

FCC TEST REPORT

Product Name: True wireless earbuds
Trade Mark: Heyday
Model No.: TW15C
Add. Model No.: N/A
Report Number: 211206004RFC-1
Test Standards: FCC 47 CFR Part 15 Subpart C
FCC ID: 2AO23-TW15C
Test Result: PASS
Date of Issue: February 15, 2022

Prepared for:

Chug, Inc.

7157 Shady Oak Road Eden Prairie, Washington Minnesota United States

Prepared by:

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February 15, 2022

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UTTR-RF-FCCPART15.247-V1.1

Version

Version No.	Date	Description
V1.0	February 15, 2022	Original



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1. GENERAL INFORMATION

1.1 CLIENT INFORMATION

Applicant:	Chug, Inc.
Address of Applicant:	7157 Shady Oak Road Eden Prairie, Washington Minnesota United States
Manufacturer:	Cirque Audio Technology Co.,Ltd.
Address of Manufacturer:	No 2, Road Beiyiheng, Huangjiabao Industrial Park, Shipai, Dongguan, Guangdong, China.

1.2 EUT INFORMATION

1.2.1 General Description of EUT

Product Name:	True wireless earbuds	
Model No.:	TW15C	
Add. Model No.:	N/A	
Trade Mark:	Heyday	
DUT Stage:	Identical Prototype	
EUT Supports Function:	2.4 GHz ISM Band:	Bluetooth 5.2
Software Version:	1.5	
Hardware Version:	2.0	
Sample Received Date:	December 6, 2021	
Sample Tested Date:	January 2, 2022 to January 9, 2022	

1.2.3 Description of Accessories

Cable	
Description:	USB Charging Cable
Cable Type:	Unshielded without ferrite
Length:	0.3 Meter

1.3 PRODUCT SPECIFICATION SUBJECTIVE TO THIS STANDARD

Frequency Band:	2400 MHz to 2483.5 MHz
Frequency Range:	2402 MHz to 2480 MHz
Bluetooth Version:	Bluetooth BR + EDR
Modulation Technique:	Frequency Hopping Spread Spectrum(FHSS)
Type of Modulation:	GFSK, $\pi/4$ DQPSK, 8DPSK
Number of Channels:	79
Channel Separation:	1 MHz
Hopping Channel Type:	Adaptive Frequency Hopping Systems
Antenna Type:	PCB Antenna
Antenna Gain:	0 dBi
Maximum Peak Power:	3.392dBm
Normal Test Voltage:	3.7 VDC

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1.4 OTHER INFORMATION

Operation Frequency Each of Channel	
$f = 2402 + k \text{ MHz}, k = 0, \dots, 78$	
Note:	
f	is the operating frequency (MHz);
k	is the operating channel.

Modulation Configure			
Modulation	Packet	Packet Type	Packet Size
GFSK	1-DH1	4	27
	1-DH3	11	183
	1-DH5	15	339
$\pi/4$ DQPSK	2-DH1	20	54
	2-DH3	26	367
	2-DH5	30	679
8DPSK	3-DH1	24	83
	3-DH3	27	552
	3-DH5	31	1021

1.5 DESCRIPTION OF SUPPORT UNITS

The EUT has been tested with associated equipment below.

1) Support Equipment

Description	Manufacturer	Model No.	Serial Number	Supplied by
Notebook	Lenovo	E450	SL10G10780	UnionTrust

2) Support Cable

Cable No.	Description	Connector	Length	Supplied by
1	Antenna Cable	SMA	0.20 Meter	UnionTrust

1.6 TEST LOCATION

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1.7 TEST FACILITY

The test facility is recognized, certified, or accredited by the following organizations:

CNAS-Lab Code: L9069

The measuring equipment utilized to perform the tests documented in this report has been calibrated once a year or in accordance with the manufacturer's recommendations, and is traceable under the ISO/IEC 17025 to international or national standards. Equipment has been calibrated by accredited calibration laboratories.

A2LA-Lab Certificate No.: 4312.01

Shenzhen UnionTrust Quality and Technology Co., Ltd. has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

ISED Wireless Device Testing Laboratories

CAB identifier: CN0032

FCC Accredited Lab.

Designation Number: CN1194

Test Firm Registration Number: 259480

1.8 DEVIATION FROM STANDARDS

None.

1.9 ABNORMALITIES FROM STANDARD CONDITIONS

None.

1.10 OTHER INFORMATION REQUESTED BY THE CUSTOMER

None.

1.11 MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the Product as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

No.	Item	Measurement Uncertainty
1	Conducted emission 9KHz-150KHz	±3.8 dB
2	Conducted emission 150KHz-30MHz	±3.4 dB
3	Radiated emission 9KHz-30MHz	±4.9 dB
4	Radiated emission 30MHz-1GHz	±4.7 dB
5	Radiated emission 1GHz-18GHz	±5.1 dB
6	Radiated emission 18GHz-26GHz	±5.2 dB
7	Radiated emission 26GHz-40GHz	±5.2 dB

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2. TEST SUMMARY

FCC 47 CFR Part 15 Subpart C Test Cases			
Test Item	Test Requirement	Test Method	Result
Antenna Requirement	FCC 47 CFR Part 15 Subpart C Section 15.203/15.247 (c)	N/A	PASS
AC Power Line Conducted Emission	FCC 47 CFR Part 15 Subpart C Section 15.207	ANSI C63.10-2013 Section 6.2	N/A ^(1,2)
Conducted Peak Output Power	FCC 47 CFR Part 15 Subpart C Section 15.247 (b)(1)	ANSI C63.10-2013 Section 7.8.5	PASS
20 dB Bandwidth	FCC 47 CFR Part 15 Subpart C Section 15.247 (a)(1)	ANSI C63.10-2013 Section 6.9.2	PASS
Carrier Frequencies Separation	FCC 47 CFR Part 15 Subpart C Section 15.247 (a)(1)	ANSI C63.10-2013 Section 7.8.2	PASS
Number of Hopping Channel	FCC 47 CFR Part 15 Subpart C Section 15.247 (b)(1)	ANSI C63.10-2013 Section 7.8.3	PASS
Dwell Time	FCC 47 CFR Part 15 Subpart C Section 15.247 (a)(1)	ANSI C63.10-2013 Section 7.8.4	PASS
Conducted Out of Band Emission	FCC 47 CFR Part 15 Subpart C Section 15.247(d)	ANSI C63.10-2013 Section 6.10.4 & Section 7.8.8	PASS
Radiated Emissions	FCC 47 CFR Part 15 Subpart C Section 15.205/15.209	ANSI C63.10-2013 Section 6.3 & 6.5 & 6.6	PASS
Band Edge Measurement	FCC 47 CFR Part 15 Subpart C Section 15.205/15.209	ANSI C63.10-2013 Section 6.10.5	PASS

Note:

- 1) N/A: In this whole report not applicable.
- 2) BT could not work when charging.

3. EQUIPMENT LIST

Radiated Emission Test Equipment List						
Used	Equipment	Manufacturer	Model No.	Serial Number	Cal. date (mm dd, yyyy)	Cal. Due date (mm dd, yyyy)
☒	3M SAC	ETS-LINDGREN	3M	N/A	Jan. 22, 2021	Jan. 21, 2024
☒	Receiver	R&S	ESIB26	100114	Nov. 05, 2021	Nov. 04, 2022
☒	Broadband Antenna	ETS-LINDGREN	3142E	00201566	Nov. 11, 2021	Nov. 10, 2023
☒	6dB Attenuator	Talent	RA6A5-N-18	18103001	Nov. 11, 2021	Nov. 10, 2023
☒	Preamplifier	HP	8447F	2805A02960	Nov. 05, 2021	Nov. 04, 2022
☒	Horn Antenna (Pre-amplifier)	ETS-LINDGREN	3117-PA	00201874	Apr. 30, 2021	Apr. 29, 2023
☒	Preamplifier	ETS-LINDGREN	00118385	00201874	Nov. 06, 2021	Nov. 05, 2022
☒	Multi device Controller	ETS-LINDGREN	7006-001	00160105	N/A	N/A
☒	Test Software	Audix	e3	Software Version: 9.160323		

Conducted RF test Equipment List						
Used	Equipment	Manufacturer	Model No.	Serial Number	Cal. date (mm dd, yyyy)	Cal. Due date (mm dd, yyyy)
☒	EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY51440197	Apr. 22, 2021	Apr. 21, 2022
☒	USB Wideband Power Sensor	KEYSIGHT	U2021XA	MY55430035	Nov. 05, 2021	Nov. 04, 2022

4. TEST CONFIGURATION

4.1 ENVIRONMENTAL CONDITIONS FOR TESTING

4.1.1 Normal or Extreme Test Conditions

Environment Parameter	Selected Values During Tests		
Test Condition	Ambient		
	Temperature (°C)	Voltage (V)	Relative Humidity (%)
NT/NV	+15 to +35	3.7V battery	20 to 75
Remark: 1) NV: Normal Voltage; NT: Normal Temperature			

4.1.2 Record of Normal Environment

Test Item	Temperature (°C)	Relative Humidity (%)	Pressure (kPa)	Tested by
Conducted Peak Output Power	24.6	53	100.8	Ouyang
20 dB Bandwidth	24.6	53	100.8	Ouyang
Carrier Frequencies Separation	24.6	53	100.8	Ouyang
Number of Hopping Channel	24.6	53	100.8	Ouyang
Dwell Time	24.6	53	100.8	Ouyang
Conducted Out of Band Emission	24.6	53	100.8	Ouyang
Radiated Emissions	24.9	55	100.5	Asia Yan
Band Edge Measurement	24.9	55	100.5	Asia Yan

4.2 TEST CHANNELS

Mode	Tx/Rx Frequency	Test RF Channel Lists		
		Lowest(L)	Middle(M)	Highest(H)
GFSK (DH1, DH3, DH5)	2402 MHz to 2480 MHz	Channel 0	Channel 39	Channel 78
		2402 MHz	2441 MHz	2480 MHz
$\pi/4$ DQPSK (DH1, DH3, DH5)	2402 MHz to 2480 MHz	Channel 0	Channel 39	Channel 78
		2402 MHz	2441 MHz	2480 MHz
8DPSK (DH1, DH3, DH5)	2402 MHz to 2480 MHz	Channel 0	Channel 39	Channel 78
		2402 MHz	2441 MHz	2480 MHz

4.3 EUT TEST STATUS

Type of Modulation	Tx Function	Description
GFSK/ $\pi/4$ DQPSK/ 8DPSK	1Tx	1. Keep the EUT in continuously transmitting with Modulation test single 2. Keep the EUT in continuously transmitting with Modulation test Hopping Frequency.

Power Setting	
GFSK	Level 54
$\pi/4$ DQPSK	Level 60
8DPSK	Level 60

Test Software

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Test software name: Airoha Tool Kit-V1.5.11.2.exe

4.4 PRE-SCAN

4.4.1 Pre-scan under all packets at middle channel

Conducted Average Power (dBm) for packets									
Type of Modulation	GFSK			$\pi/4$ DQPSK			8DPSK		
Packets	1-DH1	1-DH3	1-DH5	2-DH1	2-DH3	2-DH5	3-DH1	3-DH3	3-DH5
Power (dBm)	-3.09	0.29	1.02	-2.1	-0.42	-1.04	-2.15	-0.48	-1.06

4.4.2 Worst-case data packets

Type of Modulation	Worst-case data rates
GFSK	1-DH5
$\pi/4$ DQPSK	2-DH5
8DPSK	3-DH5

4.4.3 Tested channel detail

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data packets and antenna ports (if EUT with antenna diversity architecture). Following channel(s) was (were) selected for the final test as listed below.

Type of Modulation	GFSK			$\pi/4$ DQPSK			8DPSK		
Data Packets	1-DH 1	1-DH 3	1-DH 5	2-DH 1	2-DH 3	2-DH 5	3-DH 1	3-DH 3	3-DH 5
Available Channel	0 to 78								
Test Item	Test channel and choose of data packets								
AC Power Line Conducted Emission	Frequency Hopping Channel 0 to 78								
	☐ Link								
Conducted Peak Output Power	Channel 0 & 39 & 78								
	☐	☐	☒	☐	☐	☒	☐	☐	☒
20 dB Bandwidth	Channel 0 & 39 & 78								
	☐	☐	☒	☐	☐	☒	☐	☐	☒
Carrier Frequencies Separation	Frequency Hopping Channel 0 to 78								
	☐	☐	☒	☐	☐	☒	☐	☐	☒
Number of Hopping Channel	Frequency Hopping Channel 0 to 78								
	☐	☐	☒	☐	☐	☒	☐	☐	☒
Dwell Time	Channel 39								
	☒	☒	☒	☒	☒	☒	☒	☒	☒
Conducted Out of Band Emission	Channel 0 & 39 & 78								
	☐	☐	☒	☐	☐	☒	☐	☐	☒
Radiated Emissions	Channel 0 & 39 & 78								
	☐	☐	☒	☐	☐	☒	☐	☐	☒
Band Edge Measurements (Radiated)	Channel 0 & 78								
	☐	☐	☒	☐	☐	☐	☐	☐	☐
Remark:									
1. The mark "☒" means is chosen for testing;									
2. The mark "☐" means is not chosen for testing.									

4.5 TEST SETUP

4.5.1 For Radiated Emissions test setup

Figure 1. Below 30MHz

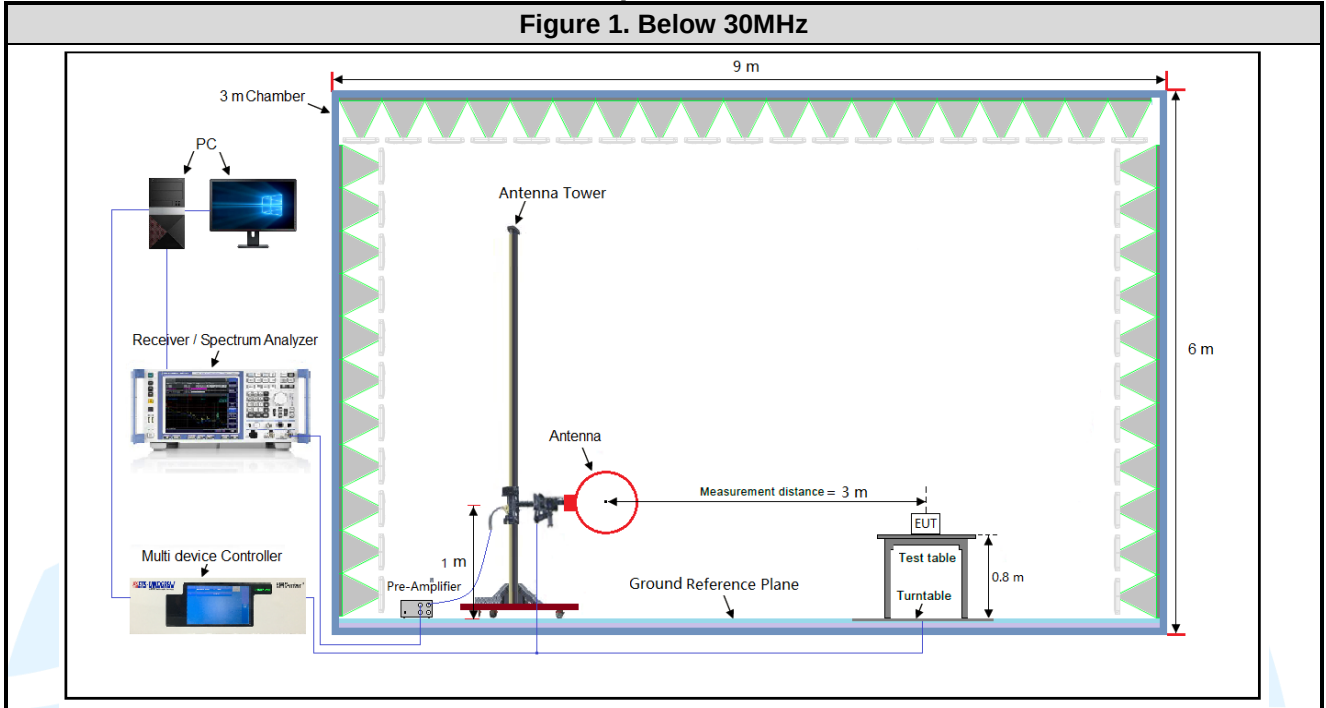
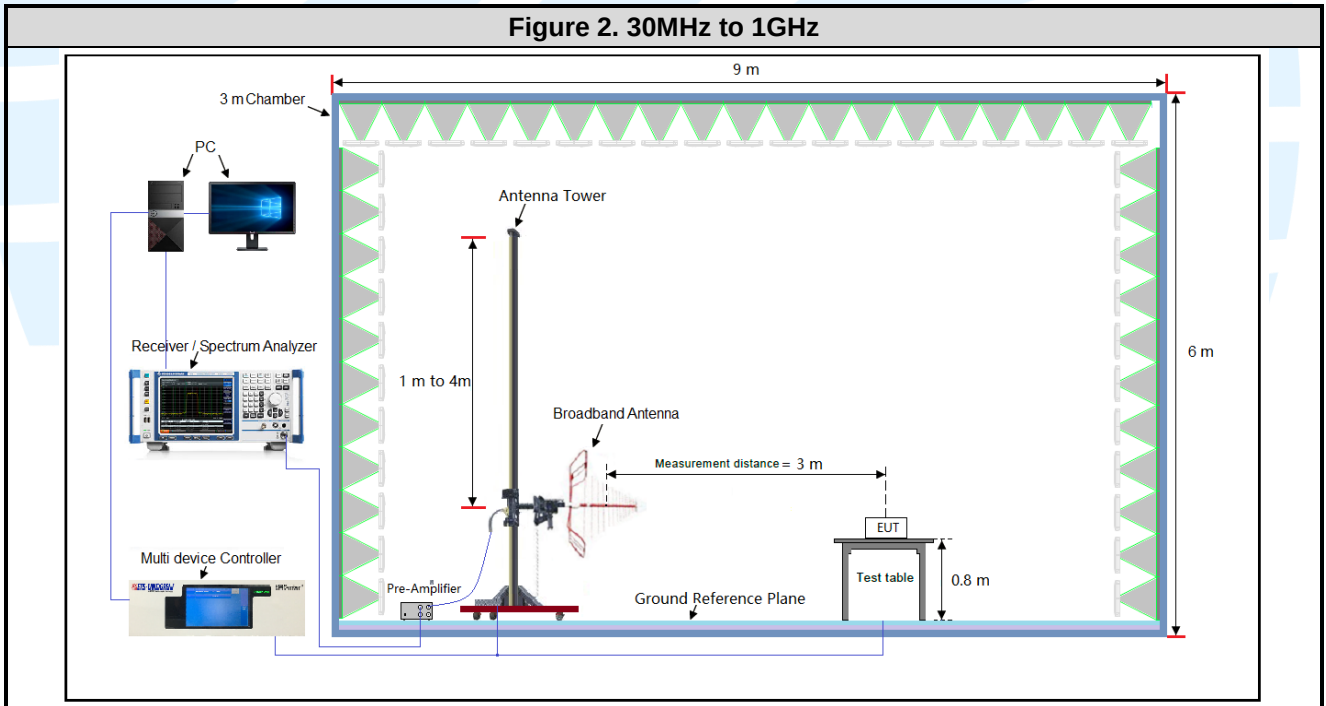
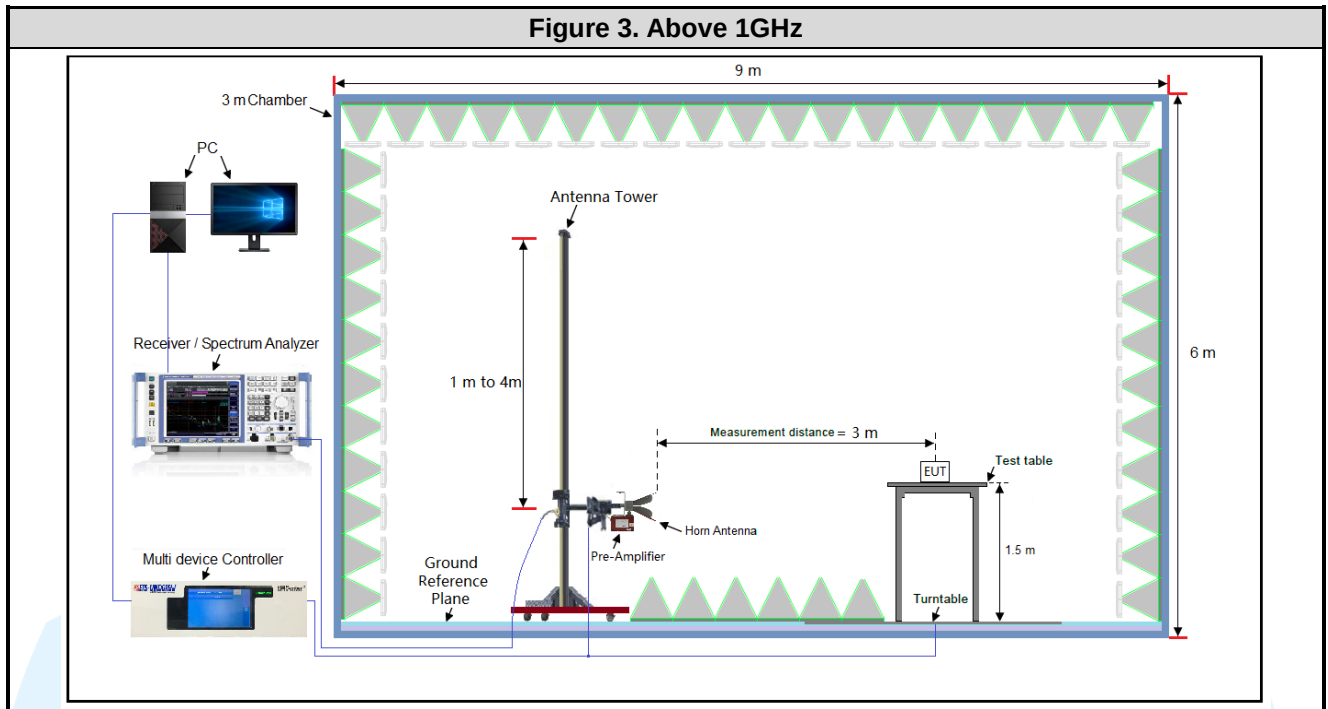
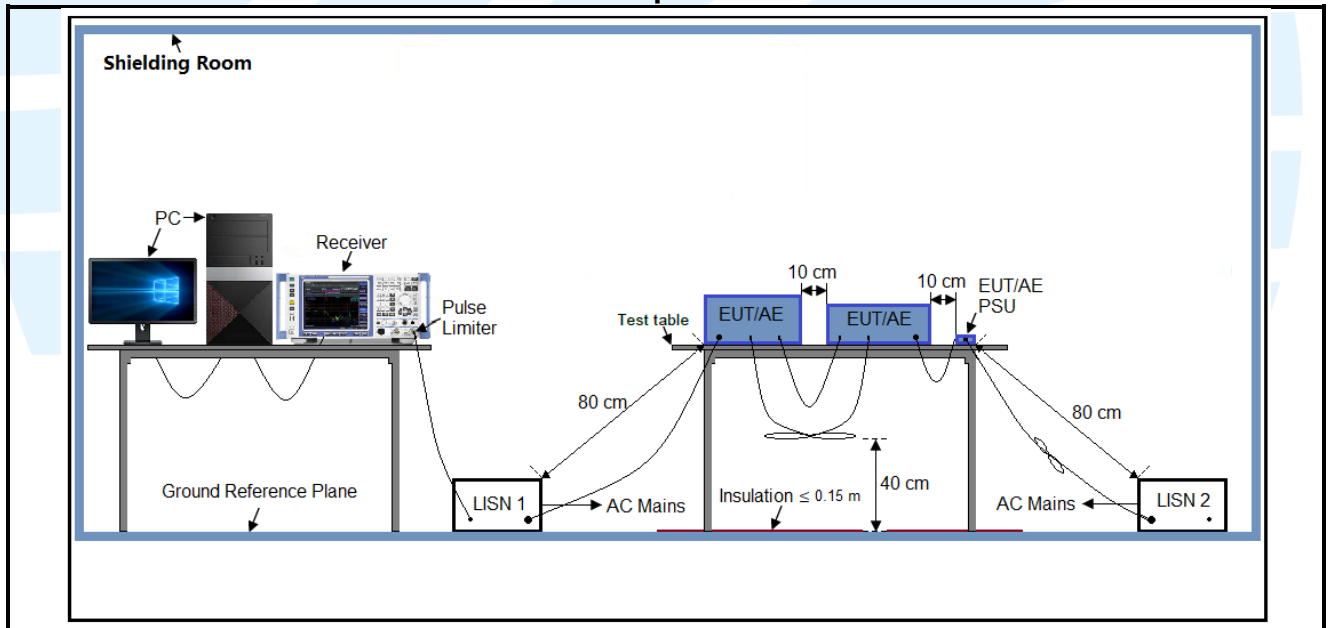


Figure 2. 30MHz to 1GHz

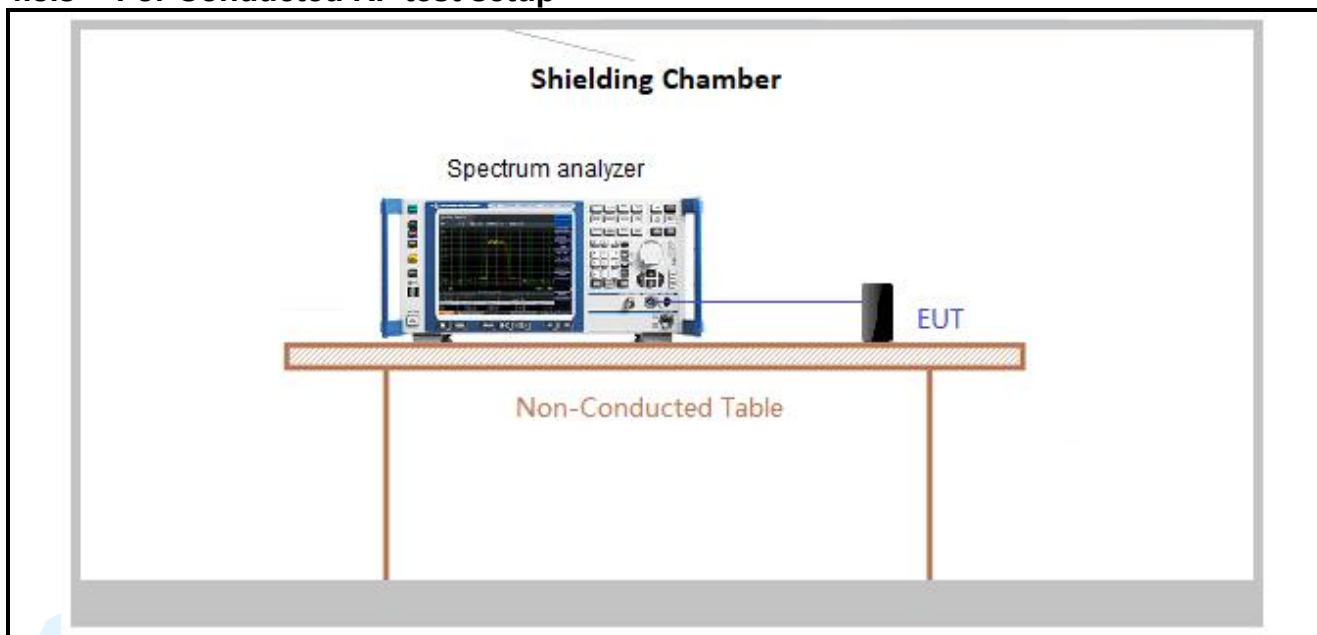




4.5.2 For Conducted Emissions test setup



4.5.3 For Conducted RF test setup



4.6 SYSTEM TEST CONFIGURATION

For emissions testing, the equipment under test (EUT) setup to transmit continuously to simplify the measurement methodology. Care was taken to ensure proper power supply voltages during testing. During testing, radiated emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario. It was powered by a 3.7V battery. Only the worst case data were recorded in this test report.

The signal is maximized through rotation and placement in the three orthogonal axes. The antenna height and polarization are varied during the search for maximum signal level. The antenna height is varied from 1 to 4 meters. Radiated emissions are taken at three meters unless the signal level is too low for measurement at that distance. If necessary, a pre-amplifier is used and/or the test is conducted at a closer distance. Therefore, all final radiated testing was performed with the EUT in (see table below) orientation.

Frequency	Mode	Antenna Port	Worst-case axis positioning
Above 1GHz	1TX	Chain 0	X axis

All readings are extrapolated back to the equivalent three meter reading using inverse scaling with distance. Analyzer resolution is 100 kHz or greater for frequencies below 1000 MHz. The resolution is 1 MHz or greater for frequencies above 1000 MHz. The spurious emissions more than 20 dB below the permissible value are not reported.

Radiated emission measurement were performed from the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

4.7 DUTY CYCLE

Test Procedure: ANSI C63.10-2013 Clause 11.6.

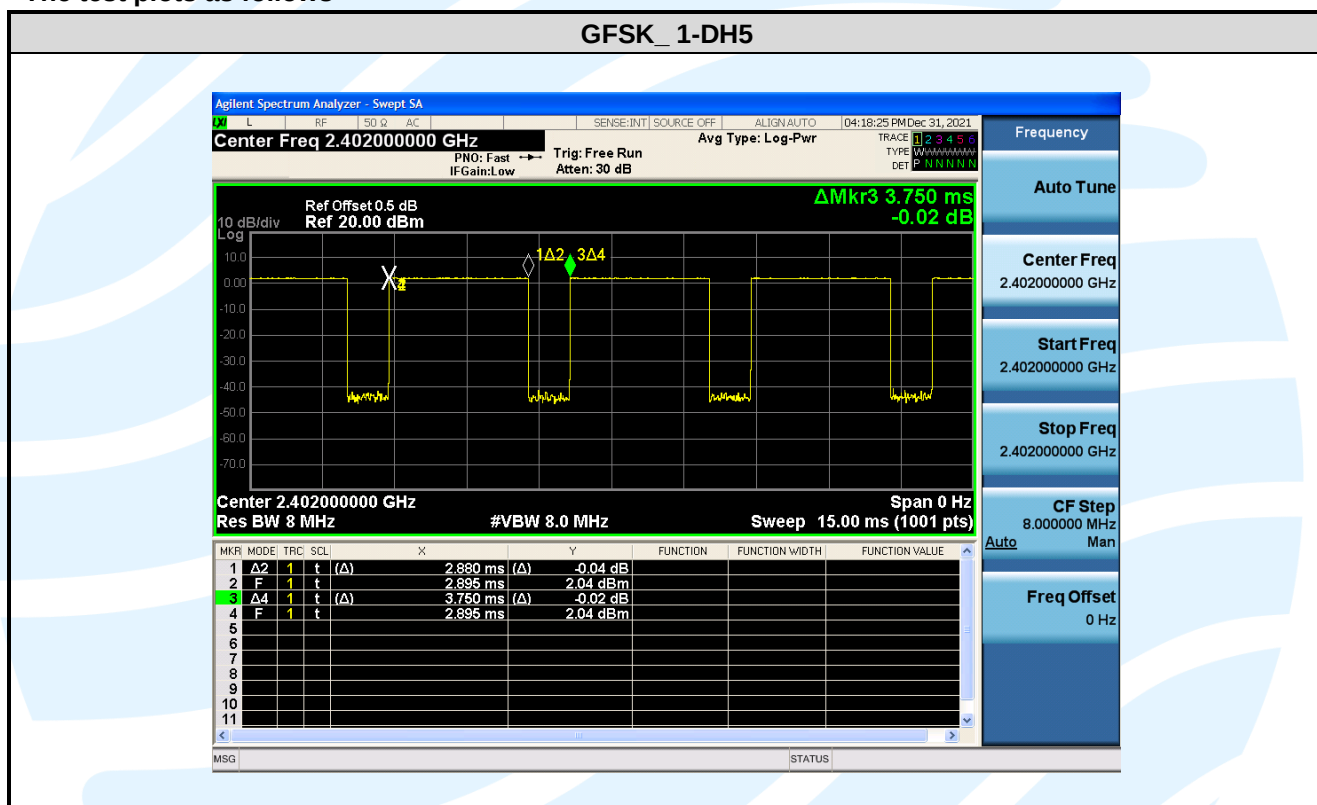
Test Results

Type of Modulation	Packets	On Time (msec)	Period (msec)	Duty Cycle (linear)	Duty Cycle (%)	Duty Cycle Factor (dB)	1/ T Minimum VBW (kHz)	Average Factor (dB)
GFSK	1-DH5	2.8800	3.7500	0.77	76.80	1.15	0.35	-2.29

Remark:

- 1) Duty cycle= On Time/ Period;
- 2) Duty Cycle factor = $10 \cdot \log(1/\text{Duty cycle})$;
- 3) Average factor = $20 \log_{10} \text{Duty Cycle}$.

The test plots as follows



5. RADIO TECHNICAL REQUIREMENTS SPECIFICATION

5.1 REFERENCE DOCUMENTS FOR TESTING

No.	Identity	Document Title
1	FCC 47 CFR Part 2	Frequency allocations and radio treaty matters; general rules and regulations
2	FCC 47 CFR Part 15	Radio Frequency Devices
3	ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices
4	KDB 558074 D01 15.247 Meas Guidance v05r02	Guidance for compliance measurements on Digital Transmission Systems, Frequency Hopping Spread Spectrum system, and Hybrid system devices operating under Section 15.247 of the FCC rules

5.2 ANTENNA REQUIREMENT

Standard Requirement
15.203 requirement: 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, 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. 15.247(b) (4) requirement: The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.
EUT Antenna: Antenna in the interior of the equipment and no consideration of replacement. The gain of the antenna is 0 dBi.

5.3 CONDUCTED PEAK OUTPUT POWER

Test Requirement: FCC 47 CFR Part 15 Subpart C Section 15.247 (b)(1)

Test Method: ANSI C63.10-2013 Section 7.8.5

Limit: 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.

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.

Test Procedure: Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.

- a) Use the following spectrum analyzer settings:
 - 1) Span: Approximately 5 x 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.

Test Setup: Refer to section 4.5.3 for details.

Instruments Used: Refer to section 3 for details

Test Results: Pass

Left:

Type of Modulation	Peak Output Power (dBm)			Peak Output Power (mW)		
	Channel 0	Channel 39	Channel 78	Channel 0	Channel 39	Channel 78
GFSK	2.039	2.032	2.248	1.600	1.600	1.680
$\pi/4$ DQPSK	2.040	2.012	2.231	1.600	1.590	1.670
8DPSK	2.233	2.221	2.246	1.670	1.670	1.750

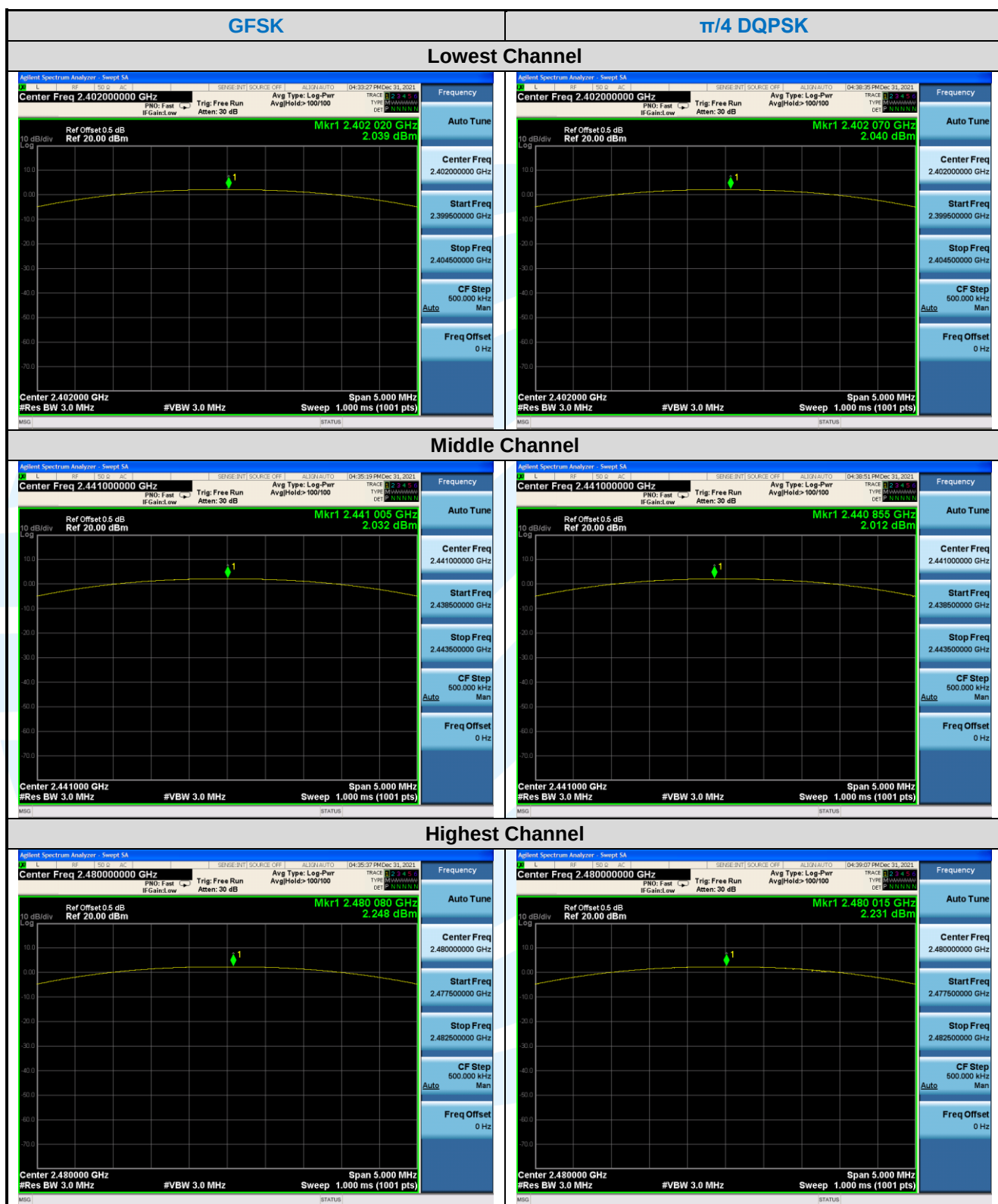
Right:

Type of Modulation	Peak Output Power (dBm)			Peak Output Power (mW)		
	Channel 0	Channel 39	Channel 78	Channel 0	Channel 39	Channel 78
GFSK	2.790	3.204	3.316	1.900	2.090	2.150
$\pi/4$ DQPSK	2.794	3.209	3.295	1.900	2.090	2.140
8DPSK	2.979	3.392	3.184	1.990	2.180	2.080

Note: The antenna gain of 0dBi less than 6dBi maximum permission antenna gain value based on 125 mW peak output power limit.

The test plots as follows:

Left:



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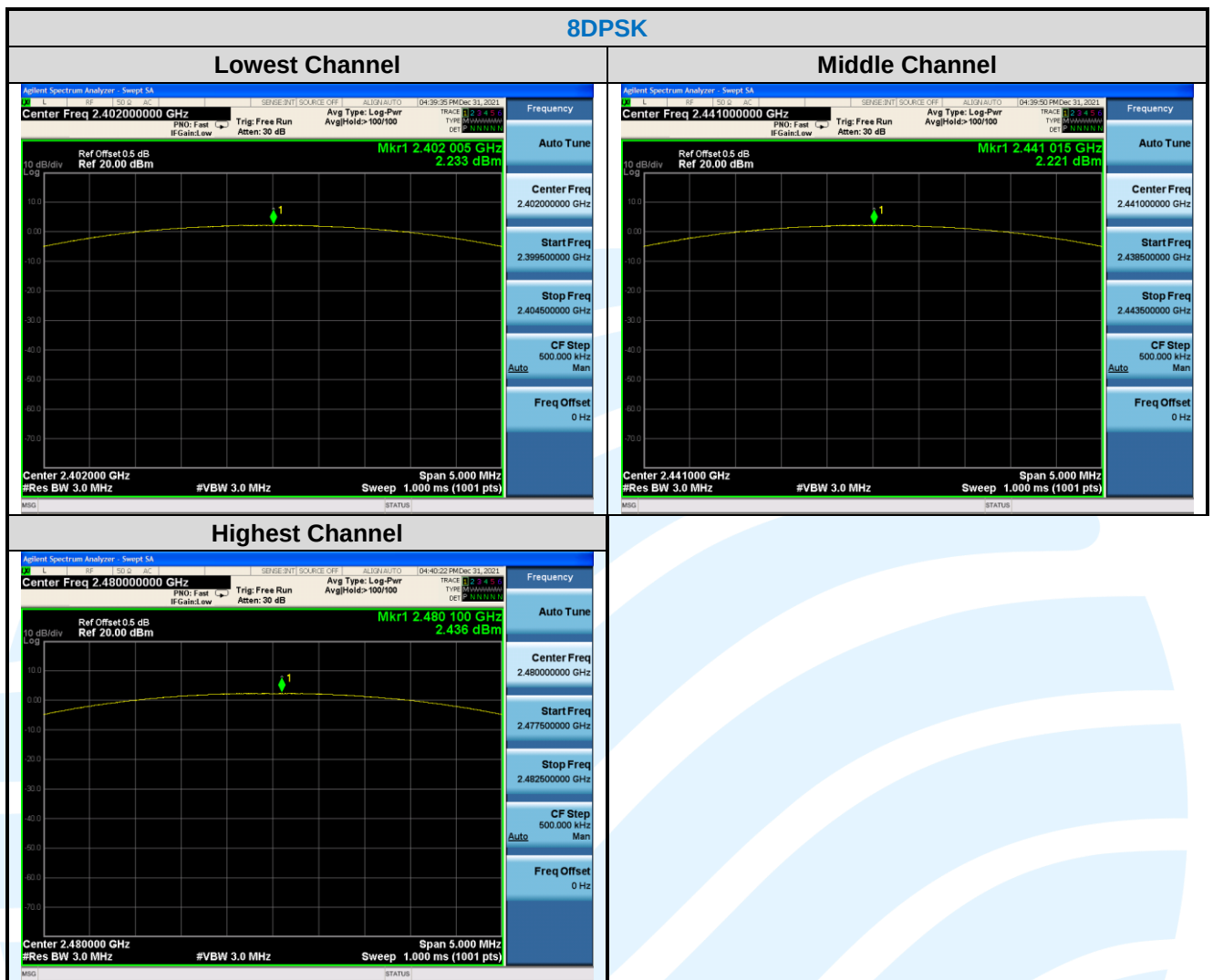
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Fax: +86-755-28230886

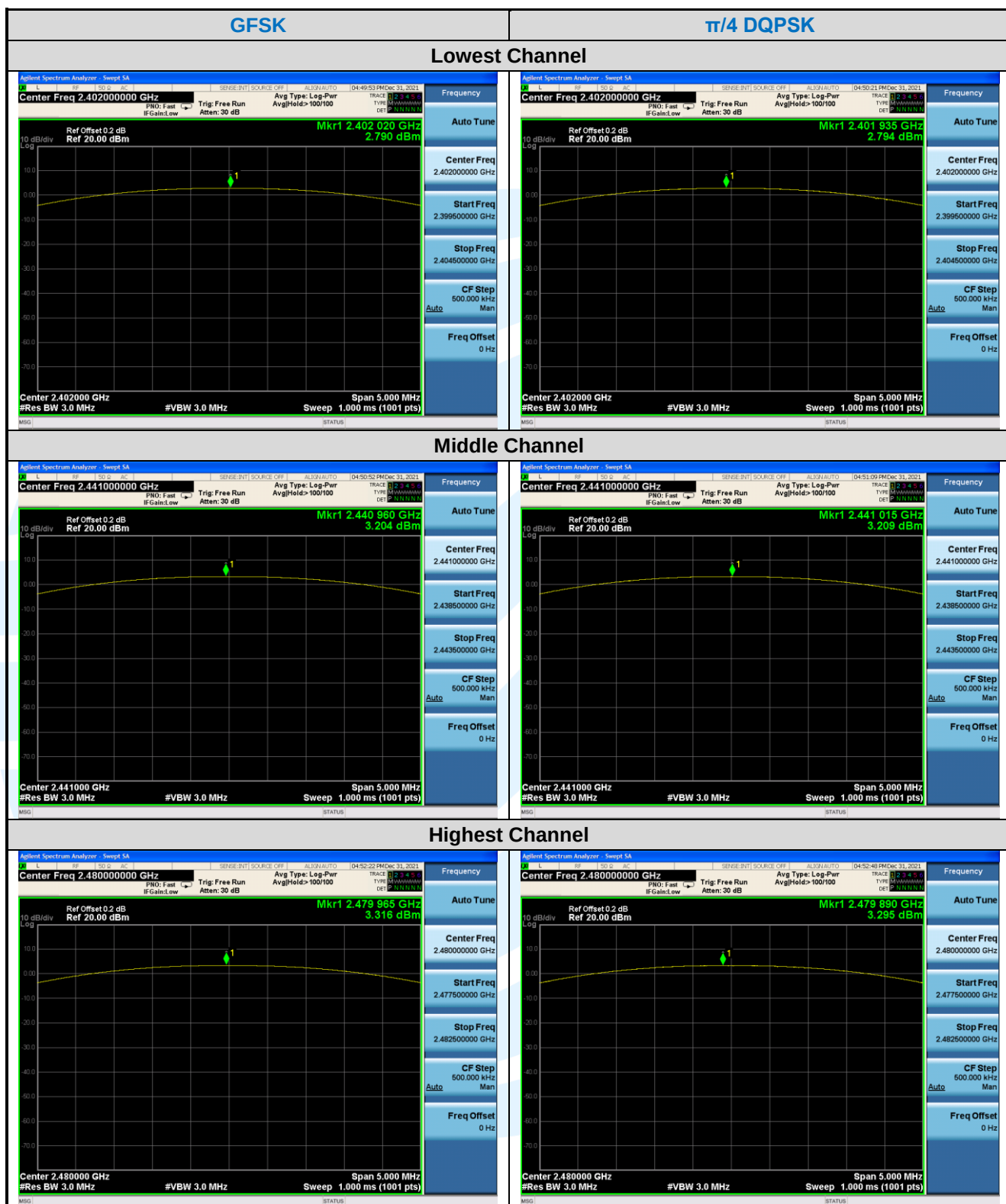
E-mail: info@uttlab.com

<http://www.uttlab.com>

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Right:



Shenzhen UnionTrust Quality and Technology Co., Ltd.

Address: Unit D/E of 9/F and 16/F, Block A, Building 6, Baoneng science and technology park, Longhua district, Shenzhen, China

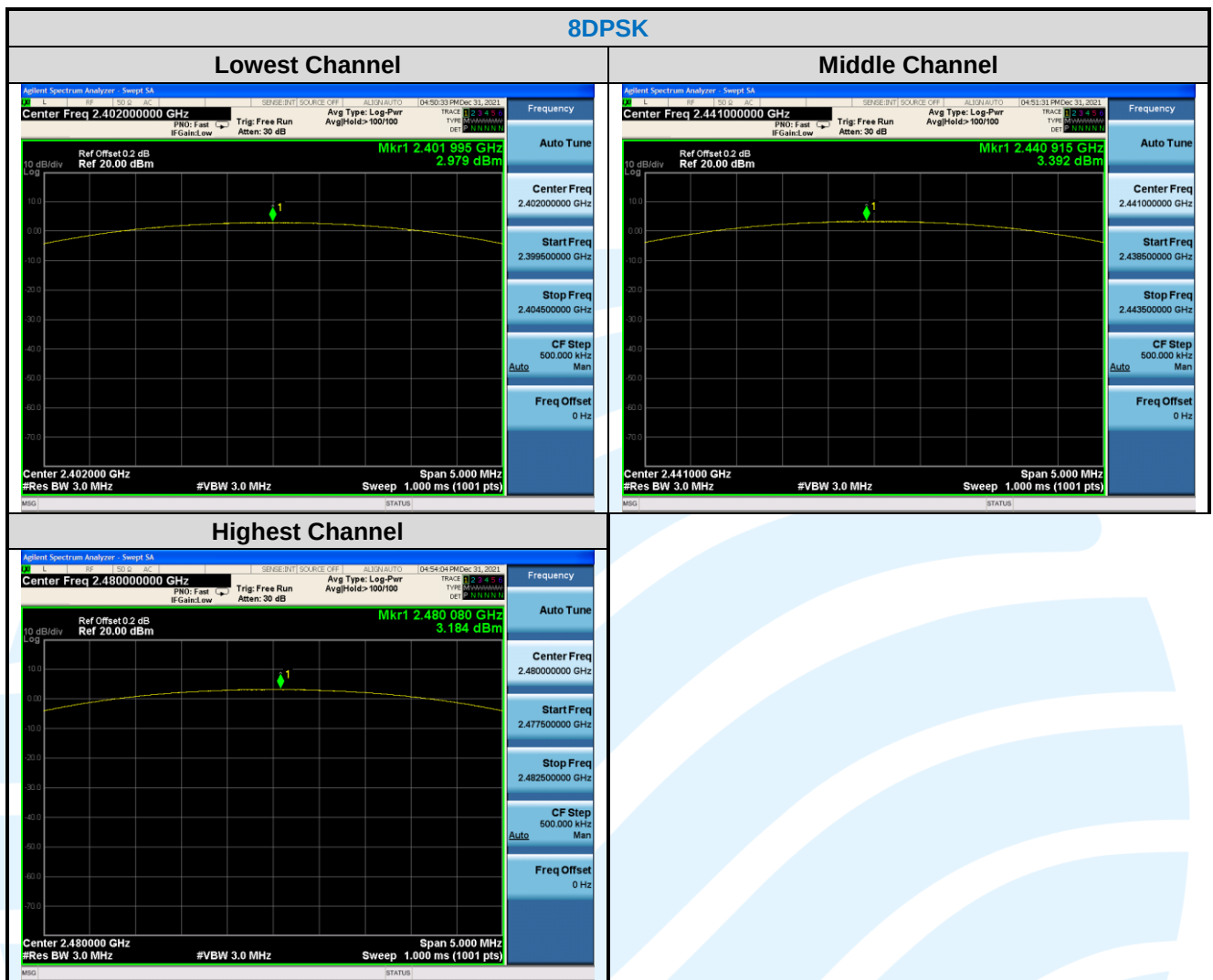
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5.420 DB BANDWIDTH

Test Requirement: FCC 47 CFR Part 15 Subpart C Section 15.247 (a)(1)

Test Method: ANSI C63.10-2013 Section 6.9.2

Limit: None; for reporting purposes only.

Test Procedure: Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.

Use the following spectrum analyzer settings:

- Span = approximately 2 to 5 times the OBW, centered on a hopping channel.
- RBW = 1% to 5% of the OBW.
- VBW $\geq 3 \times$ RBW
- Sweep = auto;
- Detector function = peak
- Trace = max hold
- All the trace to stabilize, use the marker-to-peak function to set the marker to the peak of the emission, use the marker-delta function to measure and record the 20dB down bandwidth of the emission.

Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.

Test Setup: Refer to section 4.5.3 for details.

Instruments Used: Refer to section 3 for details

Test Results: Pass

Left:

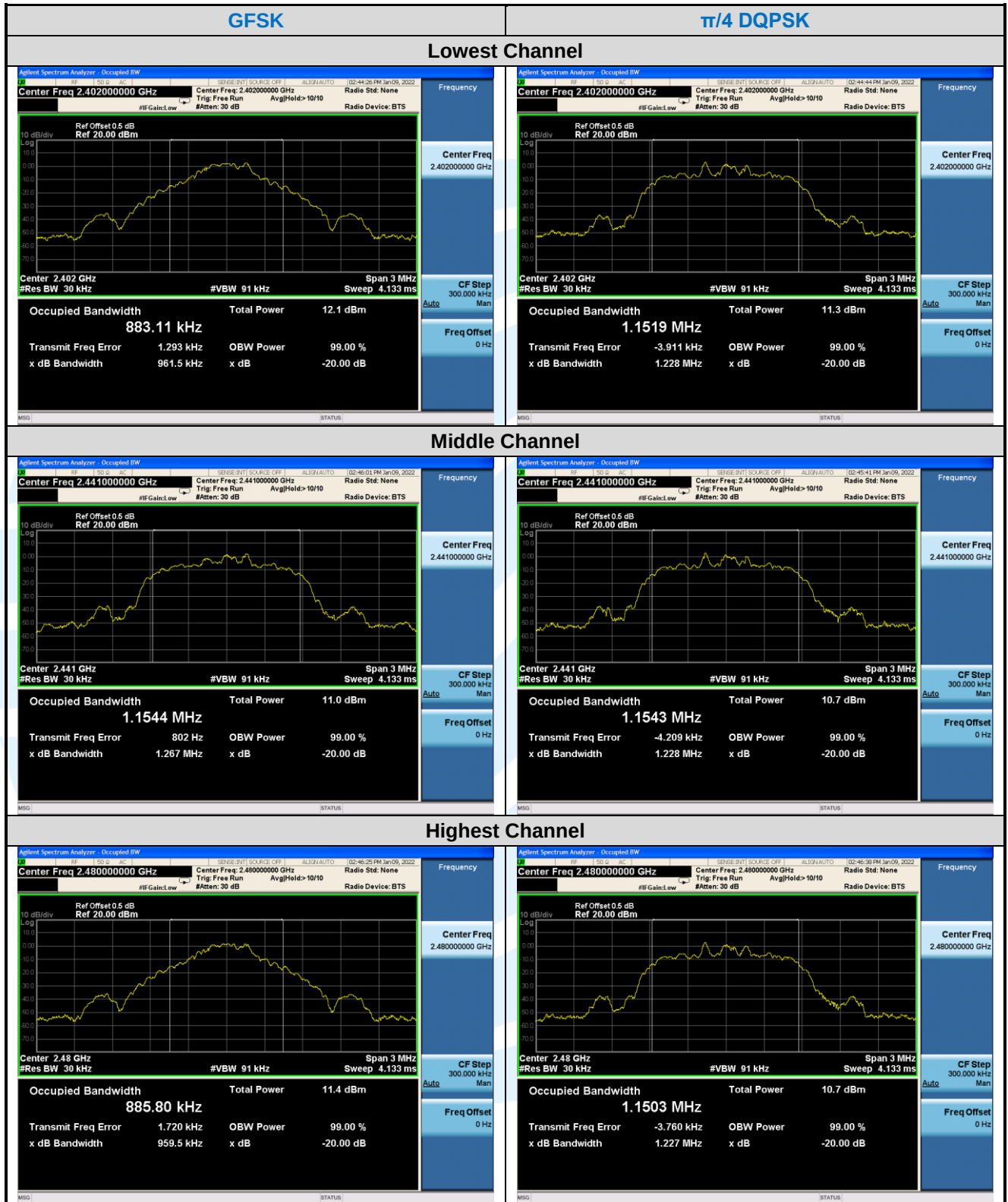
Type of Modulation	20 dB Bandwidth (MHz)			99% Bandwidth (MHz)		
	Channel 0	Channel 39	Channel 78	Channel 0	Channel 39	Channel 78
GFSK	0.9615	1.267	0.9595	0.88311	1.1544	0.88580
$\pi/4$ DQPSK	1.228	1.228	1.227	1.1519	1.1543	1.1503
8DPSK	1.266	1.265	1.270	1.1611	1.1556	1.1655

Right:

Type of Modulation	20 dB Bandwidth (MHz)			99% Bandwidth (MHz)		
	Channel 0	Channel 39	Channel 78	Channel 0	Channel 39	Channel 78
GFSK	0.9621	0.9578	0.9593	0.88327	0.88528	0.88422
$\pi/4$ DQPSK	1.231	1.228	1.228	1.1548	1.1530	1.1546
8DPSK	1.229	1.229	1.227	1.1574	1.1571	1.1540

The test plots as follows:

Left:



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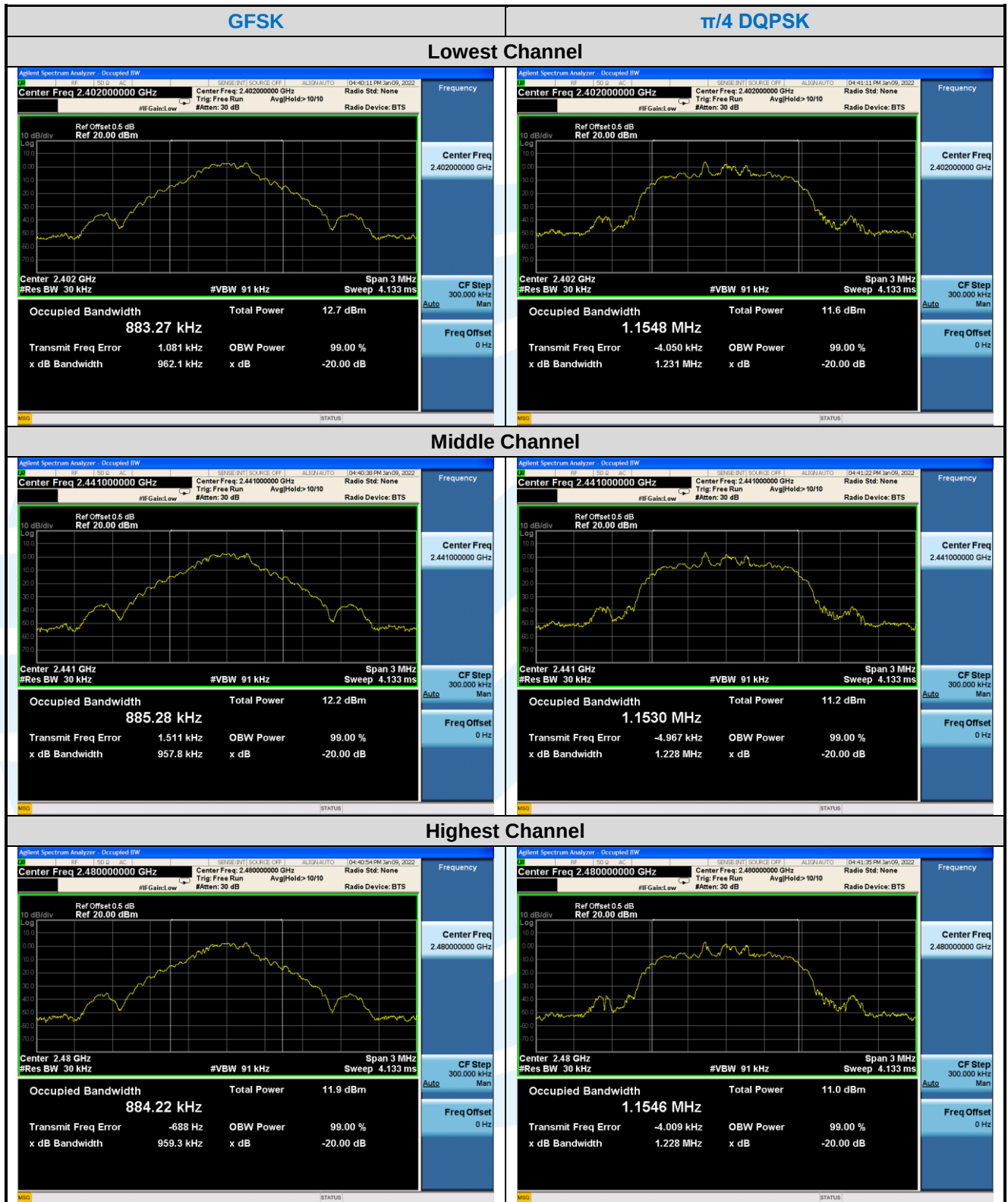
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