

R	F TEST REPORT			
Report No.:	20240917G19677X-W2			
Product Name:	OBDII			
Model No. :	BTOBDII			
FCC ID:	2BHGX-BTOBDII			
Applicant:	Thermal Master Technology Co., Ltd.			
Address:	Building C, Room 606, No. 3 Nanchang Street, Guxian Street, Yantai, Shandong, China			
Dates of Testing:	09/29/2024 - 11/12/2024			
Issued by:	CCIC Southern Testing Co., Ltd.			
Lab Location:	Electronic Testing Building, No.43, Shahe Road, Xili Street, Nanshan District, Shenzhen, Guangdong, China.			
	Tel:86-755-26627338E-Mail:manager@ccic-set.com			

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Test Report

Product:	OBDII		
Trade Name:	N/A		
Applicant:	Thermal Master Technology Co.,	Ltd.	
Applicant Address:	Building C, Room 606, No. 3 Nan Street, Yantai, Shandong, China	chang Street, Guxian	
Manufacturer	Thermal Master Technology Co.,	Ltd.	
Manufacturer Address:	Building C, Room 606, No. 3 Nan Street, Yantai, Shandong, China	ichang Street, Guxian	
Test Standards	47 CFR Part 15 Subpart C 15.24 ANSI C63.10-2020	7	
Test Result:	Pass		
Tested by:	(hwizwany zhang	2024.11.12	
	Chuiwang Zhang, Test Engineer		
Reviewed by:	Sun Jiaohui	2024.11.12	
	Sun Jiaohui, Senior Engineer		
Approved by:	Chris You Chris You	2024.11.12	
	Chris You, Manager		



TABLE OF CONTENTS

1. GENERAL INFORMATION	5
1.1. EUT Description	5
1.2. Test Standards and Results	6
1.3. Table for Supporting Units	7
1.4. EUT Operation Test Setup	7
1.5. Test environment and mode	7
1.6. Laboratory Facilities	8
2. TEST REQUIREMENTS	9
2.1. Antenna requirement	9
2.2. Maximum Conducted Output Power	10
2.3. 6dB and 99% Bandwidth	12
2.4. Power spectral density (PSD)	14
2.5. Conducted Band Edges and Spurious Emissions	16
2.6. Radiated Band Edge and Spurious Emission	18
2.7. AC Power Line Conducted Emission	26
3. LIST OF MEASURING EQUIPMENT	28
4. UNCERTAINTY OF EVALUATION	29
APPENDIX A	30



Change History				
Issue	Date	Reason for change		
1.0	2024.11.12	First edition		



1. General Information

1.1. EUT Description

Product Name	OBDII
EUT supports Radios application	Bluetooth LE
Frequency Range	2402MHz~2480MHz
Channel Number	40
Bit Rate of Transmitter	1Mbps
Modulation Type	GFSK
Antenna Type	Internal antenna
Antenna Gain	0.5dBi
Power supply	DC 12V

Note 1: For a more detailed description, please refer to Specification or User's Manual supplied by the applicant and/or manufacturer.

Note 2: The information of antenna gain and cable loss is provided by the manufacturer and our lab is not responsible for the accuracy of the antenna gain and cable loss information.



1.2. Test Standards and Results

The purpose of the report is to conduct testing according to the following FCC certification standards:

No.	Identity	Document Title		
1	47 CFR Part 15	Radio Frequency Devices		
	Subpart C			
2	ANSI C63.10-2020	American National Standard for Testing Unlicensed Wireless		
2	AINSI C03.10-2020	Devices		
	KDB 558074 D01	Cuidance for Compliance Measurement on Digital Transmission		
2	15.247 Meas	Systems, Frequency Hopping Spread Spectrum Systems, and		
5	Guidance v05r02	Hybrid System Devices Operating under Section 15.247 of the		
		FCC Rules		

Test detailed items/section required by FCC rules and results are as below:

No.	Section in CFR 47	Description	Result
1	15.203	Antenna Requirement	PASS
1 15.247(c)		Antenna Requirement	TASS
2	15.247(b)(3)	Maximum Conducted Output Power	PASS
3	15.247(a)(2)	6dB and 99% Bandwidth	PASS
4	15.247(d)	Conducted Band Edges and Spurious Emission	PASS
5	15.247(e)	Power spectral density (PSD)	PASS
6	15.207	AC Power Line Conducted Emission	N/A ^{Note 3}
	15.209		
7	15.205	Radiated Band Edges and Spurious Emission	PASS
	15.247(d)		

Note 1: The tests of Conducted Emission and Radiated Emission were performed according to the method of measurements prescribed in ANSI C63.10-2020.

Note 2: These RF tests were performed according to the method of measurements prescribed in KDB 558074 D01 15.247 Meas Guidance v05r02.

Note 3: Not applicable, EUT is powered by DC 12V only.



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

40 channels are provided for Bluetooth LE.

Test Items	Modulation Type	Data Rate	Channel
Maximum Conducted Output Power Power Spectral Density 6dB and 99% Bandwidth Conducted Spurious Emission Radiated Spurious Emission	GFSK	1Mbps	0/19/39
Band Edge	GFSK	1Mbps	0/39

1.3. Table for Supporting Units

No	Equipment	Brand Name	Model Name	Manufacturer	Serial No.	Note
1	Laptop	HP	TPN-Q221	HP	5CD14347QB	FCC DOC

1.4. EUT Operation Test Setup

For RF test items, an engineering test program was provided and enable to make EUT transmitting.

1.5. Test environment and mode

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

Operating Environment				
Temperature	15°C - 35°C			
Humidity	30% -60%			
Atmospheric Pressure	86kPa-106kPa			
Test mode:				
Continuously transmitting mode	Keep the EUT in continuous transmitting with modulation			



1.6. Laboratory Facilities

FCC-Registration No.: CN1283

CCIC Southern Testing Co., Ltd 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. Designation Number: CN1283, valid time is until Jun. 30th, 2025.

ISED Registration: 11185A

CCIC Southern Testing Co., Ltd. EMC Laboratory has been registered by Certification and Engineering Bureau of Industry Canada for the performance of radiated measurements with Registration No. 11185A on Aug. 04, 2016, valid time is until Jun. 30th, 2025. **CAB number: CN0064**

A2LA Code: 5721.01

CCIC-SET is a third party testing organization accredited by A2LA according to ISO/IEC 17025. The accreditation certificate number is 5721.01.



2. Test Requirements

2.1. Antenna requirement

2.1.1. Applicable Standard

According to FCC 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 an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

And according to FCC 47 CFR Section 15.247(c), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

2.1.2. Antenna Information

Antenna Category: Internal Antenna

A internal Antenna was soldered to the antenna port of EUT via an adaptor cable, can't be removed.

Antenna General Information:

No.	EUT	Operating frequency range	Ant. Type	Ant. Gain
1	OBDII	2402-2480MHz	Internal	0.5 dBi

2.1.3. Result: comply

The EUT has a permanently and irreplaceable attached antenna. Please refer to the EUT internal photos.



2.2. Maximum Conducted Output Power

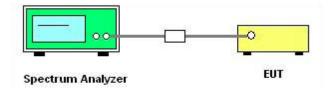
2.2.1. Limit of Maximum Conducted Output Power

For DTSs employing digital modulation techniques operating in the bands 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1W.

2.2.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.2.3. Test Setup



2.2.4. Test Procedures

- 1. The testing follows the Measurement Procedure of ANSI C63.10-2020 Section 11.9.1.1.
- 2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
- 3. Set to the maximum power setting and enable the EUT transmit continuously.
- 4. Use the following spectrum analyzer settings:

 $RBW \ge DTS$ bandwidth / $VBW \ge 3*RBW$ / Sweep time: Auto couple / Detector mode: Peak /

Trace mode: Max hold / Allow trace to fully stabilize / Use peak marker function to determine the peak amplitude level.

5. Record the measurement results in the test report.



2.2.5. Test Result of Maximum Conducted Output Power

Please refer to Appendix A for detail.



2.3. 6dB and 99% Bandwidth

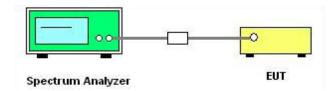
2.3.1. Limit of 6dB and 99% Bandwidth

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

2.3.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.3.3. Test Setup



2.3.4. Test Procedures

- 1. The testing follows the Measurement Procedure of ANSI C63.10-2020 Section 11.8.1.
- 2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.

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

- 4. Use the spectrum analyzer "Channel Bandwidth" function to easurement the 6dB EBW and 99% OBW.
- 5. For 6dB EBW Use the following spectrum analyzer settings:

RBW: 100kHz / VBW: 300kHz / Detector: Peak / Trace mode: Max hold / Sweep time: Auto couple / Allow trace to fully stabilize.

6. For 99% OBW Use the following spectrum analyzer settings:

Set RBW = approximately 1% EBW or 1.5 times to 5.0 times the OBW, $VBW \ge 3 \times RBW$.

7. Record the measurement results in the test report.



2.3.5. Test Results of 6dB and 99% Bandwidth

Please refer to Appendix A for detail.



2.4. Power spectral density (PSD)

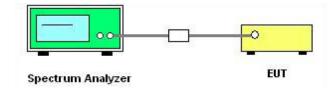
2.4.1. Limit of Power Spectral Density

The peak power spectral density shall not be greater than 8dBm in any 3kHz band at any time interval of continuous transmission.

2.4.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.4.3. Test Setup



2.4.4. Test Procedures

- 1. The testing follows the Measurement Procedure of ANSI C63.10-2020 Section 11.10.2.
- 2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
- 3. Set to the maximum power setting and enable the EUT transmit continuously.
- 4. Use the following spectrum analyzer settings:

Set instrument center frequency to DTS channel center frequency / Set the span to 1.5 times the DTS bandwidth / RBW: 3kHz / VBW: 10kHz / Detector: Peak / Sweep time: Auto couple / Trace mode: Max hold / Allow trace to fully stabilize / Use the peak marker function to determine the maximum power level.

5. Record the measurement results in the test report.



2.4.5. Test Results of Power spectral density

Please refer to Appendix A for detail.



2.5. Conducted Band Edges and Spurious Emissions

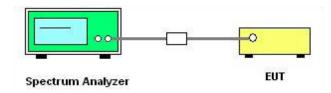
2.5.1. Limit of Conducted Band Edges and Spurious Emissions

In any 100 kHz bandwidth outside the frequency band in which the intentional radiator is perating, 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.

2.5.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.5.3. Test Setup



2.5.4. Test Procedure

- 1. The testing follows the Measurement Procedure of ANSI C63.10-2020 Section 11.11 and 11.13.
- 2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
- 3. Set to the maximum power setting and enable the EUT transmit continuously.
- 4. Use the following spectrum analyzer settings:

Reference level measurement: Set spectrum analyzer center frequency to DTS channel center frequency / Set the span to \geq 1.5 times the DTS bandwidth / RBW: 100kHz / VBW: 300kHz / Detector: Peak / Sweep time: Auto couple / Trace mode: Max hold / Allow trace to fully stabilize / Use the peak marker function to determine the maximum PSD level and attenuate it by 20dB. Emission level measurement: Set the center frequency and span to encompass frequency range to be measured / RBW: 100kHz / VBW: 300kHz / Detector: Peak / Sweep time: Auto couple / Trace mode: Max hold / Allow trace to fully stabilize / Use the peak marker function to determine the maximum amplitude level.

5. Record the measurement results in the test report.



2.5.5. Test Results of Conducted Band Edges and Spurious Emissions

Please refer to Appendix A for detail.



2.6. Radiated Band Edge and Spurious Emission

2.6.1. Limit of Radiated Band Edges and Spurious Emission

In any 100 kHz bandwidth outside the frequency band in which the 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. If the transmitter uses an RMS average conducted power limit, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. In addition, radiated emissions which fall in the estricted bands, as defi ned in §15.205(a), must also comply with the radiated emission limits specifi ed in §15.209(a).

§15.209(a) Radiated emission limits:

Frequency (MHz)	Field Strength (µV/m)	Measurement Distance (m)
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
Above 960	500	3

Restricted bands of operation refer to §15.205 (a):

MHz	MHz	MHz	GHz		
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15		
¹ 0.495-0.505	16.69475-16.69525	608-614	5.35-5.46		
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75		
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5		
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2		
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5		
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7		
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4		
6.31175-6.31225	123-138	2200-2300	14.47-14.5		
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2		
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4		
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12		
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0		
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8		
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5		
12.57675-12.57725	322-335.4	3600-4400	(2)		
13.36-13.41	1	1	/		
Note: ¹ Until February 1	, 1999, this restricted bane	d shall be 0.490-0.510 MHz	Ζ.		
² Above 38.6.					

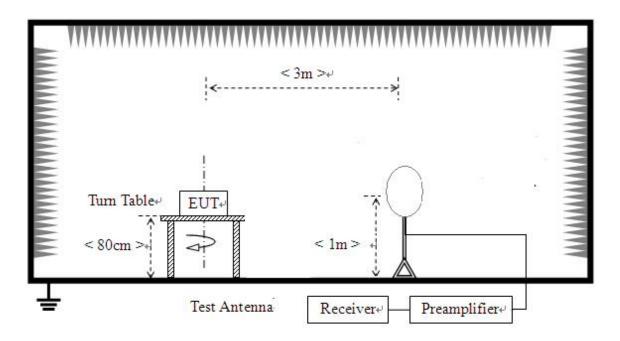


2.6.2. Measuring Instruments

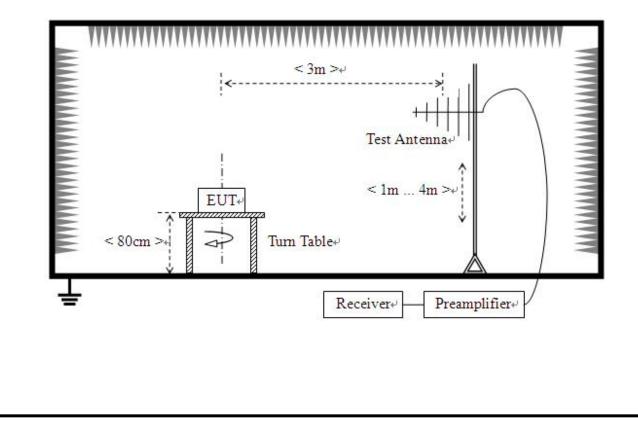
The measuring equipment is listed in the section 3 of this test report.

2.6.3. Test Setup

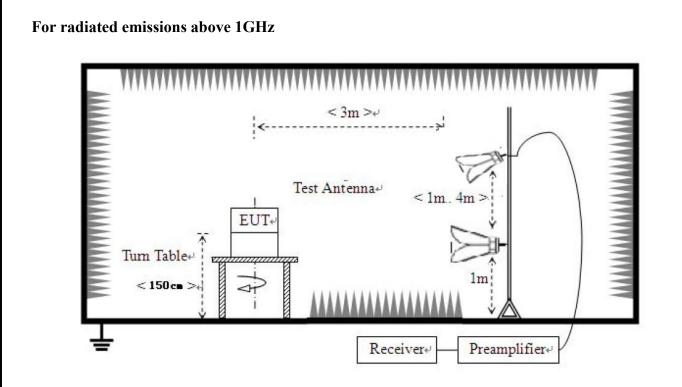
For radiated emissions from 9 kHz to 30 MHz



For radiated emissions from 30MHz to 1GHz







2.6.4. Test Procedures

- 1. The EUT was placed on the top of a rotating table 0.8m for below 1GHz and 1.5m for above 1GHz above the ground at a 3 meters semi-anechoic chamber.
- 2. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
- 3. Height of receiving antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- 4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- 5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- 6. If the emission level of the EUT in peak mode was lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions would be re-tested one by one using peak, quasi-peak or average method as specified and then



reported in a data sheet.

7. For the radiated emission test above 1GHz:

Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane. NOTE:

- 1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection at frequency below 1GHz.
- The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz for Peak detection at frequency above 1GHz.
- The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is ≥ 1/T(Duty cycle < 98%) or 10Hz (Duty cycle > 98%) for Average detection (AV) at frequency above 1GHz.
- 4. All radiated emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

2.6.5. Test Results of Radiated Band Edge and Spurious Emission

For 9 kHz to 30MHz, The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

For 30MHz to 1GHz, All of the EUT Configure mode were tested and found 2402MHz channel is the worst mode, the worst case is recorded in this report.



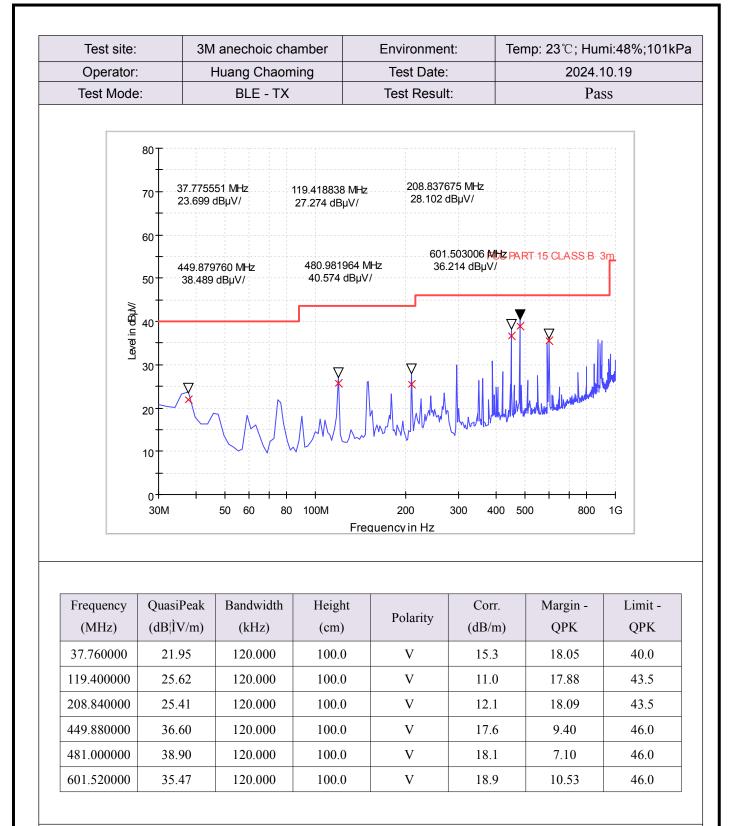
3M anechoic chamber Test site: Environment: Temp: 23°C; Humi:48%;101kPa 2024.10.19 Operator: Huang Chaoming Test Date: Test Mode: BLE - TX Test Result: Pass 80 350.741483 MHz 296.312625 MHz 389.619239 MHz 70 31.947 dBµV/ 33.973 dBµV/ 32.774 dBµV/ 60 449.879760 MHz 480.981964 MEC PART 15 CLASS B 3m 35.387 dBµV/ 420.721443 MHz 37.364 dBµV/ 50 37.914 dBµV/ Level in dBµ// 40 30 20 MAN 10 0-1G 30M 50 60 80 100M 200 300 400 500 800 Frequency in Hz Frequency QuasiPeak Bandwidth Height Corr. Margin -Limit -Polarity (dB|IV/m)(MHz) (kHz) (cm)(dB/m)**QPK QPK** 296.320000 31.87 120.000 100.0 14.9 14.13 Η 46.0 16.0 350.760000 30.99 120.000 100.0 Η 15.01 46.0 389.600000 31.44 120.000 100.0 Η 16.7 14.56 46.0 420.720000 35.07 120.000 100.0 Н 17.210.93 46.0 449.880000 32.41 120.000 100.0 Η 17.6 13.59 46.0 481.000000 34.43 120.000 100.0 Η 18.1 11.57 46.0

For 30MHz to 1000MHz

Remark:

- 1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m).
- 2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB).
- **3**. Margin value = Limit value Emission Level.
- 4. The emission levels of other frequencies are very lower than the limit and not show in test report.
- 5. Only the antenna height (from 1m to 4m) at maximum reading are recorded.





Remark:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m).

2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB).

3. Margin value = Limit value - Emission Level.

4. The emission levels of other frequencies are very lower than the limit and not show in test report.

5. Only the antenna height (from 1m to 4m) at maximum reading are recorded.

For 1GHz to 25GHz

				GFS	K_2402M	Hz			
Frequency (MHz)	Emssion Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV/m)	Correction Factor (dB/m)	Polarity	Detector
2390.00	53.85	74.00	-20.15	1.50	200	56.94	-3.09	Horizontal	Peak
2390.00	43.64	54.00	-10.36	1.50	200	46.73	-3.09	Horizontal	Average
4804.00	54.20	74.00	-19.80	1.50	200	52.94	1.26	Horizontal	Peak
4804.00	46.67	54.00	-7.33	1.50	200	45.41	1.26	Horizontal	Average
7206.00	50.91	74.00	-23.09	1.50	200	44.74	6.17	Horizontal	Peak
7206.00	41.08	54.00	-12.92	1.50	200	34.91	6.17	Horizontal	Average
2390.00	53.17	74.00	-20.83	1.50	180	56.26	-3.09	Vertical	Peak
2390.00	43.43	54.00	-10.57	1.50	180	46.52	-3.09	Vertical	Average
4804.00	53.35	74.00	-20.65	1.50	180	52.09	1.26	Vertical	Peak
4804.00	46.72	54.00	-7.28	1.50	180	45.46	1.26	Vertical	Average
7206.00	50.46	74.00	-23.54	1.50	180	44.29	6.17	Vertical	Peak
7206.00	41.46	54.00	-12.54	1.50	180	35.29	6.17	Vertical	Average
				GFS	K_2440M	Hz			
Frequency (MHz)	Emssion Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV/m)	Correction Factor (dB/m)	Polarity	Detector
4880.00	54.27	74.00	-19.73	1.50	200	53.34	0.93	Horizontal	Peak
4880.00	46.86	54.00	-7.14	1.50	200	45.93	0.93	Horizontal	Average
7320.00	50.67	74.00	-23.33	1.50	200	45.08	5.59	Horizontal	Peak
7320.00	41.23	54.00	-12.77	1.50	200	35.64	5.59	Horizontal	Average
4880.00	53.54	74.00	-20.46	1.50	180	52.61	0.93	Vertical	Peak
4880.00	46.73	54.00	-7.27	1.50	180	45.80	0.93	Vertical	Average
7320.00	50.74	74.00	-23.26	1.50	180	45.15	5.59	Vertical	Peak
7320.00	41.93	54.00	-12.07	1.50	180	36.34	5.59	Vertical	Average

Remark:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)

2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) - Pre-Amplifier Factor(dB)

3. Margin value = Emission Level – Limit value

4. The emission levels of other frequencies are very lower than the limit and not show in test report.

5. Trily the antenna height (from 1m to 4m) and turntable angle (from 0 degrees to 360 degrees) at maximum reading are recorded.



	GFSK_2480MHz								
Frequency (MHz)	Emssion Level	Limit (dBuV/m)	Margin (dB)	Antenna Height	Table Angle	Raw Value	Correction Factor (dB/m)	Polarity	Detector
2483.50	(dBuV/m) 53.55	74.00	-20.45	(m) 1.50	(Degree) 200	(dBuV/m) 58.30	-4.75	Horizontal	Peak
2483.50	43.64	54.00	-10.36	1.50	200	48.39	-4.75	Horizontal	Average
4960.00	48.12	74.00	-25.88	1.50	200	47.88	0.24	Horizontal	Peak
4960.00	39.00	54.00	-15.00	1.50	200	38.76	0.24	Horizontal	Average
7440.00	49.93	74.00	-24.07	1.50	200	44.11	5.82	Horizontal	Peak
7440.00	39.94	54.00	-14.06	1.50	200	34.12	5.82	Horizontal	Average
2483.50	53.85	74.00	-20.15	1.50	180	58.60	-4.75	Vertical	Peak
2483.50	43.65	54.00	-10.35	1.50	180	48.40	-4.75	Vertical	Average
4960.00	48.17	74.00	-25.83	1.50	180	47.93	0.24	Vertical	Peak
4960.00	39.86	54.00	-14.14	1.50	180	39.62	0.24	Vertical	Average
7440.00	48.89	74.00	-25.11	1.50	180	43.07	5.82	Vertical	Peak
7440.00	40.18	54.00	-13.82	1.50	180	34.36	5.82	Vertical	Average

Remark:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)

2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) - Pre-Amplifier Factor(dB)

3. Margin value = Emission Level – Limit value

4. The emission levels of other frequencies are very lower than the limit and not show in test report.

5. Trily the antenna height (from 1m to 4m) and turntable angle (from 0 degrees to 360 degrees) at maximum reading are recorded.



2.7. AC Power Line Conducted Emission

2.7.1. Limit of AC Power Line Conducted Emission

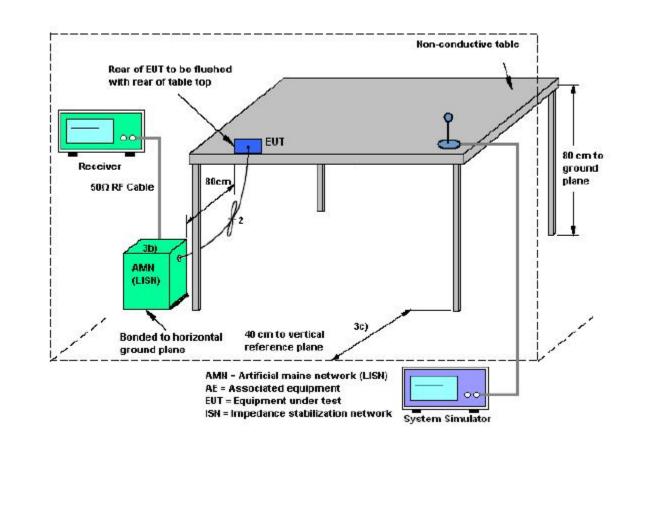
For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

Eraguanay ranga (MHz)	Conducted Limit (dBµV)			
Frequency range (MHz)	Quai-peak	Average		
0.15 - 0.50	66 to 56	56 to 46		
0.50 - 5	56	46		
5 - 30	60	50		

2.7.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.7.3. Test Setup





2.7.4. Test Procedures

- 1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
- 2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
- 3. All the support units are connecting to the other LISN.
- 4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
- 5. The FCC states that a 50 ohm, 50 micrometry LISN should be used.
- 6. Both sides of AC line were checked for maximum conducted interference.
- 7. The frequency range from 150 kHz to 30 MHz was searched.
- 8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

2.7.5. Test Results of Conducted Emission

Not applicable, EUT is powered by DC 12V only.



3. List of measuring equipment

Item	Test Equipment	Manufacturer	Model No.	Serial No.	Cal Date	Due Date
1	5M Anechoic Chamber	Albatross	SAC-5MAC 12.8x6.8x6.4m	A0304210	2023.08.01	2026.07.31
2	EMI Test Receiver	ROHDE&SCHWARZ	ESW26	A180502935	2024.05.23	2025.05.22
3	Loop Antenna	Schwarz beck	HFH2-Z2	A0304220	2022.05.02	2025.05.01
4	Broadband antenna (30MHz~1GHz)	R&S	HL562	A0304224	2023.06.08	2026.06.07
5	EMI Horn Ant. (1-18G)	ETC	MCTD-1209	A150402241	2023.05.16	2026.05.15
6	Horn antenna (18GHz~26.5GHz)	AR	AT4510	A0804450	2023.06.01	2026.05.31
7	Amplifier 30M~1GHz	MILMEGA	80RF1000-10004	A140101634	2023.11.27	2024.11.26
8	Amplifier 1G~18GHz	MILMEGA	AS0104R-800/400	A160302517	2024.05.25	2025.05.24
9	Spectrum Analyzer	KEYSIGHT	N9030A	A160702554	2024.01.18	2025.01.17
10	Test Receiver	R&S	ESIB7	A0501375	2024.02.28	2025.02.27
11	Broadband Ant.	ETC	MCTD 2786	A150402240	2023.05.22	2026.05.21
12	3M Anechoic Chamber	Albatross	SAC-3MAC 9*6*6m	A0412375	2024.02.27	2027.02.26
13	Cable(9kHz~30MHz)	/	/	C230800587	2023.08.21	2026.08.20
14	Cable(30MHz~18GHz)	/	XSMJA750-SMN M(RA)-12M	C230800588	2023.08.21	2026.08.20
15	Cable(18GHz~40GHz)	/	SUCOFLEX102	C230800590	2023.08.21	2026.08.20



4. Uncertainty of Evaluation

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.10-2020. All the measurement uncertainty value were shown with a coverage K=2 to indicate 95% level of confidence. The measurement data show herein meets or exceeds the CISPR measurement uncertainty values specified in CISPR 16-4-2 and can be compared directly to specified limit to determine compliance.

Uncertainty of AC Power Line Conducted Emission Measurement (150kHz~30MHz)

Measuring Uncertainty for a level of	2.8dB
confidence of 95%(U=2Uc(y))	

Uncertainty of Radiated Emission Measurement (9kHz~30MHz)

Measuring Uncertainty for a level of	2 5 JD
confidence of 95%(U=2Uc(y))	3.5dB

Uncertainty of Radiated Emission Measurement (30MHz~1GHz)

Measuring Uncertainty for a level of	3.91dB
confidence of 95%(U=2Uc(y))	5.51dB

Uncertainty of Radiated Emission Measurement (1GHz~18GHz)

Measuring Uncertainty for a level of	4.5 dD
confidence of 95%(U=2Uc(y))	4.5dB

Uncertainty of Radiated Emission Measurement (18GHz~40GHz)

Measuring Uncertainty for a level of	4.9dB
confidence of 95%(U=2Uc(y))	

Uncertainty of RF Conducted Measurement (9kHz~40GHz)

Measuring Uncertainty for a level of	1.3dB
confidence of 95%(U=2Uc(y))	1.5 u D



Appendix A

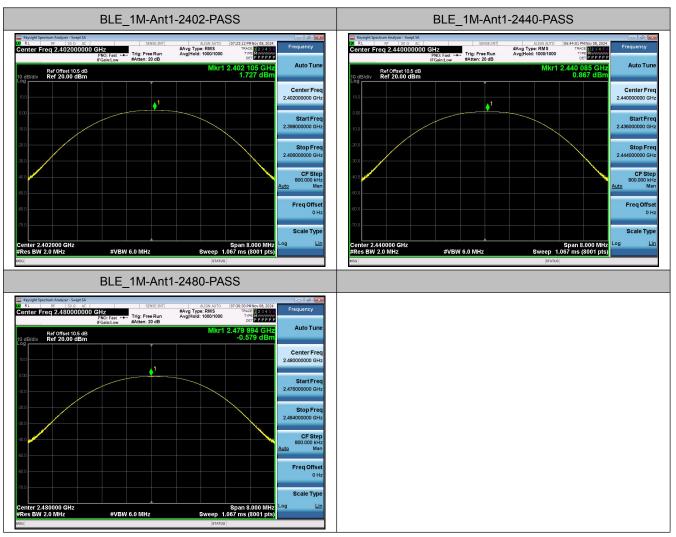
Maximum Conducted Output Power

Test Result and Data

Test Mode	Antenna	Frequency[MHz]	Peak Output Power[dBm]	Limit [dBm]	Verdict
BLE_1M	Ant1	2402	1.73	≤30	PASS
BLE_1M	Ant1	2440	0.87	≤30	PASS
BLE_1M	Ant1	2480	-0.58	≤30	PASS



Test Graphs





6dB Bandwidth

Test Result and Data

Test Mode	Antenna	Frequency[MHz]	DTS BW [MHz]	Limit[MHz]	Verdict
BLE_1M	Ant1	2402	0.708	0.5	PASS
BLE_1M	Ant1	2440	0.720	0.5	PASS
BLE_1M	Ant1	2480	0.717	0.5	PASS



Test Graphs

BLE_1M-Ant1-2402-PASS	BLE_1M-Ant1-2440-PASS
Keyligh Spectrum Analyzer - Swept SA SENSE (MT) ALLON AUTO (0722:53 PM Nov (8), 2024 Inter Freq 2.402000000 GHz Trig: Free Run #Vorg Type: RNS Trick The 2.8 45 PRO, Wide	Keysight Spectrum Analyzer - Swept SA 50195-0111 ALIGN AUTO 64-33-19 PN kvr (8, 2024 VIII R.L. RF 1510 AC 50195-0111 ALIGN AUTO 64-33-19 PN kvr (8, 2024 VIII R.L. RF 1510 AC Trig: Free Run 4Avg Type: RMS Trig: B2 845 Frequency If Gent.tox Frequency Autors 2004 AC Augited: 1000/1000 Trig: Free Run Augited: 1000/10000 Trig: Free Run F
Ref offset 10.5 dB	Ref offset 105 dB ΔMkr3 720 kHz Auto Tr. 10 dB/dw Ref 20.00 dBm 0.044 dB Center F 10 0 1 2 3Δ1 450 db 24000000 db 10 0 1 0 450 db Start F 24000000 db 10 0 1 0 450 db Start F 24000000 db
240050000 GH2 es BW 100 kHz #VBW 300 kHz Sweep 1.000 ms (1001 pts) 300.000 Hz #VBW 300 kHz Sweep 1.000 ms (1001 pts)	400 2239500000 900 900 900
NODE TRES ECL X Y Function PUNCTION NUCLE PUNCTION NUCLE N 1 7 2.401 670 GHz -5.471 BFm Function Function NULLE Freq Offset N 1 7 2.402 671 GHz -0.453 GHm Function Function NULLE Freq Offset A1 1 7 (A) -0.101 dB Freq Offset 0 Hz Image: Solid Strain S	Mini Mode Tric (sc.) X Y Function Function Work Function Work <th< td=""></th<>
BLE_1M-Ant1-2480-PASS	
Kongel Spectrom Analyse - Sweet SA Server Entry ALLOW AUTO 597 396.20 PM Nov.08, 2024 Frequency R.L SF S0.0 AC Server Entry ALLOW AUTO 57 396.20 PM Nov.08, 2024 Frequency Inter Freq 2.4800000000 FWD, Web Trig: Free Run Avg/Intel: 10001000 Trick: Figure Rule Frequency FWD, Web FWD, Web 20 B Avg/Intel: 10001000 Trick: Figure Rule	
GE/Offset 10.5 dB ΔΜΙΚΤ3 // 17 KH2 0 0	
φ Span 3.000 MHz Span 3.000 MHz CF Step 30.000 KHz R locat fric Sci. # VBW 300 KHz Sweep 1.000 ms (1001 pts) 30.000 KHz Auto	
scale type	



99% Occupied Bandwidth

Test Result and Data

Test Mode	Antenna	Frequency[MHz]	99% OBW[MHz]	Limit[MHz]	Verdict
BLE_1M	Ant1	2402	1.0525		
BLE_1M	Ant1	2440	1.0519		
BLE_1M	Ant1	2480	1.0525		



Test Graphs

BLE_1M-Ant1-2402	BLE_1M-Ant1-2440
Keysigk Spectrum Analyzer - Occupied BW SEREE.NT ALLOW AUTO 07.22:03.94 Mov (85, 2024) W 8.L FF 15.00 AC Center Freq: 2.40200000 GHz Radio Std: None Center Freq: 2.40200000 GHz Frequency Frequency #If Geint.Low #Atten: 20 dB Mkr1 2.401772 GHz	Keyight Spectrum Analyzer - Occupied BW Strike INT ALION AUTO 664-351 BW Nov 66, 2024 Frequency Center Freq 2.440000000 GHz Center Freq: 2.44000000 GHz Radio Std: None Radio Std: None #Frequency Frequency Frequency Radio Device: BTS Radio Device: BTS
Ref Offset 105 dB MKT 2.401172 GHz 2.5661 dBm Log	Original Part of the t105 dB MKT 2.440018 GHz 10 dB/div Ref 20.00 dBm 4.4176 dBm 100 1 2.44008 GHz 100 1 2.44000000 GHz 100 1 1 100 1 2.44000000 GHz 100 1 1 100 1 1 100 1 1 100 1 1 100 1 1 100 1 1 100 1 1 100 1 1 100 1 1 100 1 1 100 1 1 100 1 1 100 1 1 100 1 1 100 1
Center 2.402 GHz Span 3 MHz CF Step #Res BW 30 kHz #VBW 100 kHz Sweep 3.2 ms 400 Man	Center 2.44 GHz Span 3 MHz CF Step #Res BW 30 kHz #VBW 100 kHz Sweep 3.2 ms 00.000 kHz Manual Step
Occupied Bandwidth Total Power 8.05 dBm 1.0525 MHz Transmit Freq Error 28.911 kHz % of OBW Power 99.00 % x dB Bandwidth 1.335 MHz x dB -26.00 dB	Occupied Bandwidth Total Power 7.21 dBm 1.0519 MHz Transmit Freq Error 28.943 kHz % of OBW Power 99.00 % x dB Bandwidth 1.340 MHz x dB -26.00 dB (17.016)
BLE_1M-Ant1-2480	
Knytight Spectrum Analyzer - Occupied BW School Entry ALIGN AUTO 07:09:20 PM kov 56, 2023 Context Free 2400 AUTO 07:09:20 PM kov 56, 2023 Frequency Center Free 2.48000000 GHz Center Free 2.48000000 GHz Radio Std: None Frequency Frequency #fGeInLow #fGeInLow #fGeInLow Frequency Frequency	
Ref Offset 10.5 dB Mkr1 2.480018 GHz Center Freq 10 dBldtv 48 -5.8879 dBm 2.4800000 GHz 2.4800000 GHz 00 1 - - 2.4800000 GHz 2.4800000 GHz 00 -	
#Res BW 30 kHz #VBW 100 kHz Sweep 3.2 ms Occupied Bandwidth Total Power 5.76 dBm	
1.0525 MHz Freq Offset Transmit Freq Error 30.237 kHz % of OBW Power 99.00 % x dB Bandwidth 1.349 MHz x dB	
INSG STATUS	



Power Spectral Density

Test Result and Data

Test Mode	Antenna	Frequency[MHz]	Result[dBm/3kHz]	Limit[dBm/3kHz]	Verdict
BLE_1M	Ant1	2402	-13.35	≤8.00	PASS
BLE_1M	Ant1	2440	-14.18	≤8.00	PASS
BLE_1M	Ant1	2480	-15.45	≤8.00	PASS



Test Graphs

BLE_1M-Ant1-2402-PASS	BLE_1M-Ant1-2440-PASS
Compared Section Magnet Section Magnet Section S	Angel Statute Angel St
Ref Offset 10.5 dB MKT 2.402 02.3 4 GPz 10.8 gradie -13.351 dBm 00 -13.351 dBm 01 -13.351 dBm 02 -13.351 dBm 03 -13.351 dBm 04 -13.351 dBm 05 -13.351 dBm 06 -13.351 dBm 07 -13.351 dBm 08 -13.351 dBm 09 -13.351 dBm 09 -13.351 dBm 00 -13.351 dBm 01 -13.351 dBm 02 -13.351 dBm 03 -13.351 dBm 04 -13.351 dBm 05 -13.351 dBm 04 -13.351 dBm 05 -13.351 dBm 06 -13.351 dBm 07 -13.351 dBm 08 -13.351 dBm 08 -13.351 dBm 08 -13.351 dBm 09 -13.351 dBm 100.200 dBm -13.351 dBm 101.200 dBm -13.351 dBm <td< td=""><td>Ref Offset 10.6 dB MRT 2.440 022 b8 GFJ Center Freq 10 dB/dW -14.178 dBm Center Freq 000 -14.178 dBm Start Freq 010 -14.178 dBm -14.178 dBm 010 -14.178 dBm</td></td<>	Ref Offset 10.6 dB MRT 2.440 022 b8 GFJ Center Freq 10 dB/dW -14.178 dBm Center Freq 000 -14.178 dBm Start Freq 010 -14.178 dBm -14.178 dBm 010 -14.178 dBm
BLE_1M-Ant1-2480-PASS	MBG
Regist Systems Adapter - Swept Sta Stack Intro ALLOB AUTO OT 3052 PM/bit (8, 2014) Frequency Center Freq 2.48000000 CHz (10 dB/dwit weithing in the constraint of the constra	



Conducted Band Edges

Test Result and Data

Test Mode	Antenna	ChName	Frequency[MHz]	RefLevel[dBm]	Result[dBm]	Limit[dBm]	Verdict
BLE_1M	Ant1	Low	2402	0.48	-48.55	≤-19.52	PASS
BLE_1M	Ant1	High	2480	-1.74	-47.48	≤-21.74	PASS



Test Graphs

BLE_1M-Ant1-2	2402-PASS	BLE_1M-Ant1-2480-PASS		
Reyulght Spectrum Analyzer - Swept 55 A.L RF 200 AC Center Freq 2.3552600000 GHz FNO: Fast	ALIGN MITO 0723-11 PM Nov 06, 1024 Avg Type: RMS Trace Data Strate Data Strate VogiHold: 200/200 The Data Strate S	30 R.L RF 39.0 AC SENSE IMT ALISA AUTO 07:395 PMM or 66 20:401 Freque Center Freq 2.510000000 GHz Freque #Vor Type: RMS Trice: IB2-20:401 Freque #Vor Type: RMS Trice: IB2-20:401 Freque File Freque #Atten: X0 B X00 Trice: IB2-20:401 Freque	Jency Ito Tune	
no dB/div Ref 20.00 dBm	Mkr5 2.353 970 GHz -48.549 dBm	Ref Offset 10.5 dB Mkr4 2.528 08 GHz 40 10 dB/div Ref 20.00 dBm -47.475 dBm	to rune	
100	01 Center Freq 2.352500000 GHz	10.0 01 Cent 0.00 0.0 01 2.510000	nter Freq 0000 GHz	
200	2.30000000 GHz	30.0 A A A A A A A A A A A A A A A A A A	t art Freq 0000 GHz	
60.0 maineter Matsatteren oberterterterterterterterterterterterterte	A		top Fred 0000 GH2	
Start 2.30000 GHz #Res BW 100 kHz #VBW 300 kHz MKR NODE TRCI SCL X Y FUNCTIC	Stop 2.40500 GHz CF Step Sweep 10.07 ms (1001 pts) 10.500000 MHz N FUNCTION WIDTH FUNCTION WIDTH		CF Step 0000 MHz Mar	
N 1 2.402 270 GHz 0.483 dBm 2 N 1 2.200 270 GHz 0.53 cHz 3 N 1 7 2.300 000 GHz -55 cHz 3 N 1 7 2.300 000 GHz -55 cHz 48m 4 N 1 f 2.350 000 GHz -590.331 dBm 6 N 1 f 2.353 970 GHz -48.549 dBm	Freq Offset 0 Hz	1 N 1 f 2.480 24 GHz -1.740 dBm	e q Offset 0 Hz	
	Scale Type	9	ale Type	
		10 Log	Li	



Conducted Spurious Emissions

Test Result and Data

Test Mode	Antenna	Frequency[MHz]	FreqRange[Mhz]	RefLevel[dBm]	Result[dBm]	Limit[dBm]	Verdict
BLE_1M	Ant1	2402	0~Reference	0.50	0.50		PASS
BLE_1M	Ant1	2402	30~25000	0.50	-35.57	≤-19.5	PASS
BLE_1M	Ant1	2440	0~Reference	-0.53	-0.53		PASS
BLE_1M	Ant1	2440	30~25000	-0.53	-36.82	≤-20.53	PASS
BLE_1M	Ant1	2480	0~Reference	-1.93	-1.93		PASS
BLE_1M	Ant1	2480	30~25000	-1.93	-32.55	≤-21.93	PASS



Test Graphs

