Produkte
Products

Prüfbericht - Nr.: *Test Report No.:*	**14033654 001**		**Seite 1 von 16** *Page 1 of 16*

Auftraggeber: *Client:*	**Able Trend Technology Ltd.** **Unit 513, 5/F, Enterprise Place** **Hong Kong Science Park** **SHATIN, N.T.** **HONG KONG**		
Gegenstand der Prüfung: *Test Item:*	**Dual Mode Bluetooth Low Energy Module**		
Bezeichnung: *Identification:*	**LE2201**	**Serien-Nr.:** *Serial No.:*	**Engineering sample**
Wareneingangs-Nr.: *Receipt No.:*	**00130905133-001**	**Eingangsdatum:** *Date of Receipt:*	**05.09.2013**
Prüfort: *Testing Location:*	**TÜV Rheinland Hong Kong Ltd.** 8/F, First Group Centre, 14 Wang Tai Road, Kowloon Bay, Kowloon, Hong Kong **Hong Kong Productivity Council** HKPC Building, 78 Tat Chee Avenue, Kowloon, Hong Kong		
Zustand des Prüfgegenstandes bei Anlieferung: *Condition of test item at delivery:*	Test sample(s) is/are not damaged and suitable for testing.		
Prüfgrundlage: *Test Specification:*	**FCC Part 15 Subpart C** **ANSI C63.4-2003** **CISPR 22:1997**		
Prüfergebnis: *Test Results:*	**Das vorstehend beschriebene Gerät wurde geprüft und entspricht oben genannter Prüfgrundlage.** The above mentioned product was tested and **passed**.		
Prüflaboratorium: *Testing Laboratory:*	**TÜV Rheinland Hong Kong Ltd.** 8 - 10/F., Goldin Financial Global Square, 7 Wang Tai Road, Kowloon Bay Kowloon, Hong Kong		

geprüft/ *tested by:*			**kontrolliert/** *reviewed by:*		
25.09.2013	Mika Chan Project Manager		25.09.2013	Hugo Wan Senior Project Manager	
Datum *Date*	**Name/Stellung** *Name/Position*	**Unterschrift** *Signature*	**Datum** *Date*	**Name/Stellung** *Name/Position*	**Unterschrift** *Signature*

Sonstiges: Other Aspects	**FCCID: 2AATFMB400EL**

Abkürzungen:	P(ass) = F(ail) = N/A = N/T =	entspricht Prüfgrundlage entspricht nicht Prüfgrundlage nicht anwendbar nicht getestet	**Abbreviations:**	P(ass) = F(ail) = N/A = N/T =	passed failed not applicable not tested

Table of Content

Product information

Manufacturers declarations

	Transceiver	
	Classic BT Mode	**BLE Mode**
Operating frequency range	2402 - 2480 MHz	
Type of modulation	GFSK; Pi/4 DQPSK; 8 DPSK	GFSK
Number of channels	79	40
Channel separation	1 MHz	2 MHz
Type of antenna	PCB Antenna	
Antenna gain (dBi)	0	
Power level	fix	
Type of equipment	stand alone radio device	
Connection to public utility power line	No	
Nominal voltage	V_{nor}: 3.3V	
Independent Operation Modes	Transmitting Receiving	

Product function and intended use

The test item is a SPP v1.1 profile compliant Dual Mode Bluetooth Low Energy Module LE2201/203 that is a high performance, cost effective, low power and compact solution. The Bluetooth Smart module provides a complete 2.4GHz Bluetooth system based on Toshiba TC35661 chipset, which is a single chip radio and baseband IC for Bluetooth 2.4GHz systems. This module is fully compliant to Bluetooth SPP v1.1 profile for data communications.

It support the following Applications:
• Toys,
• Scanner
• Power Meter
• POS
• Terminal control

For details, please refer to the datasheet.

Submitted documents

Circuit Diagram
Block Diagram
Bill of material
User manual

Remark

Special accessories and auxiliary equipment

Disturbance Voltage on AC Mains:
- RS232 Level Shifter Board

- DC Power Supply
    Brand: ISO-TECH
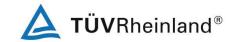   Model No.: IPS 2303DD
    Serial No: 411B088G2

Radiated Emissions:
- RS232 Level Shifter Board

- DC Power Supply
    Brand: HP
    Model No.: E3611A
    Serial No: KR51309803

List of Test and Measurement Instruments

Hong Kong Productivity Council (Registration number: 90656)

Equipment	Manufacturer	Type	S/N	Due Date
Semi-anechoic Chamber	Frankonia	Nil	Nil	12-Apr-14
Test Receiver	R & S	ESU40	100190	19-Feb-14
Bi-conical Antenna	R & S	HK116	100241	11-Jun-15
Log Periodic Antenna	R & S	HL223	841516/017	10-Jun-15
Coaxial cable 50ohm	Rosenberger	RTK081-05S-05S-10m	LA2-001-10M / 001	15-Nov-13
Microwave amplifer 0.5-26.5GHz, 25dB gain	HP	83017A	3123A00437	03-Oct-13
High Pass Filter (cutoff freq. =1000MHz)	Trilithic	23042	9829213	28-Oct-13
Horn Antenna	EMCO	3115	9002-3347	11-Jun-15
Active Loop Antenna	EMCO	6502	9107-2651	21-Jun-14

TÜV Rheinland Hong Kong Ltd.

Equipment	Manufacturer	Type	S/N	Due Date
FSP 30 Spectrum Analyser	Rohde & Schwarz	FSP 30	100007	03-Dec-14
Test Receiver	Rohde & Schwarz	ESCS30	100201	26-Feb-14
LISN	Rohde & Schwarz	ENV216	100273	06-Mar-14

Results FCC Part 15 – Subpart C

Subclause 15.203 – Antenna Information	Pass

Requirement:	No antenna other than that furnished by the responsible party shall be used with the device
Results:	Permanent attached antenna
Verdict:	Pass

Subclause 15.204 – Antenna Information	Pass

Requirement:	Provide information for every antenna proposed for the use with the EUT	
Results:	a) Antenna type:	PCB Antenna
	b) Manufacturer and model no:	N.A.
	c) Gain with reference to an isotropic radiator:	0 dBi
Verdict:	Pass	

Subclause 15.207 – Disturbance Voltage on AC Mains	Pass

Test Port: AC mains input port of the DC power supply

Applied Voltage: 120VAC

Mode of operation: Tx Frequency Hopping

Live measurement

Frequency range (MHz)	Frequency (MHz)	Quasi-peak dBµV	Average dBµV	Limit QP (dBµV)	Limit AV (dBµV)	Verdict
0,15 – 0,5	No peak found	---	---	66 - 56	56 - 46	Pass
> 0,5 - 5	No peak found	---	---	56	46	Pass
> 5 - 30	No peak found	---	---	60	50	Pass

Neutral measurement

Frequency range (MHz)	Frequency (MHz)	Quasi-peak dBµV	Average dBµV	Limit QP (dBµV)	Limit AV (dBµV)	Verdict
0,15 – 0,5	No peak found	---	---	66 - 56	56 - 46	Pass
> 0,5 - 5	No peak found	---	---	56	46	Pass
> 5 - 30	No peak found	---	---	60	50	Pass

Results:	Pre-scan has been conducted to determine the worst-case mode from all possible combinations between available modulations and packet types.
	The radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150kHz to 30MHz does not exceed the limits. For test Results plots refer to Appendix 1, page 2-3.

Subclause 15.247 (a)(1) – Carrier Frequency Separation	Pass

Requirement:	Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25kHz or the 2/3*20dB bandwidth of the hopping channel, whichever is greater.
Test Specification : FCC Part 15 Subpart A – Subclause 15.31 Mode of operation : Classic Bluetooth Tx mode (hopping on), 8DPSK Port of testing : Temporary antenna port Detector : Peak RBW/VBW : 100 kHz / 300 kHz Supply voltage : 3.3VDC from DC power supply Temperature : 23ºC Humidity : 50%	
Results:	Pre-scan has been conducted to determine the worst-case mode from all possible combinations between available modulations and packet types. The centre frequencies of the hopping channels are separated by more than the 2/3*20dB bandwidth. For test Results plots refer to Appendix 1, page 4.
Verdict:	Pass

Subclause 15.247 (a)(1)(iii) – Number of hopping channels	Pass

Requirement:	Frequency hopping systems operating in the 2400MHz-2483.5MHz bands shall use at least 15 hopping frequencies.
Test Specification : FCC Part 15 Subpart A – Subclause 15.31 Mode of operation : Classic Bluetooth Tx mode (hopping on), 8DPSK Port of testing : Temporary antenna port Detector : Peak RBW/VBW : 1 MHz / 3 MHz Supply voltage : 3.3VDC from DC power supply Temperature : 23ºC Humidity : 50%	
Results:	The total number of hopping frequencies is more than 15. For test Results plots refer to Appendix 1, page 5.
Verdict:	Pass

Subclause 15.247 (a)(1)(iii) – Time of Occupancy (Dwell Time)	Pass

Requirement:	Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

Test Specification : FCC Part 15 Subpart A – Subclause 15.31
Mode of operation : Classic Bluetooth Tx mode (hopping on), DH5 packet
Port of testing : Temporary antenna port
Detector : Peak
RBW/VBW : 1 MHz / 3 MHz
Supply voltage : 3.3VDC from DC power supply
Temperature : 23ºC
Humidity : 50%

Results: Time period calculation = 0.4 x 79 = 31.6s
Dwell time = 76 x 2.952 x 10^{-3} = 224.352 x 10^{-3} s
<= 400 x 10^{-3} s

For test protocols please refer to Appendix 1, page 6.

Verdict: Pass

Subclause 15.247 (a) – 20 dB Bandwidth	Pass

Requirement:	Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25kHz or the 2/3*20dB bandwidth of the hopping channel, whichever is greater.

Test Specification : FCC Part 15 Subpart A – Subclause 15.31
Mode of operation : Classic Bluetooth Tx mode (2402MHz, 2441MHz, 2480MHz)
Port of testing : Temporary antenna port
Detector : Peak
RBW/VBW : 30 kHz / 100 kHz
Supply voltage : 3.3VDC from DC power supply
Temperature : 23ºC
Humidity : 50%

Results:	Pre-scan has been conducted to determine the worst-case mode from all possible combinations between available modulations and packet types. For test protocols refer to Appendix 1, page 7-9.

GFSK Modulation

Frequency (MHz)	20 dB left (MHz)	20 dB right (MHz)	20dB bandwidth (MHz)
2402	0.462	0.468	0.930
2441	0.456	0.468	0.924
2480	0.462	0.468	0.930

8DPSK Modulation

Frequency (MHz)	20 dB left (MHz)	20 dB right (MHz)	20dB bandwidth (MHz)

2402	0.648	0.624	1.272
2441	0.642	0.630	1.272
2480	0.648	0.618	1.266

Subclause 15.247 (a)(2) – 6dB Bandwidth Measurement **Pass**

Requirement: Systems using digital modulation techniques may operate in the 902 – 928 MHz, 2400 – 2483.5 MHz, and 5725 – 5850 MHz bands. The minimum 6dB bandwidth shall be at least 500kHz.

Test Specification : FCC Part 15 Subpart A – Subclause 15.31
Mode of operation : BLE Tx mode, (2402MHz, 2440MHz, 2480MHz)
Port of testing : Temporary antenna port
Detector : Peak
RBW/VBW : 100KHz/ 300KHz
Supply voltage : 3.3VDC from DC power supply
Temperature : 23ºC
Humidity : 50%

Results: For test protocols please refer to Appendix 1, page 10-11.

Channel frequency (MHz)	6 dB left (MHz)	6 dB right (MHz)	20dB bandwidth (MHz)
2402	0.09	0.582	0.672
2440	0.09	0.576	0.666
2480	0.09	0.570	0.660

Subclause 15.247 (a) – Hopping Sequence **Pass**

Requirement: The hopping sequence is generated and provided with an example.

Hopping sequence

The channel is represented by a pseudo-random hopping sequence hopping through the 79 RF channels. The hopping sequence is unique for the piconet and is determined by the Bluetooth device address of the master. The X input determines the phase in the 32-hop segment, whereas Y1 and Y2 selects between master-to-slave and slave-to-master transmission. The inputs A to D determine the ordering within the segment, the inputs E and F determine the mapping onto the hop frequencies.

Example data:

Hop sequence {k} for CONNECTION STATE:
CLK start: 0x0000010
ULAP: 0x00000000

```
#ticks:      00 02 | 04 06 | 08 0a | 0c 0e | 10 12 | 14 16 | 18 1a | 1c 1e |
-------------------------------------------------------------------------------------
0x0000010: 08 66 | 10 70 | 12 19 | 14 23 | 16 01 | 18 05 | 20 33 | 22 37 |
0x0000030: 24 03 | 26 07 | 28 35 | 30 39 | 32 72 | 34 76 | 36 25 | 38 29 |
0x0000050: 40 74 | 42 78 | 44 27 | 46 31 | 48 09 | 50 13 | 52 41 | 54 45 |
0x0000070: 56 11 | 58 15 | 60 43 | 62 47 | 32 17 | 36 19 | 34 49 | 38 51 |
0x0000090: 40 21 | 44 23 | 42 53 | 46 55 | 48 33 | 52 35 | 50 65 | 54 67 |
0x00000b0: 56 37 | 60 39 | 58 69 | 62 71 | 64 25 | 68 27 | 66 57 | 70 59 |
0x00000d0: 72 29 | 76 31 | 74 61 | 78 63 | 01 41 | 05 43 | 03 73 | 07 75 |
0x00000f0: 09 45 | 13 47 | 11 77 | 15 00 | 64 49 | 66 53 | 68 02 | 70 06 |
0x0000110: 01 51 | 03 55 | 05 04 | 07 08 | 72 57 | 74 61 | 76 10 | 78 14 |
0x0000130: 09 59 | 11 63 | 13 12 | 15 16 | 17 65 | 19 69 | 21 18 | 23 22 |
0x0000150: 33 67 | 35 71 | 37 20 | 39 24 | 25 73 | 27 77 | 29 26 | 31 30 |
0x0000170: 41 75 | 43 00 | 45 28 | 47 32 | 17 02 | 21 04 | 19 34 | 23 36 |
0x0000190: 33 06 | 37 08 | 35 38 | 39 40 | 25 10 | 29 12 | 27 42 | 31 44 |
0x00001b0: 41 14 | 45 16 | 43 46 | 47 48 | 49 18 | 53 20 | 51 50 | 55 52 |
0x00001d0: 65 22 | 69 24 | 67 54 | 71 56 | 57 26 | 61 28 | 59 58 | 63 60 |
0x00001f0: 73 30 | 77 32 | 75 62 | 00 64 | 49 34 | 51 42 | 57 66 | 59 74 |
0x0000210: 53 36 | 55 44 | 61 68 | 63 76 | 65 50 | 67 58 | 73 03 | 75 11 |
0x0000230: 69 52 | 71 60 | 77 05 | 00 13 | 02 38 | 04 46 | 10 70 | 12 78 |
0x0000250: 06 40 | 08 48 | 14 72 | 16 01 | 18 54 | 20 62 | 26 07 | 28 15 |
0x0000270: 22 56 | 24 64 | 30 09 | 32 17 | 02 66 | 06 74 | 10 19 | 14 27 |
0x0000290: 04 70 | 08 78 | 12 23 | 16 31 | 18 03 | 22 11 | 26 35 | 30 43 |
0x00002b0: 20 07 | 24 15 | 28 39 | 32 47 | 34 68 | 38 76 | 42 21 | 46 29 |
0x00002d0: 36 72 | 40 01 | 44 25 | 48 33 | 50 05 | 54 13 | 58 37 | 62 45 |
0x00002f0: 52 09 | 56 17 | 60 41 | 64 49 | 34 19 | 36 35 | 50 51 | 52 67 |
0x0000310: 38 21 | 40 37 | 54 53 | 56 69 | 42 27 | 44 43 | 58 59 | 60 75 |
0x0000330: 46 29 | 48 45 | 62 61 | 64 77 | 66 23 | 68 39 | 03 55 | 05 71 |
0x0000350: 70 25 | 72 41 | 07 57 | 09 73 | 74 31 | 76 47 | 11 63 | 13 00 |
0x0000370: 78 33 | 01 49 | 15 65 | 17 02 | 66 51 | 70 67 | 03 04 | 07 20 |
0x0000390: 68 55 | 72 71 | 05 08 | 09 24 | 74 59 | 78 75 | 11 12 | 15 28 |
0x00003b0: 76 63 | 01 00 | 13 16 | 17 32 | 19 53 | 23 69 | 35 06 | 39 22 |
0x00003d0: 21 57 | 25 73 | 37 10 | 41 26 | 27 61 | 31 77 | 43 14 | 47 30 |
0x00003f0: 29 65 | 33 02 | 45 18 | 49 34 | 19 04 | 21 08 | 23 20 | 25 24 |
```

Subclause 15.247 (b) (1), (3) – Maximum Peak Output Power	Pass

Classic Bluetooth Tx mode

Requirement:	For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 Watt. For all other frequency hopping systems in the 2400 – 2483.5 MHz band: 0.125 Watts.

Test Specification	:	FCC Part 15 Subpart A – Subclause 15.31
Mode of operation	:	Classic Bluetooth Tx mode (2402MHz, 2441MHz, 2480MHz)
Port of testing	:	Temporary antenna port
Detector	:	Peak
RBW/VBW	:	3 MHz / 10 MHz
Supply voltage	:	3.3VDC from DC power supply
Temperature	:	23ºC
Humidity	:	50%

Results:	For test protocols please refer to Appendix 1, page 12-16.

GFSK Modulation

Frequency (MHz)	Maximum peak output power (dBm)	Cable attenuation (dB)	Output power (dBm)	Limit (W/dBm)	Verdict
2402	0.57	0.00	0.570	1 / 30.0	Pass
2441	0.81	0.00	0.810	1 / 30.0	Pass
2480	0.84	0.00	0.840	1 / 30.0	Pass

DQPSK Modulation

Frequency (MHz)	Maximum peak output power (dBm)	Cable attenuation (dB)	Output power (dBm)	Limit (W/dBm)	Verdict
2402	2.28	0.00	2.280	1 / 30.0	Pass
2441	2.40	0.00	2.400	1 / 30.0	Pass
2480	2.46	0.00	2.460	1 / 30.0	Pass

8DPSK Modulation

Frequency (MHz)	Maximum peak output power (dBm)	Cable attenuation (dB)	Output power (dBm)	Limit (W/dBm)	Verdict
2402	2.80	0.00	2.800	1 / 30.0	Pass
2441	2.86	0.00	2.860	1 / 30.0	Pass
2480	2.98	0.00	2.980	1 / 30.0	Pass

BLE Tx mode

Requirement:	For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850MHz bands: 1 Watt (30dBm)

Test Specification : FCC Part 15 Subpart A – Subclause 15.31
Mode of operation : BLE Tx mode, (2402MHz, 2440MHz, 2480MHz)
Port of testing : Temporary antenna port
Detector : Peak
RBW/VBW : >=DTS BW / >=3xRBW
Span : >=RBW
Supply voltage : 3.3VDC from DC power supply
Temperature : 23ºC
Humidity : 50%

Results:	For test protocols please refer to Appendix 1, page 17-18.

Frequency (MHz)	Maximum peak output power (dBm)	Cable attenuation (dB)	Output power (dBm)	Limit (W/dBm)	Verdict
2402	0.23	0.00	0.230	1 / 30.0	Pass
2440	0.18	0.00	0.180	1 / 30.0	Pass
2480	0.33	0.00	0.330	1 / 30.0	Pass

Subclause 15.247 (d) – Spurious Conducted Emissions	Pass

Test Specification	: FCC Part 15 Subpart A – Subclause 15.31
Mode of operation	: Tx mode (2402MHz, 2440/2441MHz, 2480MHz)
Port of testing	: Temporary antenna port
Detector	: Peak
RBW/VBW	: 100 kHz / 300 kHz
Supply voltage	: 3.3VDC from DC power supply
Temperature	: 23 ºC
Humidity	: 50 %

Requirement:	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

Results:	There is no peak found outside any 100kHz bandwidth of the operating frequency band in the three transmit frequency. All three transmit frequency modes comply with the limit stated in subclause 15.247(d). For test protocols refer to Appendix 1, page 19-22.

Classic Bluetooth Tx mode (8DPSK Modulation)

Operating frequency (MHz)	Spurious frequency (MHz)	Spurious Level (dBm)	Reference value (dBm)	Delta (dB)	Verdict
2402	12000	-56.01	-0.96	55.05	Pass
2441	12200	-56.20	-2.01	54.19	Pass
2480	1850	-57.02	-0.25	56.77	Pass

BLE Tx mode

Operating frequency (MHz)	Spurious frequency (MHz)	Spurious Level (dBm)	Reference value (dBm)	Delta (dB)	Verdict
2402	No Peak Found	-	-0.51	-	Pass
2440	1900	-52.58	-0.36	52.22	Pass
2480	No Peak Found	-	-1.07	-	Pass

Subclause 15.247 (d) – Spurious Radiated Emissions	Pass

Test Specification : ANSI C63.4 – 2003
Mode of operation : Tx mode (2402MHz, 2440MHz, 2480MHz), hopping off
Port of testing : Enclosure
Detector : Peak
RBW/VBW : 100 kHz / 300 kHz for f < 1 GHz
  1 MHz / 1 MHz for f > 1 GHz
Supply voltage : 3.3VDC from DC power supply
Temperature : 23ºC
Humidity : 50%

Requirement: In any 100kHz bandwidth outside the frequency band at least 20dB below the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in section15.205(a), must also comply with the radiated emission limits specified in section 15.209(a).

Results: Pre-scan has been conducted to determine the worst-case mode from all possible combinations between available modulations and packet types.

All three transmit frequency modes comply with the field strength within the restricted bands. There is no spurious found below 30MHz.

Classic Bluetooth Tx mode

Tx frequency 2402MHz   Vertical Polarization

Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m
No Peak found	-	74.0 / P
No Peak found	-	54.0 / A

Tx frequency 2402MHz   Horizontal Polarization

Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m
No Peak found	-	74.0 / P
No Peak found	-	54.0 / A

Tx frequency 2441MHz   Vertical Polarization

Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m
No Peak found	-	74.0 / P
No Peak found	-	54.0 / A

Tx frequency 2441MHz   Horizontal Polarization

Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m
No Peak found	-	74.0 / P
No Peak found	-	54.0 / A

Tx frequency 2480MHz   Vertical Polarization

Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m
No Peak found	-	74.0 / P

No Peak found	-	54.0 / A

Tx frequency 2480MHz	Horizontal Polarization	

Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m
No Peak found	-	74.0 / P
No Peak found	-	54.0 / A

BLE Tx mode

Tx frequency 2402MHz	Vertical Polarization	

Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m
No Peak found	-	74.0 / P
No Peak found	-	54.0 / A

Tx frequency 2402MHz	Horizontal Polarization	

Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m
No Peak found	-	74.0 / P
No Peak found	-	54.0 / A

Tx frequency 2440MHz	Vertical Polarization	

Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m
No Peak found	-	74.0 / P
No Peak found	-	54.0 / A

Tx frequency 2440MHz	Horizontal Polarization	

Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m
No Peak found	-	74.0 / P
No Peak found	-	54.0 / A

Tx frequency 2480MHz	Vertical Polarization	

Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m
No Peak found	-	74.0 / P
No Peak found	-	54.0 / A

Tx frequency 2480MHz	Horizontal Polarization	

Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m
No Peak found	-	74.0 / P
No Peak found	-	54.0 / A

Subclause 15.247 (d) – Band Edge Emissions	Pass

Test Specification : FCC Part 15 Subpart A – Subclause 15.31 Mode of operation : Classic Bluetooth , BLE Tx mode (2402MHz, 2480MHz) Port of testing : Temporary antenna port Detector : Peak RBW/VBW : 100 kHz / 300 kHz Supply voltage : 3.3VDC from DC power supply Temperature : 23ºC Humidity : 50%	
Requirement:	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.
Results:	There is no peak found outside any 100 kHz bandwidth of the operating frequency band. For test protocols refer to Appendix 1, page 23-25.

Subclause 15.205 – Restricted Bands Next to The Band Edge	Pass

Test Specification : FCC Part 15 Subpart A – Subclause 15.31 Mode of operation : Classic Bluetooth, BLE Tx mode (2402MHz, 2480MHz) Port of testing : Enclosure Detector : Peak RBW/VBW : 1 MHz / 1 MHz Supply voltage : 3.3VDC from DC power supply Temperature : 23ºC Humidity : 50%	
Requirement:	Radiated emissions which fall in the restricted bans, as defined in 15.205 (a), must also comply with the radiated emission limits specified in 15.209(a).
Results:	There is no peak found in the restricted bands. For test protocols refer to Appendix 1, page 26-33.

Subclause 15.247 (e) – Power Spectral Density	Pass

Requirement:	For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

Test Specification : FCC Part 15 Subpart A – Subclause 15.31
Mode of operation : BLE Tx mode (2402MHz, 2440MHz, 2480MHz)
Port of testing   : Temporary antenna port
Detector   : Peak
RBW/VBW   : >=100 KHz / >=3xRBW
span   : >=1.5 x DTS BW
Supply voltage   : 3.3VDC from DC power supply
Temperature   : 23ºC
Humidity   : 50%

Results: For test protocols please refer to Appendix 1, page 34-35.

Operating frequency (MHz)	Power density (dBm)	Limit (dBm)	Verdict
2402	-0.25	8.0	Pass
2440	-0.24	8.0	Pass
2480	-0.09	8.0	Pass

Verdict: Pass