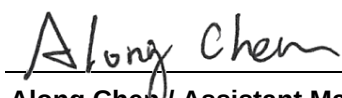


ISED Test Report

IC : 3147A-LWBPLUS
Equipment : 802.11n 2.4GHz + BT5.2 Module
Model No. : Sterling LWB+
Brand Name : Laird Connectivity
Applicant : Laird Connectivity LLC
Address : W66N220 Commerce Court, Cedarburg, WI
53012 United States Of America
Manufacturer : Laird Connectivity LLC
Address : W66N220 Commerce Court, Cedarburg, WI
53012 United States Of America
Standard : RSS-247 Issue 2 February 2017
Received Date : Oct. 04, 2021
Tested Date : Oct. 27 ~ Nov. 02, 2021

We, International Certification Corporation, 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



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Release Record

Report No.	Version	Description	Issued Date
CR1O0407AE	Rev. 01	Initial issue	Dec. 10, 2021

Summary of Test Results

IC Rules	Test Items	Measured	Result
RSS-Gen Section 8.8	AC Power Line Conducted Emissions	[dBuV]: 0.402MHz 30.36 (Margin -17.45dB) - AV	Pass
RSS-247 Section 5.5 RSS-Gen Section 8.9	Radiated Emissions	[dBuV/m at 3m]: 484.05MHz 44.42 (Margin -1.58dB) - QP	Pass
RSS-247 Section 5.4 (d)	Maximum Output Power	Power [dBm]: 5.81	Pass
RSS-247 Section 5.2 (a)	6dB Bandwidth	Meet the requirement of limit	Pass
RSS-247 Section 5.2 (b)	Power Spectral Density	Meet the requirement of limit	Pass
N/A	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

The device has 3 configurations as below:

Brand name	Model Name	Product Name	Part Number	Description
Laird Connectivity	Sterling LWB+	802.11n 2.4GHz + BT5.2 Module	453-00085	Chip Antenna
Laird Connectivity	Sterling LWB+	802.11n 2.4GHz + BT5.2 Module	453-00084	MHF4 Connector
Laird Connectivity	Sterling LWB+	802.11n 2.4GHz + BT5.2 Module	453-00083	SIP Module

Note: Part Number: 453-00084 was selected as a representative one for the final test

1.1.1 Specification of the Equipment under Test (EUT)

RF General Information				
Frequency Range (MHz)	Bluetooth Mode	Ch. Freq. (MHz)	Channel Number	Data Rate
2400-2483.5	V5.2 LE	2402-2480	0-39 [40]	1 Mbps

Note: Bluetooth LE (Low energy) uses GFSK modulation.

1.1.2 Antenna Details

Ant. No.	Manufacturer	Laird Part Number	Model	Type	Connector	Gain (dBi)
1	Laird	001-0001	2.4GHz Dipole Antenna	Dipole	RP-SMA	2
2	Laird	001-0022	FlexPIFA	PIFA	IPEX MHF4L	2
3	Laird	001-0023	FlexnNotch	PCB Dipole	IPEX MHF4L	2
4	Laird	EFA2400A3S-10MH4	mFlexPIFA	PIFA	IPEX MHF4L	2
5	Laird	001-0012	Waterproof Dipole Antenna	Dipole	RP-SMA	2
6	Laird	TRAB24003P	Phantom 800MHz - 5.8GHz	Monopole	N-female	3
7	ACX	AT3216-A2R4PAAT/LF	Chip Antenna	Chip Antenna	-	1.5

Note: Antenna 6 with highest gain was chosen for final test

1.1.3 Power Supply Type of Equipment under Test (EUT)

Power Supply Type	3.3 Vdc from host
-------------------	-------------------

1.1.4 Accessories

N/A

1.1.5 Test Sample Information

MAC of Test Sample	Radiated Emission: C0EE40B002AF AC Power Line Conducted Emission: C0EE40B002AF Antenna Port Conducted: C0EE40B002AF
---------------------------	---

1.1.6 Channel List

Frequency band (MHz)				2400~2483.5			
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
37	2402	9	2422	18	2442	28	2462
0	2404	10	2424	19	2444	29	2464
1	2406	38	2426	20	2446	30	2466
2	2408	11	2428	21	2448	31	2468
3	2410	12	2430	22	2450	32	2470
4	2412	13	2432	23	2452	33	2472
5	2414	14	2434	24	2454	34	2474
6	2416	15	2436	25	2456	35	2476
7	2418	16	2438	26	2458	36	2478
8	2420	17	2440	27	2460	39	2480

1.1.7 Test Tool and Duty Cycle

Test Tool	Tera Term, Version: V4.74	
Modulation Mode	Duty Cycle Of Test Signal (%)	Duty Factor (dB)
GFSK-1Mbps	67.74%	1.69

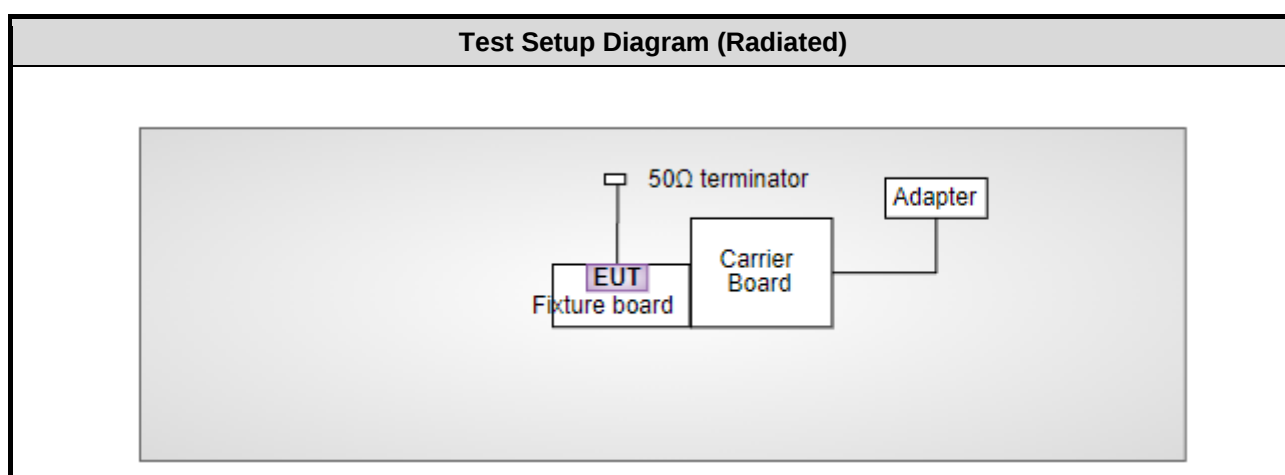
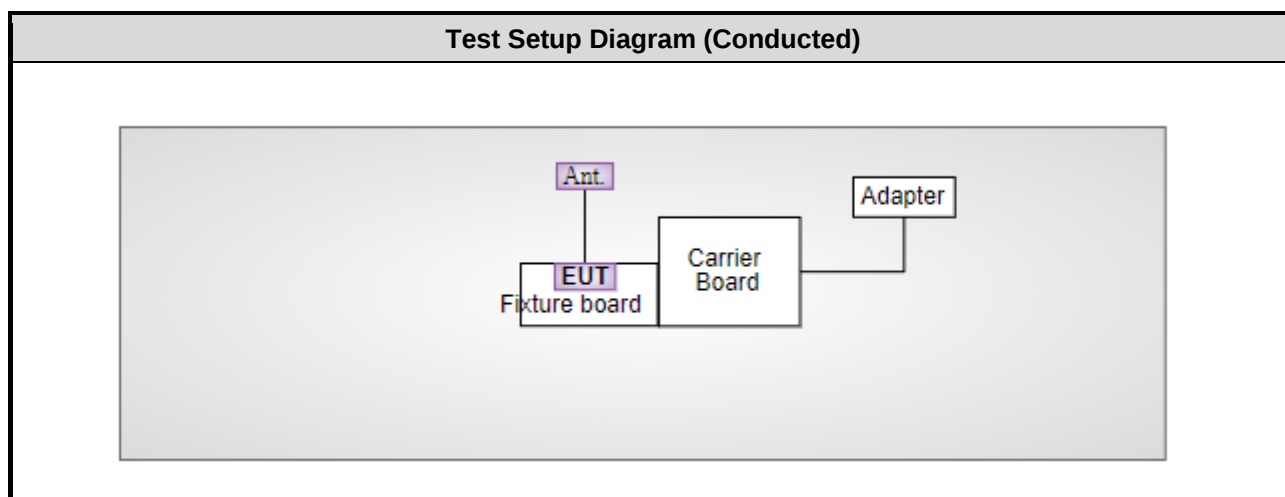
1.1.8 Power Index of Test Tool

Modulation Mode	Test Frequency (MHz)		
	2402	2440	2480
GFSK/1Mbps	default	default	default

1.2 Local Support Equipment List

Support Equipment List					
No.	Equipment	Brand	Model	FCC ID	Remarks
1	Notebook	DELL	Latitude 3400	DoC	---
2	Fixture board	---	---	---	Provided by applicant.
3	Carrier Board	Laird Connectivity	SU60-SOMC	---	Provided by applicant.
4	Adapter	I.T.E	MU24AY12020 0-A1	---	Provided by applicant.

1.3 Test Setup Chart



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

1.4 Test Equipment List and Calibration Data

Test Item	Conducted Emission				
Test Site	Conduction room 1 / (CO01-WS)				
Tested Date	Nov. 02, 2021				
Instrument	Brand	Model No.	Serial No.	Calibration Date	Calibration Until
Receiver	R&S	ESR3	101658	Feb. 08, 2021	Feb. 07, 2022
LISN	R&S	ENV216	101579	Mar. 17, 2021	Mar. 16, 2022
RF Cable-CON	Woken	CFD200-NL	CFD200-NL-001	Oct. 19, 2021	Oct. 18, 2022
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 chamber3 / (03CH03-WS)				
Tested Date	Oct. 28, 2021				
Instrument	Brand	Model No.	Serial No.	Calibration Date	Calibration Until
Receiver	R&S	ESR3	101657	Mar. 12, 2021	Mar. 11, 2022
Spectrum Analyzer	R&S	FSV40	101499	Mar. 02, 2021	Mar. 01, 2022
Loop Antenna	R&S	HFH2-Z2	100330	Nov. 17, 2020	Nov. 16, 2021
Bilog Antenna	SCHWARZBECK	VULB9168	VULB9168-685	May 06, 2021	May 05, 2022
Horn Antenna 1G-18G	SCHWARZBECK	BBHA 9120 D	BBHA 9120 D 1206	Dec. 22, 2020	Dec. 21, 2021
Horn Antenna 18G-40G	SCHWARZBECK	BBHA 9170	BBHA 9170517	Nov. 06, 2020	Nov. 05, 2021
Preamplifier	EMC	EMC02325	980187	Jul. 26, 2021	Jul. 25, 2022
Preamplifier	Agilent	83017A	MY39501309	Sep. 06, 2021	Sep. 05, 2022
Preamplifier	EMC	EMC184045B	980192	Jul. 14, 2021	Jul. 13, 2022
Loop Antenna Cable	KOAX KABEL	101354-BW	101354-BW	Oct. 05, 2021	Oct. 04, 2022
LF cable-0.8M	EMC	EMC8D-NM-NM-800	EMC8D-NM-NM-800-001	Sep. 24, 2021	Sep. 23, 2022
LF cable-3M	EMC	EMC8D-NM-NM-3000	131103	Sep. 24, 2021	Sep. 23, 2022
LF cable-13M	EMC	EMC8D-NM-NM-13000	131104	Sep. 24, 2021	Sep. 23, 2022
RF cable-3M	HUBER+SUHNER	SUCOFLEX104	MY22620/4	Sep. 24, 2021	Sep. 23, 2022
RF cable-8M	EMC	EMC104-SM-SM-8000	181107	Sep. 24, 2021	Sep. 23, 2022
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)				
Tested Date	Oct. 27 ~ Nov. 02, 2021				
Instrument	Brand	Model No.	Serial No.	Calibration Date	Calibration Until
Spectrum Analyzer	R&S	FSV40	101498	Dec. 04, 2020	Dec. 03, 2021
Power Meter	Anritsu	ML2495A	1218007	Jan. 26, 2021	Jan. 25, 2022
Power Sensor	Anritsu	MA2411B	1207367	Jan. 26, 2021	Jan. 25, 2022
Measurement Software	Sporton	SENSE-15247_DTS	V5.10	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

1.5 Test Standards

RSS-247 Issue 2 February 2017

RSS-Gen Issue 5 February 2021 Amendment 2

ANSI C63.10-2013

1.6 Reference Guidance

FCC KDB 558074 D01 15.247 Meas Guidance v05r02

1.7 Deviation from Test Standard and Measurement Procedure

None

1.8 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 ≤ 1GHz	±3.96 dB
Radiated emission > 1GHz	±4.51 dB

2 Test Configuration

2.1 Testing Facility

Test Laboratory	International Certification Corporation
Test Site	CO01-WS, TH01-WS
Address of Test Site	No.3-1, Lane 6, Wen San 3rd St., Kwei Shan Dist., Tao Yuan City 33381, Taiwan (R.O.C.)
Test Site	03CH03-WS
Address of Test Site	No.14-1, Lane 19, Wen San 3rd St., Kwei Shan Dist., Tao Yuan City 333, Taiwan (R.O.C.)

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

2.2 The Worst Test Modes and Channel Details

Test item	Mode	Test Frequency (MHz)	Data Rate	Test Configuration
AC Power Line Conducted Emissions Radiated Emissions $\leq$ 1GHz	BT LE	2402	1Mbps	---
Maximum Output Power 6dB bandwidth Power spectral density Radiated Emissions > 1GHz	BT LE	2402, 2440, 2480	1Mbps	---
NOTE: 1. The EUT was pretested with 3 orientations placed on the table for the radiated emission measurement – X, Y, and Z-plane. The Z-plane results were found as the worst case and were shown in this report. 2. The 50 Ω terminators are connected to antenna port of EUT for radiated emission measurement.				

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

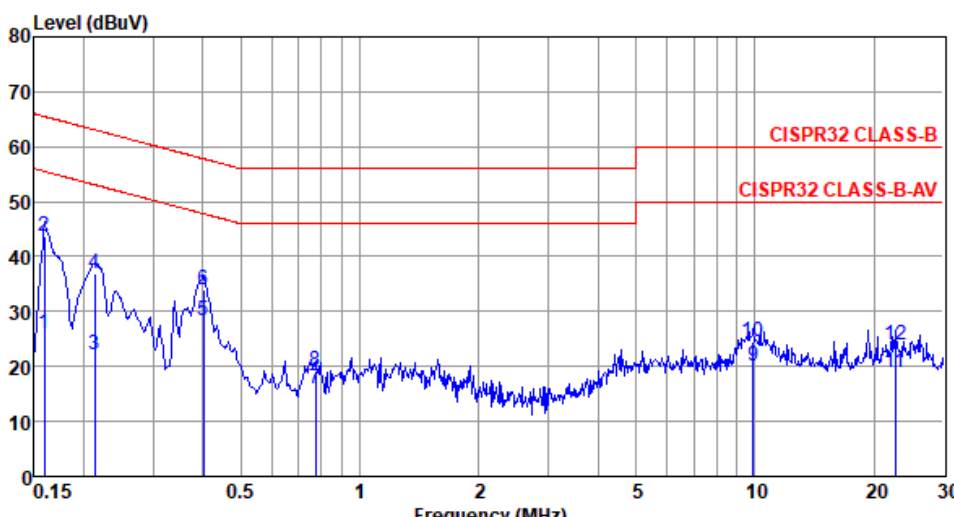
1. The device is placed on a test table, raised 80 cm above the reference ground plane. The vertical conducting plane is located 40 cm to the rear of the device.
2. The device is connected to line impedance stabilization network (LISN) and other accessories are connected to other LISN. Measured levels 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

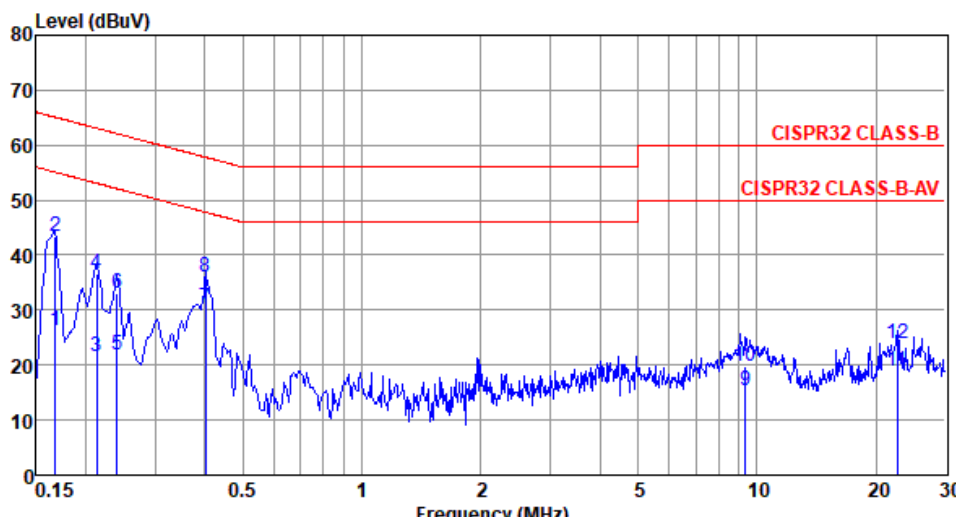
3.1.3 Test Setup



- 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	BT LE-1Mbps	Test Freq. (MHz)	2402																																																																																																																																																						
Power Phase	Line																																																																																																																																																								
Test by : Joe Liao Temperature: 22°C Humidity: 63%																																																																																																																																																									
Level (dBuV)  Frequency (MHz)																																																																																																																																																									
<table><tr><th></th><th>Freq</th><th>Level</th><th>Limit</th><th>Over</th><th>Read</th><th>Factor</th><th>Cable</th><th>Aux</th><th>Remark</th></tr><tr><th></th><th>MHz</th><th>dBuV</th><th>Line</th><th>Limit</th><th>Level</th><th>dB</th><th>loss</th><th>dB</th><th></th></tr><tr><th></th><th></th><th></th><th>dBuV</th><th>dB</th><th>dBuV</th><th></th><th>dB</th><th></th><th></th></tr><tr><td>1</td><td>0.159</td><td>26.03</td><td>55.52</td><td>-29.49</td><td>16.09</td><td>9.66</td><td>0.08</td><td>0.20</td><td>Average</td></tr><tr><td>2</td><td>0.159</td><td>43.77</td><td>65.52</td><td>-21.75</td><td>33.83</td><td>9.66</td><td>0.08</td><td>0.20</td><td>QP</td></tr><tr><td>3</td><td>0.213</td><td>22.03</td><td>53.10</td><td>-31.07</td><td>12.07</td><td>9.65</td><td>0.08</td><td>0.23</td><td>Average</td></tr><tr><td>4</td><td>0.213</td><td>36.79</td><td>63.10</td><td>-26.31</td><td>26.83</td><td>9.65</td><td>0.08</td><td>0.23</td><td>QP</td></tr><tr><td>5*</td><td>0.402</td><td>28.27</td><td>47.81</td><td>-19.54</td><td>18.19</td><td>9.64</td><td>0.08</td><td>0.36</td><td>Average</td></tr><tr><td>6</td><td>0.402</td><td>33.90</td><td>57.81</td><td>-23.91</td><td>23.82</td><td>9.64</td><td>0.08</td><td>0.36</td><td>QP</td></tr><tr><td>7</td><td>0.771</td><td>15.89</td><td>46.00</td><td>-30.11</td><td>5.73</td><td>9.65</td><td>0.14</td><td>0.37</td><td>Average</td></tr><tr><td>8</td><td>0.771</td><td>19.15</td><td>56.00</td><td>-36.85</td><td>8.99</td><td>9.65</td><td>0.14</td><td>0.37</td><td>QP</td></tr><tr><td>9</td><td>9.913</td><td>20.18</td><td>50.00</td><td>-29.82</td><td>9.58</td><td>9.71</td><td>0.45</td><td>0.44</td><td>Average</td></tr><tr><td>10</td><td>9.913</td><td>24.40</td><td>60.00</td><td>-35.60</td><td>13.80</td><td>9.71</td><td>0.45</td><td>0.44</td><td>QP</td></tr><tr><td>11</td><td>22.655</td><td>18.92</td><td>50.00</td><td>-31.08</td><td>7.90</td><td>9.67</td><td>0.68</td><td>0.67</td><td>Average</td></tr><tr><td>12</td><td>22.655</td><td>24.06</td><td>60.00</td><td>-35.94</td><td>13.04</td><td>9.67</td><td>0.68</td><td>0.67</td><td>QP</td></tr></table>					Freq	Level	Limit	Over	Read	Factor	Cable	Aux	Remark		MHz	dBuV	Line	Limit	Level	dB	loss	dB					dBuV	dB	dBuV		dB			1	0.159	26.03	55.52	-29.49	16.09	9.66	0.08	0.20	Average	2	0.159	43.77	65.52	-21.75	33.83	9.66	0.08	0.20	QP	3	0.213	22.03	53.10	-31.07	12.07	9.65	0.08	0.23	Average	4	0.213	36.79	63.10	-26.31	26.83	9.65	0.08	0.23	QP	5*	0.402	28.27	47.81	-19.54	18.19	9.64	0.08	0.36	Average	6	0.402	33.90	57.81	-23.91	23.82	9.64	0.08	0.36	QP	7	0.771	15.89	46.00	-30.11	5.73	9.65	0.14	0.37	Average	8	0.771	19.15	56.00	-36.85	8.99	9.65	0.14	0.37	QP	9	9.913	20.18	50.00	-29.82	9.58	9.71	0.45	0.44	Average	10	9.913	24.40	60.00	-35.60	13.80	9.71	0.45	0.44	QP	11	22.655	18.92	50.00	-31.08	7.90	9.67	0.68	0.67	Average	12	22.655	24.06	60.00	-35.94	13.04	9.67	0.68	0.67	QP
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Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB). 2: Over Limit (dB) = Level (dBuV) – Limit Line (dBuV).																																																																																																																																																									

Modulation Mode	BT LE-1Mbps	Test Freq. (MHz)	2402																																																																																																																																		
Power Phase	Neutral																																																																																																																																				
Test by : Joe Liao Temperature: 22°C Humidity: 63%																																																																																																																																					
Level (dBUV)  <table><tr><th></th><th>Freq MHz</th><th>Level dBUV</th><th>Limit Line dBUV</th><th>Over Limit dB</th><th>Read Level dBUV</th><th>Factor dB</th><th>Cable loss dB</th><th>Aux dB</th><th>Remark</th></tr><tr><td>1</td><td>0.168</td><td>26.15</td><td>55.08</td><td>-28.93</td><td>16.21</td><td>9.69</td><td>0.08</td><td>0.17</td><td>Average</td></tr><tr><td>2</td><td>0.168</td><td>43.44</td><td>65.08</td><td>-21.64</td><td>33.50</td><td>9.69</td><td>0.08</td><td>0.17</td><td>QP</td></tr><tr><td>3</td><td>0.213</td><td>21.67</td><td>53.10</td><td>-31.43</td><td>11.73</td><td>9.68</td><td>0.08</td><td>0.18</td><td>Average</td></tr><tr><td>4</td><td>0.213</td><td>36.64</td><td>63.10</td><td>-26.46</td><td>26.70</td><td>9.68</td><td>0.08</td><td>0.18</td><td>QP</td></tr><tr><td>5</td><td>0.240</td><td>21.87</td><td>52.08</td><td>-30.21</td><td>11.93</td><td>9.68</td><td>0.08</td><td>0.18</td><td>Average</td></tr><tr><td>6</td><td>0.240</td><td>33.15</td><td>62.08</td><td>-28.93</td><td>23.21</td><td>9.68</td><td>0.08</td><td>0.18</td><td>QP</td></tr><tr><td>7*</td><td>0.402</td><td>30.36</td><td>47.81</td><td>-17.45</td><td>20.42</td><td>9.67</td><td>0.08</td><td>0.19</td><td>Average</td></tr><tr><td>8</td><td>0.402</td><td>35.97</td><td>57.81</td><td>-21.84</td><td>26.03</td><td>9.67</td><td>0.08</td><td>0.19</td><td>QP</td></tr><tr><td>9</td><td>9.352</td><td>15.24</td><td>50.00</td><td>-34.76</td><td>4.68</td><td>9.76</td><td>0.43</td><td>0.37</td><td>Average</td></tr><tr><td>10</td><td>9.352</td><td>19.72</td><td>60.00</td><td>-40.28</td><td>9.16</td><td>9.76</td><td>0.43</td><td>0.37</td><td>QP</td></tr><tr><td>11</td><td>22.655</td><td>18.93</td><td>50.00</td><td>-31.07</td><td>7.92</td><td>9.84</td><td>0.68</td><td>0.49</td><td>Average</td></tr><tr><td>12</td><td>22.655</td><td>23.90</td><td>60.00</td><td>-36.10</td><td>12.89</td><td>9.84</td><td>0.68</td><td>0.49</td><td>QP</td></tr></table>					Freq MHz	Level dBUV	Limit Line dBUV	Over Limit dB	Read Level dBUV	Factor dB	Cable loss dB	Aux dB	Remark	1	0.168	26.15	55.08	-28.93	16.21	9.69	0.08	0.17	Average	2	0.168	43.44	65.08	-21.64	33.50	9.69	0.08	0.17	QP	3	0.213	21.67	53.10	-31.43	11.73	9.68	0.08	0.18	Average	4	0.213	36.64	63.10	-26.46	26.70	9.68	0.08	0.18	QP	5	0.240	21.87	52.08	-30.21	11.93	9.68	0.08	0.18	Average	6	0.240	33.15	62.08	-28.93	23.21	9.68	0.08	0.18	QP	7*	0.402	30.36	47.81	-17.45	20.42	9.67	0.08	0.19	Average	8	0.402	35.97	57.81	-21.84	26.03	9.67	0.08	0.19	QP	9	9.352	15.24	50.00	-34.76	4.68	9.76	0.43	0.37	Average	10	9.352	19.72	60.00	-40.28	9.16	9.76	0.43	0.37	QP	11	22.655	18.93	50.00	-31.07	7.92	9.84	0.68	0.49	Average	12	22.655	23.90	60.00	-36.10	12.89	9.84	0.68	0.49	QP
	Freq MHz	Level dBUV	Limit Line dBUV	Over Limit dB	Read Level dBUV	Factor dB	Cable loss dB	Aux dB	Remark																																																																																																																												
1	0.168	26.15	55.08	-28.93	16.21	9.69	0.08	0.17	Average																																																																																																																												
2	0.168	43.44	65.08	-21.64	33.50	9.69	0.08	0.17	QP																																																																																																																												
3	0.213	21.67	53.10	-31.43	11.73	9.68	0.08	0.18	Average																																																																																																																												
4	0.213	36.64	63.10	-26.46	26.70	9.68	0.08	0.18	QP																																																																																																																												
5	0.240	21.87	52.08	-30.21	11.93	9.68	0.08	0.18	Average																																																																																																																												
6	0.240	33.15	62.08	-28.93	23.21	9.68	0.08	0.18	QP																																																																																																																												
7*	0.402	30.36	47.81	-17.45	20.42	9.67	0.08	0.19	Average																																																																																																																												
8	0.402	35.97	57.81	-21.84	26.03	9.67	0.08	0.19	QP																																																																																																																												
9	9.352	15.24	50.00	-34.76	4.68	9.76	0.43	0.37	Average																																																																																																																												
10	9.352	19.72	60.00	-40.28	9.16	9.76	0.43	0.37	QP																																																																																																																												
11	22.655	18.93	50.00	-31.07	7.92	9.84	0.68	0.49	Average																																																																																																																												
12	22.655	23.90	60.00	-36.10	12.89	9.84	0.68	0.49	QP																																																																																																																												
Note 1: Level (dBUV) = Read Level (dBUV) + LISN Factor (dB) + Cable Loss (dB). 2: Over Limit (dB) = Level (dBUV) – Limit Line (dBUV).																																																																																																																																					

3.2 6dB and Occupied Bandwidth

3.2.1 Limit of 6dB Bandwidth

The minimum 6dB bandwidth shall be at least 500 kHz.

3.2.2 Test Procedures

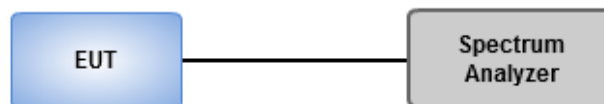
6dB Bandwidth

1. Set resolution bandwidth (RBW) = 1% to 5% of the anticipated emission, Video bandwidth = 3x the RBW.
2. Detector = Peak, Trace mode = max hold.
3. Sweep = auto couple, Allow the trace to stabilize.
4. 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 6dB relative to the maximum level measured in the fundamental emission.

Occupied Bandwidth

1. Set resolution bandwidth (RBW) = 1 MHz, Video bandwidth = 3 MHz.
2. Detector = Sample, Trace mode = max hold.
3. Sweep = auto couple, Allow the trace to stabilize.
4. Use the OBW measurement function of spectrum analyzer to measure the occupied bandwidth.

3.2.3 Test Setup



3.2.4 Test Result of 6dB and Occupied Bandwidth

Ambient Condition	22~24°C / 64~66%	Tested By	Aska Huang
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Summary

Mode	Max-N dB (Hz)	Max-OBW (Hz)	ITU-Code	Min-N dB (Hz)	Min-OBW (Hz)
2.4-2.4835GHz	-	-	-	-	-
BT-LE(1Mbps)	717.391k	1.053M	1M05F1D	710.145k	1.049M

Max-N dB = Maximum 6dB down bandwidth; Max-OBW = Maximum 99% occupied bandwidth;
Min-N dB = Minimum 6dB down bandwidth; Min-OBW = Minimum 99% occupied bandwidth

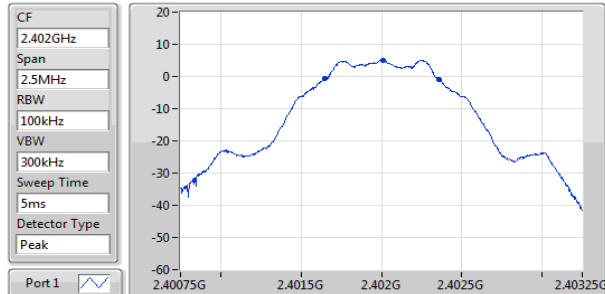
Result

Mode	Result	Limit (Hz)	Port 1-N dB (Hz)	Port 1-OBW (Hz)
BT-LE(1Mbps)	-	-	-	-
2402MHz	Pass	500k	710.145k	1.053M
2440MHz	Pass	500k	710.145k	1.053M
2480MHz	Pass	500k	717.391k	1.049M

Port X-N dB = Port X 6dB down bandwidth;
Port X-OBW = Port X 99% occupied bandwidth

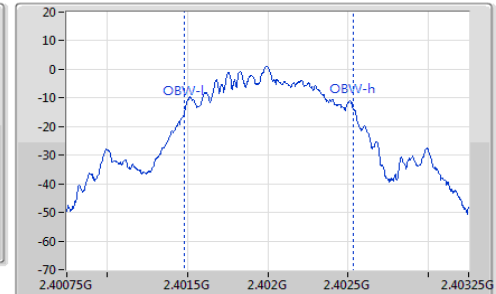
BT-LE(1Mbps)

2402MHz



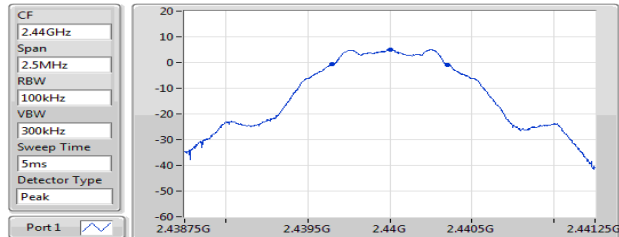
6dB(Hz)	Fl-6dB(Hz)	Fh-6dB(Hz)	OBW(Hz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(Hz)	Port
710.145k	2.401649G	2.402359G	1.053M	2.401483G	2.402535G	500k	1

EBW-DTS



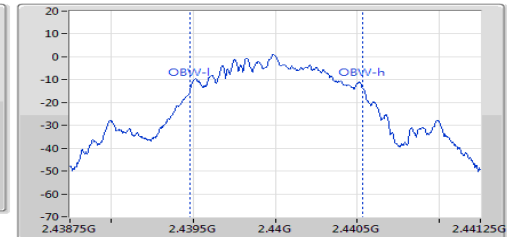
BT-LE(1Mbps)

2440MHz



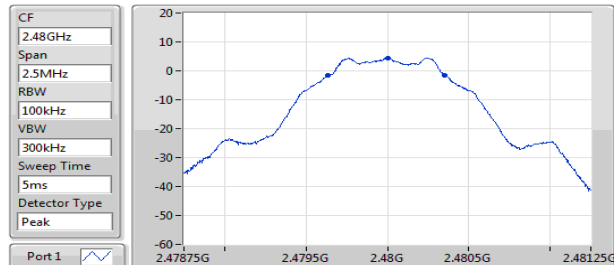
6dB(Hz)	Fl-6dB(Hz)	Fh-6dB(Hz)	OBW(Hz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(Hz)	Port
710.145k	2.439645G	2.440355G	1.053M	2.439483G	2.440535G	500k	1

EBW-DTS



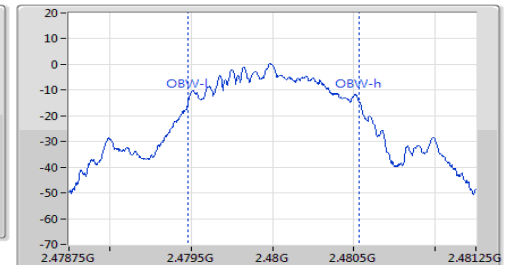
BT-LE(1Mbps)

2480MHz



6dB(Hz)	Fl-6dB(Hz)	Fh-6dB(Hz)	OBW(Hz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(Hz)	Port
717.391k	2.479638G	2.480355G	1.049M	2.479483G	2.480532G	500k	1

EBW-DTS



3.3 RF Output Power

3.3.1 Limit of RF Output Power

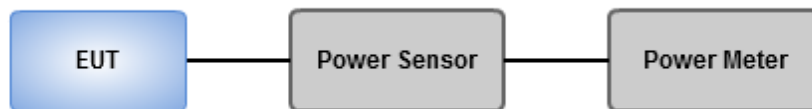
Conducted power shall not exceed 1Watt.

Antenna gain $\leq 6\text{dBi}$, no any corresponding reduction is in output power limit.

3.3.2 Test Procedures

A broadband RF power meter is used for output power measurement. The video bandwidth of power meter is greater than DTS bandwidth of EUT. 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.

3.3.3 Test Setup



3.3.4 Test Result of Maximum Output Power

Ambient Condition	22~24°C / 64~66%	Tested By	Aska Huang
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Summary of Peak Conducted Output Power

Mode	Power (dBm)	Power (W)
2.4-2.4835GHz	-	-
BT-LE(1Mbps)	5.81	0.00381

Result

Mode	Result	Antenna Gain (dBi)	Power (dBm)	Power Limit (dBm)
BT-LE(1Mbps)	-	-	-	-
2402MHz	Pass	3.00	5.81	30.00
2440MHz	Pass	3.00	5.75	30.00
2480MHz	Pass	3.00	5.19	30.00

Summary of Conducted (Average) Output Power

Mode	Power (dBm)	Power (W)
2.4-2.4835GHz	-	-
BT-LE(1Mbps)	5.65	0.00367

Result

Mode	Result	Antenna Gain (dBi)	Power (dBm)	Power Limit (dBm)
BT-LE(1Mbps)	-	-	-	-
2402MHz	Pass	3.00	5.65	-
2440MHz	Pass	3.00	5.58	-
2480MHz	Pass	3.00	5.01	-

Note: Average power is for reference only.

3.4 Power Spectral Density

3.4.1 Limit of Power Spectral Density

Power spectral density shall not be greater than 8 dBm in any 3 kHz band.

3.4.2 Test Procedures

Peak PSD

1. Set the RBW = 3 kHz, VBW = 10 kHz.
2. Detector = Peak, Sweep time = auto couple.
3. Trace mode = max hold, allow trace to fully stabilize.
4. Use the peak marker function to determine the maximum amplitude level.

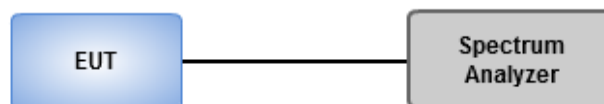
Average PSD, duty cycle $\geq 98\%$

1. Set the RBW = 30 kHz, VBW = 100 kHz.
2. Detector = RMS, Sweep time = auto couple.
3. Sweep time = auto couple.
4. Employ trace averaging (RMS) mode over a minimum of 100 traces.
5. Use the peak marker function to determine the maximum amplitude level.

Average PSD, duty cycle $< 98\%$

1. Set the RBW = 30 kHz, VBW = 100 kHz. Detector = RMS.
2. Set the sweep time to: ≥ 10 (number of measurement points in sweep) $\times$ (total on/off period of the transmitted signal).
3. Perform the measurement over a single sweep.
4. Use the peak marker function to determine the maximum amplitude level.
5. Add $10 \log (1/x)$, where x is the duty cycle.

3.4.3 Test Setup



3.4.4 Test Result of Power Spectral Density

Ambient Condition	22~24°C / 64~66%	Tested By	Aska Huang
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Summary

Mode	PD (dBm/3kHz)
2.4-2.4835GHz	-
BT-LE(1Mbps)	-8.63

Result

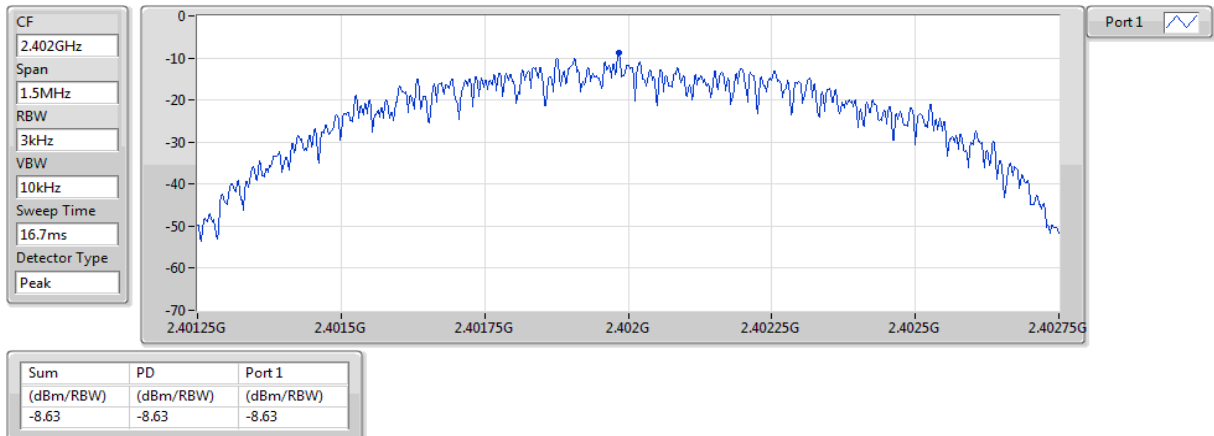
Mode	Result	Gain (dBi)	PD (dBm/3kHz)	PD Limit (dBm/3kHz)
BT-LE(1Mbps)	-	-	-	-
2402MHz	Pass	3.00	-8.63	8.00
2440MHz	Pass	3.00	-8.66	8.00
2480MHz	Pass	3.00	-9.21	8.00

PD = Maximum power density;

BT-LE(1Mbps)

PSD

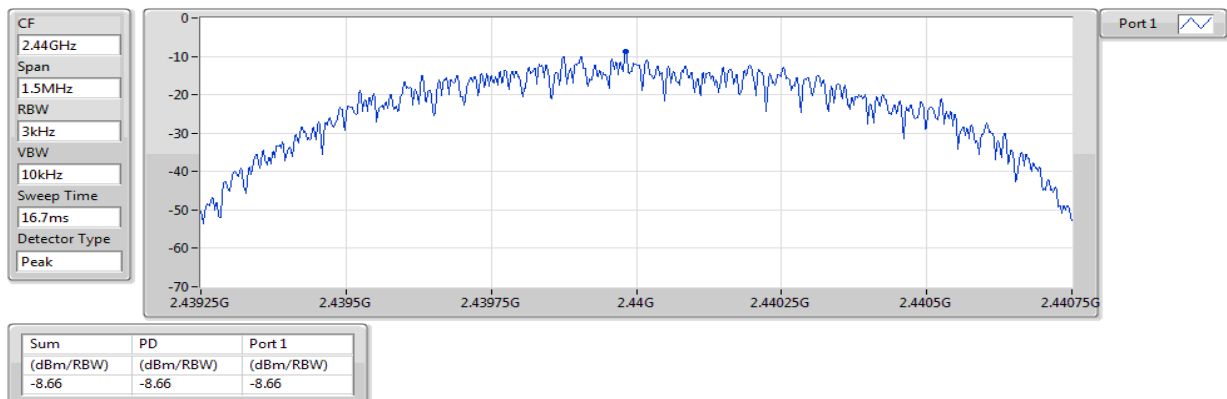
2402MHz



BT-LE(1Mbps)

PSD

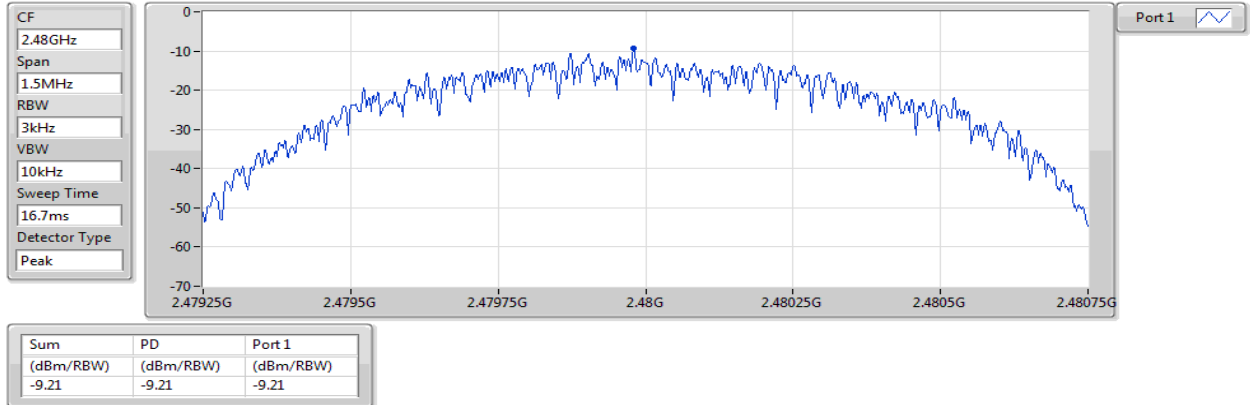
2440MHz



BT-LE(1Mbps)

PSD

2480MHz



3.5 Emissions in Restricted Frequency Bands

3.5.1 Limit of Emissions in 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.

3.5.2 Test Procedures

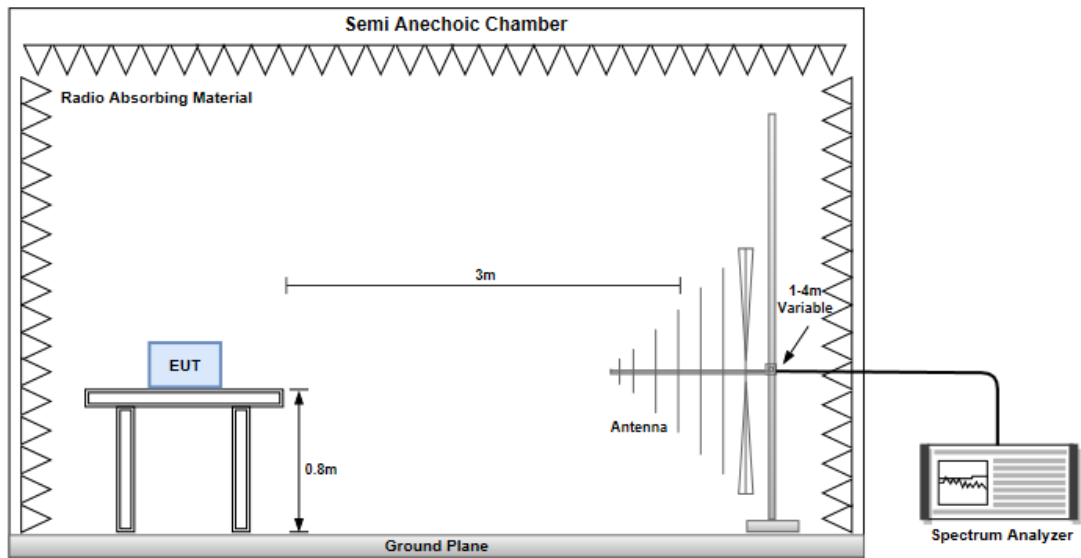
1. Measurement is made at a semi-anechoic chamber that incorporates a turntable allowing a EUT rotation of 360°. A continuously-rotating, remotely-controlled turntable is installed at the test site to support the EUT and facilitate determination of the direction of maximum radiation for each EUT emission 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:

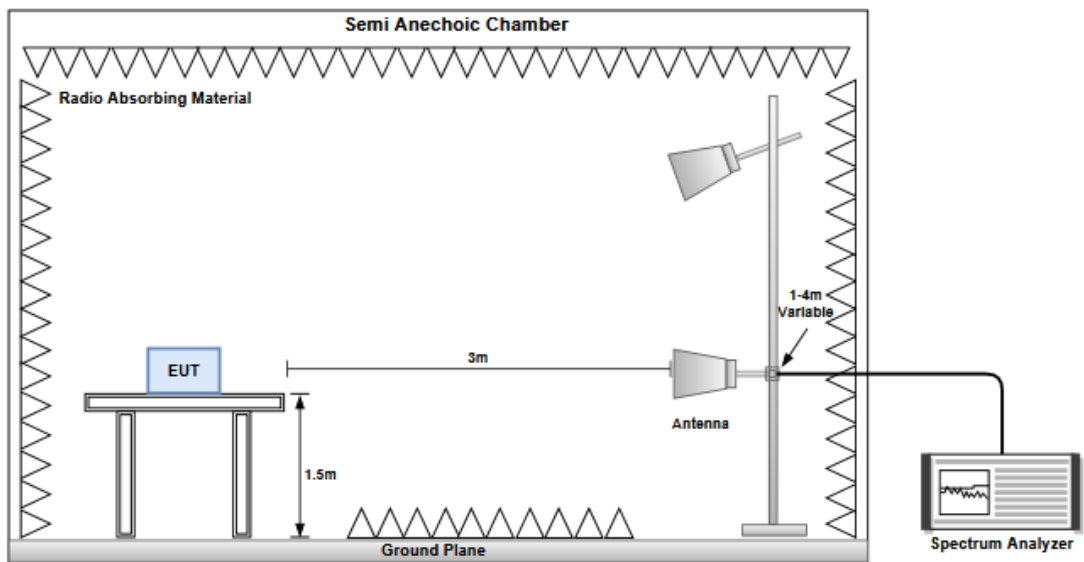
1. 120kHz measurement bandwidth of test receiver and Quasi-peak detector is for radiated emission below 1GHz.
2. RBW=1MHz, VBW=3MHz and Peak detector is for peak measured value of radiated emission above 1GHz.
3. RBW=1MHz, VBW=1/T and Peak detector is for average measured value of radiated emission above 1GHz.

3.5.3 Test Setup

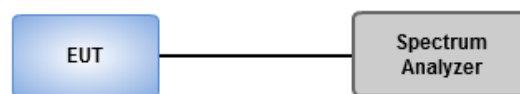
Radiated Emissions below 1 GHz



Radiated Emissions above 1 GHz



Transmitter Conducted Unwanted Emissions (30MHz~25GHz)



3.5.4 Transmitter Radiated Unwanted Emissions (Below 1GHz)

Modulation	BT LE-1Mbps	Test Freq. (MHz)	2402
Polarization	Horizontal		
Test By :Brad Wu Temperature(°C):23 Humidity(%):64			
Level (dBuV/m) <			

Modulation	BT LE-1Mbps	Test Freq. (MHz)	2402
Polarization	Vertical		
Test By :Brad Wu Temperature(°C):23 Humidity(%):64			
Level (dBuV/m) <			

3.5.5 Transmitter Radiated Unwanted Emissions (Above 1GHz)

Modulation	BT LE-1Mbps		Test Freq. (MHz)		2402	
Polarization	Horizontal					
Test By :Brad Wu Temperature(°C):23 Humidity(%):64						
Level (dBuV/m)						

Modulation	BT LE-1Mbps	Test Freq. (MHz)	2402
Polarization	Vertical		
Test By :Brad Wu Temperature(°C):23 Humidity(%):64			
Level (dBUV/m)			

Modulation	BT LE-1Mbps	Test Freq. (MHz)	2440
Polarization	Horizontal		
Test By :Brad Wu Temperature(°C):23 Humidity(%):64			
Level (dBuV/m) </			

Modulation	BT LE-1Mbps	Test Freq. (MHz)	2440
Polarization	Vertical		
Test By :Brad Wu Temperature(°C):23 Humidity(%):64			
Level (dBUV/m) <			

Modulation	BT LE-1Mbps	Test Freq. (MHz)	2480
Polarization	Horizontal		
Test By :Brad Wu Temperature(°C):23 Humidity(%):64			
Level (dBUV/m) </			

Modulation	BT LE-1Mbps	Test Freq. (MHz)	2480
Polarization	Vertical		
Test By :Brad Wu Temperature(°C):23 Humidity(%):64			
Level (dBUV/m) <			

3.5.6 Transmitter Conducted Unwanted Emissions (Below 1 GHz)

Summary

Mode	Result	F-Start (Hz)	F-Stop (Hz)	Type	Freq (Hz)	DG (dBi)	Psum (dBm)	GRF (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
2.4-2.4835GHz	-	-	-	-	-	-	-	-	-	-	-
BT-LE(1Mbps)	Pass	30M	1G	PK	38.25M	3.00	-73.56	4.7	-65.86	-55.20	-10.66

DG = Directional Gain

GRF=Ground reflection factor

PX=Port X; Psum=P1+..P2+..PX

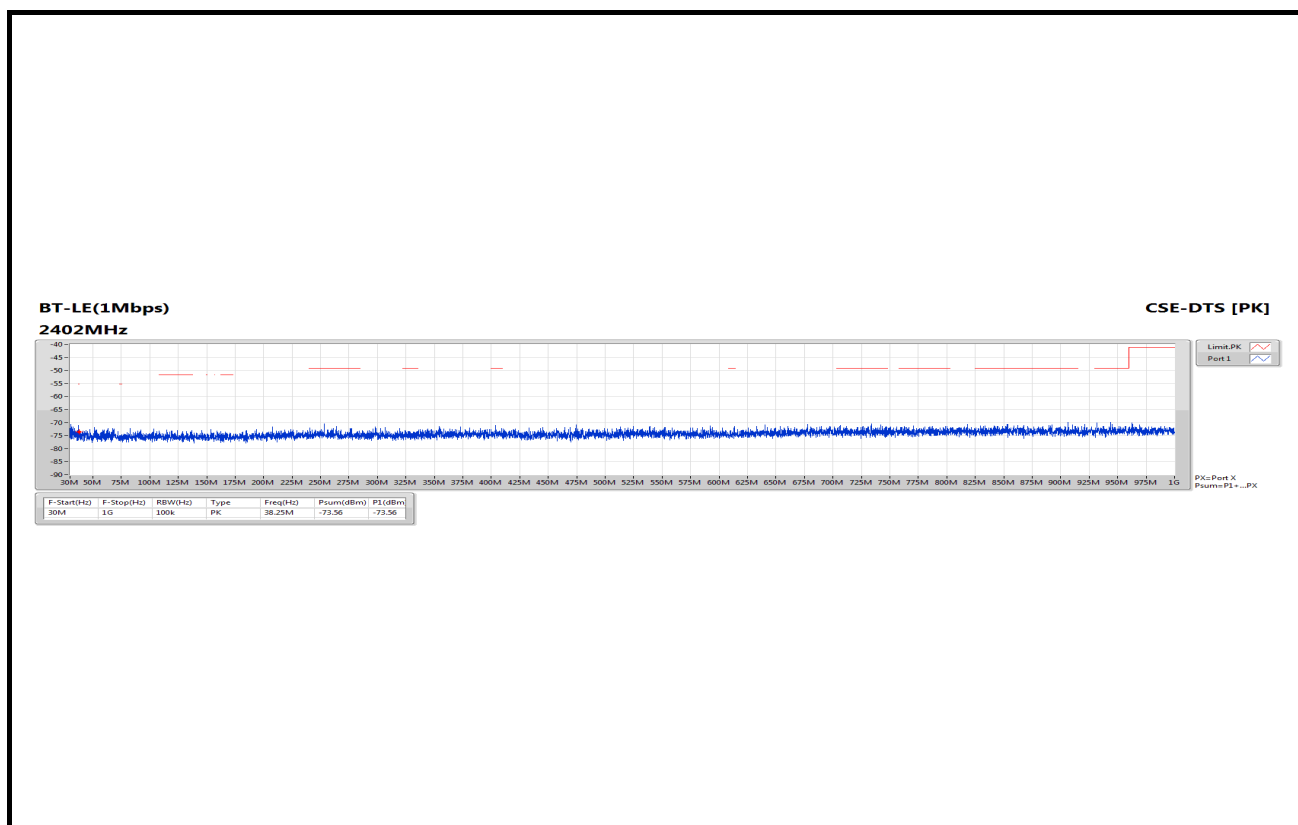
Result

Mode	Result	F-Start (Hz)	F-Stop (Hz)	Type	Freq (Hz)	DG (dBi)	Psum (dBm)	GRF (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
BT-LE(1Mbps)	-	-	-	-	-	-	-	-	-	-	-
2402MHz	Pass	30M	1G	PK	38.25M	3.00	-73.56	4.7	-65.86	-55.20	-10.66

DG = Directional Gain

GRF=Ground reflection factor

PX=Port X; Psum=P1+..P2+..PX



3.5.7 Transmitter Conducted Unwanted Emissions (Above 1GHz)

Summary

Mode	Result	F-Start (Hz)	F-Stop (Hz)	Type	Freq (Hz)	DG (dBi)	Psum (dBm)	EIRP (dBm)	Limit (dBm)	Margin (dB)
2.4-2.4835GHz	-	-	-	-	-	-	-	-	-	-
BT-LE(1Mbps)	Pass	2.4835G	2.5G	PK	2.48351G	3.00	-34.94	-31.94	-21.20	-10.74

DG = Directional Gain ; PX=Port X; Psum=P1+P2+...PX

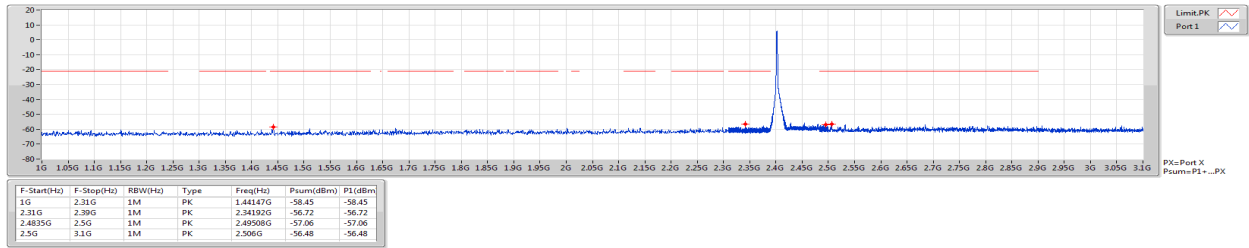
Result

Mode	Result	F-Start (Hz)	F-Stop (Hz)	Type	Freq (Hz)	DG (dBi)	Psum (dBm)	EIRP (dBm)	Limit (dBm)	Margin (dB)
BT-LE(1Mbps)	-	-	-	-	-	-	-	-	-	-
2402MHz	Pass	1G	2.31G	AV	1.44114G	3.00	-61.85	-58.85	-41.20	-17.65
2402MHz	Pass	2.31G	2.39G	AV	2.376G	3.00	-65.68	-62.68	-41.20	-21.48
2402MHz	Pass	2.4835G	2.5G	AV	2.49467G	3.00	-68.21	-65.21	-41.20	-24.01
2402MHz	Pass	2.5G	3.1G	AV	2.506G	3.00	-61.94	-58.94	-41.20	-17.74
2402MHz	Pass	1G	2.31G	PK	1.44147G	3.00	-58.45	-55.45	-21.20	-34.25
2402MHz	Pass	2.31G	2.39G	PK	2.34192G	3.00	-56.72	-53.72	-21.20	-32.52
2402MHz	Pass	2.4835G	2.5G	PK	2.49508G	3.00	-57.06	-54.06	-21.20	-32.86
2402MHz	Pass	2.5G	3.1G	PK	2.506G	3.00	-56.48	-53.48	-21.20	-32.28
2440MHz	Pass	1G	2.31G	AV	1.4639G	3.00	-61.70	-58.70	-41.20	-17.50
2440MHz	Pass	2.31G	2.39G	AV	2.38788G	3.00	-67.39	-64.39	-41.20	-23.19
2440MHz	Pass	2.4835G	2.5G	AV	2.49202G	3.00	-64.16	-61.16	-41.20	-19.96
2440MHz	Pass	2.5G	3.1G	AV	2.5438G	3.00	-62.42	-59.42	-41.20	-18.22
2440MHz	Pass	1G	2.31G	PK	1.4644G	3.00	-56.31	-53.31	-21.20	-32.11
2440MHz	Pass	2.31G	2.39G	PK	2.38808G	3.00	-58.27	-55.27	-21.20	-34.07
2440MHz	Pass	2.4835G	2.5G	PK	2.49156G	3.00	-55.13	-52.13	-21.20	-30.93
2440MHz	Pass	2.5G	3.1G	PK	2.5183G	3.00	-57.45	-54.45	-21.20	-33.25
2480MHz	Pass	1G	2.31G	AV	1.48798G	3.00	-61.89	-58.89	-41.20	-17.69
2480MHz	Pass	2.31G	2.39G	AV	2.37612G	3.00	-67.72	-64.72	-41.20	-23.52
2480MHz	Pass	2.4835G	2.5G	AV	2.48357G	3.00	-61.08	-58.08	-41.20	-16.88
2480MHz	Pass	2.5G	3.1G	AV	2.584G	3.00	-63.09	-60.09	-41.20	-18.89
2480MHz	Pass	1G	2.31G	PK	1.48798G	3.00	-58.28	-55.28	-21.20	-34.08
2480MHz	Pass	2.31G	2.39G	PK	2.34764G	3.00	-58.08	-55.08	-21.20	-33.88
2480MHz	Pass	2.4835G	2.5G	PK	2.48351G	3.00	-34.94	-31.94	-21.20	-10.74
2480MHz	Pass	2.5G	3.1G	PK	2.5837G	3.00	-57.03	-54.03	-21.20	-32.83

DG = Directional Gain ; PX=Port X; Psum=P1+P2+...PX

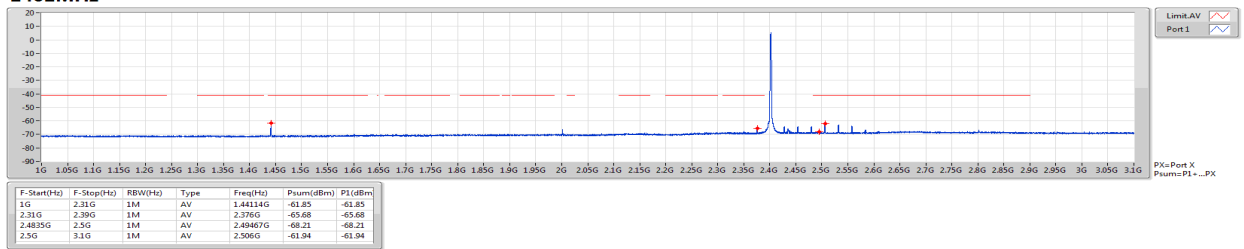
BT-LE(1Mbps)
2402MHz

CSE-DTS [PK]



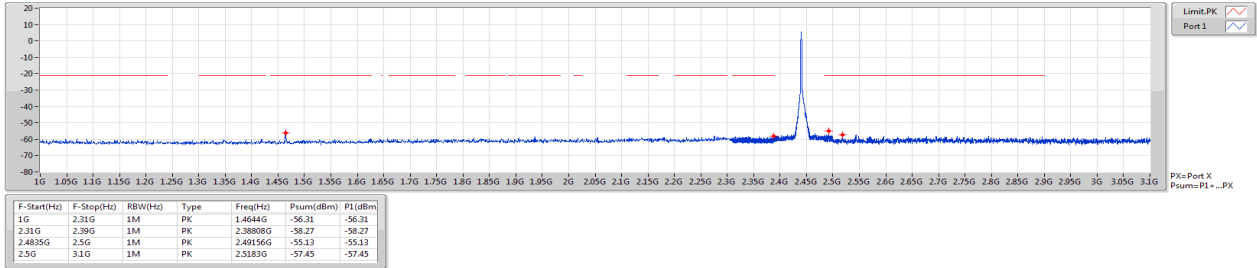
BT-LE(1Mbps)
2402MHz

CSE-DTS [AV]



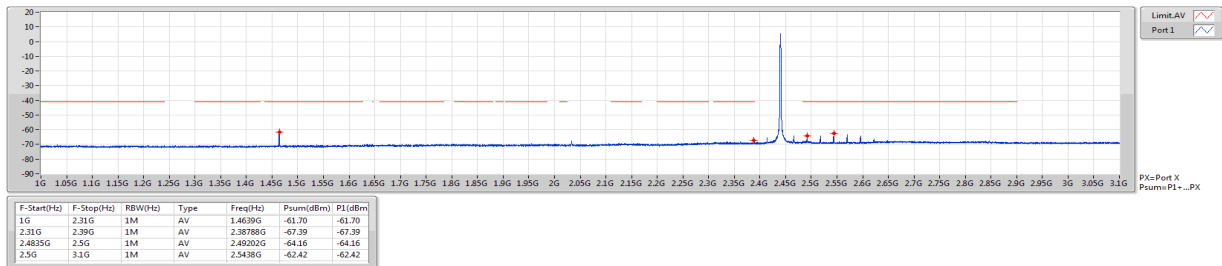
BT-LE(1Mbps)
2440MHz

CSE-DTS [PK]



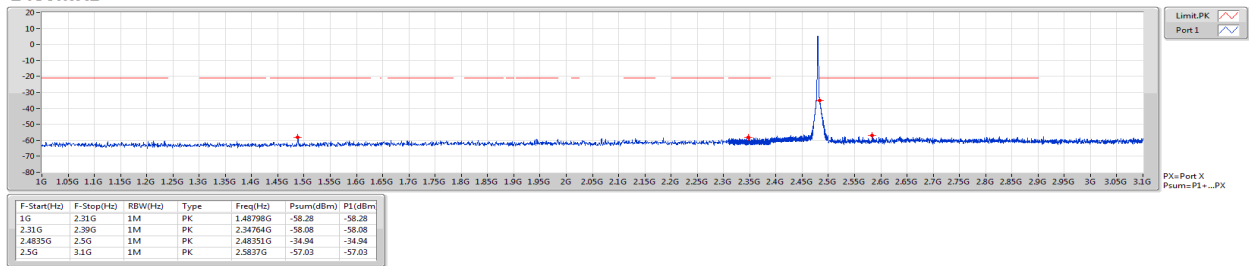
BT-LE(1Mbps)
2440MHz

CSE-DTS [AV]



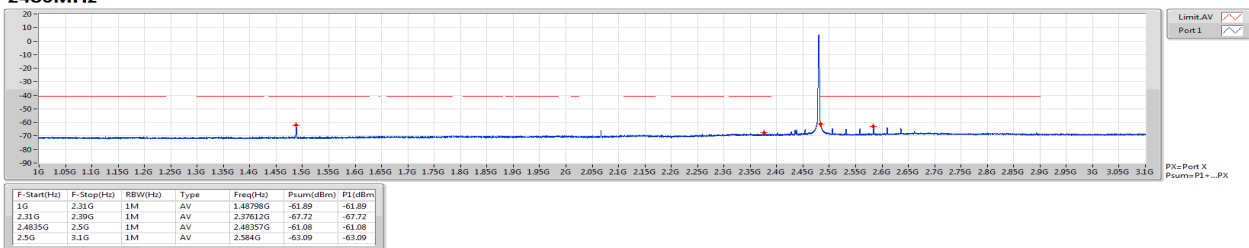
BT-LE(1Mbps)
2480MHz

CSE-DTS [PK]



BT-LE(1Mbps)
2480MHz

CSE-DTS [AV]



Summary

Mode	Result	F-Start (Hz)	F-Stop (Hz)	Type	Freq (Hz)	DG (dBi)	Psum (dBm)	EIRP (dBm)	Limit (dBm)	Margin (dB)
2.4-2.4835GHz	-	-	-	-	-	-	-	-	-	-
BT-LE(1Mbps)	Pass	4G	5G	AV	4.80375G	3.00	-45.81	-42.81	-41.20	-1.61

DG = Directional Gain ; PX=Port X; Psum=P1+P2+...PX

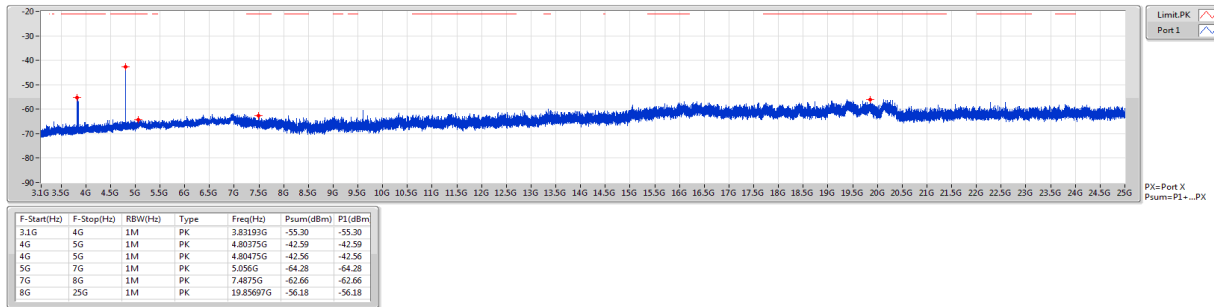
Result

Mode	Result	F-Start (Hz)	F-Stop (Hz)	Type	Freq (Hz)	DG (dBi)	Psum (dBm)	EIRP (dBm)	Limit (dBm)	Margin (dB)
BT-LE(1Mbps)	-	-	-	-	-	-	-	-	-	-
2402MHz	Pass	3.1G	4G	AV	3.84318G	3.00	-58.38	-55.38	-41.20	-14.18
2402MHz	Pass	4G	5G	AV	4.80375G	3.00	-45.81	-42.81	-41.20	-1.61
2402MHz	Pass	5G	7G	AV	5.1025G	3.00	-74.40	-71.40	-41.20	-30.20
2402MHz	Pass	7G	8G	AV	7.39125G	3.00	-72.70	-69.70	-41.20	-28.50
2402MHz	Pass	8G	25G	AV	19.42559G	3.00	-64.74	-61.74	-41.20	-20.54
2402MHz	Pass	3.1G	4G	PK	3.83193G	3.00	-55.30	-52.30	-21.20	-31.10
2402MHz	Pass	4G	5G	PK	4.80375G	3.00	-42.59	-39.59	-21.20	-18.39
2402MHz	Pass	4G	5G	PK	4.80475G	3.00	-42.56	-39.56	-21.20	-18.36
2402MHz	Pass	5G	7G	PK	5.056G	3.00	-64.28	-61.28	-21.20	-40.08
2402MHz	Pass	7G	8G	PK	7.4875G	3.00	-62.66	-59.66	-21.20	-38.46
2402MHz	Pass	8G	25G	PK	19.85697G	3.00	-56.18	-53.18	-21.20	-31.98
2440MHz	Pass	3.1G	4G	AV	3.90415G	3.00	-59.92	-56.92	-41.20	-15.72
2440MHz	Pass	4G	5G	AV	4.88G	3.00	-47.23	-44.23	-41.20	-3.03
2440MHz	Pass	5G	7G	AV	5.214G	3.00	-74.29	-71.29	-41.20	-30.09
2440MHz	Pass	7G	8G	AV	7.31925G	3.00	-69.78	-66.78	-41.20	-25.58
2440MHz	Pass	8G	25G	AV	19.41603G	3.00	-64.64	-61.64	-41.20	-20.44
2440MHz	Pass	3.1G	4G	PK	3.89178G	3.00	-54.98	-51.98	-21.20	-30.78
2440MHz	Pass	4G	5G	PK	4.87975G	3.00	-43.97	-40.97	-21.20	-19.77
2440MHz	Pass	5G	7G	PK	5.1475G	3.00	-65.11	-62.11	-21.20	-40.91
2440MHz	Pass	7G	8G	PK	7.3205G	3.00	-61.94	-58.94	-21.20	-37.74
2440MHz	Pass	8G	25G	PK	19.43409G	3.00	-55.09	-52.09	-21.20	-30.89
2480MHz	Pass	3.1G	4G	AV	3.96805G	3.00	-55.62	-52.62	-41.20	-11.42
2480MHz	Pass	4G	5G	AV	4.95975G	3.00	-48.56	-45.56	-41.20	-4.36
2480MHz	Pass	5G	7G	AV	5.1185G	3.00	-74.31	-71.31	-41.20	-30.11
2480MHz	Pass	7G	8G	AV	7.44075G	3.00	-70.27	-67.27	-41.20	-26.07
2480MHz	Pass	8G	25G	AV	19.40381G	3.00	-64.82	-61.82	-41.20	-20.62
2480MHz	Pass	3.1G	4G	PK	3.95613G	3.00	-55.02	-52.02	-21.20	-30.82
2480MHz	Pass	4G	5G	PK	4.95975G	3.00	-45.17	-42.17	-21.20	-20.97
2480MHz	Pass	5G	7G	PK	5.0745G	3.00	-64.43	-61.43	-21.20	-40.23
2480MHz	Pass	7G	8G	PK	7.4395G	3.00	-62.33	-59.33	-21.20	-38.13
2480MHz	Pass	8G	25G	PK	19.72097G	3.00	-55.81	-52.81	-21.20	-31.61

DG = Directional Gain ; PX=Port X; Psum=P1+P2+...PX

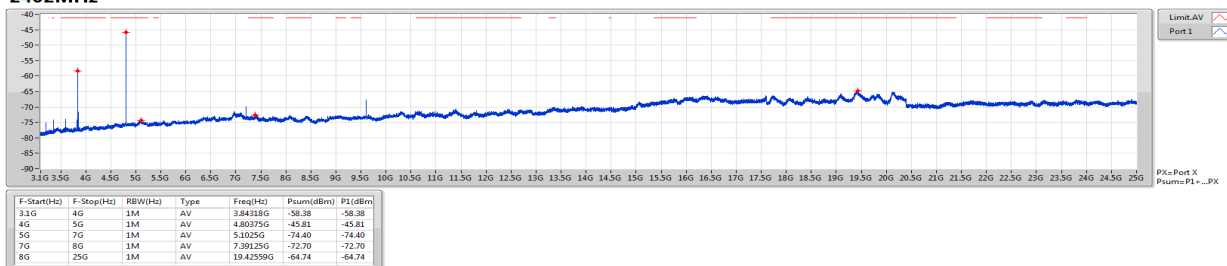
BT-LE(1Mbps)
2402MHz

CSE-DTS [PK]



BT-LE(1Mbps)
2402MHz

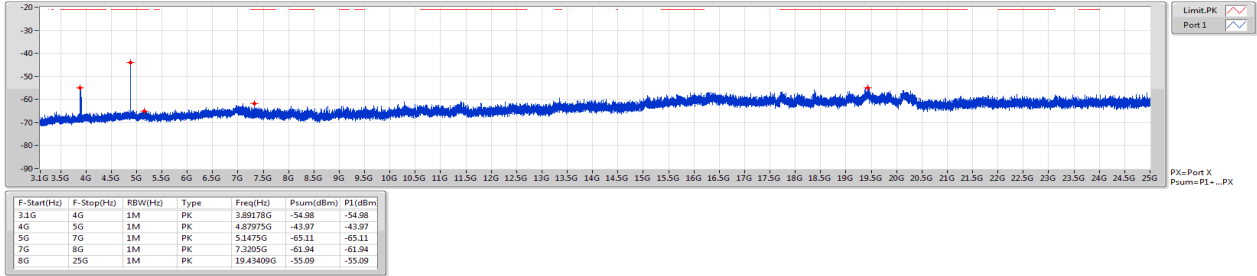
CSE-DTS [AV]



BT-LE(1Mbps)

CSE-DTS [PK]

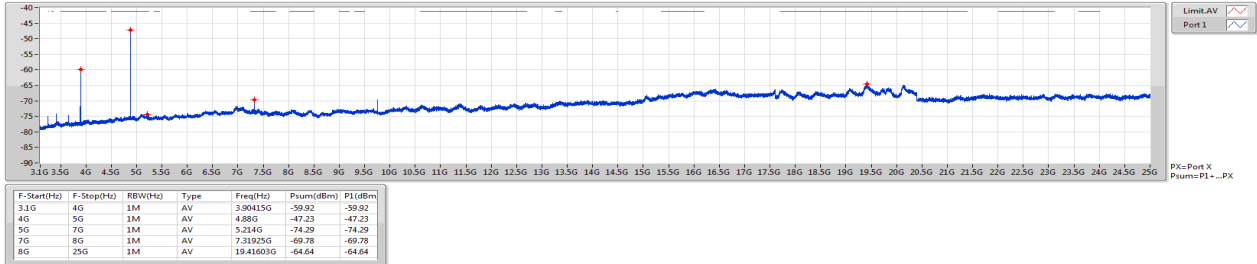
2440MHz



BT-LE(1Mbps)

CSE-DTS [AV]

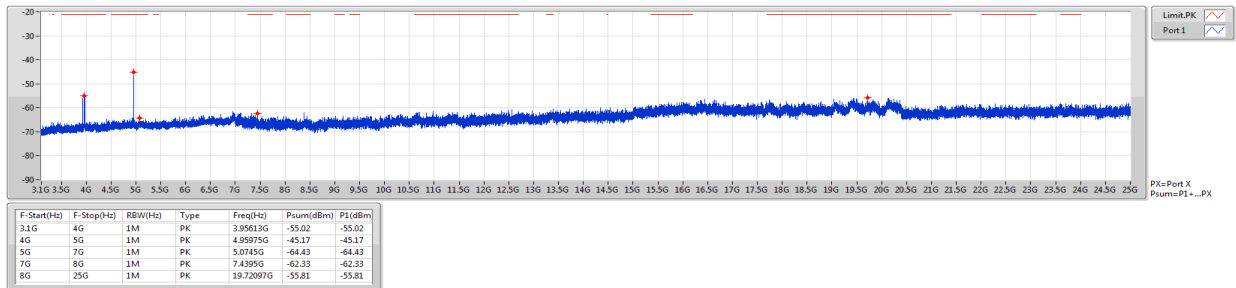
2440MHz



BT-LE(1Mbps)

2480MHz

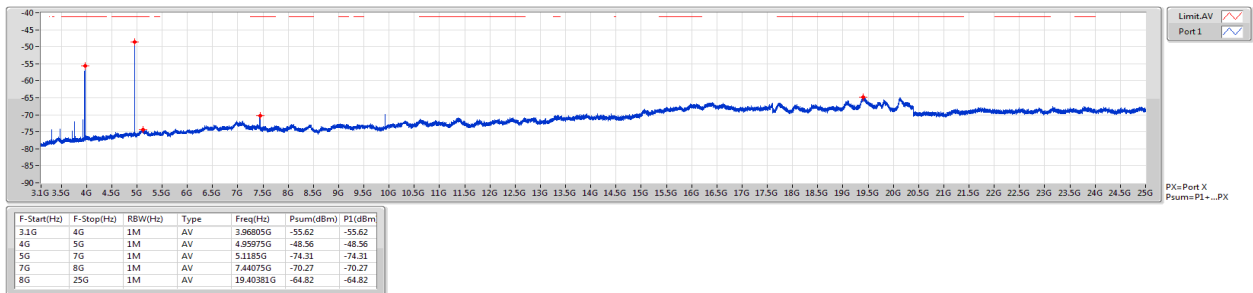
CSE-DTS [PK]



BT-LE(1Mbps)

2480MHz

CSE-DTS [AV]



3.6 Emissions in non-restricted Frequency Bands

3.6.1 Emissions in non-restricted frequency bands limit

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.

3.6.2 Test Procedures

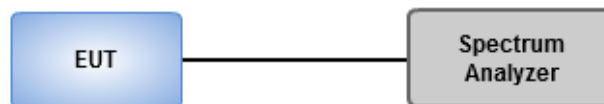
Reference level measurement

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

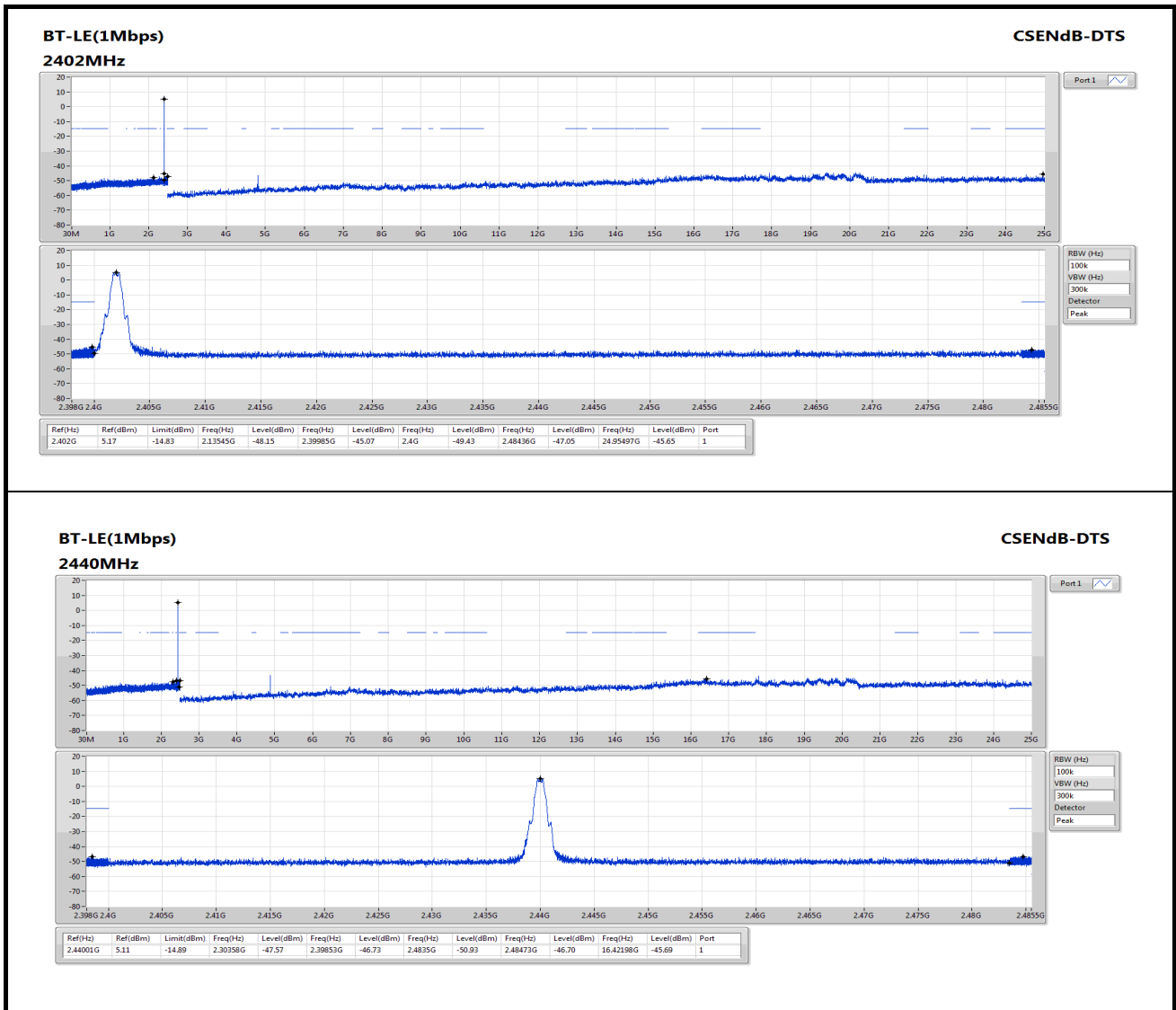
1. Set RBW=100kHz, VBW = 300kHz , Detector = Peak, Sweep time = Auto
2. Trace = max hold , Allow Trace to fully stabilize
3. Scan Frequency range is up to 25GHz
4. Use the peak marker function to determine the maximum amplitude level

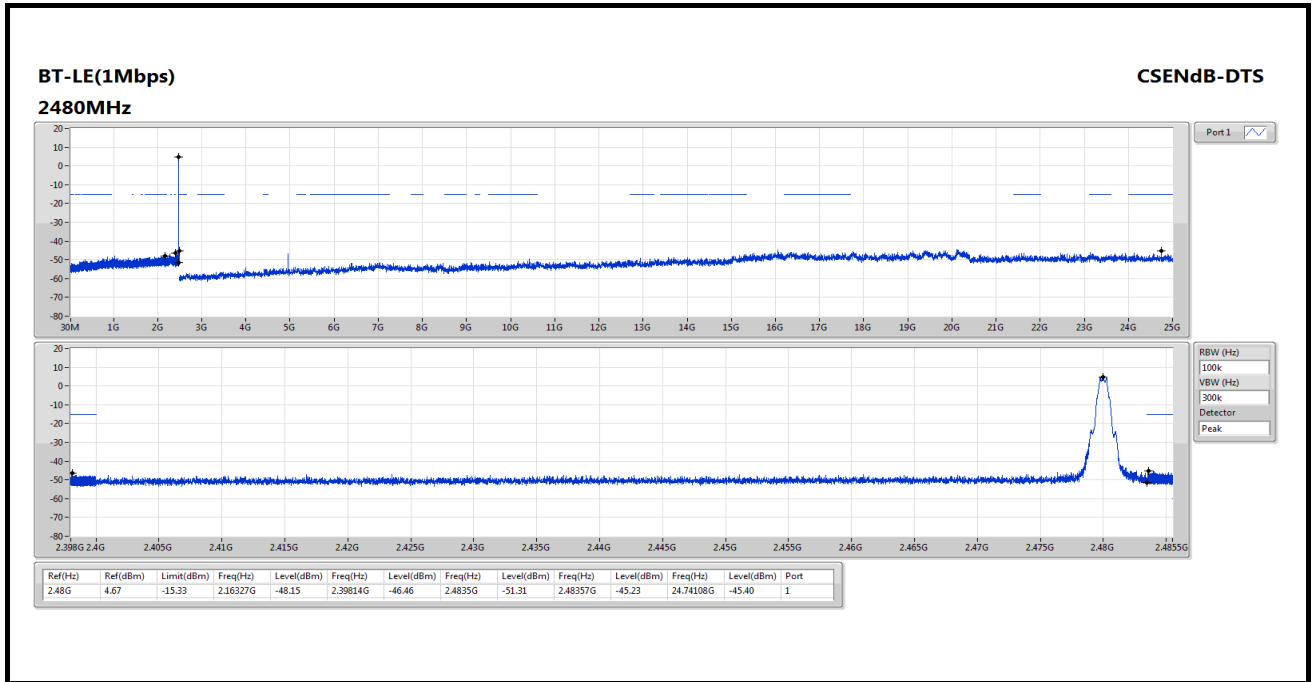
3.6.3 Test Setup



3.6.4 Test Result of Emissions in non-restricted Frequency Bands

Ambient Condition	22~24°C / 64~66%	Tested By	Aska Huang
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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 Dist., Tao Yuan
City 33381, Taiwan (R.O.C.)
No.2-1, Lane 6, Wen San 3rd
St., Kwei Shan Dist., Tao Yuan
City 33381, Taiwan (R.O.C.)

Kwei Shan Site II

Tel: 886-3-271-8640

No.14-1, Lane 19, Wen San 3rd
St., Kwei Shan Dist., 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: 886-3-318-0345

Email: ICC_Service@icertifi.com.tw

==END==