

# **FCC Test Report**

FCC ID : IPH-03616

Equipment : LinkBox
Model No. : LYWW20
Brand Name : GARMIN

Applicant : Garmin International, Inc.

Address : 1200 E. 151st Street Olathe, KS 66062 United States

Standard : 47 CFR FCC Part 15.247

Received Date : Jun. 03, 2021

Tested Date : Jun. 09 ~ Jun. 15, 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: Approved by:

Along Chen Assistant Manager Gary Chang / Manager

2732

Testing Laboratory

Report No.: FR9D2401-02AE Page: 1 of 32



# **Table of Contents**

1	GENERAL DESCRIPTION	5
1.1	Information	
1.2	Local Support Equipment List	
1.3	Test Setup Chart	
1.4	Test Equipment List and Calibration Data	8
1.5	Test Standards	9
1.6	Reference Guidance	9
1.7	Deviation from Test Standard and Measurement Procedure	9
1.8	Measurement Uncertainty	9
2	TEST CONFIGURATION	10
2.1	Testing Facility	10
2.2	The Worst Test Modes and Channel Details	10
3	TRANSMITTER TEST RESULTS	11
3.1	6dB and Occupied Bandwidth	11
3.2	RF Output Power	14
3.3	Power Spectral Density	16
3.4	Emissions in Restricted Frequency Bands	19
3.5	Emissions in non-restricted Frequency Bands	29
4	TEST LABORATORY INFORMATION	32



# **Release Record**

Report No.	Version	Description	Issued Date
FR9D2401-02AE	Rev. 01	Initial issue	Jul. 01, 2021

Report No.: FR9D2401-02AE Page: 3 of 32



# **Summary of Test Results**

FCC Rules	Test Items	Measured	Result
15.207	AC Power Line Conducted Emissions	Note	N/A
15.247(d) 15.209	Radiated Emissions	[dBuV/m at 3m]: 50.77MHz 35.14(Margin -4.86dB) - PK	Pass
15.247(b)(3)	Maximum Output Power	Power [dBm]: 4.65	Pass
15.247(a)(2)	6dB Bandwidth	Meet the requirement of limit	Pass
15.247(e)	Power Spectral Density	Meet the requirement of limit	Pass
15.203	Antenna Requirement	Meet the requirement of limit	Pass

N/A means Not Applicable.

Note: The EUT consumes DC power from battery, so the test is not required.

#### **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.

Report No.: FR9D2401-02AE Page: 4 of 32



# 1 General Description

# 1.1 Information

# 1.1.1 Specification of the Equipment under Test (EUT)

RF General Information						
Frequency Range (MHz) Bluetooth Ch. Freq. (MHz) Channel Number Data Rate						
2400-2483.5 LE 2402-2480 0-39 [40] 1 Mbps						
Note 1: Bluetooth LE (Low energy) uses GFSK modulation.						

#### 1.1.2 Antenna Details

Ant. No.	Brand Name	Model Name	Туре	Connector	Gain (dBi)
1	INPAQ TECH CO LTD	VGAP-CLB-AS-A1	Chip	N/A	2.93

# 1.1.3 Power Supply Type of Equipment under Test (EUT)

Power Supply Type	12Vdc from battery
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#### 1.1.4 Accessories

N/A

Report No.: FR9D2401-02AE Page: 5 of 32



# 1.1.5 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

# 1.1.6 Test Tool and Duty Cycle

Test Tool	Tera Term, version: V4.89	version: V4.89			
Duty Cycle and Duty Factor	Duty Cycle (%)	Duty Factor (dB)			
Duty Cycle and Duty Factor	68.28	1.66			

# 1.1.7 Power Index of Test Tool

Modulation Mode		Test Frequency (MHz)	
Modulation Mode	2402	2440	2480
BT LE-1Mbps	Default	Default	Default

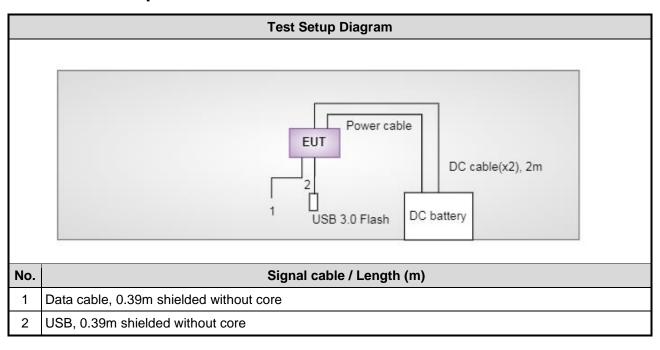
Report No.: FR9D2401-02AE Page: 6 of 32



# 1.2 Local Support Equipment List

	Support Equipment List							
No.	No. Equipment Brand Model FCC ID Remarks							
1	USB 3.0 Flash	Transcend	JetFlash 700					
2	DC battery	Top Lite	46B24L					

# 1.3 Test Setup Chart



Report No.: FR9D2401-02AE Page: 7 of 32



# 1.4 Test Equipment List and Calibration Data

Test Item	Radiated Emission	Radiated Emission						
Test Site	966 chamber1 / (03Cl	H01-WS)						
Test Date	Jun. 09, 2021 ~ Jun. 10, 2021							
Instrument	Brand Model No. Serial No. Calibration Date Calibration							
Receiver	R&S	ESR3	101657	Mar. 12, 2021	Mar. 11, 2022			
Spectrum Analyzer	R&S	FSV40	101498	Dec. 04, 2020	Dec. 03, 2021			
Loop Antenna	R&S	HFH2-Z2	100330	Nov. 17, 2020	Nov. 16, 2021			
Bilog Antenna	SCHWARZBECK	VULB9168	VULB9168-522	Jul. 10, 2020	Jul. 09, 2021			
Horn Antenna 1G-18G	SCHWARZBECK	BBHA 9120 D	BBHA 9120 D 1096	Dec. 11, 2020	Dec. 10, 2021			
Horn Antenna 18G-40G	SCHWARZBECK	BBHA 9170	BBHA 9170517	Nov. 06, 2020	Nov. 05, 2021			
Preamplifier	EMC	EMC02325	980225	Jul. 03, 2020	Jul. 02, 2021			
Preamplifier	Agilent	83017A	MY39501308	Sep. 26, 2020	Sep. 25, 2021			
Preamplifier	EMC	EMC184045B	980192	Jul. 21, 2020	Jul. 20, 2021			
Loop Antenna Cable	KOAX KABEL	101354-BW	101354-BW	Oct. 06, 2020	Oct. 05, 2021			
LF cable 3M	Woken	CFD400NL-LW	CFD400NL-001	Oct. 06, 2020	Oct. 05, 2021			
LF cable 11M	EMC	EMCCFD400-NW-N W-11000	200801	Oct. 06, 2020	Oct. 05, 2021			
LF cable 1M	EMC	EMCCFD400-NM-N M-1000	160502	Oct. 06, 2020	Oct. 05, 2021			
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16019/4	Oct. 06, 2020	Oct. 05, 2021			
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16014/4	Oct. 06, 2020	Oct. 05, 2021			
Measurement Software	AUDIX	e3	6.120210g	NA	NA			
Note: Calibration Inter	val of instruments liste	d above is one year.						

Test Item	RF Conducted	RF Conducted						
Test Site	(TH01-WS)	TH01-WS)						
Test Date	Jun. 15, 2021	Jun. 15, 2021						
Instrument	Brand	Model No.	Serial No.	Calibration Date	Calibration Until			
Spectrum Analyzer	R&S	FSV40	101063	Apr. 19, 2021	Apr. 18, 2022			
Power Meter	Anritsu	ML2495A	1241002	Nov. 04, 2020	Nov. 03, 2021			
Power Sensor	Anritsu	MA2411B	1207366	Nov. 04, 2020	Nov. 03, 2021			
Measurement Software	-	SENSE-15247_FS	V5.10.7.11	NA	NA			
Note: Calibration Inte	Note: Calibration Interval of instruments listed above is one year.							

Report No.: FR9D2401-02AE Page: 8 of 32



## 1.5 Test Standards

47 CFR FCC Part 15.247 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	±3.41 dB			
Radiated emission > 1GHz	±4.59 dB			

Report No.: FR9D2401-02AE Page: 9 of 32



# 2 Test Configuration

# 2.1 Testing Facility

Test Laboratory	International Certification Corporation
Test Site	03CH01-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.)

FCC Designation No.: TW2732FCC site registration No.: 181692

➤ ISED#: 10807A

➤ CAB identifier: TW2732

## 2.2 The Worst Test Modes and Channel Details

Test item	Mode	Test Frequency (MHz)	Data Rate	Test Configuration
Radiated Emissions ≤ 1GHz	BT LE	2402	1Mbps	
Maximum Output Power 6dB bandwidth Power spectral density Radiated Emissions > 1GHz	BT LE	2402, 2440, 2480	1Mbps	

#### NOTE:

Report No.: FR9D2401-02AE Page: 10 of 32

<sup>1.</sup> 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 6dB and Occupied Bandwidth

#### 3.1.1 Limit of 6dB Bandwidth

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

#### 3.1.2 Test Procedures

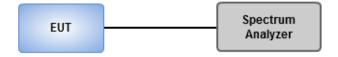
#### 6dB Bandwidth

- 1. Set resolution bandwidth (RBW) = 100 kHz, Video bandwidth = 300 kHz.
- 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% ~ 5 % of OBW, Video bandwidth = 3 x RBW
- 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.

#### 3.1.3 Test Setup



Report No.: FR9D2401-02AE Page: 11 of 32



# 3.1.4 Test Result of 6dB and Occupied Bandwidth

<b>Ambient Condition</b>	24°C / 67%	Tested By	Aska Huang
		•	

**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)	710.145k	1.024M	1M02F1D	710.145k	1.02M

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

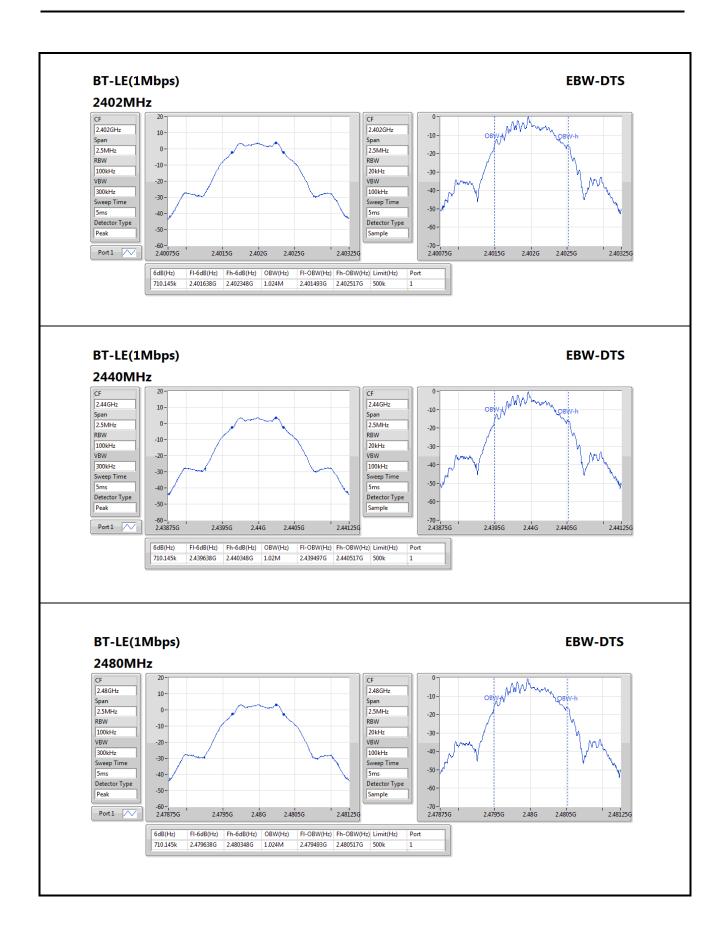
#### Result

Mode	Result	Limit (Hz)	Port 1-N dB (Hz)	Port 1-OBW (Hz)
BT-LE(1Mbps)	-	-	-	-
2402MHz	Pass	500k	710.145k	1.024M
2440MHz	Pass	500k	710.145k	1.02M
2480MHz	Pass	500k	710.145k	1.024M

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

Report No.: FR9D2401-02AE Page: 12 of 32





Report No.: FR9D2401-02AE Page: 13 of 32



# 3.2 RF Output Power

## 3.2.1 Limit of RF Output Power

Conducted power shall not exceed 1Watt.

Antenna gain <= 6dBi, no any corresponding reduction is in output power limit.

#### 3.2.2 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.

## 3.2.3 Test Setup



Report No.: FR9D2401-02AE Page: 14 of 32



# 3.2.4 Test Result of Maximum Output Power

Ambient Condition	24°C / 67%	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)	4.65	0.00292

#### Result

Mode	Result	Antenna Gain (dBi)	Power (dBm)	Power Limit (dBm)
BT-LE(1Mbps)	-	-	-	-
2402MHz	Pass	2.93	4.65	30.00
2440MHz	Pass	2.93	4.49	30.00
2480MHz	Pass	2.93	4.33	30.00

DG = Directional Gain; Port X = Port X output power

## **Summary of Conducted (Average) Output Power**

Mode	Power (dBm)	Power (W)
2.4-2.4835GHz	-	-
BT-LE(1Mbps)	4.56	0.00286

#### Result

Mode	Result	Antenna Gain (dBi)	Power (dBm)	Power Limit (dBm)
BT-LE(1Mbps)	-	-	-	-
2402MHz	Pass	2.93	4.56	-
2440MHz	Pass	2.93	4.39	-
2480MHz	Pass	2.93	4.25	-

Note: Average power is for reference only.

Report No.: FR9D2401-02AE Page: 15 of 32



# 3.3 Power Spectral Density

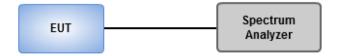
## 3.3.1 Limit of Power Spectral Density

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

#### 3.3.2 Test Procedures

- 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.

#### 3.3.3 Test Setup



Report No.: FR9D2401-02AE Page: 16 of 32



# 3.3.4 Test Result of Power Spectral Density

**Summary** 

Mode	PD (dBm/3kHz)
2.4-2.4835GHz	-
BT-LE(1Mbps)	-10.67

RBW = 3kHz;

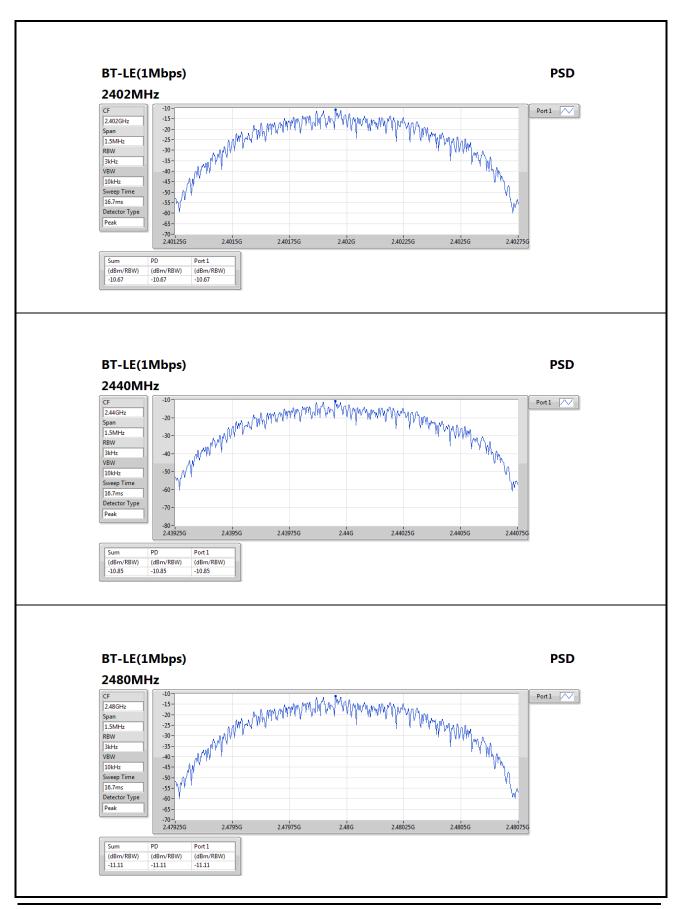
#### Result

Mode	Result	Antenna Gain (dBi)	PD (dBm/3kHz)	PD Limit (dBm/3kHz)
BT-LE(1Mbps)	-	-	-	-
2402MHz	Pass	2.93	-10.67	8.00
2440MHz	Pass	2.93	-10.85	8.00
2480MHz	Pass	2.93	-11.11	8.00

PD = Power density

Report No.: FR9D2401-02AE Page: 17 of 32





Report No.: FR9D2401-02AE Page: 18 of 32



## 3.4 Emissions in Restricted Frequency Bands

#### 3.4.1 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.

#### 3.4.2 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.

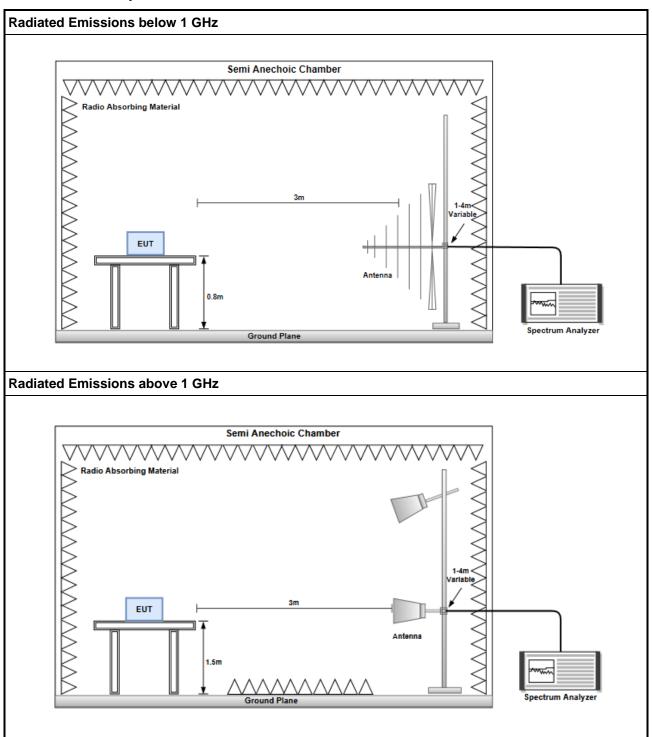
#### Note:

- 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.
- RBW=1MHz, VBW=1/T and Peak detector is for average measured value of radiated emission above 1GHz.

Report No.: FR9D2401-02AE Page: 19 of 32



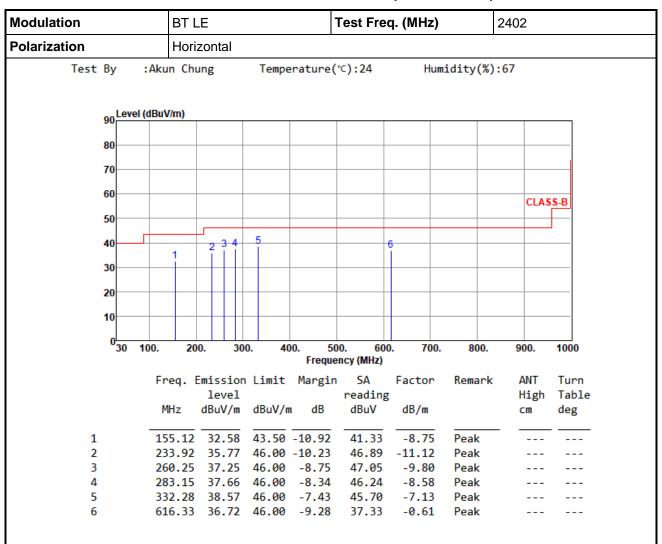
# 3.4.3 Test Setup



Report No.: FR9D2401-02AE Page: 20 of 32



#### 3.4.4 Transmitter Radiated Unwanted Emissions (Below 1GHz)



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

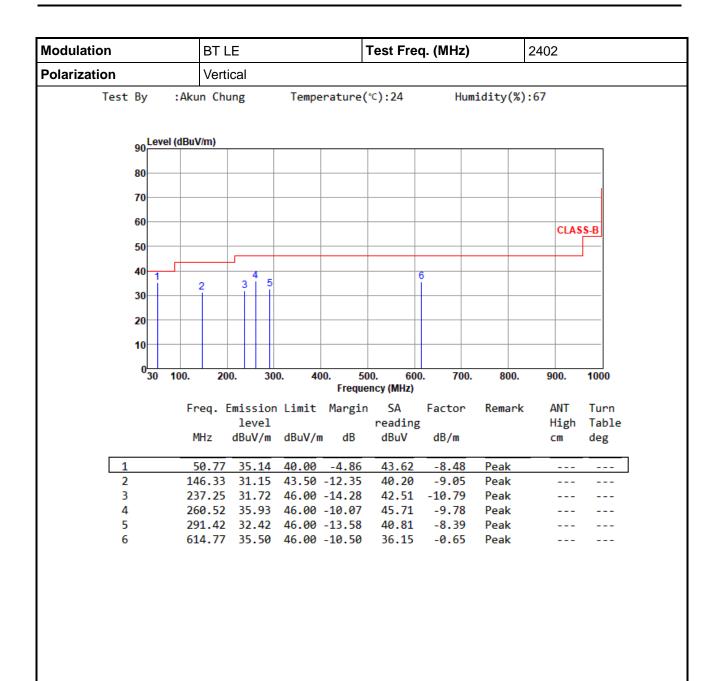
\*Factor includes antenna factor , cable loss and amplifier gain

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

Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

Report No.: FR9D2401-02AE Page: 21 of 32





\*Factor includes antenna factor , cable loss and amplifier gain

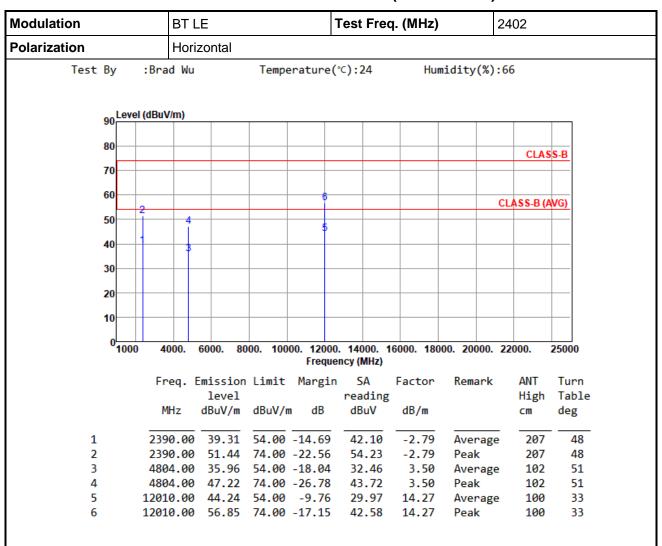
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

Report No.: FR9D2401-02AE Page: 22 of 32



#### 3.4.5 Transmitter Radiated Unwanted Emissions (Above 1GHz)



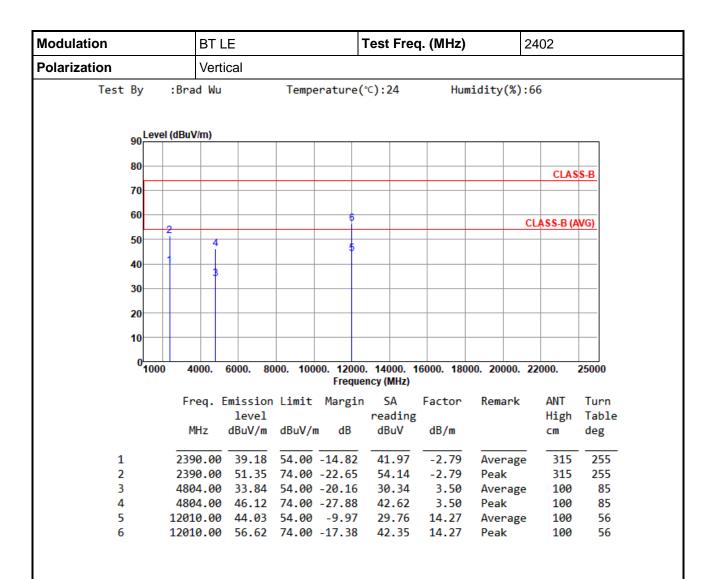
Note 1: Emission Level (dBuV/m) = SA Reading (dBuV) + Factor\* (dB/m)

\*Factor includes antenna factor, cable loss and amplifier gain

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

Report No.: FR9D2401-02AE Page: 23 of 32



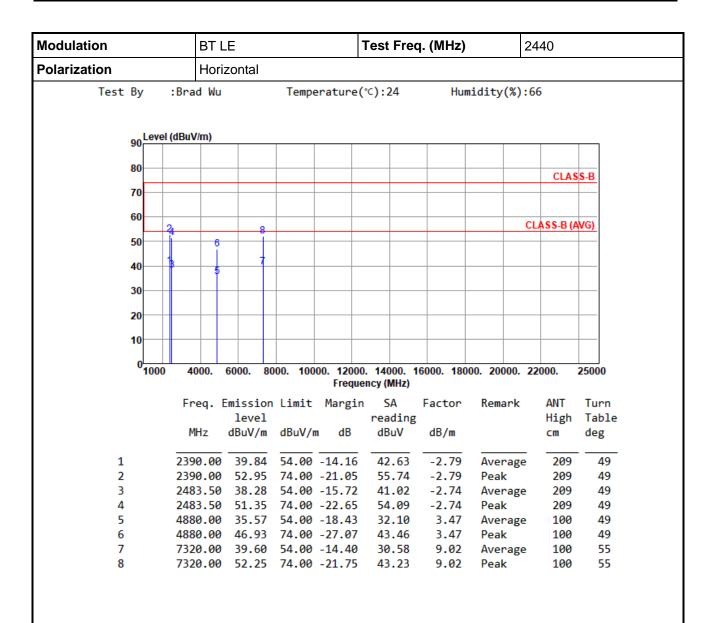


\*Factor includes antenna factor, cable loss and amplifier gain

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

Report No.: FR9D2401-02AE Page: 24 of 32



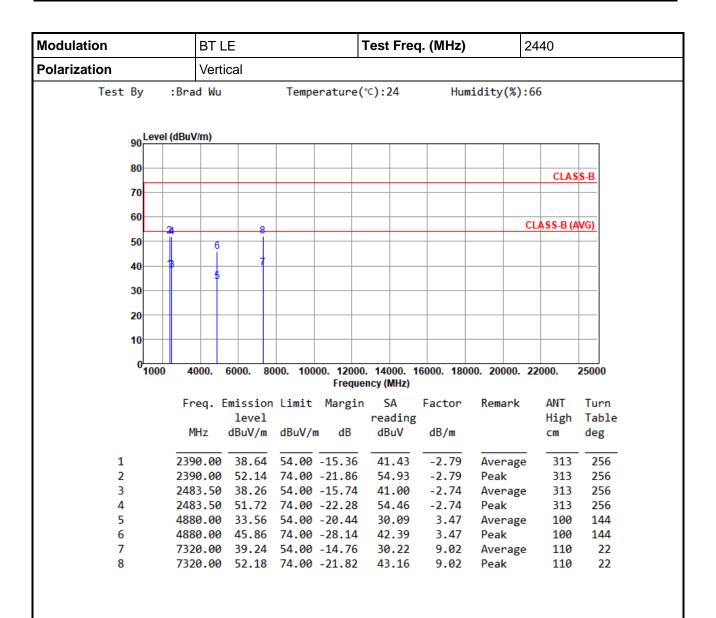


\*Factor includes antenna factor, cable loss and amplifier gain

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

Report No.: FR9D2401-02AE Page: 25 of 32



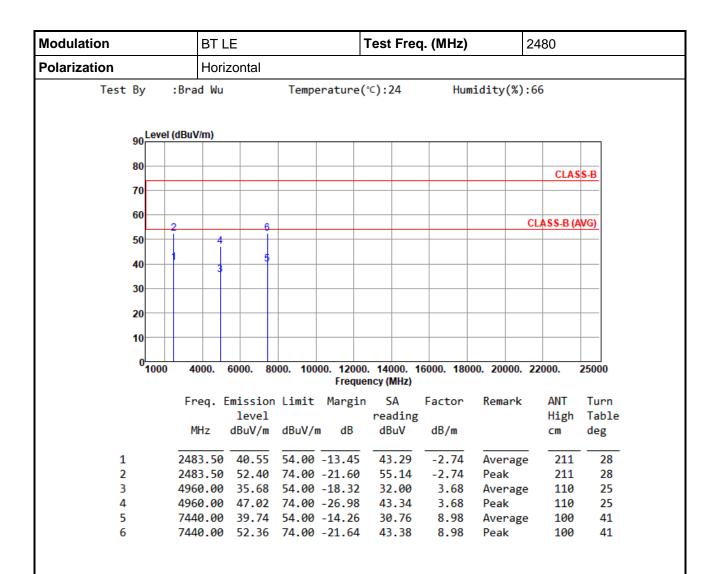


\*Factor includes antenna factor, cable loss and amplifier gain

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

Report No.: FR9D2401-02AE Page: 26 of 32



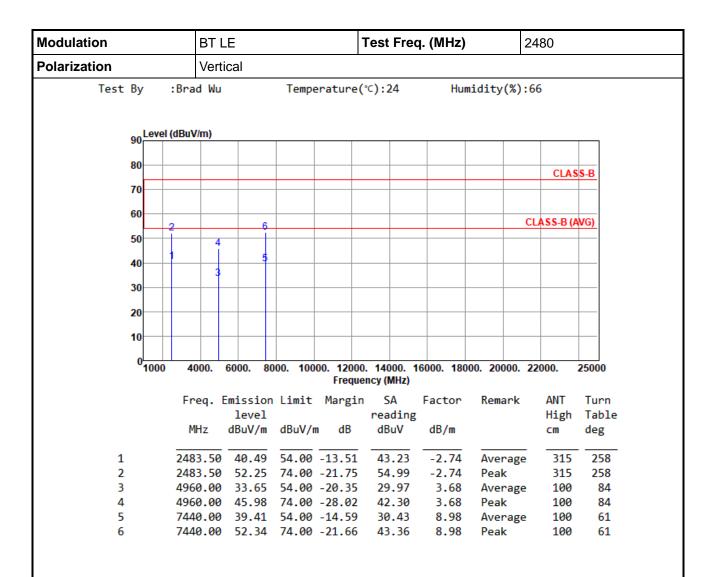


\*Factor includes antenna factor, cable loss and amplifier gain

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

Report No.: FR9D2401-02AE Page: 27 of 32





\*Factor includes antenna factor, cable loss and amplifier gain

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

Report No.: FR9D2401-02AE Page: 28 of 32



# 3.5 Emissions in non-restricted Frequency Bands

## 3.5.1 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.

#### 3.5.2 Test Procedures

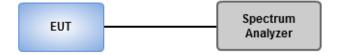
#### Reference level measurement

- 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

#### 3.5.3 Test Setup

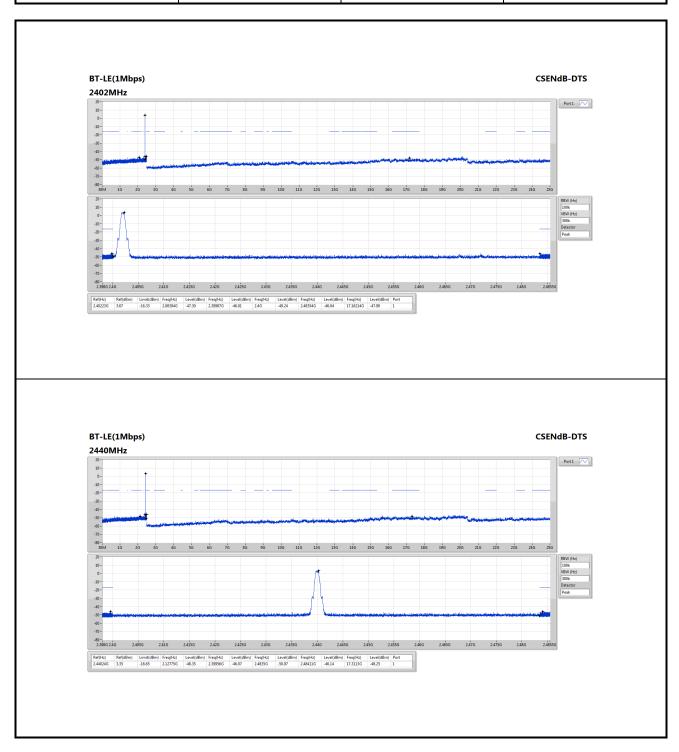


Report No.: FR9D2401-02AE Page: 29 of 32



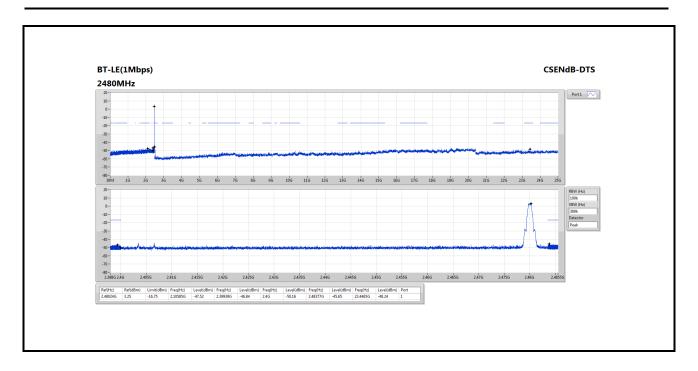
## 3.5.4 Test Result of Emissions in non-restricted Frequency Bands

Ambient Condition 24°C / 67% Tested By Aska Huang



Report No.: FR9D2401-02AE Page: 30 of 32





Report No.: FR9D2401-02AE

Page: 31 of 32



# 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 Corporation (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 <a href="http://www.icertifi.com.tw">http://www.icertifi.com.tw</a>.

#### 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: 886-3-318-0155

Email: ICC\_Service@icertifi.com.tw

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Report No.: FR9D2401-02AE Page: 32 of 32