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

ACCREDITED
TESTING LABORATORY
CERTIFICATE # 6356.01

TEST REPORT

Applicant: **Shenzhen Geekbuy E-commerce Co., LTD.**

Address: Warehouse 101H, No. 49 Wuhe Avenue, Wuhe Community, Bantian Street, Longgang District, Shenzhen,518129 China

FCC ID: **2AV3Z-NIMO**

Product Name: **Wireless speaker**

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

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

Report Number: **CR230845965-00B**

Date Of Issue: **2023/8/28**

Reviewed By: **Calvin Chen**

Title: RF Engineer

Approved By: **Sun Zhong**

Title: Manager

Test Laboratory: **China Certification ICT Co., Ltd (Dongguan)**
No. 113, Pingkang Road, Dalang Town, Dongguan, Guangdong, China
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 12
3.1.4 Test Procedure 13
3.1.5 Corrected Amplitude & Margin Calculation 13
3.2 RADIATED 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 EMISSION BANDWIDTH 16
3.3.1 Applicable Standard 16
3.3.2 EUT Setup 16
3.3.3 Test Procedure 16
3.4 CHANNEL SEPARATION 18
3.4.1 Applicable Standard 18
3.4.2 EUT Setup 18
3.4.3 Test Procedure 18
3.5 NUMBER OF HOPPING FREQUENCY 19
3.5.1 Applicable Standard 19
3.5.2 EUT Setup 19
3.5.3 Test Procedure 19
3.6 TIME OF OCCUPANCY(DWELL TIME) 20
3.6.1 Applicable Standard 20
3.6.2 EUT Setup 20
3.6.3 Test Procedure 20

3.7 MAXIMUM CONDUCTED OUTPUT POWER 21
3.7.1 Applicable Standard 21
3.7.2 EUT Setup 21
3.7.3 Test Procedure 21
3.8 100 KHZ BANDWIDTH OF FREQUENCY BAND EDGE 22
3.8.1 Applicable Standard 22
3.8.2 EUT Setup 22
3.8.3 Test Procedure 22
3.9 ANTENNA REQUIREMENT 23
3.9.1 Applicable Standard 23
3.9.2 Judgment 23
4. TEST DATA AND RESULTS 24
4.1 AC LINE CONDUCTED EMISSIONS 24
4.2 RADIATED SPURIOUS EMISSIONS 27
4.3 20 DB EMISSION BANDWIDTH 35
4.4 CHANNEL SEPARATION 39
4.5 NUMBER OF HOPPING FREQUENCY 43
4.6 TIME OF OCCUPANCY(DWELL TIME) 45
4.7 MAXIMUM CONDUCTED OUTPUT POWER 49
4.8 100 KHZ BANDWIDTH OF FREQUENCY BAND EDGE 53
5. RF EXPOSURE EVALUATION 60
5.1 APPLICABLE STANDARD 60

DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
1.0	CR230845965-00B	Original Report	2023/8/28

1. GENERAL INFORMATION

1.1 Product Description for Equipment under Test (EUT)

EUT Name:	Wireless speaker
EUT Model:	NIMO
Operation Frequency:	2402-2480 MHz
Maximum Peak Output Power (Conducted):	3.01 dBm
Modulation Type:	GFSK, π/4-DQPSK, 8DPSK
Rated Input Voltage:	DC 5V from USB port or DC 3.7V from battery
Serial Number:	29L8-1
EUT Received Date:	2023/8/10
EUT Received Status:	Good

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 below frequencies were performed the test as below:

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

Antenna Information Detail▲:

Antenna Type	input impedance (Ohm)	Frequency Range	Antenna Gain
PCB	50	2.4~2.5GHz	-6.67 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
/	/	/	/

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 Assist

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
GFSK	**10**	**10**	**10**
π/4-DQPSK	**10**	**10**	**10**
8DPSK	**10**	**10**	**10**

1.2.2 Support Equipment List and Details

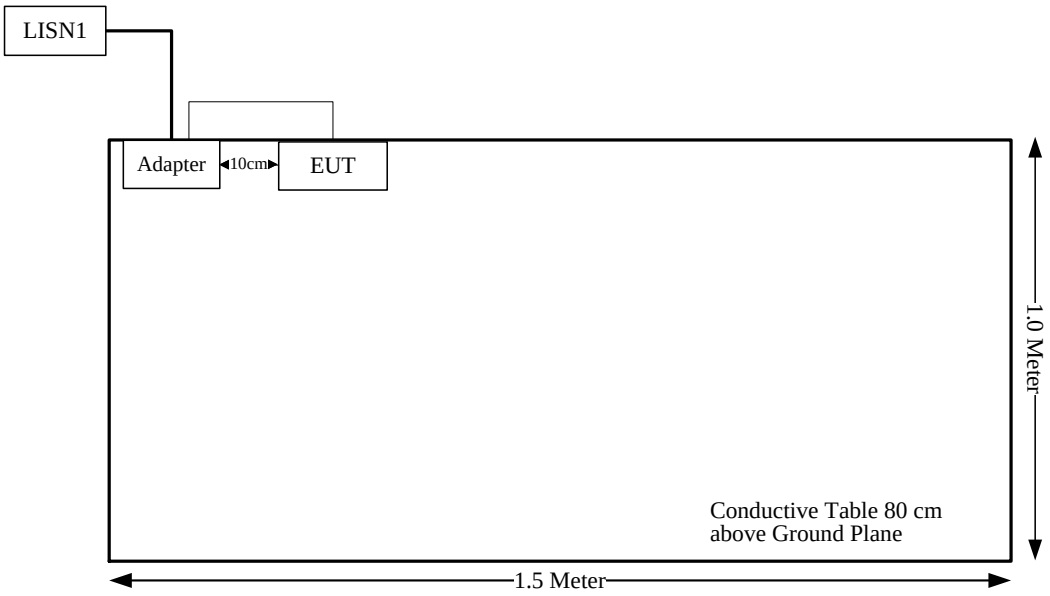
Manufacturer	Description	Model	Serial Number
Jian Aohai	Adapter	A8-050200U-US3	AD220930002

1.2.3 Support Cable List and Details

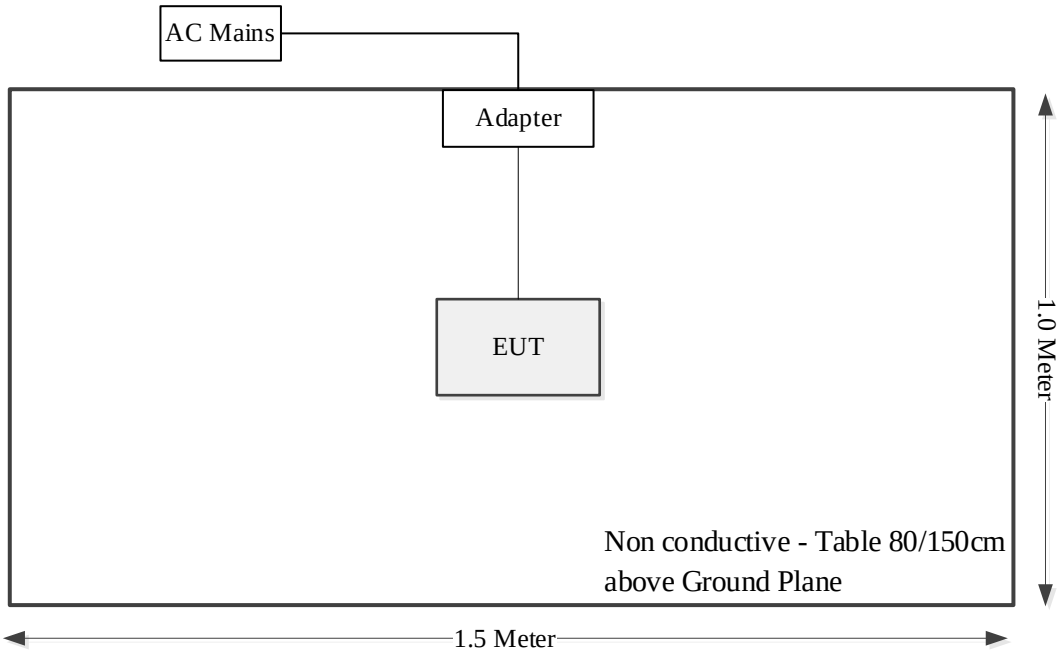
Cable Description	Shielding Type	Ferrite Core	Length (m)	From Port	To
USB Cable	No	No	1	EUT	Adapter

1.2.4 Block Diagram of Test Setup

AC line conducted emissions:



Spurious Emissions:



1.3 Measurement Uncertainty

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

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

2. SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
FCC §15.207(a)	AC Line Conducted Emissions	Compliant
FCC §15.205, §15.209, §15.247(d)	Radiated Spurious Emissions	Compliant
FCC §15.247(a)(1)	20 dB Emission Bandwidth	Compliant
FCC §15.247(a)(1)	Channel Separation	Compliant
FCC §15.247(a)(1)(iii)	Number Of Hopping Frequency	Compliant
FCC §15.247(a)(1)(iii)	Time Of Occupancy (dwell time)	Compliant
FCC §15.247(b)(1)	Maximum Conducted Output Power	Compliant
FCC §15.247(d)	100 kHz Bandwidth Of Frequency Band Edge	Compliant
FCC §15.203	Antenna Requirement	Compliant
FCC §15.247 (i) & §1.1310	RF Exposure Evaluation	Compliant

3. REQUIREMENTS AND TEST PROCEDURES

3.1 AC Line Conducted Emissions

3.1.1 Applicable Standard

FCC §15.207(a).

(a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

	Conducted limit (dBμV)	
Frequency of emission (MHz)	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

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

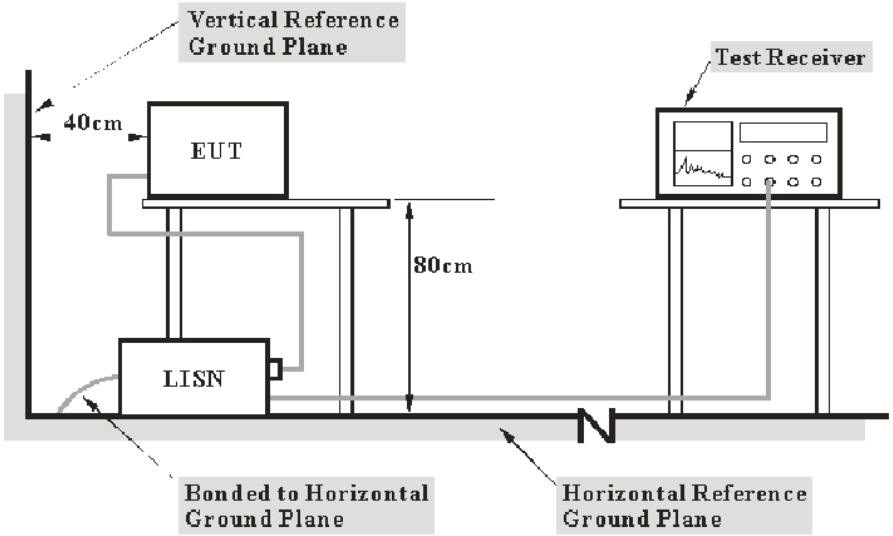
(1) For carrier current system containing their fundamental emission within the frequency band 535-1705 kHz and intended to be received using a standard AM broadcast receiver: no limit on conducted emissions.

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

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

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

3.1.2 EUT Setup



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

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

The spacing between the peripherals was 10 cm.

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 Radiated Spurious Emissions

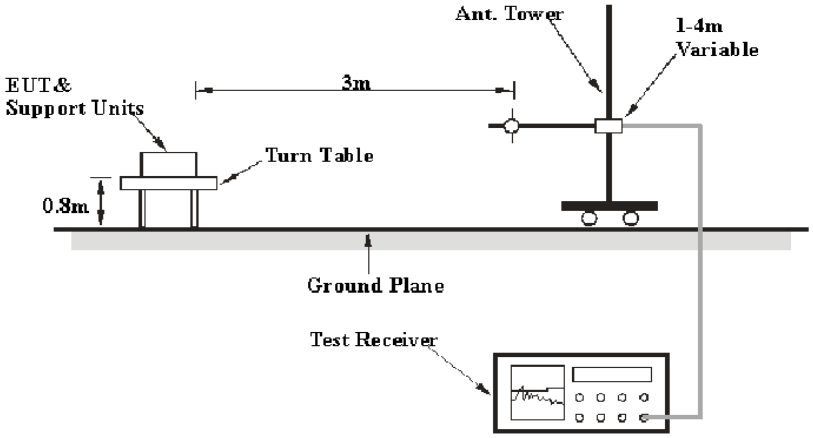
3.2.1 Applicable Standard

FCC §15.247 (d);

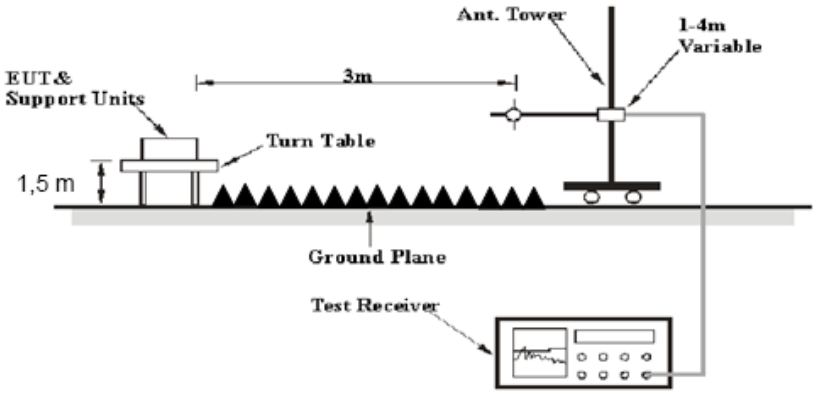
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

3.2.2 EUT Setup

Below 1GHz:



Above 1GHz:



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

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

The spacing between the peripherals was 10 cm.

3.2.3 EMI Test Receiver & Spectrum Analyzer Setup

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:

Margin = Limit – Result

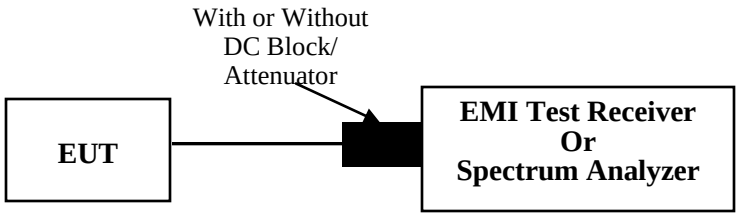
3.3 20 dB Emission Bandwidth

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.

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 (OBW/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).

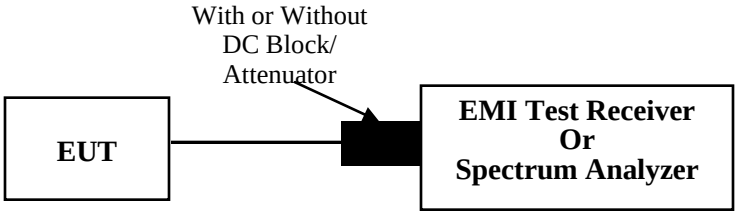
3.4 Channel Separation

3.4.1 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.

3.4.2 EUT Setup



3.4.3 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) ≥ 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.

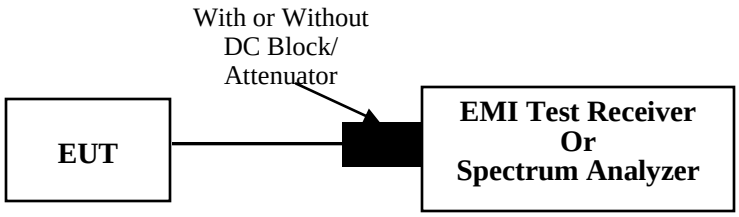
3.5 Number Of Hopping Frequency

3.5.1 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.

3.5.2 EUT Setup



3.5.3 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 ≥ RBW.
d) Sweep: Auto.
e) Detector function: Peak.
f) Trace: Max hold.
g) Allow the trace to stabilize

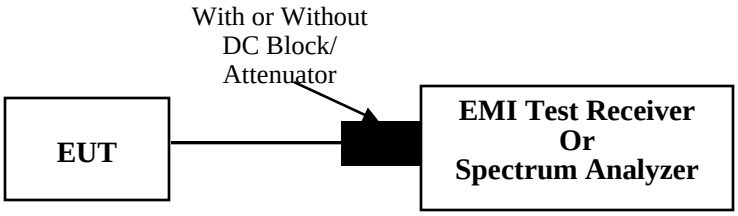
It might prove necessary to break the span up into subranges to show clearly all of the hopping frequencies. Compliance of an EUT with the appropriate regulatory limit shall be determined for the number of hopping channels. A plot of the data shall be included in the test report.

3.6 Time Of Occupancy(Dwell Time)

3.6.1 Applicable Standard

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.

3.6.2 EUT Setup



3.6.3 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 ≤ channel spacing and where possible RBW should be set >> 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.

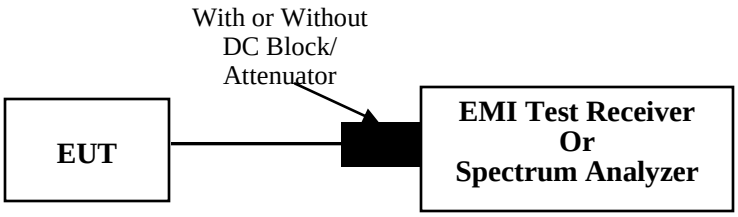
3.7 Maximum Conducted Output Power

3.7.1 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

3.7.2 EUT Setup



3.7.3 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, Offset the Insertion loss of the RF cable, DC Block/ Attenuator into the spectrum analyzer. 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 ≥ 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.

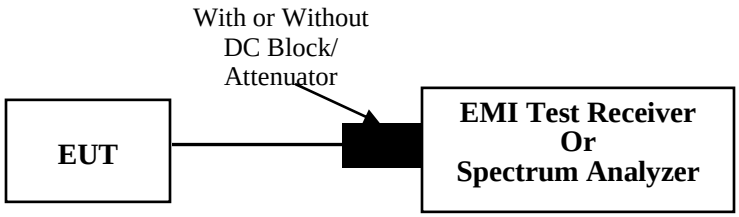
3.8 100 kHz Bandwidth Of Frequency Band Edge

3.8.1 Applicable Standard

FCC §15.247 (d);

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

3.8.2 EUT Setup



3.8.3 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 ≥ [3 × RBW].
d) Detector = peak.
e) Sweep time = auto couple.
f) Trace mode = max hold.
g) Allow trace to fully stabilize.
h) Use the peak marker function to determine the maximum amplitude level.
Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) is attenuated by at least the minimum requirements. Report the three highest emissions relative to the limit.

3.9 Antenna Requirement

3.9.1 Applicable Standard

FCC §15.203

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §§15.211, 15.213, 15.217, 15.219, 15.221, or §15.236. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

3.9.2 Judgment

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

4. TEST DATA AND RESULTS

4.1 AC Line Conducted Emissions

Serial Number:	29L8-1	Test Date:	2023/8/18
Test Site:	CE	Test Mode:	Transmitting(8DPSK high channel)
Tester:	David Huang	Test Result:	Pass

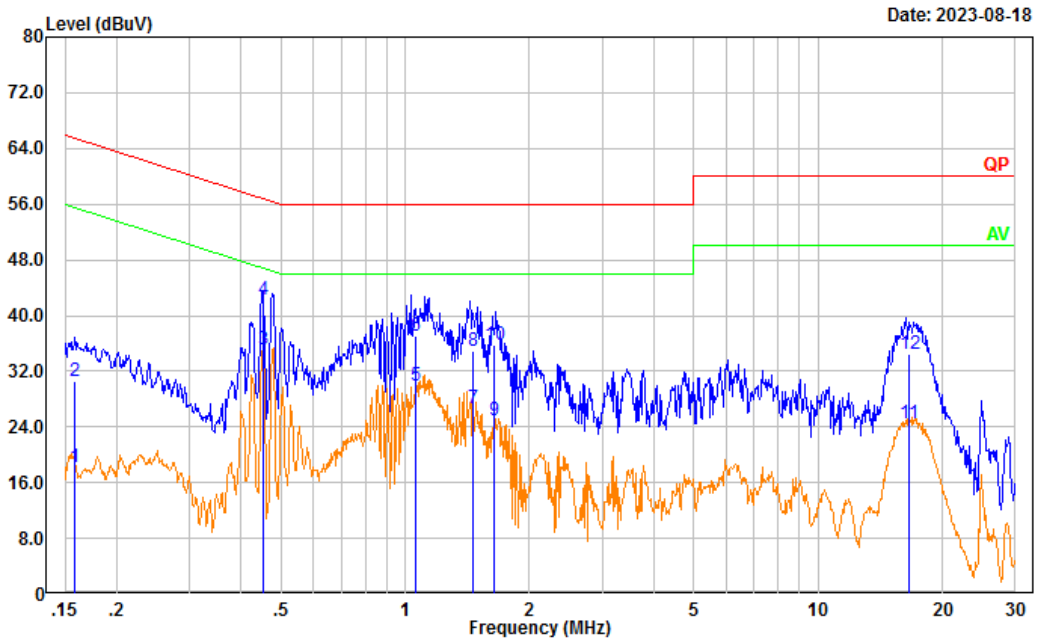
Environmental Conditions:					
Temperature: (℃)	28.3	Relative Humidity: (%)	70	ATM Pressure: (kPa)	100.5

Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	LISN	ENV216	101134	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

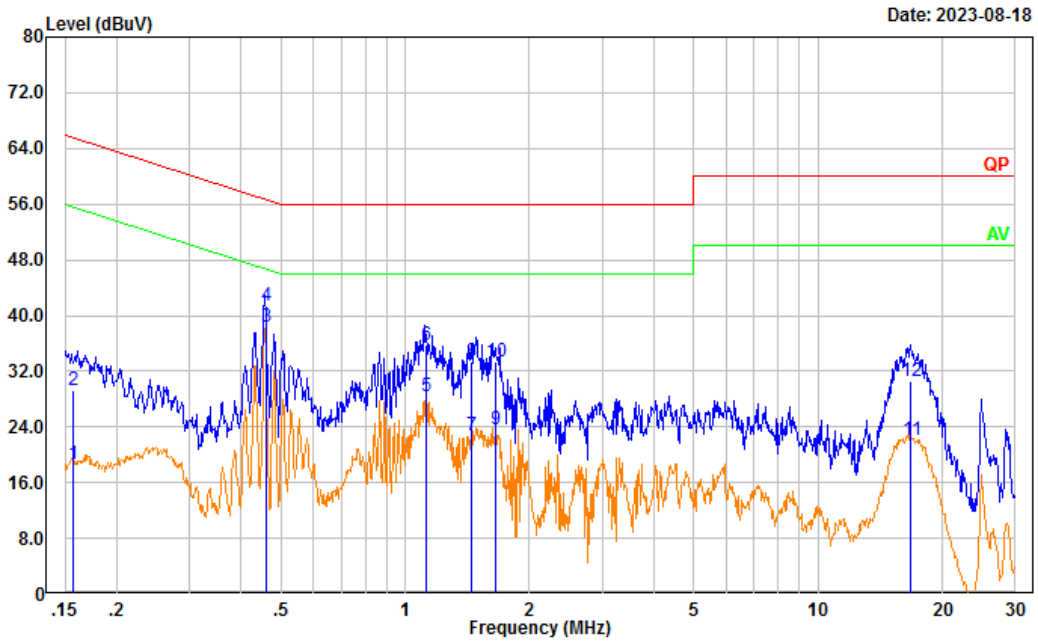
** Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).*

Project No.: CR230845965-RF
Tester: David Huang
Test Mode: Transmitting
Port: Line
Note:



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB)	Result (dBµV)	Limit (dBµV)	Margin (dB)	Detector
1	0.158	8.64	9.61	18.25	55.55	37.30	Average
2	0.158	21.07	9.61	30.68	65.55	34.87	QP
3	0.453	25.49	9.61	35.10	46.83	11.73	Average
4	0.453	32.64	9.61	42.25	56.83	14.58	QP
5	1.060	20.28	9.62	29.90	46.00	16.10	Average
6	1.060	27.46	9.62	37.08	56.00	18.92	QP
7	1.464	17.13	9.62	26.75	46.00	19.25	Average
8	1.464	25.29	9.62	34.91	56.00	21.09	QP
9	1.648	15.39	9.63	25.02	46.00	20.98	Average
10	1.648	26.12	9.63	35.75	56.00	20.25	QP
11	16.601	14.87	9.72	24.59	50.00	25.41	Average
12	16.601	24.72	9.72	34.44	60.00	25.56	QP

Project No.: CR230845965-RF
Tester: David Huang
Test Mode: Transmitting
Port: neutral
Note:



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB)	Result (dBµV)	Limit (dBµV)	Margin (dB)	Detector
1	0.156	9.09	9.61	18.70	55.65	36.95	Average
2	0.156	19.67	9.61	29.28	65.65	36.37	QP
3	0.460	28.75	9.61	38.36	46.69	8.33	Average
4	0.460	31.85	9.61	41.46	56.69	15.23	QP
5	1.120	18.80	9.62	28.42	46.00	17.58	Average
6	1.120	26.20	9.62	35.82	56.00	20.18	QP
7	1.447	13.14	9.62	22.76	46.00	23.24	Average
8	1.447	23.83	9.62	33.45	56.00	22.55	QP
9	1.650	14.08	9.63	23.71	46.00	22.29	Average
10	1.650	23.84	9.63	33.47	56.00	22.53	QP
11	16.769	12.47	9.69	22.16	50.00	27.84	Average
12	16.769	20.81	9.69	30.50	60.00	29.50	QP

4.2 Radiated Spurious Emissions

Serial Number:	29L8-1	Test Date:	2023/8/19~2023/8/25
Test Site:	966-2,966-1	Test Mode:	Transmitting
Tester:	Carl Xue, Mack Huang	Test Result:	Pass

Environmental Conditions:					
Temperature: (℃)	25.1~27.3	Relative Humidity: (%)	50~65	ATM Pressure: (kPa)	99.9~100.1

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
Audix	Test Software	E3	201021 (V9)	N/A	N/A
ETS-Lindgren	Horn Antenna	3115	9912-5985	2020/10/13	2023/10/12
R&S	Spectrum Analyzer	FSV40	101591	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
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).*

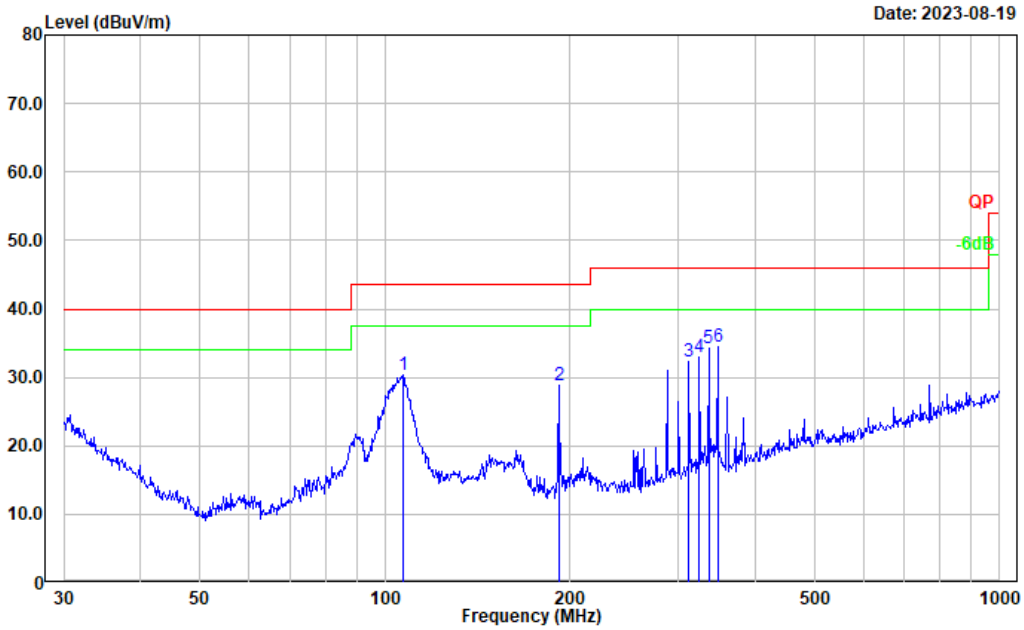
Test Data:

Please refer to the below table and plots.

After pre-scan in the X, Y and Z axes of orientation, the worst case is below:

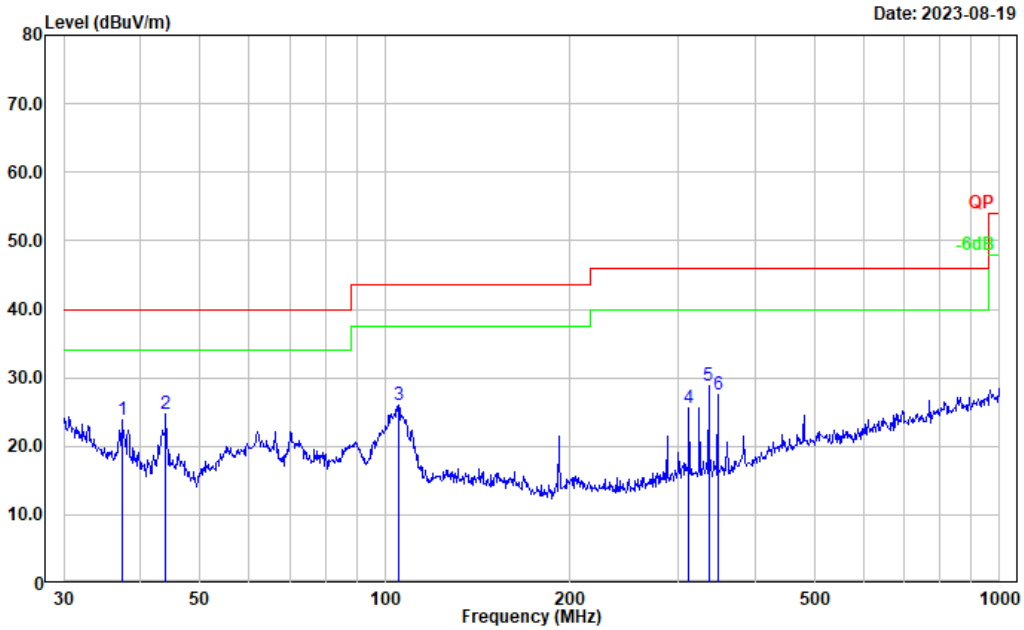
1) 30MHz-1GHz (Transmitting with 8DPSK high channel)

Project No.: CR230845965-RF
Tester: Carl Xue
Test Mode: Transmitting
Polarization: horizontal
Note:



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	107.134	43.33	-12.87	30.46	43.50	13.04	Peak
2	191.745	41.99	-13.21	28.78	43.50	14.72	Peak
3	312.179	42.94	-10.60	32.34	46.00	13.66	Peak
4	324.456	43.41	-10.41	33.00	46.00	13.00	Peak
5	336.035	44.46	-10.13	34.33	46.00	11.67	Peak
6	348.027	44.45	-10.03	34.42	46.00	11.58	Peak

Project No.: CR230845965-RF
Tester: Carl Xue
Test Mode: Transmitting
Polarization: vertical
Note:



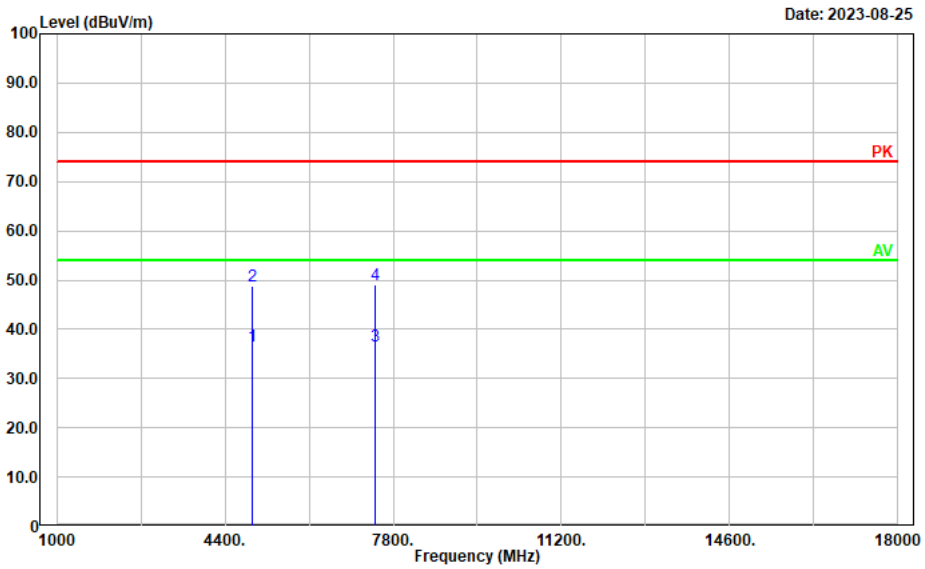
No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	37.285	32.97	-9.22	23.75	40.00	16.25	Peak
2	43.966	38.46	-13.65	24.81	40.00	15.19	Peak
3	105.272	39.36	-13.31	26.05	43.50	17.45	Peak
4	312.179	36.18	-10.60	25.58	46.00	20.42	Peak
5	336.035	38.91	-10.13	28.78	46.00	17.22	Peak
6	348.027	37.64	-10.03	27.61	46.00	18.39	Peak

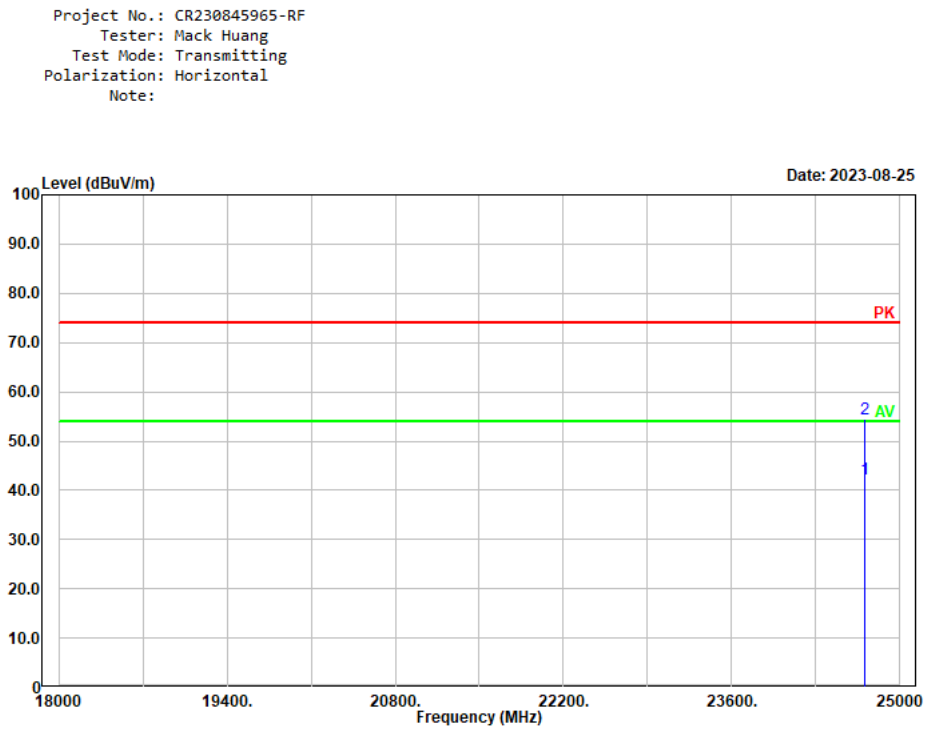
2) 1-25GHz:

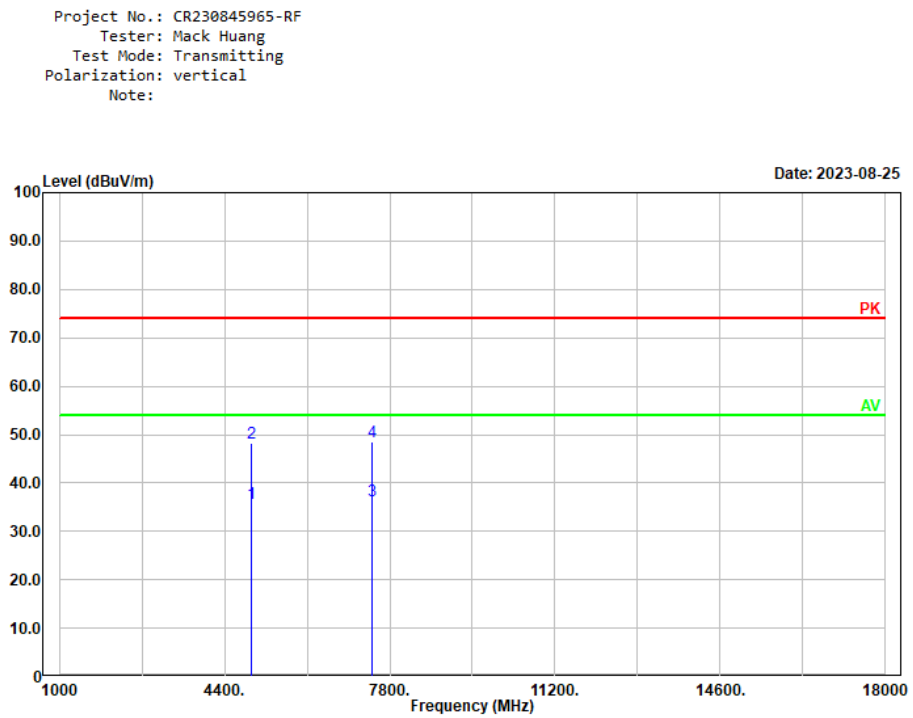
Pre-scan with BDR and EDR mode, and BDR Mode (GFSK) is the worst case as below:

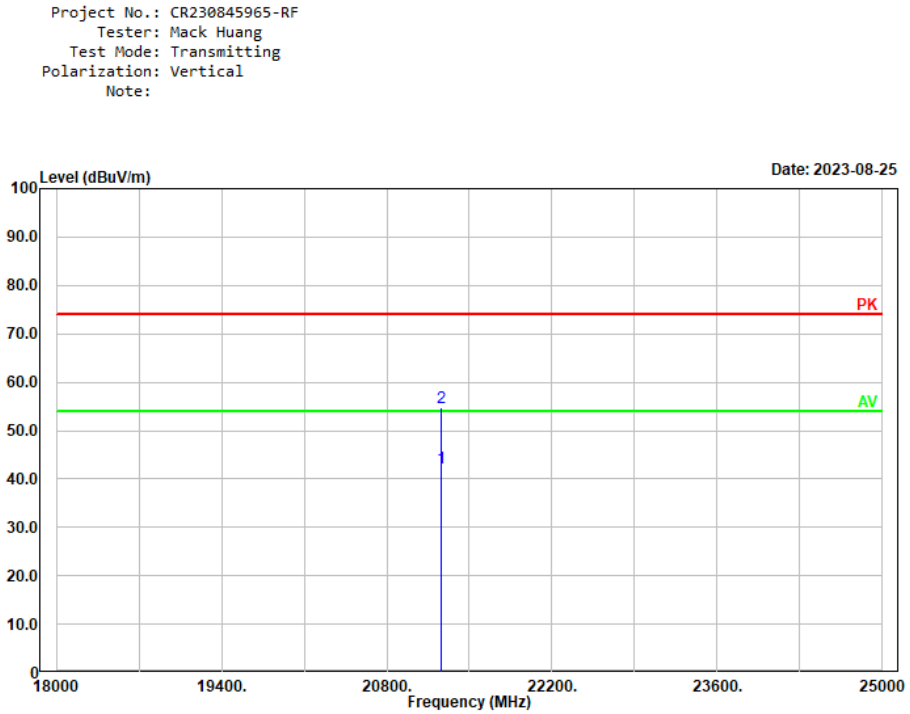
Frequency (MHz)	Receiver		Polar (H/V)	Factor (dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	Detector					
Low Channel: 2402 MHz							
2402.000	64.58	PK	H	31.51	96.09	N/A	N/A
2402.000	53.30	AV	H	31.51	84.81	N/A	N/A
2402.000	58.37	PK	V	31.51	89.88	N/A	N/A
2402.000	47.12	AV	V	31.51	78.63	N/A	N/A
2390.000	26.37	PK	H	31.46	57.83	74.00	16.17
2390.000	13.84	AV	H	31.46	45.30	54.00	8.70
4804.000	38.17	PK	H	10.91	49.08	74.00	24.92
4804.000	26.09	AV	H	10.91	37.00	54.00	17.00
7206.000	34.29	PK	H	14.22	48.51	74.00	25.49
7206.000	22.15	AV	H	14.22	36.37	54.00	17.63
Middle Channel: 2441 MHz							
2441.000	65.34	PK	H	31.61	96.95	N/A	N/A
2441.000	54.12	AV	H	31.61	85.73	N/A	N/A
2441.000	59.10	PK	V	31.61	90.71	N/A	N/A
2441.000	48.36	AV	V	31.61	79.97	N/A	N/A
4882.000	38.10	PK	H	11.07	49.17	74.00	24.83
4882.000	26.05	AV	H	11.07	37.12	54.00	16.88
7323.000	34.12	PK	H	14.80	48.92	74.00	25.08
7323.000	22.06	AV	H	14.80	36.86	54.00	17.14
High Channel: 2480 MHz							
2480.000	66.33	PK	H	31.64	97.97	N/A	N/A
2480.000	55.22	AV	H	31.64	86.86	N/A	N/A
2480.000	59.73	PK	V	31.64	91.37	N/A	N/A
2480.000	48.58	AV	V	31.64	80.22	N/A	N/A
2483.500	27.59	PK	H	31.64	59.23	74.00	14.77
2483.500	14.25	AV	H	31.64	45.89	54.00	8.11
4960.000	38.06	PK	H	11.23	49.29	74.00	24.71
4960.000	26.03	AV	H	11.23	37.26	54.00	16.74
7440.000	33.47	PK	H	15.26	48.73	74.00	25.27
7440.000	21.24	AV	H	15.26	36.50	54.00	17.50

Test plots (BDR High channel)

Horizontal	
1-18GHz	

Horizontal	
18-25GHz	

Vertical	
1-18GHz	

Vertical	
18-25GHz	

4.3 20 dB Emission Bandwidth

Serial Number:	29L8-1	Test Date:	2023/8/17
Test Site:	RF	Test Mode:	Transmitting
Tester:	LingLing Li	Test Result:	N/A

Environmental Conditions:

Temperature: (℃)	26.2	Relative Humidity: (%)	66	ATM Pressure: (kPa)	100.5

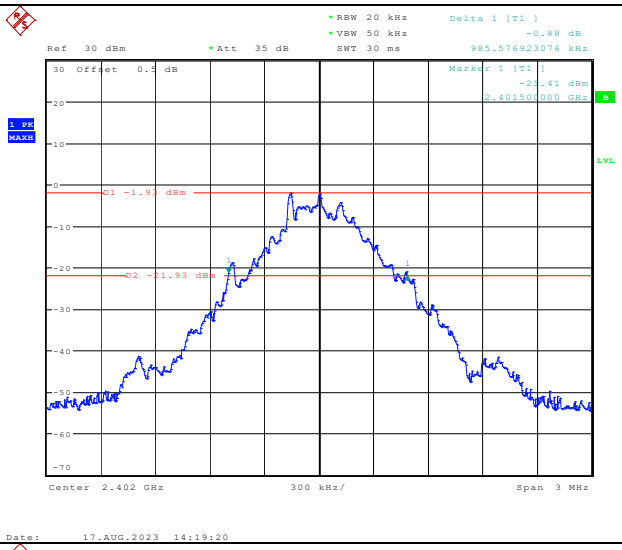
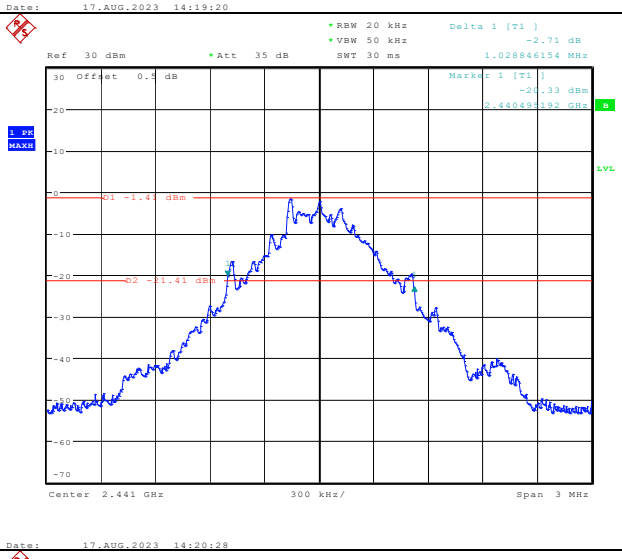
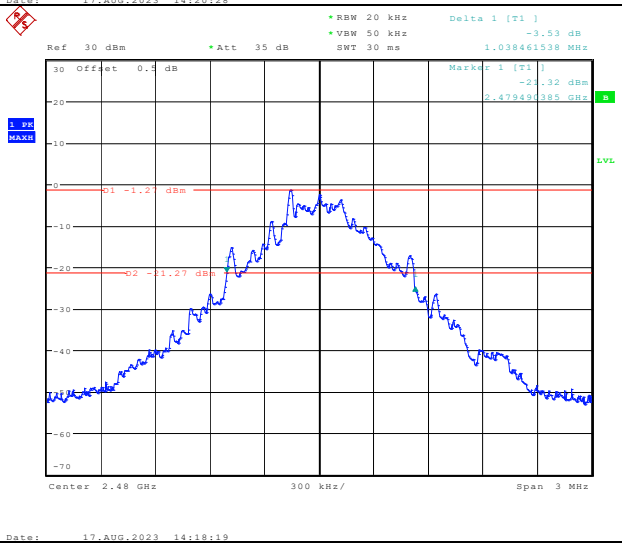
Test Equipment List and Details:

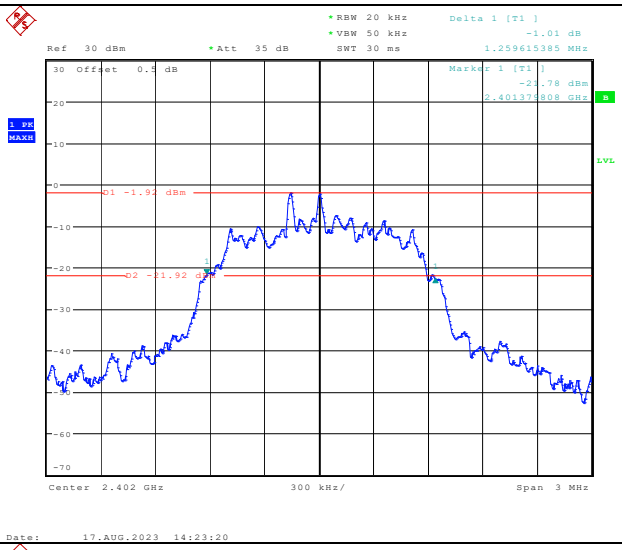
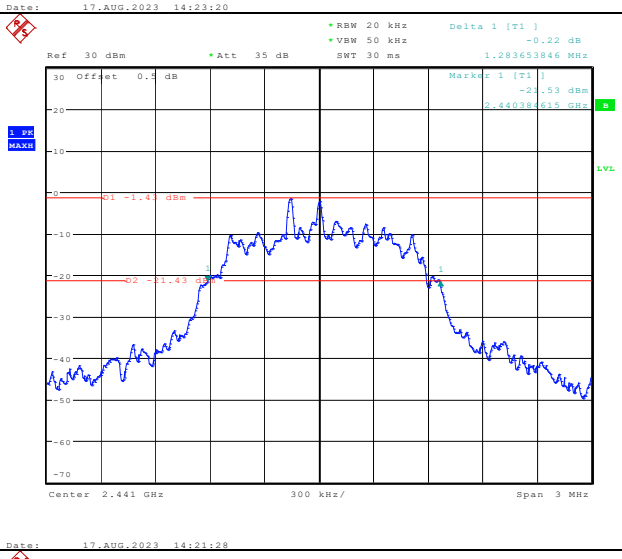
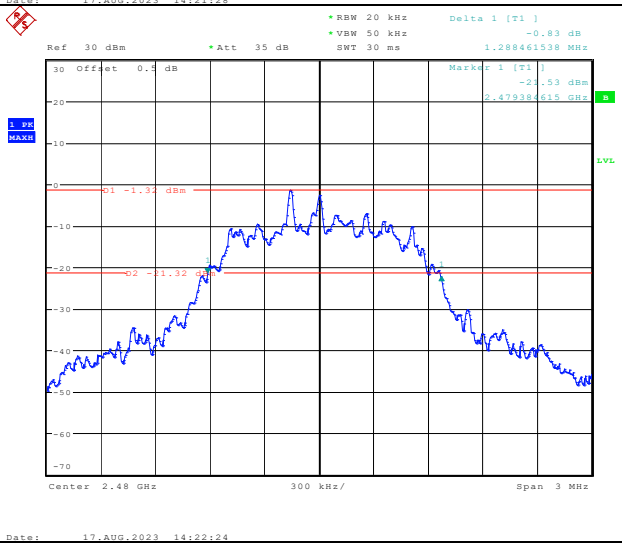
Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSU26	100147	2023/3/31	2024/3/30
zhuoxiang	Coaxial Cable	SMA-178	211002	Each time	N/A

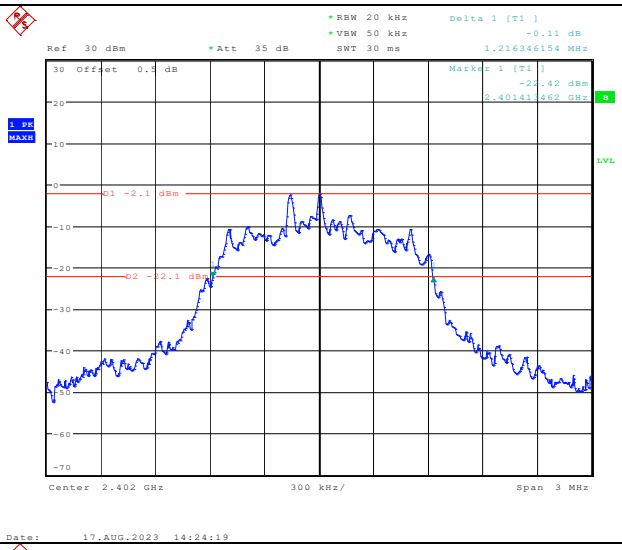
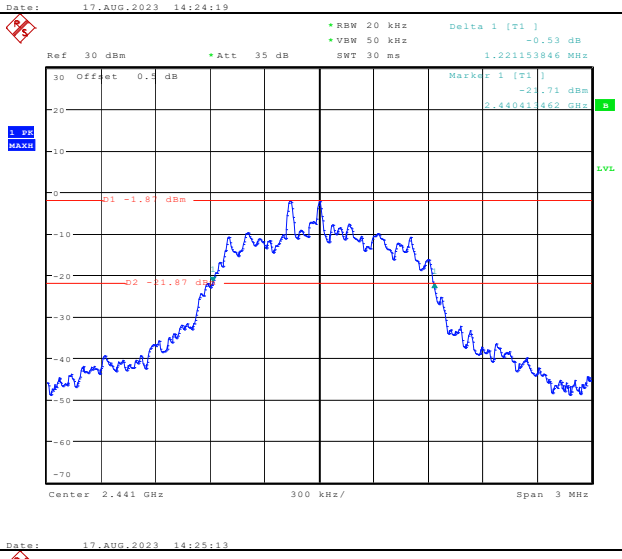
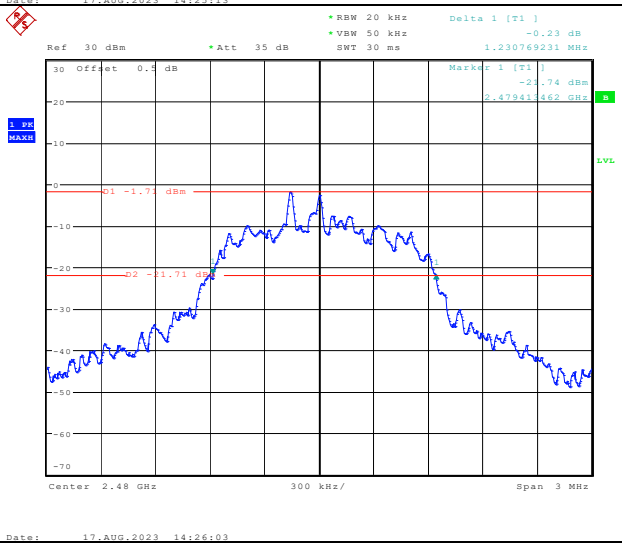
** Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).*

Test Data:

Test Modes	Test Channel	Test Frequency (MHz)	20 dB Bandwidth (MHz)
BDR Mode (GFSK)	Lowest	2402	0.986
	Middle	2441	1.029
	Highest	2480	1.038
EDR Mode (π/4-DQPSK)	Lowest	2402	1.26
	Middle	2441	1.284
	Highest	2480	1.288
EDR Mode (8DPSK)	Lowest	2402	1.216
	Middle	2441	1.221
	Highest	2480	1.231

BDR Mode (GFSK)	
Lowest Channel	
Middle Channel	
Highest Channel	

EDR Mode (π/4-DQPSK)	
Lowest Channel	
Middle Channel	
Highest Channel	

EDR Mode (8DPSK)	
Lowest Channel	
Middle Channel	
Highest Channel	

4.4 Channel Separation

Serial Number:	29L8-1	Test Date:	2023/8/17
Test Site:	RF	Test Mode:	Transmitting
Tester:	LingLing Li	Test Result:	Pass

Environmental Conditions:

Temperature: (℃)	26.2	Relative Humidity: (%)	66	ATM Pressure: (kPa)	100.5

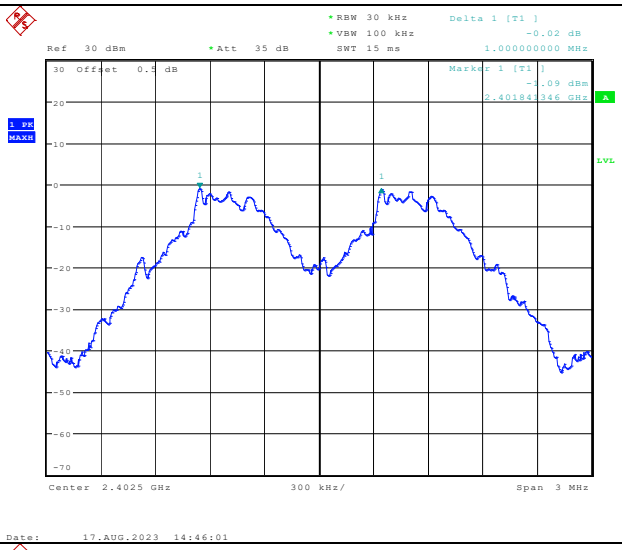
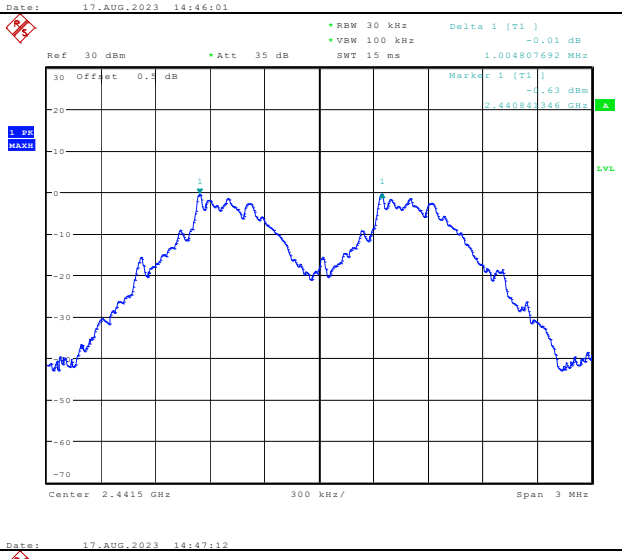
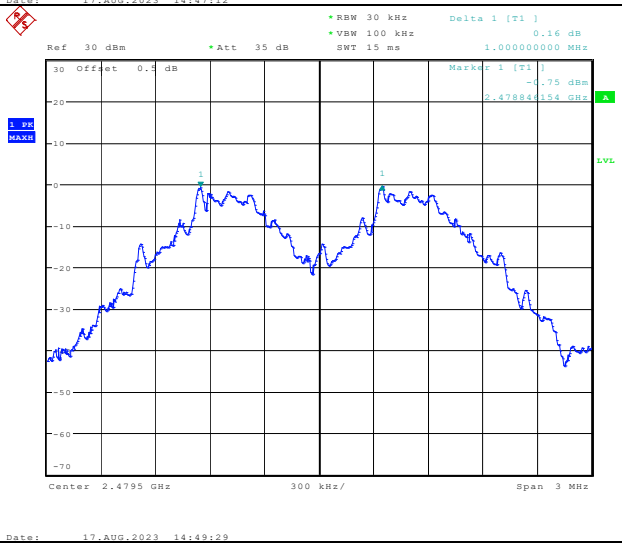
Test Equipment List and Details:

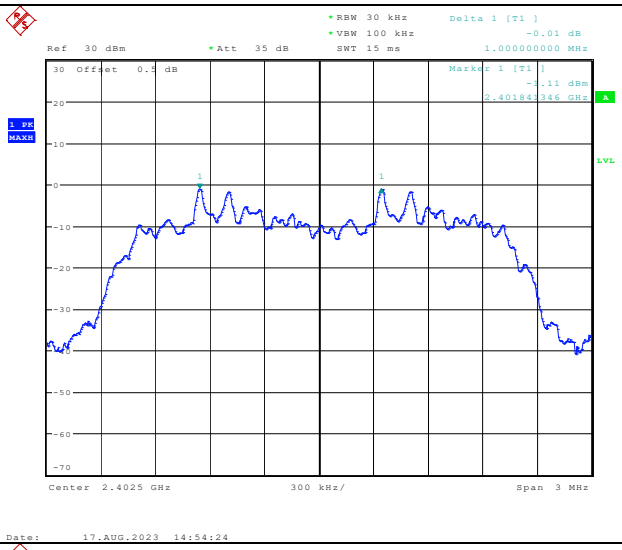
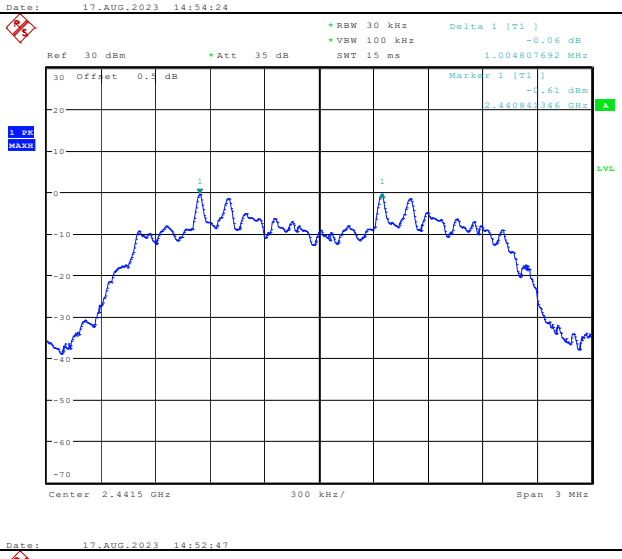
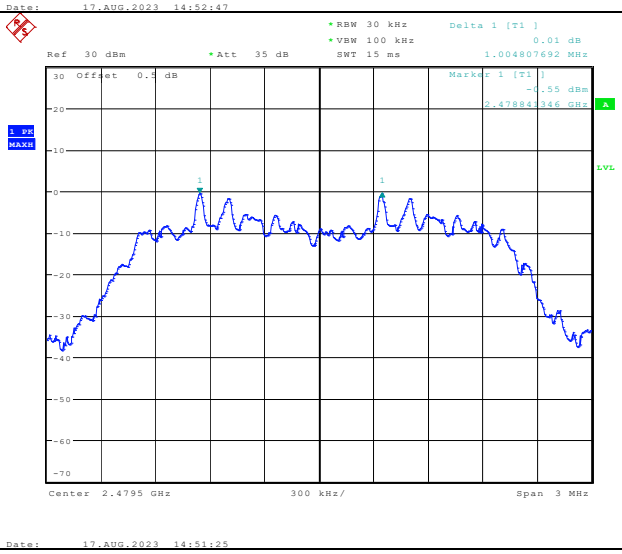
Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSU26	100147	2023/3/31	2024/3/30
zhuoxiang	Coaxial Cable	SMA-178	211002	Each time	N/A

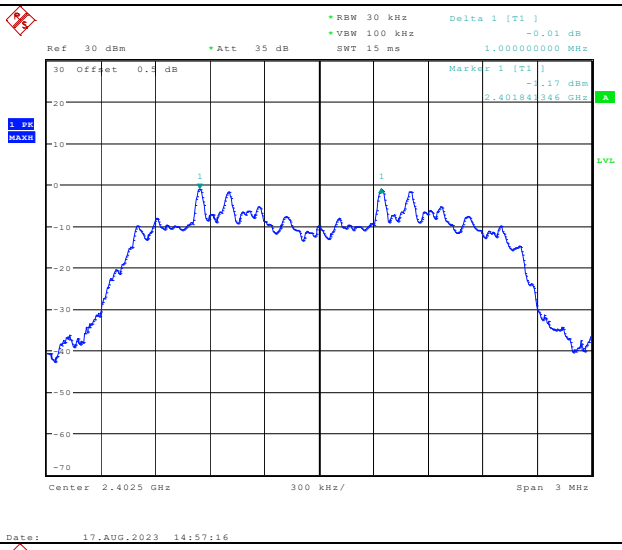
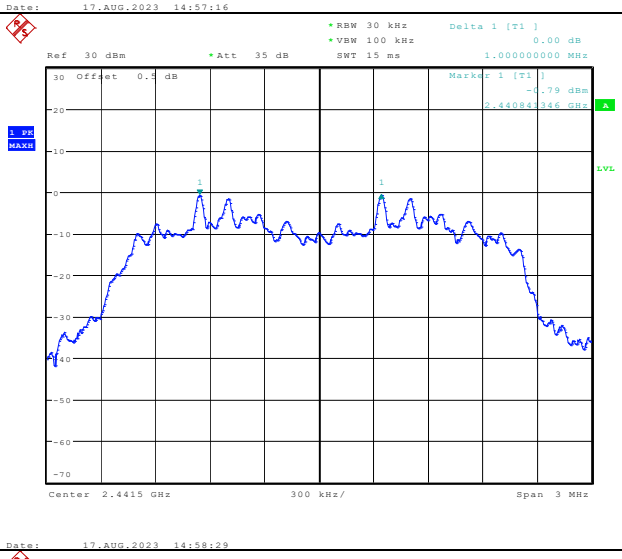
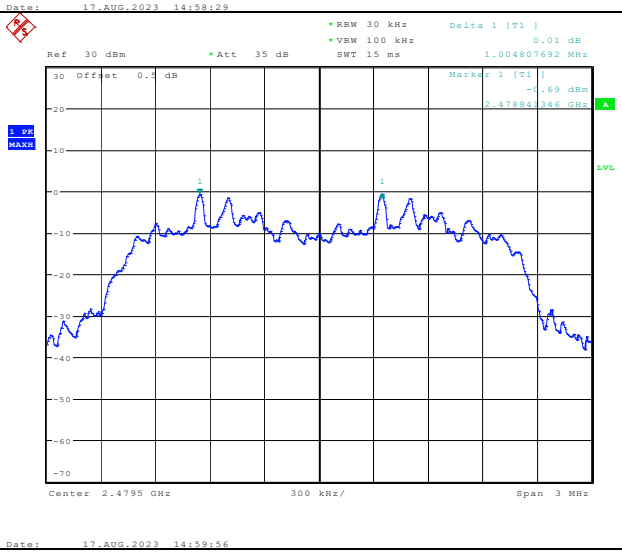
** Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).*

Test Data:

Test Modes	Test Frequency (MHz)	Channel Separation (MHz)	Limits (MHz)
BDR Mode (GFSK)	2402	1	0.657
	2441	1.005	0.686
	2480	1	0.692
EDR Mode (π/4-DQPSK)	2402	1	0.840
	2441	1.005	0.856
	2480	1.005	0.859
EDR Mode (8DPSK)	2402	1	0.811
	2441	1	0.814
	2480	1.005	0.821

BDR Mode (GFSK)	
Lowest Channel	
Middle Channel	
Highest Channel	

EDR Mode (π/4-DQPSK)	
Lowest Channel	
Middle Channel	
Highest Channel	

EDR Mode (8DPSK)	
Lowest Channel	
Middle Channel	
Highest Channel	

4.5 Number Of Hopping Frequency

Serial Number:	29L8-1	Test Date:	2023/8/17
Test Site:	RF	Test Mode:	Transmitting
Tester:	LingLing Li	Test Result:	Pass

Environmental Conditions:

Temperature: (℃)	26.2	Relative Humidity: (%)	66	ATM Pressure: (kPa)	100.5

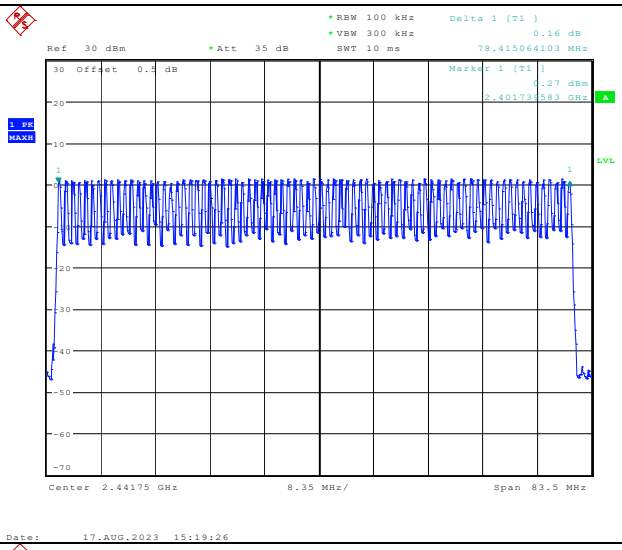
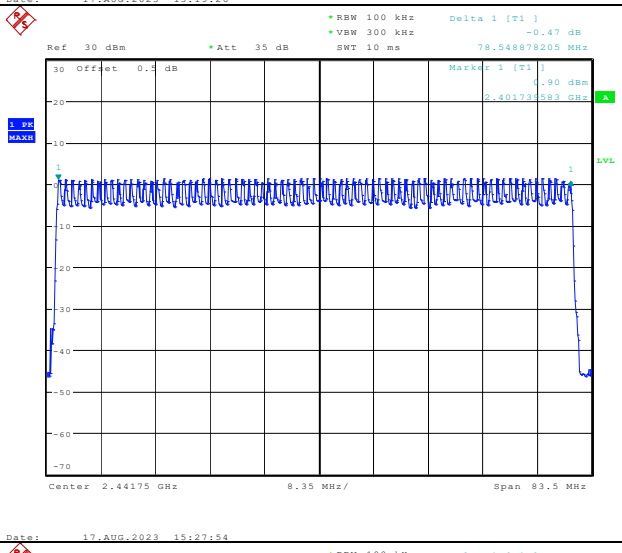
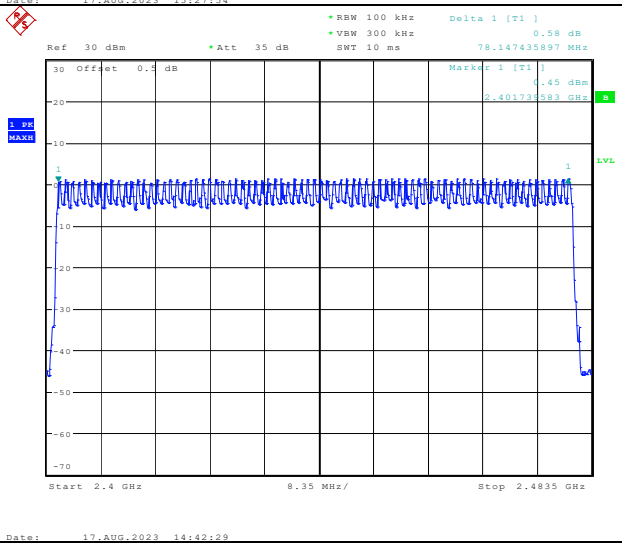
Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSU26	100147	2023/3/31	2024/3/30
zhuoxiang	Coaxial Cable	SMA-178	211002	Each time	N/A

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

Test Data:

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

Number of Hopping Channel	
BDR Mode (GFSK)	
EDR Mode (π/4-DQPSK)	
EDR Mode (8DPSK)	

4.6 Time Of Occupancy(Dwell Time)

Serial Number:	29L8-1	Test Date:	2023/8/17
Test Site:	RF	Test Mode:	Transmitting
Tester:	LingLing Li	Test Result:	Pass

Environmental Conditions:

Temperature: (℃)	26.2	Relative Humidity: (%)	66	ATM Pressure: (kPa)	100.5

Test Equipment List and Details:

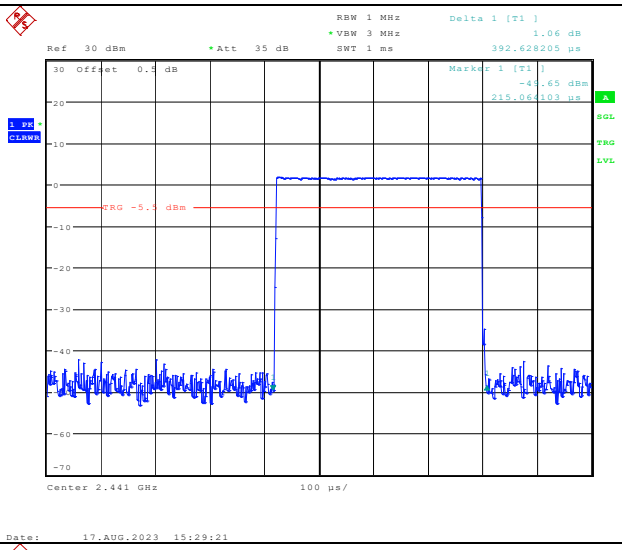
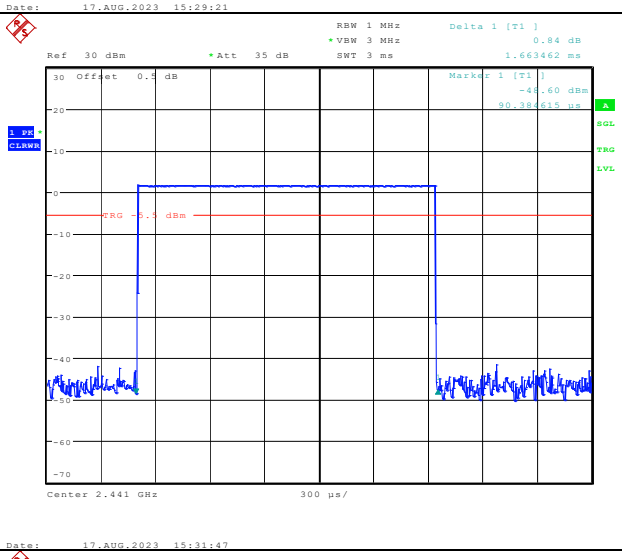
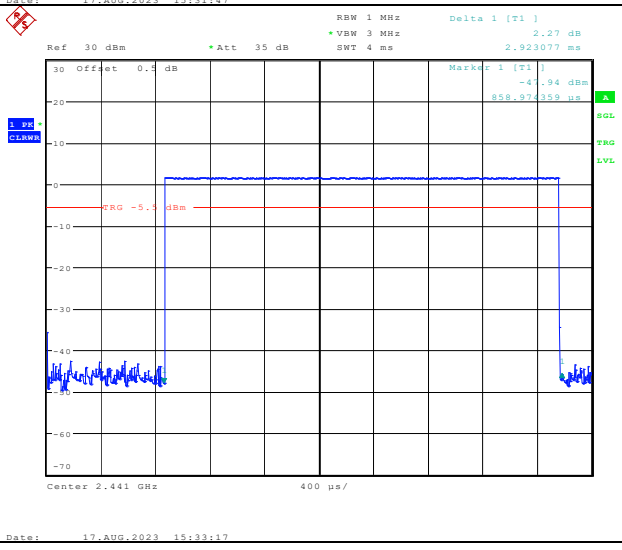
Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSU26	100147	2023/3/31	2024/3/30
zhuoxiang	Coaxial Cable	SMA-178	211002	Each time	N/A

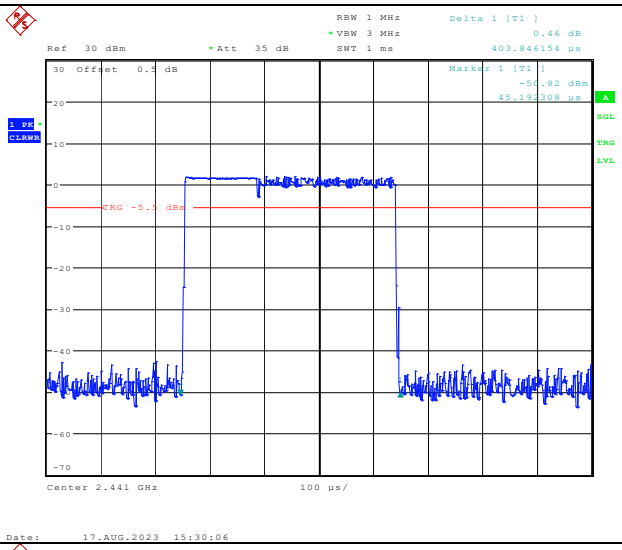
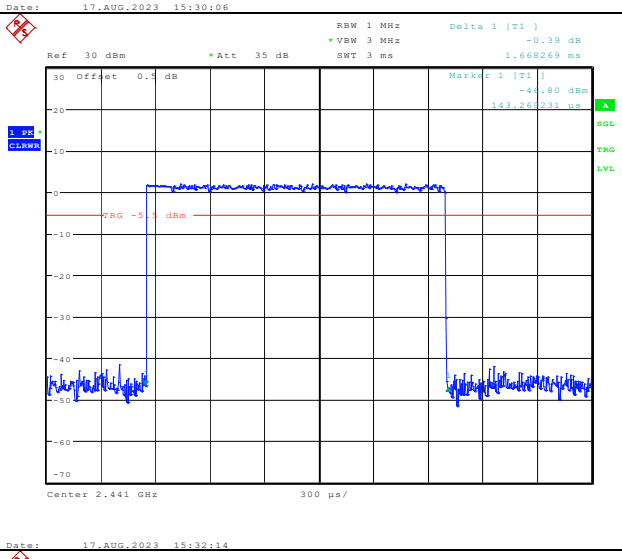
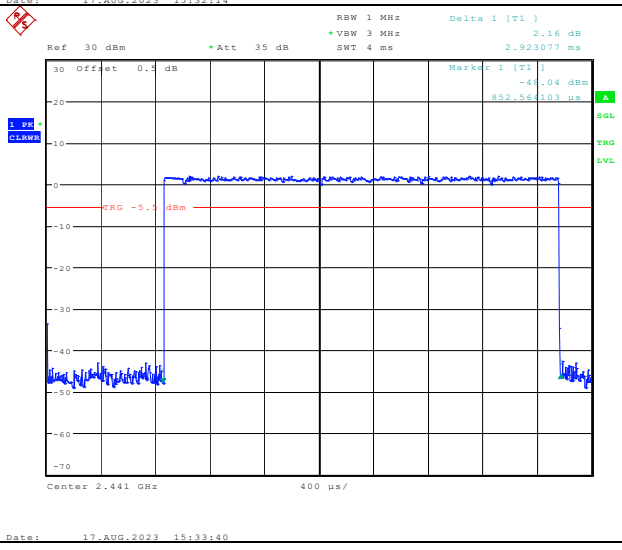
** Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).*

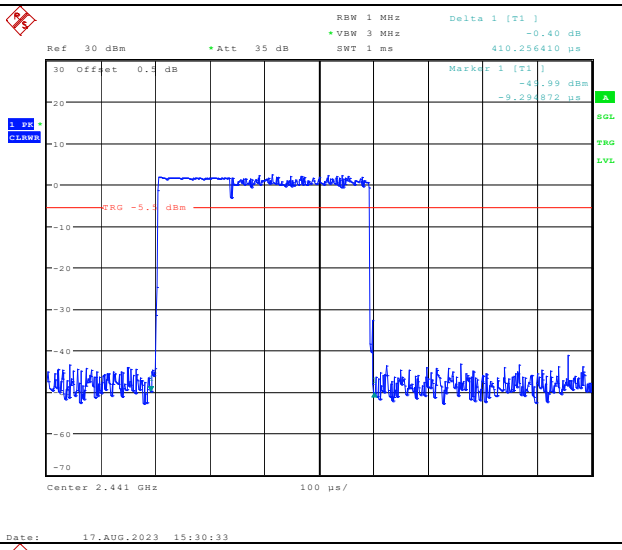
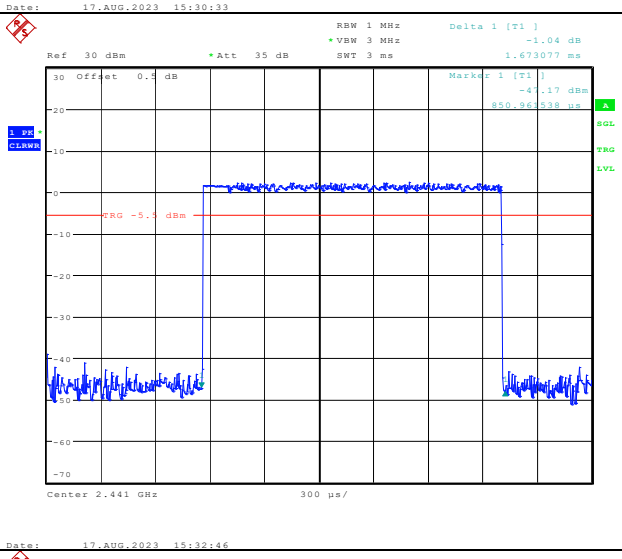
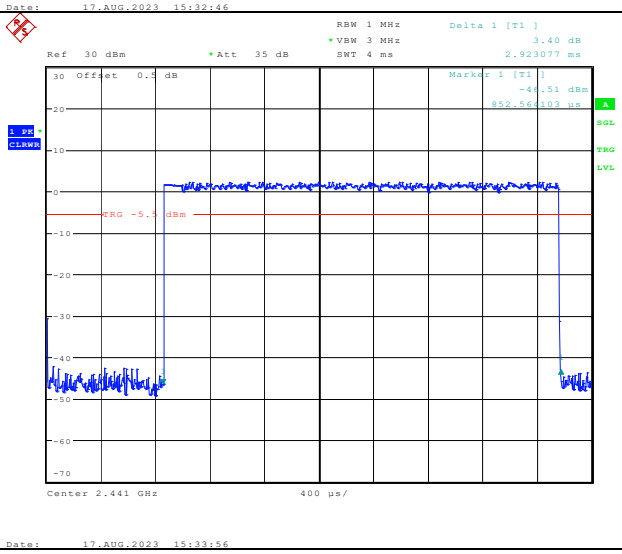
Test Data:

Test Modes	Packet Type	Test Frequency (MHz)	Pulse width (ms)	Result (s)	Limit (s)
BDR Mode (GFSK)	DH1	2441	0.393	0.126	0.400
	DH3	2441	1.663	0.266	0.400
	DH5	2441	2.923	0.312	0.400
EDR Mode (π/4-DQPSK)	2DH1	2441	0.404	0.129	0.400
	2DH3	2441	1.668	0.267	0.400
	2DH5	2441	2.923	0.312	0.400
EDR Mode (8DPSK)	3DH1	2441	0.410	0.131	0.400
	3DH3	2441	1.673	0.268	0.400
	3DH5	2441	2.923	0.312	0.400

Note:
DH1:Dwell time=Pulse time (ms) ×(1600/2/79) ×31.6 s
DH3:Dwell time=Pulse time (ms) ×(1600/4/79) ×31.6 s
DH5:Dwell time=Pulse time (ms) ×(1600/6/79) ×31.6 s

BDR Mode (GFSK)	
DH1:	
DH3:	
DH5:	

EDR Mode (π/4-DQPSK)	
2DH1:	
2DH3:	
2DH5:	

EDR Mode (8DPSK)	
3DH1:	
3DH3:	
3DH5:	

4.7 Maximum Conducted Output Power

Serial Number:	29L8-1	Test Date:	2023/8/17
Test Site:	RF	Test Mode:	Transmitting
Tester:	LingLing Li	Test Result:	Pass

Environmental Conditions:					
Temperature: (℃)	26.2	Relative Humidity: (%)	66	ATM Pressure: (kPa)	100.5

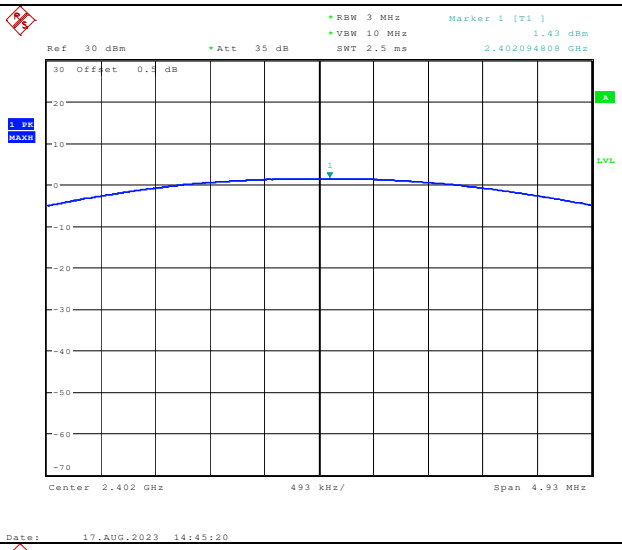
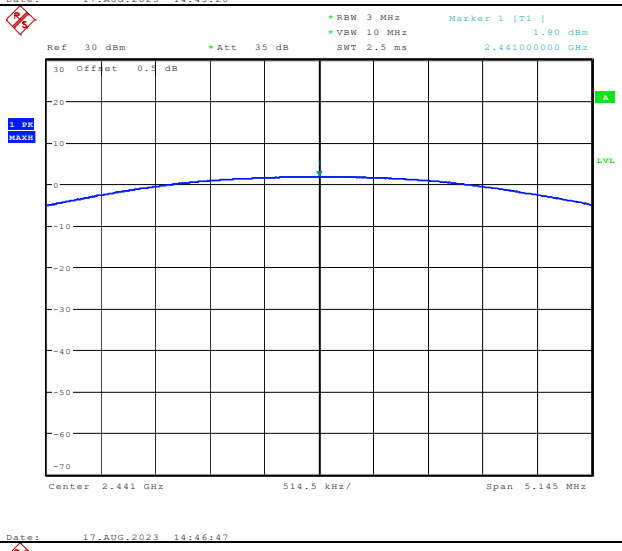
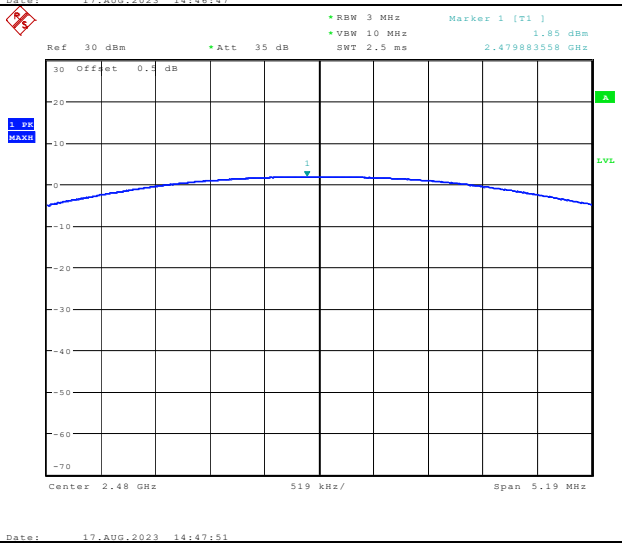
Test Equipment List and Details:

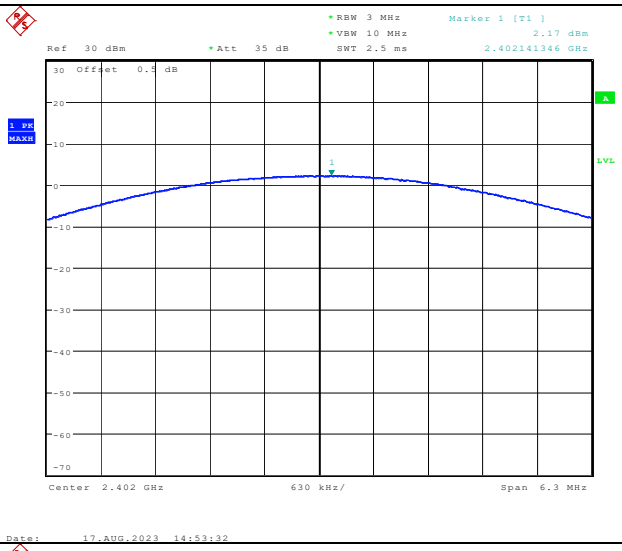
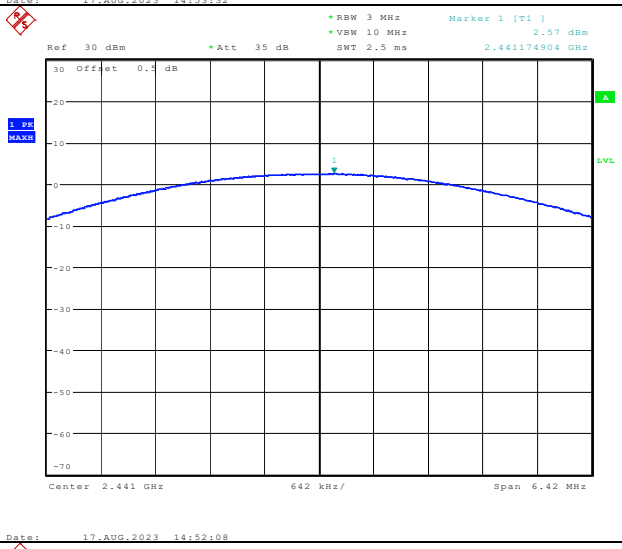
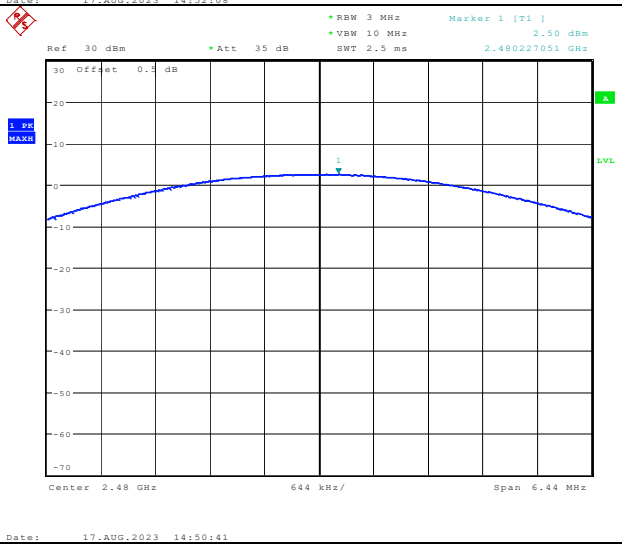
Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSU26	100147	2023/3/31	2024/3/30
zhuoxiang	Coaxial Cable	SMA-178	211002	Each time	N/A
eastsheep	Coaxial Attenuator	2W-SMA-JK-18G	21060301	Each time	N/A

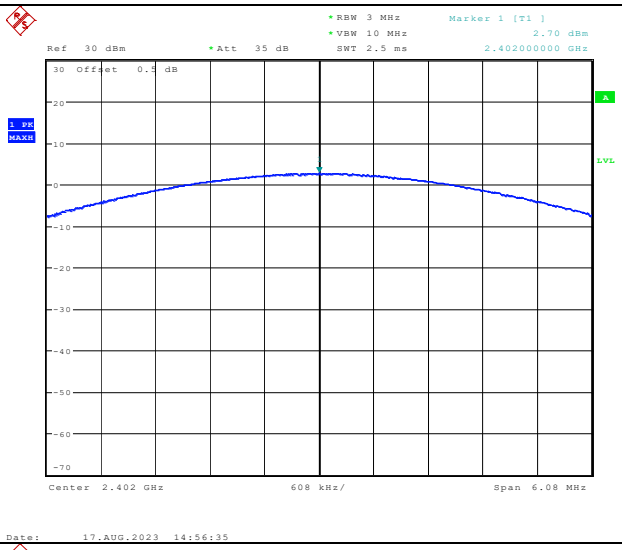
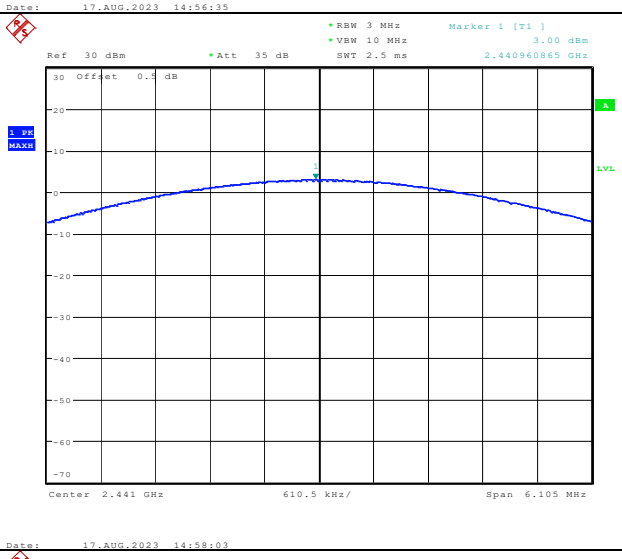
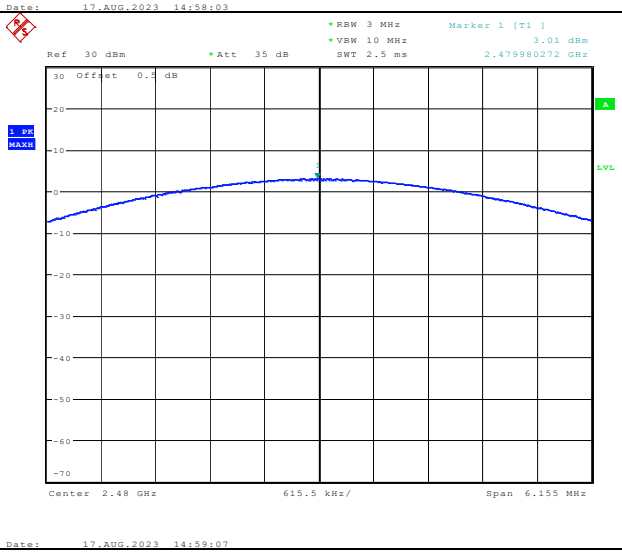
** Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).*

Test Data:

Test Modes	Test Frequency (MHz)	Peak Conducted Output Power (dBm)	Limits (dBm)
BDR Mode (GFSK)	2402	1.43	21
	2441	1.8	21
	2480	1.85	21
EDR Mode (π/4-DQPSK)	2402	2.17	21
	2441	2.57	21
	2480	2.5	21
EDR Mode (8DPSK)	2402	2.7	21
	2441	3	21
	2480	3.01	21

BDR Mode (GFSK)	
Lowest Channel	
Middle Channel	
Highest Channel	

EDR Mode (π/4-DQPSK)	
Lowest Channel	
Middle Channel	
Highest Channel	

EDR Mode (8DPSK)	
Lowest Channel	
Middle Channel	
Highest Channel	

4.8 100 kHz Bandwidth of Frequency Band Edge

Serial Number:	29L8-1	Test Date:	2023/8/17
Test Site:	RF	Test Mode:	Transmitting
Tester:	LingLing Li	Test Result:	Pass

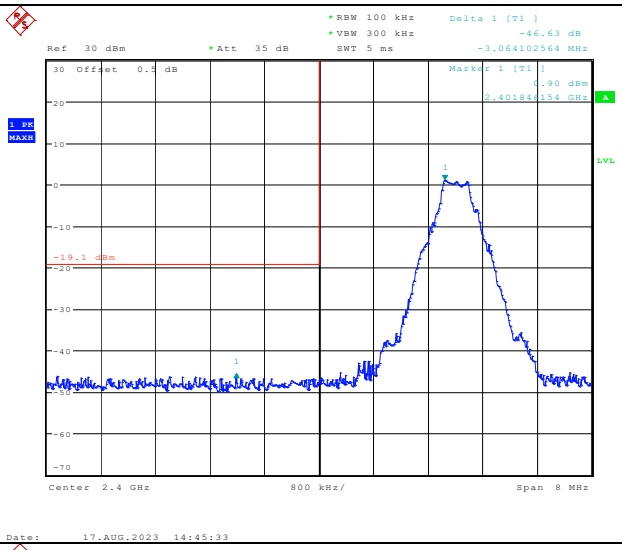
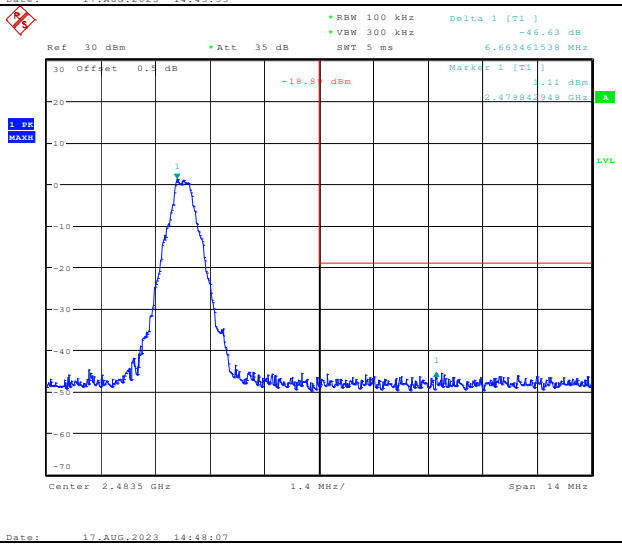
Environmental Conditions:					
Temperature: (℃)	26.2	Relative Humidity: (%)	66	ATM Pressure: (kPa)	100.5

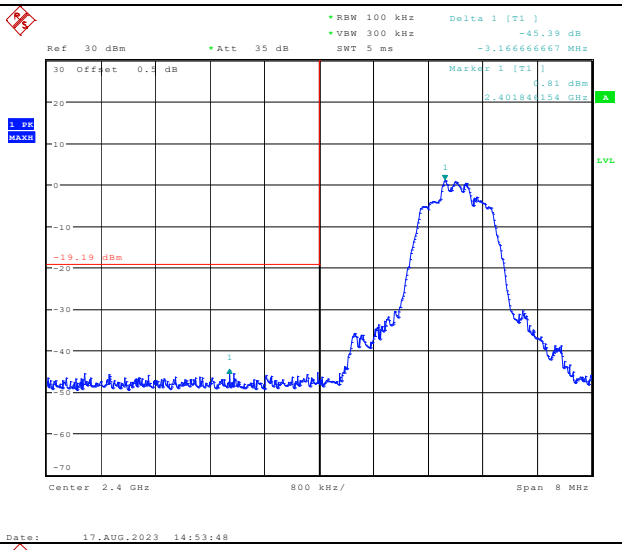
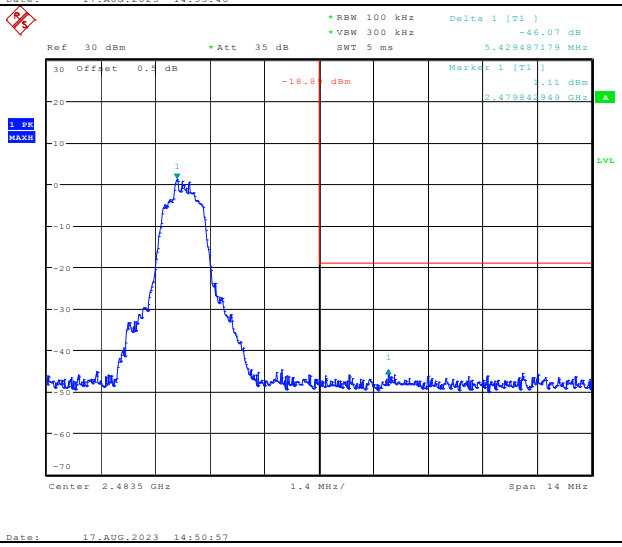
Test Equipment List and Details:

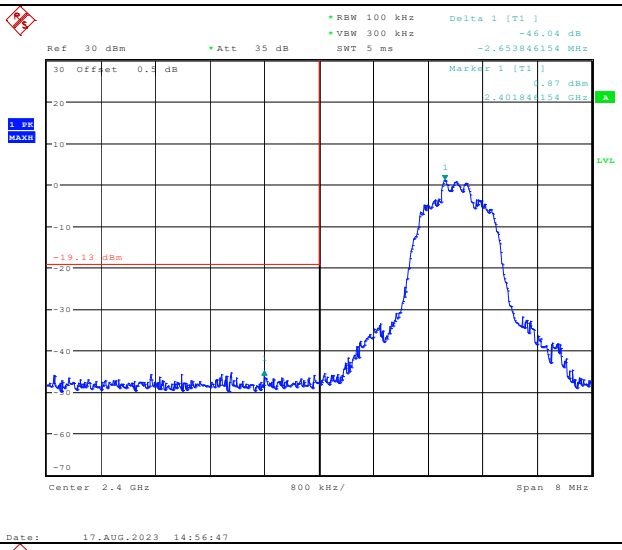
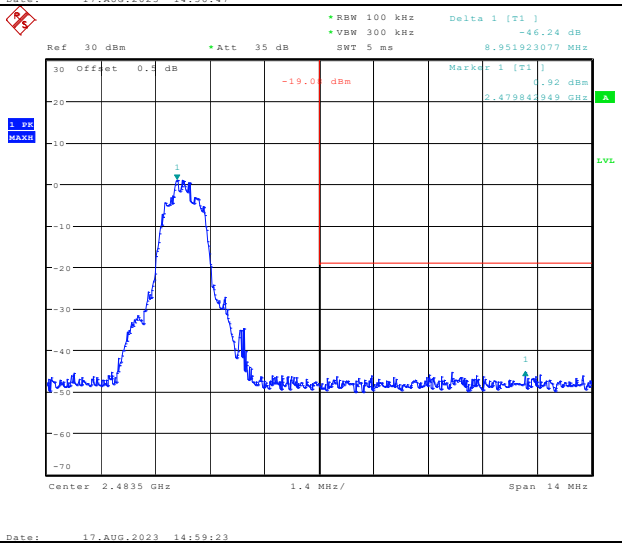
Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSU26	100147	2023/3/31	2024/3/30
zhuoxiang	Coaxial Cable	SMA-178	211002	Each time	N/A

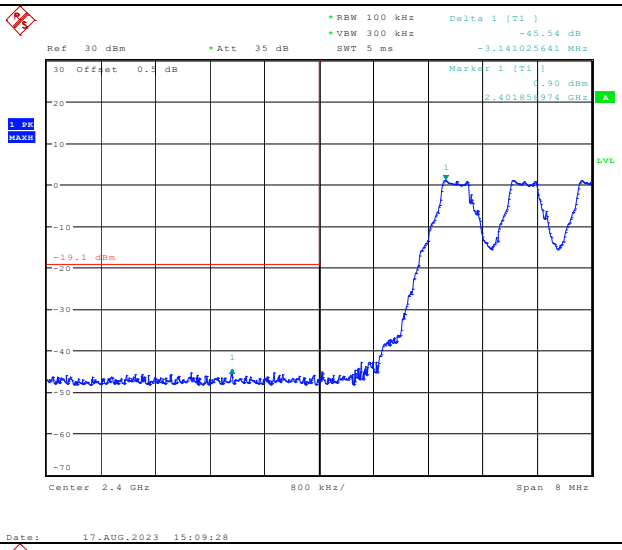
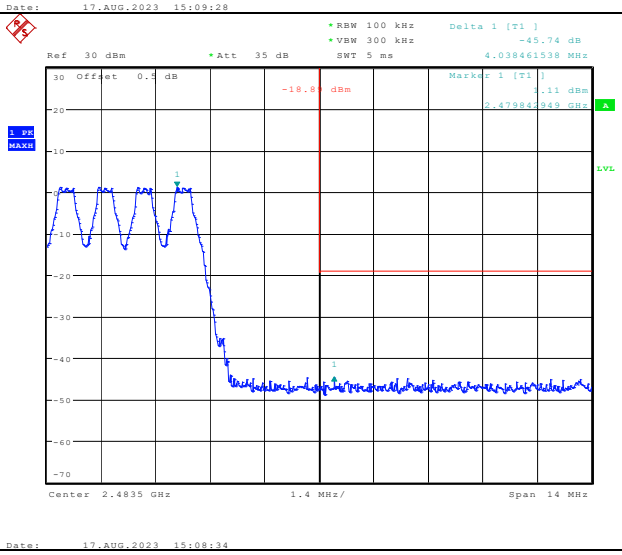
** Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).*

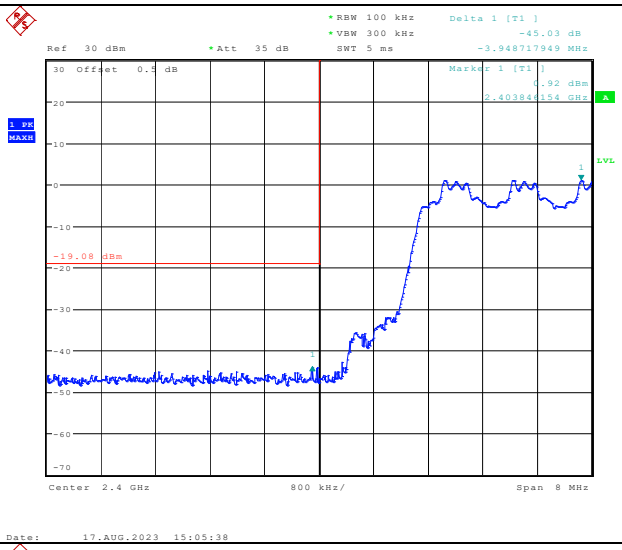
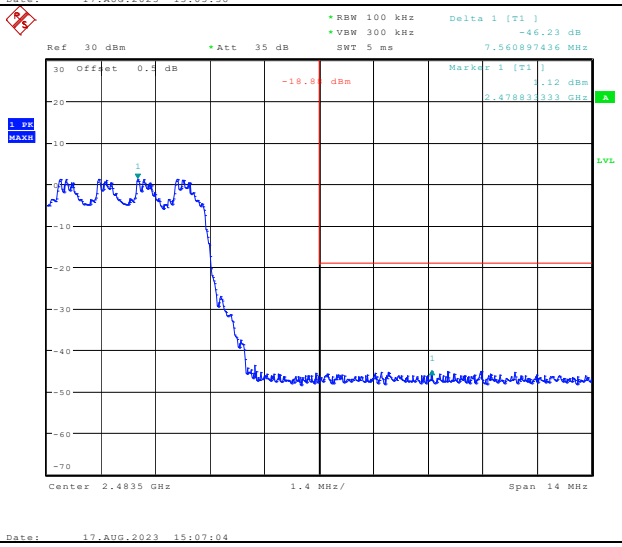
Test Data:

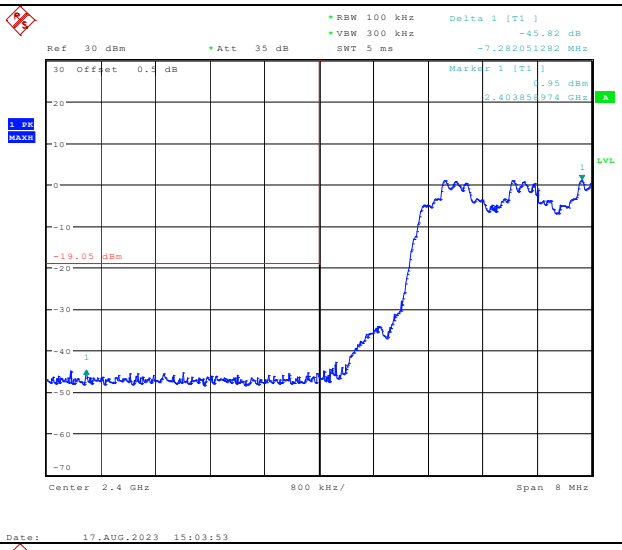
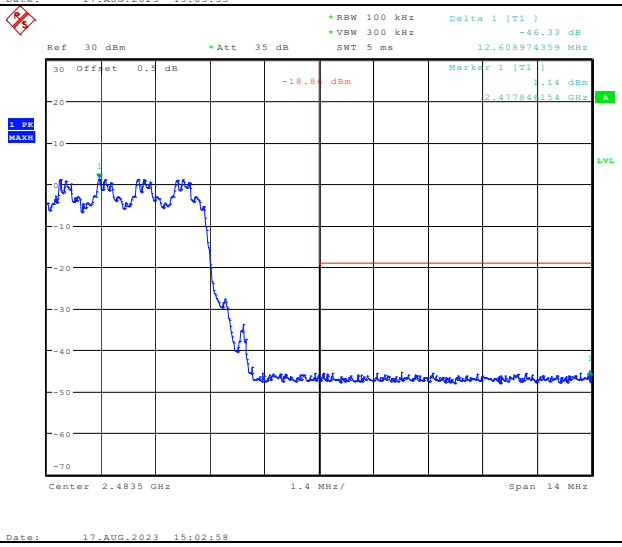
Band Edge, Single Channel	
BDR Mode (GFSK), Left Side	
BDR Mode (GFSK), Right Side	

Band Edge, Single Channel	
EDR Mode (π/4-DQPSK), Left Side	
EDR Mode (π/4-DQPSK), Right Side	

Band Edge, Single Channel	
EDR Mode (8DPSK), Left Side	
EDR Mode (8DPSK), Right Side	

Band Edge, Hopping Channel	
BDR Mode (GFSK), Left Side	
BDR Mode (GFSK), Right Side	

Band Edge, Hopping Channel	
EDR Mode (π/4-DQPSK), Left Side	
EDR Mode (π/4-DQPSK), Right Side	

Band Edge, Hopping Channel	
EDR Mode (8DPSK), Left Side	
EDR Mode (8DPSK), Right Side	

5. RF EXPOSURE EVALUATION

5.1 Applicable Standard

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

According to KDB447498 D01 General RF Exposure Guidance v06:

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:
[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] · [√f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where

- f(GHz) is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison
- 3.0 and 7.5 are referred to as the numeric thresholds in the step 2 below

The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm according to 5) in section 4.1 is applied to determine SAR test exclusion.

5.2 Measurement Result

The max conducted power including tune-up tolerance is 4 dBm (2.51 mW).
[(max. power of channel, mW)/(min. test separation distance, mm)][√f(GHz)]
=2.51/5*(√2.480) = 0.8< 3.0

Result: Compliant. The stand-alone SAR evaluation is not necessary.

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