TEST REPORT

Report No.:	**E201610210175-2**	**Application No.:**	**E201610210175**
Client:	Cyber Acoustics (HK) Ltd.		
Address:	Unit A-B, 8/F, Yue Hing Building, 101-105 Hennessy Road, Wanchai, Hong Kong		
Sample Description:	A Bluetooth 2.1 Speaker System		
Model:	CA-3712BT		
Adding Model:	CA-SP34BT		
FCC ID	ODL-CA-3712		
Test Specification:	FCC Part 15.247,Subpart C:2015; ANSI C 63.10:2013;		
Test Date:	2016-11-12 to 2017-02-28		
Issue Date:	2017-02-28		
Test Result:	*Pass.*		

Prepared By:	**Reviewed By:**	**Approved By:**
Brian Xiao / Test Engineer	Lynn Xiao /Technical Manager	Yong Dai /Technical Manager
Brian Xiao Date:2017-02-28	Lynn Xiao Date:2017-02-28	Yong Dai Date:2017-02-28

Other Aspects:

/

Abbreviations: *ok / P = passed; fail / F = failed; n.a. / N = not applicable*

The test result in this test report refers exclusively to the presented test sample. This report shall not be reproduced except in full, without the written approval of GRGT.

DIRECTIONS OF TEST

1. This station carries out test task according to the national regulation of verifications which can be traced to National Primary Standards and BIPM.

2. The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

3. If there is any objection concerning the test, the client should inform the laboratory within 15 days from the date of receiving the test report.

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1. TEST RESULT SUMMARY

FCC Part 15.247:2015			
Standard	**Item**	**Limit / Severity**	**Result**
FCC Part 15,Subpart C (15.247)	Antenna Requirement	Section 15.203	PASS
	Occupied Bandwidth	Section 15.247 (a1)	PASS
	Carrier Frequencies Separated	Section 15.247(a)(1)	PASS
	Hopping Channel Number	Section 15.247(a)(1)(iii)	PASS
	Dwell Time	Section 15.247(a)(1)(iii)	PASS
	Maximum Peak Output Power	Section 15.247(b)(1)	PASS
	Conducted Emission	Section 15.207	PASS
	Conducted Spurious Emission (30MHz to 25GHz)	Section 15.209 &15.247(d)	PASS
	Radiated Spurious Emission (30MHz to 25GHz)	Section 15.209 &15.247(d)	PASS
	Band Edges Measurement	Section 15.247 (d) &15.205	PASS

2. GENERAL DESCRIPTION OF EUT

2.1 APPLICANT

Name: Cyber Acoustics (HK) Ltd.

Address: Unit A-B, 8/F, Yue Hing Building, 101-105 Hennessy Road, Wanchai, Hong Kong

2.2 MANUFACTURER

Name: Cyber Acoustics Inc

Address: 3109NE 109th Avenue,Vancouver,WA 98682-7750,U.S.A

2.3 BASIC DESCRIPTION OF EQUIPMENT UNDER TEST

Equipment: A Bluetooth 2.1 Speaker System

Model No.: CA-3712BT

Adding Model: CA-SP34BT

Trade Name: CA

Power Supply: AC 120V/60Hz

AC adapter: /

Frequency Range 2402MHz~2480MHz

Type of Modulation Bluetooth 2.1: GFSK, 8DPSK, Pi/4 QPSK

Channels: Channels with 1MHz step

Antenna Gain: 0-3 dBi

Antenna Type Internal antenna

2.4 DESCRIPTION OF SUPPORT UNITS

Instruments:

Name of Equipment	Manufacturer	Model	Serial Number
PC	Lenovo	E40	0578DTC
USB TO TTL	/	YP-01	/
iPone 3	Apple Inc.	A1303	/

Test software:

Software version	Test level
3，1，0，2073	Power level: Specify Power Table index

3. LABORATORY AND ACCREDITATIONS

3.1 LABORATORY

The tests and measurements refer to this report were performed by Guangzhou GRG Metrology and Test CO., LTD.

Add. : 163 Pingyun Rd, West of Huangpu Ave, Guangzhou, 510656, P. R. China

Telephone: +86-20-38699959, 38699960, 38699961

Fax : +86-20-38695185

3.2 ACCREDITATIONS

Our laboratories are accredited and approved by the following approval agencies.

USA	FCC Listed Lab (No. 688188)
Canada	Registration No.:8355A-1

3.3 MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

Measurement		**Frequency**	**Uncertainty**
Radiated Emission	Horizontal	30MHz～1000MHz	4.2dB
		1GHz～26.5GHz	4.2dB
	Vertical	30MHz～1000MHz	4.4dB
		1GHz～26.5GHz	4.4dB
Conducted Emission		9kHz～30MHz	3.1 dB

This uncertainty represents an expanded uncertainty factor of *k*=2.

3.4 LIST OF USED TEST EQUIPMENT AT GRGT

Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Conducted Emissions				
EMI Receiver	R&S	ESCI	100529	2017-02-15
L.I.S.N	SCHWARZBECK	NSLK 8127	8127450	2017-06-22
Spurious Emissions/Restricted Bands				
Receiver	R&S	ESU26	100526	2017-02-16
Loop antenna	R&S	HFH2-Z2	881058/28	2017-03-10
Biconical Log-periodic Antenna	ETS.LINDGREN	3142C	75971	2017-03-14
Horn antenna	SCHWARZBECK	BBHA9120D	752	2017-03-03
Broadband Amplifiers	SCHWARZBECK	bbv9718	9718-276	2017-06-10
Semi-anechoic chamber	ETS	966(RFD-F/ A-100)	3730	2017-01-04
Occupied Bandwidth/ Dwell Time Carrier Frequency/ Hopping Channel Number/Maximum Peak Output Power/100kHz Bandwidth of Frequency Band Edge				
Spectrum Analyzer	R&S	FSV30	103246	2017-02-15

4. TEST RESULTS

4.1 E.U.T. TEST CONDITIONS

Type of antenna: **Monopole antenna antenna**

Temperature: **24.0 °C**

Humidity: **63% RH**

Atmospheric Pressure: **1011 mbar**

Test frequencies: **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:**

Frequency range over which device operates	Number of frequencies	Location in the range of operation
1 MHz or less	1	Middle
1 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

EUT channels and frequencies list:

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	14	2416	28	2430
1	2403	15	2417	29	2431
2	2404	16	2418	30	2432
3	2405	17	2419	31	2433
4	2406	18	2420	32	2434
5	2407	19	2421	33	2435
6	2408	20	2422	34	2436
7	2409	21	2423	35	2437
8	2410	22	2424	36	2438
9	2411	23	2425	37	2439
10	2412	24	2426	38	2440
11	2413	25	2427	39	2441
12	2414	26	2428	40	2442
13	2415	27	2429	41	2443

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
42	2444	55	2457	68	2470
43	2445	56	2458	69	2471
44	2446	57	2459	70	2472
45	2447	58	2460	71	2473
46	2448	59	2461	72	2474
47	2449	60	2462	73	2475
48	2450	61	2463	74	2476
49	2451	62	2464	75	2477
50	2452	63	2465	76	2478
51	2453	64	2466	77	2479
52	2454	65	2467	78	2480
53	2455	66	2468		
54	2456	67	2469		

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

Frequency Hopping System Requirement

Test Requirement: Section 15.247 (a)(1), (g), (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 hop sets 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.

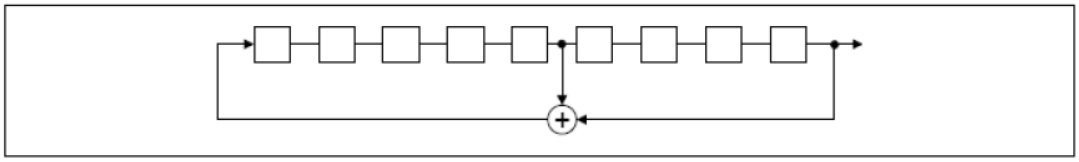
Compliance for section 15.247(a) (1)

According to Bluetooth Core Specification, the pseudorandom sequence may be generated in a ninestage 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 registers stages: 9

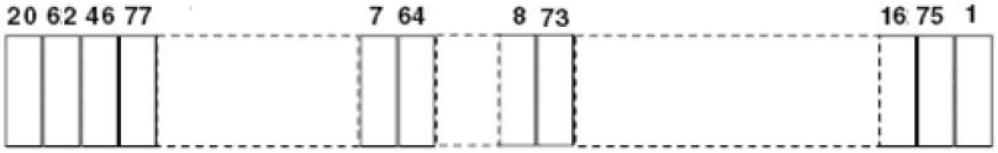
• Length of pseudo-random sequence: 2**9** -1 = 511 bits

• 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.

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)

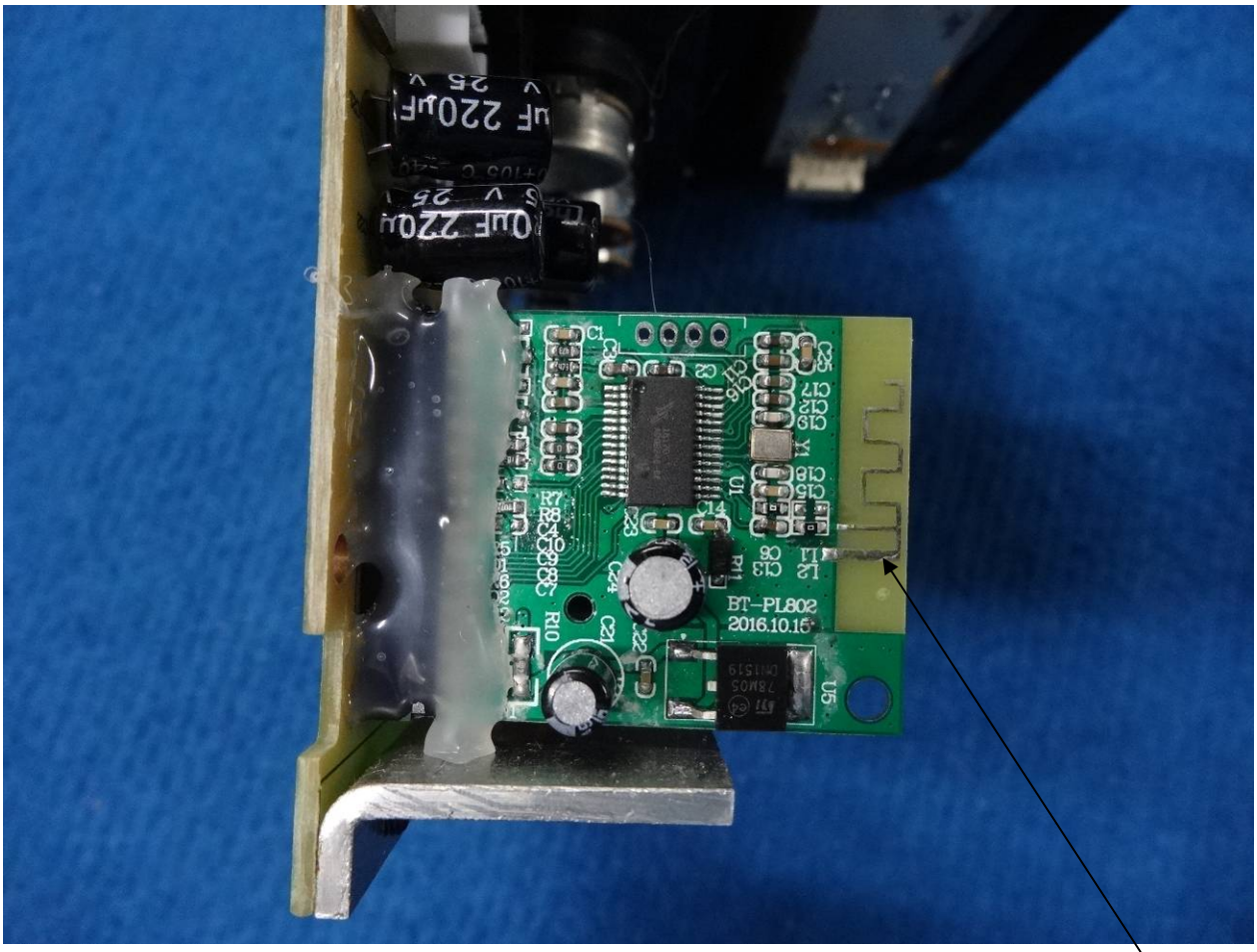
According to Bluetooth Core specification, the Bluetooth system incorporates with an adaptive system to detect other user within the spectrum band so that it individually and independently to avoid hopping on the occupied channels.

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

Reference document: BlueMod+B20-The Official Bluetooth SIG Member Website.

4.2 ANTENNA REQUIREMENT

The EUT antenna is Monopole antenna. Antenna gain is 0-3dBi .which accordance 15.203.is considered sufficient to comply with the provisions of this section.



Antenna

4.3 OCCUPIED BANDWIDTH

4.3.1 LIMITS

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.

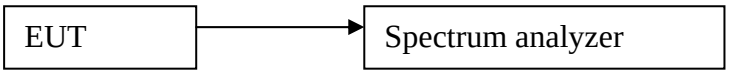
4.3.2 TEST PROCEDURES

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, centre on a hopping channel;
3. Set the spectrum analyzer: RBW >= 1% of the 20dB bandwidth (set 10kHz). VBW >= RBW. Sweep = auto; Detector Function = Peak. Trace = Max Hold.
4. Mark the peak frequency and -20dB bandwidth.
5. Bandwidth value is OBW value.

Remark:

Pre-test the 3 modulation to find GFSK and 8DPSK is worse case, so only record GFSK and 8DPSK test data.

4.3.3 TEST SETUP



4.3.4 TEST RESULTS

For GFSK

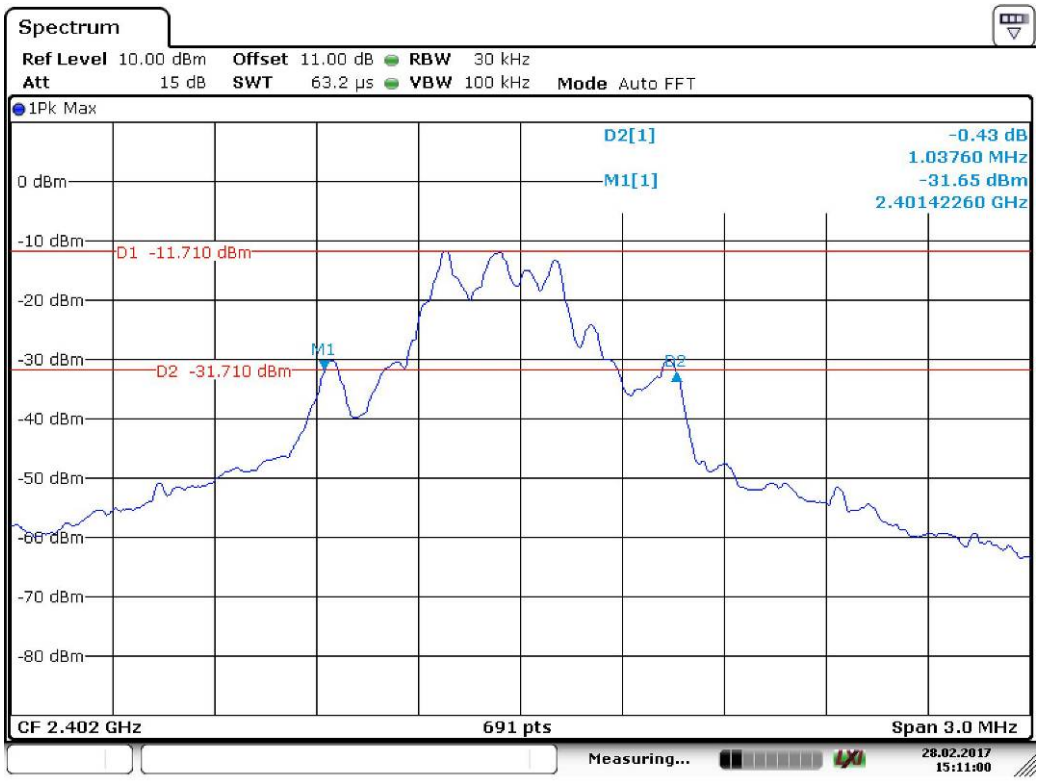
Frequency (GHz)	Test Channel	bandwidth
2.402	Lowest	1.038MHz
2.441	Middle	1.051MHz
2.480	Highest	1.051MHz

For 8DPSK

Frequency (GHz)	Test Channel	bandwidth
2.402	Lowest	1.194MHz
2.441	Middle	1.155MHz
2.480	Highest	1.155MHz

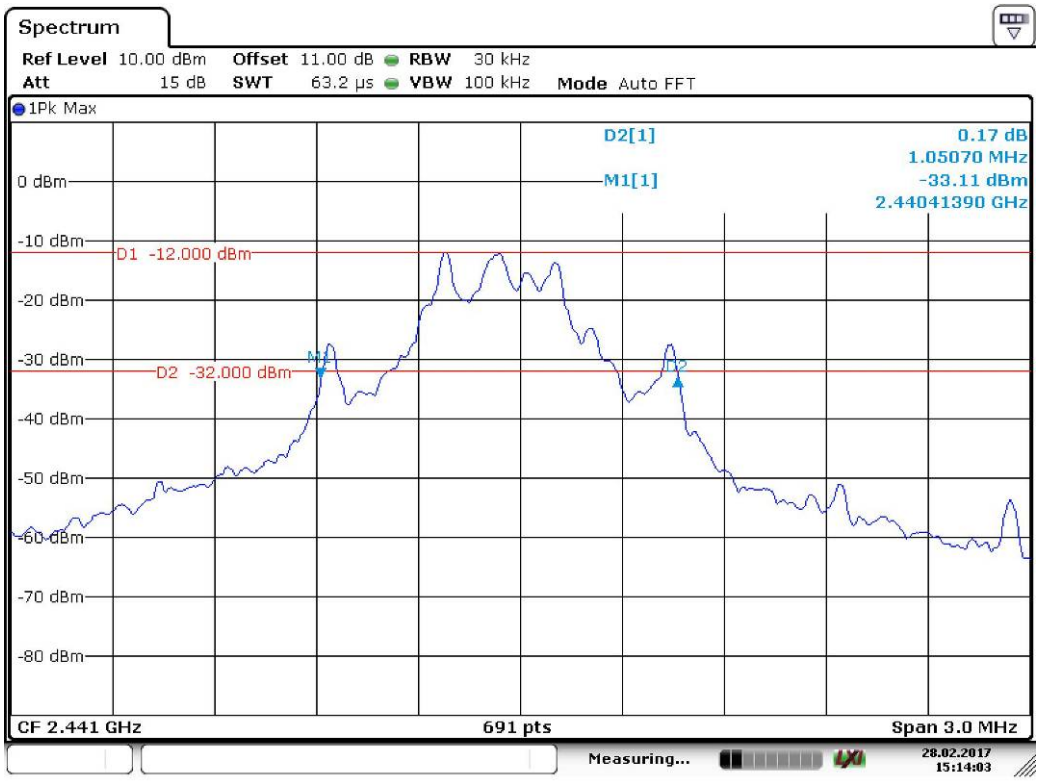
Result plot as follows:

GFSK Lowest Channel:



Date: 28.FEB.2017 15:11:00

GFSK Middle Channel:



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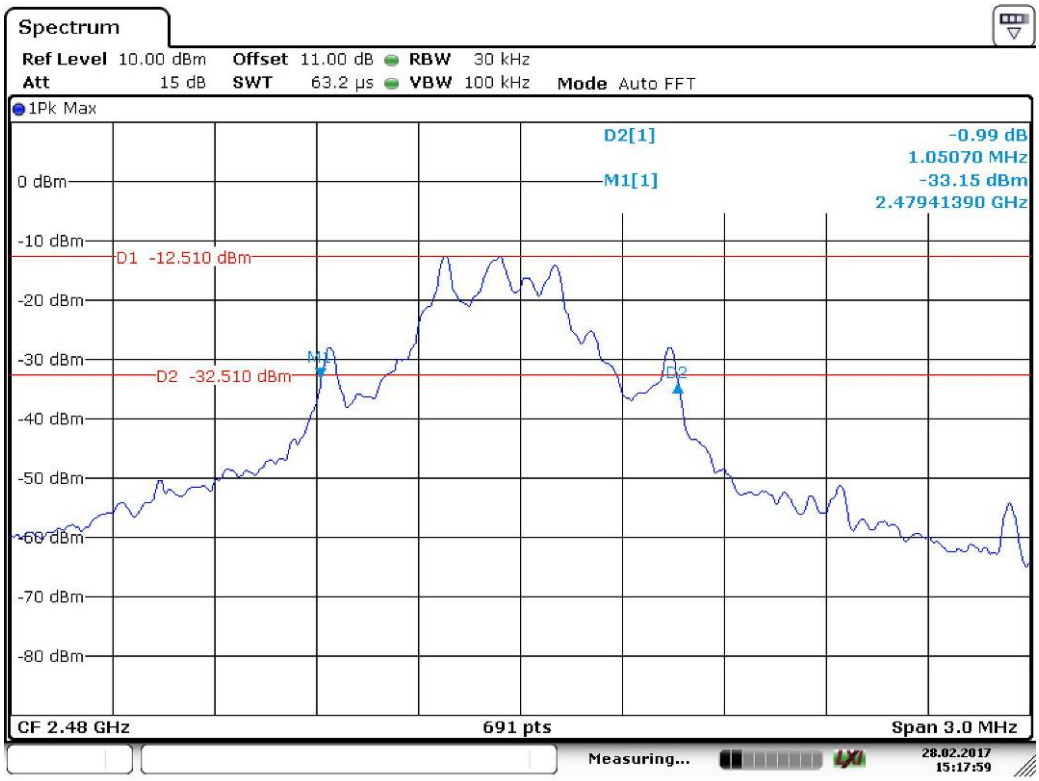
GFSK Highest Channel:



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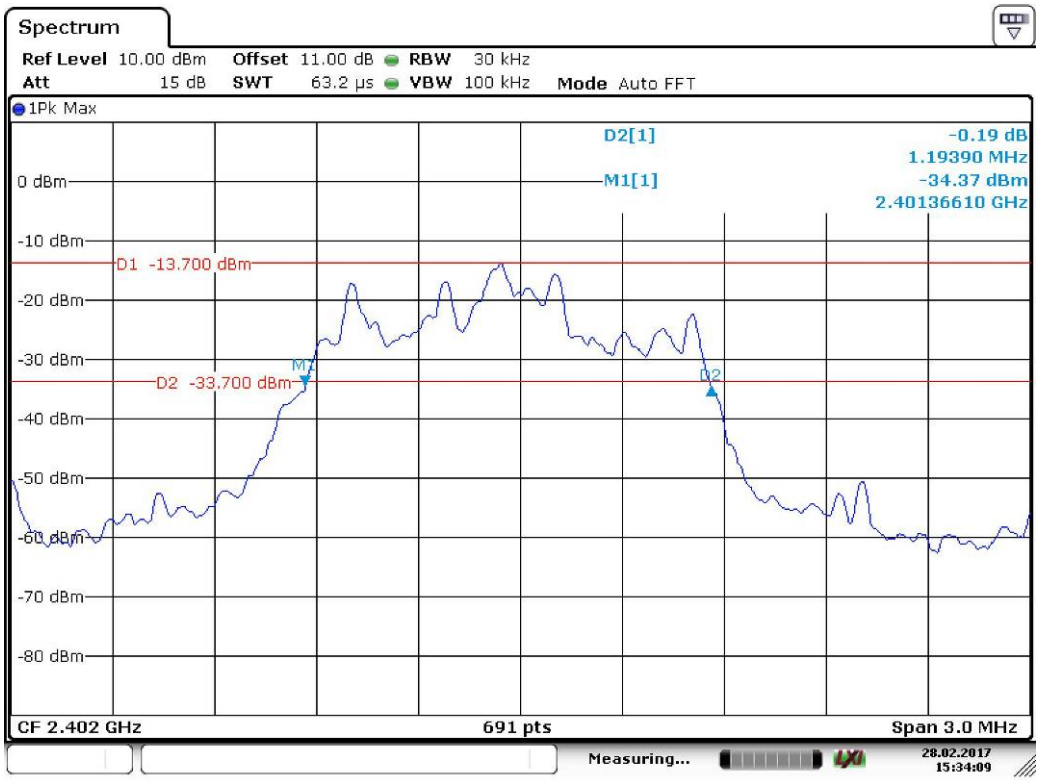
8DPSK Lowest Channel:



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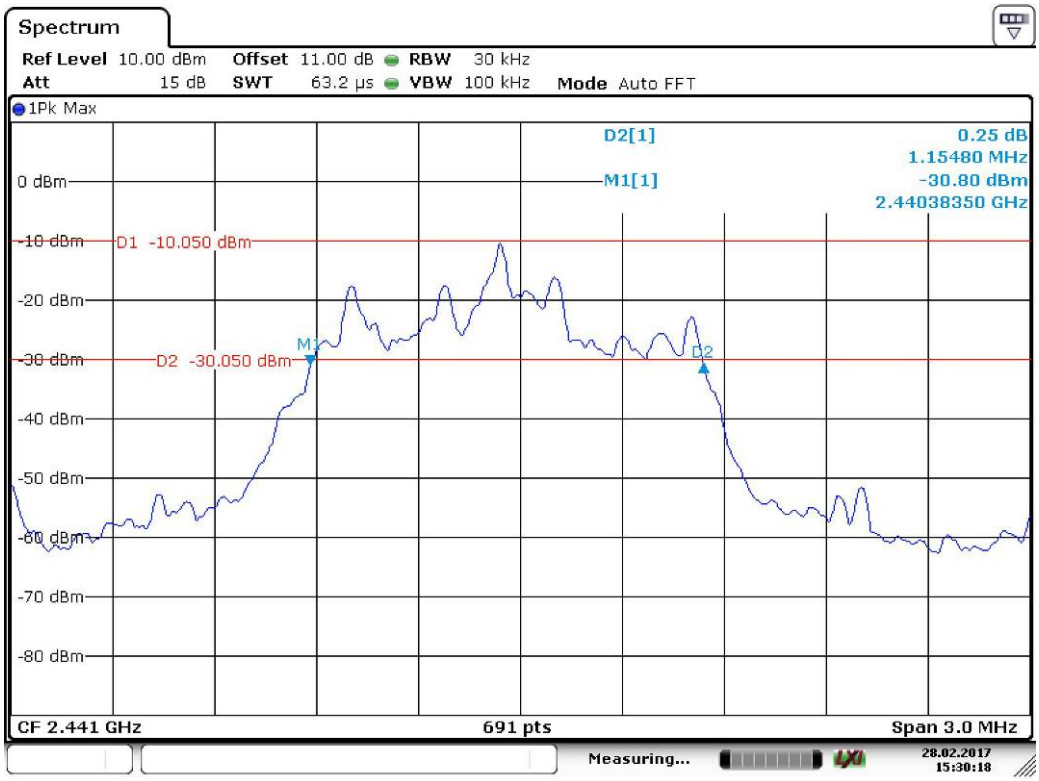
8DPSK Middle Channel:



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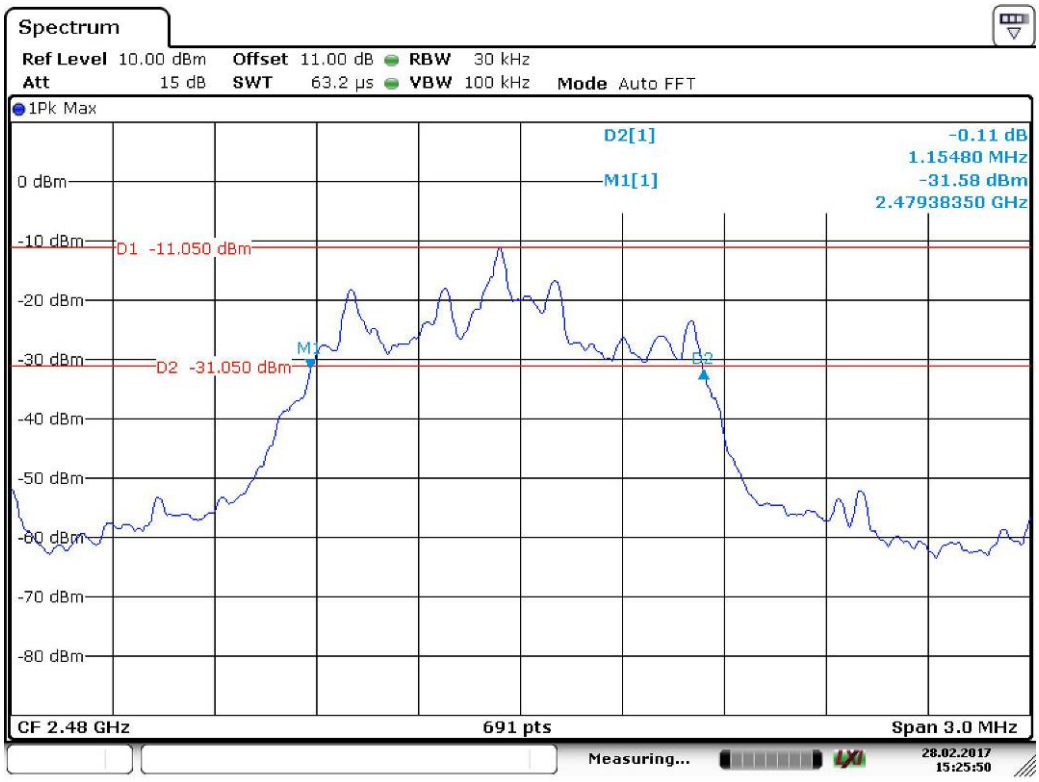
8DPSK Highest Channel:



Date: 28.FEB.2017 15:25:50

4.4 CARRIER FREQUENCIES SEPARATED

4.4.1 LIMITS

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.

4.4.2 TEST PROCEDURES

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: RBW >= 1% of the span (set 30 kHz). VBW >= RBW, Span = 3MHz. 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.

Remark：

Pre-test the 3 modulation to find GFSK and 8DPSK is worse case, so only record GFSK and 8DPSK test data.

4.4.3 TEST SETUP

EUT → Spectrum analyzer

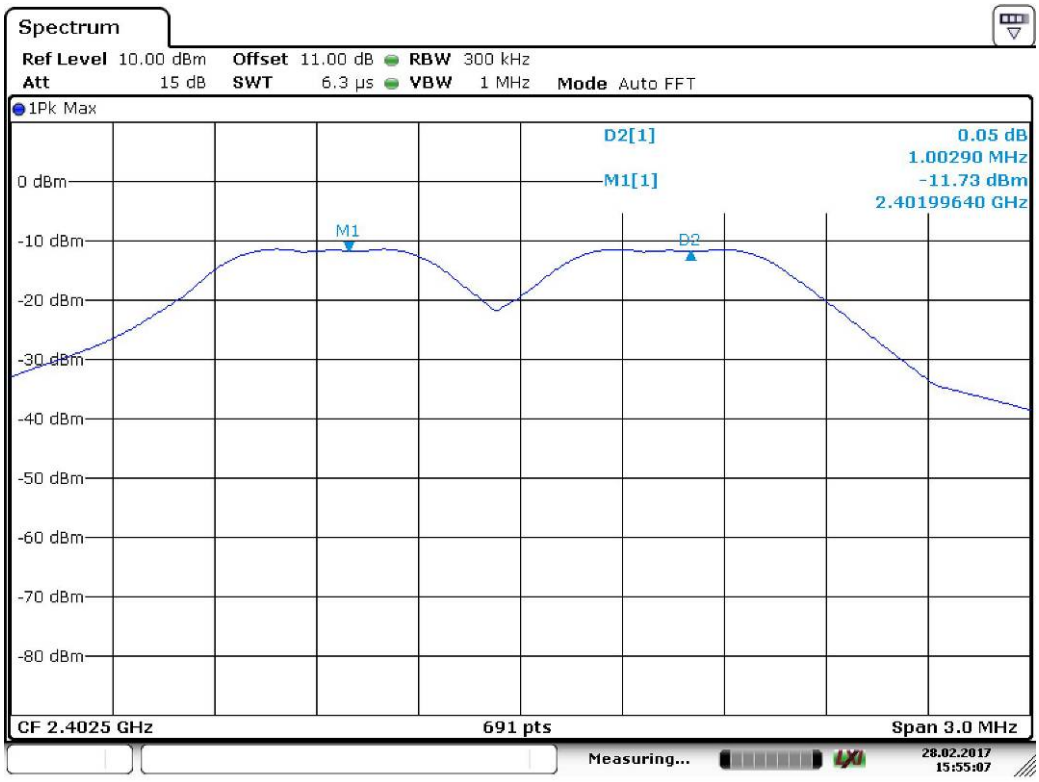
4.4.4 TEST RESULTS

Mode	Test Channel	Carrier Frequencies Separated	2/3 20 dB bandwidth	PASS/FAIL
GFSK	Lower Channels (channel 0 and channel 1)	1.0029MHz	0.692 MHz	Pass
	Middle Channels (channel 39 and channel 40)	1.0159MHz	0.701 MHz	Pass
	Upper Channels (channel 77 and channel 78)	0.9942MHz	0.701 MHz	Pass
8DPSK	Lower Channels (channel 0 and channel 1)	0.9986MHz	0.796 MHz	Pass
	Middle Channels (channel 39 and channel 40)	1.0029MHz	0.703 MHz	Pass
	Upper Channels (channel 77 and channel 78)	1.0116MHz	0.703 MHz	Pass

Note: The two-thirds of the 20 dB bandwidth is greater than 25 kHz, so the limit for the two-thirds of the 20 dB bandwidth is applied.

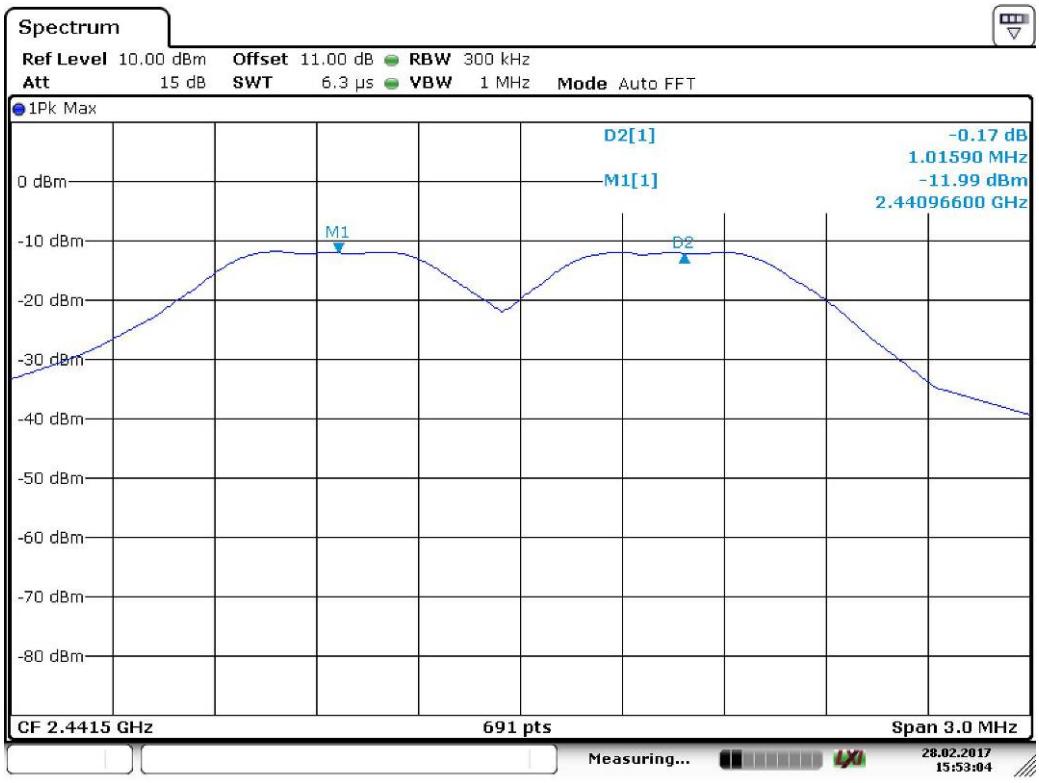
Result plot as follows:

GFSK Lowest Channels:



Date: 28.FEB.2017 15:55:08

GFSK Middle Channels:



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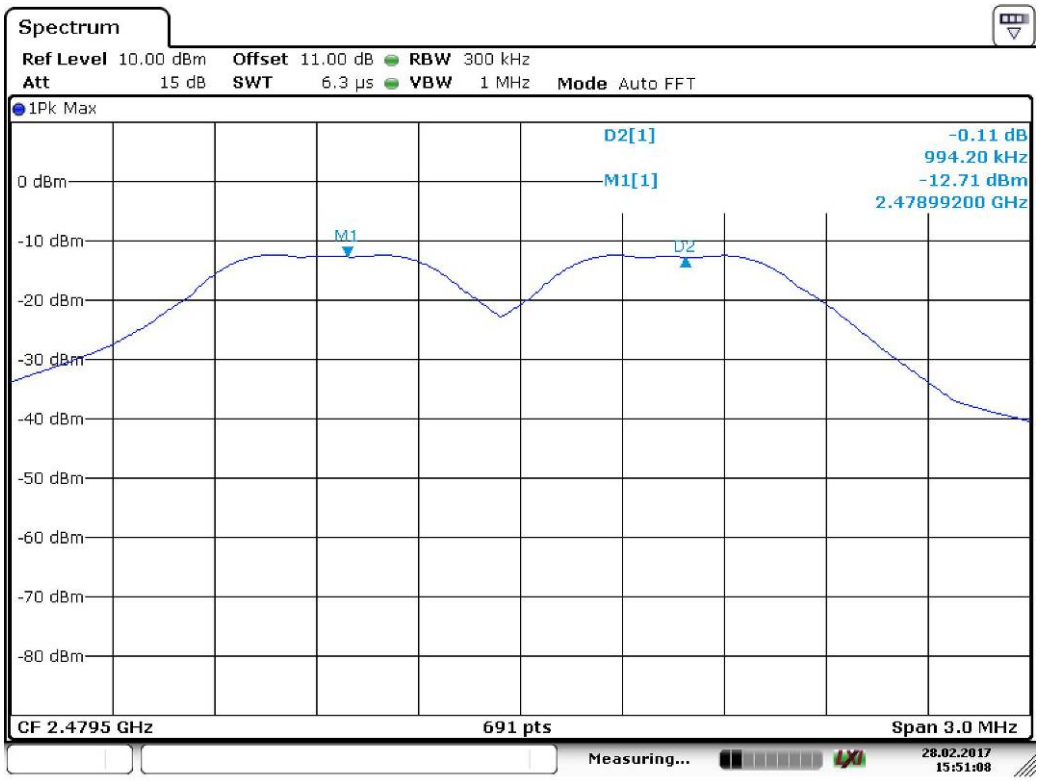
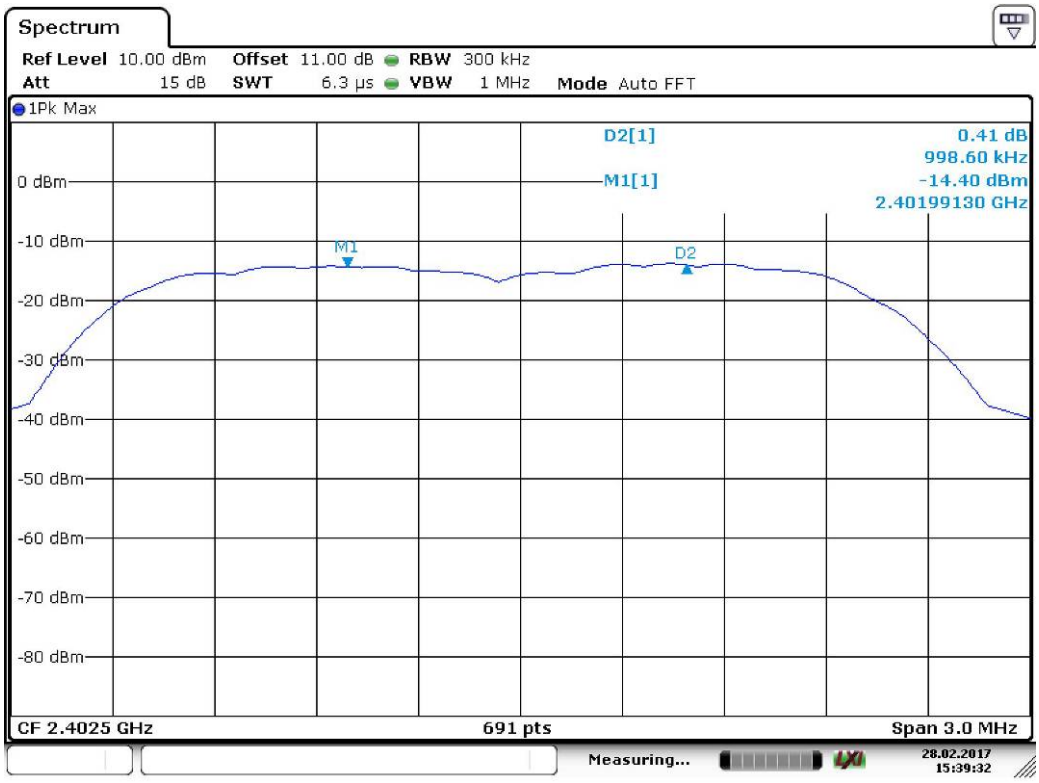
GFSK Highest Channels:



Date: 28.FEB.2017 15:51:08

8DPSK Lowest Channels:



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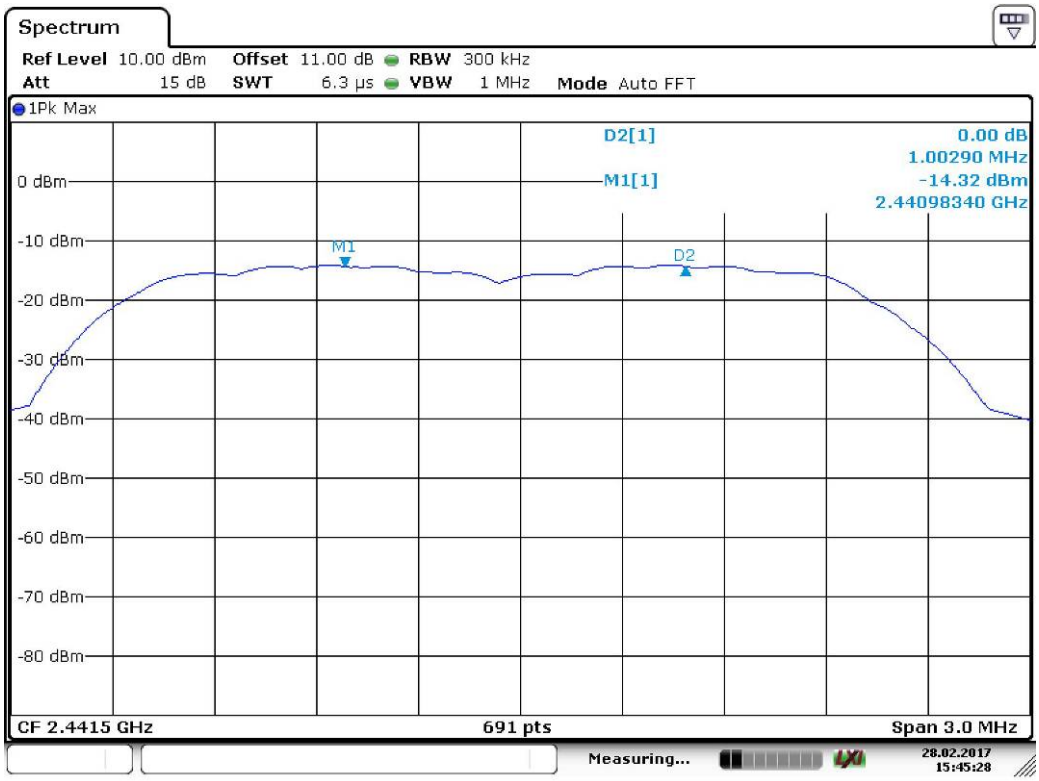
8DPSK Middle Channels:



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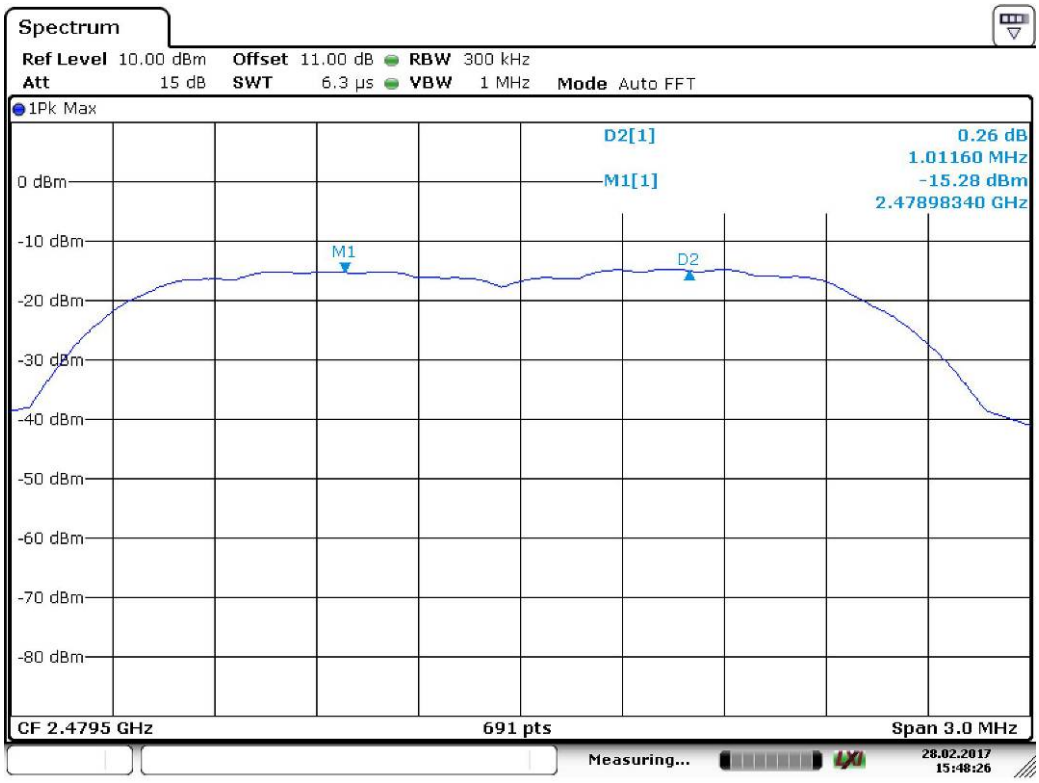
8DPSK Highest Channels:



Date: 28.FEB.2017 15:48:26

Test result: The unit does meet the FCC requirements.

4.5 HOPPING CHANNEL NUMBER

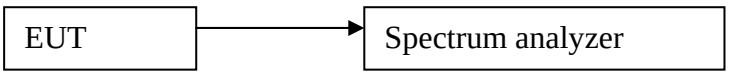
4.5.1 LIMITS

Regulation 15.247 (a) (1)(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

4.5.2 TEST PROCEDURES

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: 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 = 2400MHz. stop frequency = 2483.5MHz. Submit the test result graph.

4.5.3 TEST SETUP

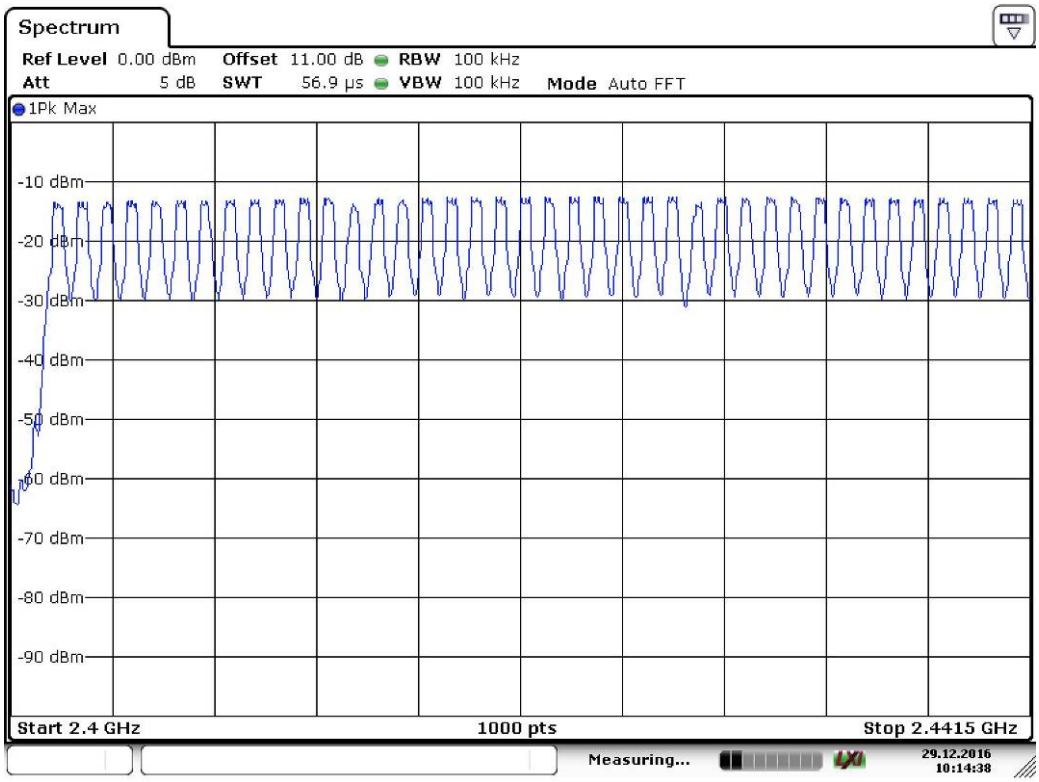


4.5.4 TEST RESULTS

Test result: Total channels are 79 channels.

Result plot as follows:

GFSK:



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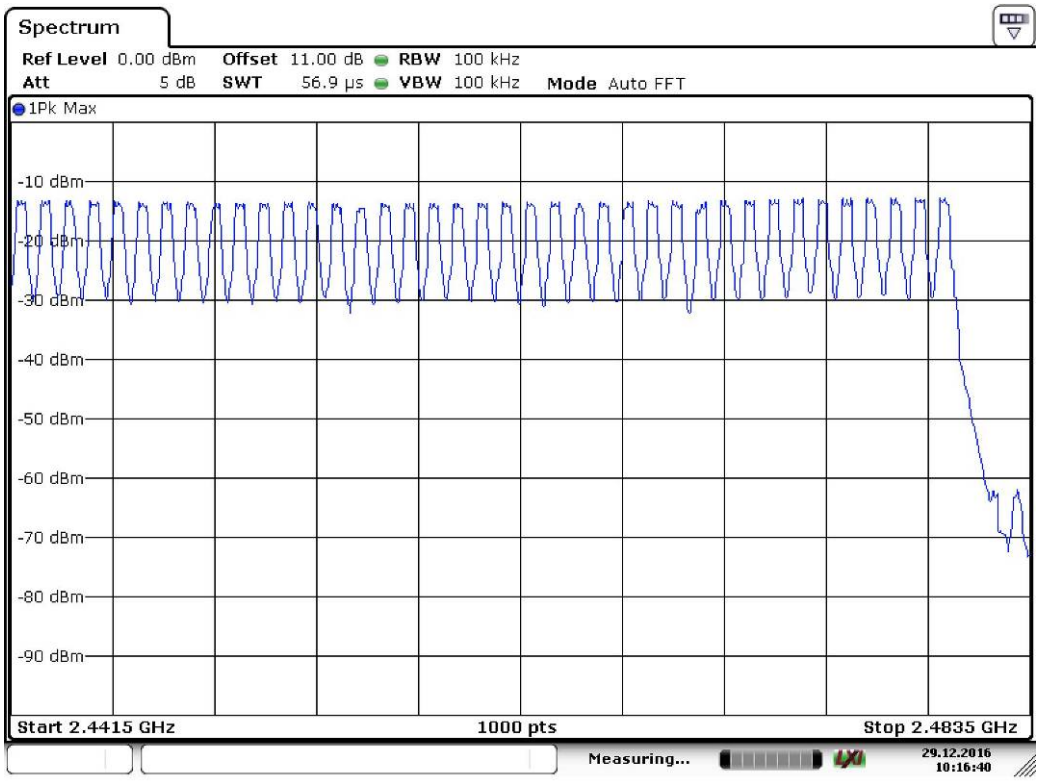
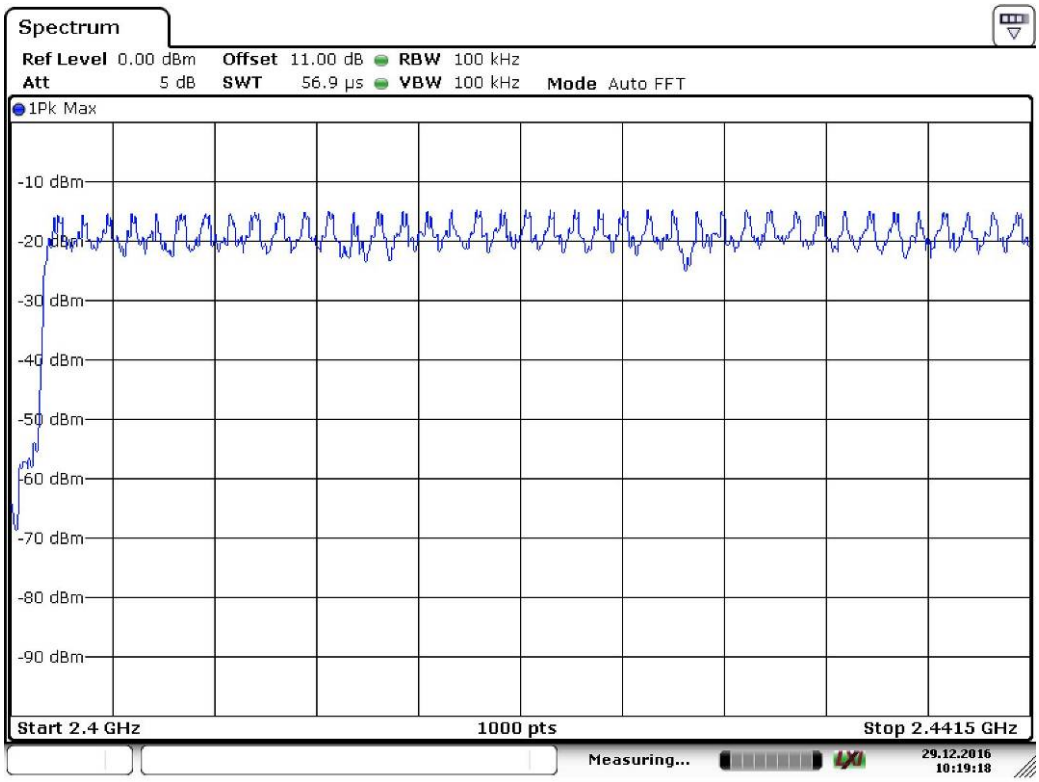
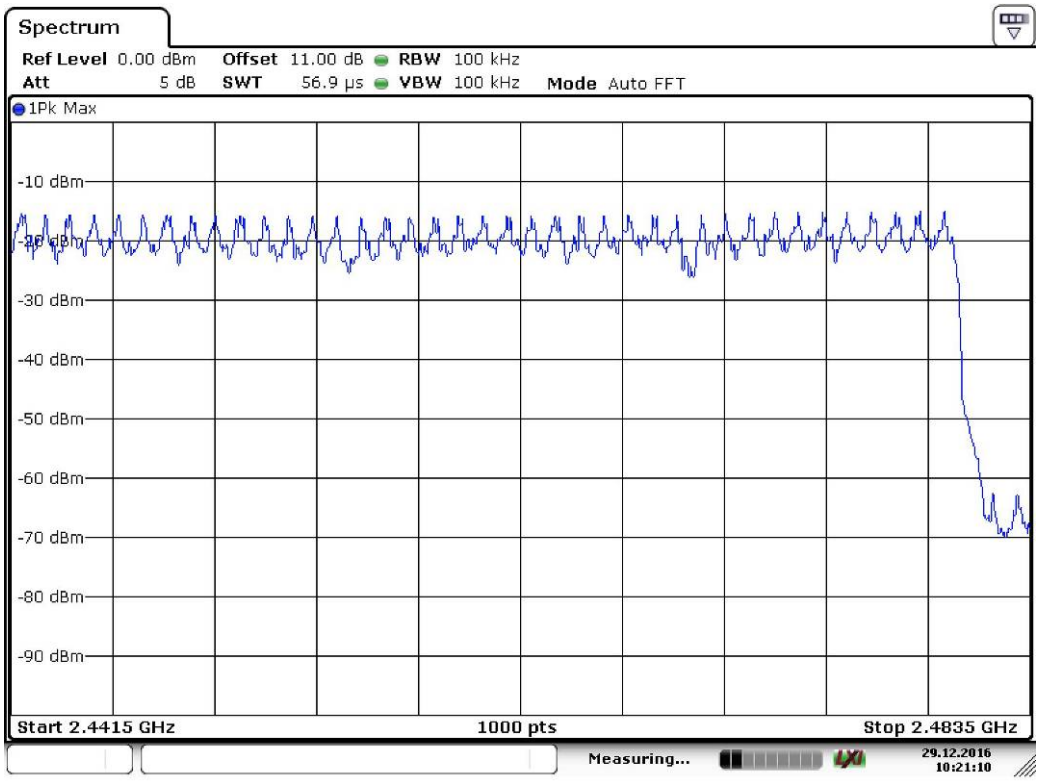


Date: 29.DEC.2016 10:16:41

8DPSK:



Date: 29.DEC.2016 10:19:18



Date: 29.DEC.2016 10:21:10

Test result: The unit does meet the FCC requirements.

4.6 DWELL TIME

4.6.1 LIMITS

Regulation 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.

4.6.2 TEST PROCEDURES

1. Remove the antenna from the EUT and then connect a low attenuation cable from the antenna port to the spectrum. The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:

a) Span: Zero span, centered on a hopping channel.

b) RBW shall be ≤ channel spacing and where possible RBW should be set >> 1 / T, where T is the expected dwell time per channel.

c) Sweep: As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger and trigger delay so that the transmitted signal starts a little to the right of the start of the plot. The trigger level might need slight adjustment to prevent triggering when the system hops on an adjacent channel; a second plot might be needed with a longer sweep time to show two successive hops on a channel.

d) Detector function: Peak.

e) Trace: Max hold.

2. Use the marker-delta function to determine the transmit time per hop. If this value varies with different modes of operation(data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation in transmit time.

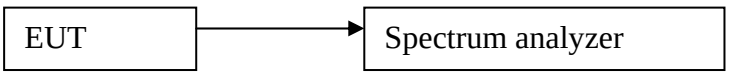
3. Repeat the measurement using a longer sweep time to determine the number of hops over the period specified in the requirements. The sweep time shall be equal to, or less than, the period specified in the requirements. Determine the number of hops over the sweep time and calculate the total number of hops in the period specified in the requirements, using the following equation:

(Number of hops in the period specified in the requirements) = (number of hops on spectrum analyzer) × (period specified in the requirements / analyzer sweep time)

4. The average time of occupancy is calculated from the transmit time per hop multiplied by the number of hops in the period specified in the requirements. If the number of hops in a specific time varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation.

5. The measured transmit time and time between hops shall be consistent with the values described in the operational description for the EUT.

4.6.3 TEST SETUP



4.6.4 TEST RESULTS

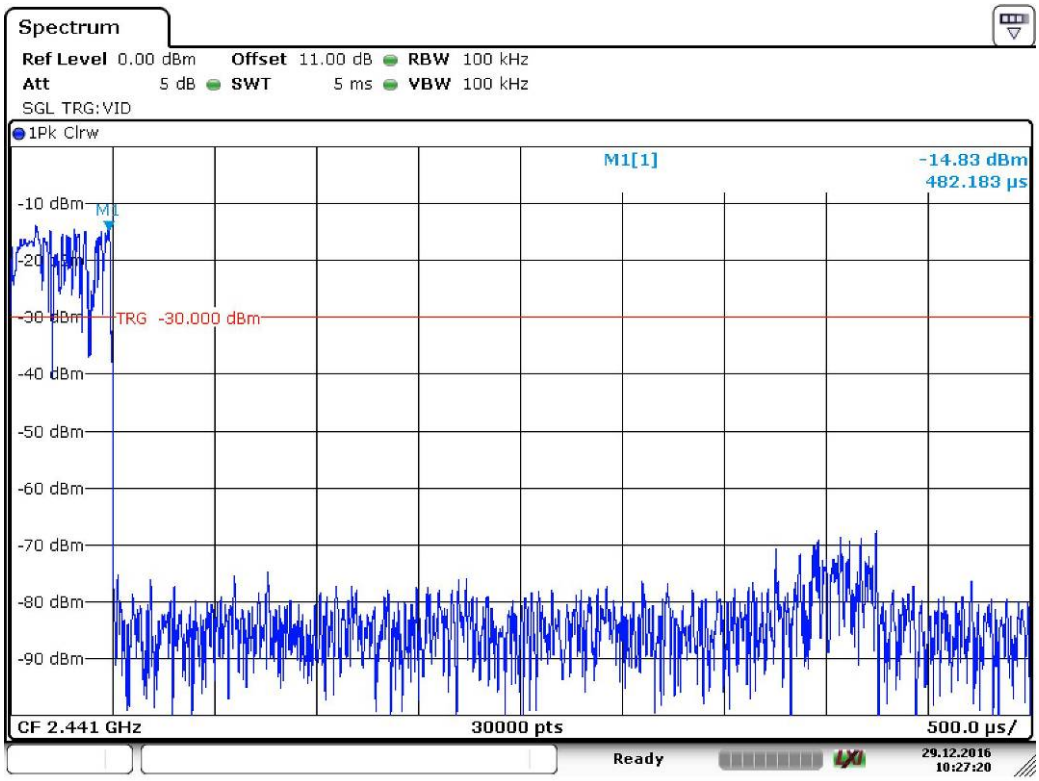
Frequency (MHz)	Modulation	Packet	Dwell Time Per Hop(ms)	Number of Hopping Channel in 31.6s	Maxinum Accumulated Dwell Time (s)	Limit (s)	Result
2441	GFSK	DH1	0.482	320	0.154	0.4	Pass
		DH3	1.741	150	0.261	0.4	Pass
		DH5	2.976	100	0.298	0.4	Pass
2441	8DPSK	3DH1	0.500	320	0.160	0.4	Pass
		3DH3	1.737	160	0.278	0.4	Pass
		3DH5	3.001	100	0.300	0.4	Pass

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

The results are not greater than 0.4 seconds.
The unit does meet the requirements.

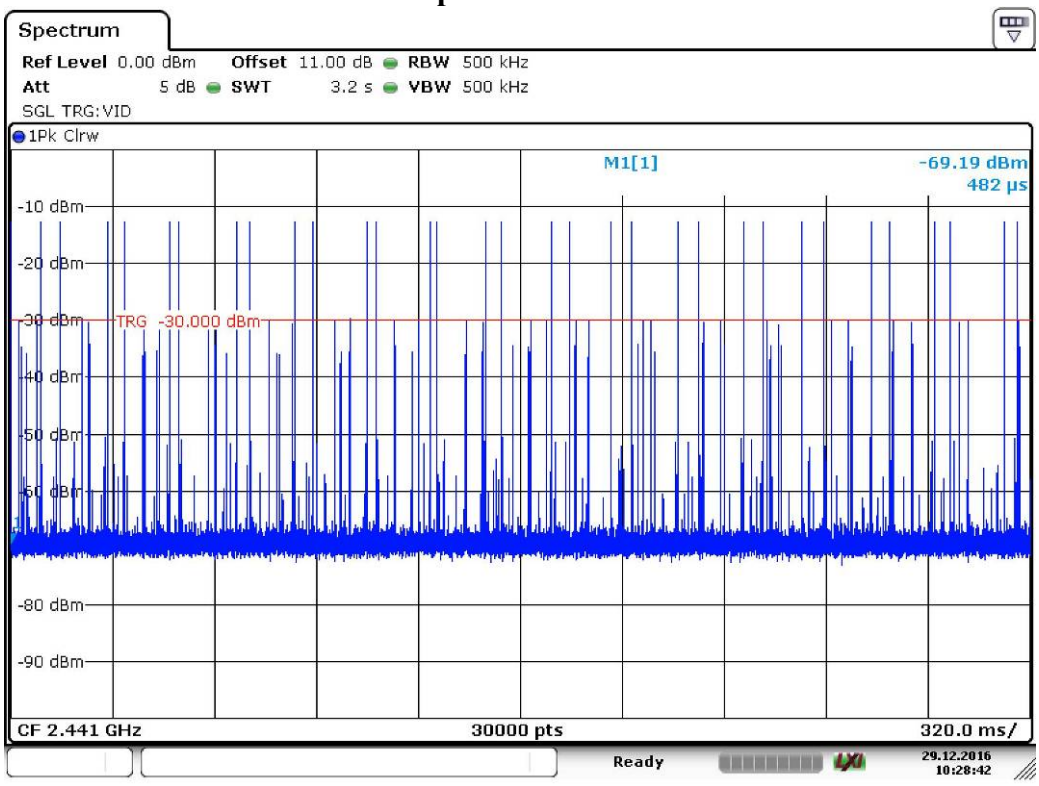
Please refer the graph as below:

For DH1:
Pulse Width:



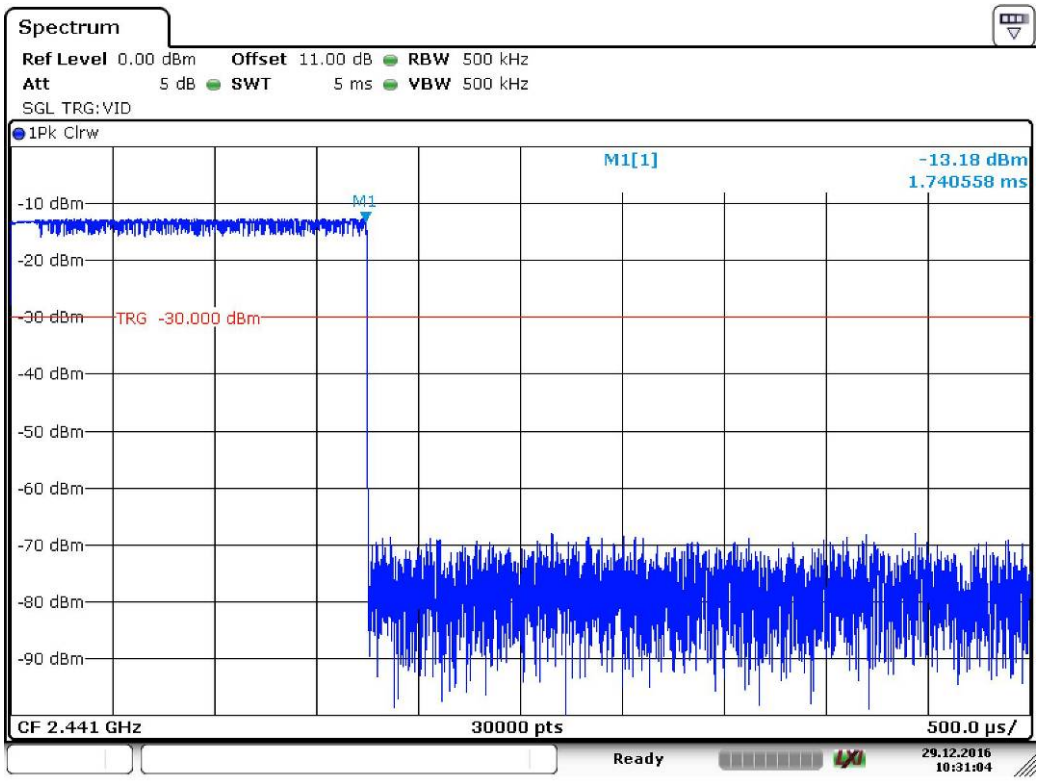
Date: 29.DEC.2016 10:27:21

Number of Pulses in 3.16 S observation periods:



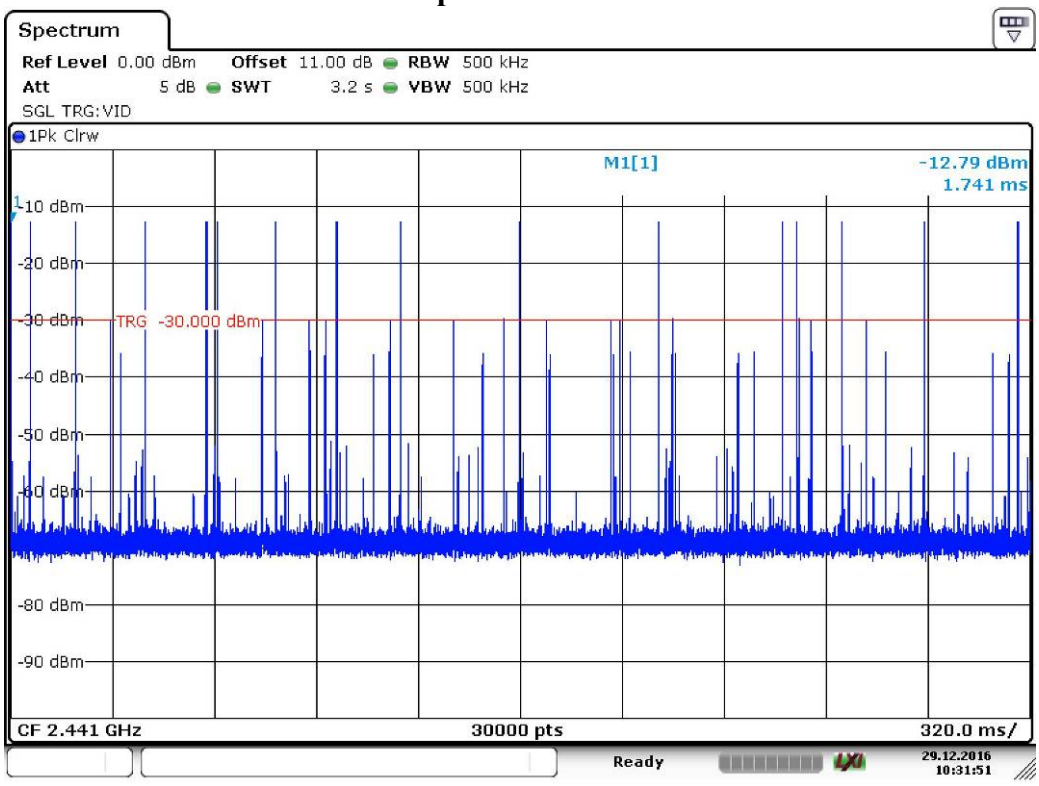
Date: 29.DEC.2016 10:28:43

For DH3:
Pulse Width:



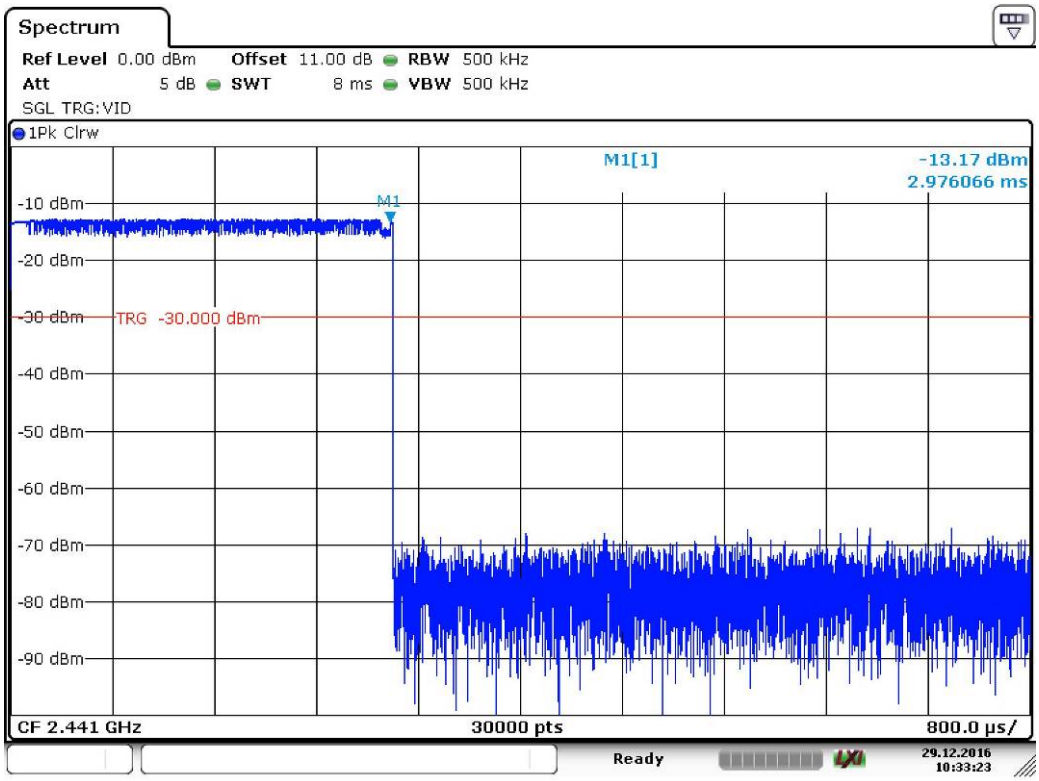
Date: 29.DEC.2016 10:31:04

Number of Pulses in 3.16 S observation periods:



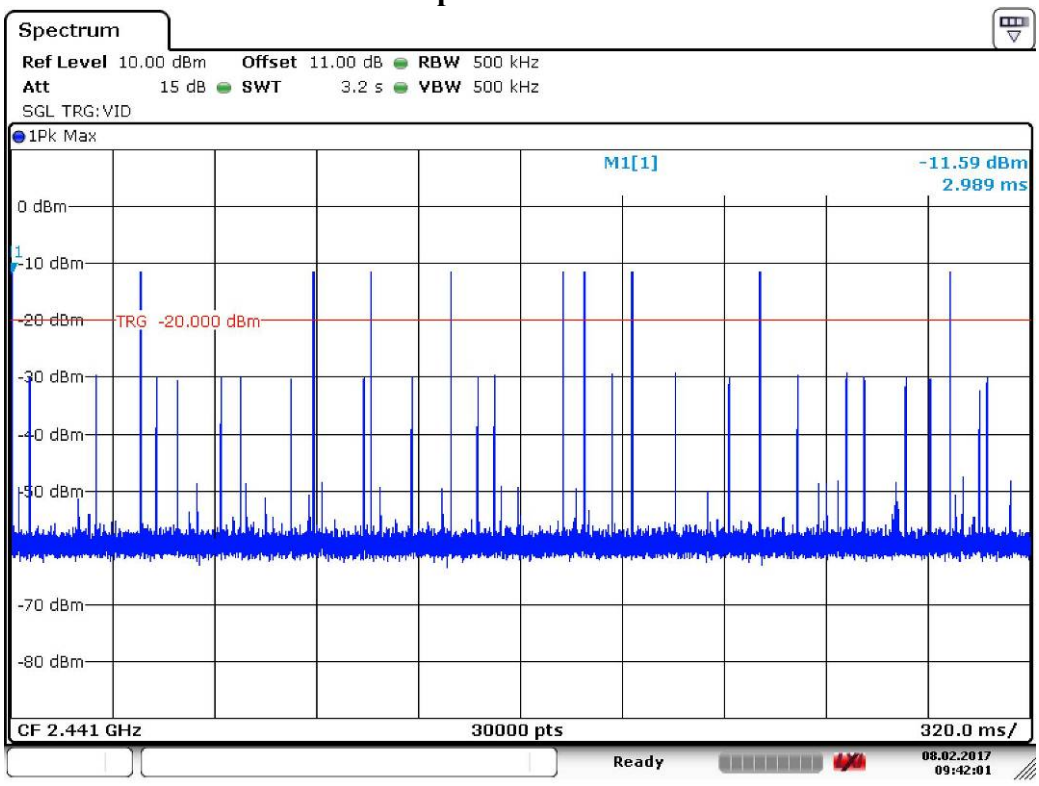
Date: 29.DEC.2016 10:31:51

For DH5:
Pulse Width:



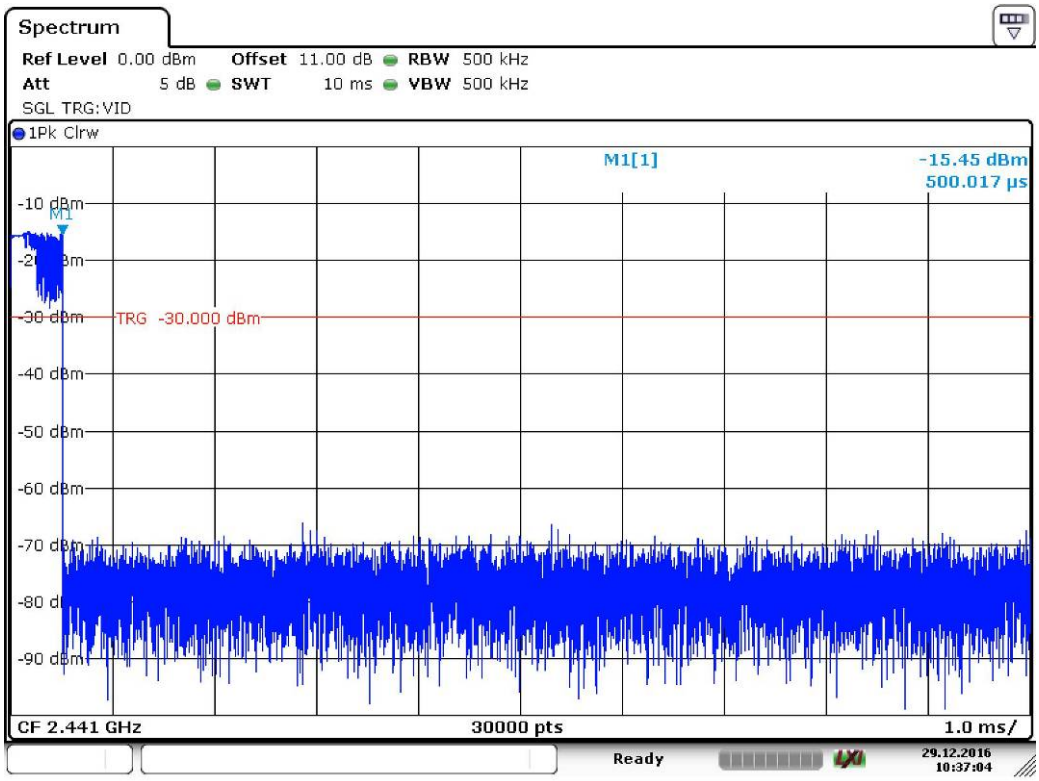
Date: 29.DEC.2016 10:33:24

Number of Pulses in 3.16 S observation periods:



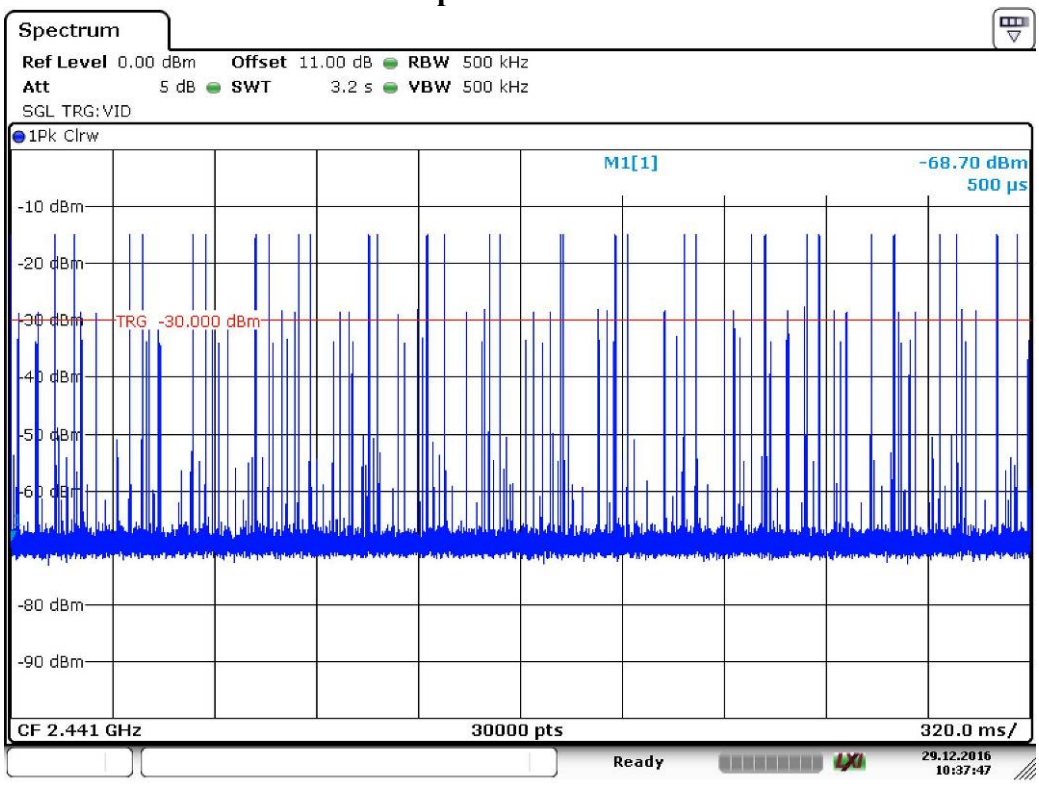
Date: 8.FEB.2017 09:42:01

For 3DH1:
Pulse Width:



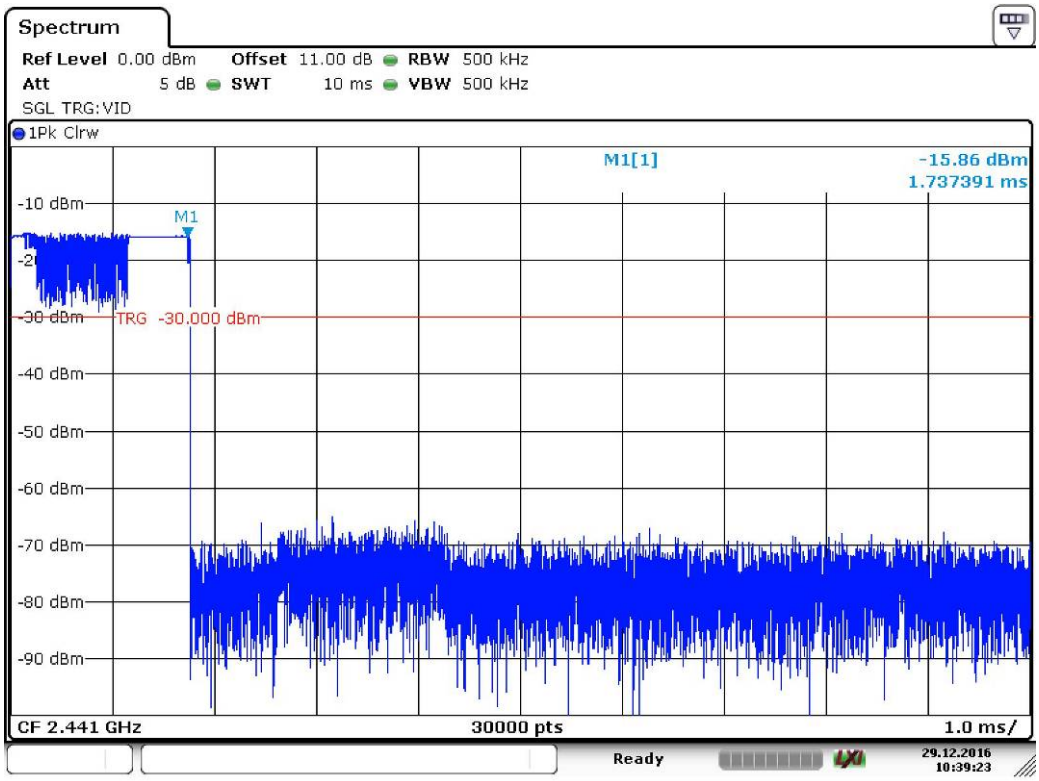
Date: 29.DEC.2016 10:37:04

Number of Pulses in 3.16 S observation periods:



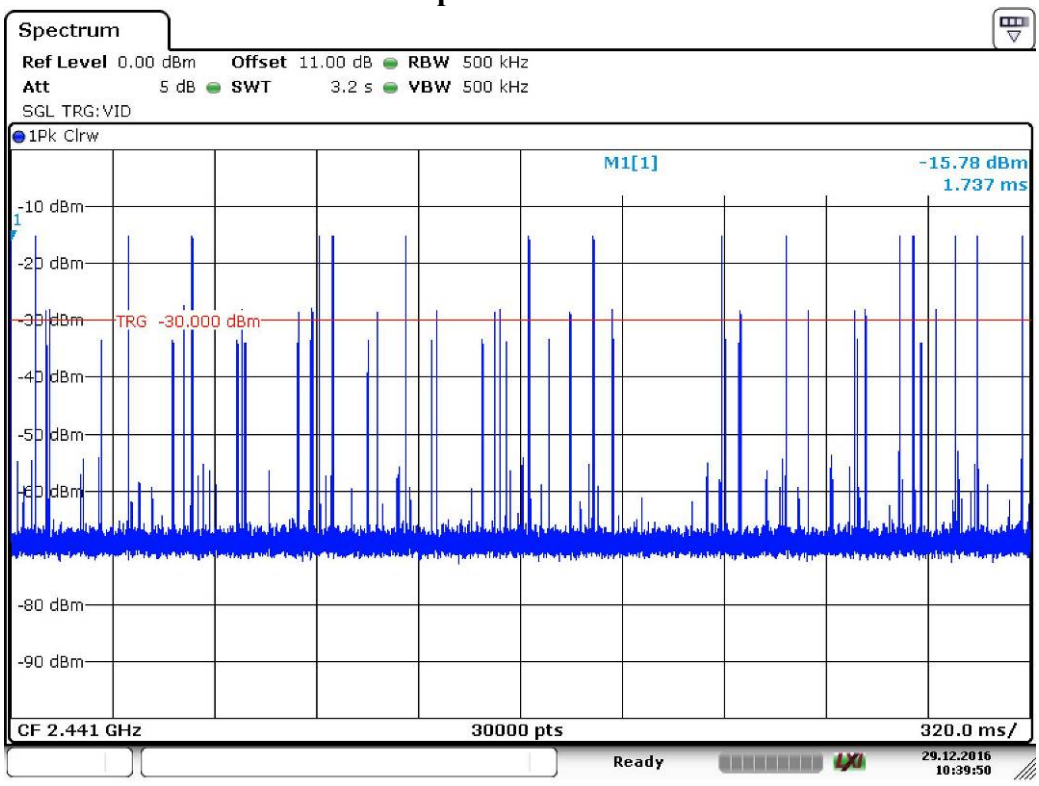
Date: 29.DEC.2016 10:37:47

For 3DH3:
Pulse Width:



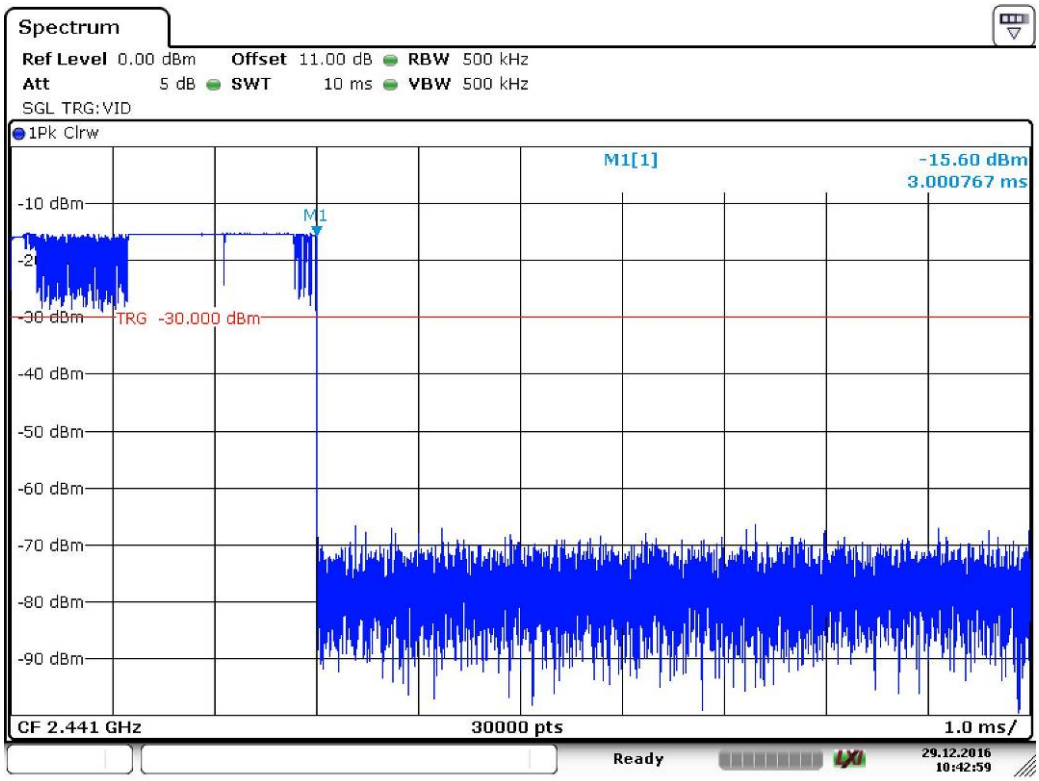
Date: 29.DEC.2016 10:39:23

Number of Pulses in 3.16 S observation periods:



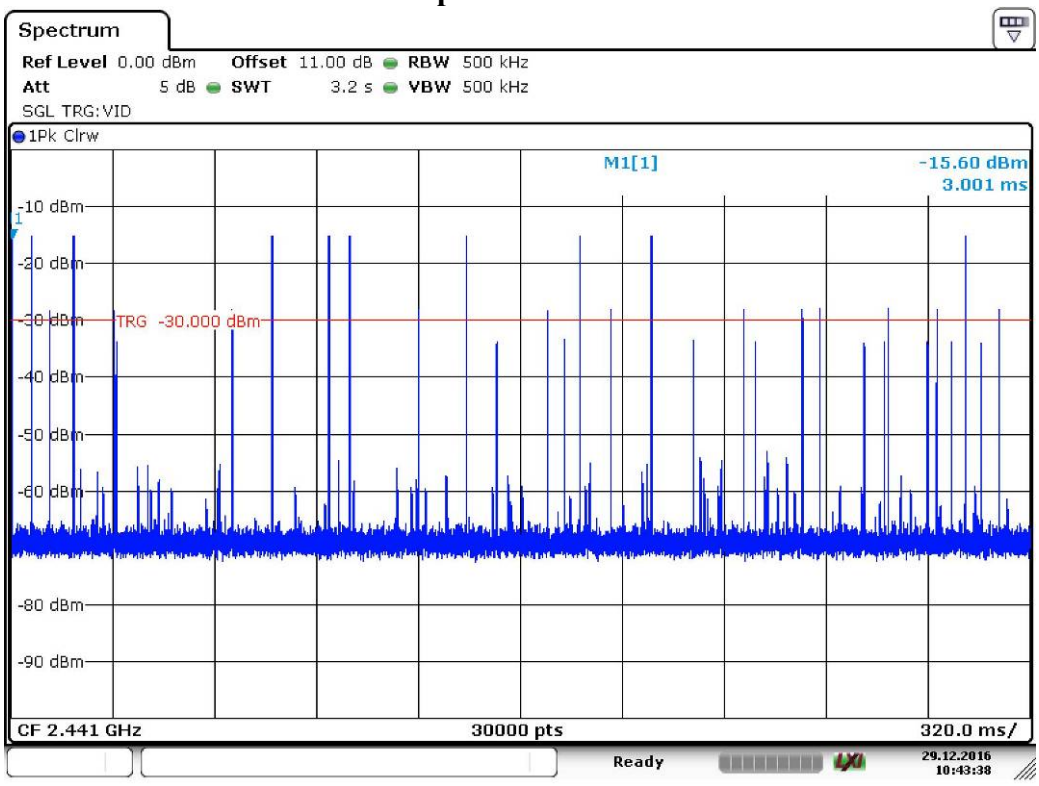
Date: 29.DEC.2016 10:39:50

For 3DH5:
Pulse Width:



Date: 29.DEC.2016 10:43:00

Number of Pulses in 3.16 S observation periods:



Date: 29.DEC.2016 10:43:38

4.7 CONDUCTED EMISSION MEASUREMENT

4.7.1 LIMITS

Frequency range	Limits (dBμV)	
	Quasi-peak	Average
150kHz ～ 0.5MHz	66～56	56～46
0.5 MHz ～ 5 MHz	56	46
5 MHz ～ 30 MHz	60	50

4.7.2 TEST PROCEDURES

Procedure of Preliminary Test

For measurement of the disturbance voltage the equipment under test (EUT) is connected to the power supply mains and any other extended network via one or more artificial network(s). An EUT, whether intended to be grounded or not, and which is to be used on a table is configured as follows:

– Either the bottom or the rear of the EUT shall be at a controlled distance of 40 cm from a reference ground plane. This ground plane is normally the wall or floor of a shielded room. It may also be a grounded metal plane of at least 2 m by 2 m. This is physically accomplished as follows:

1) Place the EUT on a table of non-conducting material which is at least 80 cm high. Place the EUT so that it is 40 cm from the wall of the shielded room, or

2) place the EUT on a table of non-conducting material which is 40 cm high so that the bottom of the EUT is 40 cm above the ground plane;

– All other conductive surfaces of the EUT shall be at least 80 cm from the reference ground plane;

– The EUT are placed on the floor that one side of the housings is 40 cm from the vertical reference ground plane and other metallic parts;

– Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth forming a bundle 30 cm to 40 cm long, hanging approximately in the middle between the ground plane and the table.

– I/O cables that are connected to a peripheral shall be bundled in the centre. The end of the cable may be terminated if required using correct terminating impedance. The total length shall not exceed 1 m.

The test mode(s) described in Item 2.4 were scanned during the preliminary test. After the preliminary scan, we found the test mode described in Item 2.4 producing the highest emission level. The EUT configuration and cable configuration of the above highest emission levels were recorded for reference of the final test.

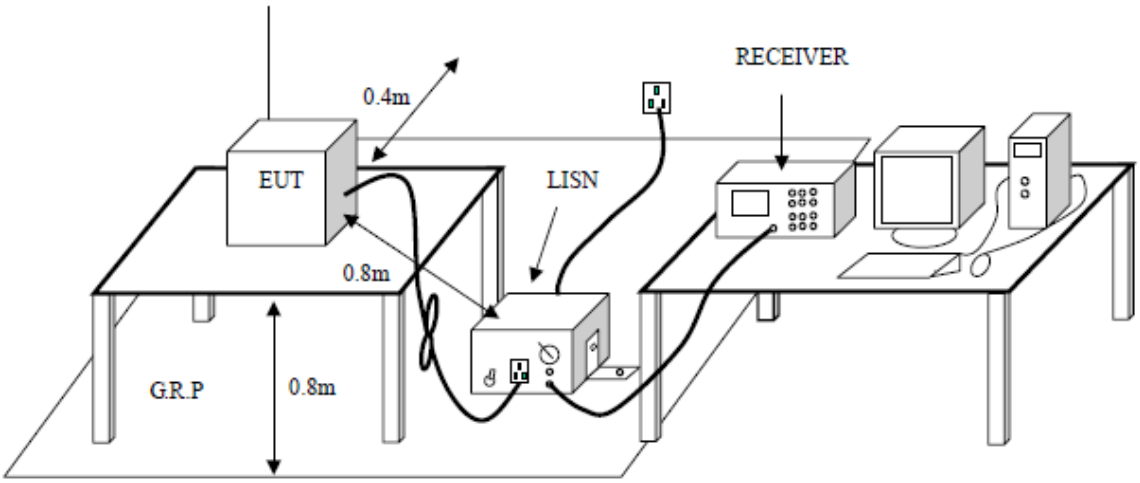
Procedure of Final Test

EUT and support equipment were set up on the test bench as per the configuration with highest emission level in the preliminary test. A scan was taken on both power lines, recording at least the six highest emissions. Emission frequency and amplitude were recorded into a computer in which correction factors were used to calculate the emission level and compare reading to the applicable limit. The test data of the worst-case condition(s) was recorded.

Note:

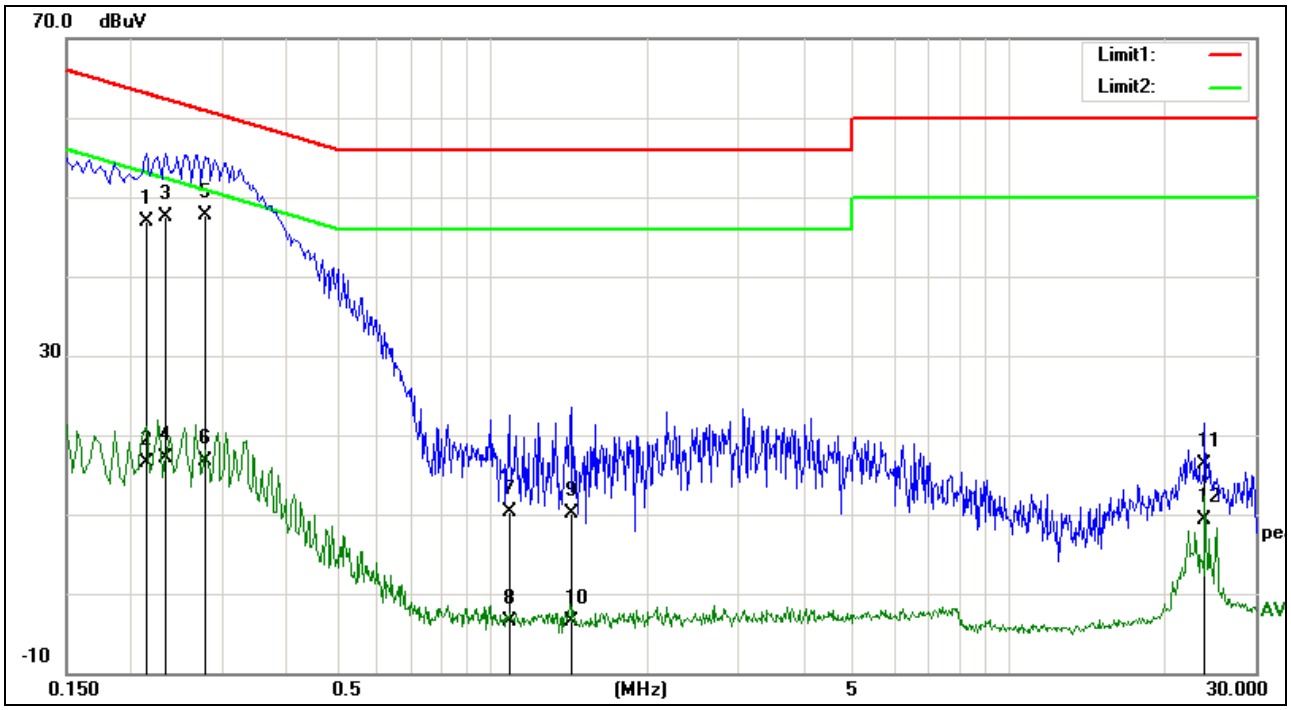
Pre-test for normal mode and EDR mode, to find the packet type 3DH5 for the EDR mode for lowest channel is the worst case. The worst case emissions were reported.

4.7.3 TEST SETUP



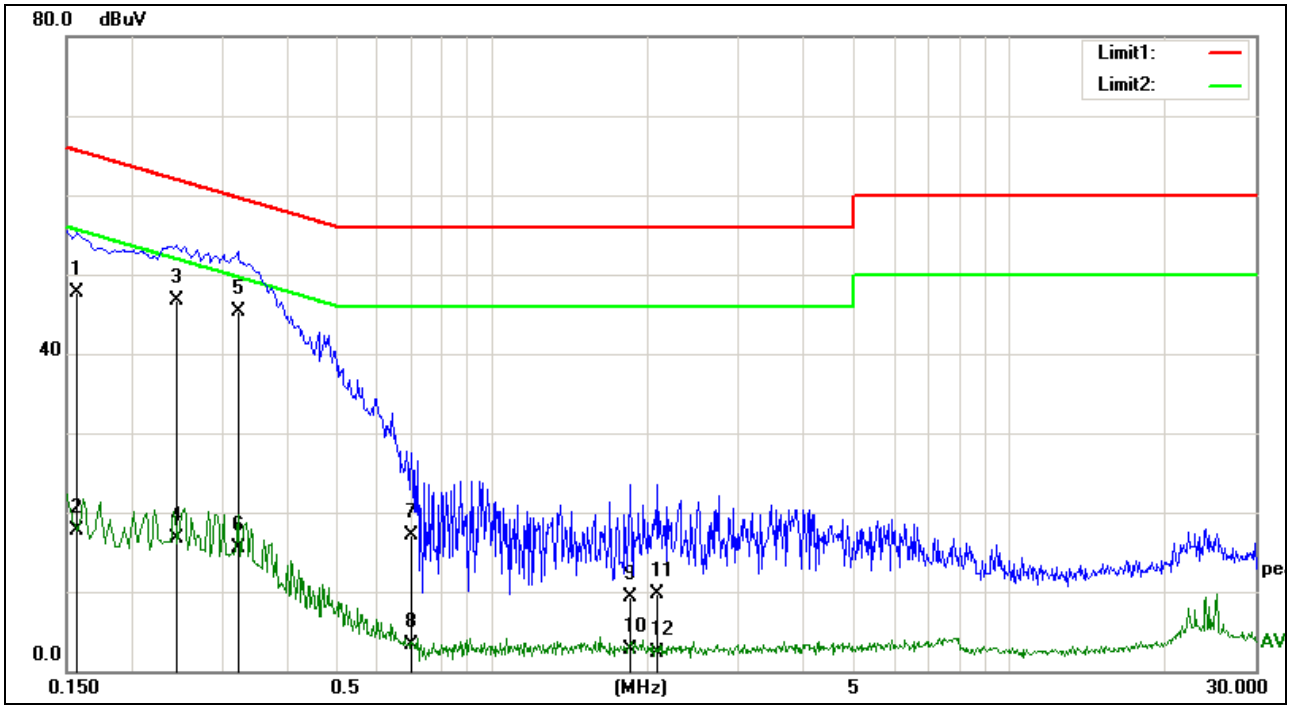
4.7.4 TEST RESULTS

Project No.:	**E201610210175 bluetooth**	**Probe:**	**L1**
Standard:	**(CE)FCC PART 15 class B_QP**	**Power Source:**	**AC 120V/60Hz**
Test item:	**Conduction Test**	**Date:**	**2016-11-15**
Temp./Hum.(%RH):	**21.9/64%RH**	**Time:**	**13:57:04**
EUT:	**A Bluetooth 2.1 Speaker System**		
Model:	**CA-3712BT**	**Test Result:**	**Pass**
Note:	**8DPSK 2402M**		
Test By:	**Shihua Xu**		



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Remark
1	0.2140	40.81	6.19	47.00	63.04	-16.04	QP
2	0.2140	10.41	6.19	16.60	53.04	-36.44	AVG
3	0.2340	41.43	6.17	47.60	62.30	-14.70	QP
4	0.2340	10.93	6.17	17.10	52.30	-35.20	AVG
5	0.2779	41.57	6.23	47.80	60.88	-13.08	QP
6	0.2779	10.47	6.23	16.70	50.88	-34.18	AVG
7	1.0820	3.98	6.32	10.30	56.00	-45.70	QP
8	1.0820	-9.72	6.32	-3.40	46.00	-49.40	AVG
9	1.4220	3.91	6.29	10.20	56.00	-45.80	QP
10	1.4220	-9.79	6.29	-3.50	46.00	-49.50	AVG
11	23.9980	9.12	7.28	16.40	60.00	-43.60	QP
12	23.9980	2.02	7.28	9.30	50.00	-40.70	AVG

Project No.:	**E201610210175 bluetooth**	**Probe:**	**N**
Standard:	**(CE)GB9254 class B_QP**	**Power Source:**	**AC 120V/60Hz**
Test item:	**Conduction Test**	**Date:**	**2016-11-15**
Temp./Hum.(%RH):	**21.9/64%RH**	**Time:**	**14:26:36**
EUT:	**A Bluetooth 2.1 Speaker System**		
Model:	**CA-3712BT**	**Test Result:**	**Pass**
Note:	**8DPSK 2402M**		
Test By:	**Shihua Xu**		



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Remark
1	0.1580	41.52	6.18	47.70	65.56	-17.86	QP
2	0.1580	11.52	6.18	17.70	55.56	-37.86	AVG
3	0.2460	40.57	6.23	46.80	61.89	-15.09	QP
4	0.2460	10.57	6.23	16.80	51.89	-35.09	AVG
5	0.3220	39.07	6.23	45.30	59.65	-14.35	QP
6	0.3220	9.27	6.23	15.50	49.65	-34.15	AVG
7	0.6980	10.86	6.24	17.10	56.00	-38.90	QP
8	0.6980	-2.94	6.24	3.30	46.00	-42.70	AVG
9	1.8540	2.94	6.36	9.30	56.00	-46.70	QP
10	1.8540	-3.56	6.36	2.80	46.00	-43.20	AVG
11	2.0900	3.44	6.36	9.80	56.00	-46.20	QP
12	2.0900	-3.96	6.36	2.40	46.00	-43.60	AVG

4.8 MAXIMUM PEAK OUTPUT POWER

4.8.1 LIMITS

Regulation 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.
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 125 mW limit applies.

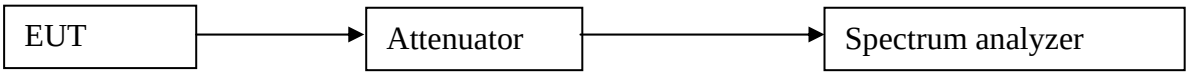
4.8.2 TEST PROCEDURES

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: RBW = 3 MHz. VBW = 3 MHz. Sweep = auto; Detector Function = Peak.
3. Keep the EUT in transmitting at lowest, medium and highest channel individually. Record the max value.

Remark:

1. Pre-test the 3 modulation to find GFSK and 8DPSK is worse case, so only record GFSK and 8DPSK test data.
2. Cable loss = 21dB，the receiver offset loss 21dB.

4.8.3 TEST SETUP



4.8.4 TEST RESULTS

For GFSK:

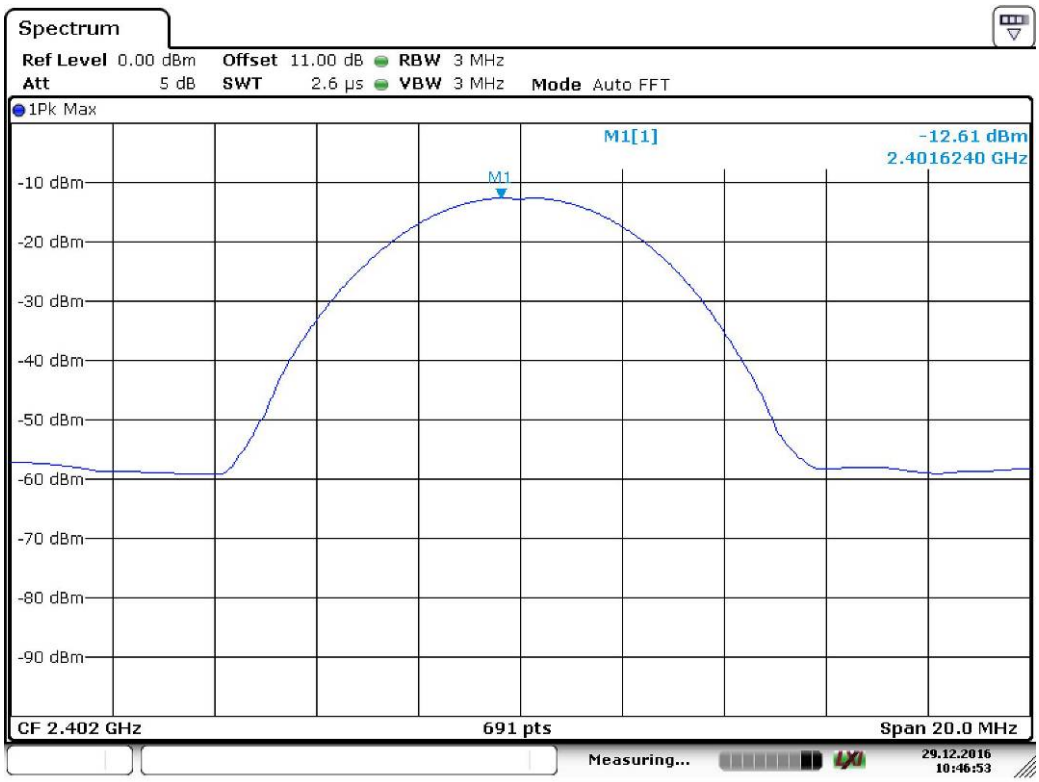
Test Channel	Fundamental Frequency (GHz)	Max Output Power(dBm)	Limit (dBm)	Pass/Fail
Lowest	2.402	-12.61	20.97	**Pass**
Middle	2.441	-12.36	20.97	**Pass**
Highest	2.480	-12.02	20.97	**Pass**

For 8DPSK:

Test Channel	Fundamental Frequency (GHz)	Max Output Power(dBm)	Limit (dBm)	Pass/Fail
Lowest	2.402	-13.70	20.97	**Pass**
Middle	2.441	-13.42	20.97	**Pass**
Highest	2.480	-13.25	20.97	**Pass**

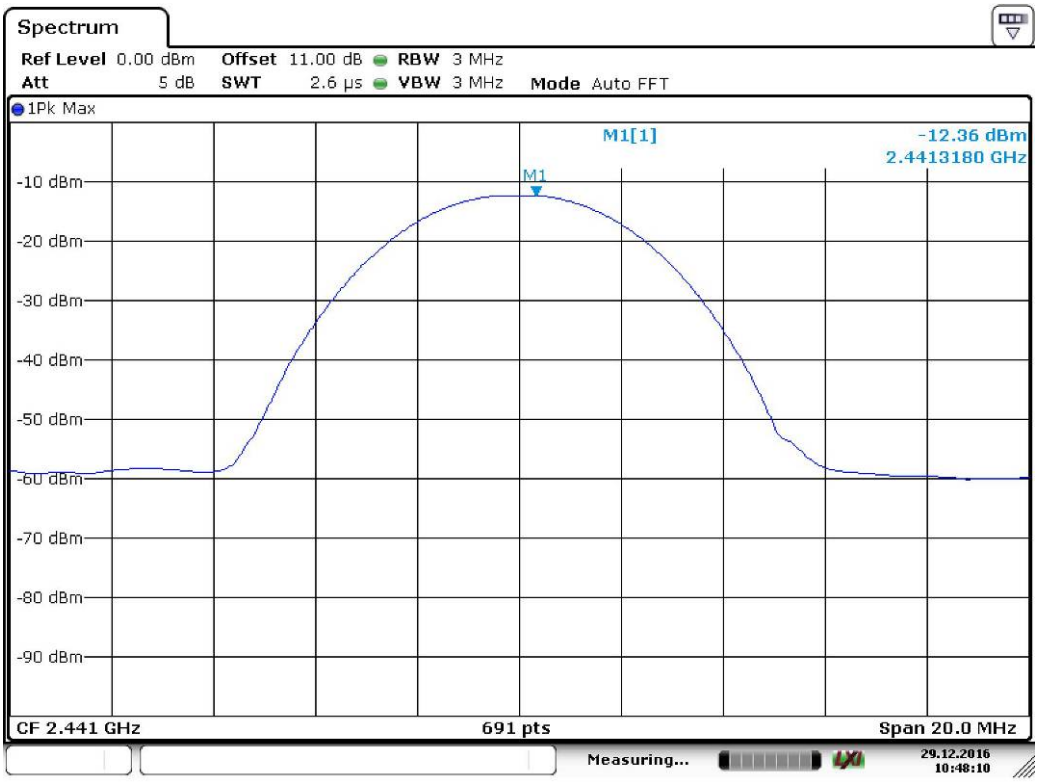
Test result: The unit does meet the FCC requirements.
Test result plot as follows:

GFSK Lowest Channel:



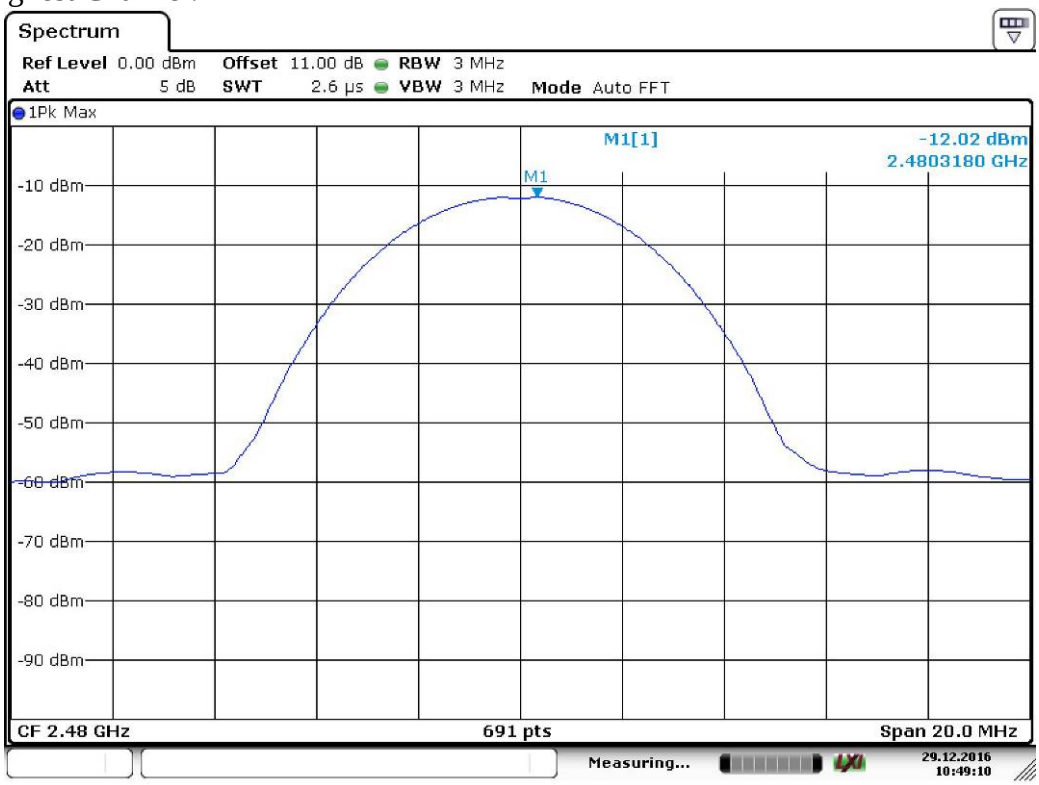
Date: 29.DEC.2016 10:46:53

GFSK Middle Channel:



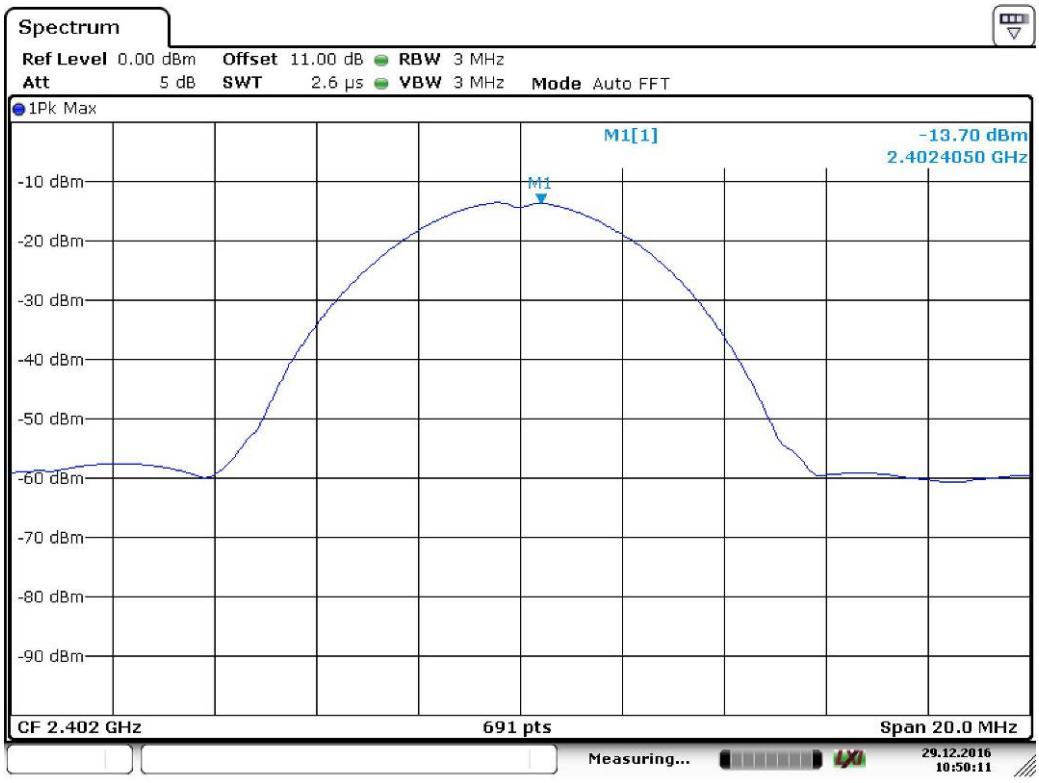
Date: 29.DEC.2016 10:48:09

GFSK Highest Channel:



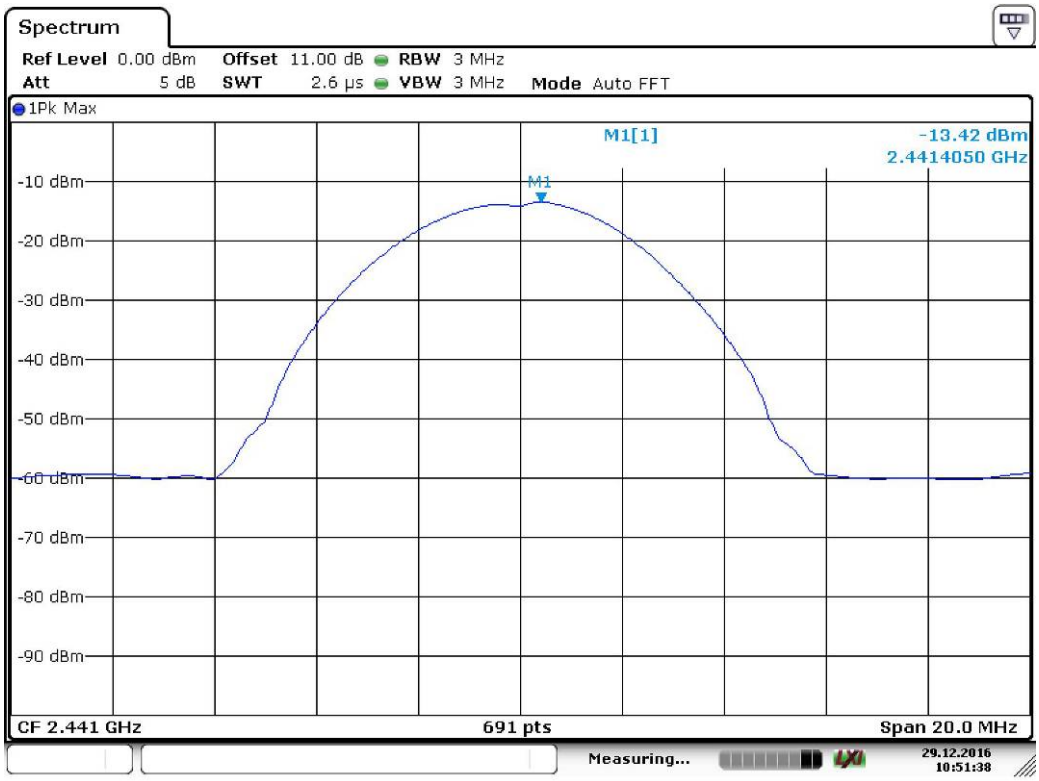
Date: 29.DEC.2016 10:49:10

8DPSK Lowest Channel:



Date: 29.DEC.2016 10:50:11

8DPSK Middle Channel:



Date: 29.DEC.2016 10:51:39

8DPSK Highest Channel:

Date: 29.DEC.2016 10:52:30

4.9 RADIATED SPURIOUS EMISSIONS

4.9.1 LIMITS

Frequency (MHz)	Quasi-peak(μV/m)	Measurement distance(m)	Quasi-peak(dBμV/m)@distance 3m
0.009-0.490	2400/F(kHz)	300	53.8~88.5
0.490-1.705	24000/F(kHz)	30	43~53.8
1.705-30.0	30	30	49.5
30 ~ 88	100	3	40
88~216	150	3	43.5
216 ~ 960	200	3	46
Above 960	500	3	54

NOTE: (1) The lower limit shall apply at the transition frequencies.

Frequency (GHz)	Quasi-peak(dBμV/m)
1 ~ 26.5	74
1~ 26.5	54

4.9.2 TEST PROCEDURES

Procedure of Preliminary Test

According to ANSI C63.10:2013, a calibrated, linearly polarized antenna shall be positioned at the specified distance from the periphery of the EUT. The specified distance is the distance between the horizontal projection onto the ground plane of the closest periphery of the EUT and the projection onto the ground plane of the center of the axis of the elements of the receiving antenna.

Measurements shall be made with the antenna positioned in both the horizontal and vertical planes of polarization. The measurement antenna shall be varied in height above the reference ground plane to obtain the maximum signal strength. Unless otherwise specified, the measurement distance shall be 3 m. The EUT put on a 0.8m tabel below 1GHz, on 1.5m table above 1GHz. At any measurement distance, the antenna height shall be varied from 1 m to 4 m. These height scans apply for both horizontal and vertical polarizations, except that for vertical polarization, the minimum height of the center of the antenna shall be increased so that the lowest point of the bottom of the lowest antenna element clears the site reference ground plane by at least 25 cm. For a tuned dipole, the minimum heights as measured from the center of the antenna are those specified in the NSA measurement requirements.

For tabletop systems, cables or wires should be manipulated within the range of likely arrangements. For floor-standing equipment, the cables or wires should be located in the same manner as the user would install them and no further manipulation is made. For combination EUTs, the tabletop and floor-standing portions of the EUT shall follow the procedures for their respective setups and cable manipulation.

Table-top equipment is placed on a non-conductive set-up table with height 0, 8/1.5 m ± 0, 01 m, ANSI C63.10:2013 specifies the method to determine the impact of the non-conductive set-up table on test results. If the manner of cable installation is not known, or if it changes with each installation, cables or wires for floor-standing equipment shall be manipulated to the extent possible to produce

the maximum level of emissions. For each mode of operation required to be tested, the frequency spectrum shall be monitored. Variations in antenna height between 1 m and 4 m, antenna polarization, EUT azimuth, and cable or wire placement shall be explored to produce the emission that has the highest amplitude relative to the limit.

Procedure of Final Test

EUT and support equipment were set up on the turntable as per the configuration with highest emission level in the preliminary test. The Analyzer / Receiver scanned from 30MHz to 1000MHz. Emissions were scanned and measured rotating the EUT to 360 degrees, varying cable placement and positioning the antenna 1 to 4 meters above the ground plane, in both the vertical and the horizontal polarization, to maximize the emission reading level. Record at least six highest emissions. Emission frequency, amplitude, antenna position, polarization and turntable position were recorded into a computer in which correction factors were used to calculate the emission level and compare reading to the applicable limit. The test data of the worst-case condition(s) was recorded.

Below 1GHz Set the spectrum analyzer: RBW =100KHz VBW >= RBW , Span = enough to captch the trace. Sweep = auto; Detector Function = Peak. Trace = Max,hold.
Above 1GHz Set the spectrum analyzer: RBW =1MHz VBW >= RBW , Span = enough to captch the trace. Sweep = auto; Detector Function = Peak. Trace = Max,hold.

Note:

Pre-test for normal mode and EDR mode, to find the packet type 3DH5 for the EDR mode is the worst case.The worst case emissions were reported.

For this intentional radiator operates below 25 GHz. the spectrum shall be investigated to the tenth harmonic of the highest fundamental frequency. And above the third harmonic of this intentional radiator, the disturbance is very low. So the test result only displays to 7rd harmonic.

4.9.3 TEST SETUP

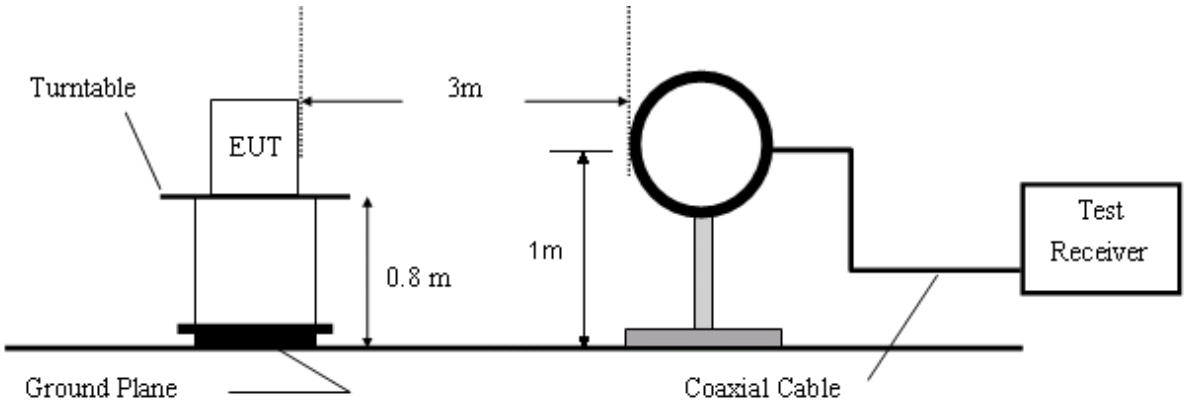


Figure 1. 9 KHz to 30MHz radiated emissions test configuration

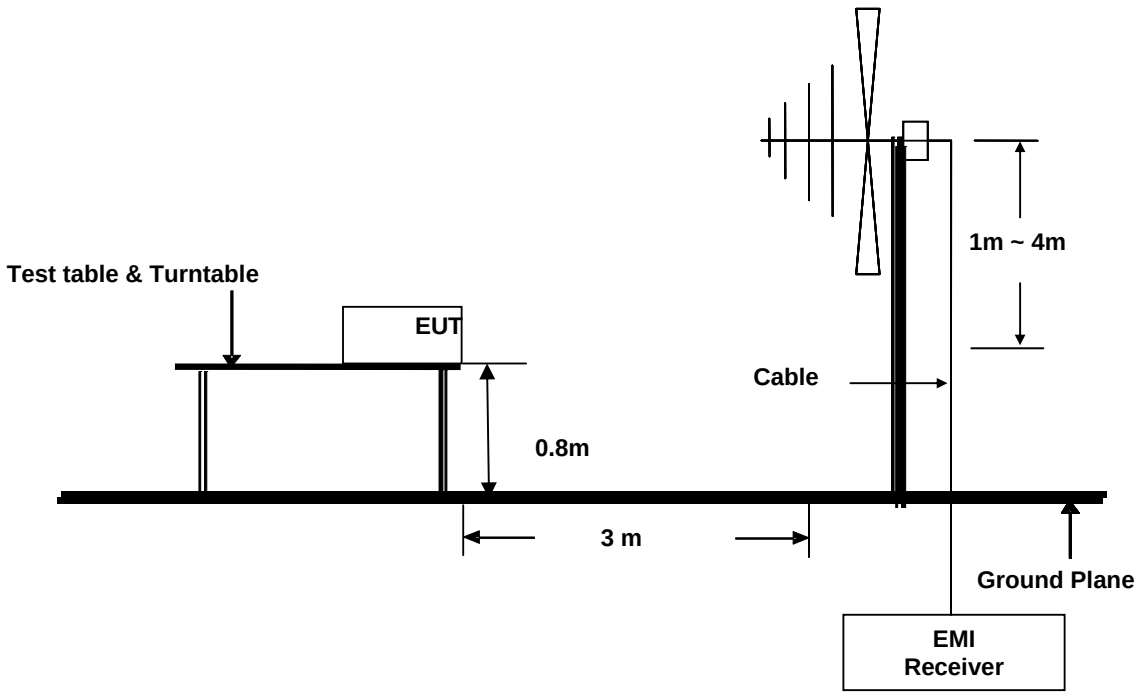


Figure 2. 30MHz to 1GHz radiated emissions test configuration

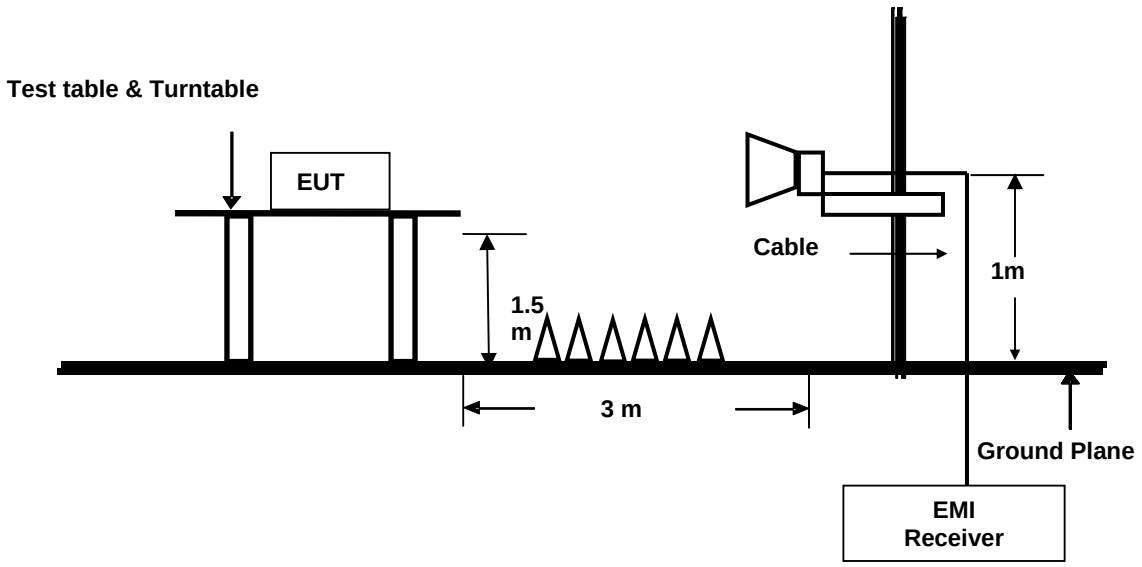


Figure 3. Above 1GHz radiated emissions test configuration

4.9.4 TEST RESULTS

1. Low Frequency 2402MHz

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

No.	Frequency (MHz)	Reading (dBuV/m)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Over Limit (dB)	Antenna polarization
1	155.6649	21.69	11.53	33.22	43.50	-10.28	Vertical
2	180.1541	20.19	10.35	30.54	43.50	-12.96	Vertical
3	191.6416	21.77	11.03	32.80	43.50	-10.70	Vertical
4	420.8830	12.70	17.74	30.44	46.00	-15.56	Vertical
5	445.2116	15.56	17.85	33.41	46.00	-12.59	Vertical
6	468.3074	12.73	18.49	31.22	46.00	-14.78	Vertical
7	155.6649	22.41	11.53	33.94	43.50	-9.56	Horizontal
8	180.1541	21.54	10.35	31.89	43.50	-11.61	Horizontal
9	191.6416	23.02	11.03	34.05	43.50	-9.45	Horizontal
10	420.8830	12.28	17.74	30.02	46.00	-15.98	Horizontal
11	445.2116	14.94	17.85	32.79	46.00	-13.21	Horizontal
12	468.3074	12.41	18.49	30.90	46.00	-15.10	Horizontal

1~18 GHz Harmonics & Spurious Emissions. Peak & Average Measurement

Peak Measurement:

No.	Frequency (MHz)	Reading (dBuV/m)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Over Limit (dB)	Antenna polarization
1	6377.667	31.16	13.18	44.34	74.00	-29.66	Vertical
2	7675.878	31.04	14.13	45.17	74.00	-28.83	Vertical
3	11170.486	29.66	17.10	46.76	74.00	-27.24	Vertical
4	13382.172	30.45	20.18	50.63	74.00	-23.37	Vertical
5	15306.102	30.00	17.57	47.57	74.00	-26.43	Vertical
6	16560.091	29.84	18.14	47.98	74.00	-26.02	Vertical
7	6377.667	30.65	13.18	43.83	74.00	-30.17	Horizontal
8	8114.615	30.31	13.89	44.20	74.00	-29.80	Horizontal
9	9995.220	29.66	15.46	45.12	74.00	-28.88	Horizontal
10	11067.480	29.79	17.01	46.80	74.00	-27.20	Horizontal
11	13444.302	30.97	20.25	51.22	74.00	-22.78	Horizontal
12	15737.456	30.14	17.51	47.65	74.00	-26.35	Horizontal

NOTE：

Above 1GHz, the tested values of Peak are lower than the correspondingly limited values of AVG.So don’t read the values of AVG.

The field strength is calculated by adding the Antenna Factor. Correct Factor.

The basic equation with a sample calculation is as follows:

Final Test Level =Receiver Reading + Correct Factor

2. Middle Frequency 2441MHz

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

No.	Frequency (MHz)	Reading (dBuV/m)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Over Limit (dB)	Antenna polarization
1	96.0079	14.85	9.66	24.51	43.50	-18.99	Vertical
2	132.2562	11.91	13.11	25.02	43.50	-18.48	Vertical
3	155.6649	20.59	11.53	32.12	43.50	-11.38	Vertical
4	180.1541	17.23	10.35	27.58	43.50	-15.92	Vertical
5	445.2116	12.89	17.85	30.74	46.00	-15.26	Vertical
6	468.3074	11.15	18.49	29.64	46.00	-16.36	Vertical
7	155.6649	23.99	11.53	35.52	43.50	-7.98	Horizontal
8	180.1540	21.93	10.35	32.28	43.50	-11.22	Horizontal
9	191.6416	21.27	11.03	32.30	43.50	-11.20	Horizontal
10	228.1107	13.90	13.00	26.90	46.00	-19.10	Horizontal
11	420.8829	12.16	17.74	29.90	46.00	-16.10	Horizontal
12	445.2115	14.25	17.85	32.10	46.00	-13.90	Horizontal

1~18 GHz Harmonics & Spurious Emissions. Peak & Average Measurement

Peak Measurement:

No.	Frequency (MHz)	Reading (dBuV/m)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Over Limit (dB)	Antenna polarization
1	7534.968	30.66	14.20	44.86	74.00	-29.14	Vertical
2	8152.289	31.04	13.85	44.89	74.00	-29.11	Vertical
3	9995.220	30.47	15.46	45.93	74.00	-28.07	Vertical
4	11646.005	30.21	17.41	47.62	74.00	-26.38	Vertical
5	13382.172	31.47	20.18	51.65	74.00	-22.35	Vertical
6	15306.102	30.25	17.57	47.82	74.00	-26.18	Vertical
7	6377.667	30.96	13.18	44.14	74.00	-29.86	Horizontal
8	7711.515	30.02	14.12	44.14	74.00	-29.86	Horizontal
9	9949.029	29.78	15.38	45.16	74.00	-28.84	Horizontal
10	11754.395	30.04	17.42	47.46	74.00	-26.54	Horizontal
11	13320.329	31.28	20.11	51.39	74.00	-22.61	Horizontal
12	15737.456	30.57	17.51	48.08	74.00	-25.92	Horizontal

NOTE：

Above 1GHz, the tested values of Peak are lower than the correspondingly limited values of AV.So don’t read the values of AVG.

The field strength is calculated by adding the Antenna Factor. Correct Factor.

The basic equation with a sample calculation is as follows:

Final Test Level =Receiver Reading + Correct Factor

3. High Frequency 2480MHz

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

No.	Frequency (MHz)	Reading (dBuV/m)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Over Limit (dB)	Antenna polarization
1	155.6649	21.69	11.53	33.22	43.50	-10.28	Vertical
2	180.1541	20.19	10.35	30.54	43.50	-12.96	Vertical
3	191.6416	21.77	11.03	32.80	43.50	-10.70	Vertical
4	420.8830	12.70	17.74	30.44	46.00	-15.56	Vertical
5	445.2116	15.56	17.85	33.41	46.00	-12.59	Vertical
6	468.3074	12.73	18.49	31.22	46.00	-14.78	Vertical
7	155.6649	22.41	11.53	33.94	43.50	-9.56	Horizontal
8	180.1541	21.54	10.35	31.89	43.50	-11.61	Horizontal
9	191.6416	23.02	11.03	34.05	43.50	-9.45	Horizontal
10	420.8830	12.28	17.74	30.02	46.00	-15.98	Horizontal
11	445.2116	14.94	17.85	32.79	46.00	-13.21	Horizontal
12	468.3074	12.41	18.49	30.90	46.00	-15.10	Horizontal

1~18 GHz Harmonics & Spurious Emissions. Peak & Average Measurement
Peak Measurement:

No.	Frequency (MHz)	Reading (dBuV/m)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Over Limit (dB)	Antenna polarization
1	5250.158	30.86	11.93	42.79	74.00	-31.21	Vertical
2	6496.934	30.64	13.29	43.93	74.00	-30.07	Vertical
3	7640.405	30.00	14.15	44.15	74.00	-29.85	Vertical
4	10276.904	31.85	15.22	47.07	74.00	-26.93	Vertical
5	13444.302	30.38	20.25	50.63	74.00	-23.37	Vertical
6	15883.925	30.76	17.41	48.17	74.00	-25.83	Vertical
7	7747.318	30.74	14.09	44.83	74.00	-29.17	Horizontal
8	10182.138	29.74	15.30	45.04	74.00	-28.96	Horizontal
9	11016.334	29.67	16.96	46.63	74.00	-27.37	Horizontal
10	11700.074	31.11	17.41	48.52	74.00	-25.48	Horizontal
11	13320.329	30.43	20.11	50.54	74.00	-23.46	Horizontal
12	16180.966	30.11	17.65	47.76	74.00	-26.24	Horizontal

NOTE：
Above 1GHz, the tested values of Peak are lower than the correspondingly limited values of AVG.So don’t read the values of AVG.
The field strength is calculated by adding the Antenna Factor. Correct Factor.
The basic equation with a sample calculation is as follows:
Final Test Level =Receiver Reading + Correct Factor

Remark:

1). No any other emissions level which are attenuated less than 20dB below the limit. According to 15.31(o), The amplitude of spurious emissions from intentional radiators and emissions from unintentional radiators which are attenuated more than 20 dB below the permissible value need not be reported unless specifically required elsewhere in this Part. Hence there no other emissions have been reported.

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 requirements.

4.10 BAND EDGES REQUIREMENT

4.10.1 LIMITS

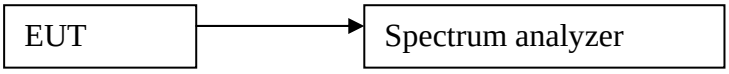
Section 15.247 (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band 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.

4.10.2 TEST PROCEDURES

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Fixing frequency mode：
4. Set RBW to 100 kHz and VBW of spectrum analyzer to 300 kHz with a convenient frequency span including 100 kHz bandwidth from band edge. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency. Repeat above procedures until all measured frequencies were complete.
5. Frequency Hopping mode:
6. Span = 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.
7. RBW ⩾1 % of spectrum analyzer display span(set 100kHz), VBW ⩾RBW(set 100kHz), Sweep = auto, Detector function = peak, Trace = max hold.

Allow the trace to stabilize. Set the marker on the emission at the band edge, or on the highest modulation product outside of the band, if this level is greater than that at the band edge.

4.10.3 TEST SETUP



4.10.4 TEST RESULTS

The unit does meet the FCC requirements.

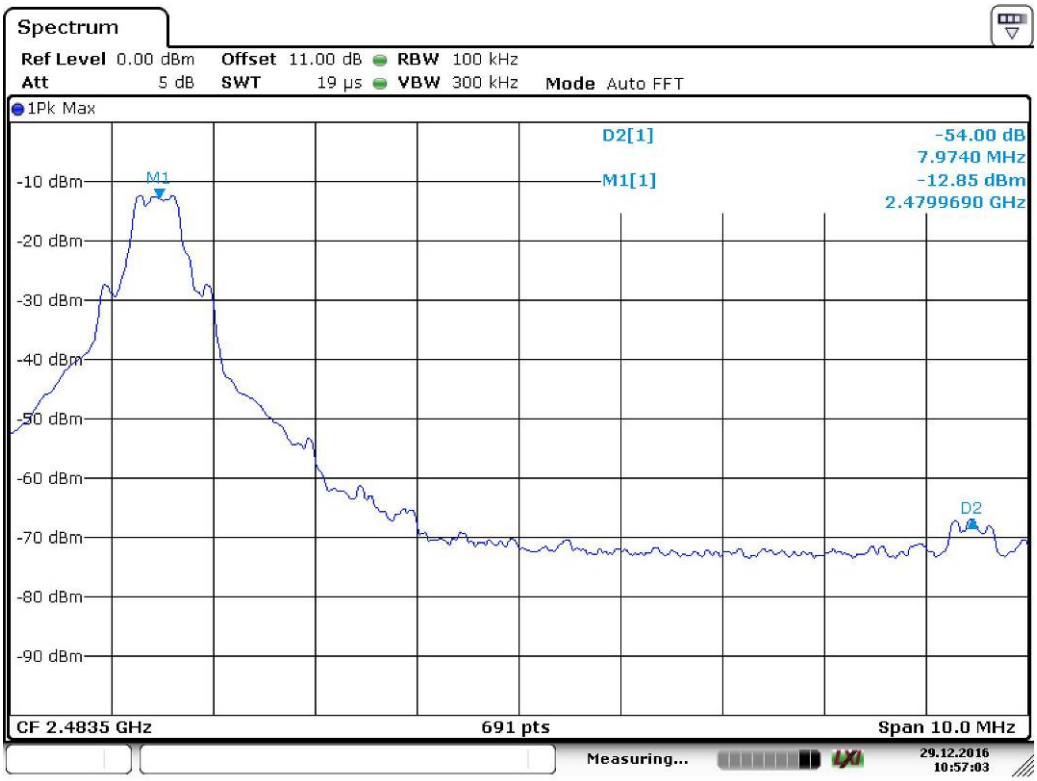
Test result plot as follows:

Fixed frequency mode:
For GFSK

Lowest Channel

Date: 29.DEC.2016 10:55:26

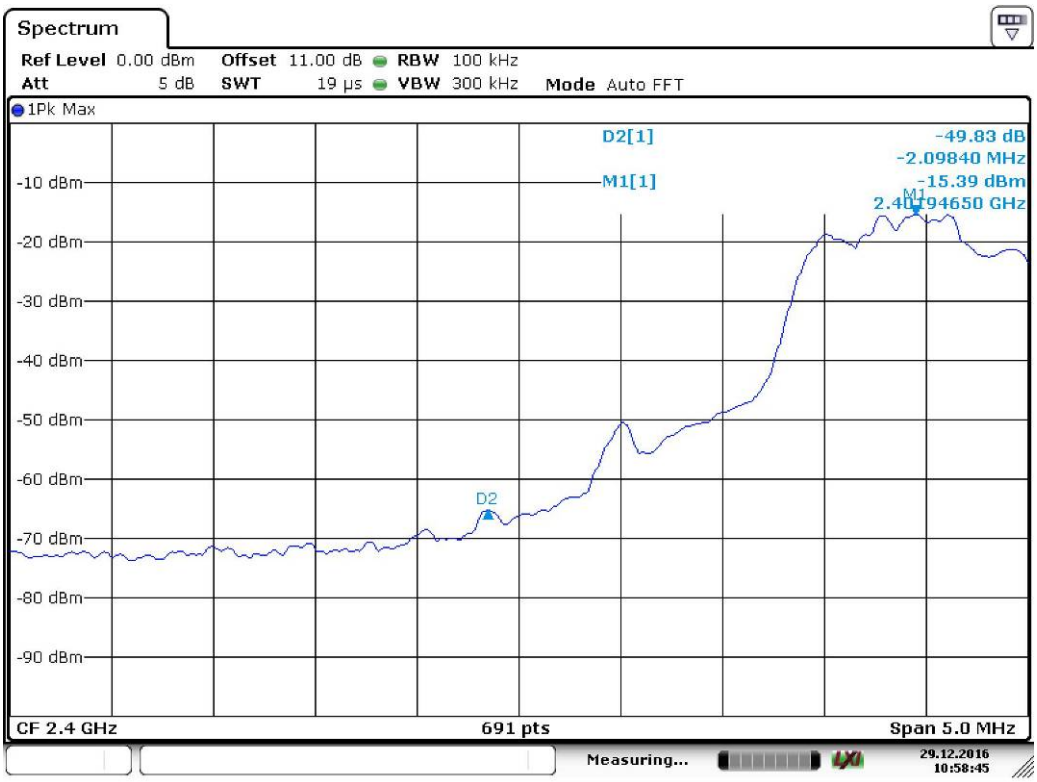
Highest Channel



Date: 29.DEC.2016 10:57:03

For 8DPSK

Lowest Channel



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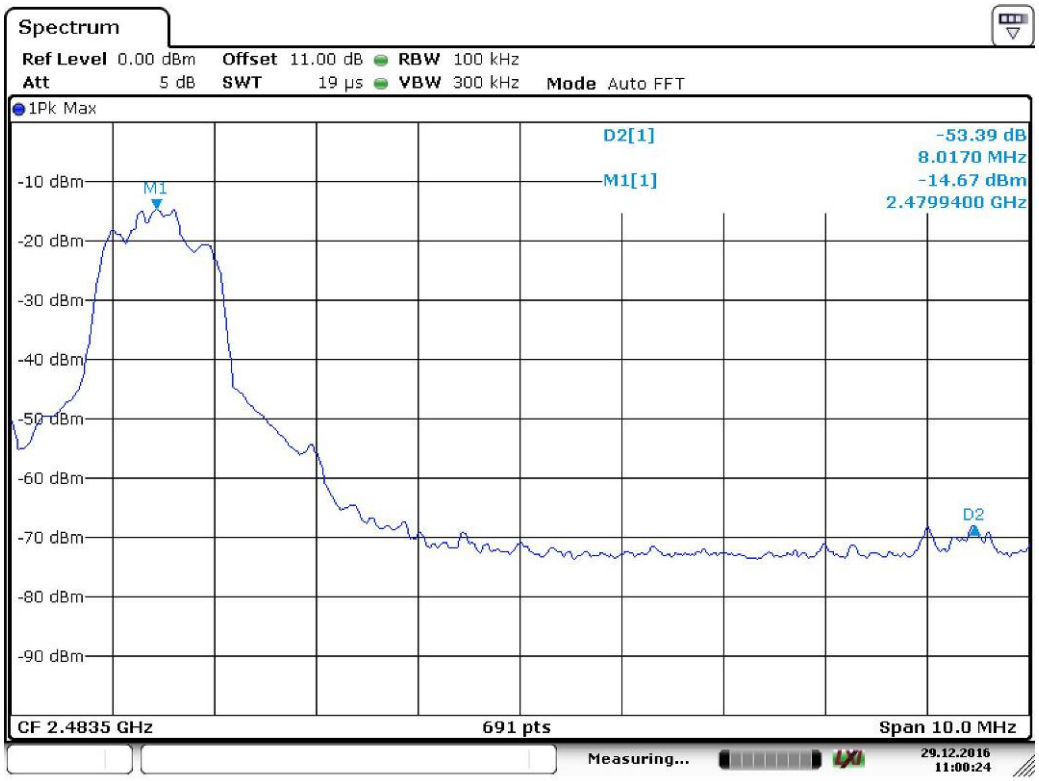
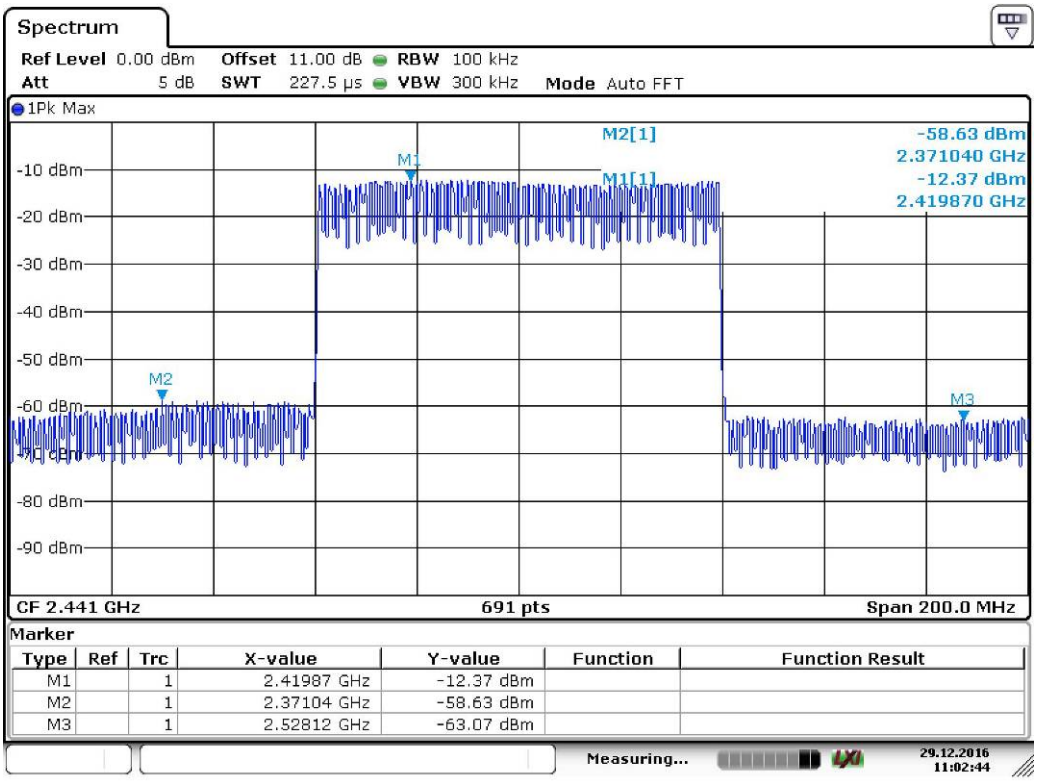
Highest Channel



Date: 29.DEC.2016 11:00:24

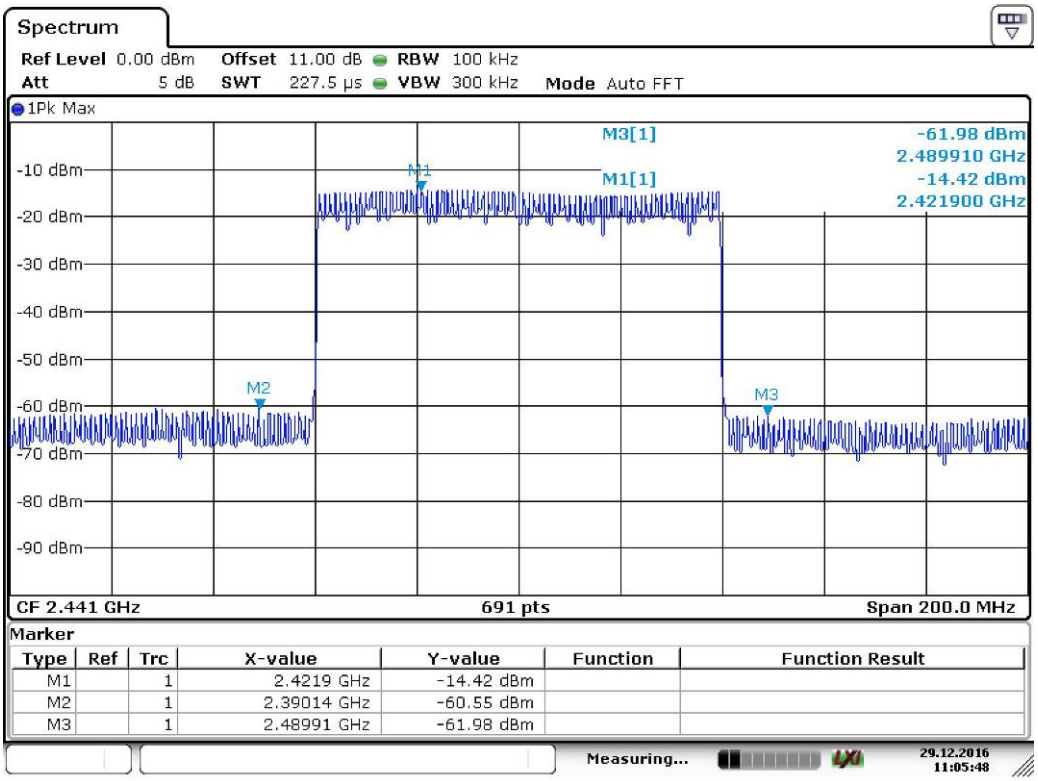
Frequency Hopping mode:

FOR GFSK:



Date: 29.DEC.2016 11:02:44

FOR 8DPSK



Date: 29.DEC.2016 11:05:48

4.10.5 RADIATED EMISSIONS WHICH FALL IN THE RESTRICTED BANDS

Test Requirement:	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)).

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 -	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.69525	960 - 1240	7.25 - 7.75
4.125 - 4.128	16.80425 -	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	16.80475	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	25.5 - 25.67	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	37.5 - 38.25	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	73 - 74.6	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	74.8 - 75.2	2200 - 2300	14.47 - 14.5
8.291 - 8.294	108 - 121.94	2310 - 2390	15.35 - 16.2
8.362 - 8.366	123 - 138	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	149.9 - 150.05	2655 - 2900	22.01 - 23.12
8.41425 - 8.41475	156.52475 -	3260 - 3267	23.6 - 24.0
12.29 - 12.293	156.52525	3332 - 3339	31.2 - 31.8
12.51975 -	156.7 - 156.9	3345.8 - 3358	36.43 - 36.5
12.52025	162.0125 - 167.17	3600 - 4400	
12.57675 -	167.72 - 173.2		
12.57725	240 - 285		
13.36 - 13.41	322 - 335.4		

Note:
The field strength was measured with an EMI measuring receiver and 1 MHz RBW / VBW for peak and with 1MHz RBW / 10Hz VBW for average at a distance of 3m.

If the Peak value below the AV limit, the AV test does not perform for this submission.
Pretest the Bluetooth normal mode and EDR mode, to find the packet type 3DH5 for the EDR mode is the worst case,so only record the worst case.

Test Result:

Channel Low

No.	Freq MHz	Reading dBuV	Factor dB	Level dBuV/m	Limit dBuV/m	Over Limit dB	Remark	Pol V/H
1	2310.000	31.47	6.94	38.41	54.00	-15.59	peak	VERTICAL
3	2390.000	32.30	7.41	39.71	54.00	-14.29	peak	VERTICAL
1	2310.000	31.93	6.94	38.87	54.00	-15.13	peak	HORIZONTAL
3	2390.000	32.08	7.41	39.49	54.00	-14.51	peak	HORIZONTAL

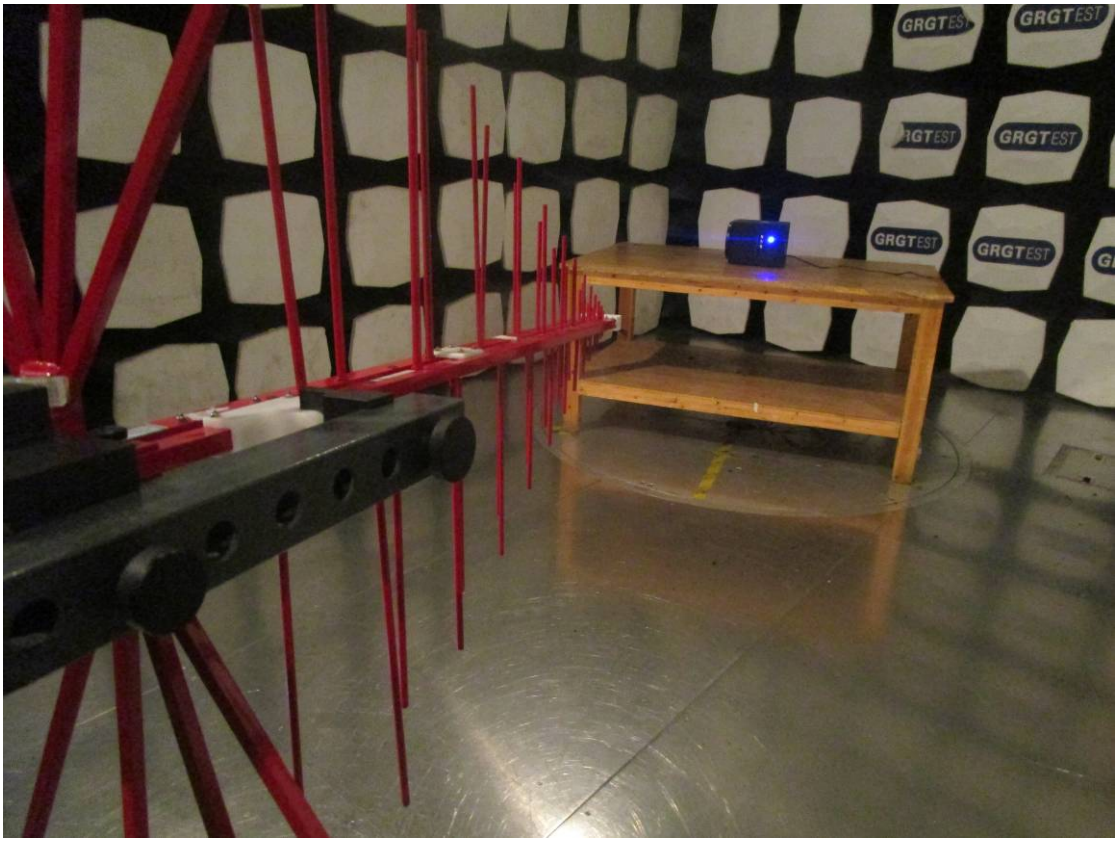
Channel High

No.	Freq MHz	Reading dBuV	Factor dB	Level dBuV/m	Limit dBuV/m	Over Limit dB	Remark	Pol V/H
1	2483.500	31.01	7.87	38.88	54.00	-15.12	peak	VERTICAL
3	2500.000	31.54	7.95	39.49	54.00	-14.51	peak	VERTICAL
1	2483.500	31.66	7.87	39.53	54.00	-14.47	peak	HORIZONTAL
3	2500.000	32.20	7.95	40.15	54.00	-13.85	peak	HORIZONTAL

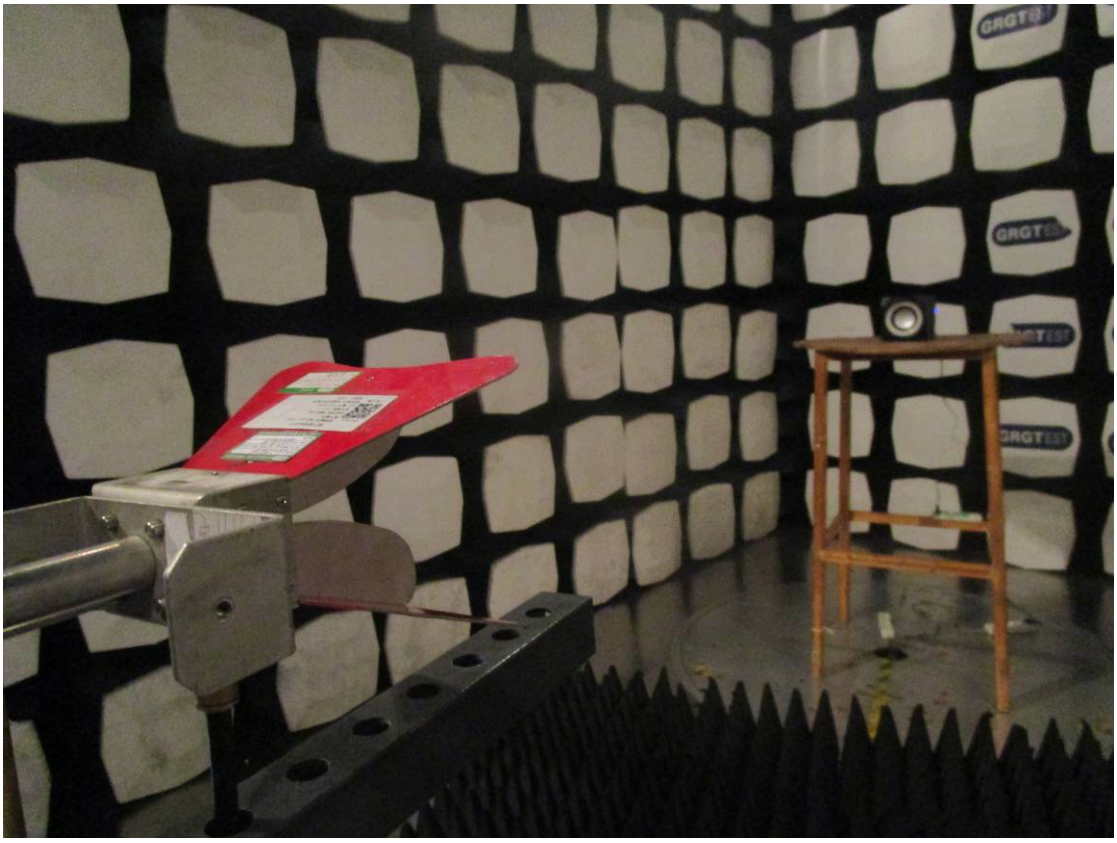
Remark: Max field strength in 3m distance. No any other emission which falls in restricted bands can be detected and be reported.

APPENDIX A: PHOTOGRAPH OF THE TEST ARRANGEMENT

RSE（Below 1GHz）



RSE（Above 1GHz）



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