



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



TEST REPORT

Applicant: Meizhou Guo Wei Electronics Co., Ltd.

Address: AD1 Section, Economic Development Area, Dongsheng Industrial District,
Meizhou, Guangdong, China.

FCC ID: 2ARRB-PIP1000PCBU

IC: 20353-PIP1000PCBU

HVIN: PIP1000-PCBU, PIP1700-P HD TOUCHCBU

Product Name: Video baby monitor

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: CR230744652-00A

Date Of Issue: 2023/9/14

Reviewed By: Calvin Chen

Title: RF Engineer

Reviewed By: Sun Zhong

Title: Manager

Test Laboratory: China Certification ICT Co., Ltd (Dongguan)

No. 113, Pingkang Road, Dalang Town, Dongguan,

Guangdong, China

Tel: +86-769-82016888

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.

This report cannot be reproduced except in full, without prior written approval of the Company.

This report is valid only with a valid digital signature. The digital signature may be available only under the Adobe software above version 7.0.

This report may contain data that are not covered by the accreditation scope and shall be marked with an asterisk “★”.

CONTENTS

TEST FACILITY	2
DECLARATIONS.....	2
DOCUMENT REVISION HISTORY	5
1. GENERAL INFORMATION.....	6
1.1 PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT)	6
1.2 DESCRIPTION OF TEST CONFIGURATION.....	7
1.2.1 EUT Operation Condition:.....	7
1.2.2 Support Equipment List and Details	7
1.2.3 Support Cable List and Details	7
1.2.4 Block Diagram of Test Setup.....	8
1.3 MEASUREMENT UNCERTAINTY	9
2. SUMMARY OF TEST RESULTS.....	10
3. REQUIREMENTS AND TEST PROCEDURES	11
3.1 AC LINE CONDUCTED EMISSIONS.....	11
3.1.1 Applicable Standard.....	11
3.1.2 EUT Setup.....	12
3.1.3 EMI Test Receiver Setup	13
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	15
3.2.5 Corrected Amplitude & Margin Calculation.....	16
3.3 20 DB BANDWIDTH.....	17
3.3.1 Applicable Standard.....	17
3.3.2 EUT Setup.....	17
3.3.3 Test Procedure	17
3.4 99% OCCUPIED BANDWIDTH:	19
3.4.1 Applicable Standard.....	19
3.4.2 EUT Setup.....	19
3.4.3 Test Procedure	20
3.5 CHANNEL SEPARATION	21
3.5.1 Applicable Standard.....	21
3.5.2 EUT Setup.....	21
3.5.3 Test Procedure	21
3.6 NUMBER OF HOPPING FREQUENCY	22
3.6.1 Applicable Standard.....	22
3.6.2 EUT Setup.....	22
3.6.3 Test Procedure	22

3.7 TIME OF OCCUPANCY(DWELL TIME)	23
3.7.1 Applicable Standard.....	23
3.7.2 EUT Setup.....	23
3.7.3 Test Procedure	23
3.8 MAXIMUM CONDUCTED OUTPUT POWER	25
3.8.1 Applicable Standard.....	25
3.8.2 EUT Setup.....	25
3.8.3 Test Procedure	25
3.9 100 KHZ BANDWIDTH OF FREQUENCY BAND EDGE	26
3.9.1 Applicable Standard.....	26
3.9.2 EUT Setup.....	26
3.9.3 Test Procedure	27
3.10 ANTENNA REQUIREMENT	28
3.10.1 Applicable Standard.....	28
3.10.2 Judgment.....	28
4. TEST DATA AND RESULTS	29
4.1 AC LINE CONDUCTED EMISSIONS	29
4.2 RADIATION SPURIOUS EMISSIONS	34
4.3 20 dB EMISSION BANDWIDTH:	44
4.4 99% OCCUPIED BANDWIDTH:	46
4.5 CHANNEL SEPARATION:	48
4.6 NUMBER OF HOPPING FREQUENCY:	50
4.7 TIME OF OCCUPANCY(DWELL TIME):	51
4.8 MAXIMUM CONDUCTED OUTPUT POWER:	53
4.9 100 KHZ BANDWIDTH OF FREQUENCY BAND EDGE:	55
5. RF EXPOSURE EVALUATION	58
5.1 APPLICABLE STANDARD	58
5.1.2 Measurement Result.....	58
5.2 EXEMPTION LIMITS FOR ROUTINE EVALUATION – RF EXPOSURE EVALUATION	59
5.2.1 Applicable Standard.....	59
5.2.2 Procedure	59
6. EUT PHOTOGRAPHS	61
7. TEST SETUP PHOTOGRAPHS	62

DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
1.0	CR230744652-00A	Original Report	2023/9/14

1. GENERAL INFORMATION

1.1 Product Description for Equipment under Test (EUT)

EUT Name:	Video baby monitor
Trade Name:	Motorola
EUT Model:	PIP1000-P CONNECT
Multiple Models:	PIP1700-P HD TOUCH CONNECT BU
Operation Frequency:	2402-2477MHz
Maximum Peak Output Power (Conducted):	16.36dBm
Modulation Type:	GFSK
Rated Input Voltage:	DC 3.87from battery or DC 5V from adapter
Serial Number:	CE&RE: 2998-2 RF: 2998-1
EUT Received Date:	2023/7/3
EUT Received Status:	Good

Note: The Multiple models are electrically identical with the test model. Please refer to the declaration letter for more detail, which was provided by manufacturer.

Operation Frequency Detail:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2402	12	2445
2	2404	13	2450
3	2406	14	2455
4	2408	15	2460
5	2410	16	2465
6	2415	17	2467
7	2420	18	2469
8	2425	19	2471
9	2430	20	2473
10	2435	21	2475
11	2440	22	2477

Per section 15.31(m)/RSS-Gen, the below frequencies were performed the test:

Test Channel	Frequency (MHz)
Lowest	2402
Middle	2440
Highest	2477

Antenna Information Detail▲:

Antenna Type	input impedance (Ohm)	Frequency Range	Antenna Gain
Monopole	50	2.4~2.5GHz	3.14 dBi

The Method of §15.203 Compliance:

- Antenna must be permanently attached to the unit.
- Antenna must use a unique type of connector to attach to the EUT.
- Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.

Accessory Information:

Accessory Description	Manufacturer	Model	Parameters
Adapter	MASS POWER	NBS10B050200VUU	Input: 100-240V~50/60Hz, 0.3A Output: 5.0V, 2A
Adapter	Shenzhen Baijunda Electronic Co.,Ltd	UT-681A-5200ZCY	Input: 100-240V~50/60Hz, 0.35 Output: 5.0V, 2A 10.0W

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 Modes	Power Level Setting		
	Lowest	Middle	Highest
FHSS	default	default	default

1.2.2 Support Equipment List and Details

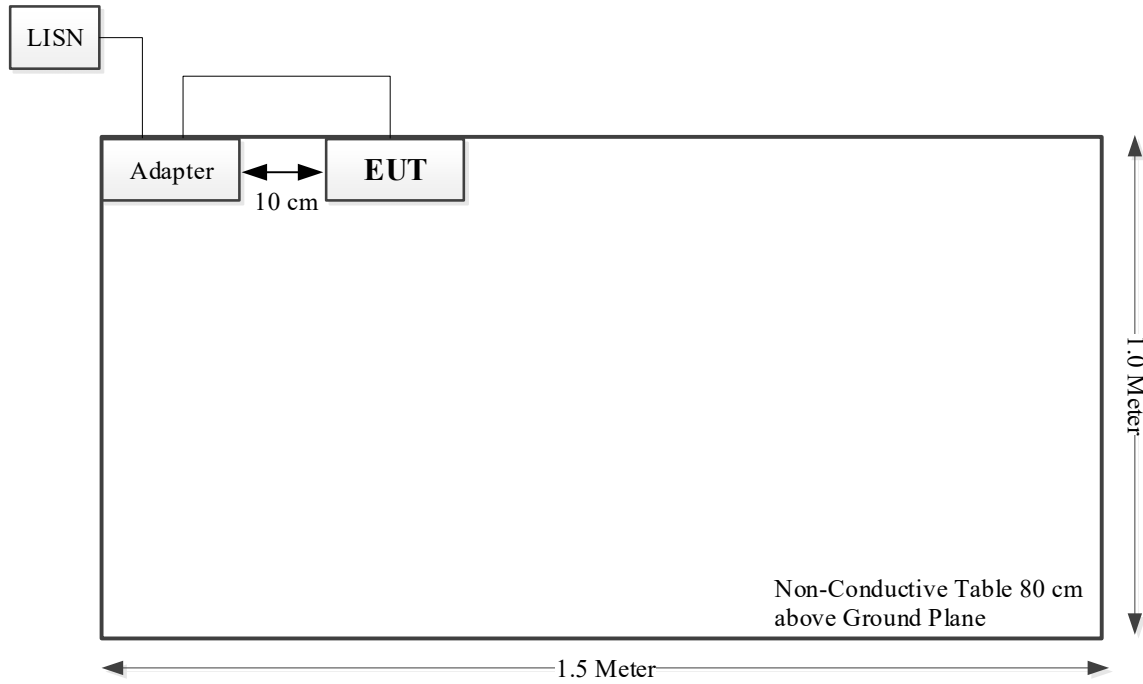
Manufacturer	Description	Model	Serial Number
MASS Power	Adapter	NBS10B050200VUU	1KD6C0002
Shenzhen Baijunda Electronic Co.,Ltd	Adapter	UT-681A-5200ZCY	Unknown

1.2.3 Support Cable List and Details

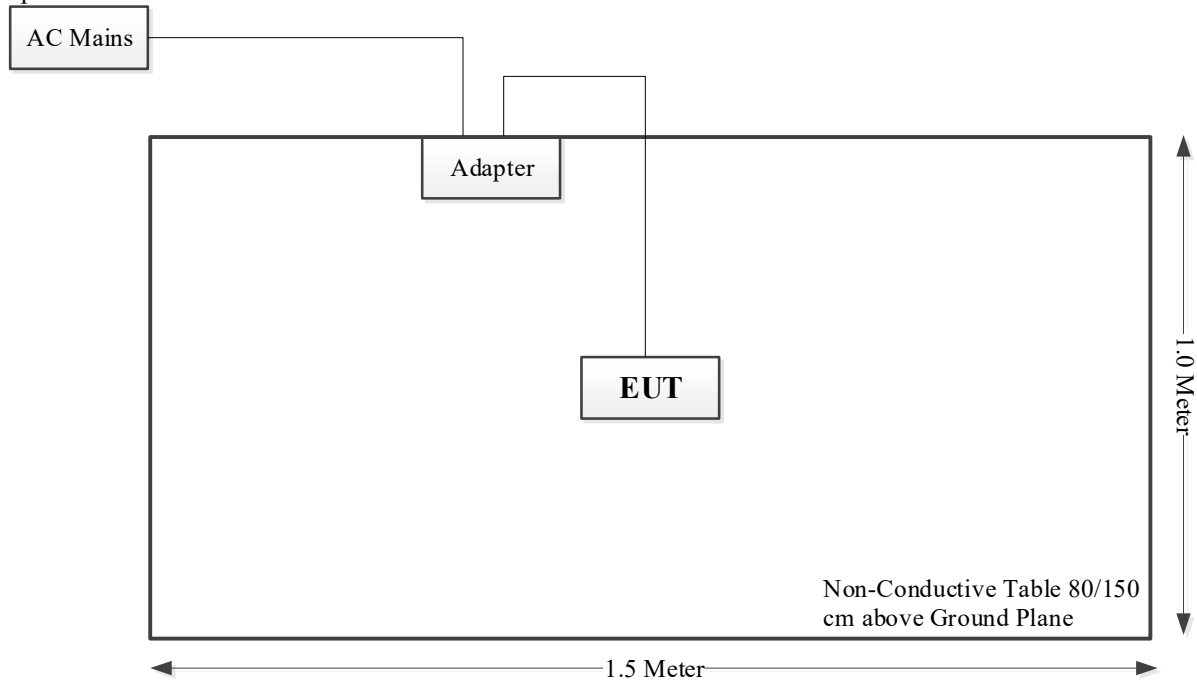
Cable Description	Shielding Type	Ferrite Core	Length (m)	From Port	To
Shenzhen Baijunda Electronic Co.,Ltd	NO	NO	3.0	Adapter	EUT

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/Rule(s)	Description of Test	Result
FCC §15.207(a) RSS-Gen Clause 8.8	AC Line Conducted Emissions	Compliant
FCC §15.205, §15.209, §15.247(d) RSS-Gen Clause 8.10	Radiated Spurious Emissions	Compliant
FCC §15.247(a)(1) RSS-247 Clause 5.1 b)	20 dB Bandwidth	Compliant
RSS-Gen Clause 6.7	99% Occupied Bandwidth	Compliant
FCC §15.247(a)(1) RSS-247 Clause 5.1 b)	Channel Separation	Compliant
FCC §15.247(a)(1)(iii) RSS-247 Clause 5.1 d)	Number Of Hopping Frequency	Compliant
FCC §15.247(a)(1)(iii) RSS-247 Clause 5.1 d)	Time Of Occupancy (dwell time)	Compliant
FCC §15.247(b)(1) RSS-247 Clause 5.4 b)	Maximum Conducted Output Power	Compliant
FCC §15.247(d) RSS-247 Clause 5.5	Band Edges	Compliant
FCC §15.203 RSS-Gen Clause 6.8	Antenna Requirement	Compliant
FCC§15.247 (i) & §1.1307 & §2.1091	RF Exposure Evaluation	Compliant
RSS-102 Clause 4	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 μ H/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.

Frequency of emission (MHz)	Conducted limit (dB μ V)	
	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 μ V within the frequency band 535-1705 kHz, as measured using a 50 μ H/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, obtaining 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 μ H / 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 (dB μ V)	
	Quasi-peak	Average
0.15 - 0.5	66 to 56 ¹	56 to 46 ¹
0.5 – 5	56	46
5 – 30	60	50

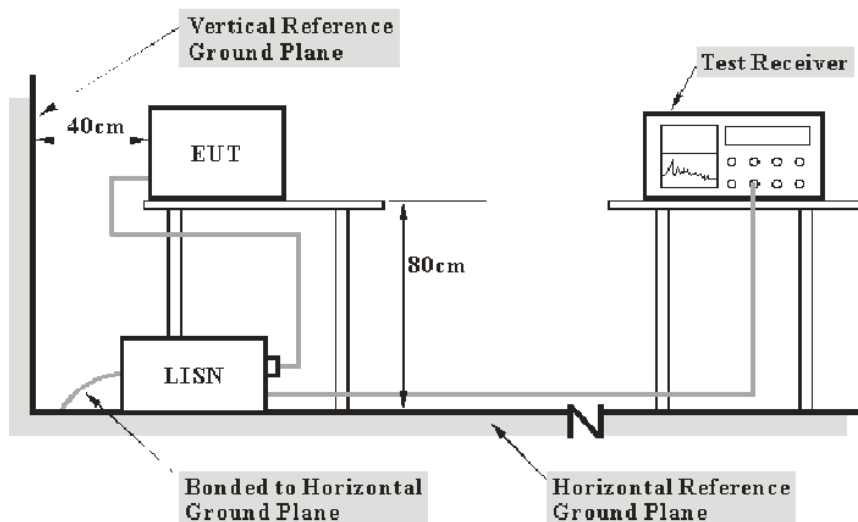
Note 1: The level decreases linearly with the logarithm of the frequency.

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);

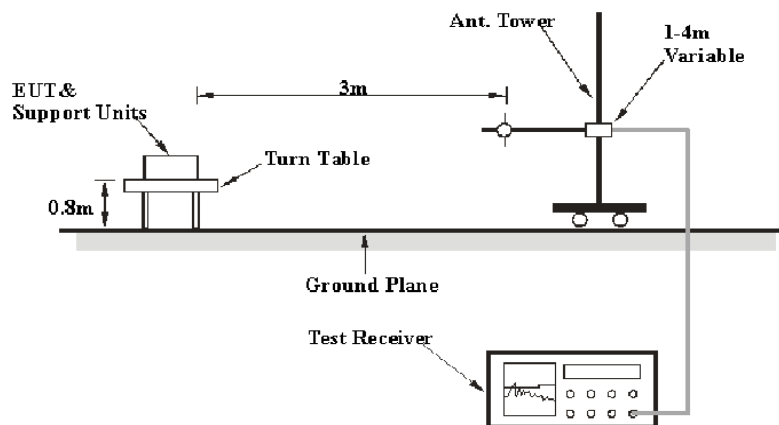
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the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

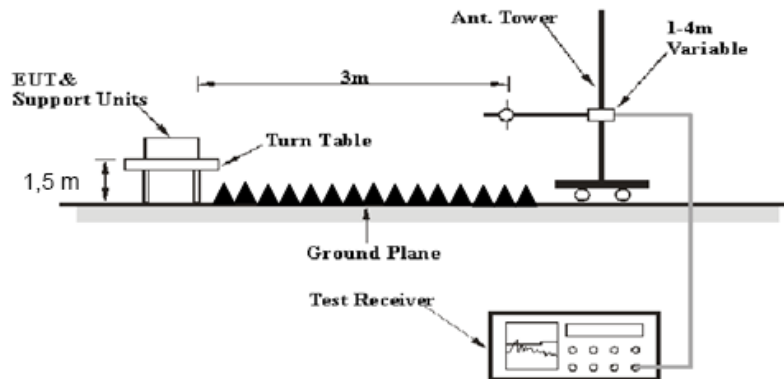
RSS-247 Clause 5.5

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:

Frequency Range	RBW	Video B/W	IF B/W	Measurement
30 MHz – 1000 MHz	120 kHz	300 kHz	120 kHz	QP
Above 1 GHz	1MHz	3 MHz	/	PK
	1MHz	10 Hz	/	AV

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:

$$\text{Result} = \text{Reading} + \text{Factor}$$

$$\text{Factor} = \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

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:

$$\text{Margin} = \text{Limit} - \text{Result}$$

3.3 20 dB Bandwidth

3.3.1 Applicable Standard

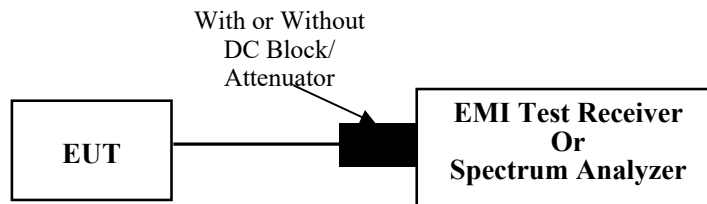
FCC §15.247 (a)(1)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

RSS-247 Clause 5.1 b)

- b) FHSs shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, FHSs operating in the band 2400-2483.5 MHz may have hopping channel carrier frequencies that are separated by 25 kHz or two thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided that the systems operate with an output power no greater than 0.125 W.

3.3.2 EUT Setup



3.3.3 Test Procedure

According to ANSI C63.10-2013 Section 6.9.2

- a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The span range for the EMI receiver or spectrum analyzer shall be between two times and five times the OBW.
- b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW and video bandwidth (VBW) shall be approximately three times RBW, unless otherwise specified by the applicable requirement.
- c) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than $[10 \log(\text{OBW}/\text{RBW})]$ below the reference level. Specific guidance is given in 4.1.5.2
- d) Steps a) through c) might require iteration to adjust within the specified tolerances.
- e) The dynamic range of the instrument at the selected RBW shall be more than 10 dB below the target “-xx dB down” requirement; that is, if the requirement calls for measuring the -20 dB OBW, the instrument noise floor at the selected RBW shall be at least 30 dB below the reference value.
- f) Set detection mode to peak and trace mode to max hold.

g) Determine the reference value: Set the EUT to transmit an unmodulated carrier or modulated signal, as applicable. Allow the trace to stabilize. Set the spectrum analyzer marker to the highest level of the displayed trace (this is the reference value).

h) Determine the “-xx dB down amplitude” using [(reference value) – xx]. Alternatively, this calculation may be made by using the marker-delta function of the instrument.

i) If the reference value is determined by an unmodulated carrier, then turn the EUT modulation ON, and either clear the existing trace or start a new trace on the spectrum analyzer and allow the new trace to stabilize. Otherwise, the trace from step g) shall be used for step j).

j) Place two markers, one at the lowest frequency and the other at the highest frequency of the envelope of the spectral display, such that each marker is at or slightly below the “-xx dB down amplitude” determined in step h). If a marker is below this “-xx dB down amplitude” value, then it shall be as close as possible to this value. The occupied bandwidth is the frequency difference between the two markers.

Alternatively, set a marker at the lowest frequency of the envelope of the spectral display, such that the marker is at or slightly below the “-xx dB down amplitude” determined in step h). Reset the marker-delta function and move the marker to the other side of the emission until the delta marker amplitude is at the same level as the reference marker amplitude. The marker-delta frequency reading at this point is the specified emission bandwidth.

k) The occupied bandwidth shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labeled. Tabular data may be reported in addition to the plot(s).

3.4 99% Occupied Bandwidth:

3.4.1 Applicable Standard

RSS-Gen Clause 6.7

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.

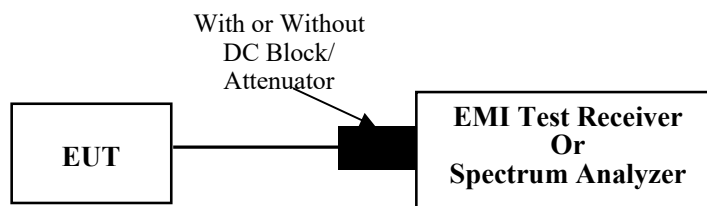
The following conditions shall be observed for measuring the occupied bandwidth and x dB bandwidth:

- 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).

3.4.2 EUT Setup



3.4.3 Test Procedure

According to ANSI C63.10-2013 Section 6.9.3

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission. The following procedure shall be used for measuring 99% power bandwidth:

- a) The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW.
- b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW, and VBW shall be approximately three times the RBW, unless otherwise specified by the applicable requirement.
- c) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than $[10 \log (OBW/RBW)]$ below the reference level. Specific guidance is given in 4.1.5.2.
- d) Step a) through step c) might require iteration to adjust within the specified range.
- e) Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.
- f) Use the 99% power bandwidth function of the instrument (if available) and report the measured bandwidth.
- g) If the instrument does not have a 99% power bandwidth function, then the trace data points are recovered and directly summed in linear power 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; that frequency is recorded as the lower frequency. The process is repeated until 99.5% of the total is reached; that frequency is recorded as the upper frequency. The 99% power bandwidth is the difference between these two frequencies.
- h) The occupied bandwidth shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labeled. Tabular data may be reported in addition to the plot(s).

3.5 Channel Separation

3.5.1 Applicable Standard

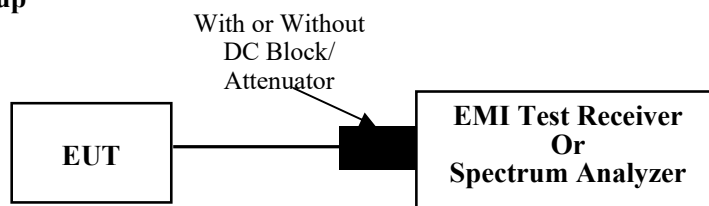
FCC §15.247 (a)(1)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

RSS-247 Clause 5.1 b)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.50 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20dB bandwidth of the hopping channel, whichever is greater provided the systems operate with an output power no greater than 125 mW.

3.5.2 EUT Setup



3.5.3 Test Procedure

According to ANSI C63.10-2013 Section 7.8.2

The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:

- Span: Wide enough to capture the peaks of two adjacent channels.
- RBW: Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.
- Video (or average) bandwidth (VBW) \geq RBW.
- Sweep: Auto.
- Detector function: Peak.
- Trace: Max hold.
- Allow the trace to stabilize.

Use the marker-delta function to determine the separation between the peaks of the adjacent channels. Compliance of an EUT with the appropriate regulatory limit shall be determined. A plot of the data shall be included in the test report.

3.6 Number Of Hopping Frequency

3.6.1 Applicable Standard

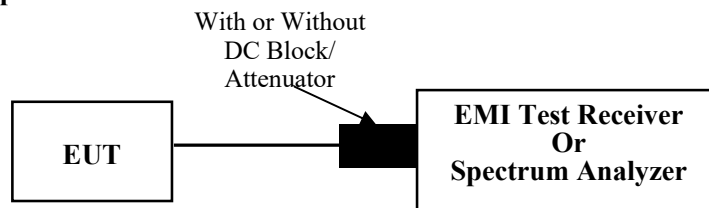
FCC §15.247 (a)(1)(iii)

Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

RSS-247 Clause 5.1 d)

Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

3.6.2 EUT Setup



3.6.3 Test Procedure

According to ANSI C63.10-2013 Section 7.8.3

The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:

- a) Span: The frequency band of operation. Depending on the number of channels the device supports, it may be necessary to divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen.
- b) RBW: To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.
- c) VBW \geq RBW.
- d) Sweep: Auto.
- e) Detector function: Peak.
- f) Trace: Max hold.
- g) Allow the trace to stabilize

It might prove necessary to break the span up into subranges to show clearly all of the hopping frequencies. Compliance of an EUT with the appropriate regulatory limit shall be determined for the number of hopping channels. A plot of the data shall be included in the test report.

3.7 Time Of Occupancy(Dwell Time)

3.7.1 Applicable Standard

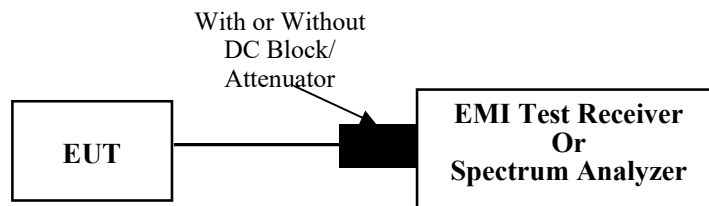
FCC §15.247 (a)(1)(iii)

Frequency hopping systems in the 2400-2483.5 MHz shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

RSS-247 Clause 5.1 d)

Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

3.7.2 EUT Setup



3.7.3 Test Procedure

According to ANSI C63.10-2013 Section 7.8.4

The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:

- a) Span: Zero span, centered on a hopping channel.
- b) RBW shall be \leq channel spacing and where possible RBW should be set $\gg 1 / T$, where T is the expected dwell time per channel.
- c) Sweep: As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger and trigger delay so that the transmitted signal starts a little to the right of the start of the plot. The trigger level might need slight adjustment to prevent triggering when the system hops on an adjacent channel; a second plot might be needed with a longer sweep time to show two successive hops on a channel.
- d) Detector function: Peak.
- e) Trace: Max hold.

Use the marker-delta function to determine the transmit time per hop. If this value varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation in transmit time.

Repeat the measurement using a longer sweep time to determine the number of hops over the period specified in the requirements. The sweep time shall be equal to, or less than, the period specified in the requirements. Determine the number of hops over the sweep time and calculate the total number of hops in the period specified in the requirements, using the following equation:

(Number of hops in the period specified in the requirements) =
(number of hops on spectrum analyzer) × (period specified in the requirements / analyzer sweep time)

The average time of occupancy is calculated from the transmit time per hop multiplied by the number of hops in the period specified in the requirements. If the number of hops in a specific time varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation.

The measured transmit time and time between hops shall be consistent with the values described in the operational description for the EUT.

3.8 Maximum Conducted Output Power

3.8.1 Applicable Standard

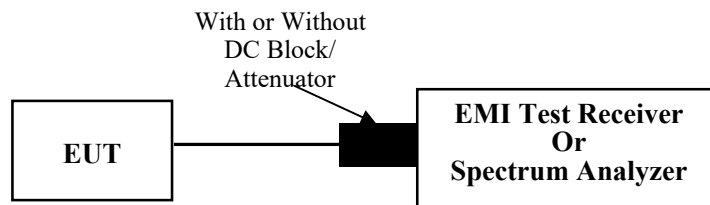
FCC §15.247 (b)(1)

For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts

According to RSS-247 Clause 5.4 b)

For FHSs operating in the band 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W if the hopset uses 75 or more hopping channels; the maximum peak conducted output power shall not exceed 0.125 W if the hopset uses less than 75 hopping channels. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e).

3.8.2 EUT Setup



3.8.3 Test Procedure

According to ANSI C63.10-2013 Section 7.8.5

This is an RF-conducted test to evaluate maximum peak output power. Use a direct connection between the antenna port of the unlicensed wireless device and the spectrum analyzer, through suitable attenuation. The hopping shall be disabled for this test:

- a) Use the following spectrum analyzer settings:
 - 1) Span: Approximately five times the 20 dB bandwidth, centered on a hopping channel.
 - 2) RBW > 20 dB bandwidth of the emission being measured.
 - 3) VBW \geq RBW.
 - 4) Sweep: Auto.
 - 5) Detector function: Peak.
 - 6) Trace: Max hold.
- b) Allow trace to stabilize.
- c) Use the marker-to-peak function to set the marker to the peak of the emission.
- d) The indicated level is the peak output power, after any corrections for external attenuators and cables.
- e) A plot of the test results and setup description shall be included in the test report.

NOTE—A peak responding power meter may be used, where the power meter and sensor system video bandwidth is greater than the occupied bandwidth of the unlicensed wireless device, rather than a spectrum analyzer.

3.9 100 kHz Bandwidth of Frequency Band Edge

3.9.1 Applicable Standard

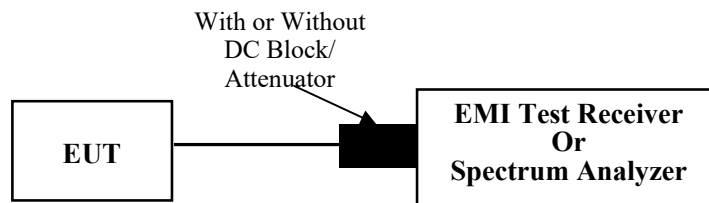
FCC §15.247 (d);

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)).

According to 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.

3.9.2 EUT Setup



3.9.3 Test Procedure

According to ANSI C63.10-2013 Section 7.8.6

For band-edge measurements, use the band-edge procedure in 6.10. Band-edge measurements shall be tested both on single channels, and with the EUT hopping.

- a) Set the center frequency and span to encompass frequency range to be measured.
- b) Set the RBW = 100 kHz.
- c) Set the VBW $\geq [3 \times \text{RBW}]$.
- 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. Report the three highest emissions relative to the limit.

3.10 Antenna Requirement

3.10.1 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 §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.

3.10.2 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:	2998-2	Test Date:	2023/9/4
Test Site:	CE	Test Mode:	Transmitting maximum output power mode (low channel)
Tester:	David Huang	Test Result:	Pass

Environmental Conditions:

Temperature: (°C)	26.4	Relative Humidity: (%)	59	ATM Pressure: (kPa)	99.7
----------------------	------	---------------------------	----	------------------------	------

Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	LISN	ENV216	101134	2023/3/31	2024/3/30
R&S	EMI Test Receiver	ESR3	102726	2023/3/31	2024/3/30
MICRO-COAX	Coaxial Cable	UTIFLEX	C-0200-01	2023/8/6	2024/8/5
Audix	Test Software	E3	190306 (V9)	N/A	N/A

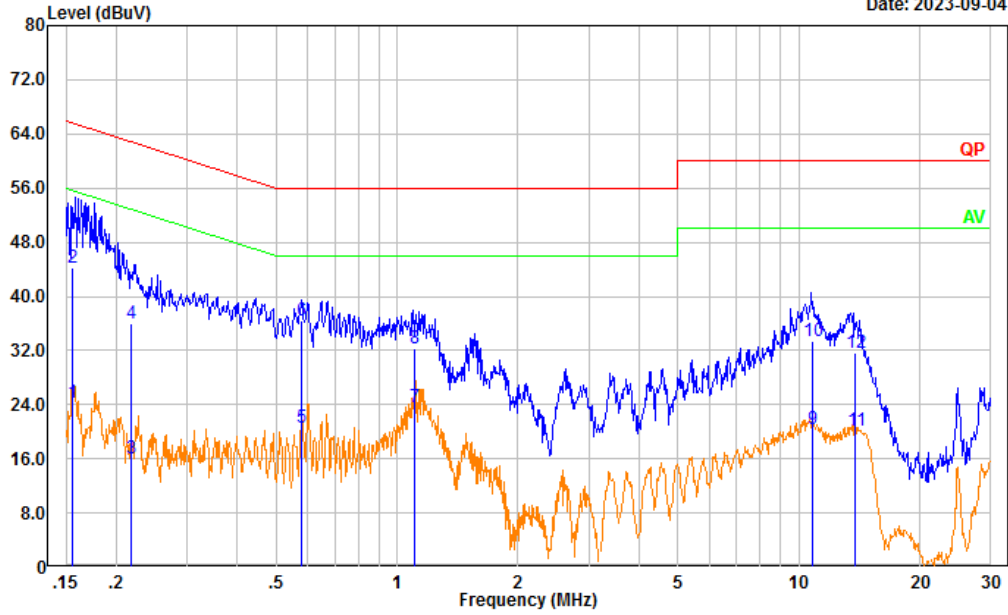
* Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data:

For adapter UT-681A-5200ZCY:

Project No.: CR230744652-RF
 Tester: David Huang
 Test Mode: Transmitting
 Port: Line
 Note:

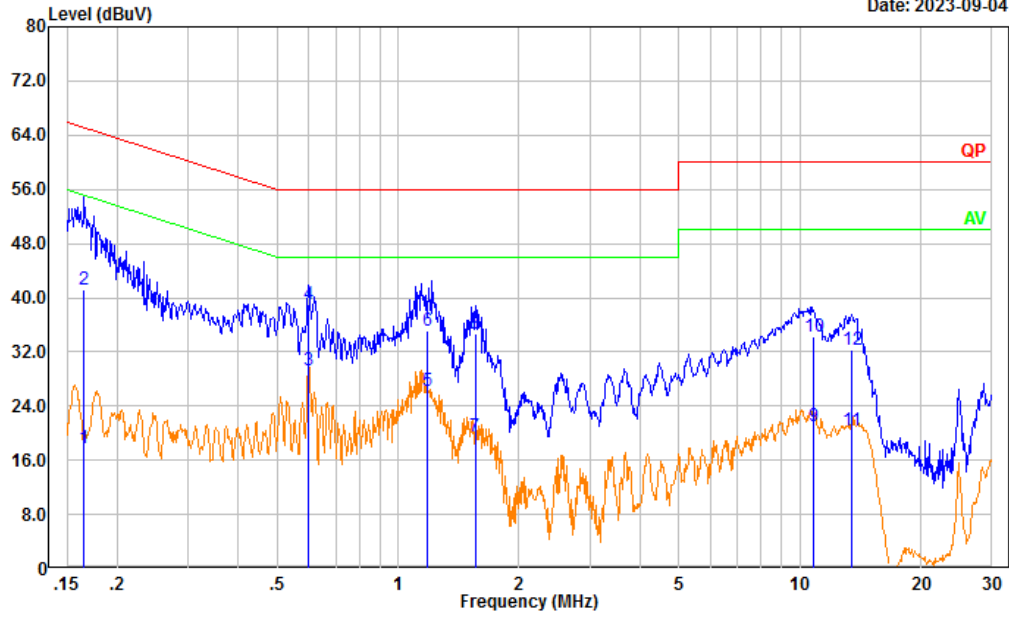
Date: 2023-09-04



No.	Frequency (MHz)	Reading (dBμV)	Factor (dB)	Result (dBμV)	Limit (dBμV)	Margin (dB)	Detector
1	0.156	14.73	9.61	24.34	55.67	31.33	Average
2	0.156	34.52	9.61	44.13	65.67	21.54	QP
3	0.218	6.46	9.61	16.07	52.91	36.84	Average
4	0.218	26.47	9.61	36.08	62.91	26.83	QP
5	0.577	10.91	9.62	20.53	46.00	25.47	Average
6	0.577	26.77	9.62	36.39	56.00	19.61	QP
7	1.109	13.98	9.62	23.60	46.00	22.40	Average
8	1.109	22.74	9.62	32.36	56.00	23.64	QP
9	10.813	10.61	9.67	20.28	50.00	29.72	Average
10	10.813	23.71	9.67	33.38	60.00	26.62	QP
11	13.843	10.47	9.68	20.15	50.00	29.85	Average
12	13.843	21.87	9.68	31.55	60.00	28.45	QP

Project No.: CR230744652-RF
 Tester: David Huang
 Test Mode: Transmitting
 Port: neutral
 Note:

Date: 2023-09-04

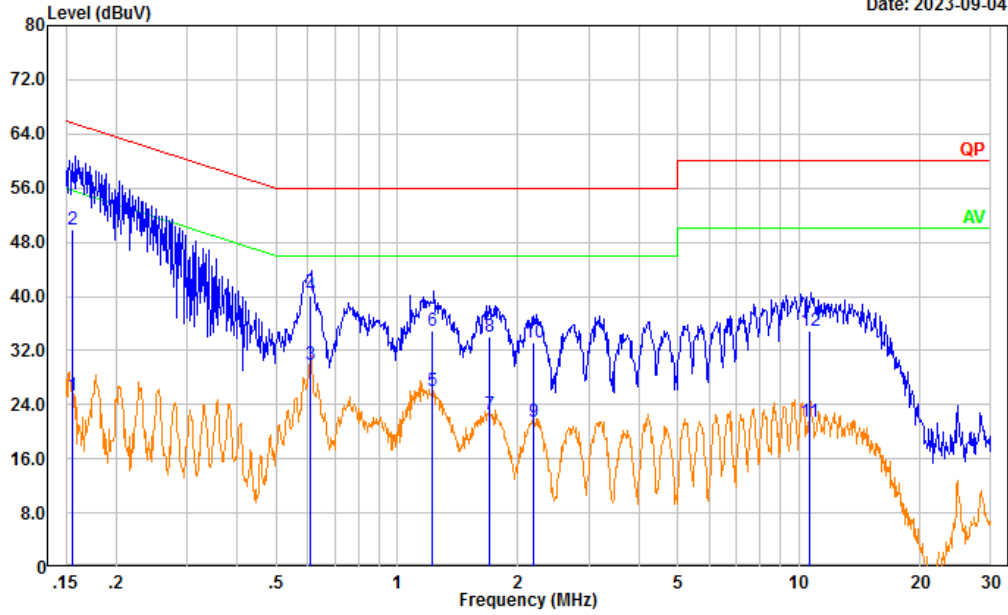


No.	Frequency (MHz)	Reading (dBμV)	Factor (dB)	Result (dBμV)	Limit (dBμV)	Margin (dB)	Detector
1	0.165	8.09	9.61	17.70	55.20	37.50	Average
2	0.165	31.51	9.61	41.12	65.20	24.08	QP
3	0.599	19.66	9.62	29.28	46.00	16.72	Average
4	0.599	29.49	9.62	39.11	56.00	16.89	QP
5	1.181	16.69	9.62	26.31	46.00	19.69	Average
6	1.181	25.49	9.62	35.11	56.00	20.89	QP
7	1.554	9.97	9.63	19.60	46.00	26.40	Average
8	1.554	25.11	9.63	34.74	56.00	21.26	QP
9	10.779	11.28	9.67	20.95	50.00	29.05	Average
10	10.779	24.59	9.67	34.26	60.00	25.74	QP
11	13.426	10.75	9.68	20.43	50.00	29.57	Average
12	13.426	22.69	9.68	32.37	60.00	27.63	QP

For adapter NBS10B050200VUU:

Project No.: CR230744652-RF
 Tester: David Huang
 Test Mode: Transmitting
 Port: Line
 Note:

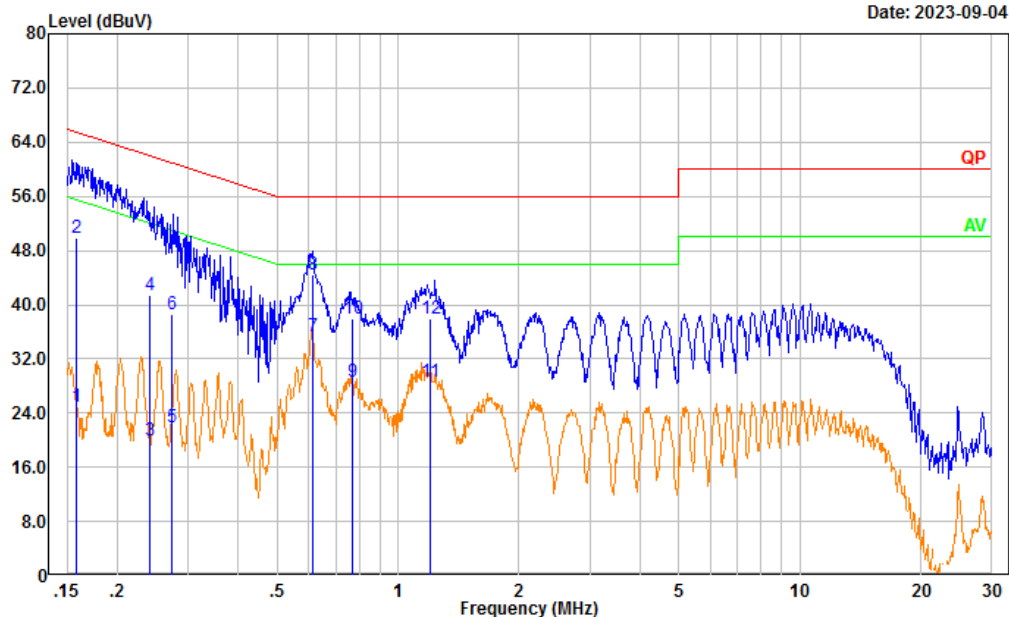
Date: 2023-09-04



No.	Frequency (MHz)	Reading (dBμV)	Factor (dB)	Result (dBμV)	Limit (dBμV)	Margin (dB)	Detector
1	0.156	15.70	9.61	25.31	55.70	30.39	Average
2	0.156	40.32	9.61	49.93	65.70	15.77	QP
3	0.608	20.37	9.62	29.99	46.00	16.01	Average
4	0.608	30.59	9.62	40.21	56.00	15.79	QP
5	1.227	16.36	9.62	25.98	46.00	20.02	Average
6	1.227	25.33	9.62	34.95	56.00	21.05	QP
7	1.697	12.85	9.63	22.48	46.00	23.52	Average
8	1.697	24.47	9.63	34.10	56.00	21.90	QP
9	2.178	11.82	9.63	21.45	46.00	24.55	Average
10	2.178	23.51	9.63	33.14	56.00	22.86	QP
11	10.598	11.84	9.67	21.51	50.00	28.49	Average
12	10.598	25.32	9.67	34.99	60.00	25.01	QP

Project No.: CR230744652-RF
 Tester: David Huang
 Test Mode: Transmitting
 Port: neutral
 Note:

Date: 2023-09-04



No.	Frequency (MHz)	Reading (dBμV)	Factor (dB)	Result (dBμV)	Limit (dBμV)	Margin (dB)	Detector
1	0.158	15.43	9.61	25.04	55.57	30.53	Average
2	0.158	40.21	9.61	49.82	65.57	15.75	QP
3	0.240	10.33	9.61	19.94	52.09	32.15	Average
4	0.240	31.70	9.61	41.31	62.09	20.78	QP
5	0.273	12.28	9.61	21.89	51.01	29.12	Average
6	0.273	29.00	9.61	38.61	61.01	22.40	QP
7	0.612	25.81	9.62	35.43	46.00	10.57	Average
8	0.612	34.86	9.62	44.48	56.00	11.52	QP
9	0.767	18.98	9.62	28.60	46.00	17.40	Average
10	0.767	28.25	9.62	37.87	56.00	18.13	QP
11	1.199	19.04	9.62	28.66	46.00	17.34	Average
12	1.199	28.35	9.62	37.97	56.00	18.03	QP

4.2 Radiation Spurious Emissions

Serial Number:	2998-2	Test Date:	2023/8/31~2023/9/3
Test Site:	966-2,966-1	Test Mode:	Transmitting
Tester:	Vic Du, Mack Huang	Test Result:	Pass

Environmental Conditions:

Temperature: (°C)	25.8~26.7	Relative Humidity: (%)	54~62	ATM Pressure: (kPa)	99.6~100.1
----------------------	-----------	------------------------------	-------	------------------------	------------

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	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
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
Quinstar	Horn Antenna	QLW-18405536-JO	15964001005	2022/9/16	2023/9/15
AH	Preamplifier	PAM-1840VH	190	2022/11/9	2023/11/8
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).

Test Data:

Please refer to the below table and plots.

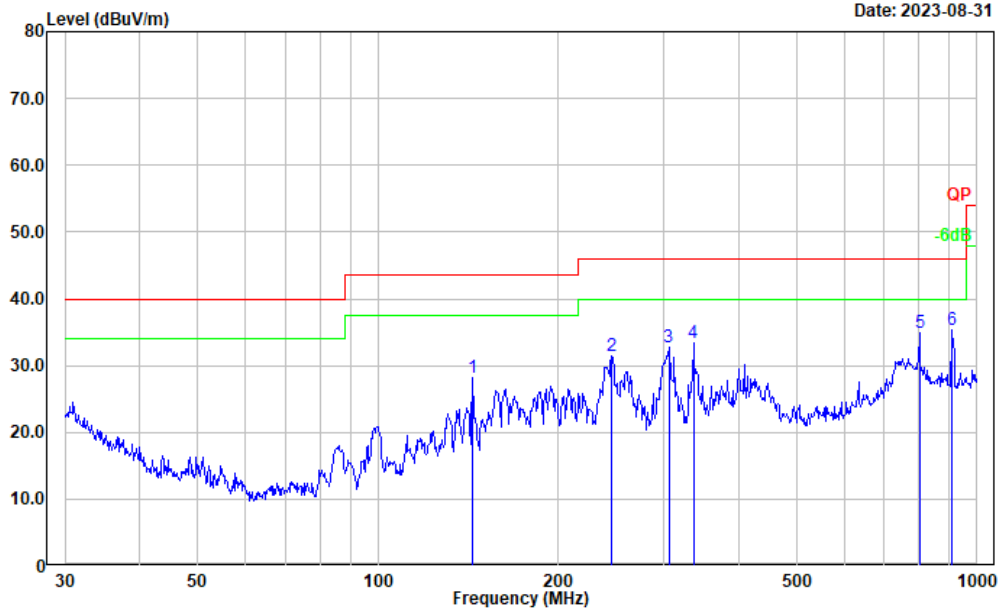
Note: The device can be mounted in multiple orientations, test was performed with X,Y, Z Axis according to C63.10 Figure 8, the worst orientation was photographed and it's data was recorded.

1) 30MHz-1GHz(maximum output power mode (low channel))

For adapter NBS10B050200VUU:

Project No.: CR230744652-RF
 Tester: Vic Du
 Test Mode: Transmitting
 Polarization: horizontal
 Note:

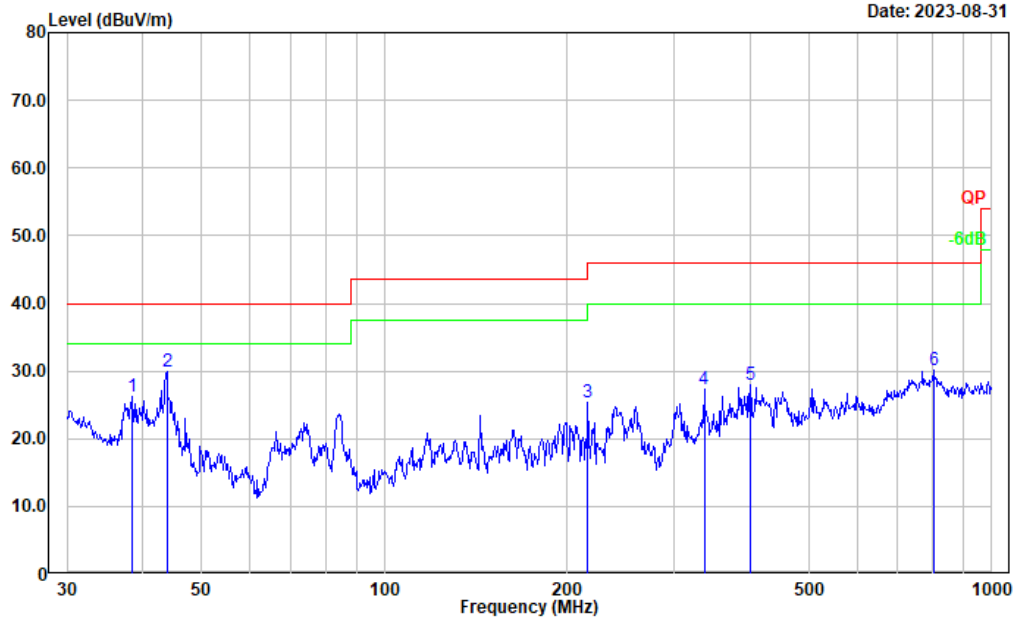
Date: 2023-08-31



No.	Frequency (MHz)	Reading (dBμV)	Factor (dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector
1	143.830	40.23	-11.96	28.27	43.50	15.23	Peak
2	245.090	44.48	-12.97	31.51	46.00	14.49	Peak
3	305.680	43.21	-10.57	32.64	46.00	13.36	Peak
4	336.035	43.56	-10.13	33.43	46.00	12.57	Peak
5	801.786	36.97	-2.14	34.83	46.00	11.17	Peak
6	909.667	35.97	-0.68	35.29	46.00	10.71	Peak

Project No.: CR230744652-RF
 Tester: Vic Du
 Test Mode: Transmitting
 Polarization: vertical
 Note:

Date: 2023-08-31

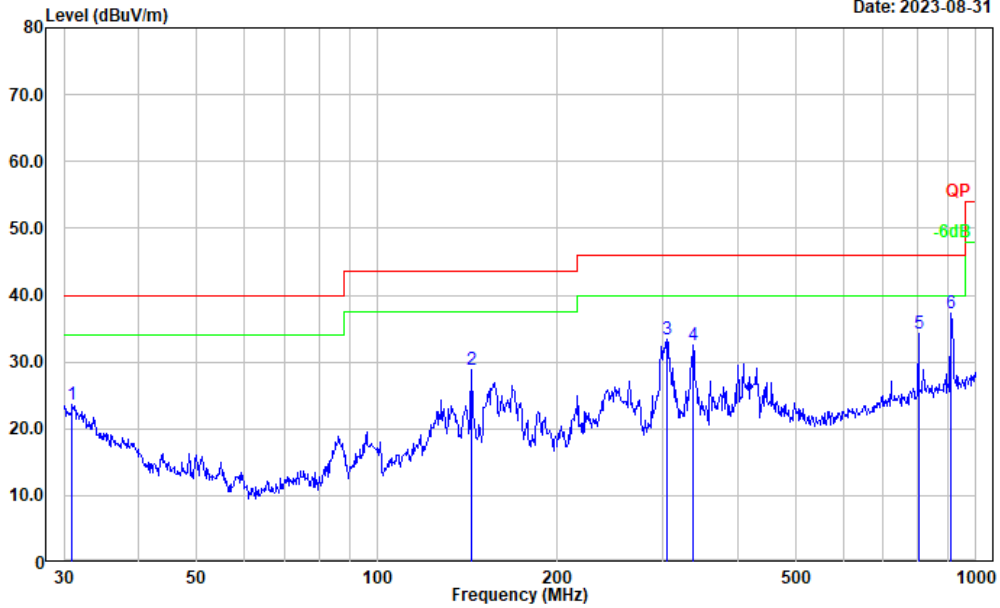


No.	Frequency (MHz)	Reading (dBμV)	Factor (dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector
1	38.481	36.45	-10.11	26.34	40.00	13.66	Peak
2	43.812	43.52	-13.56	29.96	40.00	10.04	Peak
3	216.024	38.07	-12.65	25.42	46.00	20.58	Peak
4	336.035	37.38	-10.13	27.25	46.00	18.75	Peak
5	400.432	36.73	-8.74	27.99	46.00	18.01	Peak
6	801.786	32.27	-2.14	30.13	46.00	15.87	Peak

For adapter UT-681A-5200ZCY:

Project No.: CR230744652-RF
 Tester: Vic Du
 Test Mode: Transmitting
 Polarization: horizontal
 Note:

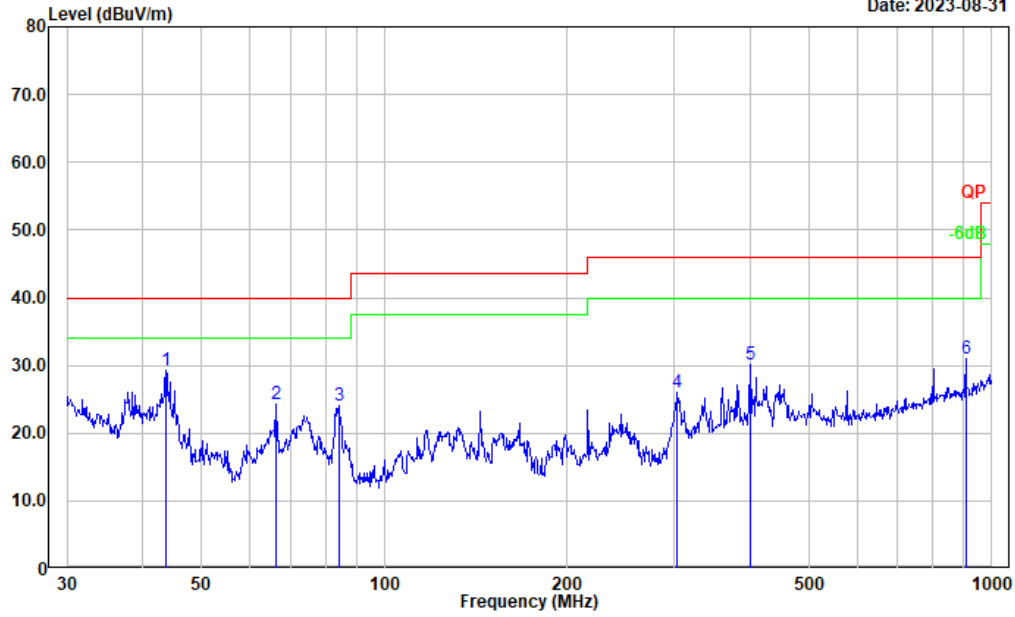
Date: 2023-08-31



No.	Frequency (MHz)	Reading (dBμV)	Factor (dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector
1	30.962	27.98	-4.34	23.64	40.00	16.36	Peak
2	143.830	40.74	-11.96	28.78	43.50	14.72	Peak
3	304.610	43.87	-10.57	33.30	46.00	12.70	Peak
4	337.216	42.62	-10.10	32.52	46.00	13.48	Peak
5	801.786	36.38	-2.14	34.24	46.00	11.76	Peak
6	909.667	38.03	-0.68	37.35	46.00	8.65	Peak

Project No.: CR230744652-RF
 Tester: Vic Du
 Test Mode: Transmitting
 Polarization: vertical
 Note:

Date: 2023-08-31



No.	Frequency (MHz)	Reading (dBμV)	Factor (dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector
1	43.659	42.74	-13.46	29.28	40.00	10.72	Peak
2	66.266	41.03	-16.84	24.19	40.00	15.81	Peak
3	84.110	41.37	-17.23	24.14	40.00	15.86	Peak
4	303.544	36.59	-10.59	26.00	46.00	20.00	Peak
5	400.432	38.78	-8.74	30.04	46.00	15.96	Peak
6	906.482	31.82	-0.80	31.02	46.00	14.98	Peak

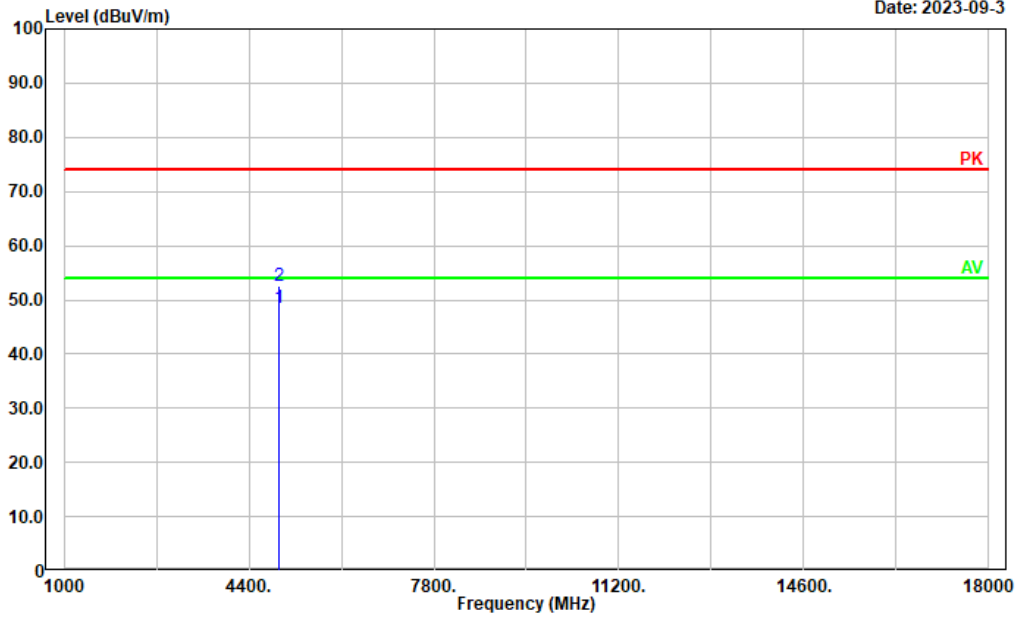
2) 1-25GHz (test with adapter UT-681A-5200ZCY):

Frequency (MHz)	Receiver		Polar (H/V)	Factor (dB/m)	Result (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
	Reading (dB μ V)	Detector					
Low Channel: 2402 MHz							
2390.000	27.00	PK	H	31.46	58.46	74.00	15.54
2390.000	17.25	AV	H	31.46	48.71	54.00	5.29
4804.000	42.79	PK	H	10.91	53.70	74.00	20.30
4804.000	38.56	AV	H	10.91	49.47	54.00	4.53
2390.000	26.86	PK	V	31.46	58.32	74.00	15.68
2390.000	16.98	AV	V	31.46	48.44	54.00	5.56
4804.000	40.65	PK	V	10.91	51.56	74.00	22.44
4804.000	35.93	AV	V	10.91	46.84	54.00	7.16
Middle Channel: 2440 MHz							
4880.000	42.56	PK	H	11.07	53.63	74.00	20.37
4880.000	38.47	AV	H	11.07	49.54	54.00	4.46
4880.000	39.92	PK	V	11.07	50.99	74.00	23.01
4880.000	35.63	AV	V	11.07	46.70	54.00	7.30
High Channel: 2477 MHz							
2483.500	27.03	PK	H	31.64	58.67	74.00	15.33
2483.500	15.86	AV	H	31.64	47.50	54.00	6.50
4954.000	42.17	PK	H	11.24	53.41	74.00	20.59
4954.000	38.54	AV	H	11.24	49.78	54.00	4.22
2483.500	26.56	PK	V	31.64	58.20	74.00	15.80
2483.500	14.32	AV	V	31.64	45.96	54.00	8.04
4954.000	40.23	PK	V	11.24	51.47	74.00	22.53
4954.000	36.95	AV	V	11.24	48.19	54.00	5.81

**Worst Harmonic Margin Test plots (high channel was the worst)
1-18GHz(Horizontal):**

Project No.: CR230744652
Tester: Mack Huang
Test Mode: Transmitting
Polarization: Horizontal
Note:

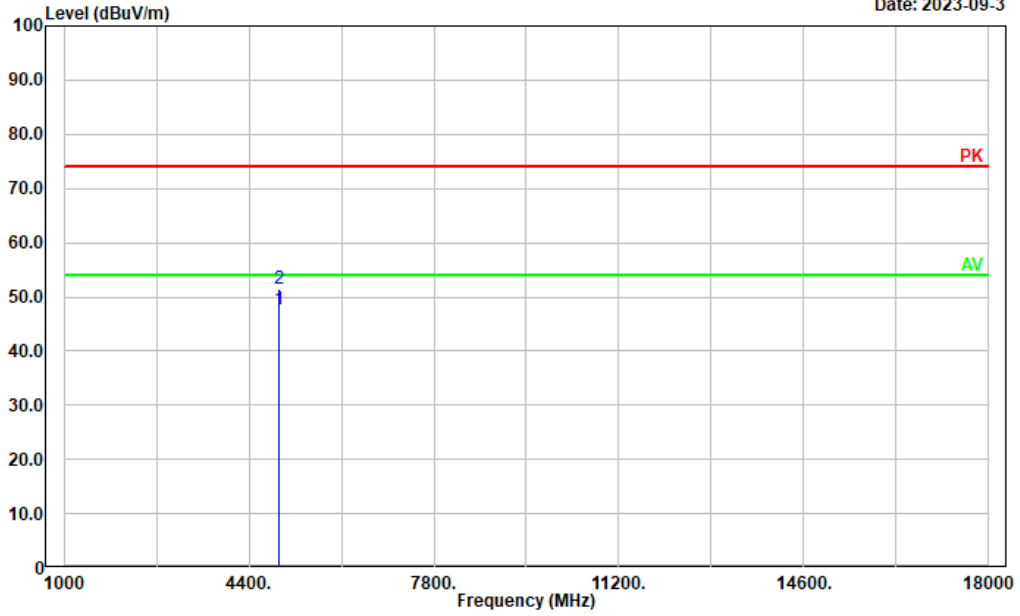
Date: 2023-09-3



Vertical

Project No.: CR230744652
Tester: Mack Huang
Test Mode: Transmitting
Polarization: Vertical
Note:

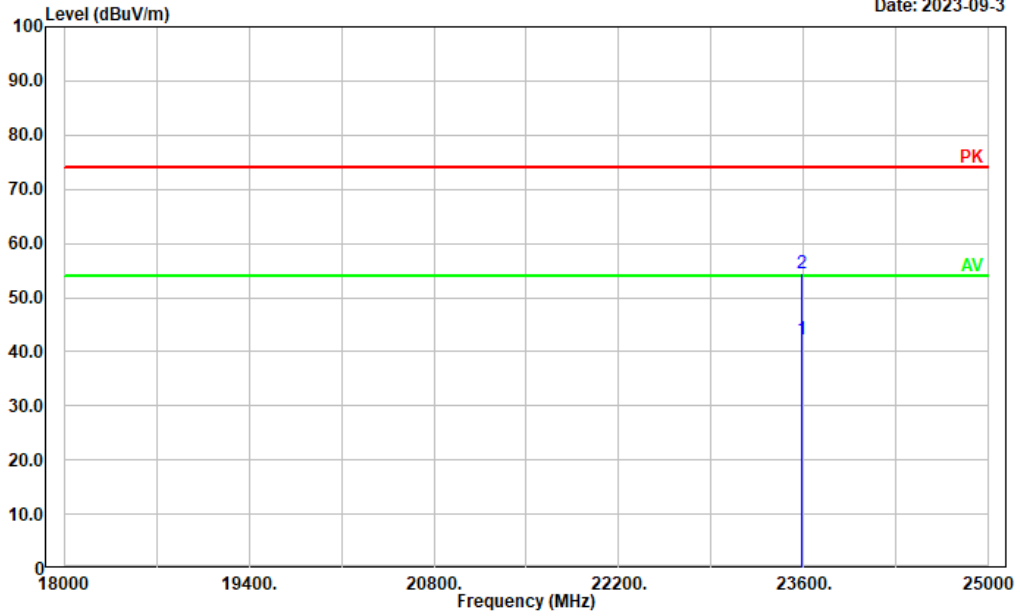
Date: 2023-09-3



18-25GHz(Horizontal):

Project No.: CR230744652
Tester: Mack Huang
Test Mode: Transmitting
Polarization: Horizontal
Note:

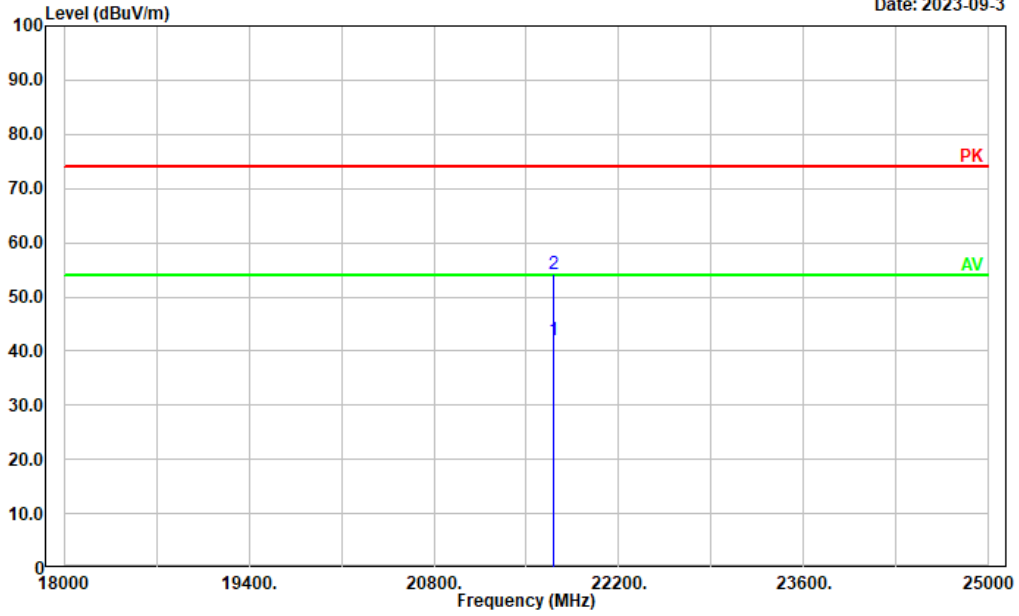
Date: 2023-09-3



Vertical

Project No.: CR230744652
Tester: Mack Huang
Test Mode: Transmitting
Polarization: Vertical
Note:

Date: 2023-09-3



4.3 20 dB Emission Bandwidth:

Serial Number:	2998-1	Test Date:	2023/7/5
Test Site:	RF	Test Mode:	Transmitting
Tester:	Arthur Su	Test Result:	N/A

Environmental Conditions:

Temperature: (°C)	24.7	Relative Humidity: (%)	59	ATM Pressure: (kPa)	100.3
----------------------	------	------------------------------	----	------------------------	-------

Test Equipment List and Details:

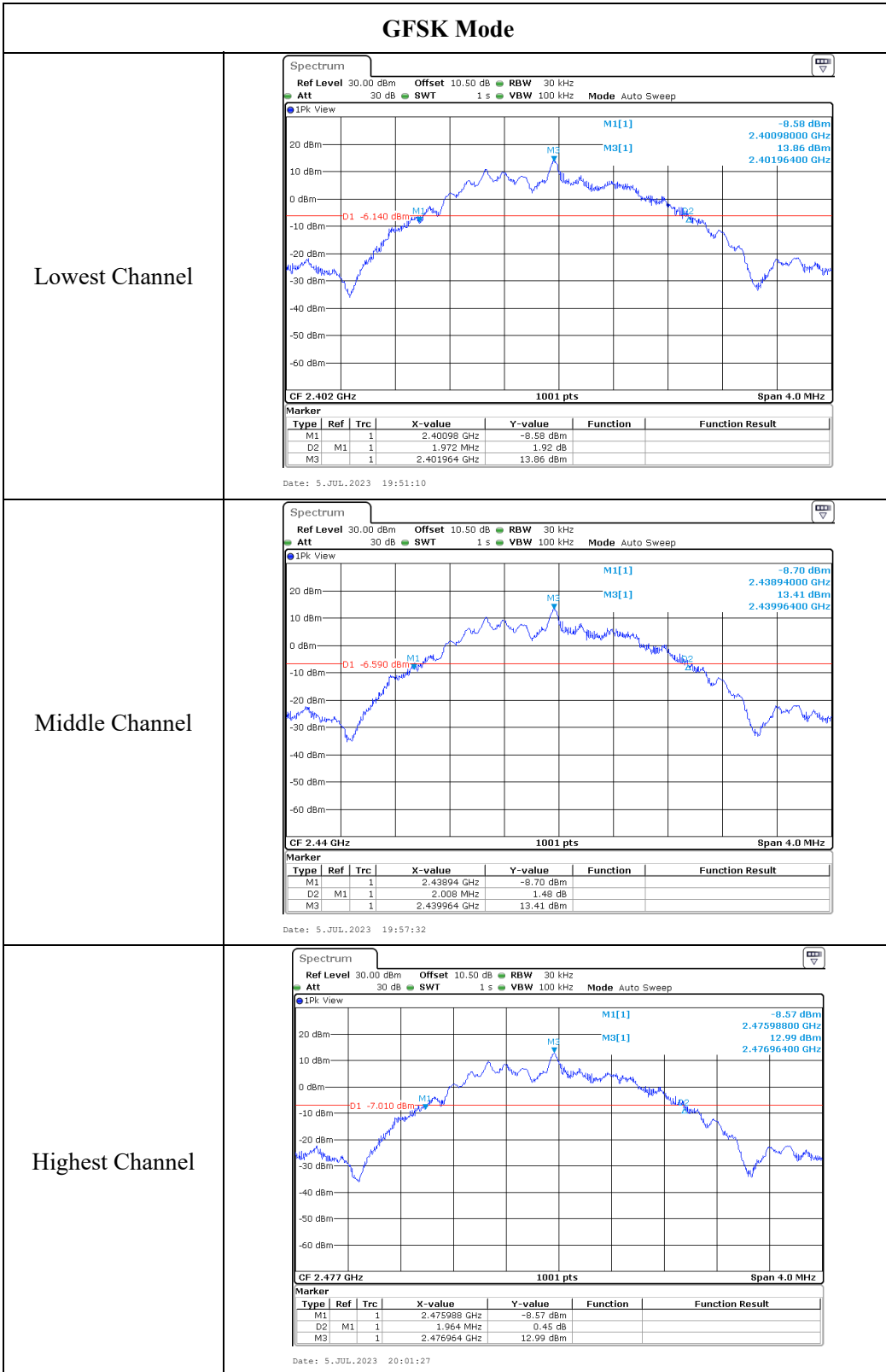
Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSV40-N	102259	2023/4/18	2024/4/17
zhuoxiang	Coaxial Cable	SMA-178	211001	Each time	N/A
eastsheep	Coaxial Attenuator	2W-SMA-JK-18G	21060301	Each time	N/A

* 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)	20 dB Bandwidth (MHz)
Lowest	2402	1.972
Middle	2440	2.008
Highest	2477	1.964

GFSK Mode



4.4 99% Occupied Bandwidth:

Serial Number:	2998-1	Test Date:	2023/7/5
Test Site:	RF	Test Mode:	Transmitting
Tester:	Arthur Su	Test Result:	N/A

Environmental Conditions:

Temperature: (°C)	24.7	Relative Humidity: (%)	59	ATM Pressure: (kPa)	100.3
----------------------	------	------------------------------	----	------------------------	-------

Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSV40-N	102259	2023/4/18	2024/4/17
zhuoxiang	Coaxial Cable	SMA-178	211001	Each time	N/A
eastsheep	Coaxial Attenuator	2W-SMA-JK-18G	21060301	Each time	N/A

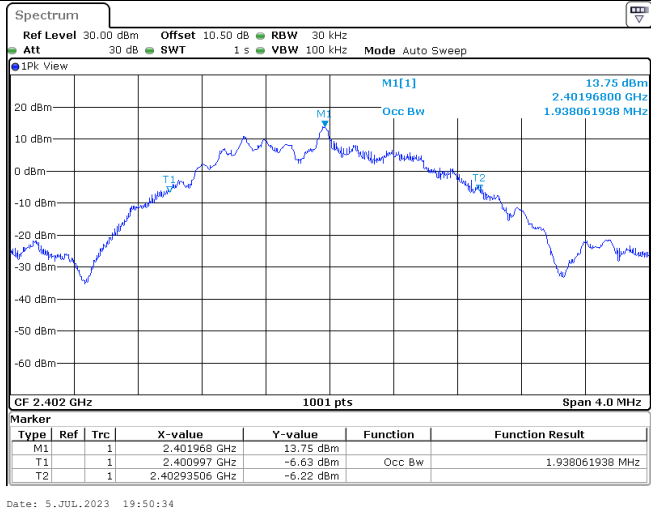
* Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data:

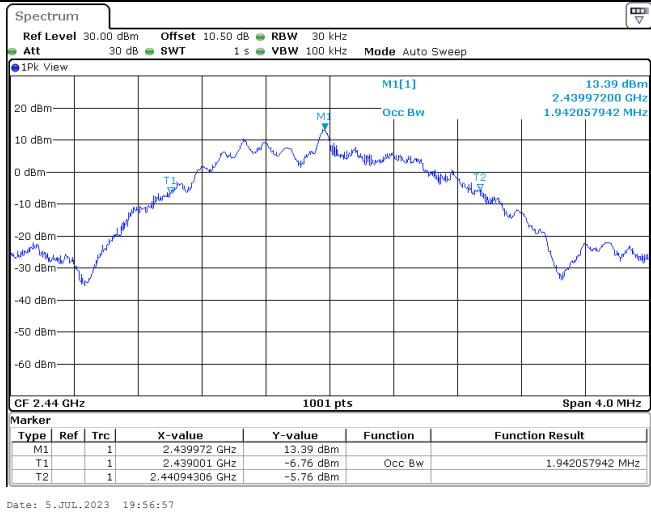
Test Channel	Test Frequency (MHz)	99% Occupied Bandwidth (MHz)
Lowest	2402	1.938
Middle	2440	1.942
Highest	2477	1.950

GFSK Mode

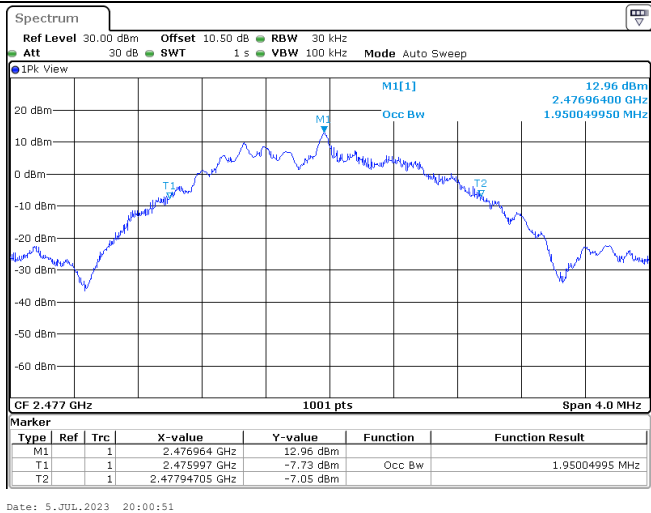
Lowest Channel



Middle Channel



Highest Channel



4.5 Channel Separation:

Serial Number:	2998-1	Test Date:	2023/7/5
Test Site:	RF	Test Mode:	Transmitting
Tester:	Arthur Su	Test Result:	Pass

Environmental Conditions:

Temperature: (°C)	24.7	Relative Humidity: (%)	59	ATM Pressure: (kPa)	100.3
----------------------	------	------------------------------	----	------------------------	-------

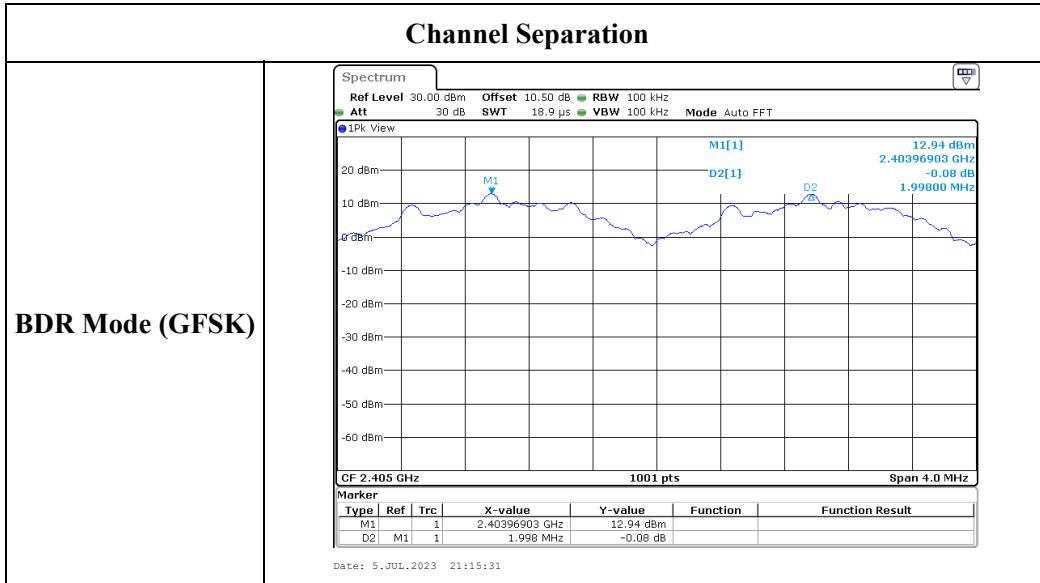
Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSV40-N	102259	2023/4/18	2024/4/17
zhuoxiang	Coaxial Cable	SMA-178	211001	Each time	N/A
eastsheep	Coaxial Attenuator	2W-SMA-JK-18G	21060301	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 Range (MHz)	Channel Separation (MHz)	Limits (MHz)
Hopping	2404~2406	1.998	1.315



4.6 Number Of Hopping Frequency:

Serial Number:	2998-1	Test Date:	2023/7/5
Test Site:	RF	Test Mode:	Transmitting
Tester:	Arthur Su	Test Result:	Pass

Environmental Conditions:

Temperature: (°C)	24.7	Relative Humidity: (%)	59	ATM Pressure: (kPa)	100.3
----------------------	------	---------------------------	----	------------------------	-------

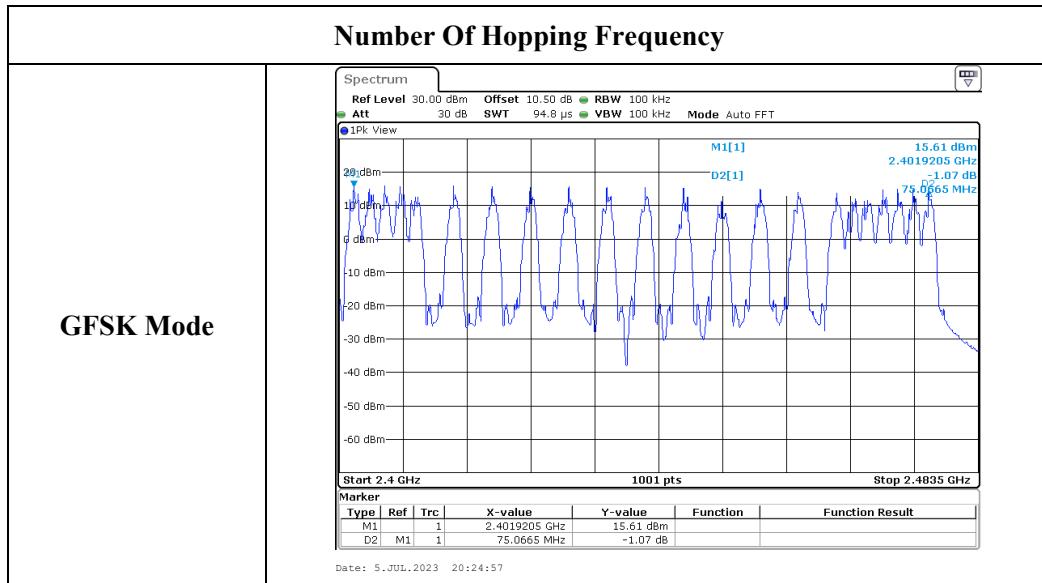
Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSV40-N	102259	2023/4/18	2024/4/17
zhuoxiang	Coaxial Cable	SMA-178	211001	Each time	N/A
eastsheep	Coaxial Attenuator	2W-SMA-JK-18G	21060301	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:

Frequency Range (MHz)	Number of Hopping Channel	Limits
2402-2477	22	≥15



4.7 Time Of Occupancy(Dwell Time):

Serial Number:	2998-1	Test Date:	2023/7/5
Test Site:	RF	Test Mode:	Transmitting
Tester:	Arthur Su	Test Result:	Pass

Environmental Conditions:

Temperature: (°C)	24.7	Relative Humidity: (%)	59	ATM Pressure: (kPa)	100.3
----------------------	------	------------------------------	----	------------------------	-------

Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSV40-N	102259	2023/4/18	2024/4/17
zhuoxiang	Coaxial Cable	SMA-178	211001	Each time	N/A
eastsheep	Coaxial Attenuator	2W-SMA-JK-18G	21060301	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).

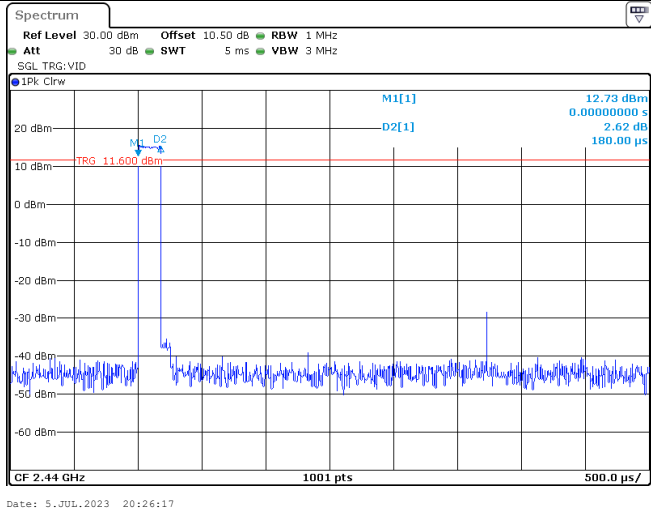
Test Data:

Test Frequency (MHz)	Pulse width (ms)	Observation time (s)	Hopping Numbers in Observation time	Dwell Time (s)	Limit (s)
2440	0.180	8.8	160	0.029	0.400

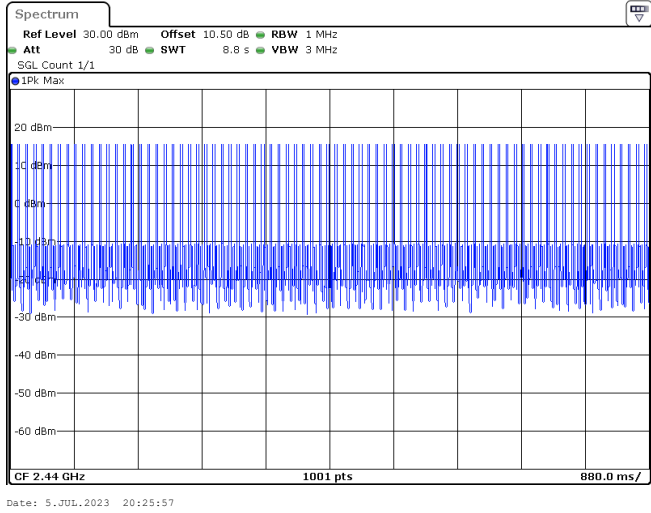
Note: Observation time= Hopping Channel Number× 0.4

Dwell Time

Pulse width



Hopping Numbers



4.8 Maximum Conducted Output Power:

Serial Number:	2998-1	Test Date:	2023/7/5
Test Site:	RF	Test Mode:	Transmitting
Tester:	Arthur Su	Test Result:	Pass

Environmental Conditions:

Temperature: (°C)	24.7	Relative Humidity: (%)	59	ATM Pressure: (kPa)	100.3
----------------------	------	------------------------------	----	------------------------	-------

Test Equipment List and Details:

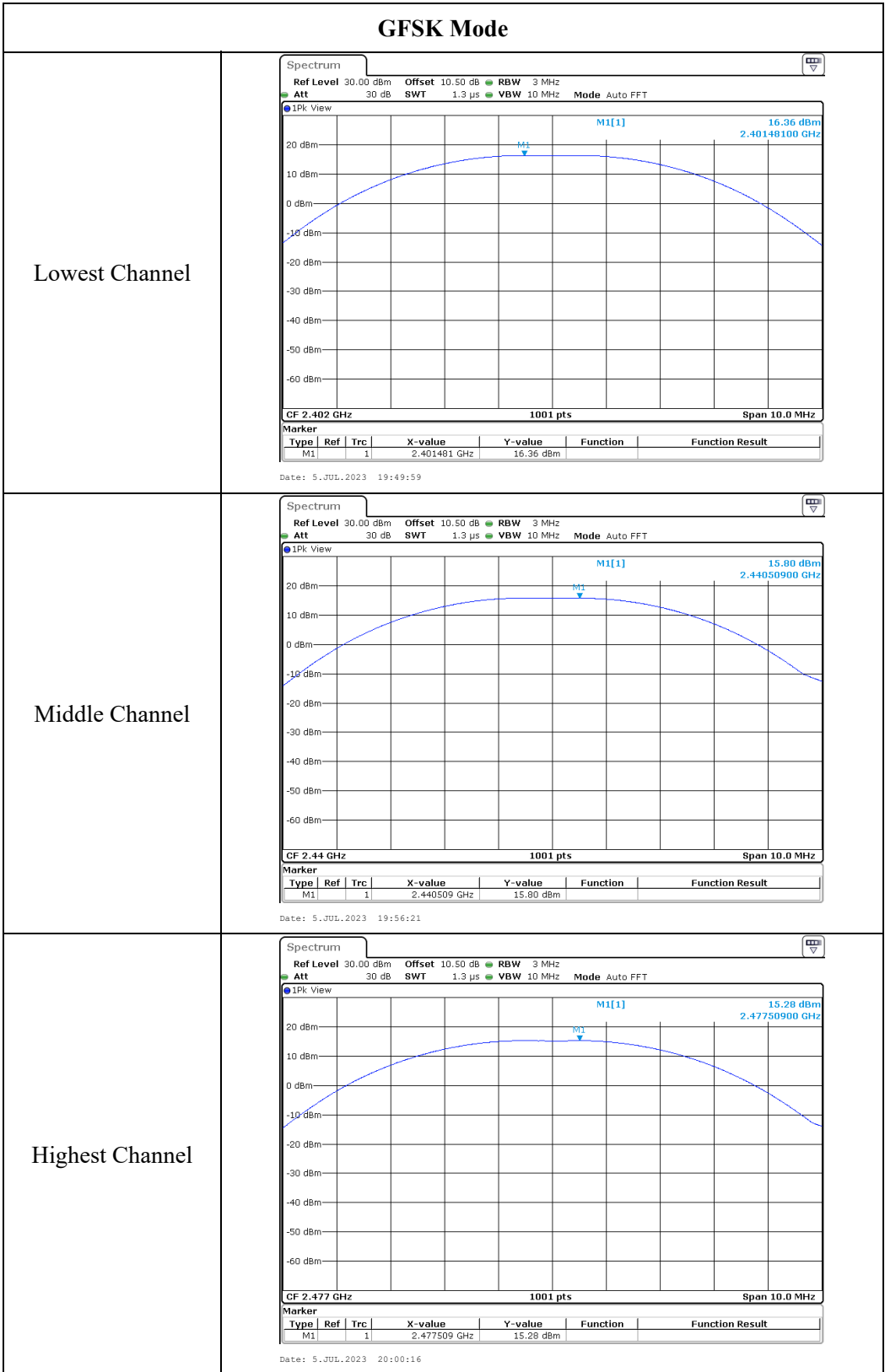
Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSV40-N	102259	2023/4/18	2024/4/17
zhuoxiang	Coaxial Cable	SMA-178	211001	Each time	N/A
eastsheep	Coaxial Attenuator	2W-SMA-JK-18G	21060301	Each time	N/A

* 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 Peak Conducted Output Power (dBm)	Limits (dBm)
Lowest	2402	16.36	21
Middle	2440	15.80	21
Highest	2477	15.28	21
Max.EIRP:	19.5	(dBm)	
EIRP Limit for RSS-247:36 dBm			

GFSK Mode



4.9 100 kHz Bandwidth of Frequency Band Edge:

Serial Number:	2998-1	Test Date:	2023/7/5
Test Site:	RF	Test Mode:	Transmitting
Tester:	Arthur Su	Test Result:	Pass

Environmental Conditions:

Temperature: (°C)	24.7	Relative Humidity: (%)	59	ATM Pressure: (kPa)	100.3
----------------------	------	------------------------------	----	------------------------	-------

Test Equipment List and Details:

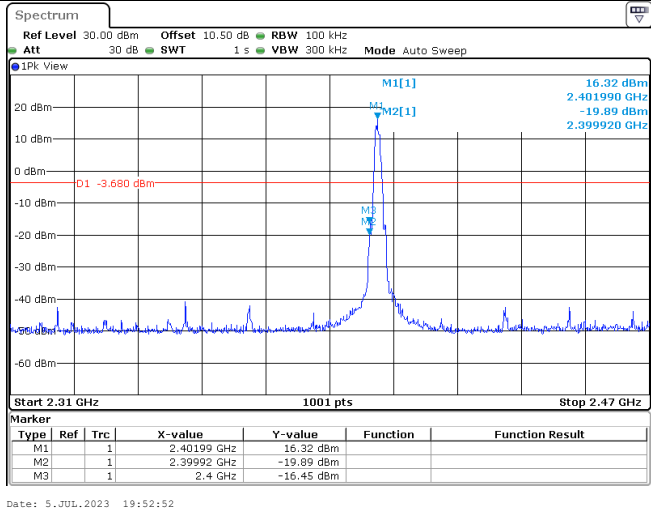
Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSV40-N	102259	2023/4/18	2024/4/17
zhuoxiang	Coaxial Cable	SMA-178	211001	Each time	N/A
eastsheep	Coaxial Attenuator	2W-SMA-JK-18G	21060301	Each time	N/A

* 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).

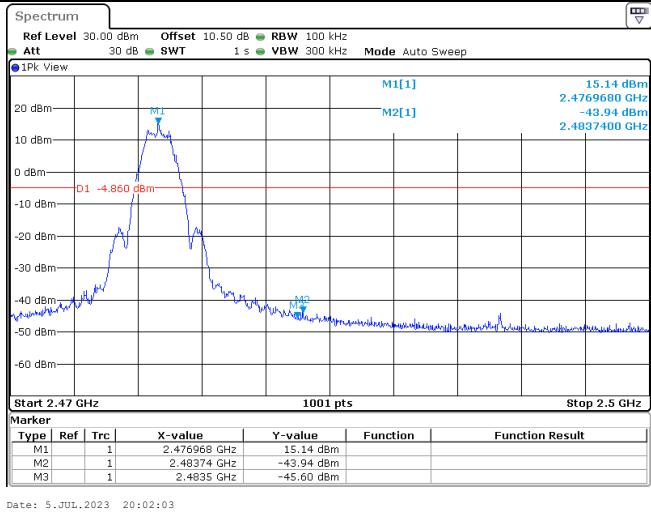
Test Data:

Single Channel Mode

Band Edge,
Left Side

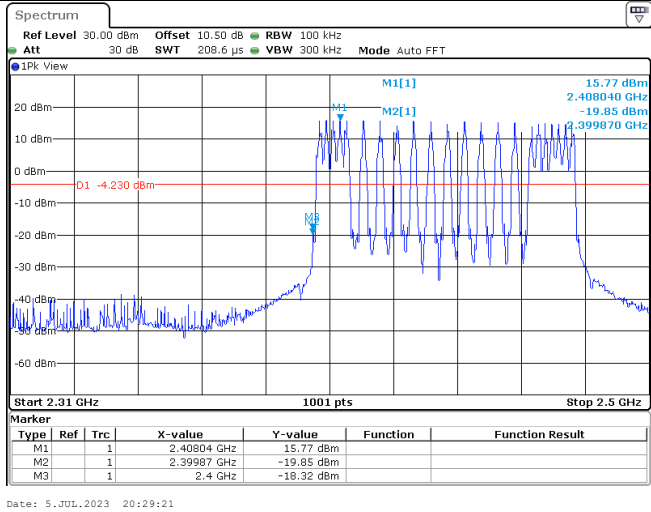


Band Edge,
Right Side

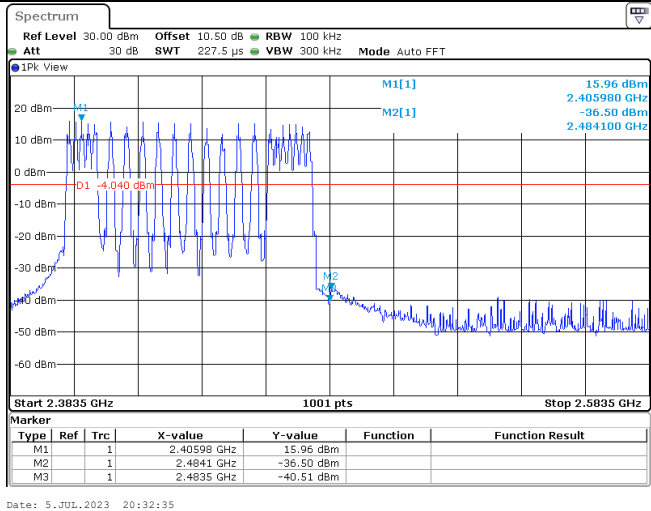


Hopping Mode

**Band Edge,
Left Side**



**Band Edge,
Right Side**



5. RF EXPOSURE EVALUATION

5.1 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 $\lambda/2\pi$, 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 $\lambda/4$ 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

Radio	Frequency (MHz)	$\lambda/2\pi$ (mm)	Distance (mm)	Exemption ERP (mW)	Maximum Conducted Power including Tune-up Tolerance (dBm)	Antenna Gain (dBi)	ERP	
							dBm	mW
Wi-Fi	2412-2462	19.80	200	768	22.0	3.66	23.51	224.39
FHSS 2.4G	2402-2477	19.80	200	768	16.5	3.14	17.49	56.10

Note:

The Maximum Conducted Power including Tune-up Tolerance was declared by manufacturer.
The Wi-Fi and FHSS can transmit simultaneously.

The ratio = $ERP_{Wi-Fi} + ERP_{FHSS} = 224.39/768 + 56.10/768 = 0.365 < 1$

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

According to RSS-102 § 4Table 4, RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)

Table 4: RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m ²)	Reference Period (minutes)
0.003-10 ²¹	83	90	-	Instantaneous*
0.1-10	-	0.73/ <i>f</i>	-	6**
1.1-10	87/ <i>f</i> ^{0.5}	-	-	6**
10-20	27.46	0.0728	2	6
20-48	58.07/ <i>f</i> ^{0.25}	0.1540/ <i>f</i> ^{0.25}	8.944/ <i>f</i> ^{0.5}	6
48-300	22.06	0.05852	1.291	6
300-6000	3.142 <i>f</i> ^{0.3417}	0.008335 <i>f</i> ^{0.3417}	0.02619 <i>f</i> ^{0.6834}	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	616000/ <i>f</i> ^{1.2}
150000-300000	0.158 <i>f</i> ^{0.5}	4.21 x 10 ⁻⁴ <i>f</i> ^{0.5}	6.67 x 10 ⁻⁵ <i>f</i>	616000/ <i>f</i> ^{1.2}

Note: *f* is frequency in MHz.
 *Based on nerve stimulation (NS).
 ** Based on specific absorption rate (SAR).

5.2.2 Procedure

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/cm²);

P = power input to the antenna (in appropriate units, e.g., mW);

G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain;

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm);

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

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

Calculated Result:

Mode	Frequency (MHz)	Antenna Gain		Conducted output power including Tune-up Tolerance		Evaluation Distance (m)	Power Density (W/m ²)	MPE limit (W/m ²)
		(dBi)	(numeric)	(dBm)	(W)			
Wi-Fi	2412-2462	3.66	2.32	22.0	0.158	0.2	0.73	5.37
FHSS 2.4G	2402-2477	3.14	2.06	16.5	0.045	0.2	0.18	5.35

Note:

The Maximum Conducted Power including Tune-up Tolerance was declared by manufacturer.
The Wi-Fi and FHSS cann transmit simultaneously.

The ratio = $MPE_{Wi-Fi}/Limit + MPE_{FHSS}/Limit = 0.73/5.37 + 0.18/5.35 = 0.17 < 1$

Result: Compliant

6. EUT PHOTOGRAPHS

Please refer to the attachment CR230744652-EXP EUT EXTERNAL PHOTOGRAPHS and CR230744652-INP EUT INTERNAL PHOTOGRAPHS

7. TEST SETUP PHOTOGRAPHS

Please refer to the attachment CR230744652-00A-TSP TEST SETUP PHOTOGRAPHS.

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