

FCC Test Report

Report No.: RWAP202400182A

Applicant: JPL Telecom LLC

Address: JPL Telecom LLC 445 W Merritt Avenue, MERRITT ISLAND, FL

32953, United States

Product Name: Bluetooth DND(Do Not Disturb) LIGHT DEVICE

Product Model: DND-1000S

Multiple Models: N/A

Trade Mark: N/A

FCC ID: 2BFHCDND-1000S

Standards: FCC CFR Title 47 Part 15C (§15.247)

Test Date: 2024-03-05 to 2024-03-12

Test Result: Complied

Report Date: 2024-03-18

Reviewed by:

Approved by:

Abel Chen

Project Engineer

Jacob Kong

Jacob Gong

Manager

Prepared by:

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Revision History

Version No.	Issued Date	Description	
00	2024-03-18	Original	

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1 General Information

1.1 Client Information

Applicant:	JPL Telecom LLC
Address:	JPL Telecom LLC 445 W Merritt Avenue, MERRITT ISLAND, FL 32953, United States
Manufacturer:	DIOWAVE Co.,Ltd
Address:	#1314-ho, AP Tower, Gasan-Digital-1ro 16, GeumChun-Gu, Seoul, Korea

1.2 Product Description of EUT

The EUT is Bluetooth DND(Do Not Disturb) LIGHT DEVICE that contains BLE(1M) radio, this report covers the full testing of the BLE(1M) radio.

Sample Serial Number	6H-3 for CE Test, 6H-2 for RE test, 6H-1 for RF conducted test (assigned by WATC)
Sample Received Date	2024-03-01
Sample Status	Good Condition
Frequency Range	2402MHz - 2480MHz(BLE1M)
Maximum Conducted Peak Output Power	0.29dBm
Modulation Technology	GFSK
Spatial Streams	SISO (1TX, 1RX)
Antenna Gain [#]	5.470dBi
Power Supply	DC 3.7V From battery or DC 5V from Type C port
Operating temperature [#]	-10 deg.C to +50 deg.C
Adapter Information	N/A
Modification	Sample No Modification by the test lab

1.3 Antenna information

15.203 requirement:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

Device Antenna information:

The BLE antenna is an internal antenna which cannot replace by end-user, please see product internal photos for details.

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1.4 Related Submittal(s)/Grant(s)

No related submittal(s)/Grant(s)

1.5 Measurement Uncertainty

Parameter		Expanded Uncertainty (Confidence of 95%(U = 2Uc(y)))	
AC Power Lines Condu	cted Emissions	±3.14dB	
Emissions, Radiated	Below 30MHz	±2.78dB	
	Below 1GHz	±4.84dB	
	Above 1GHz	±5.44dB	
Emissions, Conducted	I	1.75dB	
Conducted Power		0.74dB	
Frequency Error		150Hz	
Bandwidth		0.34%	
Power Spectral Density		0.74dB	

Note: The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval. Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.

1.6 Laboratory Location

World Alliance Testing & Certification (Shenzhen) Co., Ltd

No. 1002, East Block, Laobing Building, Xingye Road 3012, Xixiang street, Bao'an District, Shenzhen, Guangdong, People's Republic of China

Tel: +86-755-29691511, Email: qa@watc.com.cn

The lab has been recognized as the FCC accredited lab under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No. : 463912, the FCC Designation No. : CN5040.

The lab has been recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements, the CAB identifier: CN0160.

1.7 Test Methodology

FCC CFR 47 Part 2

FCC CFR 47 Part 15

KDB 558074 D01 DTS Meas Guidance v05r02

ANSI C63.10-2020

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2 Description of Measurement

2.1 Test Configuration

Operating channels:							
Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)		
0	2402	19	2440	38	2478		
1	2404	20	2442	39	2480		
				/	/		
18	2438			/	/		

According to ANSI C63.10-2020 chapter 5.6.1 Table 11 requirement, select lowest channel, middle channel, and highest channel in the frequency range in which device operates for testing. The detailed frequency points are as follows:

Lowest channel		Middle channel		Highest channel	
Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)
0	2402	19	2440	39	2480

Test Mode:						
Transmitting mode:	nitting mode: Keep the EUT in continuous transmitting with modulation					
Exercise software#:	Putty	Putty				
Mada	Data nata	Power Level Setting [#]				
Mode	Data rate	Low Channel	Middle Channel	High Channel		
BLE 1M	BLE 1M 1Mbps default default default					
The exercise softwa	The exercise software and the maximum power setting that provided by manufacturer.					

Worst-Case Configuration:

For radiated emissions, EUT was investigated in three orthogonal orientation, the worst-case orientation was recorded in report

For AC power line conducted emission and radiated emission 9kHz-1GHz and above 18GHz were performed with the EUT transmits at the channel with highest output power as worst-case scenario.

2.2 Test Auxiliary Equipment

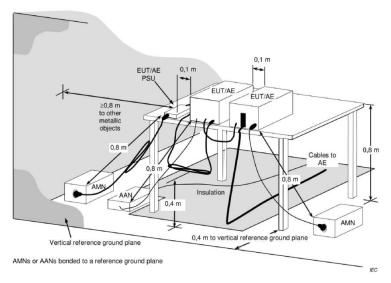
Manufacturer	Description	Model	Serial Number
MEIZU	power supply adapter	unknown	unknown

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2.3 Test Setup

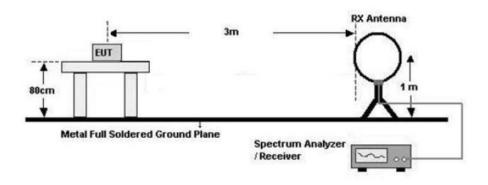
1) Conducted emission measurement:



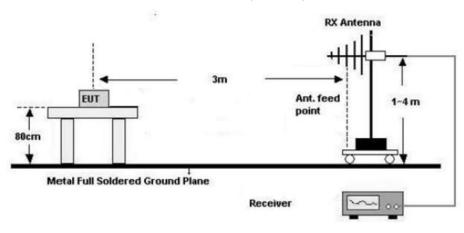
Note: The 0.8 m distance specified between EUT/AE/PSU and AMN/AAN, is applicable only to the EUT being measured. If the device is AE then it shall be >0.8 m.

2) Radiated emission measurement:

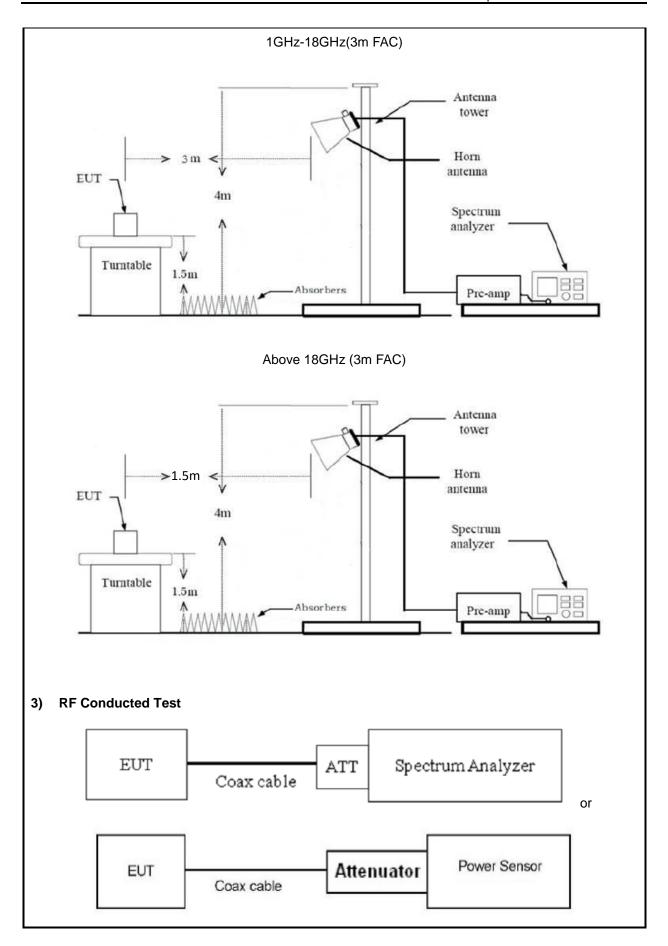
Below 30MHz (3m SAC)



30MHz-1GHz (3m SAC)











2.4 Test Procedure

Conducted emission:

- 1. The E.U.T is placed on a non-conducting table 40cm from the vertical ground plane and 80cm above the horizontal ground plane (Please refer to the block diagram of the test setup and photographs).
- Both sides of A.C. line are checked for maximum conducted interference. In order to find the
 maximum emission, the relative positions of equipment and all of the interface cables must be
 changed according to ANSI C63.10 on conducted measurement.
- 3. Line conducted data is recorded for both Line and Neutral

Radiated Emission Procedure:

a) For below 30MHz

- 1. All measurements were made at a test distance of 3 m. The measured data was extrapolated from the test distance (3m) to the specification distance (300 m from 9-490 kHz and 30 m from 490 kHz- 30 MHz) to clearly show the relative levels of fundamental and spurious emissions and demonstrate compliance with the requirement that the level of any spurious emissions be below the level of the intentionally transmitted signal. The extrapolation factor for the limits were 40*Log (test distance / specification distance).
- 2. Loop antenna use, investigation was done on the three antenna orientations (parallel, perpendicular, gound-parallel)

b) For 30MHz-1GHz:

- 1. The EUT was placed on the tabletop of a rotating table 0.8 m the ground at a 3 m semi anechoic chamber. The measurement distance from the EUT to the receiving antenna is 3 m.
- 2. EUT works in each mode of operation that needs to be tested. The highest signal levels relative to the limit shall be determined by rotating the EUT from 0° to 360° and with varying the measurement antenna height between 1 m and 4 m in vertical and horizontal polarizations.

c) For above 1GHz:

- 1. The EUT was placed on the tabletop of a rotating table 1.5 m the ground at a 3 m fully anechoic room. The measurement distance from the EUT to the receiving antenna is 3 m (1-18GHz) and 1.5 m (above 18GHz).
- 2. EUT works in each mode of operation that needs to be tested, and having the EUT continuously working. The highest signal levels relative to the limit shall be determined by rotating the EUT from 0° to 360° and with varying the measurement antenna height between 1 m and 4 m in vertical and horizontal polarizations.
- 3. Open the test software to control the test antenna and test turntable. Perform the test, save the test results, and export the test data.
- 4. Base on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field.

RF Conducted Test:

1. The antenna port of EUT was connected to the RF port of the test equipment (Power Meter or



Spectrum analyzer) through Attenuator and RF cable.

- 2. The cable assembly insertion loss of 6.5dB (including 6.0 dB Attenuator and 0.5dB cable) was entered as an offset in the power meter. Note: Actual cable loss was unavailable at the time of testing, therefore a loss of 0.5dB was assumed as worst case. This was later verified to be true by laboratory. (if the RF cable provided by client, the cable loss declared by client)
- 3. The EUT is keeping in continuous transmission mode and tested in all modulation modes.

2.5 Measurement Method

Description of Test	Measurement Method	
AC Line Conducted Emissions	ANSI C63.10-2020 Section 6.2	
Maximum Conducted Output Power	ANSI C63.10-2020 Section 11.9.1.1	
Power Spectral Density	ANSI C63.10-2020 Section 11.10.2	
6 dB Emission Bandwidth	ANSI C63.10-2020 Section 11.8.1	
99% Occupied Bandwidth	ANSI C63.10-2020 Section 6.9.3	
100kHz Bandwidth of Frequency Band Edge	ANSI C63.10-2020 Section 6.10	
Radiated emission	ANSI C63.10-2020 Section 11.11&11.12.1	
Duty Cycle	ANSI C63.10-2020 Section 11.6	

2.6 Measurement Equipment

Manufacturer	Description	Model	Management No.	Calibration Date	Calibration Due Date		
	AC Line Conducted Emission Test						
ROHDE&	EMI TEST	ESR	101817	2023/7/3	2024/7/2		
SCHWARZ	RECEIVER	ESK	101617	2023/1/3	2024/1/2		
R&S	LISN	ENV216	101748	2023/8/1	2024/7/31		
N/A	Coaxial Cable	NO.12	N/A	2023/7/3	2024/7/2		
Fored	Test Software	EZ-EMC	Ver.	/	/		
Farad			EMEC-3A1				
		Radiated Emissio	n Test				
R&S	EMI test receiver	ESR3	102758	2023/7/3	2024/7/2		
ROHDE&	SPECTRUM	FSV40-N	101608	2022/7/2	2024/7/2		
SCHWARZ	ANALYZER	F3V4U-IN	101608	2023/7/3	2024/1/2		
SONOMA	Low frequency	040	400044	0000/7/40	000 4/7/44		
INSTRUMENT	amplifier	310	186014	2023/7/12	2024/7/11		
COM-POWER	preamplifier	PAM-118A	18040152	2023/8/21	2024/8/20		

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COM-POWER	Amplifier	PAM-840A	461306	2023/8/8	2024/8/7
ETS	Passive Loop Antenna	6512	29604	2023/7/7	2024/7/6
SCHWARZBECK	Log - periodic wideband antenna	VULB 9163	9163-872	2023/7/7	2024/7/6
Astro Antenna Ltd	Horn antenna	AHA-118S	3015	2023/7/6	2024/7/5
Ducommun technologies	Horn Antenna	ARH-4223-02	1007726-03	2023/7/10	2024/7/9
Oulitong	Band Reject Filter	OBSF-2400-248 3.5-50N	OE02103119	2023/9/15	2024/9/14
N/A	Coaxial Cable	N/A	NO.9	2023/8/8	2024/8/7
N/A	Coaxial Cable	N/A	NO.10	2023/8/8	2024/8/7
N/A	Coaxial Cable	N/A	NO.11	2023/8/8	2024/8/7
Audix	Test Software	E3	191218 V9	/	/
		RF Conducted	Test		
ROHDE& SCHWARZ	SPECTRUM ANALYZER	FSU-26	200680/026	2023/7/12	2024/7/11
narda	6dB attenuator	603-06-1	N/A	2023/7/26	2024/7/25

Note: All equipment is calibrated with valid calibrations. Each measurement data is traceable to the national or International standards.



3 Test Results

3.1 Test Summary

FCC Rules	Description of Test	Result
§15.203	Antenna Requirement	Compliance
§15.207 (a)	AC Line Conducted Emissions	Compliance
§15.247(b)(3)	Maximum Conducted Output Power	Compliance
§15.247(e)	Power Spectral Density	Compliance
§15.247 (a)(2)	6 dB Emission Bandwidth	Compliance
-	99% Occupied Bandwidth	Report only
§15.247(d)	100kHz Bandwidth of Frequency Band Edge	Compliance
§15.205, §15.209, §15.247(d)	Radiated emission	Compliance
-	Duty Cycle	Report only



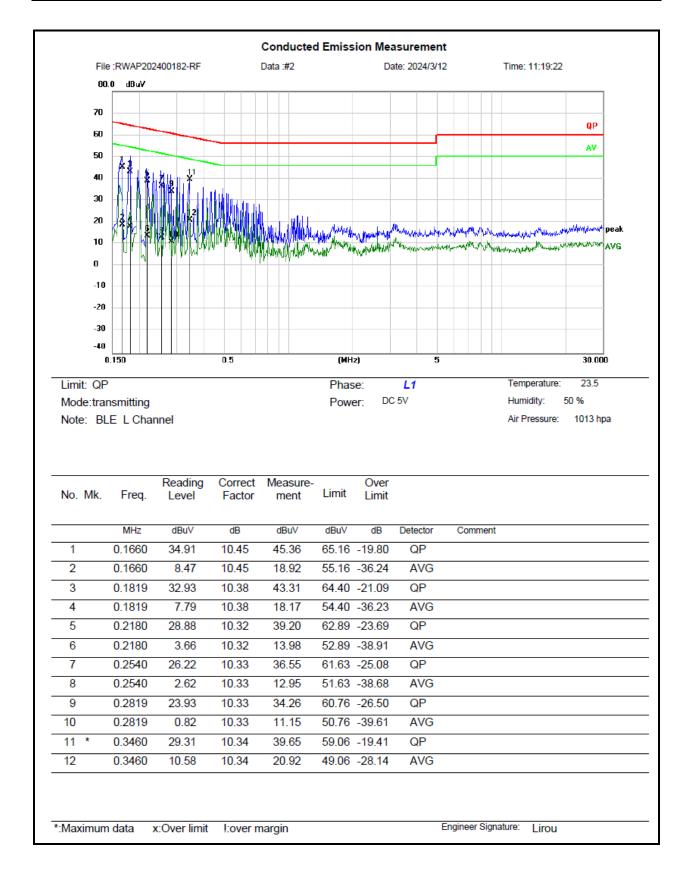
3.2 Limit

Test items	Limit
AC Line Conducted Emissions	See details §15.207 (a)
Conducted Output Power	For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt.
6dB Emission Bandwidth	The minimum 6 dB bandwidth shall be at least 500 kHz.
Power Spectral Density	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.
Spurious Emissions, 100kHz Bandwidth of Frequency Band Edge	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

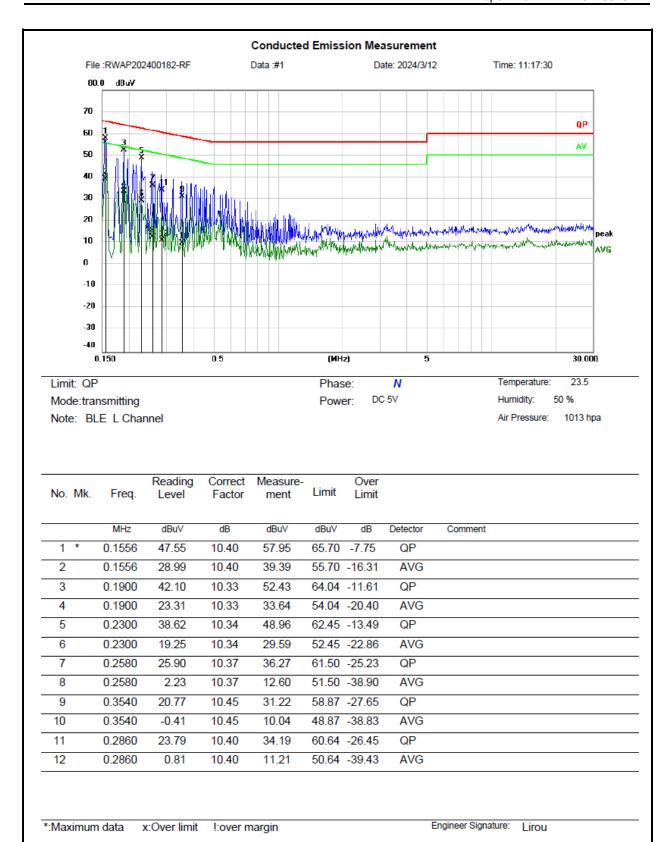


3.3 AC Line Conducted Emissions Test Data

Test Date:	2024-03-12	Test By:	Lirou Li
Environment condition:	Temperature: 23.5°C; Relative	Humidity:50%; ATM Pres	ssure: 101.3kPa







Remark:

Measurement (dBuV)= Reading Level (dBuV) + Correct Factor(dB)

Correct Factor(dB)= LISN Voltage Division Factor (dB)+ Cable loss(dB)

Over = Measurement - Limit





3.4 Radiated emission Test Data

9 kHz-30MHz:

Test Date:	2024-03-12	Test By:	Bard Huang			
Environment condition:	Temperature: 23.5°C; Relative Humidity:54%; ATM Pressure: 101.3kPa					

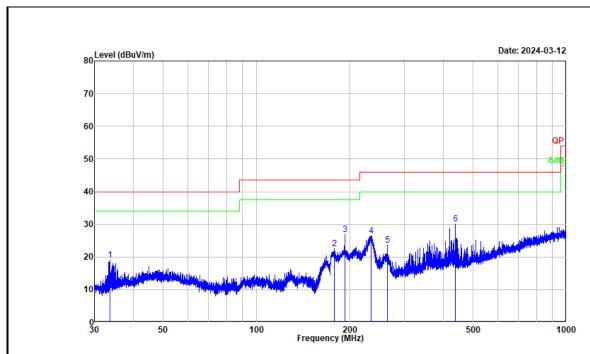
For radiated emissions below 30MHz, there were no emissions found within 20dB of limit.

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30MHz-1GHz:

Test Date:	2024-03-12	Test By:	Bard Huang			
Environment condition:	Temperature: 23.5°C; Relative Humidity:54%; ATM Pressure: 101.3kPa					



Project No. : RWAP202400182 Test Mode : Transmitting Test Voltage : DC 5V

Environment : 23.5℃/54%R.H./101.3kPa

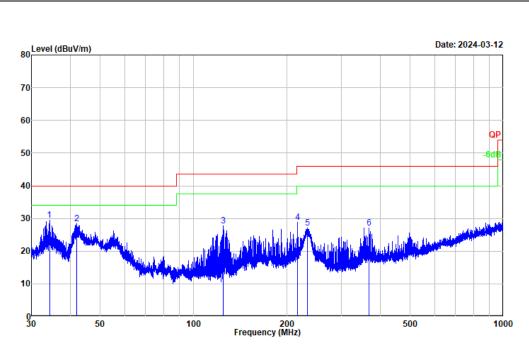
Tested by : Bard Huang Polarization : horizontal

Remark : BLE 1M low channel

No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Over Limit (dB)	Detector
1	33.681	34.26	-15.09	19.17	40.00	-20.83	Peak
2	178.485	38.36	-15.76	22.60	43.50	-20.90	Peak
3	192.548	41.22	-14.39	26.83	43.50	-16.67	Peak
4	233.921	39.40	-12.87	26.53	46.00	-19.47	Peak
5	264.006	35.75	-12.16	23.59	46.00	-22.41	Peak
6	437.458	38.37	-8.24	30.13	46.00	-15.87	Peak

Remarks: Factor = Antenna factor + Cable loss - Preamp gain





Project No. : RWAP202400182 Test Mode : Transmitting Test Voltage : DC 5V

Environment : 23.5 $^{\circ}$ C/54%R.H./101.3kPa

Tested by : Bard Huang Polarization : vertical

: BLE 1M low channel

No.	Frequency (MHz)	Reading (dBμV)	Factor (dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Over Limit (dB)	Detector
1	34.307	44.45	-14.97	29.48	40.00	-10.52	Peak
2	42.082	40.87	-12.50	28.37	40.00	-11.63	Peak
3	124.974	44.63	-16.82	27.81	43.50	-15.69	Peak
4	216.172	42.51	-13.78	28.73	46.00	-17.27	Peak
5	232.693	39.96	-12.92	27.04	46.00	-18.96	Peak
6	369.035	36.51	-9.34	27.17	46.00	-18.83	Peak

Remarks: Factor = Antenna factor + Cable loss - Preamp gain

Remark:

Result = Reading + Factor

Factor = Antenna factor + Cable loss - Amplifier gain

Over Limit = Result - Limit



Above 1GHz:

Test Date:	2024-03-05	Test By:	Bard Huang			
Environment condition:	Temperature: 23.8°C; Relative Humidity:70%; ATM Pressure: 100.3kPa					

Frequency (MHz)	Reading level (dBµV)	Polar	Corrected Factor (dB/m)	Corrected Amplitude (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Remark		
	BLE 1M								
			Low Ch	annel					
2362.229	38.79	horizontal	8.25	47.04	54.00	-6.96	Average		
2362.229	56.67	horizontal	8.25	64.92	74.00	-9.08	Peak		
2389.412	37.92	vertical	8.25	46.17	54.00	-7.83	Average		
2389.412	51.66	vertical	8.25	59.91	74.00	-14.09	Peak		
4804.000	50.24	horizontal	0.21	50.45	74.00	-23.55	Peak		
7206.000	47.13	horizontal	3.40	50.53	54.00	-3.47	Average		
7206.000	53.83	horizontal	3.40	57.23	74.00	-16.77	Peak		
4804.000	50.20	vertical	0.21	50.41	74.00	-23.59	Peak		
7206.000	45.30	vertical	3.40	48.70	54.00	-5.30	Average		
7206.000	51.83	vertical	3.40	55.23	74.00	-18.77	Peak		
			Middle C	hannel					
4880.000	48.50	horizontal	0.44	48.94	74.00	-25.06	Peak		
7320.000	47.10	horizontal	3.04	50.14	54.00	-3.86	Average		
7320.000	55.51	horizontal	3.04	58.55	74.00	-15.45	Peak		
4880.000	48.72	vertical	0.44	49.16	74.00	-24.84	Peak		
7320.000	44.36	vertical	3.04	47.40	54.00	-6.60	Average		
7320.000	53.25	vertical	3.04	56.29	74.00	-17.71	Peak		
			High Ch	annel					
2483.567	36.49	horizontal	8.25	44.74	54.00	-9.26	Average		
2483.567	51.28	horizontal	8.25	59.53	74.00	-14.47	Peak		
2483.654	37.54	vertical	8.25	45.79	54.00	-8.21	Average		
2483.654	50.98	vertical	8.25	59.23	74.00	-14.77	Peak		
4960.000	48.79	horizontal	0.93	49.72	74.00	-24.28	Peak		
7440.000	47.12	horizontal	3.11	50.23	54.00	-3.77	Average		
7440.000	57.47	horizontal	3.11	60.58	74.00	-13.42	Peak		
4960.000	47.97	vertical	0.93	48.90	74.00	-25.10	Peak		
7440.000	44.19	vertical	3.11	47.30	54.00	-6.70	Average		
7440.000	57.80	vertical	3.11	60.91	74.00	-13.09	Peak		





Remark:

Corrected Amplitude= Reading level + corrected Factor

Corrected Factor = Antenna factor + Cable loss - Amplifier gain

Margin = Corrected Amplitude - Limit

For the test result of Peak below the Peak limit more than 20dB, which can compliance with the average limit, just the Peak level was recorded.

The emission levels of other frequencies that were lower than the limit 20dB, not show in test report.

For emissions in 18GHz-25GHz range, all emissions were investigated and in the noise floor level.

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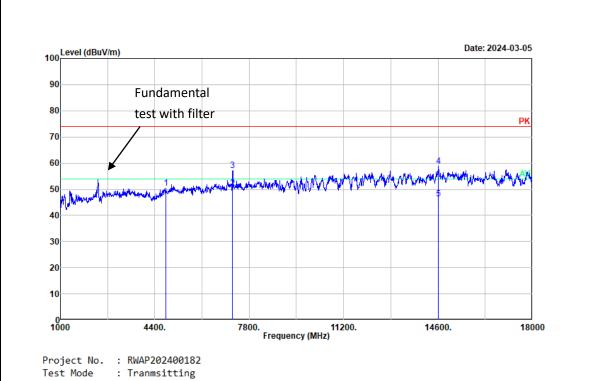
2402MHz



Mode:

Test plot for example as below:

BLE 1M



Channel:

Test Mode : Tranmsitting Test Voltage : DC 5V

Environment : $23.8\,^{\circ}\mathrm{C}/70\%\mathrm{R.H.}/100.3\mathrm{kPa}$

Tested by : Bard Huang Polarization : horizontal

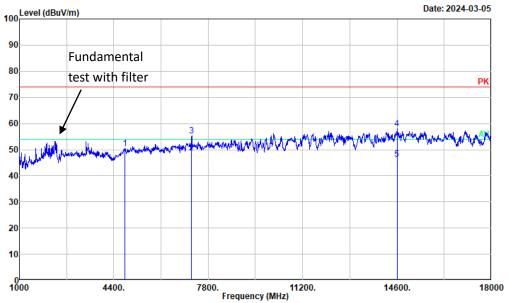
: BLE 1M low channel

No.	Frequency (MHz)	Reading (dBμV)	Factor (dB/m)	Result (dBμV/m)	Limit (dBµV/m)	Over Limit (dB)	Detector
1	4804.000	50.24	0.21	50.45	74.00	-23.55	Peak
2	7206.000	47.13	3.40	50.53	54.00	-3.47	Average
3	7206.000	53.83	3.40	57.23	74.00	-16.77	Peak
4	14615.310	49.33	9.38	58.71	74.00	-15.29	Peak
5	14615.310	36.84	9.38	46.22	54.00	-7.78	Average

Remarks: Factor = Antenna factor + Cable loss - Preamp gain







Project No. : RWAP202400182 Test Mode : Tranmsitting

Test Voltage : DC 5V

Environment : 23.8℃/70%R.H./100.3kPa Tested by : Bard Huang

Polarization : vertical
Remark : BLE 1M low channel

No.	Frequency (MHz)	Reading (dBμV)	Factor (dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Over Limit (dB)	Detector
1	4804.000	50.20	0.21	50.41	74.00	-23.59	Peak
2	7206.000	45.30	3.40	48.70	54.00	-5.30	Average
3	7206.000	51.83	3.40	55.23	74.00	-18.77	Peak
4	14598.300	48.42	9.45	57.87	74.00	-16.13	Peak
5	14598.300	36.91	9.45	46.36	54.00	-7.64	Average

Remarks: Factor = Antenna factor + Cable loss - Preamp gain



3.5 RF Conducted Test Data

Test Date:	2024-03-05	Test By:	Ryan Zhang
Environment condition:	Temperature: 25.8°C; Relative	essure: 100.7kPa	

3.5.1 6 dB Emission Bandwidth and 99% Occupied Bandwidth

Test Mode	Channel	6dB BW [MHz]	99% OBW[MHz]	6dB BW Limit[MHz]	Verdict
BLE 1M	2402	0.720	1.076	0.5	pass
	2440	0.724	1.076	0.5	pass
	2480	0.732	1.076	0.5	pass

3.5.2 Maximum Conducted Peak Output Power

Test Mode	Channel [MHz]	Result [dBm]	Limit [dBm]	Verdict
BLE 1M	2402	0.29	30	Pass
	2440	0.17	30	Pass
	2480	-0.00	30	Pass

3.5.3 Power Spectral Density

Test Mode	Channel	Result	Limit	Verdict
	[MHz]	[dBm/3kHz] [dBm/3kHz		
BLE 1M	2402	-11.76	8	Pass
	2440	-12.61	8	Pass
	2480	-12.58	8	Pass

3.5.4 100 kHz Bandwidth of Frequency Band Edge

Test Mode	Channel	Result	Limit	Verdict
BLE 1M	2402	Refer test plot	Refer test plot	Pass
	2480	Refer test plot	Refer test plot	Pass

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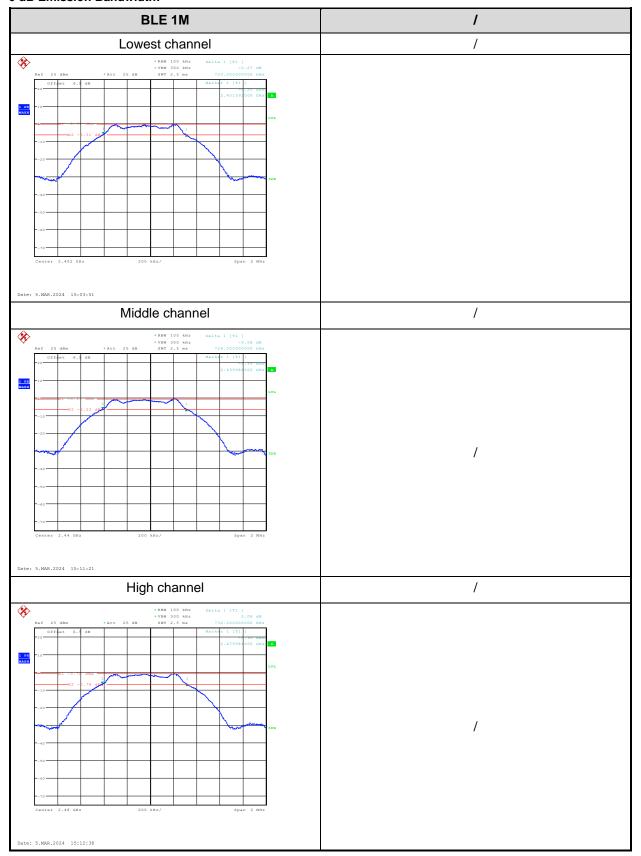
3.5.5 Duty Cycle

Test Mode	Channel	Ton (ms)	Ton+off (ms)	Duty Cycle [%]	1/T	VBW setting [Hz]
BLE 1M	2440	100	100	100	/	10



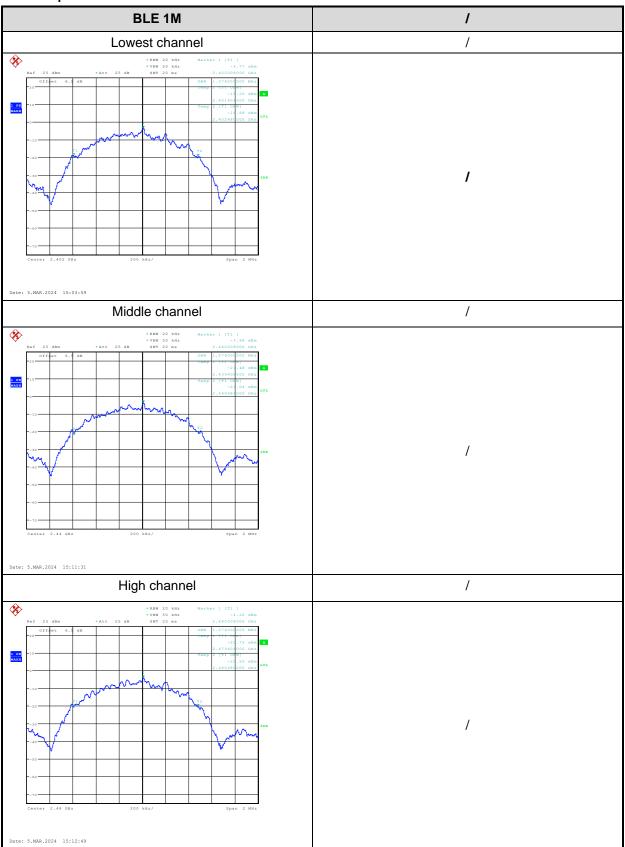
Test Plots:

6 dB Emission Bandwidth:



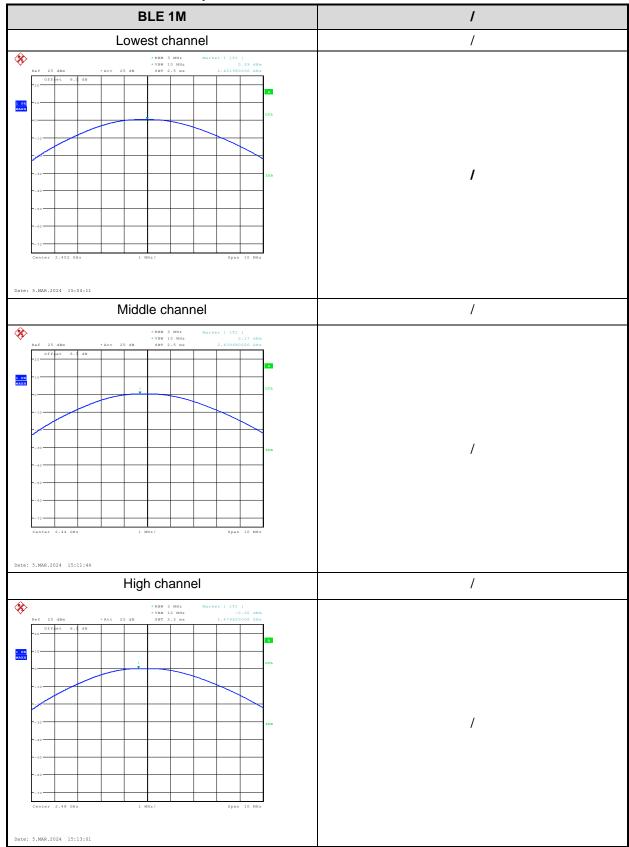


99% Occupied Bandwidth:



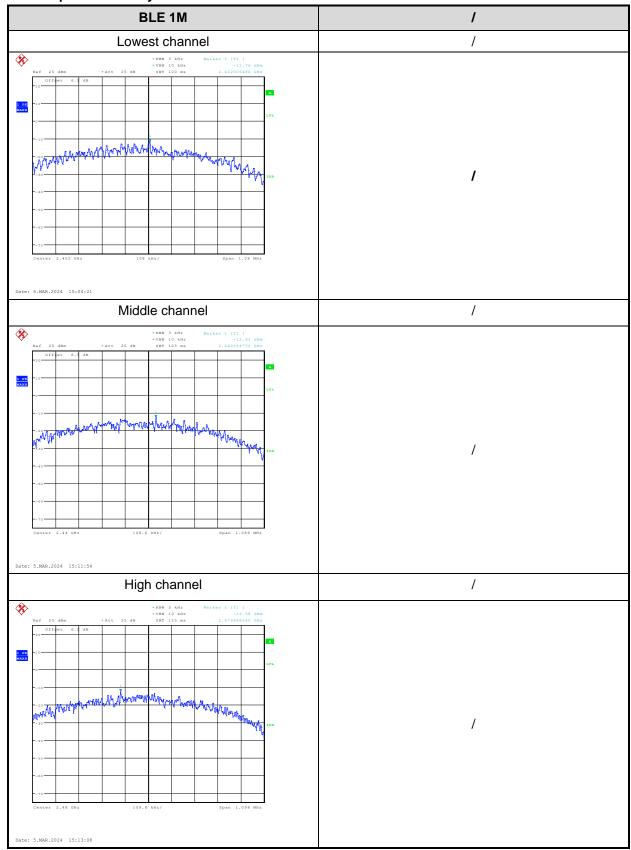


Maximum Conducted Peak Output Power:



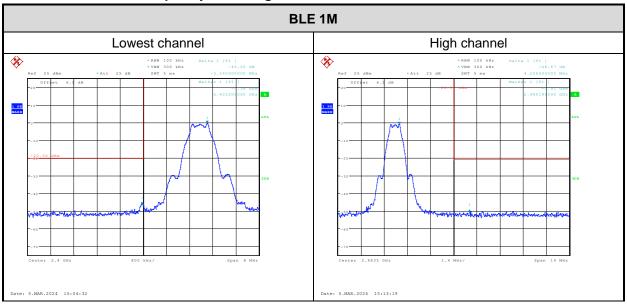


Power Spectral Density:



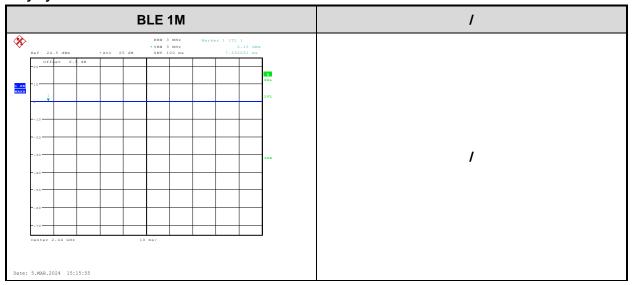


100kHz Bandwidth of Frequency Band Edge:





Duty cycle:





4 Test Setup Photo

Please refer to the attachment RWAP202400182 Test Setup photo.



5 E.U.T Photo

Please refer to the attachment RWAP202400182 External photo and RWAP202400182 Internal photo.

---End of Report---