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TEST REPORT

Application No.:	GZEM1710006288CR
Applicant:	Xiamen Cowell Industrial Co., Ltd
Address of Applicant:	No.1999, Dongfu Industrial Zone, Haicang District, Xiamen City, China
Manufacturer:	The same as Applicant
Address of Manufacturer:	The same as Applicant
Factory:	The same as Applicant
Address of Factory:	The same as Applicant
Equipment Under Test (EUT):	
EUT Name:	treadmill
FCC ID:	2AOQ5-R20-PM810
Model No.:	PM810, PM820 ¤
¤	Please refer to section 3 of this report which indicates which model was actually tested and which were electrically identical.
Trade Mark:	PACEMASTER
Standards :	47 CFR Part 15, Subpart C:2016 section 15.247
Date of Receipt:	2017-10-27
Date of Test:	2017-11-16 to 2017-12-11
Date of Issue:	2018-03-15
Test Result:	**Pass***

* In the configuration tested, the EUT complied with the standards specified above.

Kobe Jian
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. 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.

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2 Version

Revision Record				
Version	**Chapter**	**Date**	**Modifier**	**Remark**
00		2018-03-15		Original

Authorized for issue by:				
Tested By		Vico.Cui **Vico Cui /Project Engineer**		2017-11-16 to 2017-12-11 **Date**
Checked By		Ricky Liu **Ricky_Liu /Reviewer**		2017-12-15 **Date**

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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 6.9.2	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)	FCC PART 15 C section 15.247(a)(1)	PASS
Maximum Peak Output Power	FCC PART 15 C section 15.247(b)(1)	ANSI C63.10: Clause 7.8.5	PASS
Unwanted Emission (30 MHz to 25 GHz)	FCC PART 15 C section 15.247(d)	ANSI C63.10: Clause 7.8.8	PASS
Radiated Spurious Emissions	FCC PART 15 C Section 15.209 and 15.205	ANSI C63.10:	PASS **
Radiated Emissions which fall in the restricted bands	FCC PART 15 C section 15.247(d)	ANSI C63.10: Clause 6.3, 6.5 and 6.6	PASS
Band Edges Measurement	FCC PART 15 C section 15.247 (d) &15.205	ANSI C63.10: Clause 6.10	PASS
Conducted Emissions at Mains Terminals	FCC PART 15 C section 15.207	ANSI C63.10 : Clause 6.2	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 C63.10:2013 in the whole report.

DA 00-705 was used as a guideline in preparing this Test Report.

Conducted testing use a direct connection between the antenna port of the device and the spectrum analyzer, may through suitable attenuator, all the attenuation in the conducted RF path, include cable loss or external attenuation will be offset to the spectrum analyzer during testing. Detailed offset value, please refer to the corresponding test plot.

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¤ Declaration of EUT Family Grouping:

Model No.: PM810, PM820

According to the declaration from the applicant, the electrical circuit design, layout, components used and internal wiring were identical for all models, only with different on model name, and motor rated power. Here two models **PM820 with motors SLM100L1-4(3.5HP), MS-BP160CQ & PM810 with motors SLM100L1-4(3.0HP), MS-BP160.**

Therefore only one model **PM820 with motors SLM100L1-4(3.5HP)** was tested in this report.

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5 General Information

5.1 Details of E.U.T.

Operating Frequency	2402 MHz to 2480 MHz
Type of Modulation:	GFSK, (π/4)DQPSK, 8DPSK
Number of Channels	79 Channels
Channel Separation:	1 MHz
Antenna Type	Integral
Antenna gain:	0 dBi
Speciality:	Bluetooth 2.1+EDR mode
Function:	Treadmill with BT and WIFI function for data transmission.
Remark:	This report is only for Bluetooth part.
Power Supply:	AC 120V 60Hz
Power Cord:	1 X about 1.8m three wires unscreened AC input cable.

5.2 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.

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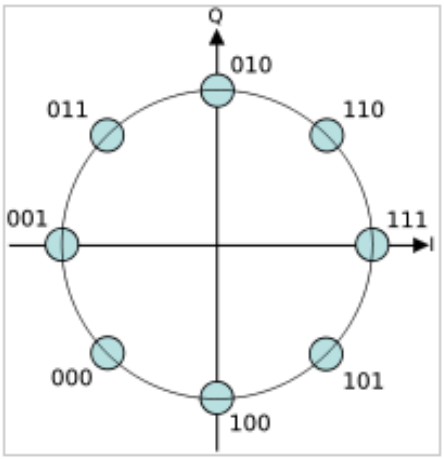

Constellation diagram for 8-PSK with Gray coding.

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.

5.3 Description of Support Units

The EUT has been tested with corresponding accessories as below supplied by SGS:

Description	Manufacturer	Model No.	SN/Certificate NO
NoteBook	IBM	T30	S/N78-3VMLX 06/01
BT test board	SGS EMC	RF 07	RF 07

Using the special software and development board we can enter the product for engineer mode then we can control the EUT to select the wanted channel for test. The test board and PC are only to configure the engineer mode and not used to final test

5.4 Deviation from Standards

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

5.5 Abnormalities from Standard Conditions

None.

5.6 Other Information Requested by the Customer

None.

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5.7 Test Location

All tests were performed at:

SGS-CSTC Standards Technical Services Co., Ltd., Guangzhou Branch 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.

5.8 Measurement Uncertainty

No.	Item	Measurement uncertainty
1	Conducted emission	1.02dB(9kHz to 150kHz)
		1.05dB(150kHz to 30MHz)
2	Radiated emission	5.06dB(30MHz to 1GHz)
		5.06dB(1GHz to 26GHz)

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5.9 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 accredited by the National Voluntary Laboratory Accreditation Program (NVLAP/NIST). NVLAP Code: 200611-0.

  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.

- **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 Recognized Accredited Test Firm(Registration No.: 486818)**

  SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory 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: CN5016, Test Firm Registration Number: 486818, Jul 13, 2017.

- **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 and Rules of procedure IECEE 02, and the relevant IECEE CB-Scheme Operational documents.

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6 Equipment List

FCC & IC equipment						
No.	Test Equipment	Manufacturer	Model No.	Serial No.	Cal. date (YYYY-MM-DD)	Cal.Due date (YYYY-MM-DD)
EMC0525	Compact Semi-Anechoic Chamber	ChangZhou ZhongYu	N/A	N/A	2016-12-04	2019-12-03
EMC0522	EMI Test Receiver	Rohde & Schwarz	ESIB26	100283	2017-01-20	2018-01-19
EMC0056	EMI Test Receiver	Rohde & Schwarz	ESCI	100236	2017-01-20	2018-01-19
EMC0528	RI High frequency Cable	SGS	20 m	N/A	2016-04-19	2018-04-18
EMC2025	Trilog Broadband Antenna 30-1000MHz	SCHWARZBECK MESS-ELEKTRONIK	VULB 9160	9160-3372	2016-09-08	2019-09-07
SEM003-18	Trilog Broadband Antenna 25-2000MHz	SCHWARZBECK MESS-ELEKTRONIK	VULB 9168	665	2016-06-29	2019-06-28
EMC0524	Bi-log Type Antenna	Schaffner -Chase	CBL6112B	2966	2016-09-08	2019-09-07
EMC0519	Bilog Type Antenna	Schaffner -Chase	CBL6143	5070	2017-05-04	2020-05-03
EMC2026	Horn Antenna 1-18GHz	SCHWARZBECK MESS-ELEKTRONIK	BBHA 9120D	9120D-841	2016-09-09	2019-09-08
EMC0521	1-26.5 GHz Pre-Amplifier	Agilent	8449B	3008A01649	2017-01-20	2018-01-19
EMC2065	Amplifier	HP	8447F	N/A	2017-06-19	2018-06-18
EMC0523	Active Loop Antenna	EMCO	6502	42963	2016-02-27	2018-02-26
EMC2041	Broad-Band Horn Antenna (14)15-26.5(40)GHz	SCHWARZBECK MESS-ELEKTRONI	BBHA 9170	9170-375	2017-05-23	2020-05-22
EMC2079	High Pass Filter(915MHz)	FSY MICROWAVE	HM1465-9SS	009	2017-01-20	2018-01-19
EMC2069	2.4GHz Filter	Micro-Tronics	BRM 50702	149	2017-01-20	2018-01-19
EMC0530	10m Semi-Anechoic Chamber	ETS	N/A	N/A	2016-04-30	2018-04-29
EMC2136	MI Cable	SGS	0.8m	N/A	2017-11-02	2018-11-01
EMC2137	MI Cable	SGS	0.8m	N/A	2017-11-02	2018-11-01
EMC2138	EXA Signal Analyzer	KEYSIGHT	N9010A	MY57120105	2017-11-15	2018-11-14
EMC0069	Signal Analyzer(20Hz ~ 26.5Ghz	R&S	FSIQ26	100312	2017-11-20	2018-11-19

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Conducted Emission						
No.	Test Equipment	Manufacturer	Model No.	Serial No.	Cal. date (YYYY-MM-DD)	Cal.Due date (YYYY-MM-DD)
EMC0306	Shielding Room	Zhong Yu	8 x 3 x 3.8 m^3	N/A	2016-12-27	2019-12-26
EMC0118	Two-line v-netwok	R&S	ENV216	100359	2017-01-20	2018-01-19
EMC0102	LISN	SCHAFFNER CHASE	MN2050D/1	1421	2017-09-20	2018-09-19
EMC0506	EMI Test Receiver	Rohde & Schwarz	ESCS30	100085	2017-11-27	2018-11-26
EMC0107	Coaxial Cable	SGS	2m	N/A	2016-07-24	2018-07-23
EMC0106	Voltage Probe	SGS	N/A	N/A	2016-04-05	2018-04-04
EMC2123	8 Line ISN Cat 6	SCHWARZBECK MESS-ELEKTRONIK	NTFM 8158	NTFM 8158 0151	2017-06-23	2018-06-22
EMC2124	8 Line ISN Cat 5	SCHWARZBECK MESS-ELEKTRONIK	CAT5 8158	CAT5 8158-188	2017-06-23	2018-06-22
EMC2126	8 Line ISN Cat 3	SCHWARZBECK MESS-ELEKTRONIK	CAT3 8158	CAT38158-0081	2017-06-23	2018-06-22
EMC2122	ISN S8	SCHWARZBECK MESS-ELEKTRONIK	ISN S8	57	2017-06-23	2018-06-22
EMC2121	ISN S1	SCHWARZBECK MESS-ELEKTRONIK	ISN S1	10	2017-06-23	2018-06-22
EMC2125	2 wires ISN	SCHWARZBECK MESS-ELEKTRONIK	NTFM 8131	8131-198	2017-06-23	2018-06-22
EMC2047	CDN	Elektronik-Feinmechanik	L-801:AF2	2793	2015-09-19	2018-09-18
EMC2048	CDN	Elektronik-Feinmechanik	L-801:M2/M3	2738	2015-09-25	2018-09-24
EMC2062	6dB Attenuator	HP	8491A	24487	2016-04-05	2018-04-04
EMC0167	Conical metal housing	SGS-EMC	N/A	N/A	2016-04-19	2018-04-18

General used equipment						
No.	Test Equipment	Manufacturer	Model No.	Serial No.	Cal. date (YYYY-MM-DD)	Cal.Due date (YYYY-MM-DD)
EMC0006	DMM	Fluke	73	70681569	2017-07-26	2018-07-25
EMC0007	DMM	Fluke	73	70671122	2017-07-26	2018-07-25

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7 Test Results

7.1 E.U.T. test conditions

Test Voltage:	AC 120V
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:

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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

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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	/	/

Using the special software and development board we can enter the product for engineer mode then we can control the EUT to select the wanted channel for test as above list.

Test frequencies are the lowest channel: 0 channel(2402 MHz), middle channel: 40 channel(2442 MHz) and highest channel: 78 channel(2480 MHz)

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7.2 Antenna Requirement

Standard requirement

15.203 requirement:

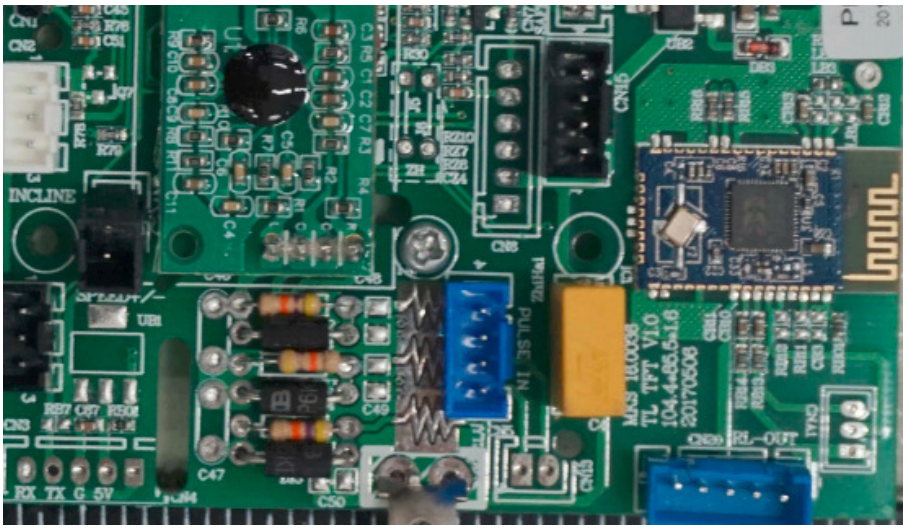
For intentional device. According to 15.203. an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

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 PCB antenna and no consideration of replacement. The maximum gain of the antenna is 0 dBi.



Test result: The unit does meet the FCC requirements.

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7.3 Occupied Bandwidth

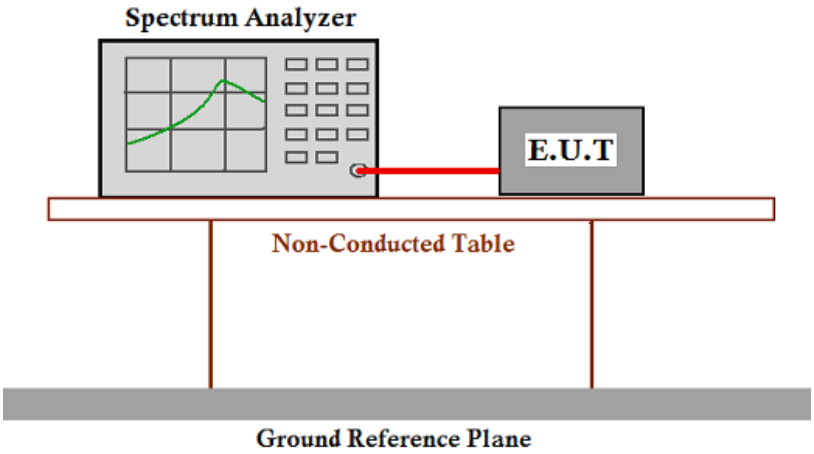
Test Requirement: FCC Part 15 C section 15.247

(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 6.9.2

Test Status: Pre-test the EUT in continuous transmitting mode at the lowest (2402 MHz), middle (2442 MHz) and highest (2480 MHz) channel with different data package. Compliance test in normal mode (DH5 data packet with GFSK modulation type) and EDR mode (3DH5 data packet with 8DPSK modulation type) 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 5 times the 20dB bandwidth, centring on a hopping channel;
3. Set the spectrum analyzer: RBW:1% ~5% of the 20dB bandwidth ,VBW >=3 RBW. Sweep = auto; Detector Function = Peak. Trace = Max Hold.
4. Mark the peak frequency and -20 dB points bandwidth.

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Test result:

Normal mode (DH5 data packet with GFSK modulation type):

Test Channel	Bandwidth(MHz)	2/3 bandwidth (MHz)
Lowest	1.22	0.813
Middle	1.22	0.813
Highest	1.22	0.813

EDR mode (3DH5 data packet with 8DPSK modulation type):

Test Channel	Bandwidth (MHz)	2/3 bandwidth (MHz)
Lowest	1.46	0.97
Middle	1.48	0.98
Highest	1.44	0.96

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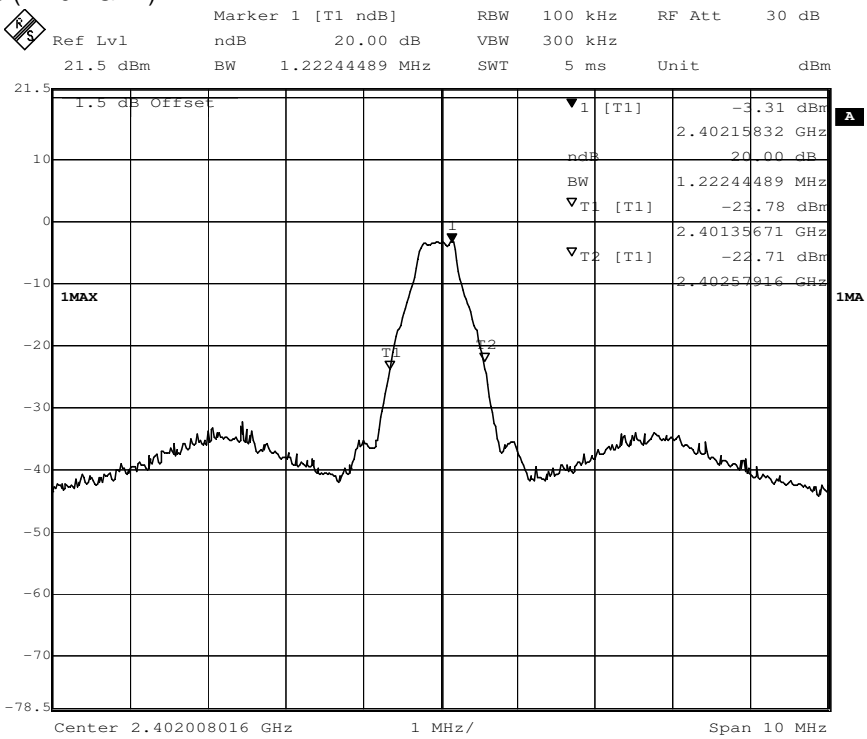
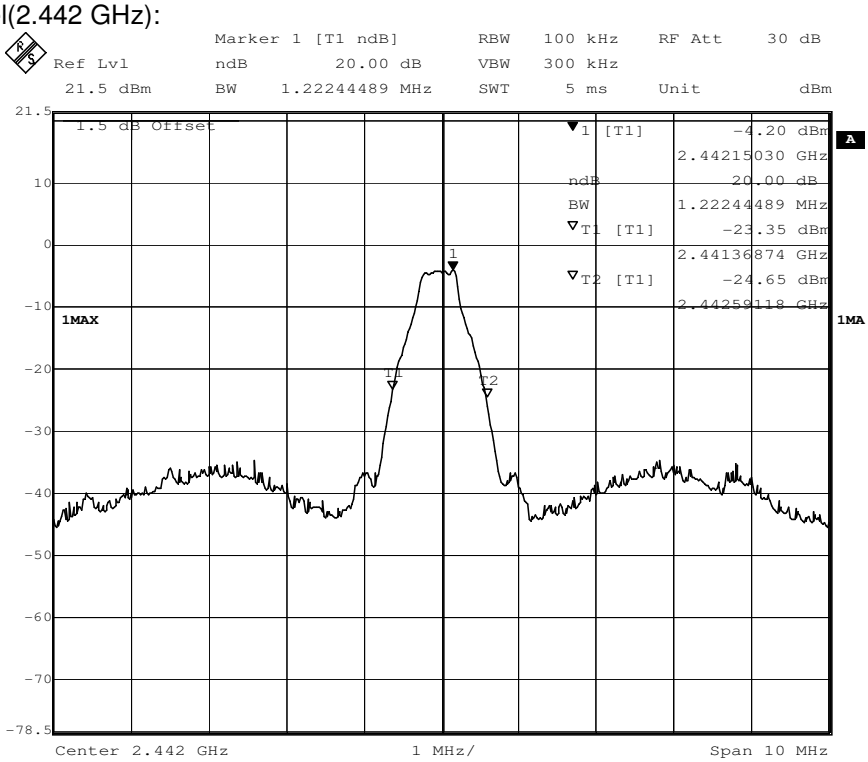
Result plot as follows:
Normal mode (DH5 data packet with GFSK modulation type):
Lowest Channel(2.402 GHz):



Middle Channel(2.442 GHz):



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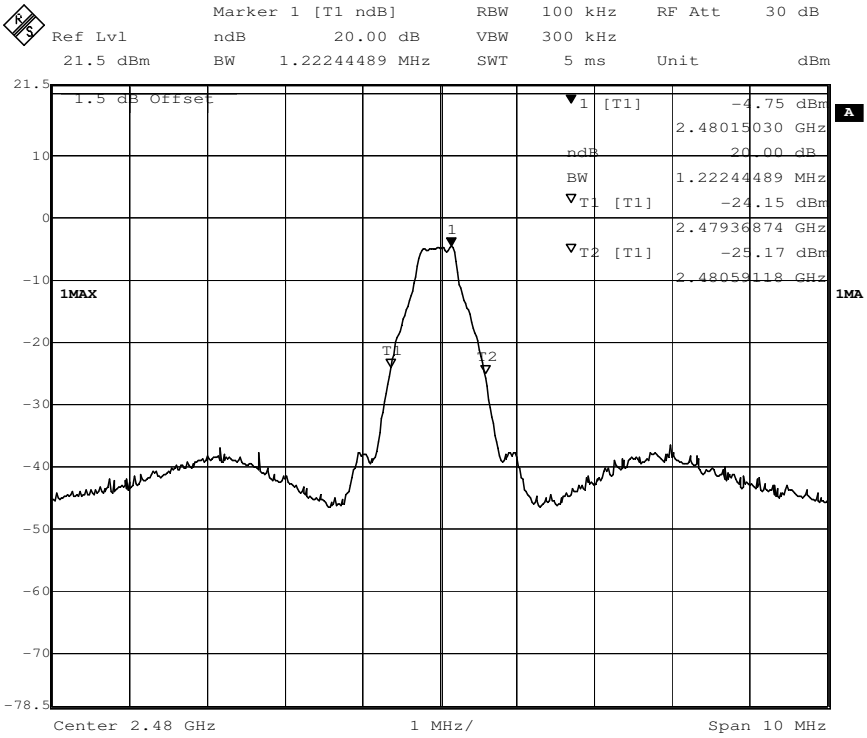
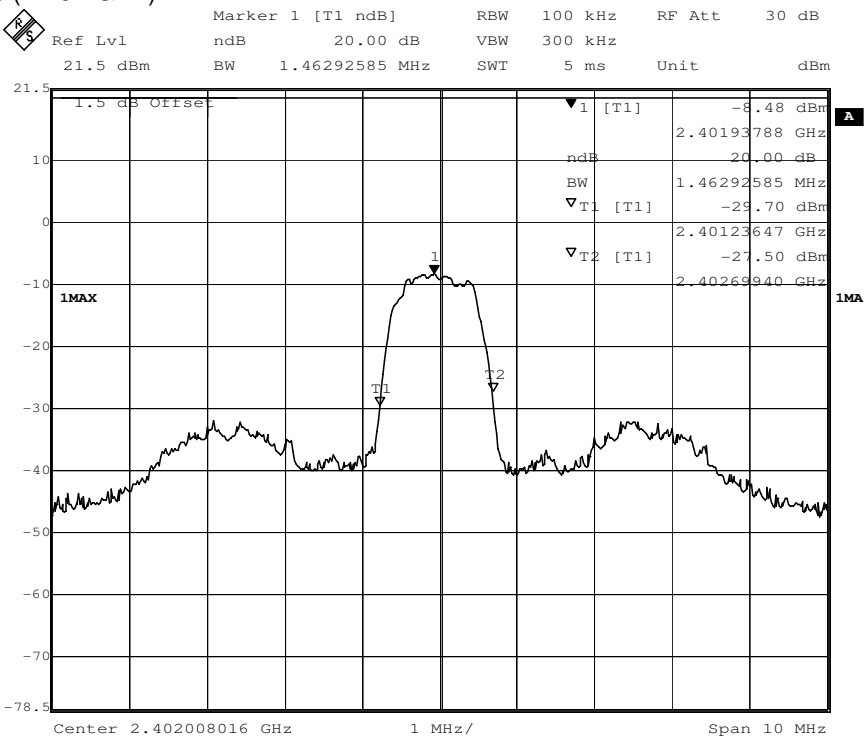
Highest Channel(2.480 GHz):



EDR mode (3DH5 data packet with 8DPSK modulation type):

Lowest Channel(2.402 GHz):



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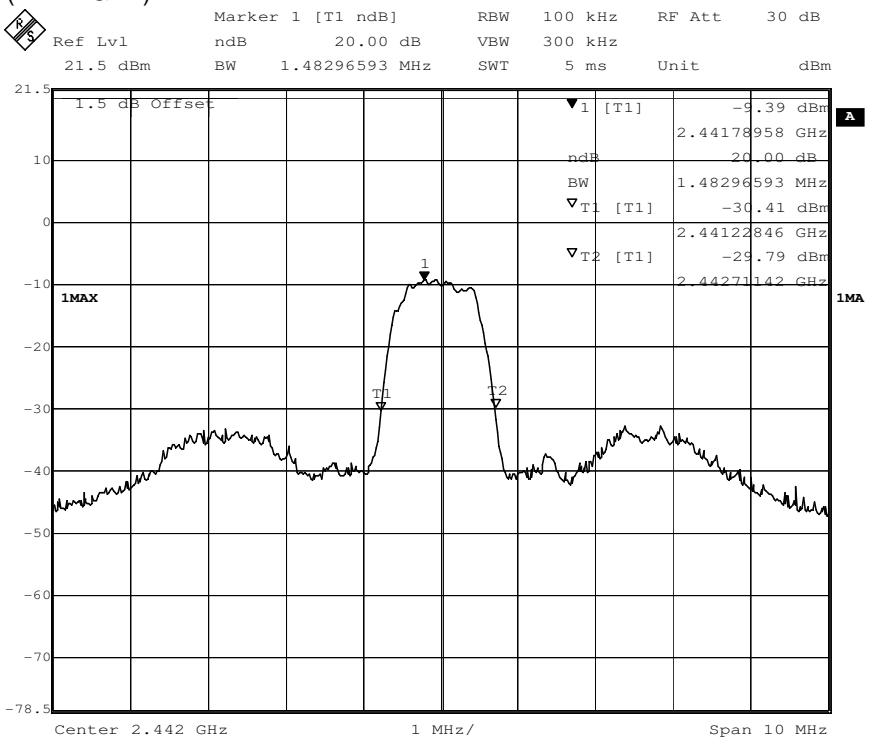
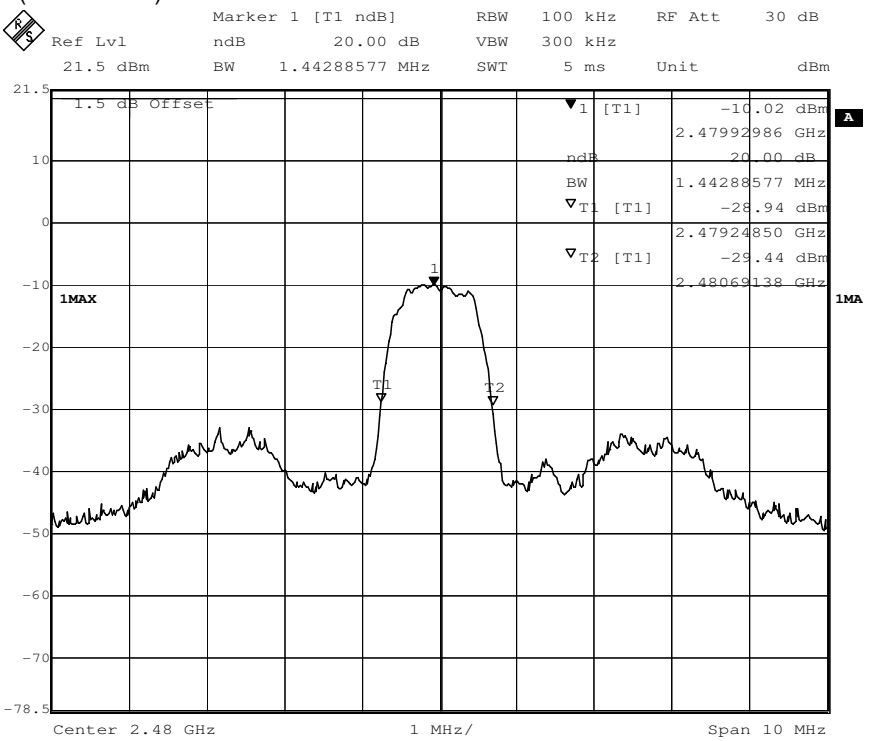
Middle Channel(2.442 GHz):



Highest Channel(2.480 GHz):



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7.4 Carrier Frequencies Separated

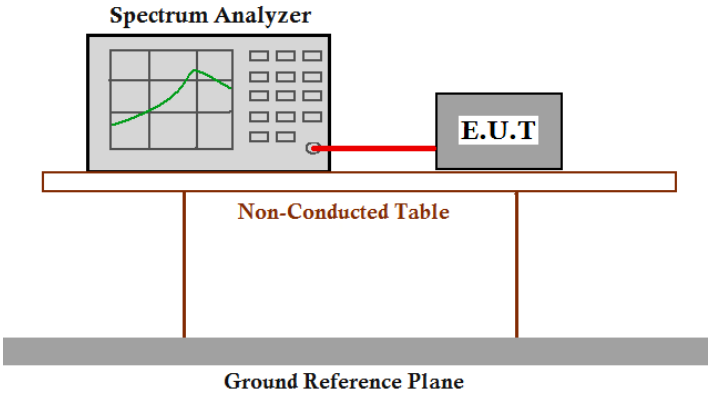
Test Requirement: FCC Part 15 C section 15.247

(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: ANSI C63.10: Clause 7.8.2

Test Status: Pre-test the EUT in hopping mode with different data packet. Compliance test in hopping with EDR mode (3DH5 data packet with 8DPSK modulation type) 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.

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Test result:

Test Channel	Carrier Frequencies Separated	Limit①	Pass/Fail
Lower Channels (channel 0 and channel 1)	1.002MHz	0.97	Pass
Middle Channels (channel 39 and channel 40)	1.002MHz	0.97	Pass
Upper Channels (channel 77 and channel 78)	1.042MHz	0.96	Pass

Remark:

① The limit is two-thirds of the 20dB bandwidth EDR(3DH5) mode due to the transmission power is less than 0.125 W shown on section 7.3 of this report.

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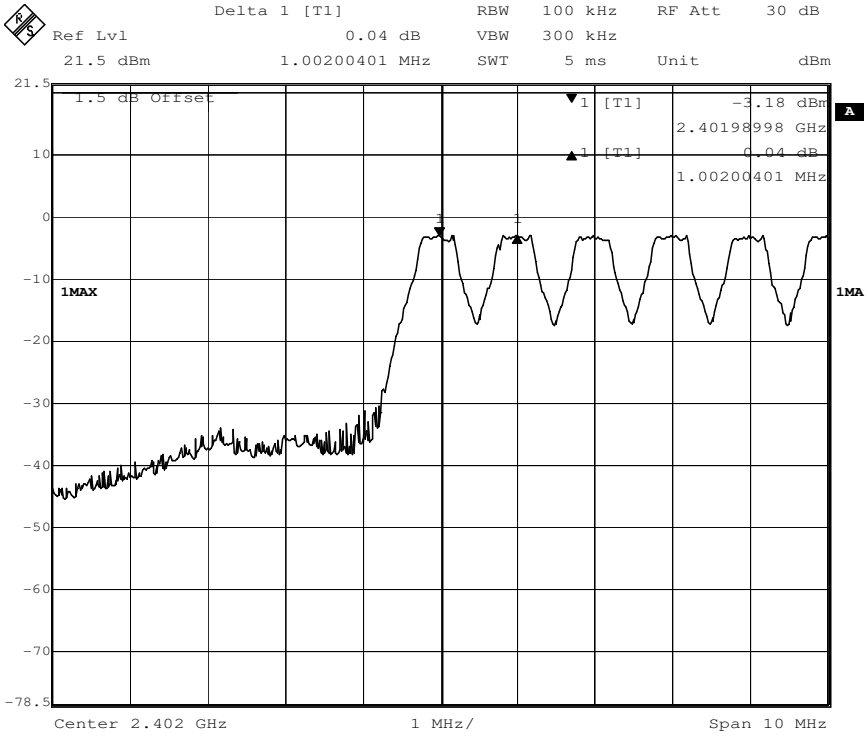
Result plot as follows:

Lowest Channels: **Carrier Frequencies Separated**



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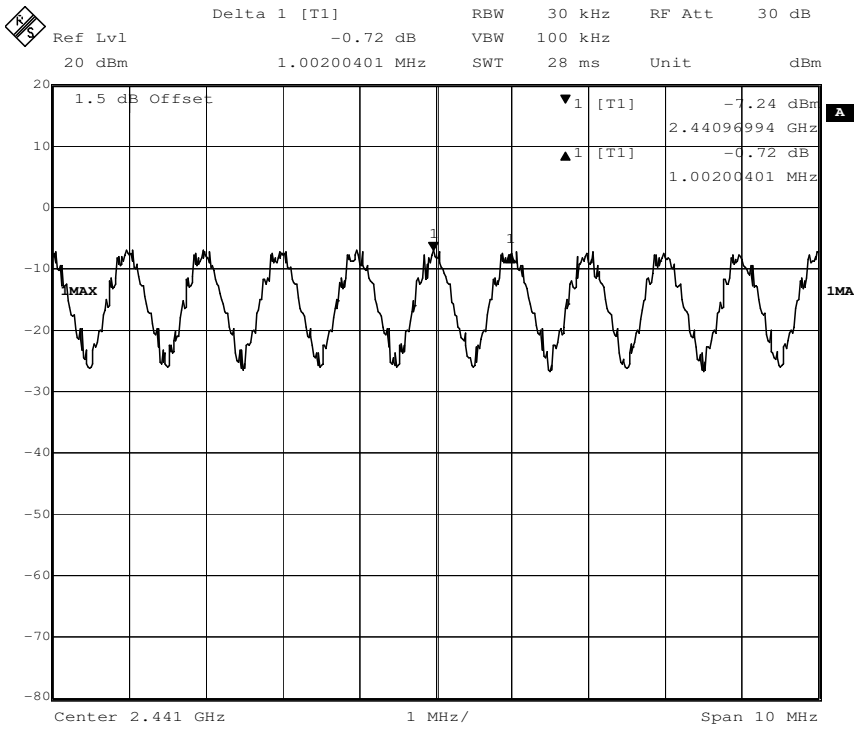
Middle Channels: **Carrier Frequencies Separated**



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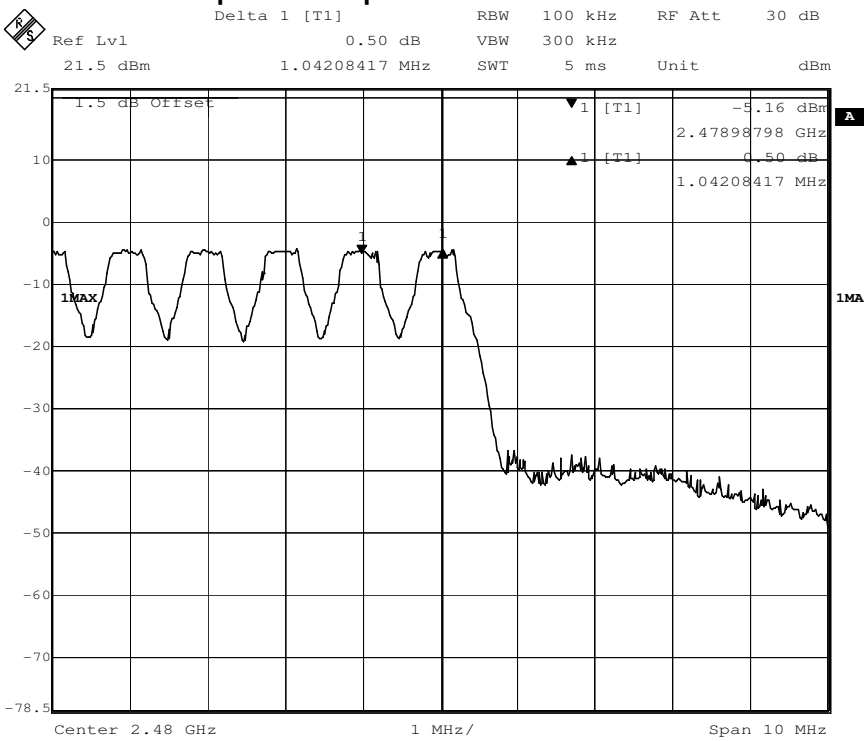
Highest Channels: **Carrier Frequencies Separated**



Test result: The unit does meet the FCC requirements.

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7.5 Hopping Channel Number

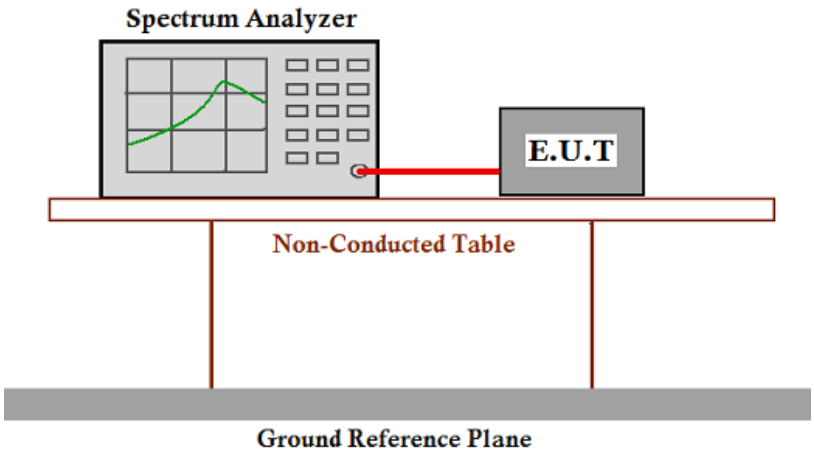
Test Requirement: FCC Part15 C section 15.247

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

Test Method: ANSI C63.10: Clause 7.8.3

Test Status: Pre-test the EUT in hopping mode with different data packet. Compliance test in hopping with EDR mode (3DH5 data packet with 8DPSK modulation type) 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.

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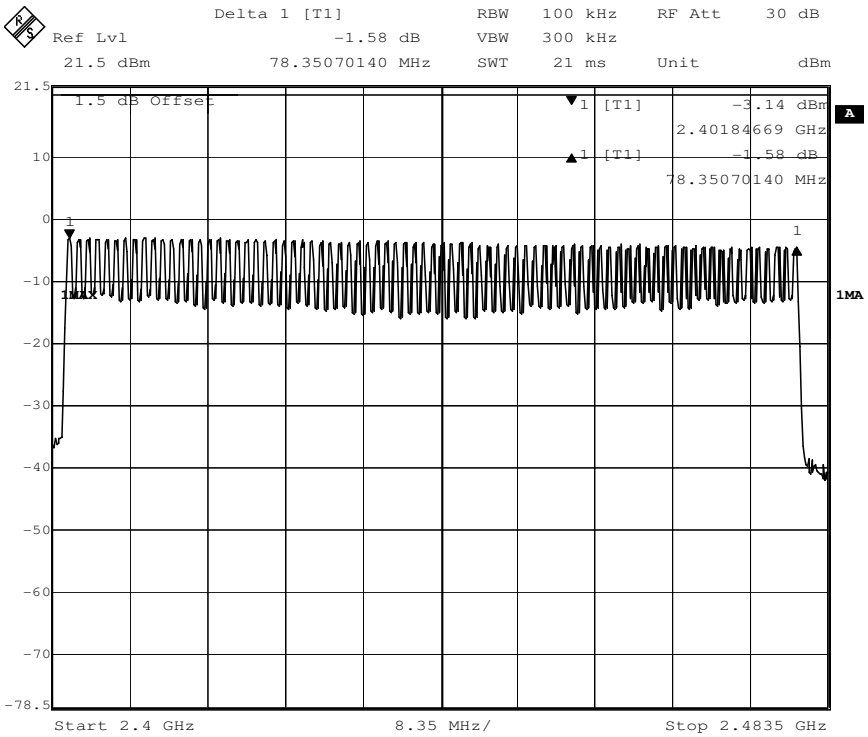
Test result: Total channels are 79 channels.



Test result: The unit does meet the FCC requirements.

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7.6 Dwell Time

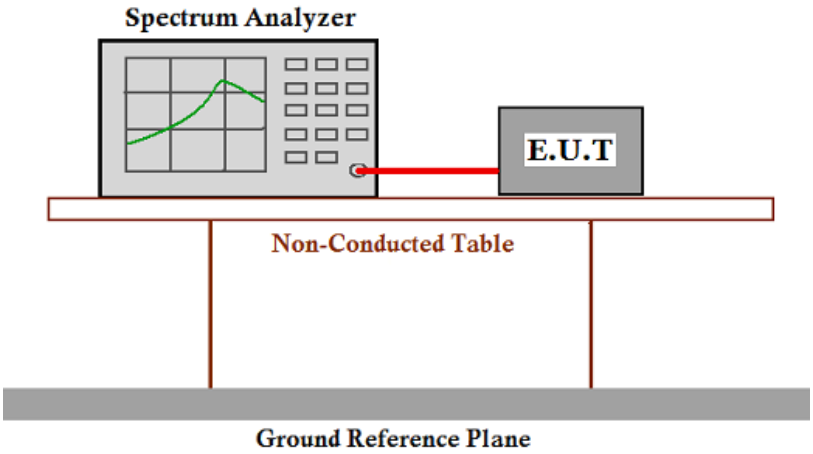
Test Requirement: FCC Part 15 C section 15.247

(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: ANSI C63.10: Clause 7.8.4

Test Status: Test the EUT in hopping mode at the lowest (2402 MHz), middle (2442 MHz) and highest (2480 MHz) channel with different data packet. Compliance test in hopping mode with EDR mode (3DH1, 3DH3 and 3DH5 data packet with 8DPSK modulation type) 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.

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Test Result:

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

1. Channel 0: 2.402GHz											
3DH1 time slot	=	0.362	(ms)	*	33	*	(31.6/3.16)	=	119.460	ms
3DH3 time slot	=	1.691	(ms)	*	16	*	(31.6/3.16)	=	270.560	ms
3DH5 time slot	=	2.935	(ms)	*	10	*	(31.6/3.16)	=	293.500	ms
2. Channel 39: 2.442GHz										
3DH1 time slot	=	0.36	(ms)	*	32	*	(31.6/3.16)	=	115.200	ms
3DH3 time slot	=	1.678	(ms)	*	17	*	(31.6/3.16)	=	285.260	ms
3DH5 time slot	=	2.935	(ms)	*	11	*	(31.6/3.16)	=	322.850	ms
3. Channel 78: 2.480GHz										
3DH1 time slot	=	0.36	(ms)	*	32	*	(31.6/3.16)	=	115.200	ms
3DH3 time slot	=	1.672	(ms)	*	17	*	(31.6/3.16)	=	284.240	ms
3DH5 time slot	=	2.945	(ms)	*	11	*	(31.6/3.16)	=	323.950	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.

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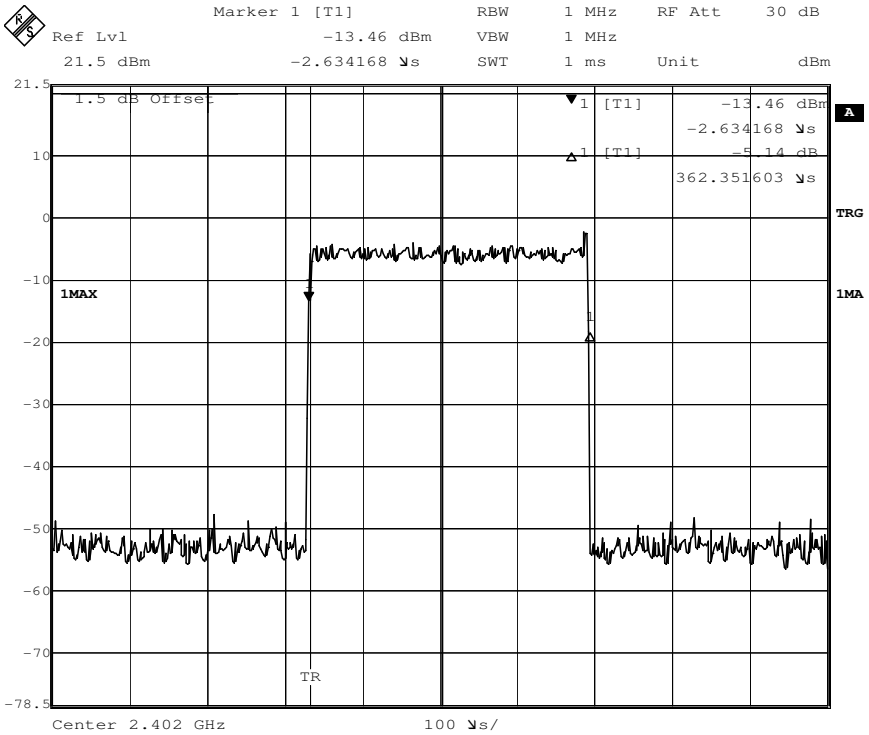
Result plot as follows:

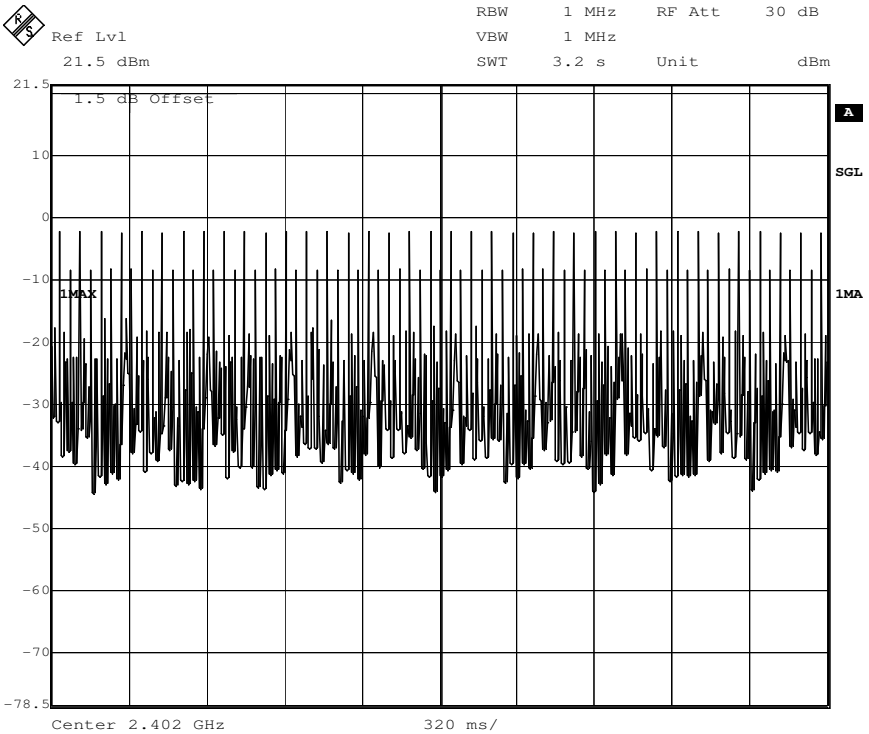
1. Lowest channel (2.402 GHz):

(1). 3DH1

Pulse Width:



Number of Pulses in 3.16 S observation period:



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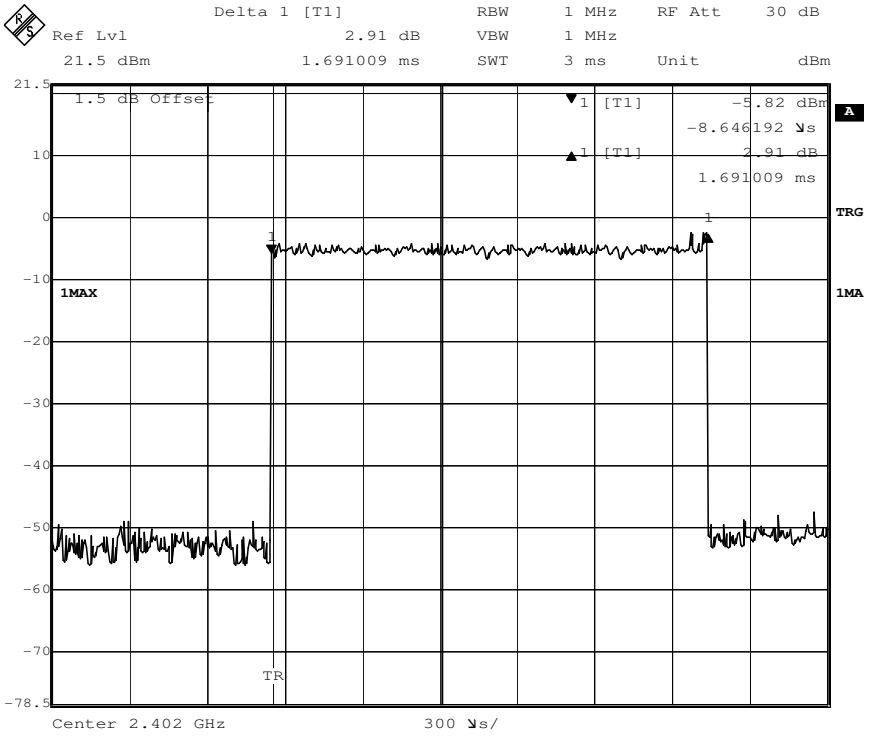
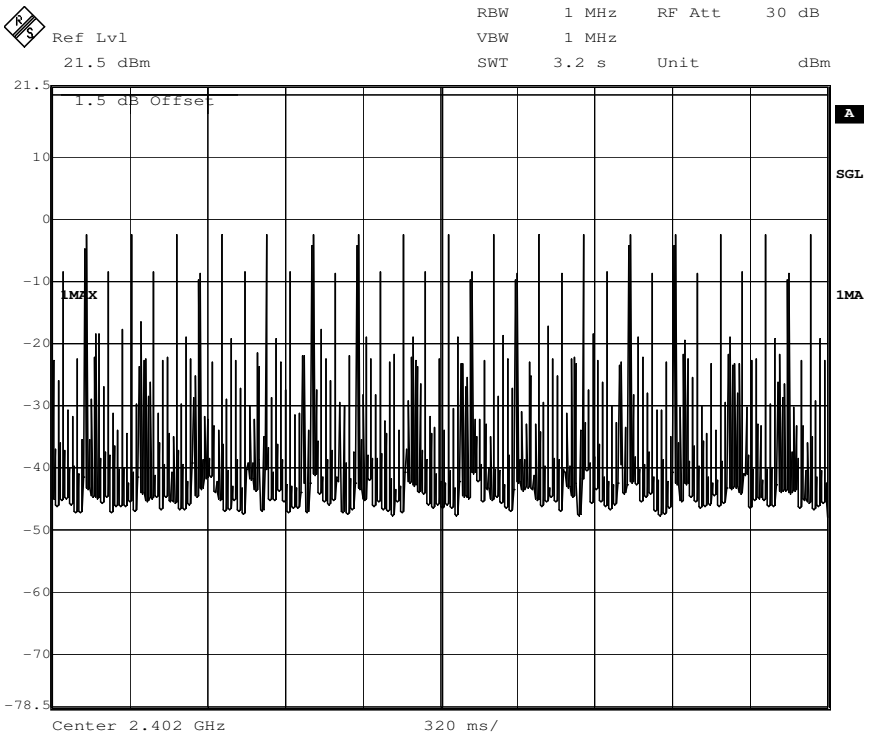
(2) 3DH3

Pulse Width:



Number of Pulses in 3.16 S observation period:



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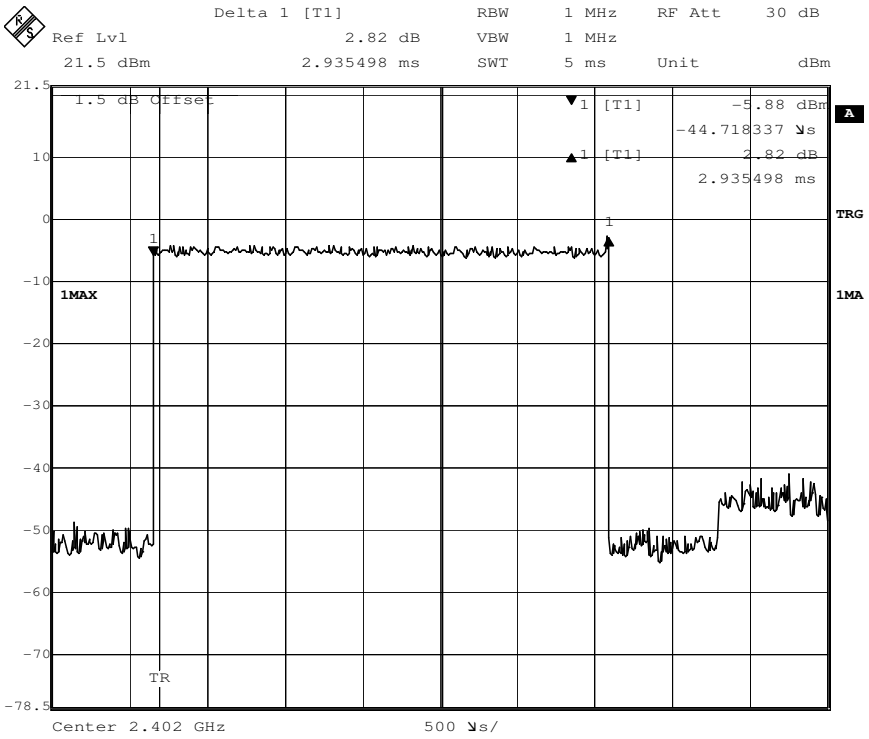
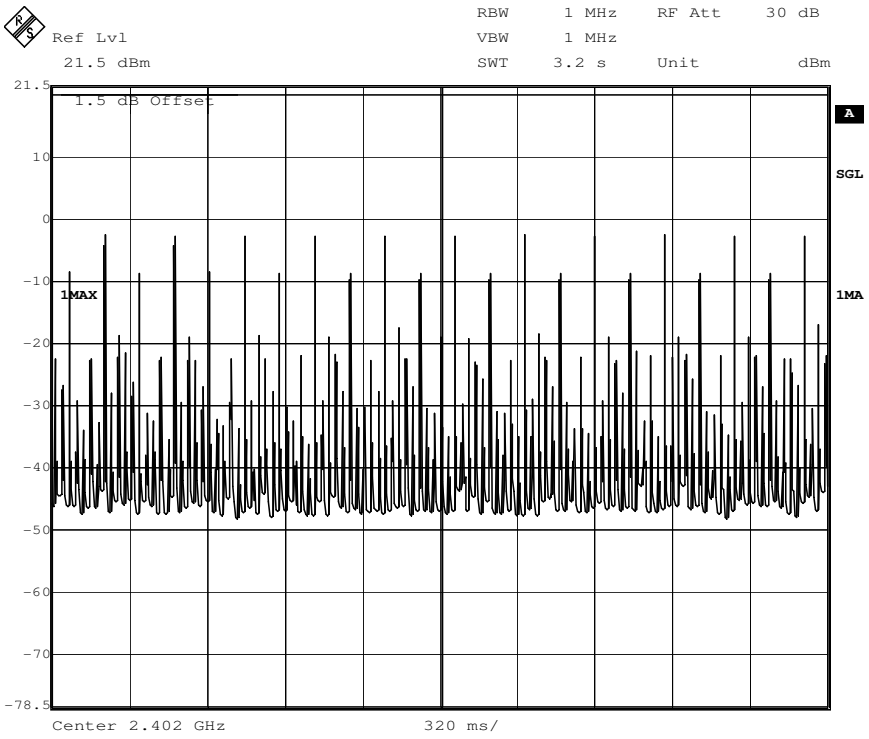
(3) 3DH5

Pulse Width:



Number of Pulses in 3.16 S observation period:



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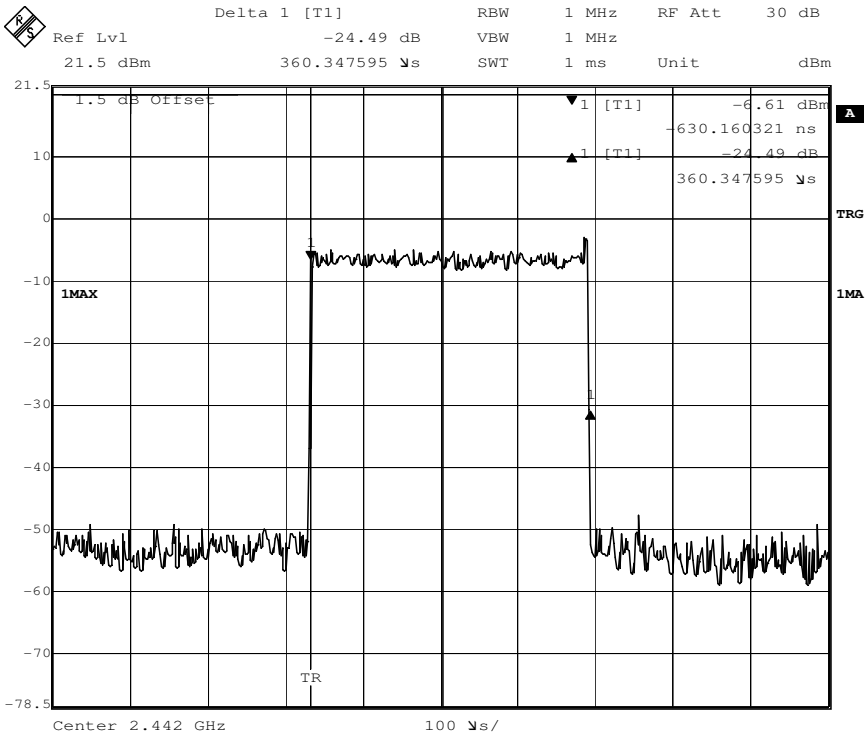
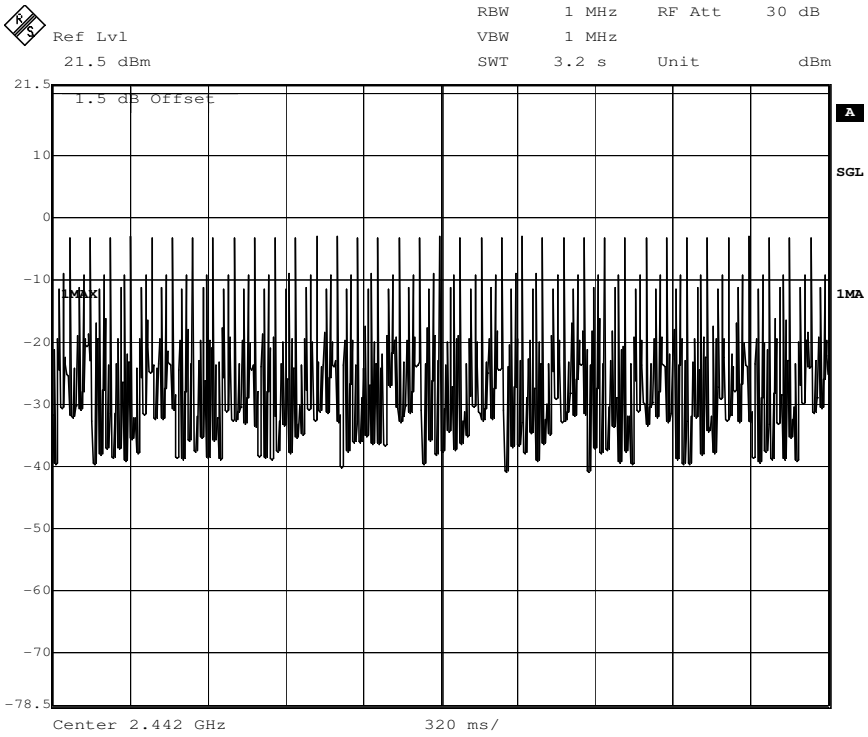
2. Middle Channel (2.442 GHz):

(1). 3DH1

Pulse Width:



Number of Pulses in 3.16 S observation period:



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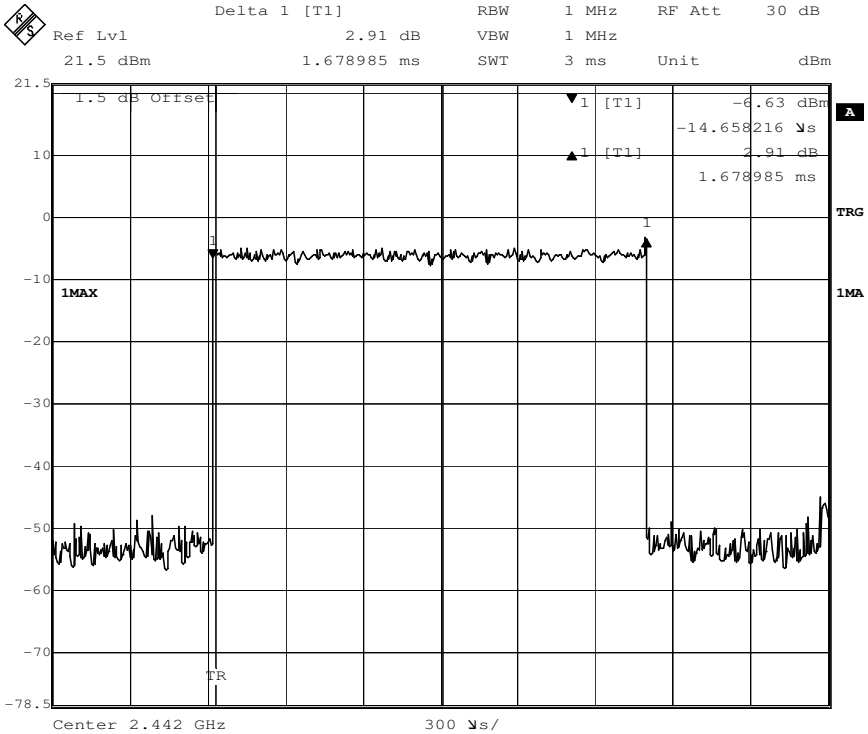
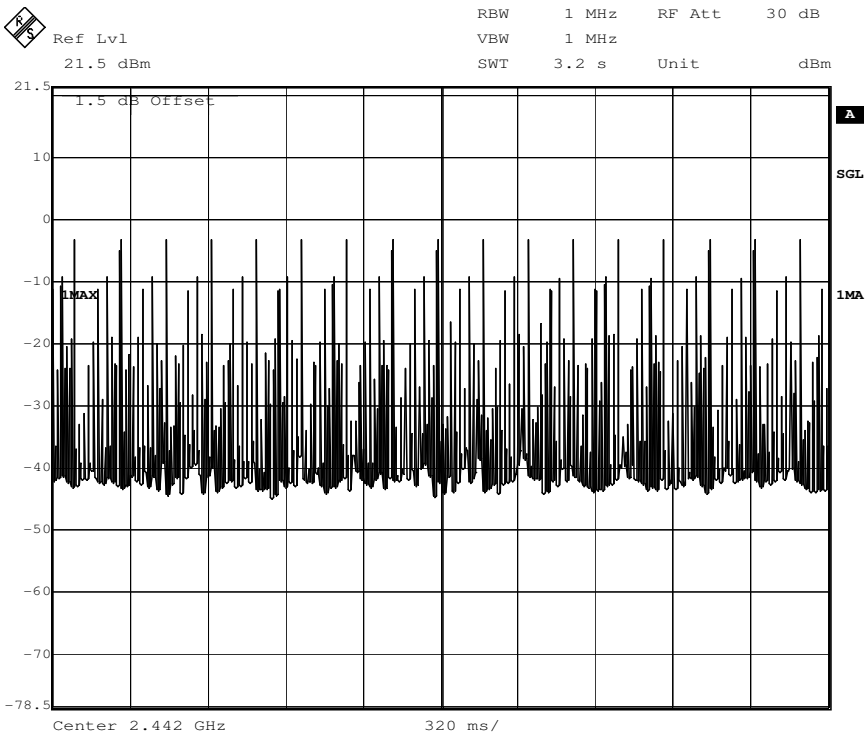
(2) 3DH3

Pulse Width:



Number of Pulses in 3.16 S observation period:



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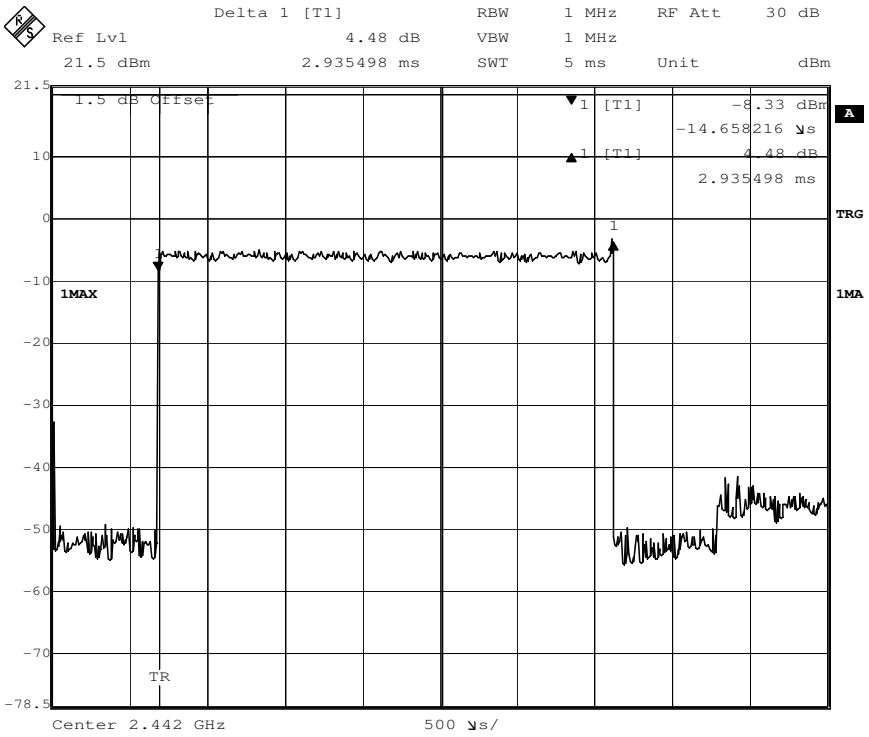
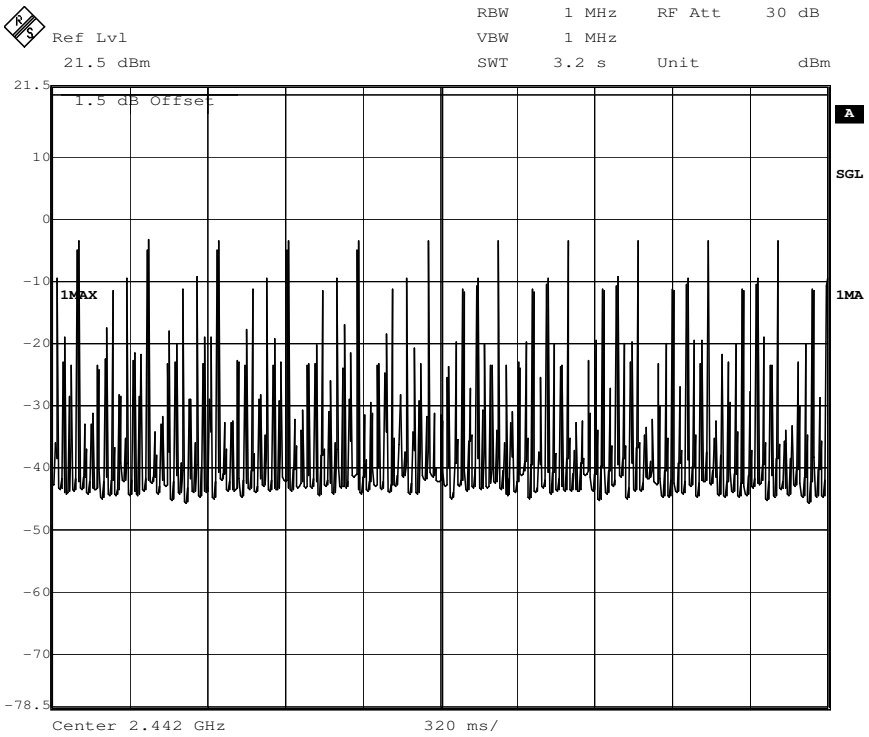
(3) 3DH5

Pulse Width:



Number of Pulses in 3.16 S observation period:



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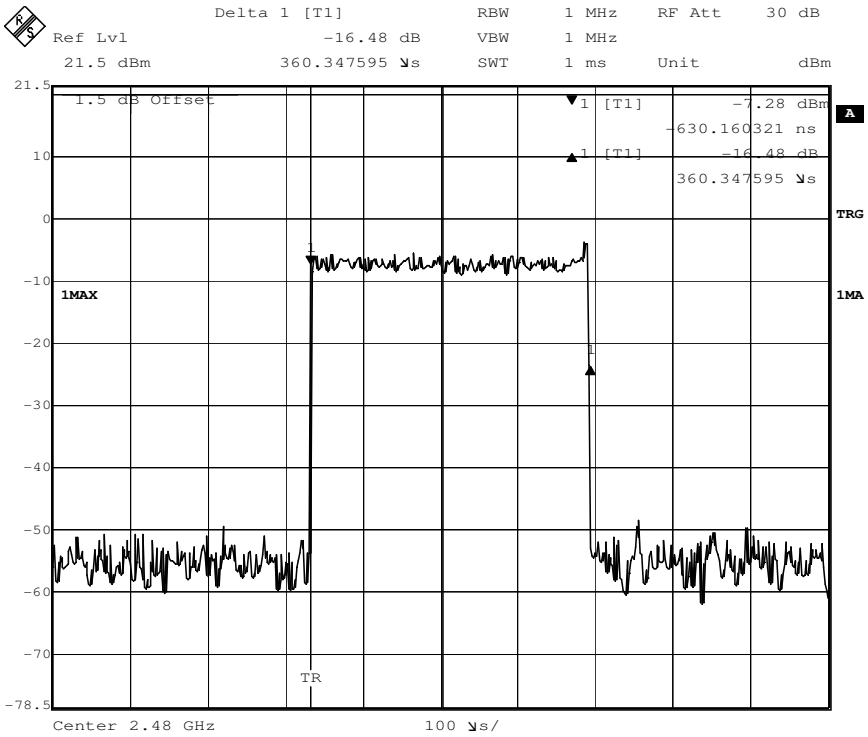
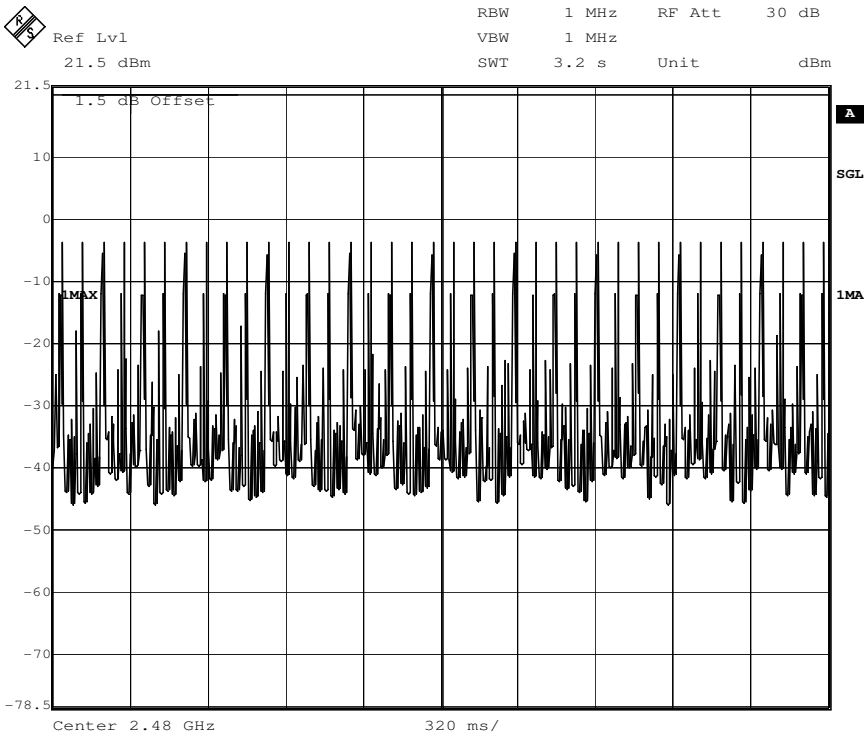
3. Highest Channel (2.480 GHz):

(1). 3DH1

Pulse Width:



Number of Pulses in 3.16 S observation period:



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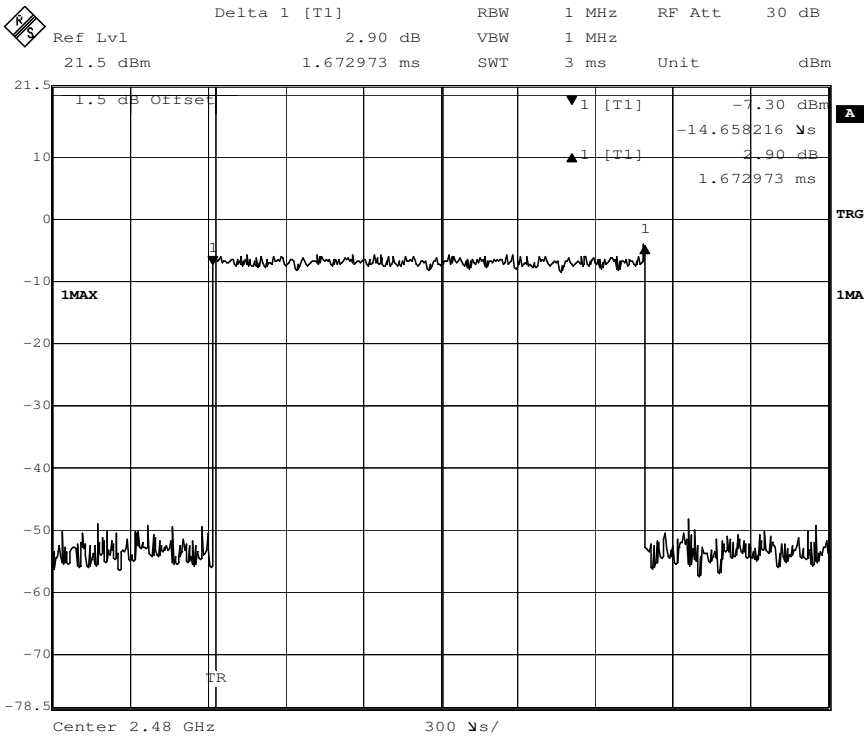
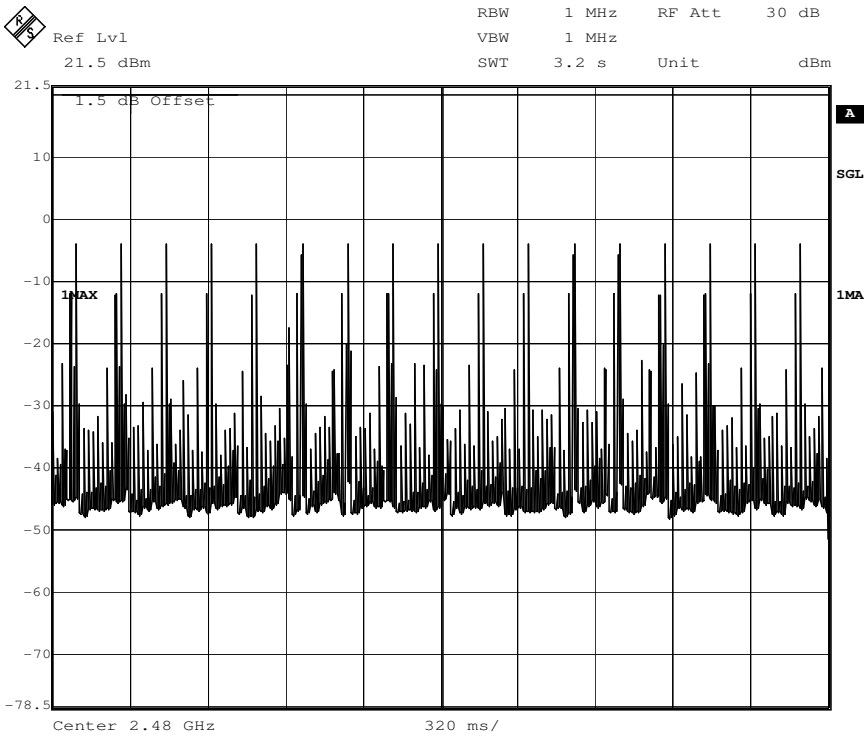
(2) 3DH3

Pulse Width:



Number of Pulses in 3.16 S observation period:



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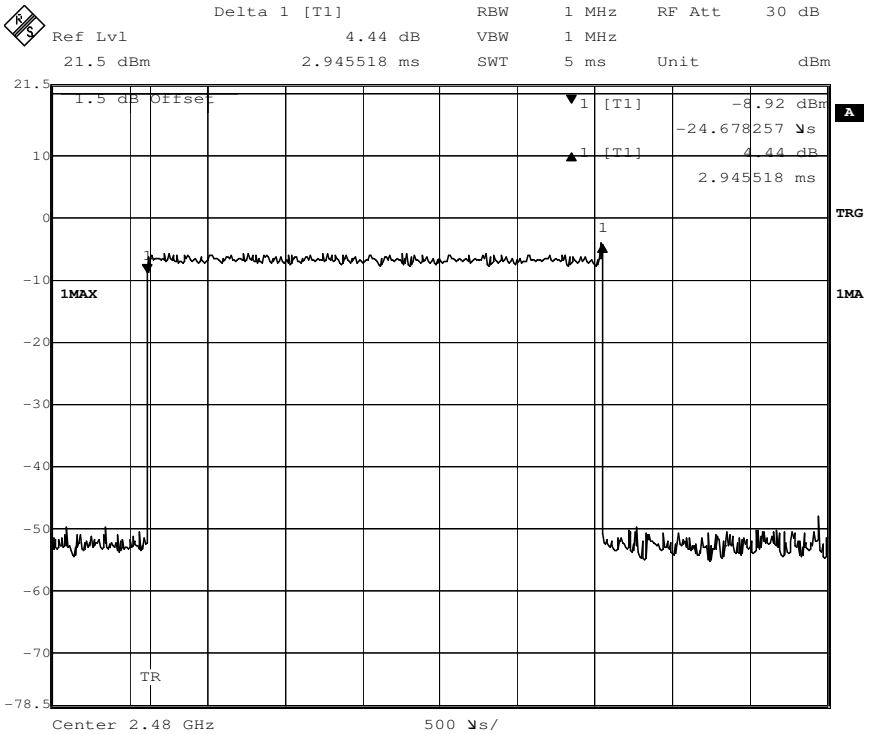
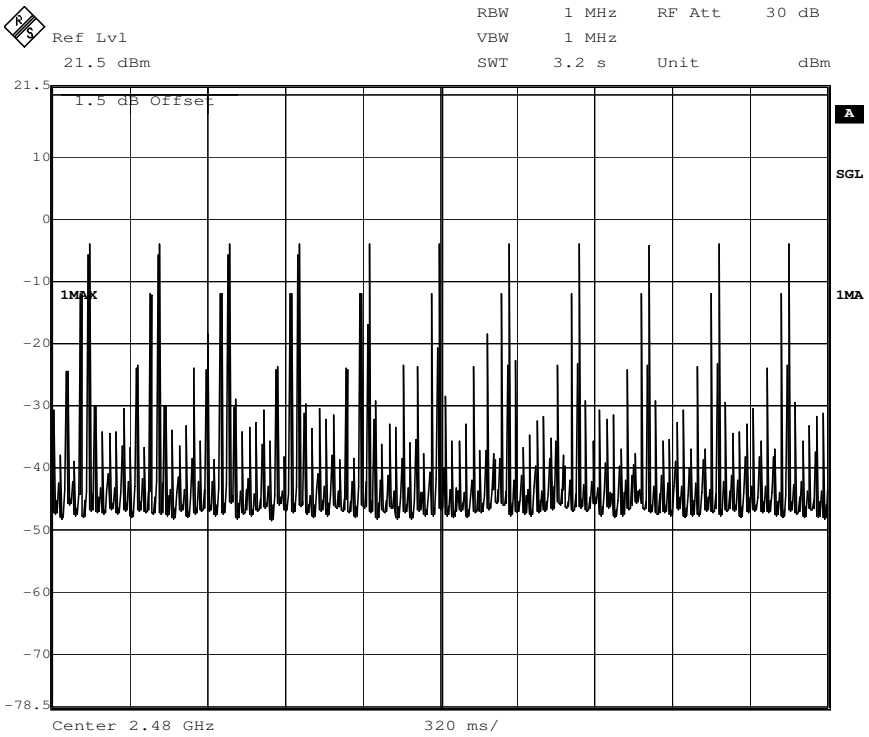
(3) 3DH5

Pulse Width:



Number of Pulses in 3.16 S observation period:



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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.

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7.7.2 Other requirements Frequency Hopping Spread Spectrum System

Test Requirement: 47 CFR Part 15**C Section 15.247 (a)(1), (h) requirement:**

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.

Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

Compliance for section 15.247(a)(1)

According to Bluetooth Core Specification, 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)

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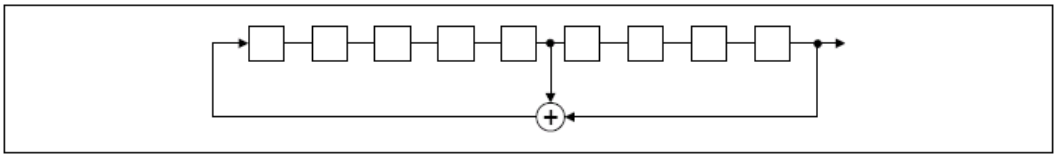
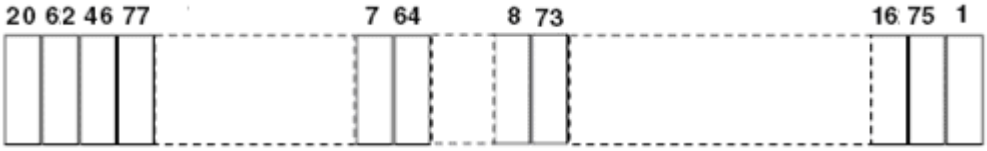


Linear Feedback Shift Register for Generation of the PRBS sequence

An example of Pseudorandom Frequency Hopping Sequence as follow:



Each frequency used equally on the average by each transmitter.

According to Bluetooth Core Specification, Bluetooth receivers are designed to have input and IF bandwidths that match the hopping channel bandwidths of any Bluetooth transmitters and shift frequencies in synchronization with the transmitted signals.

Compliance for section 15.247(g)

According to Bluetooth Core Specification, the Bluetooth system transmits the packet with the pseudorandom hopping frequency with a continuous data and the short burst transmission from the Bluetooth system is also transmitted under the frequency hopping system with the pseudorandom hopping frequency system.

Compliance for section 15.247(h)

According to Bluetooth Core specification, the Bluetooth system incorporates with an adaptive system to detect other user within the spectrum band so that it individually and independently to avoid hopping on the occupied channels.

According to the Bluetooth Core specification, the Bluetooth system is designed not have the ability to coordinated with other FHSS System in an effort to avoid the simultaneous occupancy of individual hopping frequencies by multiple transmitter.

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7.8 Maximum Peak Output Power

Test Requirement: FCC Part 15 C section 15.247

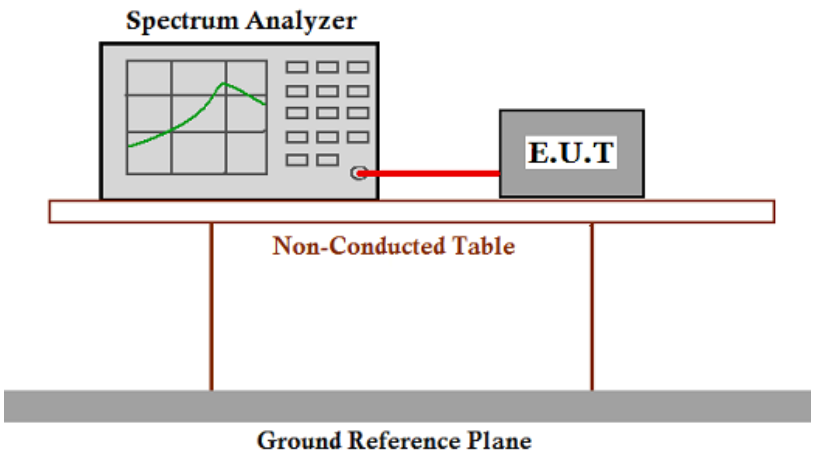
(b)(1)For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

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

Test Method: ANSI C63.10: Clause 7.8.5

Test mode: Pre-test the EUT in continuous transmitting mode at the lowest (2402 MHz), middle (2442 MHz) and highest (2480 MHz) channel with different data packet. Compliance test in continuous transmitting mode with normal mode (DH5 data packet with GFSK modulation type) and EDR mode (3DH5 data packet with 8DPSK modulation type) 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 > 20 dB bandwidth of the emission being measured, VBW>= RBW. Sweep = auto; Detector Function = Peak.
3. Keep the EUT in transmitting at lowest, medium and highest channel individually. Record the max value.

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Test Result:

Normal mode:

Test Channel	Fundamental Frequency (MHz)	Output Conducted Power (dBm)	Limit (dBm)	Result
Lowest	2402	-2.58	20.96	Pass
Middle	2442	-3.33	20.96	Pass
Highest	2480	-3.98	20.96	Pass

EDR mode:

Test Channel	Fundamental Frequency (MHz)	Output Conducted Power (dBm)	Limit (dBm)	Result
Lowest	2402	-3.80	20.96	Pass
Middle	2442	-4.63	20.96	Pass
Highest	2480	-5.35	20.96	Pass

Test result: The unit does meet the FCC requirements.

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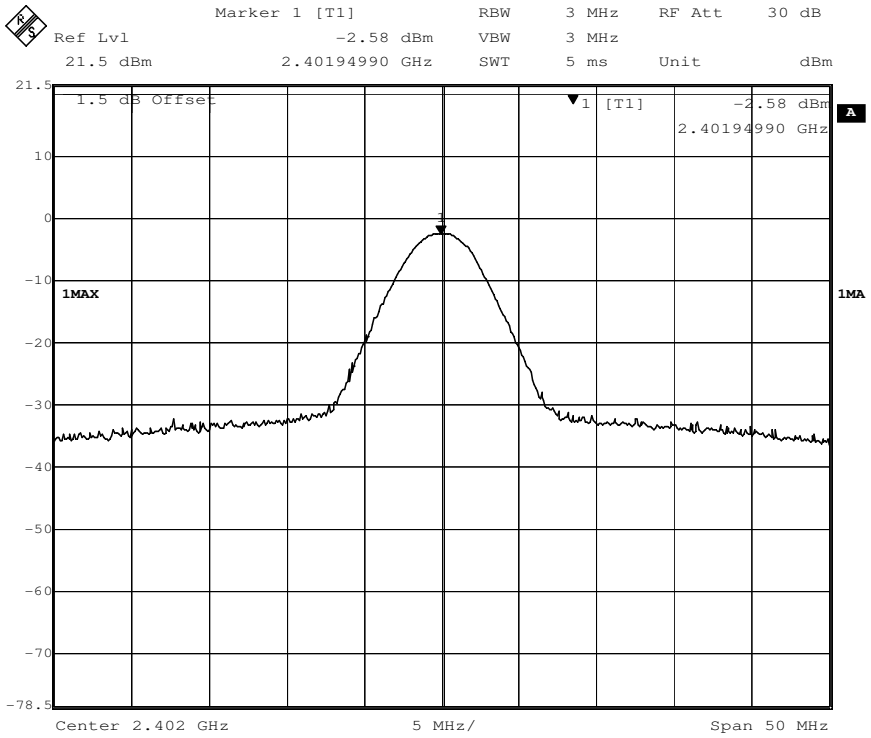
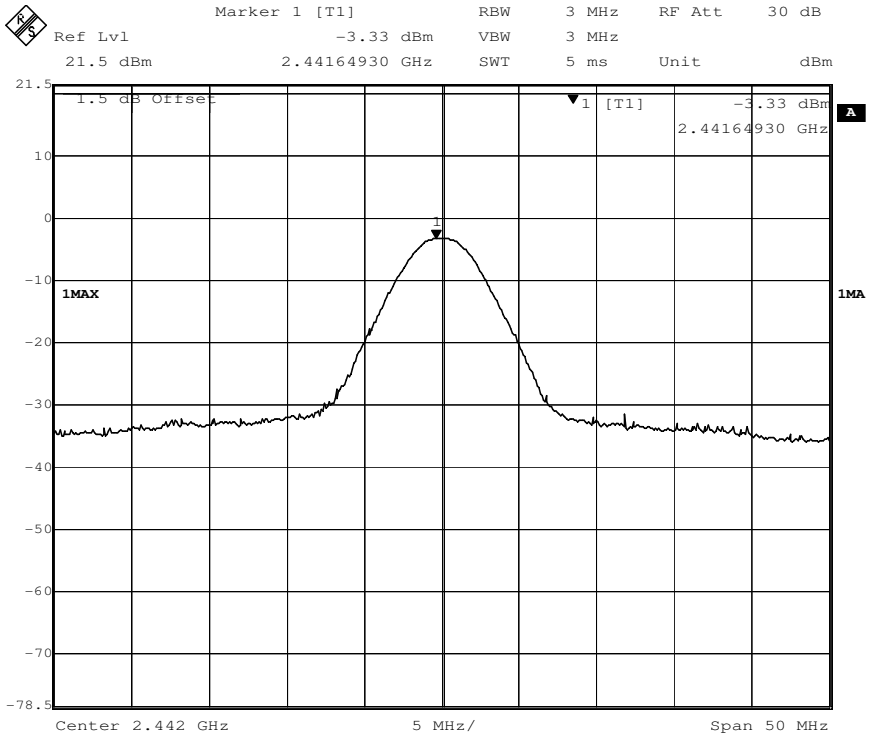
Result plot as follows:

Normal mode (DH5 data packet with GFSK modulation type):

Lowest Channel(2.402 GHz):



Middle Channel(2.442 GHz):



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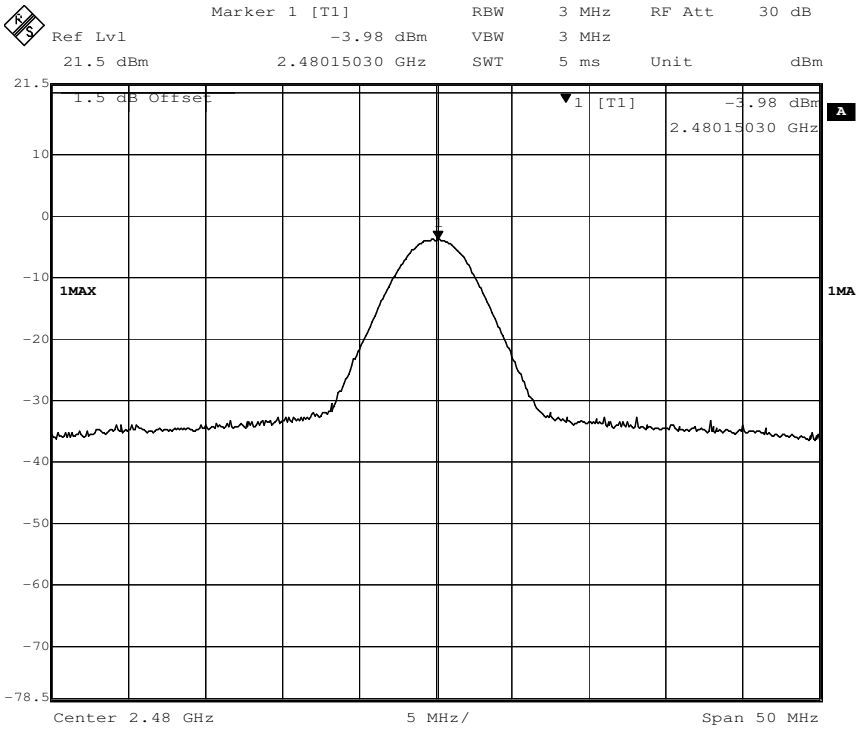
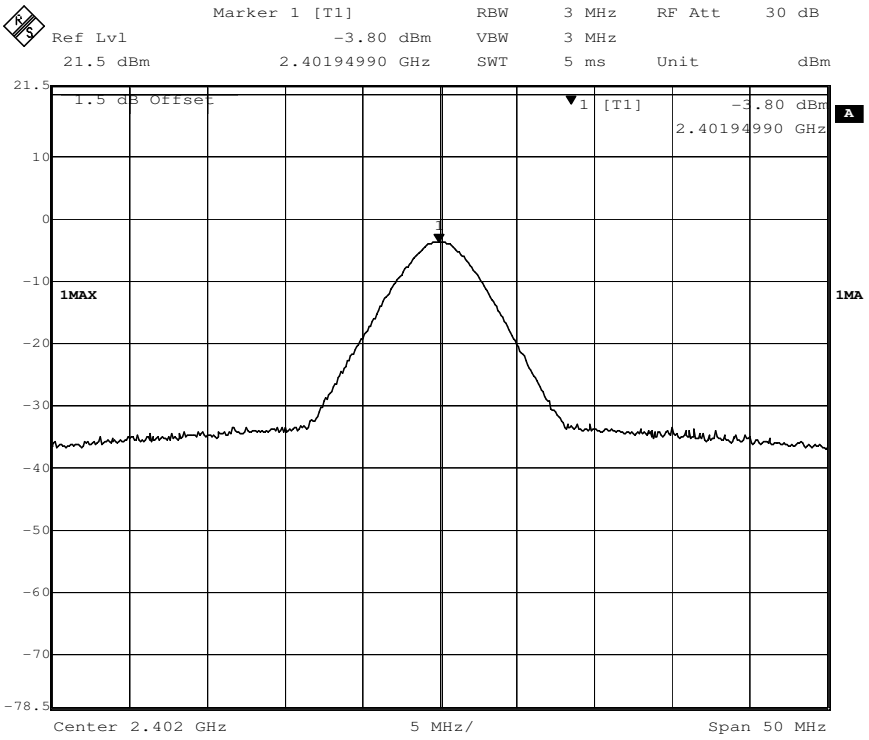
Highest Channel(2.480 GHz):



EDR mode (3DH5 data packet with 8DPSK modulation type):

Lowest channel(2.402 GHz):



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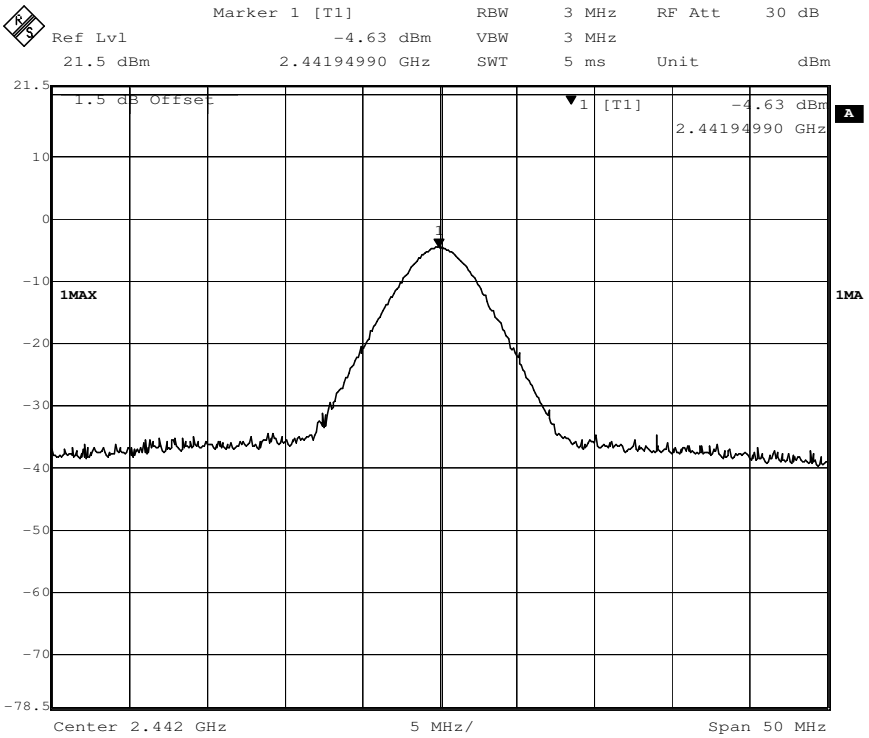
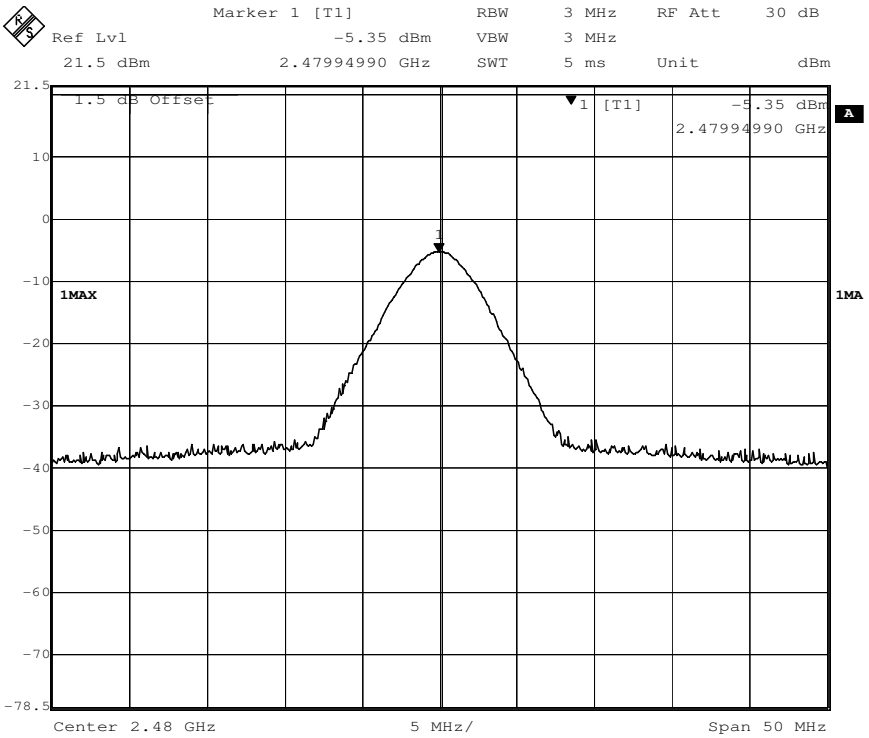
Middle channel(2.442 GHz):



Highest channel(2.480 GHz):



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7.9 Conducted Spurious Emissions

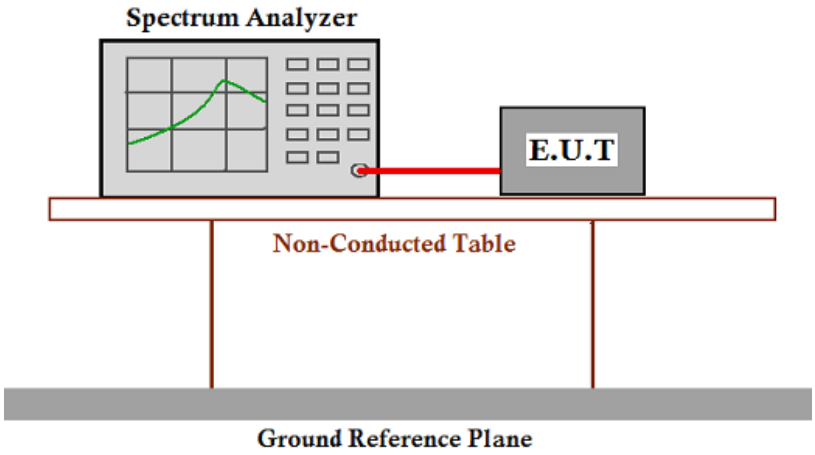
Test Requirement: FCC Part15 C section 15.247

(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 7.8.8

Test Status: Pre-test the EUT in continuous transmitting mode at the lowest (2402 MHz), middle (2442 MHz) and highest (2480 MHz) channel with different data packet. Compliance test in continuous transmitting mode with Normal mode (DH5 data packet with GFSK modulation type) 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 = 300KHz. Sweep = auto; Detector Function = Peak (Max. hold).

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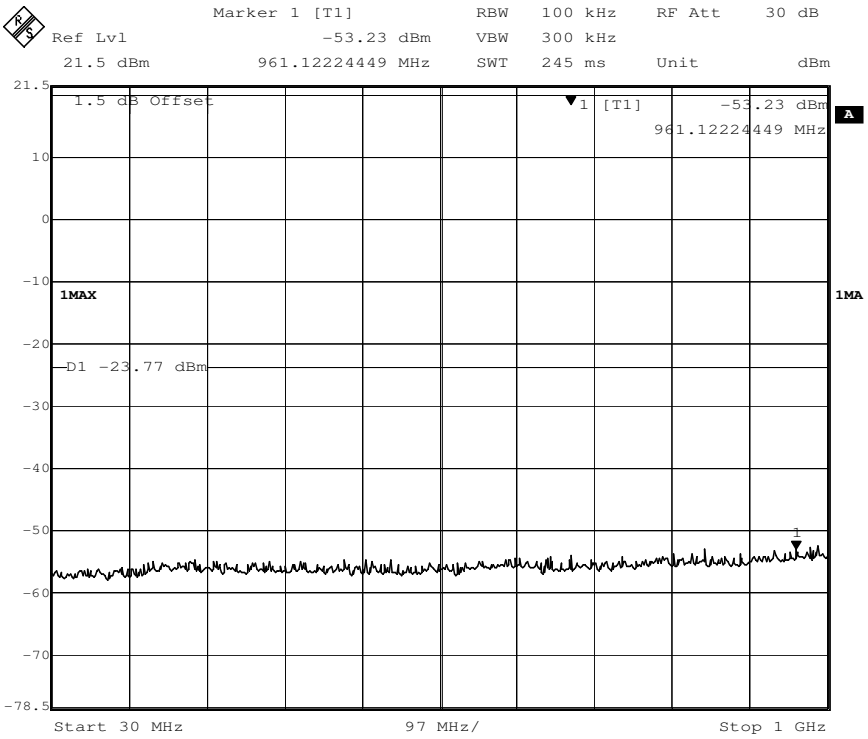
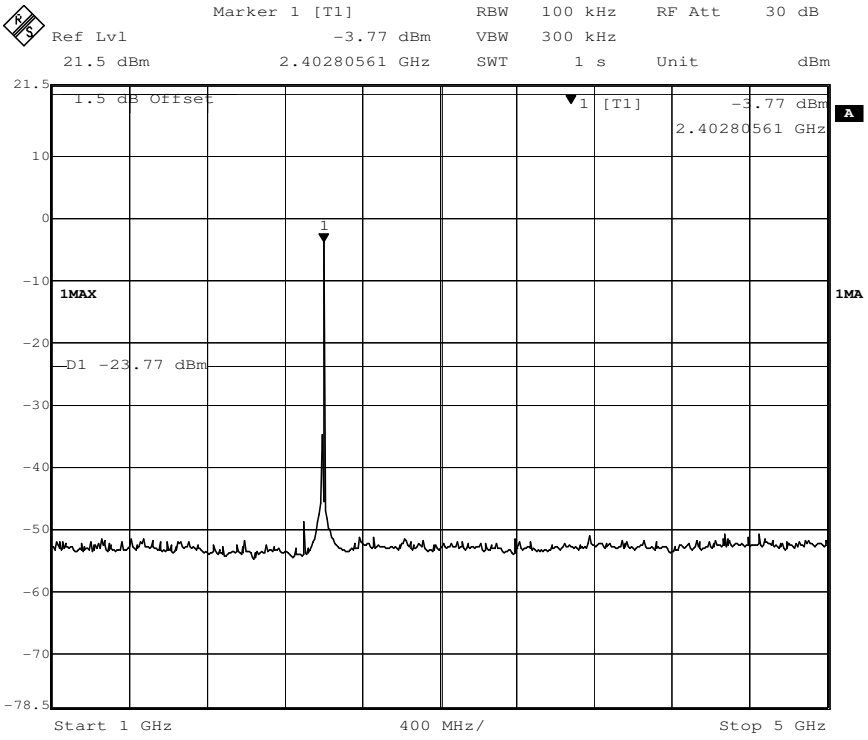
Result plot as follows:

Lowest Channel: 30MHz to 1GHz



Lowest Channel: 1GHz to 5GHz



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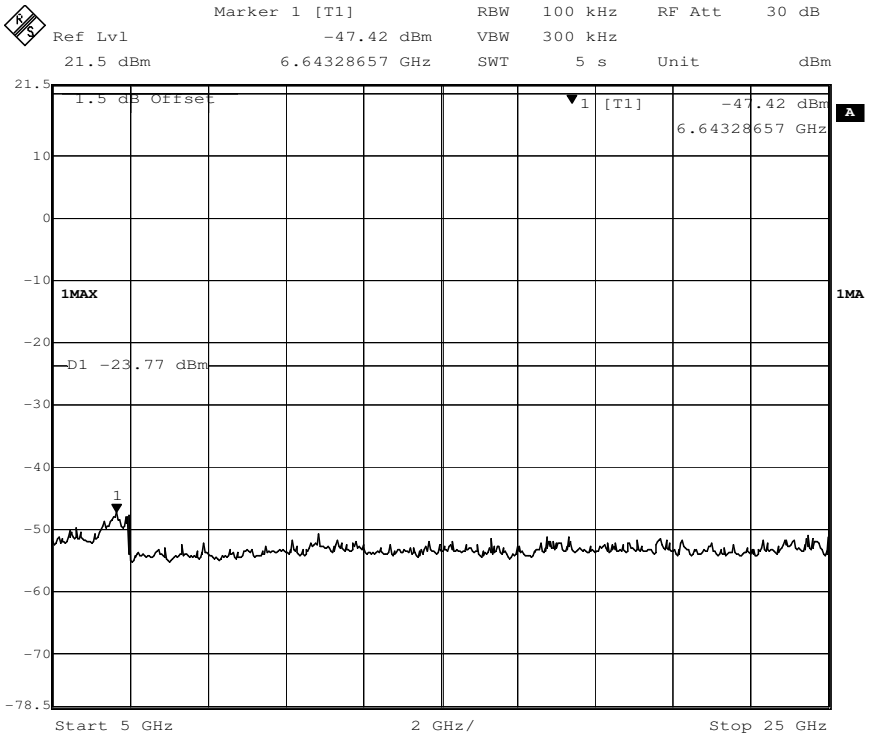
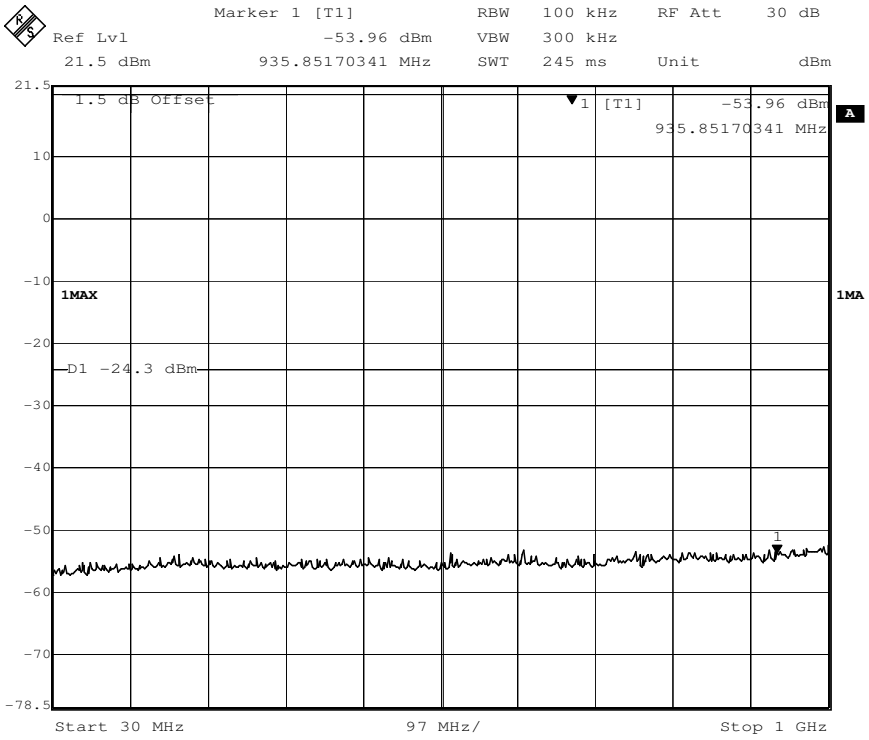
Lowest Channel: 5GHz to 25GHz



Middle Channel: 30MHz to 1GHz



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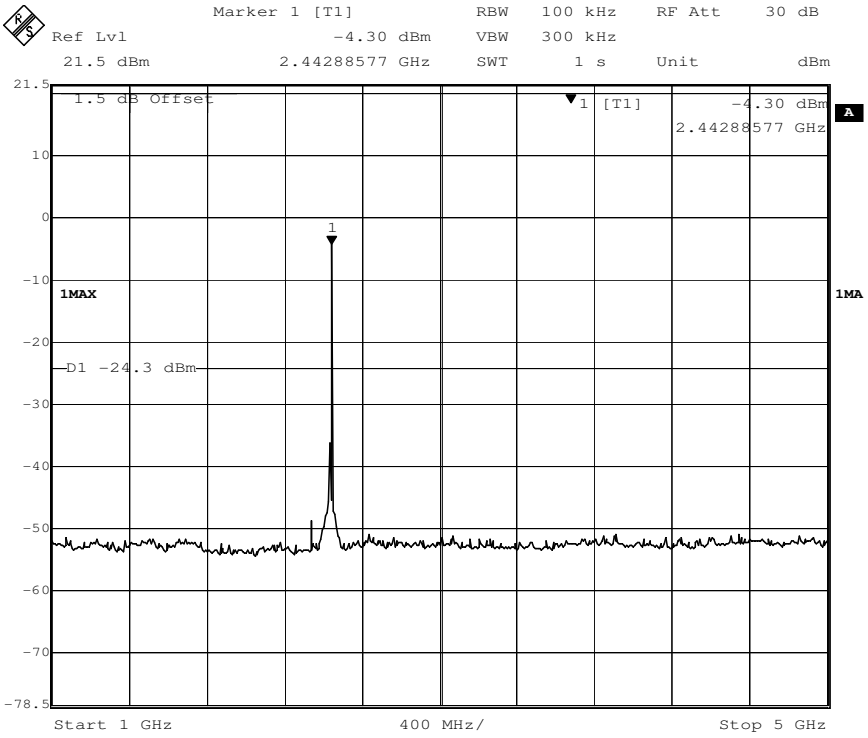
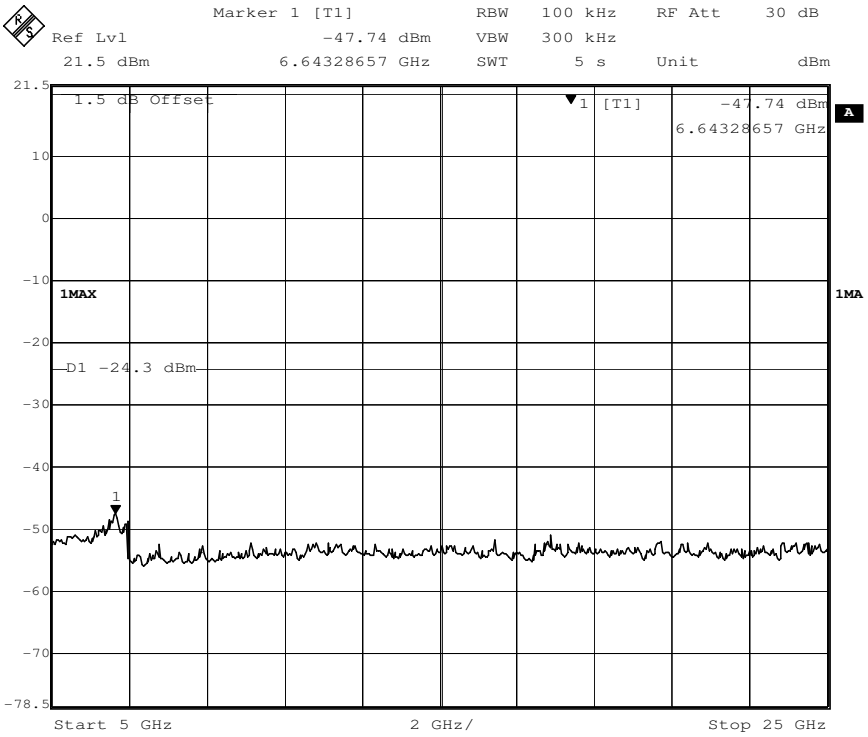
Middle Channel: 1GHz to 5GHz



Middle Channel: 5GHz to 25GHz



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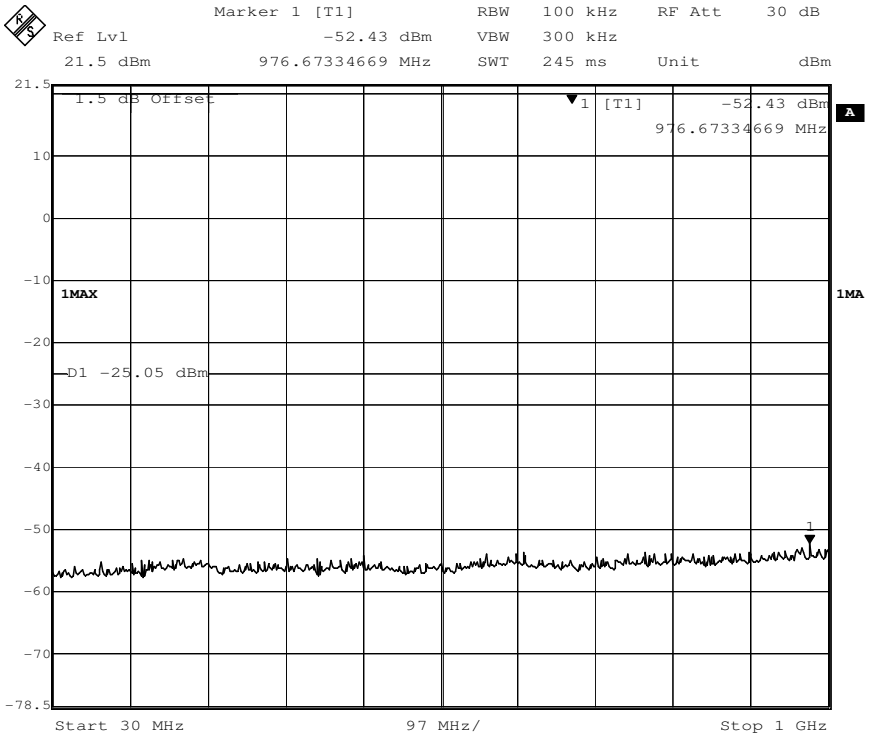
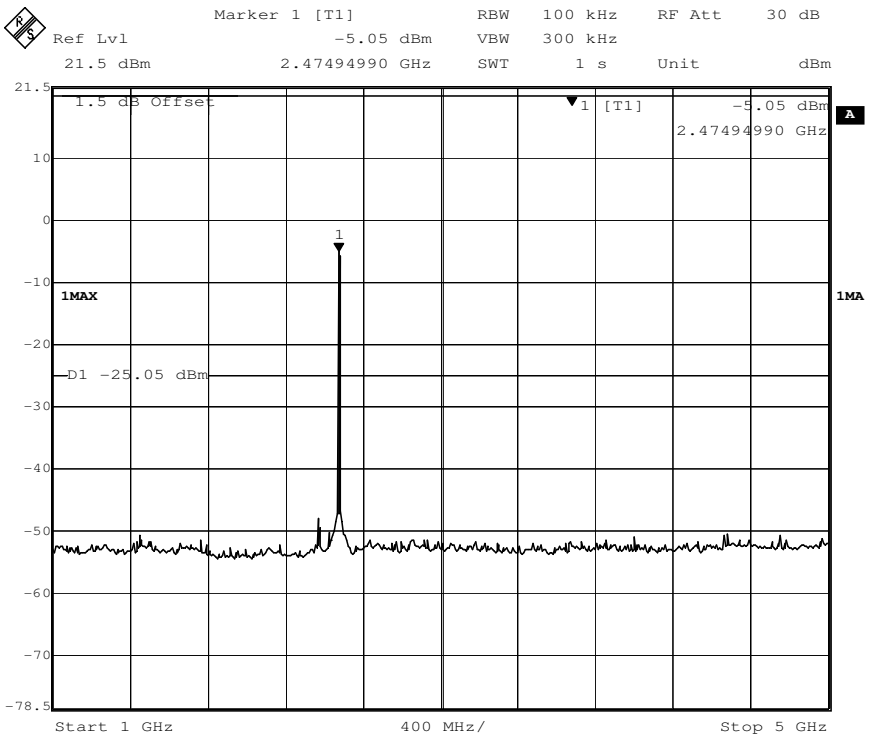
Highest Channel: 30MHz to 1GHz



Highest Channel: 1GHz to 5GHz



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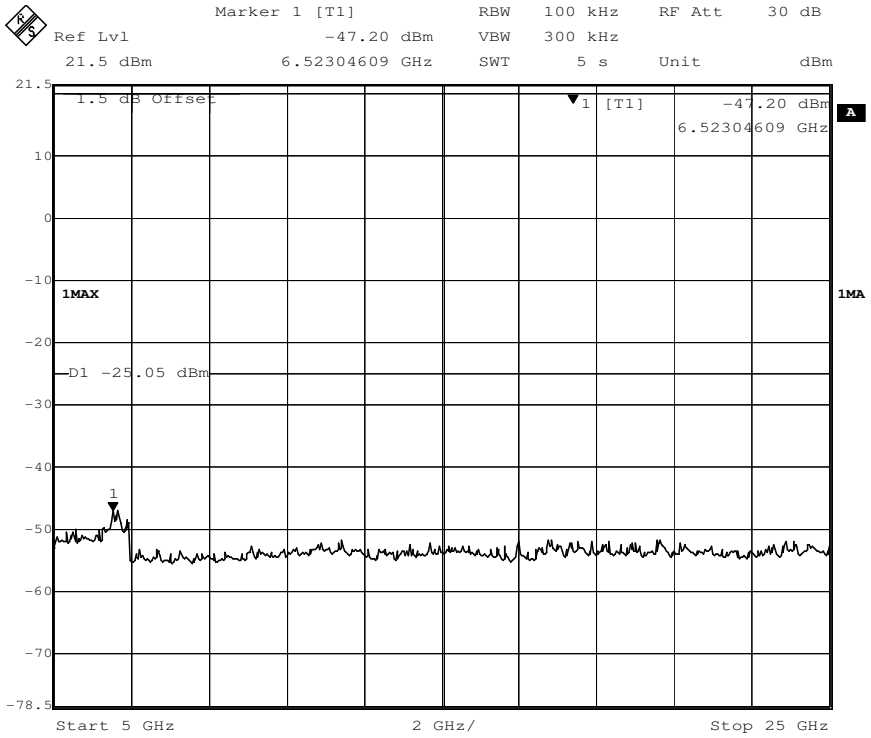
Highest Channel: 5GHz to 25GHz



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7.10 Radiated Spurious Emissions

Test Requirement: 47 CFR Part 15C Section 15.209 and 15.205

Test Method: ANSI C63.10: 2013

Test Site: Measurement Distance:3m (Semi-Anechoic Chamber below 1GHz, Full Anechoic Chamber above 1GHz)

Receiver Setup:

Frequency	Detector	RBW	VBW	Remark
0.009MHz-0.090MHz	Peak	10kHz	30kHz	Peak
0.009MHz-0.090MHz	Average	10kHz	30kHz	Average
0.090MHz-0.110MHz	Quasi-peak	10kHz	30kHz	Quasi-peak
0.110MHz-0.490MHz	Peak	10kHz	30kHz	Peak
0.110MHz-0.490MHz	Average	10kHz	30kHz	Average
0.490MHz -30MHz	Quasi-peak	10kHz	30kHz	Quasi-peak
30MHz-1GHz	Quasi-peak	100 kHz	300kHz	Quasi-peak
Above 1GHz	Peak	1MHz	3MHz	Peak
	Peak	1MHz	10Hz	Average

Limit:

Frequency	Field strength (microvolt/meter)	Limit (dBuV/m)	Remark	Measurement distance (m)
0.009MHz-0.490MHz	2400/F(kHz)	-	-	300
0.490MHz-1.705MHz	24000/F(kHz)	-	-	30
1.705MHz-30MHz	30	-	-	30
30MHz-88MHz	100	40.0	Quasi-peak	3
88MHz-216MHz	150	43.5	Quasi-peak	3
216MHz-960MHz	200	46.0	Quasi-peak	3
960MHz-1GHz	500	54.0	Quasi-peak	3
Above 1GHz	500	54.0	Average	3

Note: 15.35(b), Unless otherwise specified, the limit on peak radio frequency emissions is 20dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device.

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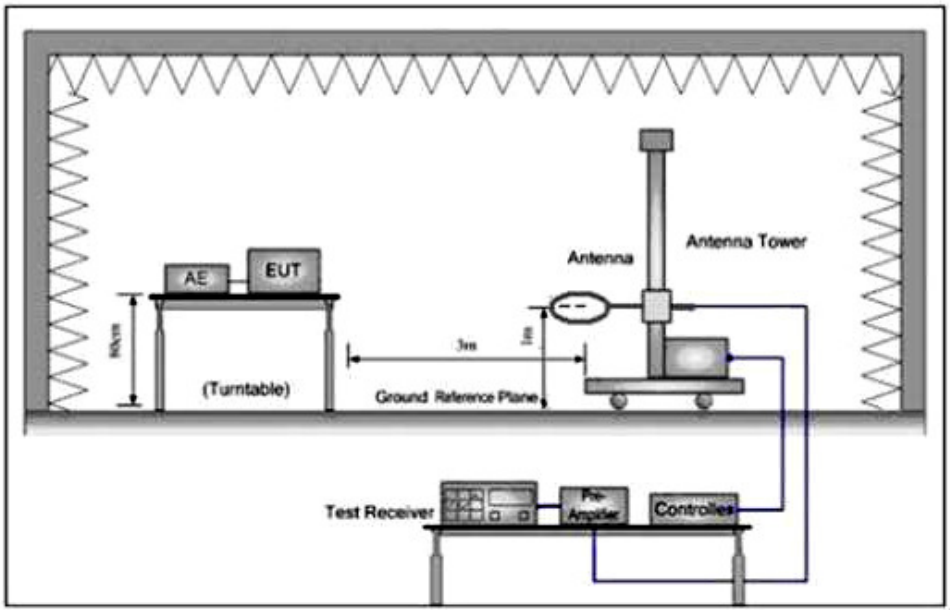
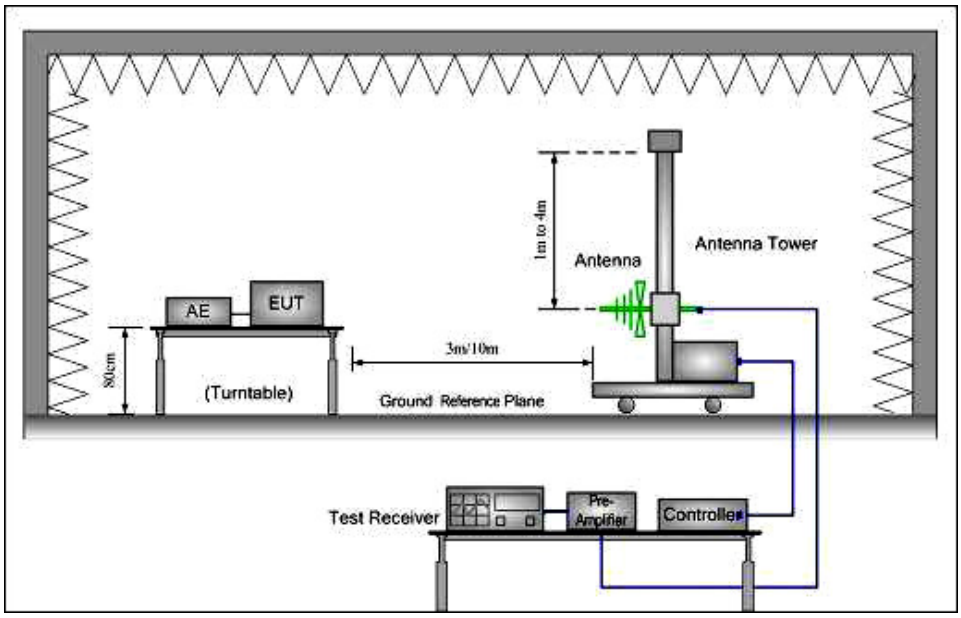
Test Setup:



Below 30MHz



30MHz to 1GHz

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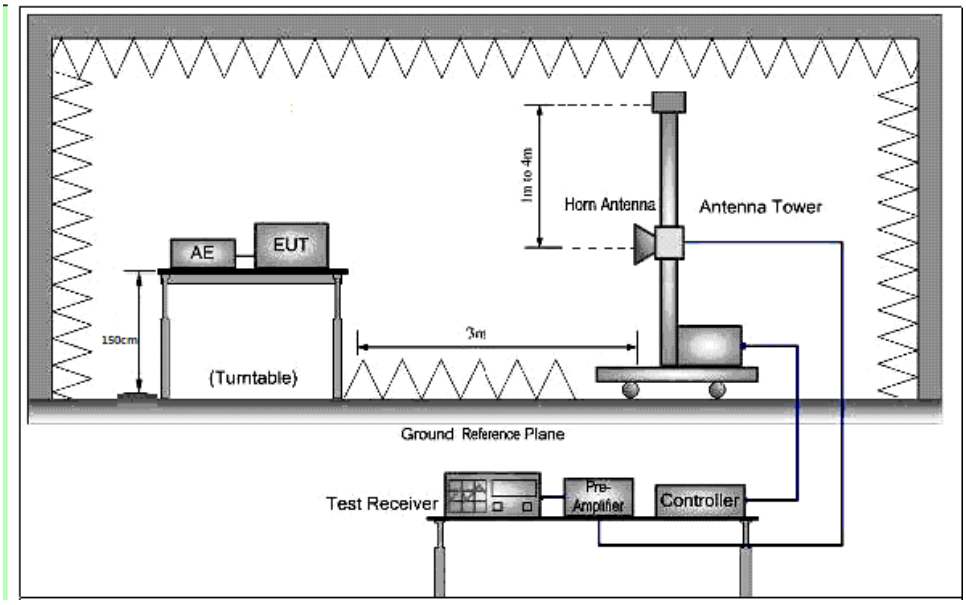

Above 1 GHz

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Test Procedure:

a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 and 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter full-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
c. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
d. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degree to 360 degrees to find the maximum reading.
f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
g. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
h. Test the EUT in the lowest channel (2402MHz),the middle channel (2442MHz),the Highest channel (2480MHz)
i. Repeat above procedures until all frequencies measured was complete.

Exploratory Test Mode: Non-hopping transmitting mode with all kind of modulation and all kind of data type Transmitting mode.

Final Test Mode: Through Pre-scan, find the DH5 of data type and GFSK modulation is the worst case.

Test the EUT in transmitting mode.

For below 1GHz part, through pre-scan, the worst case is the lowest channel.

Only the worst case is recorded in the report.

Instruments Used: Refer to section 6 for details

Test Results: Pass

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Test Result:

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

The measurements with Loop antenna and the amplitude of spurious emissions from the radiator are attenuated more than 20dB below the limit, so the test data were not recorded in the test report.

30MHz~1GHz Field Strength of Unwanted Emissions. Quasi-Peak Measurement

The measurements with Log antenna.

Lowest channel/ Vertical:

	Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Level	Limit Line	Over Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	38.481	26.55	13.73	0.70	27.00	13.98	40.00	-26.02	VERTICAL	QP
2	49.707	26.41	14.49	0.70	27.00	14.60	40.00	-25.40	VERTICAL	QP
3	63.092	26.56	13.75	0.80	27.00	14.11	40.00	-25.89	VERTICAL	QP
4	154.279	26.40	13.56	1.31	26.76	14.51	43.50	-28.99	VERTICAL	QP
5	182.559	27.12	12.56	1.45	26.69	14.44	43.50	-29.06	VERTICAL	QP
6	857.025	30.33	23.03	3.10	27.70	28.76	46.00	-17.24	VERTICAL	QP

Lowest channel /Horizontal:

	Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Level	Limit Line	Over Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	31.510	25.72	14.06	0.60	27.00	13.38	40.00	-26.62	HORIZONTAL	QP
2	46.340	24.51	14.29	0.70	27.00	12.50	40.00	-27.50	HORIZONTAL	QP
3	60.069	26.36	14.10	0.80	27.00	14.26	40.00	-25.74	HORIZONTAL	QP
4	135.982	25.39	12.75	1.25	26.86	12.53	43.50	-30.97	HORIZONTAL	QP
5	177.509	25.44	12.78	1.42	26.70	12.94	43.50	-30.56	HORIZONTAL	QP
6	912.862	30.49	23.51	3.13	27.63	29.50	46.00	-16.50	HORIZONTAL	QP

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Above 1GHz Field Strength of Unwanted Emissions. Peak & Average Measurement

Lowest channel/ Vertical:

	Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Level	Limit Line	Over Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	4804.419	43.28	30.79	9.95	40.21	43.81	54.00	-10.19	VERTICAL	Average
2	4804.419	55.20	30.79	9.95	40.21	55.73	74.00	-18.27	VERTICAL	Peak
3	6377.195	30.73	33.91	11.58	39.60	36.62	54.00	-17.38	VERTICAL	Average
4	6377.195	40.48	33.91	11.58	39.60	46.37	74.00	-27.63	VERTICAL	Peak
5	7206.260	26.11	35.45	12.73	39.25	35.04	54.00	-18.96	VERTICAL	Average
6	7206.260	38.55	35.45	12.73	39.25	47.48	74.00	-26.52	VERTICAL	Peak
7	9608.991	23.27	37.51	14.48	37.97	37.29	54.00	-16.71	VERTICAL	Average
8	9608.991	33.93	37.51	14.48	37.97	47.95	74.00	-26.05	VERTICAL	Peak
9	10735.250	22.12	39.42	14.88	37.91	38.51	54.00	-15.49	VERTICAL	Average
10	10735.250	32.84	39.42	14.88	37.91	49.23	74.00	-24.77	VERTICAL	Peak
11	12010.880	24.09	39.50	15.80	38.08	41.31	54.00	-12.69	VERTICAL	Average
12	12010.880	32.14	39.50	15.80	38.08	49.36	74.00	-24.64	VERTICAL	Peak

Lowest channel /Horizontal:

	Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Level	Limit Line	Over Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	4804.419	45.73	30.79	9.95	40.21	46.26	54.00	-7.74	HORIZONTAL	Average
2	4804.419	55.60	30.79	9.95	40.21	56.13	74.00	-17.87	HORIZONTAL	Peak
3	6195.508	30.52	33.00	11.31	39.75	35.08	54.00	-18.92	HORIZONTAL	Average
4	6195.508	40.77	33.00	11.31	39.75	45.33	74.00	-28.67	HORIZONTAL	Peak
5	7206.267	27.37	35.45	12.73	39.25	36.30	54.00	-17.70	HORIZONTAL	Average
6	7206.267	38.23	35.45	12.73	39.25	47.16	74.00	-26.84	HORIZONTAL	Peak
7	9608.684	23.56	37.51	14.48	37.97	37.58	54.00	-16.42	HORIZONTAL	Average
8	9608.684	34.34	37.51	14.48	37.97	48.36	74.00	-25.64	HORIZONTAL	Peak
9	10698.510	22.28	39.34	14.87	37.90	38.59	54.00	-15.41	HORIZONTAL	Average
10	10698.510	32.83	39.34	14.87	37.90	49.14	74.00	-24.86	HORIZONTAL	Peak
11	12010.280	18.53	39.50	15.80	38.08	35.75	54.00	-18.25	HORIZONTAL	Average
12	12010.280	32.39	39.50	15.80	38.08	49.61	74.00	-24.39	HORIZONTAL	Peak

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Middle channel	Peak Measurement:							
Frequency (MHz)	Reading Level (dBμV)	Antenna factors (dB/m)	Cable loss (dB)	Preamp factor (dB)	Emission Level (dBμV/m)	Limit (dBμV/m)	Over limit	Antenna polarization
3924.14	40.49	29.35	8.92	40.05	38.71	74.00	-35.29	V
4626.95	39.66	30.31	9.71	40.18	39.50	74.00	-34.50	V
5780.30	39.52	32.14	10.86	39.99	42.53	74.00	-31.47	V
6894.81	39.16	34.98	12.38	39.34	47.18	74.00	-26.82	V
9258.91	31.00	36.95	14.35	38.15	44.15	74.00	-29.85	V
10948.78	30.64	39.90	14.98	37.95	47.57	74.00	-26.43	V
3007.87	42.38	27.90	7.71	39.42	38.57	74.00	-35.43	H
4193.87	39.72	29.71	9.21	40.11	38.53	74.00	-35.47	H
5284.90	40.86	31.58	10.34	40.16	42.62	74.00	-31.38	H
6855.06	39.42	34.93	12.33	39.35	47.33	74.00	-26.67	H
10854.25	31.01	39.72	14.94	37.93	47.74	74.00	-26.26	H
13837.02	30.84	40.95	17.92	38.37	51.34	74.00	-22.66	H

Middle channel	Average Measurement:							
Frequency (MHz)	Reading Level (dBμV)	Antenna factors (dB/m)	Cable loss (dB)	Preamp factor (dB)	Emission Level (dBμV/m)	Limit (dBμV/m)	Over limit	Antenna polarization
3924.14	30.37	29.35	8.92	40.05	28.59	54.00	-25.41	V
4626.95	28.36	30.31	9.71	40.18	28.20	54.00	-25.80	V
5780.30	27.92	32.14	10.86	39.99	30.93	54.00	-23.07	V
6894.81	24.63	34.98	12.38	39.34	32.65	54.00	-21.35	V
9258.91	21.32	36.95	14.35	38.15	34.47	54.00	-19.53	V
10948.78	20.03	39.90	14.98	37.95	36.96	54.00	-17.04	V
3007.87	32.30	27.90	7.71	39.42	28.49	54.00	-25.51	H
4193.87	29.61	29.71	9.21	40.11	28.42	54.00	-25.58	H
5284.90	30.50	31.58	10.34	40.16	32.26	54.00	-21.74	H
6855.06	28.35	34.93	12.33	39.35	36.26	54.00	-17.74	H
10854.25	21.54	39.72	14.94	37.93	38.27	54.00	-15.73	H
13837.02	21.64	40.95	17.92	38.37	42.14	54.00	-11.86	H

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Highest channel / Vertical:

	Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Level	Limit Line	Over Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	4960.332	45.21	31.05	10.07	40.23	46.10	54.00	-7.90	VERTICAL	Average
2	4960.332	55.60	31.05	10.07	40.23	56.49	74.00	-17.51	VERTICAL	Peak
3	7440.038	24.16	35.92	13.04	39.20	33.92	54.00	-20.08	VERTICAL	Average
4	7440.038	37.00	35.92	13.04	39.20	46.76	74.00	-27.24	VERTICAL	Peak
5	8721.160	21.56	36.27	13.97	38.66	33.14	54.00	-20.86	VERTICAL	Average
6	8721.160	32.58	36.27	13.97	38.66	44.16	74.00	-29.84	VERTICAL	Peak
7	9920.789	23.79	37.92	14.41	37.84	38.28	54.00	-15.72	VERTICAL	Average
8	9920.789	33.91	37.92	14.41	37.84	48.40	74.00	-25.60	VERTICAL	Peak
9	12400.900	21.20	38.93	16.29	38.12	38.30	54.00	-15.70	VERTICAL	Average
10	12400.900	32.38	38.93	16.29	38.12	49.48	74.00	-24.52	VERTICAL	Peak
11	13757.270	21.06	40.79	17.81	38.35	41.31	54.00	-12.69	VERTICAL	Average
12	13757.270	32.36	40.79	17.81	38.35	52.61	74.00	-21.39	VERTICAL	Peak

Highest channel /Horizontal:

	Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Level	Limit Line	Over Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	4960.332	45.54	31.05	10.07	40.23	46.43	54.00	-7.57	HORIZONTAL	Average
2	4960.332	54.54	31.05	10.07	40.23	55.43	74.00	-18.57	HORIZONTAL	Peak
3	6303.890	28.57	33.60	11.49	39.67	33.99	54.00	-20.01	HORIZONTAL	Average
4	6303.890	40.82	33.60	11.49	39.67	46.24	74.00	-27.76	HORIZONTAL	Peak
5	7440.741	26.36	35.92	13.04	39.20	36.12	54.00	-17.88	HORIZONTAL	Average
6	7440.741	37.18	35.92	13.04	39.20	46.94	74.00	-27.06	HORIZONTAL	Peak
7	9920.991	22.43	37.92	14.41	37.84	36.92	54.00	-17.08	HORIZONTAL	Average
8	9920.991	33.65	37.92	14.41	37.84	48.14	74.00	-25.86	HORIZONTAL	Peak
9	11467.000	23.37	39.15	15.75	38.03	40.24	54.00	-13.76	HORIZONTAL	Average
10	11467.000	33.49	39.15	15.75	38.03	50.36	74.00	-23.64	HORIZONTAL	Peak
11	12400.560	23.37	38.93	16.29	38.12	40.47	54.00	-13.53	HORIZONTAL	Average
12	12400.560	32.75	38.93	16.29	38.12	49.85	74.00	-24.15	HORIZONTAL	Peak

Test result: The unit does meet the FCC requirements.

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7.11 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 6.3, 6.5 and 6.6

Test Status: Pre-test the EUT in continuous transmitting mode at the lowest (2402 MHz), middle (2442 MHz) and highest (2480 MHz) channel with different data packet. Compliance test in continuous transmitting mode with normal mode (DH5 data packet with GFSK modulation type) as the worst case was found.

Test the EUT at Charge + Transmitting mode.

Measurement Distance: 3m (Semi-Anechoic Chamber below 1GHz, Full Anechoic Chamber above 1GHz)

Limit: Section 15.209(a)

Frequency	Limit (dBuV/m @3m)	Remark
30MHz-88MHz	40.0	Quasi-peak Value
88MHz-216MHz	43.5	Quasi-peak Value
216MHz-960MHz	46.0	Quasi-peak Value
960MHz-1GHz	54.0	Quasi-peak Value
Above 1GHz	54.0	Average Value
	74.0	Peak Value

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

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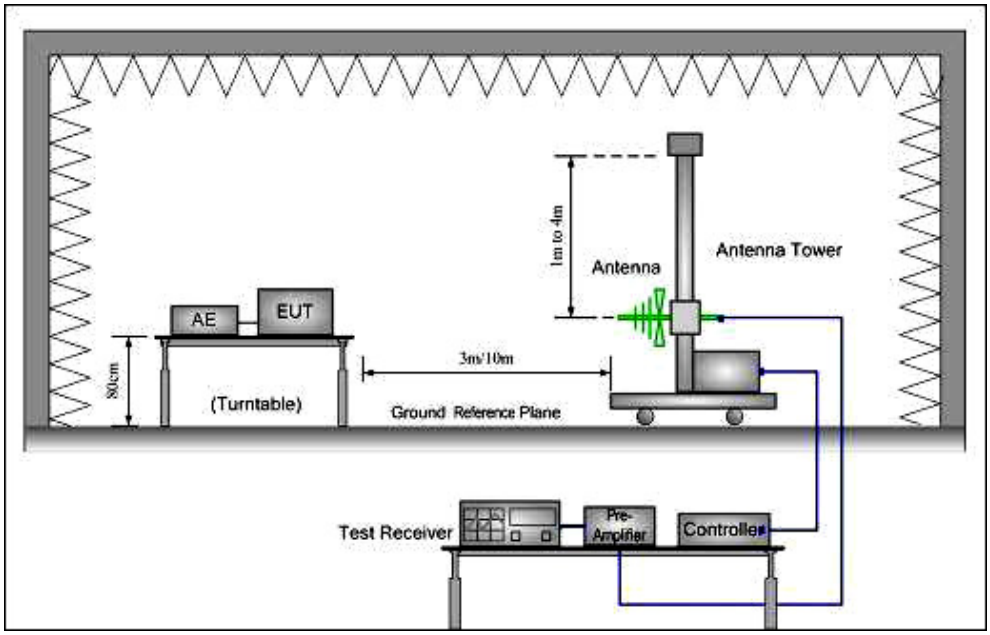
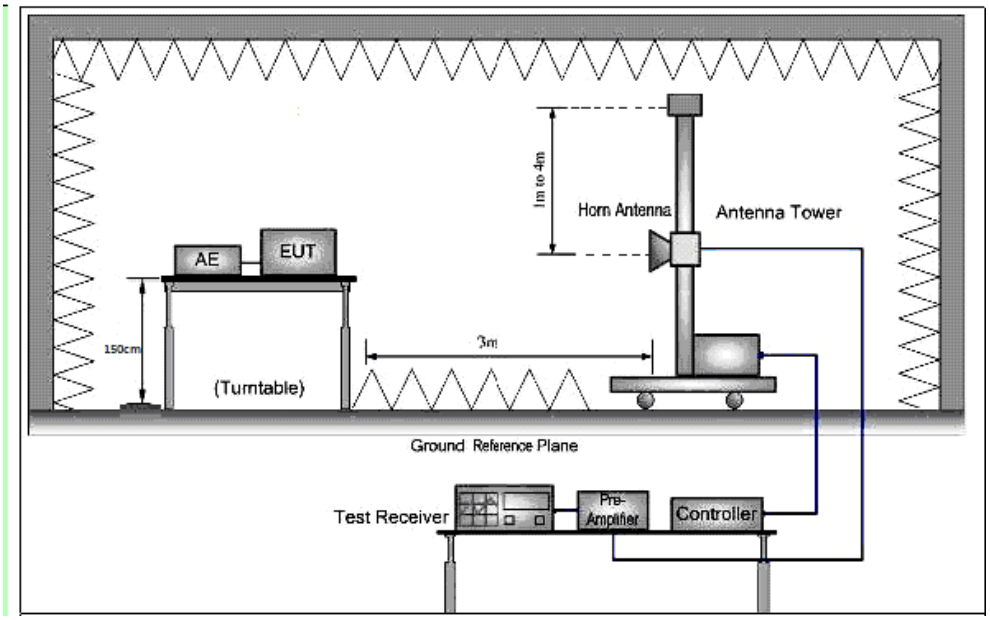
Test Configuration:

1) 30 MHz to 1 GHz emissions:



2) Above 1 GHz emissions:



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Test Procedure:

Test site with RF absorbing material covering the ground plane that met the site validation criterion called out in CISPR 16-1-4:2010 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.

From 30MHz to 1GHz, read the Quasi-Peak field strength of the emissions with receiver QP detector RBW=120KHz.

Above 1GHz, read the Peak field strength and Average field strength.

Read the Peak field strength through RBW=1MHz,VBW=3MHz in spectrum analyzer setting;

Read the Average field strength through RBW=1MHz,VBW=10Hz in spectrum analyzer setting;

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 average field strength 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.

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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 -	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.52525	2655 - 2900	22.01 - 23.12
8.41425 - 8.41475	156.7 - 156.9	3260 - 3267	23.6 - 24.0
12.29 - 12.293	162.0125 - 167.17	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	167.72 - 173.2	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	240 - 285	3600 - 4400	
13.36 - 13.41	322 - 335.4		

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Test Result:

30 MHz to 1 GHz Measurement

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

Above 1GHz Measurement

Lowest channel / Vertical:

	Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Level	Limit Line	Over Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	2310.000	31.67	26.25	6.80	39.07	25.65	54.00	-28.35	VERTICAL	Average
2	2310.000	41.65	26.25	6.80	39.07	35.63	74.00	-38.37	VERTICAL	Peak
3	2390.000	39.05	26.43	6.87	39.10	33.25	54.00	-20.75	VERTICAL	Average
4	2390.000	49.30	26.43	6.87	39.10	43.50	74.00	-30.50	VERTICAL	Peak
5	2483.500	31.78	26.58	7.07	39.14	26.29	54.00	-27.71	VERTICAL	Average
6	2483.500	42.80	26.58	7.07	39.14	37.31	74.00	-36.69	VERTICAL	Peak
7	2500.000	32.77	26.60	7.10	39.14	27.33	54.00	-26.67	VERTICAL	Average
8	2500.000	43.40	26.60	7.10	39.14	37.96	74.00	-36.04	VERTICAL	Peak

Lowest channel /Horizontal:

	Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Level	Limit Line	Over Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	2310.000	31.99	26.25	6.80	39.07	25.97	54.00	-28.03	HORIZONTAL	Average
2	2310.000	41.31	26.25	6.80	39.07	35.29	74.00	-38.71	HORIZONTAL	Peak
3	2390.000	55.65	26.43	6.87	39.10	49.85	54.00	-4.15	HORIZONTAL	Average
4	2390.000	44.24	26.43	6.87	39.10	38.44	74.00	-35.56	HORIZONTAL	Peak
5	2483.500	31.58	26.58	7.07	39.14	26.09	54.00	-27.91	HORIZONTAL	Average
6	2483.500	42.10	26.58	7.07	39.14	36.61	74.00	-37.39	HORIZONTAL	Peak
7	2500.000	31.62	26.60	7.10	39.14	26.18	54.00	-27.82	HORIZONTAL	Average
8	2500.000	42.63	26.60	7.10	39.14	37.19	74.00	-36.81	HORIZONTAL	Peak

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Highest channel / Vertical:

	Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Level	Limit Line	Over Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	2310.000	30.33	26.25	6.80	39.07	24.31	54.00	-29.69	VERTICAL	Average
2	2310.000	41.74	26.25	6.80	39.07	35.72	74.00	-38.28	VERTICAL	Peak
3	2390.000	29.05	26.43	6.87	39.10	23.25	54.00	-30.75	VERTICAL	Average
4	2390.000	44.24	26.43	6.87	39.10	38.44	74.00	-35.56	VERTICAL	Peak
5	2483.500	41.60	26.58	7.07	39.14	36.11	54.00	-17.89	VERTICAL	Average
6	2483.500	57.12	26.58	7.07	39.14	51.63	74.00	-22.37	VERTICAL	Peak
7	2500.000	35.58	26.60	7.10	39.14	30.14	54.00	-23.86	VERTICAL	Average
8	2500.000	47.02	26.60	7.10	39.14	41.58	74.00	-32.42	VERTICAL	Peak

Highest channel /Horizontal:

	Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Level	Limit Line	Over Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	2310.000	30.39	26.25	6.80	39.07	24.37	54.00	-29.63	HORIZONTAL	Average
2	2310.000	41.31	26.25	6.80	39.07	35.29	74.00	-38.71	HORIZONTAL	Peak
3	2390.000	31.45	26.43	6.87	39.10	25.65	54.00	-28.35	HORIZONTAL	Average
4	2390.000	42.56	26.43	6.87	39.10	36.76	74.00	-37.24	HORIZONTAL	Peak
5	2483.500	47.08	26.58	7.07	39.14	41.59	54.00	-12.41	HORIZONTAL	Average
6	2483.500	59.73	26.58	7.07	39.14	54.24	74.00	-19.76	HORIZONTAL	Peak
7	2500.000	37.26	26.60	7.10	39.14	31.82	54.00	-22.18	HORIZONTAL	Average
8	2500.000	50.66	26.60	7.10	39.14	45.22	74.00	-28.78	HORIZONTAL	Peak

Test result: The unit does meet the FCC requirements.

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7.12 Band Edges Requirement

Test Requirement: FCC Part15 C section 15.247

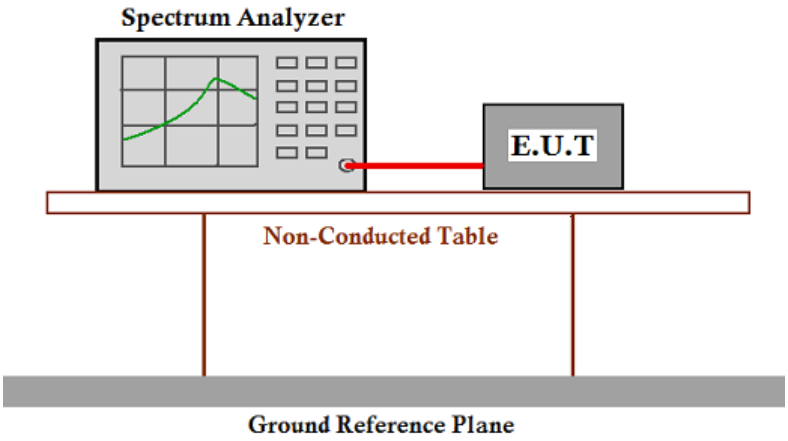
(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains 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 6.10

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. Through Pre-scan, find the DH5 data packet with GFSK modulation type is the worst case.
Test the EUT in charging + transmitting mode and charging mode.
Pre-test the EUT in hopping mode and non-hopping mode, found the worse case is non-hopping mode, only the worst case was record in the report.

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 band edge, as well as any modulation products which fall outside of the authorized band of operation.)
RBW = 100 kHz and VBW = 300 kHz
Sweep = auto
Detector function = peak
Trace = max hold

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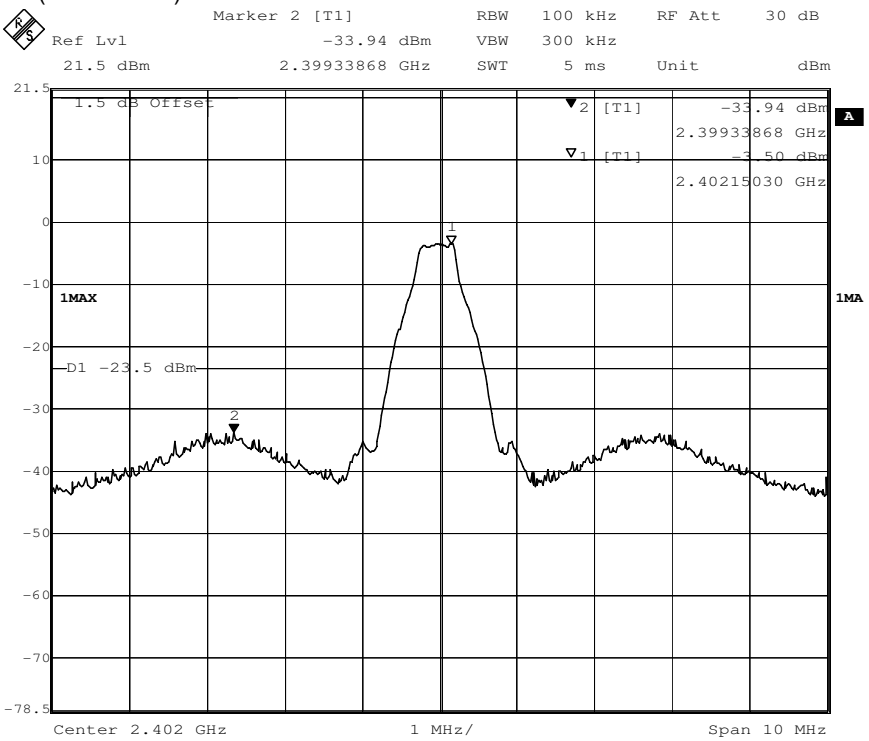
Test Result:

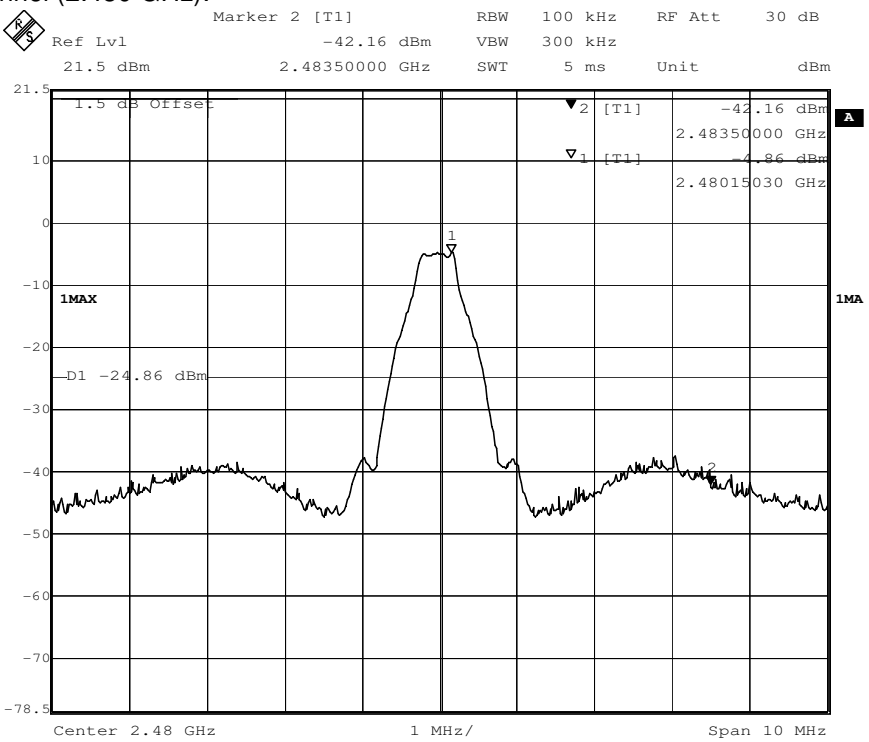
Compare with the output power of the lowest frequency, the Lower Edges attenuated more than 20dB
Compare with the output power of the highest frequency, the Upper Edges attenuated more than 20dB.

Non-hopping mode:

Lowest channel(2.402 GHz):



Highest Channel (2.480 GHz):



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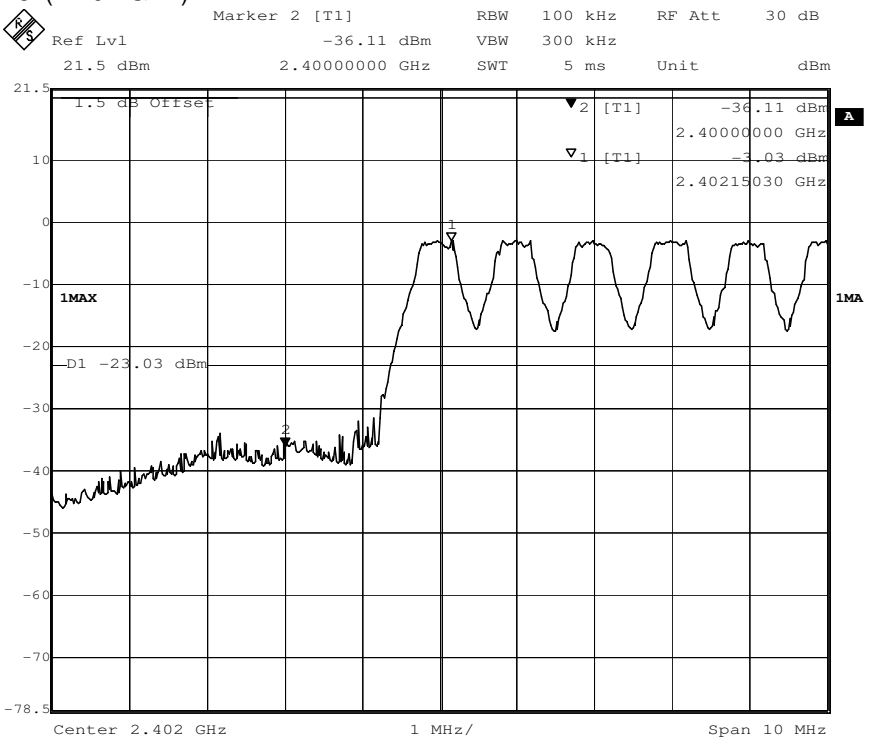
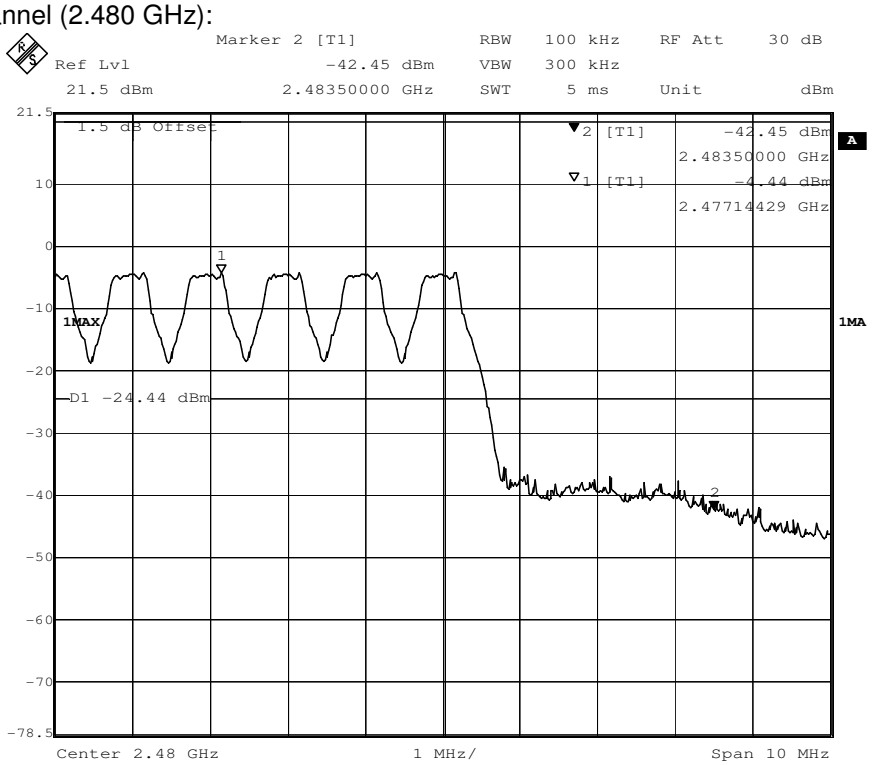
Hopping mode:

Lowest channel (2.402 GHz):



Highest Channel (2.480 GHz):



Test result: The unit does meet the FCC requirements.

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7.13 Conducted Emissions at Mains Terminals 150 kHz to 30 MHz

Test Requirement: FCC Part 15 C section 15.207

Test Method: ANSI C63.10: Clause 6.2

Frequency Range: 150 kHz to 30 MHz

Detector: Peak for pre-scan (9 kHz Resolution Bandwidth)

Test Limit

Limits for conducted disturbance at the mains ports of class B

Frequency Range (MHz)	Class B Limit dB(μV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50
NOTE 1 The limit decreases linearly with the logarithm of the frequency in the range 0,15 MHz to 0,50 MHz.		

EUT Operation: Test in normal operating mode. 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.

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

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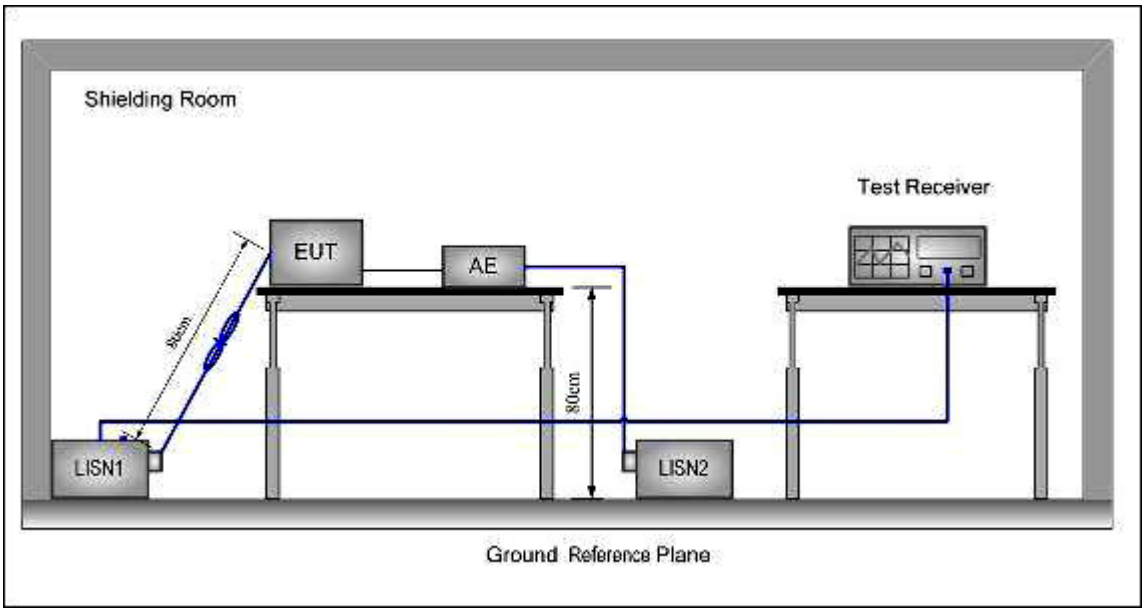
Test Configuration:



Test procedure:

1. The mains terminal disturbance voltage test was conducted in a shielded room.

2. The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides a 50Ω/50μH + 5Ω linear impedance. The power cables of all other units of the EUT were connected to a second LISN 2, which was bonded to the ground reference plane in the same way as the LISN 1 for the unit being measured. A multiple socket outlet strip was used to connect multiple power cables to a single LISN provided the rating of the LISN was not exceeded.

3. The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane, but separated from metallic contact with the ground reference plane by 0.1m of insulation.

4. The test was performed with a vertical ground reference plane. The rear of the EUT shall be 0,4 m from the vertical ground reference plane. The vertical ground reference plane was bonded to the horizontal ground reference plane. The LISN 1 was placed 0,8 m from the boundary of the unit under test and bonded to a ground reference plane for LISNs mounted on top of the ground reference plane. This distance was between the closest points of the LISN 1 and the EUT. All other units of the EUT and associated equipment was at least 0,8 m from the LISN 2.

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Measurement Data

An initial pre-scan was performed on the live and neutral lines with peak detector.

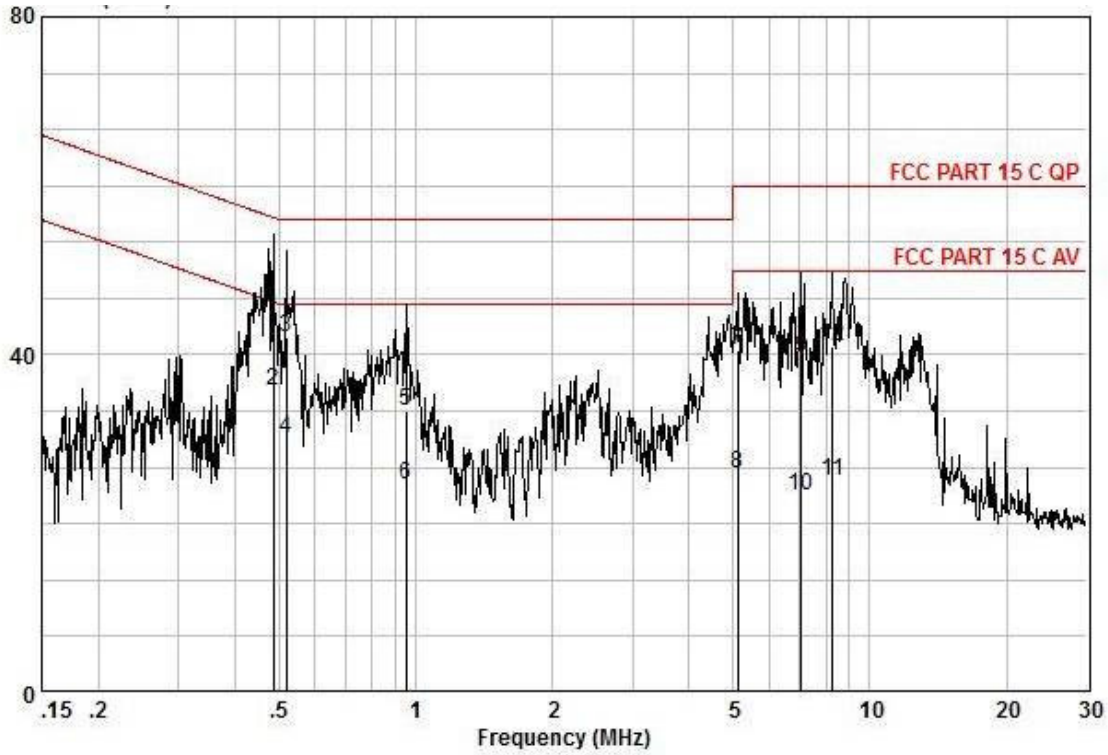
Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission were detected. For EUT the communicating was worst case mode.

The following Quasi-Peak and Average measurements were performed on the EUT:

Test Result:

Neutral Line

Level(dBµV)



Pol :NEUTRAL
No :
Model :

Frequency MHz	read level dBuV	Cable Loss dB	LISN Factor dB	Measured level dBuV	Limit Line dBuV	Over limit dB	Remark
0,49	35,28	0,20	9,55	45,03	56,23	-11,20	QP
0,49	25,99	0,20	9,55	35,74	46,23	-10,49	AVERAGE
0,52	32,28	0,21	9,55	42,04	56,00	-13,96	QP
0,52	20,36	0,21	9,55	30,12	46,00	-15,88	AVERAGE
0,95	23,56	0,29	9,59	33,44	56,00	-22,56	QP
0,95	14,76	0,29	9,59	24,64	46,00	-21,36	AVERAGE
5,11	30,20	0,70	9,61	40,51	60,00	-19,49	QP
5,11	15,68	0,70	9,61	25,99	50,00	-24,01	AVERAGE
7,06	29,38	0,65	9,59	39,62	60,00	-20,38	QP
7,06	13,18	0,65	9,59	23,42	50,00	-26,58	AVERAGE
8,28	14,76	0,63	9,61	25,00	50,00	-25,00	AVERAGE
8,28	30,80	0,63	9,61	41,04	60,00	-18,96	QP

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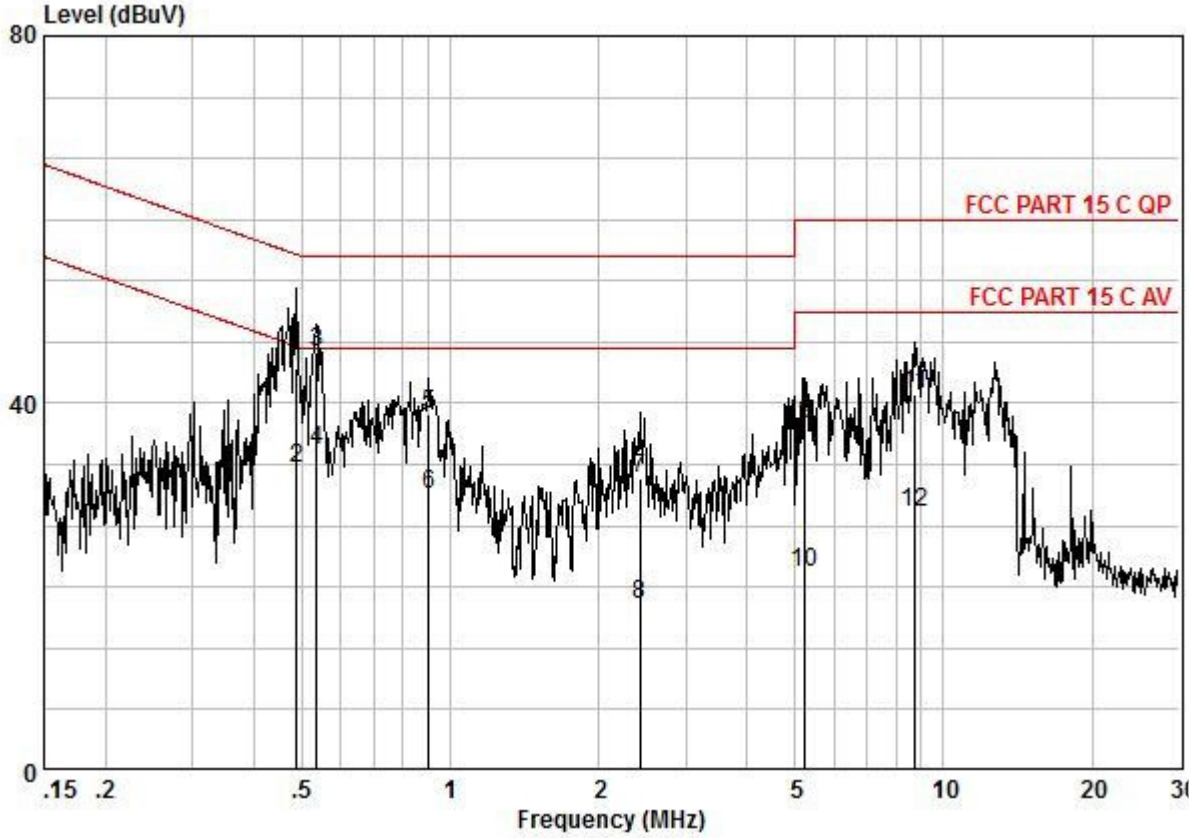
Live Line



Pol :LIVE
No :
Model :

Frequency MHz	read level dBuV	Cable Loss dB	LISN Factor dB	Measured level dBuV	Limit Line dBuV	Over limit dB	Remark
0,49	34,00	0,20	9,65	43,85	56,19	-12,34	QP
0,49	22,99	0,20	9,65	32,84	46,19	-13,35	AVERAGE
0,53	35,80	0,21	9,64	45,65	56,00	-10,35	QP
0,53	24,97	0,21	9,64	34,82	46,00	-11,18	AVERAGE
0,90	29,00	0,28	9,62	38,91	56,00	-17,09	QP
0,90	20,19	0,28	9,62	30,10	46,00	-15,90	AVERAGE
2,42	21,84	0,46	9,61	31,92	56,00	-24,08	QP
2,42	7,93	0,46	9,61	18,01	46,00	-27,99	AVERAGE
5,25	27,46	0,69	9,63	37,78	60,00	-22,22	QP
5,25	11,18	0,69	9,63	21,50	50,00	-28,50	AVERAGE
8,78	30,64	0,62	9,64	40,90	60,00	-19,10	QP
8,78	17,95	0,62	9,64	28,21	50,00	-21,79	AVERAGE

--End of Report--

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