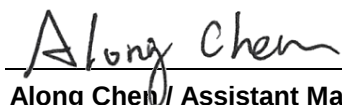


FCC Test Report

FCC ID : YAISB52
Equipment : Wireless SOM Module
Model No. : SB52
Brand Name : InnoComm
Applicant : InnoComm Mobile Technology Corp
Address : 3F, No. 6, Hsin Ann Rd., Hsinchu Science Park,
Hsinchu 30078, Taiwan
Standard : 47 CFR FCC Part 15.247
Received Date : Mar. 17, 2020
Tested Date : May 11 ~ May 20, 2020

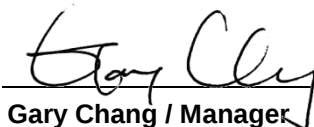
We, International Certification Corp., would like to declare that the tested sample has been evaluated and in compliance with the requirement of the above standards. The test results contained in this report refer exclusively to the product. It may be duplicated completely for legal use with the approval of the applicant. It shall not be reproduced except in full without the written approval of our laboratory.

Reviewed by:



Along Chen / Assistant Manager

Approved by:



Gary Chang / Manager



Table of Contents

1	GENERAL DESCRIPTION	5
1.1	Information.....	5
1.2	Local Support Equipment List	8
1.3	Test Setup Chart	8
1.4	The Equipment List	9
1.5	Test Standards	11
1.6	Deviation from Test Standard and Measurement Procedure.....	11
1.7	Measurement Uncertainty	11
2	TEST CONFIGURATION	12
2.1	Testing Condition	12
2.2	The Worst Test Modes and Channel Details	12
3	TRANSMITTER TEST RESULTS.....	13
3.1	Conducted Emissions.....	13
3.2	Unwanted Emissions into Restricted Frequency Bands	16
3.3	Unwanted Emissions into Non-Restricted Frequency Bands	33
3.4	Conducted Output Power	38
3.5	Number of Hopping Frequency	41
3.6	20dB and Occupied Bandwidth	44
3.7	Channel Separation.....	49
3.8	Number of Dwell Time	54
4	TEST LABORATORY INFORMATION	62

Release Record

Report No.	Version	Description	Issued Date
FR031702AD	Rev. 01	Initial issue	May 27, 2020

Summary of Test Results

FCC Rules	Test Items	Measured	Result
15.207	Conducted Emissions	[dBuV]: 0.249MHz 60.42 (Margin -1.36dB) - QP	Pass
15.247(d) 15.209	Radiated Emissions	[dBuV/m at 3m]: 43.58MHz 27.79 (Margin -12.21dB) - PK	Pass
15.247(d)	Band Edge	Meet the requirement of limit	Pass
15.247(b)(1)	Conducted Output Power	Power [dBm]: 4.52	Pass
15.247(a)(1)(iii)	Number of Hopping Channels	Meet the requirement of limit	Pass
15.247(a)(1)	Hopping Channel Separation	Meet the requirement of limit	Pass
15.247(a)(1)(iii)	Dwell Time	Meet the requirement of limit	Pass
15.203	Antenna Requirement	Meet the requirement of limit	Pass

Declaration of Conformity:

The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.

Comments and Explanations:

The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

1 General Description

1.1 Information

1.1.1 Specification of the Equipment under Test (EUT)

RF General Information				
Frequency Range (MHz)	Bluetooth Mode	Ch. Frequency (MHz)	Channel Number	Data Rate
2400-2483.5	BR	2402-2480	0-78 [79]	1 Mbps
2400-2483.5	EDR	2402-2480	0-78 [79]	2 Mbps
2400-2483.5	EDR	2402-2480	0-78 [79]	3 Mbps
Note 1: RF output power specifies that Maximum Peak Conducted Output Power. Note 2: Bluetooth BR uses a GFSK. Note 3: Bluetooth EDR uses a combination of $\pi/4$ -DQPSK and 8DPSK.				

1.1.2 Antenna Details

Ant. No.	Type	Connector	Gain (dBi)	Remarks
1	Monopole	ipex	1.87	---

1.1.3 Power Supply Type of Equipment under Test (EUT)

Power Supply Type	3.8 Vdc
-------------------	---------

1.1.4 Accessories

N/A

1.1.5 Channel List

Frequency band (MHz)				2400~2483.5			
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	20	2422	40	2442	60	2462
1	2403	21	2423	41	2443	61	2463
2	2404	22	2424	42	2444	62	2464
3	2405	23	2425	43	2445	63	2465
4	2406	24	2426	44	2446	64	2466
5	2407	25	2427	45	2447	65	2467
6	2408	26	2428	46	2448	66	2468
7	2409	27	2429	47	2449	67	2469
8	2410	28	2430	48	2450	68	2470
9	2411	29	2431	49	2451	69	2471
10	2412	30	2432	50	2452	70	2472
11	2413	31	2433	51	2453	71	2473
12	2414	32	2434	52	2454	72	2474
13	2415	33	2435	53	2455	73	2475
14	2416	34	2436	54	2456	74	2476
15	2417	35	2437	55	2457	75	2477
16	2418	36	2438	56	2458	76	2478
17	2419	37	2439	57	2459	77	2479
18	2420	38	2440	58	2460	78	2480
19	2421	39	2441	59	2461	---	---

1.1.6 Test Tool and Duty Cycle

Test Tool	CBT control	
Modulation Mode	Duty Cycle Of Test Signal (%)	Duty Factor (dB)
DH5	77.61%	1.10
3DH5	78.29%	1.06

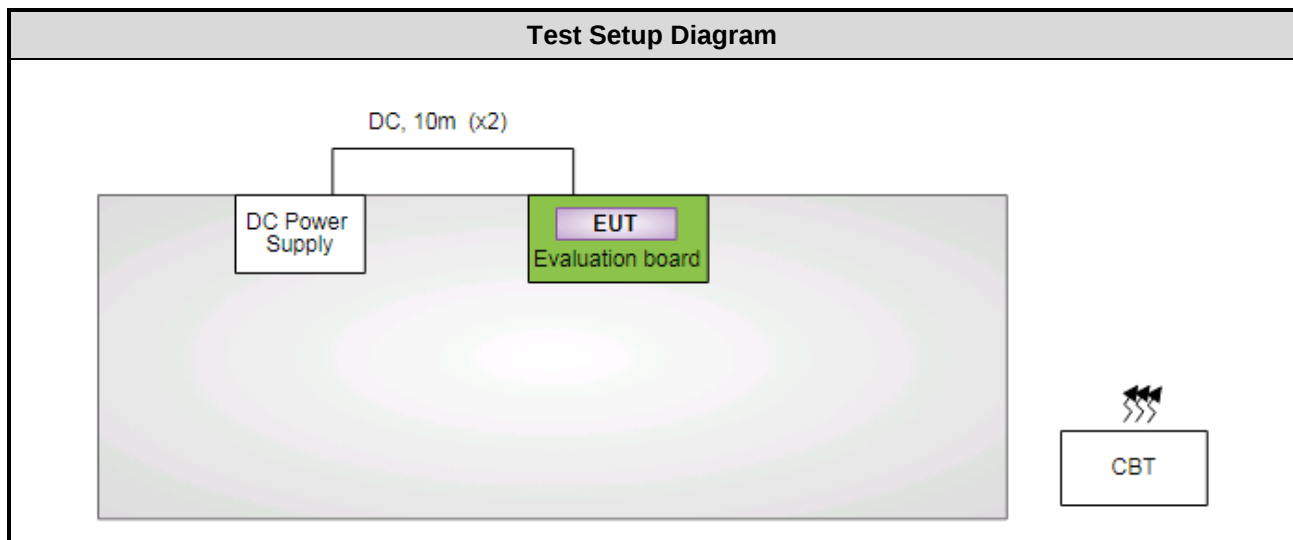
1.1.7 Power Index of Test Tool

Modulation Mode	Test Frequency (MHz)		
	2402	2441	2480
GFSK/1Mbps	default	default	default
$\pi/4$ -DQPSK /2Mbps	default	default	default
8DPSK/3Mbps	default	default	default

1.2 Local Support Equipment List

Support Equipment List					
No.	Equipment	Brand	Model	FCC ID	Remarks
1	Notebook	DELL	Latitude E5470	DoC	---
2	DC Cable	ICC	DCC-10m-R	---	---
3	DC Cable	ICC	DCC-10m-B	---	---
4	DC Power Supply	GWINSTEK	GPC-60300	---	---
5	Evaluation board	---	---	---	Provided by applicant.

1.3 Test Setup Chart



Note: The notebook is disconnected from EUT and removed from test table when EUT is set to transmit continuously.

1.4 The Equipment List

Test Item	Conducted Emission				
Test Site	Conduction room 1 / (CO01-WS)				
Test Date	May 20, 2020				
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until
Receiver	R&S	ESR3	101658	Dec. 12, 2019	Dec. 11, 2020
LISN	R&S	ENV216	101579	Mar. 12, 2020	Mar. 11, 2021
RF Cable-CON	Woken	CFD200-NL	CFD200-NL-001	Oct. 22, 2019	Oct. 21, 2020
Measurement Software	AUDIX	e3	6.120210k	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

Test Item	Radiated Emission				
Test Site	966 chamber 3 / (03CH03-WS)				
Test Date	May 11, 2020				
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until
Spectrum Analyzer	R&S	FSV40	101499	Jan. 09, 2020	Jan. 08, 2021
Receiver	R&S	ESR3	101657	Feb. 14, 2020	Feb. 13, 2021
Bilog Antenna	SCHWARZBECK	VULB9168	VULB9168-685	Apr. 29, 2020	Apr. 28, 2021
Horn Antenna 1G-18G	SCHWARZBECK	BBHA 9120 D	BBHA 9120 D 1206	Dec. 27, 2019	Dec. 26, 2020
Horn Antenna 18G-40G	SCHWARZBECK	BBHA 9170	BBHA 9170517	Nov. 15, 2019	Nov. 14, 2020
Loop Antenna	R&S	HFH2-Z2	100330	Nov. 13, 2019	Nov. 12, 2020
Loop Antenna Cable	KOAX KABEL	101354-BW	101354-BW	Oct. 07, 2019	Oct. 06, 2020
Preamplifier	EMC	EMC02325	980187	Aug. 14, 2019	Aug. 13, 2020
Preamplifier	Agilent	83017A	MY53270014	Aug. 07, 2019	Aug. 06, 2020
Preamplifier	EMC	EMC184045B	980192	Aug. 01, 2019	Jul. 31, 2020
RF cable-3M	HUBER+SUHNER	SUCOFLEX104	MY22620/4	Sep. 27, 2019	Sep. 26, 2020
RF cable-8M	EMC	EMC104-SM-SM-8000	181107	Sep. 27, 2019	Sep. 26, 2020
RF cable-1M	HUBER+SUHNER	SUCOFLEX104	MY22624/4	Sep. 27, 2019	Sep. 26, 2020
LF cable-0.8M	EMC	EMC8D-NM-NM-8000	EMC8D-NM-NM-800-001	Sep. 27, 2019	Sep. 26, 2020
LF cable-3M	EMC	EMC8D-NM-NM-3000	131103	Sep. 27, 2019	Sep. 26, 2020
LF cable-13M	EMC	EMC8D-NM-NM-13000	131104	Sep. 27, 2019	Sep. 26, 2020
Measurement Software	AUDIX	e3	6.120210g	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

Test Item	RF Conducted				
Test Site	(TH01-WS)				
Test Date	May 20, 2020				
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until
Spectrum Analyzer	R&S	FSV40	101063	Apr. 30, 2020	Apr. 29, 2021
Spectrum Analyzer	R&S	FSV40	101499	Jan. 09, 2020	Jan. 08, 2021
TEMP&HUMIDITY CHAMBER	GIANT FORCE	GCT-225-40-SP-SD	MAF1212-002	Dec. 12, 2019	Dec. 11, 2020
Power Meter	Anritsu	ML2495A	1241002	Oct. 23, 2019	Oct. 22, 2020
Power Sensor	Anritsu	MA2411B	1207366	Oct. 23, 2019	Oct. 22, 2020
DC POWER SOURCE	GW INSTRON	GPC-6030D	GES855395	Oct. 29, 2019	Oct. 28, 2020
AC POWER SOURCE	APC	AFC-500W	F312060012	Dec. 02, 2019	Dec. 01, 2020
Measurement Software	Sporton	Sporton_1	1.3.30	NA	NA
Bluetooth Tester	R&S	CBT	100959	Oct. 18, 2019	Oct. 17, 2020
Note: Calibration Interval of instruments listed above is one year.					

1.5 Test Standards

According to the specification of EUT, the EUT must comply with following standards and KDB documents.

47 CFR FCC Part 15.247

ANSI C63.10-2013

FCC KDB 558074 D01 15.247 Meas Guidance v05r02

1.6 Deviation from Test Standard and Measurement Procedure

None

1.7 Measurement Uncertainty

The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor ($k=2$)).

Measurement Uncertainty	
Parameters	Uncertainty
Bandwidth	± 34.130 Hz
Conducted power	± 0.808 dB
Power density	± 0.583 dB
Conducted emission	± 2.715 dB
AC conducted emission	± 2.92 dB
Radiated emission ≤ 1 GHz	± 3.96 dB
Radiated emission > 1 GHz	± 4.51 dB
Time	$\pm 0.1\%$

2 Test Configuration

2.1 Testing Condition

Test Item	Test Site	Ambient Condition	Tested By
AC Conduction	CO01-WS	22°C / 67%	Alex Tsai
Radiated Emissions	03CH03-WS	24°C / 63%	Roger Lu
RF Conducted	TH01-WS	22°C / 63%	Brad Wu

- FCC Designation No.: TW0009
- FCC site registration No.: 207696
- ISSED#: 10807A
- CAB identifier: TW2732

2.2 The Worst Test Modes and Channel Details

Test item	Mode	Test Frequency (MHz)	Data Rate (Mbps)	Test Configuration
Conducted Emissions Radiated Emissions ≤ 1GHz	GFSK	2402	1Mbps	---
Radiated Emissions > 1GHz	GFSK 8DPSK	2402, 2441, 2480 2402, 2441, 2480	1Mbps 3Mbps	---
Conducted Output Power	GFSK π/4 DQPSK 8DPSK	2402, 2441, 2480 2402, 2441, 2480 2402, 2441, 2480	1Mbps 2Mbps 3Mbps	---
Number of Hopping Channels	GFSK π/4 DQPSK 8DPSK	2402~2480 2402~2480 2402~2480	1Mbps 2Mbps 3Mbps	---
Hopping Channel Separation 20dB and Occupied bandwidth	GFSK π/4 DQPSK 8DPSK	2402, 2441, 2480 2402, 2441, 2480 2402, 2441, 2480	1Mbps 2Mbps 3Mbps	---
Dwell Time	GFSK π/4 DQPSK 8DPSK	2402 2402 2402	1Mbps 2Mbps 3Mbps	---

NOTE:

1. The EUT was pretested with 3 orientations placed on the table for the radiated emission measurement – X, Y, and Z-plane. The **X-plane** results were found as the worst case and were shown in this report.

3 Transmitter Test Results

3.1 Conducted Emissions

3.1.1 Limit of Conducted Emissions

Conducted Emissions Limit		
Frequency Emission (MHz)	Quasi-Peak	Average
0.15-0.5	66 - 56 *	56 - 46 *
0.5-5	56	46
5-30	60	50

Note 1: * Decreases with the logarithm of the frequency.

3.1.2 Test Procedures

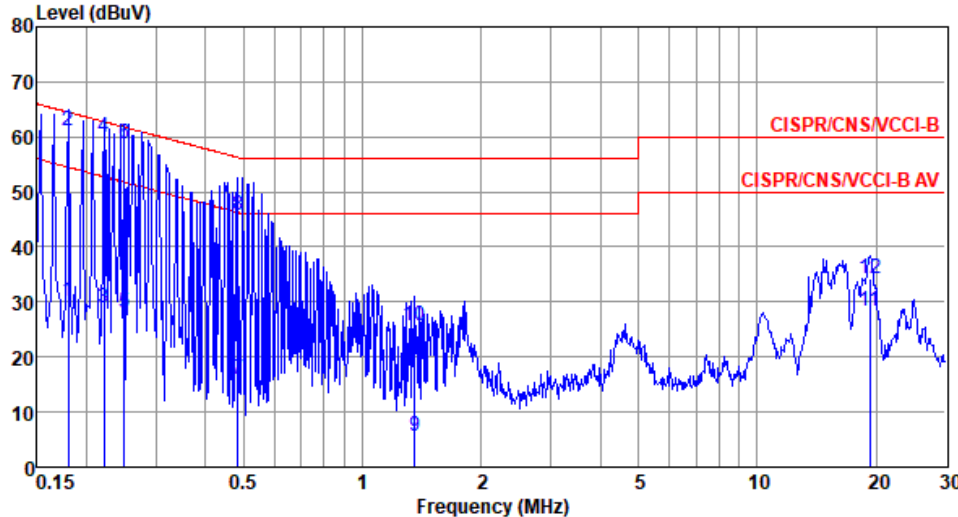
1. The device is placed on a test table, raised 80 cm above the reference ground plane. The vertical conducting plane is located 40 cm to the rear of the device.
2. The device is connected to line impedance stabilization network (LISN) and other accessories are connected to other LISN. Measured levels of AC power line conducted emission are across the 50 Ω LISN port.
3. AC conducted emission measurements is made over frequency range from 150 kHz to 30 MHz.
4. This measurement was performed with AC 120V/60Hz

3.1.3 Test Setup



- Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) are 80 cm from EUT and at least 80 cm from other units and other metal planes

3.1.4 Test Result of Conducted Emissions

Modulation Mode	GFSK	Test Freq. (MHz)	2402																																																																																																																																							
Power Phase	Line																																																																																																																																									
Level (dBUV)  <table><tr><th></th><th>Freq</th><th>Level</th><th>Limit</th><th>Over</th><th>Read</th><th>LISN</th><th>cable</th><th></th></tr><tr><th></th><th>MHz</th><th>dBuV</th><th>Line</th><th>Limit</th><th>Level</th><th>factor</th><th>loss</th><th>Remark</th></tr><tr><th></th><th></th><th></th><th>dBuV</th><th>dB</th><th>dBuV</th><th>dB</th><th>dB</th><th></th></tr><tr><td>1</td><td>0.180</td><td>30.18</td><td>54.50</td><td>-24.32</td><td>20.49</td><td>9.63</td><td>0.06</td><td>Average</td></tr><tr><td>2</td><td>0.180</td><td>61.24</td><td>64.50</td><td>-3.26</td><td>51.55</td><td>9.63</td><td>0.06</td><td>QP</td></tr><tr><td>3</td><td>0.222</td><td>29.07</td><td>52.74</td><td>-23.67</td><td>19.38</td><td>9.63</td><td>0.06</td><td>Average</td></tr><tr><td>4*</td><td>0.222</td><td>59.95</td><td>62.74</td><td>-2.79</td><td>50.26</td><td>9.63</td><td>0.06</td><td>QP</td></tr><tr><td>5</td><td>0.249</td><td>27.91</td><td>51.78</td><td>-23.87</td><td>18.21</td><td>9.63</td><td>0.07</td><td>Average</td></tr><tr><td>6</td><td>0.249</td><td>58.63</td><td>61.78</td><td>-3.15</td><td>48.93</td><td>9.63</td><td>0.07</td><td>QP</td></tr><tr><td>7</td><td>0.484</td><td>16.05</td><td>46.27</td><td>-30.22</td><td>6.33</td><td>9.63</td><td>0.09</td><td>Average</td></tr><tr><td>8</td><td>0.484</td><td>45.67</td><td>56.27</td><td>-10.60</td><td>35.95</td><td>9.63</td><td>0.09</td><td>QP</td></tr><tr><td>9</td><td>1.359</td><td>5.54</td><td>46.00</td><td>-40.46</td><td>-4.24</td><td>9.63</td><td>0.15</td><td>Average</td></tr><tr><td>10</td><td>1.359</td><td>25.68</td><td>56.00</td><td>-30.32</td><td>15.90</td><td>9.63</td><td>0.15</td><td>QP</td></tr><tr><td>11</td><td>19.326</td><td>28.28</td><td>50.00</td><td>-21.72</td><td>17.91</td><td>9.72</td><td>0.65</td><td>Average</td></tr><tr><td>12</td><td>19.326</td><td>34.28</td><td>60.00</td><td>-25.72</td><td>23.91</td><td>9.72</td><td>0.65</td><td>QP</td></tr></table>					Freq	Level	Limit	Over	Read	LISN	cable			MHz	dBuV	Line	Limit	Level	factor	loss	Remark				dBuV	dB	dBuV	dB	dB		1	0.180	30.18	54.50	-24.32	20.49	9.63	0.06	Average	2	0.180	61.24	64.50	-3.26	51.55	9.63	0.06	QP	3	0.222	29.07	52.74	-23.67	19.38	9.63	0.06	Average	4*	0.222	59.95	62.74	-2.79	50.26	9.63	0.06	QP	5	0.249	27.91	51.78	-23.87	18.21	9.63	0.07	Average	6	0.249	58.63	61.78	-3.15	48.93	9.63	0.07	QP	7	0.484	16.05	46.27	-30.22	6.33	9.63	0.09	Average	8	0.484	45.67	56.27	-10.60	35.95	9.63	0.09	QP	9	1.359	5.54	46.00	-40.46	-4.24	9.63	0.15	Average	10	1.359	25.68	56.00	-30.32	15.90	9.63	0.15	QP	11	19.326	28.28	50.00	-21.72	17.91	9.72	0.65	Average	12	19.326	34.28	60.00	-25.72	23.91	9.72	0.65	QP
	Freq	Level	Limit	Over	Read	LISN	cable																																																																																																																																			
	MHz	dBuV	Line	Limit	Level	factor	loss	Remark																																																																																																																																		
			dBuV	dB	dBuV	dB	dB																																																																																																																																			
1	0.180	30.18	54.50	-24.32	20.49	9.63	0.06	Average																																																																																																																																		
2	0.180	61.24	64.50	-3.26	51.55	9.63	0.06	QP																																																																																																																																		
3	0.222	29.07	52.74	-23.67	19.38	9.63	0.06	Average																																																																																																																																		
4*	0.222	59.95	62.74	-2.79	50.26	9.63	0.06	QP																																																																																																																																		
5	0.249	27.91	51.78	-23.87	18.21	9.63	0.07	Average																																																																																																																																		
6	0.249	58.63	61.78	-3.15	48.93	9.63	0.07	QP																																																																																																																																		
7	0.484	16.05	46.27	-30.22	6.33	9.63	0.09	Average																																																																																																																																		
8	0.484	45.67	56.27	-10.60	35.95	9.63	0.09	QP																																																																																																																																		
9	1.359	5.54	46.00	-40.46	-4.24	9.63	0.15	Average																																																																																																																																		
10	1.359	25.68	56.00	-30.32	15.90	9.63	0.15	QP																																																																																																																																		
11	19.326	28.28	50.00	-21.72	17.91	9.72	0.65	Average																																																																																																																																		
12	19.326	34.28	60.00	-25.72	23.91	9.72	0.65	QP																																																																																																																																		
Note 1: Level (dBUV) = Read Level (dBUV) + LISN Factor (dB) + Cable Loss (dB). 2: Over Limit (dB) = Level (dBUV) – Limit Line (dBUV).																																																																																																																																										

Modulation Mode	GFSK	Test Freq. (MHz)	2402																																																																																																																												
Power Phase	Neutral																																																																																																																														
Level (dBUV) <table><tr><th>Freq</th><th>Level</th><th>Limit</th><th>Over</th><th>Read</th><th>LISN</th><th>cable</th><th></th></tr><tr><th>MHz</th><th>dBuV</th><th>Line</th><th>Limit</th><th>Level</th><th>factor</th><th>loss</th><th>Remark</th></tr><tr><td>1</td><td>0.159</td><td>31.03</td><td>55.52</td><td>-24.49</td><td>21.32</td><td>9.66</td><td>0.05</td><td>Average</td></tr><tr><td>2</td><td>0.159</td><td>63.14</td><td>65.52</td><td>-2.38</td><td>53.43</td><td>9.66</td><td>0.05</td><td>QP</td></tr><tr><td>3</td><td>0.201</td><td>29.74</td><td>53.58</td><td>-23.84</td><td>20.03</td><td>9.65</td><td>0.06</td><td>Average</td></tr><tr><td>4</td><td>0.201</td><td>62.02</td><td>63.58</td><td>-1.56</td><td>52.31</td><td>9.65</td><td>0.06</td><td>QP</td></tr><tr><td>5</td><td>0.219</td><td>29.73</td><td>52.88</td><td>-23.15</td><td>20.02</td><td>9.65</td><td>0.06</td><td>Average</td></tr><tr><td>6</td><td>0.219</td><td>61.46</td><td>62.88</td><td>-1.42</td><td>51.75</td><td>9.65</td><td>0.06</td><td>QP</td></tr><tr><td>7</td><td>0.249</td><td>28.49</td><td>51.78</td><td>-23.29</td><td>18.77</td><td>9.65</td><td>0.07</td><td>Average</td></tr><tr><td>8*</td><td>0.249</td><td>60.42</td><td>61.78</td><td>-1.36</td><td>50.70</td><td>9.65</td><td>0.07</td><td>QP</td></tr><tr><td>9</td><td>0.538</td><td>14.70</td><td>46.00</td><td>-31.30</td><td>4.96</td><td>9.65</td><td>0.09</td><td>Average</td></tr><tr><td>10</td><td>0.538</td><td>43.76</td><td>56.00</td><td>-12.24</td><td>34.02</td><td>9.65</td><td>0.09</td><td>QP</td></tr><tr><td>11</td><td>16.226</td><td>24.77</td><td>50.00</td><td>-25.23</td><td>14.34</td><td>9.81</td><td>0.62</td><td>Average</td></tr><tr><td>12</td><td>16.226</td><td>32.05</td><td>60.00</td><td>-27.95</td><td>21.62</td><td>9.81</td><td>0.62</td><td>QP</td></tr></table>				Freq	Level	Limit	Over	Read	LISN	cable		MHz	dBuV	Line	Limit	Level	factor	loss	Remark	1	0.159	31.03	55.52	-24.49	21.32	9.66	0.05	Average	2	0.159	63.14	65.52	-2.38	53.43	9.66	0.05	QP	3	0.201	29.74	53.58	-23.84	20.03	9.65	0.06	Average	4	0.201	62.02	63.58	-1.56	52.31	9.65	0.06	QP	5	0.219	29.73	52.88	-23.15	20.02	9.65	0.06	Average	6	0.219	61.46	62.88	-1.42	51.75	9.65	0.06	QP	7	0.249	28.49	51.78	-23.29	18.77	9.65	0.07	Average	8*	0.249	60.42	61.78	-1.36	50.70	9.65	0.07	QP	9	0.538	14.70	46.00	-31.30	4.96	9.65	0.09	Average	10	0.538	43.76	56.00	-12.24	34.02	9.65	0.09	QP	11	16.226	24.77	50.00	-25.23	14.34	9.81	0.62	Average	12	16.226	32.05	60.00	-27.95	21.62	9.81	0.62	QP
Freq	Level	Limit	Over	Read	LISN	cable																																																																																																																									
MHz	dBuV	Line	Limit	Level	factor	loss	Remark																																																																																																																								
1	0.159	31.03	55.52	-24.49	21.32	9.66	0.05	Average																																																																																																																							
2	0.159	63.14	65.52	-2.38	53.43	9.66	0.05	QP																																																																																																																							
3	0.201	29.74	53.58	-23.84	20.03	9.65	0.06	Average																																																																																																																							
4	0.201	62.02	63.58	-1.56	52.31	9.65	0.06	QP																																																																																																																							
5	0.219	29.73	52.88	-23.15	20.02	9.65	0.06	Average																																																																																																																							
6	0.219	61.46	62.88	-1.42	51.75	9.65	0.06	QP																																																																																																																							
7	0.249	28.49	51.78	-23.29	18.77	9.65	0.07	Average																																																																																																																							
8*	0.249	60.42	61.78	-1.36	50.70	9.65	0.07	QP																																																																																																																							
9	0.538	14.70	46.00	-31.30	4.96	9.65	0.09	Average																																																																																																																							
10	0.538	43.76	56.00	-12.24	34.02	9.65	0.09	QP																																																																																																																							
11	16.226	24.77	50.00	-25.23	14.34	9.81	0.62	Average																																																																																																																							
12	16.226	32.05	60.00	-27.95	21.62	9.81	0.62	QP																																																																																																																							
Note 1: Level (dBUV) = Read Level (dBUV) + LISN Factor (dB) + Cable Loss (dB). Note 2: Over Limit (dB) = Level (dBUV) – Limit Line (dBUV).																																																																																																																															

3.2 Unwanted Emissions into Restricted Frequency Bands

3.2.1 Limit of Unwanted Emissions into Restricted Frequency Bands

Restricted Band Emissions Limit			
Frequency Range (MHz)	Field Strength (uV/m)	Field Strength (dBuV/m)	Measure Distance (m)
0.009~0.490	2400/F(kHz)	48.5 - 13.8	300
0.490~1.705	24000/F(kHz)	33.8 - 23	30
1.705~30.0	30	29	30
30~88	100	40	3
88~216	150	43.5	3
216~960	200	46	3
Above 960	500	54	3

Note 1:
Qusai-Peak value is measured for frequency below 1GHz except for 9~90 kHz, 110~490 kHz frequency band. Peak and average value are measured for frequency above 1GHz. The limit on average radio frequency emission is as above table. The limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit

Note 2:
Measurements may be performed at a distance other than what is specified provided. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor as below, Frequency at or above 30 MHz: 20 dB/decade Frequency below 30 MHz: 40 dB/decade.

3.2.2 Test Procedures

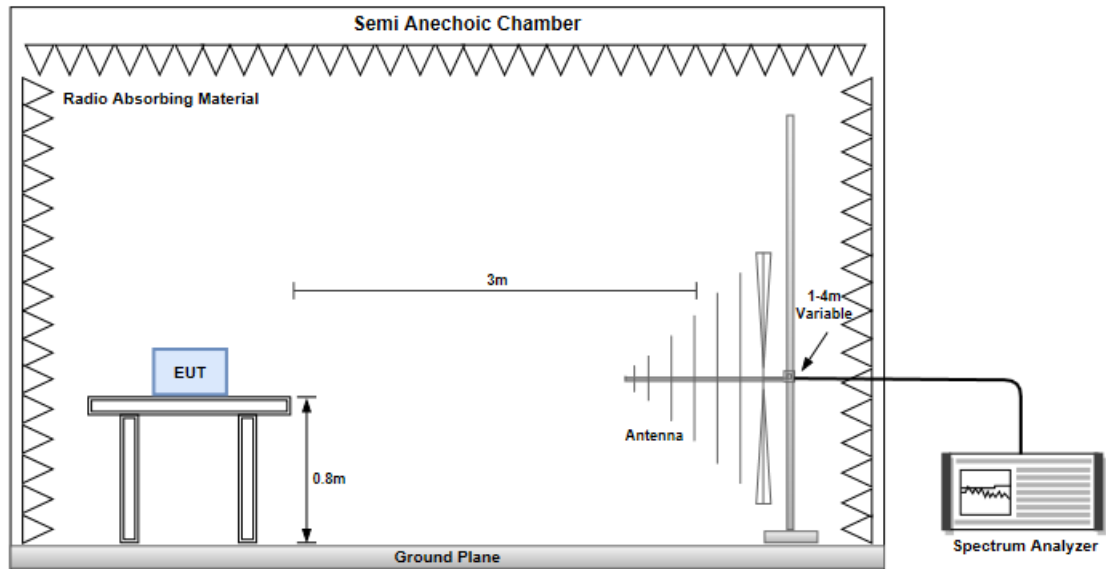
1. Measurement is made at a semi-anechoic chamber that incorporates a turntable allowing a EUT rotation of 360°. A continuously-rotating, remotely-controlled turntable is installed at the test site to support the EUT and facilitate determination of the direction of maximum radiation for each EUT emission frequency. The EUT is placed at test table. For emissions testing at or below 1 GHz, the table height is 80 cm above the reference ground plane. For emission measurements above 1 GHz, the table height is 1.5 m
2. Measurement is made with the antenna positioned in both the horizontal and vertical planes of polarization. The measurement antenna is varied in height (1m ~ 4m) above the reference ground plane to obtain the maximum signal strength. Distance between EUT and antenna is 3 m.
3. This investigation is performed with the EUT rotated 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations.

Note:

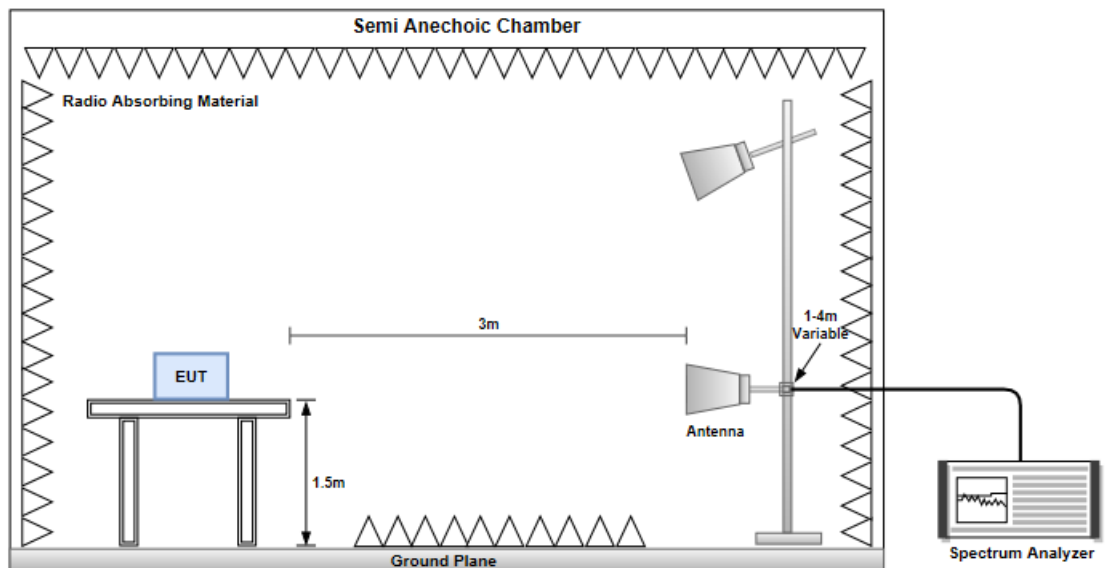
1. 120kHz measurement bandwidth of test receiver and Quasi-peak detector is for radiated emission below 1GHz.
2. Radiated emission above 1GHz / Peak value
RBW=1MHz, VBW=3MHz and Peak detector
Radiated emission above 1GHz / Average value for harmonics
The average value is: Average = Peak value + 20log(Duty cycle) Where the duty factor is calculated from following formula for DH5 packet type which has worst duty factor:
3.
$$20\log (\text{Duty cycle}) = 20\log \frac{1\text{s} / 1600 * 5}{100 \text{ ms}} = -30.1\text{dB}$$
4. Radiated emission above 1GHz / Average value for other emissions
RBW=1MHz, VBW=1/T and Peak detector

3.2.3 Test Setup

Radiated Emissions below 1 GHz



Radiated Emissions above 1 GHz



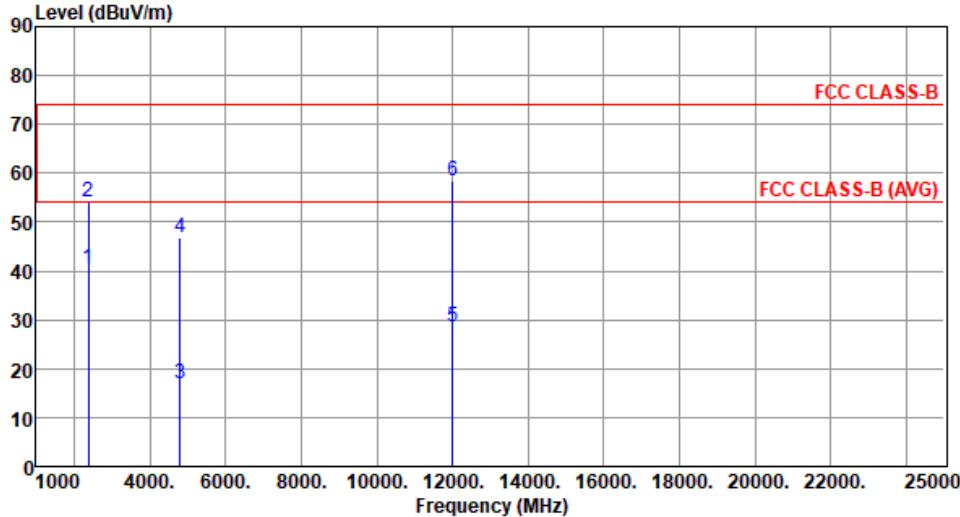
3.2.4 Transmitter Radiated Unwanted Emissions (Below 1GHz)

Modulation	GFSK	Test Freq. (MHz)	2402
Polarization	Horizontal		
Level (dBuV/m)			

Modulation	GFSK	Test Freq. (MHz)	2402
Polarization	Vertical		
Level (dBuV/m)			

3.2.5 Transmitter Radiated Unwanted Emissions (Above 1GHz) for GFSK

Modulation	GFSK	Test Freq. (MHz)	2402
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2390.00	40.67	54.00	-13.33	40.43	0.24	Average	100	303
2	2390.00	54.09	74.00	-19.91	53.85	0.24	Peak	100	303
3	4804.00	16.86	54.00	-37.14	10.43	6.43	Average	100	60
4	4804.00	46.96	74.00	-27.04	40.53	6.43	Peak	100	60
5	12010.00	28.47	54.00	-25.53	12.41	16.06	Average	100	30
6	12010.00	58.57	74.00	-15.43	42.51	16.06	Peak	100	30

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
 *Factor includes antenna factor , cable loss and amplifier gain
 Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Modulation	GFSK	Test Freq. (MHz)	2402
Polarization	Vertical		
Level (dBuV/m)			

Modulation	GFSK	Test Freq. (MHz)	2441
Polarization	Horizontal		
Level (dBUV/m) <			

Modulation	GFSK	Test Freq. (MHz)	2441
Polarization	Vertical		
Level (dBUV/m) <			

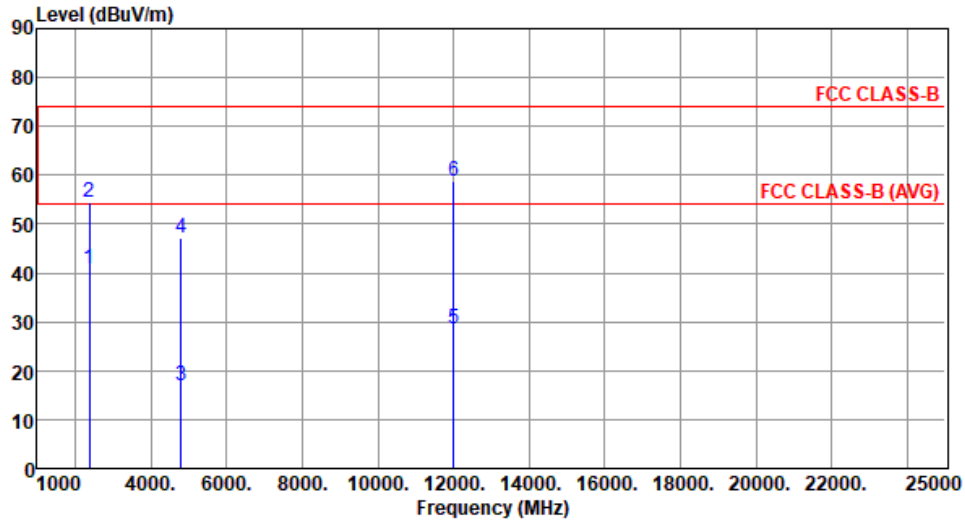
Modulation	GFSK	Test Freq. (MHz)	2480
Polarization	Horizontal		
Level (dBUV/m)			

Modulation	GFSK	Test Freq. (MHz)	2480
Polarization	Vertical		
Level (dBuV/m) <			

3.2.6 Transmitter Radiated Unwanted Emissions (Above 1GHz) for 8DPSK

Modulation	8DPSK	Test Freq. (MHz)	2402
Polarization	Horizontal		
Level (dBuV/m) <			

Modulation	8DPSK	Test Freq. (MHz)	2402
Polarization	Vertical		



	Freq. MHz	Emission level dBUV/m	Limit dBUV/m	Margin dB	SA reading dBUV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2390.00	40.89	54.00	-13.11	40.65	0.24	Average	100	215
2	2390.00	54.30	74.00	-19.70	54.06	0.24	Peak	100	215
3	4804.00	16.91	54.00	-37.09	10.48	6.43	Average	100	60
4	4804.00	47.01	74.00	-26.99	40.58	6.43	Peak	100	60
5	12010.00	28.54	54.00	-25.46	12.48	16.06	Average	100	55
6	12010.00	58.64	74.00	-15.36	42.58	16.06	Peak	100	55

Note 1: Emission Level (dBUV/m) = SA Reading (dBUV/m) + Factor* (dB)

*Factor includes antenna factor , cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBUV/m) – Limit (dBUV/m).

Modulation	8DPSK	Test Freq. (MHz)	2441
Polarization	Horizontal		
Level (dBuV/m)			

Modulation	8DPSK	Test Freq. (MHz)	2441
Polarization	Vertical		
Level (dBUV/m) <			

Modulation	8DPSK	Test Freq. (MHz)	2480
Polarization	Horizontal		
Level (dBUV/m)			

Modulation	8DPSK	Test Freq. (MHz)	2480
Polarization	Vertical		
Level (dBUV/m)			

3.3 Unwanted Emissions into Non-Restricted Frequency Bands

3.3.1 Limit of Unwanted Emissions into Non-Restricted Frequency Bands

Peak power in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz.

3.3.2 Test Procedures

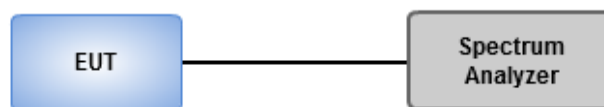
Reference level measurement

1. Set RBW=100kHz, VBW = 300kHz , Detector = Peak, Sweep time = Auto
2. Trace = max hold , Allow Trace to fully stabilize
3. Use the peak marker function to determine the maximum PSD level

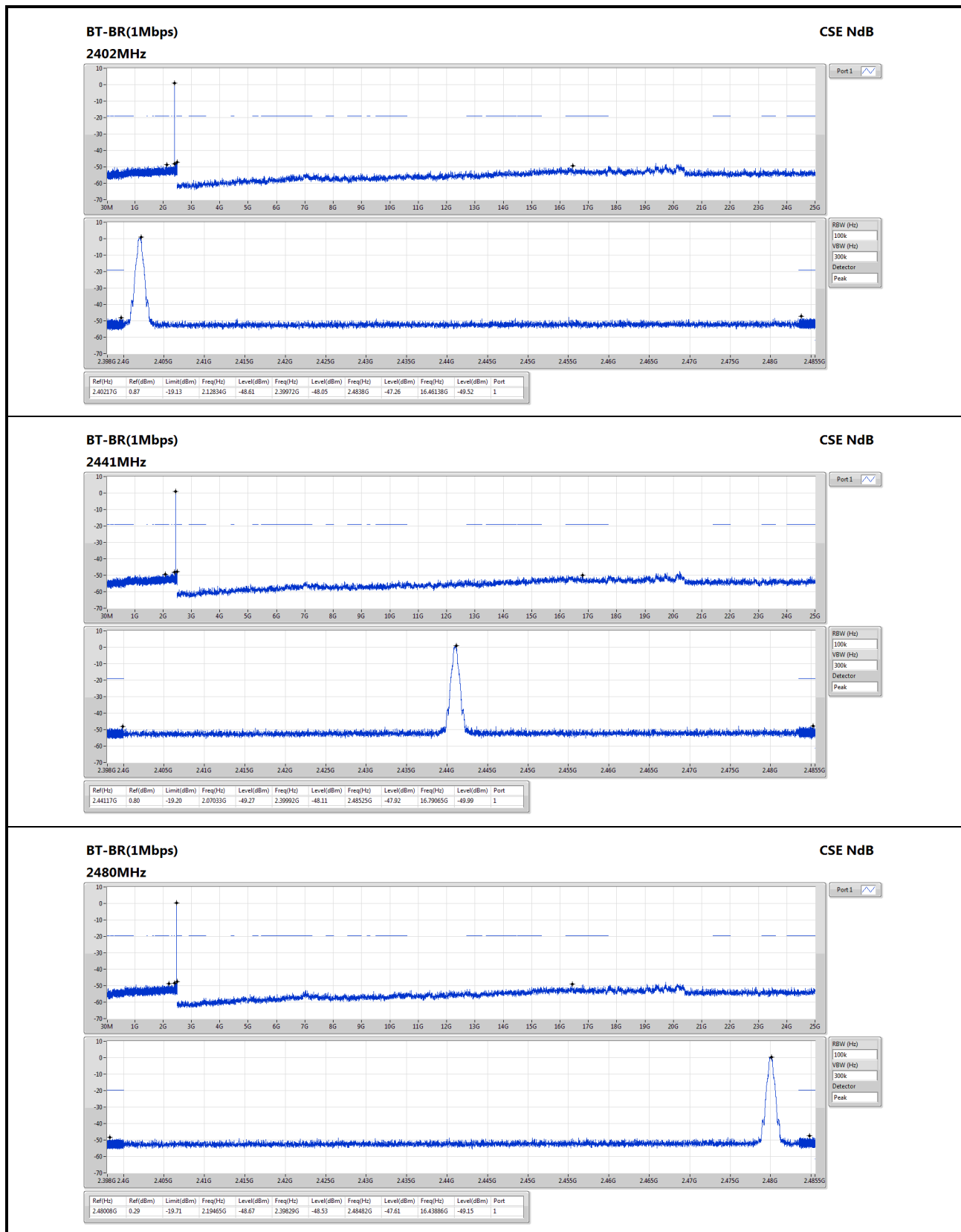
Emission level measurement

1. Set RBW=100kHz, VBW = 300kHz , Detector = Peak, Sweep time = Auto
2. Trace = max hold , Allow Trace to fully stabilize
3. Scan Frequency range is up to 25GHz
4. Use the peak marker function to determine the maximum amplitude level

3.3.3 Test Setup



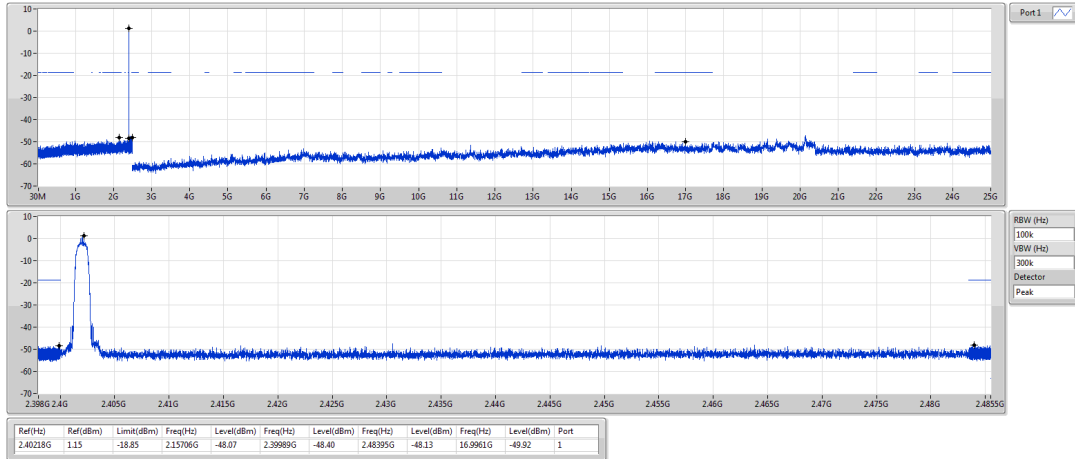
3.3.4 Unwanted Emissions into Non-Restricted Frequency Bands



BT-EDR(2Mbps)

CSE NdB

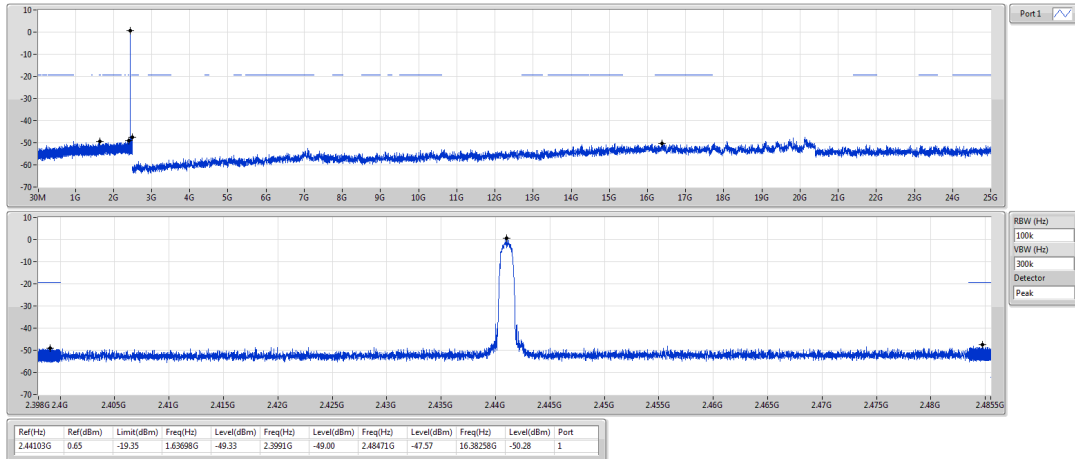
2402MHz



BT-EDR(2Mbps)

CSE NdB

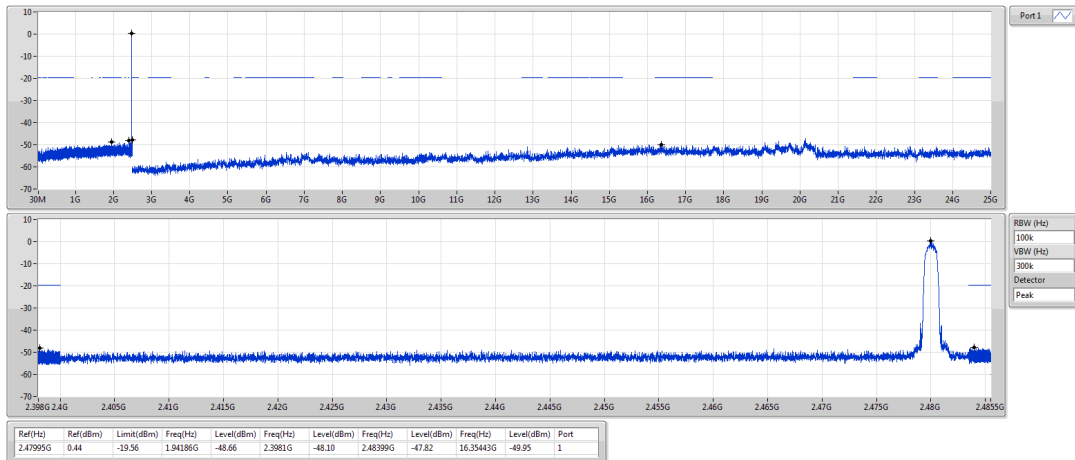
2441MHz



BT-EDR(2Mbps)

CSE NdB

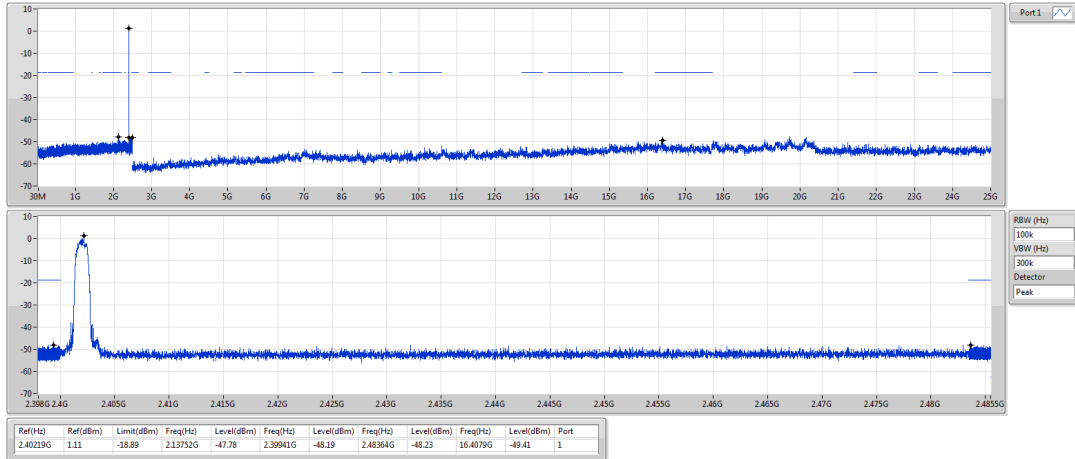
2480MHz



BT-EDR(3Mbps)

CSE NdB

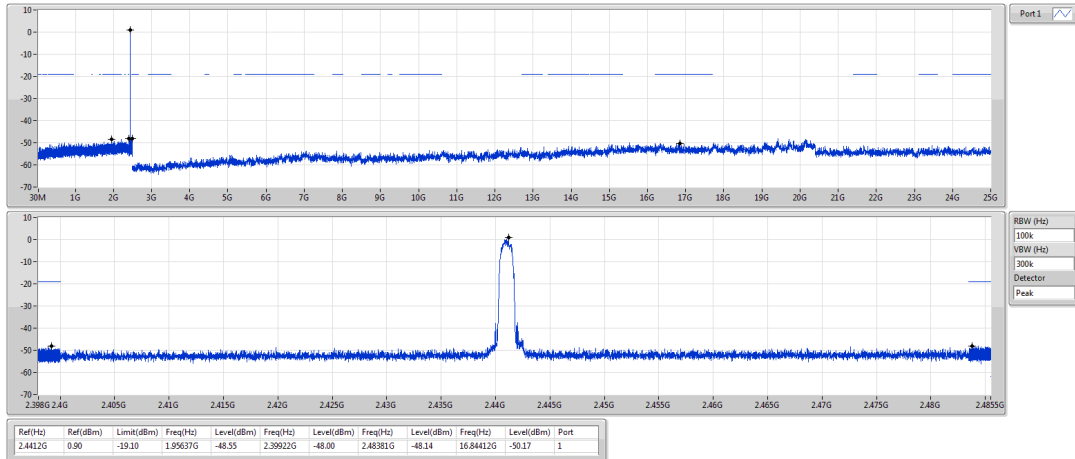
2402MHz



BT-EDR(3Mbps)

CSE NdB

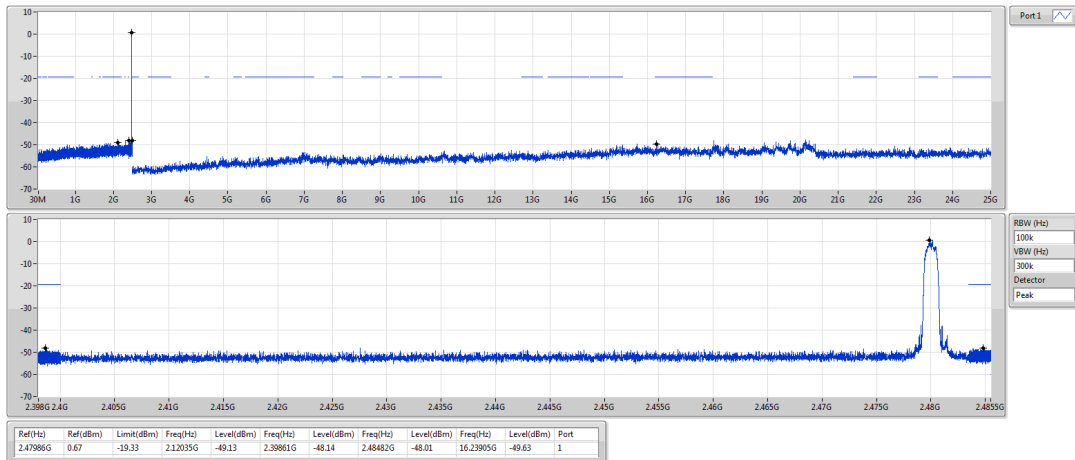
2441MHz



BT-EDR(3Mbps)

CSE NdB

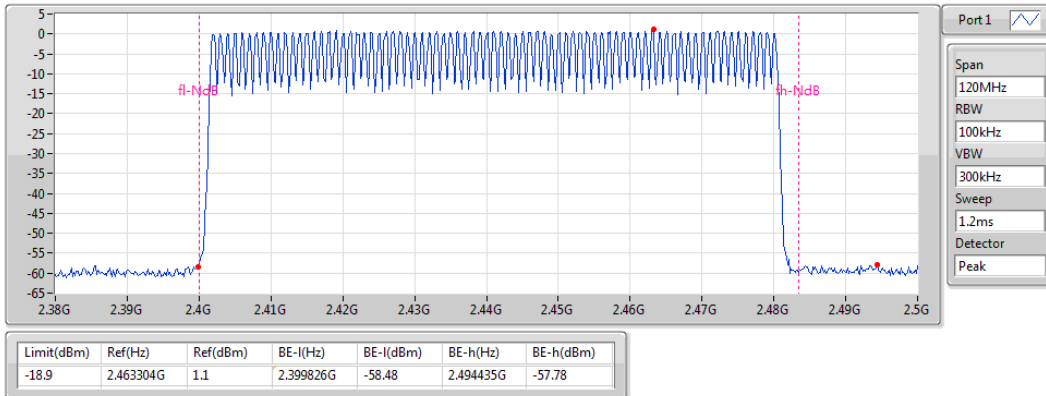
2480MHz



BT-BR(1Mbps)

2441MHz

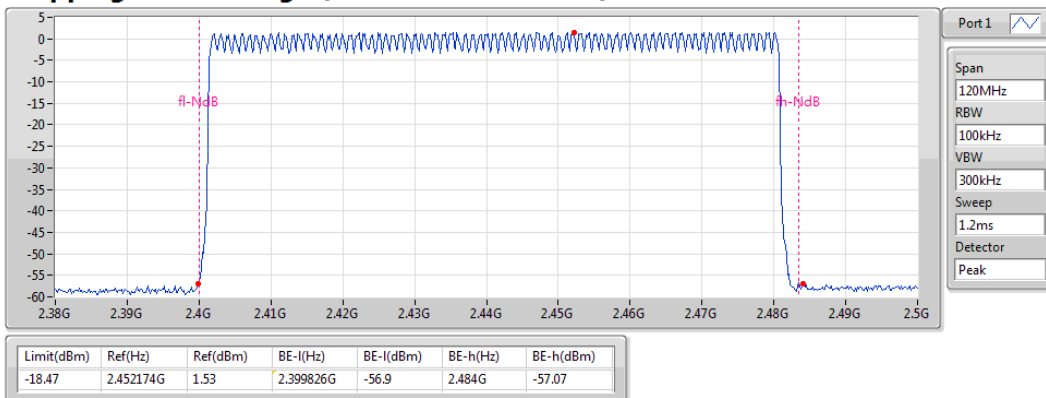
Hopping Ch Bandedge (Non-restricted Band)



BT-EDR(2Mbps)

2441MHz

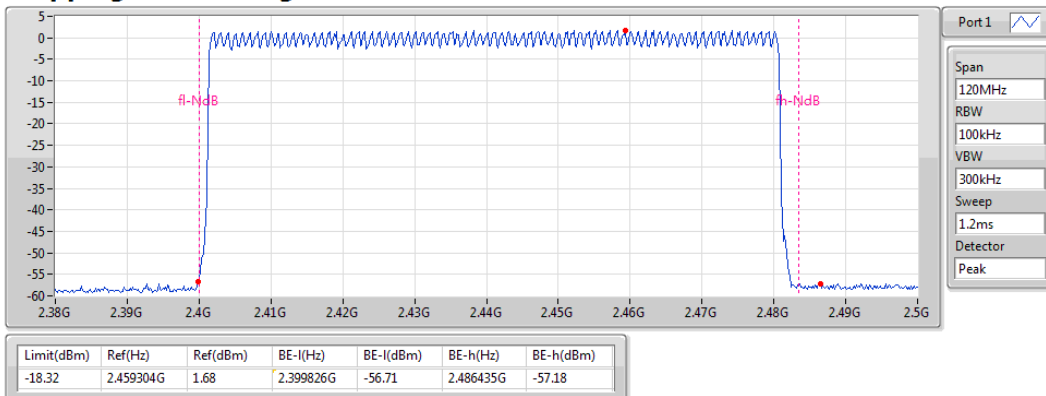
Hopping Ch Bandedge (Non-restricted Band)



BT-EDR(3Mbps)

2441MHz

Hopping Ch Bandedge (Non-restricted Band)



3.4 Conducted Output Power

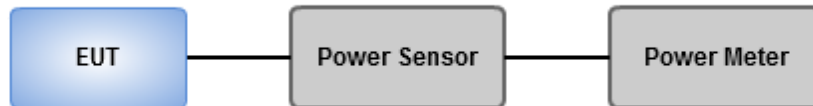
3.4.1 Limit of Conducted Output Power

- ☐ 1 Watt
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.
- ☒ 0.125 Watt
For all other frequency hopping systems in the 2400–2483.5 MHz band.
- ☐ 0.125 Watt
For Frequency hopping systems operating in the 2400–2483.5 MHz band have hopping channel carrier frequencies that are separated by two-thirds of the 20 dB bandwidth of the hopping channel.

3.4.2 Test Procedures

1. A wideband power meter is used for power measurement. Bandwidth of power sensor and meter is 50MHz
2. If duty cycle of test signal is not 100 %, trigger and gating function of power meter will be enabled to capture transmission burst for measuring output power

3.4.3 Test Setup



3.4.4 Test Result of Conducted Output Power

Peak Power

Summary

Mode	Power (dBm)	Power (W)
2.4-2.4835GHz	-	-
BT-BR(1Mbps)	1.75	0.00150
BT-EDR(2Mbps)	4.43	0.00277
BT-EDR(3Mbps)	4.52	0.00283

Result

Mode	Result	Gain (dBi)	Power (dBm)	Power Limit (dBm)
BT-BR(1Mbps)	-	-	-	-
2402MHz	Pass	1.87	1.75	21.00
2441MHz	Pass	1.87	1.60	21.00
2480MHz	Pass	1.87	1.29	21.00
BT-EDR(2Mbps)	-	-	-	-
2402MHz	Pass	1.87	4.43	21.00
2441MHz	Pass	1.87	4.29	21.00
2480MHz	Pass	1.87	4.03	21.00
BT-EDR(3Mbps)	-	-	-	-
2402MHz	Pass	1.87	4.52	21.00
2441MHz	Pass	1.87	4.34	21.00
2480MHz	Pass	1.87	4.12	21.00

Average Power

Summary

Mode	Power	Power
	(dBm)	(W)
2.4-2.4835GHz	-	-
BT-BR(1Mbps)	1.55	0.00143
BT-EDR(2Mbps)	1.62	0.00145
BT-EDR(3Mbps)	1.69	0.00148

Result

Mode	Result	Gain (dBi)	Power (dBm)	Power Limit (dBm)
BT-BR(1Mbps)	-	-	-	-
2402MHz	Pass	1.87	1.55	-
2441MHz	Pass	1.87	1.43	-
2480MHz	Pass	1.87	1.07	-
BT-EDR(2Mbps)	-	-	-	-
2402MHz	Pass	1.87	1.62	-
2441MHz	Pass	1.87	1.51	-
2480MHz	Pass	1.87	1.21	-
BT-EDR(3Mbps)	-	-	-	-
2402MHz	Pass	1.87	1.69	-
2441MHz	Pass	1.87	1.56	-
2480MHz	Pass	1.87	1.26	-

Note: Average power is for reference only.

3.5 Number of Hopping Frequency

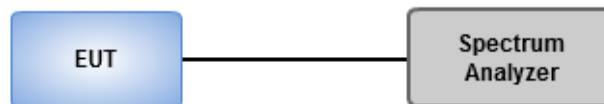
3.5.1 Limit of Number of Hopping Frequency

Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels.

3.5.2 Test Procedures

1. Set RBW = 100kHz, VBW = 300kHz, Sweep time = Auto, Detector = Peak Trace max hold.
2. Allow trace to stabilize.

3.5.3 Test Setup



3.5.4 Test Result of Number of Hopping Frequency

Summary

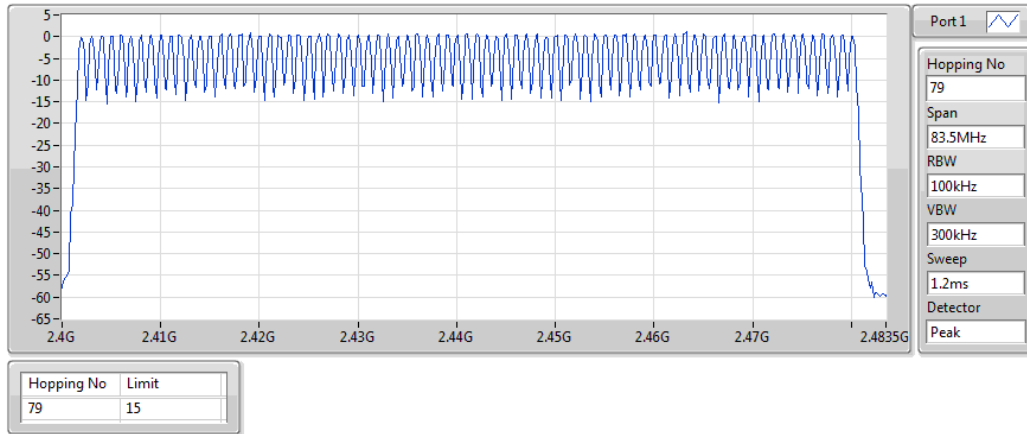
Mode	Max-Hop No
2.4-2.4835GHz	-
BT-BR(1Mbps)	79
BT-EDR(2Mbps)	79
BT-EDR(3Mbps)	79

Result

Mode	Result	Hopping No	Limit
BT-BR(1Mbps)	-	-	-
2441MHz	Pass	79	15
BT-EDR(2Mbps)	-	-	-
2441MHz	Pass	79	15
BT-EDR(3Mbps)	-	-	-
2441MHz	Pass	79	15

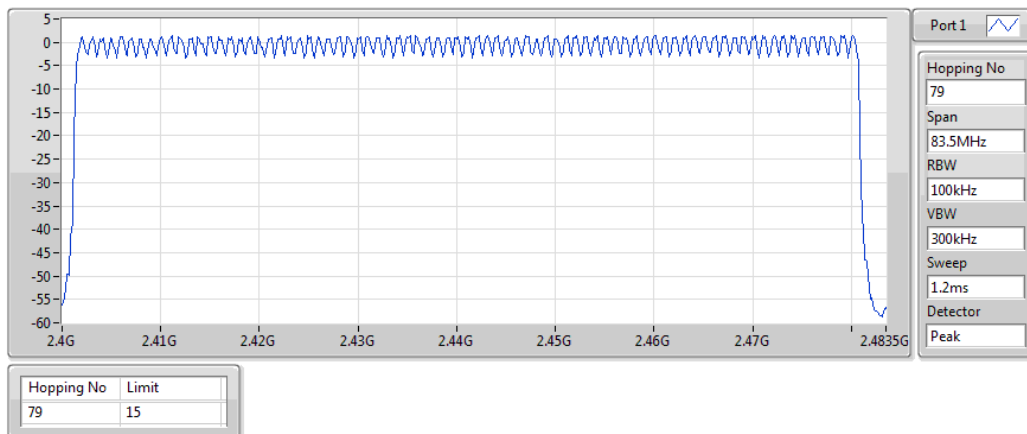
BT-BR(1Mbps)

2441MHz



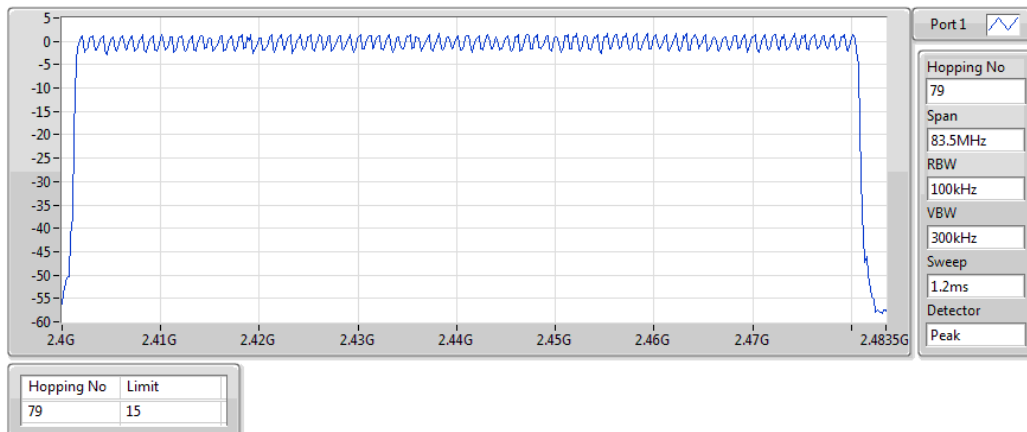
BT-EDR(2Mbps)

2441MHz



BT-EDR(3Mbps)

2441MHz



3.6 20dB and Occupied Bandwidth

3.6.1 Test Procedures

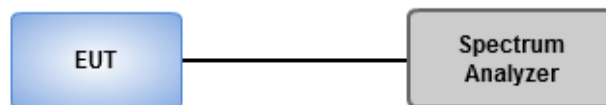
20dB Bandwidth

1. Set RBW=10kHz VBW= 30kHz for BT BR mode, RBW=20kHz, VBW=100kHz for other modes, Sweep time = Auto, Detector=Peak , Trace max hold
2. Allow trace to stabilize
3. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 20 dB relative to the maximum level measured in the fundamental emission.

Occupied Bandwidth

1. Set RBW=10kHz VBW= 30kHz for BT BR mode, RBW=20kHz, VBW=100kHz for other modes, Sweep time = Auto, Detector=Sample , Trace max hold
2. Allow trace to stabilize
3. Use Occupied bandwidth function of spectrum analyzer to measuring 99% occupied bandwidth

3.6.2 Test Setup



3.6.3 Test result of 20dB and Occupied Bandwidth

Summary

Mode	Max-N dB (Hz)	Max-OBW (Hz)	ITU-Code	Min-N dB (Hz)	Min-OBW (Hz)
2.4-2.4835GHz	-	-	-	-	-
BT-BR(1Mbps)	920.29k	882.779k	883KF1D	920.29k	868.307k
BT-EDR(2Mbps)	1.315M	1.19M	1M19G1D	1.308M	1.176M
BT-EDR(3Mbps)	1.312M	1.19M	1M19G1D	1.279M	1.179M

Max-N dB = Maximum20dB downbandwidth;**Max-OBW** = Maximum99% occupied bandwidth;

Min-N dB = Minimum20dB downbandwidth;**Min-OBW** = Minimum99% occupied bandwidth;

Result

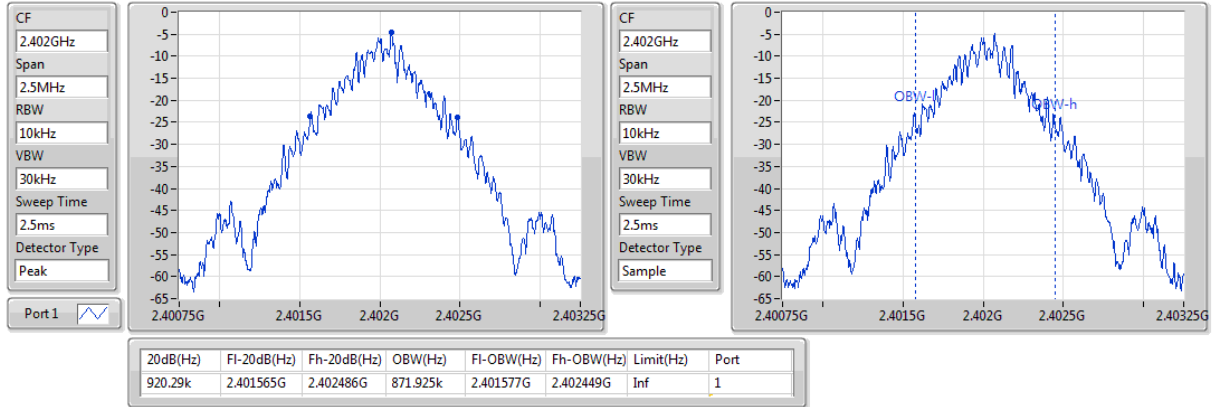
Mode	Result	Limit (Hz)	Port 1-N dB (Hz)	Port 1-OBW (Hz)
BT-BR(1Mbps)	-	-	-	-
2402MHz	Pass	Inf	920.29k	871.925k
2441MHz	Pass	Inf	920.29k	868.307k
2480MHz	Pass	Inf	920.29k	882.779k
BT-EDR(2Mbps)	-	-	-	-
2402MHz	Pass	Inf	1.308M	1.176M
2441MHz	Pass	Inf	1.308M	1.179M
2480MHz	Pass	Inf	1.315M	1.19M
BT-EDR(3Mbps)	-	-	-	-
2402MHz	Pass	Inf	1.279M	1.179M
2441MHz	Pass	Inf	1.312M	1.187M
2480MHz	Pass	Inf	1.279M	1.19M

Port X-N dB = Port X20dB downbandwidth; **Port X-OBW** = Port X99% occupied bandwidth;

BT-BR(1Mbps)

EBW

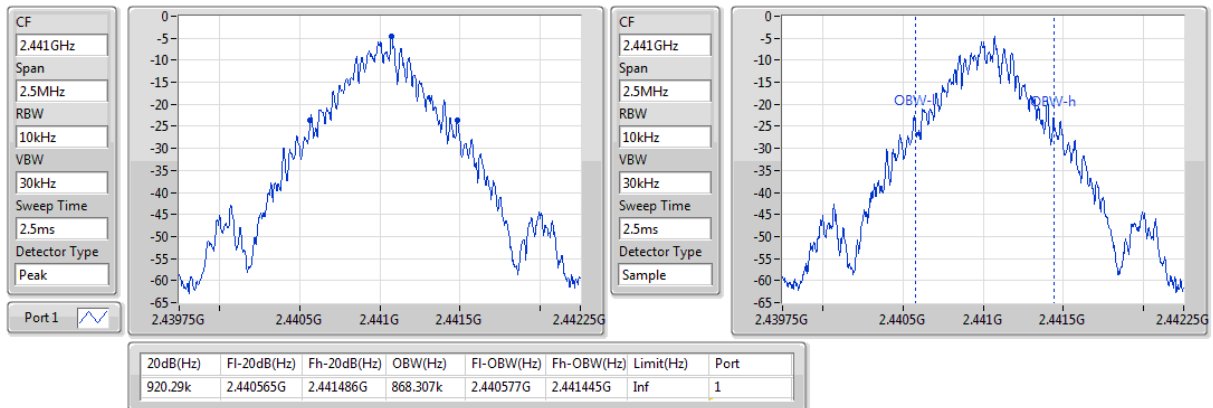
2402MHz



BT-BR(1Mbps)

EBW

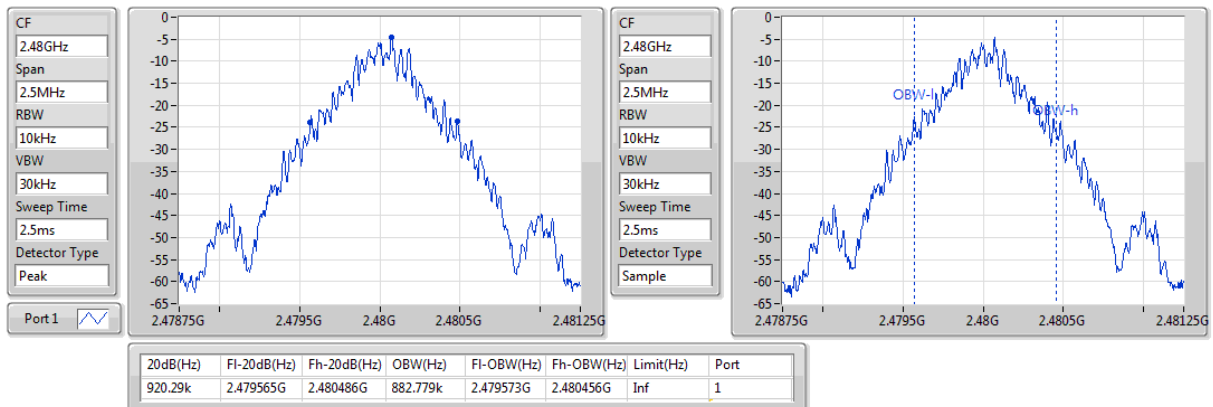
2441MHz



BT-BR(1Mbps)

EBW

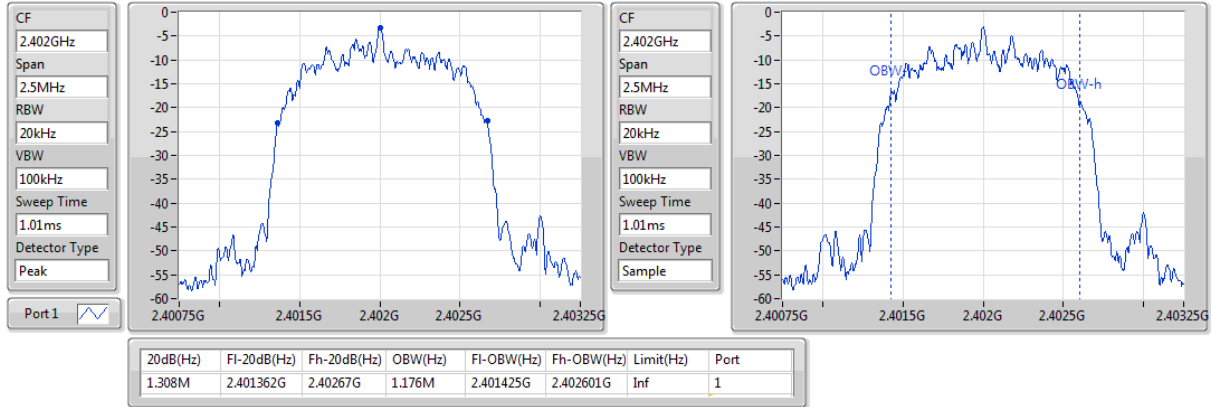
2480MHz



BT-EDR(2Mbps)

EBW

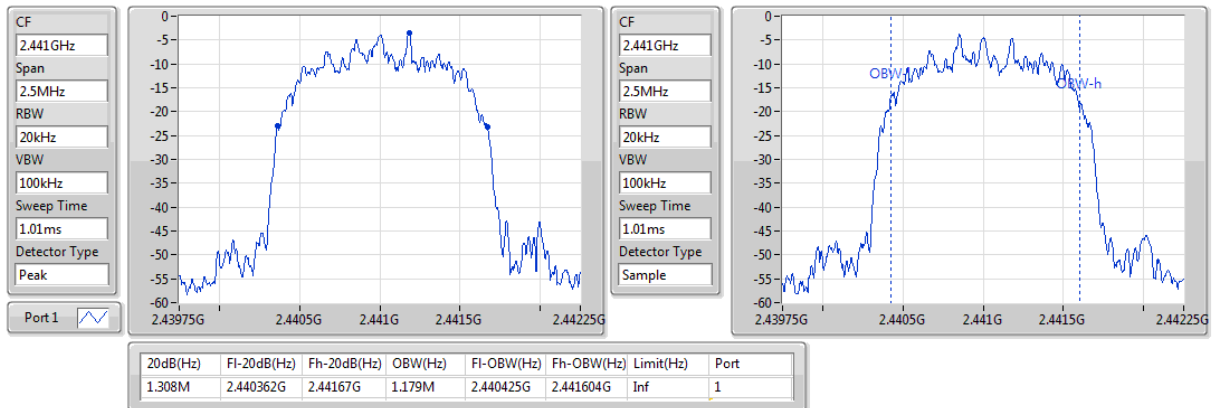
2402MHz



BT-EDR(2Mbps)

EBW

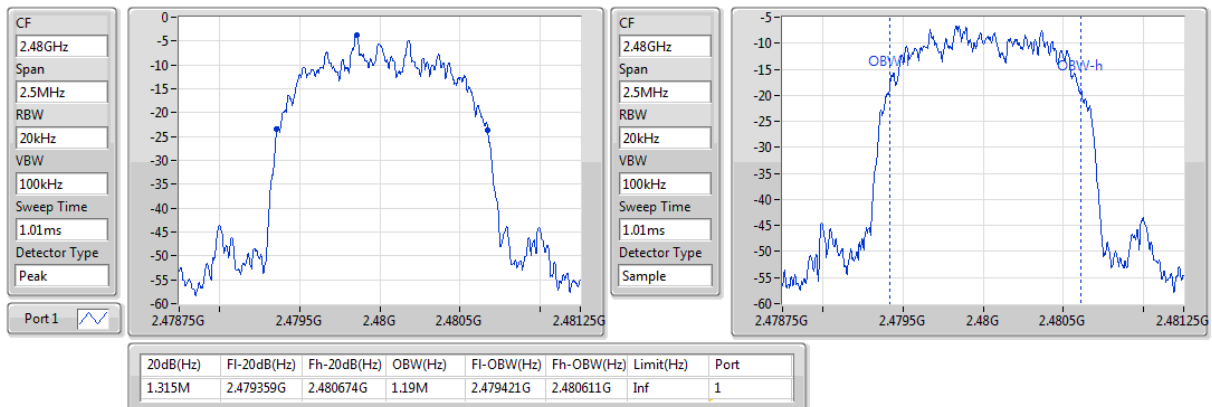
2441MHz



BT-EDR(2Mbps)

EBW

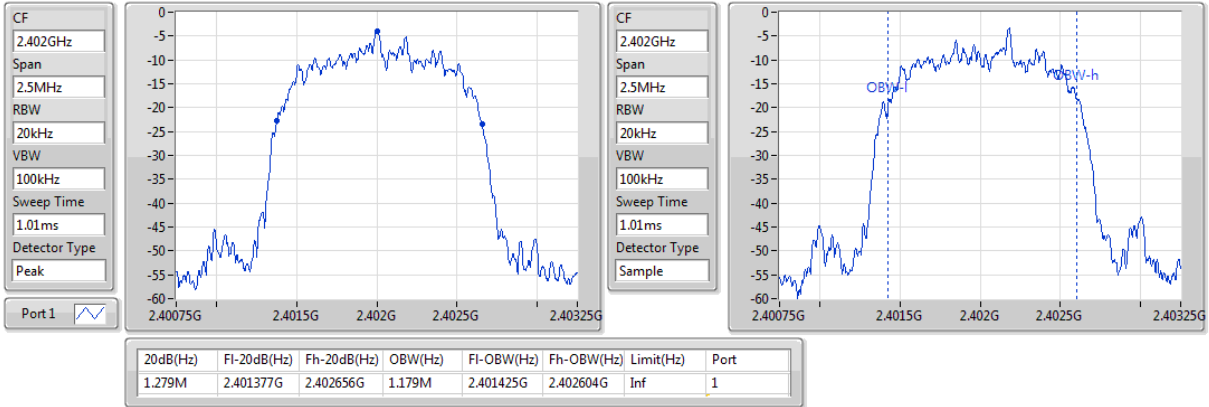
2480MHz



BT-EDR(3Mbps)

EBW

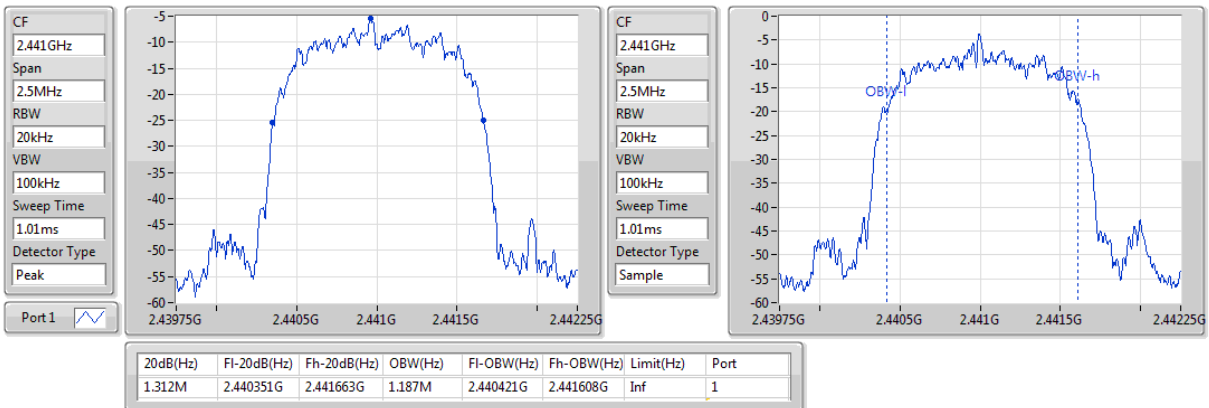
2402MHz



BT-EDR(3Mbps)

EBW

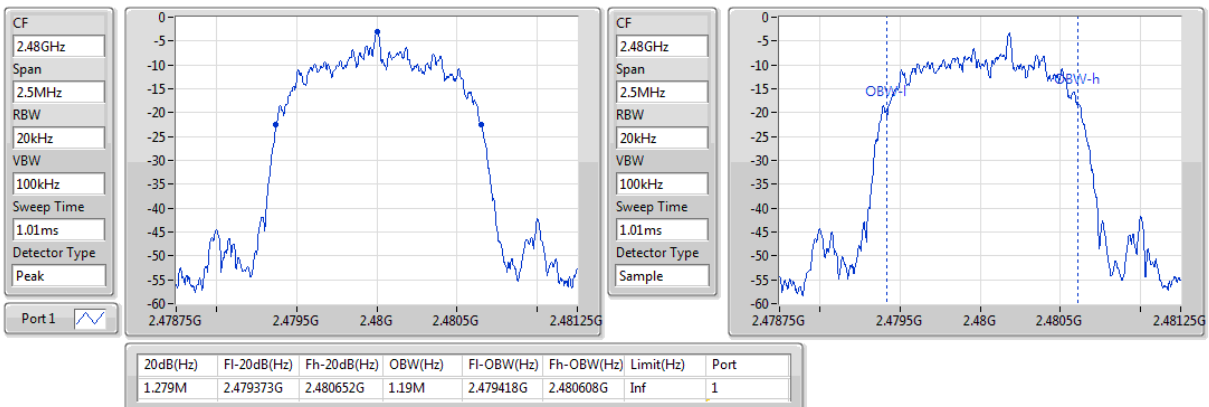
2441MHz



BT-EDR(3Mbps)

EBW

2480MHz



3.7 Channel Separation

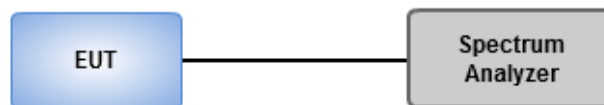
3.7.1 Limit of Channel Separation

- ☐ 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.
- ☒ 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.

3.7.2 Test Procedures

1. Set RBW=30kHz, VBW=100kHz, Sweep time = Auto, Detector=Peak Trace max hold
2. Allow trace to stabilize
3. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The EUT shall show compliance with the appropriate regulatory limit

3.7.3 Test Setup



3.7.4 Test result of Channel Separation

Summary

Mode	Max-Space (Hz)	Min-Space (Hz)
2.4-2.4835GHz	-	-
BT-BR(1Mbps)	1.004348M	1.004348M
BT-EDR(2Mbps)	1.004348M	1M
BT-EDR(3Mbps)	1.004348M	1M

Result

Mode	Result	Fl (Hz)	Fh (Hz)	Ch.Space (Hz)	Limit (Hz)
BT-BR(1Mbps)	-	-	-	-	-
2402MHz	Pass	2.402004G	2.403009G	1.004348M	612.91314k
2441MHz	Pass	2.441004G	2.442009G	1.004348M	612.91314k
2480MHz	Pass	2.479004G	2.480009G	1.004348M	612.91314k
BT-EDR(2Mbps)	-	-	-	-	-
2402MHz	Pass	2.402004G	2.403004G	1M	871.128k
2441MHz	Pass	2.441004G	2.442004G	1M	871.128k
2480MHz	Pass	2.479004G	2.480009G	1.004348M	875.79k
BT-EDR(3Mbps)	-	-	-	-	-
2402MHz	Pass	2.402004G	2.403004G	1M	851.814k
2441MHz	Pass	2.441004G	2.442004G	1M	873.792k
2480MHz	Pass	2.479004G	2.480009G	1.004348M	851.814k

BT-BR(1Mbps)

Channel Separation

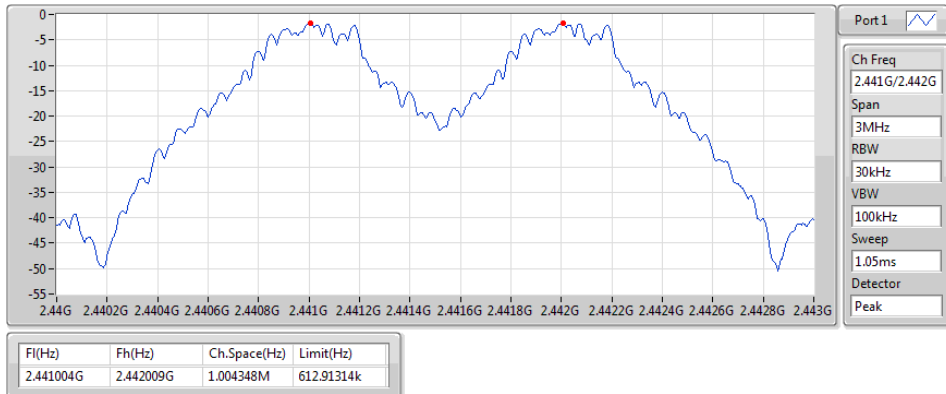
2.402G/2.403GHz



BT-BR(1Mbps)

Channel Separation

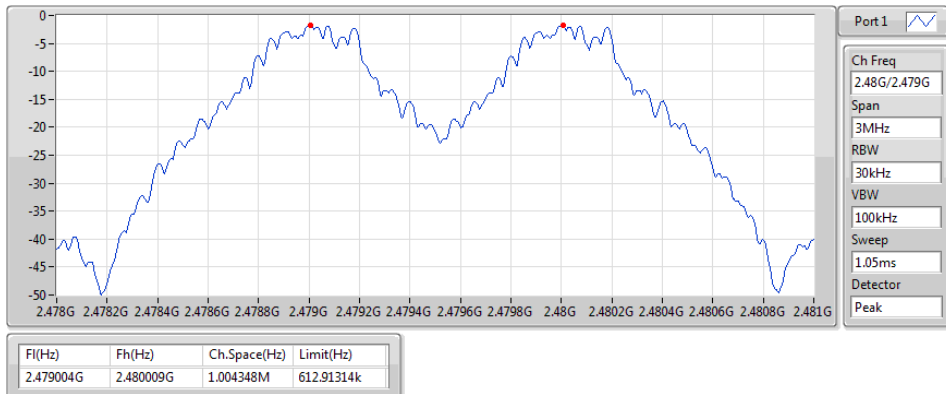
2.441G/2.442GHz



BT-BR(1Mbps)

Channel Separation

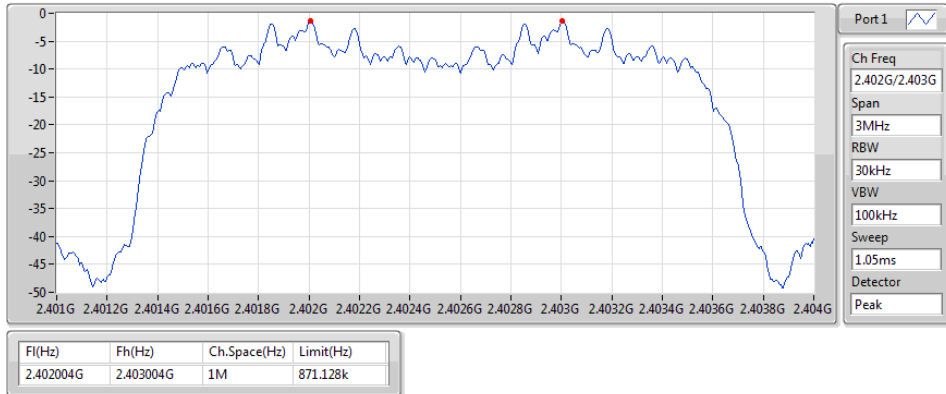
2.48G/2.479GHz



BT-EDR(2Mbps)

Channel Separation

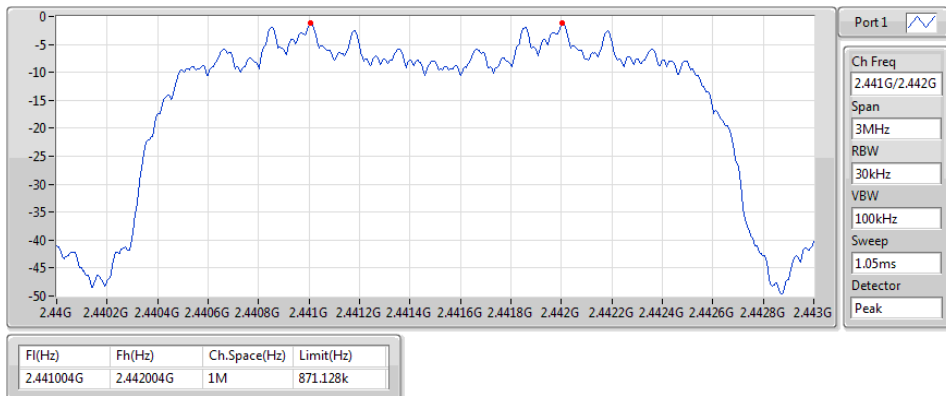
2.402G/2.403GHz



BT-EDR(2Mbps)

Channel Separation

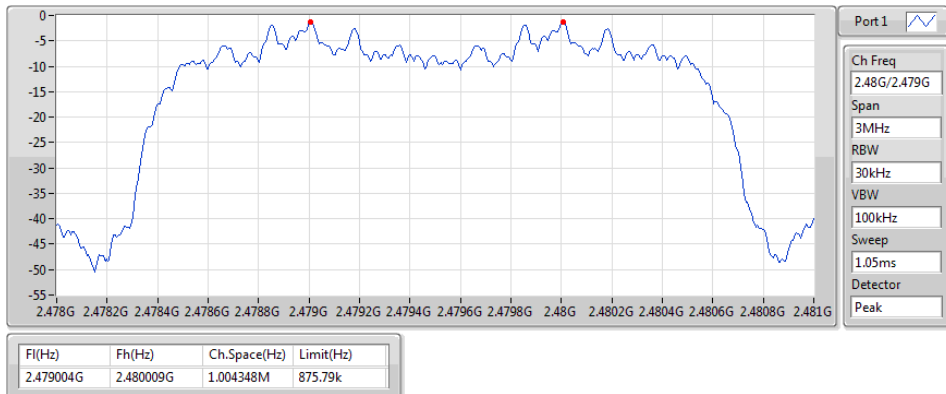
2.441G/2.442GHz



BT-EDR(2Mbps)

Channel Separation

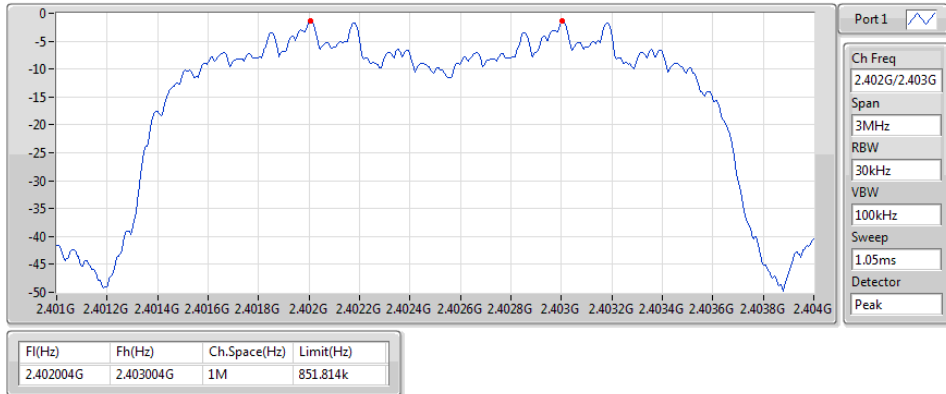
2.48G/2.479GHz



BT-EDR(3Mbps)

Channel Separation

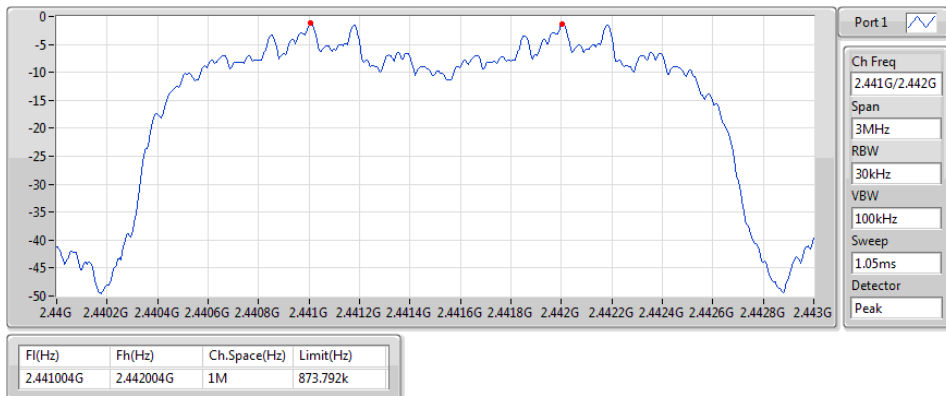
2.402G/2.403GHz



BT-EDR(3Mbps)

Channel Separation

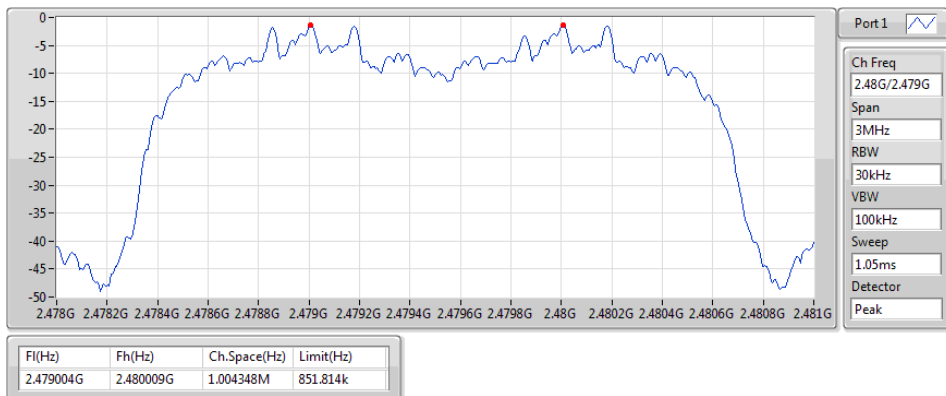
2.441G/2.442GHz



BT-EDR(3Mbps)

Channel Separation

2.48G/2.479GHz



3.8 Number of Dwell Time

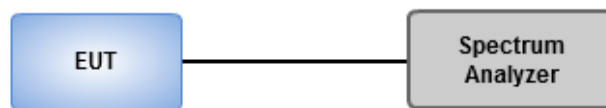
3.8.1 Limit of Dwell time

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.

3.8.2 Test Procedures

1. Set RBW=100 kHz, VBW=300 kHz, Sweep time=5 ms, Detector=Peak, Span=0 Hz, Trace max hold.
2. Enable gating and trigger function of spectrum analyzer to measure burst on time.
3. Set RBW=100 kHz, VBW=300 kHz, Sweep time=5 s / 2 s, Detector=Peak, Span=0 Hz, Trace max hold.
4. Enable gating and trigger function of spectrum analyzer to measure burst on number of transmission.
5. Set RBW=100 kHz, VBW=300 kHz, Sweep time=31.6 s / 8 s, Detector=Peak, Span=0 Hz, Trace max hold.
6. Enable gating and trigger function of spectrum analyzer to measure burst on number of transmission of entire time cycle.

3.8.3 Test Setup



3.8.4 Test Result of Dwell Time

Result/ Non AFH mode

Mode	Result	Period (s)	Dwell (s)	Limit (s)	Tx On (ms)	Number of transmission in a 5 s
BT-BR(1Mbps)	-	-	-	-	-	-
2402MHz-1DH5	PASS	31.6	0.3543861	0.4	2.95125	19
BT-EDR(2Mbps)	-	-	-	-	-	-
2402MHz-2DH5	PASS	31.6	0.349470385	0.4	2.91031	19
BT-EDR(3Mbps)	-	-	-	-	-	-
2402MHz-3DH5	PASS	31.6	0.312684029	0.4	2.91031	17

Note 1: Dwell time =Number of transmission in a 5 second x Tx On Time x 6.32

Note 2: DH5 was the worst mode.

Result/ AFH mode

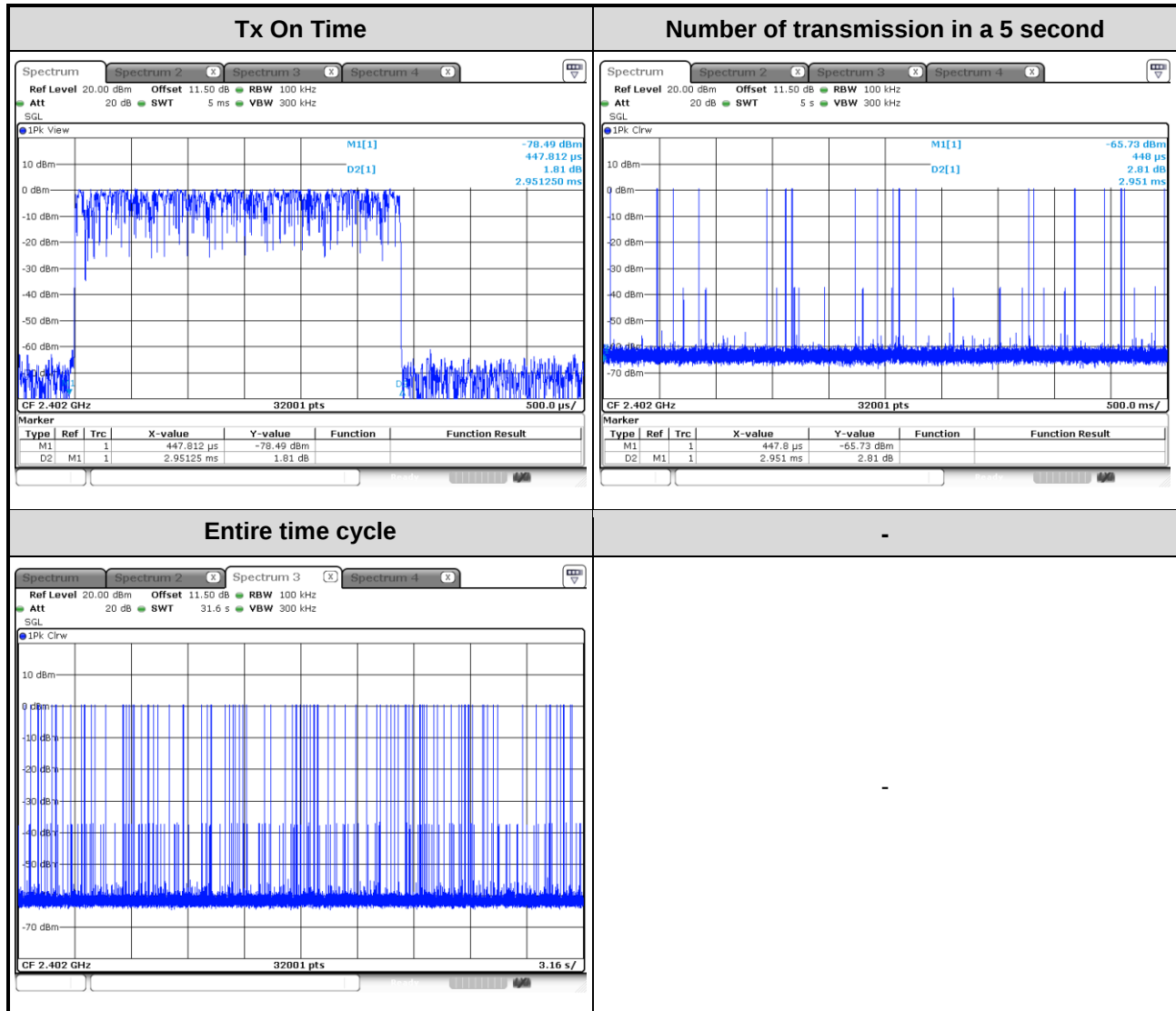
Mode	Result	Period (s)	Dwell (s)	Limit (s)	Tx On (ms)	Number of transmission in a 2 s
BT-BR(1Mbps)	-	-	-	-	-	-
2402MHz-1DH5	PASS	8	0.2910313	0.4	2.91031	25
BT-EDR(2Mbps)	-	-	-	-	-	-
2402MHz-2DH5	PASS	8	0.2905938	0.4	2.90594	25
BT-EDR(3Mbps)	-	-	-	-	-	-
2402MHz-3DH5	PASS	8	0.2909219	0.4	2.90922	25

Note 1: Dwell time =Number of transmission in a 2 second x Tx On Time x 4

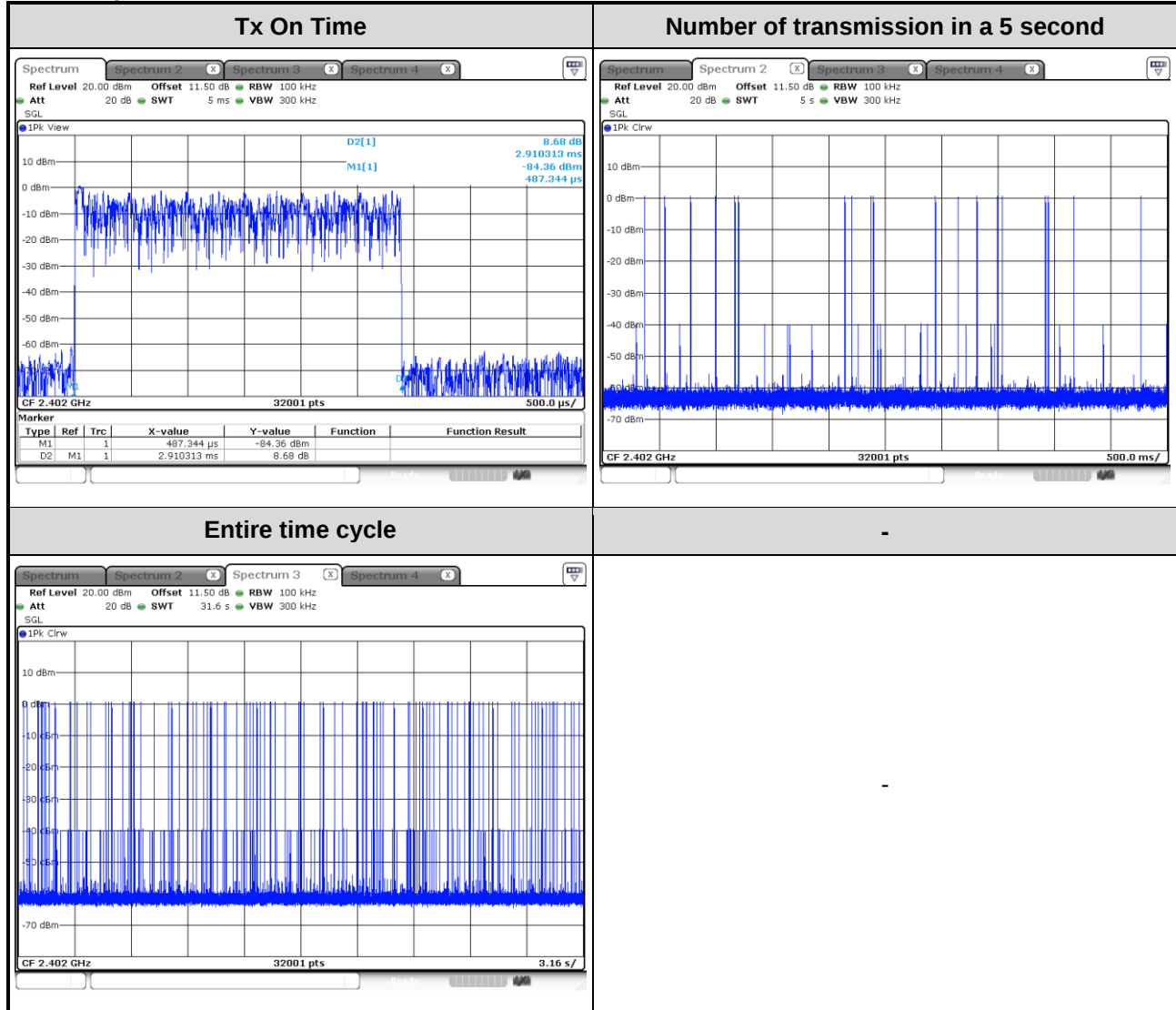
Note 2: DH5 was the worst mode.

Result/ Non AFH mode

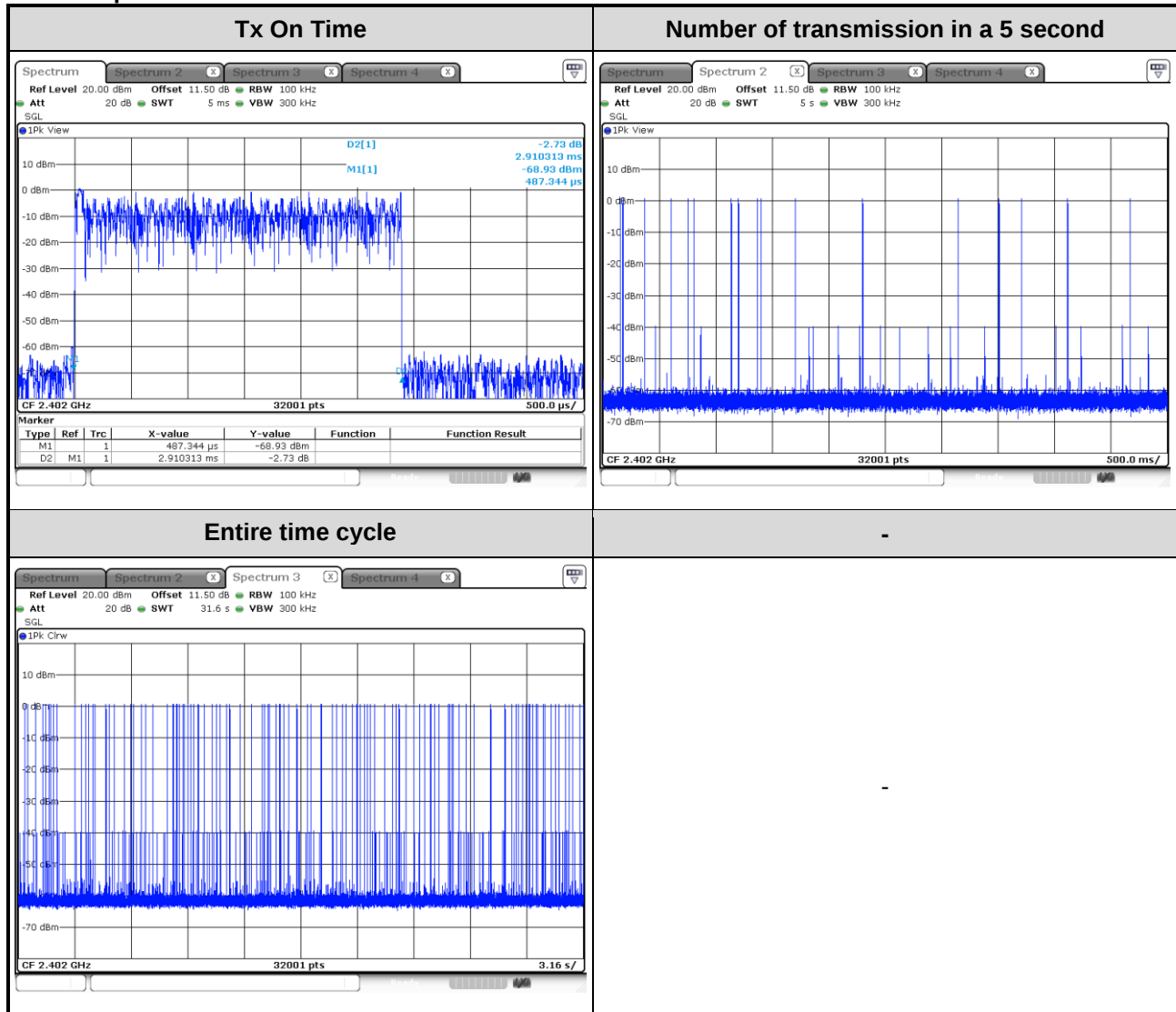
DH5-1Mbps



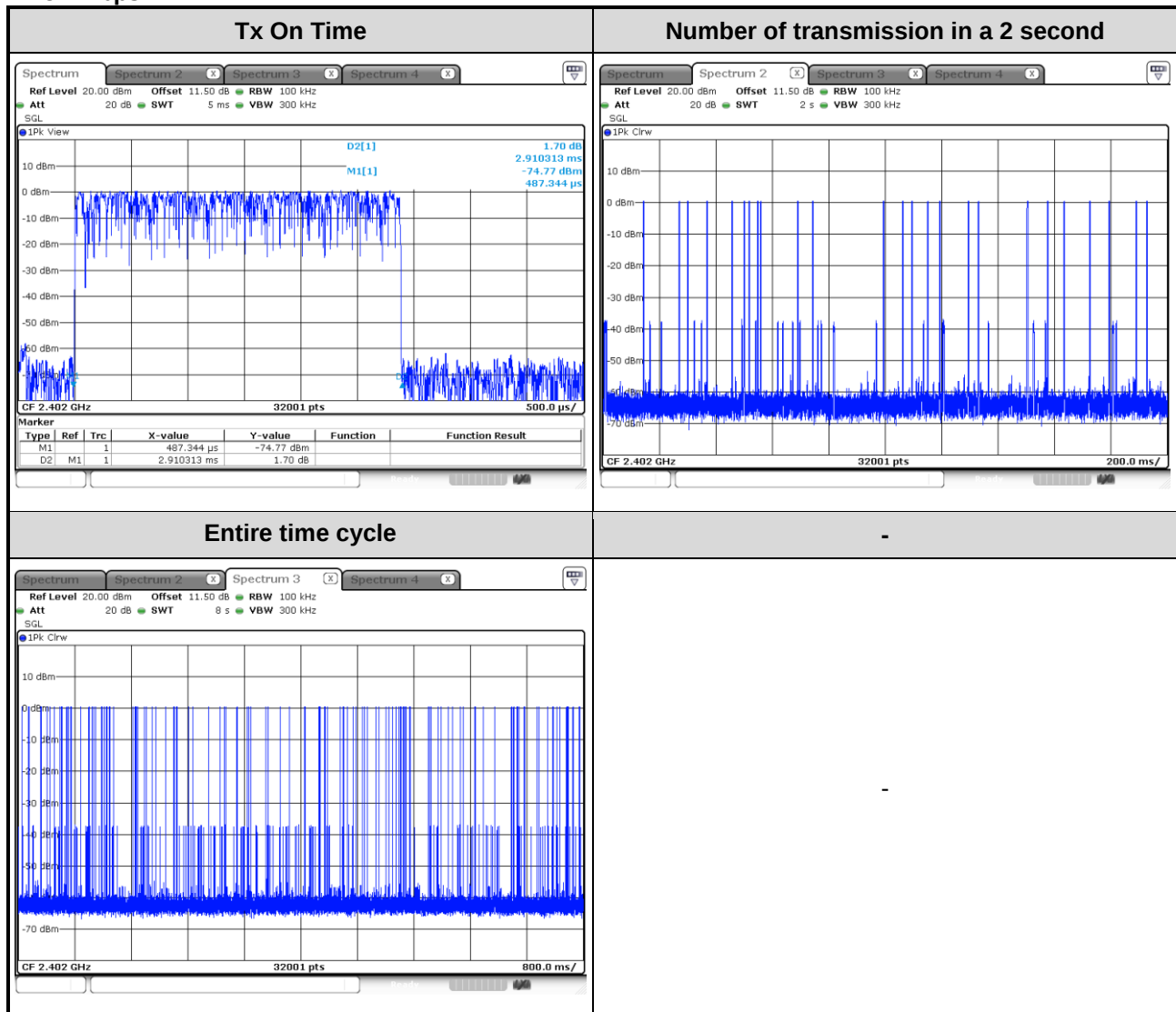
DH5-2Mbps



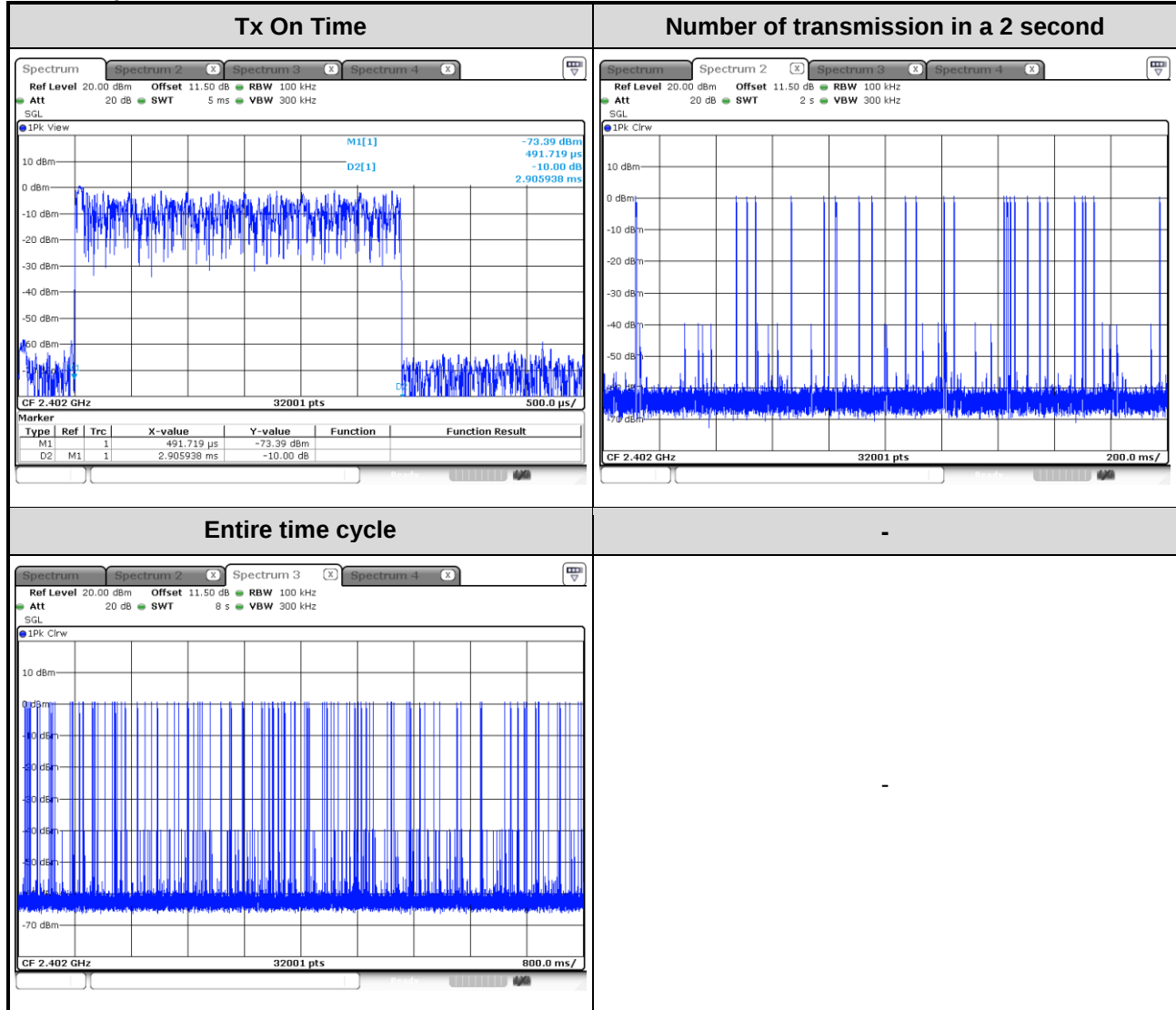
DH5-3Mbps



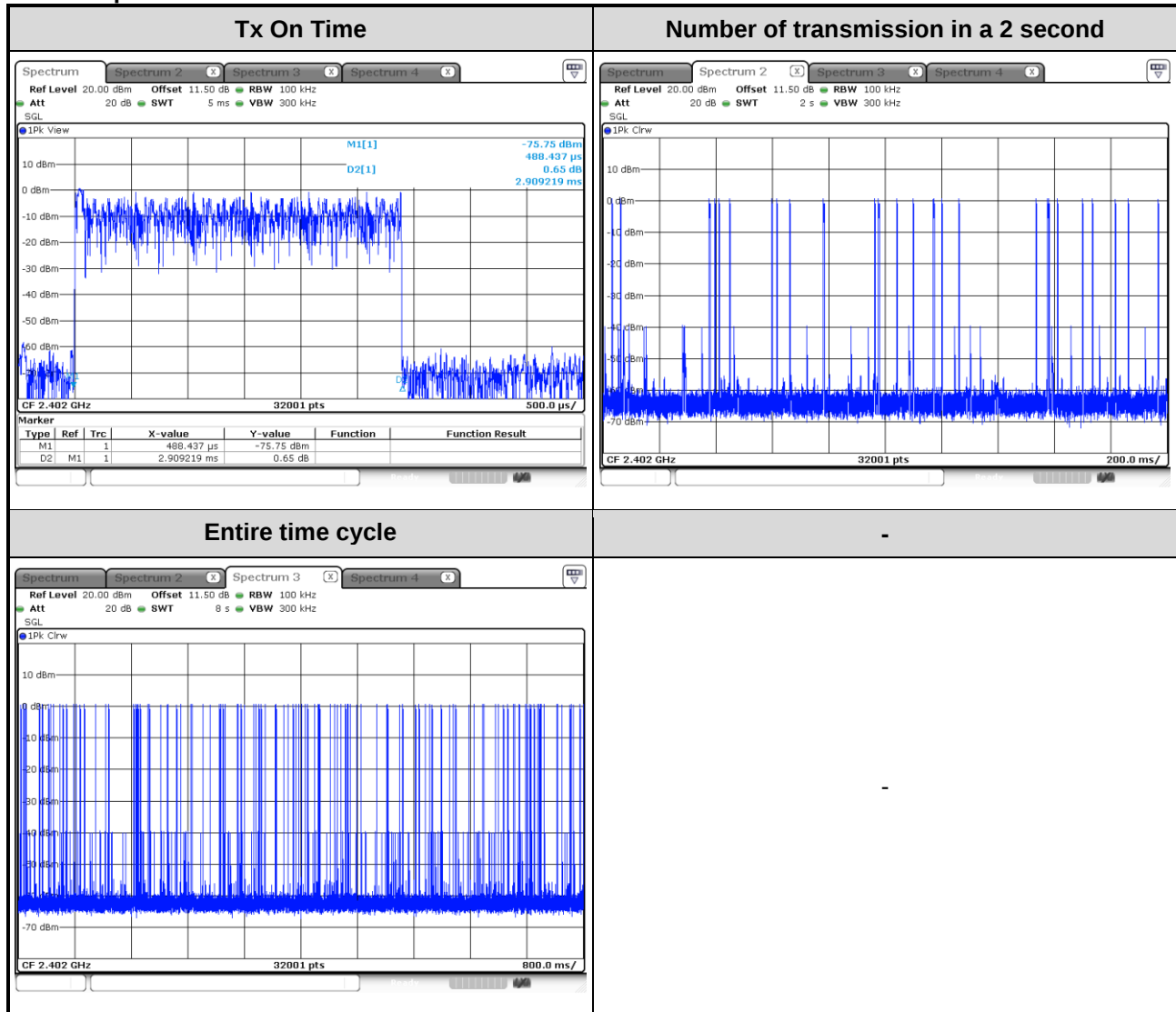
Result/ AFH mode
DH5-1Mbps



DH5-2Mbps



DH5-3Mbps



4 Test laboratory information

Established in 2012, ICC provides foremost EMC & RF Testing and advisory consultation services by our skilled engineers and technicians. Our services employ a wide variety of advanced edge test equipment and one of the widest certification extents in the business.

International Certification Corp (EMC and Wireless Communication Laboratory), it is our definitive objective is to institute long term, trust-based associations with our clients. The expectation we set up with our clients is based on outstanding service, practical expertise and devotion to a certified value structure. Our passion is to grant our clients with best EMC / RF services by oriented knowledgeable and accommodating staff.

Our Test sites are located at Linkou District and Kwei Shan District. Location map can be found on our website <http://www.icertifi.com.tw>.

Linkou

Tel: 886-2-2601-1640

No. 30-2, Ding Fwu Tsuen, Lin
Kou District, New Taipei City,
Taiwan, R.O.C.

Kwei Shan

Tel: 886-3-271-8666

No. 3-1, Lane 6, Wen San 3rd St.,
Kwei Shan District, Tao Yuan City
333, Taiwan, R.O.C.

Kwei Shan Site II

Tel: 886-3-271-8640

No. 14-1, Lane 19, Wen San 3rd
St., Kwei Shan District, Tao Yuan
City 333, Taiwan, R.O.C.

If you have any suggestion, please feel free to contact us as below information.

Tel: 886-3-271-8666

Fax: 886-3-318-0155

Email: ICC_Service@icertifi.com.tw

==END==