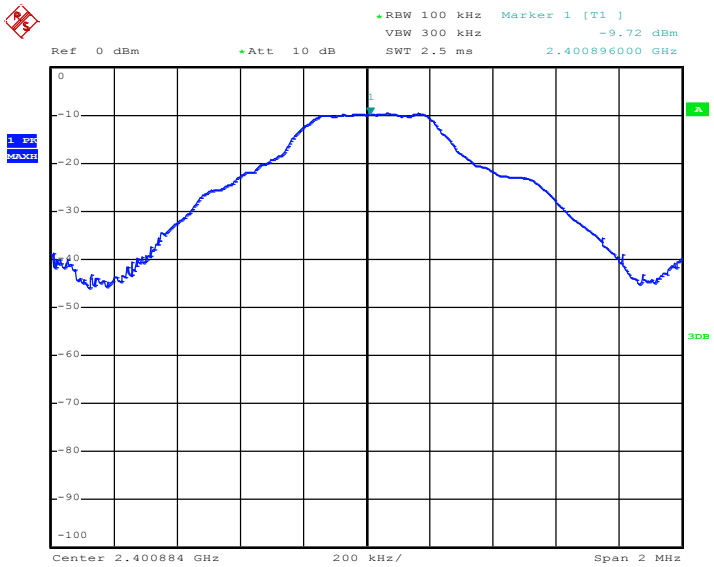
1. Remove the antenna from the EUT and then connect a low attenuation RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 2 MHz. VBW = 2 MHz. Sweep = auto; Detector Function = Peak.
3. Keep the EUT in transmitting at lowest, medium and highest channel individually. Record the max value.

Test Result:				
Normal mode:				
Test Channel	**Fundamental Frequency (MHz)**	**Output Power (dBm)**	**Limit (dBm)**	**Result**
Lowest	2402	**-9.72**	30.0	Pass
Middle	2440	-11.97	30.0	Pass
Highest	2480	-14.69	30.0	Pass
EDR mode:				
Test Channel	**Fundamental Frequency (MHz)**	**Output Power (dBm)**	**Limit (dBm)**	**Result**
Lowest	2402	**-9.90**	30.0	Pass
Middle	2440	-12.39	30.0	Pass
Highest	2480	-14.91	30.0	Pass
Remark: cable lose=1.5 dB				
Test result: The unit does meet the FCC requirements.				

Result plot as follows:

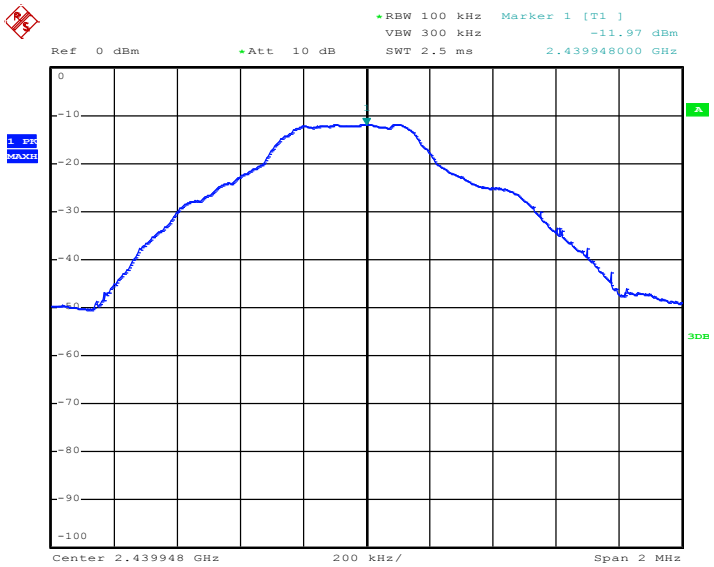
Normal mode:

Lowest Channel(2.402 MHz):



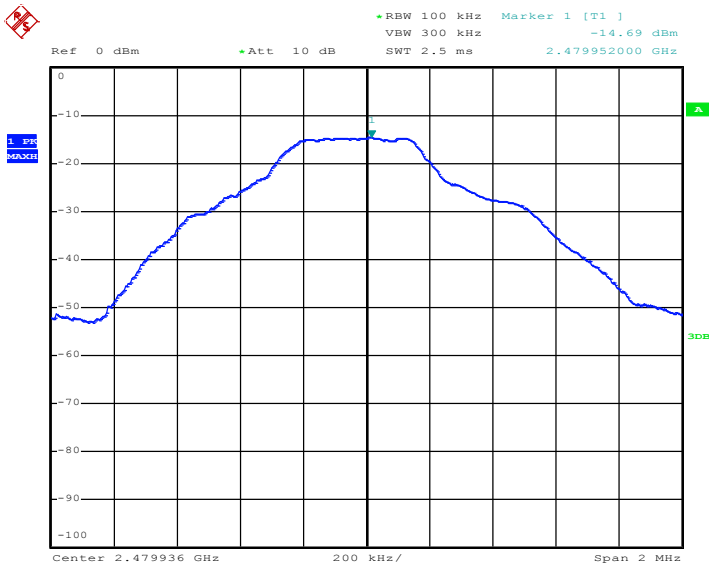
Date: 20.APR.2018 09:22:25

Middle Channel(2.440 GHz):



Date: 20.APR.2018 09:23:10

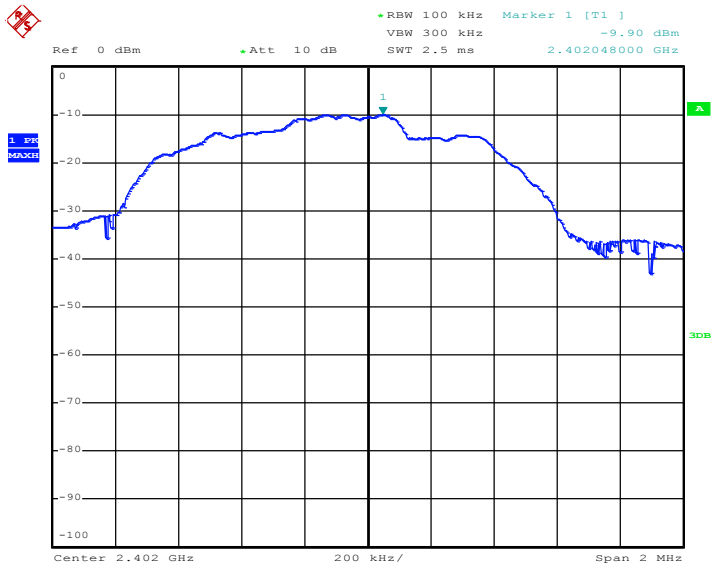
Highest Channel(2.480 GHz):



Date: 20.APR.2018 09:23:39

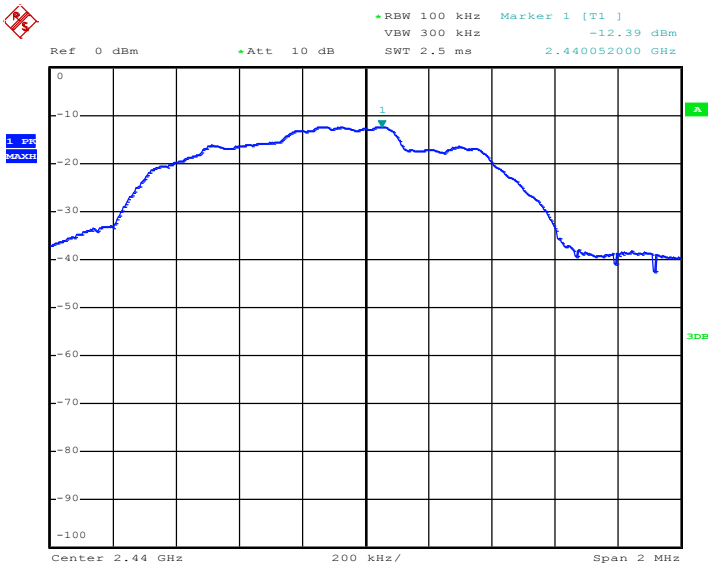
EDR mode:

Lowest channel(2.402 GHz):



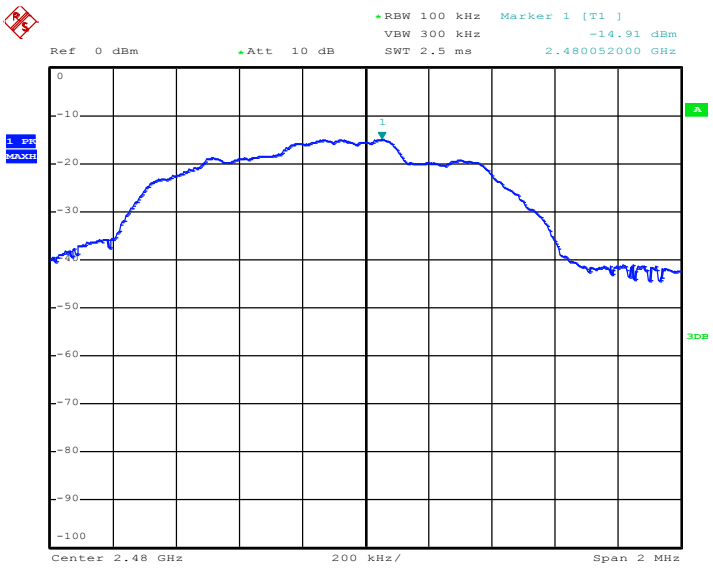
Date: 20.APR.2018 09:24:43

Middle channel(2.440 GHz):



Date: 20.APR.2018 09:25:41

Highest channel(2.480 GHz):



Date: 20.APR.2018 09:26:43

6.9 Conducted Spurious Emissions

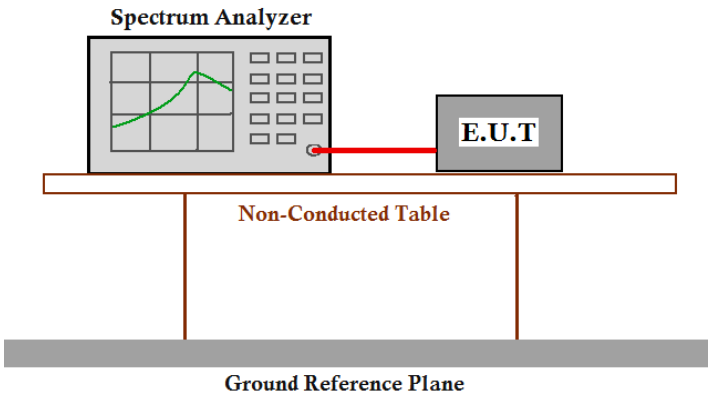
Test Requirement: FCC Part15 C section 15.247

(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 a radiated measurement. Provided the transmitter demonstrates compliance with the peak conducted power limits.

Test Method: ANSI C63.10: Clause 6.7

Test Status: Pre-test the EUT in continuous transmitting mode at the lowest (2402 MHz), middle (2440 MHz) and highest (2480 MHz) channel with different data packet. Compliance test in continuous transmitting mode with normal mode (DH5) as the worst case was found.

Test Configuration:



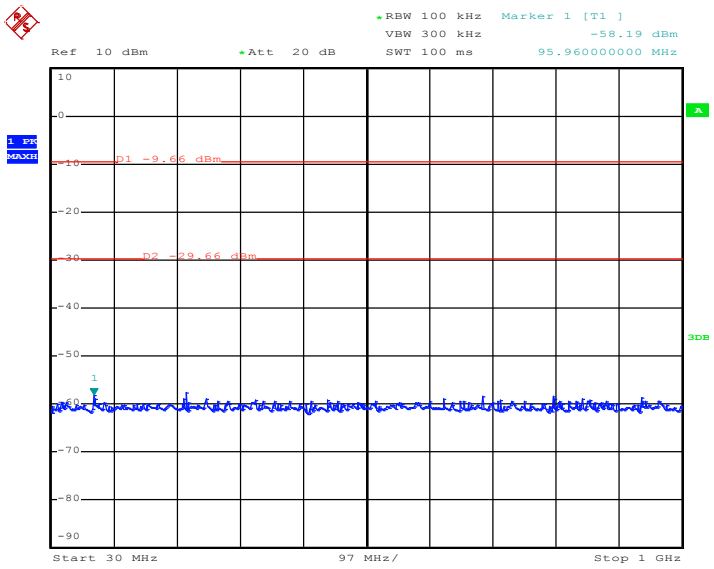
Test Procedure:

1. Remove the antenna from the EUT and then connect a low attenuation RF cable from the antenna port to the spectrum.

2. Set the spectrum analyzer: RBW = 100 kHz. VBW >= RBW. Sweep = auto; Detector Function = Peak (Max. hold).

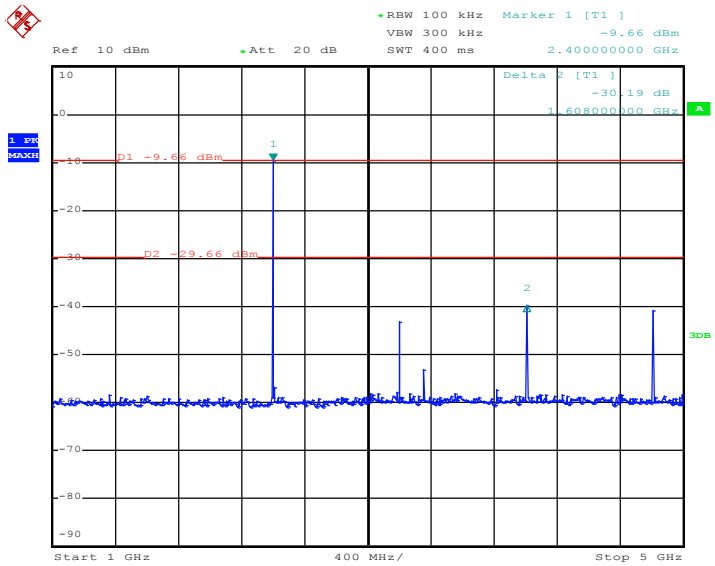
Result plot as follows:

Lowest Channel: 30 MHz to 1 GHz



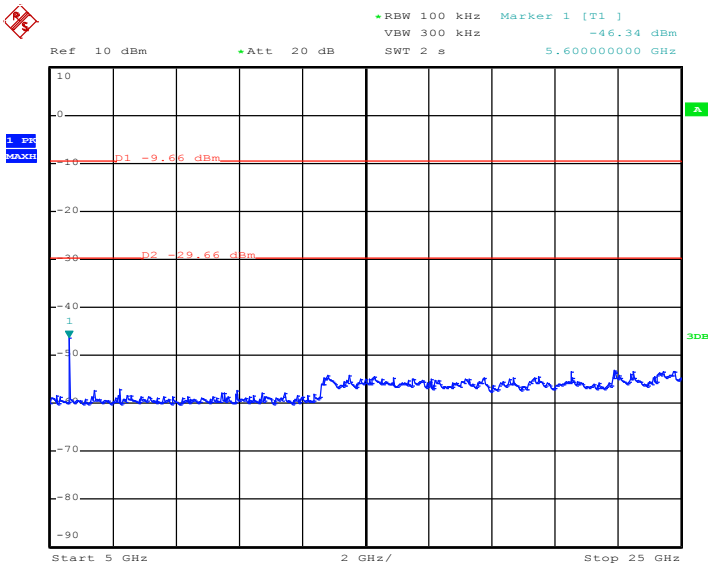
Date: 18.APR.2018 11:05:15

Lowest Channel: 1 GHz to 5 GHz



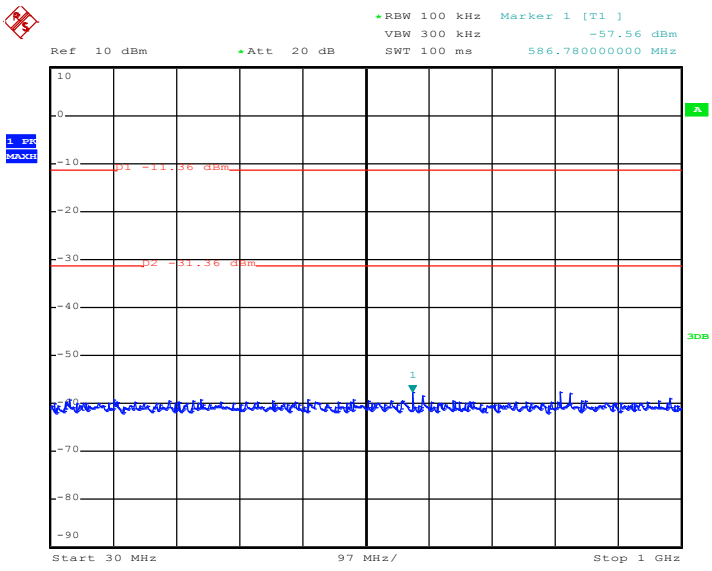
Date: 18.APR.2018 11:03:09

Lowest Channel: 5 GHz to 25 GHz



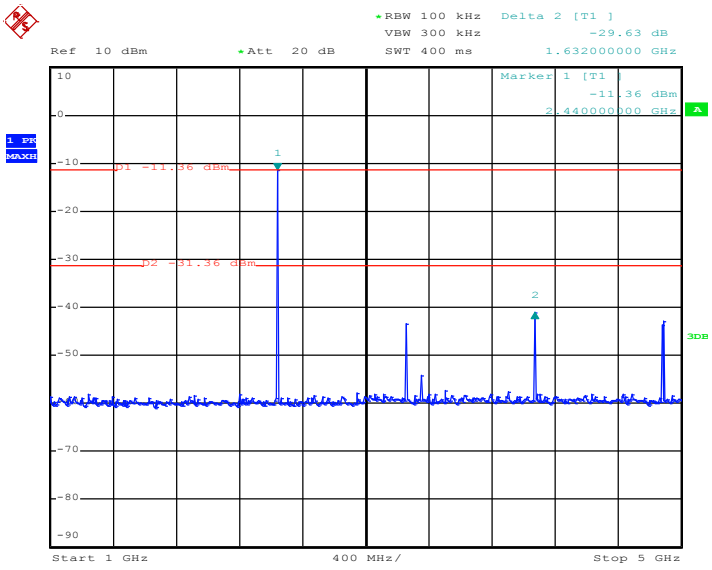
Date: 18.APR.2018 11:04:35

Middle Channel: 30 MHz to 1 GHz



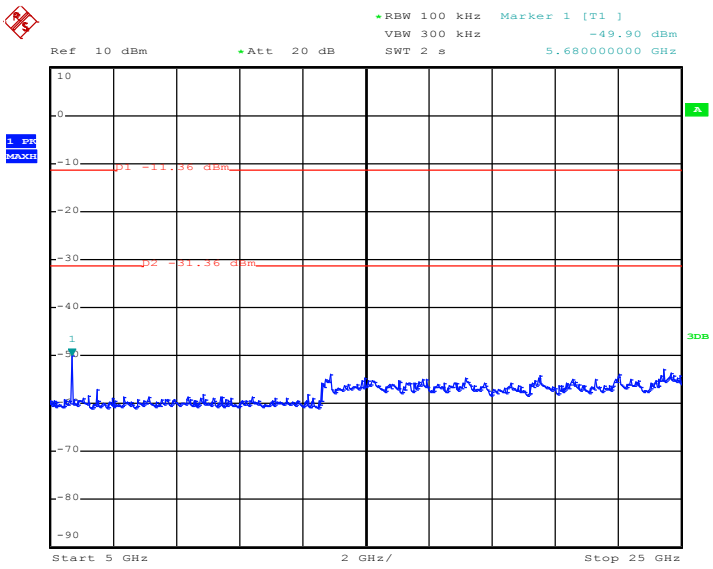
Date: 18.APR.2018 11:11:40

Middle Channel: 1 GHz to 5 GHz



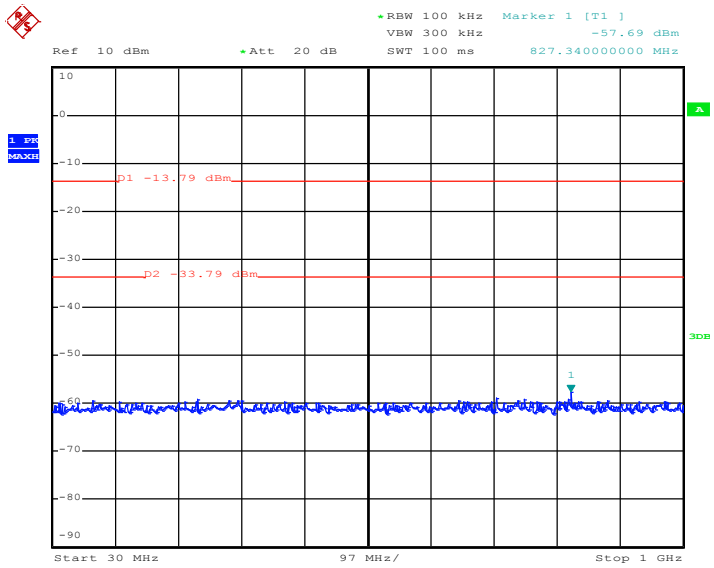
Date: 18.APR.2018 11:11:06

Middle Channel: 5 GHz to 25 GHz



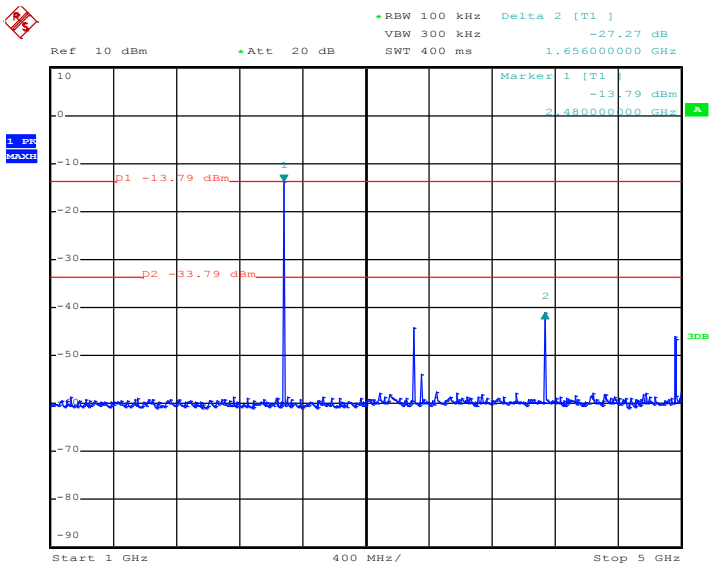
Date: 18.APR.2018 11:12:07

Highest Channel: 30 MHz to 1 GHz



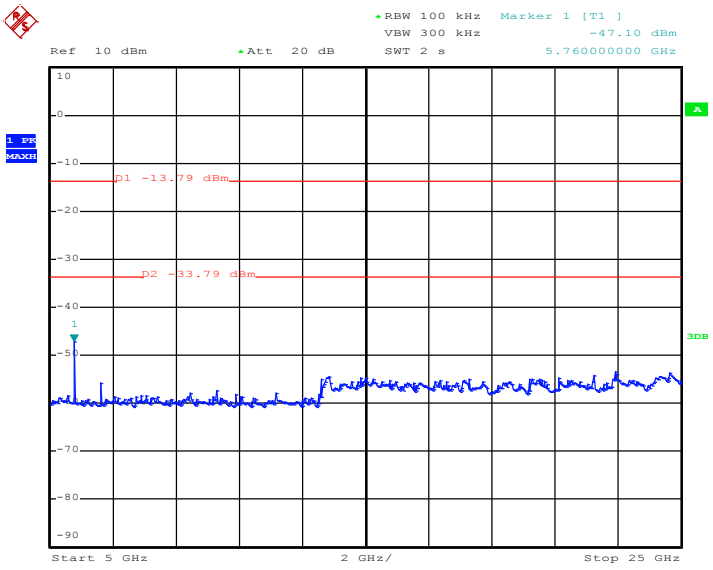
Date: 18.APR.2018 11:16:12

Highest Channel: 1 GHz to 5 GHz



Date: 18.APR.2018 11:15:43

Highest Channel: 5 GHz to 25 GHz



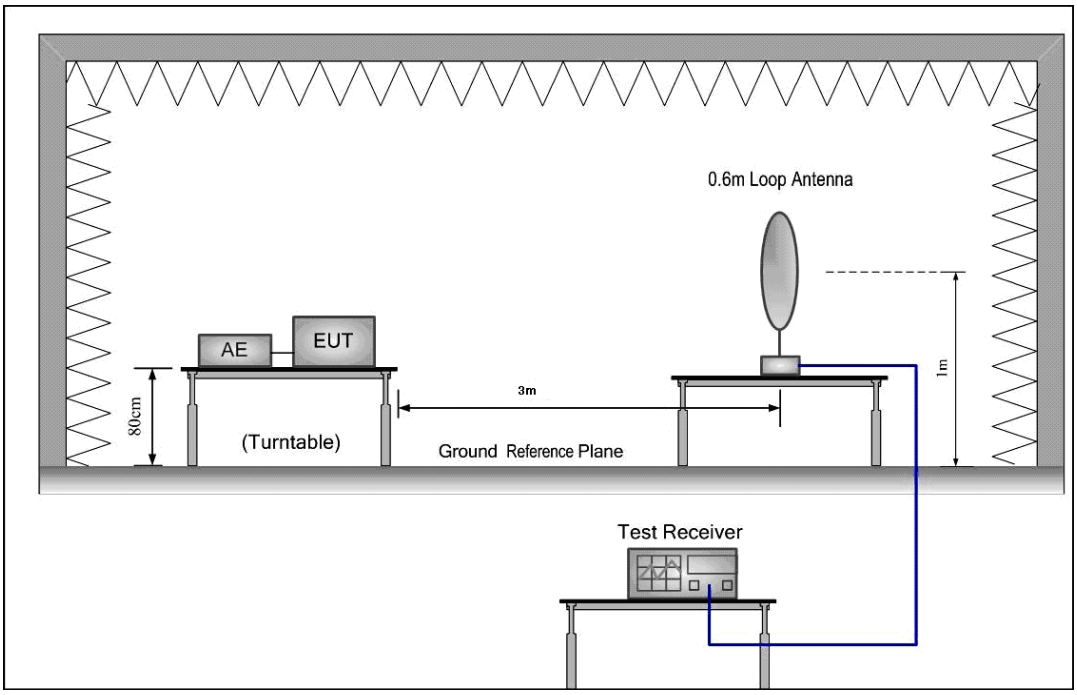
Date: 18.APR.2018 11:16:53

6.10 Radiated Spurious Emissions

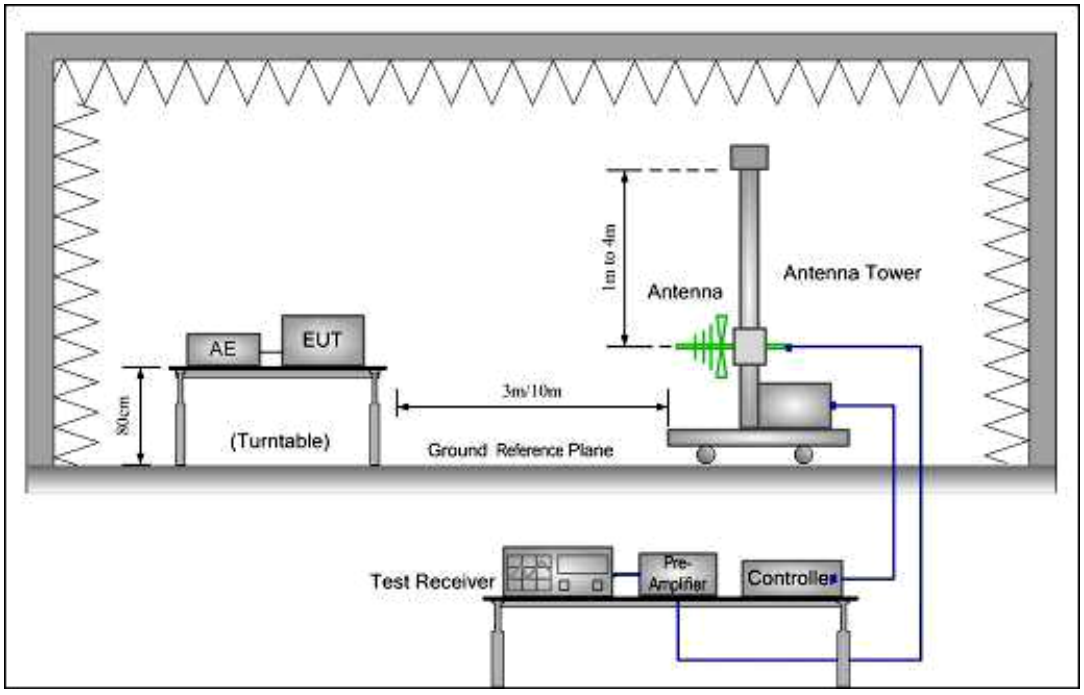
Test Requirement:	FCC Part15 C section 15.247 (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating. The radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that Contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, and provided the transmitter demonstrates compliance with the peak conducted power limits.
Test Method:	ANSI C63.10: Clause 6.4, 6.5 and 6.6
Test Status:	Pre-test the EUT in continuous transmitting mode at the lowest (2402 MHz), middle (2440 MHz) and highest (2480 MHz) channel with different data packet. Compliance test in continuous transmitting mode with normal mode (DH5) as the worst case was found.
Detector:	For PK value: RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz VBW ≥ RBW Sweep = auto Detector function = peak Trace = max hold For AV value: RBW = 1 MHz for f ≥ 1 GHz, VBW =10 Hz Sweep = auto Detector function = peak Trace = max hold
15.209 Limit:	40.0 dBμV/m between 30MHz & 88MHz 43.5 dBμV/m between 88MHz & 216MHz 46.0 dBμV/m between 216MHz & 960MHz 54.0 dBμV/m above 960MHz

Test Configuration:

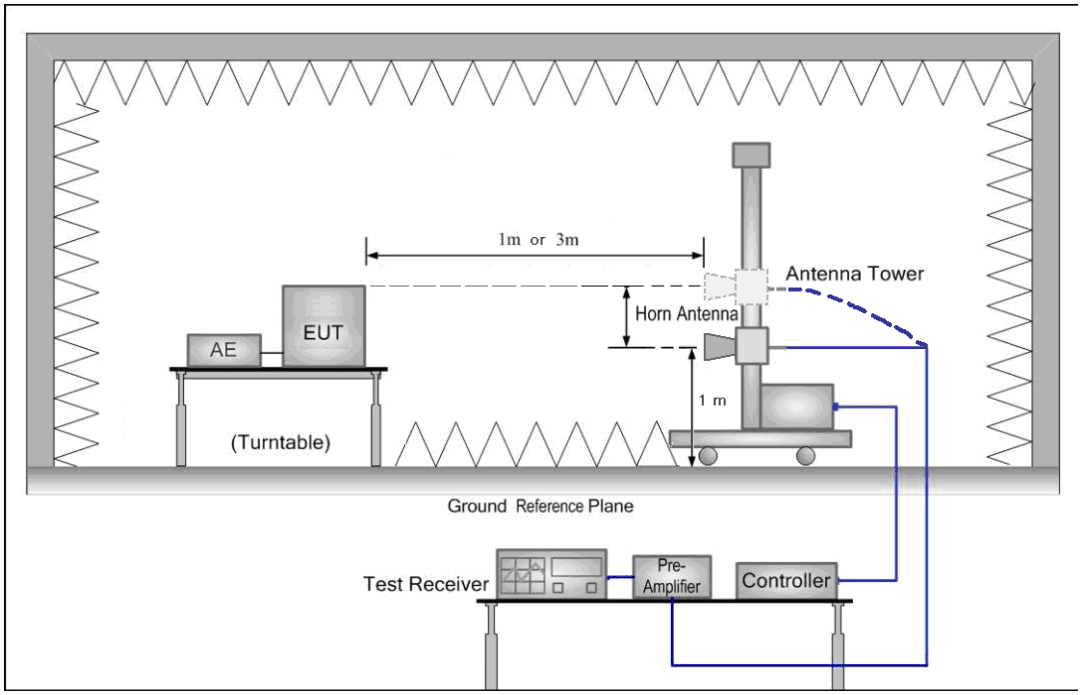
1) 9 kHz to 30 MHz emissions:



2) 30 MHz to 1 GHz emissions:



3) 1 GHz to 40 GHz emissions:



Test Procedure:

Test site with RF absorbing material covering the ground plane that met the site validation criterion called out in CISPR 16-1-4:2007 was used to perform radiated emission test above 1 GHz.

The receiver scanned from the lowest frequency generated within the EUT to 25GHz.When an emission was found, the table was rotated to produce the maximum signal strength. An initial pre-scan was performed for in peak detection mode using the receiver. The EUT was measured for both the Horizontal and Vertical polarities and performed a pre-test three orthogonal planes. For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. The worst-case emissions were reported.

Now set the VBW to 10 Hz, while maintaining all of the other instrument settings. This peak level, once corrected, must comply with the limit specified in Section 15.209. If the dwell time per channel of the hopping signal is less than 100 ms, then the reading obtained with the 10 Hz VBW may be further adjusted by a "duty cycle correction factor", derived from 20log (dwell time/100 ms), in an effort to demonstrate compliance with the 15.209 limit.

Submit this data.

6.10.1 Harmonic and other spurious emissions

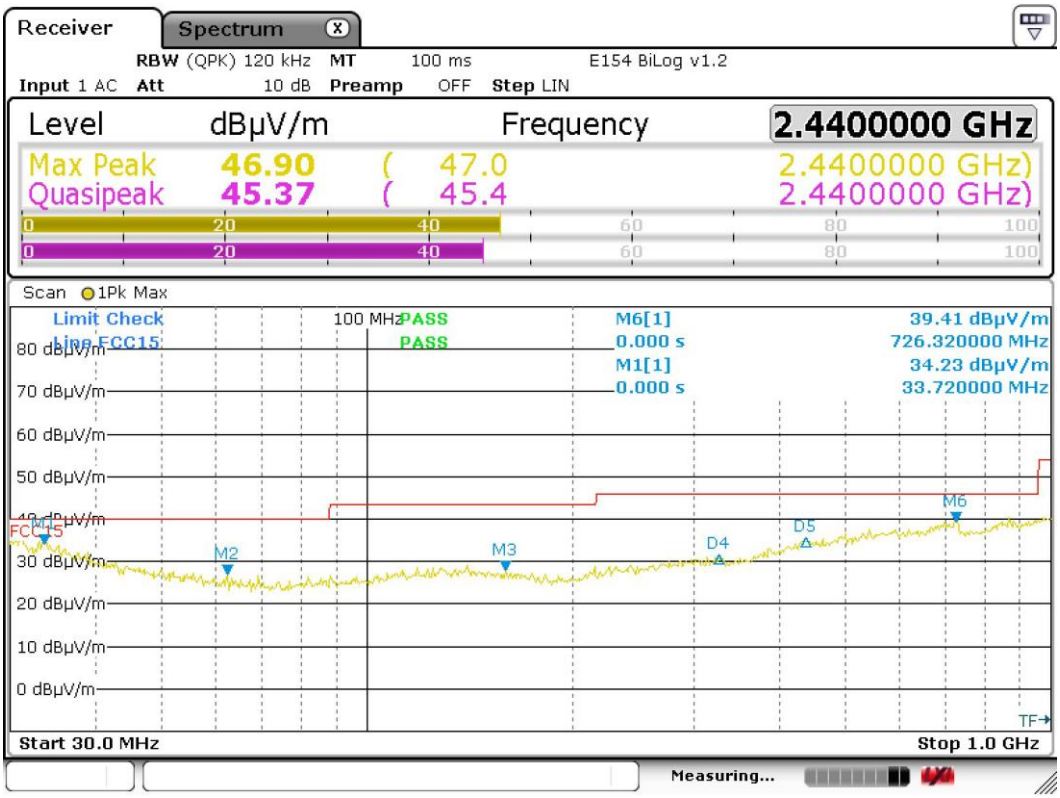
6.10.1.1 Test the lowest Channel in transmitting status

9 kHz~30 MHz Field Strength of Unwanted Emissions. Quasi-Peak Measurement

The measurements with active loop antenna were greater than 20dB below the limit, so the test data were not recorded in the test report.

30 MHz~1 GHz Spurious Emissions .Quasi-Peak Measurement

Quasi-peak measurement:



Frequency (MHz)	Antenna Polarization	Correction Factor (dB/m)	Receiver QP Reading (dBµV)	Emission Level (dBµV/m)	Limit (dBµV/m)	Over Limit (dB)
33.720	V	17.3	8.4	25.7	40	-14.3
62.520	V	9.5	6.4	15.9	40	-24.1
139.800	H	11.1	7.2	18.3	43.5	-25.2
292.720	H	12.9	7.6	20.5	46	-25.5
404.240	H	15.6	6.4	22.0	46	-24.0
726.320	H	19.7	9.8	29.5	46	-16.5

1. All readings are Quasi-Peak values.

2. Correction Factor = Antenna Factor + Cable Loss.

1~25 GHz Harmonics & Spurious Emissions. Peak & Average Measurement:

Frequency (MHz)	Antenna Polarization	Emission Level (dBμV/m)		Limit (dBμV/m)		Remark
		Peak	Average	Peak	Average	
4003	H	51.79	41.59	74	54	Pass
4804	H	50.79	39.46	74	54	Pass
5604	H	51.97	43.85	74	54	Pass
4003	V	47.58	37.74	74	54	Pass
4804	V	47.68	37.53	74	54	Pass
5604	V	48.44	39.07	74	54	Pass

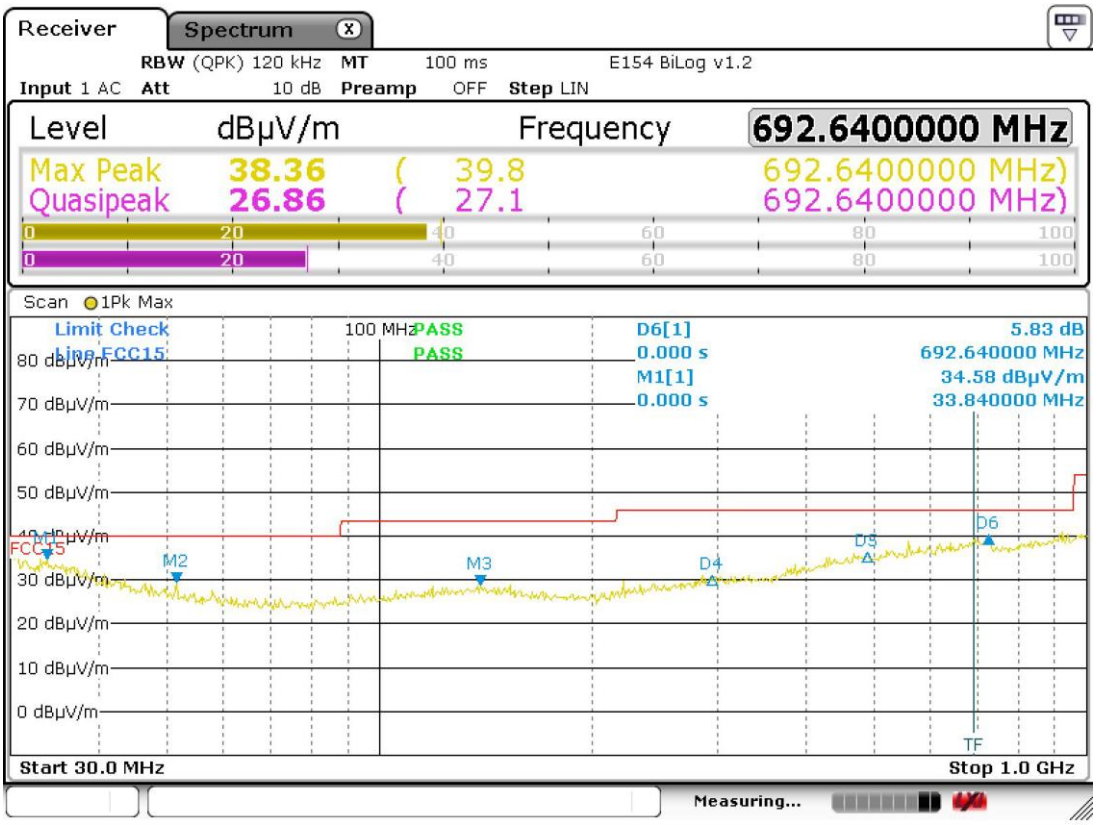
6.10.1.2 Test the middle Channel in transmitting status

9 kHz~30 MHz Field Strength of Unwanted Emissions.Quasi-Peak Measurement

The measurements with active loop antenna were greater than 20dB below the limit, so the test data were not recorded in the test report.

30 MHz~1 GHz Spurious Emissions .Quasi-Peak Measurement

Quasi-peak measurement:



Frequency (MHz)	Antenna Polarization	Correction Factor (dB/m)	Receiver QP Reading (dBµV)	Emission Level (dBµV/m)	Limit (dBµV/m)	Over Limit (dB)
33.840	V	17.2	8.5	25.7	40	-14.3
51.520	V	11.3	6.3	17.6	40	-22.4
138.880	V	11.1	6.5	17.6	43.5	-25.9
260.680	H	11.6	7.3	18.9	46	-27.1
455.040	H	17.0	6.5	23.5	46	-22.5
692.640	H	19.4	7.7	27.1	46	-18.9

1. All readings are Quasi-Peak values.

2. Correction Factor = Antenna Factor + Cable Loss.

1~25 GHz Harmonics & Spurious Emissions. Peak & Average Measurement:

Frequency (MHz)	Antenna Polarization	Emission Level (dBμV/m)		Limit (dBμV/m)		Remark
		Peak	Average	Peak	Average	
4066	H	50.89	40.31	74	54	Pass
4880	H	52.01	41.54	74	54	Pass
5693	H	51.62	39.48	74	54	Pass
4066	V	46.03	36.43	74	54	Pass
4880	V	48.97	38.89	74	54	Pass
5693	V	49.34	38.96	74	54	Pass

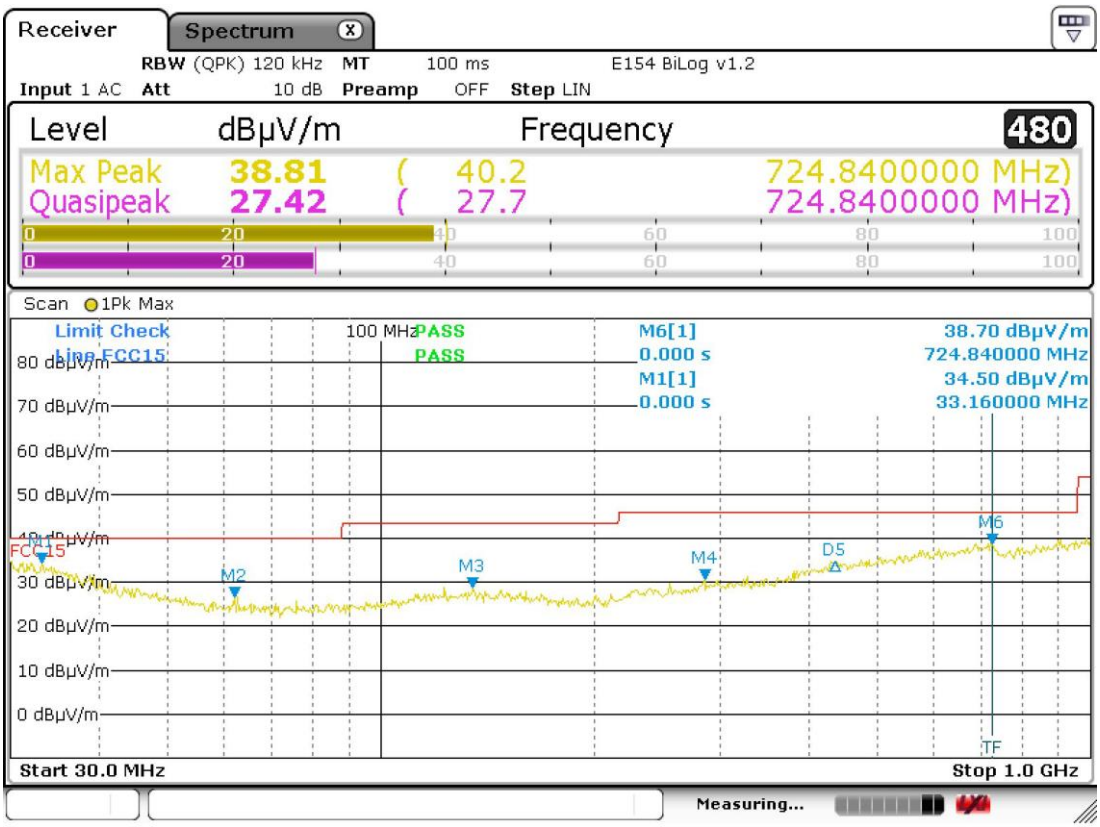
6.10.1.3 Test the highest Channel in transmitting status

9 kHz~30 MHz Field Strength of Unwanted Emissions.Quasi-Peak Measurement

The measurements with active loop antenna were greater than 20dB below the limit, so the test data were not recorded in the test report.

30 MHz~1 GHz Spurious Emissions .Quasi-Peak Measurement

Quasi-peak measurement:



Frequency (MHz)	Antenna Polarization	Correction Factor (dB/m)	Receiver QP Reading (dBµV)	Emission Level (dBµV/m)	Limit (dBµV/m)	Over Limit (dB)
33.160	H	17.5	8.5	26.0	40	-14.0
62.040	H	9.5	6.4	15.9	40	-24.1
134.760	H	11.1	7.1	18.2	43.5	-25.3
285.440	H	12.6	7.5	20.1	46	-25.9
402.560	H	15.6	6.3	21.9	46	-24.1
724.840	H	19.6	8.1	27.7	46	-18.3

1. All readings are Quasi-Peak values.

2. Correction Factor = Antenna Factor + Cable Loss.

1~25 GHz Harmonics & Spurious Emissions. Peak & Average Measurement:

Frequency (MHz)	Antenna Polarization	Emission Level (dBμV/m)		Limit (dBμV/m)		Remark
		Peak	Average	Peak	Average	
4066	H	50.89	40.31	74	54	Pass
4880	H	52.01	41.54	74	54	Pass
5693	H	51.62	39.48	74	54	Pass
4066	V	46.03	36.43	74	54	Pass
4880	V	48.97	38.89	74	54	Pass
5693	V	49.34	38.96	74	54	Pass

Remark:

1). The field strength is calculated by adding the Antenna Factor. Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:

Final Test Level =Receiver Reading + Antenna Factor + Cable Loss –Preamplifier Factor.

2). As shown in Section, for frequencies above 1000 MHz. the above field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

3). The test only perform the EUT in transmitting status since the test frequencies were over 1GHz only required transmitting status.

Test result: The unit does meet the FCC requirements.

6.10.2 Radiated Emissions which fall in the restricted bands

Test Requirement:	FCC Part15 C Section 15.247 (d) 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)).
Test Method:	ANSI C63.10: Clause 6.4, 6.5 and 6.6
Test Status:	Pre-test the EUT in continuous transmitting mode at the lowest (2402 MHz), middle (2440 MHz) and highest (2480 MHz) channel with different data packet. Compliance test in continuous transmitting mode with normal mode (DH5) as the worst case was found.
Measurement Distance:	3m (Semi-Anechoic Chamber)
Limit:	Section 15.209(a) 40.0 dBμV/m between 30MHz & 88MHz; 43.5 dBμV/m between 88MHz & 216MHz; 46.0 dBμV/m between 216MHz & 960MHz; 54.0 dBμV/m above 960MHz.
Detector:	For PK value: RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz VBW ≥ RBW Sweep = auto Detector function = peak Trace = max hold For AV value: RBW = 1 MHz for f ≥ 1 GHz, VBW =10 Hz Sweep = auto Detector function = peak Trace = max hold

Test Result:

Test at lowest Channel (2.402 GHz) in transmitting status

Frequency (MHz)	Antenna Polarization	Emission Level (dBμV/m)		Limit (dBμV/m)		Remark
		Peak	Average	Peak	Average	
2310.0	H	33.11	18.33	74	54	Pass
2390.0	H	45.72	21.07	74	54	Pass
2483.5	H	56.73	36.61	74	54	Pass
2500.0	H	40.26	19.39	74	54	Pass
2310.0	V	33.74	18.46	74	54	Pass
2390.0	V	42.78	21.02	74	54	Pass
2483.5	V	48.30	29.61	74	54	Pass
2500.0	V	34.89	19.28	74	54	Pass

Test at middle Channel(2.440 GHz) in transmitting status

Frequency (MHz)	Antenna Polarization	Emission Level (dBμV/m)		Limit (dBμV/m)		Remark
		Peak	Average	Peak	Average	
2310.0	H	33.11	18.33	74	54	Pass
2390.0	H	45.72	21.07	74	54	Pass
2483.5	H	56.73	36.61	74	54	Pass
2500.0	H	40.26	19.39	74	54	Pass
2310.0	V	33.74	18.46	74	54	Pass
2390.0	V	42.78	21.02	74	54	Pass
2483.5	V	48.30	29.61	74	54	Pass
2500.0	V	34.89	19.28	74	54	Pass

Test at highest Channel (2.480 GHz) in transmitting status

Frequency (MHz)	Antenna Polarization	Emission Level (dBμV/m)		Limit (dBμV/m)		Remark
		Peak	Average	Peak	Average	
2310.0	H	33.11	18.33	74	54	Pass
2390.0	H	45.72	21.07	74	54	Pass
2483.5	H	56.73	36.61	74	54	Pass
2500.0	H	40.26	19.39	74	54	Pass
2310.0	V	33.74	18.46	74	54	Pass
2390.0	V	42.78	21.02	74	54	Pass
2483.5	V	48.30	29.61	74	54	Pass
2500.0	V	34.89	19.28	74	54	Pass

Remark: above table only record the worse data of emissions in restricted frequency bands.

Test result: The unit does meet the FCC requirements.

Section 15.205 Restricted bands of operation.

(a) Except as shown in paragraph (d) of this section. only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
[1]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	2655 - 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	
13.36 - 13.41			

6.11 Band Edges Requirement

Test Requirement: FCC Part15 C section 15.247

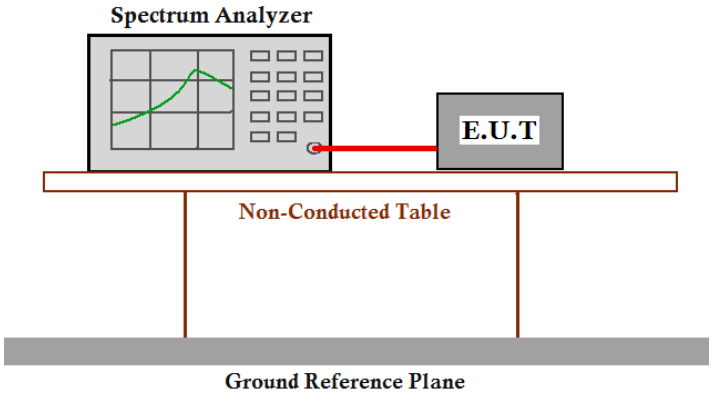
(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated 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, as permitted under paragraph (b)(3) of this section, 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)).

Frequency Band: 2400 MHz to 2483.5 MHz

Test Method: ANSI C63.10 (2013) Section 7.8.6

Test Status: Pre-test the EUT in continuous transmitting mode at the lowest (2402 MHz), and highest (2480 MHz) channel and hopping mode with different data packet. Compliance test in continuous transmitting mode with normal (DH5) and EDR mode (3DH5) as the worst case was found.

Test Configuration:



Test Procedure: Use the following spectrum analyzer settings:

Span = 10MHz (wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation.)

RBW = 100 kHz (1% of the span) and VBW = 300 kHz

Sweep = auto

Detector function = peak

Trace = max hold

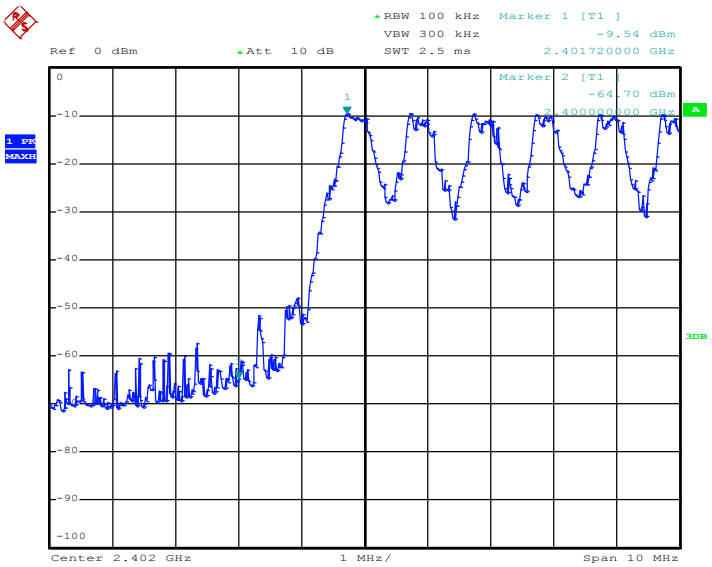
Test Result:

Compare with the output power of the lowest frequency, the Lower Edges attenuated more than 20dB

Compare with the output power of the highest frequency, the Upper Edges attenuated more than 20dB.

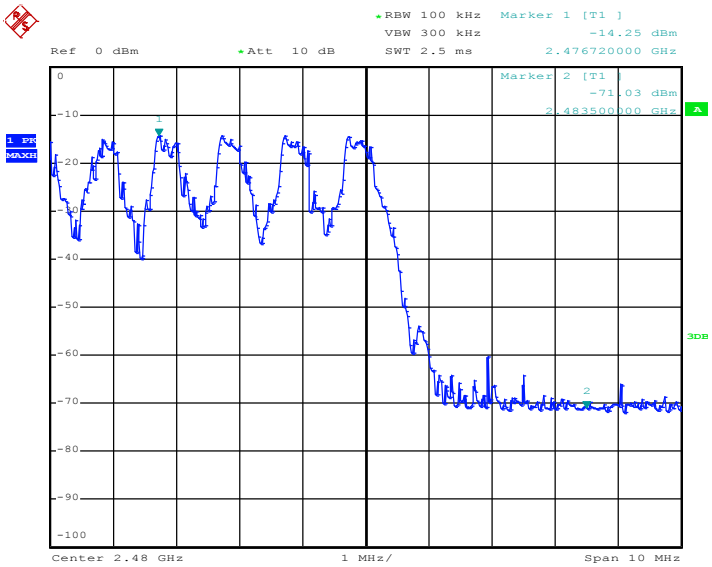
Normal mode: DH5

Lowest channel(2.402 GHz):



Date: 20.APR.2018 09:54:26

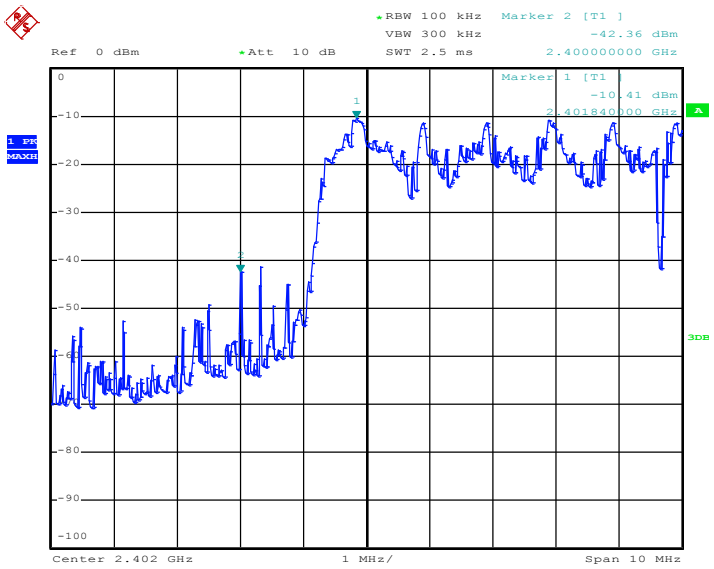
Highest Channel(2.480 GHz):



Date: 20.APR.2018 10:00:14

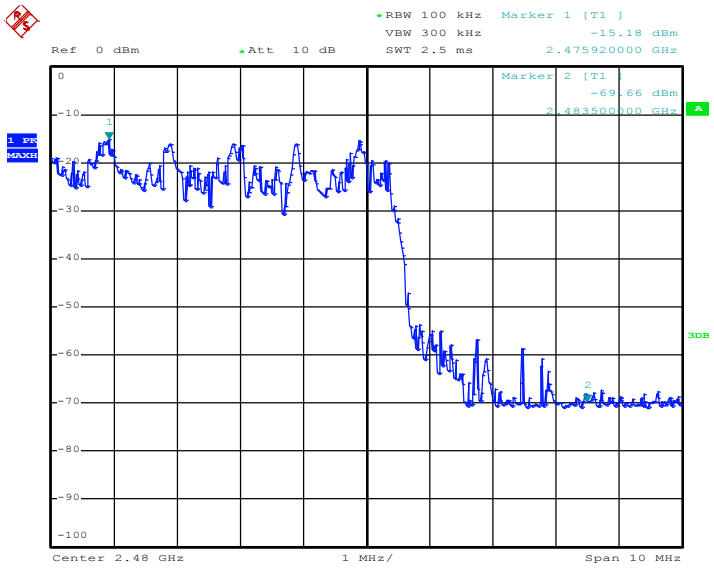
EDR mode: 3DH5

Lowest channel(2.402 GHz):



Date: 20.APR.2018 09:57:04

Highest Channel(2.480 GHz):

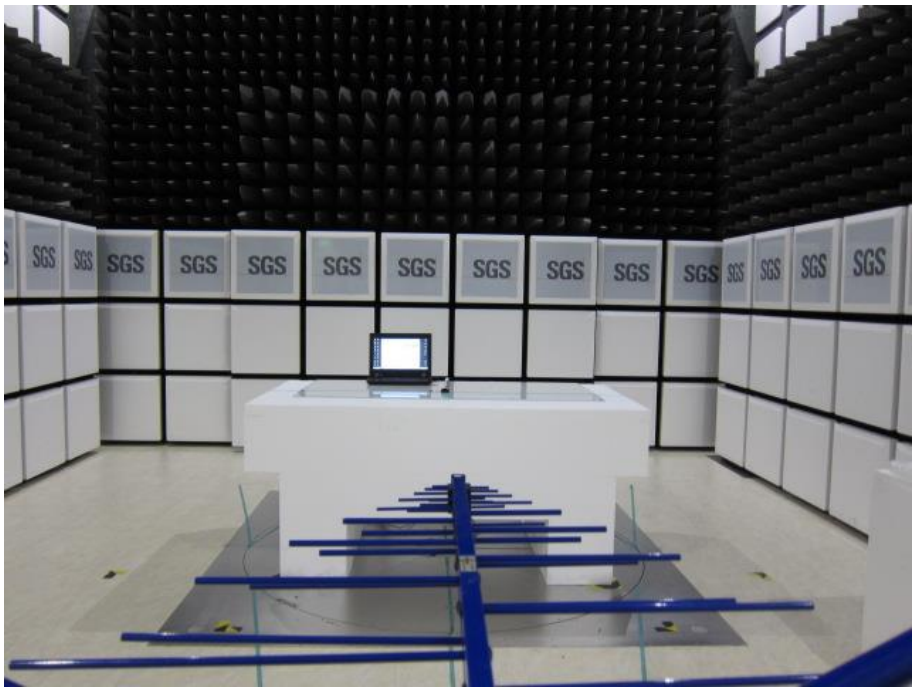


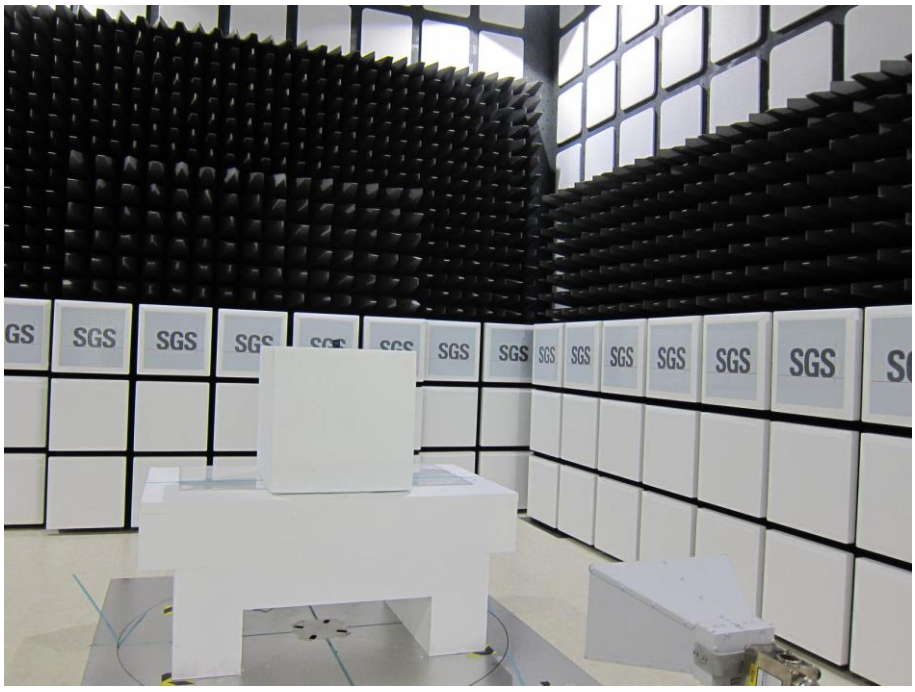
Date: 20.APR.2018 09:59:25

Test result: The unit does meet the FCC requirements.

7 Photographs

7.1 Radiated Spurious Emission Test Setup





8 EUT Constructional Details

--End of Report--