

# FCC TEST REPORT

**Product Name:** Handheld Smart Terminal



or RHINO

**Model No.:** T5se

**Add. Model No.:** N/A

**Report Number:** 220412017RFC-1

**Test Standards:** FCC 47 CFR Part 15 Subpart C

**FCC ID:** 2AUOUT5SE

**Test Result:** PASS

**Date of Issue:** August 10, 2022

Prepared for:

**Rhino Mobility LLC**  
8 The Green, Suite A, Dover, Delaware, 19901, USA

Prepared by:

**Shenzhen UnionTrust Quality and Technology Co., Ltd.**  
**Unit D/E of 9/F and 16/F, Block A, Building 6, Baoneng science and**  
**technology park, Longhua district, Shenzhen, China**

**TEL: +86-755-2823 0888**

**FAX: +86-755-2823 0886**

Prepared by:

A handwritten signature of Kieron Luo.

Kieron Luo  
Project Engineer

Reviewed by:

A handwritten signature of Henry Lu.

Henry Lu  
Team Leader

Approved by:

A handwritten signature of Kevin Liang.

Kevin Liang  
Assistant Manager

Date: August 10, 2022

**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

Tel: +86-755-28230888

Fax: +86-755-28230886

E-mail: info@uttlab.com

<http://www.uttlab.com>

UTTR-RF-FCCPART15.247-V1.1

**Version**

Version No.	Date	Description
V1.0	August 10, 2022	Original

**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

Tel: +86-755-28230888

Fax: +86-755-28230886

E-mail: info@uttlab.com

<http://www.uttlab.com>

UTTR-RF-FCCPART15.247-V1.1

## CONTENTS

<b>1. GENERAL INFORMATION .....</b>	<b>4</b>
1.1 CLIENT INFORMATION .....	4
1.2 EUT INFORMATION .....	4
1.2.1 GENERAL DESCRIPTION OF EUT .....	4
1.2.2 DESCRIPTION OF ACCESSORIES .....	5
1.3 PRODUCT SPECIFICATION SUBJECTIVE TO THIS STANDARD .....	5
1.4 OTHER INFORMATION .....	6
1.5 DESCRIPTION OF SUPPORT UNITS .....	6
1.6 TEST LOCATION .....	6
1.7 TEST FACILITY .....	6
1.8 DEVIATION FROM STANDARDS .....	7
1.9 ABNORMALITIES FROM STANDARD CONDITIONS .....	7
1.10 OTHER INFORMATION REQUESTED BY THE CUSTOMER .....	7
1.11 MEASUREMENT UNCERTAINTY .....	7
<b>2. TEST SUMMARY .....</b>	<b>8</b>
<b>3. EQUIPMENT LIST .....</b>	<b>9</b>
<b>4. TEST CONFIGURATION .....</b>	<b>10</b>
4.1 ENVIRONMENTAL CONDITIONS FOR TESTING .....	10
4.1.1 NORMAL OR EXTREME TEST CONDITIONS .....	10
4.1.2 RECORD OF NORMAL ENVIRONMENT AND TEST SAMPLE .....	10
4.2 TEST CHANNELS .....	10
4.3 EUT TEST STATUS .....	10
4.4 TEST SETUP .....	11
4.4.1 FOR RADIATED EMISSIONS TEST SETUP .....	11
4.4.2 FOR CONDUCTED EMISSIONS TEST SETUP .....	12
4.4.3 FOR CONDUCTED RF TEST SETUP .....	13
4.5 SYSTEM TEST CONFIGURATION .....	13
4.6 DUTY CYCLE .....	14
<b>5. RADIO TECHNICAL REQUIREMENTS SPECIFICATION .....</b>	<b>15</b>
5.1 REFERENCE DOCUMENTS FOR TESTING .....	15
5.2 ANTENNA REQUIREMENT .....	15
5.3 CONDUCTED PEAK OUTPUT POWER .....	16
5.4 6 dB BANDWIDTH .....	17
5.5 POWER SPECTRAL DENSITY .....	19
5.6 CONDUCTED OUT OF BAND EMISSION .....	22
5.7 RADIATED SPURIOUS EMISSIONS .....	25
5.8 BAND EDGE MEASUREMENTS (RADIATED) .....	29
5.9 CONDUCTED EMISSION .....	32
<b>APPENDIX 1 PHOTOS OF TEST SETUP .....</b>	<b>35</b>
<b>APPENDIX 2 PHOTOS OF EUT CONSTRUCTIONAL DETAILS .....</b>	<b>35</b>

## 1. GENERAL INFORMATION

### 1.1 CLIENT INFORMATION

<b>Applicant:</b>	Rhino Mobility LLC
<b>Address of Applicant:</b>	8 The Green, Suite A, Dover, Delaware,19901, USA
<b>Manufacturer:</b>	Rhino Mobility LLC
<b>Address of Manufacturer:</b>	8 The Green, Suite A, Dover, Delaware,19901, USA

### 1.2 EUT INFORMATION

#### 1.2.1 General Description of EUT

<b>Product Name:</b>	Handheld Smart Terminal							
<b>Model No.:</b>	T5se							
<b>Add. Model No.:</b>	N/A							
<b>Trade Mark:</b>	 or RHINO							
<b>DUT Stage:</b>	Identical Prototype							
<b>EUT Supports Function:</b> (Provided by the customer)	UTRA Bands:	Band II/ Band IV/ Band V						
	E-UTRA Bands:	FDD Band 2/ Band 4/ Band 5/ Band 7/ Band 12/ Band 13/ Band 14/ Band 17/ Band 25/ Band 26/ Band 30/ Band 66/ Band 71						
		TDD Band 41						
	2.4 GHz ISM Band:	IEEE 802.11b/g/n						
		Bluetooth V4.2						
	5 GHz U-NII Bands:	5 150 MHz to 5 250 MHz	IEEE 802.11a/n/ac					
		5 250 MHz to 5 350 MHz	IEEE 802.11a/n/ac					
		5 725 MHz to 5 850 MHz	IEEE 802.11a/n/ac					
	RNSS Bands:	1559 MHz to 1610 MHz	GPS/ Galileo/ GLONASS					
	NFC:	13.553 MHz to 13.567 MHz						
<b>Software Version:</b>	T5se(001)_20220624 (Provided by the customer)							
<b>Hardware Version:</b>	AL_Z06_MB_V12 (Provided by the customer)							
<b>Sample Received Date:</b>	April 13, 2022							
<b>Sample Tested Date:</b>	April 28, 2022 to June 27, 2022							
Note: The T5se have two LCD modules from different vendors. This report has evaluated and pre-testing of two batches of LCD modules, with only the worst data recorded in the report.								
<b>Remark:</b> The above EUT's information was provided by customer. Please refer to the specifications or user's manual for more detailed description.								

### 1.2.2 Description of Accessories

Adapter	
<b>Model No.:</b>	XY-PP018U1
<b>Input:</b>	100-240 V~50/60 Hz 0.5A
<b>Output:</b>	3.6-6.0 V == 3.0A, 6.0-9.0 V == 2.0A, 9.0-12.0 V == 1.5A
<b>AC Cable:</b>	N/A
<b>DC Cable:</b>	N/A

Internal Battery	
<b>Model No.:</b>	BPT5se
<b>Battery Type:</b>	Lithium-ion Rechargeable Battery
<b>Rated Voltage:</b>	3.85 Vdc
<b>Limited Charge Voltage:</b>	4.4 Vdc
<b>Rated Capacity:</b>	3000 mAh

External Battery Pack	
<b>Model No.:</b>	T5SE-EBAT-3K-BLK
<b>Battery Type:</b>	Lithium-ion Rechargeable Battery
<b>Rated Voltage:</b>	3.85 Vdc
<b>Limited Charge Voltage:</b>	4.4 Vdc
<b>Rated Capacity:</b>	3030 mAh

Cable	
<b>Description:</b>	USB Type-C Plug Cable
<b>Cable Type:</b>	Shielded without ferrite
<b>Length:</b>	1 Meter

### 1.3 PRODUCT SPECIFICATION SUBJECTIVE TO THIS STANDARD

<b>Frequency Band:</b>	2400 MHz to 2483.5 MHz
<b>Frequency Range:</b>	2402 MHz to 2480 MHz
<b>Bluetooth Version:</b>	Bluetooth LE
<b>Type of Modulation:</b>	GFSK
<b>Number of Channels:</b>	40
<b>Channel Separation:</b>	2 MHz
<b>Antenna Type:</b> (Provided by the customer)	LDS Antenna
<b>Antenna Gain:</b> (Provided by the customer)	2.12 dBi
<b>Maximum Peak Power:</b>	6.56 dBm
<b>Normal Test Voltage:</b>	3.85 Vdc

## 1.4 OTHER INFORMATION

Operation Frequency Each of Channel	
$f = 2402 + 2k \text{ MHz}, k = 0, \dots, 39$	
Note:	
$f$	is the operating frequency (MHz);
$k$	is the operating channel.

## 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
--	--	--	--	--

### 2) Support Cable

Cable No.	Description	Connector	Length	Supplied by
1	Antenna Cable	SMA	0.3 Meter	UnionTrust

## 1.6 TEST LOCATION

### 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, China 518109

Telephone: +86 (0) 755 2823 0888

Fax: +86 (0) 755 2823 0886

## 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

### 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

Tel: +86-755-28230888

Fax: +86-755-28230886

E-mail: info@uttlab.com

<http://www.uttlab.com>

UTTR-RF-FCCPART15.247-V1.1

**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	±3.2 dB
2	Conducted emission 150kHz-30MHz	±2.7 dB
3	Radiated emission 9kHz-30MHz	±4.7 dB
4	Radiated emission 30MHz-1GHz	±4.6 dB
5	Radiated emission 1GHz-18GHz	±4.4 dB
6	Radiated emission 18GHz-40GHz	±4.6 dB

## 2. TEST SUMMARY

FCC 47 CFR Part 15 Subpart C Test Cases			
Test Item	Test Requirement	Test Method	Result
<b>Antenna Requirement</b>	FCC 47 CFR Part 15 Subpart C Section 15.203/15.247 (b)	N/A	PASS
<b>AC Power Line Conducted Emission</b>	FCC 47 CFR Part 15 Subpart C Section 15.207	ANSI C63.10-2013 Clause 6.2	PASS
<b>Conducted Peak Output Power</b>	FCC 47 CFR Part 15 Subpart C Section 15.247 (b)(3)	ANSI C63.10-2013 Clause 11.9.1.3	PASS
<b>6dB Bandwidth</b>	FCC 47 CFR Part 15 Subpart C Section 15.247 (a)(2)	ANSI C63.10-2013 Clause 11.8.1	PASS
<b>Power Spectral Density</b>	FCC 47 CFR Part 15 Subpart C Section 15.247 (e)	ANSI C63.10-2013 Clause 11.10.2	PASS
<b>Conducted Out of Band Emission</b>	FCC 47 CFR Part 15 Subpart C Section 15.247(d)	ANSI C63.10-2013 Clause 11.11	PASS
<b>Radiated Spurious Emissions</b>	FCC 47 CFR Part 15 Subpart C Section 15.205/15.209	ANSI C63.10-2013 Clause 11.11 & Clause 11.12	PASS
<b>Band Edge Measurements (Radiated)</b>	FCC 47 CFR Part 15 Subpart C Section 15.205/15.209	ANSI C63.10-2013 Clause 11.13	PASS

**Disclaimer and Explanations:**  
The declared of product specification and data (e.g., antenna gain, RF specification, etc) for EUT presented in the report are provided by the customer, and the customer takes all the responsibilities for the accuracy of product specification.

### 3. EQUIPMENT LIST

Radiated Emission Test Equipment List						
Used	Equipment	Manufacturer	Model No.	Serial Number	Cal. date	Cal. Due date
<input checked="" type="checkbox"/>	3M Chamber & Accessory Equipment	ETS-LINDGREN	3M	Euroshiedpn-CT001270-1317	22-Jan-2021	21-Jan-2024
<input checked="" type="checkbox"/>	Receiver	R&S	ESIB26	100114	5-Nov-2021	4-Nov-2022
<input checked="" type="checkbox"/>	Loop Antenna	ETS-LINDGREN	6502	00202525	11-Nov-2021	10-Nov-2023
<input checked="" type="checkbox"/>	Broadband Antenna	ETS-LINDGREN	3142E	00201566	11-Nov-2021	10-Nov-2023
<input checked="" type="checkbox"/>	6dB Attenuator	Talent	RA6A5-N-18	18103001	11-Nov-2021	10-Nov-2023
<input checked="" type="checkbox"/>	Preamplifier	HP	8447F	2805A02960	5-Nov-2021	4-Nov-2022
<input checked="" type="checkbox"/>	Horn Antenna (Pre-amplifier)	ETS-LINDGREN	3117-PA	00201874	30-Apr-2021	29-Apr-2023
<input checked="" type="checkbox"/>	Pre-amplifier	ETS-LINDGREN	00118385		17-Apr-2022	16-Apr-2024
<input checked="" type="checkbox"/>	Horn Antenna (Pre-amplifier)	ETS-LINDGREN	3116C-PA	00202652	14-Nov-2020	13-Nov-2022
<input checked="" type="checkbox"/>	Pre-amplifier	ETS-LINDGREN	00118384	00202652	17-Nov-2020	16-Nov-2022
<input checked="" type="checkbox"/>	Band Reject Filter (2400MHz~2500MHz)	Micro-Tronics	BRM50702	G248	6-Nov-2021	5-Nov-2022
<input checked="" type="checkbox"/>	Multi device Controller	ETS-LINDGREN	7006-001	00160105	N/A	N/A
<input checked="" type="checkbox"/>	Test Software	Audix	e3	Software Version: 9.160323		

Conducted Emission Test Equipment List						
Used	Equipment	Manufacturer	Model No.	Serial Number	Cal. date	Cal. Due date
<input checked="" type="checkbox"/>	Receiver	R&S	ESR7	101181	5-Nov-2021	4-Nov-2022
<input checked="" type="checkbox"/>	Pulse Limiter	R&S	ESH3-Z2	0357.8810.54	5-Nov-2021	4-Nov-2022
<input checked="" type="checkbox"/>	LISN	R&S	ESH2-Z5	860014/024	5-Nov-2021	4-Nov-2022
<input type="checkbox"/>	LISN	ETS-Lindgren	3816/2SH	00201088	5-Nov-2021	4-Nov-2022
<input checked="" type="checkbox"/>	Test Software	Audix	e3	Software Version: 9 20151119i		

RF Conducted Test Equipment List						
Used	Equipment	Manufacturer	Model No.	Serial Number	Cal. date	Cal. Due date
<input checked="" type="checkbox"/>	EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY51440197	22-Apr-2021	22-Apr-2022
<input checked="" type="checkbox"/>	USB Wideband Power Sensor				15-Apr-2022	14-Apr-2023
<input checked="" type="checkbox"/>	USB Wideband Power Sensor	KEYSIGHT	U2021XA	MY55430035	5-Nov-2021	4-Nov-2022
<input type="checkbox"/>	USB Wideband Power Sensor	KEYSIGHT	U2021XA	MY55430023	5-Nov-2021	4-Nov-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	3.85	20 to 75
<b>Remark:</b>			
1) NV: Normal Voltage; NT: Normal Temperature			

#### 4.1.2 Record of Normal Environment and Test Sample

Test Item	Temp. (°C)	Relative Humidity (%)	Pressure (kPa)	Sample No.	Tested by
AC Power Line Conducted Emission	24.5	49	101.1	220412020-A06/17	David Zhang
Conducted Peak Output Power	22.5	56	100.1	220412020-A03/17	Hank Wu
6dB Bandwidth					
Power Spectral Density	21.5	52	100.3	220412020-A06/17	Fire Huo
Conducted Out of Band Emission					
Radiated Spurious Emissions					
Band Edge Measurements (Radiated)					

## 4.2 TEST CHANNELS

Type of Modulation	Tx/Rx Frequency	Test RF Channel Lists		
		Lowest(L)	Middle(M)	Highest(H)
GFSK	2402 MHz to 2480 MHz	Channel 0	Channel 19	Channel 39
		2402 MHz	2440 MHz	2480 MHz

## 4.3 EUT TEST STATUS

Type of Modulation	Tx Function	Description
GFSK	1Tx	1. Keep the EUT in continuously transmitting with modulation test single.

#### Power Setting (Provided by the customer)

Power Setting: not applicable, test used software default power level.

#### Test Software (Provided by the customer)

Engineer mode: \*#\*#3646633#\*#\*

## 4.4 TEST SETUP

### 4.4.1 For Radiated Emissions test setup

Figure 1. Below 30MHz

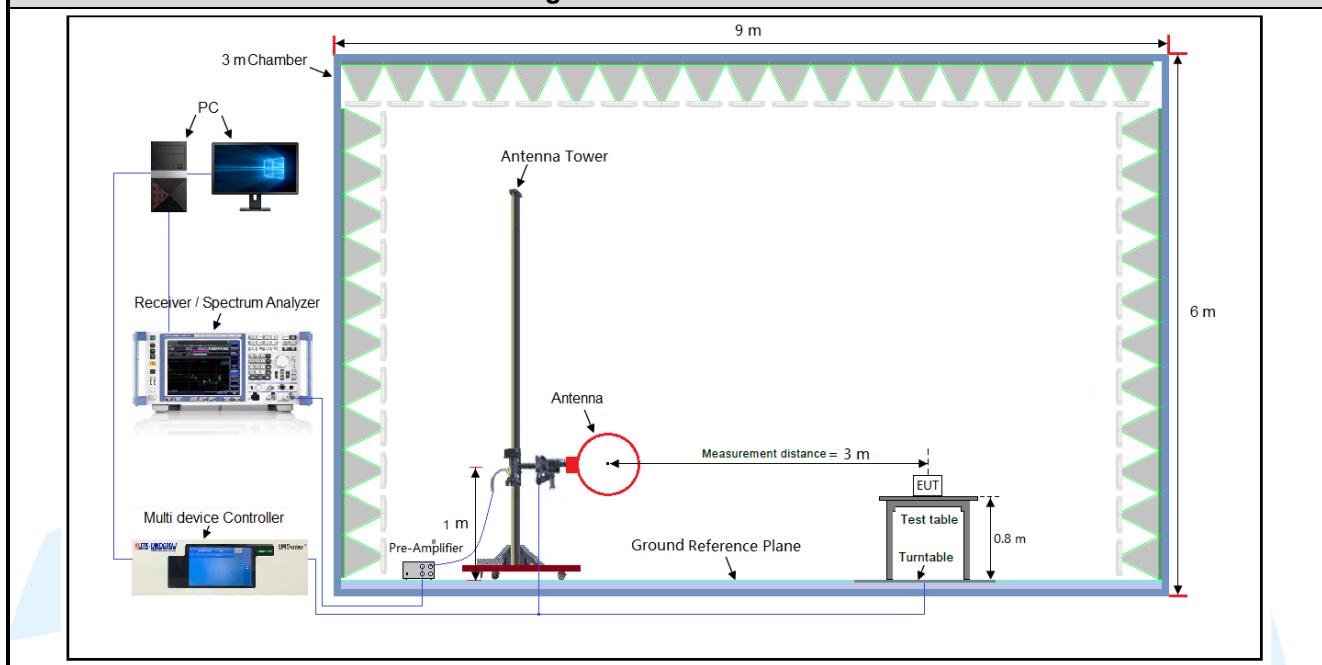
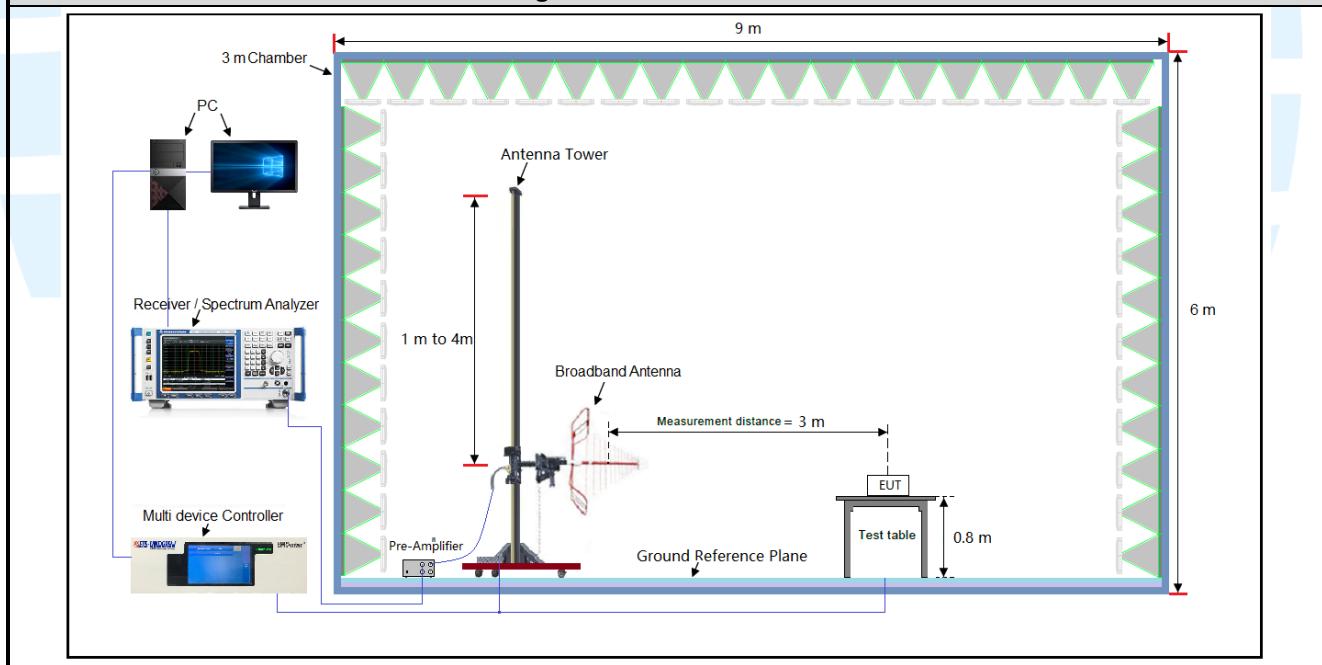
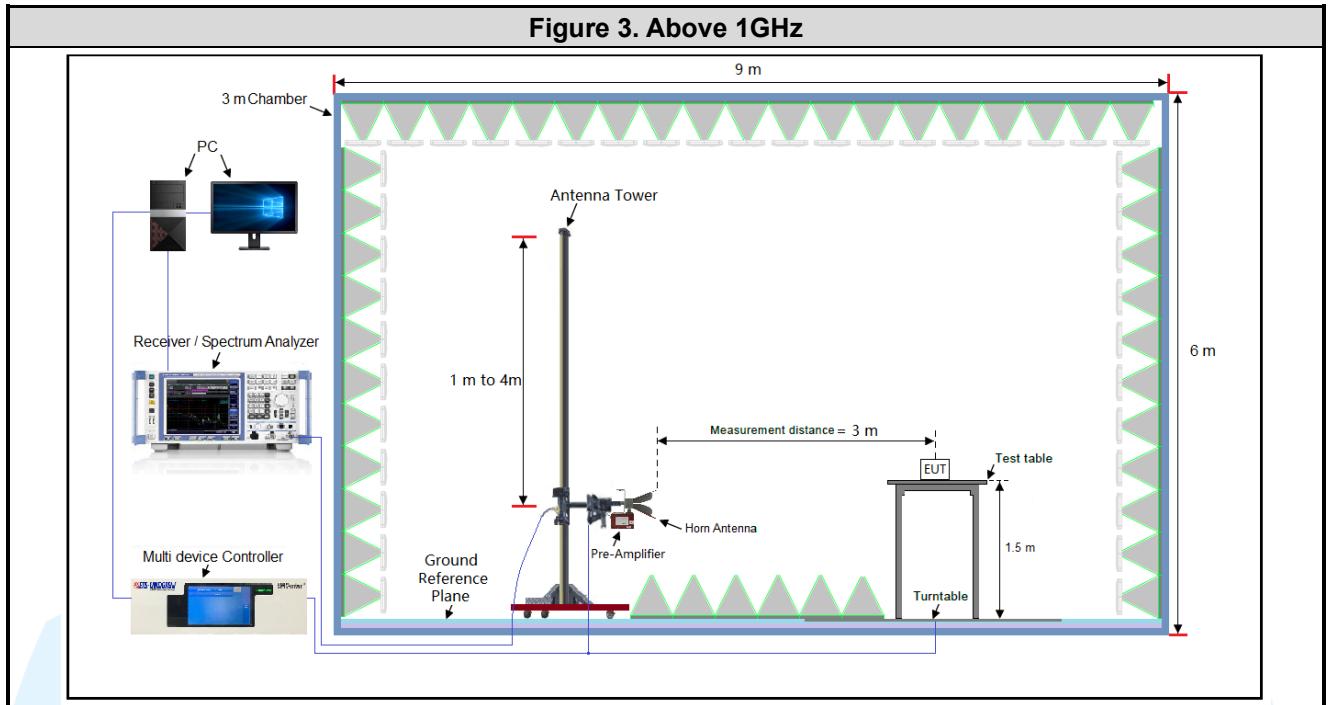


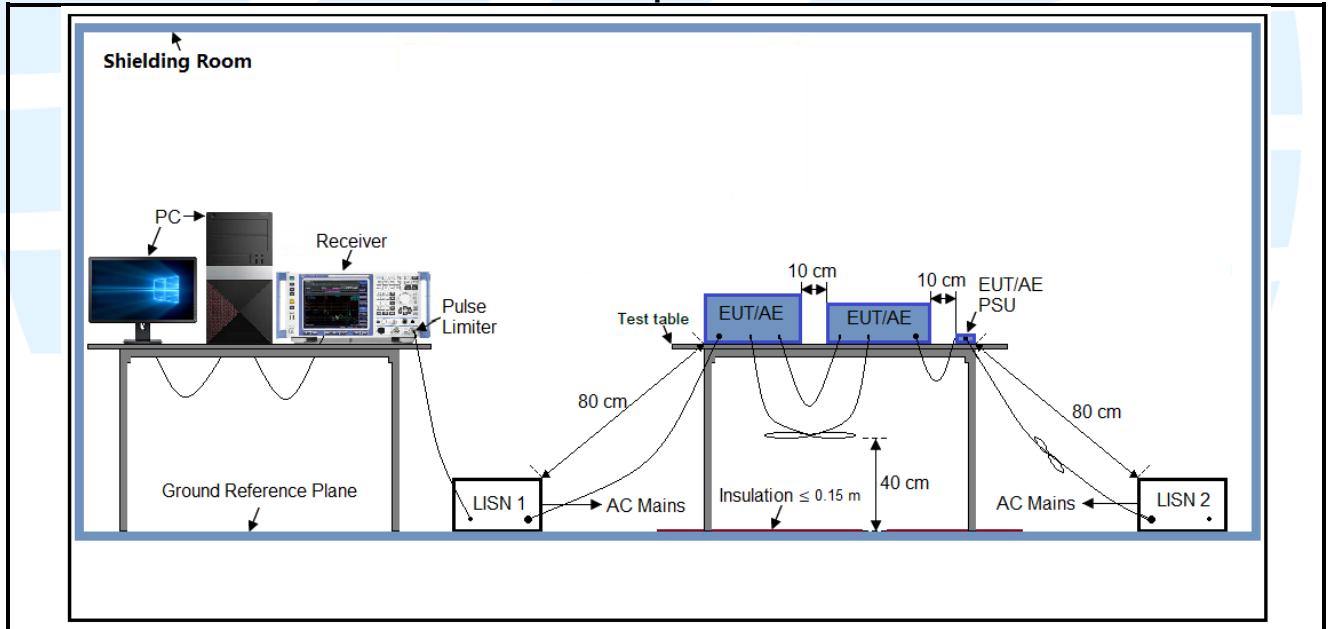
Figure 2. 30MHz to 1GHz



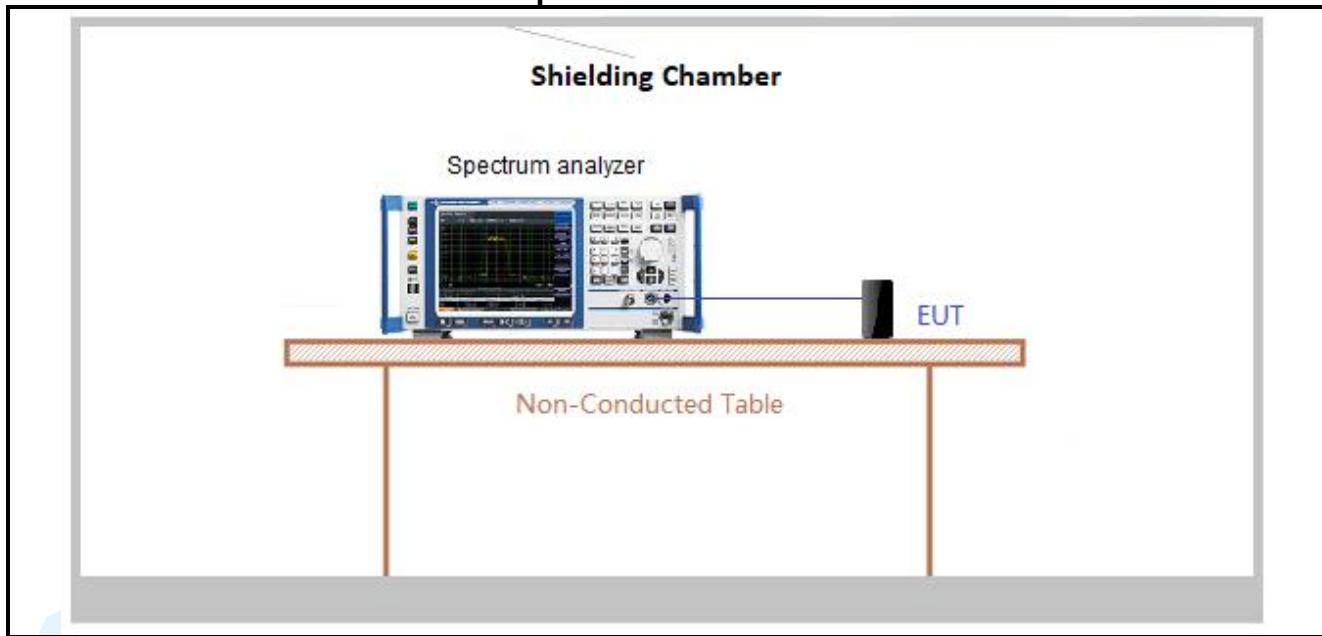
**Figure 3. Above 1GHz**



#### 4.4.2 For Conducted Emissions test setup



#### 4.4.3 For Conducted RF test setup



### 4.5 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 3.85V 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 orientation.

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.

## 4.6 DUTY CYCLE

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

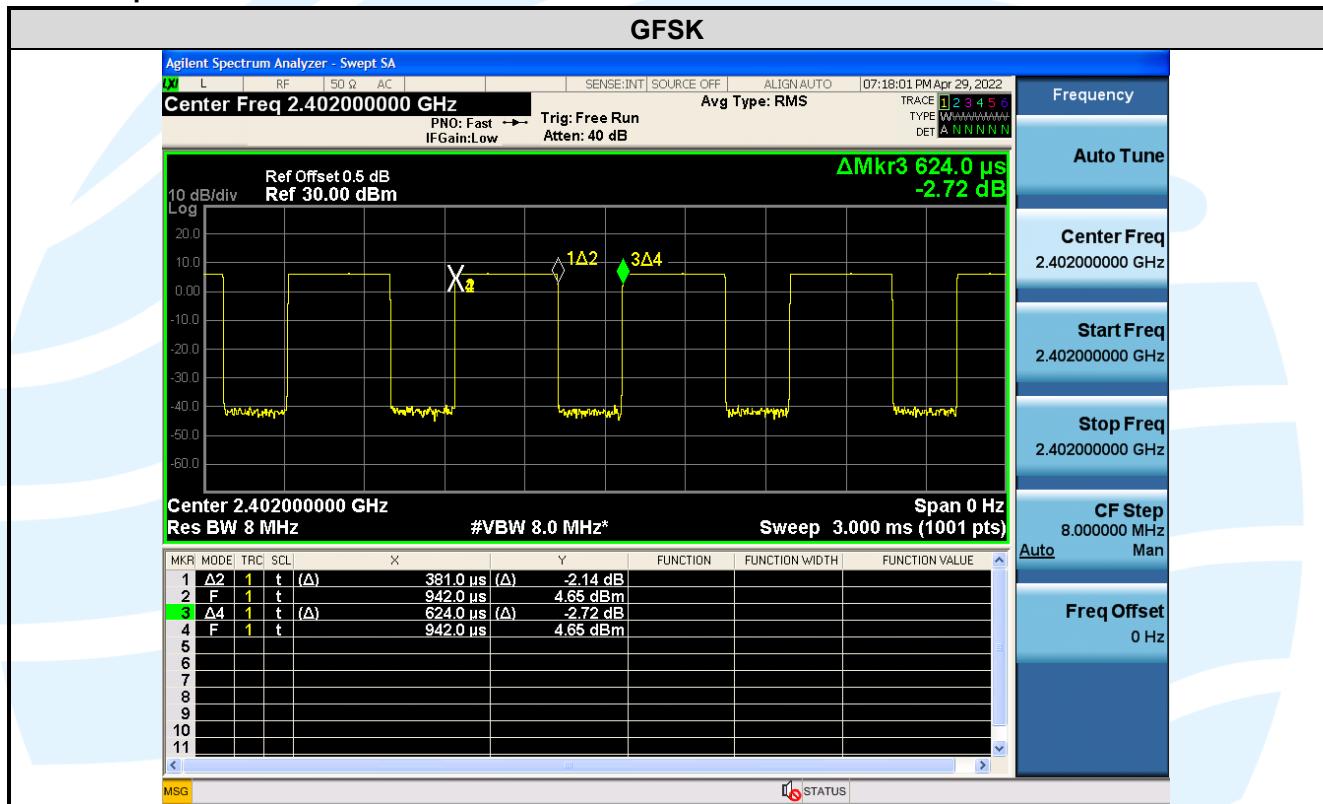
### Test Results

Modulation	On Time (msec)	Period (msec)	Duty Cycle (linear)	Duty Cycle (%)	Duty Cycle Factor (dB)	1/T Minimum VBW (kHz)
GFSK	0.381	0.624	0.6106	61.06%	2.14	2.62

### Remark:

- 1) Duty cycle= On Time/ Period;
- 2) Duty Cycle factor =  $10 * \log(1/ \text{Duty cycle})$ ;

The test plot 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
<b>15.203 requirement:</b> 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.
<b>15.247(b) (4) requirement:</b> 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.
<b>EUT Antenna:</b> Antenna in the interior of the equipment and no consideration of replacement. The gain of the antenna is 2.12 dBi.

### 5.3 CONDUCTED PEAK OUTPUT POWER

**Test Requirement:** FCC 47 CFR Part 15 Subpart C Section15.247 (b)(3)

**Test Method:** ANSI C63.10-2013 Clause 11.9.1.3

**Limit:** For systems using digital modulation in the 2400-2483.5 MHz bands: 1 Watt.

**Test Procedure:**

1. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power meter.
2. Measure out each test modes' peak or average output power, record the power level.

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

**Test Setup:** Refer to section 4.4.3 for details.

**Instruments Used:** Refer to section 3 for details

**Test Results:** Pass

Modulation	Channel	Frequency (MHz)	Maximum Conducted Peak Power	Maximum Conducted Avg Power	Limit (dBm)	Result
GFSK	0	2402	6.56	4.17	30	Pass
	19	2440	6.05	3.73	30	Pass
	39	2480	5.29	2.93	30	Pass

Note: The antenna gain of 2.12 dBi less than 6dBi maximum permission antenna gain value based on 1 watt peak output power limit.

## 5.4.6 DB BANDWIDTH

**Test Requirement:** FCC 47 CFR Part 15 Subpart C Section 15.247 (a)(2)

**Test Method:** ANSI C63.10-2013 Clause 11.8.1

**Limit:** For direct sequence systems, the minimum 6dB bandwidth shall be at least 500kHz

**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:

a) Set RBW = 100 kHz.

b) Set the video bandwidth (VBW)  $\geq 3 \times$  RBW.

c) Detector = Peak.

d) Trace mode = max hold.

e) Sweep = auto couple.

f) Allow the trace to stabilize.

g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

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

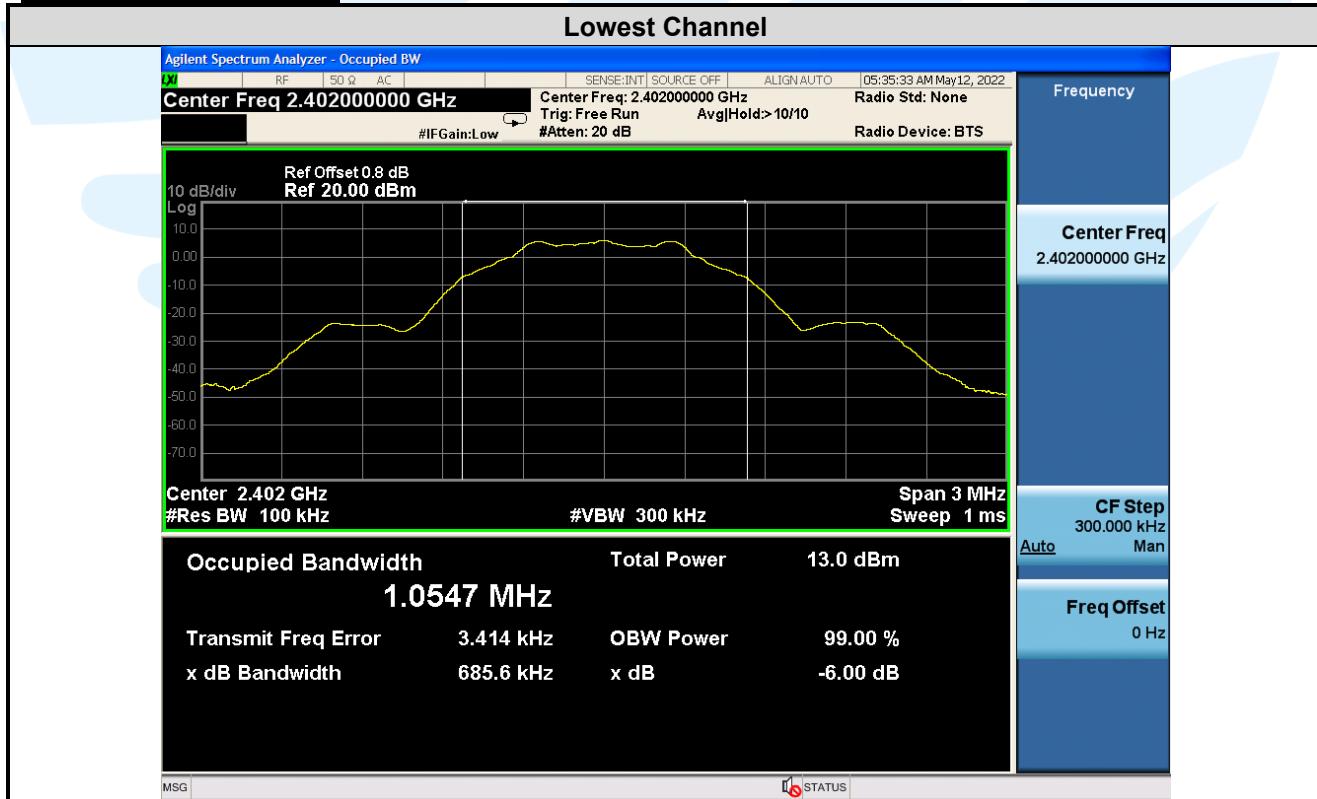
**Test Setup:** Refer to section 4.4.3 for details.

**Instruments Used:** Refer to section 3 for details

**Test Results:**

Type of Modulation	Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	99% Bandwidth (MHz)	6 dB Bandwidth Limit	Result
GFSK	0	2402	0.6856	1.0547	> 500 kHz	Pass
	19	2440	0.6827	1.0560	> 500 kHz	Pass
	39	2480	0.6797	1.0537	> 500 kHz	Pass

The test plots as follows:



**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

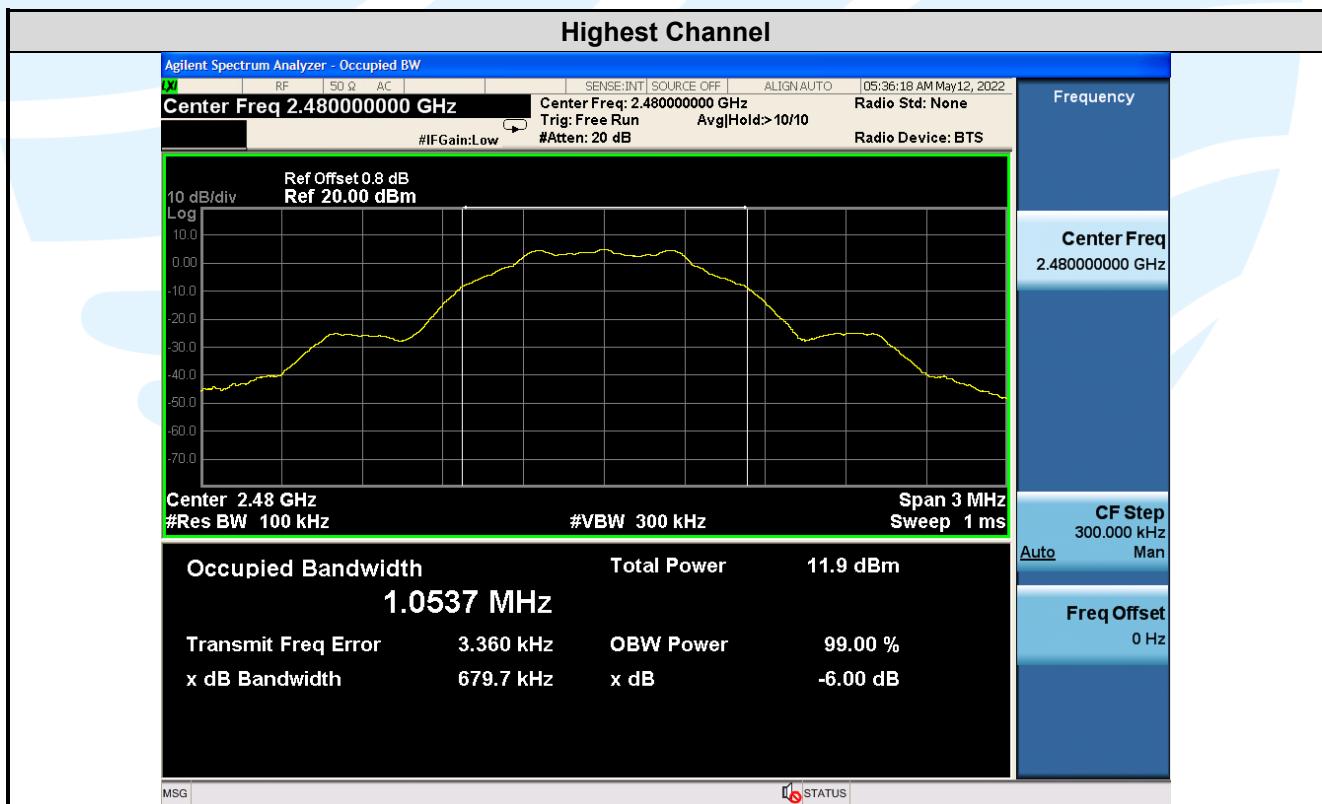
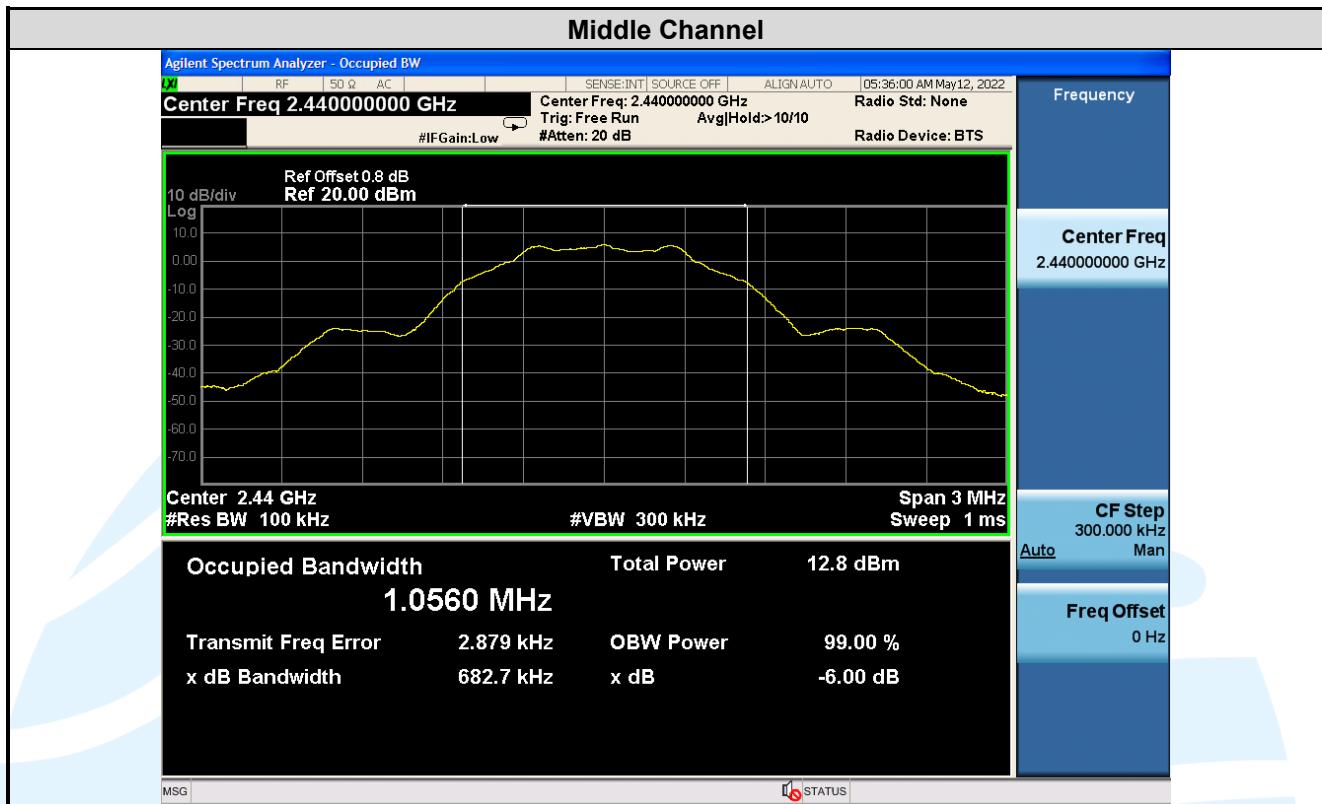
Tel: +86-755-28230888

Fax: +86-755-28230886

E-mail: info@uttlab.com

<http://www.uttlab.com>

UTTR-RF-FCCPART15.247-V1.1



## 5.5 POWER SPECTRAL DENSITY

**Test Requirement:** FCC 47 CFR Part 15 Subpart C Section 15.247 (e)

**Test Method:** ANSI C63.10-2013 Clause 11.10.2

**Limit:**

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3kHz band during any time interval of continuous transmission.

**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:

- a) Set analyzer center frequency to DTS channel center frequency.
- b) Set the span to 1.5 times the DTS bandwidth.
- c) Set the RBW to:  $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$ .
- d) Set the VBW  $\geq 3 \times \text{RBW}$ .
- e) Detector = peak.
- f) Sweep time = auto couple.
- g) Trace mode = max hold.
- h) Allow trace to fully stabilize.
- i) Use the peak marker function to determine the maximum amplitude level within the RBW.
- j) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

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

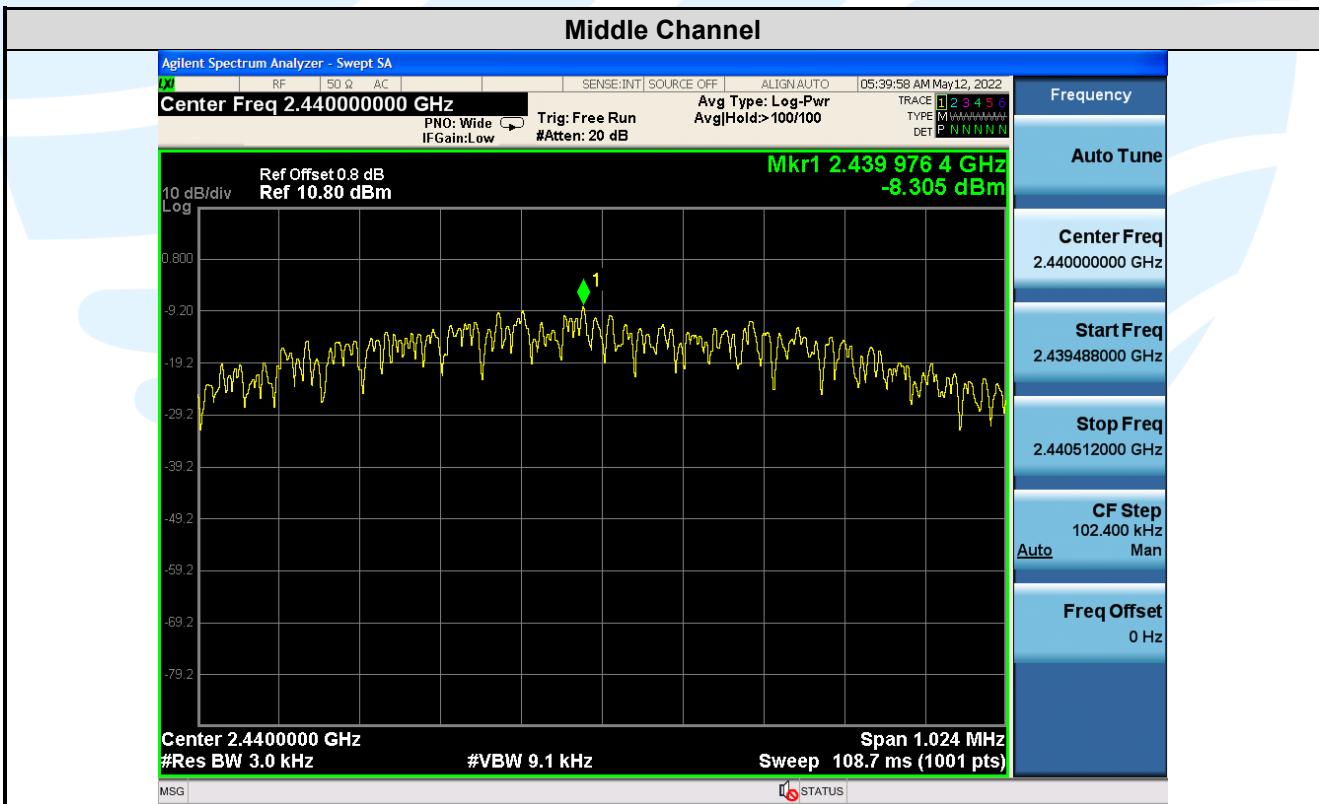
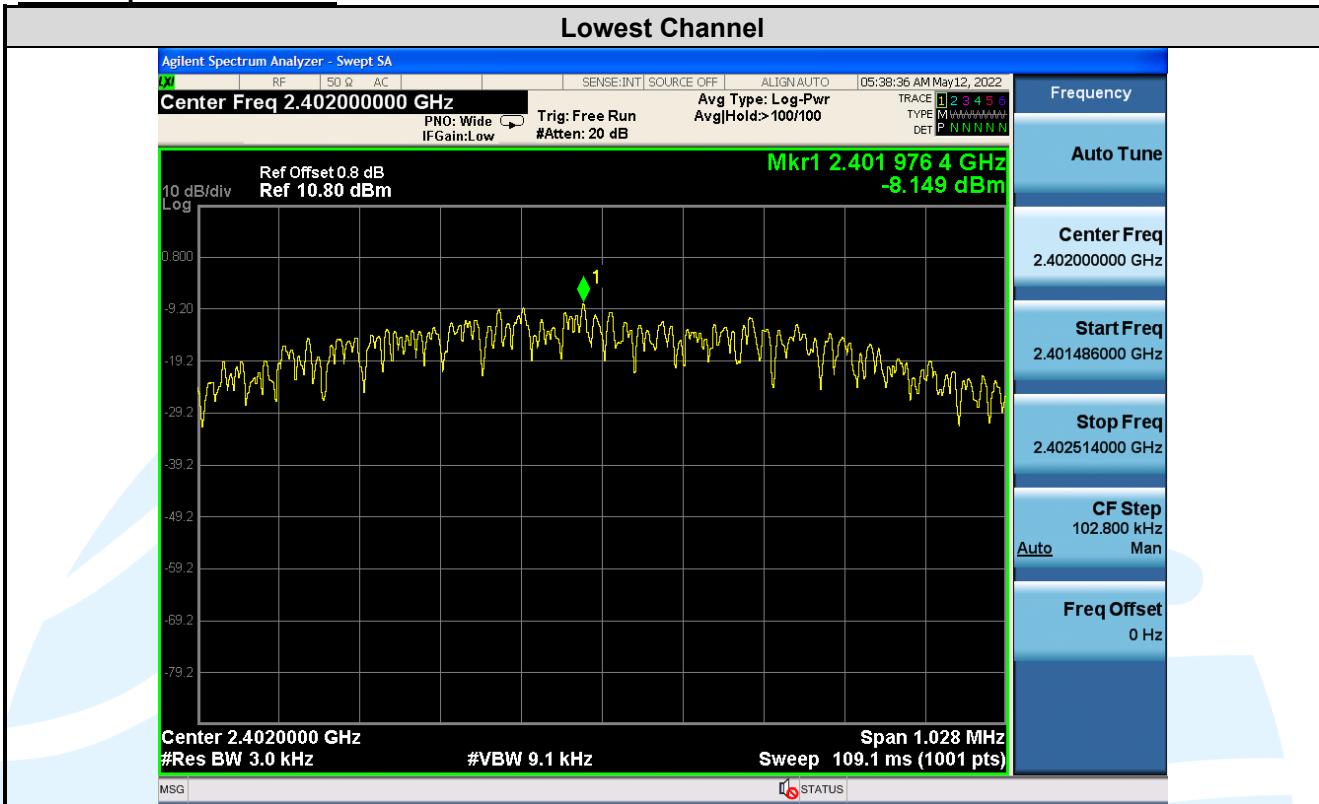
**Test Setup:** Refer to section 4.4.3 for details.

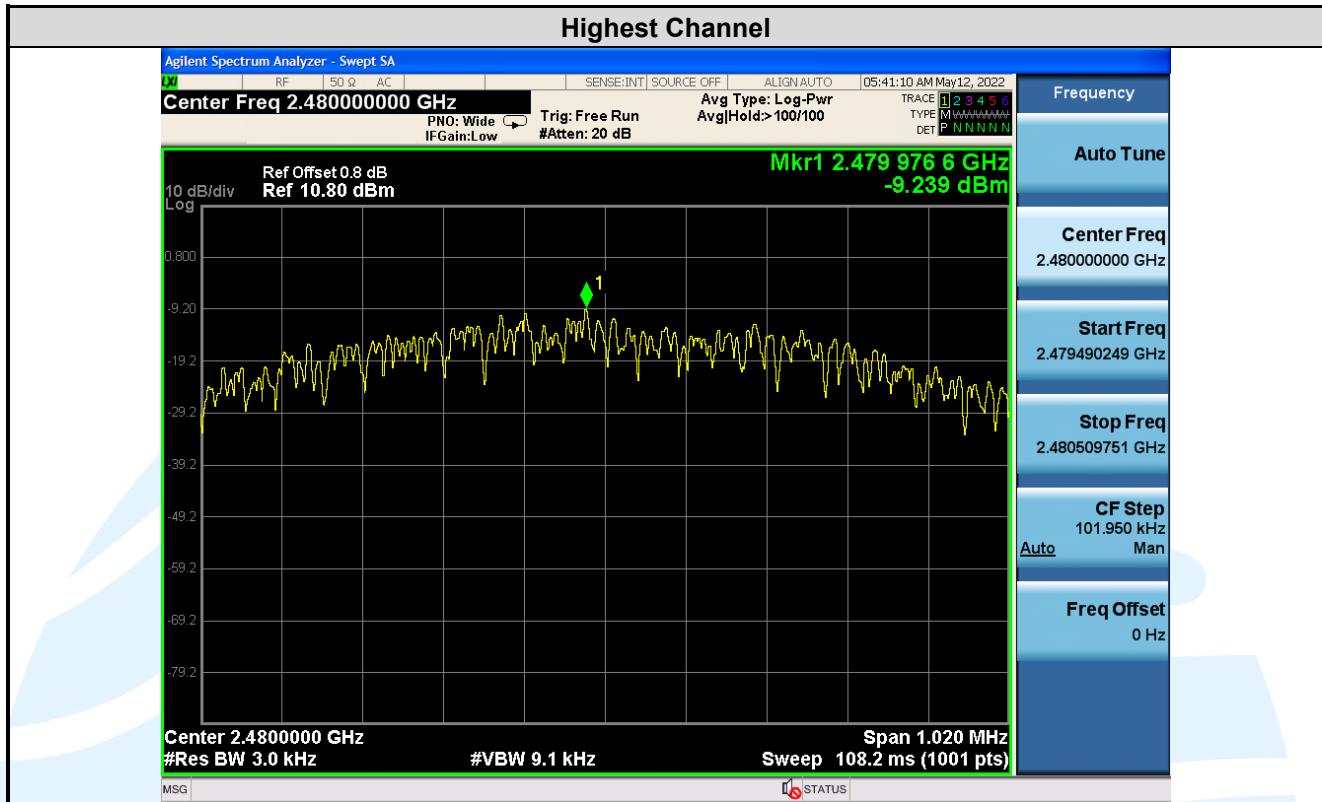
**Instruments Used:** Refer to section 3 for details

**Test Results:** Pass

Type of Modulation	Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Result
GFSK	0	2402	-8.149	8	Pass
	19	2440	-8.305	8	Pass
	39	2480	-9.239	8	Pass

The test plots as follows:





## 5.6 CONDUCTED OUT OF BAND EMISSION

**Test Requirement:** FCC 47 CFR Part 15 Subpart C Section 15.247(d)

**Test Method:** ANSI C63.10-2013 Clause 11.11

**Limit:** In any 100kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power.

**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:

**Step 1: Measurement Procedure REF**

- a) Set instrument center frequency to DTS channel center frequency.
- b) Set the span to  $\geq$  1.5 times the DTS bandwidth.
- c) Set the RBW = 100 kHz.
- d) Set the VBW  $\geq$  3 x RBW.
- e) Detector = peak.
- f) Sweep time = auto couple.
- g) Trace mode = max hold.
- h) Allow trace to fully stabilize.
- i) Use the peak marker function to determine the maximum PSD level.
- j) Note that the channel found to contain the maximum PSD level can be used to establish the reference level.

**Step 2: Measurement Procedure OOB**

- a) Set RBW = 100 kHz.
- b) Set VBW  $\geq$  300 kHz.
- c) Detector = peak.
- d) Sweep = auto couple.
- e) Trace Mode = max hold.
- f) Allow trace to fully stabilize.
- g) Use the peak marker function to determine the maximum amplitude level.

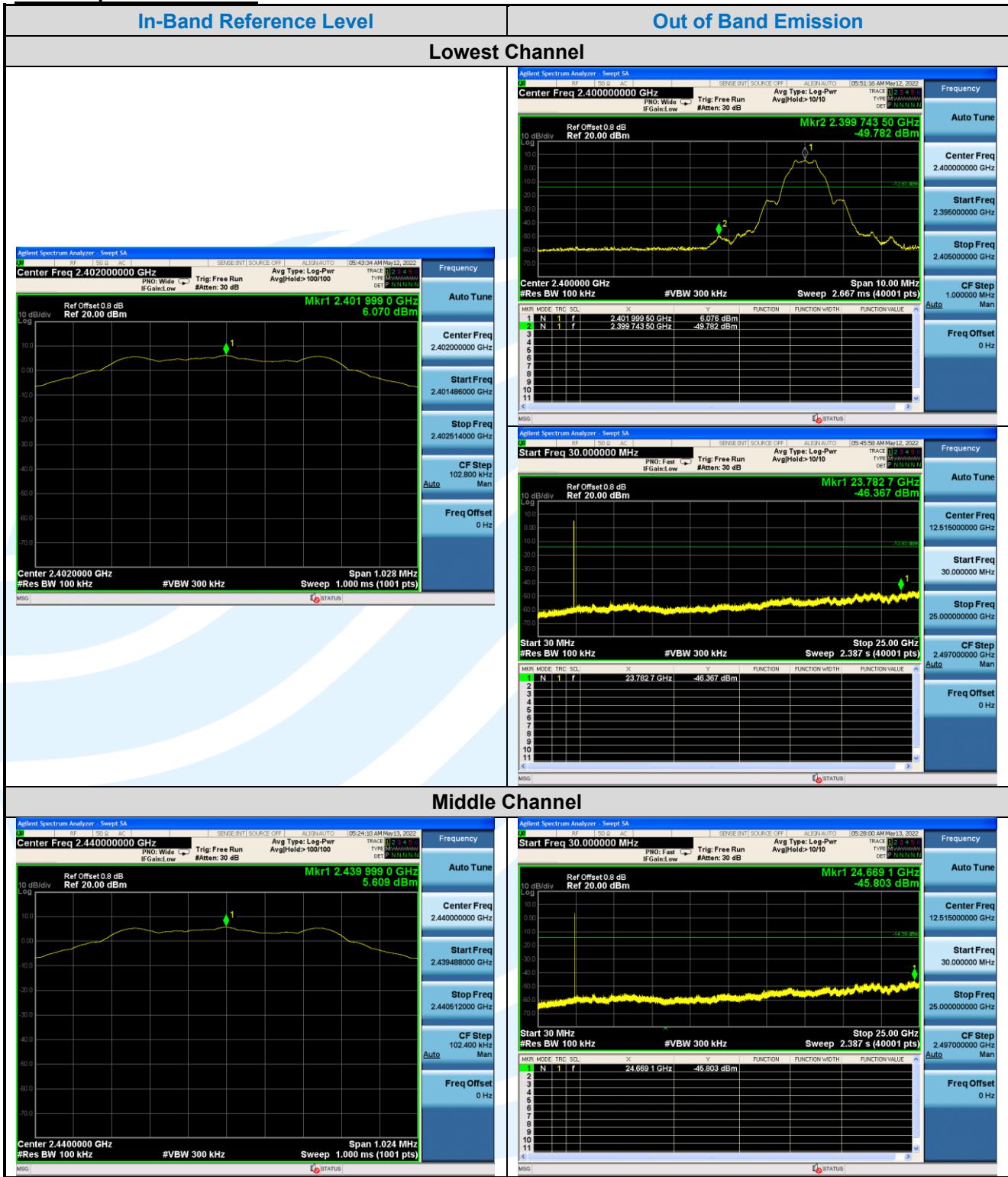
Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.

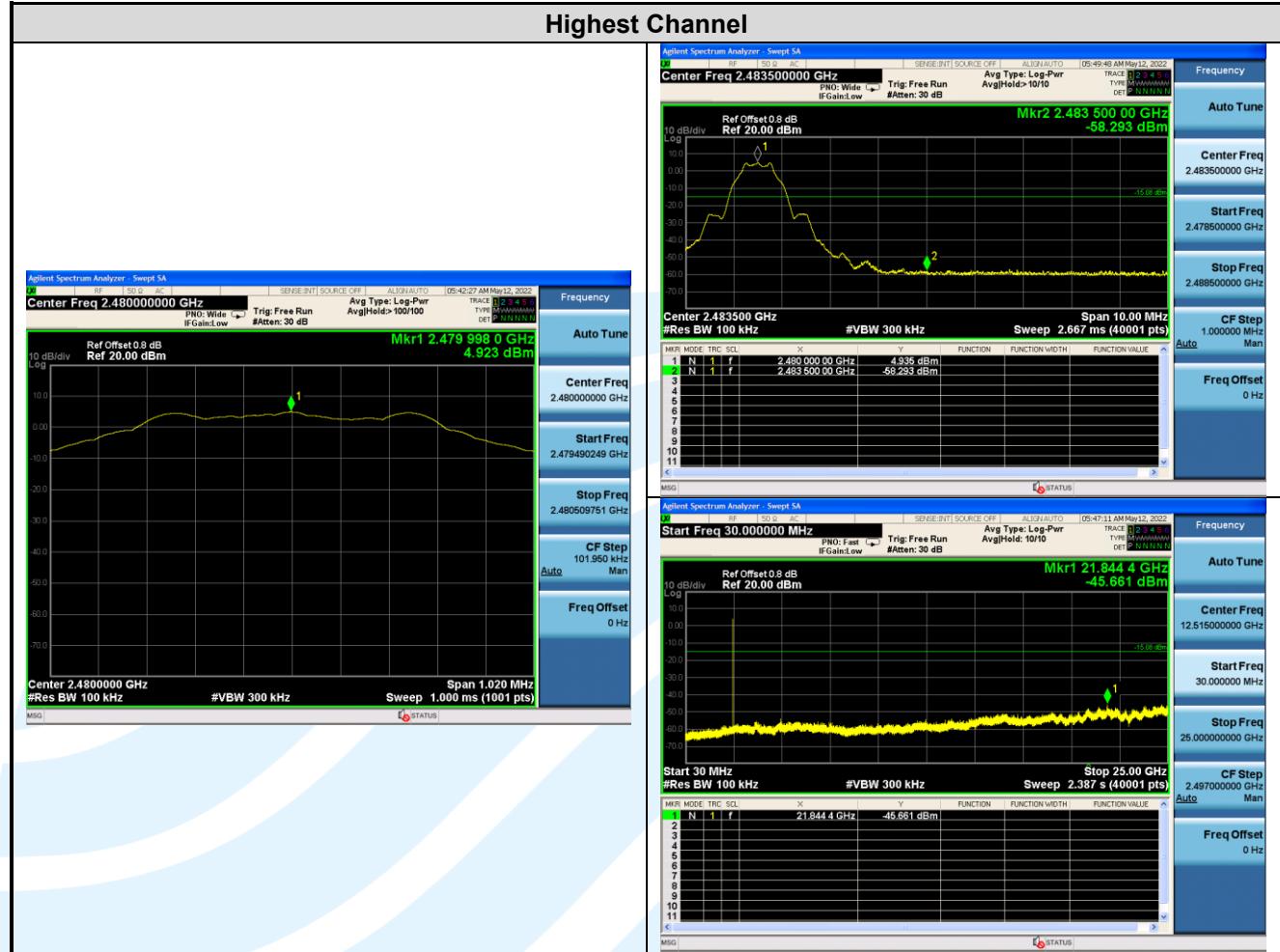
**Test Setup:** Refer to section 4.4.3 for details.

**Instruments Used:** Refer to section 3 for details

**Test Results:** Pass

The test plots as follows:





## 5.7 RADIATED SPURIOUS EMISSIONS

**Test Requirement:** FCC 47 CFR Part 15 Subpart C Section 15.205/15.209

**Test Method:** ANSI C63.10-2013 Clause 11.11 & Clause 11.12

### Receiver Setup:

Frequency	RBW
0.009 MHz-0.150 MHz	200/300 kHz
0.150 MHz -30 MHz	9/10 kHz
30 MHz-1 GHz	100/120 kHz
Above 1 GHz	1 MHz

### Limits:

#### Spurious Emissions

Frequency	Field strength (microvolt/meter)	Limit (dB $\mu$ V/m)	Remark	Measurement distance (m)
0.009 MHz-0.490 MHz	2400/F(kHz)	--	--	300
0.490 MHz-1.705 MHz	24000/F(kHz)	--	--	30
1.705 MHz-30 MHz	30	--	--	30
30 MHz-88 MHz	100	40.0	Quasi-peak	3
88 MHz-216 MHz	150	43.5	Quasi-peak	3
216 MHz-960 MHz	200	46.0	Quasi-peak	3
960MHz-1GHz	500	54.0	Quasi-peak	3
Above 1 GHz	500	54.0	Average	3

### Remark:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dB $\mu$ V/m) = 20 log Emission level (uV/m).
3. For frequencies above 1000 MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20 dB under any condition of modulation.

**Test Setup:** Refer to section 4.4.1 for details.

### Test Procedures:

#### 1. From 30 MHz to 1GHz test procedure as below:

- 1) The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- 2) The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- 3) The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- 4) For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rota table table was turned from 0 degrees to 360 degrees to find the maximum reading.
- 5) The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- 6) If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

#### 2. Above 1GHz test procedure as below:

- 1) Different between above is the test site, change from Semi- Anechoic Chamber to fully Anechoic Chamber and change form table 0.8 meter to 1.5 meter (Above 18GHz the distance is 1 meter and table is 1.5 meter).

### 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

Tel: +86-755-28230888

Fax: +86-755-28230886

E-mail: info@uttlab.com

<http://www.uttlab.com>

UTTR-RF-FCCPART15.247-V1.1

- 2) Test the EUT in the lowest channel, middle channel, the Highest channel
- 3) The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the Y axis positioning which is worse case.
- 4) Repeat above procedures until all frequencies measured was complete.

**Equipment Used:** Refer to section 3 for details.

**Test Result:** Pass

**The measurement data as follows:**

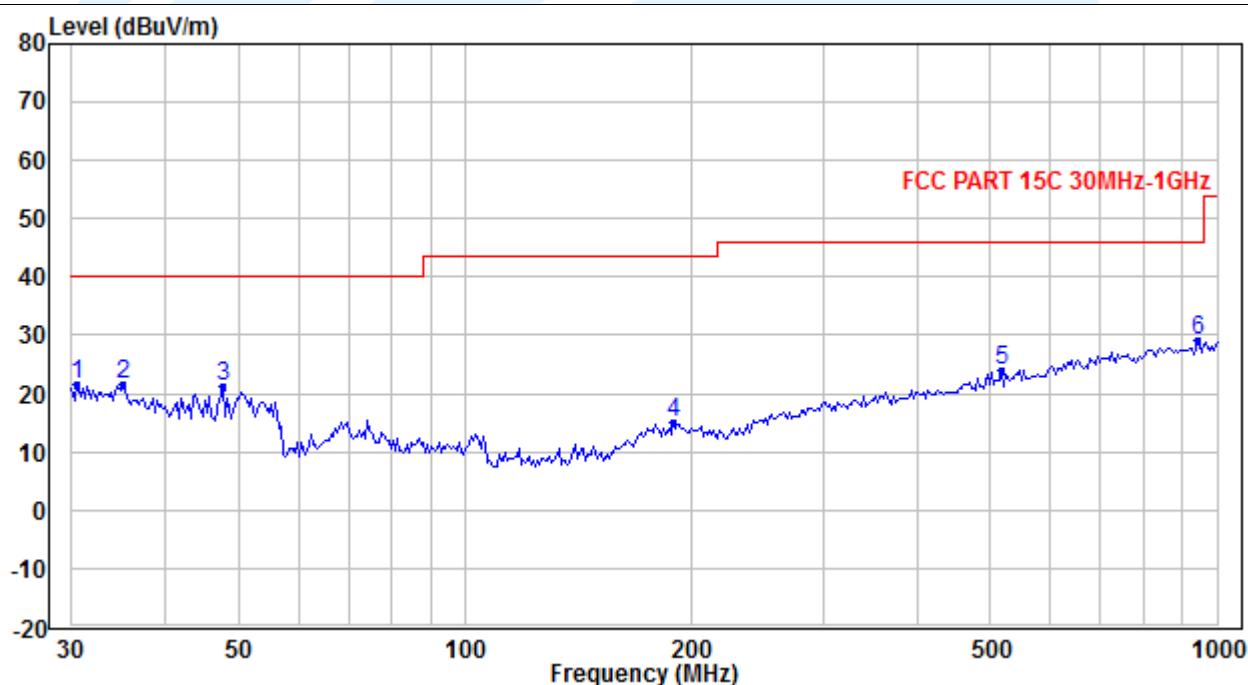
**Radiated Emission Test Data (9 kHz ~ 30 MHz):**

The amplitude of spurious emissions attenuated more than 20 dB below the permissible value is not required to be report.

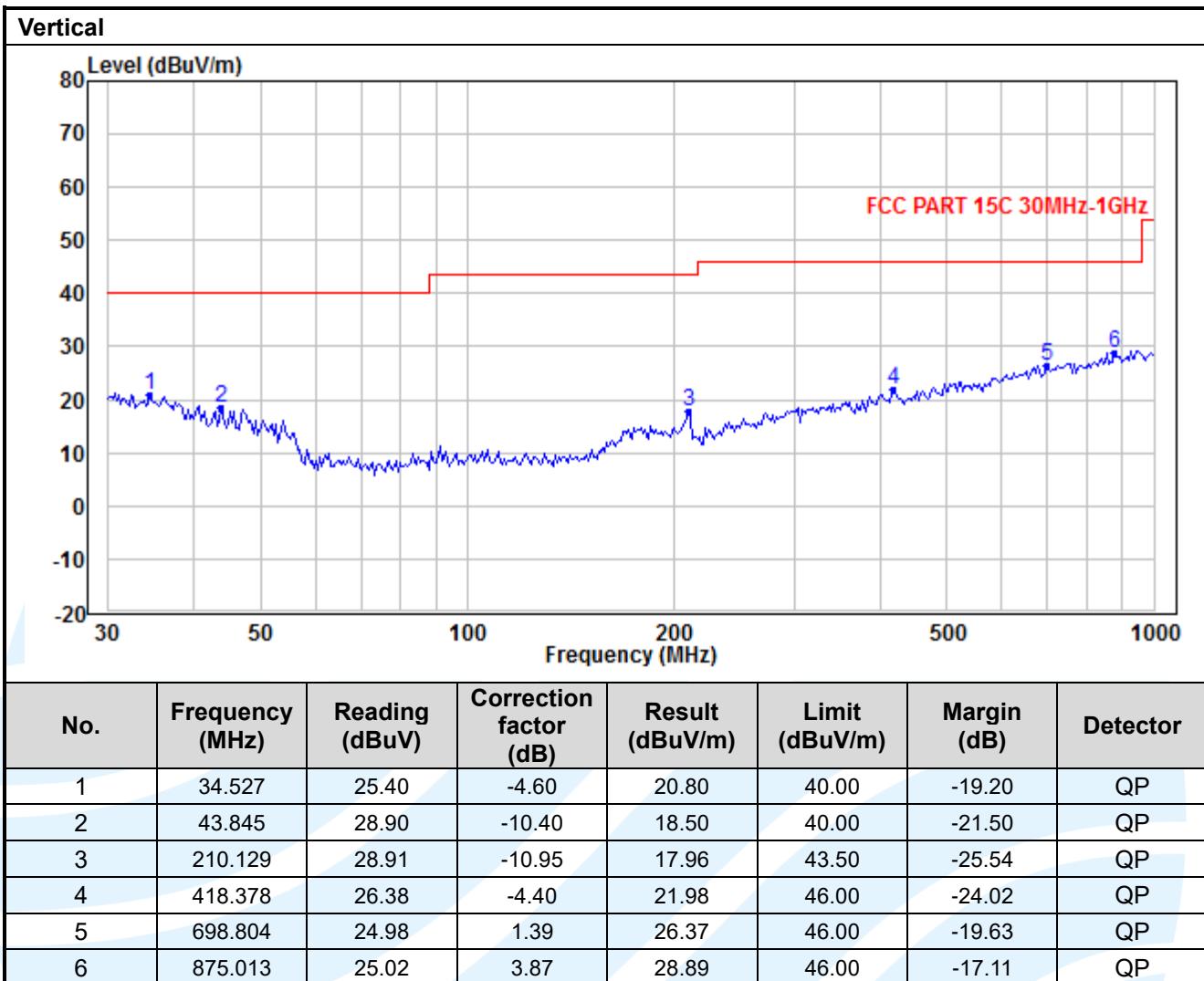
**Radiated Emission Test Data (30 MHz ~ 1 GHz):**

**Worst-Case Configuration**

**Horizontal**



No.	Frequency (MHz)	Reading (dBuV)	Correction factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	30.425	26.13	-4.46	21.67	40.00	-18.33	QP
2	35.016	25.84	-4.28	21.56	40.00	-18.44	QP
3	47.703	34.16	-13.04	21.12	40.00	-18.88	QP
4	189.108	25.28	-10.38	14.90	43.50	-28.60	QP
5	516.565	26.43	-2.46	23.97	46.00	-22.03	QP
6	945.334	24.66	4.61	29.27	46.00	-16.73	QP



Radiated Emission Test Data (Above 1GHz):								
Lowest Channel:								
No.	Frequency (MHz)	Reading (dB $\mu$ V)	Correction factor (dB/m)	Result (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Detector	Antenna Polaxis
1	4804	42.2	-2.3	39.8	74	-34.2	Peak	Horizontal
2	4804	29.0	-2.3	26.7	54	-27.3	Average	Horizontal
3	7206	41.7	1.4	43.1	74	-30.9	Peak	Horizontal
4	7206	28.9	1.4	30.3	54	-23.7	Average	Horizontal
5	4804	40.5	-2.3	38.1	74	-35.9	Peak	Vertical
6	4804	28.9	-2.3	26.6	54	-27.4	Average	Vertical
7	7206	40.6	1.4	42.1	74	-32.0	Peak	Vertical
8	7206	28.9	1.4	30.3	54	-23.7	Average	Vertical
Middle Channel:								
1	4880	39.9	-2.3	37.6	74	-36.4	Peak	Horizontal
2	4880	27.2	-2.3	24.9	54	-29.1	Average	Horizontal
3	7320	39.3	1.6	40.9	74	-33.1	Peak	Horizontal
4	7320	28.2	1.6	29.8	54	-24.2	Average	Horizontal
5	4880	40.8	-2.3	38.5	74	-35.5	Peak	Vertical
6	4880	28.9	-2.3	26.6	54	-27.4	Average	Vertical
7	7320	41.5	1.6	43.1	74	-30.9	Peak	Vertical
8	7320	28.2	1.6	29.8	54	-24.2	Average	Vertical
Highest Channel:								
1	4960	40.6	-2.3	38.4	74	-35.7	Peak	Horizontal
2	4960	29.3	-2.3	27.0	54	-27.0	Average	Horizontal
3	7440	40.3	1.8	42.1	74	-31.9	Peak	Horizontal
4	7440	29.8	1.8	31.6	54	-22.4	Average	Horizontal
5	4804	42.2	-2.3	39.8	74	-34.2	Peak	Vertical
6	4804	29.2	-2.3	26.9	54	-27.1	Average	Vertical
7	7440	41.2	1.8	43	74	-31.0	Peak	Vertical
8	7440	29.7	1.8	31.5	54	-22.5	Average	Vertical

**Remark:**

1. Correct Factor = Antenna Factor + Cable Loss - Amplifier Gain, the value was added to Original Receiver Reading by the software automatically.
2. Result = Reading + Correct Factor.
3. Margin = Result – Limit

## 5.8 BAND EDGE MEASUREMENTS (RADIATED)

**Test Requirement:** FCC 47 CFR Part 15 Subpart C Section 15.205/15.209

**Test Method:** ANSI C63.10-2013 Clause 11.13

**Limits:**

Radiated emissions which fall in the restricted bands, as defined in section 15.205(a), must also comply with the radiated emission limits specified in section 15.209(a).

Frequency	Limit (dB $\mu$ V/m @3m)	Remark
30 MHz-88 MHz	40.0	Quasi-peak Value
88 MHz-216 MHz	43.5	Quasi-peak Value
216 MHz-960 MHz	46.0	Quasi-peak Value
960 MHz-1 GHz	54.0	Quasi-peak Value
Above 1 GHz	54.0	Average Value
	74.0	Peak Value

**Test Setup:** Refer to section 4.4.1 for details.

**Test Procedures:**

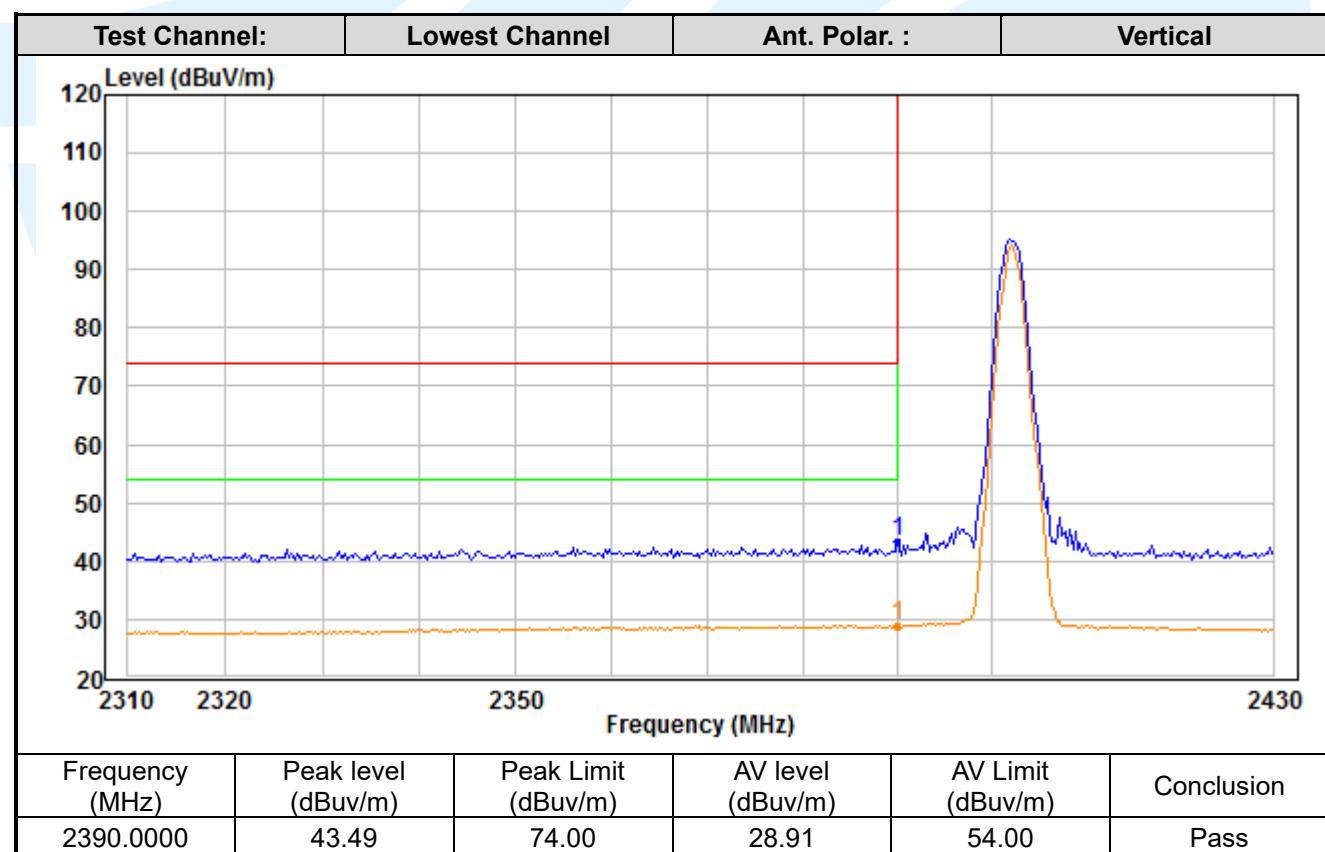
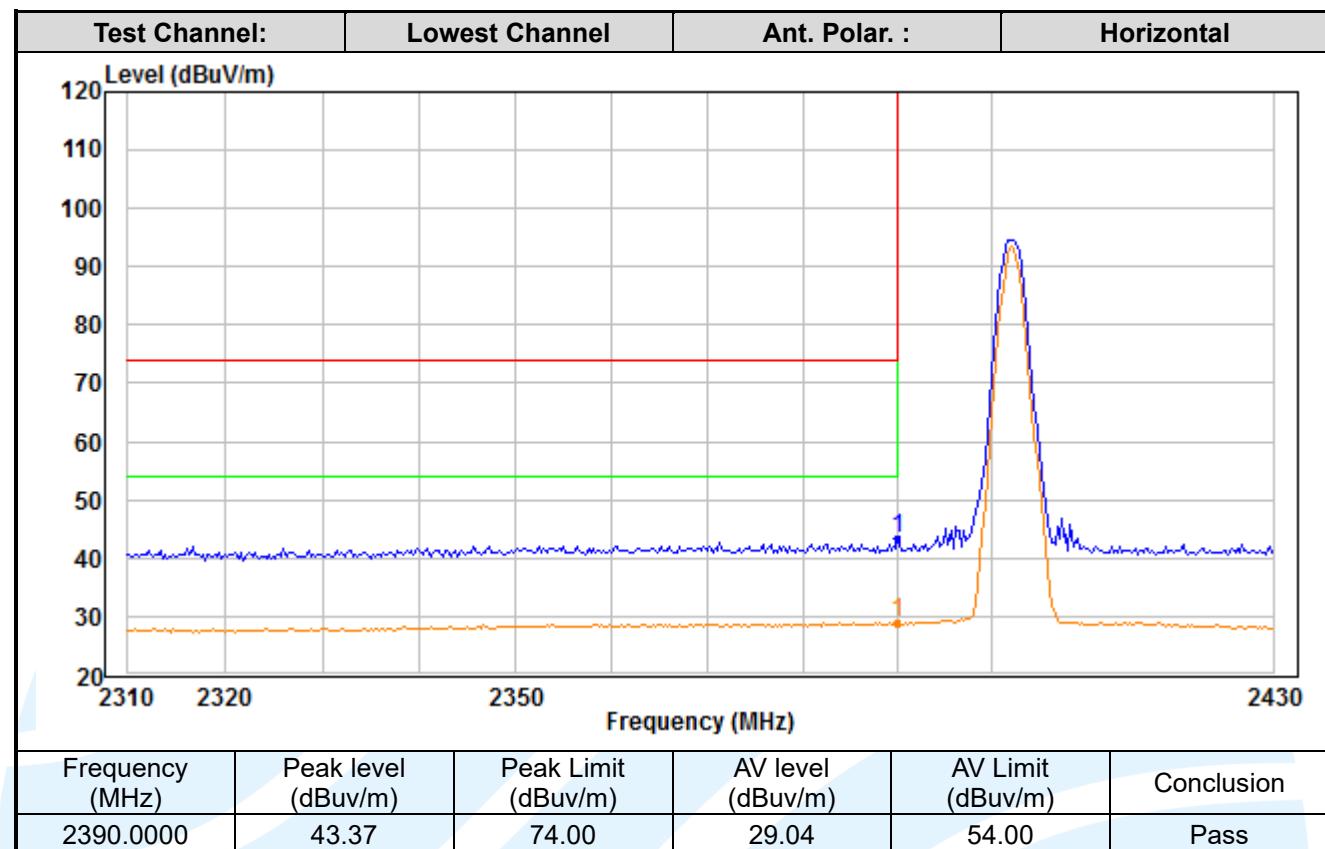
Radiated band edge measurements at 2390 MHz and 2483.5 MHz were made with the unit transmitting in the low end of the channel range and the high end closest to the restricted bands respectively. The emissions were made on the 966 Semi-Chamber. Use (resolution bandwidth (RBW) = 1 MHz, video bandwidth (VBW) = 3 MHz for peak levels and RBW = 1 MHz and VBW = 10 Hz or 1/T for average levels).

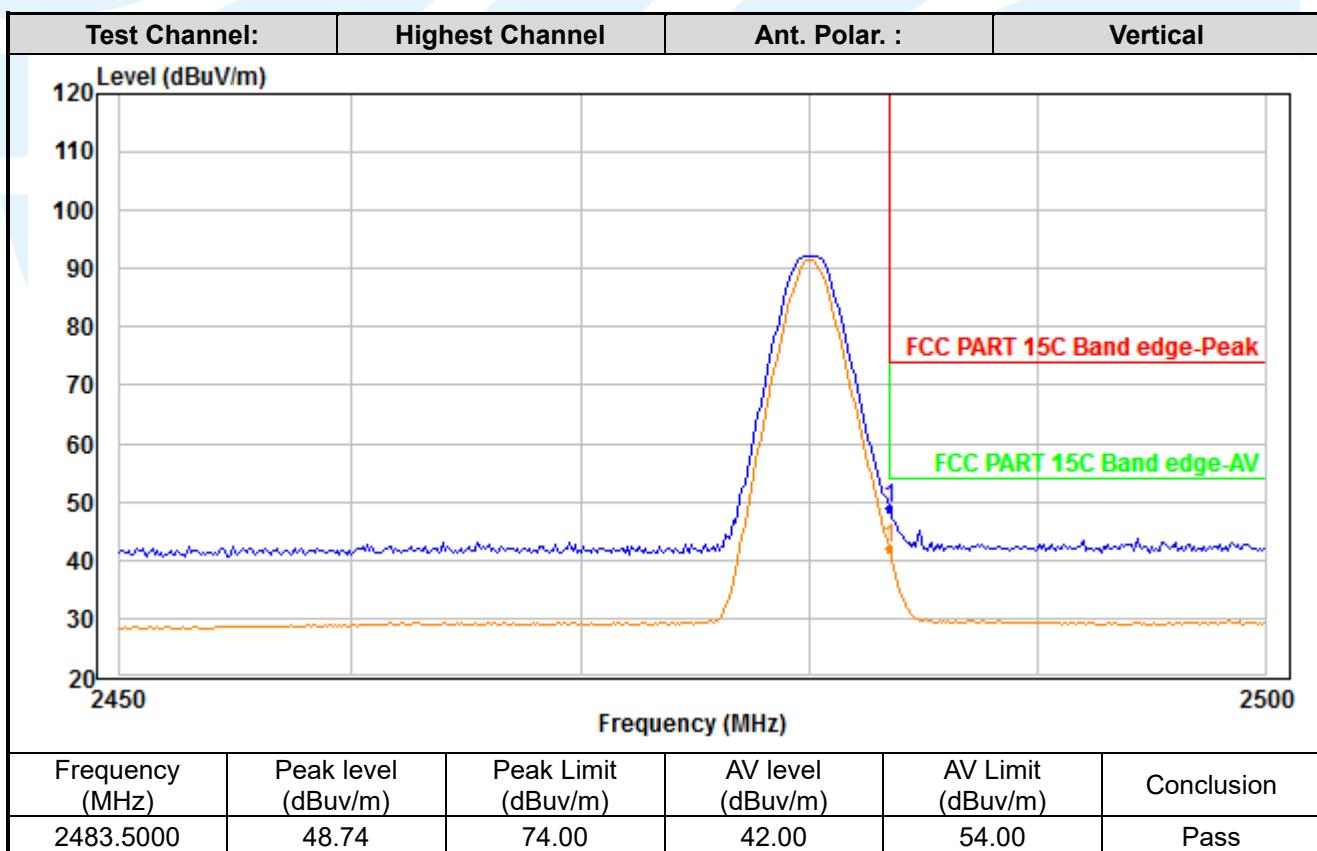
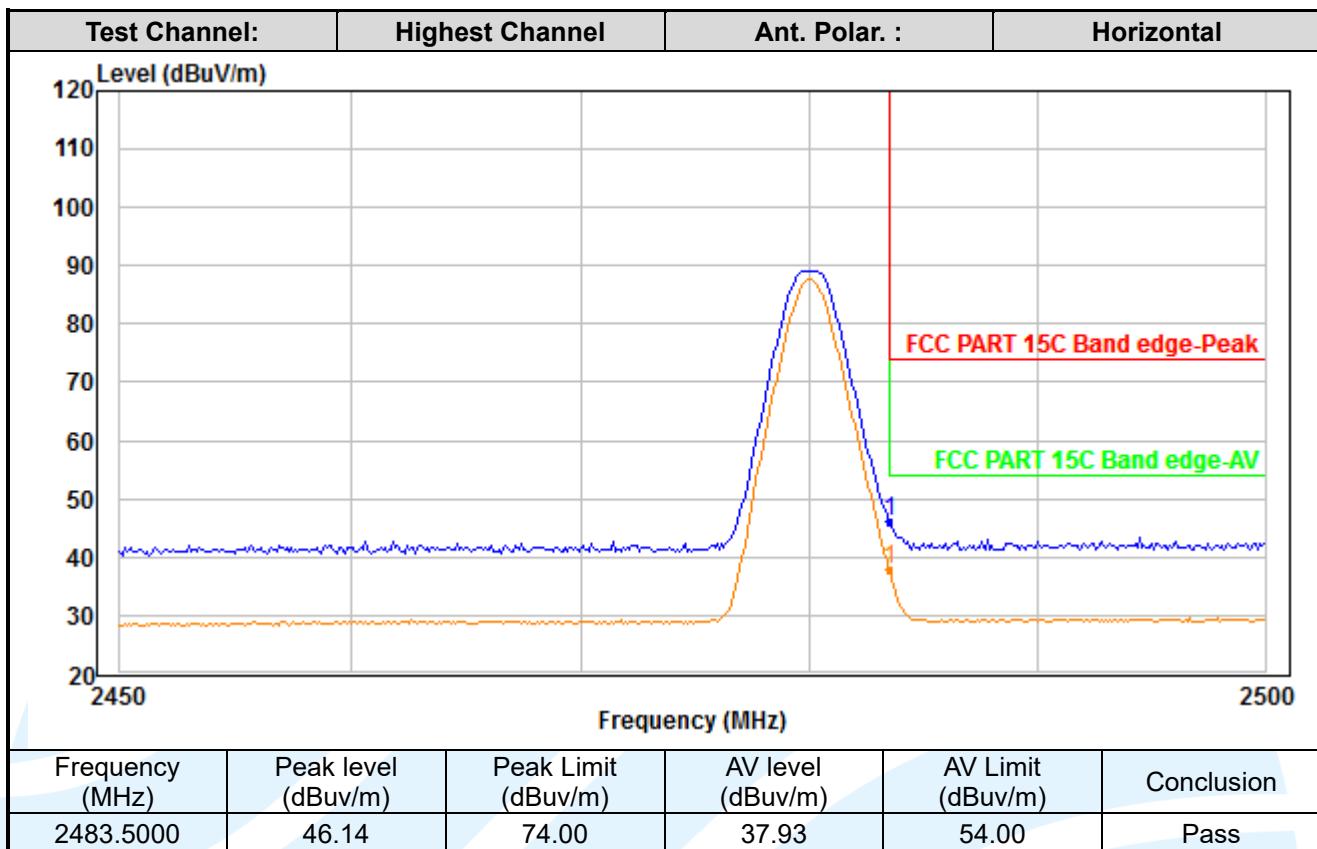
1. Use radiated spurious emission test procedure described in clause 5.10. The transmitter output (antenna port) was connected to the test receiver.
2. Set the PK and AV limit line.
3. Record the fundamental emission and emissions out of the band-edge.
4. Determine band-edge compliance as required.

**Equipment Used:** Refer to section 3 for details.

**Test Result:** Pass

**The measurement data as follows:**





## 5.9 CONDUCTED EMISSION

**Test Requirement:** 47 CFR Part 15C Section 15.207

**Test Method:** ANSI C63.10-2013 Section 6.2

**Limits:**

Frequency range (MHz)	Limits (dB(μV))	
	Quasi-peak	Average
0,15 to 0,50	66 to 56	56 to 46
0,50 to 5	56	46
5 to 30	60	50

**Remark:**

1. The lower limit shall apply at the transition frequencies.
2. The limit decreases linearly with the logarithm of the frequency in the range 0.15 to 0.50 MHz.

**Test Setup:** Refer to section 4.4.2 for details.

**Test Procedures:**

Test frequency range :150KHz-30MHz

- 1) The mains terminal disturbance voltage test was conducted in a shielded room.
- 2) The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides a  $50\Omega/50\mu\text{H} + 5\Omega$  linear impedance. The power cables of all other units of the EUT were connected to a second LISN 2, which was bonded to the ground reference plane in the same way as the LISN 1 for the unit being measured. A multiple socket outlet strip was used to connect multiple power cables to a single LISN provided the rating of the LISN was not exceeded.
- 3) The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane,
- 4) The test was performed with a vertical ground reference plane. The rear of the EUT shall be 0.4 m from the vertical ground reference plane. The vertical ground reference plane was bonded to the horizontal ground reference plane. The LISN 1 was placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane for LISNs mounted on top of the ground reference plane. This distance was between the closest points of the LISN 1 and the EUT. All other units of the EUT and associated equipment was at least 0.8 m from the LISN 2.
- 5) In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10 on conducted measurement.

**Equipment Used:** Refer to section 3 for details.

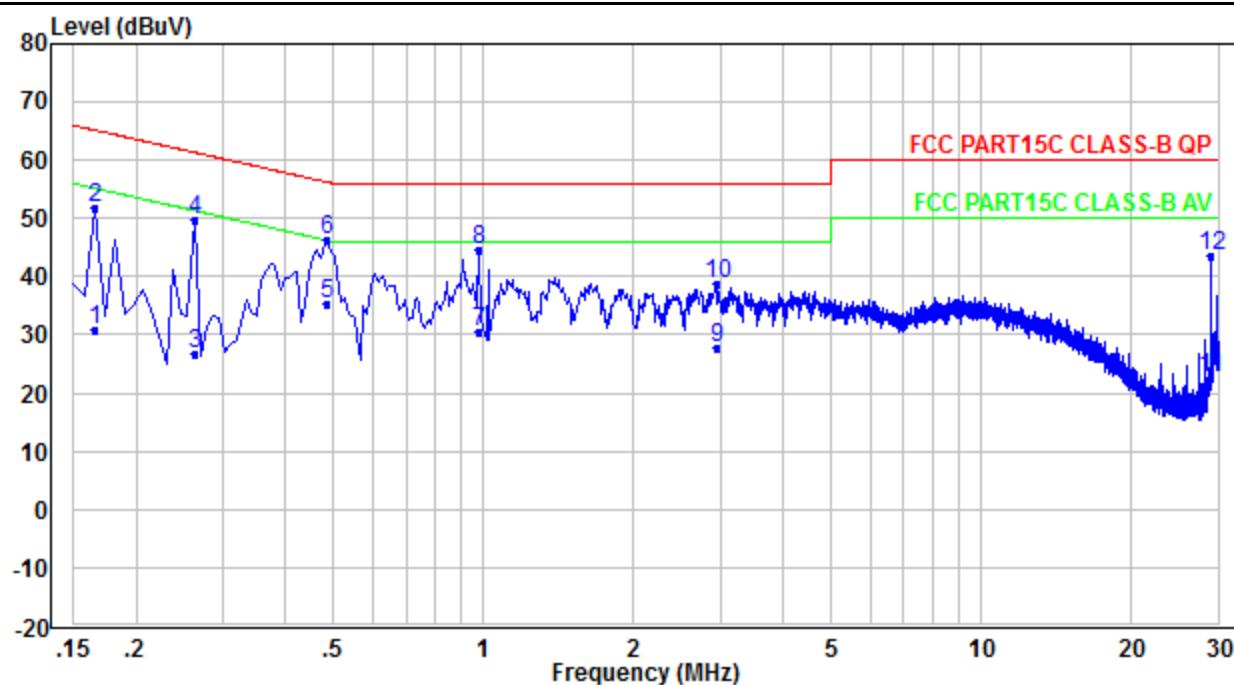
**Test Result:** Pass

The measurement data as follows:

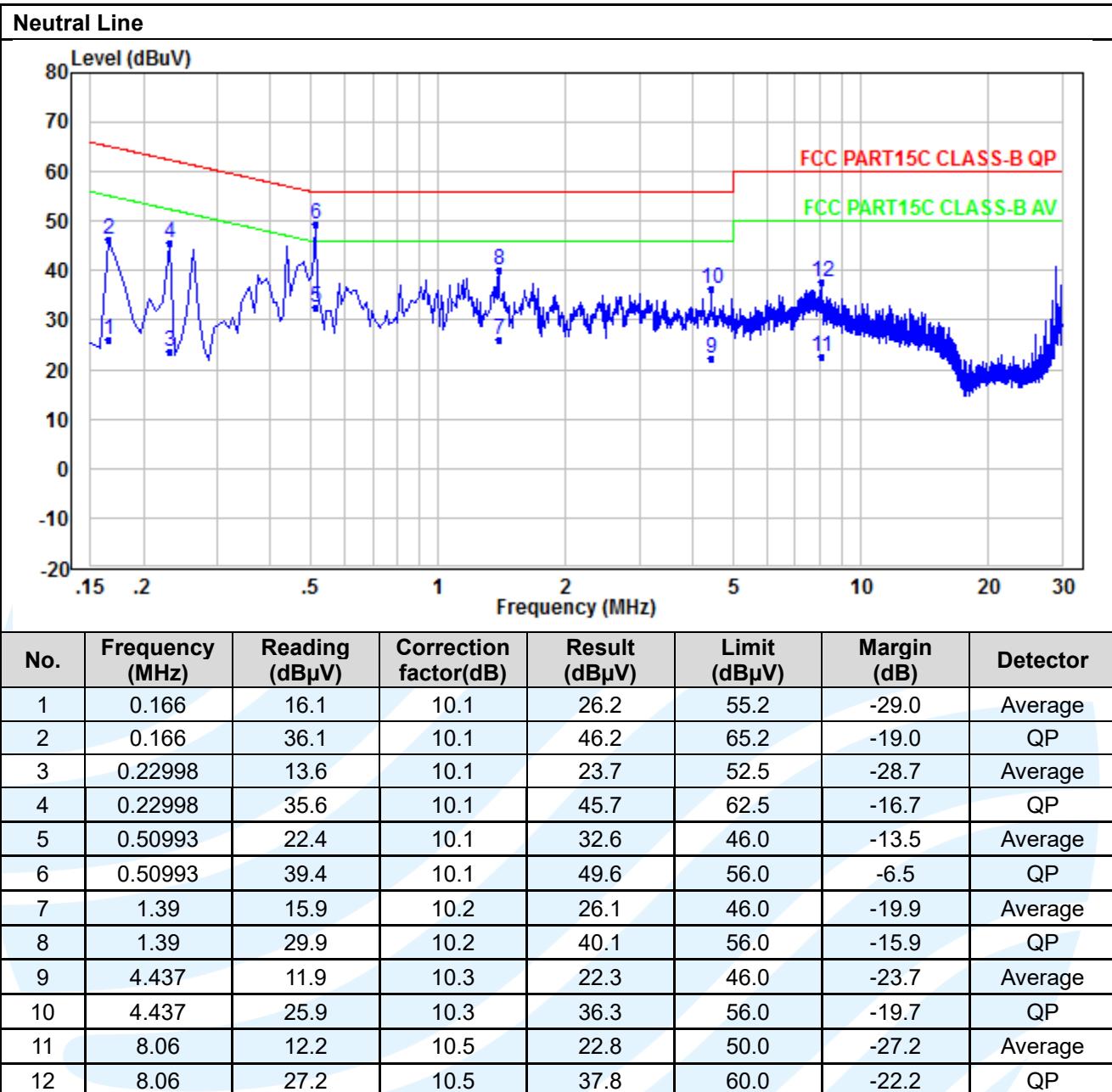
Quasi Peak and Average:

Mode: BT Link

Live Line



No.	Frequency (MHz)	Reading (dB $\mu$ V)	Correction factor(dB)	Result (dB $\mu$ V)	Limit (dB $\mu$ V)	Margin (dB)	Detector
1	0.166	20.6	10.1	30.8	55.2	-24.4	Average
2	0.166	41.6	10.1	51.8	65.2	-13.4	QP
3	0.26198	16.6	10.1	26.7	51.4	-24.6	Average
4	0.26198	39.6	10.1	49.7	61.4	-11.6	QP
5	0.48593	25.3	10.2	35.4	46.2	-10.8	Average
6	0.48593	36.3	10.2	46.4	56.2	-9.8	QP
7	0.98183	20.2	10.2	30.5	46.0	-15.6	Average
8	0.98183	34.2	10.2	44.5	56.0	-11.6	QP
9	2.949	17.5	10.3	27.8	46.0	-18.3	Average
10	2.949	28.5	10.3	38.8	56.0	-17.3	QP
11	29.048	11.6	10.9	22.6	50.0	-27.4	Average
12	29.048	32.6	10.9	43.6	60.0	-16.4	QP



## Remark:

1. Correct Factor = LISN Factor + Cable Loss + Pulse Limiter Factor, the value was added to Original Receiver Reading by the software automatically.
2. Result = Reading + Correct Factor.
3. Margin = Result - Limit
4. An initial pre-scan was performed on the Phase and neutral lines with peak detector. Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission were detected.
5. All possible modes of operation were investigated, and testing at two nominal voltages of 240V/50Hz and 120V/60Hz, only the worst case emissions reported.

## APPENDIX 1 PHOTOS OF TEST SETUP

See test photos attached in Appendix 1 for the actual connections between Product and support equipment.

## APPENDIX 2 PHOTOS OF EUT CONSTRUCTIONAL DETAILS

Refer to Appendix 2 for EUT external and internal photos.

\*\*\* End of Report \*\*\*

---

The test report is effective only with both signature and specialized stamp. The result(s) shown in this report refer only to the sample(s) tested. Without written approval of UnionTrust, this report can't be reproduced except in full.

---