



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



TEST REPORT

Applicant: Anker Innovations Limited

Address: Room 1318-19, Hollywood Plaza, 610 Nathan Road, Mongkok, Kowloon, Hong Kong

FCC ID: 2AOKB-D2341

IC: 23451-D2341

HVIN: D2341, D2350

Product Name: Nebula Cosmos Laser(Nebula Cosmos Laser 4K)

**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 compliance with the requirement of the relative standards by China Certification ICT Co., Ltd (Dongguan)

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Test Facility

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

The lab has been recognized as the FCC accredited lab under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No. : 442868, the FCC Designation No. : CN1314.

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

Declarations

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

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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	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.....	15
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:	18
3.4.1 Applicable Standard.....	18
3.4.2 EUT Setup.....	18
3.4.3 Test Procedure	19
3.5 CHANNEL SEPARATION	20
3.5.1 Applicable Standard.....	20
3.5.2 EUT Setup.....	20
3.5.3 Test Procedure	20
3.6 NUMBER OF HOPPING FREQUENCY	21
3.6.1 Applicable Standard.....	21
3.6.2 EUT Setup.....	21
3.6.3 Test Procedure	21
3.7 TIME OF OCCUPANCY(DWELL TIME).....	22
3.7.1 Applicable Standard.....	22

3.7.2 EUT Setup.....22

3.7.3 Test Procedure22

3.8 CONDUCTED PEAK OUTPUT POWER23

3.8.1 Applicable Standard.....23

3.8.2 EUT Setup.....23

3.8.3 Test Procedure23

3.9 100 KHZ BANDWIDTH OF FREQUENCY BAND EDGE.....24

3.9.1 Applicable Standard.....24

3.9.2 EUT Setup.....24

3.9.3 Test Procedure24

3.10 ANTENNA REQUIREMENT.....25

3.10.1 Applicable Standard.....25

3.10.2 Judgment.....25

4. TEST DATA AND RESULTS 26

4.1 AC LINE CONDUCTED EMISSIONS.....26

4.2 RADIATION SPURIOUS EMISSIONS31

4.3 20 dB EMISSION BANDWIDTH:39

4.3 99% OCCUPIED BANDWIDTH:43

4.5 CHANNEL SEPARATION:47

4.6 NUMBER OF HOPPING FREQUENCY:51

4.7 TIME OF OCCUPANCY(DWELL TIME):.....53

4.8 PEAK CONDUCTED OUTPUT POWER:57

4.9 100 KHZ BANDWIDTH OF FREQUENCY BAND EDGE:58

5. RF EXPOSURE EVALUATION 65

5.1 MAXIMUM PERMISSIBLE EXPOSURE (MPE)65

5.1.1 APPLICABLE STANDARD.....65

5.1.2 PROCEDURE.....65

5.1.3 CALCULATED RESULT66

5.2 EXEMPTION LIMITS FOR ROUTINE EVALUATION – RF EXPOSURE EVALUATION 67

5.2.1 APPLICABLE STANDARD.....67

5.2.2 CALCULATED RESULT67

1. GENERAL INFORMATION

1.1 Product Description for Equipment under Test (EUT)

EUT Name:	Nebula Cosmos Laser(Nebula Cosmos Laser 4K)
EUT Model:	D2350
Multiple model:	D2341
Operation Frequency:	2402-2480 MHz
Maximum Peak Output Power (Conducted):	4.59 dBm
Modulation Type:	GFSK, $\pi/4$ -DQPSK, 8DPSK
Rated Input Voltage:	AC 100-240 V 50/60Hz
Serial Number:	CR21090056-RF-S1(Model: D2350) CR21090056-RF-S2(Model: D2341)
EUT Received Date:	2021.09.28

Note: The Multiple models are identical with Test model, please refer to the declaration letter for more detail, which was provided by manufacturer. Test only performed with model: D2350, except AC line conducted test and radiation emission below 1GHz test.

Operation Frequency Detail:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	40	2442
1	2403	41	2443
...
...
..	...	78	2480
39	2441	/	/

Per section 15.31(m), the lowest frequency, middle frequency, and highest frequency were performed the test as below:

Test Channel	Frequency (MHz)
Lowest	2402
Middle	2441
Highest	2480

Antenna Information Detail▲:

Antenna Manufacturer	Antenna Type	input impedance (Ohm)	Antenna Gain /Frequency Range	§15.203& RSS-Gen Requirement
Anker Innovations Limited	FPC	50	2.87 dBi/2.4~2.5GHz	Compliance

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:	FCC_V2.24		
The software " FCC_V2.24 "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
GFSK	4	4	4
$\pi/4$ -DQPSK	4	4	4
8DPSK	4	4	4

1.2.2 Support Equipment List and Details

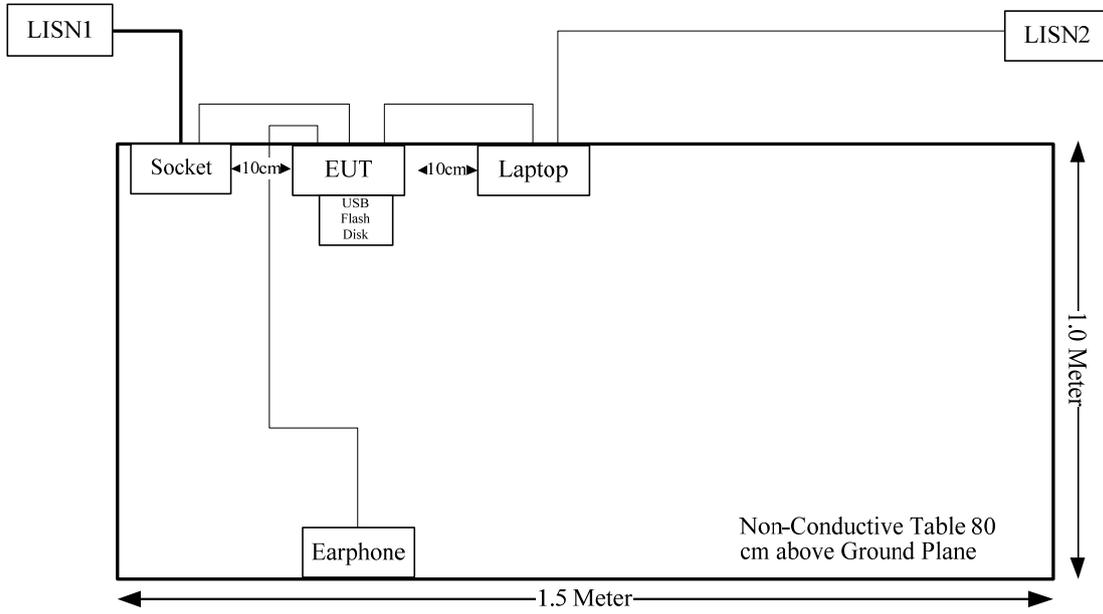
Manufacturer	Description	Model	Serial Number
Unknown	Earphone	Unknown	Earphone 01
Kingston	USB Flash Disk	DataTraveler	122775
DELL	Laptop	E6410	QDS-BRCM1017

1.2.3 Support Cable List and Details

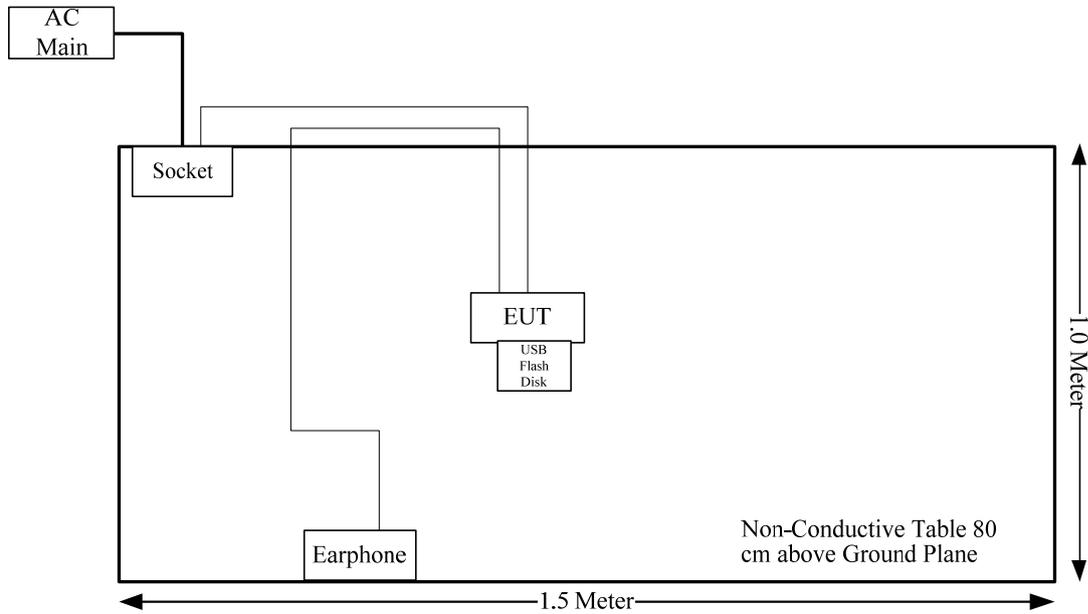
Cable Description	Shielding Type	Ferrite Core	Length (m)	From Port	To
Earphone Cable	No	No	1.2	Headphone	EUT
HDMI Cable	yes	yes	1.5	Laptop	EUT

1.2.4 Block Diagram of Test Setup

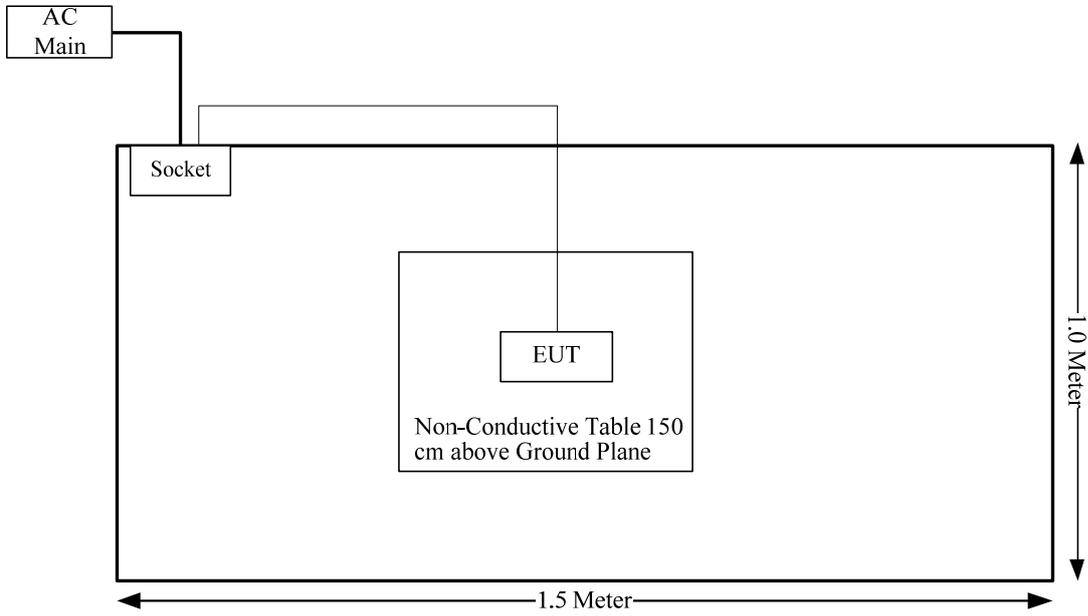
AC line conducted emissions:



Spurious emissions below 1GHz:



Spurious emissions Above 1GHz:



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

FCC Rules	Description of Test	Result
FCC §15.207(a) RSS-Gen Clause 8.8	AC line conducted emissions	Compliance
FCC §15.205, §15.209, §15.247(d) RSS-Gen Clause 8.10	Spurious emissions	Compliance
FCC §15.247(a)(1) RSS-247 Clause 5.1 b)	20 dB bandwidth	Compliance
RSS-Gen Clause 6.7	99% Occupied Bandwidth	Compliance
FCC §15.247(a)(1) RSS-247 Clause 5.1 b)	Channel separation	Compliance
FCC §15.247(a)(1)(iii) RSS-247 Clause 5.1 d)	Number of hopping Frequency	Compliance
FCC §15.247(a)(1)(iii) RSS-247 Clause 5.1 d)	Time of occupancy (dwell time)	Compliance
FCC §15.247(b)(1) RSS-247 Clause 5.4 b)	Peak output power measurement	Compliance
FCC §15.247(d) RSS-247 Clause 5.5	Band edges	Compliance
FCC §15.203 RSS-GEN Clause 6.8	Antenna requirement	Compliance
§15.247 (i) & §1.1310 & §2.1091	Maximum Permissible Exposure (MPE)	Compliance
RSS-102 Clause 2.5.2	Exemption Limits For Routine Evaluation-RF Exposure Evaluation	Compliance

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

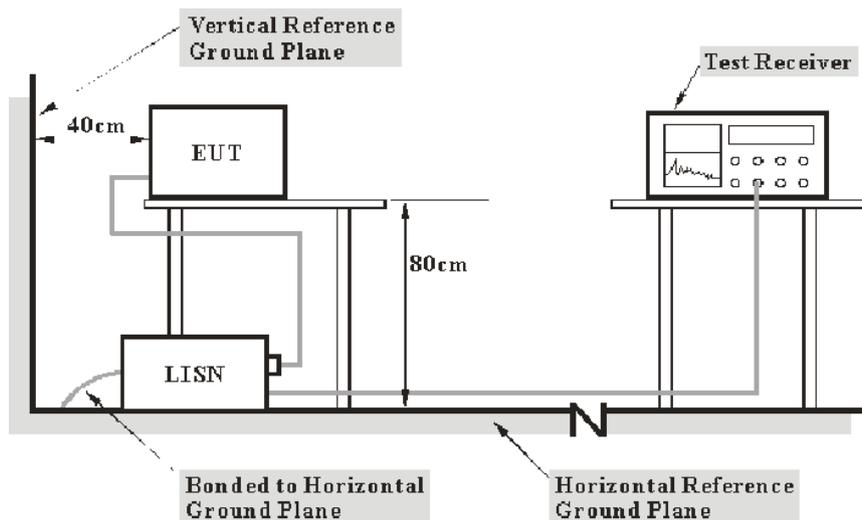
Note 1: The level decreases linearly with the logarithm of the frequency.

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);

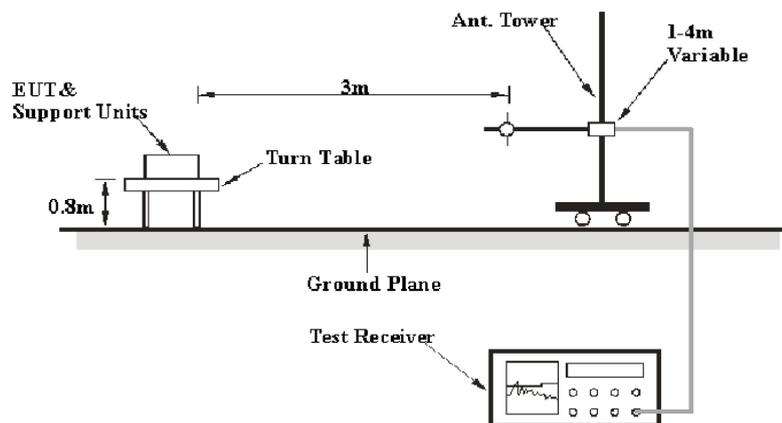
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the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

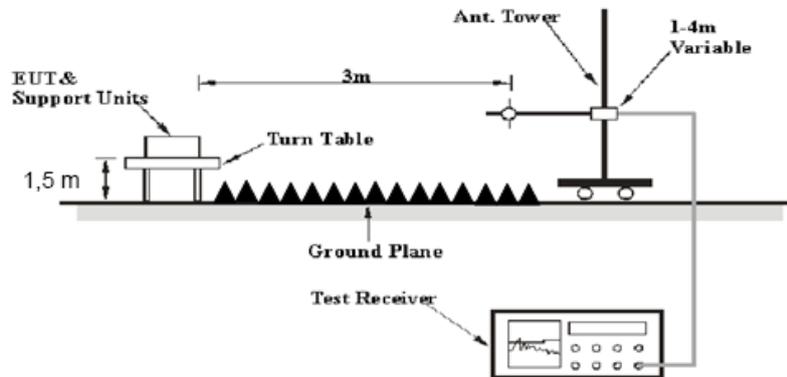
RSS-247 Clause 5.5

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

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:

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:

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

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

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT on the test table without connection to measurement instrument. Turn on the EUT. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

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

5. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
6. Position the EUT on the test table without connection to measurement instrument. Turn on the EUT. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
7. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
8. Use Occupied bandwidth test function, measure the 99% Occupied bandwidth.
9. Repeat above procedures until all frequencies measured were complete.

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:

- a) Span: Wide enough to capture the peaks of two adjacent channels.
- b) 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.
- c) Video (or average) bandwidth (VBW) \geq RBW.
- d) Sweep: Auto.
- e) Detector function: Peak.
- f) Trace: Max hold.
- g) 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

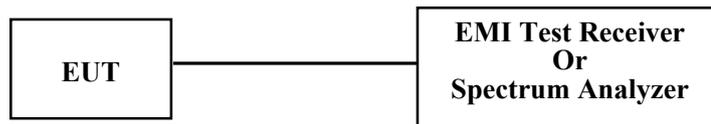
FCC §15.247 (a)(1)(iii)

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

The EUT was worked in channel hopping; the time of single pulses was tested.

3.8 Conducted Peak Output Power

3.8.1 Applicable Standard

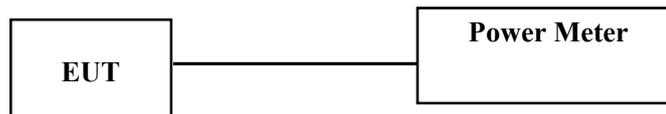
FCC §15.247 (b)(1)

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)

- 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

1. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to one test equipment.
2. Add a correction factor to the display.

3.9 100 kHz Bandwidth of Frequency Band Edge

3.9.1 Applicable Standard

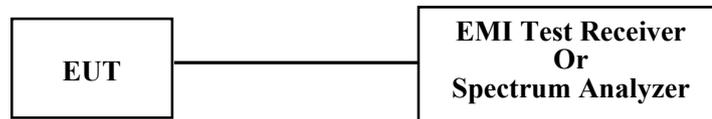
FCC §15.247 (d);

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

- 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 specified in 11.11. 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

Please refer to the Antenna Information detail in Section 1.

4. TEST DATA AND RESULTS

4.1 AC Line Conducted Emissions

Serial Number:	CR21090056-RF-S1	Test Date:	2021-10-24
Test Site:	CE	Test Mode:	Transmitting
Tester:	Alex Hu	Test Result:	Pass

Environmental Conditions:					
Temperature: (°C)	26.2	Relative Humidity: (%)	62	ATM Pressure: (kPa)	100.4

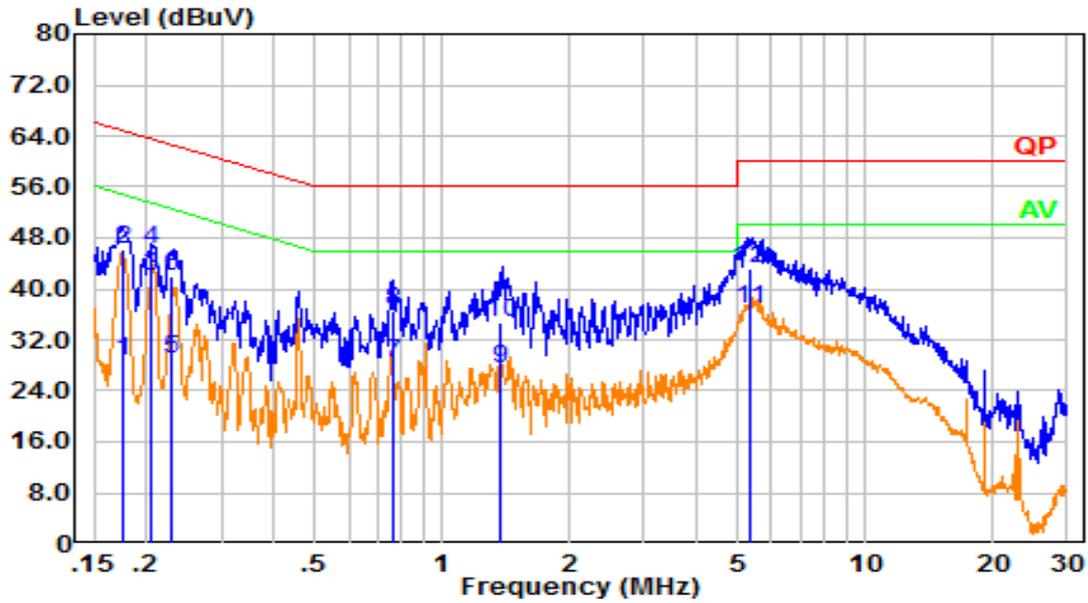
Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	LISN	ENV216	101132	2021-04-25	2022-04-24
R&S	EMI Test Receiver	ESR3	102726	2021-07-22	2022-07-21
MICRO-COAX	Coaxial Cable	UTIFLEX	C-0200-01	2021-08-08	2022-08-07
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).

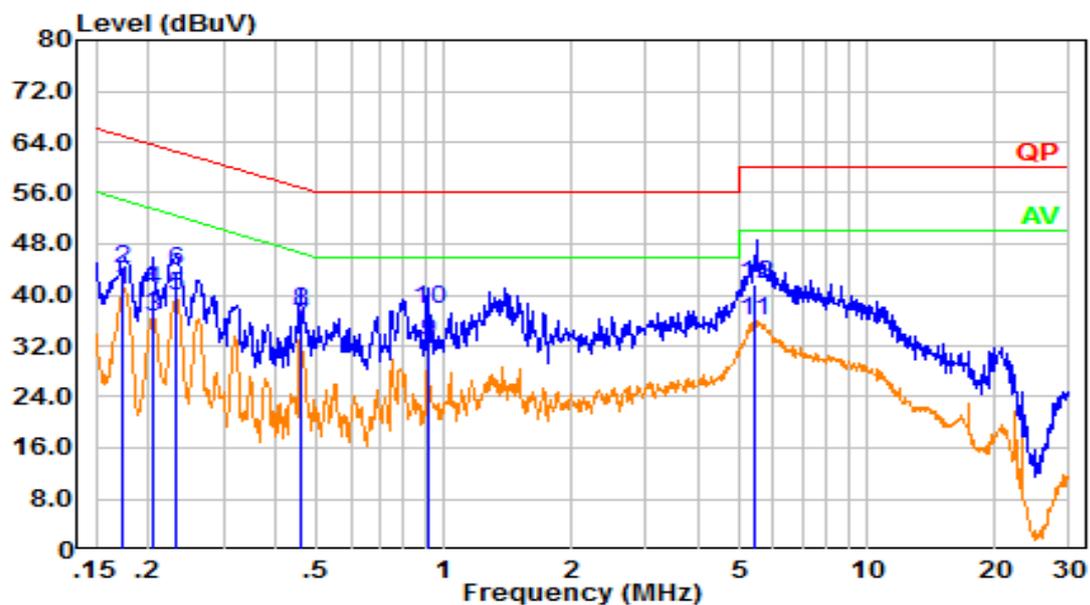
Model: D2350

Line:



No.	Frequency (MHz)	Reading (dB μ V)	Factor (dB)	Result (dB μ V)	Limit (dB μ V)	Margin (dB)	Detector
1	0.175	19.06	9.61	28.67	54.73	26.06	Average
2	0.175	36.48	9.61	46.09	64.73	18.63	QP
3	0.204	32.29	9.61	41.90	53.44	11.54	Average
4	0.204	36.46	9.61	46.07	63.44	17.37	QP
5	0.230	19.29	9.61	28.90	52.44	23.54	Average
6	0.230	32.29	9.61	41.90	62.44	20.54	QP
7	0.762	18.90	9.62	28.52	46.00	17.48	Average
8	0.762	26.94	9.62	36.56	56.00	19.44	QP
9	1.374	17.70	9.62	27.33	46.00	18.67	Average
10	1.374	25.09	9.62	34.71	56.00	21.29	QP
11	5.307	27.16	9.66	36.82	50.00	13.18	Average
12	5.307	33.47	9.66	43.13	60.00	16.87	QP

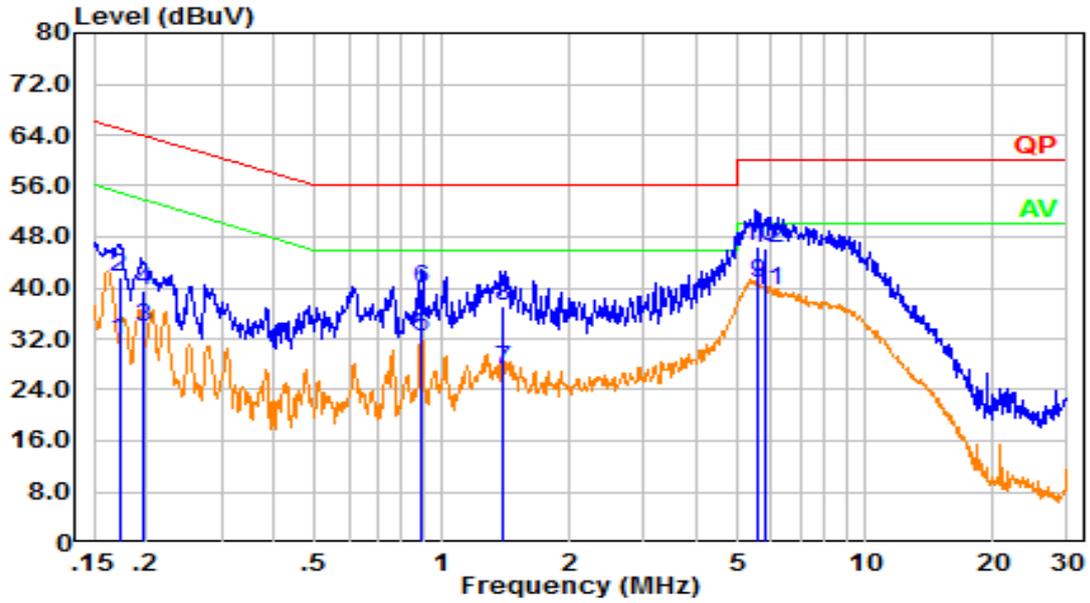
Neutral:



No.	Frequency (MHz)	Reading (dB μ V)	Factor (dB)	Result (dB μ V)	Limit (dB μ V)	Margin (dB)	Detector
1	0.174	31.17	9.61	40.78	54.76	13.98	Average
2	0.174	34.61	9.61	44.22	64.76	20.54	QP
3	0.205	26.79	9.61	36.40	53.41	17.01	Average
4	0.205	31.05	9.61	40.66	63.41	22.75	QP
5	0.232	30.21	9.61	39.82	52.38	12.56	Average
6	0.232	34.21	9.61	43.82	62.38	18.56	QP
7	0.457	25.47	9.61	35.08	46.74	11.66	Average
8	0.457	27.85	9.61	37.46	56.74	19.29	QP
9	0.916	22.89	9.62	32.51	46.00	13.49	Average
10	0.916	28.01	9.62	37.63	56.00	18.37	QP
11	5.413	26.20	9.66	35.86	50.00	14.14	Average
12	5.413	31.91	9.66	41.57	60.00	18.43	QP

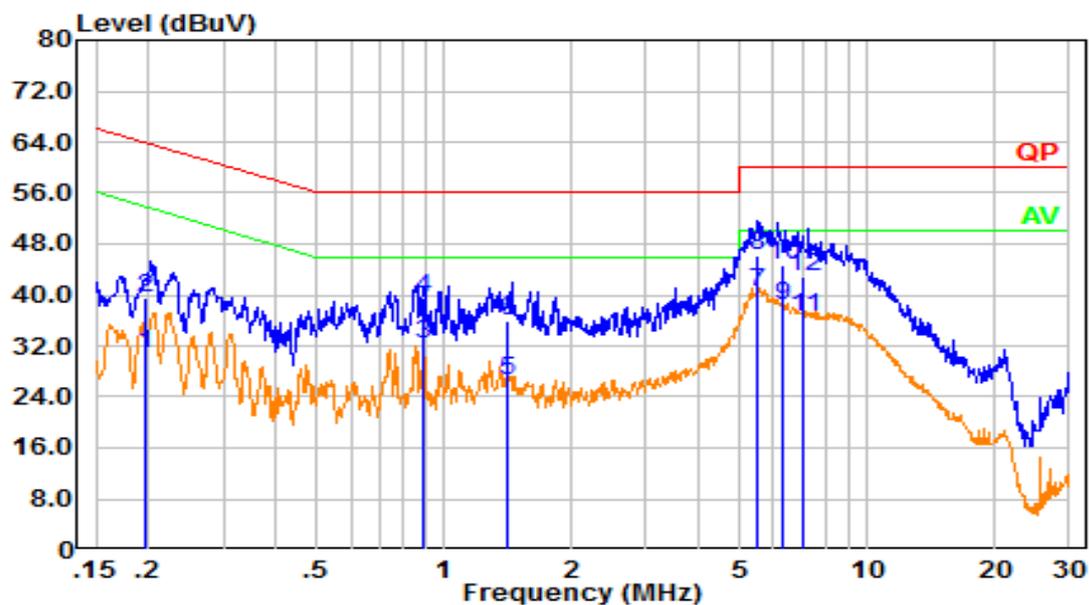
Model: D2341

Line:



No.	Frequency (MHz)	Reading (dBμV)	Factor (dB)	Result (dBμV)	Limit (dBμV)	Margin (dB)	Detector
1	0.172	22.14	9.61	31.75	54.86	23.11	Average
2	0.172	32.00	9.61	41.61	64.86	23.25	QP
3	0.195	24.16	9.61	33.77	53.82	20.04	Average
4	0.195	30.07	9.61	39.68	63.82	24.13	QP
5	0.890	22.78	9.62	32.40	46.00	13.60	Average
6	0.890	30.23	9.62	39.85	56.00	16.15	QP
7	1.383	17.56	9.62	27.19	46.00	18.81	Average
8	1.383	27.61	9.62	37.23	56.00	18.77	QP
9	5.598	31.24	9.66	40.90	50.00	9.10	Average
10	5.598	36.97	9.66	46.63	60.00	13.37	QP
11	5.842	29.93	9.66	39.59	50.00	10.41	Average
12	5.842	36.40	9.66	46.06	60.00	13.94	QP

Neutral:



No.	Frequency (MHz)	Reading (dB μ V)	Factor (dB)	Result (dB μ V)	Limit (dB μ V)	Margin (dB)	Detector
1	0.197	21.09	9.61	30.70	53.72	23.03	Average
2	0.197	29.95	9.61	39.56	63.72	24.16	QP
3	0.893	22.58	9.62	32.20	46.00	13.80	Average
4	0.893	30.06	9.62	39.68	56.00	16.32	QP
5	1.410	17.04	9.62	26.66	46.00	19.34	Average
6	1.410	26.17	9.62	35.80	56.00	20.20	QP
7	5.455	30.92	9.66	40.58	50.00	9.42	Average
8	5.455	36.48	9.66	46.14	60.00	13.86	QP
9	6.273	28.69	9.66	38.35	50.00	11.65	Average
10	6.273	35.02	9.66	44.68	60.00	15.32	QP
11	7.090	26.95	9.66	36.61	50.00	13.39	Average
12	7.090	33.27	9.66	42.93	60.00	17.07	QP

4.2 Radiation Spurious Emissions

Serial Number:	CR21090056-RF-S1	Test Date:	2021-10-28~2021-10-29
Test Site:	966-1/966-2	Test Mode:	Transmitting
Tester:	Great Qiao, Carl Liang	Test Result:	Pass

Environmental Conditions:

Temperature: (°C)	24.3~27.6	Relative Humidity: (%)	61	ATM Pressure: (kPa)	101.5
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Test Equipment List and Details:

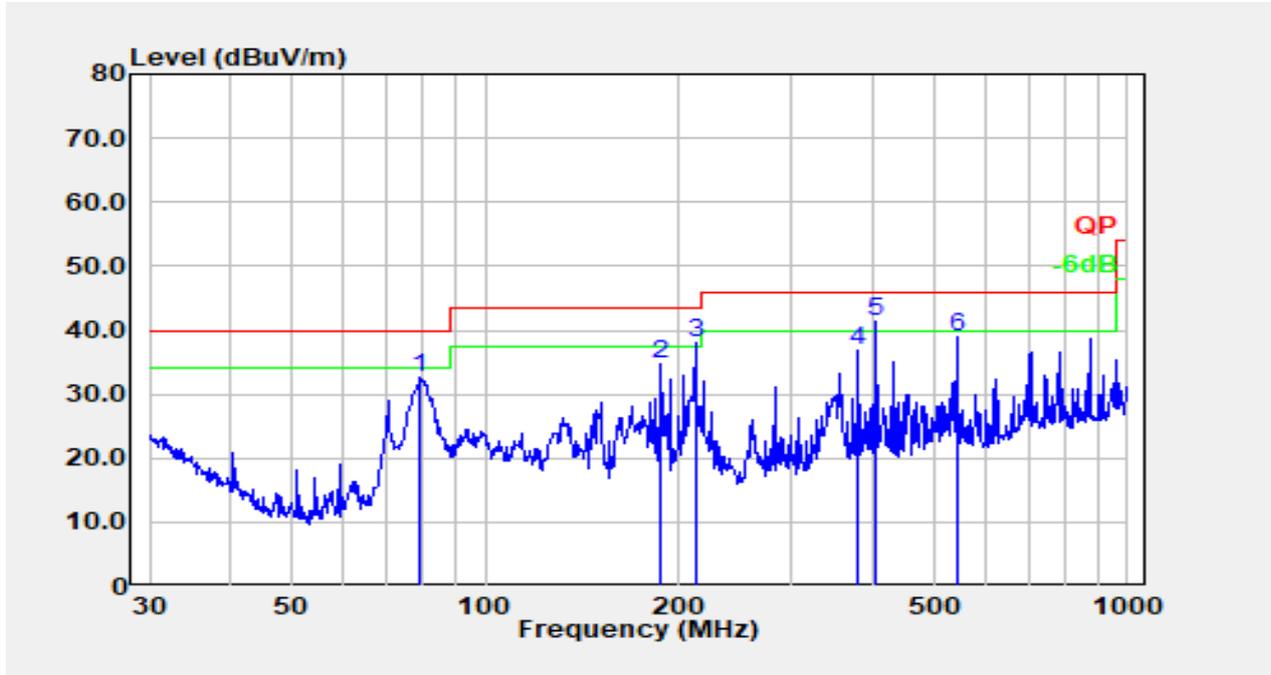
Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Sunol Sciences	Antenna	JB6	A082520-5	2020-10-19	2023-10-18
R&S	EMI Test Receiver	ESR3	102724	2021-07-22	2022-07-21
TIMES MICROWAVE	Coaxial Cable	LMR-600-UltraFlex	C-0470-02	2021-07-18	2022-07-17
TIMES MICROWAVE	Coaxial Cable	LMR-600-UltraFlex	C-0780-01	2021-07-18	2022-07-17
Sonoma	Amplifier	310N	186165	2021-07-18	2022-07-17
Audix	Test Software	E3	201021 (V9)	N/A	N/A
ETS-Lindgren	Horn Antenna	3115	9912-5985	2020-10-13	2023-10-12
PASTERNAK	Horn Antenna	PE9852/2F-20	112002	2021-02-05	2023-02-04
R&S	Spectrum Analyzer	FSV40	101591	2021-07-22	2022-07-21
MICRO-COAX	Coaxial Cable	UFA210A-1-1200-70U300	217423-008	2021-08-08	2022-08-07
MICRO-COAX	Coaxial Cable	UFA210A-1-2362-300300	235780-001	2021-08-08	2022-08-07
MICRO-COAX	Coaxial Cable	UFB142A-1-2362-200200	235772-001	2021-08-08	2022-08-07
Mini	Pre-amplifier	ZVA-183-S+	5969001149	2021-08-08	2022-08-07
AH	Preamplifier	PAM-1840VH	190	2020-11-20	2021-11-19
E-Microwave	Band Rejection Filter	2400-2483.5MHz	OE01902424	2021-08-08	2022-08-07
Mini Circuits	High Pass Filter	VHF-6010+	31119	2021-08-08	2022-08-07

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

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

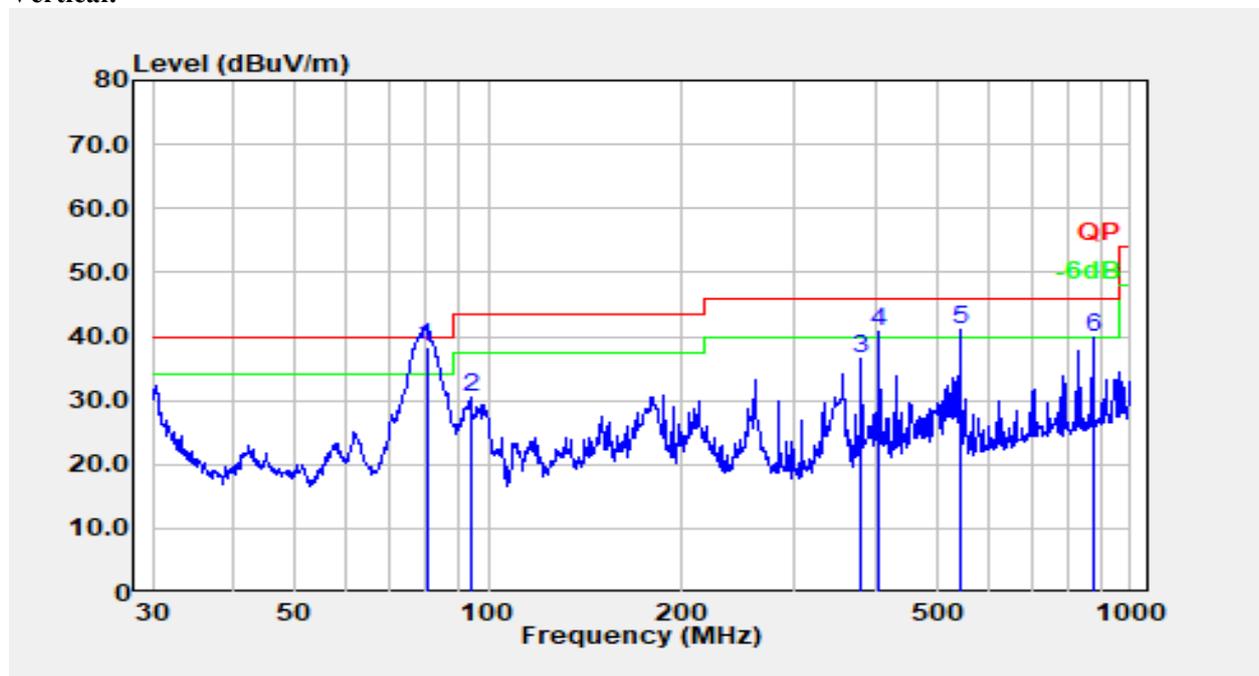
Model: D2350

Horizontal:



No.	Frequency (MHz)	Reading (dBμV)	Factor (dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector
1	78.965	50.10	-17.60	32.50	40.00	7.50	Peak
2	187.096	48.51	-13.72	34.79	43.50	8.71	Peak
3	212.270	50.65	-12.69	37.96	43.50	5.54	QP
4	381.249	46.16	-9.31	36.85	46.00	9.15	Peak
5	406.088	50.06	-8.81	41.25	46.00	4.75	QP
6	541.373	45.05	-6.16	38.89	46.00	7.11	Peak

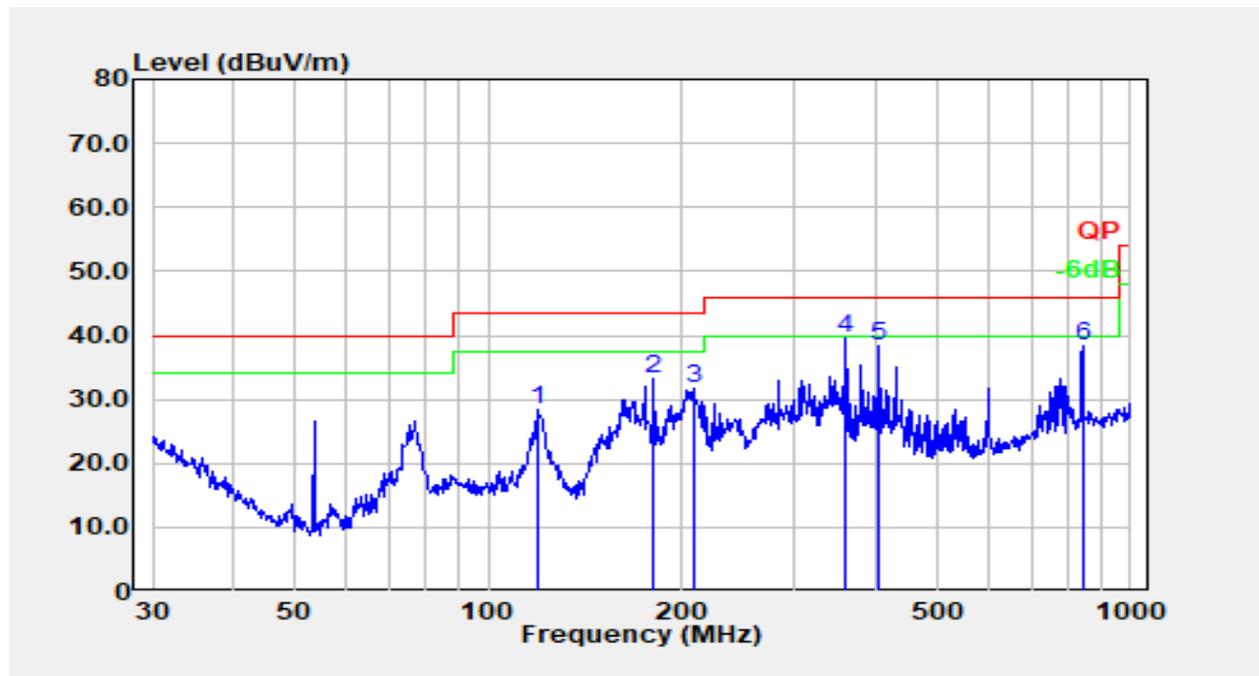
Vertical:



No.	Frequency (MHz)	Reading (dB μ V)	Factor (dB/m)	Result (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Detector
1	80.081	56.10	-17.70	38.40	40.00	1.60	QP
2	93.768	46.63	-16.22	30.41	43.50	13.09	Peak
3	381.249	45.75	-9.31	36.44	46.00	9.56	Peak
4	406.088	49.47	-8.81	40.66	46.00	5.34	QP
5	541.373	47.30	-6.16	41.14	46.00	4.86	QP
6	875.247	41.17	-1.41	39.76	46.00	6.24	Peak

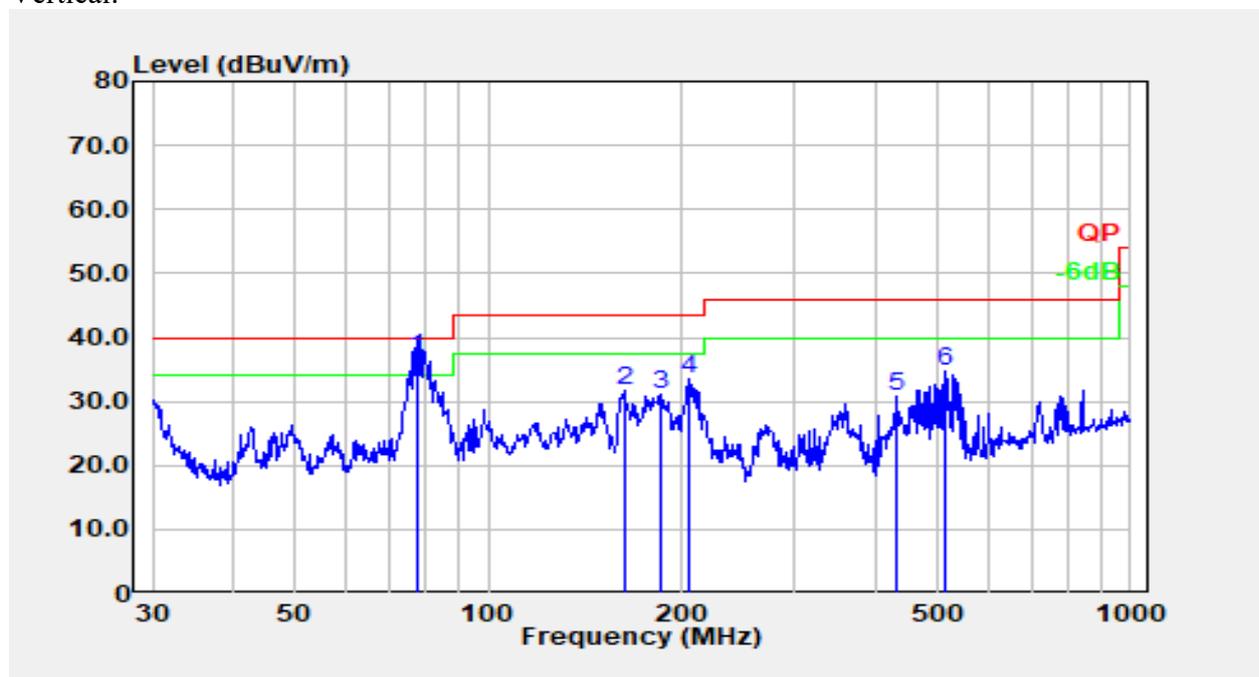
Model: D2341

Horizontal:



No.	Frequency (MHz)	Reading (dB μ V)	Factor (dB/m)	Result (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Detector
1	119.856	40.15	-11.75	28.40	43.50	15.10	Peak
2	181.283	47.15	-13.79	33.36	43.50	10.14	Peak
3	208.580	44.37	-12.58	31.79	43.50	11.71	Peak
4	360.448	49.70	-10.04	39.66	46.00	6.34	Peak
5	406.088	47.26	-8.81	38.45	46.00	7.55	Peak
6	842.130	40.07	-1.86	38.21	46.00	7.79	Peak

Vertical:



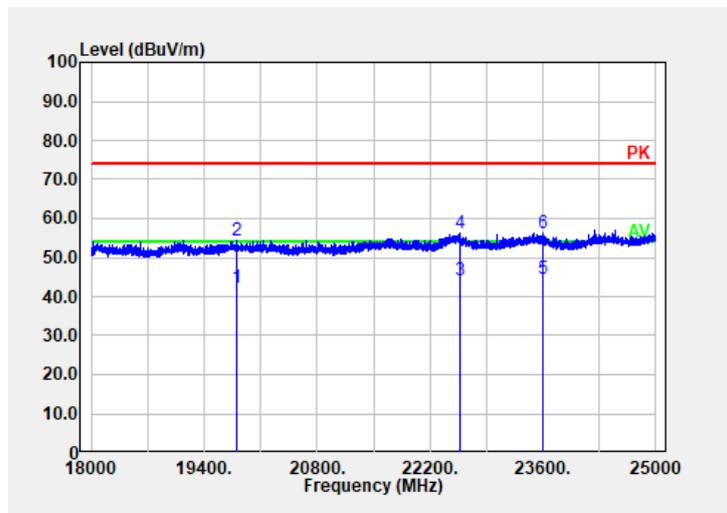
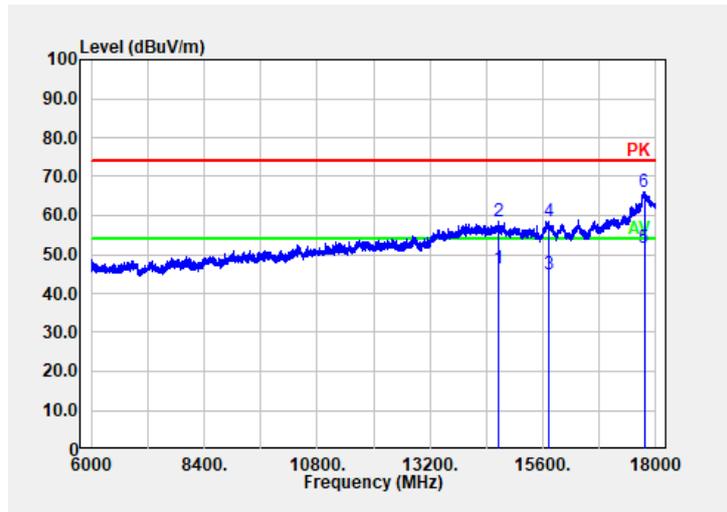
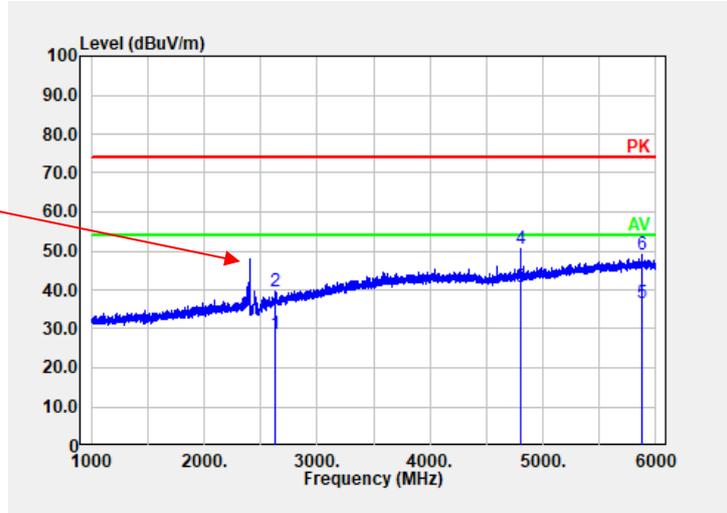
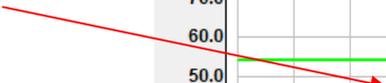
No.	Frequency (MHz)	Reading (dB μ V)	Factor (dB/m)	Result (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Detector
1	77.865	54.20	-17.49	36.71	40.00	3.29	QP
2	162.611	44.28	-12.54	31.74	43.50	11.76	Peak
3	185.788	44.72	-13.71	31.01	43.50	12.49	Peak
4	204.955	46.19	-12.53	33.66	43.50	9.84	Peak
5	431.032	38.38	-7.68	30.70	46.00	15.30	Peak
6	513.633	40.89	-6.06	34.83	46.00	11.17	Peak

2) 1-25GHz:*BDR Mode(GFSK) was the worst:*

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							
2402.00	70.48	PK	H	31.51	101.99	N/A	N/A
2402.00	64.57	AV	H	31.51	96.08	N/A	N/A
2402.00	67.86	PK	V	31.51	99.37	N/A	N/A
2402.00	62.17	AV	V	31.51	93.68	N/A	N/A
2390.00	28.37	PK	H	31.46	59.83	74.00	14.17
2390.00	17.15	AV	H	31.46	48.61	54.00	5.39
4804.00	41.49	PK	H	10.64	52.13	74.00	21.87
4804.00	30.16	AV	H	10.64	40.80	54.00	13.20
7206.00	35.62	PK	H	13.97	49.59	74.00	24.41
7206.00	23.10	AV	H	13.97	37.07	54.00	16.93
Middle Channel: 2441 MHz							
2441.00	69.65	PK	H	31.61	101.26	N/A	N/A
2441.00	63.12	AV	H	31.61	94.73	N/A	N/A
2441.00	66.31	PK	V	31.61	97.92	N/A	N/A
2441.00	60.58	AV	V	31.61	92.19	N/A	N/A
4882.00	40.35	PK	H	10.51	50.86	74.00	23.14
4882.00	30.25	AV	H	10.51	40.76	54.00	13.24
7323.00	35.62	PK	H	14.31	49.93	74.00	24.07
7323.00	23.54	AV	H	14.31	37.85	54.00	16.15
High Channel: 2480 MHz							
2480.00	70.08	PK	H	31.64	101.72	N/A	N/A
2480.00	64.46	AV	H	31.64	96.10	N/A	N/A
2480.00	67.58	PK	V	31.64	99.22	N/A	N/A
2480.00	61.54	AV	V	31.64	93.18	N/A	N/A
2483.50	27.85	PK	H	31.64	59.49	74.00	14.51
2483.50	17.23	AV	H	31.64	48.87	54.00	5.13
4960.00	40.21	PK	H	10.91	51.12	74.00	22.88
4960.00	29.84	AV	H	10.91	40.75	54.00	13.25
7440.00	35.74	PK	H	14.79	50.53	74.00	23.47
7440.00	23.57	AV	H	14.79	38.36	54.00	15.64

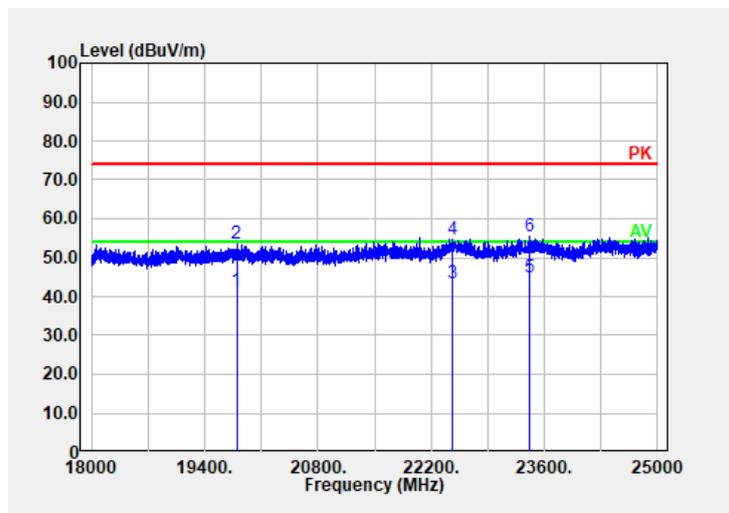
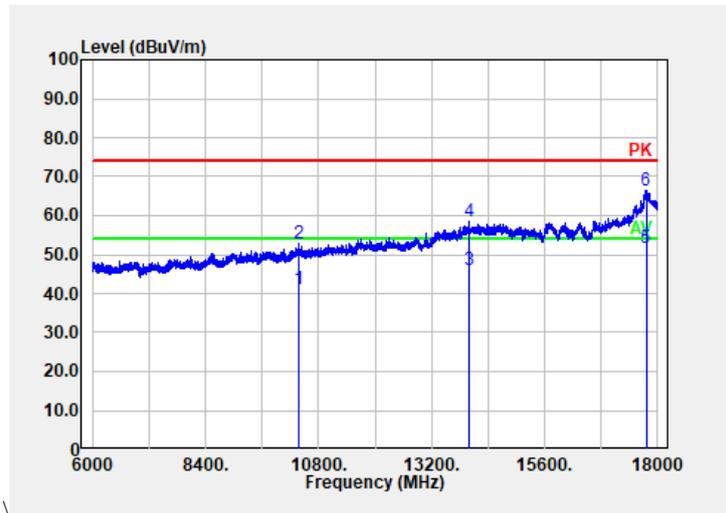
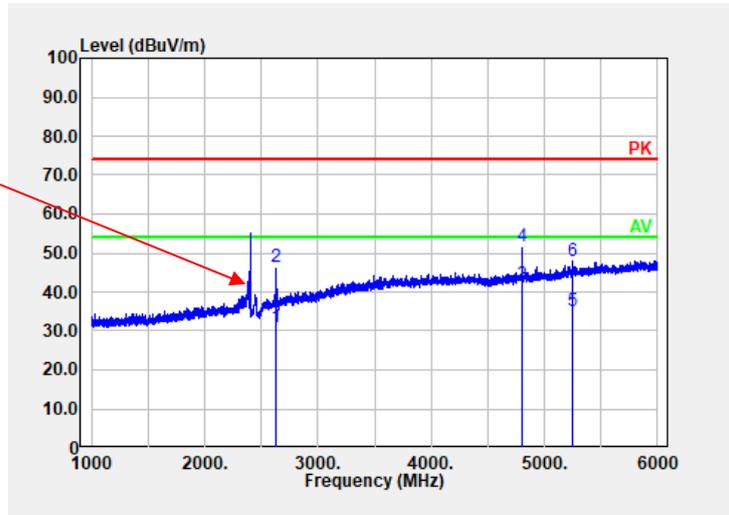
Worst Test plots(GFSK Low channel was the worst)
Horizontal:

Fundamental
Test with Band
Rejection Filter



Vertical:

Fundamental Test with Band Rejection Filter



4.3 20 dB Emission Bandwidth:

Serial Number:	CR21090056-RF-S1	Test Date:	2021/10/21
Test Site:	RF	Test Mode:	Transmitting
Tester:	Wolf Mo	Test Result:	N/A

Environmental Conditions:

Temperature: (°C)	25.9	Relative Humidity: (%)	60	ATM Pressure: (kPa)	100.8
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Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSU26	200256	2021-07-22	2022-07-21
zhuoxiang	Coaxial Cable	SMA-178	211001	Each time	N/A

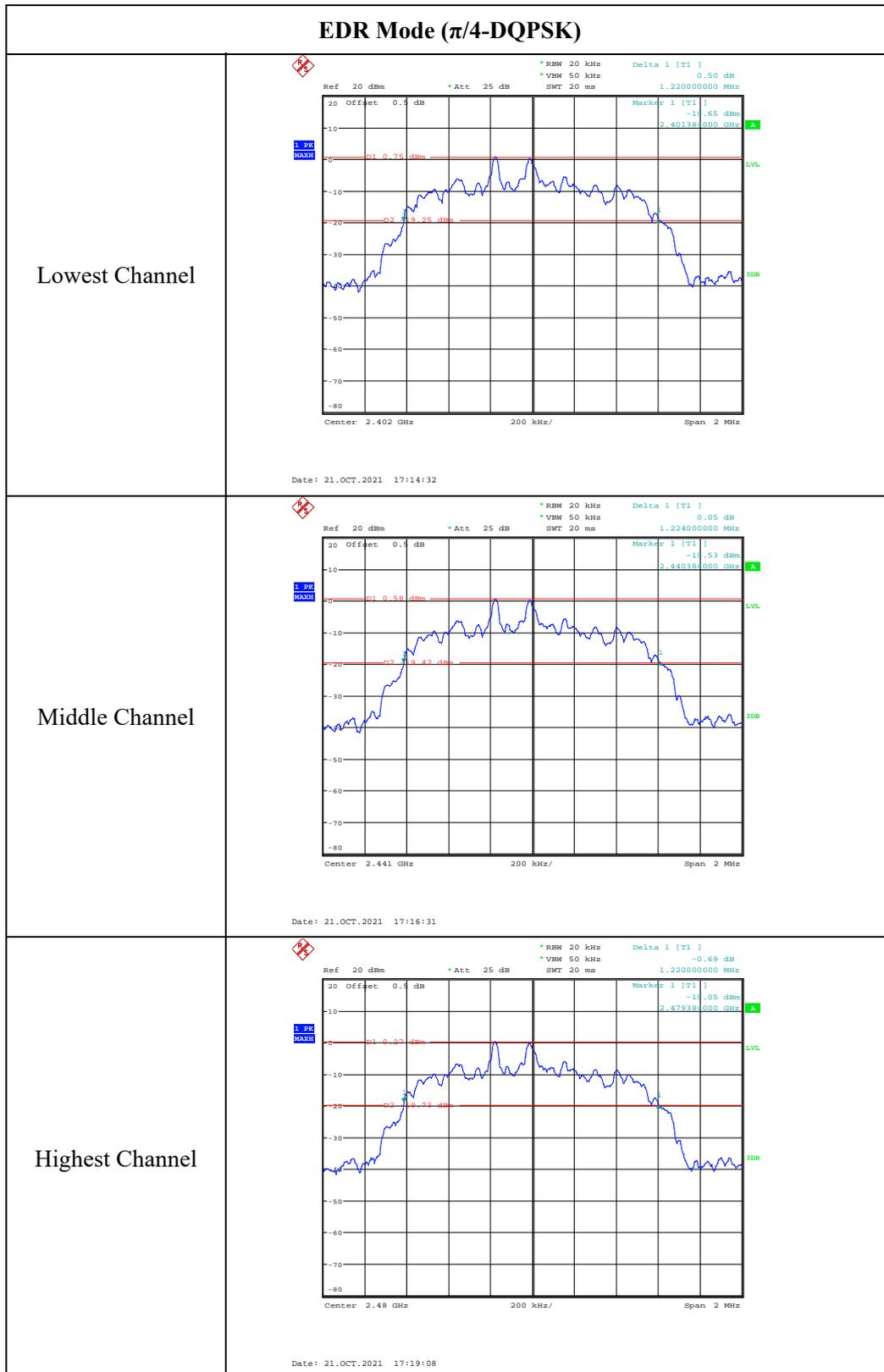
* Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

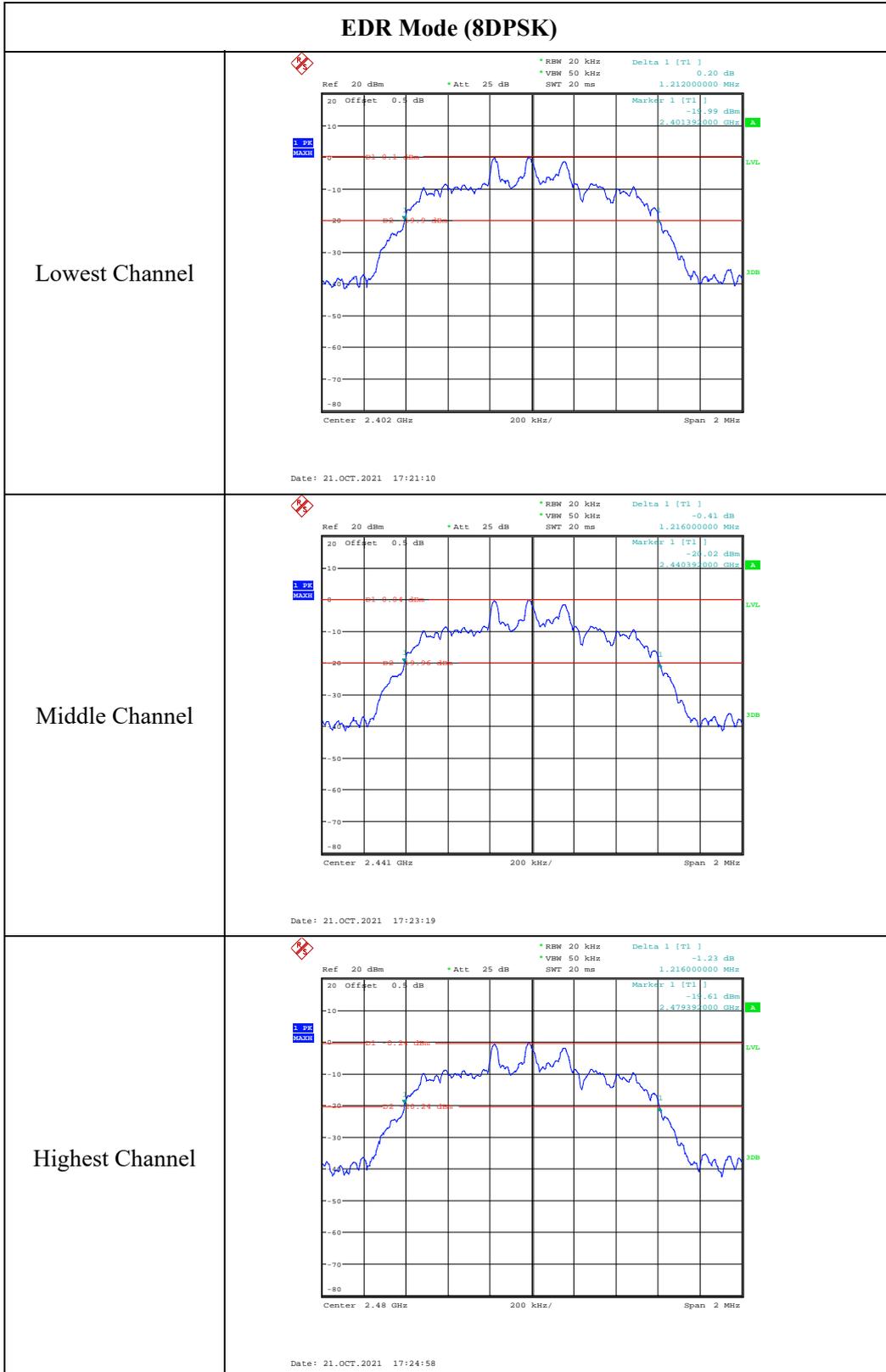
Test Data:

Test Modes	Test Channel	Test Frequency (MHz)	20 dB Bandwidth (MHz)
BDR Mode (GFSK)	Lowest	2402	0.872
	Middle	2441	0.924
	Highest	2480	0.928
EDR Mode ($\pi/4$ -DQPSK)	Lowest	2402	1.22
	Middle	2441	1.224
	Highest	2480	1.22
EDR Mode (8DPSK)	Lowest	2402	1.212
	Middle	2441	1.216
	Highest	2480	1.216

BDR Mode (GFSK)

<p>Lowest Channel</p>	<p>Ref 20 dBm *Att 25 dB *RBW 20 kHz Delta 1 [T1] 0.41 dB *VBM 50 kHz SWT 20 ms 972.000000000 kHz Marker 1 [T1] -14.73 dBm 2.401520000 GHz</p> <p>Center 2.402 GHz 200 kHz/ Span 2 MHz</p> <p>Date: 21.OCT.2021 17:08:55</p>
<p>Middle Channel</p>	<p>Ref 20 dBm *Att 25 dB *RBW 20 kHz Delta 1 [T1] -0.18 dB *VBM 50 kHz SWT 20 ms 924.000000000 kHz Marker 1 [T1] -15.00 dBm 2.440530000 GHz</p> <p>Center 2.441 GHz 200 kHz/ Span 2 MHz</p> <p>Date: 21.OCT.2021 17:10:45</p>
<p>Highest Channel</p>	<p>Ref 20 dBm *Att 25 dB *RBW 20 kHz Delta 1 [T1] -0.19 dB *VBM 50 kHz SWT 20 ms 928.000000000 kHz Marker 1 [T1] -15.27 dBm 2.479530000 GHz</p> <p>Center 2.48 GHz 200 kHz/ Span 2 MHz</p> <p>Date: 21.OCT.2021 17:12:09</p>





4.3 99% Occupied Bandwidth:

Serial Number:	CR21090056-RF-S1	Test Date:	2021/10/21
Test Site:	RF	Test Mode:	Transmitting
Tester:	Wolf Mo	Test Result:	Pass

Environmental Conditions:

Temperature: (°C)	25.9	Relative Humidity: (%)	60	ATM Pressure: (kPa)	100.8
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Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSU26	200256	2021-07-22	2022-07-21
zhuoxiang	Coaxial Cable	SMA-178	211001	Each time	N/A

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

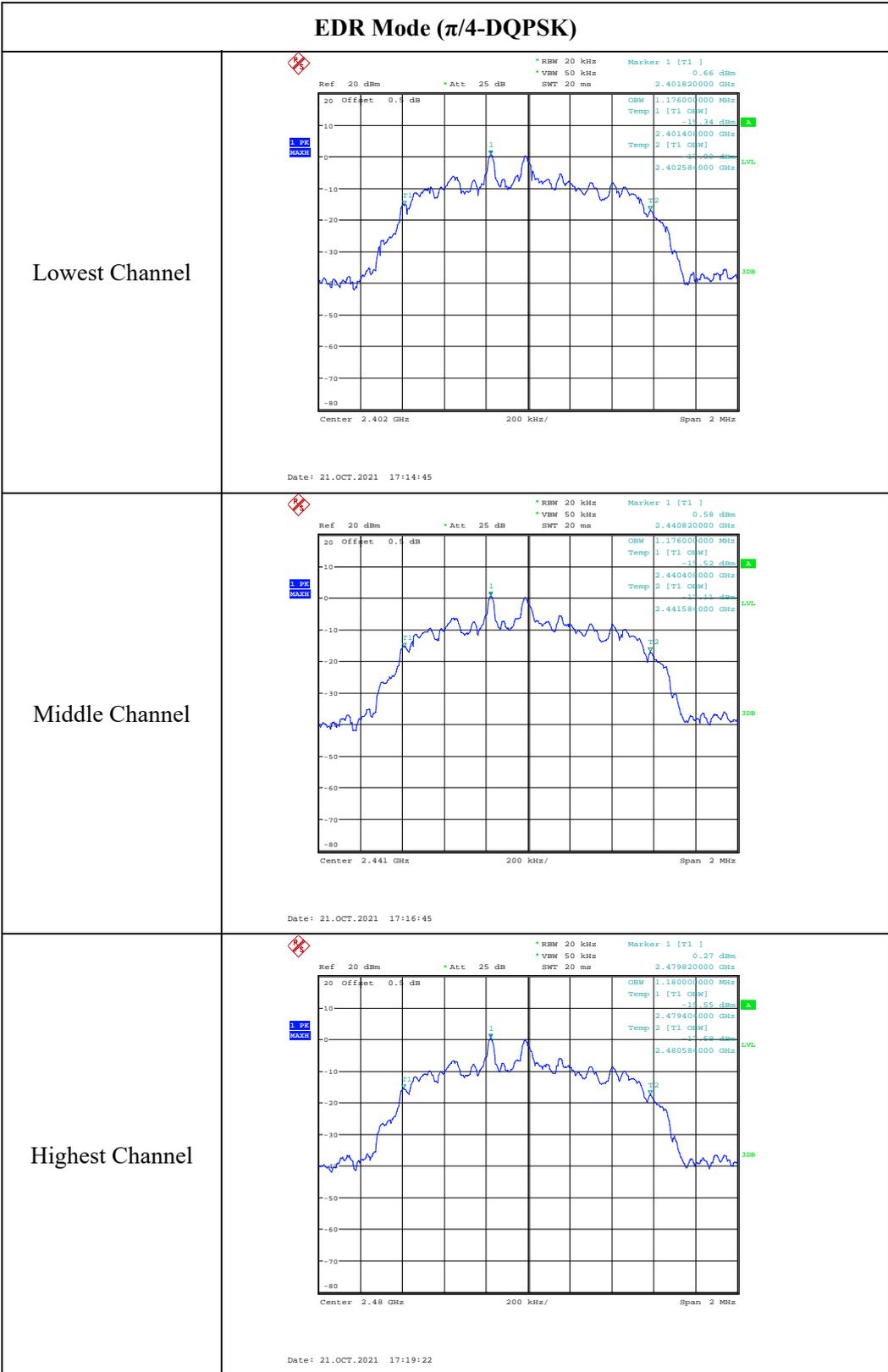
Test Data:

Test Modes	Test Channel	Test Frequency (MHz)	99% Occupied Bandwidth (MHz)
BDR Mode (GFSK)	Lowest	2402	0.876
	Middle	2441	0.876
	Highest	2480	0.880
EDR Mode ($\pi/4$ -DQPSK)	Lowest	2402	1.176
	Middle	2441	1.176
	Highest	2480	1.180
EDR Mode (8DPSK)	Lowest	2402	1.156
	Middle	2441	1.156
	Highest	2480	1.156

BDR Mode (GFSK)

<p>Lowest Channel</p>	<p>Ref 20 dBm * Att 25 dB * RBW 20 kHz Marker 1 [T1] * VBW 50 kHz 0.75 dBm SWT 20 ms 2.401924000 GHz</p> <p>Offset 0.4 dB OBW 0.000000000 kHz Temp 1 [T1 OHW] -15.70 dBm 2.401544000 GHz Temp 2 [T1 OHW] -2.56 dBm 2.402424000 GHz</p> <p>Center 2.402 GHz 200 kHz/ Span 2 MHz</p> <p>Date: 21.OCT.2021 17:09:09</p>
<p>Middle Channel</p>	<p>Ref 20 dBm * Att 25 dB * RBW 20 kHz Marker 1 [T1] * VBW 50 kHz 0.81 dBm SWT 20 ms 2.440820000 GHz</p> <p>Offset 0.4 dB OBW 0.000000000 kHz Temp 1 [T1 OHW] -15.78 dBm 2.440544000 GHz Temp 2 [T1 OHW] -2.82 dBm 2.441424000 GHz</p> <p>Center 2.441 GHz 200 kHz/ Span 2 MHz</p> <p>Date: 21.OCT.2021 17:11:02</p>
<p>Highest Channel</p>	<p>Ref 20 dBm * Att 25 dB * RBW 20 kHz Marker 1 [T1] * VBW 50 kHz 0.42 dBm SWT 20 ms 2.479820000 GHz</p> <p>Offset 0.4 dB OBW 0.000000000 kHz Temp 1 [T1 OHW] -15.01 dBm 2.479544000 GHz Temp 2 [T1 OHW] -2.88 dBm 2.480424000 GHz</p> <p>Center 2.48 GHz 200 kHz/ Span 2 MHz</p> <p>Date: 21.OCT.2021 17:12:23</p>

EDR Mode ($\pi/4$ -DQPSK)



EDR Mode (8DPSK)

<p>Lowest Channel</p>	<p>Date: 21.OCT.2021 17:21:24</p>
<p>Middle Channel</p>	<p>Date: 21.OCT.2021 17:23:33</p>
<p>Highest Channel</p>	<p>Date: 21.OCT.2021 17:25:12</p>

4.5 Channel Separation:

Serial Number:	CR21090056-RF-S1	Test Date:	2021/10/21
Test Site:	RF	Test Mode:	Transmitting
Tester:	Wolf Mo	Test Result:	Pass

Environmental Conditions:

Temperature: (°C)	25.9	Relative Humidity: (%)	60	ATM Pressure: (kPa)	100.8
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Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSU26	200256	2021/7/22	2022/7/21
zhuoxiang	Coaxial Cable	SMA-178	211001	Each time	N/A

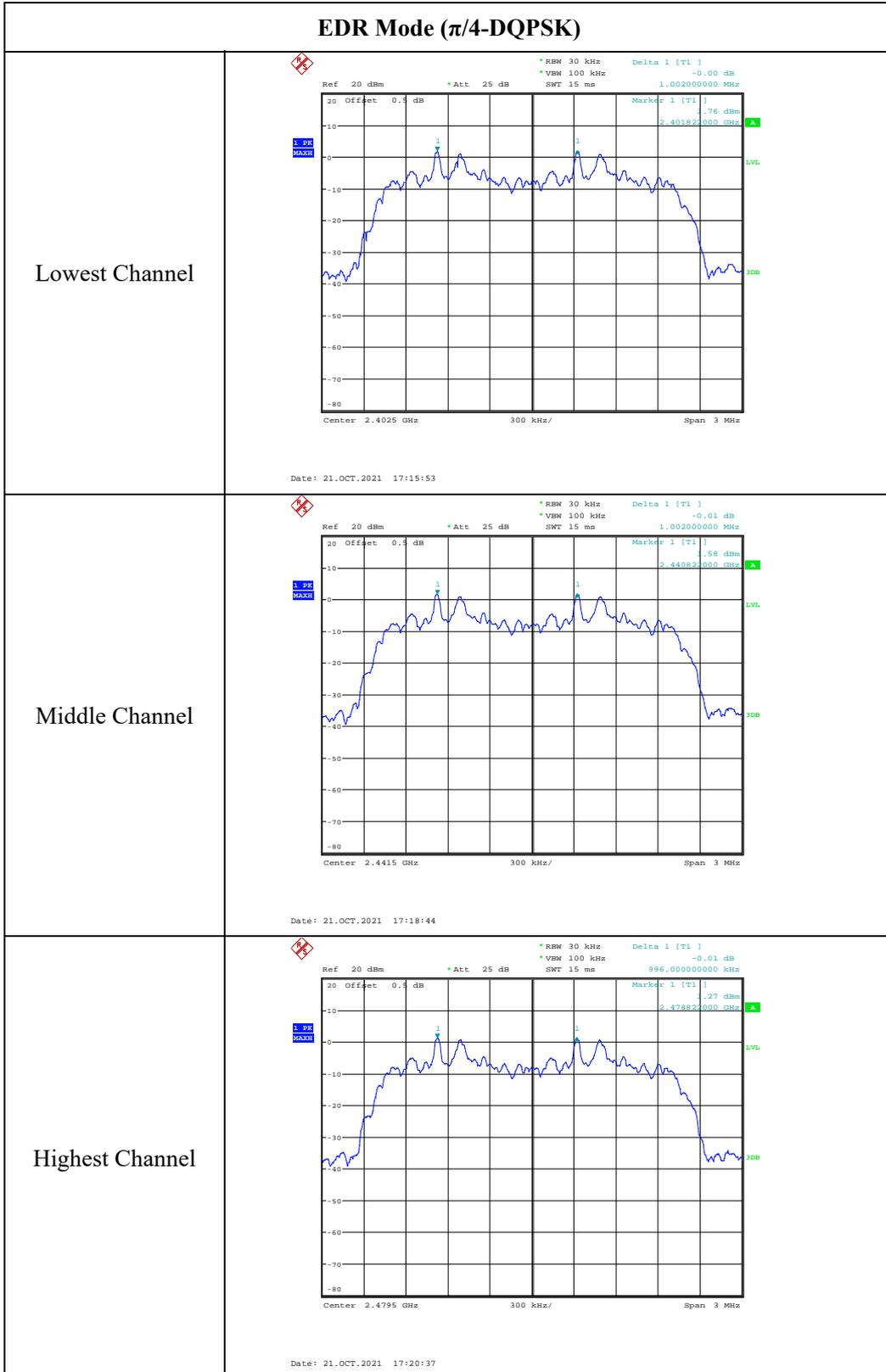
* Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data:

Test Modes	Test Frequency (MHz)	Channel Separation (MHz)	Limits (MHz)
BDR Mode (GFSK)	2402	1.002	0.581
	2441	1.002	0.616
	2480	0.996	0.619
EDR Mode ($\pi/4$ -DQPSK)	2402	1.002	0.813
	2441	1.002	0.816
	2480	0.996	0.813
EDR Mode (8DPSK)	2402	1.002	0.808
	2441	1.008	0.811
	2480	0.996	0.811

BDR Mode (GFSK)

<p>Lowest Channel</p>	<p>Date: 21.OCT.2021 17:10:17</p>
<p>Middle Channel</p>	<p>Date: 21.OCT.2021 17:11:44</p>
<p>Highest Channel</p>	<p>Date: 21.OCT.2021 17:13:44</p>



EDR Mode (8DPSK)

<p>Lowest Channel</p>	<p>Ref: 20 dBm *Att: 25 dB *RBW: 30 kHz Delta 1 [T1] -0.02 dB *VBW: 100 kHz *SWT: 15 ms 1.002000000 MHz</p> <p>Center: 2.4025 GHz 300 kHz/ Span: 3 MHz</p> <p>Date: 21.OCT.2021 17:22:43</p>
<p>Middle Channel</p>	<p>Ref: 20 dBm *Att: 25 dB *RBW: 30 kHz Delta 1 [T1] 0.00 dB *VBW: 100 kHz *SWT: 15 ms 1.008000000 MHz</p> <p>Center: 2.4415 GHz 300 kHz/ Span: 3 MHz</p> <p>Date: 21.OCT.2021 17:24:33</p>
<p>Highest Channel</p>	<p>Ref: 20 dBm *Att: 25 dB *RBW: 30 kHz Delta 1 [T1] -0.01 dB *VBW: 100 kHz *SWT: 15 ms 996.000000000 MHz</p> <p>Center: 2.4795 GHz 300 kHz/ Span: 3 MHz</p> <p>Date: 21.OCT.2021 17:26:26</p>

4.6 Number Of Hopping Frequency:

Serial Number:	CR21090056-RF-S1	Test Date:	2021/10/21
Test Site:	RF	Test Mode:	Transmitting
Tester:	Wolf Mo	Test Result:	Pass

Environmental Conditions:

Temperature: (°C)	25.9	Relative Humidity: (%)	60	ATM Pressure: (kPa)	100.8
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Test Equipment List and Details:

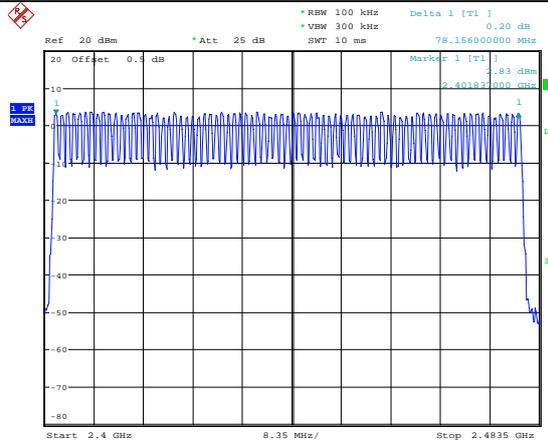
Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSU26	200256	2021/7/22	2022/7/21
zhuoxiang	Coaxial Cable	SMA-178	211001	Each time	N/A

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

Test Data:

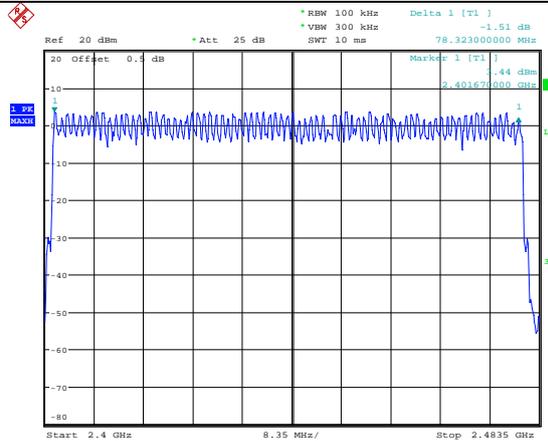
Test Modes	Frequency Range (MHz)	Number of Hopping Channel	Limits
GFSK	2400-2483.5	79	≥15
$\pi/4$ -DQPSK	2400-2483.5	79	≥15
8DPSK	2400-2483.5	79	≥15

BDR Mode (GFSK)



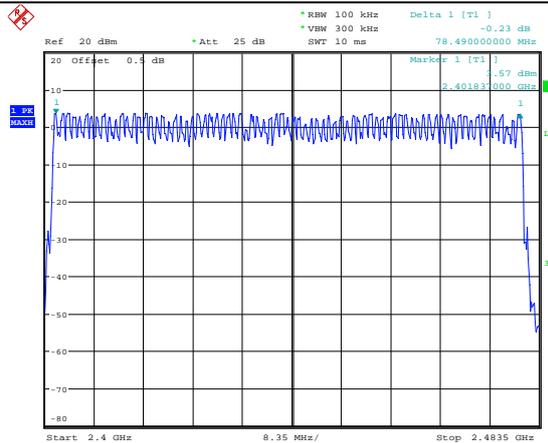
Date: 21.OCT.2021 17:38:19

EDR Mode ($\pi/4$ -DQPSK)



Date: 21.OCT.2021 17:42:12

EDR Mode (8DPSK)



Date: 21.OCT.2021 17:47:16

4.7 Time Of Occupancy(Dwell Time):

Serial Number:	CR21090056-RF-S1	Test Date:	2021/10/21
Test Site:	RF	Test Mode:	Transmitting
Tester:	Wolf Mo	Test Result:	Pass

Environmental Conditions:

Temperature: (°C)	25.9	Relative Humidity: (%)	60	ATM Pressure: (kPa)	100.8
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Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSU26	200256	2021/7/22	2022/7/21
zhuoxiang	Coaxial Cable	SMA-178	211001	Each time	N/A

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

Test Data:

Test Modes	Packet Type	Test Frequency (MHz)	Pulse width (ms)	Result (s)	Limit (s)
BDR Mode (GFSK)	DH1	2441	0.382	0.122	0.400
	DH3	2441	1.653	0.264	0.400
	DH5	2441	2.962	0.316	0.400
EDR Mode ($\pi/4$ -DQPSK)	2DH1	2441	0.390	0.125	0.400
	2DH3	2441	1.663	0.266	0.400
	2DH5	2441	2.940	0.314	0.400
EDR Mode (8DPSK)	3DH1	2441	0.390	0.125	0.400
	3DH3	2441	1.663	0.266	0.400
	3DH5	2441	2.948	0.314	0.400

Note:

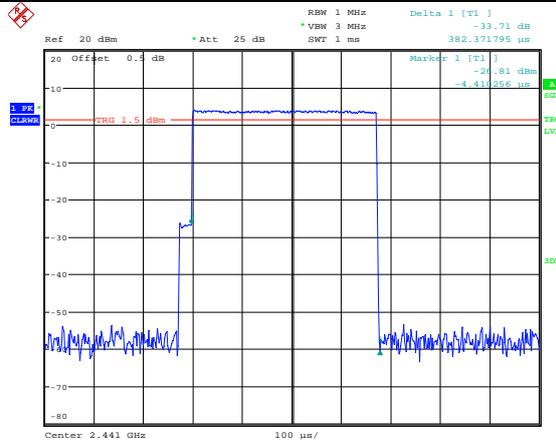
DH1:Dwell time=Pulse time (ms) \times (1600/2/79) \times 31.6 s

DH3:Dwell time=Pulse time (ms) \times (1600/4/79) \times 31.6 s

DH5:Dwell time=Pulse time (ms) \times (1600/6/79) \times 31.6 s

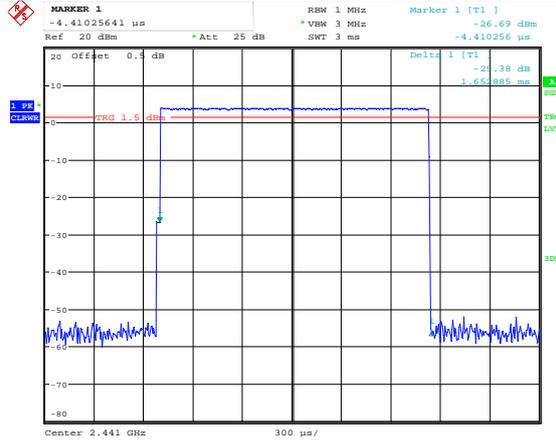
BDR Mode (GFSK)

DH1: Middle Channel



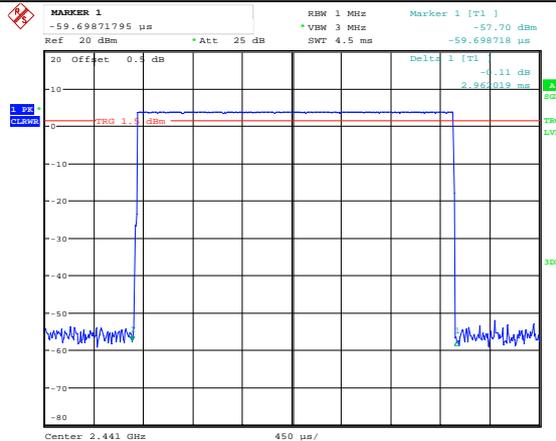
Date: 21.OCT.2021 18:01:28

DH3: Middle Channel

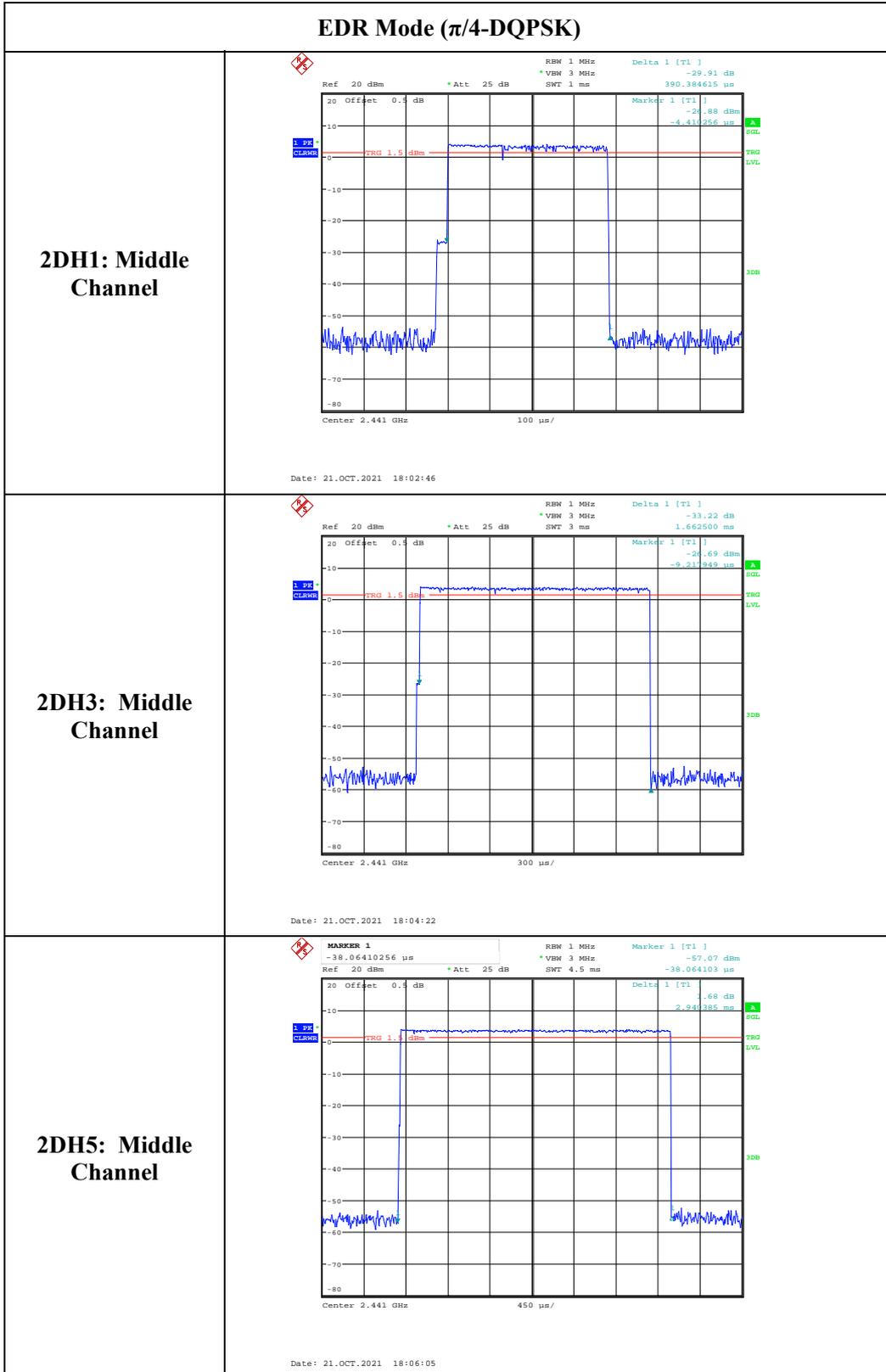


Date: 21.OCT.2021 18:03:51

DH5: Middle Channel

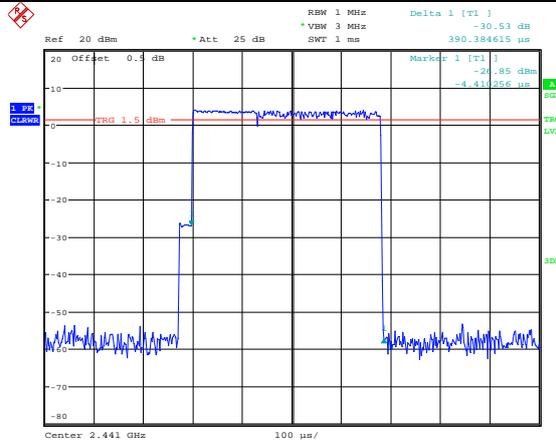


Date: 21.OCT.2021 18:05:39



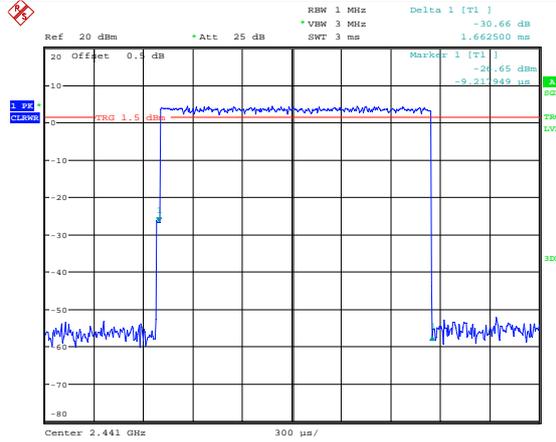
EDR Mode (8DPSK)

3DH1: Middle Channel



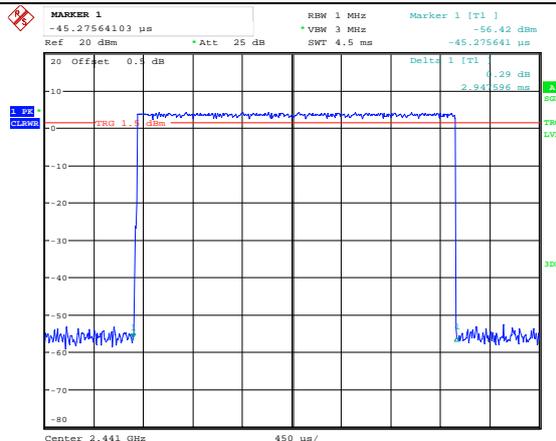
Date: 21.OCT.2021 18:03:03

3DH3: Middle Channel



Date: 21.OCT.2021 18:04:45

3DH5: Middle Channel



Date: 21.OCT.2021 18:06:35

4.8 Peak Conducted Output Power:

Serial Number:	CR21090056-RF-S1	Test Date:	2021/10/21
Test Site:	RF	Test Mode:	Transmitting
Tester:	Wolf Mo	Test Result:	Pass

Environmental Conditions:

Temperature: (°C)	25.9	Relative Humidity: (%)	60	ATM Pressure: (kPa)	100.8
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Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
zhuoxiang	Coaxial Cable	SMA-178	211001	Each time	N/A
eastsheep	Coaxial Attenuator	2W-SMA-JK-18G	21060301	Each time	N/A
Agilent	USB Wideband Power Sensor	U2021XA	MY54080015	2021/7/22	2022/7/21

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

Test Data:

Test Modes	Test Frequency (MHz)	Peak Conducted Output Power (dBm)	Limits (dBm)
BDR Mode (GFSK)	2402	4.33	21
	2441	4.3	21
	2480	3.97	21
EDR Mode ($\pi/4$ -DQPSK)	2402	4.59	21
	2441	4.41	21
	2480	4.11	21
EDR Mode (8DPSK)	2402	4.58	21
	2441	4.49	21
	2480	4.14	21

Note: Maximum EIRP=4.59+2.87=7.46dBi, the EIRP compliance the requirement of RSS-247.

4.9 100 kHz Bandwidth of Frequency Band Edge:

Serial Number:	CR21090056-RF-S1	Test Date:	2021/10/21
Test Site:	RF	Test Mode:	Transmitting
Tester:	Wolf Mo	Test Result:	Pass

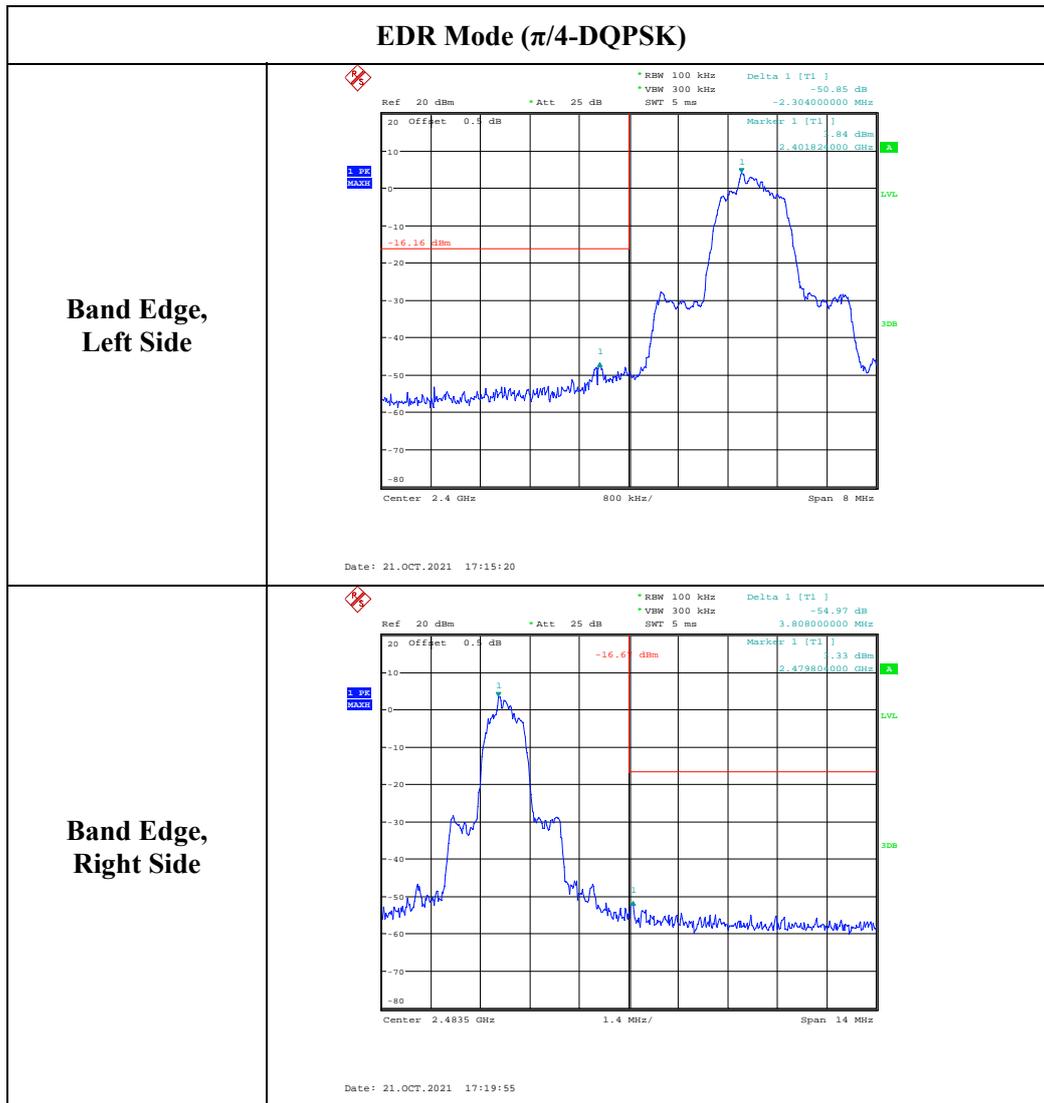
Environmental Conditions:

Temperature: (°C)	25.9	Relative Humidity: (%)	60	ATM Pressure: (kPa)	100.8
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Test Equipment List and Details:

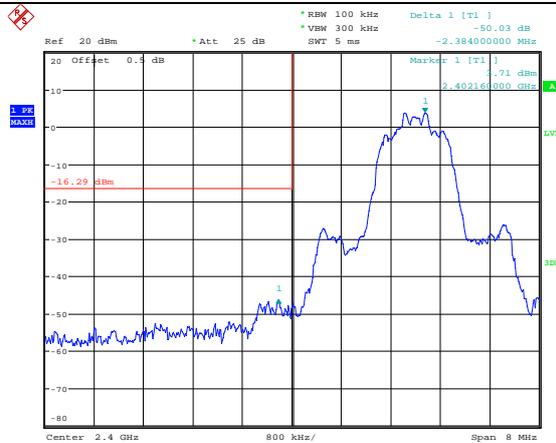
Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSU26	200256	2021/7/22	2022/7/21
zhuoxiang	Coaxial Cable	SMA-178	211001	Each time	N/A

* 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).



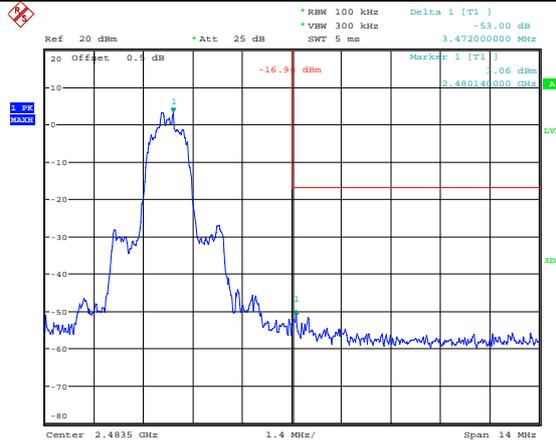
EDR Mode (8DPSK)

**Band Edge,
Left Side**



Date: 21.OCT.2021 17:21:58

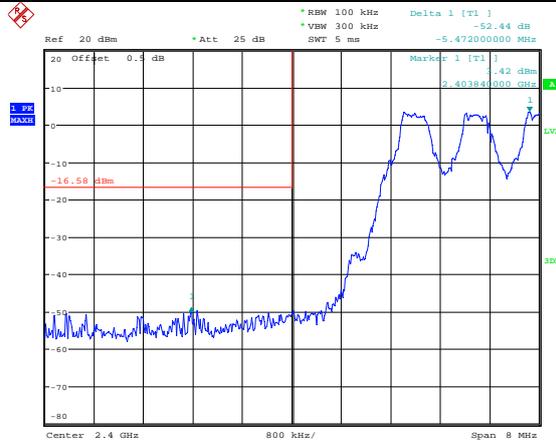
**Band Edge,
Right Side**



Date: 21.OCT.2021 17:25:45

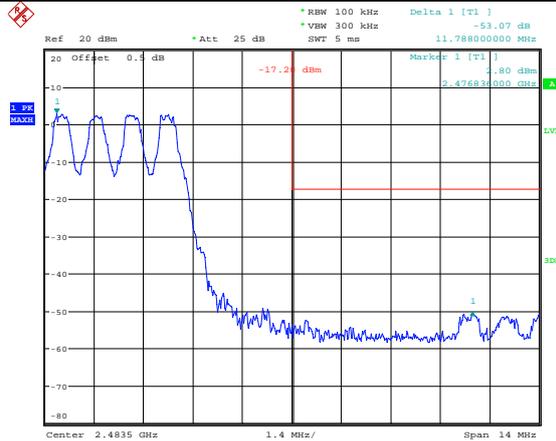
Hopping Mode, BDR Mode (GFSK)

**Band Edge,
Left Side**



Date: 21.OCT.2021 17:28:13

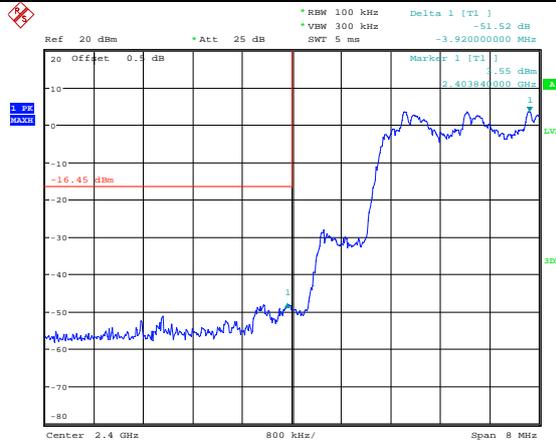
**Band Edge,
Right Side**



Date: 21.OCT.2021 17:30:01

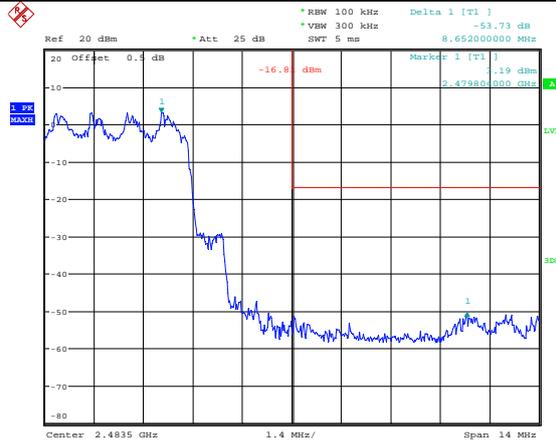
Hopping Mode, EDR Mode ($\pi/4$ -DQPSK)

**Band Edge,
Left Side**



Date: 21.OCT.2021 17:30:58

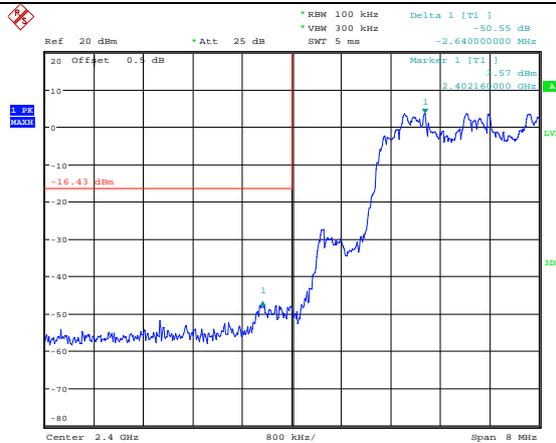
**Band Edge,
Right Side**



Date: 21.OCT.2021 17:32:06

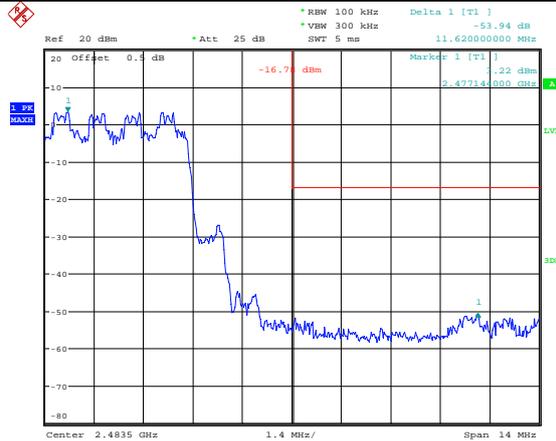
Hopping Mode, EDR Mode (8DPSK)

**Band Edge,
Left Side**



Date: 21.OCT.2021 17:32:57

**Band Edge,
Right Side**



Date: 21.OCT.2021 17:34:10

5. RF EXPOSURE EVALUATION

5.1 MAXIMUM PERMISSIBLE EXPOSURE (MPE)

5.1.1 Applicable Standard

FCC §15.247 (i) & §1.1310 & §2.1091

Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines. See §1.1307(b)(1) of this chapter.

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

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

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

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

5.1.2 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:

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

5.1.3 Calculated Result

Operation Modes	Frequency (MHz)	Antenna Gain		Conducted output power including Tune-up Tolerance		Evaluation Distance (cm)	Power Density (mW/cm ²)	MPE Limit (mW/cm ²)
		(dBi)	(numeric)	(dBm)	(mW)			
Bluetooth BDR/EDR	2402-2480	2.87	1.94	5	3.16	20.00	0.0012	1.0
Bluetooth LE	2402-2480	2.87	1.94	5	3.16	20.00	0.0012	1.0
SRD	2402-2477	2.85	1.93	6	3.98	20.00	0.0015	1.0

The Bluetooth and SRD can transmit simultaneously:

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

$$=S_{BT}/S_{limit-BT} + S_{SRD}/S_{limit-SRD}$$

$$=0.0012/1+0.0015/1$$

$$=0.0027$$

$$< 1.0$$

Result: The device meet FCC MPE at 20 cm distance

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

Mode	Frequency (MHz)	Antenna Gain	Conducted output power including Tune-up Tolerance	EIRP		Exemption limits (mW)	Exemption
		(dBi)	(dBm)	(dBm)	(mW)		
Bluetooth BDR/EDR	2402-2480	2.87	5	7.87	6.12	2676	Yes
Bluetooth LE	2402-2480	2.87	5	7.87	6.12	2676	Yes
SRD	2402-2477	2.85	6	8.85	7.67	2676	Yes

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

***** END OF REPORT *****