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

ACCREDITED
TESTING LABORATORY
CERTIFICATE # 6356.01

TEST REPORT

Applicant: **Xiamen Tenia Lighting & Electrical Co., Ltd.**
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FCC ID: **2AV7W-DNA4CZB**
IC: **26051-DNA4CZB**
HVIN: **DNA042CU3-ZB-600-P**
Product Name: **Dimmer**
Model Number: **DNA042CU3-ZB-600-P**

Standard(s): **47 CFR Part 15, Subpart C(15.247)**
RSS-247 Issue 2, February 2017
RSS-Gen, Issue 5, February 2021 Amendment 2
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: **CR22090021-00A**

Date Of Issue: **2022-10-18**

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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.

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CONTENTS

TEST FACILITY 2
DECLARATIONS 2
1. GENERAL INFORMATION 5
1.1 PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT) 5
1.2 DESCRIPTION OF TEST CONFIGURATION 6
1.2.2 Support Equipment List and Details 6
1.2.3 Support Cable List and Details 6
1.2.4 Block Diagram of Test Setup 7
1.3 MEASUREMENT UNCERTAINTY 8
2. SUMMARY OF TEST RESULTS 9
3. REQUIREMENTS AND TEST PROCEDURES 10
3.1 AC LINE CONDUCTED EMISSIONS 10
3.1.1 Applicable Standard 10
3.1.2 EUT Setup 12
3.1.3 EMI Test Receiver Setup 12
3.1.4 Test Procedure 13
3.1.5 Corrected Amplitude & Margin Calculation 13
3.2 RADIATION SPURIOUS EMISSIONS 14
3.2.1 Applicable Standard 14
3.2.2 EUT Setup 14
3.2.3 EMI Test Receiver & Spectrum Analyzer Setup 15
3.2.4 Test Procedure 16
3.2.5 Corrected Amplitude & Margin Calculation 16
3.3 6 DB EMISSION BANDWIDTH: 17
3.3.1 Applicable Standard 17
3.3.2 EUT Setup 17
3.3.3Test Procedure 17
3.4 99% OCCUPIED BANDWIDTH: 18
3.4.1 Applicable Standard 18
3.4.2 EUT Setup 18
3.4.3Test Procedure 18
3.5 MAXIMUM PEAK CONDUCTED OUTPUT POWER: 19
3.5.1 Applicable Standard 19
3.5.2 EUT Setup 19
3.5.3Test Procedure 19
3.6 MAXIMUM POWER SPECTRAL DENSITY: 20
3.6.1 Applicable Standard 20
3.6.2 EUT Setup 20
3.6.3Test Procedure 20
3.7 100 KHZ BANDWIDTH OF FREQUENCY BAND EDGE: 21
3.7.1 Applicable Standard 21

3.7.2 EUT Setup....21
3.7.3 Test Procedure....21
3.8 DUTY CYCLE:....22
3.8.1 EUT Setup....22
3.8.2Test Procedure....22
3.9 ANTENNA REQUIREMENT....23
3.9.1 Applicable Standard....23
3.9.2 Judgment....23
4. Test DATA AND RESULTS....24
4.1 AC LINE CONDUCTED EMISSIONS....24
4.2 RADIATION SPURIOUS EMISSIONS....27
4.3 6 DB EMISSION BANDWIDTH:....33
4.5 99% OCCUPIED BANDWIDTH:....36
4.5 MAXIMUM PEAK CONDUCTED OUTPUT POWER:....39
4.6 MAXIMUM POWER SPECTRAL DENSITY:....40
4.7 100 KHZ BANDWIDTH OF FREQUENCY BAND EDGE:....43
4.8 DUTY CYCLE:....45
5. RF EXPOSURE EVALUATION....47
5.1 MPE-BASED EXEMPTION....47
5.1.1 APPLICABLE STANDARD....47
5.1.2 MEASUREMENT RESULT....47
5.2 EXEMPTION LIMITS FOR ROUTINE EVALUATION – RF EXPOSURE EVALUATION 48
5.2.1 APPLICABLE STANDARD....48
5.2.2 CALCULATED RESULT....48

1. GENERAL INFORMATION

1.1 Product Description for Equipment under Test (EUT)

EUT Name:	Dimmer
EUT Model:	DNA042CU3-ZB-600-P
Operation Frequency:	2405-2480MHz
Maximum Peak Output Power (Conducted):	18.88dBm
Modulation Type:	OQPSK
Rated Input Voltage:	AC120V/60Hz
Serial Number:	CR22090021-RF-S1
EUT Received Date:	2022.9.15
EUT Received Status:	Good

Operation Frequency Detail:
For Zigbee:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
11	**2405**	19	2445
12	2410	20	2450
13	2415	21	2455
14	2420	22	2460
15	2425	23	2465
16	2430	24	2470
17	2435	25	**2475**
18	**2440**	26	**2480**

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

Test Channel	Frequency (MHz)
Lowest	2405
Middle	2440
Highest	2480

Note: 2475MHz was tested since the power level setting higher than Highest channel 2480MHz.

Antenna Information Detail▲:

Antenna Manufacturer	Antenna Type	input impedance (Ohm)	/Frequency Range	Antenna Gain
Hangzhou TUYA	PCB	50	2.4~2.5GHz	2.5dBi

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:

No.

1.2 Description of Test Configuration

1.2.1 EUT Operation Condition:

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

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

Test Channel	Frequency (MHz)	Power Level Setting
Lowest	2405	20
Middle	2440	20
Additional	2475	20
Highest	2480	13

1.2.2 Support Equipment List and Details

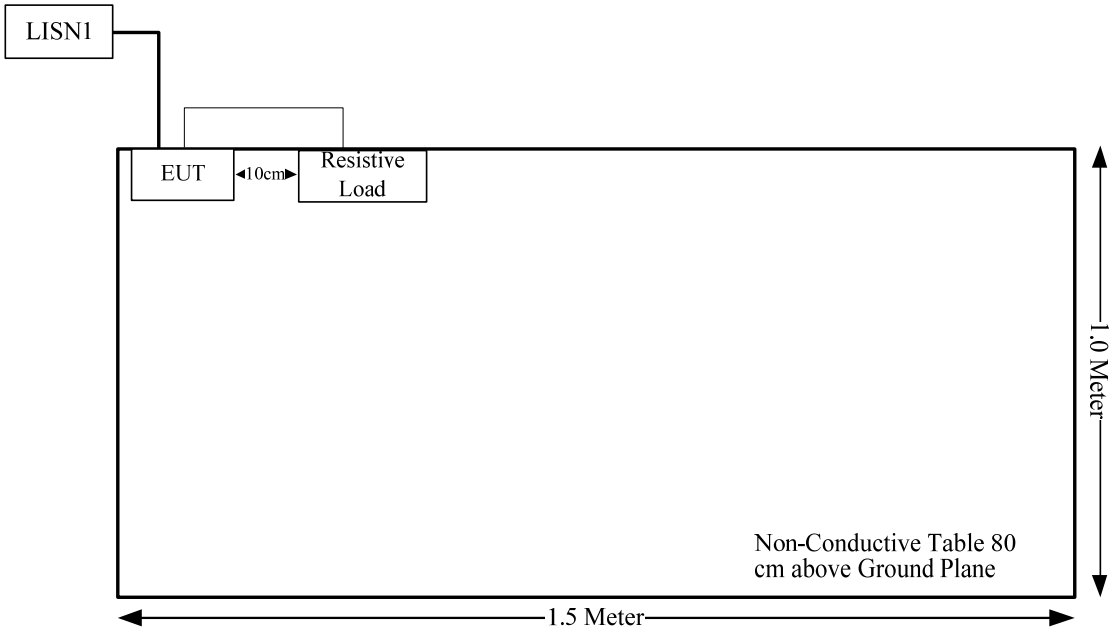
Manufacturer	Description	Model	Serial Number
Hengxin electronic	Resistive Load	RX20-T2000W	EMZBRL21120403EN

1.2.3 Support Cable List and Details

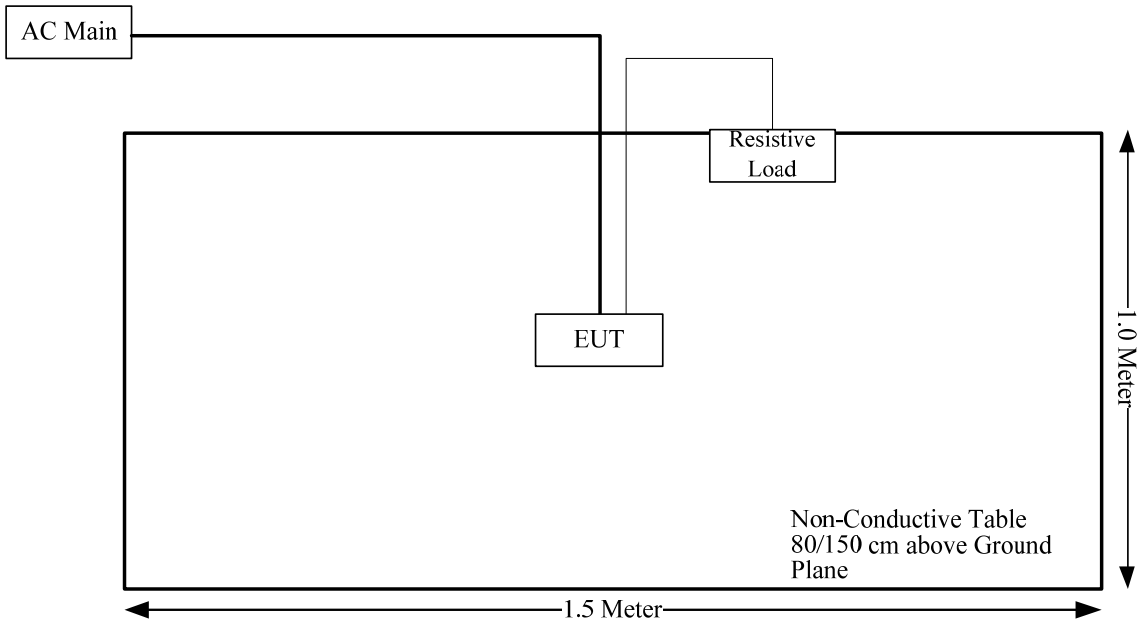
Cable Description	Shielding Type	Ferrite Core	Length (m)	From Port	To
Power Cable	No	No	1.2	EUT	Resistive Load

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) RSS-Gen Clause 8.8	AC line conducted emissions	Compliant
§15.205, §15.209, §15.247(d) RSS-Gen Clause 8.10	Spurious Emissions	Compliant
§15.247 (a)(2) RSS-247 Clause 5.2 a)	6 dB Bandwidth	Compliant
RSS-Gen Clause 6.7	99% Occupied Bandwidth	Compliant
§15.247(b)(3) RSS-247 Clause 5.4 d)	Maximum Conducted Output Power	Compliant
§15.247(d) RSS-247 Clause5.5	100 kHz Bandwidth of Frequency Band Edge	Compliant
§15.247(e) RSS-247 Clause5.2 b)	Power Spectral Density	Compliant
§15.203 RSS-GEN Clause 6.8	Antenna Requirement	Compliant
§15.247 (i) & §1.1307 & §2.1091	RF Exposure Evaluation	Compliant
RSS-102 Clause 2.5.2	Exemption Limits For Routine Evaluation-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.

RSS-Gen Clause 8.8

Unless stated otherwise in the applicable RSS, for radio apparatus that are designed to be connected to the public utility AC power network, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the range 150 kHz to 30 MHz shall not exceed the limits in table 4, as measured using a 50 µH / 50 Ω line impedance stabilization network. This requirement applies for the radio frequency voltage measured between each power line and the ground terminal of each AC power-line mains cable of the EUT.
For an EUT that connects to the AC power lines indirectly, through another device, the requirement for compliance with the limits in table 4 shall apply at the terminals of the AC power-line mains cable of a representative support device, while it provides power to the EUT. The lower limit applies at the boundary between the frequency ranges. The device used to power the EUT shall be representative of typical applications.

Table 4 – AC power-line conducted emissions limits

Frequency (MHz)	Conducted limit (dBµV)	
	Quasi-peak	Average
0.15 - 0.5	66 to 56[1]	56 to 46[1]
0.5 – 5	56	46
5 – 30	60	50

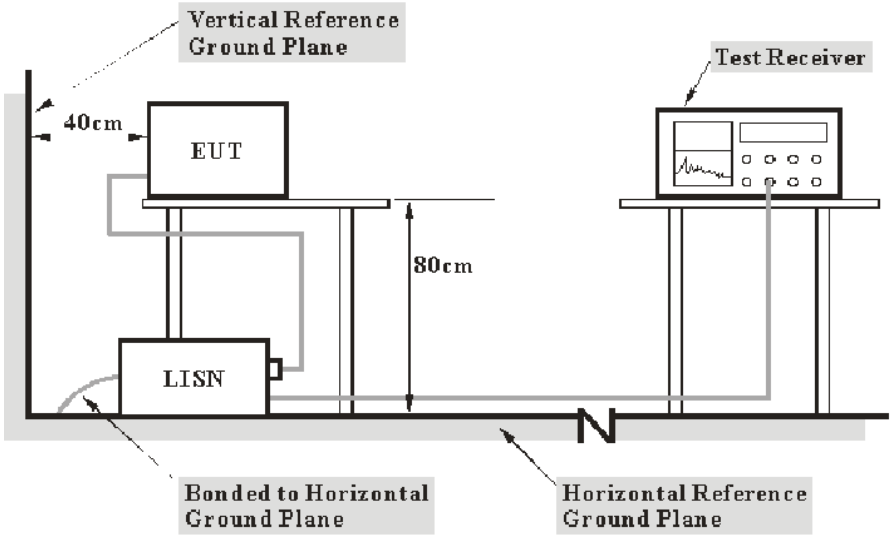
Note 1: The level decreases linearly with the logarithm of the frequency.

For an EUT with a permanent or detachable antenna operating between 150 kHz and 30 MHz, the AC power-line conducted emissions must be measured using the following configurations:

(a) Perform the AC power-line conducted emissions test with the antenna connected to determine compliance with the limits of table 4 outside the transmitter's fundamental emission band.

(b) Retest with a dummy load instead of the antenna to determine compliance with the limits of table 4 within the transmitter's fundamental emission band. For a detachable antenna, remove the antenna and connect a suitable dummy load to the antenna connector. For a permanent antenna, remove the antenna and terminate the RF output with a dummy load or network that simulates the antenna in the fundamental frequency band.

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,RSS-Gen 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);

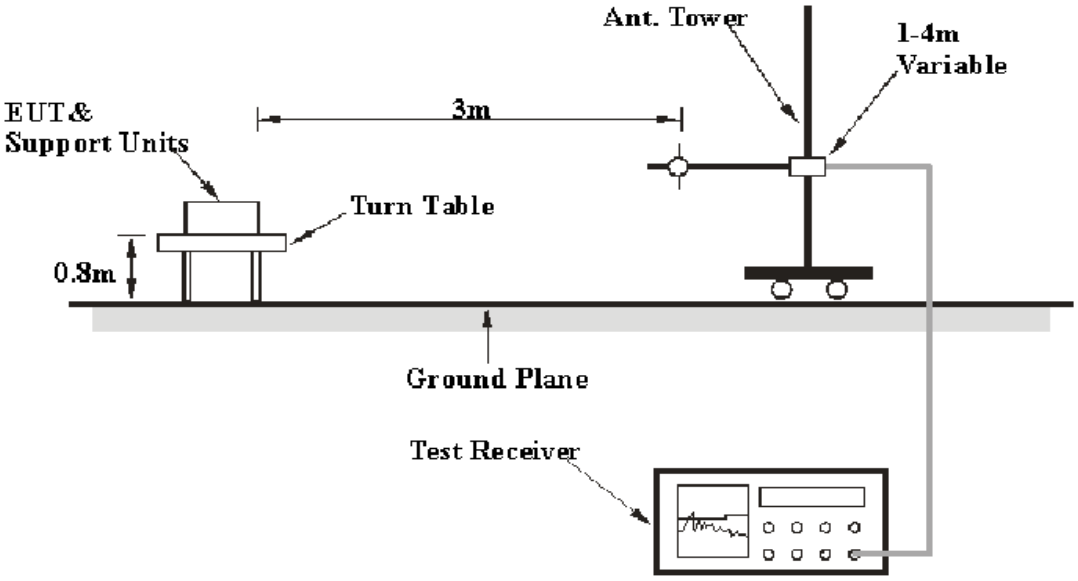
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the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

RSS-247 Clause 5.5

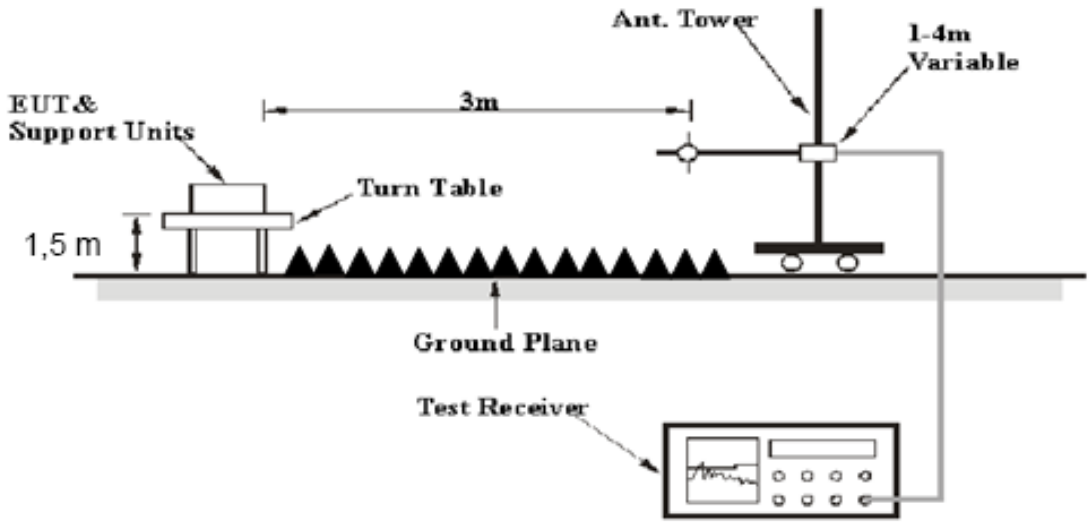
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required

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,RSS-247,RSS-Gen 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:

30MHz-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
AV	>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 6 dB Emission Bandwidth:

3.3.1 Applicable Standard

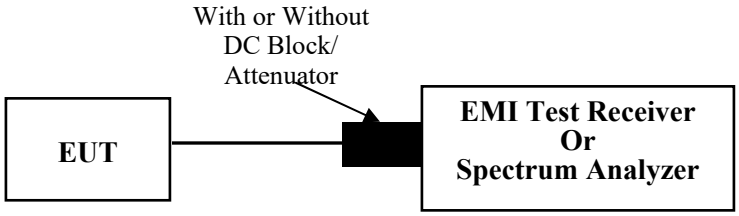
FCC §15.247 (a)(2)

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.

RSS-247 Clause 5.2 a

The minimum 6 dB bandwidth shall be 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.

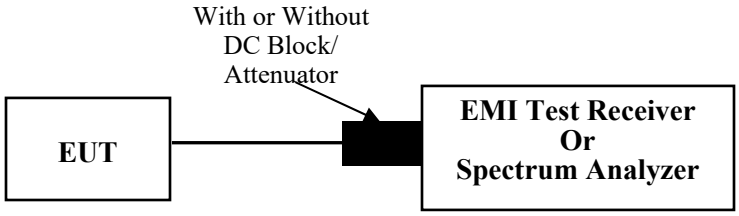
3.4 99% Occupied Bandwidth:

3.4.1 Applicable Standard

RSS-Gen Clause 5.2 a

The occupied bandwidth or the "99% emission bandwidth" is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.
In some cases, the "x dB bandwidth" is required,which is defined as the frequency range between two points, one at the lowest frequency below and one at the highest frequency above the carrier frequency, at which the maximum power level of the transmitted emission is attenuated x dB below the maximum in-band power level of the modulated signal, where the two points are on the outskirts of the in-band emission.

3.4.2 EUT Setup



3.4.3Test Procedure

RSS-Gen Clause 5.2 a

The following conditions shall be observed for measuring the occupied bandwidth and x dB bandwidth:
• The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
• The span of the spectrum analyzer shall be set large enough to capture all products of the modulation process, including the emission skirts, around the carrier frequency, but small enough to avoid having other emissions (e.g. on adjacent channels) within the span.
• The detector of the spectrum analyzer shall be set to "Sample". However, a peak, or peak hold, may be used in place of the sampling detector since this usually produces a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold (or "Max Hold") may be necessary to determine the occupied / x dB bandwidth if the device is not transmitting continuously.
• The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the actual occupied / x dB bandwidth and the video bandwidth (VBW) shall not be smaller than three times the RBW value. Video averaging is not permitted.
Note: It may be necessary to repeat the measurement a few times until the RBW and VBW are in compliance with the above requirement.
For the 99% emission bandwidth, the trace data points are recovered and directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached, and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded. The difference between the two recorded frequencies is the occupied bandwidth (or the 99% emission bandwidth).

3.5 Maximum peak conducted output power:

3.5.1 Applicable Standard

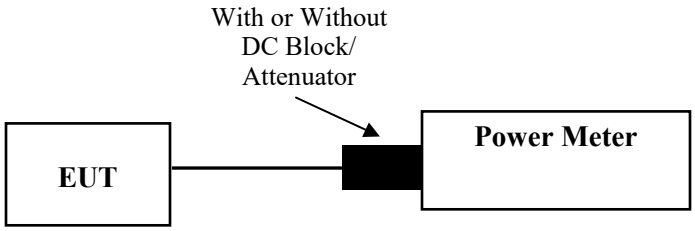
FCC §15.247 (b)(3)

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.

RSS-247 Clause 5.4 d

For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e).

3.5.2 EUT Setup



3.5.3Test Procedure

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.

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 peak output power, record the result.

3.6 Maximum power spectral density:

3.6.1 Applicable Standard

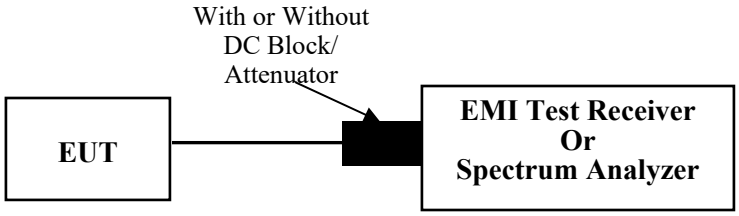
FCC §15.247 (e)

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.

RSS-247 Clause5.2 b

The transmitter power spectral density conducted from the transmitter 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 section 5.4(d), (i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power).

3.6.2 EUT Setup



3.6.3Test 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.

3.7 100 kHz Bandwidth of Frequency Band Edge:

3.7.1 Applicable Standard

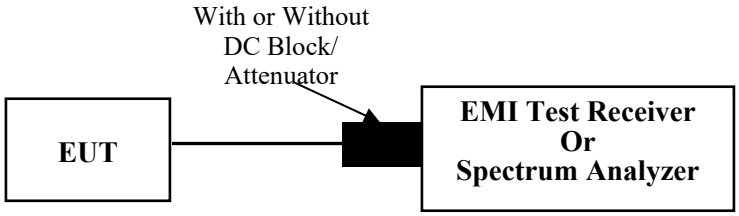
FCC §15.247 (d);

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)).

RSS-247 Clause 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required

3.7.2 EUT Setup



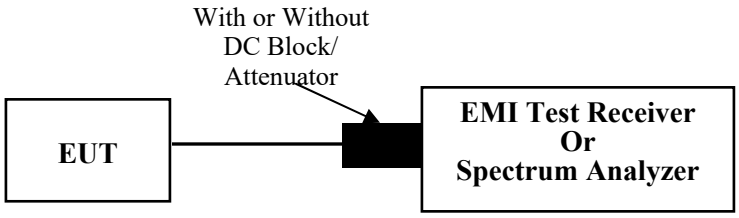
3.7.3 Test Procedure

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.

3.8 Duty Cycle:

3.8.1 EUT Setup



3.8.2Test 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.)

3.9 Antenna Requirement

3.9.1 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.

RSS-GEN Clause 6.8

The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotropically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.

For expediting the testing, measurements may be performed using only the antenna with highest gain of each combination of transmitter and antenna type, with the transmitter output power set at the maximum level. However, the transmitter shall comply with the applicable requirements under all operational conditions and when in combination with any type of antenna from the list provided in the test report (and in the notice to be included in the user manual, provided below).
When measurements at the antenna port are used to determine the RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna's manufacturer.
The test report shall state the RF power, output power setting and spurious emission measurements with each antenna type that is used with the transmitter being tested.
For licence-exempt equipment with detachable antennas, the user manual shall also contain the following notice in a conspicuous location:
This radio transmitter [enter the device's ISED certification number] has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Immediately following the above notice, the manufacturer shall provide a list of all antenna types which can be used with the transmitter, indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna type.

3.9.2 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:	CR22090021-RF-S1	Test Date:	2022/09/22
Test Site:	CE	Test Mode:	Transmitting
Tester:	Vic Du	Test Result:	Pass

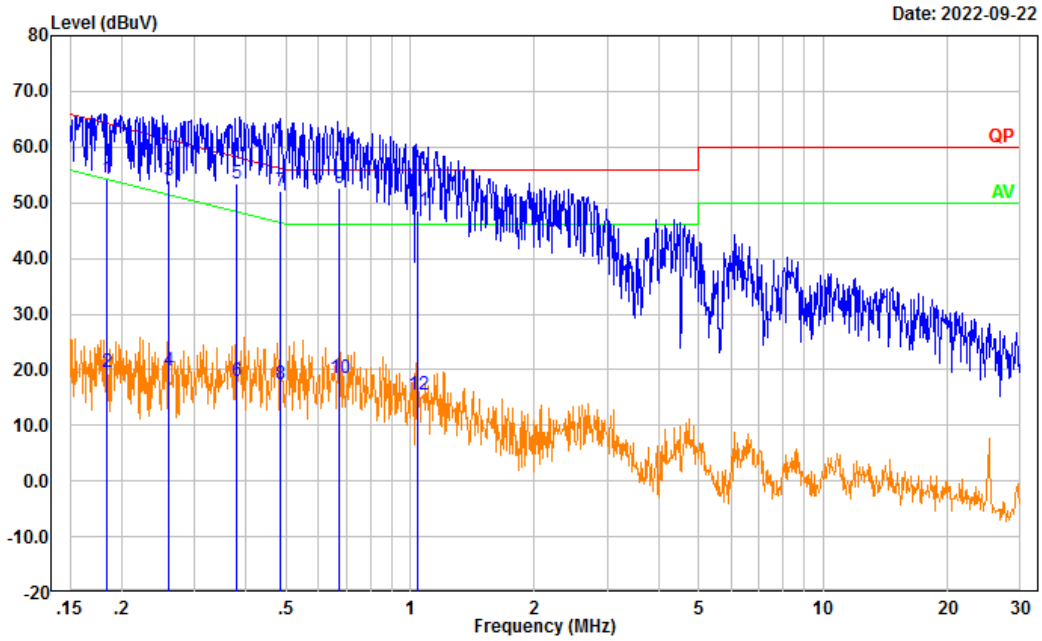
Environmental Conditions:					
Temperature: (℃)	27.9	Relative Humidity: (%)	64	ATM Pressure: (kPa)	100.4

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

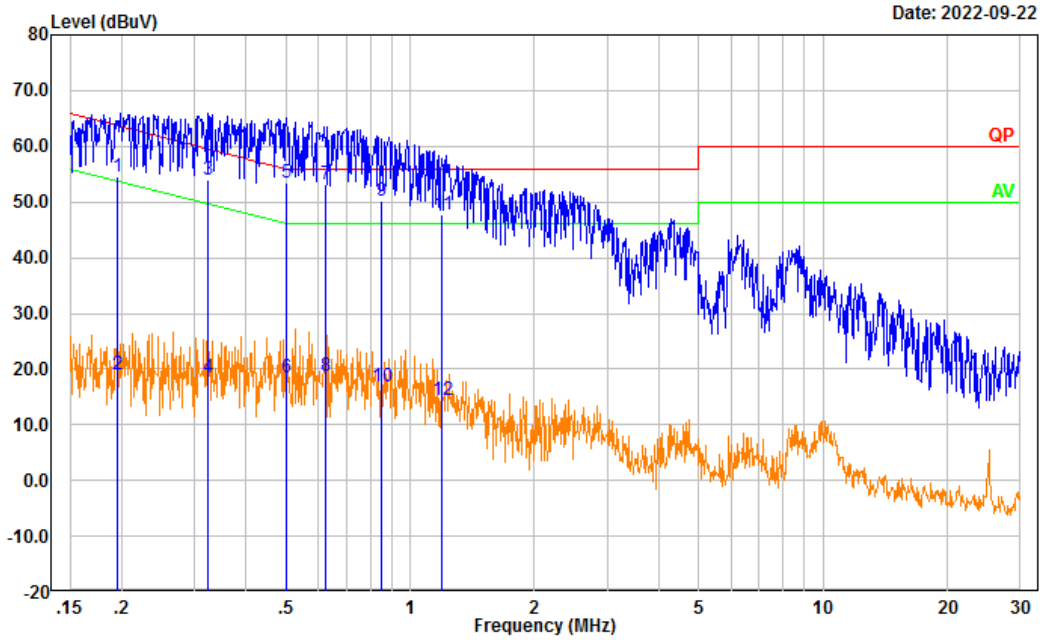
** Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).*

Test Mode: Transmitting
Power Source: AC 120V/60Hz
Port: Line
Note:



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB)	Result (dBµV)	Limit (dBµV)	Margin (dBµV)	Detector
1	0.183	44.70	9.61	54.31	64.33	10.02	QP
2	0.183	10.00	9.61	19.61	54.33	34.72	Average
3	0.259	44.45	9.61	54.06	61.46	7.40	QP
4	0.259	10.11	9.61	19.72	51.46	31.74	Average
5	0.379	43.75	9.61	53.36	58.30	4.94	QP
6	0.379	8.28	9.61	17.89	48.30	30.41	Average
7	0.484	42.48	9.61	52.09	56.27	4.18	QP
8	0.484	7.71	9.61	17.32	46.27	28.95	Average
9	0.675	43.14	9.62	52.76	56.00	3.24	QP
10	0.675	8.83	9.62	18.45	46.00	27.55	Average
11	1.045	38.92	9.62	48.54	56.00	7.46	QP
12	1.045	5.87	9.62	15.49	46.00	30.51	Average

Test Mode: Transmitting
Power Source: AC 120V/60Hz
Port: neutral
Note:



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB)	Result (dBµV)	Limit (dBµV)	Margin (dBµV)	Detector
1	0.196	44.98	9.61	54.59	63.79	9.20	QP
2	0.196	9.53	9.61	19.14	53.79	34.65	Average
3	0.323	44.43	9.61	54.04	59.62	5.58	QP
4	0.323	9.00	9.61	18.61	49.62	31.01	Average
5	0.500	43.77	9.61	53.38	56.01	2.63	QP
6	0.500	8.94	9.61	18.55	46.01	27.46	Average
7	0.624	43.62	9.62	53.24	56.00	2.76	QP
8	0.624	9.24	9.62	18.86	46.00	27.14	Average
9	0.852	40.54	9.62	50.16	56.00	5.84	QP
10	0.852	7.17	9.62	16.79	46.00	29.21	Average
11	1.197	38.02	9.62	47.64	56.00	8.36	QP
12	1.197	4.77	9.62	14.39	46.00	31.61	Average

4.2 Radiation Spurious Emissions

Serial Number:	CR22090021-RF-S1	Test Date:	2022-09-22 ~2022-09-27
Test Site:	966-2, 966-1	Test Mode:	Transmitting
Tester:	Carl Xue	Test Result:	Pass

Environmental Conditions:					
Temperature: (℃)	25.5~26.1	Relative Humidity: (%)	52~58	ATM Pressure: (kPa)	100.4~100.9

Test Equipment List and Details:

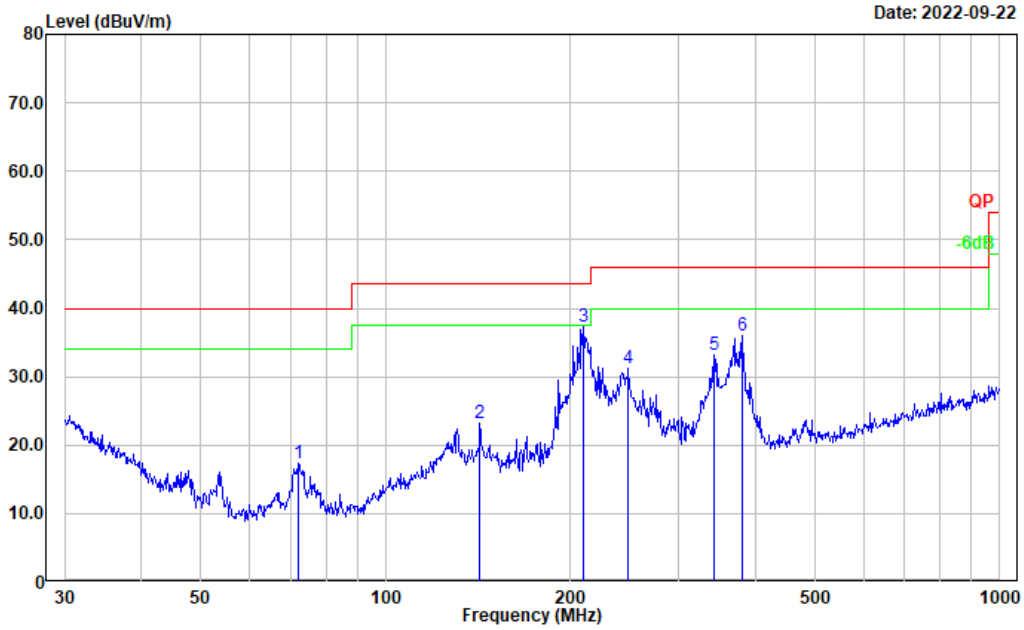
Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Sunol Sciences	Antenna	JB6	A082520-5	2020-10-19	2023-10-18
R&S	EMI Test Receiver	ESR3	102724	2022-07-15	2023-07-14
TIMES MICROWAVE	Coaxial Cable	LMR-600-UltraFlex	C-0470-02	2022-07-17	2023-07-16
TIMES MICROWAVE	Coaxial Cable	LMR-600-UltraFlex	C-0780-01	2022-07-17	2023-07-16
Sonoma	Amplifier	310N	186165	2022-07-17	2023-07-16
Audix	Test Software	E3	201021 (V9)	N/A	N/A
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	2021-11-10	2022-11-09
PASTERNACK	Horn Antenna	PE9852/2F-20	112002	2021-02-05	2024-02-04
AH	Preamplifier	PAM-1840VH	190	2021-11-19	2022-11-18
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

** 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:

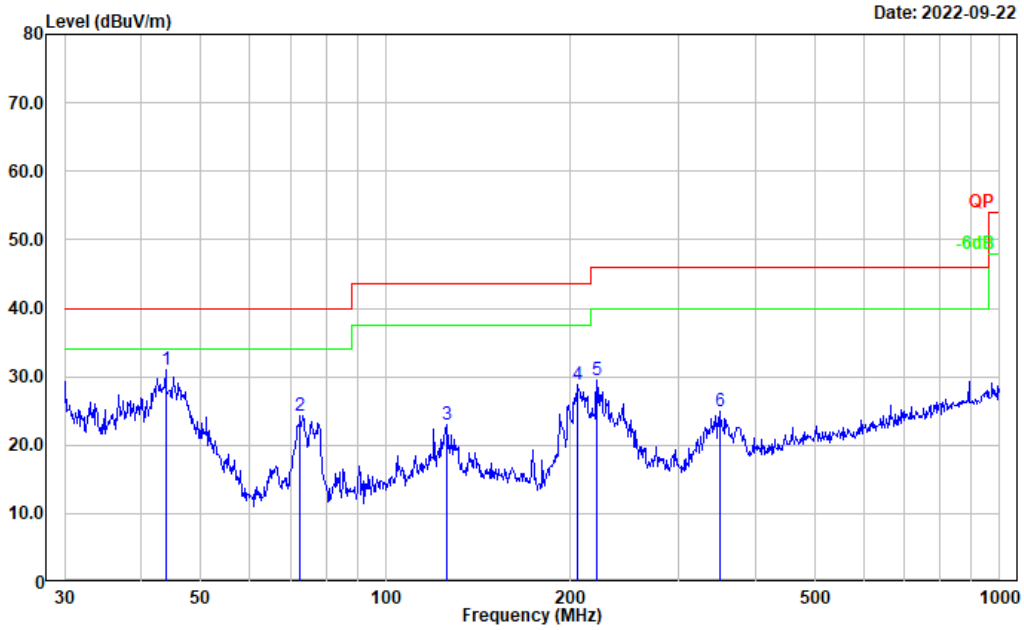
1) 30MHz-1GHz(Low channel was the worst)

Test Mode: Transmitting
Power Source: AC 120V/60Hz
Polarization: horizontal
Note:



No.	Frequency (MHz)	Reading (dBμV)	Factor (dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector
1	72.084	33.93	-16.69	17.24	40.00	22.76	Peak
2	142.324	35.03	-11.92	23.11	43.50	20.39	Peak
3	210.048	49.75	-12.47	37.28	43.50	6.22	Peak
4	248.552	44.29	-13.05	31.24	46.00	14.76	Peak
5	341.979	43.18	-10.05	33.13	46.00	12.87	Peak
6	379.914	45.09	-9.10	35.99	46.00	10.01	Peak

Test Mode: Transmitting
Power Source: AC 120V/60Hz
Polarization: vertical
Note:

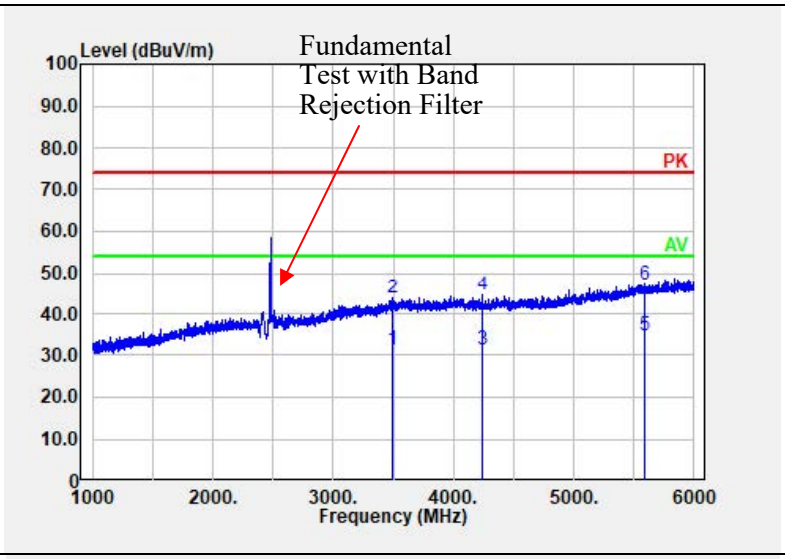
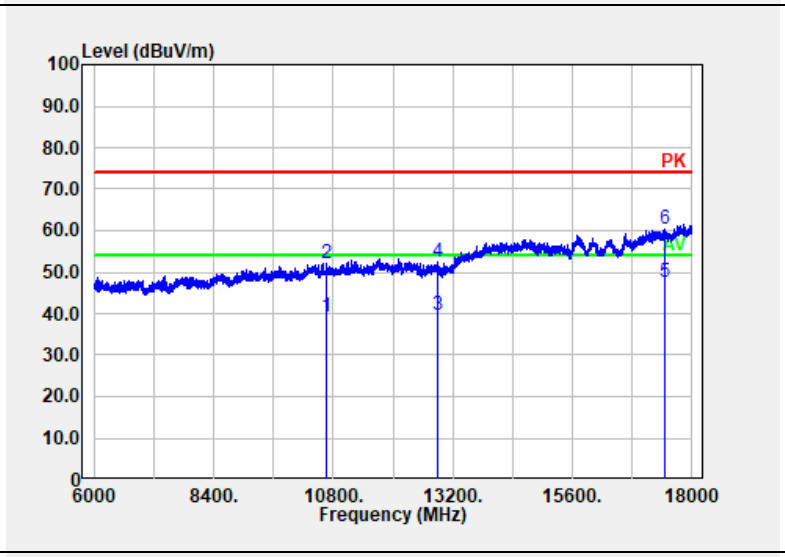
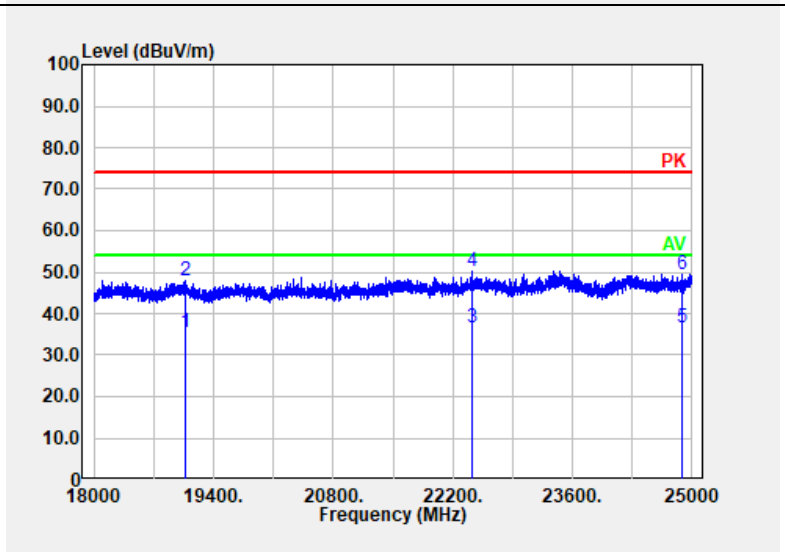


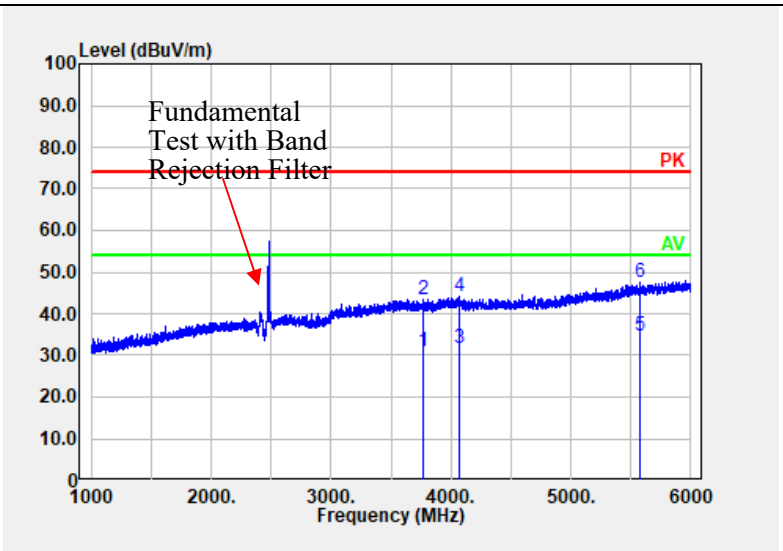
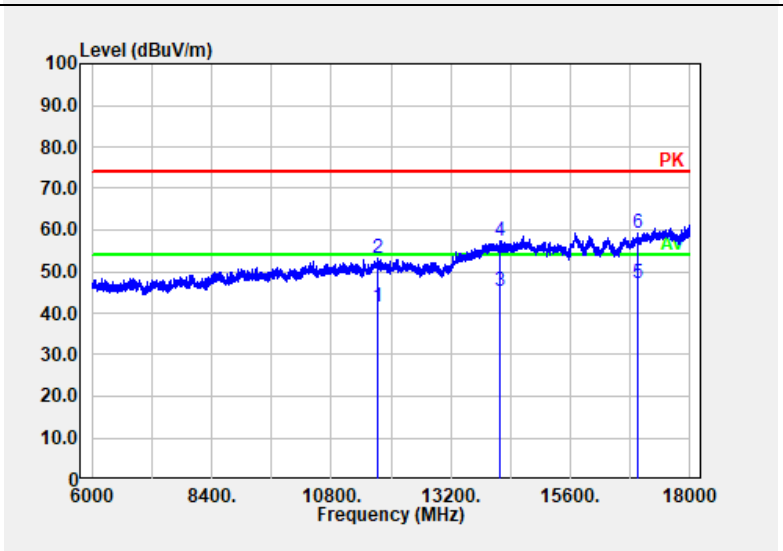
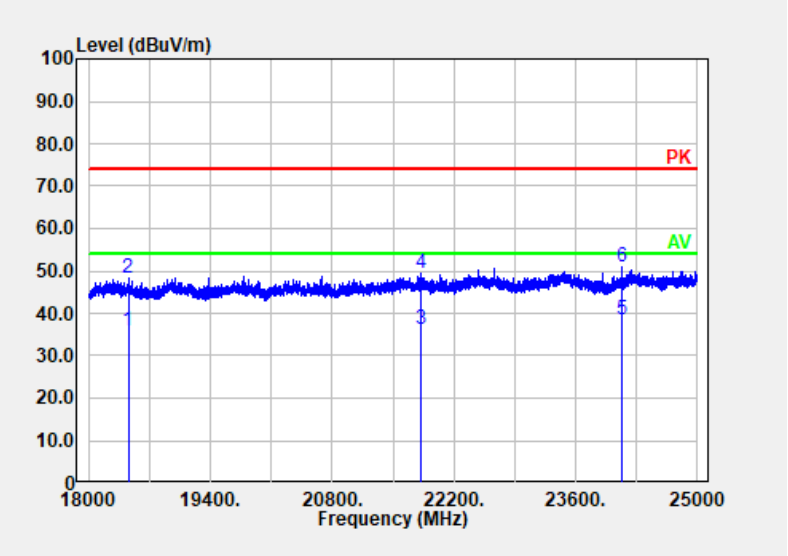
No.	Frequency (MHz)	Reading (dBμV)	Factor (dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector
1	43.812	44.65	-13.56	31.09	40.00	8.91	Peak
2	72.592	41.06	-16.71	24.35	40.00	15.65	Peak
3	125.446	34.27	-11.30	22.97	43.50	20.53	Peak
4	204.955	41.25	-12.36	28.89	43.50	14.61	Peak
5	220.617	42.24	-12.83	29.41	46.00	16.59	Peak
6	350.477	34.89	-10.03	24.86	46.00	21.14	Peak

2) 1-25GHz:

Frequency (MHz)	Receiver		Polar (H/V)	Factor (dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	Detector					
Low Channel: 2405 MHz							
2405.00	79.51	PK	H	31.51	111.02	N/A	N/A
2405.00	73.75	AV	H	31.51	105.26	N/A	N/A
2405.00	76.33	PK	V	31.51	107.84	N/A	N/A
2405.00	70.61	AV	V	31.51	102.12	N/A	N/A
2390.00	26.37	PK	H	31.46	57.83	74.00	16.17
2390.00	13.52	AV	H	31.46	44.98	54.00	9.02
4810.00	39.52	PK	H	10.92	50.44	74.00	23.56
4810.00	26.56	AV	H	10.92	37.48	54.00	16.52
7215.00	39.53	PK	H	14.28	53.81	74.00	20.19
7215.00	26.84	AV	H	14.28	41.12	54.00	12.88
Middle Channel: 2440 MHz							
2440.00	78.96	PK	H	31.60	110.56	N/A	N/A
2440.00	72.98	AV	H	31.60	104.58	N/A	N/A
2440.00	76.99	PK	V	31.60	108.59	N/A	N/A
2440.00	71.13	AV	V	31.60	102.73	N/A	N/A
4880.00	35.67	PK	H	11.07	46.74	74.00	27.26
4880.00	22.76	AV	H	11.07	33.83	54.00	20.17
7320.00	37.01	PK	H	14.80	51.81	74.00	22.19
7320.00	23.97	AV	H	14.80	38.77	54.00	15.23
Additional Channel: 2475 MHz							
2475.00	79.93	PK	H	31.64	111.57	N/A	N/A
2475.00	73.85	AV	H	31.64	105.49	N/A	N/A
2475.00	79.29	PK	V	31.64	110.93	N/A	N/A
2475.00	73.67	AV	V	31.64	105.31	N/A	N/A
2483.50	29.12	PK	H	31.64	60.76	74.00	13.24
2483.50	15.93	AV	H	31.64	47.57	54.00	6.43
4950.00	37.20	PK	H	11.24	48.44	74.00	25.56
4950.00	24.32	AV	H	11.24	35.56	54.00	18.44
7425.00	40.57	PK	H	15.14	55.71	74.00	18.29
7425.00	27.54	AV	H	15.14	42.68	54.00	11.32
High Channel: 2480 MHz							
2480.00	73.53	PK	H	31.64	105.17	N/A	N/A
2480.00	67.76	AV	H	31.64	99.40	N/A	N/A
2480.00	71.61	PK	V	31.64	103.25	N/A	N/A
2480.00	65.96	AV	V	31.64	97.60	N/A	N/A
2483.50	33.25	PK	H	31.64	64.89	74.00	9.11
2483.50	18.87	AV	H	31.64	50.51	54.00	3.49
4960.00	38.71	PK	H	11.23	49.94	74.00	24.06
4960.00	25.78	AV	H	11.23	37.01	54.00	16.99
7440.00	35.14	PK	H	15.26	50.40	74.00	23.60
7440.00	22.51	AV	H	15.26	37.77	54.00	16.23

Worst Test plots(2475MHz 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:	CR22090021-RF-S1	Test Date:	2022/9/22-2022/10/11
Test Site:	RF	Test Mode:	Transmitting
Tester:	Julie Tan	Test Result:	Pass

Environmental Conditions:					
Temperature: (℃)	25.8-26.5	Relative Humidity: (%)	36-59	ATM Pressure: (kPa)	100.4-101.3

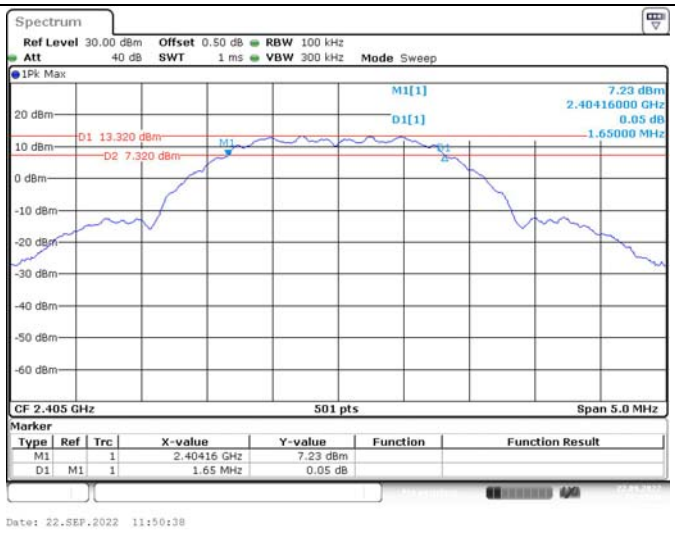
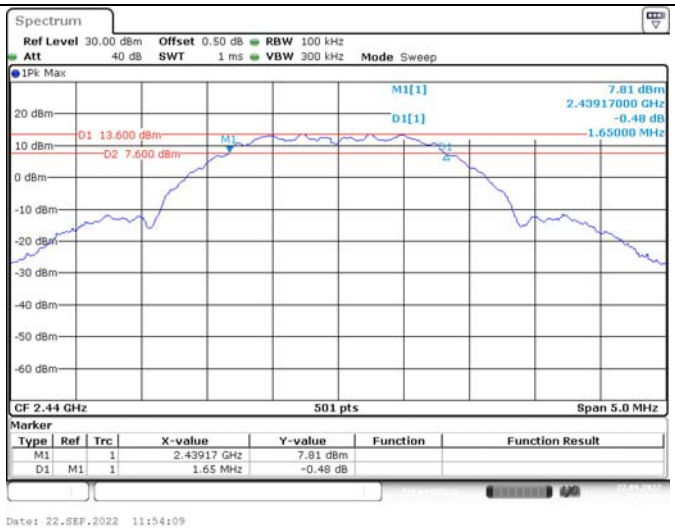
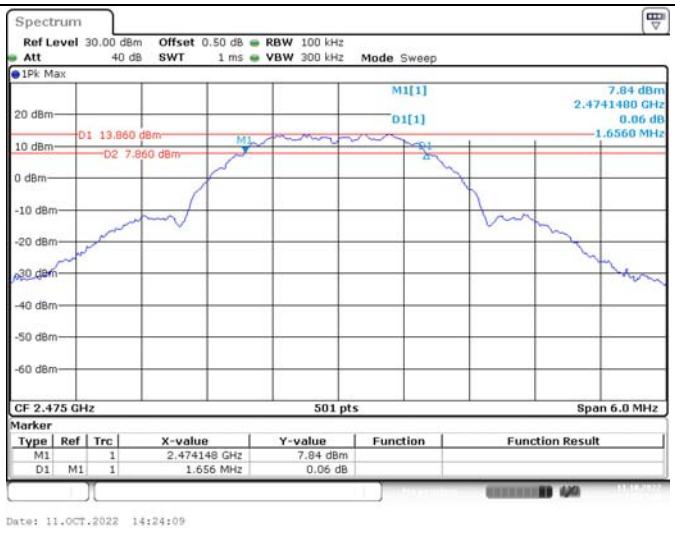
Test Equipment List and Details:

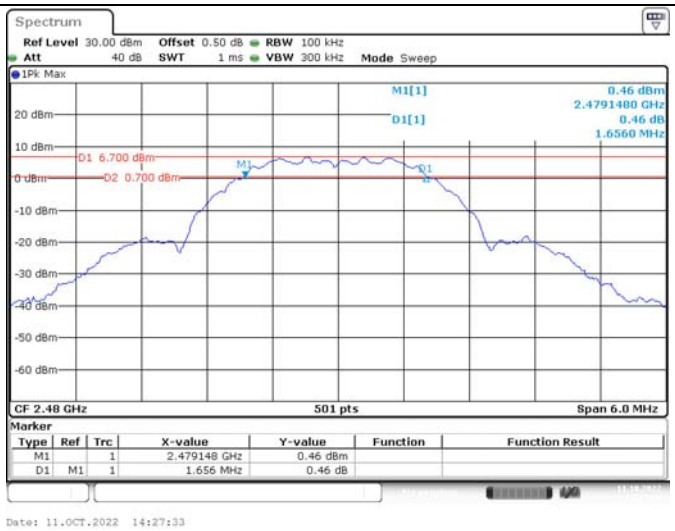
Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSV40	101943	2022/07/25	2023/07/24
Mini-Circuits	DC Block	BLK-18-S+	1554404	Each time	N/A
zhuoxiang	Coaxial Cable	SMA-178	211002	Each time	N/A

** 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)	6 dB Bandwidth (MHz)	Limit (MHz)
Lowest	2405	1.650	⩾0.5
Middle	2440	1.650	⩾0.5
Highest	2480	1.656	⩾0.5
Additional	2475	1.656	⩾0.5

6dB Emission Bandwidth	
Lowest Channel	
Middle Channel	
Additional Channel	

6dB Emission Bandwidth	
Highest Channel	

4.5 99% Occupied Bandwidth:

Serial Number:	CR22090021-RF-S1	Test Date:	2022/9/22-2022/10/11
Test Site:	RF	Test Mode:	Transmitting
Tester:	Julie Tan	Test Result:	N/A

Environmental Conditions:					
Temperature: (℃)	25.8-26.5	Relative Humidity: (%)	36-59	ATM Pressure: (kPa)	100.4-101.3

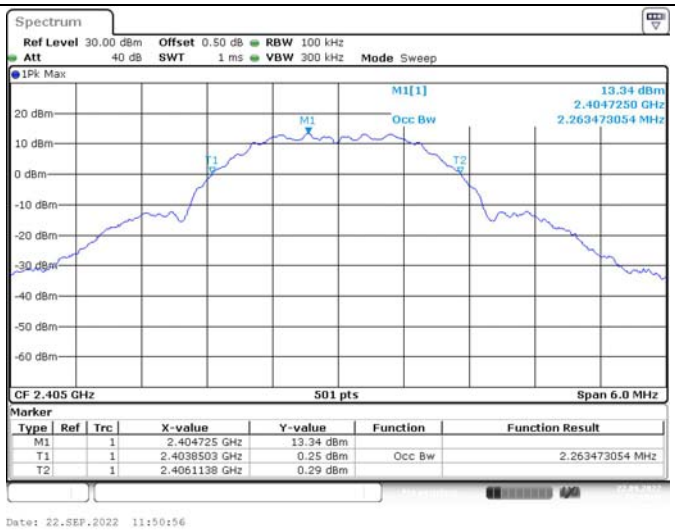
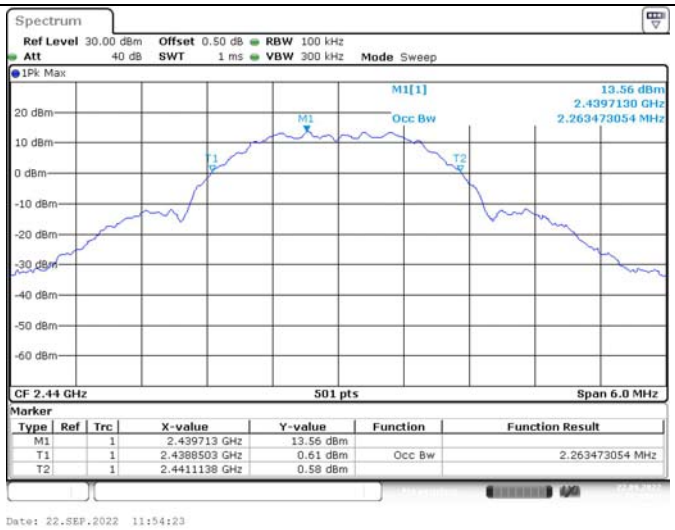
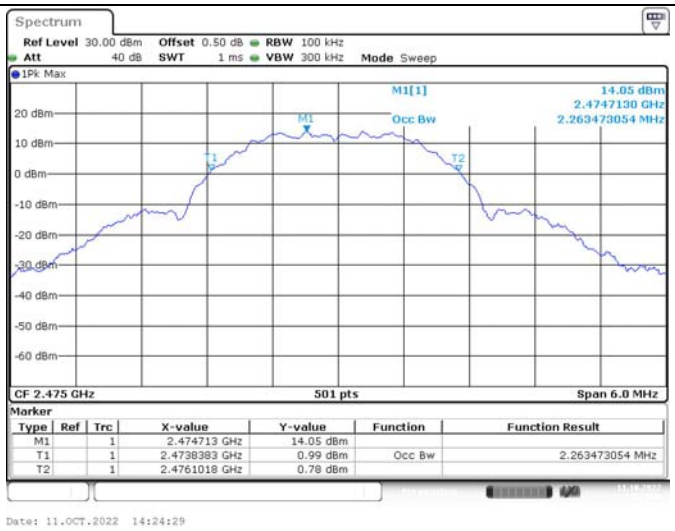
Test Equipment List and Details:

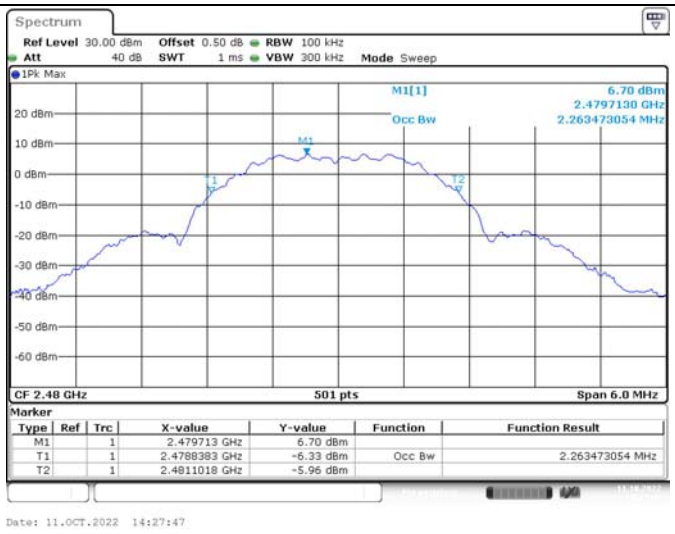
Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSV40	101943	2022/07/25	2023/07/24
Mini-Circuits	DC Block	BLK-18-S+	1554404	Each time	N/A
zhuoxiang	Coaxial Cable	SMA-178	211002	Each time	N/A

** 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)	99% Occupied Bandwidth (MHz)
Lowest	2405	2.263
Middle	2440	2.263
Highest	2480	2.263
Additional	2475	2.263

99% Occupied Bandwidth	
Lowest Channel	
Middle Channel	
Additional Channel	

99% Occupied Bandwidth	
Highest Channel	

4.5 Maximum peak conducted output power:

Serial Number:	CR22090021-RF-S1	Test Date:	2022/9/22-2022/10/11
Test Site:	RF	Test Mode:	Transmitting
Tester:	Julie Tan	Test Result:	Pass

Environmental Conditions:					
Temperature: (℃)	25.8-26.5	Relative Humidity: (%)	36-59	ATM Pressure: (kPa)	100.4-101.3

Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Agilent	USB Wideband Power Sensor	U2021XA	MY54080015	2022-07-15	2023-07-14
eastsheep	Coaxial Attenuator	2W-SMA-JK-18G	21060301	Each time	N/A
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)	Maximum Conducted Peak Output Power (dBm)	Limit (dBm)
Lowest	2405	18.59	≤30
Middle	2440	18.71	≤30
Highest	2480	12.65	≤30
Additional	2475	18.88	≤30
Max.EIRP:	21.38	dBm	
EIRP Limit for RSS-247:36 dBm			

4.6 Maximum power spectral density:

Serial Number:	CR22090021-RF-S1	Test Date:	2022/9/22-2022/10/11
Test Site:	RF	Test Mode:	Transmitting
Tester:	Julie Tan	Test Result:	Pass

Environmental Conditions:					
Temperature: (℃)	25.8-26.5	Relative Humidity: (%)	36-59	ATM Pressure: (kPa)	100.4-101.3

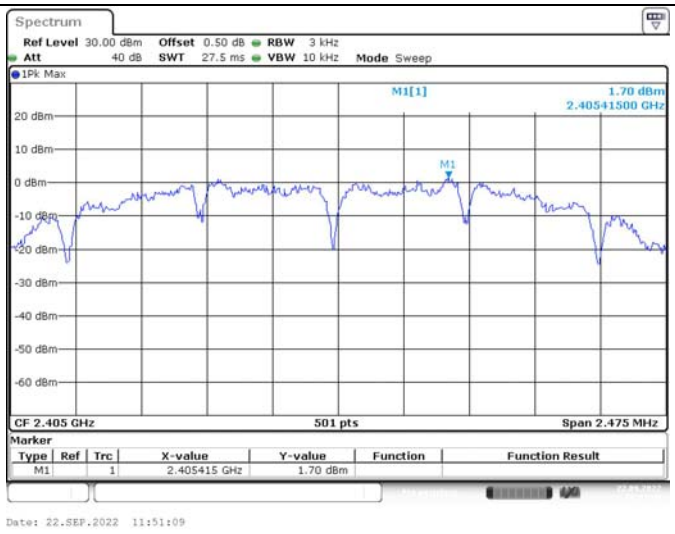
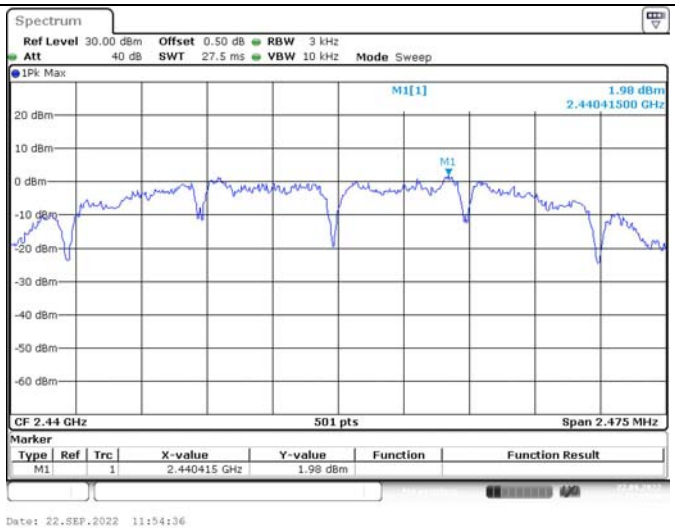
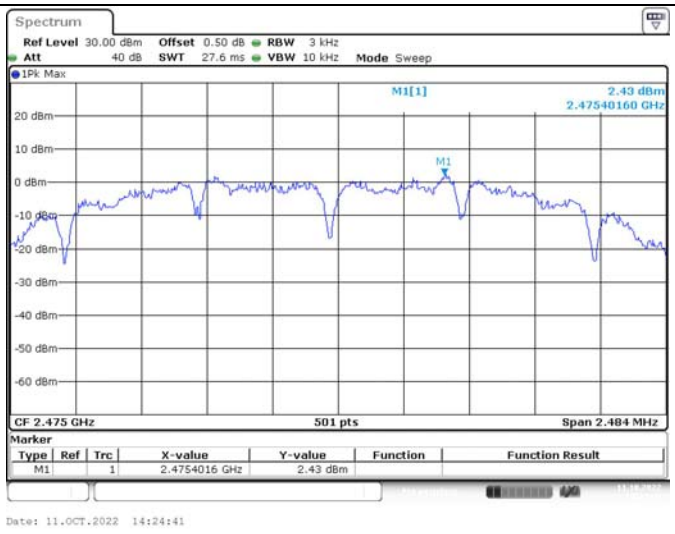
Test Equipment List and Details:

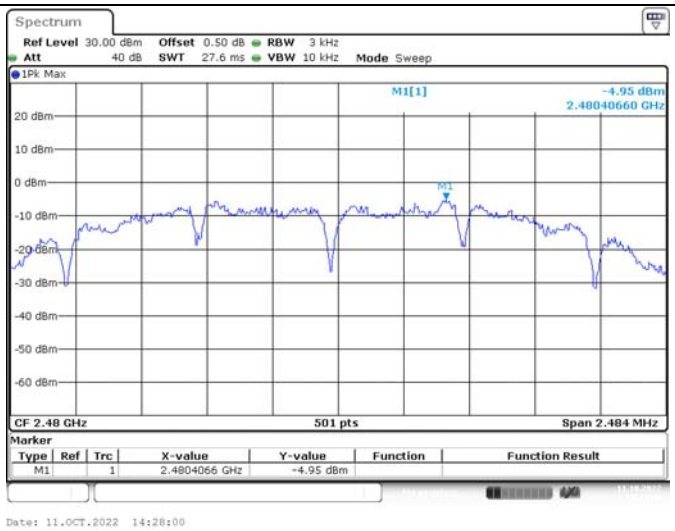
Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSV40	101943	2022-07-25	2023-07-24
Mini-Circuits	DC Block	BLK-18-S+	1554404	Each time	N/A
zhuoxiang	Coaxial Cable	SMA-178	211002	Each time	N/A

** 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)
Lowest	2405	1.7	≤8.00
Middle	2440	1.98	≤8.00
Highest	2480	-4.95	≤8.00
Additional	2475	2.43	≤8.00

Maximum power spectral density	
Lowest Channel	
Middle Channel	
Additional Channel	

Maximum power spectral density	
Highest Channel	

4.7 100 kHz Bandwidth of Frequency Band Edge:

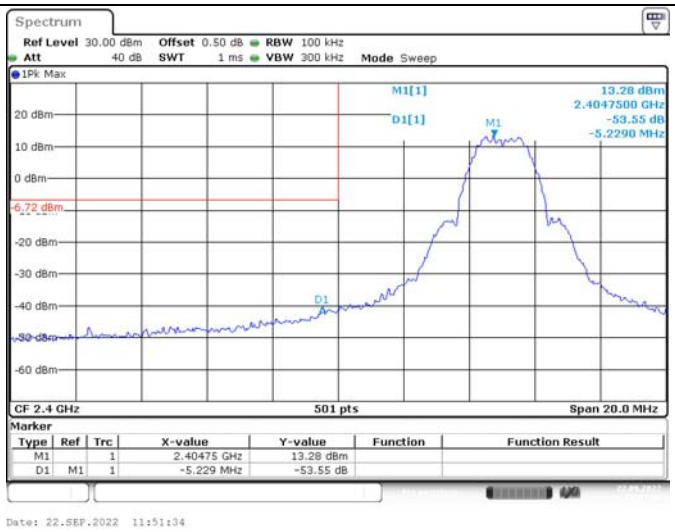
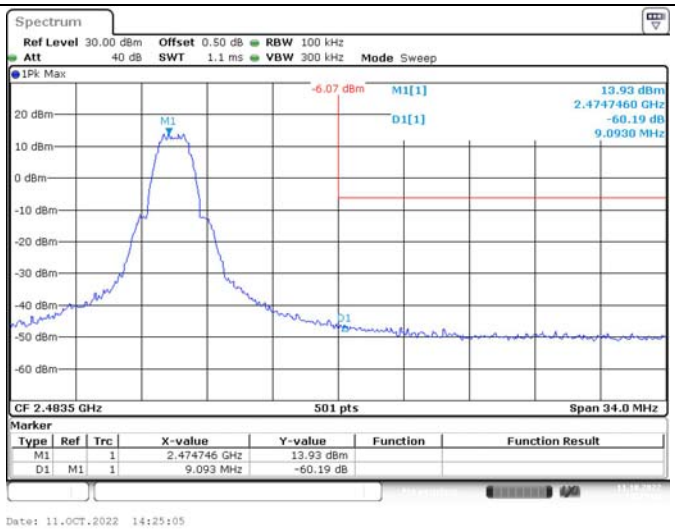
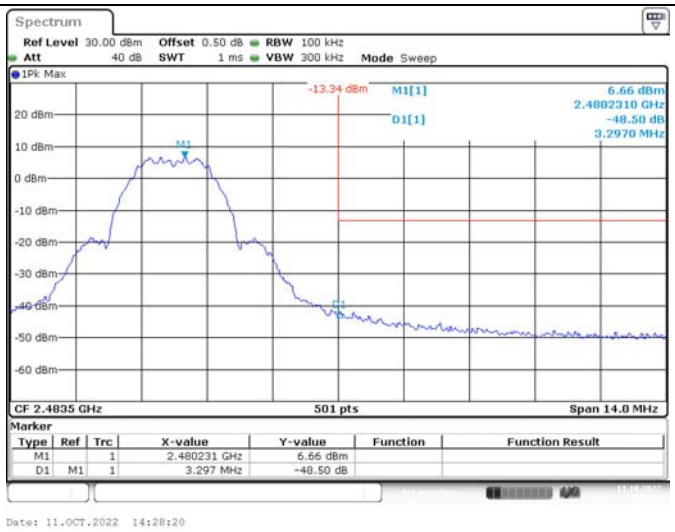
Serial Number:	CR22090021-RF-S1	Test Date:	2022/9/22-2022/10/11
Test Site:	RF	Test Mode:	Transmitting
Tester:	Julie Tan	Test Result:	Pass

Environmental Conditions:					
Temperature: (℃)	25.8-26.5	Relative Humidity: (%)	36-59	ATM Pressure: (kPa)	100.4-101.3

Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSV40	101943	2022-07-25	2023-07-24
Mini-Circuits	DC Block	BLK-18-S+	1554404	Each time	N/A
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	
Lowest Band edge	
Additional Channel Band edge	
Highest Band edge	

4.8 Duty Cycle:

Serial Number:	CR22090021-RF-S1	Test Date:	2022/9/22-2022/10/11
Test Site:	RF	Test Mode:	Transmitting
Tester:	Julie Tan	Test Result:	N/A

Environmental Conditions:					
Temperature: (℃)	25.8-26.5	Relative Humidity: (%)	36-59	ATM Pressure: (kPa)	100.4-101.3

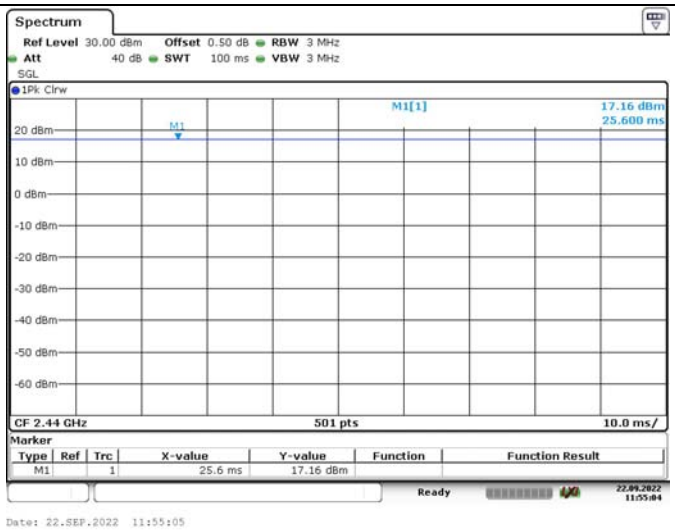
Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSV40	101943	2022-07-25	2023-07-24
Mini-Circuits	DC Block	BLK-18-S+	1554404	Each time	N/A
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 Frequency (MHz)	Ton (ms)	Ton+off (ms)	Duty cycle (%)
2440	100	100	100.00

Duty Cycle	
Middle Channel	

5. RF EXPOSURE EVALUATION

5.1 MPE-Based Exemption

5.1.1 Applicable Standard

According to §1.1307(b)(3)(i)

(C) Or using Table 1 and the minimum separation distance (R in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates, the ERP (watts) is no more than the calculated value prescribed for that frequency. For the exemption in Table 1 to apply, R must be at least λ/2π, where λ is the free-space operating wavelength in meters. If the ERP of a single RF source is not easily obtained, then the available maximum time-averaged power may be used in lieu of ERP if the physical dimensions of the radiating structure(s) do not exceed the electrical length of λ/4 or if the antenna gain is less than that of a half-wave dipole (1.64 linear value).

Table 1 to § 1.1307(b)(3)(i)(C) - Single RF Sources Subject to Routine Environmental Evaluation

RF Source frequency (MHz)	Threshold ERP (watts)
0.3-1.34	1,920 R^2.
1.34-30	3,450 R^2/f^2.
30-300	3.83 R^2.
300-1,500	0.0128 R^2f.
1,500-100,000	19.2R^2.

5.1.2 Measurement Result

Operation Modes	Frequency (MHz)	λ/2π (mm)	Distance (mm)	Exemption ERP		Maximum Conducted Power including Tune-up Tolerance (dBm)	Antenna Gain (dBi)	ERP (dBm)	MPE-Based Exemption
				(mW)	(dBm)				
Zigbee	2405-2480	19.86	200	768	28.85	19	2.5	19.35	Compliant

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

5.2 EXEMPTION LIMITS FOR ROUTINE EVALUATION – RF EXPOSURE EVALUATION

5.2.1 Applicable Standard

RSS-102 § (2.5.2):

RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm, except when the device operates as follows:

- below 20 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1 W (adjusted for tune-up tolerance);
- at or above 20 MHz and below 48 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $4.49/f^{0.5}$ W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 48 MHz and below 300 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance);
- at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $1.31 \times 10^{-2} f^{0.6834}$ W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 5 W (adjusted for tune-up tolerance).

In these cases, the information contained in the RF exposure technical brief may be limited to information that demonstrates how the e.i.r.p. was derived.

5.2.2 Calculated Result

Frequency (MHz)	Antenna Gain	Conducted output power including Tune-up Tolerance	EIRP		Exemption limits (mW)	Exemption
	(dBi)	(dBm)	(dBm)	(mW)		
2405-2480	2.5	19	21.5	141.25	2678.71	Yes

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Note: the Conducted output power including Tune-up Tolerance was declared by manufacturer.

Result: Compliance. The device is compliance exemption from Routine Evaluation Limits –RF exposure Evaluation.

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