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

ACCREDITED
TESTING LABORATORY
CERTIFICATE # 6356.01

TEST REPORT

Applicant: **SHENZHEN TOPFLYtech CO., LIMITED**

Address: Rm409 Scientific Research Building Tsinghua, Hi-tech Park Hi-tech Industrial Nanshan District, shenzhen, China

FCC ID: **2ASWY23EG912UGL**

Product Name: **LTE Module**

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: **CR230741544-00AA2**

Date Of Issue: **2023/9/21**

Reviewed By: **Calvin Chen**
Title: RF Engineer

Approved By: **Sun Zhong**
Title: Manager

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

Revision Number	Report Number	Description of Revision	Date of Revision
1.0	CR230741544-00AA2	Original Report	2023/9/21

1. GENERAL INFORMATION

1.1 Product Description for Equipment under Test (EUT)

EUT Name:	LTE Module
Trade Name:	TOPFLYtech
EUT Model:	EG912U-GL
Operation Frequency:	2402-2480 MHz
Maximum Peak Output Power (Conducted):	5.64dBm
Modulation Type:	GFSK
Rated Input Voltage:	DC 3.8V
Serial Number:	RF Conducted Test: 28GI-3 AC line conducted emissions/ Radiated Spurious Emissions: PCB ANT: 28GI-1, Ceramic ANT1: 296H-2, Ceramic ANT2: 296K-4
EUT Received Date:	2023/8/1
EUT Received Status:	Good
Test Purpose:	
This is Class II permissive change application for FCC ID: 2ASWY23EG912UGL, the below changes was made based on the device certified on 08/22/2023, which was provided by the manufacturer▲: 1): Adding three BT antennas.	

Operation Frequency Detail:
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 Model	Antenna Type	input impedance (Ohm)	Frequency Range	Antenna Gain
1	Ceramic	50	2.4~2.5GHz	1.2dBi
2	Ceramic	50	2.4~2.5GHz	1.67dBi
3	PCB	50	2.4~2.5GHz	1.7dBi

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	Parameters
/	/	/	/

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:	QRCT

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

1.2.2 Support Equipment List and Details

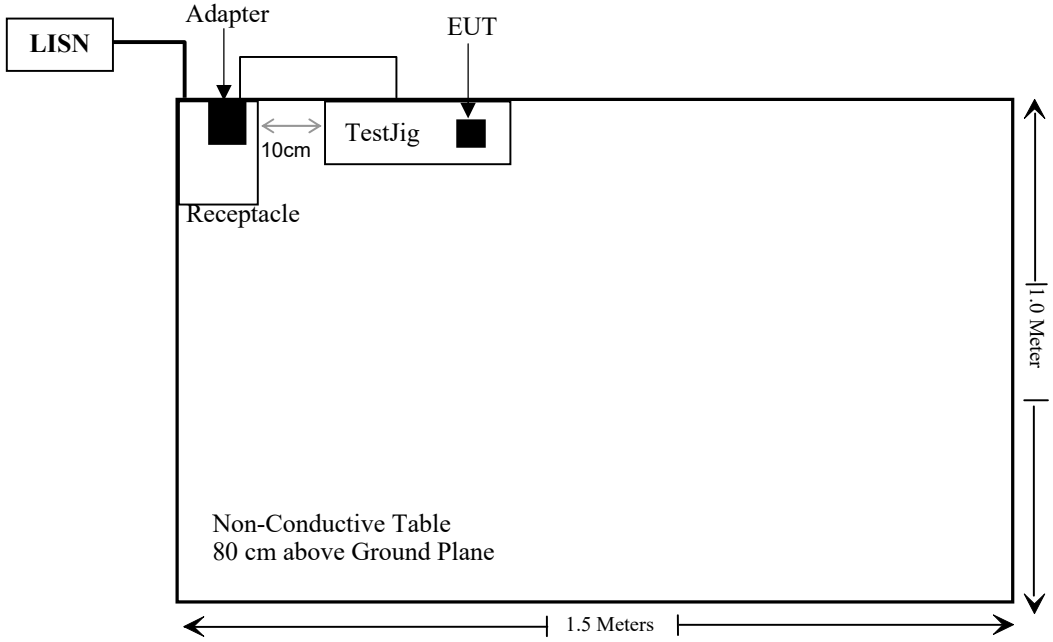
Manufacturer	Description	Model	Serial Number
GPO	Adapter	GTA92-0501000US	AD220930004
ZHAOXIN	DC Power Supply	RXN-6010D	21R6010D0912386
TOPFLYtech	Test Jig	Unknown	Unknown

1.2.3 Support Cable List and Details

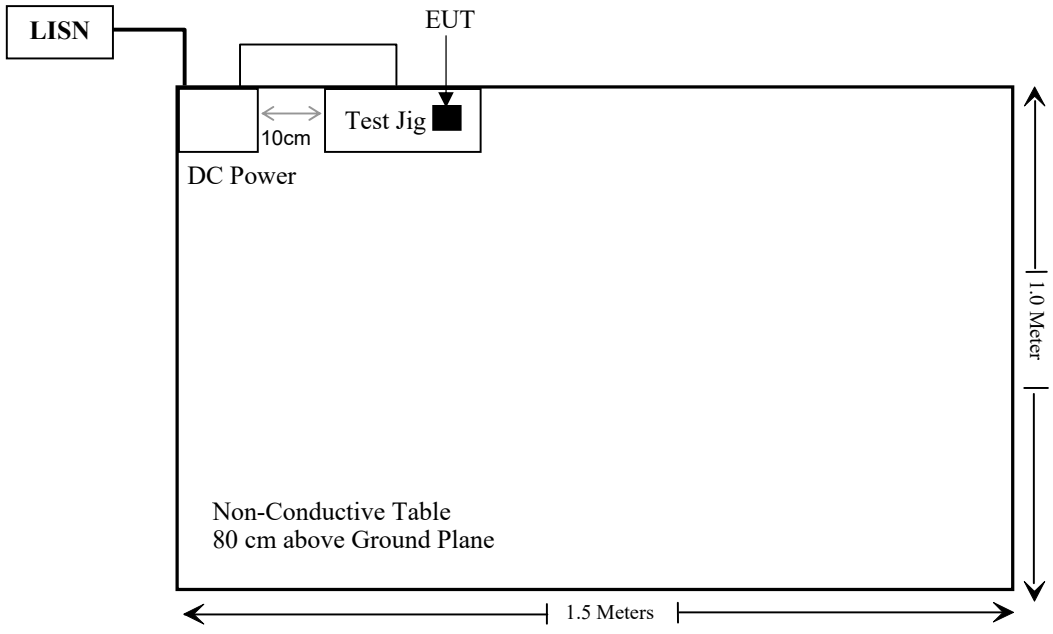
Cable Description	Shielding Type	Ferrite Core	Length (m)	From Port	To
USB cable	No	No	1	adapter	test Jig
DC cable	No	No	1.5	DC Power	test Jig

1.2.4 Block Diagram of Test Setup

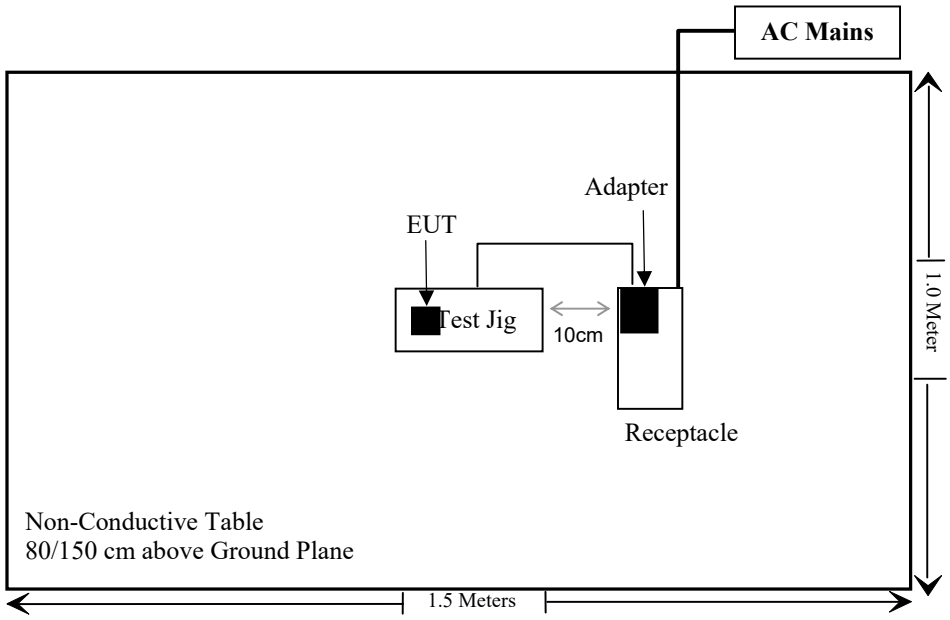
AC line conducted emissions:
Ceramic ANT1&2



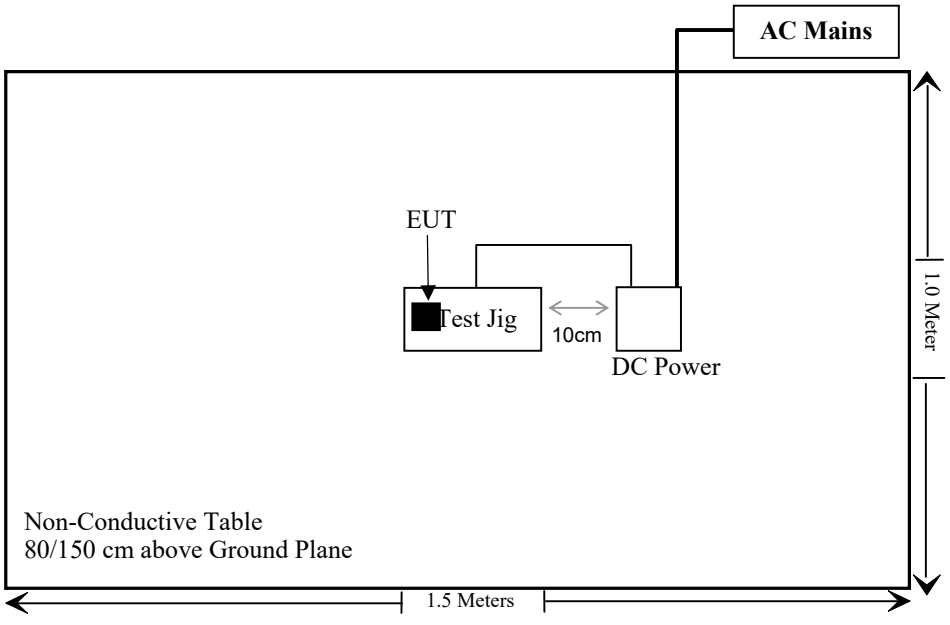
PCB ANT



Spurious Emissions:
Ceramic ANT1&2



PCB ANT



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)	Radiated Spurious Emissions	Compliant
§15.247 (a)(2)	Minimum 6 dB Bandwidth	Note*
§15.247(b)(3)	Maximum Conducted Output Power	Compliant
§15.247(e)	Power Spectral Density	Note*
§15.247(d)	100 kHz Bandwidth of Frequency Band Edge	Note*
§15.203	Antenna Requirement	Compliant
FCC§15.247 (i) & §1.1310 & §2.1091	RF Exposure Evaluation	Compliant

Note*: per spot check with the output power, the RF parameters identical with the original device, the result please refer to the original report: FR2D1203B, China Certification ICT Co., Ltd (Dongguan) is not responsible for the authenticity of any test data provided in the original report.

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:

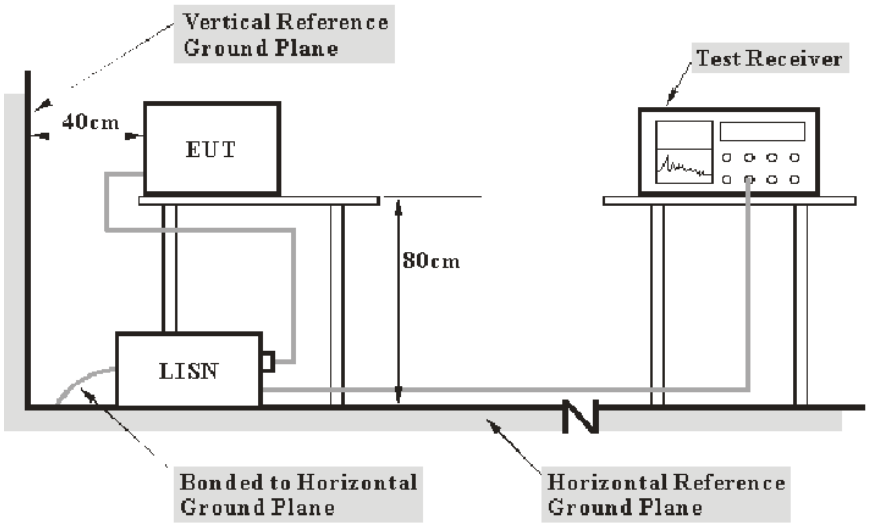
(1) For carrier current system containing their fundamental emission within the frequency band 535-1705 kHz and intended to be received using a standard AM broadcast receiver: no limit on conducted emissions.

(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.

The adapter or EUT was connected to the main LISN with a 120 V/60 Hz AC power source.

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

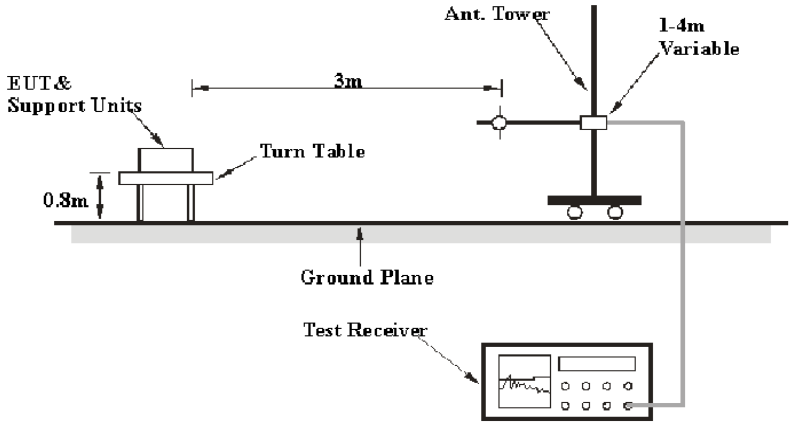
3.2.1 Applicable Standard

FCC §15.247 (d);

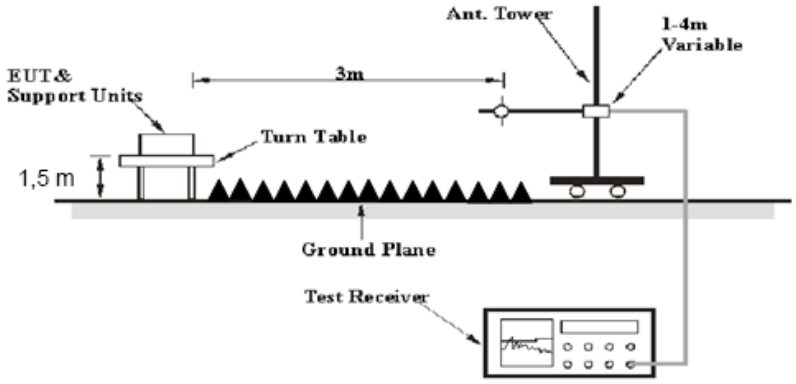
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the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

Note: T is minimum transmission duration

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

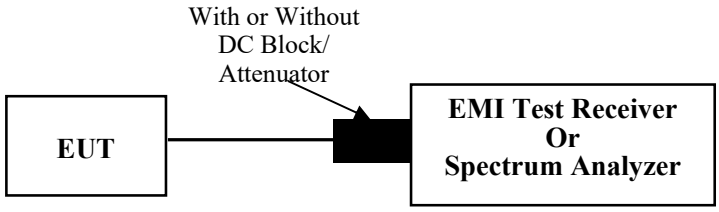
3.3 Minimum 6 dB Bandwidth

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



3.3.3 Test 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.

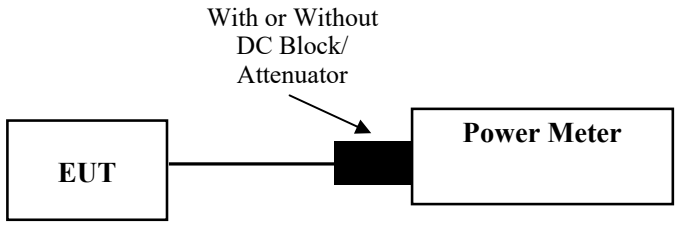
3.4 Maximum Conducted Output Power

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.

3.5.2 EUT Setup



3.5.3 Test Procedure

For Peak Power

According to ANSI C63.10-2013 Section 11.9.1.3

The maximum peak conducted output power may be measured using a broadband peak 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.

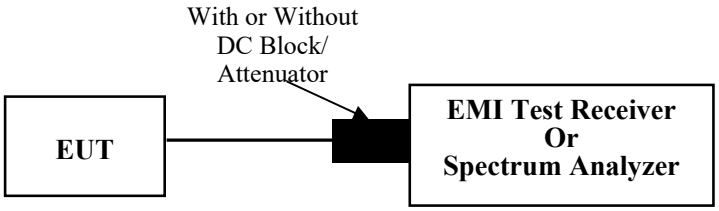
3.5 Maximum power spectral density

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



3.5.3 Test 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.

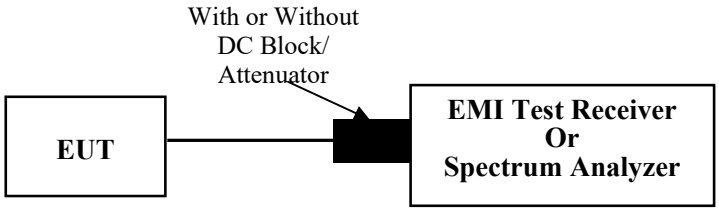
3.6 100 kHz Bandwidth of Frequency Band Edge

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



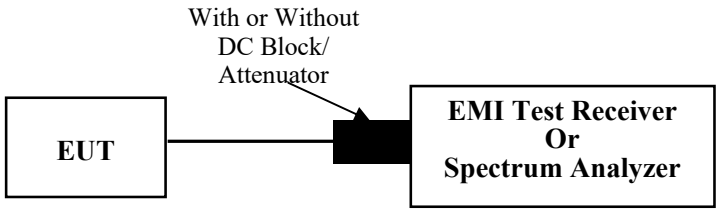
3.6.3 Test Procedure

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



3.7.2 Test 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:	28GI-1, 296H-2, 296K-4	Test Date:	2023/9/18
Test Site:	CE	Test Mode:	Transmitting (BLE 1M Middle channel was the worst)
Tester:	David Huang	Test Result:	Pass

Environmental Conditions:					
Temperature: (℃)	24.9	Relative Humidity: (%)	55	ATM Pressure: (kPa)	99.9

Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	LISN	ENV216	101134	2023/03/31	2024/03/30
R&S	EMI Test Receiver	ESR3	102726	2023/03/31	2024/03/30
MICRO-COAX	Coaxial Cable	UTIFLEX	C-0200-01	2023/08/06	2024/08/05
Audix	Test Software	E3	190306 (V9)	N/A	N/A

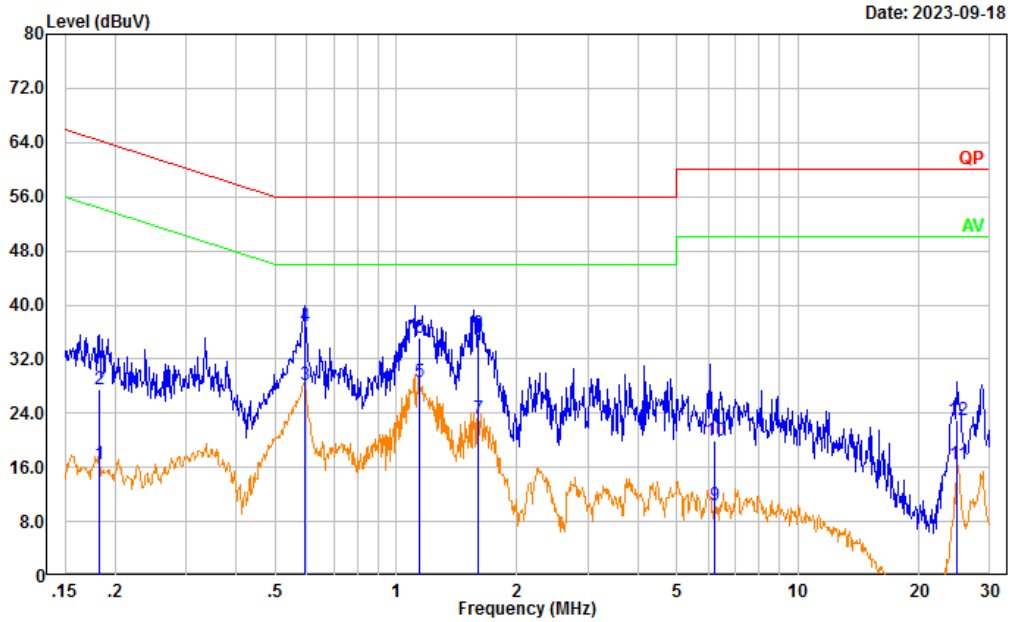
** Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).*

Test Data:

Pre-scan BLE 1Mbps with low, middle, high channel, the worst case middle channel was recorded.

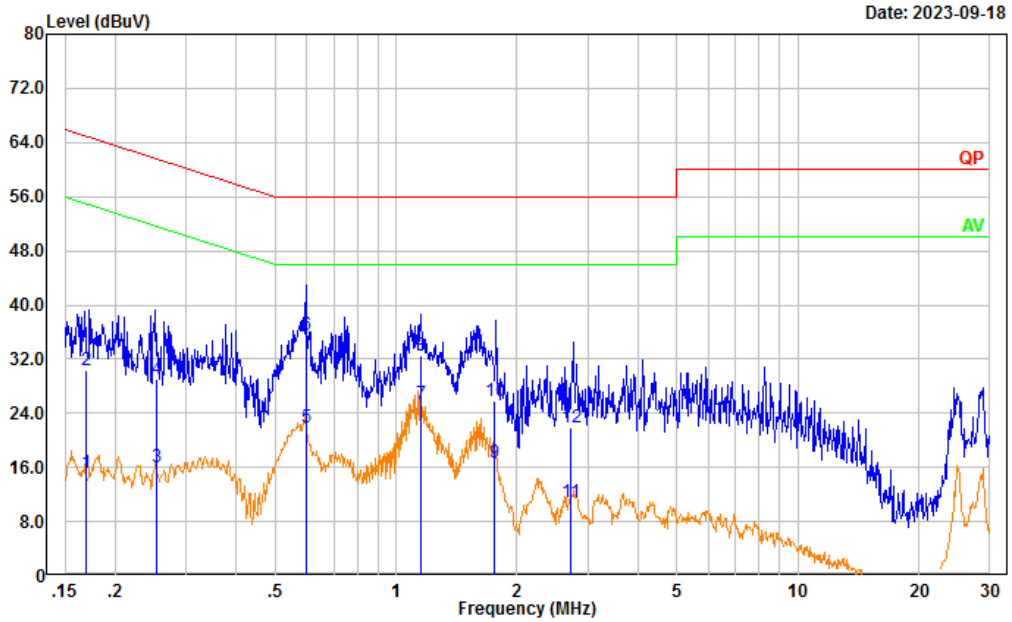
Ceramic ANT1:

Project No.: CR230741544-RFA2
Tester: David Huang
Port: Line
Note:



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB)	Result (dBµV)	Limit (dBµV)	Margin (dB)	Detector
1	0.183	6.88	9.61	16.49	54.36	37.87	Average
2	0.183	17.92	9.61	27.53	64.36	36.83	QP
3	0.592	18.57	9.62	28.19	46.00	17.81	Average
4	0.592	27.23	9.62	36.85	56.00	19.15	QP
5	1.141	19.02	9.62	28.64	46.00	17.36	Average
6	1.141	25.51	9.62	35.13	56.00	20.87	QP
7	1.602	13.47	9.63	23.10	46.00	22.90	Average
8	1.602	26.05	9.63	35.68	56.00	20.32	QP
9	6.204	0.72	9.66	10.38	50.00	39.62	Average
10	6.204	10.24	9.66	19.90	60.00	40.10	QP
11	24.897	6.66	9.81	16.47	50.00	33.53	Average
12	24.897	13.14	9.81	22.95	60.00	37.05	QP

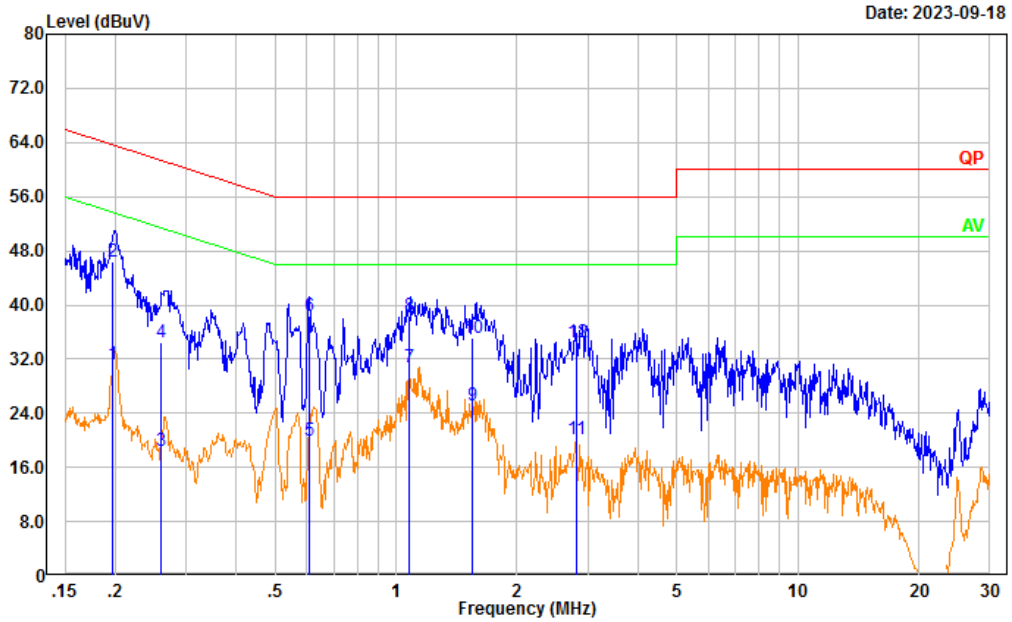
Project No.: CR230741544-RFA2
Tester: David Huang
Port: neutral
Note:



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB)	Result (dBµV)	Limit (dBµV)	Margin (dB)	Detector
1	0.170	5.48	9.61	15.09	54.97	39.88	Average
2	0.170	20.66	9.61	30.27	64.97	34.70	QP
3	0.253	6.38	9.61	15.99	51.66	35.67	Average
4	0.253	19.51	9.61	29.12	61.66	32.54	QP
5	0.597	12.37	9.62	21.99	46.00	24.01	Average
6	0.597	25.97	9.62	35.59	56.00	20.41	QP
7	1.153	15.67	9.62	25.29	46.00	20.71	Average
8	1.153	22.91	9.62	32.53	56.00	23.47	QP
9	1.761	7.16	9.63	16.79	46.00	29.21	Average
10	1.761	16.07	9.63	25.70	56.00	30.30	QP
11	2.722	1.17	9.64	10.81	46.00	35.19	Average
12	2.722	12.25	9.64	21.89	56.00	34.11	QP

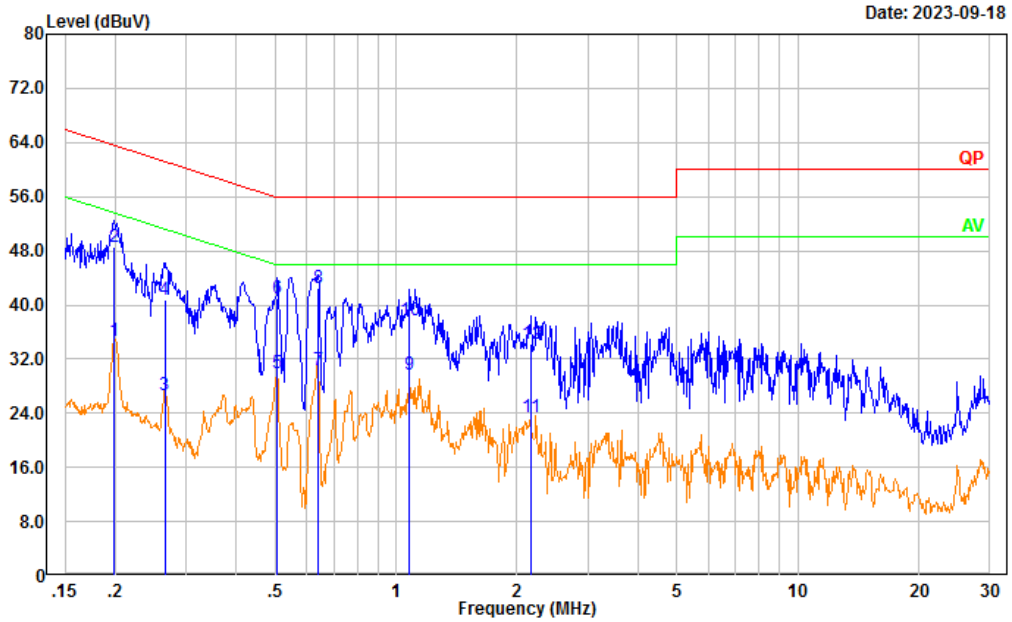
Ceramic ANT2:

Project No.: CR230741544-RFA2
Tester: David Huang
Port: Line
Note:



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB)	Result (dBµV)	Limit (dBµV)	Margin (dB)	Detector
1	0.198	21.64	9.61	31.25	53.71	22.46	Average
2	0.198	36.68	9.61	46.29	63.71	17.42	QP
3	0.261	8.87	9.61	18.48	51.41	32.93	Average
4	0.261	24.89	9.61	34.50	61.41	26.91	QP
5	0.608	10.39	9.62	20.01	46.00	25.99	Average
6	0.608	28.67	9.62	38.29	56.00	17.71	QP
7	1.082	21.14	9.62	30.76	46.00	15.24	Average
8	1.082	28.68	9.62	38.30	56.00	17.70	QP
9	1.553	15.49	9.63	25.12	46.00	20.88	Average
10	1.553	25.47	9.63	35.10	56.00	20.90	QP
11	2.805	10.53	9.65	20.18	46.00	25.82	Average
12	2.805	24.91	9.65	34.56	56.00	21.44	QP

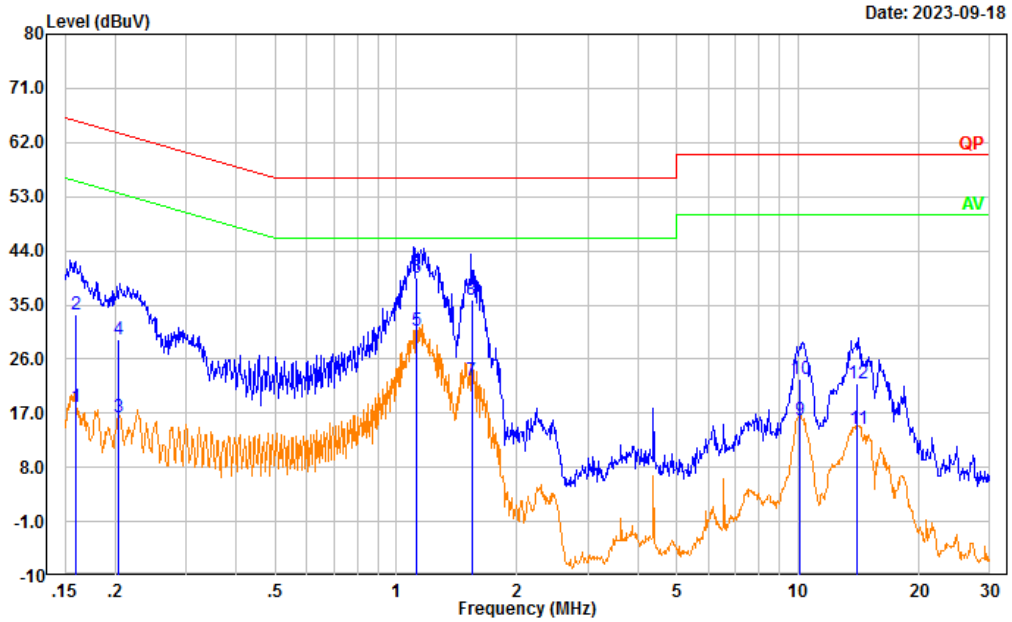
Project No.: CR230741544-RFA2
Tester: David Huang
Port: neutral
Note:



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB)	Result (dBµV)	Limit (dBµV)	Margin (dB)	Detector
1	0.199	25.02	9.61	34.63	53.64	19.01	Average
2	0.199	38.86	9.61	48.47	63.64	15.17	QP
3	0.266	17.07	9.61	26.68	51.25	24.57	Average
4	0.266	31.08	9.61	40.69	61.25	20.56	QP
5	0.506	20.29	9.61	29.90	46.00	16.10	Average
6	0.506	31.34	9.61	40.95	56.00	15.05	QP
7	0.640	20.75	9.62	30.37	46.00	15.63	Average
8	0.640	32.90	9.62	42.52	56.00	13.48	QP
9	1.082	20.12	9.62	29.74	46.00	16.26	Average
10	1.082	28.16	9.62	37.78	56.00	18.22	QP
11	2.160	13.86	9.63	23.49	46.00	22.51	Average
12	2.160	24.69	9.63	34.32	56.00	21.68	QP

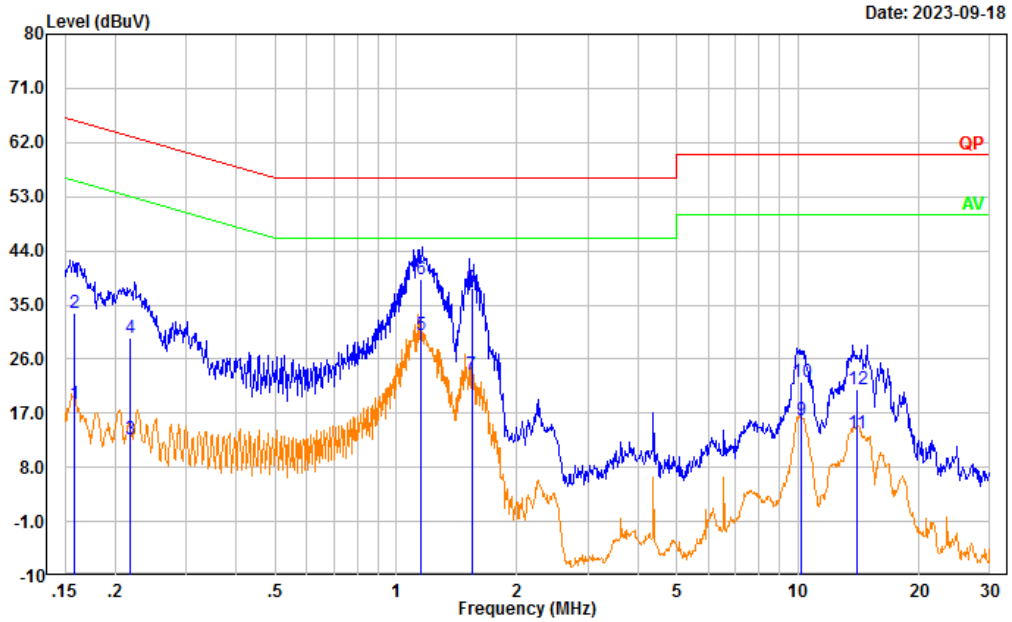
PCB ANT:

Project No.: CR230741544-RF
Tester: David Huang
Port: Line
Note:



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB)	Result (dBµV)	Limit (dBµV)	Margin (dB)	Detector
1	0.159	8.50	9.61	18.11	55.51	37.40	Average
2	0.159	23.74	9.61	33.35	65.51	32.16	QP
3	0.204	6.72	9.61	16.33	53.44	37.11	Average
4	0.204	19.65	9.61	29.26	63.44	34.18	QP
5	1.120	21.00	9.62	30.62	46.00	15.38	Average
6	1.120	29.91	9.62	39.53	56.00	16.47	QP
7	1.541	12.90	9.63	22.53	46.00	23.47	Average
8	1.541	26.17	9.63	35.80	56.00	20.20	QP
9	10.092	6.20	9.67	15.87	50.00	34.13	Average
10	10.092	13.02	9.67	22.69	60.00	37.31	QP
11	14.051	4.66	9.68	14.34	50.00	35.66	Average
12	14.051	12.35	9.68	22.03	60.00	37.97	QP

Project No.: CR230741544-RF
Tester: David Huang
Port: neutral
Note:



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB)	Result (dBµV)	Limit (dBµV)	Margin (dB)	Detector
1	0.158	8.93	9.61	18.54	55.58	37.04	Average
2	0.158	24.11	9.61	33.72	65.58	31.86	QP
3	0.219	3.11	9.61	12.72	52.87	40.15	Average
4	0.219	19.99	9.61	29.60	62.87	33.27	QP
5	1.158	20.40	9.62	30.02	46.00	15.98	Average
6	1.158	29.57	9.62	39.19	56.00	16.81	QP
7	1.541	13.84	9.63	23.47	46.00	22.53	Average
8	1.541	28.20	9.63	37.83	56.00	18.17	QP
9	10.152	6.09	9.67	15.76	50.00	34.24	Average
10	10.152	12.50	9.67	22.17	60.00	37.83	QP
11	14.009	4.06	9.68	13.74	50.00	36.26	Average
12	14.009	11.39	9.68	21.07	60.00	38.93	QP

4.2 Radiation Spurious Emissions

Serial Number:	28GI-1, 296H-2, 296K-4	Test Date:	30MHz-1GHz: 2023/9/18 1GHz -25GHz: 2023/8/6
Test Site:	966-1, 966-2	Test Mode:	Transmitting
Tester:	Vic Du, Coco Tian	Test Result:	Pass

Environmental Conditions:					
Temperature: (℃)	26.1~27.9	Relative Humidity: (%)	65~66	ATM Pressure: (kPa)	100.5~100.6

Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
30MHz-1GHz					
Sunol Sciences	Antenna	JB6	A082520-5	2020/10/19	2023/10/18
R&S	EMI Test Receiver	ESR3	102724	2023/3/31	2024/3/30
TIMES MICROWAVE	Coaxial Cable	LMR-600-UltraFlex	C-0470-02	2023/7/16	2024/7/15
TIMES MICROWAVE	Coaxial Cable	LMR-600-UltraFlex	C-0780-01	2023/7/16	2024/7/15
Sonoma	Amplifier	310N	186165	2023/7/16	2024/7/15
Audix	Test Software	E3	201021 (V9)	N/A	N/A
1GHz -25GHz					
ETS-Lindgren	Horn Antenna	3115	9912-5985	2020/10/13	2023/10/12
R&S	Spectrum Analyzer	FSV40	101591	2023/3/31	2024/3/30
MICRO-COAX	Coaxial Cable	UFA210A-1-1200-70U300	217423-008	2023/8/6	2024/8/5
MICRO-COAX	Coaxial Cable	UFA210A-1-2362-300300	235780-001	2023/8/6	2024/8/5
Mini	Pre-amplifier	ZVA-183-S+	5969001149	2022/11/9	2023/11/8
Audix	Test Software	E3	201021 (V9)	N/A	N/A
PASTERNACK	Horn Antenna	PE9852/2F-20	112002	2021/2/5	2024/2/4
Quinstar	Preamplifier	QLW-18405536-JO	15964001005	2022/9/16	2023/9/15
MICRO-COAX	Coaxial Cable	UFB142A-1-2362-200200	235772-001	2023/8/6	2024/8/5
E-Microwave	Band Rejection Filter	2400-2483.5MHz	OE01902424	2023/8/6	2024/8/5
Mini Circuits	High Pass Filter	VHF-6010+	31119	2023/8/6	2024/8/5

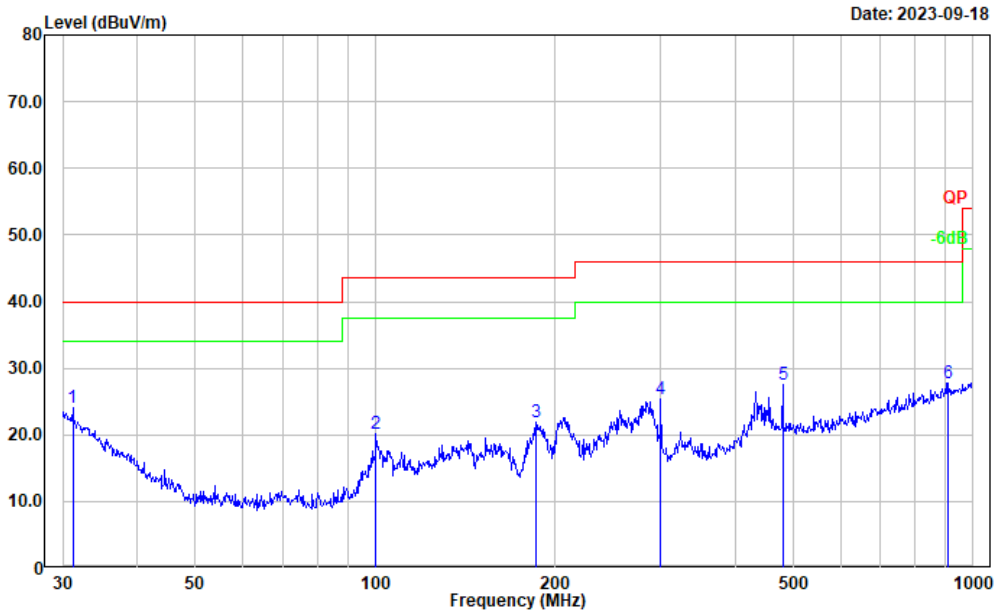
** Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).*

1) 30MHz-1GHz (Middle Channel was the worst)

Pre-scan BLE 1Mbps with low, middle, high channel, the worst case middle channel was recorded.

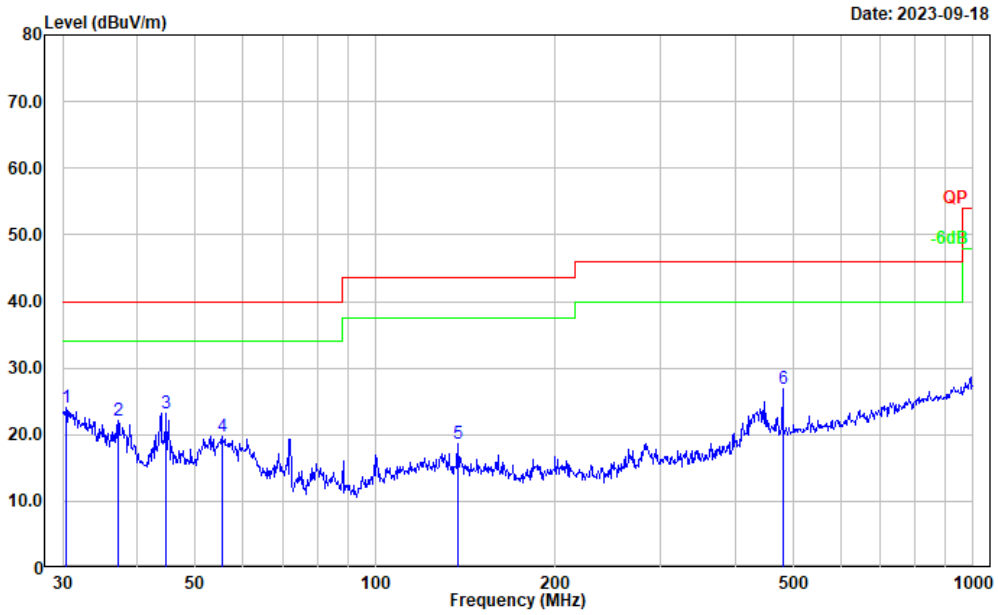
Ceramic ANT1

Project No.: CR230741544-RFA2
Tester: Vic Du
Polarization: horizontal
Note:



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	31.180	28.53	-4.50	24.03	40.00	15.97	Peak
2	100.229	34.34	-14.28	20.06	43.50	23.44	Peak
3	185.788	35.39	-13.56	21.83	43.50	21.67	Peak
4	300.367	36.03	-10.63	25.40	46.00	20.60	Peak
5	480.528	33.73	-6.25	27.48	46.00	18.52	Peak
6	906.482	28.65	-0.80	27.85	46.00	18.15	Peak

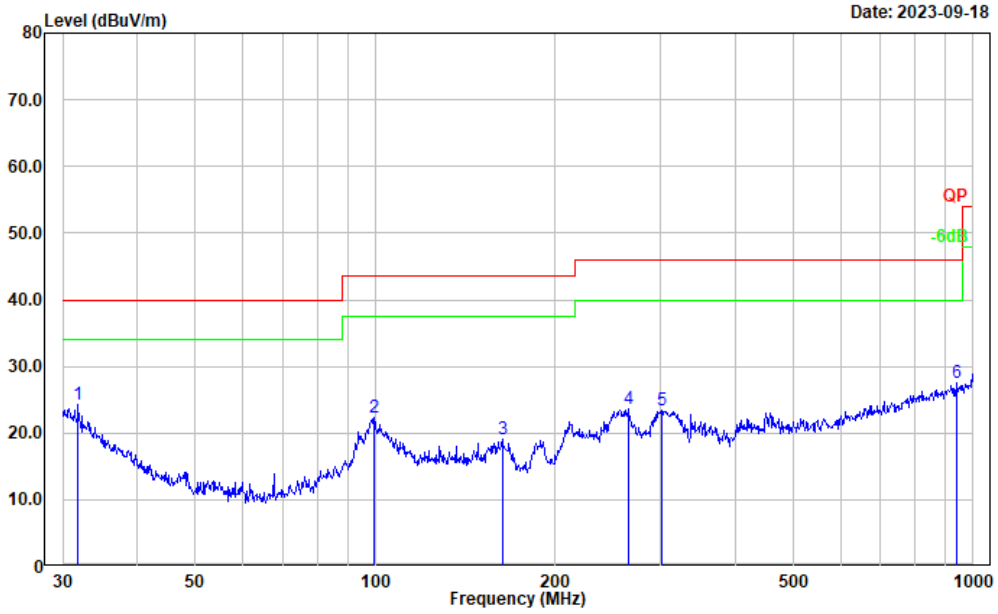
Project No.: CR230741544-RFA2
Tester: Vic Du
Polarization: vertical
Note:



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	30.424	28.10	-3.93	24.17	40.00	15.83	Peak
2	37.155	31.15	-9.12	22.03	40.00	17.97	Peak
3	44.743	37.27	-14.08	23.19	40.00	16.81	Peak
4	55.609	37.01	-17.31	19.70	40.00	20.30	Peak
5	137.420	30.47	-11.75	18.72	43.50	24.78	Peak
6	480.528	33.17	-6.25	26.92	46.00	19.08	Peak

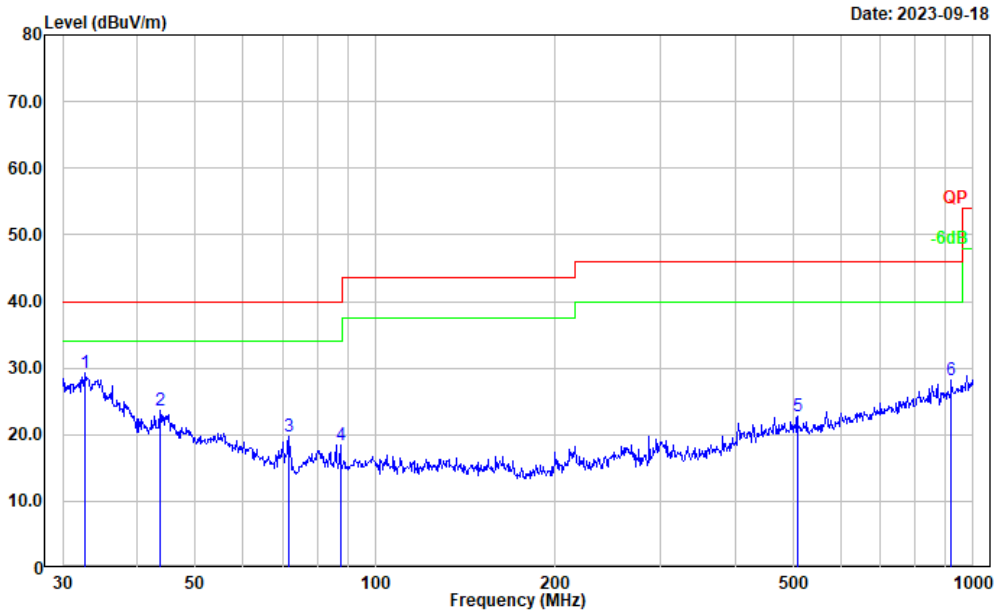
Ceramic ANT2

Project No.: CR230741544-RFA2
Tester: Vic Du
Polarization: horizontal
Note:



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	31.843	29.19	-5.00	24.19	40.00	15.81	Peak
2	99.528	36.77	-14.43	22.34	43.50	21.16	Peak
3	163.182	31.44	-12.35	19.09	43.50	24.41	Peak
4	264.746	35.83	-12.29	23.54	46.00	22.46	Peak
5	301.422	34.12	-10.61	23.51	46.00	22.49	Peak
6	938.833	27.95	-0.40	27.55	46.00	18.45	Peak

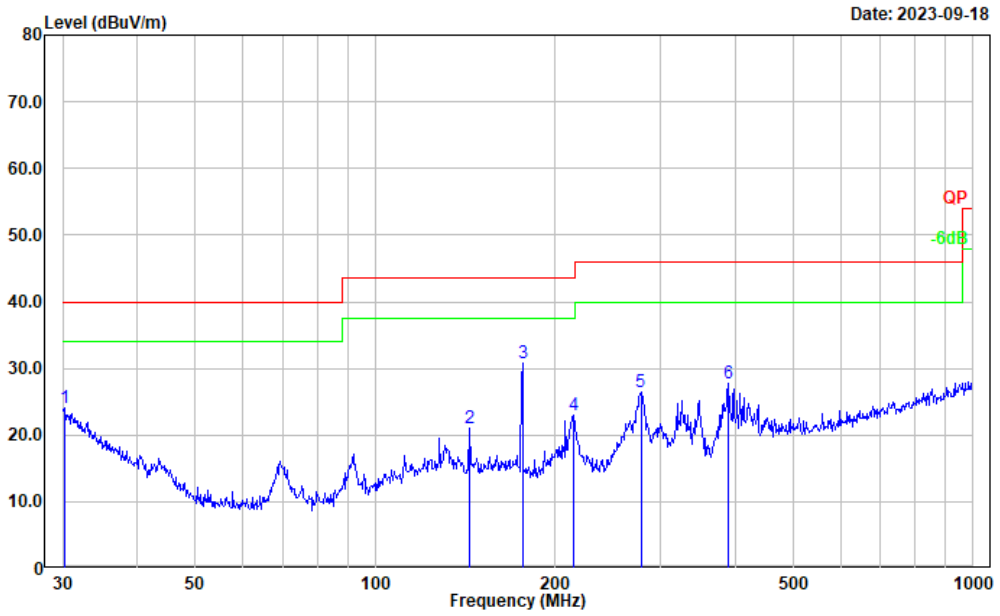
Project No.: CR230741544-RFA2
Tester: Vic Du
Polarization: vertical
Note:



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	32.749	34.96	-5.71	29.25	40.00	10.75	Peak
2	43.659	37.18	-13.46	23.72	40.00	16.28	Peak
3	71.832	36.40	-16.66	19.74	40.00	20.26	Peak
4	87.418	35.43	-17.07	18.36	40.00	21.64	Peak
5	508.258	28.60	-5.85	22.75	46.00	23.25	Peak
6	919.287	28.82	-0.69	28.13	46.00	17.87	Peak

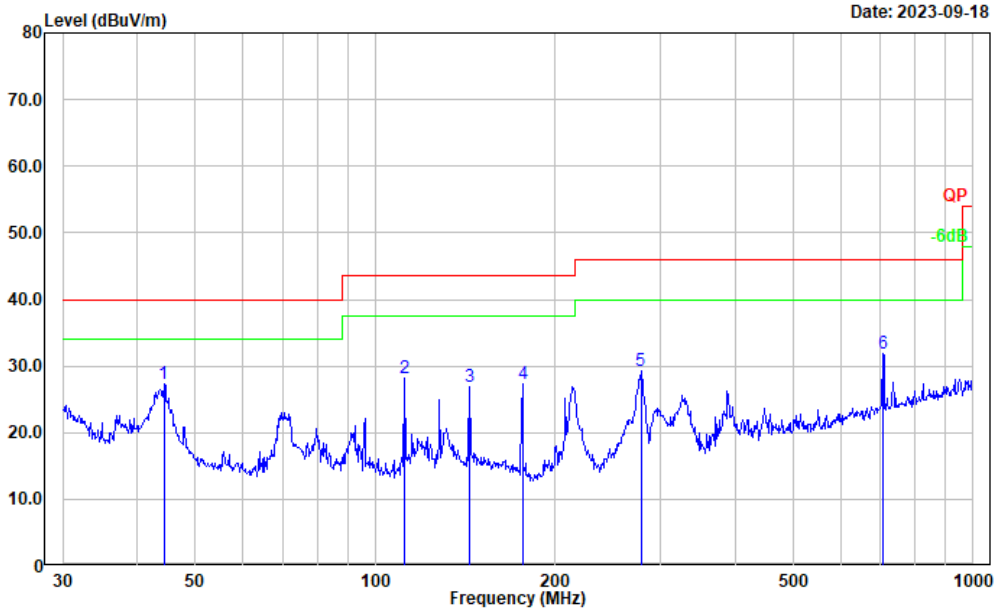
PCB ANT

Project No.: CR230741544-RFA2
Tester: Vic Du
Polarization: horizontal
Note:



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	30.211	27.85	-3.76	24.09	40.00	15.91	Peak
2	143.830	32.94	-11.96	20.98	43.50	22.52	Peak
3	176.269	44.06	-13.31	30.75	43.50	12.75	Peak
4	214.514	35.64	-12.60	23.04	43.50	20.46	Peak
5	278.067	38.30	-11.75	26.55	46.00	19.45	Peak
6	389.355	36.74	-8.91	27.83	46.00	18.17	Peak

Project No.: CR230741544-RFA2
Tester: Vic Du
Polarization: vertical
Note:



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	44.275	41.12	-13.82	27.30	40.00	12.70	Peak
2	112.131	40.34	-12.15	28.19	43.50	15.31	Peak
3	143.830	38.86	-11.96	26.90	43.50	16.60	Peak
4	176.269	40.66	-13.31	27.35	43.50	16.15	Peak
5	278.067	41.03	-11.75	29.28	46.00	16.72	Peak
6	706.700	35.31	-3.49	31.82	46.00	14.18	Peak

2) 1-25GHz:
BLE 1Mbps:

Ceramic ANT1

Frequency (MHz)	Receiver		Polar (H/V)	Factor (dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	Detector					
Low Channel: 2402 MHz							
2390.000	21.04	PK	H	31.46	52.50	74.00	21.50
2390.000	8.36	AV	H	31.46	39.82	54.00	14.18
4804.000	37.13	PK	H	10.91	48.04	74.00	25.96
4804.000	24.50	AV	H	10.91	35.41	54.00	18.59
Middle Channel: 2440 MHz							
4880.000	37.00	PK	H	11.07	48.07	74.00	25.93
4880.000	24.26	AV	H	11.07	35.33	54.00	18.67
High Channel: 2480 MHz							
2483.500	20.91	PK	H	31.64	52.55	74.00	21.45
2483.500	7.57	AV	H	31.64	39.21	54.00	14.79
4960.000	37.67	PK	H	11.23	48.90	74.00	25.10
4960.000	24.79	AV	H	11.23	36.02	54.00	17.98

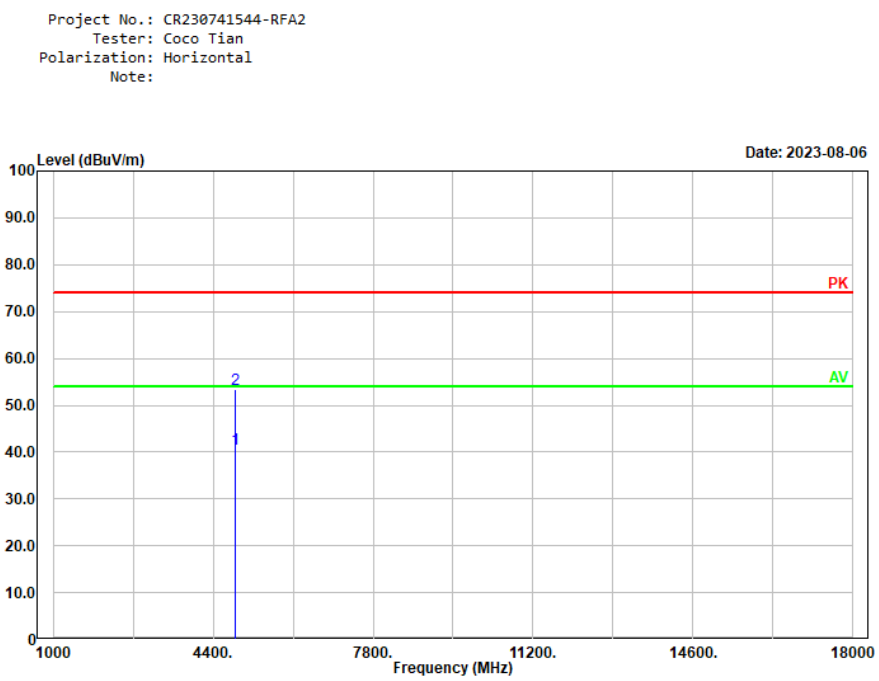
Ceramic ANT2

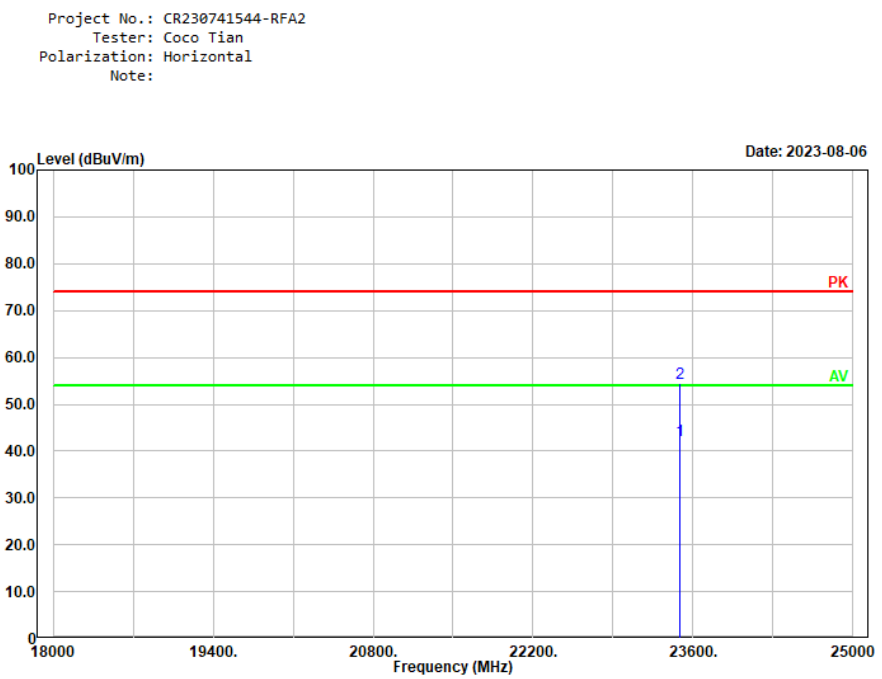
Frequency (MHz)	Receiver		Polar (H/V)	Factor (dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	Detector					
Low Channel: 2402 MHz							
2390.000	20.97	PK	H	31.46	52.43	74.00	21.57
2390.000	7.92	AV	H	31.46	39.38	54.00	14.62
4804.000	37.46	PK	H	10.91	48.37	74.00	25.63
4804.000	24.02	AV	H	10.91	34.93	54.00	19.07
Middle Channel: 2440 MHz							
4880.000	37.25	PK	H	11.07	48.32	74.00	25.68
4880.000	24.01	AV	H	11.07	35.08	54.00	18.92
High Channel: 2480 MHz							
2483.500	21.12	PK	H	31.64	52.76	74.00	21.24
2483.500	8.23	AV	H	31.64	39.87	54.00	14.13
4960.000	37.96	PK	H	11.23	49.19	74.00	24.81
4960.000	24.91	AV	H	11.23	36.14	54.00	17.86

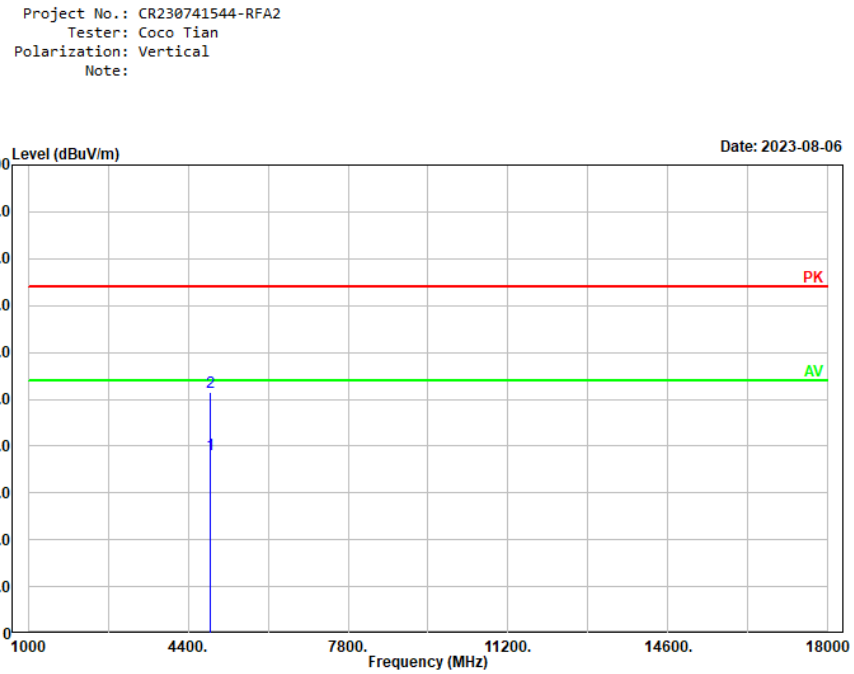
PCB ANT

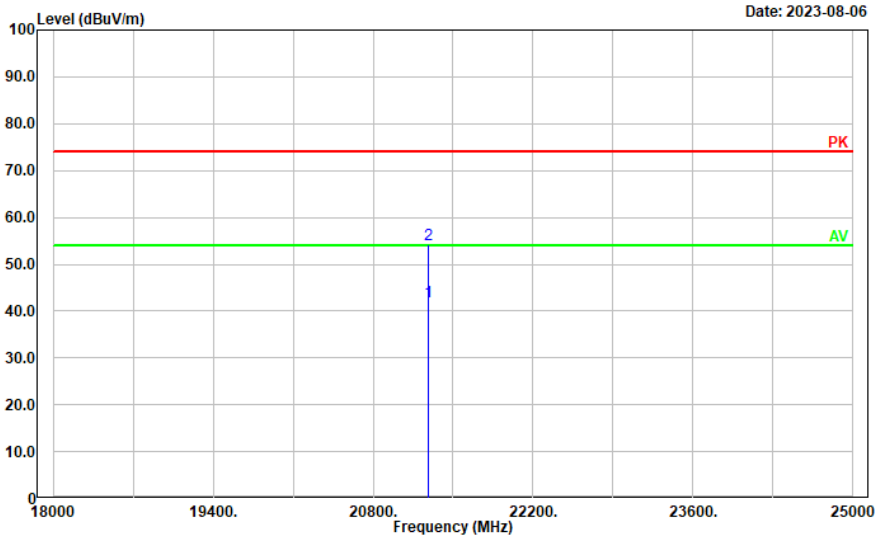
Frequency (MHz)	Receiver		Polar (H/V)	Factor (dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	Detector					
Low Channel: 2402 MHz							
2390.000	23.28	PK	H	31.46	54.74	74.00	19.26
2390.000	10.16	AV	H	31.46	41.62	54.00	12.38
4804.000	43.48	PK	H	10.91	54.39	74.00	19.61
4804.000	30.75	AV	H	10.91	41.66	54.00	12.34
Middle Channel: 2440 MHz							
4880.000	43.11	PK	H	11.07	54.18	74.00	19.82
4880.000	30.64	AV	H	11.07	41.71	54.00	12.29
High Channel: 2480 MHz							
2483.500	25.33	PK	H	31.64	56.97	74.00	17.03
2483.500	12.64	AV	H	31.64	44.28	54.00	9.72
4960.000	42.21	PK	H	11.23	53.44	74.00	20.56
4960.000	29.18	AV	H	11.23	40.41	54.00	13.59

Worst Test plots for Harmonic Margin (PCB ANT, Middle channel)

Horizontal	
1-18GHz	

Horizontal	
18-25GHz	

Vertical	
1-18GHz	

Vertical	
18-25GHz	Project No.: CR230741544-RFA2 Tester: Coco Tian Polarization: Vertical Note: 

4.3 Maximum Conducted Output Power

Serial Number:	28GI-3	Test Date:	2023/8/2
Test Site:	RF	Test Mode:	Transmitting
Tester:	Rou Luo	Test Result:	Pass

Environmental Conditions:					
Temperature: (℃)	25	Relative Humidity: (%)	48	ATM Pressure: (kPa)	101.1

Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Anritsu	Power Meter	ML2495A	1106009	2023/8/4	2024/8/3
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)	Maximum Conducted Peak Output Power (dBm)	Limit (dBm)
BLE 1Mbps	2402	4.35	≤30
	2440	5.64	≤30
	2480	3.14	≤30

5. RF EXPOSURE EVALUATION

5.1 Maximum Permissible Exposure (MPE)

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/f^2)	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);

5.1.2 Measurement Result

For worst case:

Mode	Frequency (MHz)	Antenna Gain		Tune up conducted power		Evaluation Distance (cm)	Power Density (mW/cm^2)	MPE Limit (mW/cm^2)
		(dBi)	(numeric)	(dBm)	(mW)			
BLE	2402-2480	1.7	1.48	6.0	3.98	20	0.0012	1

Note: The tune-up power and antenna gain was declared by the applicant.

Result: The device meet FCC MPE at 20 cm distance

6. EUT PHOTOGRAPHS

Please refer to the attachment CR230741544-EXP EUT EXTERNAL PHOTOGRAPHS and CR230741544-INP EUT INTERNAL PHOTOGRAPHS

7. TEST SETUP PHOTOGRAPHS

Please refer to the attachment CR230741544-00AA2-TSP TEST SETUP PHOTOGRAPHS.

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