中认信通
CHINA CERTIFICATION ICT CO., LTD (DONGGUAN)

ACCREDITED
TESTING LABORATORY
CERTIFICATE # 6356.01

TEST REPORT

Applicant: **NetComm Wireless Pty Ltd**

Address: Level 5, 18-20 Orion Road,Lane Cove NSW 2066,Australia

FCC ID: **XIA-CFW3212**

Product Name: **5G Sub6 Self Install Outdoor CPE**

Standard(s): **47 CFR Part 15, Subpart C(15.247)**
ANSI C63.10-2013
KDB 558074 D01 15.247 Meas Guidance v05r02

The above equipment has been tested and found compliant with the requirement of the relative standards by China Certification ICT Co., Ltd (Dongguan)

Report Number: **CR221264490-00BM2**

Date Of Issue: **2023/8/5**

Reviewed By: **Sun Zhong** Sun Zhong

Title: Manager

Test Laboratory: **China Certification ICT Co., Ltd (Dongguan)**
No. 113, Pingkang Road, Dalang Town, Dongguan,
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Test Facility

The Test site used by China Certification ICT Co., Ltd (Dongguan) to collect test data is located on the No. 113, Pingkang Road, Dalang Town, Dongguan, Guangdong, China.

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. : 442868, the FCC Designation No. : CN1314.

The lab has been recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements, the CAB identifier: CN0123.

Declarations

China Certification ICT Co., Ltd (Dongguan) is not responsible for the authenticity of any test data provided by the applicant. Data included from the applicant that may affect test results are marked with a triangle symbol "▲". Customer model name, addresses, names, trademarks etc. are not considered data.

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested.

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CONTENTS

DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
1.0	CR221264490-00B	Original Report	2023/2/7
2.0	CR221264490-00BM1	Update Section 5.2,5.3	2023/7/27
3.0	CR221264490-00BM2	Update Section 5.2	2023/8/5

1. GENERAL INFORMATION

1.1 Product Description for Equipment under Test (EUT)

Manufacturer:	Casa Systems, Inc.
Manufacturer Address:	100 Old River Road Andover, MA 01810
Trade Name:	casa systems
EUT Name:	5G Sub6 Self Install Outdoor CPE
EUT Model:	CFW-3212
Operation Frequency:	2402-2480 MHz
Maximum Peak Output Power (Conducted):	2.84 dBm
Modulation Type:	GFSK`
Rated Input Voltage:	DC 24V from POE
Serial Number:	1X1V-1
EUT Received Date:	2022/12/31
EUT Received Status:	Good

For BLE:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	20	2442
1	2404	…	…
…	…	…	…
…	…	…	…
..	…	38	2478
19	2440	39	2480

Per section 15.31(m), the below frequencies were performed the test as below:

Test Channel	Frequency (MHz)
Lowest	2402
Middle	2440
Highest	2480

Antenna Information Detail▲:

Antenna Type	input impedance (Ohm)	Frequency Range	Antenna Gain
Chip	50	2.4~2.5 GHz	2.66 dBi

The Method of §15.203 Compliance:

☒Antenna must be permanently attached to the unit.

☐Antenna must use a unique type of connector to attach to the EUT.

☐Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.

Accessory Information:

Accessory Description	Manufacturer	Model
Adapter	SHENZHENFUSHIGANGY CO.,LTD	AS2406A-2401000US
POE Injector	UnKnown	MEMOHIP01

1.2 Description of Test Configuration

1.2.1 EUT Operation Condition:

For BLE:

EUT Operation Mode:	The system was configured for testing in Engineering Mode, which was provided by the manufacturer.
Equipment Modifications:	No
EUT Exercise Software:	ESP_RF_Test

The software was provided by manufacturer. The maximum power was configured as below, that was provided by the manufacturer▲:

Test Modes	Power Level Setting		
	Lowest Channel	Middle Channel	Highest Channel
1Mbps	**default**	**default**	**default**
2Mbps	**default**	**default**	**default**

1.2.2 Support Equipment List and Details

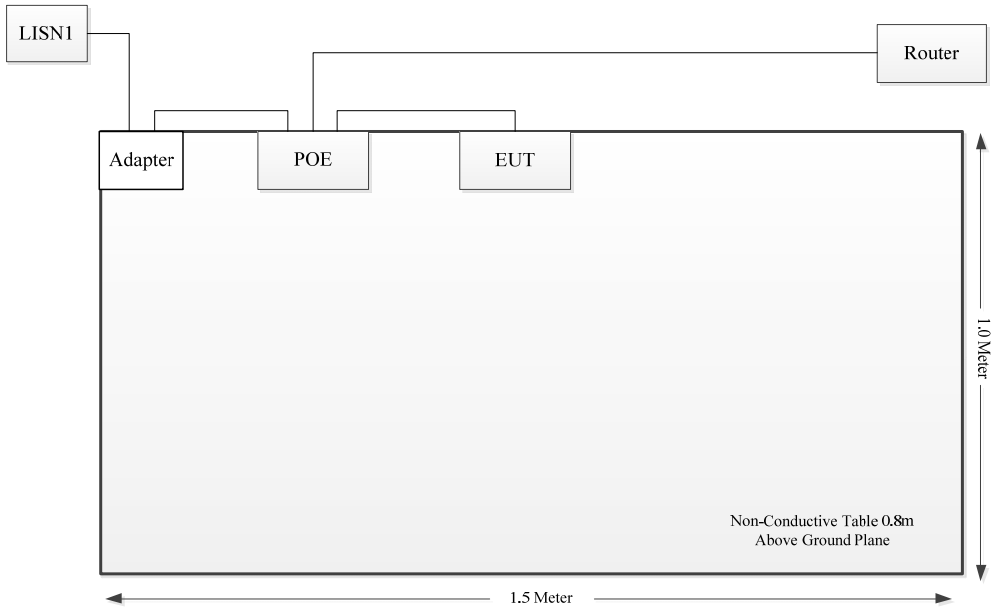
Manufacturer	Description	Model	Serial Number
TOTO LINK	Router	X5000R	X5000RK9T0560

1.2.3 Support Cable List and Details

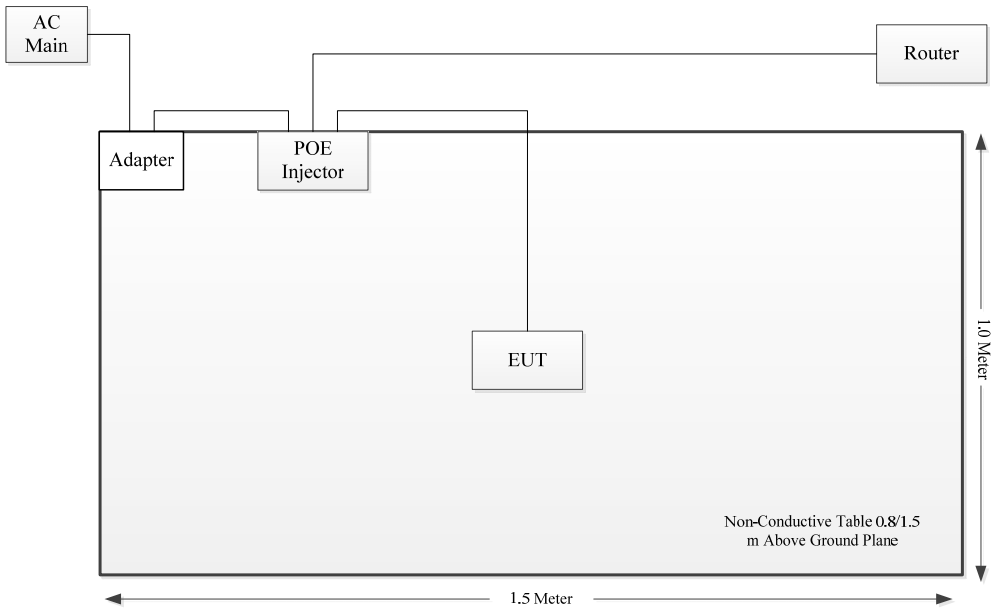
Cable Description	Shielding Type	Ferrite Core	Length (m)	From Port	To
RJ45	No	Yes	10	POE Injector	Router
RJ45	No	No	3	POE Injector	EUT
Power Cable	No	No	1	POE Injector	Adapter

1.2.4 Block Diagram of Test Setup

AC line conducted emissions:



Spurious emissions:



1.3 Measurement Uncertainty

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

Parameter	Measurement Uncertainty
Occupied Channel Bandwidth	±5 %
RF output power, conducted	±0.61dB
Power Spectral Density, conducted	±0.61 dB
Unwanted Emissions, radiated	30M~200MHz: 4.15 dB,200M~1GHz: 5.61 dB,1G~6GHz: 5.14 dB, 6G~18GHz: 5.93 dB,18G~26.5G:5.47 dB,26.5G~40G:5.63 dB
Unwanted Emissions, conducted	±1.26 dB
Temperature	±1℃
Humidity	±5%
DC and low frequency voltages	±0.4%
Duty Cycle	1%
AC Power Lines Conducted Emission	2.8 dB (150 kHz to 30 MHz)

2. SUMMARY OF TEST RESULTS

Standard(s) Section	Test Items	Result
§15.207(a)	AC line conducted emissions	Compliant
§15.205, §15.209, §15.247(d)	Spurious Emissions	Compliant
§15.247 (a)(2)	6 dB Bandwidth	Compliant
§15.247(b)(3)	Maximum Conducted Output Power	Compliant
§15.247(d)	100 kHz Bandwidth of Frequency Band Edge	Compliant
§15.247(e)	Power Spectral Density	Compliant
§15.203	Antenna Requirement	Compliant
FCC§15.247 (i) & §1.1310	RF Exposure Evaluation	Compliant

3. REQUIREMENTS AND TEST PROCEDURES

3.1 AC Line Conducted Emissions

3.1.1 Applicable Standard

FCC§15.207(a).

(a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator 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, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

	Conducted limit (dBμV)	
Frequency of emission (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.

(b) The limit shown in paragraph (a) of this section shall not apply to carrier current systems operating as intentional radiators on frequencies below 30 MHz. In lieu thereof, these carrier current systems shall be subject to the following standards:

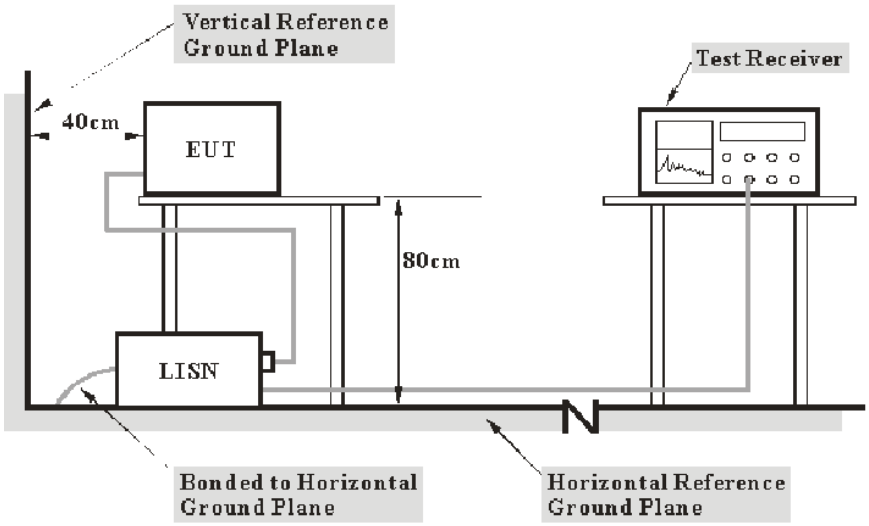
(1) For carrier current system containing their fundamental emission within the frequency band 535-1705 kHz and intended to be received using a standard AM broadcast receiver: no limit on conducted emissions.

(2) For all other carrier current systems: 1000 μV within the frequency band 535-1705 kHz, as measured using a 50 μH/50 ohms LISN.

(3) Carrier current systems operating below 30 MHz are also subject to the radiated emission limits in §15.205, §15.209, §15.221, §15.223, or §15.227, as appropriate.

(c) Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines. Devices that include, or make provisions for, the use of battery chargers which permit operating while charging, AC adapters or battery eliminators or that connect to the AC power lines indirectly, obtainig their power through another device which is connected to the AC power lines, shall be tested to demonstrate compliance with the conducted limits.

3.1.2 EUT Setup



Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 limits.

The spacing between the peripherals was 10 cm.

3.1.3 EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30 MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations:

Frequency Range	IF B/W
150 kHz – 30 MHz	9 kHz

3.1.4 Test Procedure

The frequency and amplitude of the six highest ac power-line conducted emissions relative to the limit, measured over all the current-carrying conductors of the EUT power cords, and the operating frequency or frequency to which the EUT is tuned (if appropriate), should be reported, unless such emissions are more than 20 dB below the limit. AC power-line conducted emissions measurements are to be separately carried out only on each of the phase ("hot") line(s) and (if used) on the neutral line(s), but not on the ground [protective earth] line(s). If less than six emission frequencies are within 20 dB of the limit, then the noise level of the measuring instrument at representative frequencies should be reported. The specific conductor of the power-line cord for each of the reported emissions should be identified. Measure the six highest emissions with respect to the limit on each current-carrying conductor of each power cord associated with the EUT (but not the power cords of associated or peripheral equipment that are part of the test configuration). Then, report the six highest emissions with respect to the limit from among all the measurements identifying the frequency and specific current-carrying conductor identified with the emission. The six highest emissions should be reported for each of the current-carrying conductors, or the six highest emissions may be reported over all the current-carrying conductors.

3.1.5 Corrected Amplitude & Margin Calculation

The basic equation is as follows:

Result = Reading + Factor
Factor = attenuation caused by cable loss + voltage division factor of AMN

The "**Margin**" column of the following data tables indicates the degree of compliance within the applicable limit. The equation for margin calculation is as follows:

Margin = Limit – Result

3.2 Radiation Spurious Emissions

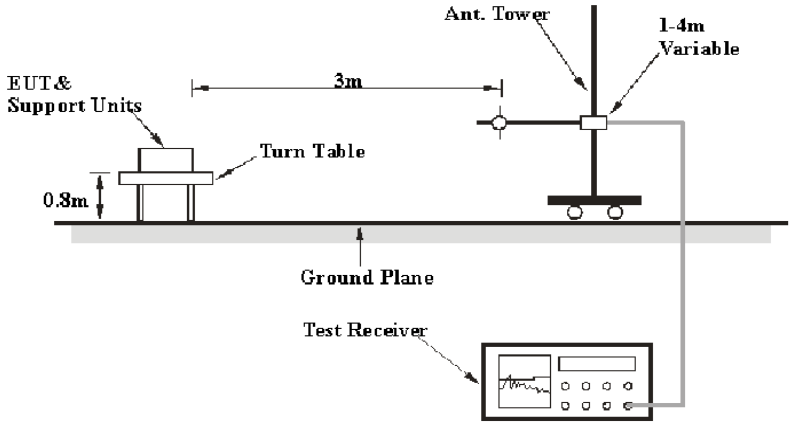
3.2.1 Applicable Standard

FCC §15.247 (d);

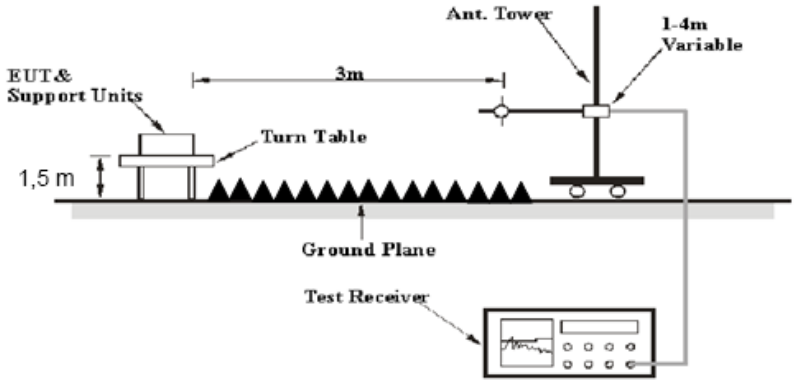
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the 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)).

3.2.2 EUT Setup

Below 1GHz:



Above 1GHz:



The radiated emissions were performed in the 3 meters distance, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209, and FCC 15.247 limits.

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

The spacing between the peripherals was 10 cm.

3.2.3 EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 30 MHz to 25 GHz.

During the radiated emission test, the EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:

30-1000MHz:

Measurement	RBW	Video B/W	IF B/W
QP	120 kHz	300 kHz	120kHz

1GHz- 25GHz:

Measurement	Duty cycle	RBW	Video B/W
PK	Any	1MHz	3 MHz
Ave.	>98%	1MHz	10 Hz
	<98%	1MHz	1/T

If the maximized peak measured value complies with under the QP/Average limit more than 6dB, then it is unnecessary to perform an QP/Average measurement.

3.2.4 Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

Data was recorded in Quasi-peak detection mode for frequency range of 30 MHz-1 GHz, peak and Average detection modes for frequencies above 1 GHz.

3.2.5 Corrected Amplitude & Margin Calculation

The basic equation is as follows:

Result = Reading + Factor
Factor = Antenna Factor + Cable Loss- Amplifier Gain

The "**Margin**" column of the following data tables indicates the degree of compliance within the applicable limit. The equation for margin calculation is as follows:

Margin = Limit – Result

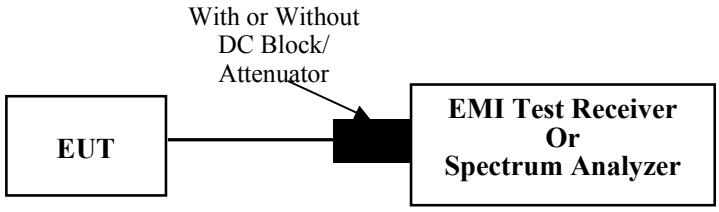
3.3 6 dB Emission Bandwidth:

3.3.1 Applicable Standard

FCC §15.247 (a)(2)

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

3.3.2 EUT Setup



3.3.3Test Procedure

According to ANSI C63.10-2013 Section 11.8

a) Set RBW = 100 kHz.
b) Set the video bandwidth (VBW) ≥ 3×RBW.
c) Detector = Peak.
d) Trace mode = max hold.
e) Sweep = auto couple.
f) Allow the trace to stabilize.
g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

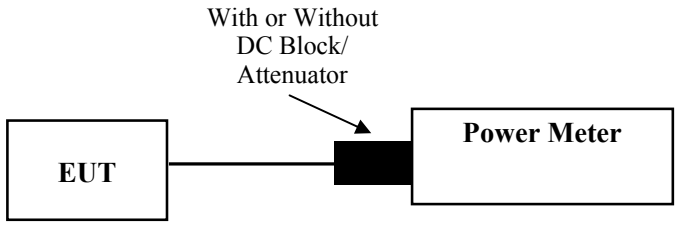
3.4 Maximum conducted output power:

3.4.1 Applicable Standard

FCC §15.247 (b)(3)

For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

3.4.2 EUT Setup



3.4.3Test Procedure

According to ANSI C63.10-2013 Section 11.9.1.3

The maximum conducted output power may be measured using a broadband RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the DTS bandwidth and shall use a fast-responding diode detector.

a) Set the EUT in transmitting mode.
b) Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to test equipment.
c) Add a correction factor to the display.
d) Set the power meter to test output power, record the result.

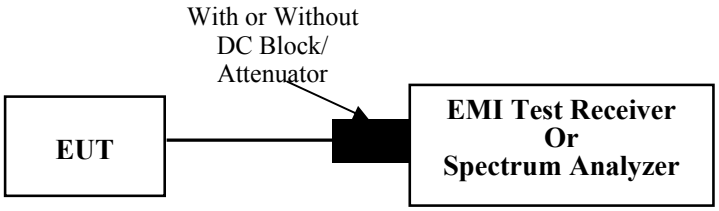
3.5 Maximum power spectral density:

3.5.1 Applicable Standard

FCC §15.247 (e)

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. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

3.5.2 EUT Setup



3.5.3Test Procedure

According to ANSI C63.10-2013 Section 11.10.2

a) Set analyzer center frequency to DTS channel center frequency.
b) Set the span to 1.5 times the DTS bandwidth.
c) Set the RBW to 3 kHz ≤ RBW ≤ 100 kHz.
d) Set the VBW ≥ [3 · RBW].
e) Detector = peak.
f) Sweep time = auto couple.
g) Trace mode = max hold.
h) Allow trace to fully stabilize.
i) Use the peak marker function to determine the maximum amplitude level within the RBW.
j) If measured value exceeds requirement, then reduce RBW (but no less than 3 kHz) and repeat.

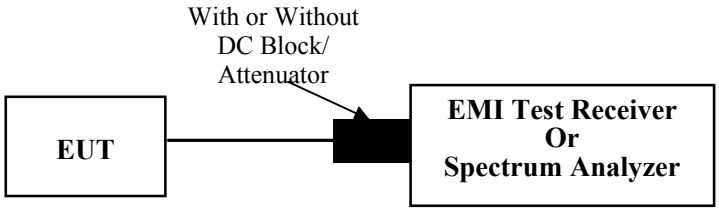
3.6 100 kHz Bandwidth of Frequency Band Edge:

3.6.1 Applicable Standard

FCC §15.247 (d);

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)).

3.6.2 EUT Setup



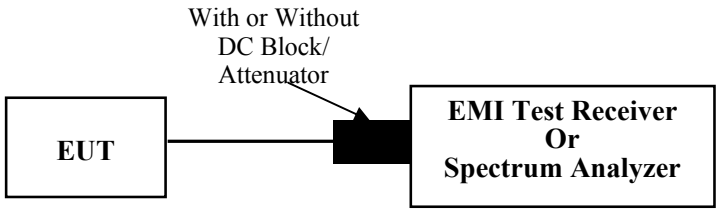
3.6.3 Test Procedure

According to ANSI C63.10-2013 Section 11.11

a) Set the center frequency and span to encompass frequency range to be measured.
b) Set the RBW = 100 kHz.
c) Set the VBW ≥ [3 × RBW].
d) Detector = peak.
e) Sweep time = auto couple.
f) Trace mode = max hold.
g) Allow trace to fully stabilize.
h) Use the peak marker function to determine the maximum amplitude level.
Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) is attenuated by at least the minimum requirements specified in 11.11. Report the three highest emissions relative to the limit.

3.7 Duty Cycle:

3.7.1 EUT Setup



3.7.2Test Procedure

According to ANSI C63.10-2013 Section 11.6

The zero-span mode on a spectrum analyzer or EMI receiver if the response time and spacing between bins on the sweep are sufficient to permit accurate measurements of the ON and OFF times of the transmitted signal:
1) Set the center frequency of the instrument to the center frequency of the transmission.
2) Set RBW ≥ OBW if possible; otherwise, set RBW to the largest available value.
3) Set VBW ≥ RBW. Set detector = peak or average.
4) The zero-span measurement method shall not be used unless both RBW and VBW are > 50/T and the number of sweep points across duration T exceeds 100. (For example, if VBW and/or RBW are limited to 3 MHz, then the zero-span method of measuring the duty cycle shall not be used if T ≤ 16.7 μs.)

3.8 Antenna Requirement

3.8.1 Applicable Standard

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. 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. This requirement does not apply to carrier current devices or to devices operated under the provisions of §§15.211, 15.213, 15.217, 15.219, 15.221, or §15.236. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

3.8.2 Judgment

Compliant. Please refer to the Antenna Information detail in Section 1.

4. Test DATA AND RESULTS

4.1 AC Line Conducted Emissions

Serial Number:	1X1V-1	Test Date:	2023/1/13
Test Site:	CE	Test Mode:	Transmitting(2Mbps middle channel was the worst)
Tester:	Vic Du	Test Result:	Pass

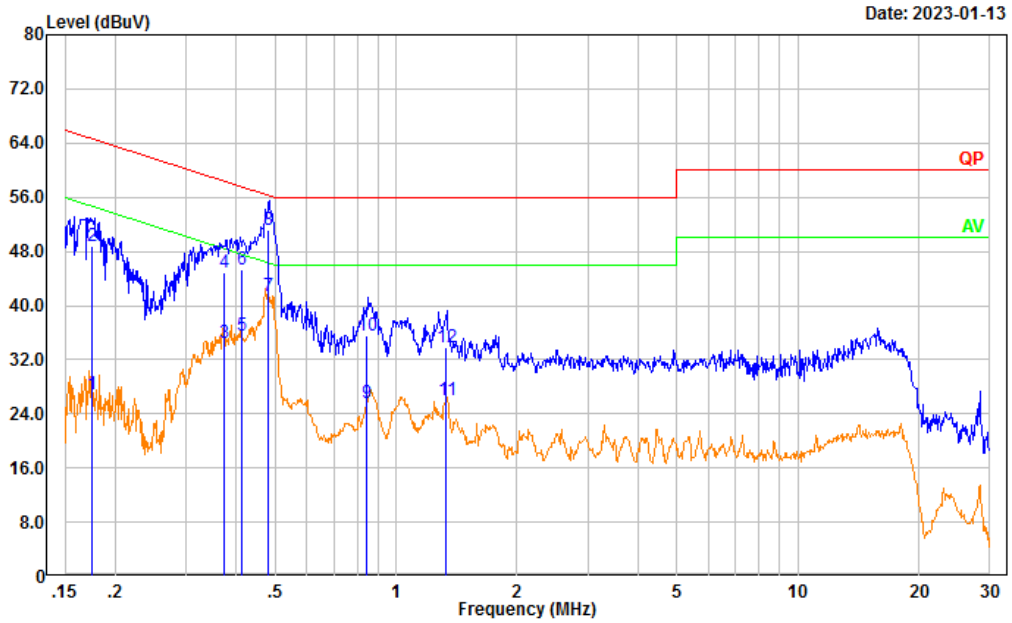
Environmental Conditions:					
Temperature: (℃)	22.7	Relative Humidity: (%)	72	ATM Pressure: (kPa)	100.5

Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	LISN	ENV216	101134	2022/04/01	2023/03/31
R&S	EMI Test Receiver	ESR3	102726	2022/07/15	2023/07/14
MICRO-COAX	Coaxial Cable	UTIFLEX	C-0200-01	2022/08/07	2023/08/06
Audix	Test Software	E3	190306 (V9)	N/A	N/A

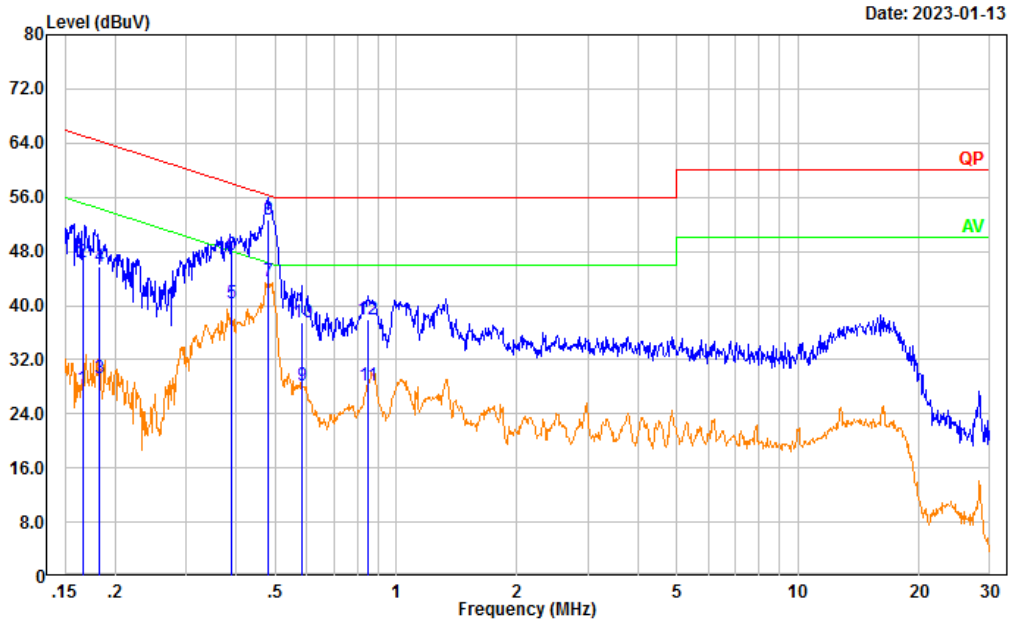
** Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).*

Test Mode: Transmiting
Port: Line
Note:



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB)	Result (dBµV)	Limit (dBµV)	Margin (dB)	Detector
1	0.175	17.23	9.61	26.84	54.73	27.89	Average
2	0.175	39.09	9.61	48.70	64.73	16.03	QP
3	0.375	24.89	9.61	34.50	48.40	13.90	Average
4	0.375	35.24	9.61	44.85	58.40	13.55	QP
5	0.413	26.00	9.61	35.61	47.59	11.98	Average
6	0.413	35.64	9.61	45.25	57.59	12.34	QP
7	0.479	31.77	9.61	41.38	46.35	4.97	Average
8	0.479	41.58	9.61	51.19	56.35	5.16	QP
9	0.846	15.89	9.62	25.51	46.00	20.49	Average
10	0.846	26.02	9.62	35.64	56.00	20.36	QP
11	1.332	16.47	9.62	26.09	46.00	19.91	Average
12	1.332	24.27	9.62	33.89	56.00	22.11	QP

Test Mode: Transmiting
Port: neutral
Note:



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB)	Result (dBµV)	Limit (dBµV)	Margin (dB)	Detector
1	0.166	18.04	9.61	27.65	55.17	27.52	Average
2	0.166	36.82	9.61	46.43	65.17	18.74	QP
3	0.183	19.67	9.61	29.28	54.33	25.05	Average
4	0.183	36.23	9.61	45.84	64.33	18.49	QP
5	0.388	30.80	9.61	40.41	48.10	7.69	Average
6	0.388	37.89	9.61	47.50	58.10	10.60	QP
7	0.481	33.87	9.61	43.48	46.32	2.84	Average
8	0.481	43.06	9.61	52.67	56.32	3.65	QP
9	0.582	18.58	9.62	28.20	46.00	17.80	Average
10	0.582	27.91	9.62	37.53	56.00	18.47	QP
11	0.849	18.51	9.62	28.13	46.00	17.87	Average
12	0.849	28.32	9.62	37.94	56.00	18.06	QP

4.2 Radiation Spurious Emissions

Serial Number:	1X1V-1	Test Date:	2023/1/29~2023/2/7
Test Site:	966-1/966-2	Test Mode:	Transmitting
Tester:	coco Tian, Vic Du	Test Result:	Pass

Environmental Conditions:					
Temperature: (℃)	20.7~22.2	Relative Humidity: (%)	35~66	ATM Pressure: (kPa)	101.5~101.9

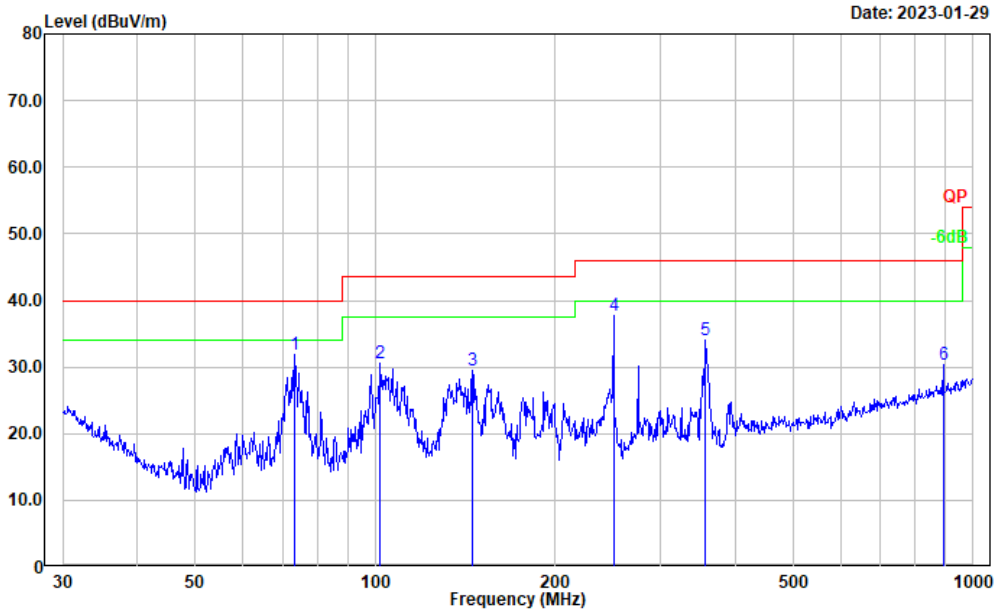
Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
ETS-Lindgren	Horn Antenna	3115	9912-5985	2020/10/13	2023/10/12
R&S	Spectrum Analyzer	FSV40	101591	2022/07/15	2023/07/14
MICRO-COAX	Coaxial Cable	UFA210A-1-1200-70U300	217423-008	2022/08/07	2023/08/06
MICRO-COAX	Coaxial Cable	UFA210A-1-2362-300300	235780-001	2022/08/07	2023/08/06
Mini	Pre-amplifier	ZVA-183-S+	5969001149	2022/11/09	2023/11/08
Audix	Test Software	E3	201021 (V9)	N/A	N/A
PASTERNACK	Horn Antenna	PE9852/2F-20	112002	2021/02/05	2024/02/04
AH	Preamplifier	PAM-1840VH	190	2022/11/09	2023/11/08
MICRO-COAX	Coaxial Cable	UFB142A-1-2362-200200	235772-001	2022/08/07	2023/08/06
E-Microwave	Band Rejection Filter	2400-2483.5MHz	OE01902424	2022/08/07	2023/08/06
Mini Circuits	High Pass Filter	VHF-6010+	31119	2022/08/07	2023/08/06
Sunol Sciences	Antenna	JB6	A082520-5	2020/10/19	2023/10/18
R&S	EMI Test Receiver	ESR3	102724	2022/07/15	2023/07/14
TIMES MICROWAVE	Coaxial Cable	LMR-600-UltraFlex	C-0470-02	2022/07/17	2023/07/16
TIMES MICROWAVE	Coaxial Cable	LMR-600-UltraFlex	C-0780-01	2022/07/17	2023/07/16
Sonoma	Amplifier	310N	186165	2022/07/17	2023/07/16

** Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).*

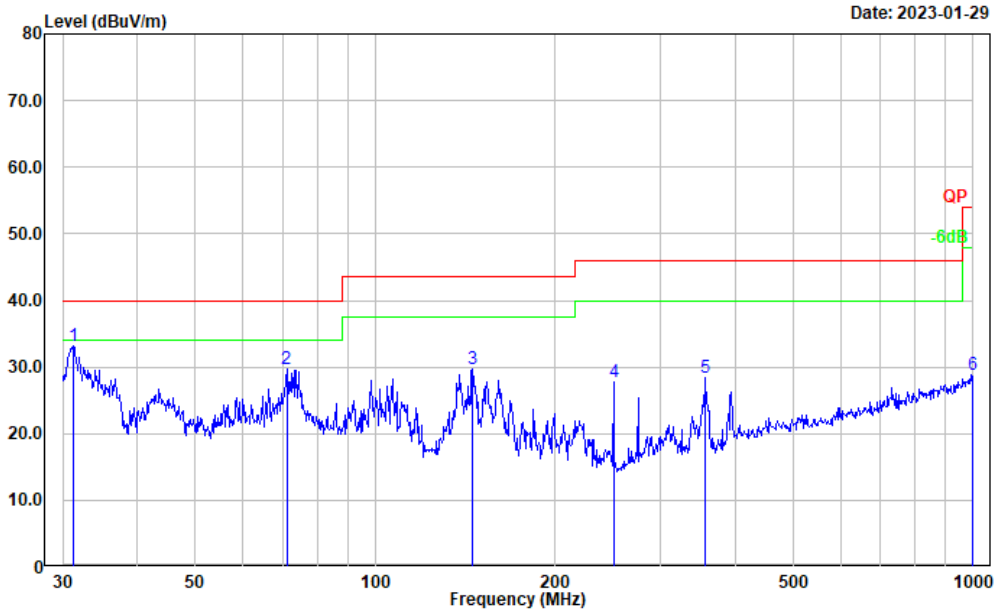
1) 30MHz-1GHz (2Mbps middle channel was the worst)

Test Mode: Transmitting
Polarization: horizontal
Note:



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	73.103	48.73	-16.75	31.98	40.00	8.02	Peak
2	102.001	44.44	-13.97	30.47	43.50	13.03	Peak
3	145.351	41.48	-11.95	29.53	43.50	13.97	Peak
4	250.301	50.82	-13.08	37.74	46.00	8.26	Peak
5	356.676	43.89	-9.89	34.00	46.00	12.00	Peak
6	890.728	31.54	-1.12	30.42	46.00	15.58	Peak

Test Mode: Transmitting
Polarization: vertical
Note:



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	31.289	37.72	-4.59	33.13	40.00	6.87	Peak
2	71.080	46.39	-16.59	29.80	40.00	10.20	Peak
3	145.351	41.70	-11.95	29.75	43.50	13.75	Peak
4	250.301	40.82	-13.08	27.74	46.00	18.26	Peak
5	356.676	38.20	-9.89	28.31	46.00	17.69	Peak
6	1000.000	27.86	1.03	28.89	54.00	25.11	Peak

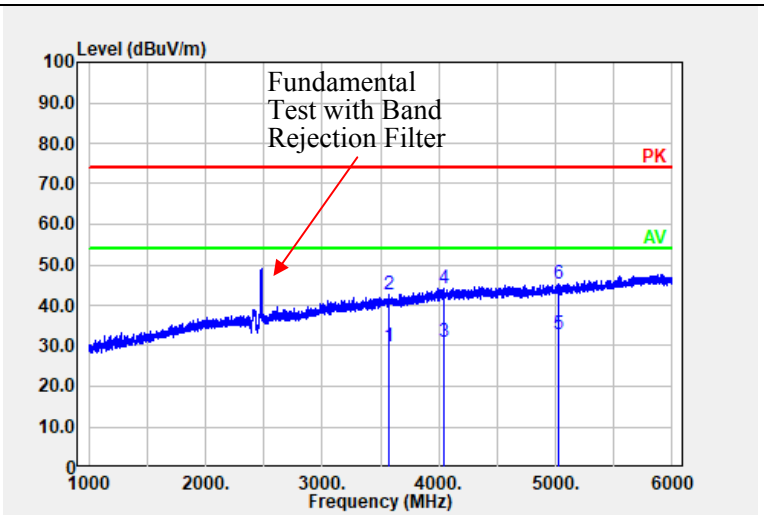
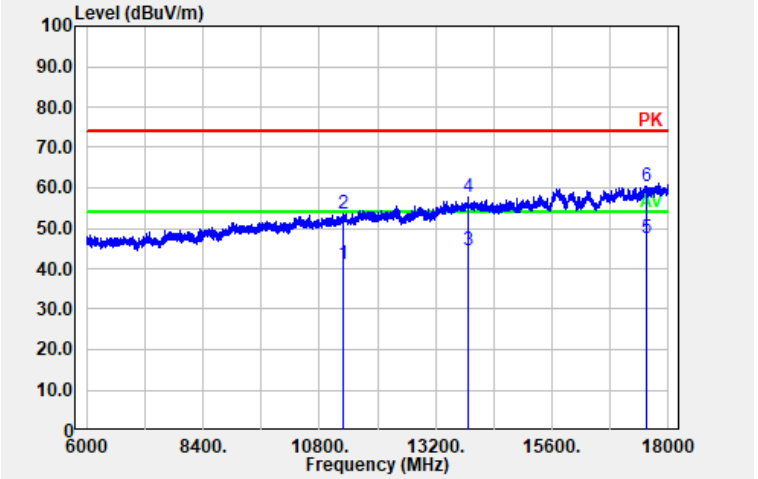
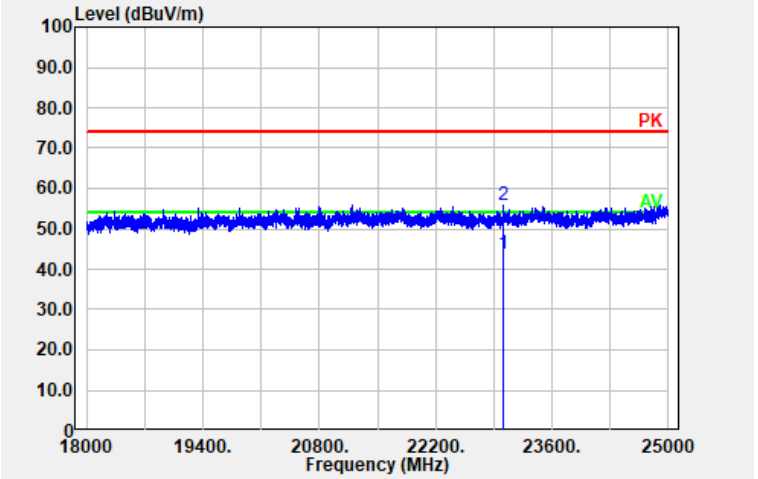
2) Above 1GHz:
BLE 1Mbps:

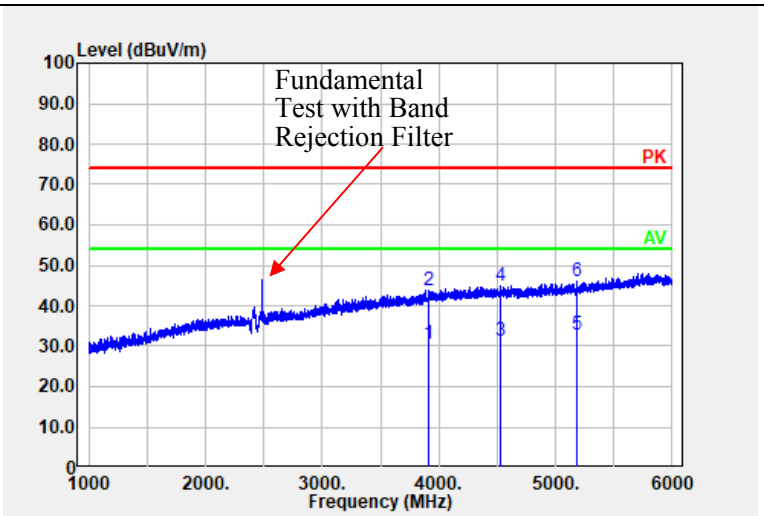
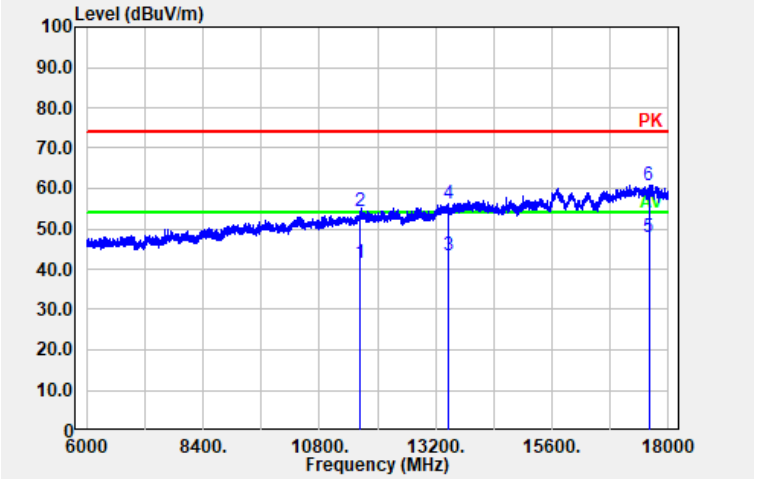
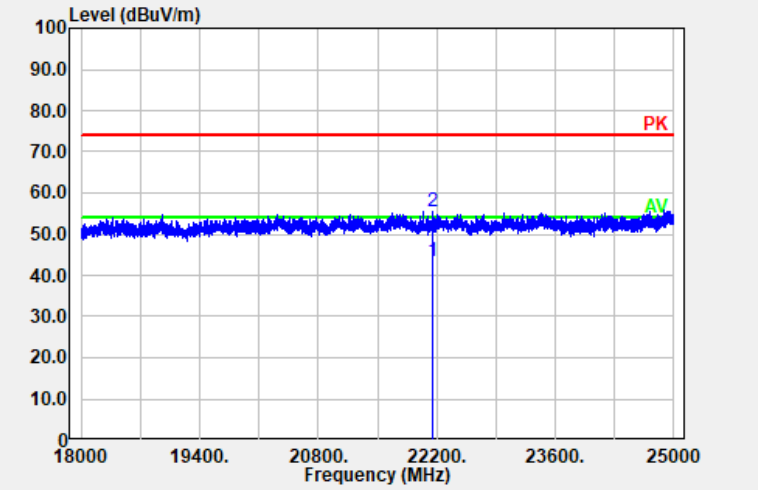
Frequency (MHz)	Receiver		Polar (H/V)	Factor (dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	Detector					
Low Channel: 2402 MHz							
2402.000	64.34	PK	H	31.51	95.85	N/A	N/A
2402.000	61.35	AV	H	31.51	92.86	N/A	N/A
2402.000	62.34	PK	V	31.51	93.85	N/A	N/A
2402.000	59.64	AV	V	31.51	91.15	N/A	N/A
2390.000	26.35	PK	H	31.46	57.81	74.00	16.19
2390.000	13.64	AV	H	31.46	45.10	54.00	8.90
4804.000	34.65	PK	H	10.91	45.56	74.00	28.44
4804.000	21.58	AV	H	10.91	32.49	54.00	21.51
7206.000	35.62	PK	H	14.22	49.84	74.00	24.16
7206.000	22.47	AV	H	14.22	36.69	54.00	17.31
Middle Channel: 2440 MHz							
2440.000	64.11	PK	H	31.60	95.71	N/A	N/A
2440.000	61.12	AV	H	31.60	92.72	N/A	N/A
2440.000	62.11	PK	V	31.60	93.71	N/A	N/A
2440.000	59.41	AV	V	31.60	91.01	N/A	N/A
4880.000	35.28	PK	H	11.07	46.35	74.00	27.65
4880.000	22.47	AV	H	11.07	33.54	54.00	20.46
7320.000	34.52	PK	H	14.80	49.32	74.00	24.68
7320.000	21.45	AV	H	14.80	36.25	54.00	17.75
High Channel: 2480 MHz							
2480.000	64.22	PK	H	31.64	95.86	N/A	N/A
2480.000	61.02	AV	H	31.64	92.66	N/A	N/A
2480.000	62.43	PK	V	31.64	94.07	N/A	N/A
2480.000	59.81	AV	V	31.64	91.45	N/A	N/A
2483.500	26.62	PK	H	31.64	58.26	74.00	15.74
2483.500	13.91	AV	H	31.64	45.55	54.00	8.45
4960.000	34.42	PK	H	11.23	45.65	74.00	28.35
4960.000	21.85	AV	H	11.23	33.08	54.00	20.92
7440.000	34.49	PK	H	15.26	49.75	74.00	24.25
7440.000	21.70	AV	H	15.26	36.96	54.00	17.04

BLE 2Mbps:

Frequency (MHz)	Receiver		Polar (H/V)	Factor (dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	Detector					
Low Channel: 2402 MHz							
2402.000	64.99	PK	H	31.51	96.50	N/A	N/A
2402.000	62.30	AV	H	31.51	93.81	N/A	N/A
2402.000	63.21	PK	V	31.51	94.72	N/A	N/A
2402.000	60.19	AV	V	31.51	91.70	N/A	N/A
2390.000	27.22	PK	H	31.46	58.68	74.00	15.32
2390.000	14.51	AV	H	31.46	45.97	54.00	8.03
4804.000	35.52	PK	H	10.91	46.43	74.00	27.57
4804.000	22.45	AV	H	10.91	33.36	54.00	20.64
7206.000	36.49	PK	H	14.22	50.71	74.00	23.29
7206.000	23.34	AV	H	14.22	37.56	54.00	16.44
Middle Channel: 2440 MHz							
2440.000	64.58	PK	H	31.60	96.18	N/A	N/A
2440.000	61.37	AV	H	31.60	92.97	N/A	N/A
2440.000	62.58	PK	V	31.60	94.18	N/A	N/A
2440.000	59.84	AV	V	31.60	91.44	N/A	N/A
4880.000	35.75	PK	H	11.07	46.82	74.00	27.18
4880.000	22.94	AV	H	11.07	34.01	54.00	19.99
7320.000	34.99	PK	H	14.80	49.79	74.00	24.21
7320.000	22.31	AV	H	14.80	37.11	54.00	16.89
High Channel: 2480 MHz							
2480.000	65.01	PK	H	31.64	96.65	N/A	N/A
2480.000	62.17	AV	H	31.64	93.81	N/A	N/A
2480.000	63.43	PK	V	31.64	95.07	N/A	N/A
2480.000	60.29	AV	V	31.64	91.93	N/A	N/A
2483.500	27.42	PK	H	31.64	59.06	74.00	14.94
2483.500	14.51	AV	H	31.64	46.15	54.00	7.85
4960.000	35.55	PK	H	11.23	46.78	74.00	27.22
4960.000	22.45	AV	H	11.23	33.68	54.00	20.32
7440.000	36.66	PK	H	15.26	51.92	74.00	22.08
7440.000	23.34	AV	H	15.26	38.60	54.00	15.40

Worst Test plots(2Mbps High channel was the worst)

Horizontal	
1-6GHz	
6-18GHz	
18-25GHz	

Vertical	
1-6GHz	
6-18GHz	
18-25GHz	

4.3 6 dB Emission Bandwidth:

Serial Number:	1X1V-1	Test Date:	2023/2/7
Test Site:	RF	Test Mode:	Transmitting
Tester:	Claire Liu	Test Result:	Pass

Environmental Conditions:					
Temperature: (℃)	26.1	Relative Humidity: (%)	59	ATM Pressure: (kPa)	101.5

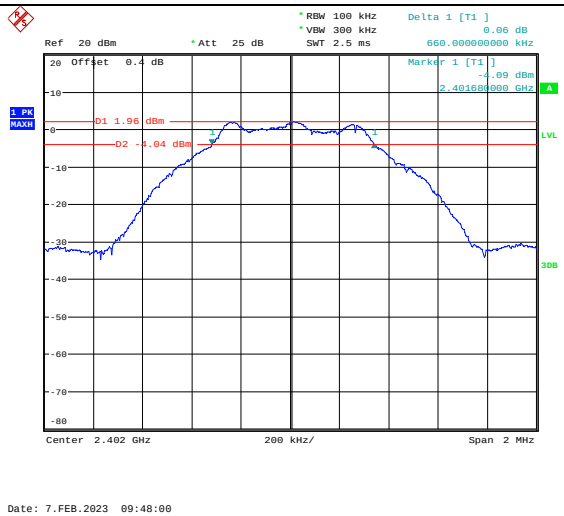
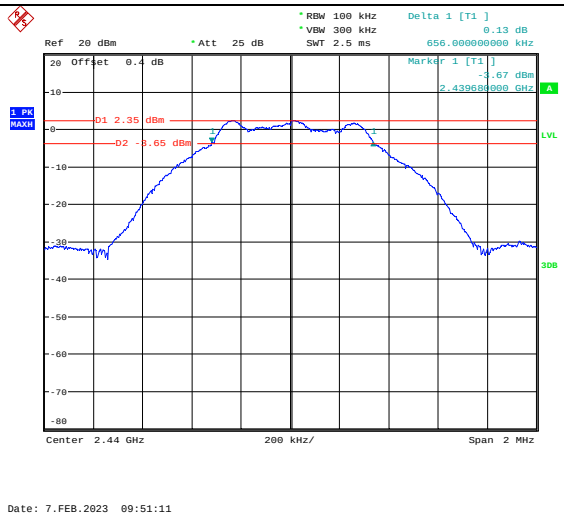
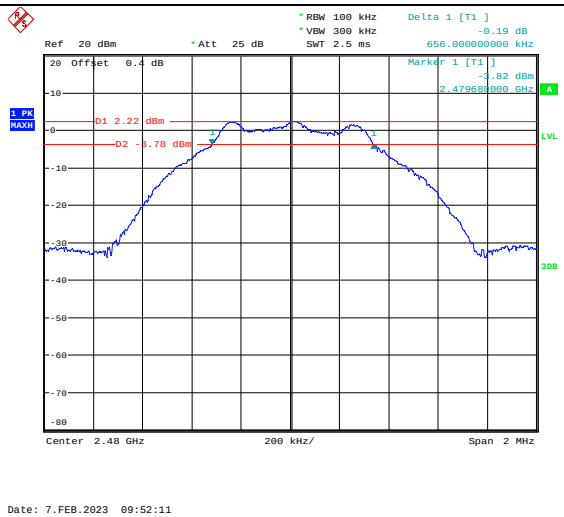
Test Equipment List and Details:

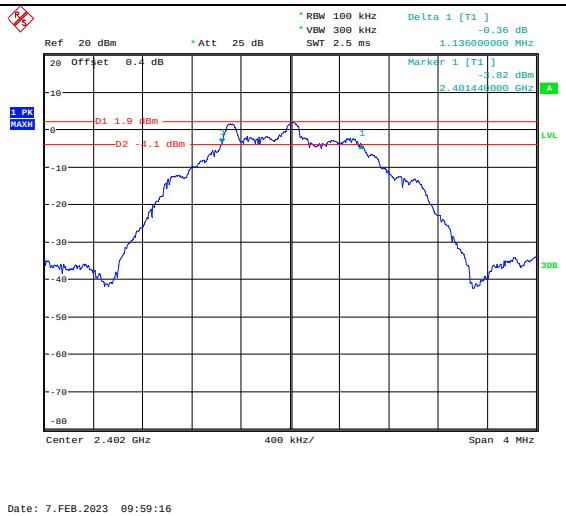
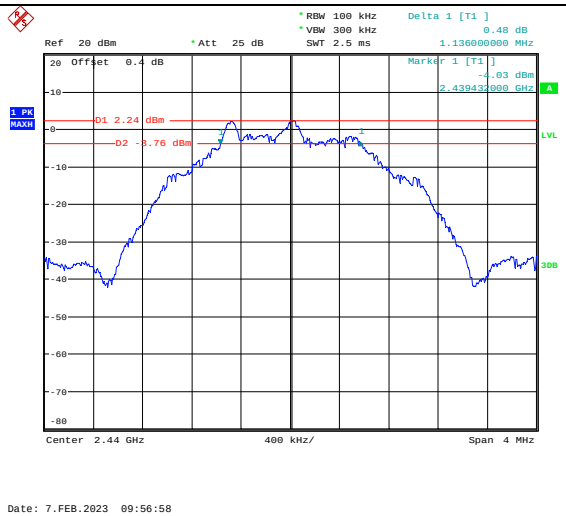
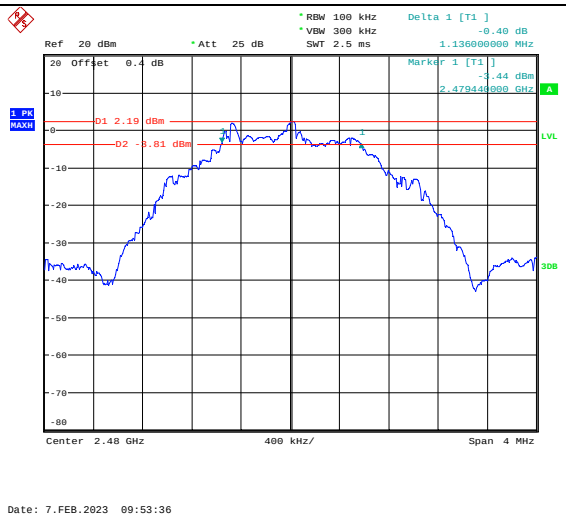
Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSU26	200256	2022/07/15	2023/07/14
zhuoxiang	Coaxial Cable	SMA-178	211002	Each time	N/A

** Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).*

Test Data:

Test Modes	Test Frequency (MHz)	6 dB Bandwidth (MHz)	Limit (MHz)
BLE 1Mbps	2402	0.660	≥0.5
	2440	0.656	≥0.5
	2480	0.656	≥0.5
BLE 2Mbps	2402	1.136	≥0.5
	2440	1.136	≥0.5
	2480	1.136	≥0.5

6dB Emission Bandwidth	
BLE 1Mbps Lowest Channel	
BLE 1Mbps Middle Channel	
BLE 1Mbps Highest Channel	

6dB Emission Bandwidth	
BLE 2Mbps Lowest Channel	
BLE 2Mbps Middle Channel	
BLE 2Mbps Highest Channel	

4.4 99% Occupied Bandwidth:

Serial Number:	1X1V-1	Test Date:	2023/2/7
Test Site:	RF	Test Mode:	Transmitting
Tester:	Claire Liu	Test Result:	N/A

Environmental Conditions:					
Temperature: (℃)	26.1	Relative Humidity: (%)	59	ATM Pressure: (kPa)	101.5

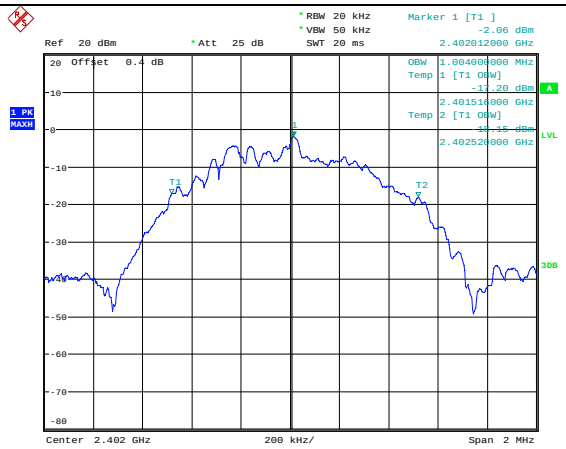
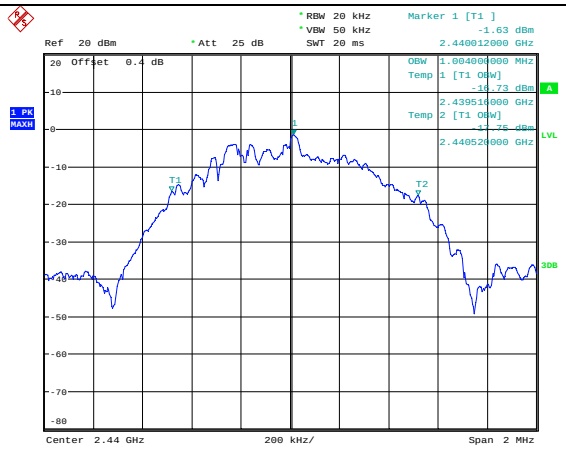
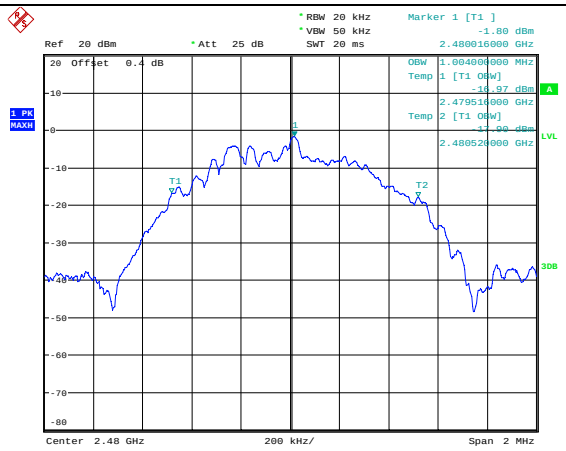
Test Equipment List and Details:

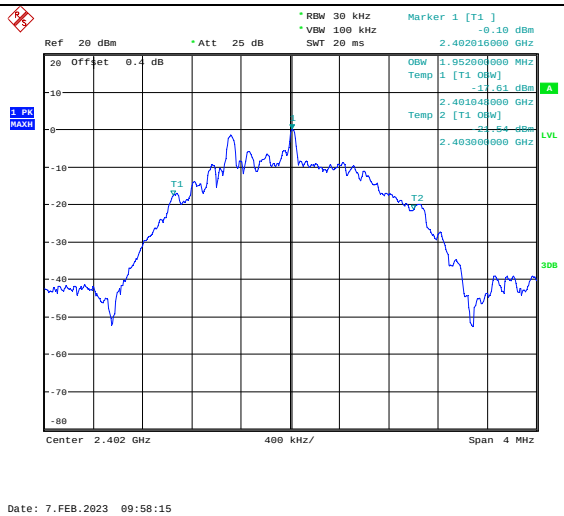
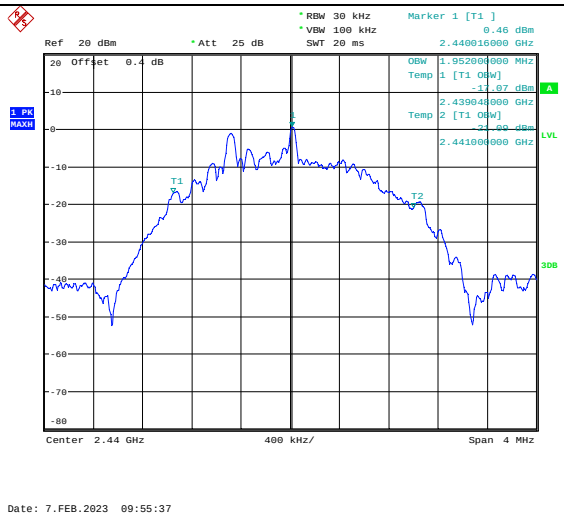
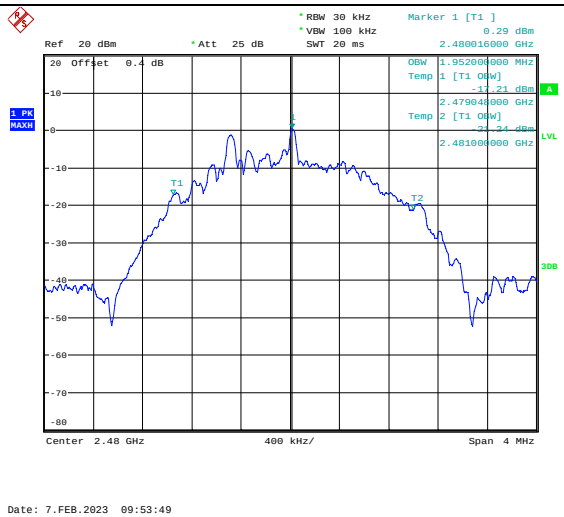
Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSU26	200256	2022/07/15	2023/07/14
zhuoxiang	Coaxial Cable	SMA-178	211002	Each time	N/A

** Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).*

Test Data:

Test Modes	Test Frequency (MHz)	99% Occupied Bandwidth (MHz)
BLE 1Mbps	2402	1.004
	2440	1.004
	2480	1.004
BLE 2Mbps	2402	1.952
	2440	1.952
	2480	1.952

99% Occupied Bandwidth	
BLE 1Mbps Lowest Channel	
BLE 1Mbps Middle Channel	
BLE 1Mbps Highest Channel	

99% Occupied Bandwidth	
BLE 2Mbps Lowest Channel	
BLE 2Mbps Middle Channel	
BLE 2Mbps Highest Channel	

4.5 Maximum conducted output power:

Serial Number:	1X1V-1	Test Date:	2023/2/7
Test Site:	RF	Test Mode:	Transmitting
Tester:	Claire Liu	Test Result:	Pass

Environmental Conditions:					
Temperature: (℃)	26.1	Relative Humidity: (%)	59	ATM Pressure: (kPa)	101.5

Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
zhuoxiang	Coaxial Cable	SMA-178	211002	Each time	N/A
Agilent	USB Wideband Power Sensor	U2021XA	MY54080015	2022/07/15	2023/07/14

** Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).*

Test Data:

Test Modes	Test Channel	Test Frequency (MHz)	Maximum Conducted Peak Output Power (dBm)	Limit (dBm)
BLE 1Mbps	Lowest	2402	2.39	⩽30
	Middle	2440	2.82	⩽30
	Highest	2480	2.64	⩽30
BLE 2Mbps	Lowest	2402	2.32	⩽30
	Middle	2440	2.84	⩽30
	Highest	2480	2.66	⩽30

4.5 Maximum power spectral density:

Serial Number:	1X1V-1	Test Date:	2023/2/7
Test Site:	RF	Test Mode:	Transmitting
Tester:	Claire Liu	Test Result:	Pass

Environmental Conditions:					
Temperature: (℃)	26.1	Relative Humidity: (%)	59	ATM Pressure: (kPa)	101.5

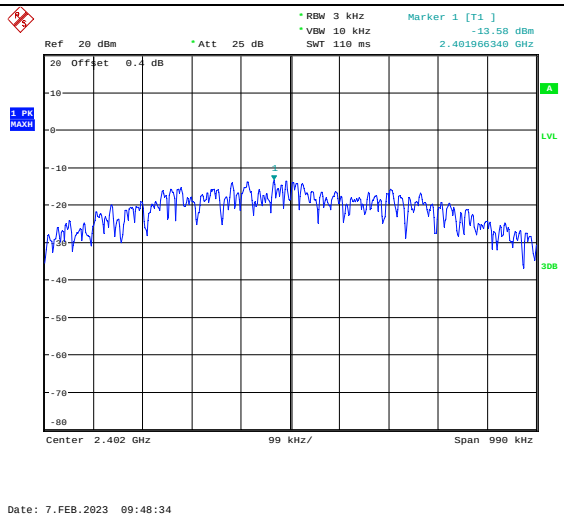
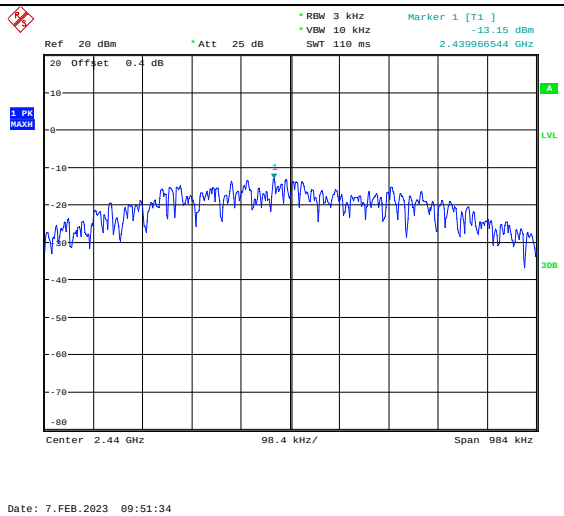
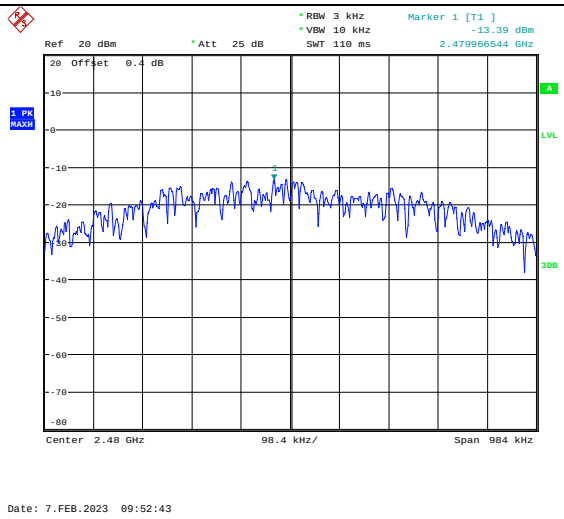
Test Equipment List and Details:

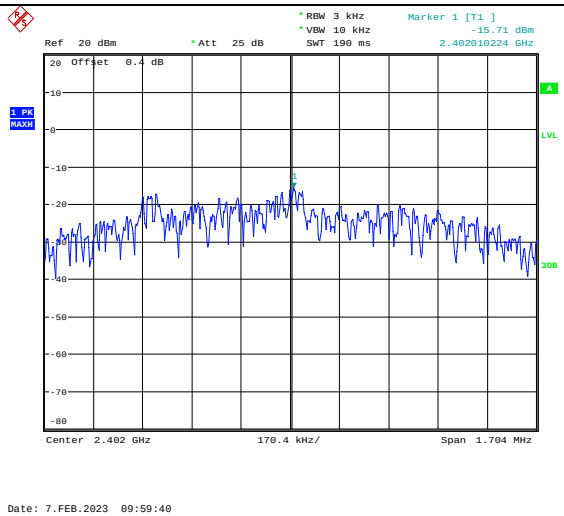
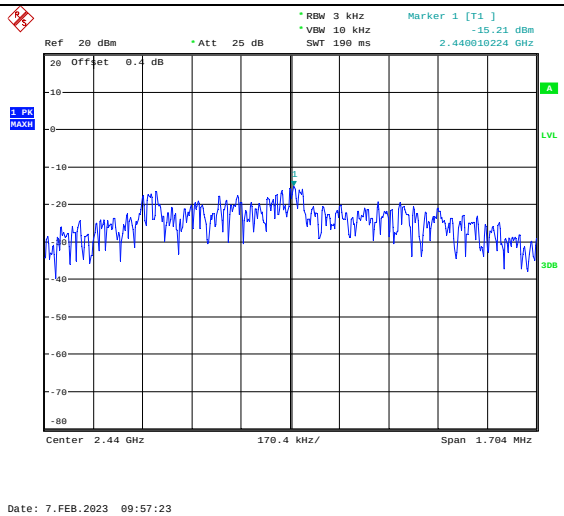
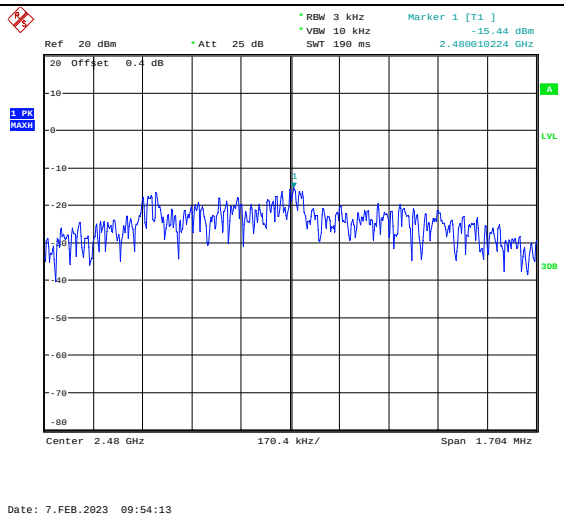
Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSU26	200256	2022/07/15	2023/07/14
zhuoxiang	Coaxial Cable	SMA-178	211002	Each time	N/A

** Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).*

Test Data:

Test Channel	Test Frequency (MHz)	Power Spectral Density (dBm/3kHz)	Limit (dBm/3kHz)
BLE 1Mbps	2402	-13.58	≤8.00
	2440	-13.15	≤8.00
	2480	-13.39	≤8.00
BLE 2Mbps	2402	-15.71	≤8.00
	2440	-15.21	≤8.00
	2480	-15.44	≤8.00

Maximum power spectral density	
BLE 1Mbps Lowest Channel	
BLE 1Mbps Middle Channel	
BLE 1Mbps Highest Channel	

Maximum power spectral density	
BLE 2Mbps Lowest Channel	
BLE 2Mbps Middle Channel	
BLE 2Mbps Highest Channel	

4.6 100 kHz Bandwidth of Frequency Band Edge:

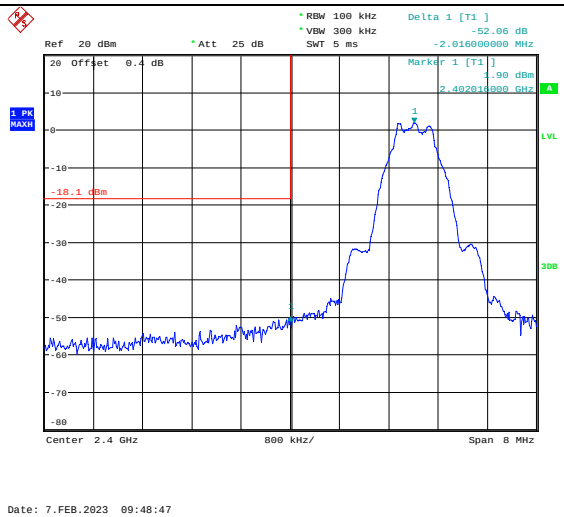
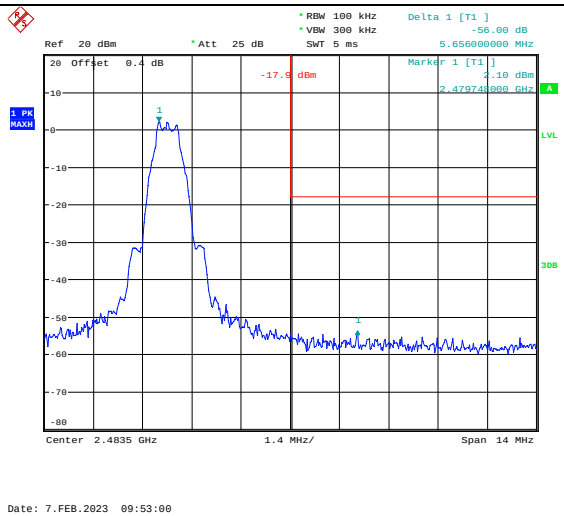
Serial Number:	1X1V-1	Test Date:	2023/2/7
Test Site:	RF	Test Mode:	Transmitting
Tester:	Claire Liu	Test Result:	Pass

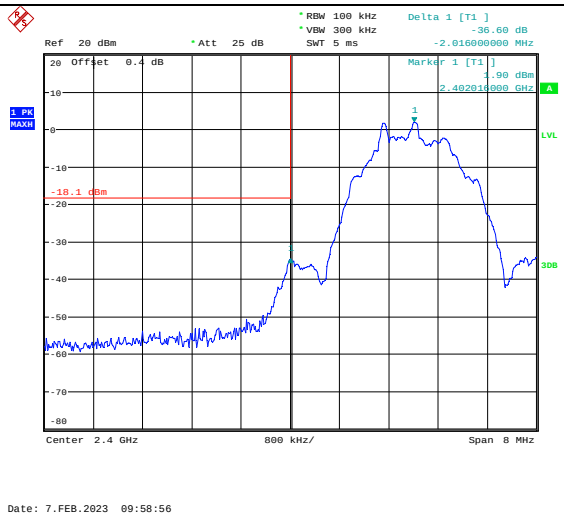
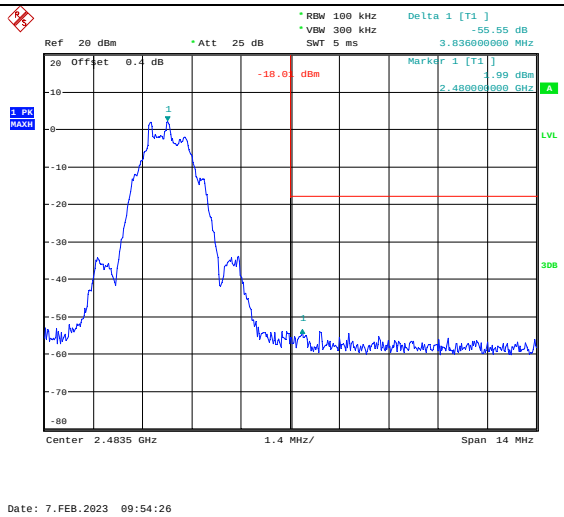
Environmental Conditions:					
Temperature: (℃)	26.1	Relative Humidity: (%)	59	ATM Pressure: (kPa)	101.5

Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSU26	200256	2022/07/15	2023/07/14
zhuoxiang	Coaxial Cable	SMA-178	211002	Each time	N/A

** Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).*

100 kHz Bandwidth of Frequency Band Edge	
BLE 1Mbps Lowest Band edge	
BLE 1Mbps Highest Band edge	

100 kHz Bandwidth of Frequency Band Edge	
BLE 2Mbps Lowest Band edge	
BLE 2Mbps Highest Band edge	

4.7 Duty Cycle:

Serial Number:	1X1V-1	Test Date:	2023/2/7
Test Site:	RF	Test Mode:	Transmitting
Tester:	Claire Liu	Test Result:	N/A

Environmental Conditions:					
Temperature: (℃)	26.1	Relative Humidity: (%)	59	ATM Pressure: (kPa)	101.5

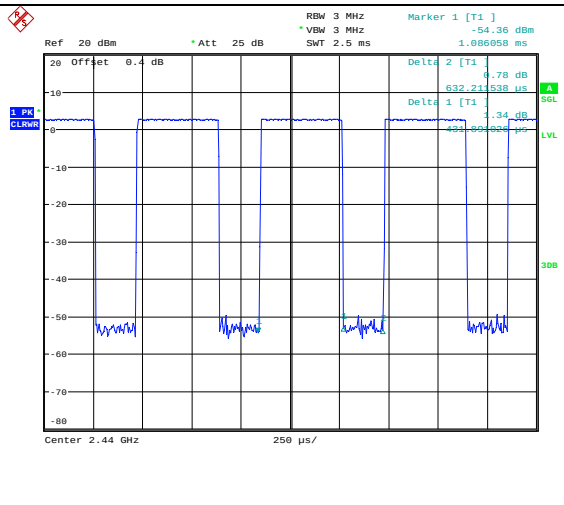
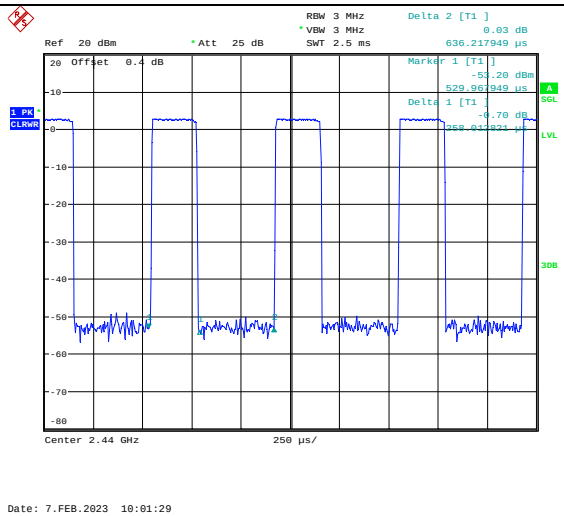
Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSU26	200256	2022/07/15	2023/07/14
zhuoxiang	Coaxial Cable	SMA-178	211002	Each time	N/A

** Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).*

Test Data:

Test Modes	Ton (ms)	Ton+off (ms)	Duty cycle (%)
BLE 1Mbps	0.432	0.632	68.35
BLE 2Mbps	0.258	0.636	40.57

Duty Cycle	
BLE 1Mbps	
BLE 2Mbps	

5. RF EXPOSURE EVALUATION

5.1 Applicable Standard

According to subpart 15.247(i)and subpart §1.1310, systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

Limits for Maximum Permissible Exposure (MPE) (§1.1310, §2.1091)

(B) Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	**Electric Field Strength (V/m)**	**Magnetic Field Strength (A/m)**	**Power Density (mW/cm^2)**	**Averaging Time (minutes)**
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*(180/f²)	30
30–300	27.5	0.073	0.2	30
300–1500	/	/	f/1500	30
1500–100,000	/	/	1.0	30

f = frequency in MHz; * = Plane-wave equivalent power density;

According to §1.1310 and §2.1091 RF exposure is calculated.

Calculation formula:

Prediction of power density at the distance of the applicable MPE limit
$S = PG/4\pi R^2$ = power density (in appropriate units, e.g. mW/cm^2);
P = power input to the antenna (in appropriate units, e.g., mW);
G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain;
R = distance to the center of radiation of the antenna (appropriate units, e.g., cm);

For simultaneously transmit system, the calculated power density should comply with:

$$\sum_i \frac{S_i}{S_{Limit,i}} \leq 1$$

5.2 EUT WWAN Information▲:

Operation Modes	Operation Frequency (MHz)	Maximum Conducted Power including Tune-up Tolerance (dBm)	Antenna Gain (dBi)	ERP or EIRP (dBm)	ERP or EIRP Limit (dBm)	Conducted Power Limit (dBm)
LTE/NR B2	1850-1910	25	2.23	27.23	33	/
LTE B4	1710-1755	25	3.27	28.27	30	/
LTE/NR B5	824-849	25	-0.24	22.61	38.45	/
LTE/NR B7	2500-2570	25	4.02	/	/	33
LTE/NR B12	699-716	25	-0.55	22.3	44.77	/
LTE/NR B13	777-787	25	0.64	23.49	44.77	/
LTE/NR B14	788-798	25	0.54	23.39	44.77	/
LTE B17	704-716	25	-0.55	22.3	44.77	/
LTE/NR B25	1850-1915	25	2.23	27.23	33	/
LTE/NR B26	814-849	25	-0.11	24.89	38.45	/
LTE/NR B30	2305-2315	25	2.68	27.68	33	/
LTE/NR B38	2570-2620	28	3.15	31.15	33	/
LTE B41	2496-2690	28	4.02	/	/	33
NR B41	2496-2690	31	4.02	/	/	33
LTE/NR B48	3550-3700	20	2.48	22.48	23	/
LTE/NR B66	1710-1780	25	3.27	28.27	30	/
LTE/NR B71	663-698	25	-0.81	22.04	44.77	/
NR B77	3450-3550 3700-3980	31	4.43	35.43	62.15	/
NR B78	3300-3800	31	2.95	33.95	62.15	/

Note:
The devices contain certified WWAN Module, FCC ID: XIA2023RG520NNA.
The device was used for fixed application.

5.3 Measurement Result

Operation Modes	Frequency (MHz)	Antenna Gain		Conducted output power including Tune-up Tolerance		Evaluation Distance	Power Density	MPE Limit
		(dBi)	(numeric)	(dBm)	(mW)	(cm)	(mW/cm^2)	(mW/cm^2)
BLE	2402-2480	2.66	1.85	3	2.00	20	0.0007	1
LTE/NR B2	1850-1910	2.23	1.67	25	316.23	20	0.1051	1
LTE B4	1710-1755	3.27	2.12	25	316.23	20	0.1334	1
LTE/NR B5	824-849	-0.24	0.95	25	316.23	20	0.0598	0.549
LTE/NR B7	2500-2570	4.02	2.52	25	316.23	20	0.1585	1
LTE/NR B12	699-716	-0.55	0.88	25	316.23	20	0.0554	0.466
LTE/NR B13	777-787	0.64	1.16	25	316.23	20	0.0730	0.518
LTE/NR B14	788-798	0.54	1.13	25	316.23	20	0.0711	0.525
LTE B17	704-716	-0.55	0.88	25	316.23	20	0.0554	0.469
LTE/NR B25	1850-1915	2.23	1.67	25	316.23	20	0.1051	1
LTE/NR B26	814-849	-0.11	0.97	25	316.23	20	0.0610	0.543
LTE/NR B30	2305-2315	2.68	1.85	25	316.23	20	0.1164	1
LTE/NR B38	2570-2620	3.15	2.07	28	630.96	20	0.2598	1
LTE B41	2496-2690	4.02	2.52	28	630.96	20	0.3163	1
NR B41	2496-2690	4.02	2.52	31	1258.93	20	0.6311	1
LTE/NR B48	3550-3700	2.48	1.77	20	100.00	20	0.0352	1
LTE/NR B66	1710-1780	3.27	2.12	25	316.23	20	0.1334	1
LTE/NR B71	663-698	-0.81	0.83	25	316.23	20	0.0522	0.442
NR B77	3450-3550 3700-3980	4.43	2.77	31	1258.93	20	0.6938	1
NR B78	3300-3800	2.95	1.97	31	1258.93	20	0.4934	1

The WWAN and BlE can transmit simultaneously, the worst case as below::

$$\sum_i \frac{S_i}{S_{Limit,i}}$$

$=S_{WWAN}/S_{limit\text{-}\ WAAN}+ S_{BLW}/S_{limit\text{-}\ BLE}$

=0.6938/1+0.0007/1

=0.69

< 1.0

Result: The device compliant the Exemption at 20cm distances.

===== END OF REPORT ====