

# TEST REPORT

Product Name: Breathing and Video Monitor  
Trade Mark: vtech  
Model No.: VM5253 BU  
Add. Model No.: VM5X53-ab BU  
Report Number: 181214024RFC-1  
Test Standards: FCC 47 CFR Part 15 Subpart C  
FCC ID: EW780-1501-00  
Joh no: HK18120034  
Test Result: PASS  
Date of Issue: September 26, 2019

Prepared for:

**VTech Telecommunications Ltd.**  
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Prepared by:

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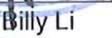
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September 26, 2019

**Version**

Version No.	Date	Description
V1.0	September 26, 2019	Original



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## 1. GENERAL INFORMATION

### 1.1 CLIENT INFORMATION

<b>Applicant:</b>	VTech Telecommunications Ltd.
<b>Address of Applicant:</b>	23/F, Tai Ping Industrial Centre, Block 1,57 Ting Kok Road, Tai Po, Hong Kong.
<b>Manufacturer:</b>	VTech (Dongguan) Telecommunications Limited.
<b>Address of Manufacturer:</b>	VTech Science Park, Xia Ling Bei Management Zone, Liaobu, Dongguan, Guangdong, China.

### 1.2 EUT INFORMATION

#### 1.2.1 General Description of EUT

<b>Product Name:</b>	Breathing and Video Monitor	
<b>Model No.:</b>	VM5253 BU	
<b>Add. Model No.:</b>	VM5X53-ab BU	
<b>Trade Mark:</b>	vtech	
<b>DUT Stage:</b>	Production Unit	
<b>EUT Supports Function:</b>	2.4 GHz ISM Band:	General 2.4GHz Technique
	3.1GHz -10.6GHz:	7.29GHz UWB
<b>Sample Received Date:</b>	December 7, 2018	
<b>Sample Tested Date:</b>	December 7, 2018 to January 23, 2019	
<b>Note:</b> The Model(s): VM5X53-ab BU is the same as the Model: VM5253 BU in electronics/electrical designs including software & firmware, PCB layout and construction design/physical design/enclosure as declared by client. The only differences between these models are color and model number to be sold for marketing purpose as declared by client. Suffix ("a,b,x") indicates different number of baby unit, different color of enclosure, and different type packaging as declared by client.		

#### 1.2.2 Description of Accessories

Adapter	
<b>Model No.:</b>	S006AKU0500100
<b>Input:</b>	100-240 V~50/60 Hz 200mA
<b>Output:</b>	5.0 V = 1000mA
<b>DC Cable:</b>	1.80 Meter, Unshielded without ferrite

### 1.3 PRODUCT SPECIFICATION SUBJECTIVE TO THIS STANDARD

<b>Frequency Band:</b>	2400 MHz to 2483.5 MHz
<b>Frequency Range:</b>	2405 MHz to 2475 MHz
<b>Modulation Technique:</b>	Frequency Hopping Spread Spectrum(FHSS)
<b>Type of Modulation:</b>	GFSK
<b>Number of Channels:</b>	17/32 (see note 1)
<b>Channel Separation:</b>	2 MHz
<b>Hopping Channel Type:</b>	Adaptive Frequency Hopping Systems
<b>Antenna Type:</b>	Integral Antenna
<b>Antenna Gain:</b>	0 dBi
<b>Maximum Peak Power:</b>	16.97 dBm
<b>Normal Test Voltage:</b>	120V~60Hz
<b>Note 1:</b> According to declared of equipment manufacturer, this EUT operation frequency range is 2405 MHz to 2475 MHz, the number of channels available is 32, and channel separation is 2 MHz, but when the product is power on, only 17 of the 32 channels are chosen, and the channel spacing is greater than or equal to 2 MHz	

### 1.4 OTHER INFORMATION

Operation Frequency Each of Channel							
1	2	3	4	5	6	7	8
2405MHz	2407MHz	2409MHz	2411MHz	2413MHz	2415MHz	2418MHz	2420MHz
9	10	11	12	13	14	15	16
2422MHz	2424MHz	2426MHz	2428MHz	2430MHz	2433MHz	2435MHz	2437MHz
17	18	19	20	21	22	23	24
2439MHz	2441MHz	2444MHz	2446MHz	2450MHz	2452MHz	2454MHz	2456MHz
25	26	27	28	29	30	31	32
2458.5MHz	2460.5MHz	2462.5MHz	2467 MHz	2469MHz	2471MHz	2473MHz	2475MHz

### 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
Adapter	N/A	S006AKU0500100	N/A	Applicant
Breathing and Video Monitor-Production Unit	VTech Telecommunications Ltd.	VM5253 PU	N/A	Applicant

2) Support Cable

Cable No.	Description	Connector	Length	Supplied by
1	Antenna Cable	SMA	0.30 Meter	UnionTrust

### 1.6 TEST LOCATION

**Shenzhen UnionTrust Quality and Technology Co., Ltd.**

Address: 16/F, Block A, Building 6, Baoneng Science and Technology Park, Qingxiang Road No.1, Longhua New District, Shenzhen, 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/EN 17025 to international or national standards. Equipment has been calibrated by accredited calibration laboratories.

**IC-Registration No.: 21600-1**

The 3m Semi-anechoic chamber of Shenzhen UnionTrust Quality and Technology Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 21600-1.

**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: 2005 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

**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
8	Occupied Channel Bandwidth	±2.3 %
9	Frequency Hopping	±2.7 %
10	RF output power, conducted	±0.52 dB
11	Power Spectral Density	±1.44 dB
12	Spurious emissions ,conducted	±1.48 dB
13	Temperature	±0.64 °C
14	Humidity	±2.8 %
15	Supply voltages	±0.49 %
16	Time	±1.1 %

## 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	PASS
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

### 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)
<input checked="" type="checkbox"/>	3M Chamber & Accessory Equipment	ETS-LINDGREN	3M	N/A	Dec. 03, 2018	Dec. 03, 2021
<input checked="" type="checkbox"/>	Receiver	R&S	ESIB26	100114	Nov. 24, 2018	Nov. 24, 2019
<input checked="" type="checkbox"/>	Loop Antenna	ETS-LINDGREN	6502	00202525	Dec. 03, 2018	Dec. 03, 2019
<input checked="" type="checkbox"/>	Broadband Antenna	ETS-LINDGREN	3142E	00201566	Dec. 08, 2018	Dec. 08, 2019
<input checked="" type="checkbox"/>	6dB Attenuator	Talent	RA6A5-N-18	18103001	Dec. 08, 2018	Dec. 08, 2019
<input checked="" type="checkbox"/>	Preamplifier	HP	8447F	2805A02960	Nov. 24, 2018	Nov. 24, 2019
<input type="checkbox"/>	Broadband Antenna (Pre-amplifier)	ETS-LINDGREN	3142E-PA	00201891	May 19, 2018	May 19, 2019
<input type="checkbox"/>	6dB Attenuator	Talent	RA6A5-N-18	18103002	Nov. 24, 2018	Nov. 24, 2019
<input type="checkbox"/>	Horn Antenna	ETS-LINDGREN	3117	00164202	Dec. 08, 2018	Dec. 08, 2019
<input checked="" type="checkbox"/>	Horn Antenna (Pre-amplifier)	ETS-LINDGREN	3117-PA	00201874	May 22, 2018	May 22, 2019
<input type="checkbox"/>	Horn Antenna	ETS-LINDGREN	3116C	00200180	May 20, 2018	May 20, 2019
<input checked="" type="checkbox"/>	Horn Antenna (Pre-amplifier)	ETS-LINDGREN	3116C-PA	00202652	Jan. 05, 2019	Jan. 05, 2020
<input checked="" type="checkbox"/>	Multi device Controller	ETS-LINDGREN	7006-001	00160105	N/A	N/A
<input checked="" type="checkbox"/>	Band Rejection Filter (2400MHz~2500MHz)	Micro-Tronics	BRM50702	G248	Jun. 06, 2018	Jun. 06, 2019
<input checked="" type="checkbox"/>	Test Software	Audix	e3	Software Version: 9.160333		

Conducted Emission Test Equipment List						
Used	Equipment	Manufacturer	Model No.	Serial Number	Cal. date (mm dd, yyyy)	Cal. Due date (mm dd, yyyy)
<input checked="" type="checkbox"/>	Receiver	R&S	ESR7	1316.3003K07-101181-K3	Nov. 24, 2018	Nov. 24, 2019
<input checked="" type="checkbox"/>	Pulse Limiter	R&S	ESH3-Z2	0357.8810.54	Nov. 24, 2018	Nov. 24, 2019
<input checked="" type="checkbox"/>	LISN	R&S	ESH2-Z5	860014/024	Nov. 24, 2018	Nov. 24, 2019
<input checked="" type="checkbox"/>	LISN	ETS-Lindgren	3816/2SH	00201088	Nov. 24, 2018	Nov. 24, 2019
<input checked="" type="checkbox"/>	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)
<input checked="" type="checkbox"/>	EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY51440197	Nov. 24, 2018	Nov. 24, 2019
<input checked="" type="checkbox"/>	EXA Spectrum Analyzer	KEYSIGHT	N9010B	MY57110211	Nov. 24, 2018	Nov. 24, 2019
<input checked="" type="checkbox"/>	USB Wideband Power Sensor	KEYSIGHT	U2021XA	MY55430035	Nov. 24, 2018	Nov. 24, 2019
<input type="checkbox"/>	USB Wideband Power Sensor	KEYSIGHT	U2021XA	MY55430023	Nov. 24, 2018	Nov. 24, 2019

## 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	Relative Humidity (%)
NT/NV	+15 to +35	120V~60Hz	20 to 75
<b>Remark:</b>			
1) NV: Normal Voltage; NT: Normal Temperature			

#### 4.1.2 Record of Normal Environment

Test Item	Temperature (°C)	Relative Humidity (%)	Pressure (kPa)	Tested by
AC Power Line Conducted Emission	22.5	49	99.80	Tony Kang
Conducted Peak Output Power	22.5	49	99.80	Tony Kang
20 dB Bandwidth & Occupied Bandwidth	22.5	49	99.80	Tony Kang
Carrier Frequencies Separation	22.5	49	99.80	Tony Kang
Number of Hopping Channel	22.5	49	99.80	Tony Kang
Dwell Time	22.5	49	99.80	Tony Kang
Conducted Out of Band Emission	22.5	49	99.80	Tony Kang
Radiated Emissions	25.4	53	99.80	Fire Huo
Band Edge Measurement	25.4	53	99.80	Fire Huo

## 4.2 TEST CHANNELS

Mode	Tx/Rx Frequency	Test RF Channel Lists		
		Lowest(L)	Middle(M)	Highest(H)
GFSK	2405 MHz to 2475 MHz	Channel 1	Channel 18	Channel 32
		2405 MHz	2441 MHz	2475 MHz

## 4.3 EUT TEST STATUS

Type of Modulation	Tx Function	Description
GFSK	1Tx	<ol style="list-style-type: none"> <li>Keep the EUT in continuously transmitting with Modulation test single</li> <li>Keep the EUT in continuously transmitting with Modulation test Hopping Frequency.</li> </ol>

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

Test Software
Test software name: MBP483 test mode

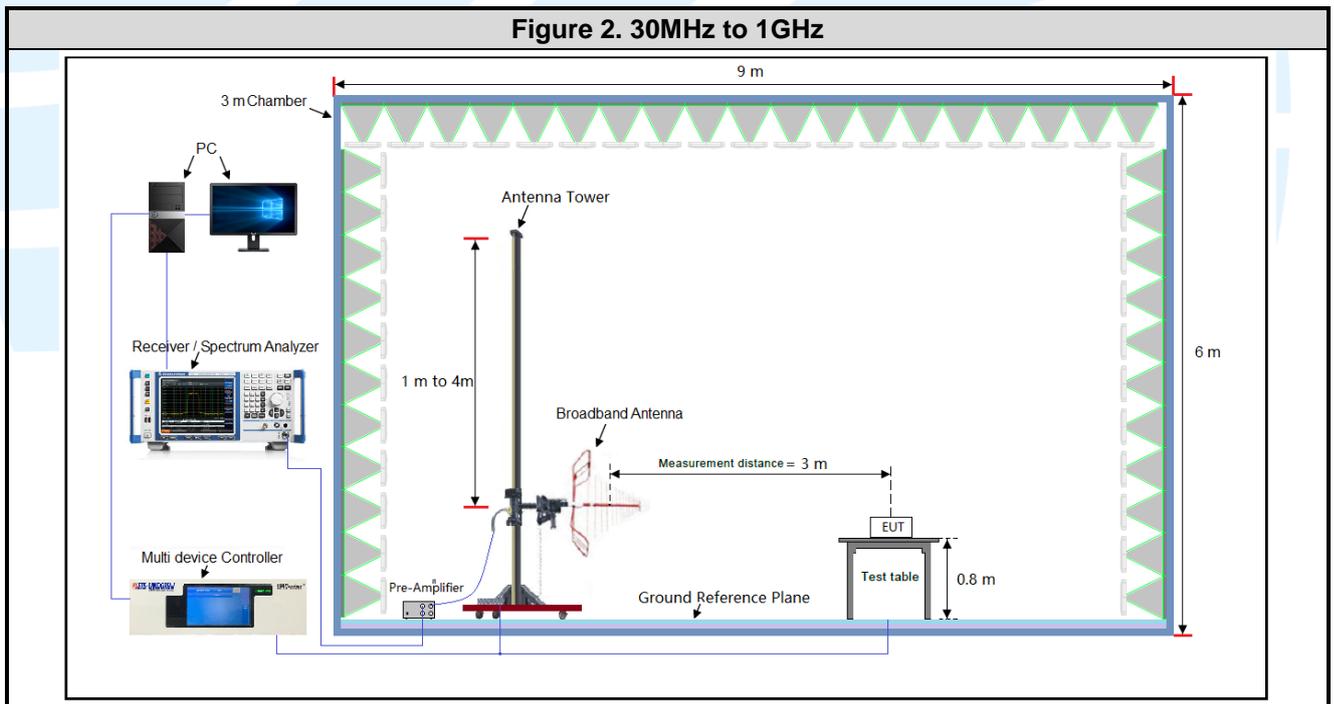
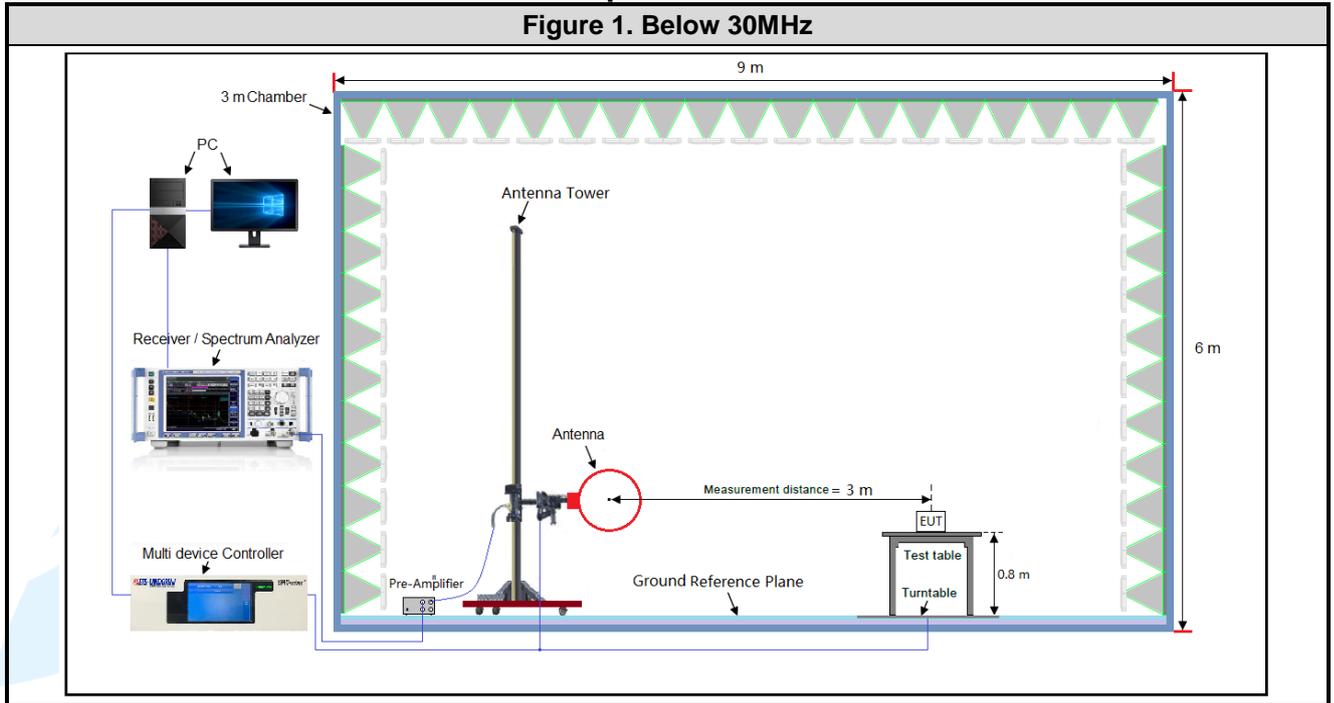
### 4.4 TESTED CHANNEL DETAIL

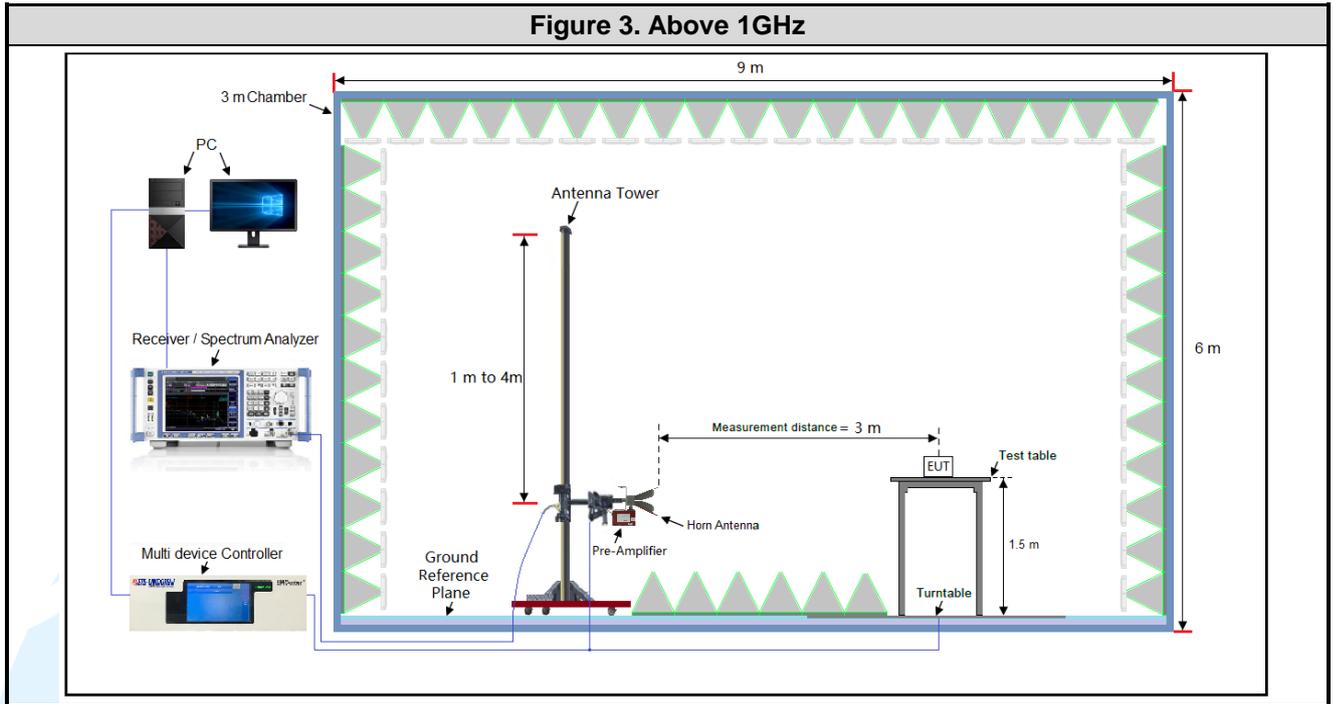
Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data packets and antenna ports (if EUT with antenna diversity architecture). Following channel(s) was (were) selected for the final test as listed below.

Type of Modulation	GFSK
Available Channel	1 to 32
Test Item	Test channel and choose of data packets
AC Power Line Conducted Emission	Frequency Hopping Channel 1 to 32
	Link
Conducted Peak Output Power	Channel 1 & 18 & 32
20 dB Bandwidth	Channel 1 & 18 & 32
Carrier Frequencies Separation	Frequency Hopping Channel 1 to 32
Number of Hopping Channel	Frequency Hopping Channel 1 to 32
Dwell Time	Channel 18
Conducted Out of Band Emission	Channel 1 & 18 & 32
Radiated Emissions	Channel 1 & 18 & 32
Band Edge Measurements (Radiated)	Channel 1 & 32

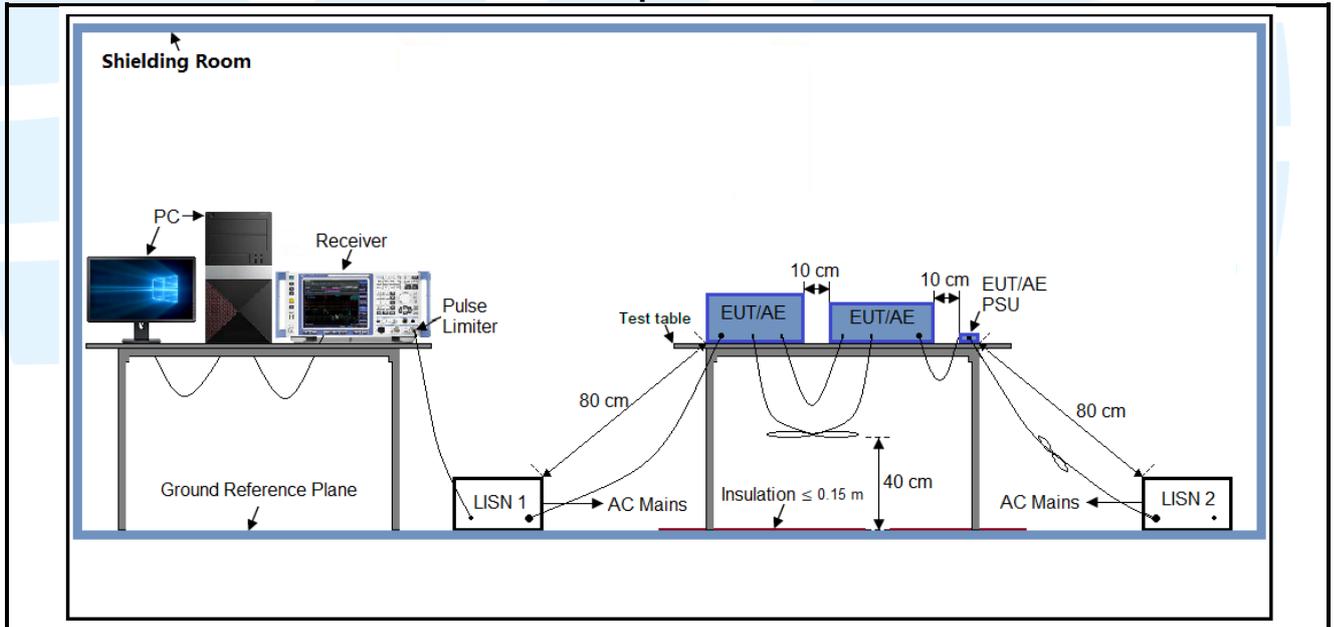
### 4.5 TEST SETUP

#### 4.5.1 For Radiated Emissions test setup

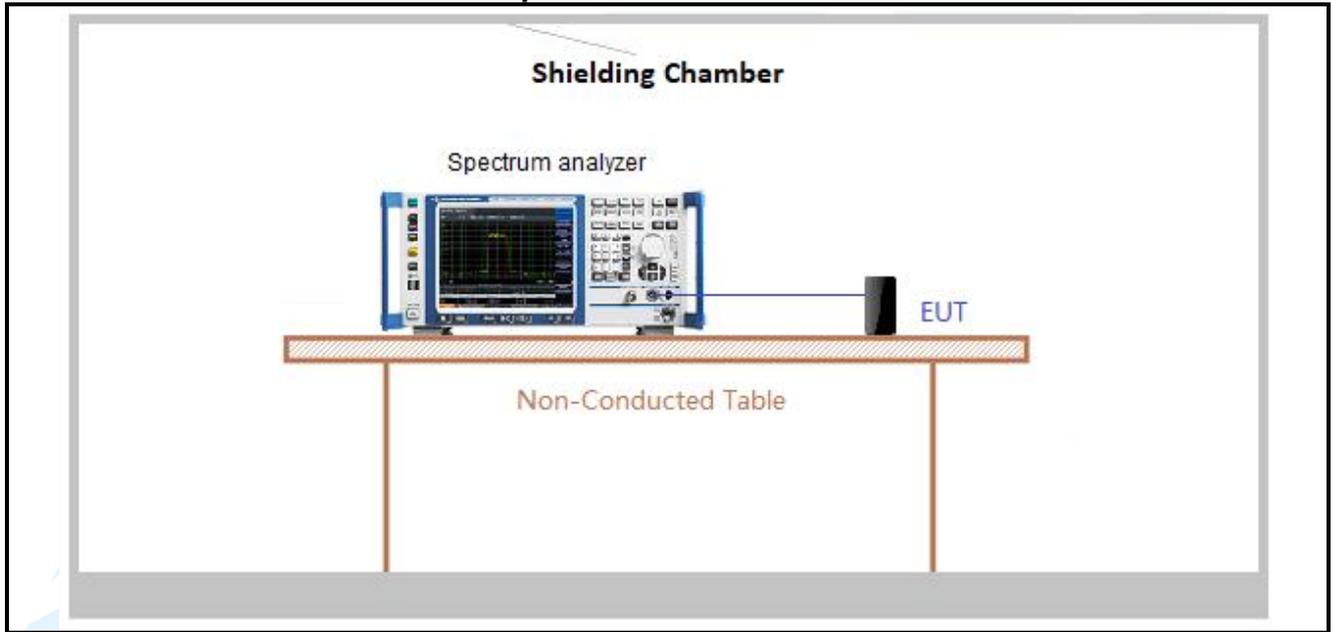




**4.5.2 For Conducted Emissions test setup**



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 adapter. 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	Y 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.

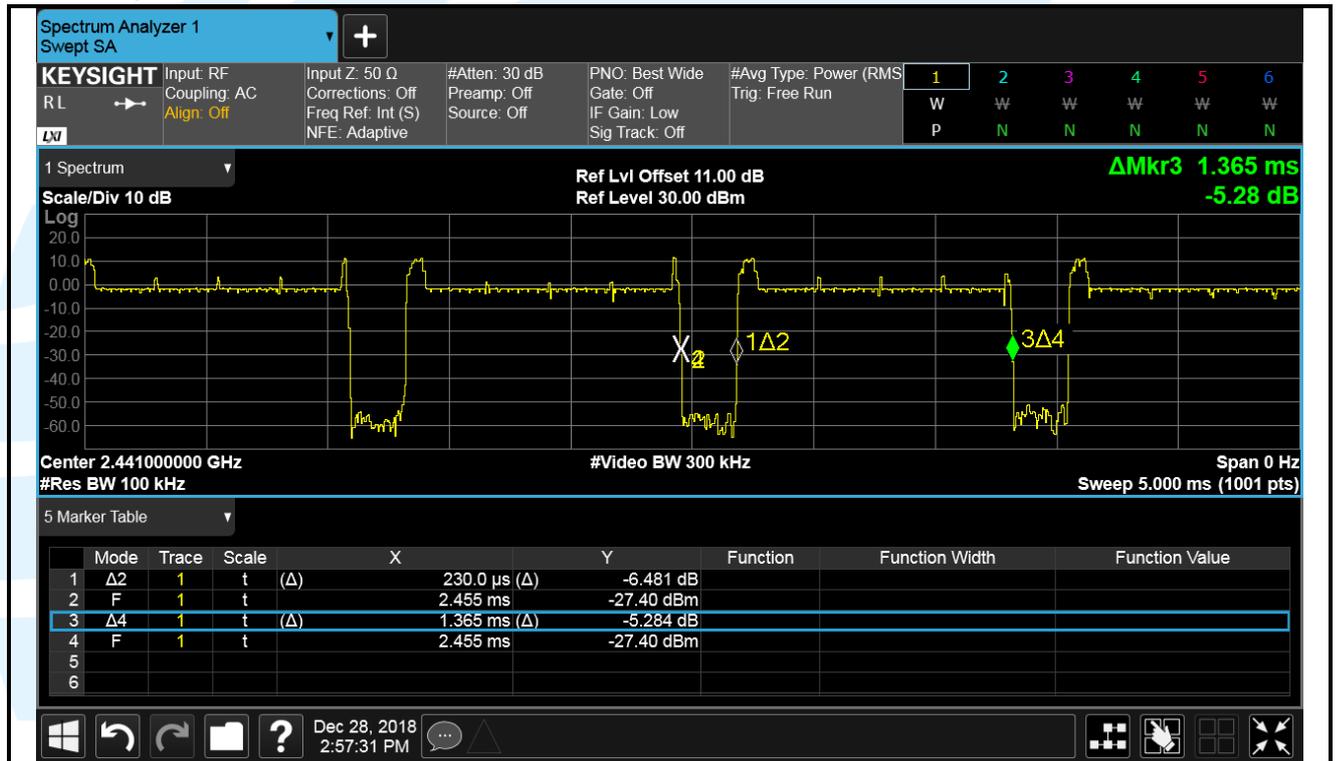
**Test Results**

Type of Modulation	On Time (msec)	Period (msec)	Duty Cycle (linear)	Duty Cycle (%)	Duty Cycle Factor (dB)	1/ T Minimum VBW (kHz)	Average Factor (dB)
GFSK	1.135	1.365	0.83	83.15	0.80	0.88	-1.60

**Remark:**

- 1) Duty cycle= On Time/ Period;
- 2) Duty Cycle factor = 10 \* log(1/ Duty cycle);
- 3) Average factor = 20 log<sub>10</sub> 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

### 5.2 ANTENNA REQUIREMENT

Standard Requirement
<p><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.</p>
<p><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.</p>
<p><b>EUT Antenna:</b> Antenna in the interior of the equipment and no consideration of replacement. The gain of the antenna is 0 dBi.</p>

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

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

**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.

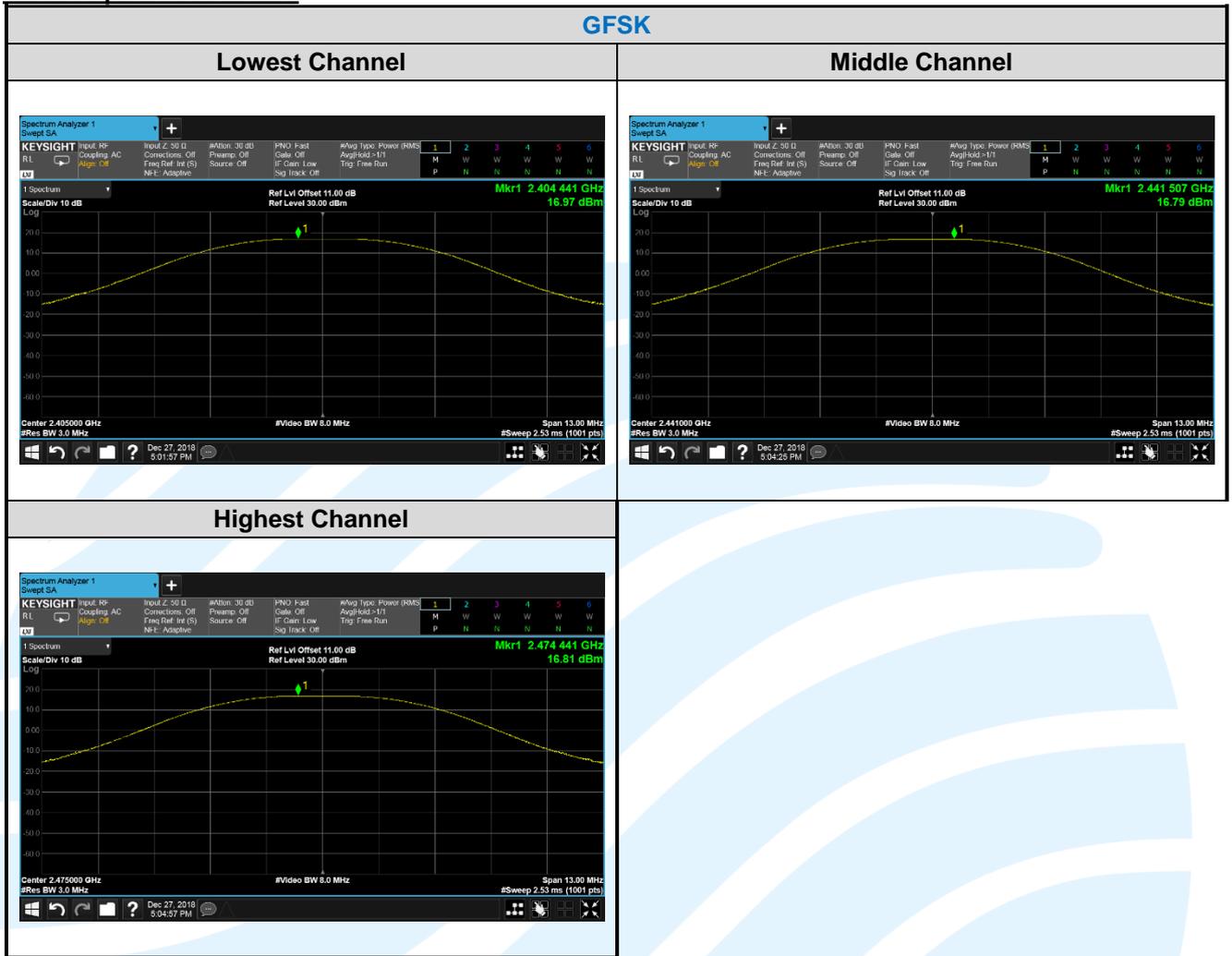
**Instruments Used:** Refer to section 3 for details

**Test Results:** Pass

Type of Modulation	Peak Output Power (dBm)			Peak Output Power (mW)		
	Channel 1	Channel 18	Channel 32	Channel 1	Channel 18	Channel 32
GFSK	16.97	16.79	16.81	49.77	47.75	47.97

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

The test plots as follows:



### 5.420 DB BANDWIDTH & OCCUPIED 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:

- a) Span = approximately 2 to 5 times the OBW, centered on a hopping channel.
- b) RBW = 1% to 5% of the OBW.
- c) VBW ≥ 3 x RBW
- d) Sweep = auto;
- e) Detector function = peak
- f) Trace = max hold
- g) 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

Type of Modulation	20 dB Bandwidth (MHz)			Occupied Bandwidth (MHz)		
	Channel 1	Channel 18	Channel 32	Channel 1	Channel 18	Channel 32
GFSK	2.397	2.424	2.479	2.2769	2.2508	2.2745

The test plots as follows:



### 5.5 CARRIER FREQUENCIES SEPARATION

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

**Test Method:** ANSI C63.10-2013 Section 7.8.2

**Limit:** 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.  
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.  
Use the following spectrum analyzer settings:

- a) Span: Wide enough to capture the peaks of two adjacent channels.
- b) RBW: Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.
- c) Video (or average) bandwidth (VBW)  $\geq$  RBW.
- d) Sweep: Auto.
- e) Detector function: Peak.
- f) Trace: Max hold.
- g) Allow the trace to stabilize.
- h) Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

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

Type of Modulation	Adjacent Channel Separation (MHz)	Minimum Limit (MHz)
	Channel 39	Channel 39
GFSK	2.032	1.598
Note: The minimum limit is two-third 20 dB bandwidth.		



## 5.6 NUMBER OF HOPPING CHANNEL

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

**Test Method:** ANSI C63.10-2013 Section 7.8.3

**Limit:** Frequency hopping systems in the 2400 – 2483.5 MHz band shall use at least 15 non-overlapping channels.

**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) 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 < 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.

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

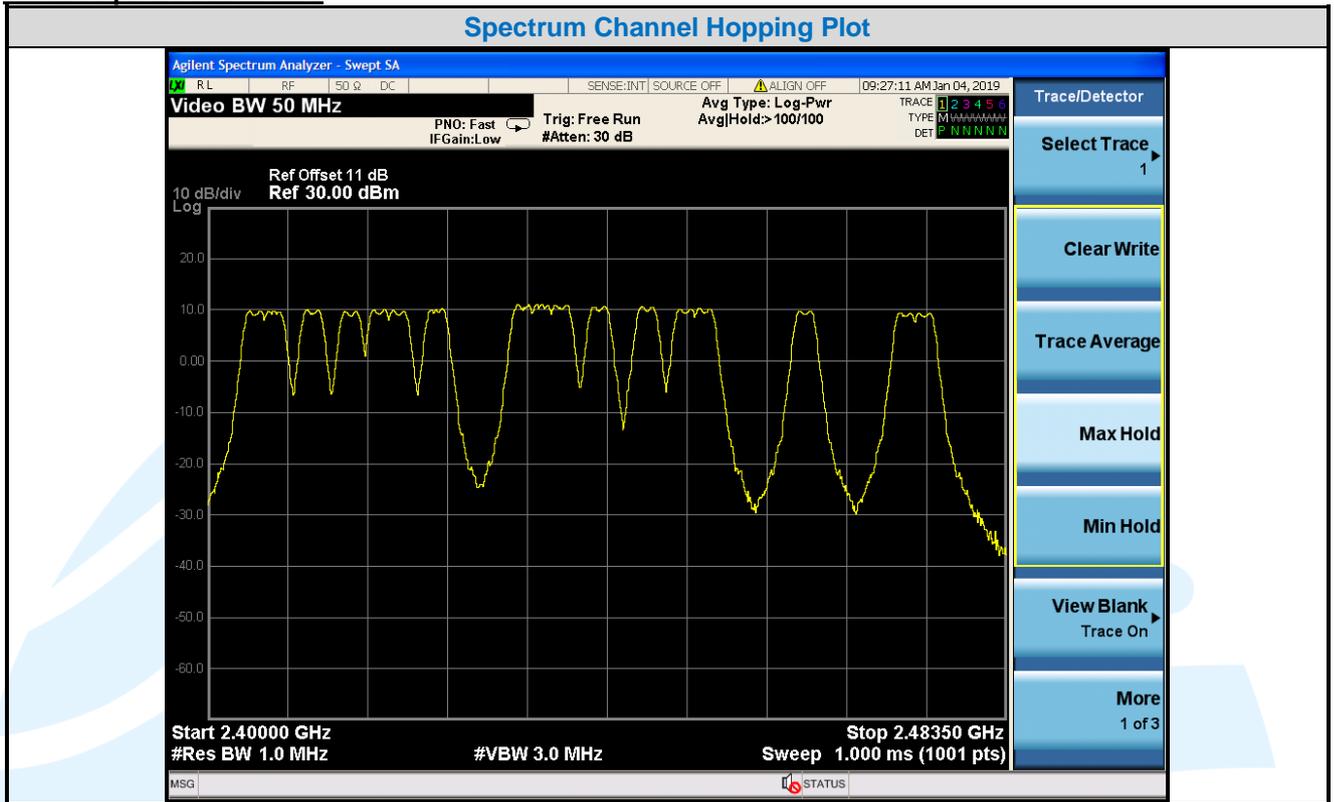
**Test Setup:** Refer to section 4.5.3 for details.

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

**Test Results:** Pass

Type of Modulation	Number of Hopping Channel
GFSK	17

The test plots as follows:



### 5.7 DWELL TIME

**Test Requirement:** FCC 47 CFR Part 15 Subpart C Section 15.247(a)(1)  
**Test Method:** ANSI C63.10-2013 Section 7.8.4  
**Limit:** 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.  
**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) Span = zero span, centered on a hopping channel
- b) RBW shall be  $\leq$  channel spacing and where possible RBW should be set  $\gg 1 / T$ , where T is the expected dwell time per channel.
- c) Sweep = As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger and trigger delay so that the transmitted signal starts a little to the right of the start of the plot. The trigger level might need slight adjustment to prevent triggering when the system hops on an adjacent channel; a second plot might be needed with a longer sweep time to show two successive hops on a channel.
- d) Detector function = peak
- e) Trace = max hold
- f) Use the marker-delta function to determine the dwell time

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

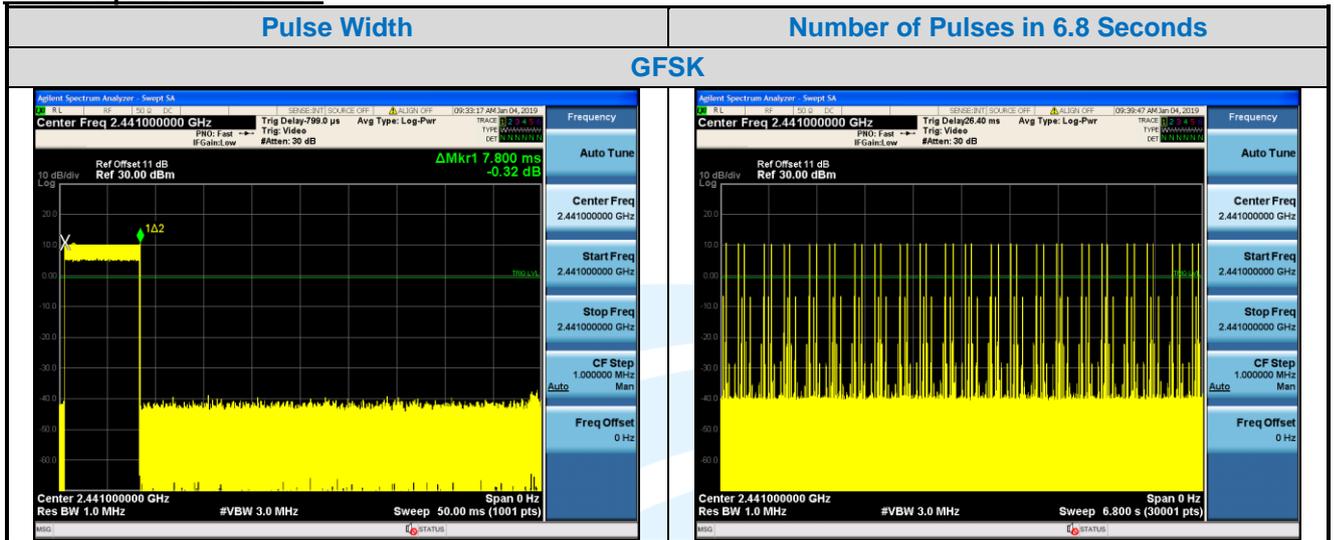
**Test Setup:** Refer to section 4.5.3 for details.

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

**Test Results:** Pass

Type of Modulation	Test Frequency	Pulse Width	Number of Pulses in 6.8 seconds	Dwell Time	Limit
		ms		ms	ms
GFSK	2441MHz	7.800	43.000	335.40	< 400

The test plots as follows:



## 5.8 CONDUCTED OUT OF BAND EMISSION

- Test Requirement:** FCC 47 CFR Part 15 Subpart C Section 15.247(d)
- Test Method:** ANSI C63.10-2013 Section 6.10.4 & Section 7.8.8
- 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 2400 MHz or 2483.5 MHz.
- b) Wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products that fall outside of the authorized band of operation.
- c) Set the RBW = 100 kHz.
- d) Set the VBW  $\geq 3 \times$  RBW.
- e) Detector = peak.
- f) Sweep time = auto couple.
- g) Sweep points  $\geq 2 \times$  Span/RBW
- h) Trace mode = max hold.
- i) Allow the trace to stabilize.
- j) Set the marker on the emission at the band edge, or on the highest modulation product outside of the band, if this level is greater than that at the band edge. Enable the marker-delta function, and then use the marker-to-peak function to move the marker to the peak of the in-band emission.

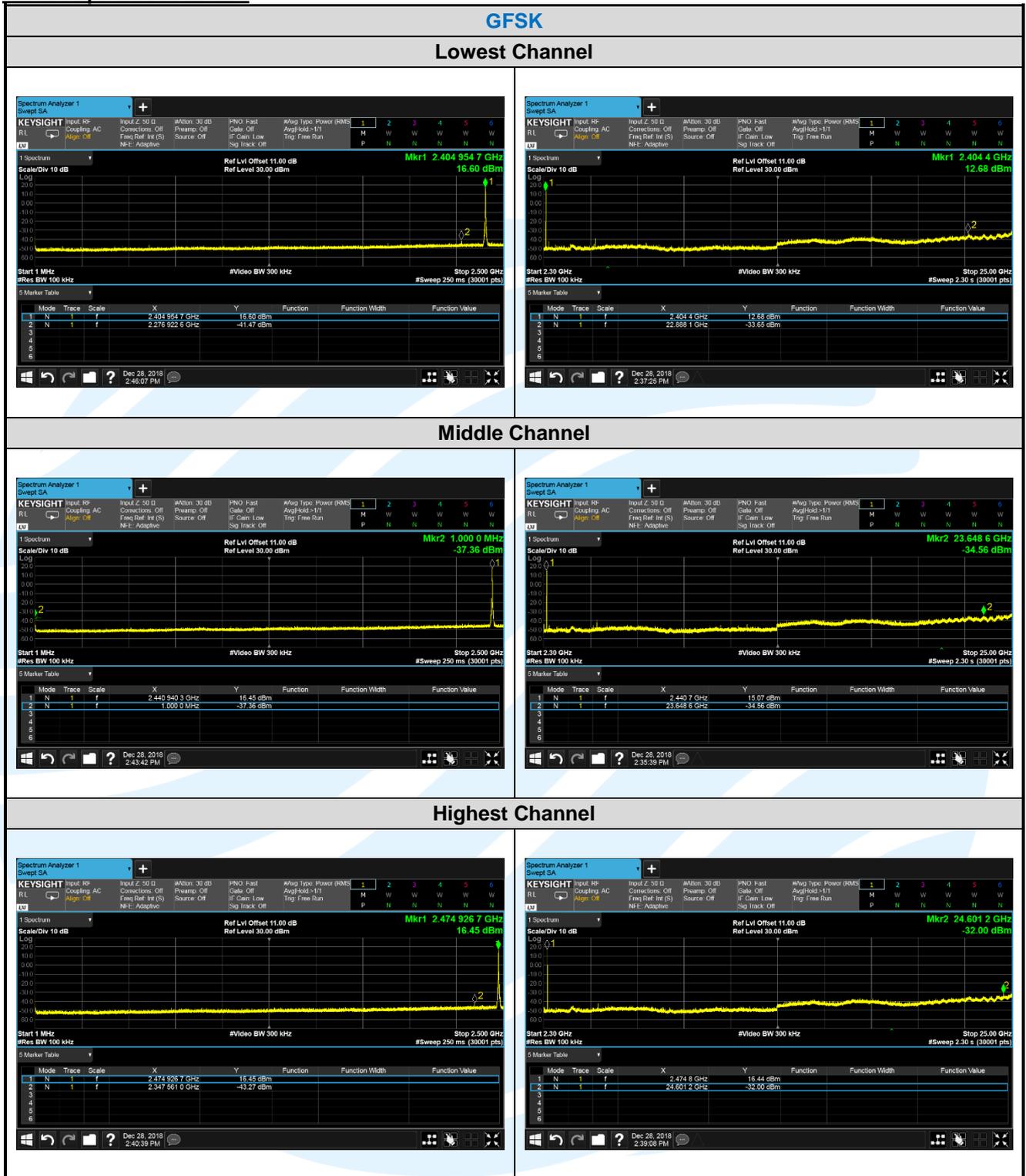
### Step 2: Measurement Procedure OOBE

- 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 4.5.3 for details.
- Instruments Used:** Refer to section 3 for details
- Test Mode:** Hopping Frequencies Transmitter mode
- Test Results:** Pass
- Test Data:**

The test plots as follows:



Remark:

1) The disturbance above 25GHz was very low, and the above harmonics were the highest point could be found when testing, so only the above harmonics had been displayed. The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.



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### 5.9 RADIATED SPURIOUS EMISSIONS

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

**Test Method:** ANSI C63.10-2013 Section 6.3 & 6.5 & 6.6

**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 (dBµV/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 (dBuV/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 4.5.1 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).
  - 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

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the Y axis positioning which it is worse case.

4) Repeat above procedures until all frequencies measured was complete.

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

**Test Result:** Pass

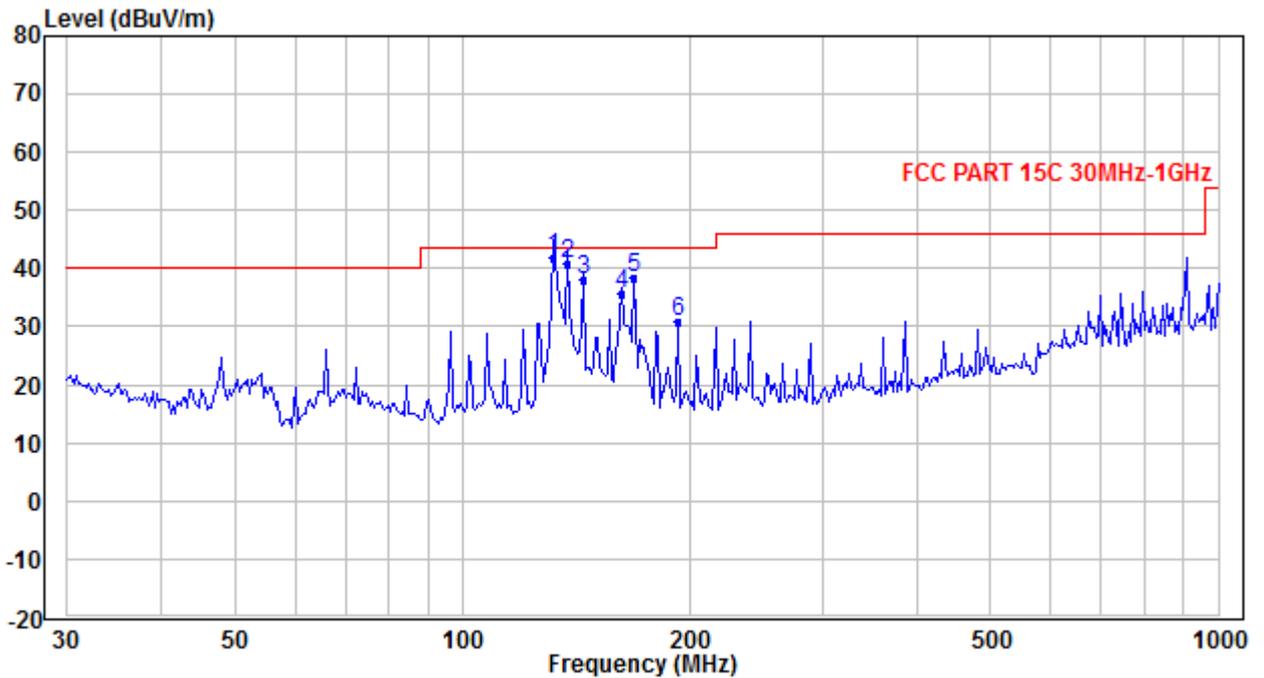
**The measurement data as follows:**

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

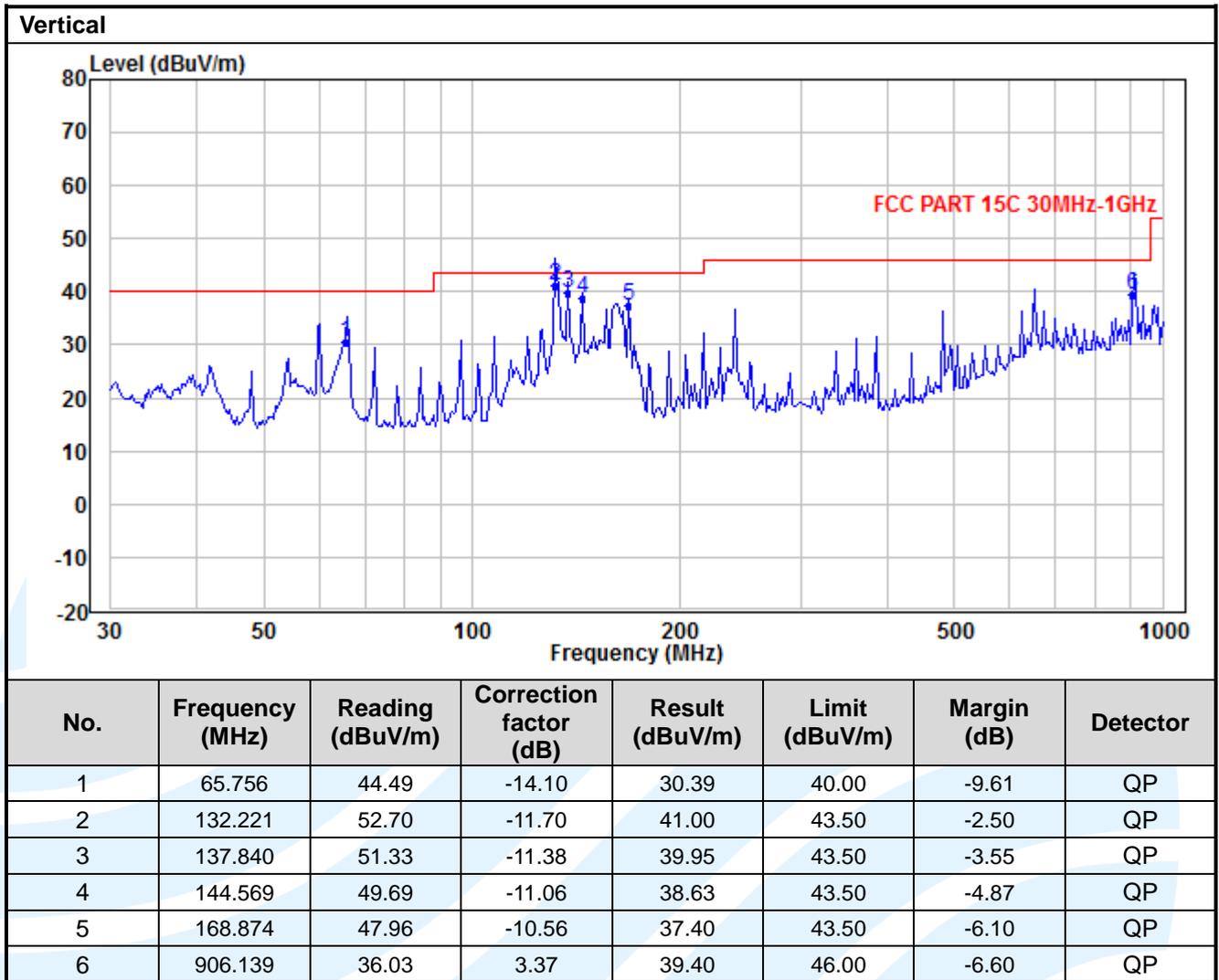
The amplitude of spurious emissions attenuated more than 20 dB below the permissible value is not required to be report.

**Radiated Emission Test Data (30 MHz ~ 1 GHz):  
Worst-Case(Lowest Channel)**

**Horizontal**



No.	Frequency (MHz)	Reading (dBUV/m)	Correction factor (dB)	Result (dBUV/m)	Limit (dBUV/m)	Margin (dB)	Detector
1	132.244	53.56	-11.70	41.86	43.50	-1.64	QP
2	137.732	52.23	-11.39	40.84	43.50	-2.66	QP
3	144.445	49.29	-11.06	38.23	43.50	-5.27	QP
4	162.123	46.30	-10.47	35.83	43.50	-7.67	QP
5	168.753	49.09	-10.56	38.53	43.50	-4.97	QP
6	193.089	40.85	-10.09	30.76	43.50	-12.74	QP



Radiated Emission Test Data (Above 1GHz):						
Lowest Channel:						
No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Polaxis
1	4810.00	56.79	74.00	-17.21	Peak	Horizontal
2	4810.00	38.64	54.00	-15.36	Average	Horizontal
3	7215.00	49.45	74.00	-24.55	Peak	Horizontal
4	7215.00	37.48	54.00	-16.52	Average	Horizontal
5	4810.00	60.14	74.00	-13.86	Peak	Vertical
6	4810.00	40.62	54.00	-13.38	Average	Vertical
7	7215.00	48.25	74.00	-25.75	Peak	Vertical
8	7215.00	36.67	54.00	-17.33	Average	Vertical

Middle Channel:						
No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Polaxis
1	4861.30	59.50	74.00	-14.50	Peak	Horizontal
2	4861.30	38.97	54.00	-15.03	Average	Horizontal
3	7323.00	49.61	74.00	-24.39	Peak	Horizontal
4	7323.00	36.64	54.00	-17.36	Average	Horizontal
5	4861.30	68.77	74.00	-5.23	Peak	Vertical
6	4861.30	46.09	54.00	-7.91	Average	Vertical
7	7323.00	48.28	74.00	-25.72	Peak	Vertical
8	7323.00	36.37	54.00	-17.63	Average	Vertical

Highest Channel:						
No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Polaxis
1	4950.00	59.25	74.00	-14.75	Peak	Horizontal
2	4950.00	39.34	54.00	-14.66	Average	Horizontal
3	7425.00	49.93	74.00	-24.07	Peak	Horizontal
4	7425.00	37.74	54.00	-16.26	Average	Horizontal
5	4950.00	65.33	74.00	-8.67	Peak	Vertical
6	4950.00	43.87	54.00	-10.13	Average	Vertical
7	7425.00	48.95	74.00	-25.05	Peak	Vertical
8	7425.00	36.66	54.00	-17.34	Average	Vertical

**Remark:**

1) The disturbance above 18GHz was very low, and the above harmonics were the highest point could be found when testing, so only the above harmonics had been displayed. The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.

### 5.10 BAND EDGE MEASUREMENTS (RADIATED)

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

**Test Method:** ANSI C63.10-2013 Section 6.10.5

**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 4.5.1 for details.

**Test Procedures:**

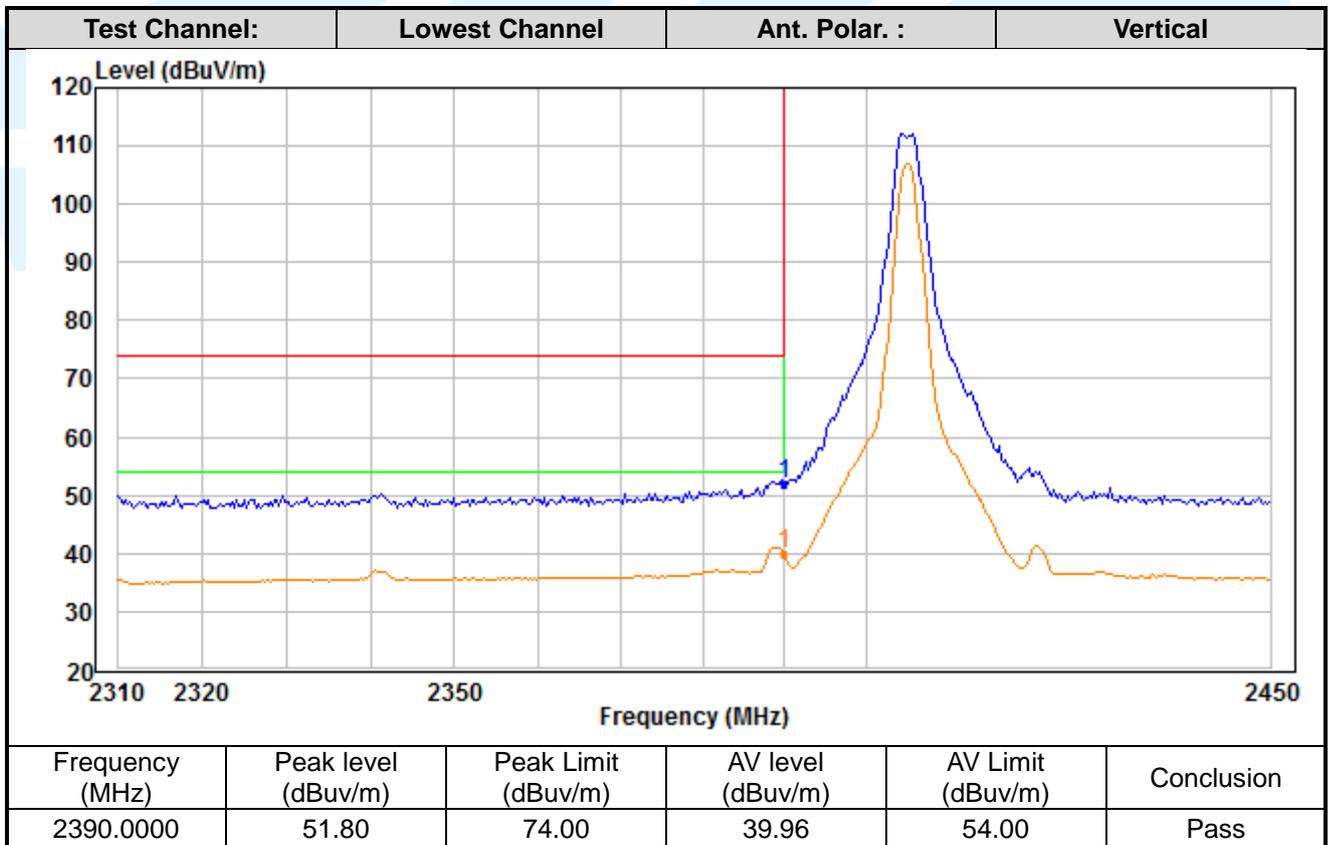
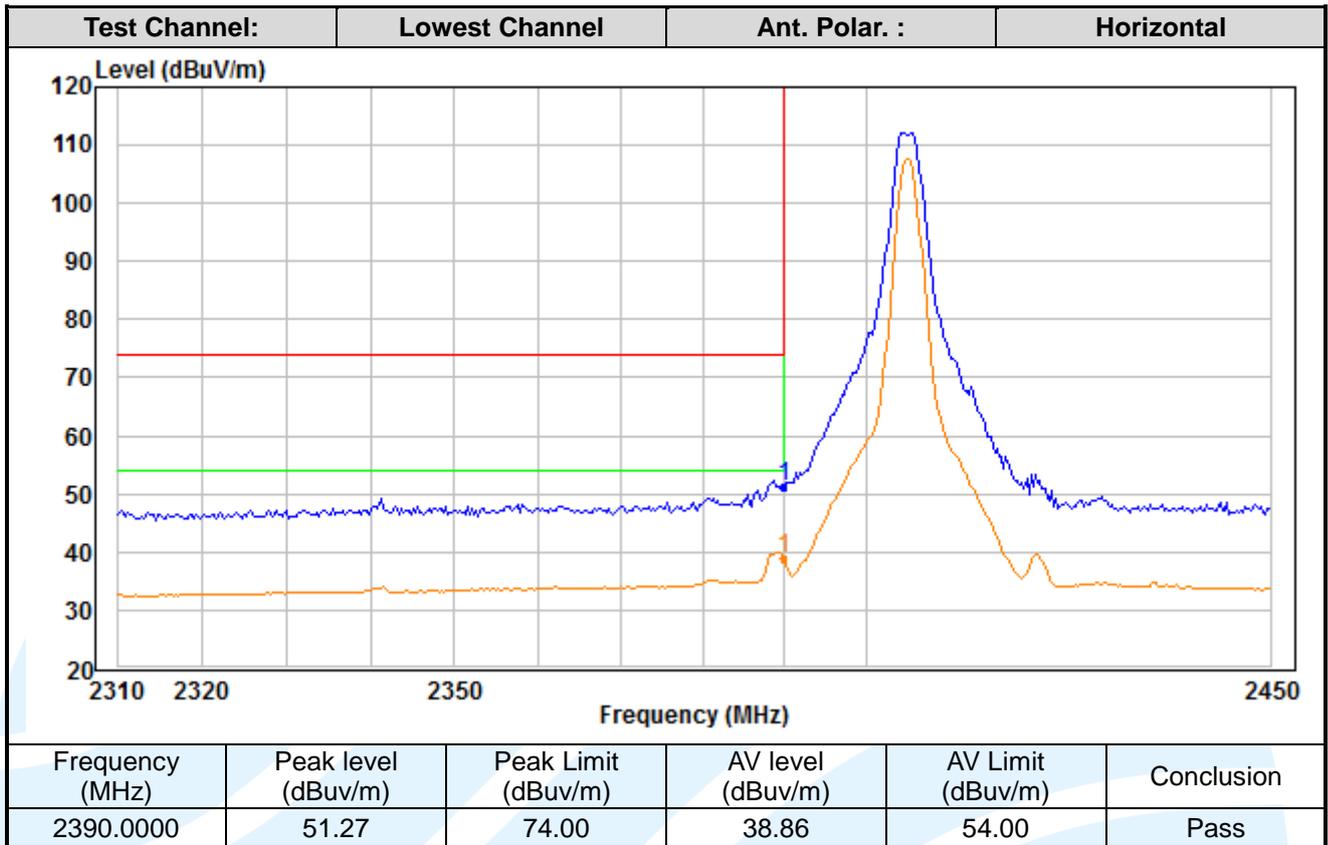
Radiated band edge measurements at 2390 MHz and 2483.5 MHz were made with the unit transmitting in the low end of the channel range and the high end closest to the restricted bands respectively. The emissions were made on the 966 Semi-Chamber. Use (resolution bandwidth (RBW) = 1 MHz, video bandwidth (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:**



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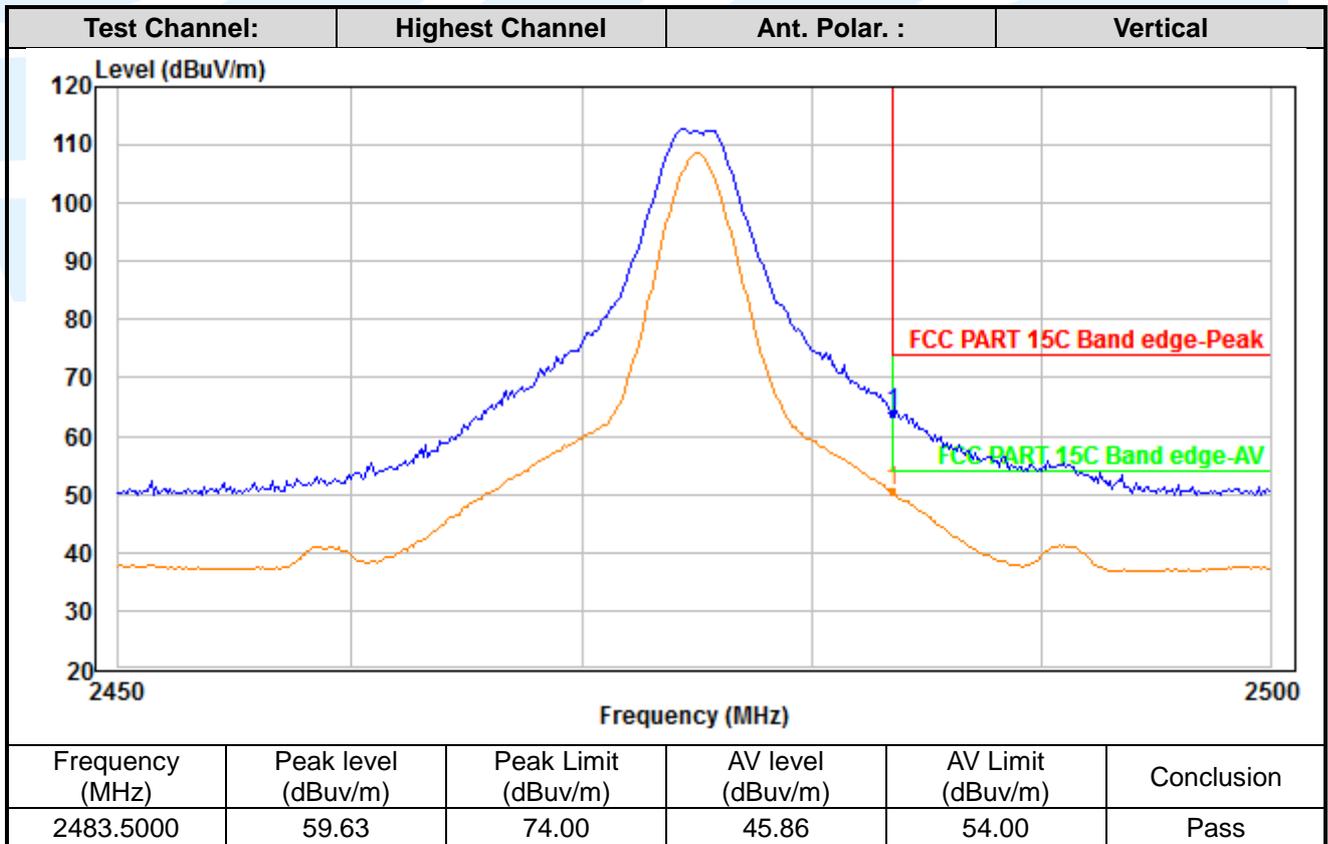
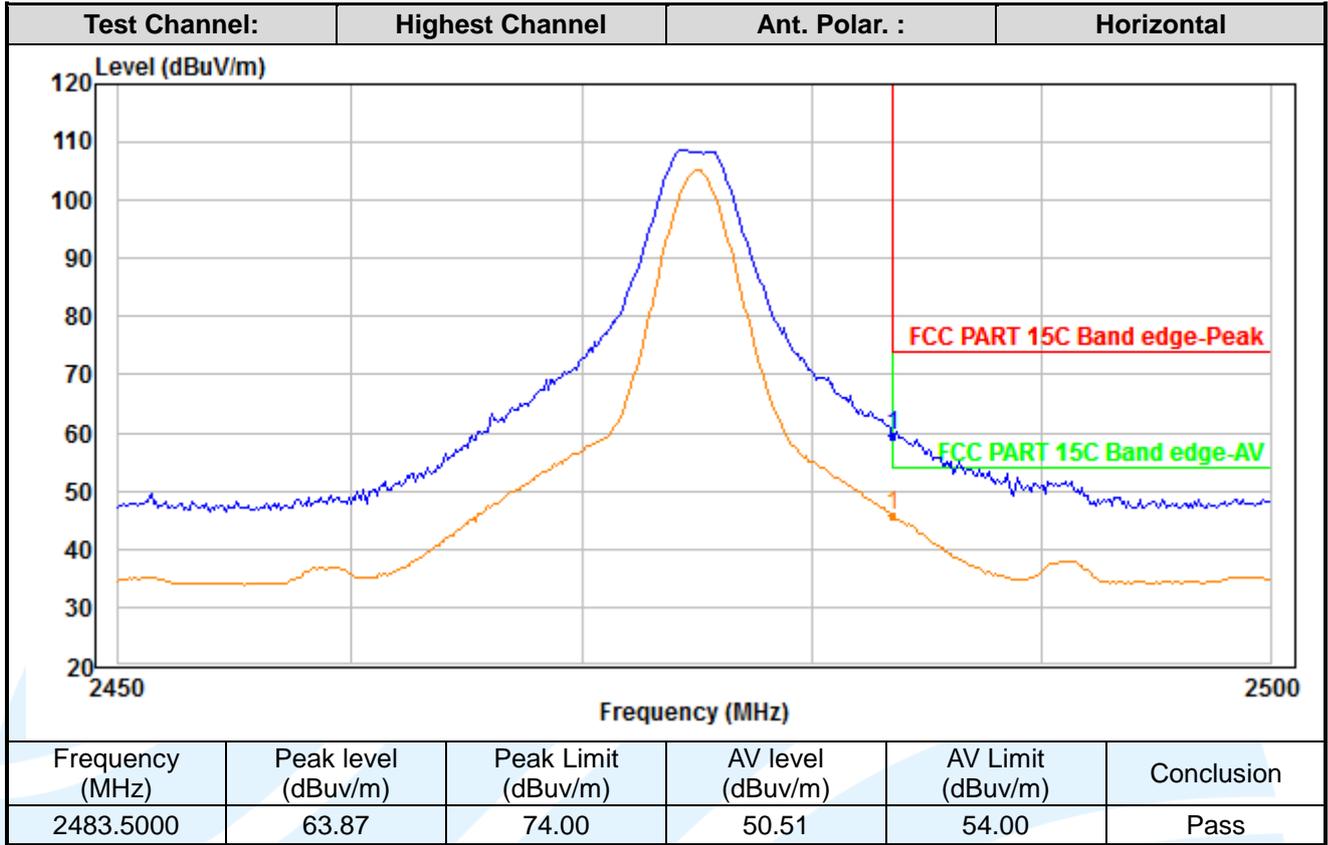
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### 5.11 CONDUCTED EMISSION

**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 4.5.2 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 50Ω/50μH + 5Ω 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.

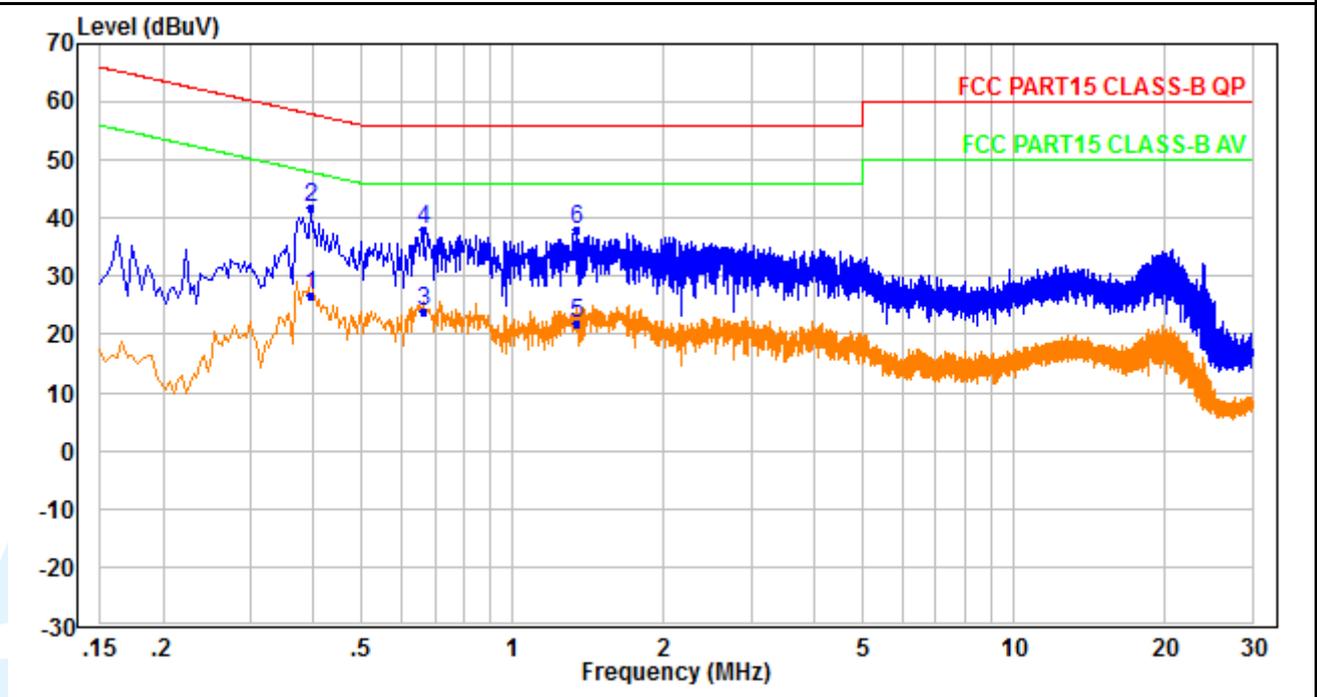
**Test Result:** Pass

The measurement data as follows:

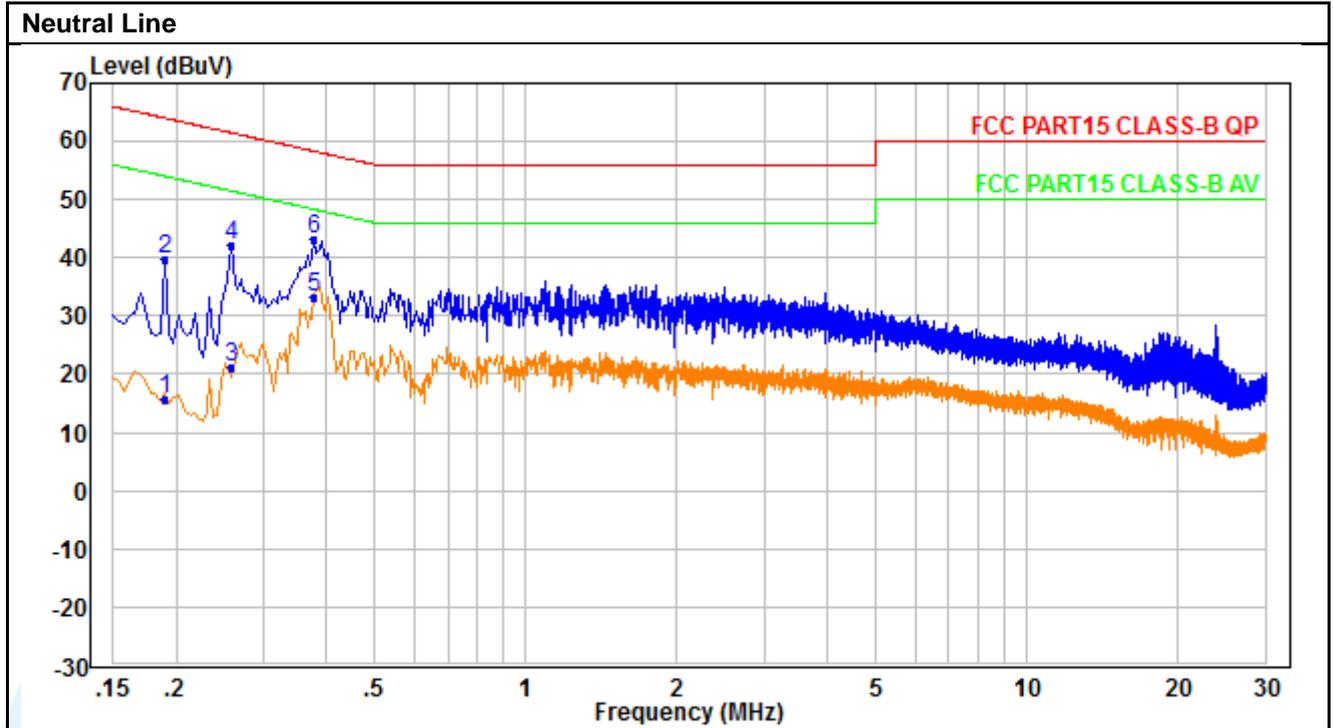
Quasi Peak and Average:

Mode: Link

Live Line



No.	Frequency (MHz)	Reading (dBuV)	Correction factor (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector
1	0.394	16.89	9.90	26.79	47.98	-21.19	Average
2	0.394	31.91	9.90	41.81	57.98	-16.17	QP
3	0.662	14.84	9.14	23.98	46.00	-22.02	Average
4	0.662	28.81	9.14	37.95	56.00	-18.05	QP
5	1.342	12.78	9.15	21.93	46.00	-24.07	Average
6	1.342	28.78	9.15	37.93	56.00	-18.07	QP



No.	Frequency (MHz)	Reading (dBUV)	Correction factor (dB)	Result (dBUV)	Limit (dBUV)	Margin (dB)	Detector
1	0.190	6.37	9.37	15.74	54.04	-38.30	Average
2	0.190	30.30	9.37	39.67	64.04	-24.37	QP
3	0.258	11.79	9.33	21.12	51.50	-30.38	Average
4	0.258	32.72	9.33	42.05	61.50	-19.45	QP
5	0.378	23.99	9.30	33.29	48.32	-15.03	Average
6	0.378	33.91	9.30	43.21	58.32	-15.11	QP

Remark:

1. 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.

## 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 \*\*\*

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