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Registration number: 282399

Report No.: GZEM120400124801

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FCC ID: Q2V5D2007083MW

TEST REPORT

Application No.:	GZEM1204001248RF
Applicant:	MAXWISE Production Enterprise Ltd.
FCC ID:	Q2V5D2007083MW
Product Name:	Wii Wireless Controller
Product Description:	Wii Wireless Controller
Model No.:	5D20070MW, 5D20076MW, 5D20072MW, 5D20078MW, 5D20068MW, 5D20069MW, 5D20082MW, 5D20074MW, 5D20075MW, 5D20083MW, 5D20067MW, 5D20073MW *
*	Please refer to section 3 of this report for details
Standards:	FCC PART 15 Subpart C: 2011 section 15.247
Date of Receipt:	2012-04-23
Date of Test:	2012-04-23 to 2012-06-15
Date of Issue:	2012-06-20
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



Strong Yao
Manager*

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.

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.

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2 Version

Revision Record				
Version	Chapter	Date	Modifier	Remark
00		2012-06-20		Original

Authorized for issue by:			
Tested By		 (Daniel He) /Signature	2012-04-23 to 2012-06-15 Date
Prepared By		 (Daniel He) /Signature	2012-06-18 Date
Checked By		 (Strong Yao) /Reviewer	2012-06-20 Date

3 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)	DA 00-705	PASS
Hopping Channel Number	FCC PART 15 C section 15.247(a)(1)(iii)	DA 00-705	PASS
Dwell Time	FCC PART 15 C section 15.247(a)(1)(iii)	DA 00-705	PASS
Pseudorandom Frequency Hopping Sequence	FCC PART 15 C section 15.247(a)(1)	DA 00-705	PASS
Maximum Peak Output Power	FCC PART 15 C section 15.247(b)(1)	ANSI C63.10: Clause 6.10.1	PASS
Conducted Spurious Emission (30 MHz to 25 GHz)	FCC PART 15 C section 15.247(d)	ANSI C63.10: Clause 6.7	PASS
Radiated Spurious Emission (30 MHz to 25 GHz)	FCC PART 15 C section 15.247(d)	ANSI C63.10: Clause 6.4, 6.5 and 6.6	PASS
Band Edges Measurement	FCC PART 15 C section 15.247 (d) &15.205	ANSI C63.10: Clause 6.9.1	PASS

Remark:

N/A: not applicable. Refer to the relative section for the details.

EUT: In this whole report EUT means Equipment Under Test.

Tx: In this whole report Tx (or tx) means Transmitter.

Rx: In this whole report Rx (or rx) means Receiver.

RF: In this whole report RF means Radio Frequency.

ANSI C63.10: the detail version is ANSI C63.10:2009 in the whole report.

DA 00-705: "Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems"

• **Model No.:** 5D20070MW, 5D20076MW, 5D20072MW, 5D20078MW, 5D20068MW, 5D20069MW,
5D20082MW, 5D20074MW, 5D20075MW, 5D20083MW, 5D20067MW, 5D20073MW.

According to the confirmation from the applicant, since the electrical circuit design, layout, components used and internal wiring were identical for the above items, only with different Model No. and appearance.

Therefore only one model **5D20070MW** was tested in this report.

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5 General Information

5.1 Client Information

Applicant: MAXWISE Production Enterprise Ltd.
Address of Applicant: Room 1501, 15/F., AT Tower, 180 Electric Road, North Point, Hong Kong

5.2 General Description of E.U.T.

Product Name: Wii Wireless Controller
Model No.: 5D20070MW

5.3 Details of E.U.T.

Operating Frequency 2402 MHz to 2480 MHz
Type of Modulation: GFSK, $(\pi/4)$ DQPSK, 8DPSK
Number of Channels 79 Channels
Channel Separation: 1 MHz
Dwell time Per channel is less than 0.4s.
Antenna Type PCB Layout Inverted F
Antenna gain: 0 dBi
Speciality: Bluetooth (2.0)
Function: Wii Wireless Controller
Power Supply: DC 3.0 V size "AA" batteries x 2

5.4 Modulation configure

Modulation	Packet	Packet Type	Packet Size
GFSK	DH1	4	24
	DH3	11	183
	DH5	15	339

Remark:

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

5.5 Description of Support Units

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

5.6 Deviation from Standards

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

5.7 Abnormalities from Standard Conditions

None.

5.8 Other Information Requested by the Customer

None.

5.9 Test Location

All tests were performed at:

SGS-CSTC Standards Technical Services Co., Ltd., Guangzhou EMC Laboratory,
198 Kezhu Road, Scientech Park, Guangzhou Economic & Technology Development District,
Guangzhou, China 510663

Tel: +86 20 82155555 Fax: +86 20 82075059

No tests were sub-contracted.

5.10 Test Facility

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

- **NVLAP (Lab Code: 200611-0)**

SGS-CSTC Standards Technical Services Co., Ltd., Guangzhou EMC Laboratory is recognized under the National Voluntary Laboratory Accreditation Program (NVLAP/NIST). NVLAP Code: 200611-0.

- **ACMA**

SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory can also perform testing for the Australian C-Tick mark as a result of our NVLAP accreditation.

- **SGS UK(Certificate No.: 32), SGS-TUV SAARLAND and SGS-FIMKO**

Have approved SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory as a supplier of EMC TESTING SERVICES and SAFETY TESTING SERVICES.

- **CNAS (Lab Code: L0167)**

SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory has been assessed and in compliance with CNAS-CL01:2006 accreditation criteria for testing laboratories (identical to ISO/IEC 17025:2005 General Requirements) for the Competence of Testing Laboratories.

- **FCC (Registration No.: 282399)**

SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration 282399, May 31, 2002.

- **Industry Canada (Registration No.: 4620B-1)**

The 3m/10m Alternate Semi-anechoic chamber of SGS-CSTC Standards Technical Services Co., Ltd. has been registered by Certification and Engineering of Industry Canada for radio equipment testing with Registration No. 4620B-1.

- **VCCI (Registration No.: R-2460, C-2584, G-449 and T-1179)**

The 10m Semi-anechoic chamber and Shielded Room of SGS-CSTC Standards Technical Services Co., Ltd. have been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: R-2460, C-2584, G-449 and T-1179 respectively.

- **CBTL (Lab Code: TL129)**

SGS-CSTC Standards Technical Services Co., Ltd., E&E Laboratory has been assessed and fully comply with the requirements of ISO/IEC 17025:2005, the Basic Rules, IECEE 01:2006-10 and Rules of procedure IECEE 02:2006-10, and the relevant IECEE CB-Scheme Operational documents.

6 Equipment Used during Test

RE in Chamber						
No.	Test Equipment	Manufacturer	Model No.	Serial No.	Cal.Due date (YYYY-MM-DD)	Calibration Interval
EMC0525	Compact Semi-Anechoic Chamber	ChangZhou ZhongYu	N/A	N/A	2012-09-06	2Y
EMC0522	EMI Test Receiver	Rohde & Schwarz	ESIB26	100283	2012-11-11	1Y
EMC0056	EMI Test Receiver	Rohde & Schwarz	ESCI	10036	2013-03-12	1Y
EMC0528	RI High frequency Cable	SGS	20 m	N/A	2013-06-01	1Y
EMC2025	Trilog Broadband Antenna 30-3000MHz	SCHWARZBECK MESS-ELEKTRONIK	VULB 9163	9163-450	2012-10-20	1Y
EMC0524	Bi-log Type Antenna	Schaffner -Chase	CBL6112B	2966	2012-11-28	1Y
EMC0519	Bilog Type Antenna	Schaffner -Chase	CBL6143	5070	2012-11-28	1Y
EMC2026	Horn Antenna 1-18GHz	R&S	BBHA 9120D	9120D-841	2012-10-20	1Y
EMC0518	Horn Antenna	Rohde & Schwarz	HF906	100096	2012-08-29	1Y
EMC0521	1-26.5 GHz Pre-Amplifier	Agilent	8449B	3008A01649	2012-08-29	1Y
EMC0049	Amplifier	Agilent	8447D	2944A10862	2013-03-12	1Y
EMC0075	310N Amplifier	Sonama	310N	272683	2012-08-29	1Y
EMC0523	Active Loop Antenna	EMCO	6502	42963	2012-11-17	1Y
EMC2041	Broad-Band Horn Antenna (14)15-26.5(40)GHz	SCHWARZBECK MESS-ELEKTRONI	BBHA 9170	9170-375	2014-06-01	3Y
EMC0530	10m Semi-Anechoic Chamber	ETS	N/A	N/A	2014-04-27	2Y

Conducted Emission						
No.	Test Equipment	Manufacturer	Model No.	Serial No.	Cal.Due date (YYYY-MM-DD)	Calibration Interval
EMC0306	Shielding Room	Zhong Yu	8 x 3 x 3.8 m ³	N/A	N/A	N/A
EMC0118	Two-line v-netwok	R&S	ENV216	100359	2012-08-29	1Y
EMC0102	LISN	SCHAFFNER CHASE	MN2050D/1	1421	2012-11-23	1Y
EMC2046	Artificial Mains Network (LISN)	AFJ Instruments	LT32C	S.N.32031120150	2013-03-12	1Y
EMC0506	EMI Test Receiver	Rohde & Schwarz	ESCS30	100085	2012-11-24	1Y
EMC0107	Coaxial Cable	SGS	2m	N/A	2012-07-18	1Y
EMC0106	Voltage Probe	SGS	N/A	N/A	N/A	1Y
EMC0120	8 Line ISN	Fischer Custom Communications Inc.	FCC-TLISN-T8-02	20550	2012-11-11	1Y
EMC0121	4 Line ISN	Fischer Custom Communications Inc.	FCC-TLISN-T4-02	20549	2012-11-11	1Y
EMC0122	2 Line ISN	Fischer Custom Communications Inc.	FCC-TLISN-T2-02	20548	2012-11-11	1Y
EMC167	Conical metal housing	SGS-EMC	N/A	N/A	2013-02-16	1Y



SGS-CSTC Standards Technical Services Co., Ltd.

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General used equipment						
No.	Test Equipment	Manufacturer	Model No.	Serial No.	Cal.Due date (YYYY-MM-DD)	Calibration Interval
EMC0006	DMM	Fluke	73	70681569	2012-11-14	1Y
EMC0007	DMM	Fluke	73	70671122	2012-11-14	1Y

7 Test Results

7.1 E.U.T. test conditions

Test Voltage:	DC 3.0V
Temperature:	20.0 -25.0 °C
Humidity:	38-50 % RH
Atmospheric Pressure:	1000 -1010 mbar
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	11	2413	22	2424
1	2403	12	2414	23	2425
2	2404	13	2415	24	2426
3	2405	14	2416	25	2427
4	2406	15	2417	26	2428
5	2407	16	2418	27	2429
6	2408	17	2419	28	2430
7	2409	18	2420	29	2431
8	2410	19	2421	30	2432
9	2411	20	2422	31	2433
10	2412	21	2423	32	2434
33	2435	49	2451	65	2467
34	2436	50	2452	66	2468
35	2437	51	2453	67	2469
36	2438	52	2454	68	2470
37	2439	53	2455	69	2471
38	2440	54	2456	70	2472
39	2441	55	2457	71	2473
40	2442	56	2458	72	2474
41	2443	57	2459	73	2475
42	2444	58	2460	74	2476
43	2445	59	2461	75	2477
44	2446	60	2462	76	2478
45	2447	61	2463	77	2479
46	2448	62	2464	78	2480
47	2449	63	2465		
48	2450	64	2466		

Test frequencies are the lowest channel: 0 channel(2402 MHz), middle channel: 39 channel(2441 MHz) and highest channel: 78 channel(2480 MHz)

7.2 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 best case gain of the antenna is 0dBi.

Test result: The unit does meet the FCC requirements.

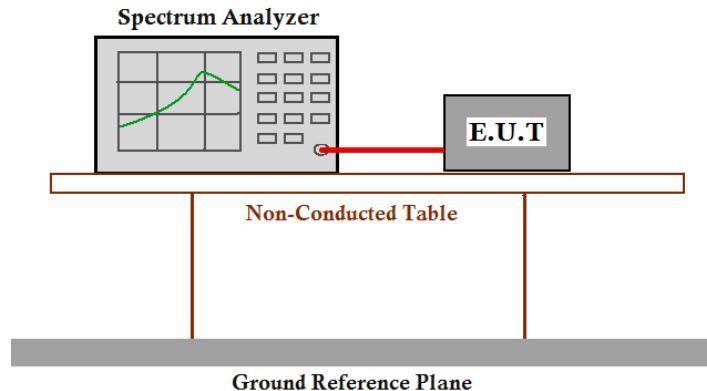
7.3 Occupied Bandwidth

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 (2441 MHz) and highest (2480 MHz) channel with different data package. Compliance test in 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 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 \geq 1% of the 20Db bandwidth VBW \geq RBW. Sweep = auto; Detector Function = Peak. Trace = Max Hold.
4. Mark the peak frequency and -20Db points bandwidth.

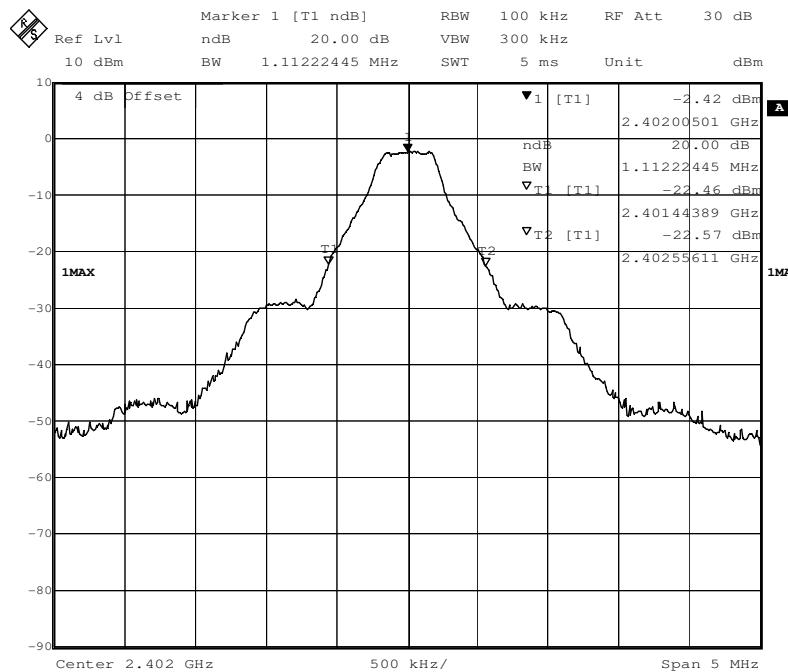
Test result:**Normal mode:**

Test Channel	Bandwidth(MHz)	2/3 bandwidth(MHz)
Lowest	1.1122	0.7415
Middle	1.1322	0.7548
Highest	1.1422	0.7615

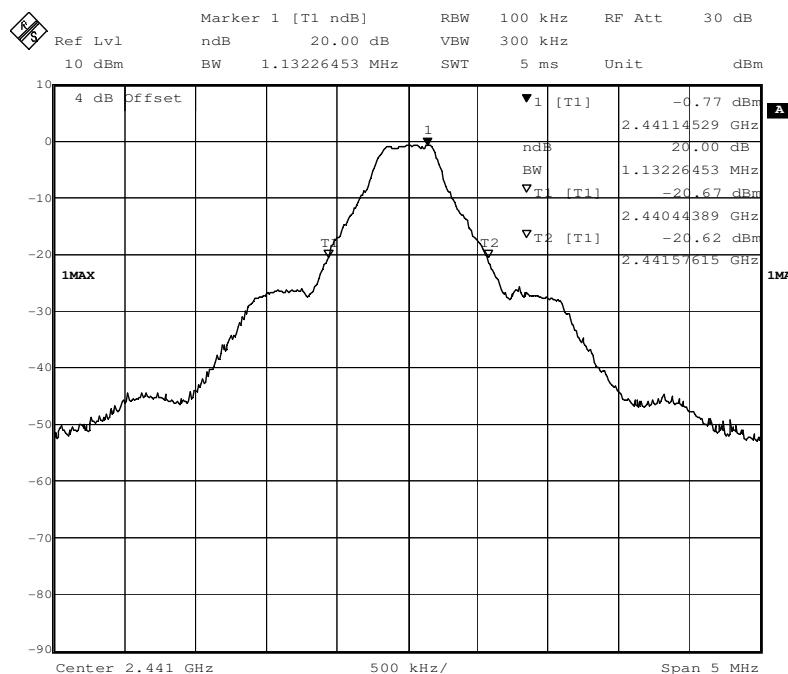
Result plot as follows:

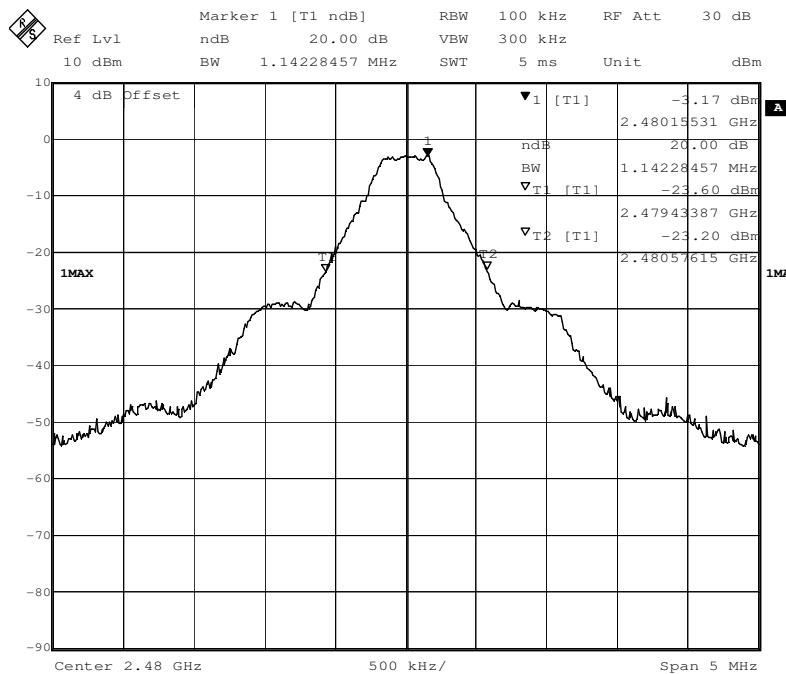
DH5:

Lowest Channel:



Middle Channel:



Highest Channel:

7.4 Carrier Frequencies Separated

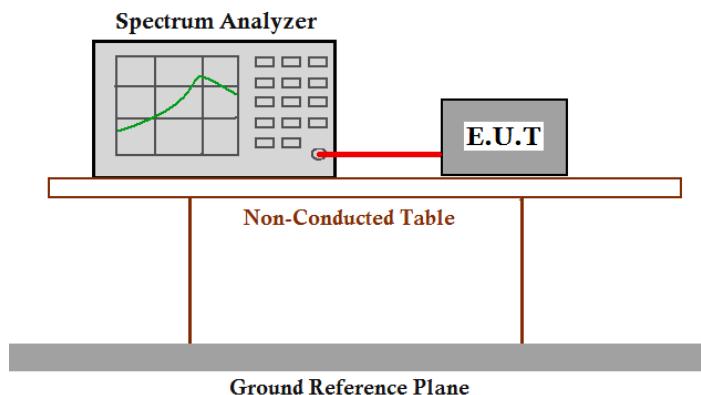
Test Requirement: FCC Part 15 C section 15.247

(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: DA 00-705

Test Status: Pre-test the EUT in continuous transmitting mode at the lowest (2402 MHz), middle (2441 MHz) and highest (2480 MHz) channel and hopping mode with different data packet. Compliance test in hopping 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 \geq 1% of the span, VBW \geq 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.

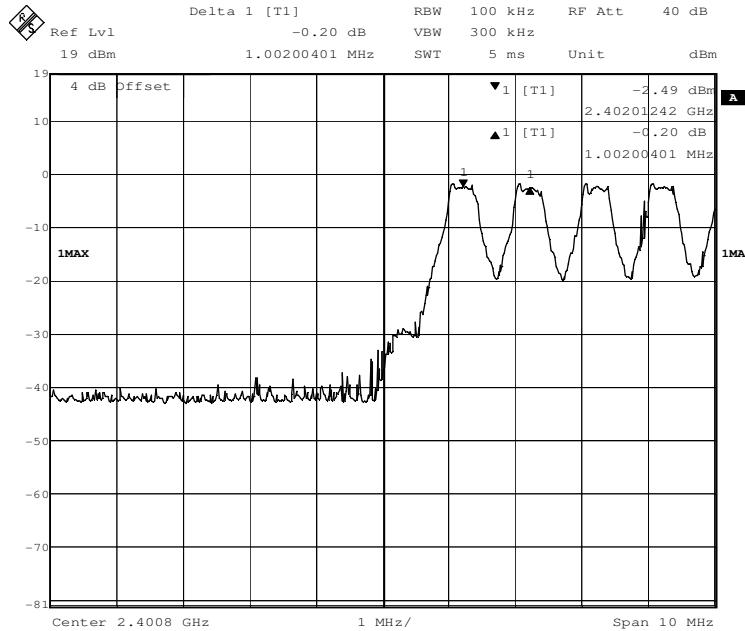
Test result:

Test Channel	Carrier Frequencies Separated	Pass/Fail
Lower Channels (channel 0 and channel 1)	1.002	Pass
Middle Channels (channel 39 and channel 40)	1.012	Pass
Upper Channels (channel 77 and channel 78)	1.002	Pass

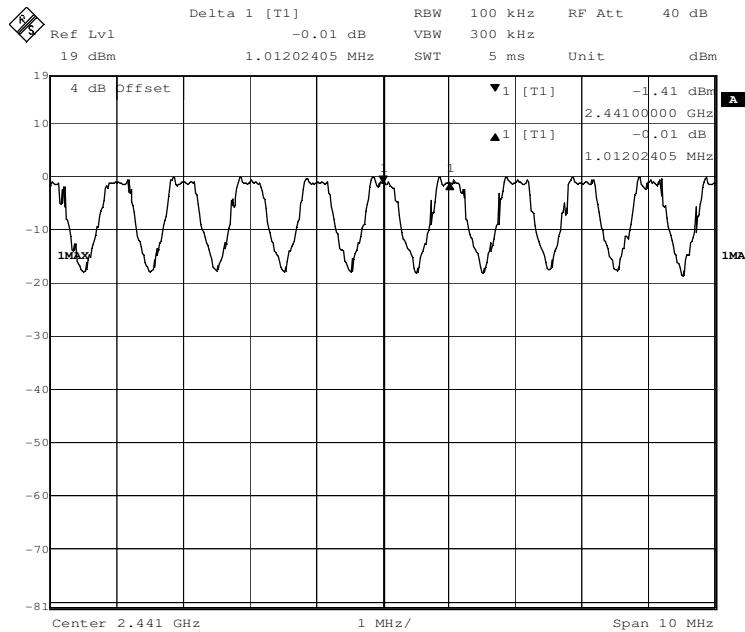
Remark:

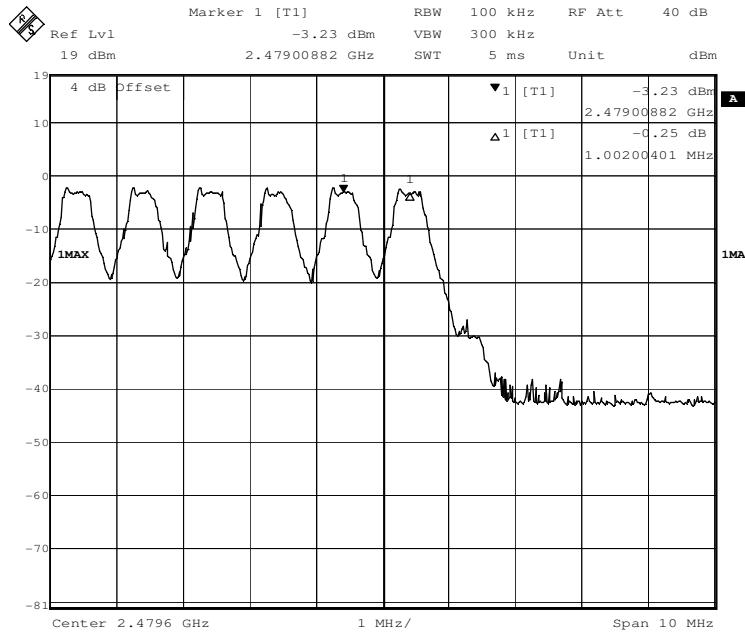
The limit is maximum two-thirds of the 20 dB bandwidth: 761.5KHz.

1. Lowest Channels: Carrier Frequencies Separated



2. Middle Channels: Carrier Frequencies Separated



3. Highest Channels: Carrier Frequencies Separated**Test result: The unit does meet the FCC requirements.**

7.5 Hopping Channel Number

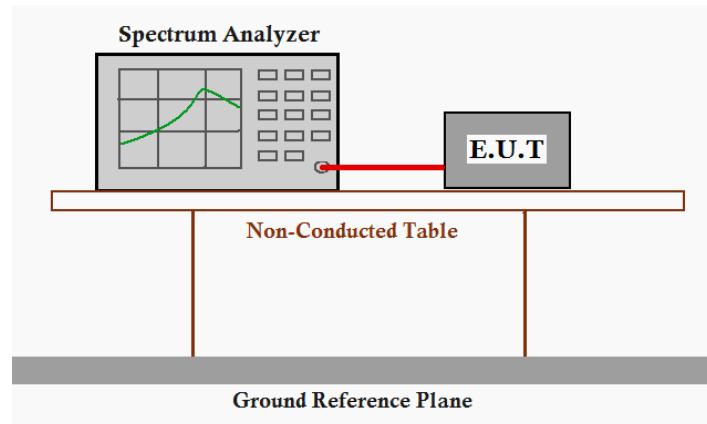
Test Requirement: FCC Part15 C section 15.247

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

Test Method: DA 00-705

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

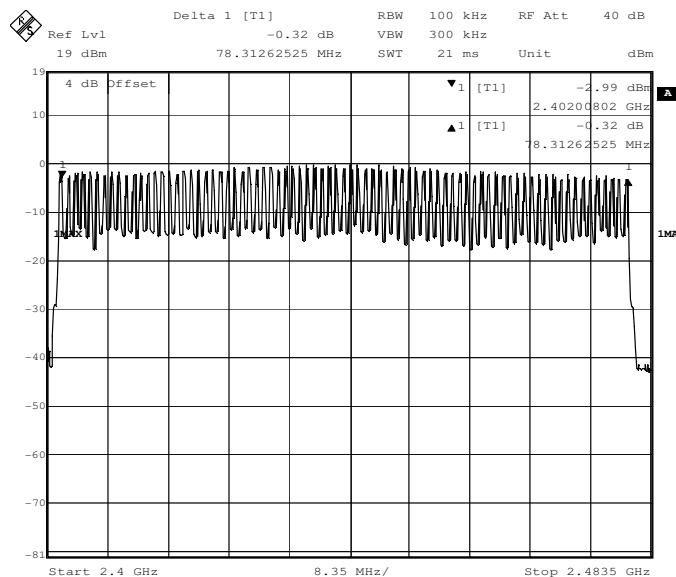
Test Configuration:



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 = 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.



Test result: The unit does meet the FCC requirements.

7.6 Dwell Time

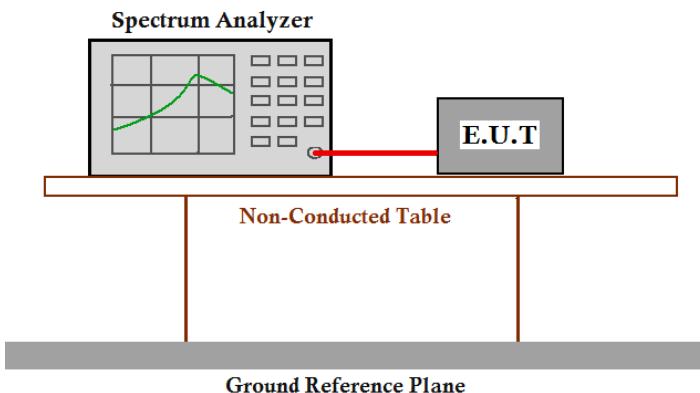
Test Requirement: FCC Part 15 C section 15.247

(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: DA 00-705

Test Status: Test the EUT in hopping mode at the lowest (2402 MHz), middle (2441 MHz) and highest (2480 MHz) channel with different data packet. Compliance test in hopping mode with Normal mode (DH1, DH3 and 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 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: $T = 0.4 \text{ Second/Channel} \times 79 \text{ Channel} = 31.6 \text{ s}$

1. Channel 0: 2.402GHz

DH1 time slot	=	0.185	(ms)	*	33	*	(31.6/3.16)	=	61.05	ms
DH3 time slot	=	1.587	(ms)	*	16	*	(31.6/3.16)	=	253.92	ms
DH5 time slot	=	2.822	(ms)	*	11	*	(31.6/3.16)	=	310.42	ms

2. Channel 39: 2.441GHz

DH1 time slot	=	0.194	(ms)	*	33	*	(31.6/3.16)	=	64.02	ms
DH3 time slot	=	1.596	(ms)	*	16	*	(31.6/3.16)	=	255.36	ms
DH5 time slot	=	2.839	(ms)	*	11	*	(31.6/3.16)	=	312.29	ms

3. Channel 78: 2.480GHz

DH1 time slot	=	0.194	(ms)	*	33	*	(31.6/3.16)	=	64.02	ms
DH3 time slot	=	1.596	(ms)	*	16	*	(31.6/3.16)	=	255.36	ms
DH5 time slot	=	2.839	(ms)	*	11	*	(31.6/3.16)	=	312.29	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)

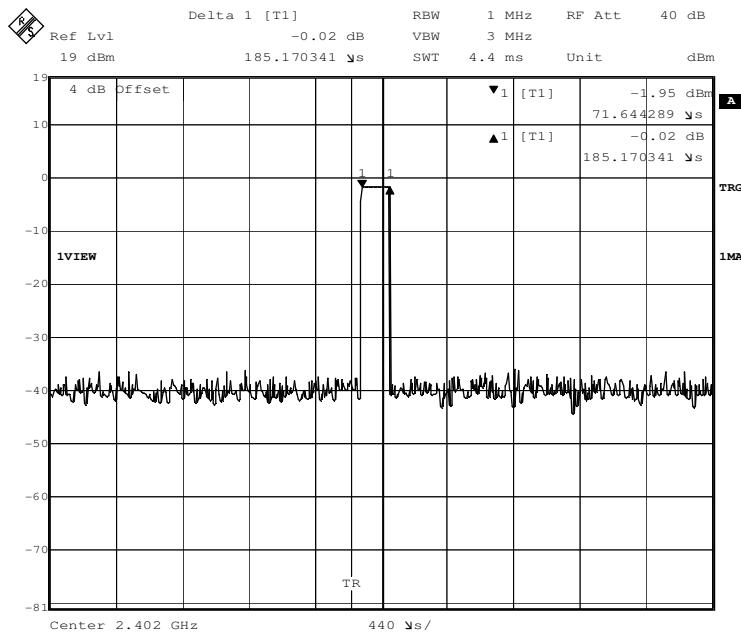
The results are not greater than 0.4 seconds.

The unit does meet the FCC requirements.

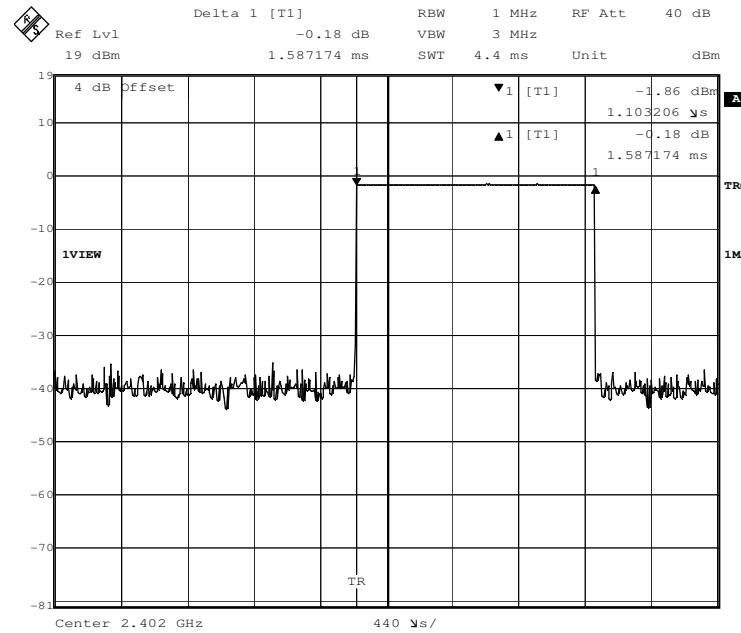
Please refer the graph as below:

1. Lowest channel (2.402 GHz):

(1). DH1

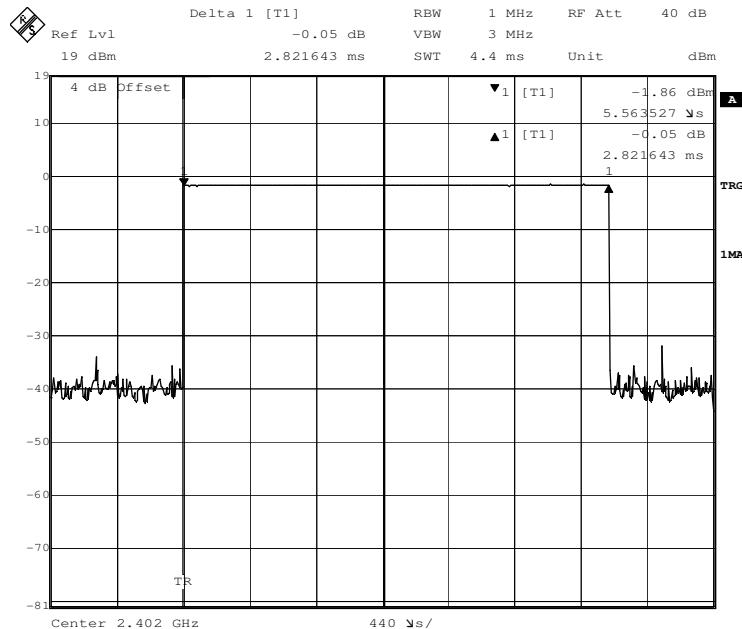


(2) DH3



(3) DH5

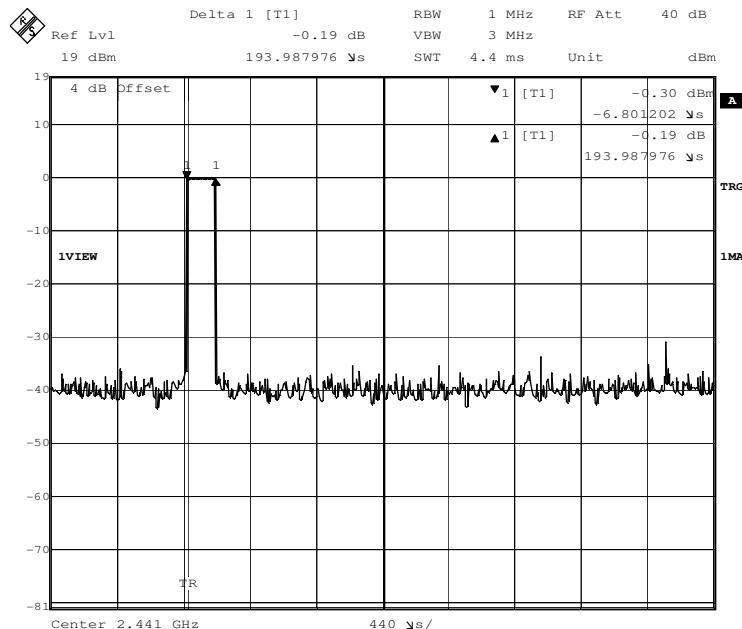
Pulse Width:

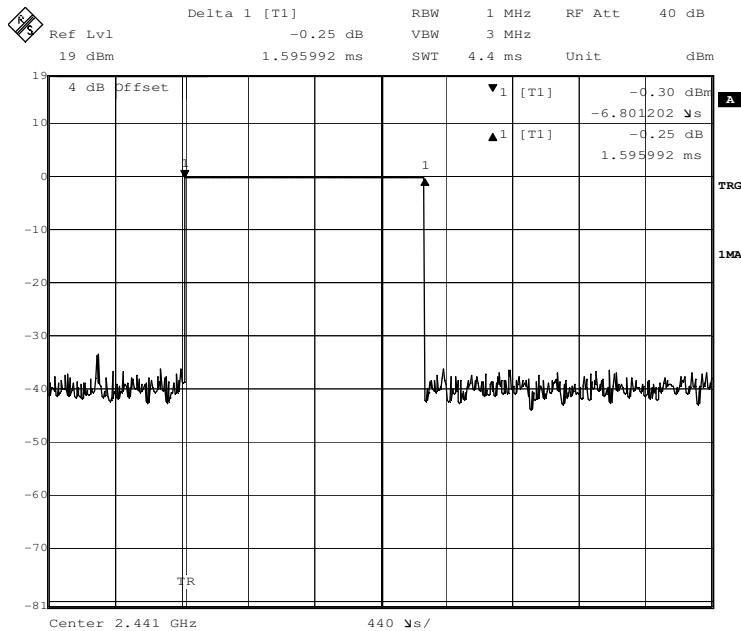
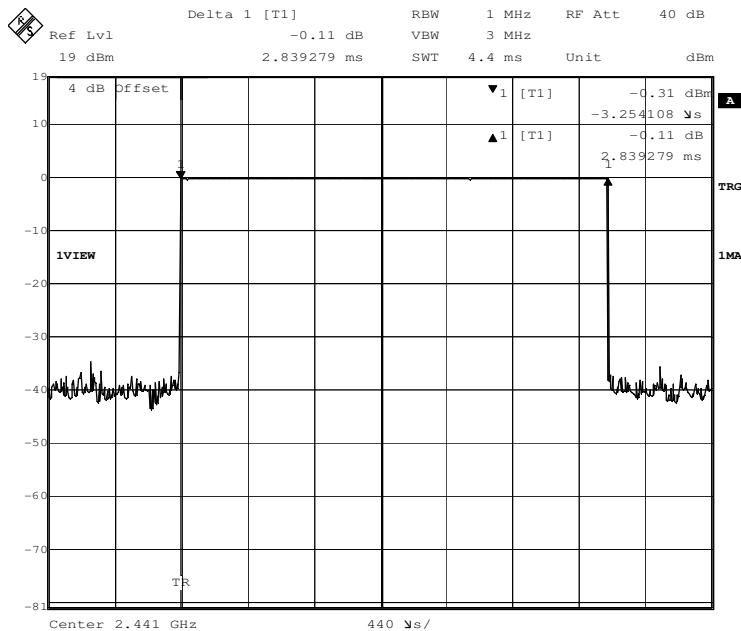


2. Middle Channel (2.441 GHz)

(1). DH1

Pulse Width:

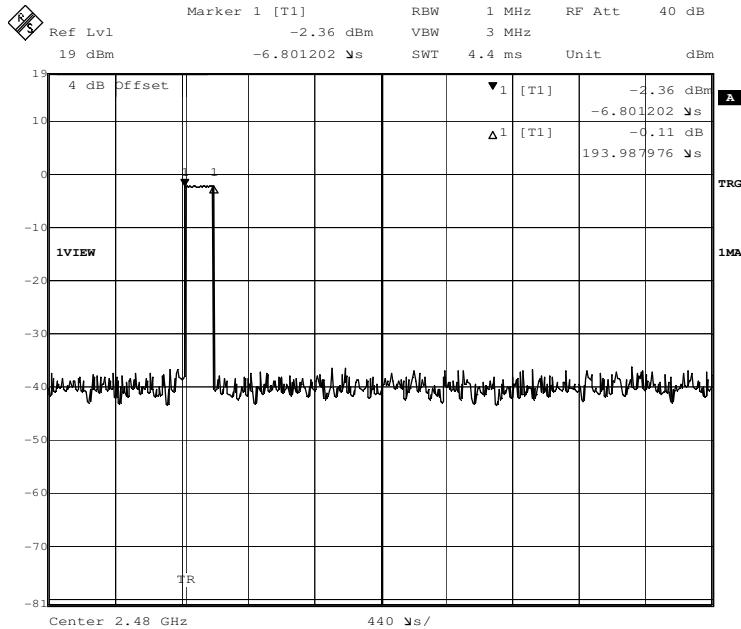


(2) DH3
Pulse Width:

(3) DH5
Pulse Width:


3. Highest Channel (2.480 GHz)

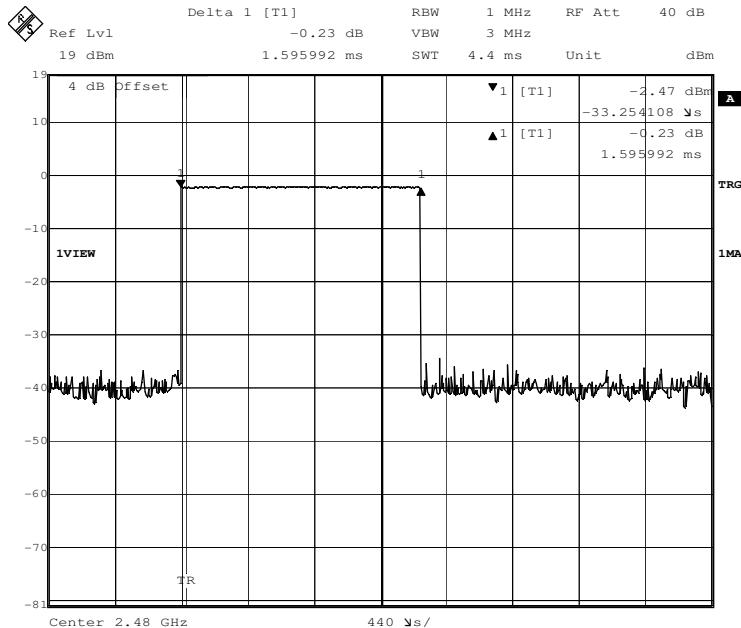
(1). DH1

Pulse Width:



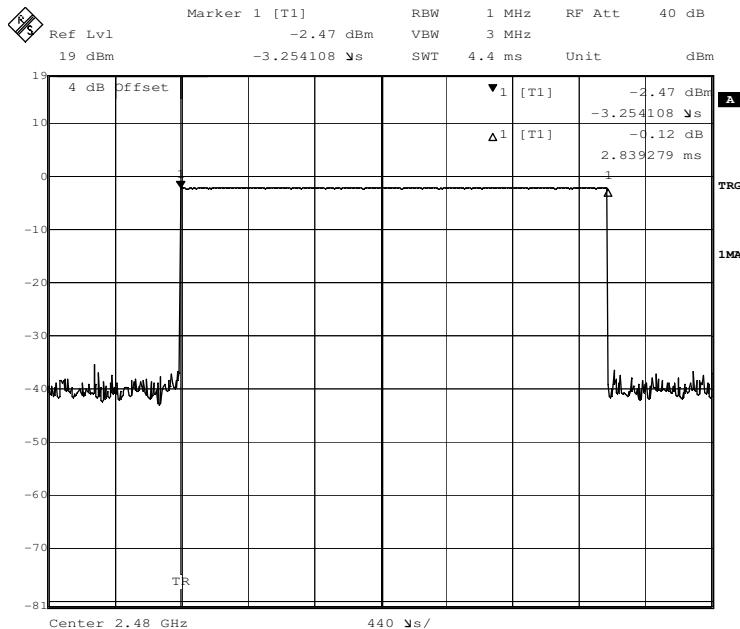
(2) DH3

Pulse Width:



(3) DH5

Pulse Width:



7.7 Pseudorandom Frequency Hopping Sequence

7.7.1 Standard requirement

15.247(a)(1) requirement:

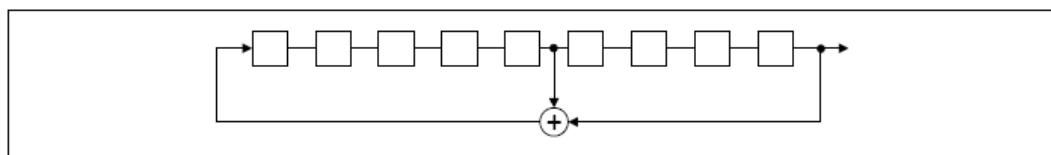
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

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.

7.7.2 EUT Pseudorandom Frequency Hopping Sequence

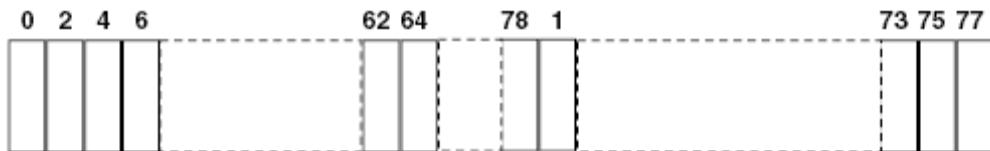
The pseudorandom sequence may be generated in a nine-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first ONE of 9 consecutive ONEs; i.e. the shift register is initialized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

7.8 Maximum Peak Output Power

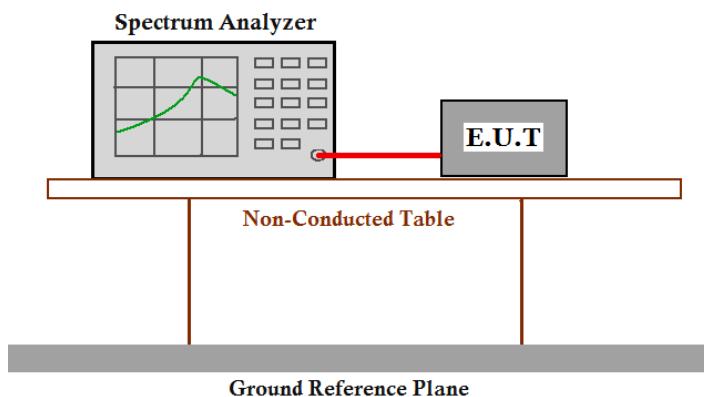
Test Requirement: FCC Part 15 C section 15.247
(b)(1)For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 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 (2441 MHz) and highest (2480 MHz) channel with different data packet. Compliance test in continuous transmitting mode with normal (DH5) as the worst case was found.

Test Configuration:



Test Procedure:

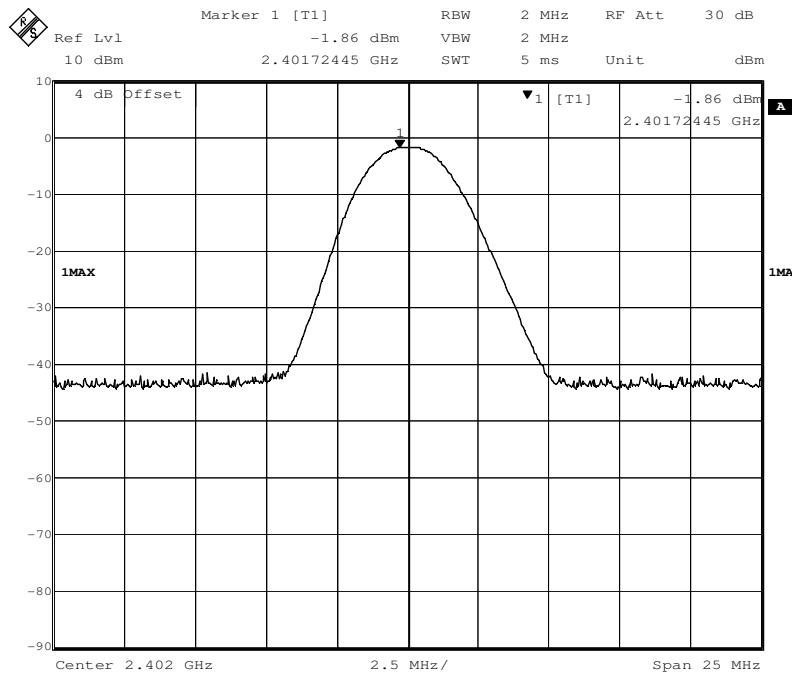
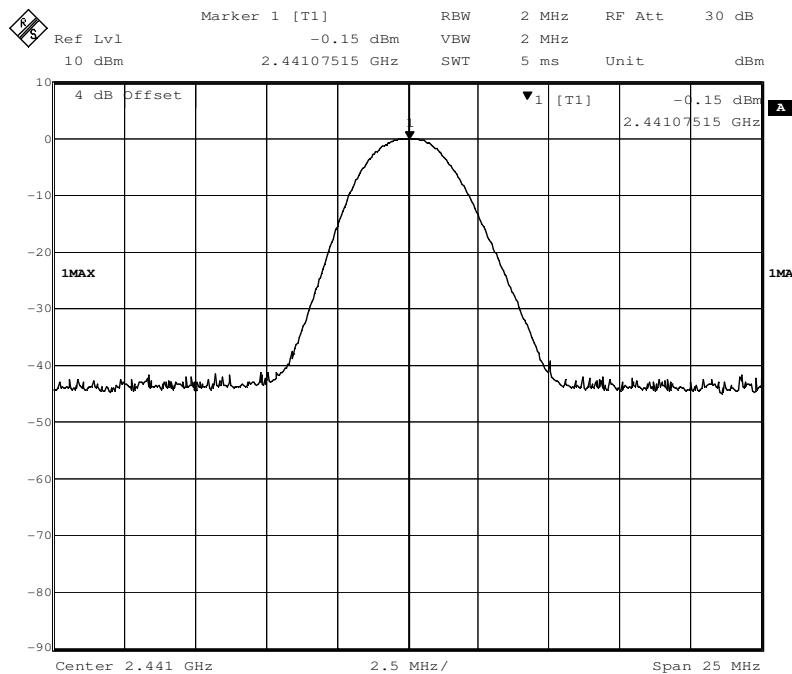
1. Remove the antenna from the EUT and then connect a low attenuation RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 2 MHz. VBW = 2 MHz. Sweep = auto; Detector Function = Peak.
3. Keep the EUT in transmitting at lowest, medium and highest channel individually. Record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

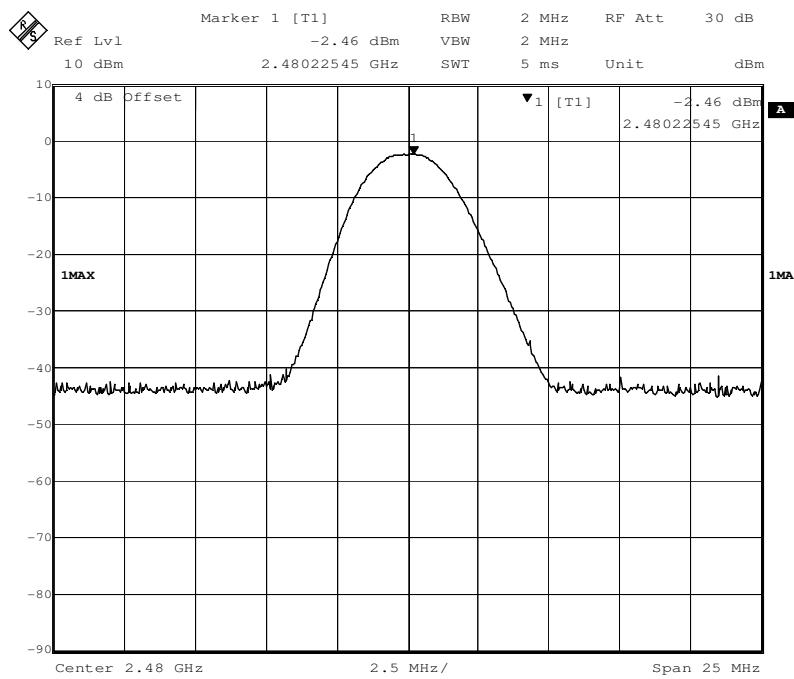
Test Result:				
Normal mode:				
Test Channel	Fundamental Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Result
Lowest	2402	-1.86	30.0	Pass
Middle	2441	-0.15	30.0	Pass
Highest	2480	-2.46	30.0	Pass

Remark: cable loss=4.0dB

Test result: The unit does meet the FCC requirements.

Test result plot as follows:

Normal mode:**Lowest Channel:****Middle Channel:**

Highest Channel:

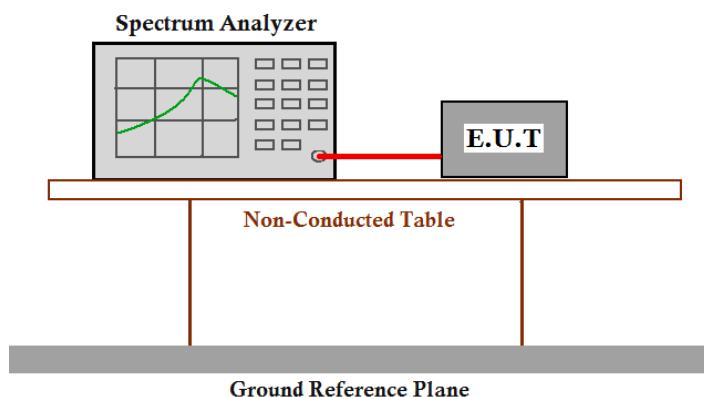
7.9 Conducted Spurious Emissions

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 (2441 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.

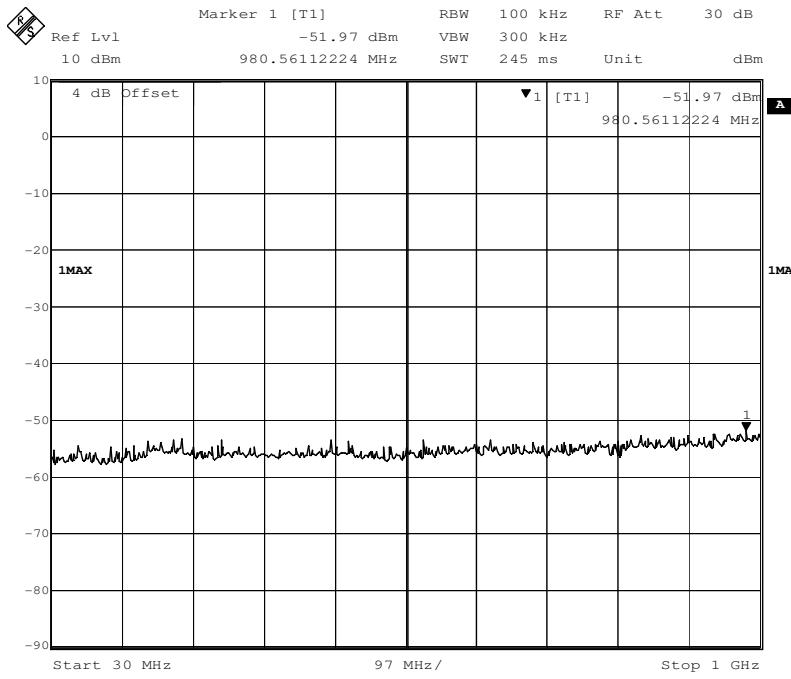
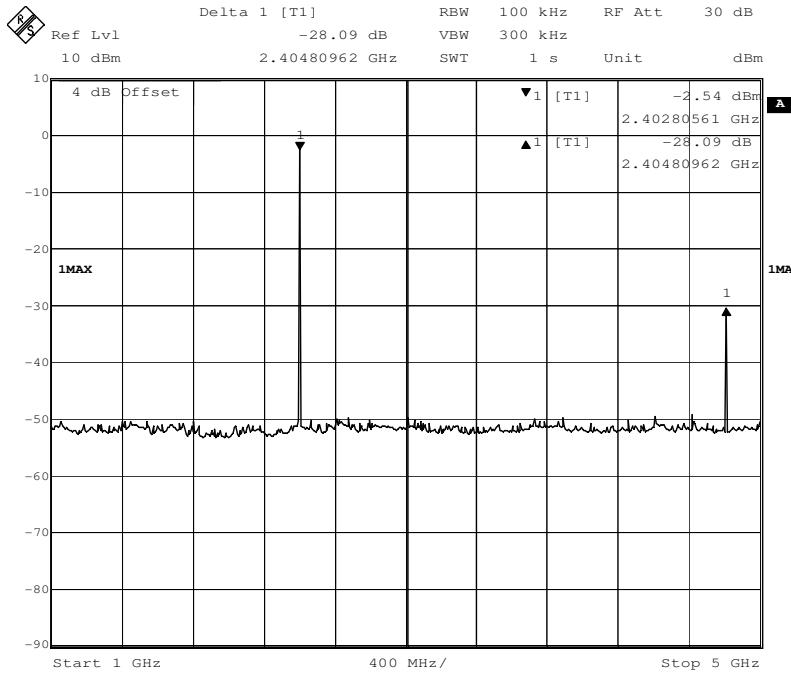
Test Configuration:

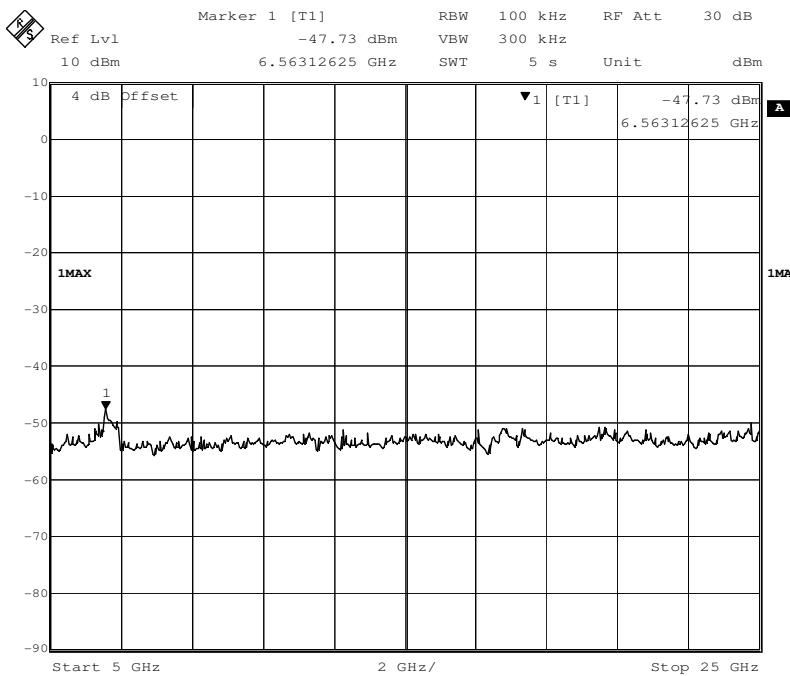
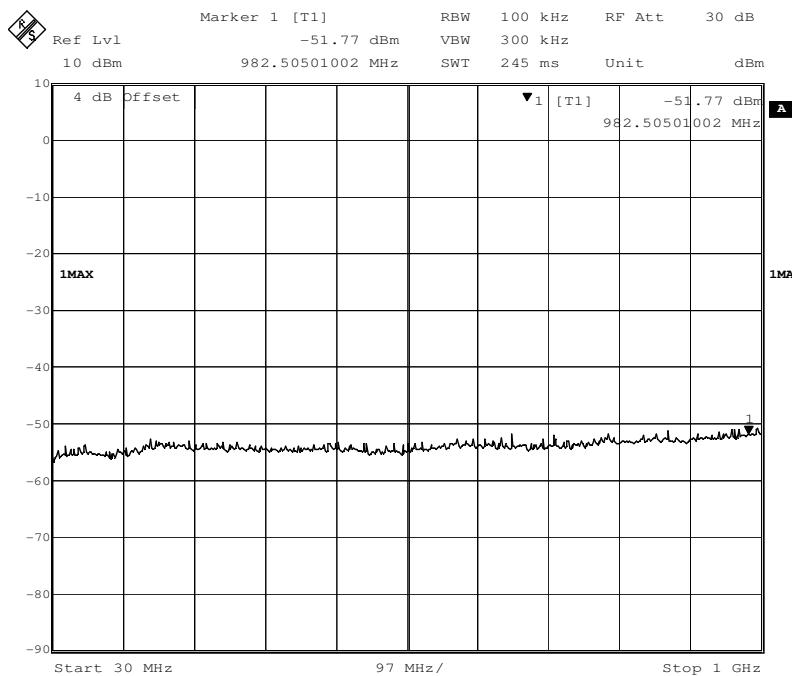


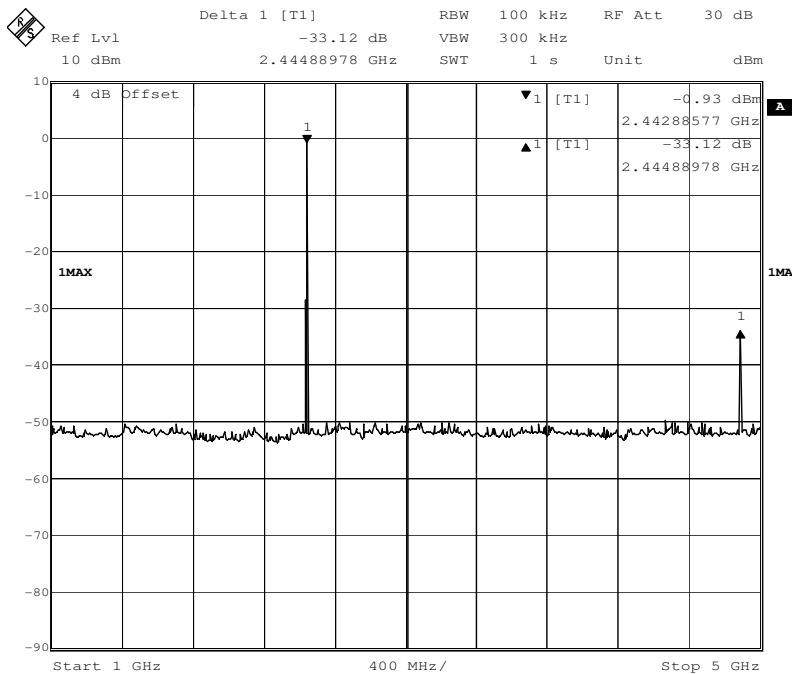
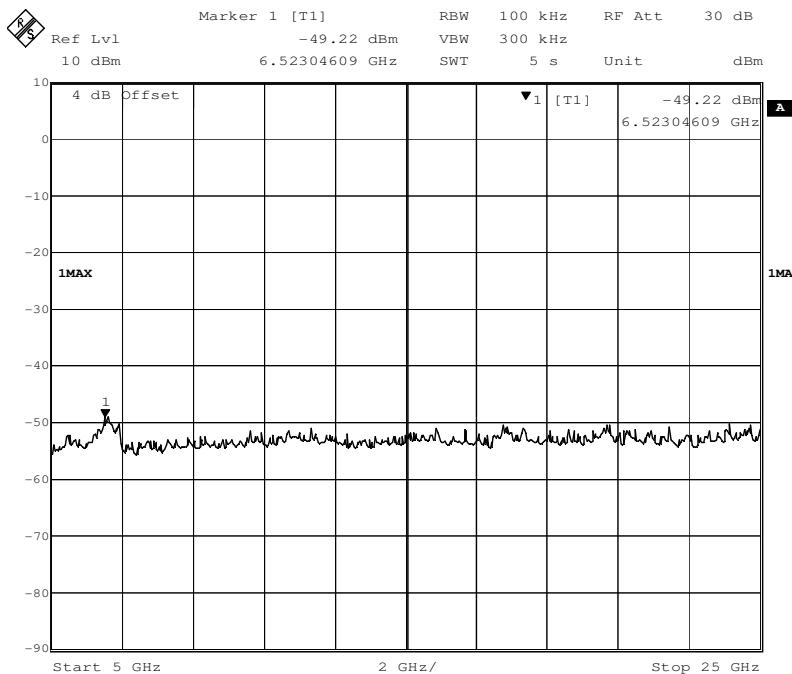
Test Procedure:

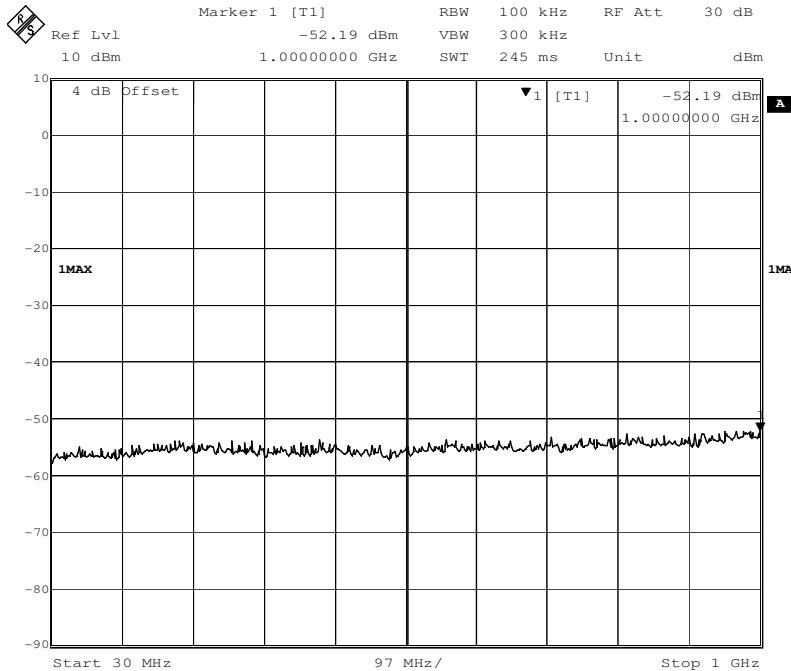
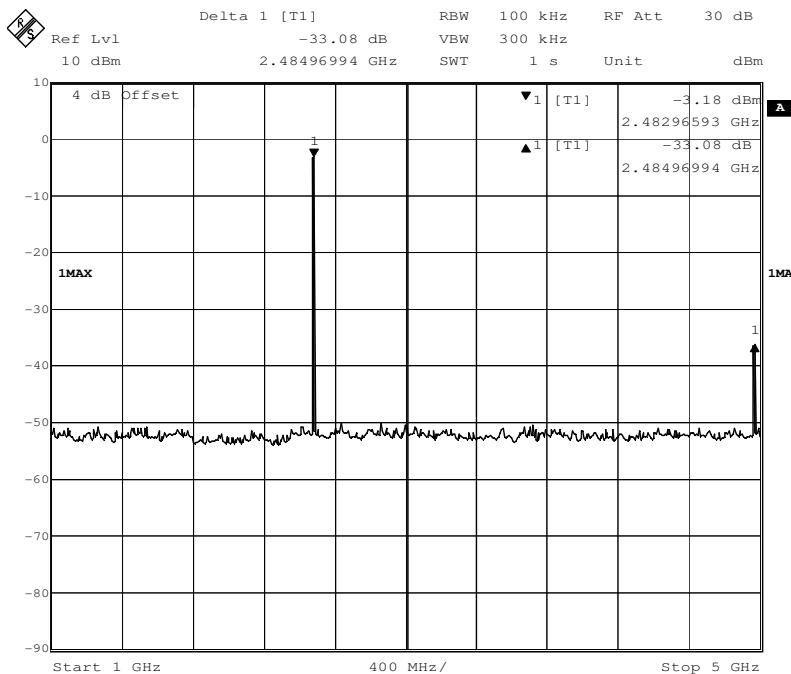
1. Remove the antenna from the EUT and then connect a low attenuation RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 100 kHz. VBW >= RBW. Sweep = auto; Detector Function = Peak (Max. hold).

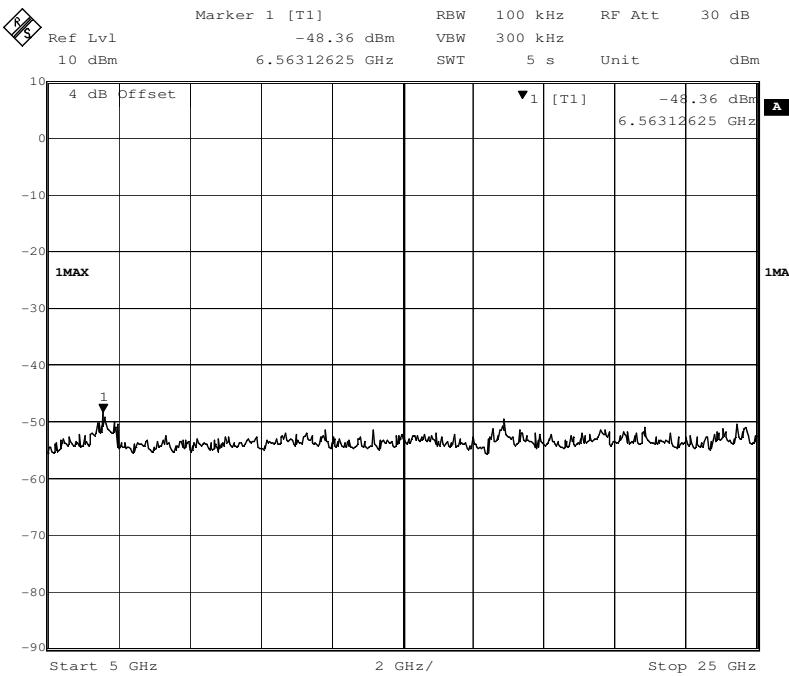
Test result plot as follows:

Lowest Channel: 30 M to 1 GHz

1 G to 5 GHz


5 G to 25 GHz

Middle Channel: 30 M to 1 GHz


1 G to 5 GHz

5 G to 25 GHz


Highest Channel: 30 M to 1 GHz

1 G to 5 GHz


5 G to 25 GHz

7.10 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 (2441 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 $f \geq 1$ GHz, 100 kHz for $f < 1$ GHz

VBW \geq RBW

Sweep = auto

Detector function = peak

Trace = max hold

For AV value:

RBW = 1 MHz for $f \geq 1$ GHz, 100 kHz for $f < 1$ GHz

VBW = 10 Hz

Sweep = auto

Detector function = peak

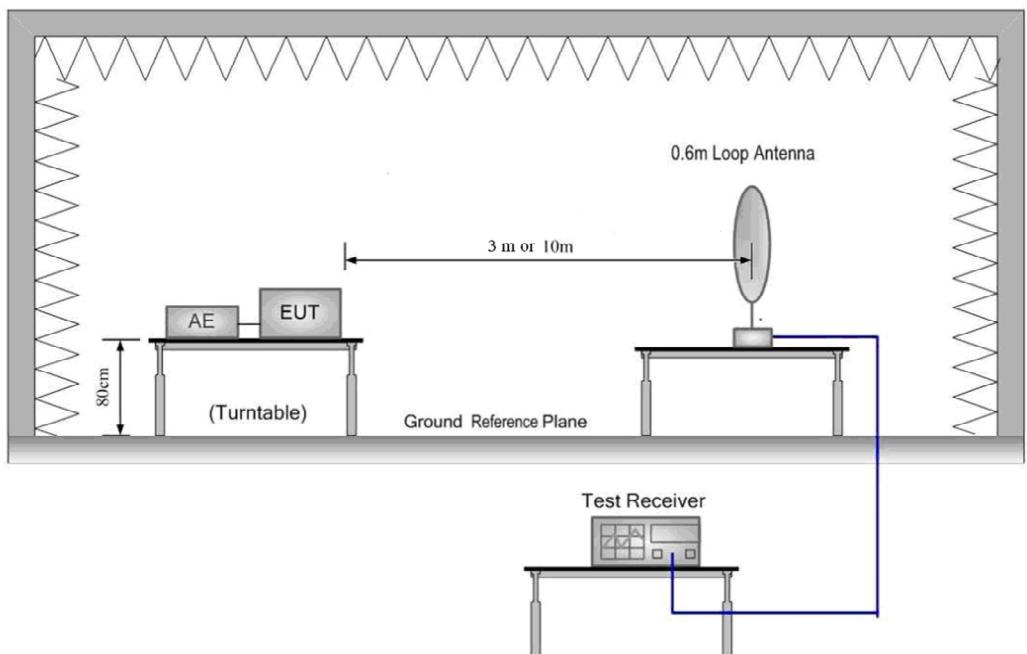
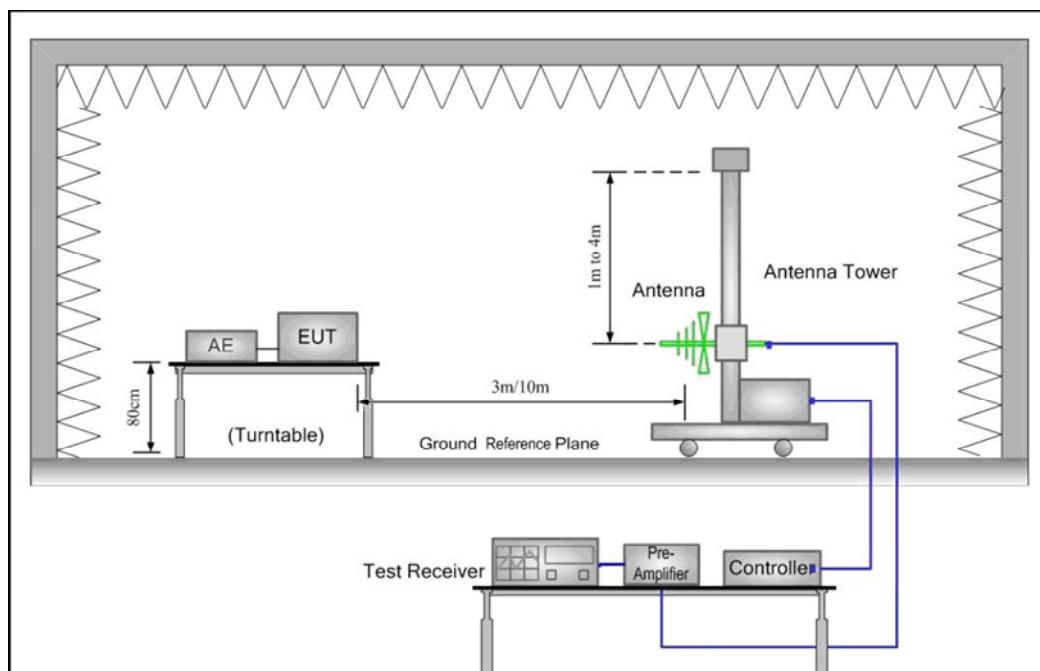
Trace = max hold

15.209 Limit: 40.0 dB μ V/m between 30MHz & 88MHz

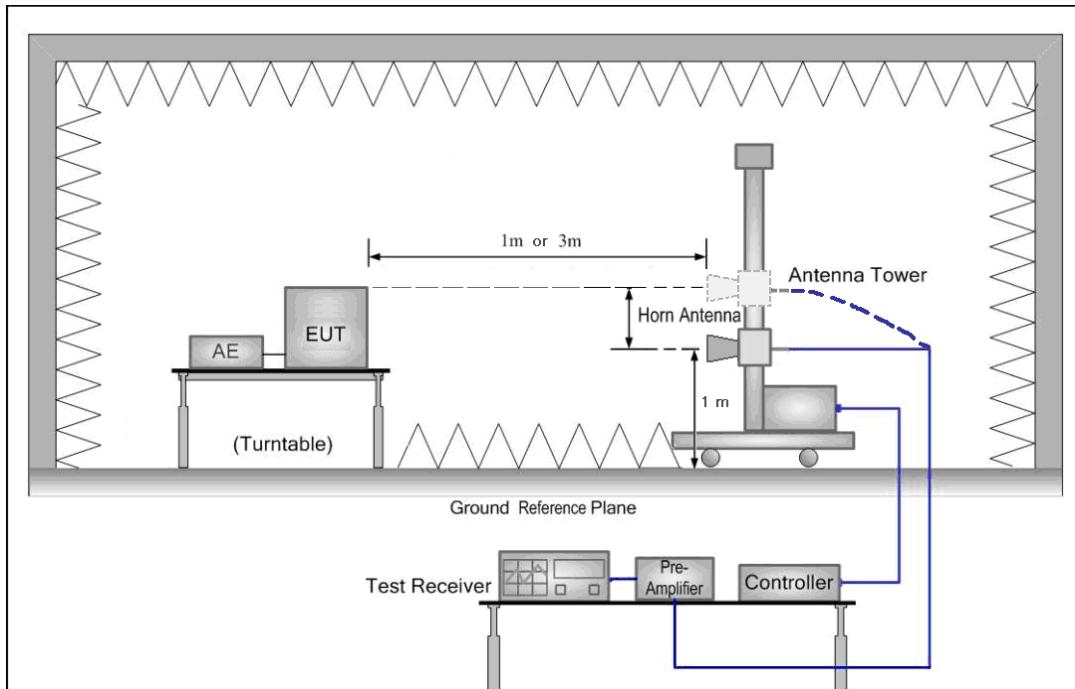
43.5 dB μ V/m between 88MHz & 216MHz

46.0 dB μ V/m between 216MHz & 960MHz

54.0 dB μ V/m above 960MHz

Test Configuration:1) 9KH to 30MHz2) 30 MHz to 1 GHz emissions:

3) 1 GHz to 40 GHz emissions:



Test Procedure: The receiver was scanned from 9KHz 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 $20\log(\text{dwell time}/100 \text{ ms})$, in an effort to demonstrate compliance with the 15.209 limit.

Submit this data.

Remark:

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.

7.10.1 Harmonic and other spurious emissions

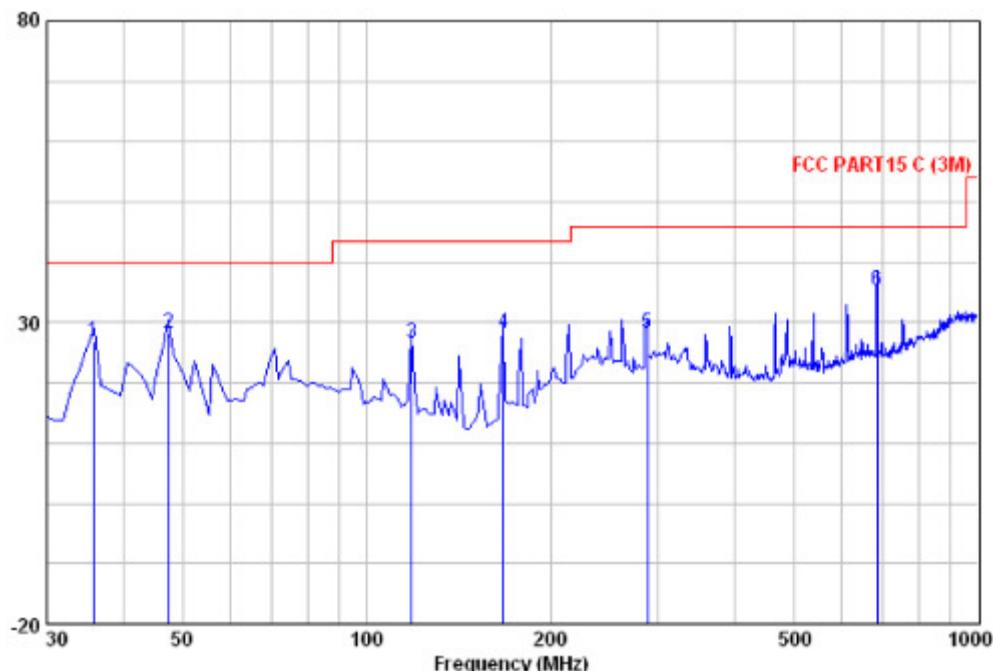
7.10.1.1 Test at low Channel in transmitting status

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

Vertical:

Peak scan

Level (dB μ V/m)

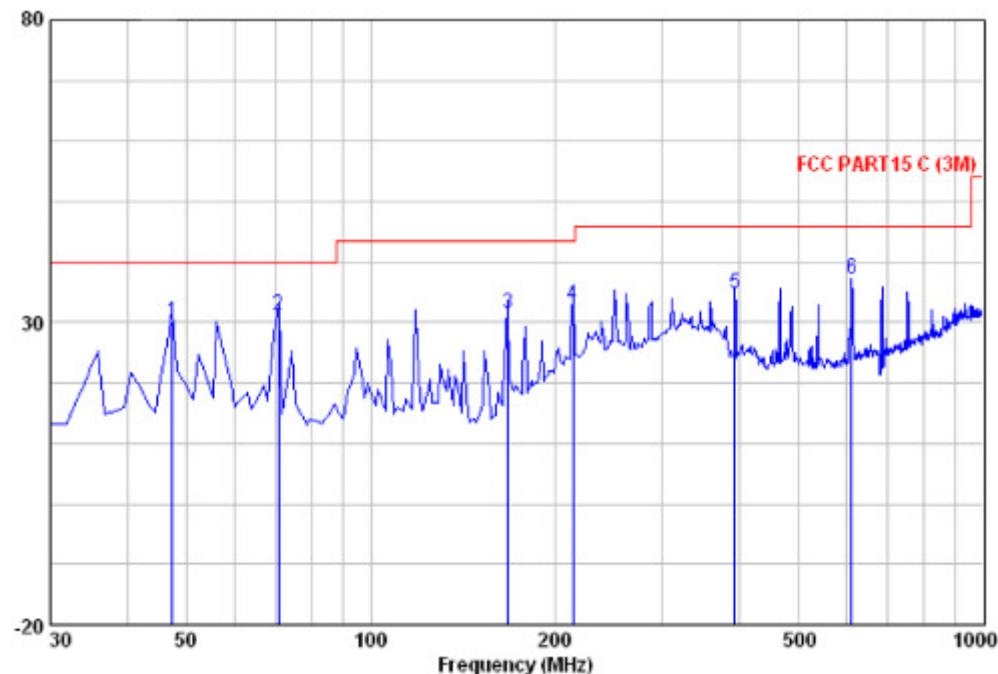


Quasi-peak measurement

Freq MHz	Read Level dBuV	Antenna Factor dB/m	Cable Loss dB	Preamp Factor dB	Line Level dBuV/m	Limit Line dBuV/m	Over Line dB	Over Limit dB	Remark
	MHz	dBuV	dB/m	dB	dBuV/m	dBuV/m	dB	dB	
35.820	43.52	12.54	0.40	29.50	26.96	40.00	-13.04	QP	
47.460	43.68	13.41	0.70	29.50	28.29	40.00	-11.71	QP	
118.420	44.51	10.79	0.90	29.70	26.50	43.50	-17.00	QP	
167.740	47.89	8.90	1.10	29.62	28.27	43.50	-15.23	QP	
288.020	43.54	12.84	1.50	29.59	28.29	46.00	-17.71	QP	
683.780	43.38	18.75	2.50	29.31	35.32	46.00	-10.68	QP	

Horizontal:

Peak scan

Level (dB μ V/m)

Quasi-peak measurement

Freq MHz	Read Level dB μ V	Antenna Factor	Cable Loss dB	Preamp Factor	Level dB μ V/m	Limit Line dB μ V/m	Over Limit dB	Remark
	MHz	dB/m	dB	dB		dB μ V/m	dB μ V/m	
47.460	45.66	13.41	0.70	29.50	30.27	40.00	-9.73	QP
70.740	51.68	8.52	0.70	29.60	31.29	40.00	-8.71	QP
167.740	51.01	8.90	1.10	29.62	31.38	43.50	-12.12	QP
214.300	49.96	11.00	1.30	29.52	32.74	43.50	-10.76	QP
393.750	47.72	14.92	1.80	29.60	34.84	46.00	-11.16	QP
611.030	45.68	18.50	2.30	29.39	37.09	46.00	-8.91	QP

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

Peak Measurement:

Frequency (MHz)	Antenna factors (dB/m)	Cable loss (dB)	Preamp factor (dB)	Reading Level (dB μ V)	Emission Level (dB μ V/m)	Limit (dB μ V/m)	Antenna polarization
4804.000	31.53	6.20	33.48	51.23	55.48	74.00	V
7206.000	36.47	7.20	32.76	48.35	59.26	74.00	V
9608.000	38.08	8.56	34.08	49.62	62.18	74.00	V
4804.000	31.53	6.20	33.48	49.56	53.81	74.00	H
7206.000	36.47	7.20	32.76	48.79	59.70	74.00	H
9608.000	38.08	8.56	34.08	48.93	61.49	74.00	H

Average Measurement:

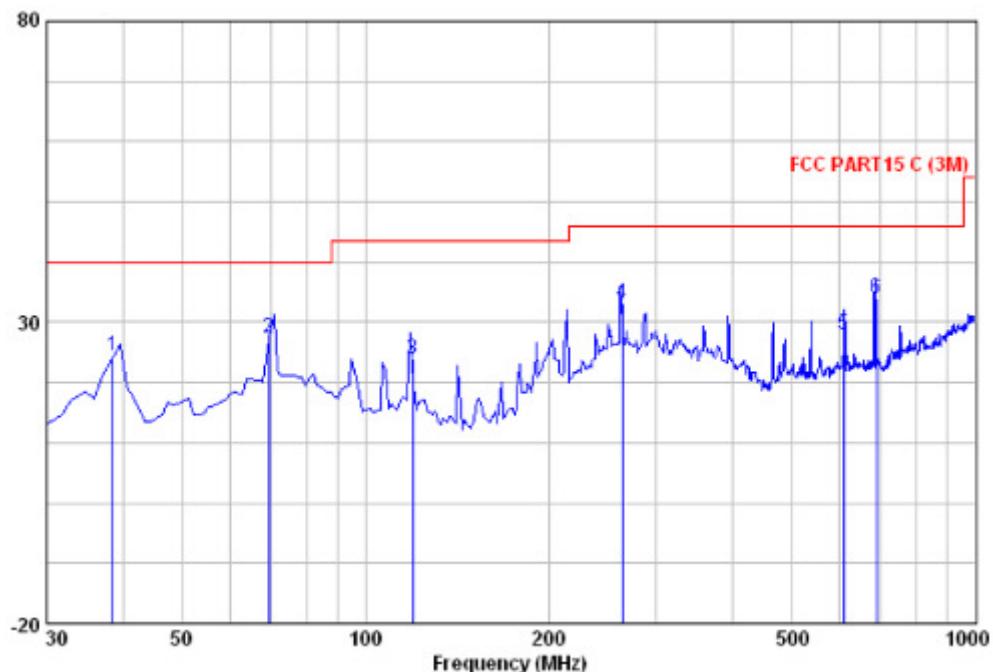
Frequency (MHz)	Antenna factors (dB/m)	Cable loss (dB)	Preamp factor (dB)	Reading Level (dB μ V)	Emission Level (dB μ V/m)	Limit (dB μ V/m)	Antenna polarization
4804.000	31.53	6.20	33.48	42.95	47.20	54.00	V
7206.000	36.47	7.20	32.76	38.05	48.96	54.00	V
9608.000	38.08	8.56	34.08	37.34	49.90	54.00	V
4804.000	31.53	6.20	33.48	39.51	43.76	54.00	H
7206.000	36.47	7.20	32.76	39.90	50.81	54.00	H
9608.000	38.08	8.56	34.08	37.85	50.41	54.00	H

7.10.1.2 Test at middle Channel in transmitting status

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

Vertical:

Peak scan

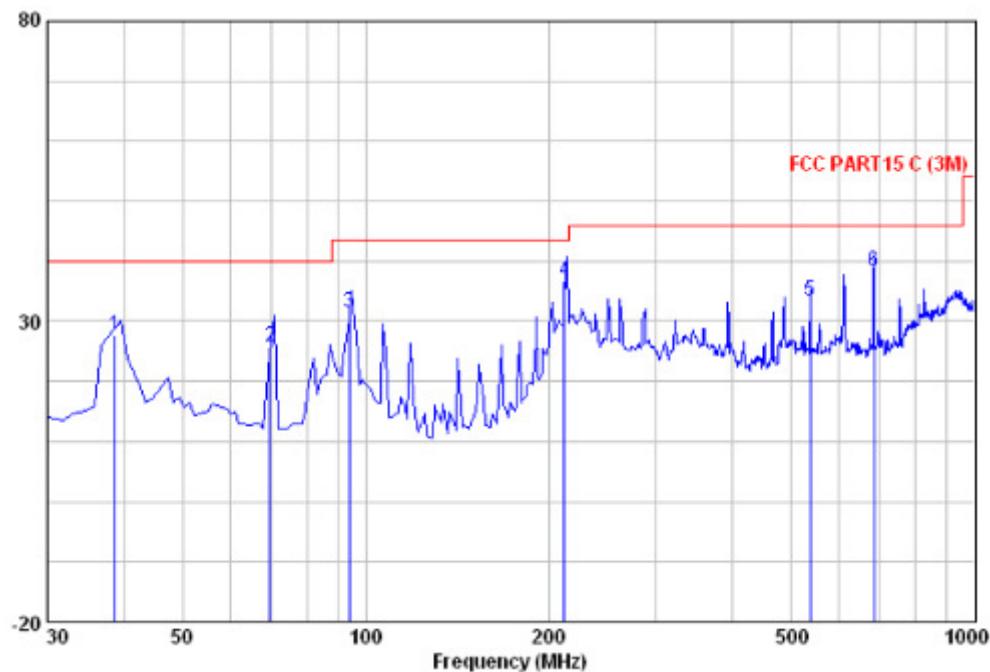
Level (dB μ V/m)

Quasi-peak measurement

Freq MHz	Read	Antenna Level dB μ V	Antenna Factor	Cable Loss dB	Preamp Factor	Line Level dB μ V/m	Line Limit dB μ V/m	Over Limit dB	Over Limit Remark
38.430	40.11	13.20	0.50	29.50	24.31	40.00	-15.69	QP	
69.370	47.47	8.92	0.70	29.59	27.50	40.00	-12.50	QP	
119.560	42.16	10.58	0.90	29.70	23.95	43.50	-19.55	QP	
263.770	49.04	12.17	1.50	29.57	33.15	46.00	-12.85	QP	
609.090	36.57	18.48	2.30	29.39	27.97	46.00	-18.03	QP	
687.970	41.88	18.76	2.50	29.31	33.84	46.00	-12.16	QP	

Horizontal:

Peak scan

Level (dB μ V/m)

Quasi-peak measurement

Freq MHz	Read	Antenna	Cable	Preamp	Limit Line dBuV/m	Over Line dB	Over Limit dB	Remark
	Level dB μ V	Factor	Loss dB	Factor				
38.712	43.45	13.25	0.50	29.50	27.70	40.00	-12.30	QP
69.640	45.80	8.79	0.70	29.60	25.70	40.00	-14.30	QP
94.020	47.49	12.67	0.90	29.68	31.37	43.50	-12.13	QP
212.360	53.96	10.97	1.30	29.51	36.71	43.50	-6.79	QP
537.310	43.27	17.31	2.20	29.46	33.32	46.00	-12.68	QP
685.720	46.40	18.76	2.50	29.31	38.35	46.00	-7.65	QP

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

Peak Measurement:

Frequency (MHz)	Antenna factors (dB/m)	Cable loss (dB)	Preamp factor (dB)	Reading Level (dB μ V)	Emission Level (dB μ V/m)	Limit (dB μ V/m)	Antenna polarization
4882.000	31.57	6.27	33.15	55.79	60.48	74.00	V
7323.000	36.50	7.68	32.61	48.69	60.26	74.00	V
9764.000	38.51	8.66	34.17	47.32	60.32	74.00	V
4882.000	31.57	6.27	33.15	49.87	54.56	74.00	H
7323.000	36.50	7.68	32.61	48.79	60.36	74.00	H
9764.000	38.51	8.66	34.17	46.21	59.21	74.00	H

Average Measurement:

Frequency (MHz)	Antenna factors (dB/m)	Cable loss (dB)	Preamp factor (dB)	Reading Level (dB μ V)	Emission Level (dB μ V/m)	Limit (dB μ V/m)	Antenna polarization
4882.000	31.57	6.27	33.15	45.61	50.30	54.00	V
7323.000	36.50	7.68	32.61	38.18	49.75	54.00	V
9764.000	38.51	8.66	34.17	37.22	50.22	54.00	V
4882.000	31.57	6.27	33.15	39.36	44.05	54.00	H
7323.000	36.50	7.68	32.61	38.26	49.83	54.00	H
9764.000	38.51	8.66	34.17	37.29	50.29	54.00	H

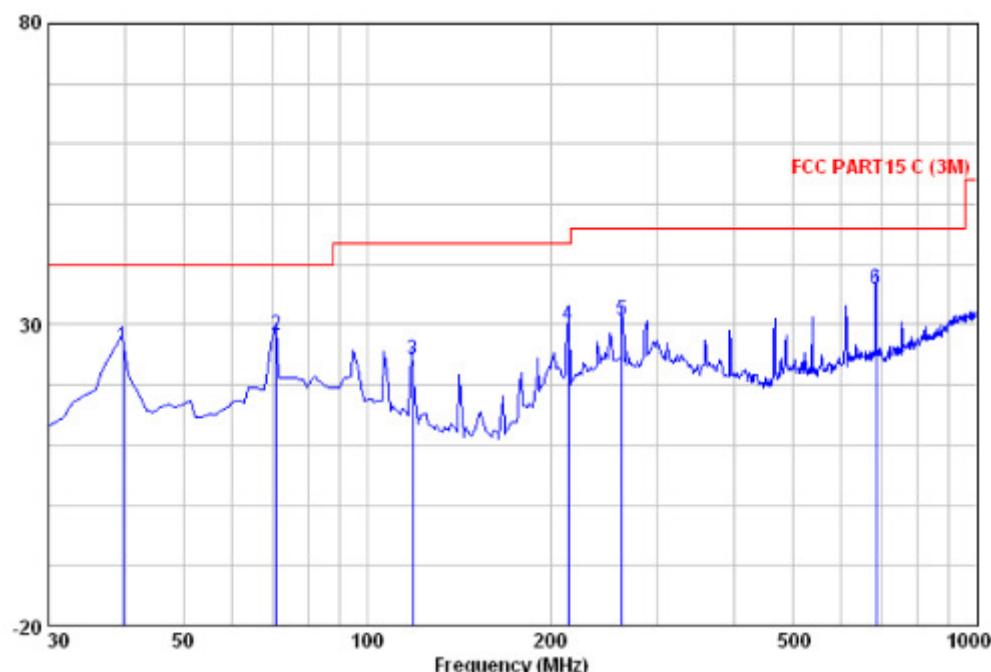
7.10.1.3 Test at high Channel in transmitting status

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

Vertical:

Peak scan

Level (dB μ V/m)

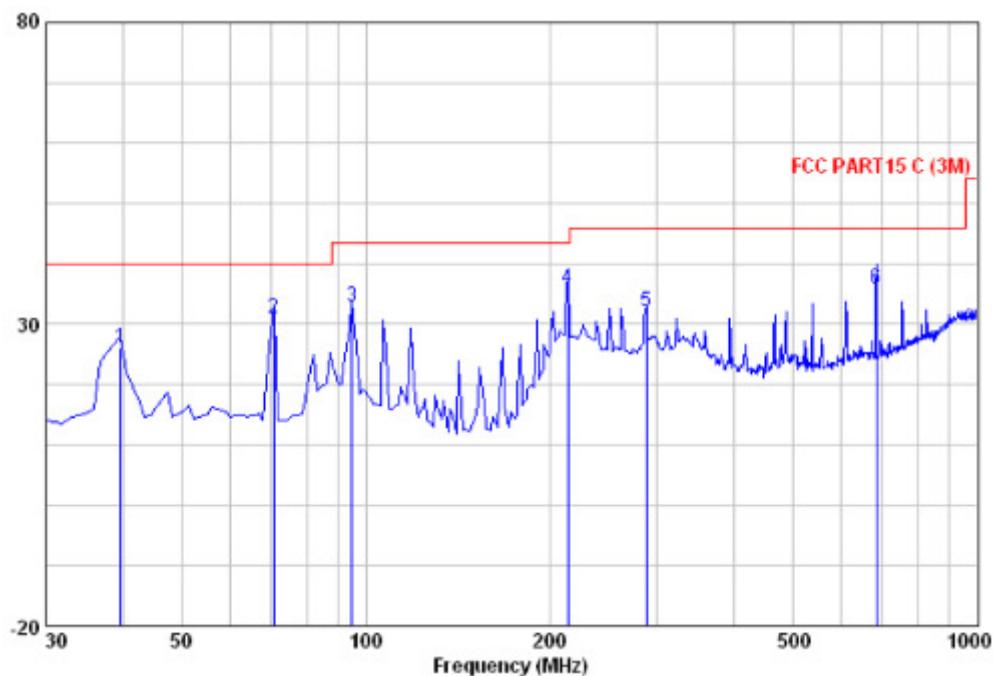


Quasi-peak measurement

Freq MHz	Read Antenna Level Factor		Cable Loss Factor		Preamp Level		Limit Line	Over Limit	Remark
	dB μ V	dB/m	dB	dB	dB μ V/m	dB μ V/m	dB	dB	
39.750	41.75	13.49	0.50	29.50	26.24	40.00	-13.76	QP	
70.890	48.48	8.52	0.70	29.60	28.10	40.00	-11.90	QP	
118.870	42.27	10.69	0.90	29.70	24.16	43.50	-19.34	QP	
214.300	47.15	11.00	1.30	29.52	29.93	43.50	-13.57	QP	
261.830	46.74	12.13	1.50	29.57	30.80	46.00	-15.20	QP	
683.780	44.04	18.75	2.50	29.31	35.98	46.00	-10.02	QP	

Horizontal:

Peak scan

Level (dB μ V/m)

Quasi-peak measurement

Freq MHz	Read Antenna Level Factor		Cable Preamp Loss Factor		Level dB μ V/m	Limit Line dB μ V/m	Over Limit dB	Over Limit Remark
	MHz	dB μ V	dB/m	dB				
39.710	41.60	13.49	0.50	29.50	26.09	40.00	-13.91	QP
70.750	51.29	8.52	0.70	29.60	30.91	40.00	-9.09	QP
94.990	48.91	12.84	0.90	29.69	32.97	43.50	-10.53	QP
214.300	53.00	11.00	1.30	29.52	35.79	43.50	-7.71	QP
288.020	47.18	12.84	1.50	29.59	31.93	46.00	-14.07	QP
683.880	44.05	18.75	2.50	29.31	35.99	46.00	-10.01	QP

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

Peak Measurement:

Frequency (MHz)	Antenna factors (dB/m)	Cable loss (dB)	Preamp factor (dB)	Reading Level (dB μ V)	Emission Level (dB μ V/m)	Limit (dB μ V/m)	Antenna polarization
4960.000	31.70	6.20	32.82	55.24	60.32	74.00	V
7440.000	36.60	7.47	32.46	47.19	58.80	74.00	V
9920.000	38.68	8.75	34.26	47.10	60.27	74.00	V
4960.000	31.70	6.20	32.82	49.44	54.52	74.00	H
7440.000	36.60	7.47	32.46	47.21	58.82	74.00	H
9920.000	38.68	8.75	34.26	46.89	60.06	74.00	H

Average Measurement:

Frequency (MHz)	Antenna factors (dB/m)	Cable loss (dB)	Preamp factor (dB)	Reading Level (dB μ V)	Emission Level (dB μ V/m)	Limit (dB μ V/m)	Antenna polarization
4960.000	31.70	6.20	32.82	42.26	47.34	54.00	V
7440.000	36.60	7.47	32.46	39.26	50.87	54.00	V
9920.000	38.68	8.75	34.26	37.86	51.03	54.00	V
4960.000	31.70	6.20	32.82	43.26	48.34	54.00	H
7440.000	36.60	7.47	32.46	39.26	50.87	54.00	H
9920.000	38.68	8.75	34.26	37.42	50.59	54.00	H

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.

7.10.2 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 (2441 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 dB μ V/m between 30MHz & 88MHz;

43.5 dB μ V/m between 88MHz & 216MHz;

46.0 dB μ V/m between 216MHz & 960MHz;

54.0 dB μ V/m above 960MHz.

Detector: For PK value:

RBW = 1 MHz for $f \geq 1$ GHz, 100 kHz for $f < 1$ GHz

VBW \geq RBW

Sweep = auto

Detector function = peak

Trace = max hold

For AV value:

RBW = 1 MHz for $f \geq 1$ GHz, 100 kHz for $f < 1$ GHz

VBW = 10 Hz

Sweep = auto

Detector function = peak

Trace = max hold

Test Result:**1. Low Channel**

Frequency (MHz)	Antenna factors (dB/m)	Cable loss(dB)	Preamp factor(dB)	Peak Reading Level (dB μ V)	Average Reading Level (dB μ V)	Peak Emission Level (dB μ V/m)	Average Emission Level (dB μ V/m)
2310.000	27.93	4.23	35.60	49.02	36.12	45.58	32.68
2390.000	27.61	4.30	35.60	50.71	44.63	47.02	40.94
2500.000	27.55	4.40	35.60	48.31	35.26	44.66	31.61
2483.500	27.55	4.40	35.60	47.32	36.71	43.67	33.06

2. Middle Channel

Frequency (MHz)	Antenna factors (dB/m)	Cable loss(dB)	Preamp factor(dB)	Peak Reading Level (dB μ V)	Average Reading Level (dB μ V)	Peak Emission Level (dB μ V/m)	Average Emission Level (dB μ V/m)
2310.000	27.93	4.23	35.60	48.42	38.11	44.98	34.67
2390.000	27.61	4.30	35.60	49.31	39.76	45.62	36.07
2500.000	27.55	4.40	35.60	48.45	38.49	44.80	34.84
2483.500	27.55	4.40	35.60	49.16	39.98	45.51	36.33

3. High Channel

Frequency (MHz)	Antenna factors (dB/m)	Cable loss(dB)	Preamp factor(dB)	Peak Reading Level (dB μ V)	Average Reading Level (dB μ V)	Peak Emission Level (dB μ V/m)	Average Emission Level (dB μ V/m)
2310.000	27.93	4.23	35.60	48.96	38.67	45.52	35.23
2390.000	27.61	4.30	35.60	47.49	39.63	43.80	35.94
2500.000	27.55	4.40	35.60	49.82	38.92	46.17	35.27
2483.500	27.55	4.40	35.60	50.96	40.82	47.31	37.17

Remark: No any other emission which falls in restricted bands can be detected and be reported.

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			

7.11 Band Edges Requirement

Test Requirement: FCC Part15 C section 15.247

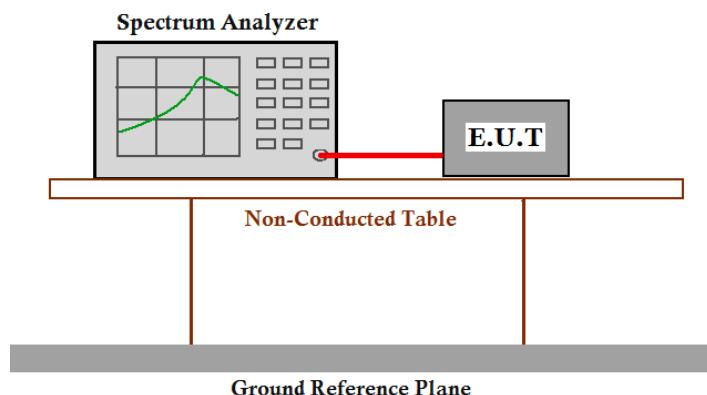
(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains 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: Clause 6.9.2

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) as the worst case was found.

Test Configuration:



Test Procedure: Set RBW of spectrum analyzer to 100 kHz and VBW of spectrum analyzer to 100 kHz with suitable frequency span including 100 kHz bandwidth from band edge.

The band edges was measured and recorded Result:

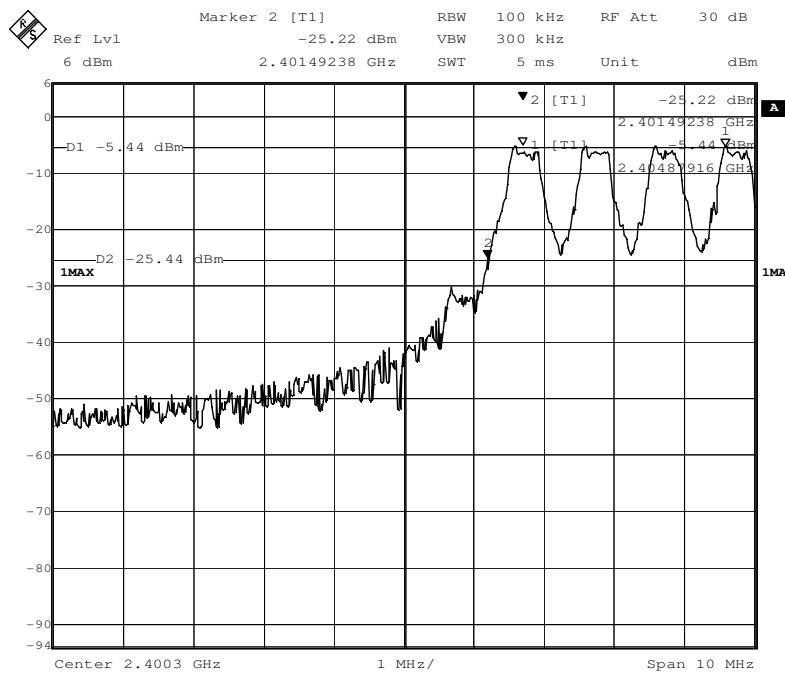
The Lower Edges attenuated more than 20dB.

The Upper Edges attenuated more than 20dB.

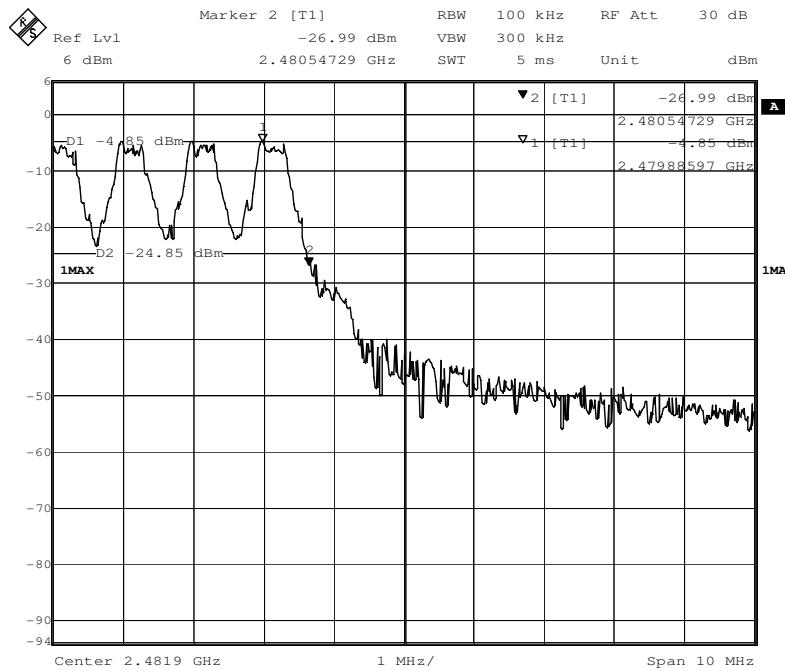
The graph as below. Represents the emissions take for this device.

DH5:

Low channel:



Highest Channel:


Test result: The unit does meet the FCC requirements.
--End of Report--