

**CTC** Laboratories, Inc.

Room 101 Building B, No. 7, Lanqing 1st Road, Luhu Community, Guanhu Subdistrict, Longhua District, Shenzhen, Guangdong, China

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TEST REPORT					
Report No:	CTC20231665E01				
FCC ID:	2AR24-AIBOX500				
Applicant:	Shenzhen Absen Optoelectronic				
Address:	18-20/F, Tower A, Building 3, Phase N0.2018, Xuegang Rd, Bantian, Lo Guangdong, P.R. China				
Manufacturer	Shenzhen Absen Optoelectronic C	o.,Ltd			
Address	18-20/F, Tower A, Building 3, Phase N0.2018, Xuegang Rd, Bantian, Lo Guangdong, P.R. China				
Product Name:	LED Multimedia Processor				
Trade Mark:	Absen				
Model/Type reference:	AiBox 500				
Listed Model(s):	/				
Standard:	FCC CFR Title 47 Part 15 Subpar	t C Section 15.247			
Date of receipt of test sample:	Aug. 18, 2023				
Date of testing	Aug. 19, 2023 ~ Dec. 11, 2023				
Date of issue	Jul. 3, 2024				
Result	PASS				
Compiled by:		Lucy Lan			
(Printed name+signature)	Lucy Lan				
Supervised by:		Zric Zhang			
(Printed name+signature)	Eric Zhang	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~			
Approved by:		Zric zhang Johnas			
(Printed name+signature)	Totti Zhao	1			
Testing Laboratory Name:	CTC Laboratories, Inc.				
Address:	Address Room 101 Building B, No. 7, Langing 1st Road, Luhu				
	Community, Guanhu Subdistrict, Lo Guangdong, China	onghua District, Shenzhen,			
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not be reproduced except in full, without the written approval of our laboratory. The client should not use it to claim product endorsement by CTC. The Test Result in the report only apply to the tested sample.					
The test report shall be invalid without all the signatures of testing engineers, reviewer and approver.					
Any objections must be raised to CT	-	-			
not be taken into consideration beyond this limit. The test report merely corresponds to the test sample.					



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## **1. TEST SUMMARY**

### 1.1. Test Standards

The tests were performed according to following standards:

FCC Rules Part 15.247: Operation within the bands 902–928MHz, 2400–2483.5MHz, and 5725-5850MHz.

ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

### **1.2. Report Version**

Revised No.	Report No.	Date of issue	Description
01	CTC20231665E01	Jul. 3, 2024	Original

### **1.3. Test Description**

FCC Part 15 Subpart C (15.247)				
Test Item	Result	Test Engineer		
Antenna Requirement	15.203	Pass	Lucy Lan	
Conducted Emission	15.207	Pass	Lucy Lan	
Conducted Band Edge and Spurious Emissions	15.247(d)	Pass	Lucy Lan	
Radiated Band Edge and Spurious Emissions	15.205&15.209& 15.247(d)	Pass	Lucy Lan	
6dB Bandwidth	15.247(a)(2)	Pass	Lucy Lan	
Conducted Max Output Power	15.247(b)(3)	Pass	Lucy Lan	
Power Spectral Density	15.247(e)	Pass	Lucy Lan	
Transmitter Radiated Spurious	15.209&15.247(d)	Pass	Lucy Lan	

Note:

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1. The measurement uncertainty is not included in the test result.

N/A: means this test item is not applicable for this device according to the technology characteristic of 2. device.

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### 1.4. Test Facility

### Address of the report laboratory

### CTC Laboratories, Inc.

Add: Room 101 Building B,Room 107, 108, 207, 208, 303 Building A, No. 7, Lanqing 1st Road, Luhu Community, Guanhu Subdistrict, Longhua District, Shenzhen, Guangdong, China (formerly 2/F., Building 1 and 1-2/F., Building 2, Jiaquan Building, High-Tech Park, Guanlan Sub-District, Longhua New District, Shenzhen, Guangdong, China)

### Laboratory accreditation

The test facility is recognized, certified, or accredited by the following organizations:

### A2LA-Lab Cert. No.: 4340.01

CTC Laboratories, Inc. EMC Laboratory has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025:2017 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

### Industry Canada (Registration No.: 9783A, CAB Identifier: CN0029)

CTC Laboratories, Inc. EMC Laboratory has been registered by Certification and Engineer Bureau of Industry Canada for the performance of with Registration NO.: 9783A on Jan, 2016.

### FCC (Registration No.: 951311, Designation Number CN1208)

CTC Laboratories, Inc. EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration 951311, Aug 26, 2017.



### 1.5. Measurement Uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to TR-100028-01 "Electromagnetic compatibility and Radio spectrum Matters (ERM);Uncertainties in the measurement of mobile radio equipment characteristics; Part 1" and TR-100028-02 "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics; Part 2" and is documented in the CTC Laboratories, Inc. quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Test Items	Measurement Uncertainty	Notes
DTS Bandwidth	±0.0196%	(1)
Maximum Conducted Output Power	±0.686 dB	(1)
Maximum Power Spectral Density Level	±0.743 dB	(1)
Band-edge Compliance	±1.328 dB	(1)
Unwanted Emissions In Non-restricted Freq Bands	9kHz-1GHz: ±0.746dB 1GHz-26GHz: ±1.328dB	(1)
Conducted Emissions 9kHz~30MHz	±3.08 dB	(1)
Radiated Emissions 30~1000MHz	±4.51 dB	(1)
Radiated Emissions 1~18GHz	±5.84 dB	(1)
Radiated Emissions 18~40GHz	±6.12 dB	(1)

Below is the best measurement capability for CTC Laboratories, Inc.

Note (1): This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

### 1.6. Environmental Conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature:	15 °C to 35 °C
Relative Humidity:	20 % to 75 %
Air Pressure:	101 kPa



## 2. GENERAL INFORMATION

### 2.1. Client Information

Applicant:	Shenzhen Absen Optoelectronic Co.,Ltd	
Address:	18-20/F, Tower A, Building 3, Phase I, Tian An Cloud Park, N0.2018, Xuegang Rd, Bantian, Longgang District, Shenzhen, Guangdong, P.R. China	
Manufacturer:	Shenzhen Absen Optoelectronic Co.,Ltd	
Address:	18-20/F, Tower A, Building 3, Phase I, Tian An Cloud Park, N0.2018, Xuegang Rd, Bantian, Longgang District, Shenzhen, Guangdong, P.R. China	
Factory:	Huizhou Absen Optoelectronic Limited.	
Address:	No. 03, Donghua South road, Dongjiang Hi-tech Industry Park, Huizhou. Guangdong, China	

### 2.2. General Description of EUT

Product Name:	LED Multimedia Processor
Trade Mark:	Abyen
Model/Type reference:	AiBox 500
Listed Model(s):	/
Model Difference:	/
Power Supply:	AC 100-240V~2.5A 50/60Hz
RF Module Model:	AP6275S
Hardware Version:	/
Software Version:	/
Bluetooth 5.1 / BLE	
Modulation:	GFSK
Operation Frequency:	2402MHz~2480MHz
Channel Number:	40
Channel Separation:	2MHz
Data Rate:	1Mbps
Antenna Type:	External Antenna
Antenna Gain:	3.55dBi

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### 2.3. Accessory Equipment Information

Equipment Information						
Name	Model S/N Manufacturer					
Notebook	ThinkPad T460s	/	Lenovo			
Cable Information	Cable Information					
Name Shielded Type Ferrite Core Length						
USB Cable	Unshielded	NO	150cm			
Test Software Information						
Name	Version	/	/			
adb.exe	1	/	1			



### 2.4. Operation State

Operation Frequency List: The EUT has been tested under typical operating condition. The Applicant provides communication tools software to control the EUT for staying in continuous transmitting and receiving mode for testing. BT BLE, 40 channels are provided to the EUT. Channels 00/19/39 were selected for testing.

**Operation Frequency List:** 

Channel	Frequency (MHz)
00	2402
01	2404
:	:
18	2438
19	2440
20	2442
÷	:
38	2478
39	2480

Note: The display in grey were the channel selected for testing.

#### Test Mode:

For RF test items:

The engineering test program was provided and enabled to make EUT continuous transmit.

For AC power line conducted emissions:

The EUT was set to connect with the Bluetooth instrument under large package sizes transmission.

For Radiated spurious emissions test item:

The engineering test program was provided and enabled to make EUT continuous transmit. The EUT in each of three orthogonal axis emissions had been tested, but only the worst case (X axis) data recorded in the report.

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### 2.5. Measurement Instruments List

RF Tes	RF Test System					
Item	Test Equipment	Manufacturer	Model No.	Serial No.	Calibrated Until	
1	MXA Signal Analyzer	Keysight	N9020A	MY46471737	Dec. 16, 2023	
2	High and low temperature test chamber	ESPEC	MT3035	/	Mar. 24, 2024	
3	Test Software	WCS	WCS-WCN	2023.08.04	/	

Radiated Emission (3m chamber 3)					
Item	Test Equipment	Manufacturer	Model No.	Serial No.	Calibrated Until
1	Trilog-Broadband Antenna	Schwarzbeck	VULB 9163	01026	Dec. 18, 2024
2	Horn Antenna	Schwarzbeck	BBHA 9120D	9120D-647	Dec. 01, 2024
3	Test Receiver	Keysight	N9038A	MY56400071	Dec. 16, 2023
4	Broadband Amplifier	SCHWARZBECK	BBV9743B	259	Dec. 16, 2023
5	Mirowave Broadband Amplifier	SCHWARZBECK	BBV9718C	111	Dec. 16, 2023
6	3m chamber 3	YIHENG	EE106	/	Aug. 28, 2026
7	Test Software	FARA	EZ-EMC	FA-03A2	1

Conduc	ted Emission				
Item	Test Equipment	Manufacturer	Model No.	Serial No.	Calibrated Until
1	LISN	R&S	ENV216	101112	Dec. 16, 2023
2	LISN	R&S	ENV216	101113	Dec. 16, 2023
3	EMI Test Receiver	R&S	ESCS30	100353	Dec. 16, 2023
4	ISN CAT6	Schwarzbeck	NTFM 8158	CAT6-8158-0046	Dec. 16, 2023
5	ISN CAT5	Schwarzbeck	NTFM 8158	CAT5-8158-0046	Dec. 16, 2023
6	Test Software	R&S	EMC32	6.10.10	/

Note: 1. The Cal. Interval was one year.

2. The Cal. Interval was three years of the antenna.

3. The cable loss has been calculated in test result which connection between each test instruments.

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# 3. TEST ITEM AND RESULTS

### 3.1. Conducted Emission

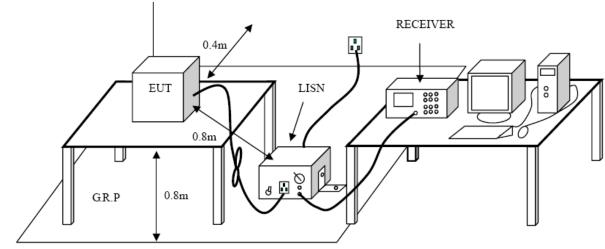
### <u>Limit</u>

### FCC CFR Title 47 Part 15 Subpart C Section 15.207

	Conducte	ed Limit (dBμV)		
Frequency (MHz)	Quasi-peak	Average		
0.15 - 0.5	66 to 56 *	56 to 46 *		
0.5 - 5	56	46		
5 - 30	60	50		

\* Decreases with the logarithm of the frequency.

### **Test Configuration**



### **Test Procedure**

1. The EUT was setup according to ANSI C63.10:2013 requirements.

The EUT was placed on a platform of nominal size, 1 m by 1.5 m, raised 80 cm above the conducting 2. ground plane. The vertical conducting plane was located 40 cm to the rear of the EUT. All other surfaces of EUT were at least 80 cm from any other grounded conducting surface.

The EUT and simulators are connected to the main power through a line impedance stabilization 3 network (LISN). The LISN provides a 50 ohm / 50 µH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN. (Please refer to the 4. block diagram of the test setup and photographs)

Each current-carrying conductor of the EUT power cord, except the ground (safety) conductor, was 5. individually connected through a LISN to the input power source.

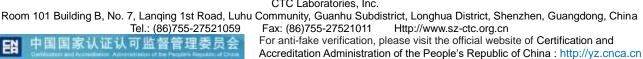
The excess length of the power cord between the EUT and the LISN receptacle were folded back and 6. forth at the center of the lead to form a bundle not exceeding 40 cm in length.

Conducted emissions were investigated over the frequency range from 0.15MHz to 30MHz using a 7. receiver bandwidth of 9 kHz.

During the above scans, the emissions were maximized by cable manipulation. 8.

### **Test Mode**

Please refer to the clause 2.4.



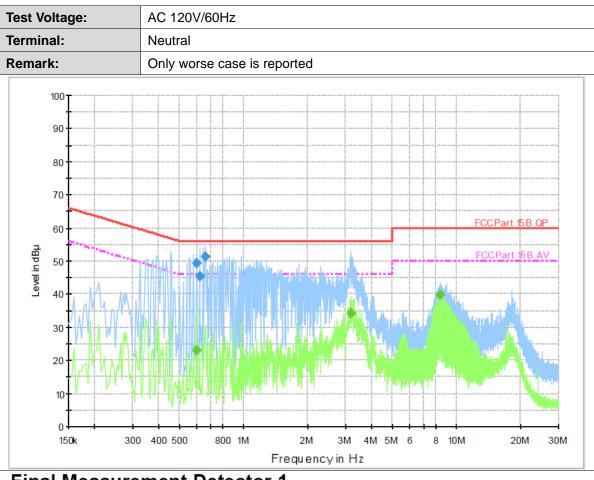


Test V	oltage	:	AC 120V/	60Hz						
<b>Fermi</b> r	nal:		Line							
Remai	rk:		Only wors	se case is re	ported					
	100 T								1	
	+									
	90									
	80								-	
	70									
	60								FCCPa	<u>rt 15 B QP</u>
Level in dBµ	50	·····	RAND						FCCPa	rt <u>158 AV</u>
sel	+	M			19 <b>1</b> E	9700)N	10			
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	150k	300	400 500	800 1M	2M			6 8 1	OM	20M 30M
				F	reque	ncyin	Hz			
Fina	al Me	asure	ment D	etector	1					
	uency	QuasiPeal		Bandwidth		er Li	ne Corr	r. Margir	n Limit	Comment
	Hz)	(dB µ V)	Time	(kHz)			(dB		(dB µ	
			(ms)						V)	
	18000	46.				L1				
	58500 46500	49. 51.				L1				
3.0	40000	51.		u 9.00	u j Un		9.	<u></u> .	0 00.0	
Fina	al Me			etector 2						
	uency Hz)	Average (dB µ V)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dB µ V)	Comment
0.4	56000	25.0	1000.00	9.000	On	L1	9.5	21.8	46.8	
	46500	39.1	1000.00	9.000	On	L1	9.5	6.9	46.0	
3.6	83500	41.7	1000.00	9.000	On	L1	9.7	8.3	50.0	

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### **Final Measurement Detector 1**

Frequency (MHz)	QuasiPeak (dB μ ∀)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dB µ ∀)	Comment
0.600000	49.3	1000.00	9.000	On	Ν	9.4	6.7	56.0	
0.618000	45.4	1000.00	9.000	On	Ν	9.4	10.6	56.0	
0.658500	51.3	1000.00	9.000	On	N	9.4	4.7	56.0	

### Final Measurement Detector 2

Frequency (MHz)	Average (dB µ ∨)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dB µ ∀)	Comment
0.600000	23.1	1000.00	9.000	On	N	9.4	22.9	46.0	
3.169500	34.1	1000.00	9.000	On	Ν	9.4	11.9	46.0	
8.304000	39.6	1000.00	9.000	On	Ν	9.6	10.4	50.0	

Emission Level = Read Level + Correct Factor

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### 3.2. Radiated Emission

<u>Limit</u>

### FCC CFR Title 47 Part 15 Subpart C Section 15.209

Frequency	Field Strength	Measurement Distance
(MHz)	(microvolts/meter)	(meters)
0.009~0.490	2400/F (kHz)	300
0.490~1.705	24000/F (kHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
960~1000	500	3

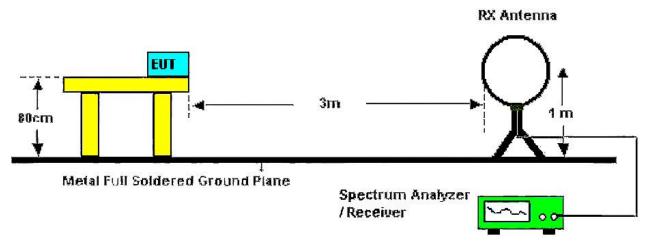
	dBµV/m	(at 3 meters)
Frequency Range (MHz)	Peak	Average
Above 1000	74	54

Note:

(1) The tighter limit applies at the band edges.

(2) Emission Level (dBµV/m)=20log Emission Level (µV/m).

### **Test Configuration**



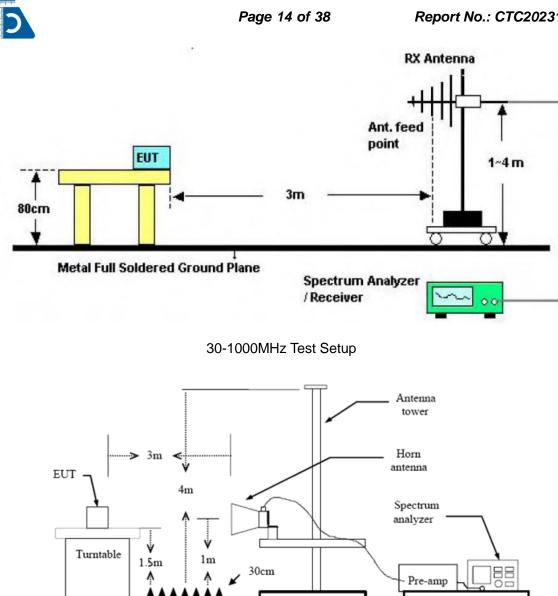
Below 30MHz Test Setup

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Above 1GHz Test Setup

### **Test Procedure**

1. The EUT was setup and tested according to ANSI C63.10:2013.

The EUT is placed on a turn table which is 0.8 meter above ground for below 1 GHz, and 1.5 m for 2. above 1 GHz. The turn table is rotated 360 degrees to determine the position of the maximum emission level.

3. The EUT was set 3 meters from the receiving antenna, which was mounted on the top of a variable height antenna tower.

For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna 4. tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.

5. Set to the maximum power setting and enable the EUT transmit continuously.

- Use the following spectrum analyzer settings 6.
- Span shall wide enough to fully capture the emission being measured; (1)
- (2) 9k 150kHz:

RBW=300 Hz, VBW=1 kHz, Sweep=auto, Detector function=peak, Trace=max hold (3) 0.15M – 30MHz:

RBW=10 kHz, VBW=30 kHz, Sweep=auto, Detector function=peak, Trace=max hold (4) 30M - 1 GHz:

RBW=120 kHz, VBW=300 kHz, Sweep=auto, Detector function=peak, Trace=max hold If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the

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peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.

(5) From 1 GHz to 10<sup>th</sup> harmonic:

RBW=1MHz, VBW=3MHz Peak detector for Peak value.

RBW=1MHz, VBW see note 1 with Peak Detector for Average Value.

Note 1: For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 3 MHz for peak measurements and 1 MHz resolution bandwidth with 1/T video bandwidth with peak detector for average measurements. For the Duty Cycle please refer to clause 3.8 Duty Cycle.

### Test Mode

Please refer to the clause 2.4.

#### Test Result

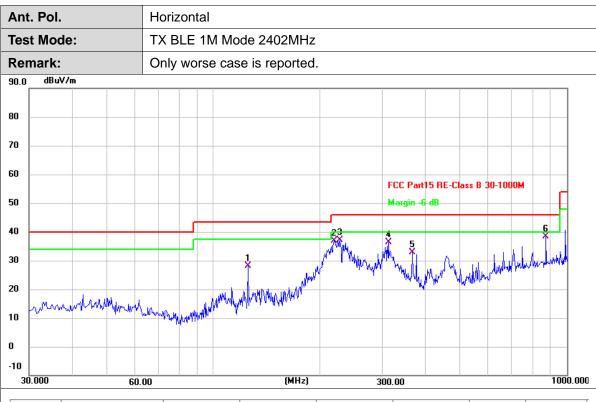
#### 9 kHz~30 MHz

From 9 kHz to 30 MHz: The conclusion is PASS.

Note: The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.







No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	125.0600	47.06	-18.82	28.24	43.50	-15.26	QP
2	219.7967	52.45	-15.51	36.94	46.00	-9.06	QP
3	228.2033	52.52	-15.27	37.25	46.00	-8.75	QP
4	312.5933	49.51	-13.22	36.29	46.00	-9.71	QP
5	365.2967	44.70	-11.92	32.78	46.00	-13.22	QP
6 *	874.8700	41.44	-2.98	38.46	46.00	-7.54	QP

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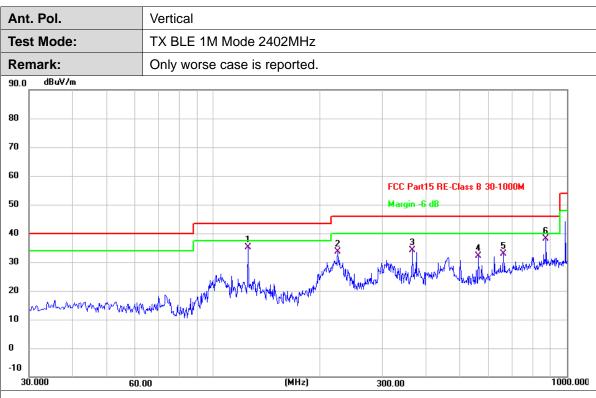
1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor 2.Margin value = Level -Limit value

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No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	125.0600	53.91	-18.82	35.09	43.50	-8.41	QP
2	224.9700	48.92	-15.35	33.57	46.00	-12.43	QP
3	365.6200	46.02	-11.92	34.10	46.00	-11.90	QP
4	562.5300	39.83	-7.63	32.20	46.00	-13.80	QP
5	662.4400	38.79	-5.97	32.82	46.00	-13.18	QP
6 *	874.8700	41.18	-2.98	38.20	46.00	-7.80	QP

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1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor

2.Margin value = Level -Limit value

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Ant. Pol.	Horizontal
Test Mode:	TX BLE 1M Mode 2402MHz
Remark:	No report for the emission which more than 20 dB below the prescribed limit.

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)		Margin (dB)	Detector
1	4803.489	40.55	2.16	42.71	74.00	-31.29	peak
2 *	4803.557	28.04	2.16	30.20	54.00	-23.80	AVG

1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor

2.Margin value = Level -Limit value

Ant. Pol.	Vertical
Test Mode:	TX BLE 1M Mode 2402MHz
Remark:	No report for the emission which more than 20 dB below the prescribed limit.

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)		Margin (dB)	Detector
1 *	4803.443	34.22	2.16	36.38	54.00	-17.62	AVG
2	4803.470	44.27	2.16	46.43	74.00	-27.57	peak

Remarks:

1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor

2.Margin value = Level -Limit value



Ant. Pol.		Horizontal									
Test Mod	de:	TX BLE 1M M	lode 2440Mł	Ηz							
Remark:		No report for limit.	the emission	which more t	han 20 dB be	elow the p	rescribed				
No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector				
1	4880.151	42.24	2.31	44.55	74.00	-29.45	peak				
2 *	4880.464	31.18	2.31	33.49	54.00	-20.51	AVG				
	-	-	-		-						

1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor

2.Margin value = Level -Limit value

Ant. Pol.		Vertical					
est Mo	de:	TX BLE 1M M	1ode 2440MH	Ηz			
Remark:		No report for limit.	the emission	which more the	han 20 dB be	low the p	escribed
No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1 *	4879.487	38.42	2.31	40.73	54.00	-13.27	AVG
2	4880.284	45.34	2.31	47.65	74.00	-26.35	peak

2.Margin value = Level -Limit value

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Ant. Pol.		Horizontal								
Test Mod	de:	TX BLE 1M N	/lode 2480MH	Ηz						
Remark:		No report for limit.	the emission	which more t	han 20 dB be	elow the p	rescribed			
No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector			
1	4960.138	41.78	2.48	44.26	74.00	-29.74	peak			
2 *	4960.445	29.85	2.48	32.33	54.00	-21.67	AVG			
-		-								

1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor

2.Margin value = Level -Limit value

		Vertical							
est Mod	de:	TX BLE 1M M	1ode 2480MF	łz					
emark:		No report for t limit.	the emission	which more th	han 20 dB be	low the pr	escribed		
No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)		Limit (dBuV/m)	Margin (dB)	Detector		
	. ,	· · ·	· · · ·	·	. ,	. ,			
1 *	4959.422	36.94	2.48	39.42	54.00	-14.58	AVG		
2	4960.062	44.77	2.48	47.25	74.00	-26.75	peak		

2.Margin value = Level -Limit value

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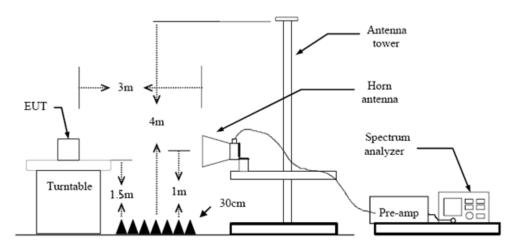
### 3.3. Band Edge Emissions (Radiated)

Limit

### FCC CFR Title 47 Part 15 Subpart C Section 15.247 (d)

Restricted Frequency Band	(dBµV/m	ı) (at 3m)
(MHz)	Peak	Average
2310 ~ 2390	74	54
2483.5 ~ 2500	74	54

### **Test Configuration**



### **Test Procedure**

1. The EUT was setup and tested according to ANSI C63.10:2013 requirements.

The EUT is placed on a turn table which is 1.5 meter above ground. The turn table is rotated 360 2. degrees to determine the position of the maximum emission level.

The EUT was positioned such that the distance from antenna to the EUT was 3 meters. 3.

4. The antenna is scanned from 1 meter to 4 meters to find out the maximum emission level. This is repeated for both horizontal and vertical polarization of the antenna. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10:2013 on radiated measurement. The receiver set as follow: 5

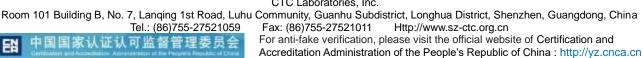
RBW=1MHz, VBW=3MHz Peak detector for Peak value.

RBW=1MHz, VBW see note 1 with Peak Detector for Average Value.

Note 1: For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 3 MHz for peak measurements and 1 MHz resolution bandwidth with 1/T video bandwidth with peak detector for average measurements. For the Duty Cycle please refer to clause 3.8 Duty Cycle.

### **Test Mode**

Please refer to the clause 2.4.





Ant. Po	nt. Pol. Horizontal											
est Mo	ode:		TX BLE 1M Mode 2402MHz									
20.0 dE	luV/m		1				i					
10												
00												
0												
								FCC Part15 C	- Above 1G P	ĸ		
0												
								FCC Part15 C	- Above 1G A	v		
									1 X	$\rightarrow$		
			61					man and the second second second	2			
0												
o												
0.0 2304.50	0 2314.50	2324.50	2334.50	22	44.50 (MHz		2364.50	2374.50 2384	.50 2394.	50 2404.		
								1				
No.		uency Hz)	Readir (dBuV		Factor (dB/m)		level 3uV/m)	Limit (dBuV/m)	Margin (dB)	Detector		
1	2390	0.000	18.00	)	30.84	4	8.84	74.00	-25.16	peak		
2 *	2390	0.000	4.32		30.84	3	35.16	54.00	-18.84	AVG		
			•						•			

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1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor 2.Margin value = Level -Limit value



nt. Pol			Vertica	l										
est Mo	de:		TX BLI	E 1M N	lode 24	02MF	Ηz							
20.0 dBu	ıV/m		1					1						1
10														
00													Λ	
ı 📖													Д	
ı 📖									500	D		DV	$\square$	
) <u> </u>									FUU	Part15 C	- Above 1G	РК	$\left  \right $	
) —										D	41 10			
									FLL	Partis L	- Above 1G	AV		
ı											Ş		$\neg$	
)	and the work of	under an	hansalaanahanana		muromohro	********	presidente de la constante de l La constante de la constante de		water that we	404040-00900	herhander <b>K</b> ander van de her	e and a start of the		
ı														
)														
).0 2305.000	2315.00	2325.00	2335.0	10 23	45.00	(MHz)	236	5.00	2375.00	2385	00 239	5.00	240	5.1
No.		uency Hz)		ding uV)	Fac (dB/			vel iV/m)	1	nit V/m)	Margi (dB)	n <sub>D</sub>	etect	.01
1	2390	0.000	18	.87	30.8	34	49	.71	74	.00	-24.2	9 F	beal	٢
2 *	2390	0.000	5.	07	30.8	34	35	.91	54	.00	-18.0	э /	٩Ve	3
Remarks														

1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor 2.Margin value = Level -Limit value

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est Mode: 20.0 dBuV/m		-	TX BLE 1	M Mod	le 24801	ЛНz								
10	ı 													
							1	1						
00														
								FCC Part15 (	C - Above 1G	РК				
								FCC Part15 (	C - Above 1G	AV				
X														
- Sm		hander anno 19		musher	harton an	www.	modellan - readerly	14 <sup>1</sup> 141/1141/1141/1141/1141/1141/1141/1	homon marshipson	un and the second second				
1														
).0 2478.000 2	488.00	2498.00	2508.00	2518.0	)0 (MH:	z) 25	38.00 2	2548.00 2558	3.00 256	8.00 2578.1				
No.	Freque (MH		Readin (dBuV	<b>U</b>	Factor		evel	Limit (dBuV/m)	Margir (dB)	Detector				
1	2483.		17.35		31.24		3.59	74.00	-25.41	l peak				
2 *	2483.		4.74		31.24	_	5.98	54.00	-18.02	· ·				

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1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor 2.Margin value = Level -Limit value



nt. Po	l.		Vertical										
est Mo	de:		TX BLE	1M N	/lode 248	ЭMF	łz						
20.0 dB	uV/m												_
10													
									FCC	Part15 C	- Above 1G	РК	
0	1 X								FCC	Part15 C	- Above 1G	AV	
	2 minut	10.349.00.00.00.00.00.00.00.00.00.00		hana	an a	- dread	han the the the test of te		,	~~~~~~	and the second		<b>.</b>
)													
D													
0.0 2 <b>475.50</b>	0 2485.50	2495.50	2505.50	25	i15.50 (M	Hz)	253	5.50	2545.50	2555.	50 256	5.50 25	75.5
			I								I		
No.		uency Hz)	Read (dBu	-	Facto (dB/m			vel IV/m)		nit V/m)	Margi (dB)	n Detec	tor
1	2483	3.500	16.9	6	31.24	1	48	.20	74	.00	-25.80	) pea	ık
2 *	2483	3.500	6.4	7	31.24	1	37	.71	54	.00	-16.29	9 AV	G
emark													

II) 2.Margin value = Level -Limit value

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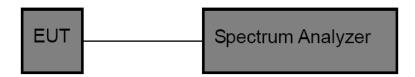
### 3.4. Band Edge and Spurious Emissions (Conducted)

### Limit

### FCC CFR Title 47 Part 15 Subpart C Section 15.247 (d) / RSS-247 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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.

### Test Configuration



### **Test Procedure**

- The transmitter output was connected to the spectrum analyzer through an attenuator, the path loss 1. was compensated to the results for each measurement.
- Set to the maximum power setting and enable the EUT transmit continuously. 2.
- Use the following spectrum analyzer settings: 3. RBW = 100 kHz, VBW  $\geq$  RBW, scan up through 10<sup>th</sup> harmonic. Sweep = auto, Detector function = peak, Trace = max hold.
- Measure and record the results in the test report. 4.

### Test Mode

Please refer to the clause 2.4.

### **Test Result**

### (1) Band Edge Conducted Test & Conducted Spurious Emissions Test

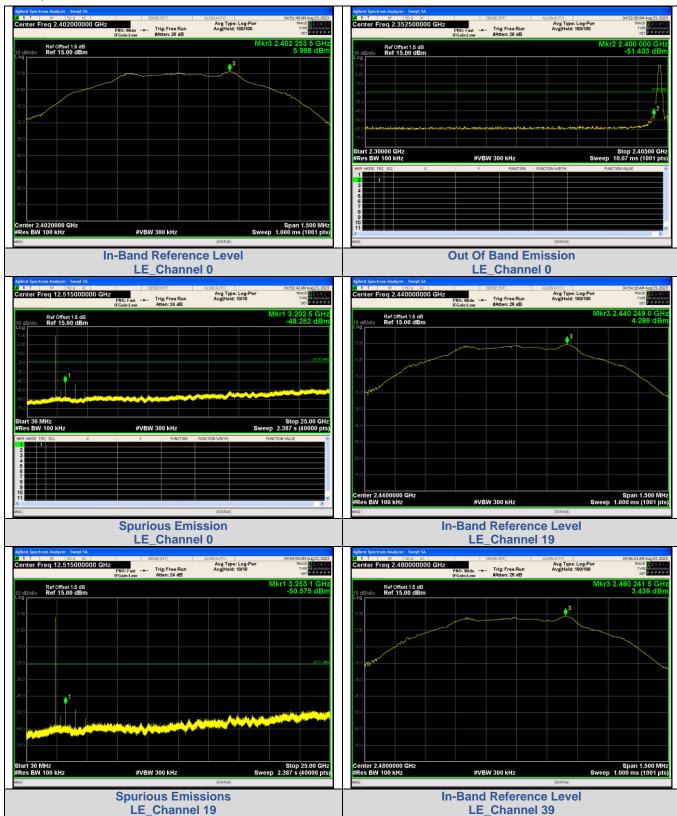
Mode	Channel	OOB Emission Frequency (MHz)	OOB Emission Level (dBm)	Limit (dBm)	Over Limit (dB)	Result
	0	2400.00	-51.403	-24.0	-27	PASS
	0	3202.52	-48.252	-24.0	-24.252	PASS
LE	19	3253.08	-50.575	-25.71	-24.865	PASS
	39	2483.50	-60.437	-26.56	-34	PASS
	39	23615.4	-52.895	-26.56	-26.335	PASS

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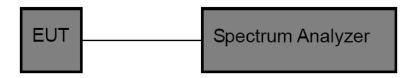
### 3.5. DTS Bandwidth

Limit

### FCC CFR Title 47 Part 15 Subpart C Section 15.247 (a)(2) / RSS-247 5.2 a

Test Item	Limit	Frequency Range (MHz)
DTS Bandwidth	≥500 kHz (6dB bandwidth)	2400~2483.5

### **Test Configuration**



### **Test Procedure**

- 1. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.
- DTS Spectrum Setting: 2.
  - (1) Set RBW = 100 kHz.
  - (2) Set the video bandwidth (VBW)  $\geq$  3 RBW.
  - (3) Detector = Peak.
  - (4) Trace mode = Max hold.
  - (5) Sweep = Auto couple.
  - **OCB Spectrum Setting:**
  - (1) Set RBW = 1% ~ 5% occupied bandwidth.
  - (2) Set the video bandwidth (VBW)  $\geq$  3 RBW.
  - (3) Detector = Peak.
  - (4) Trace mode = Max hold.
  - (5) Sweep = Auto couple.

NOTE: The EUT was set to continuously transmitting in each mode and low, Middle and high channel for the test.

### **Test Mode**

Please refer to the clause 2.4.

### **Test Result**

Mode	Channel	Center Frequency (MHz)	6 dB Bandwidth (MHz)	99% Bandwidth (MHz)	Limit (MHz)	Result
	0	2402	0.6629	1.0517		PASS
LE	19	2440	0.6602	1.0524	0.5	PASS
	39	2480	0.6617	1.0530		PASS



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Aldred Systum Andrar, Docsided BW     201/02 (M1000000000000000000000000000000000000	191AUTO 01-51:09AM Aug 23, 2023 0 GHz Radio Std: None Avg Hold: 100/100 Radio Device: BTS	Aglent Spectrum Analyzer - Occupied BW	Hz SBKE:IM Center Freq: 2, →→ Trig: Free Run #IFGain:Low #Atten: 26 dB	ALIGN AUTO 140000000 GHz AvgjHold: 100/100	04:53:36 AM Aug 23, 2023 Radio Std: None Radio Device: BTS
Ref Offset 1.5 dB       10 dBldiv     Ref 16.50 dBm       6g		Ref Offset 15.dB     Ref Offset 15.dB       Log     6.50     6.50       12.6     6.50     6.50       13.6     6.50     6.50       13.5     6.50     6.50       13.5     6.50     6.50       13.5     6.50     6.50       13.5     6.50     6.50       13.5     6.50     6.50       13.5     6.50     6.50       13.5     6.50     6.50			
Center 2.402 GHz #Res BW 100 kHz #VBW 300 kHz	Span 2 MHz z Sweep 1.333 ms	Center 2.44 GHz #Res BW 100 kHz	#VBW	300 kHz	Span 2 MHz Sweep   1.333 ms
Occupied Bandwidth Total Power 1.0662 MHz	12.5 dBm	Occupied Bandwidth 1.0	Total Powe 680 MHz	er 10.7 dBm	
Transmit Freq Error 7.394 kHz OBW Power	99.00 %	Transmit Freq Error	1.203 kHz OBW Powe	er 99.00 %	
x dB Bandwidth 662.9 kHz x dB	-6.00 dB	x dB Bandwidth	660.2 kHz x dB	-6.00 dB	
	STATUS			STATUS	
LE Channel (		MSG	LE Chann		
Adjunt Skotchan Auklyzer, Okcagied INV     SED 62571     441       Center Freq 2.480000000 GHz     SED 62571     441       Center Freq 2.480000000 GHz     SEG 645     Trig Freq 2.48000000       It dialay     Ref Offset 15 dB     SEG 645     Trig Freq 2.48000000       10 dBday     Ref Offset 15 dB     SEG 645     Trig Freq 2.48000000       30     Seg 645     SEG 645     SEG 645       10 dBday     Ref Offset 15 dB     SEG 645     SEG 645       10 dBday     Ref 16.30 dBm     SEG 645     SEG 645       13 5     SEG 645     SEG 645     SEG 645	Avg Hold>100/100 Radio Device: BTS		Void		
Occupied Bandwidth Total Power 1.0692 MHZ Transmit Freq Error -9.349 kHz OBW Power x dB Bandwidth 661.7 kHz x dB MICI MIC	9.87 dBm 99.00 % -6.00 dB				

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#### 99% Bandwidth:

Agilent Spectrum Analyzer - Occupied BW			Agilent Spectrum Analyzer - Occupied BW				
OZ     R.T.     RF     50.9. AC     AC       Center Freq 2.402000000 GHz     #IFGain:Low     #IFGain:Low	SENSE:BIT ALIGNAUTO Center Freq: 2.40200000 GHz Trig: Free Run Avg Hold: 100/100 #Atten: 40 dB	04:50:58 AM Aug 23, 2023 Radio Std: None Radio Device: BTS	Center Freq 2.440000000 G	Hz #IFGain:Low	Center Freq: 2.440000 Trig: Free Run #Atten: 40 dB	ALIGN AUTO 0000 GHz Avg Hold: 100/100	04:53:26 AM Aug 23, 2023 Radio Std: None Radio Device: BTS
		Mkr2 2.402541 GHz	Ref Offset 1.5 dB	- n Gameen		Λ	/kr2 2.4405354 GHz
Ref Offset 1.5 dB 10 dB/div Ref 21.50 dBm Log		-13.616 dBm	Ref Offset 1.5 dB 10 dB/div Ref 21.50 dBm Log	r			-16.355 dBm
11.5			11.5				
-5.0	· · · · · · · · · · · · · · · · · · ·	2	-8.50	1	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	2
-18.5			-18.5				m
28.5		1 mm	-28.5				T. mm
-48.5		~~	-48.5				~~·
-68.5			-58.5				
68.5			-60.5				
Center 2.402 GHz #Res BW 20 kHz	#VBW 62 kHz	Span 2 MHz Sweep 5.333 ms	Center 2.44 GHz #Res BW 20 kHz		#VBW 62 kH	lz	Span 2 MH Sweep 5.333 m
Occupied Bandwidth 1.0517 MHz	Total Power 12.3 dBm		Occupied Bandwidth	524 MHz	Total Power	10.4 dBm	
Transmit Freq Error 15.357 kHz	OBW Power 99.00 %		Transmit Freq Error	9.400 kHz	OBW Power	99.00 %	
x dB Bandwidth 1.320 MHz	x dB -26.00 dB		x dB Bandwidth	1.322 MHz	x dB	-26.00 dB	
45G	STATUS		MSG			STATUS	
L	E_Channel 0			LE_	Channel	19	
Aglient Spectrum Analyzer - Occupied BW Q R T RF 50.0 AC Center Freq 2.480000000 GHz #IFGain:Low		04:55:32 AM Aug 23, 2023 Radio Std: None Radio Device: BTS					
Ref Offset 1.5 dB 10 dB/div Ref 21.50 dBm		Mkr2 2.4805292 GHz -16.874 dBm					
11.5							
1.50 	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~						
4.50		2					
-28.5							
-38.5		We was and					
-58.5					Void		
-68.5							
Center 2.48 GHz #Res BW 20 kHz	#VBW 62 kHz	Span 2 MHz Sweep 5.333 ms					
Occupied Bandwidth 1.0530 MHz	Total Power 9.33 dBm						
Transmit Freq Error 2.804 kHz							
x dB Bandwidth 1.318 MHz							
15G	STATUS						
	E Channel 39						
L							

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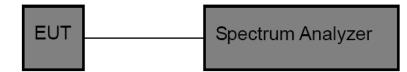
### 3.6. Peak Output Power

Limit

### FCC CFR Title 47 Part 15 Subpart C Section 15.247 (b)(3)

Section	Test Item	Limit	Frequency Range (MHz)
FCC CFR 47 Part15.247 (b)(3)	Maximum Conducted Output Power	1 Watt or 30dBm	2400~2483.5

### **Test Configuration**



### **Test Procedure**

1. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.

- Spectrum Setting: 2.
  - (1) Set RBW ≥ DTS Bandwidth.
  - (2) Set VBW  $\geq$  3\*RBW.
  - (3) Set Span  $\geq$  3\*RBW.
  - (4) Sweep time = Auto couple.
  - (5) Detector = Peak.
  - (6) Trace mode = Max hold.

Allow trace to fully stabilize. Then use the peak marker function to determine the maximum amplitude level.

### **Test Mode**

Please refer to the clause 2.4.

### Test Result

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Test Mode	Frequency (MHz)	Conducted Output Power (dBm)	Limit (dBm)	Verdict
	2402	6.472	≤30	Pass
BLE_1M	2440	4.764	≤30	Pass
	2480	3.887	≤30	Pass

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Test plot as follows:

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Agition Spectrum Analyzer - Sweet SA U 8 T 89 800 Act 900 Act	Agitant Spectrum Analyzer - Swept SA.     Stretc Entr     ALSYLATIO     0453-45 AM Aug 23, 0223       If N T     IP     1500     AC     Stretc Entr     Aug Type: Log-Pwr     Stretc Entr       Centor Freq 2.44000000 GHz     Tot Entro     Tot Entro     Not Type: Log-Pwr     Stretc Entro
PNO: Fast Ing. Free Run Avginera. 100100 DET PPPPPP IFGain:Low #Atten: 26 dB DET PPPPPP	PN0: Fast Thg. Free Run Avginera. 100100 DET PPPPP P
Ref Offset 1.5 dB Mkr1 2.402 120 GHz 10 dB/div Ref 11.50 dBm 6.472 dBm	Ref Offset 1.5 dB     Mkr1 2.440 102 GHz       10 dB/div     Ref 11.50 dBm     4.764 dBm
1:0	150
850	850
	-18.5
20.5	
38.5	38.5
18.5 million and a free state of the state o	125 April Martin
69.6	
	22.53
785	78.5
Center 2.402000 GHz Span 6.000 MHz #Res BW 1.0 MHz #VBW 3.0 MHz Sweep 1.000 ms (1001 pts)	Center 2.440000 GHz Span 6.000 MH #Res BW 1.0 MHz #VBW 3.0 MHz Sweep 1.000 ms (1001 pts
#Res BW 1.0 MHz #VBW 3.0 MHz Sweep 1.000 ms (1001 pts) #SG STATUS	#Res BW 1.0 MHz #VBW 3.0 MHz Sweep 1.000 ms (1001 pts MSG STATUS
Peak Output Power	Peak Output Power
LE Channel 0	LE_Channel 19
Aginati Spectrum Analyzer, Serger SA R T P7 Serger Science Serger SA Conter Freq 2-480000000 GHz Vide Serg Data Arag Type: Log-Part Roots Arag 20, 2023 Conter Freq 2-480000000 GHz	
PN0: Fast The run Avginera. Nor no IFGain:Low #Atten: 26 dB	
Ref Offset 1.5 dB     Mkr1 2.480 102 GHz       10 dB/div     Ref 11.50 dBm     3.887 dBm	
150	
8.50	
18.5	
28.6	Void
30.5 <b>1</b>	VOIG
-85 North Wether and a	
60.5	
785	
Center 2.480000 GHz Span 6.000 MHz #Res BW 1.0 MHz #VBW 3.0 MHz Sweep 1.000 ms (1001 pts)	
#Res BW 1.0 MHz #VBW 3.0 MHz Sweep 1.000 ms (1001 pts) #86	
Peak Output Power	
LE_Channel 39	
	1

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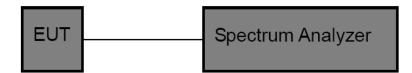
#### **Power Spectral Density** 3.7.

Limit

### FCC CFR Title 47 Part 15 Subpart C Section 15.247 (e)

Test Item	Limit	Frequency Range (MHz)
Power Spectral Density	8 dBm (in any 3 kHz)	2400~2483.5

### **Test Configuration**



### **Test Procedure**

- 1. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.
- 2. The EUT was directly connected to the Spectrum Analyzer and antenna output port as show in the block diagram above. The measurement according to section 10.2 of KDB 558074 D01 DTS Meas Guidance v05r02.

3. Spectrum Setting:

Set analyzer center frequency to DTS channel center frequency.

Set the span to 1.5 times the DTS bandwidth.

Set the RBW:3 kHz.

Set the VBW≥3RBW

Detector: peak.

Sweep time: auto.

Allow trace to fully stabilize. Then use the peak marker function to determine the maximum amplitude level.

### **Test Mode**

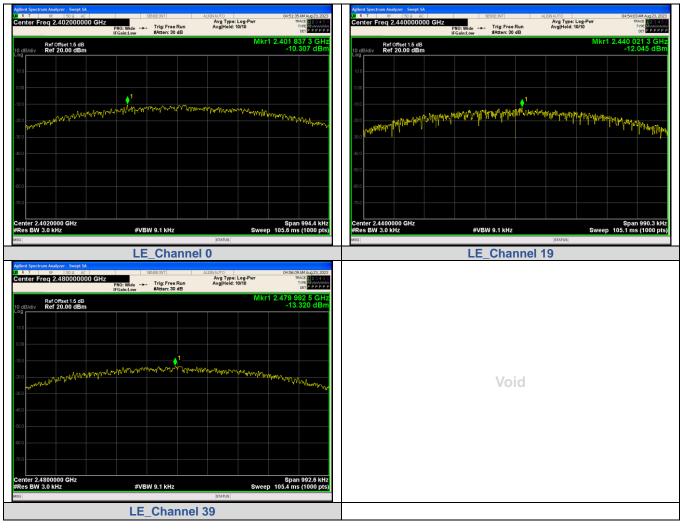
Please refer to the clause 2.4.

### Test Result

Test Mode	Frequency (MHz)	Power Spectral Density (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
	2402	-10.307	≤8	Pass
BLE_1M	2440	-12.045	≤8	Pass
	2480	-13.320	≤8	Pass



Test plot as follows:



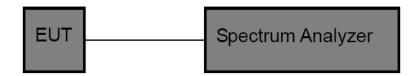


### 3.8. Duty Cycle

### <u>Limit</u>

None, for report purposes only.

### **Test Configuration**



### **Test Procedure**

- 1. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.
- 2. The EUT was directly connected to the Spectrum Analyzer and antenna output port as show in the block diagram above. The measurement according to section 10.2 of KDB 558074 D01 DTS Meas Guidance v05r02.

Spectrum Setting:
Set analyzer center frequency to test channel center frequency.
Set the span to 0Hz.
Set the RBW to 10MHz.
Set the VBW to 10MHz.
Detector: Peak.
Sweep time: Auto.
Allow trace to fully stabilize. Then use the peak marker function to determine the maximum amplitude level.

### Test Mode

Please refer to the clause 2.4.

#### Test Result

Test Mode	Frequency (MHz)	Transmission Duration (ms)	Transmission Period (ms)	Duty Cycle (%)	1/T Minimum VBW (kHz)	Final Setting for VBW (kHz)
	2402	2.122	2.499	84.90	0.47	1
BLE_1M	2440	2.122	2.499	84.90	0.47	1
	2480	2.122	2.499	84.90	0.47	1

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### 3.9. Antenna Requirement

### **Requirement**

### FCC CFR Title 47 Part 15 Subpart C Section 15.203

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 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.

### FCC CFR Title 47 Part 15 Subpart C Section 15.247(c) (1)(i)

(i) Systems operating in the 2400~2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.

### Test Result

The directional gain of the antenna is less than 6dBi, please refer to the EUT internal photographs antenna photo.

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