



FCC Part 15, Subpart C, Section 15.247  
Industry Canada, RSS-210 and RSS-GEN

Test Report

On

2.4 GHz Transceiver  
FCC ID: 2ADEPT6XSMIPM  
IC: 12436AT6XSMIPM

**Customer Name:** IONX, LLC

**Customer P.O.:** 4500252567

**Date of Report:** March 30, 2015

**Test Report No.:** R-2058P, Rev. B

**Test Start Date:** September 15, 2014

**Test Finish Date:** September 30, 2014

**Test Technician:** D. Fiore

**EMC Test Engineer:** D. Landers

**Report Prepared By:** C. Reitz

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## Technical Information

**Report Number:** R-2058P, Rev. B

**Customer:** IONX, LLC.

**Address:** 515 S. Franklin Street  
West Chester, PA 19382

**Manufacturer:** IEC Electronics

**Manufacturer Address:** 105 Norton Street  
Newark, NY 14513

**Test Sample:** 2.4 GHz Transceiver

**Model Number:** T6X

**FCC ID:** 2ADEPT6XSMIPM

**IC:** 12436AT6XSMIPM  
2.4 to 2.48 GHz Frequency Hopping Spread Spectrum

**Type:** Transceiver  
7.2 VDC derived from (8) D-Cell and  
(2) AA-Cell Internal Batteries

**Power Requirements:**

**Frequency of Operation:** 2.4 to 2.48 GHz

**FCC Equipment Class:** DSS

**IC Type of Equipment:** Low Power Device

**Equipment Use:** Mobile > 20 cm

### Test Specification:

FCC Rules and Regulations Part 15, Subpart C, Section 15.247  
Radio Standards Specification, RSS-210, Issue 8, June, 2010

### Test Procedure:

ANSI C63.4:2009 - Filing and Measurement Guidelines for Frequency Hopping Spread  
Spectrum Systems, FCC: DA 00-705  
RSS-GEN, Issue 4, November 2014

### Test Facility:

Retlif Testing Laboratories  
3131 Detwiler Road  
Harleysville, PA 19438

FCC Registered Test Site Number: 98314



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### Tests Performed

<b>FCC Part 15, Subpart C</b>	<b>Industry Canada RSS-210</b>	<b>Test Method</b>
15.247(a)(1)	A8.1(b)	Channel Separation
15.247(a)(1)	A8.1(a)	20 dB Bandwidth
15.247(a)(1)(iii)	A8.1(d)	Number of Channels and Occupancy Time
15.247(b)(1) and (4)	A8.4(2)	Peak Conducted Output Power
15.247(d)	A8.5	Antenna Port, Conducted Emissions
15.247(d)	A8.5	Spurious Radiated Emissions, 32 kHz to 25 GHz
15.247(d)	A8.5	Band Edge Compliance of RF Conducted Emissions
15.247(d)/15.209(a)	A2.9(b)	Field Strength of Spurious Emissions (Digital Device)



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## Certification and Signatures

We certify that this report is a true representation of the results obtained from the tests of the equipment stated. We further certify that the measurements shown in this report were made in accordance with the procedures indicated and vouch for the qualifications of all Retlif Testing Laboratories personnel taking them.



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Dean F. Landers  
EMC Test Engineer  
NVLAP Approved Signatory

### Non-Warranty Provision

The testing services have been performed, findings obtained and reports prepared in accordance with generally accepted laboratory principles and practices. This warranty is in lieu of all others, either expressed or implied.

### Non-Endorsement

This test report contains only findings and results arrived at after employing the specific test procedures and standards listed herein. It is not intended to constitute a recommendation, endorsement or certification of the product or material tested. This test report must not be used by the client to claim product endorsement by NVLAP or any agency of the U.S. Government.



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## **Requirements and Test Results**

### **Requirement:**

#### **FCC Section 15.247 (a)(1)**

#### **Channel Separation and 20 dB Bandwidth**

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

#### **IC Section A8.1(b)**

#### **Frequency Hopping Systems**

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 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 the systems operate with an output power no greater than 0.125 W. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

- Results:  
The carrier frequencies were separated by 25 kHz and had a 20 dB bandwidth of greater than 35 kHz which complies with the requirements specified above.



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## **Requirements and Test Results (con't)**

### **FCC Section 15.247 (a)(1)(iii)**

#### **Number of Channels and Occupancy Time**

Frequency hopping systems operating in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

### **IC Section A8.1(d)**

#### **Frequency Hopping Systems**

Frequency hopping systems operating in the band 2400–2483.5 MHz shall use at least 15 hopping 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. Transmissions on particular hopping frequencies may be avoided or suppressed provided that a minimum of 15 hopping channels are used.

- The test sample utilized 16 hopping channels. The average time of occupancy was 4.05 ms within a period of 6.4 seconds.



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## **Requirements and Test Results (con't)**

### **FCC Section 15.247 (b)(1) and (4) Peak Conducted Output Power**

(1) For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

(4) The conducted output power limit specified in Paragraph (b) of Section 15.247 is based on the use of antenna with directional gains that do not exceed 6 dBi. Except as shown in Paragraph (c) of Section 15.247, 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 Paragraph (b)(1), (b)(2) and (b)(3) of Section 15.247, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

### **IC Section A8.4(2) Transmitter Output Power and e.i.r.p. Requirements**

For frequency hopping systems operating in the band 2400-2483.5 MHz employing at least 75 hopping channels, the maximum peak conducted output power shall not exceed 1 W; for all other frequency hopping systems in the band, the maximum peak conducted output power shall not exceed 0.125 W. Except as provided in Section A8.4(5) of RSS-210, the e.i.r.p. shall not exceed 4 W.

- **Results**

The frequency hopping system utilizes a patch antenna for transmitting with no directional gain. The peak output power limit was 0.125 watts. The frequency hopping system had a maximum peak conducted output power of 43.05 milliwatts.



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## **Requirements and Test Results (con't)**

### **FCC Section 15.247 (d)**

#### **Spurious Emissions and Band Edge Compliance of RF Conducted Emissions**

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under Paragraph (b)(3) of Section 15.247, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, 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) (see Section 15.205(c)).

### **IC Section A8.5**

#### **Out-of-Band Emissions and Band Edge Compliance of RF Conducted Emissions**

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the radio frequency power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under Section A8.4(4) of RSS-210, the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Tables 2 and 3 of RSS-210 is not required.

- **Results**

The antenna conducted spurious emissions comply with the requirement that the radio frequency power be at least 20 dB below the highest in band level.

Harmonic and Spurious Emissions which were found to be within the restricted bands of operation, as defined in section 15.205 (a) were found to be in compliance with the general limits specified in section 15.209 (a).

The band-edge compliance of Conducted RF Emissions comply with the requirement that the radio frequency power be at least 20 dB below the channels closest to the band-edge at the band-edge (2400 MHz and 2483.5 MHz).



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**Requirements and Test Results (con't)**

**FCC Section 15.247 (a)**

**Field Strength of Spurious Emissions**

Operation under the provisions of Section 15.247 is limited to frequency hopping and digitally modulated intentional radiators that comply with the provisions stated in Section 15.247(a)(1).

**FCC Section 15.209(a)**

**Radiated Emission Limits, General Requirements**

Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in Table 1.

**IC RSS-210, 2.9(b)**

**General Field Strength Limits**

Table 1 shows the general field strength limits of unwanted emissions, where applicable, for transmitters operating in accordance with the provisions specified in this RSS.

Table 1 - Radiated Emission Limits

<b>Frequency of Emission (MHz)</b>	<b>Field Strength (microvolts/meter)</b>	<b>Measurement Distance (meters)</b>
30 to 88	100	3
88 to 216	150	3
216 to 960	200	3
Above 960	500	3

- Results:  
The field strength of spurious radiated emissions did not exceed the limits specified in Table 1.

**FCC Section 15.247 (g)**

**Frequency Hopping Spread Spectrum Systems**

Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information stream). In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

- Results:  
The frequency hopping system utilized the minimum number (15) of hopping channels specified in this section and operates as a true frequency hopping system.



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## **Requirements and Test Results (con't)**

### **FCC Section 15.247 (h)**

#### **Incorporation of Intelligence within a Frequency Hopping Spread Spectrum System**

The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

- Results:

The EUT does not have the ability to be coordinated with other FHSS systems in an effort to avoid the simultaneous occupancy of individual hopping frequencies by multiple transmitters.

### **FCC Section 15.247 (i)**

#### **RF Exposure Limits**

Spread Spectrum Transmitters operating under 15.247 are categorically excluded from routine environmental evaluation for demonstrating RF exposure compliance with respect to MPE or SAR limits however per 15.247(i) must be operated in a manner that ensures the public is not exposed to RF energy levels in excess of the commission's guidelines. The user/installation manual contains the proper cautionary statements and specifies that the device be installed and operated so that a minimum separation distance of 20 cm will be maintained. Based on the transmitter power and maximum antenna gain (see calculation below) the 20 cm separation distance exceeds the calculated distance for acceptable MPE power density levels to meet both the Occupational/Controlled Exposure and the General Population/Uncontrolled Exposure requirements of FCC Part 1.1310. The calculation below uses the more stringent General Population MPE Limits.



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## Requirements and Test Results (con't)

$$S = \frac{PG}{4\pi Dsq}$$

D = Minimum Separation Distance in cm

S = Max allowed Power Density in mW/cmsq

Per 1.1310 For the Frequency of 2.4 to 2.48 GHz S = 1.0 mW/cmsq

Power = Max Power Input to Antenna = 43.05 mW

Gain = Max Power Gain of Antenna = 3.5 dBi = 2.24 numeric

$$1.0 \text{ mW/cmsq} = \frac{43.05 \times 2.24}{4 \times (3.14) \times D^2} = \frac{96.43}{12.56 \times D^2}$$

$$D^2 = \frac{96.43}{12.56 \times 1.0} = 7.68$$

$$D = \sqrt{7.68} = 2.77 \text{ cm}$$



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## Equipment List

### FCC Section 15.247(a)(1) / IC Section A8.1(b) Channel Separation

EN	Manufacturer	Description	Range	Model No.	Cal Date	Due Date
8493	NARDA	MED PWR ATTEN	DC-4.0 GHZ, 20W	766-10	6/3/2014	6/30/2015
R650	AGILENT / HP	SPECTRUM ANALYZER	100 Hz - 26.5 GHz	E7405A	3/27/2014	3/31/2015

### FCC Section 15.247(a)(1) / IC Section A8.1(a) 20 dB Bandwidth

EN	Manufacturer	Description	Range	Model No.	Cal Date	Due Date
8493	NARDA	MED PWR ATTEN	DC-4.0 GHZ, 20W	766-10	6/3/2014	6/30/2015
R650	AGILENT / HP	SPECTRUM ANALYZER	100 Hz - 26.5 GHz	E7405A	3/27/2014	3/31/2015

### FCC Section 15.247 (a)(1)(iii) / IC Section A8.1(d) Number of Channels and Occupancy Time

EN	Manufacturer	Description	Range	Model No.	Cal Date	Due Date
8493	NARDA	MED PWR ATTEN	DC-4.0 GHZ, 20W	766-10	6/3/2014	6/30/2015
R650	AGILENT / HP	SPECTRUM ANALYZER	100 Hz - 26.5 GHz	E7405A	3/27/2014	3/31/2015

### FCC Section 15.247 (b)(1) / IC Section A8.4(2) Peak Conducted Output Power

EN	Manufacturer	Description	Range	Model No.	Cal Date	Due Date
8493	NARDA	MED PWR ATTEN	DC-4.0 GHZ, 20W	766-10	6/3/2014	6/30/2015
R650	AGILENT / HP	SPECTRUM ANALYZER	100 Hz - 26.5 GHz	E7405A	3/27/2014	3/31/2015

### FCC Section 15.247 (d) / IC Section A8.(5) Antenna Port, Conducted Emissions

EN	Manufacturer	Description	Range	Model No.	Cal Date	Due Date
8493	NARDA	MED PWR ATTEN	DC-4.0 GHZ, 20W	766-10	6/3/2014	6/30/2015
R650	AGILENT / HP	SPECTRUM ANALYZER	100 Hz - 26.5 GHz	E7405A	3/27/2014	3/31/2015

### FCC Section 15.247 (d) / IC Section A8.(5) Band Edge Compliance of RF Conducted Emissions

EN	Manufacturer	Description	Range	Model No.	Cal Date	Due Date
R650	AGILENT / HP	SPECTRUM ANALYZER	100 Hz - 26.5 GHz	E7405A	3/27/2014	3/31/2015



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## Equipment List (con't)

### FCC Section 15.247 (d) / IC Section A8.(5) Spurious Emissions, 32 kHz to 25 GHz

EN	Manufacturer	Description	Range	Model No.	Cal Date	Due Date
713D	MICRO-COAX	CABLE ASSEMBLY	3 FT.	UFB311A1-0360-50U50U	9/5/2013	9/30/2014
713F	MICRO-COAX	CABLE ASSEMBLY	25 FT	UFB311A1-2400-50U50U	9/5/2013	9/30/2014
8018	EMCO	DOUBLE RIDGED GUIDE ANTENNA	1 GHZ - 18 GHZ	3115	11/6/2013	5/31/2015
8317	AGILENT / HP	PRE-AMPLIFIER	1-26.5 GHz, 30 dB	8449B	6/12/2014	6/30/2015
R650	AGILENT / HP	SPECTRUM ANALYZER	100 Hz - 26.5 GHz	E7405A	3/27/2014	3/31/2015
8433	ETS/EMCO	ANTENNA, BICONILOG	20 – 6000 MHz	3142D	3/10/2014	9/30/2015
3207	ETS/EMCO	ANTENNA, ACTIVE LOOP	10 kHz -30MHz	6502	1/26/2015	1/31/2016

### FCC Section 15.247 (d) / 15.209(a) / IC Section A2.9(b) Field Strength of Spurious Emissions (Digital Device)

EN	Manufacturer	Description	Range	Model No.	Cal Date	Due Date
713D	MICRO-COAX	CABLE ASSEMBLY	3 FT.	UFB311A1-0360-50U50U	9/5/2013	9/30/2014
713F	MICRO-COAX	CABLE ASSEMBLY	25 FT	UFB311A1-2400-50U50U	9/5/2013	9/30/2014
8018	EMCO	DOUBLE RIDGED GUIDE ANTENNA	1 GHZ - 18 GHZ	3115	11/6/2013	5/31/2015
8317	AGILENT / HP	PRE-AMPLIFIER	1-26.5 GHz, 30 dB	8449B	6/12/2014	6/30/2015
R650	AGILENT / HP	SPECTRUM ANALYZER	100 Hz - 26.5 GHz	E7405A	3/27/2014	3/31/2015
8433	ETS/EMCO	ANTENNA, BICONILOG	20 – 6000 MHz	3142D	3/10/2014	9/30/2015



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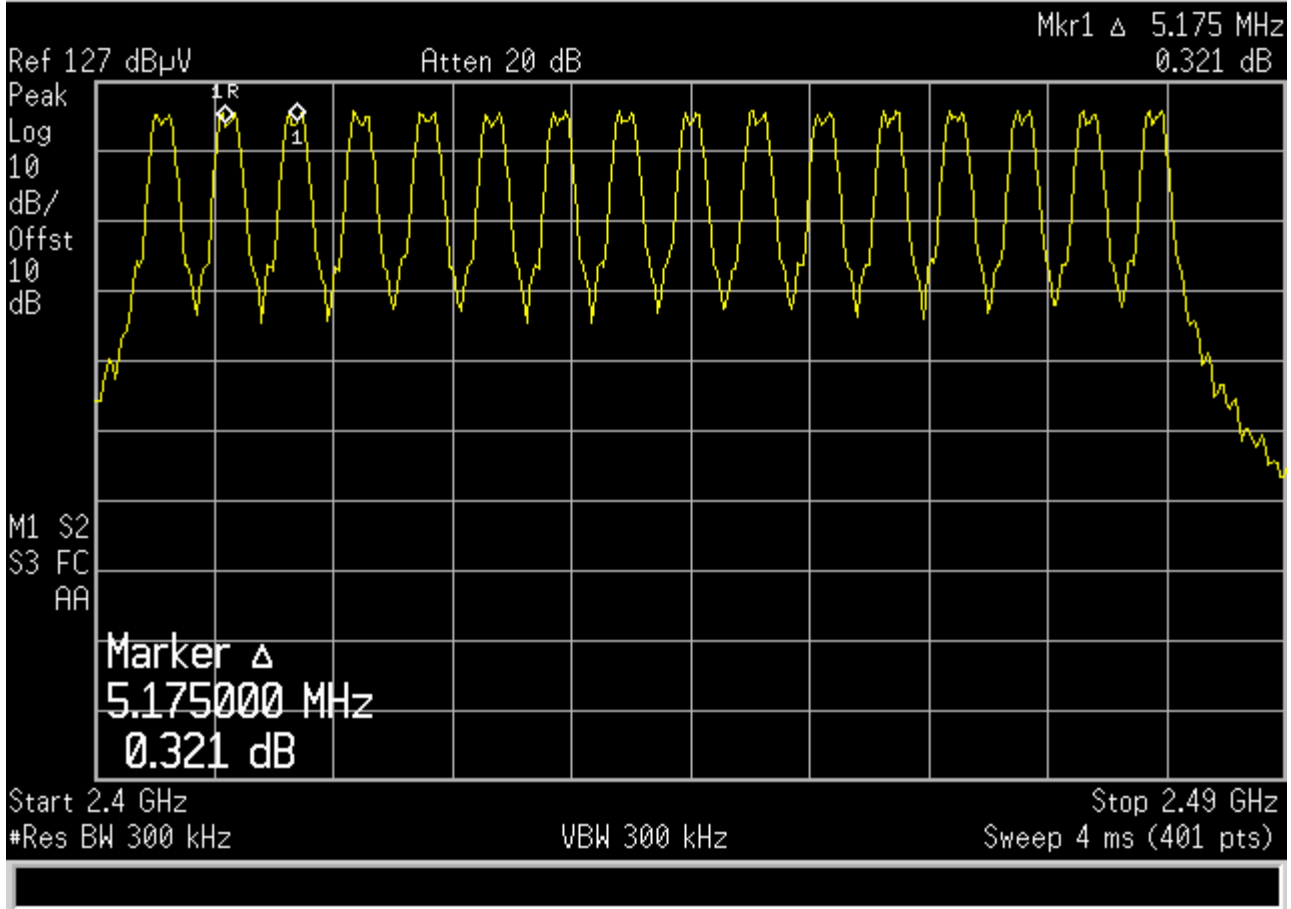
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**FCC Section 15.247(a)(1) / IC Section A8.1(b)  
Channel Separation  
Test Data**



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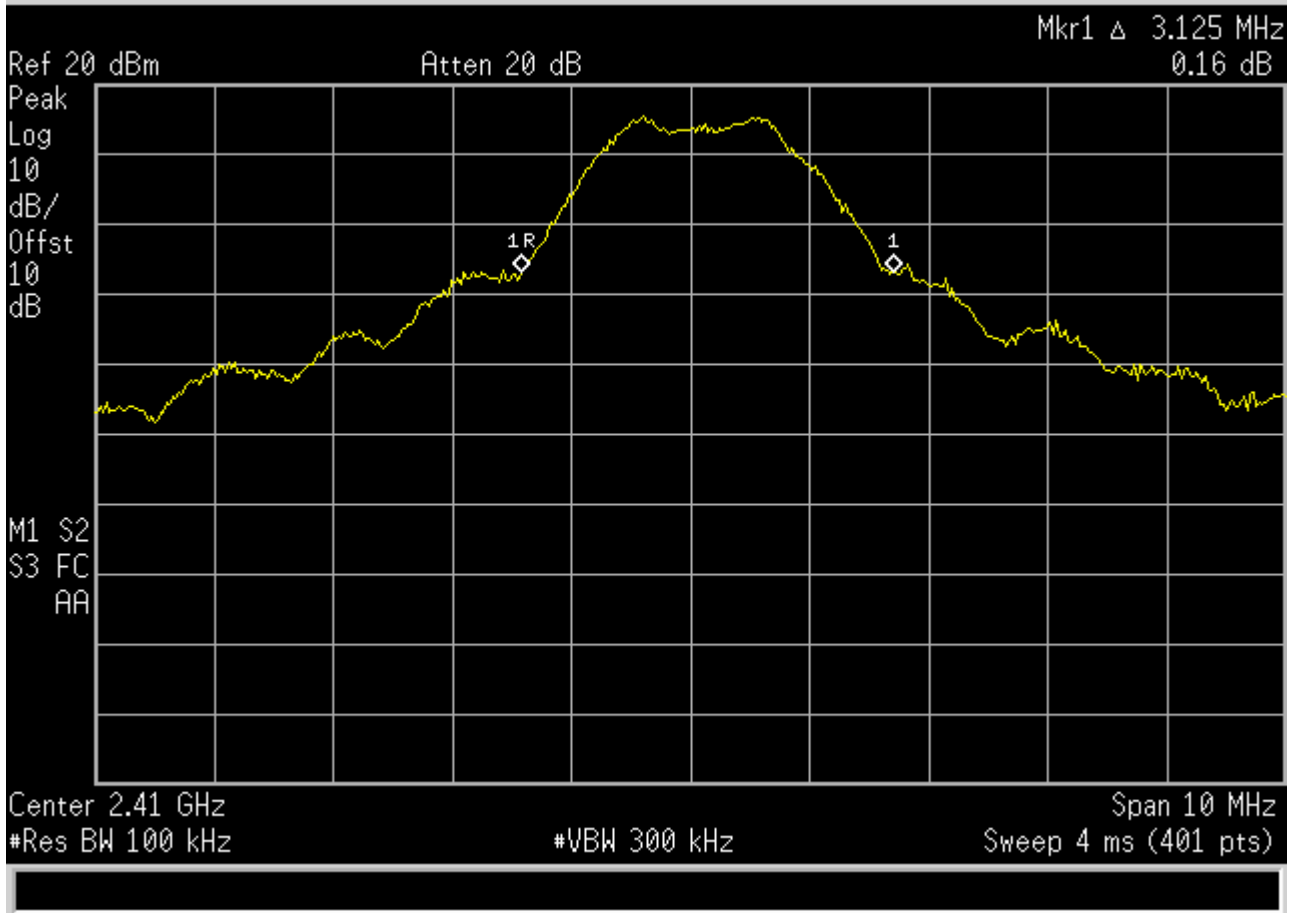
**FCC Section 15.247(a)(1) / IC Section A8.1(a)  
20 dB Bandwidth  
Test Data**



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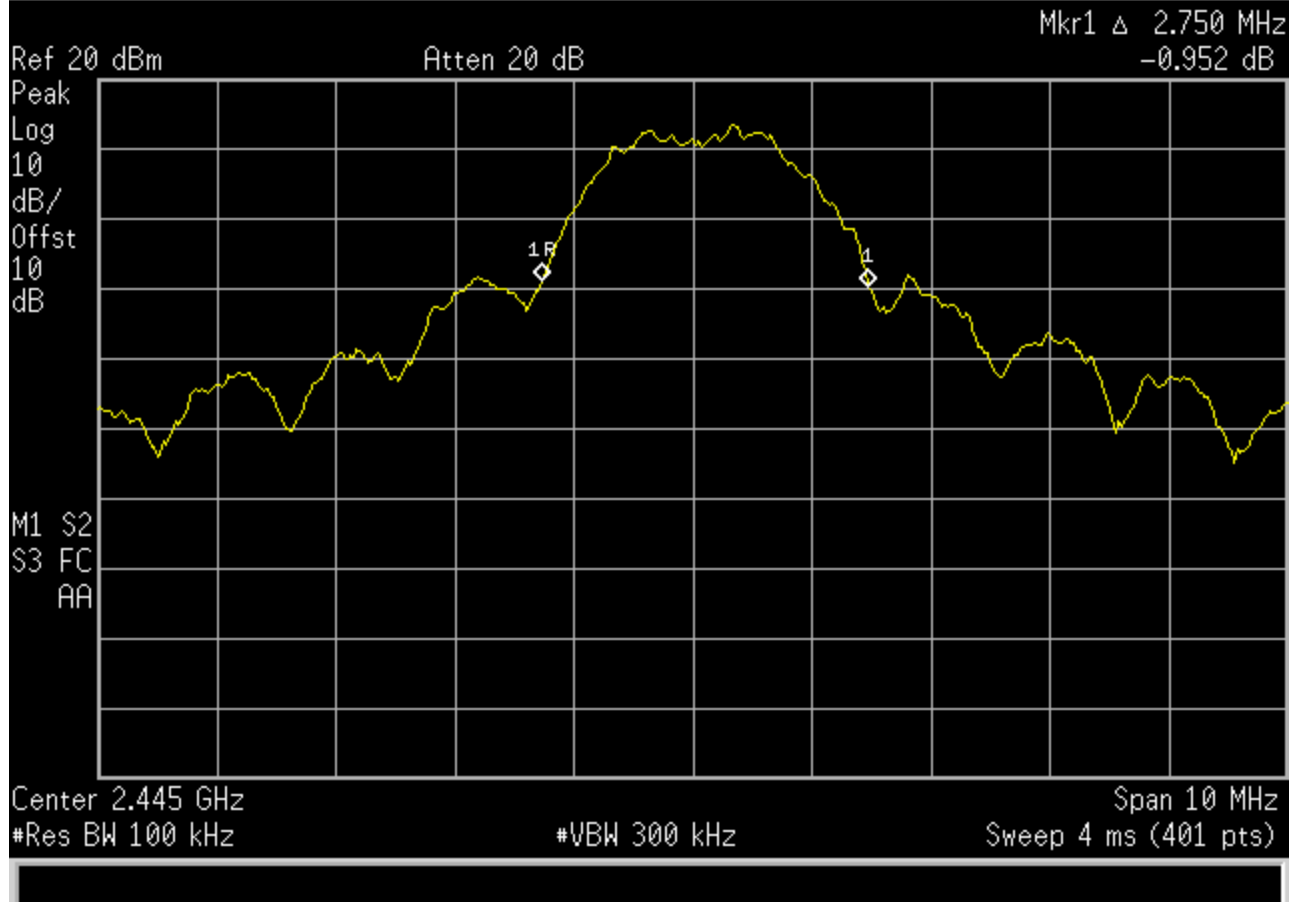
**FCC Part 15, Subpart C, 15.247(a)(1), 20 dB Bandwidth, 2400-2483.5 MHz Band**

**Note:** The minimum 6 dB bandwidth of the hopping channel is at least 500 kHz. 6dB bandwidth measured at 1.875 MHz. EUT transmitting on channel 1 at 2.410 GHz.



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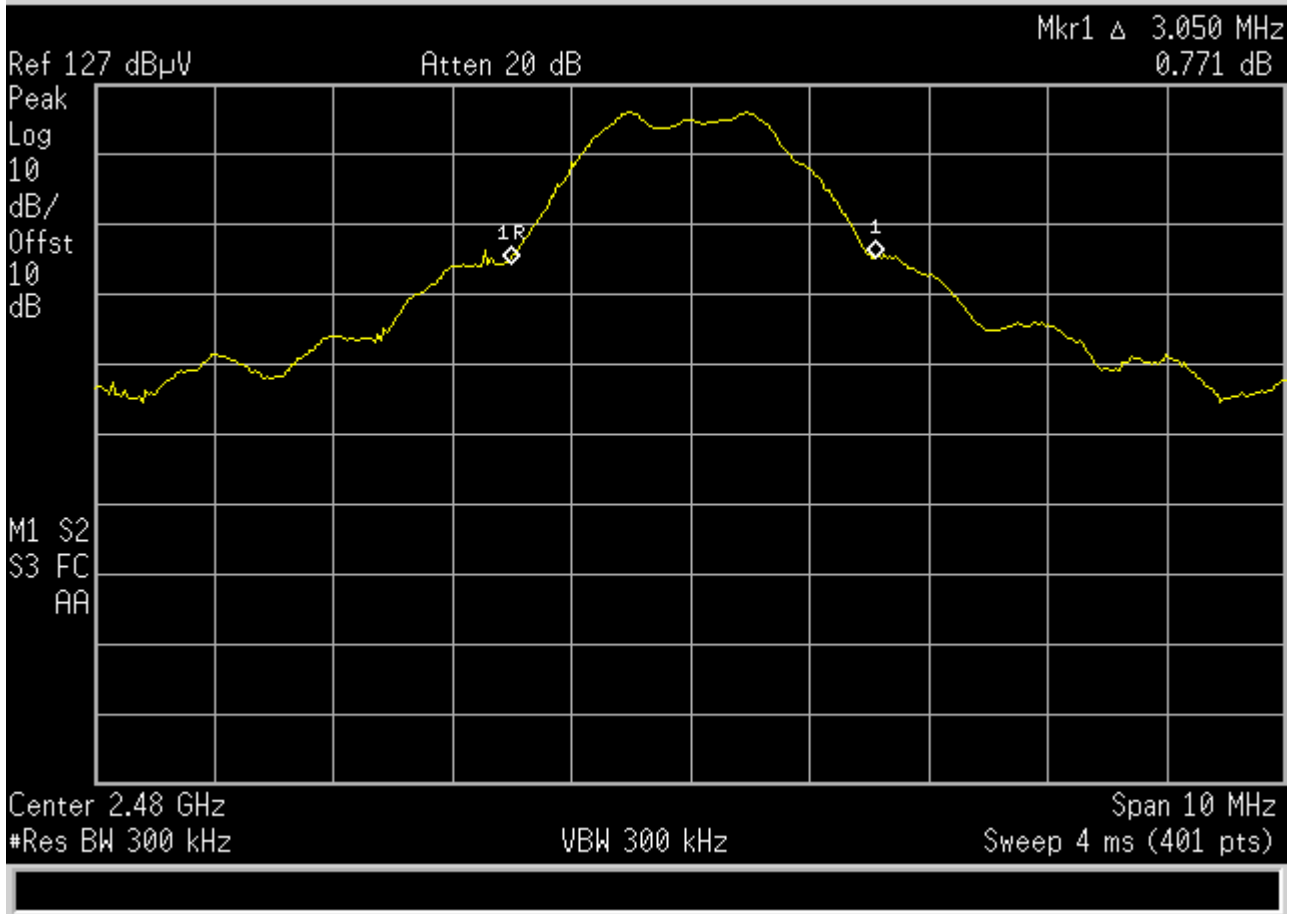
**FCC Part 15, Subpart C, 15.247(a)(1), 20 dB Bandwidth, 2400-2483.5 MHz Band**

**Note:** The minimum 6 dB bandwidth of the hopping channel is at least 500 kHz. 6dB bandwidth measured at 1.825 MHz. EUT transmitting on channel 8 at 2.445 GHz.



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**FCC Part 15, Subpart C, 15.247(a)(1), 20 dB Bandwidth, 2400-2483.5 MHz Band**

**Note:** The minimum 6 dB bandwidth of the hopping channel is at least 500 kHz. 6dB bandwidth measured at 1.850 MHz. EUT transmitting on channel 15 at 2.480 GHz.



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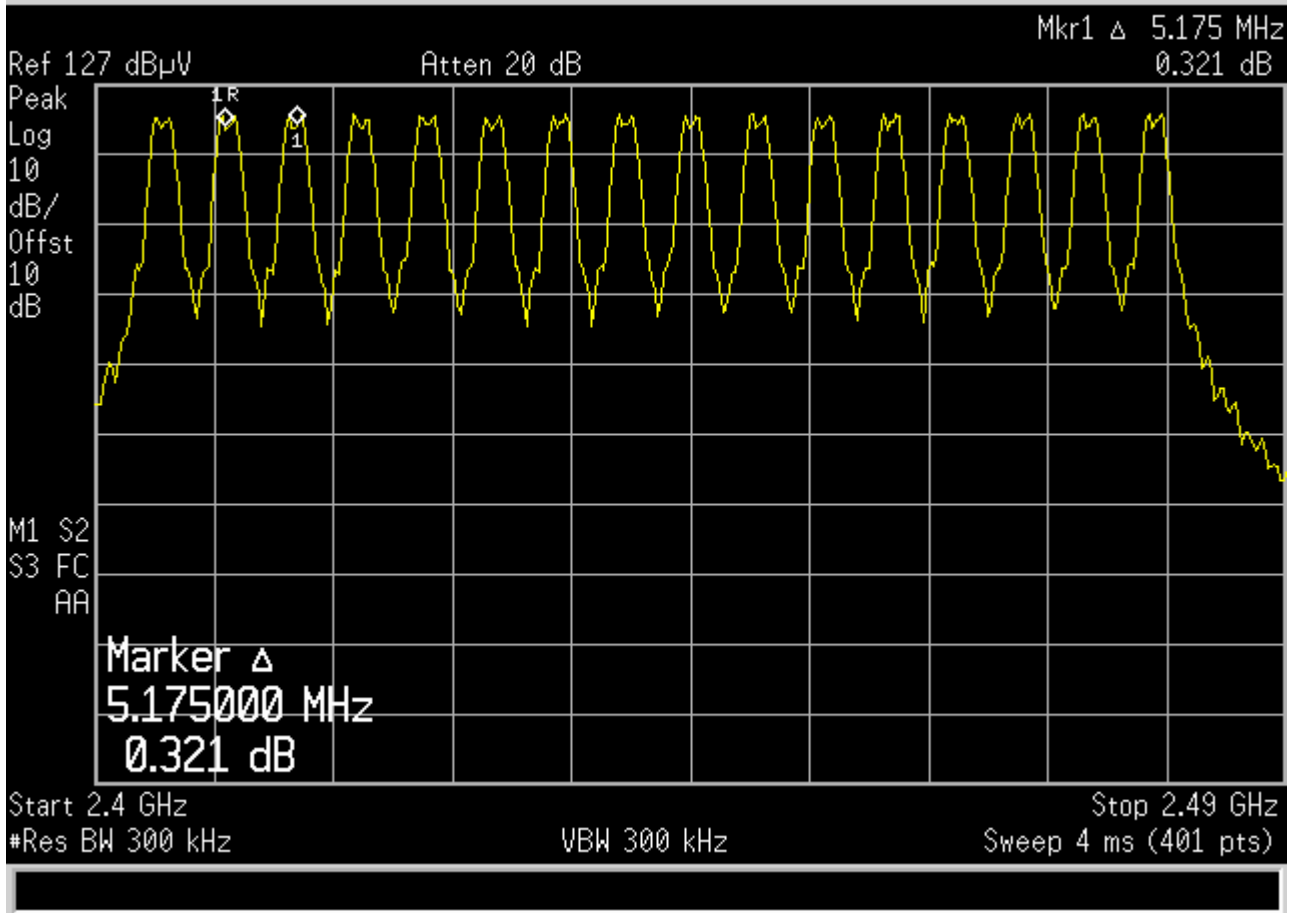
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**FCC Section 15.247 (a)(1)(iii) / IC Section A8.1(d)  
Number of Channels and Occupancy Time  
Test Data**



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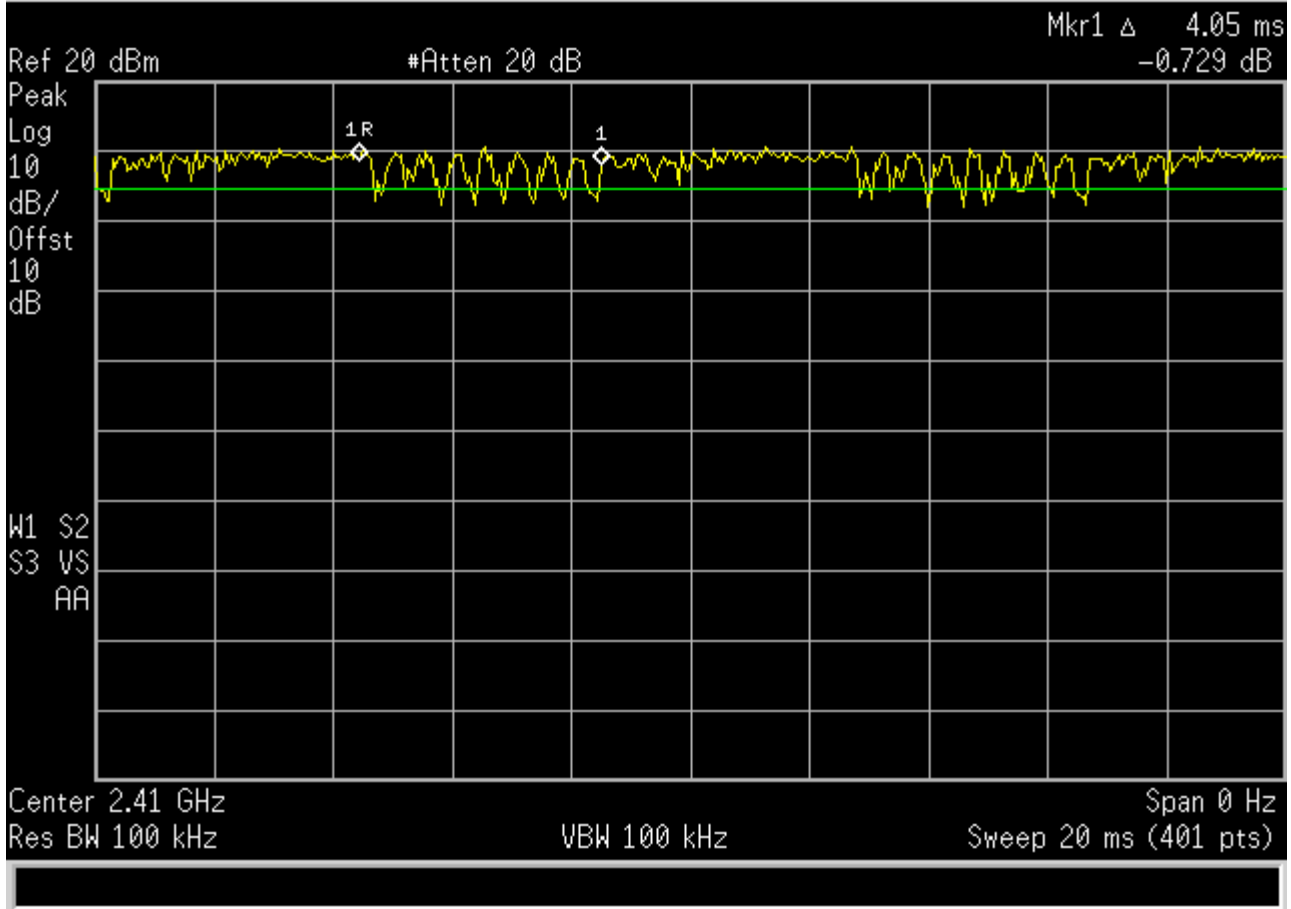
FCC Part 15, Subpart C, 15.247(a)(1)(iii) Number of Channels and Occupancy Time, 2400-2483.5 MHz Band

Note: EUT shows 16 total hopping channels



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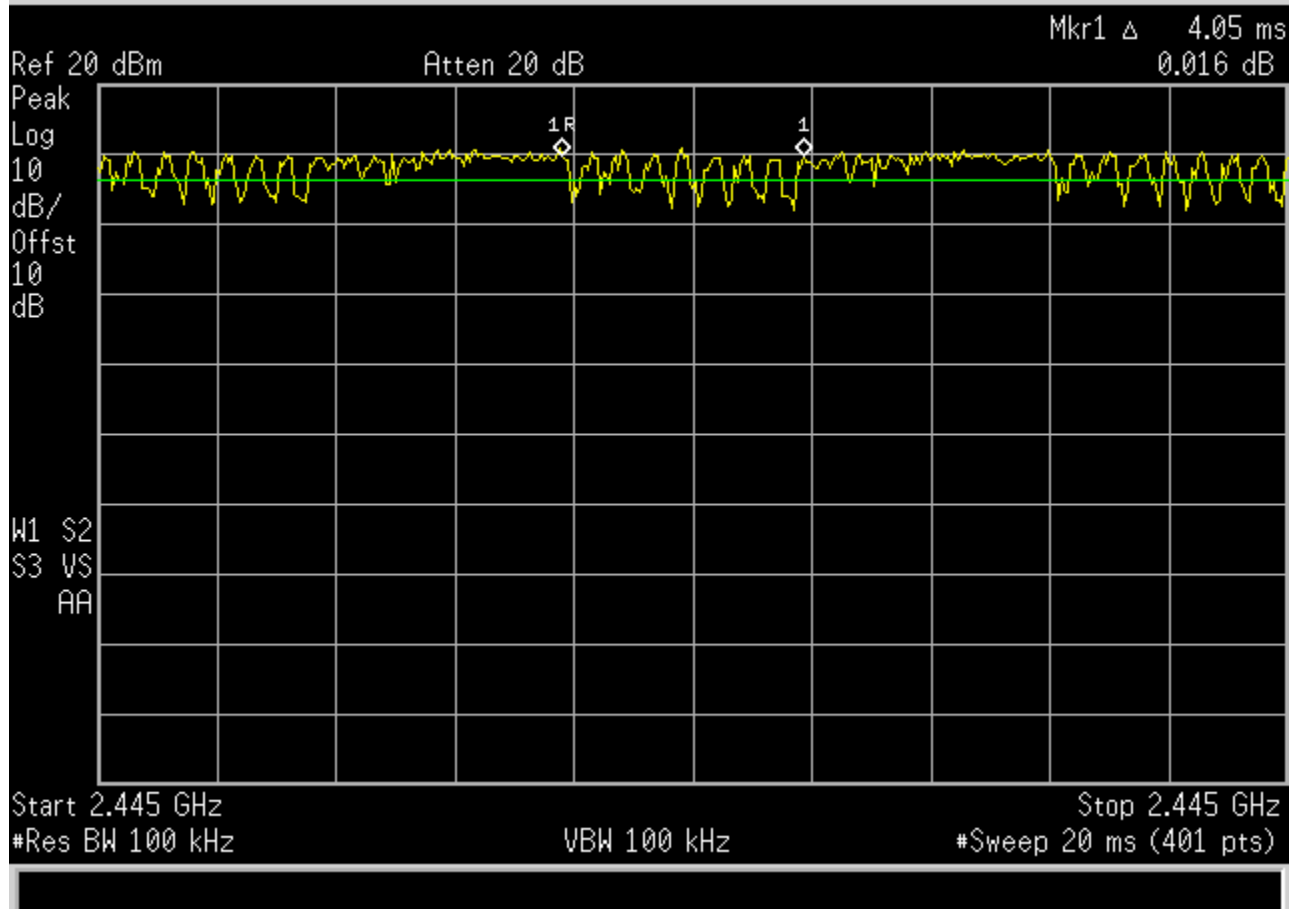
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FCC Part 15, Subpart C, 15.247(a)(1)(iii) Number of Channels and Occupancy Time, 2400-2483.5 MHz Band  
Note: EUT transmitting on channel 1 at 2.410 GHz.



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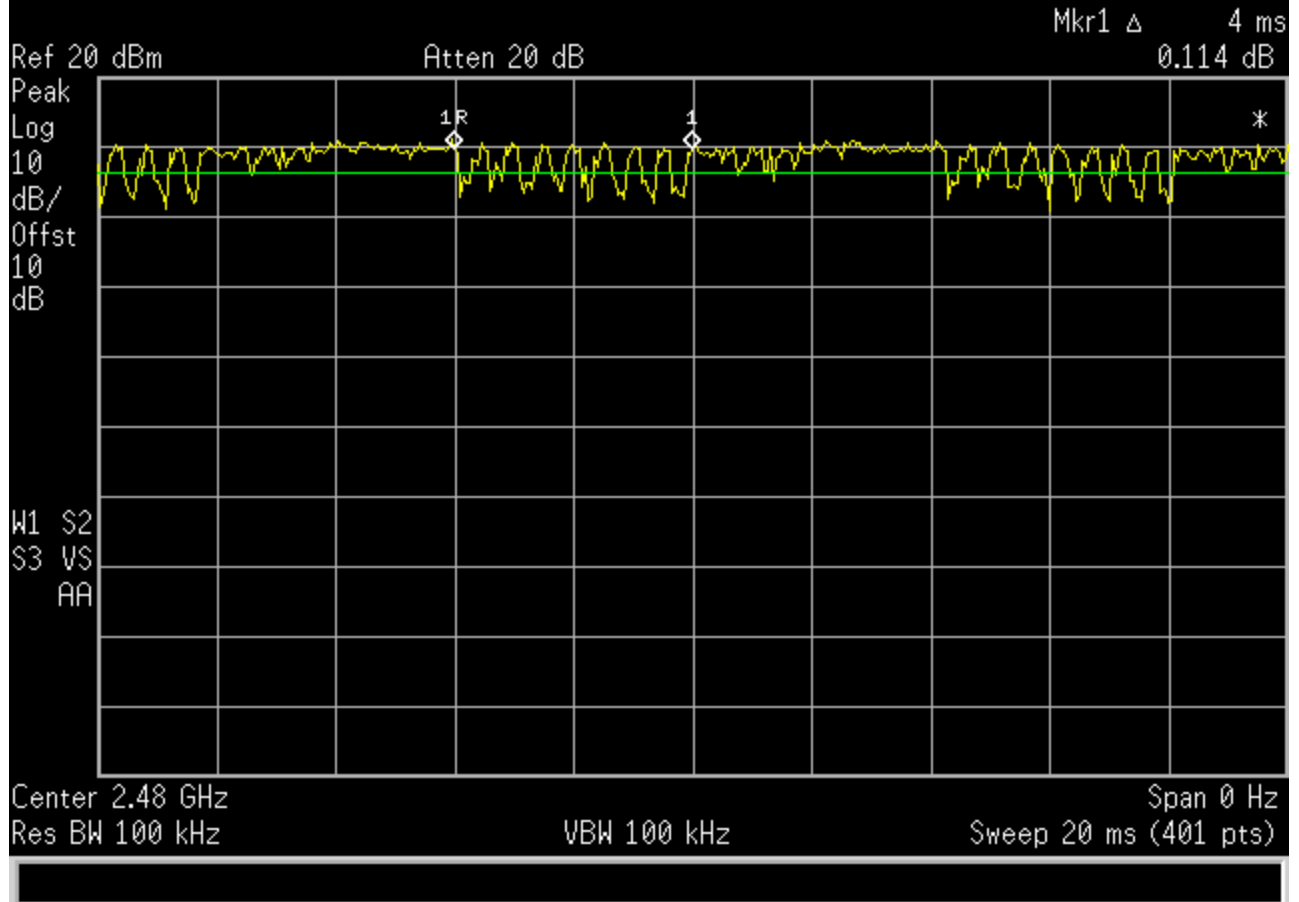
**FCC Part 15, Subpart C, 15.247(a) Occupancy Time, 2400-2483.5 MHz Band**

**Note:** EUT transmitting on channel 8 at 2.445 GHz.



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**FCC Part 15, Subpart C, 15.247(a) Occupancy Time, 2400-2483.5 MHz Band**

**Note:** EUT transmitting on channel 15 at 2.48 GHz.



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**FCC Section 15.247 (b)(1) and (4) / IC Section A8.4(2)  
Peak Conducted Output Power  
Test Data**



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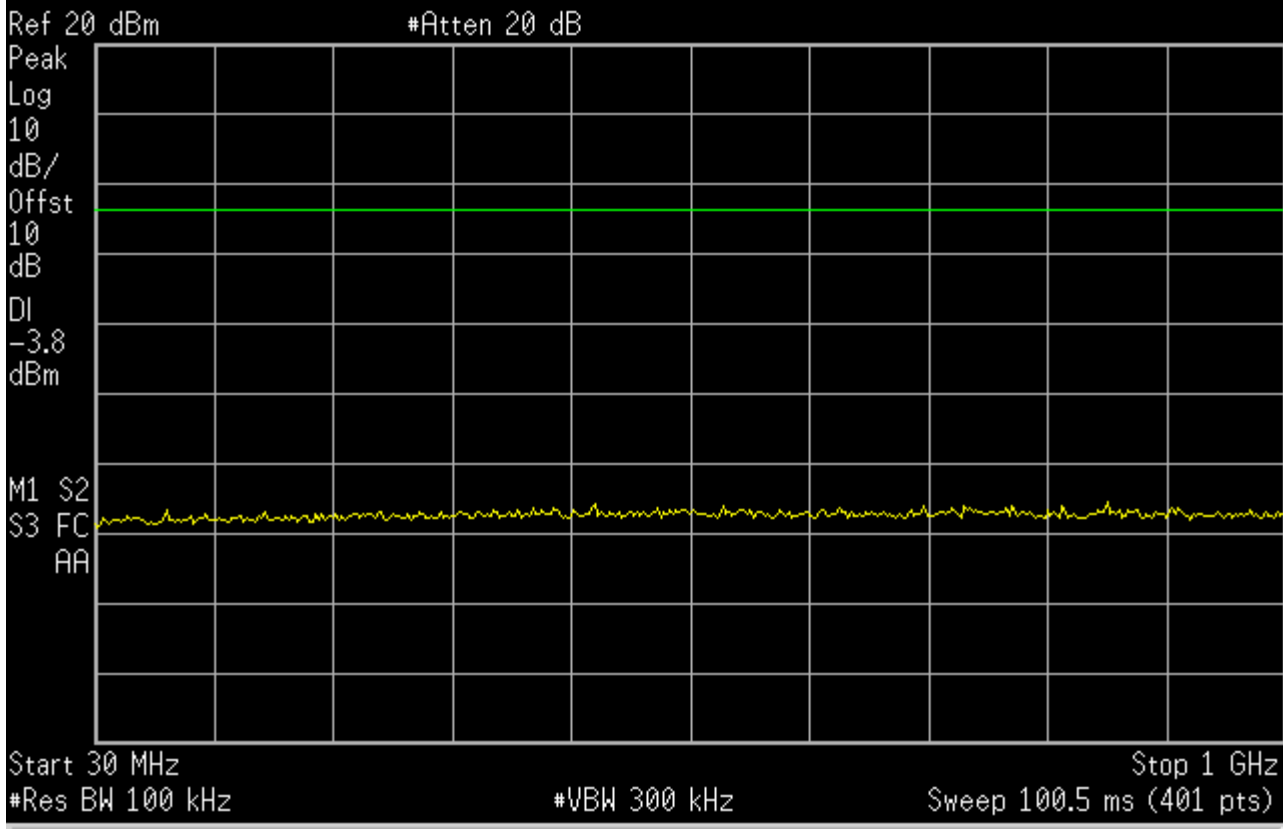


**FCC Section 15.247 (d) / IC Section A8.5  
Antenna Port, Conducted Emissions, 2400-2483.5 MHz  
Test Data**



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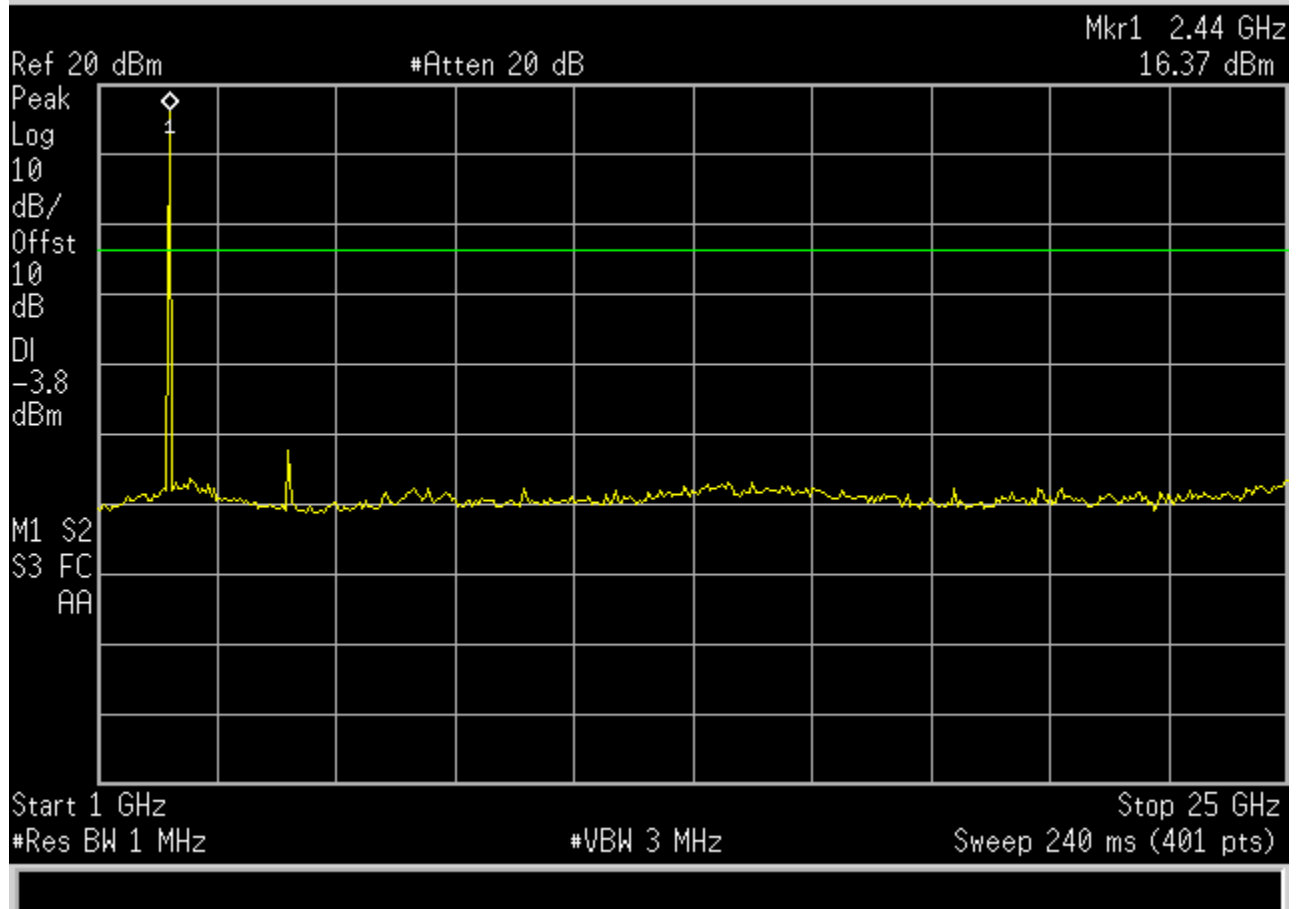
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**FCC Part 15, Subpart C, 15.247(d) Antenna Conducted Emissions, 2400-2483.5 MHz Band**  
**Note:** EUT transmitting on channel 1 at 2.410 GHz.



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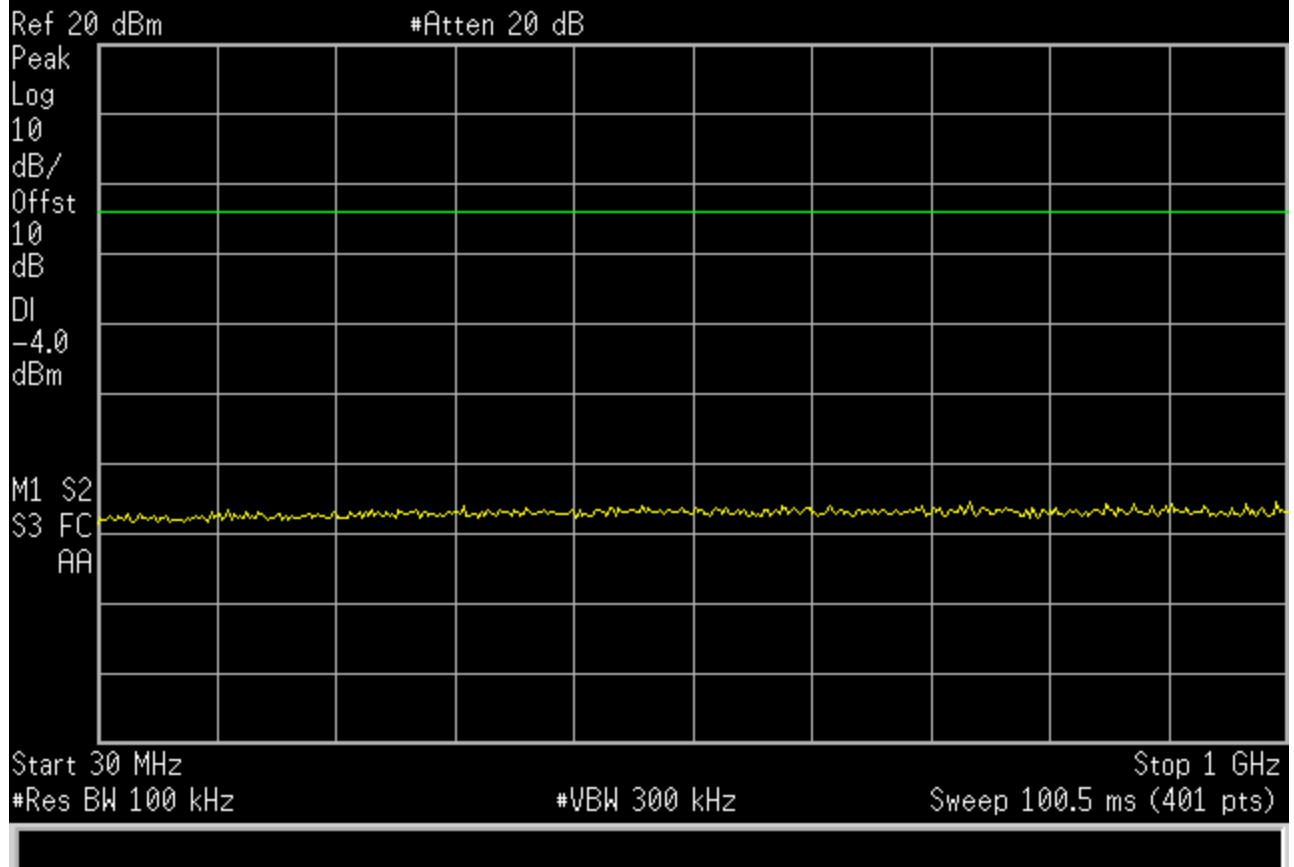
**FCC Part 15, Subpart C, 15.247(d) Antenna Conducted Emissions, 2400-2483.5 MHz Band**

**Note:** EUT transmitting on channel 1 at 2.410 GHz.



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**FCC Part 15, Subpart C, 15.247(d) Antenna Conducted Emissions, 2400-2483.5 MHz Band**

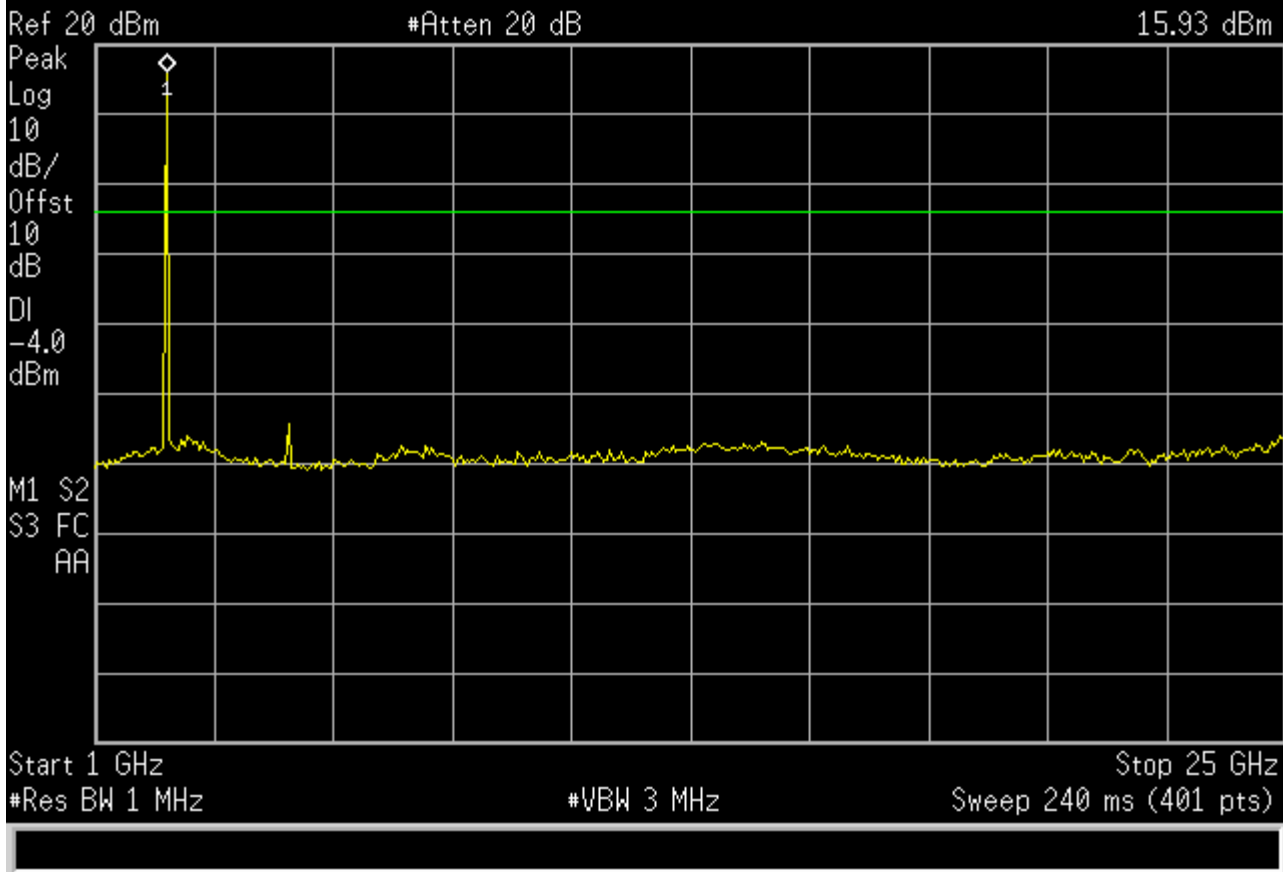
**Note:** EUT transmitting on channel 8 at 2.445 GHz.



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Mkr1 2.44 GHz  
15.93 dBm



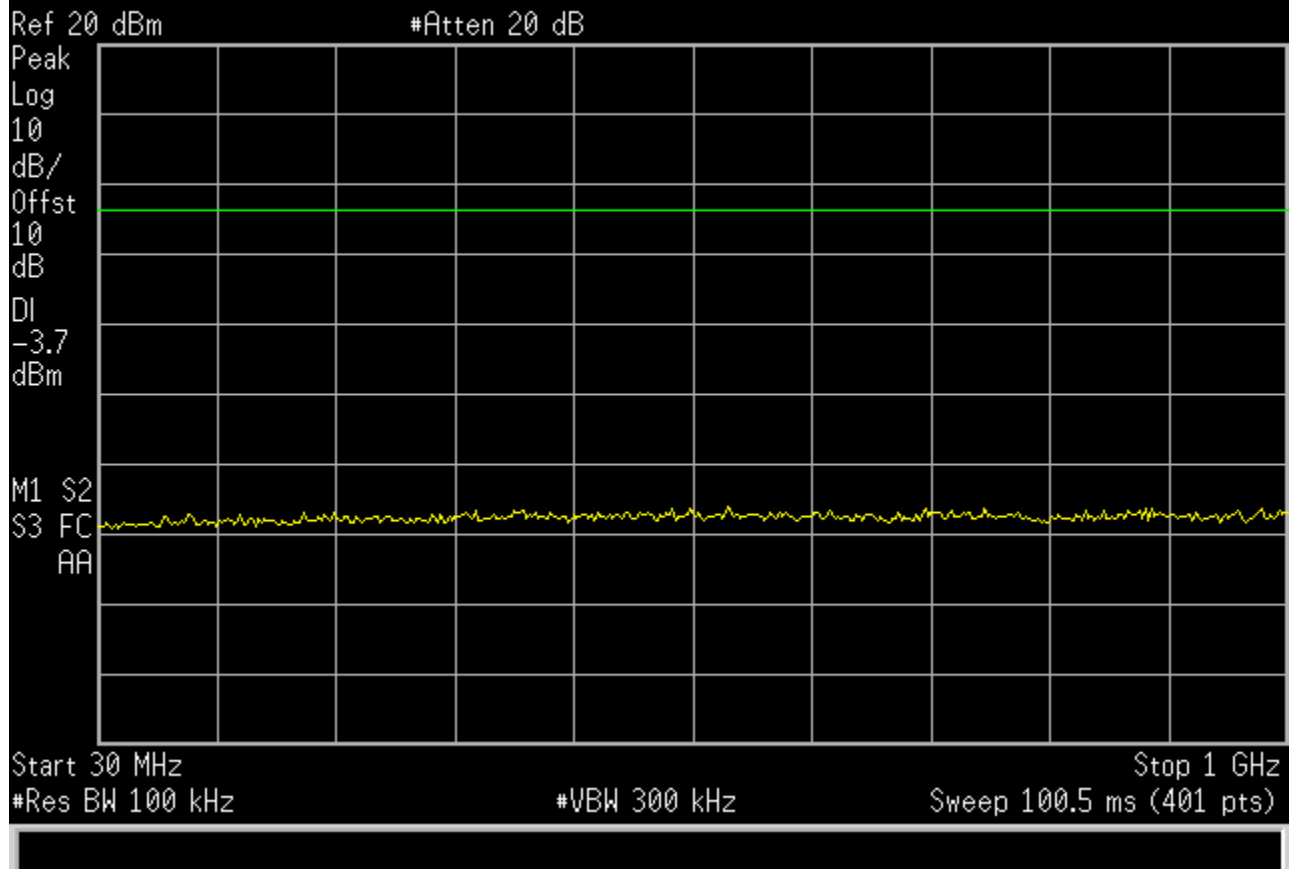
**FCC Part 15, Subpart C, 15.247(d) Antenna Conducted Emissions, 2400-2483.5 MHz Band**

**Note:** EUT transmitting on channel 8 at 2.445 GHz.



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**FCC Part 15, Subpart C, 15.247(d) Antenna Conducted Emissions, 2400-2483.5 MHz Band**

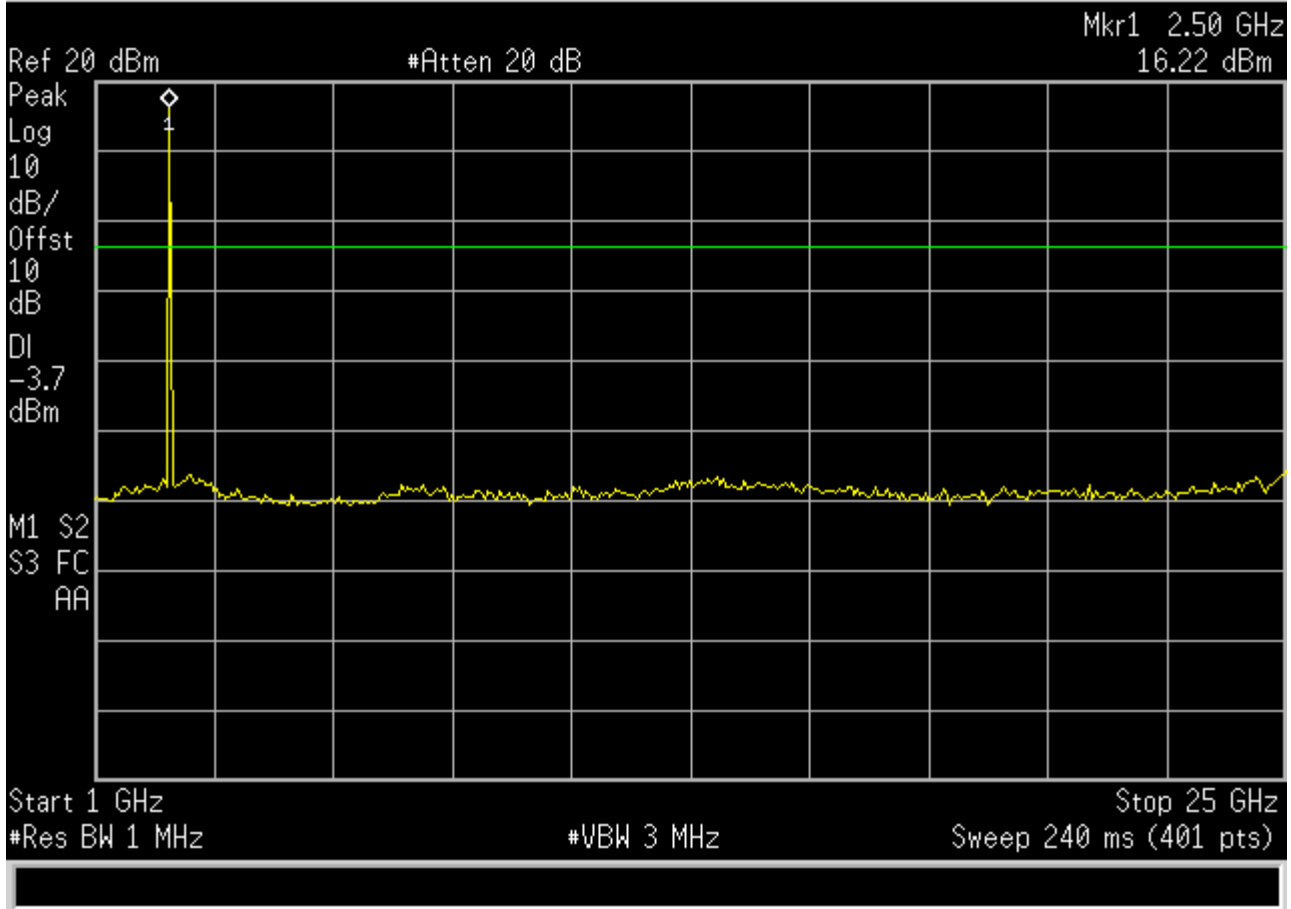
**Note:** EUT transmitting on channel 15 at 2.480 GHz.



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**FCC Part 15, Subpart C, 15.247(d) Antenna Conducted Emissions, 2400-2483.5 MHz Band**

**Note:** EUT transmitting on channel 15 at 2.480 GHz.



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**FCC Section 15.247 (d) / IC Section A8.(5)  
Spurious Emissions, 30 MHz to 25 GHz  
Test Data**



**Retlif Testing Laboratories**

Report No. R-2058P, Rev. B



<b>Test Method:</b>	FCC Part 15, Subpart C, Section 15.247 (d), Spurious Radiated Emissions		
<b>Customer:</b>	IONX, LLC	<b>Job No.</b>	R-2058P
<b>Test Sample:</b>	2.4 GHz Transceiver		
<b>Model No.:</b>	T6X		
<b>Operating Mode:</b>	Continuous Transmitting at 2.410 GHz		
<b>Technician:</b>	D.Fiore	<b>Date:</b>	9/29/14

**Notes:** Test Distance: 3 Meters  
Detector: Average  
RBW / VBW: 1 MHz / 10 Hz  
Temp:20° RH:45%

Test Freq.	Antenna Pol./Height	EUT Position	Meter Reading	Correction Factor	Corrected Reading	Converted Reading	Limit
GHz	(V/H) /	Degrees	dBuV	dB	dBuV/m	uV/M	uV/M
2.410	H / 1.00	180.0	98.86	-5.19	93.67	48277.38	50,000
2.410	V / 1.00	180.0	95.6	-5.19	90.41	33151.26	50,000
**4.82	H / 1.00	180.0	50.43	1.26	51.69	384.15	500
**4.82	V / 1.00	180.0	48.28	1.26	49.54	299.91	500
7.23	H / 1.00	200.0	44.58	5.13	49.71	305.84	500
7.23	V / 1.00	250.3	40.07	5.13	45.20	181.97	500
9.64	H / 1.00	180.0	43.70	7.28	50.98	354.00	500
9.64	V / 1.00	180.0	45.21	7.28	52.49	421.21	500

\*\* Restricted Bands



**Retlif Testing Laboratories**

Report No. R-2058P, Rev. B

<b>Test Method:</b>	FCC Part 15, Subpart C, Section 15.247 (d), Spurious Radiated Emissions		
<b>Customer:</b>	IONX, LLC	<b>Job No.</b>	R-2058P
<b>Test Sample:</b>	2.4 GHz Transceiver		
<b>Model No.:</b>	T6X		
<b>Operating Mode:</b>	Continuous Transmitting at 2.445 GHz		
<b>Technician:</b>	D.Fiore	<b>Date:</b>	9/29/14
<b>Notes:</b>	Test Distance: 3 Meters Detector: Peak RBW / VBW: 1 MHz / 3 MHz Temp:20° RH:23%		

Test Freq.	Antenna Pol./Height	EUT Position	Meter Reading	Correction Factor	Corrected Reading	Converted Reading	Limit
GHz	(V/H) /	Degrees	dBuV	dB	dBuV/m	uV/M	uV/M
2.445	H / 1.00	180.0	113.4	-5.19	108.21	257335.68	500,000
2.445	V / 1.00	180.0	96.5	-5.19	91.31	36770.54	500,000
**4.890	H / 1.00	180.0	72.50	1.26	73.76	4874.89	5,000
**4.890	V / 1.00	180.0	63.20	1.26	64.46	1671.09	5,000
**7.335	H / 1.00	200.0	58.20	5.13	63.33	1467.23	5,000
**7.335	V / 1.00	250.3	56.30	5.13	61.43	1178.96	5,000
9.780	H / 1.00	180.0	54.2	7.28	61.48	1185.77	5,000
9.780	V / 1.00	180.0	52.3	7.28	59.58	952.80	5,000

\*\* Restricted Bands



**Retlif Testing Laboratories**  
Report No. R-2058P, Rev. B

Test Method:	FCC Part 15, Subpart C, Section 15.247 (d), Spurious Radiated Emissions		
Customer:	IONX, LLC	Job No.	R-2058P
Test Sample:	2.4 GHz Transceiver		
Model No.:	T6X		
Operating Mode:	Continuous Transmitting at 2.445 GHz		
Technician:	D.Fiore	Date:	9/29/14
Notes:	Test Distance: 3 Meters Detector: Average RBW / VBW: 1 MHz / 10 Hz Temp:20° RH:23%		

Test Freq.	Antenna Pol./Height	EUT Position	Meter Reading	Correction Factor	Corrected Reading	Converted Reading	Limit
GHz	(V/H) /	Degrees	dBuV	dB	dBuV/m	uV/M	uV/M
2.445	H / 1.00	180.0	98.74	-5.19	93.55	47610.28	50,000
2.445	V / 1.00	180.0	89.4	-5.19	84.21	16236.78	50,000
**4.890	H / 1.00	180.0	52.40	1.26	53.66	481.95	500
**4.890	V / 1.00	180.0	51.23	1.26	52.49	421.21	500
**7.335	H / 1.00	200.0	48.70	5.13	53.83	491.47	500
**7.335	V / 1.00	250.3	46.23	5.13	51.36	369.83	500
9.780	H / 1.00	180.0	41.20	7.28	48.48	265.46	500
9.780	V / 1.00	180.0	43.69	7.28	50.97	353.59	500

\*\* Restricted Bands



<b>Test Method:</b>	FCC Part 15, Subpart C, Section 15.247 (d), Spurious Radiated Emissions		
<b>Customer:</b>	IONX, LLC	<b>Job No.</b>	R-2058P
<b>Test Sample:</b>	2.4 GHz Transceiver		
<b>Model No.:</b>	T6X		
<b>Operating Mode:</b>	Continuously Transmitting at 2.480 GHz		
<b>Technician:</b>	D.Fiore	<b>Date:</b>	9/29/14

**Notes:** Test Distance: 3 Meters  
 Detector: Peak  
 RBW / VBW: 1 MHz / 3 MHz  
 Temp:20° RH:23%

Test Freq.	Antenna Pol./Height	EUT Position	Meter Reading	Correction Factor	Corrected Reading	Converted Reading	Limit
GHz	(V/H) /	Degrees	dBuV	dB	dBuV/m	uV/M	uV/M
2.480	H / 1.00	180.0	105.0	-5.19	99.81	97836.29	500,000
2.480	V / 1.00	216.7	110.9	-5.19	105.71	192974.53	500,000
**4.960	H / 1.00	245.4	47.52	1.26	48.78	274.78	5,000
**4.960	V / 1.69	151.8	70.96	1.26	72.21	4081.59	5,000
**7.440	H / 1.30	326.8	42.70	5.13	47.83	246.32	5,000
**7.440	V / 1.10	209.4	55.96	5.13	61.09	1133.70	5,000
9.920	H / 1.42	171.1	43.70	7.28	50.98	354.00	5,000
9.920	V / 1.08	168.8	41.70	7.28	48.98	281.19	5,000

\*\* Restricted Bands



**Retlif Testing Laboratories**  
 Report No. R-2058P, Rev. B

<b>Test Method:</b>	FCC Part 15, Subpart C, Section 15.247 (d), Spurious Radiated Emissions		
<b>Customer:</b>	IONX, LLC	<b>Job No.</b>	R-2058P
<b>Test Sample:</b>	2.4 GHz Transceiver		
<b>Model No.:</b>	T6X		
<b>Operating Mode:</b>	Continuously Transmitting at 2.480 GHz		
<b>Technician:</b>	D.Fiore	<b>Date:</b>	9/29/14
<b>Notes:</b>	Test Distance: 3 Meters Detector: Average RBW / VBW: 1 MHz / 10 Hz Temp:20° RH:23%		

Test Freq.	Antenna Pol./Height	EUT Position	Meter Reading	Correction Factor	Corrected Reading	Converted Reading	Limit
GHz	(V/H) /	Degrees	dBuV	dB	dBuV/m	uV/M	uV/M
2.480	H / 1.00	180.0	98.90	-5.19	93.71	48473.01	50,000
2.480	V / 1.00	216.7	98.86	-5.19	93.67	48277.38	50,000
**4.960	H / 1.00	245.4	40.49	1.26	41.75	122.32	500
**4.960	V / 1.69	151.8	51.50	1.26	52.76	434.51	500
**7.440	H / 1.30	326.8	34.28	5.13	39.41	93.43	500
**7.440	V / 1.00	209.4	48.50	5.13	53.63	480.29	500
9.920	H / 1.42	171.1	37.28	7.28	44.56	169.04	500
9.920	V / 1.08	168.8	36.23	7.28	43.51	149.79	500

\*\* Restricted Bands



**Retlif Testing Laboratories**

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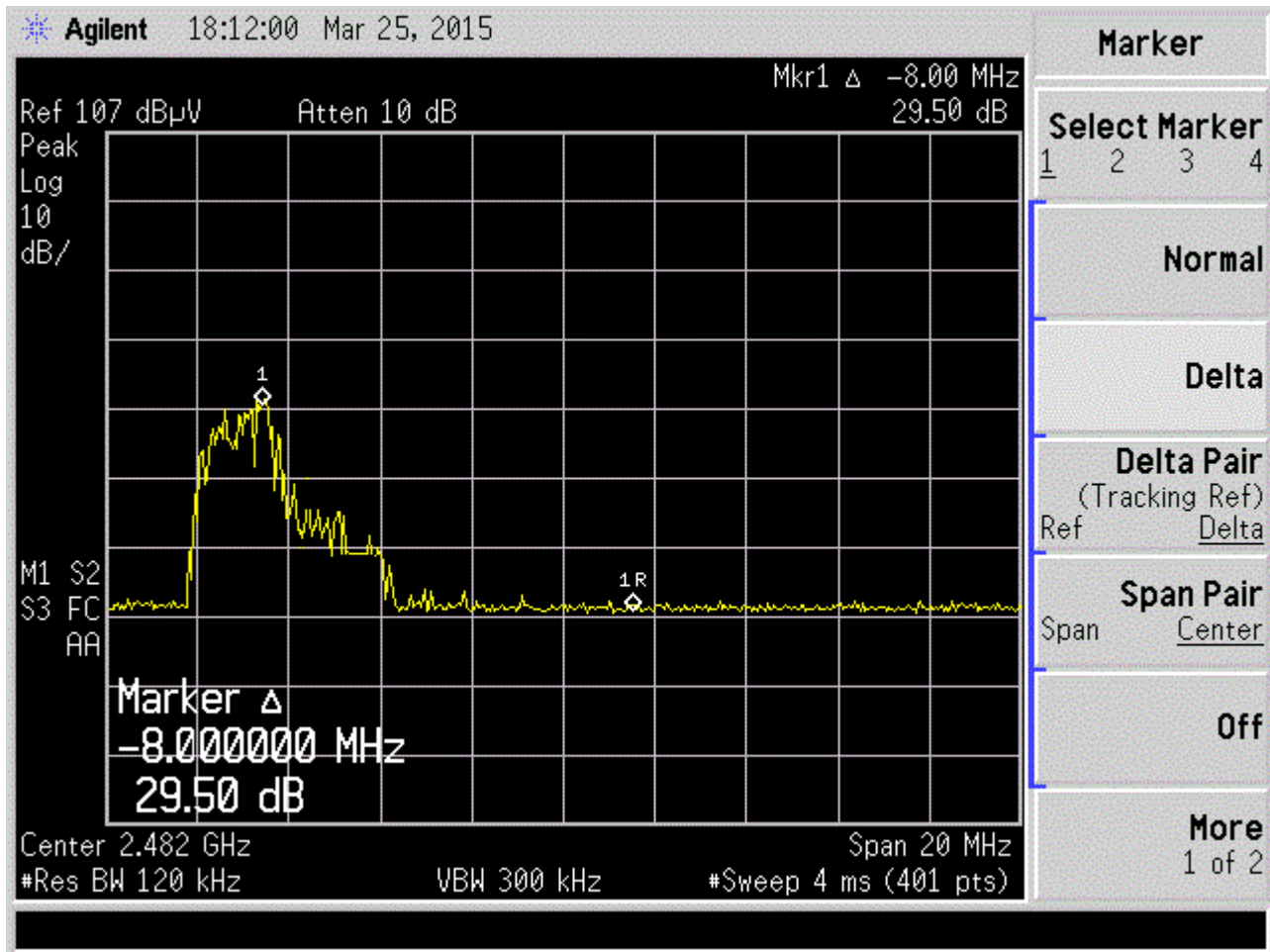


**FCC Section 15.247 (d) / IC Section A8.(5)  
Band-edge Compliance of RF Conducted Emissions  
Test Data**



**Retlif Testing Laboratories**

Report No. R-2058P, Rev. B




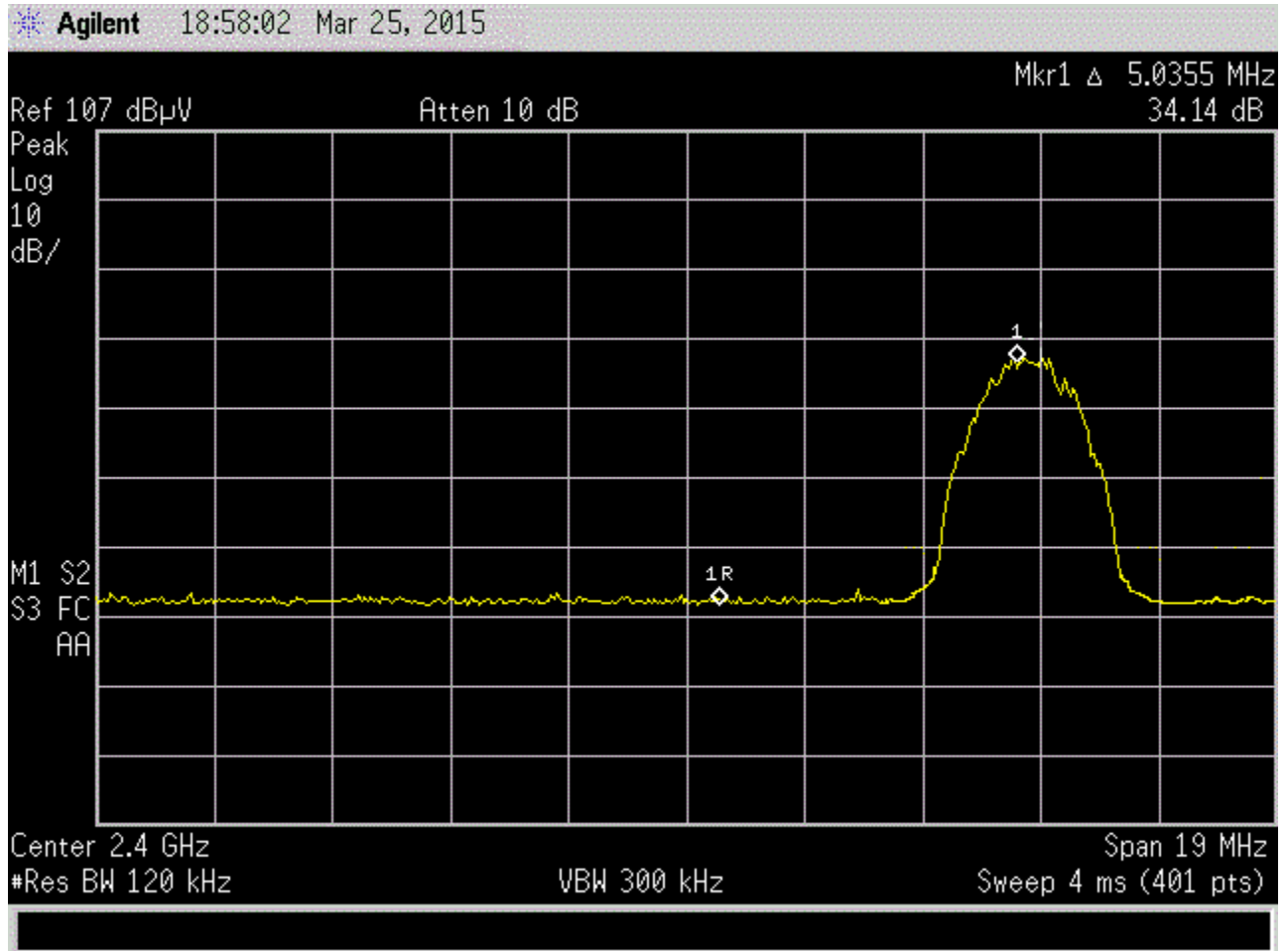
FHSS System set to continuously transmit on channel 1  
 RBW  $\geq$  1% of the span (120 kHz)  
 VBW  $\geq$  RBW (300 kHz)  
 Sweep = auto  
 Detector function = peak  
 Trace = max hold

Trace was allowed to stabilize. Marker set on the emission at the bandedge. Marker delta function was enabled, then used the marker-to-peak function to move the marker to the peak of the in-band emission.

**FCC Part 15, Subpart C, 15.247(d), Band-edge Compliance of RF Conducted Emissions**  
 Note: EUT transmitting on channel 1

Customer	IONX, LLC		
Test Sample	Train Consist Monitoring System		
Model Number	T6X		
Date: 3-25-15	Tech: D.Landers	Sheet 1 of 3	

	<b>Retlif Testing Laboratories</b>
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FHSS System set to continuously transmit on channel 15  
 RBW  $\geq$  1% of the span (120 kHz)  
 VBW  $\geq$  RBW (300 kHz)  
 Sweep = auto  
 Detector function = peak  
 Trace = max hold

Trace was allowed to stabilize. Marker set on the emission at the bandedge. Marker delta function was enabled, then used the marker-to-peak function to move the marker to the peak of the in-band emission.

**FCC Part 15, Subpart C, 15.247(d), Band-edge Compliance of RF Conducted Emissions**

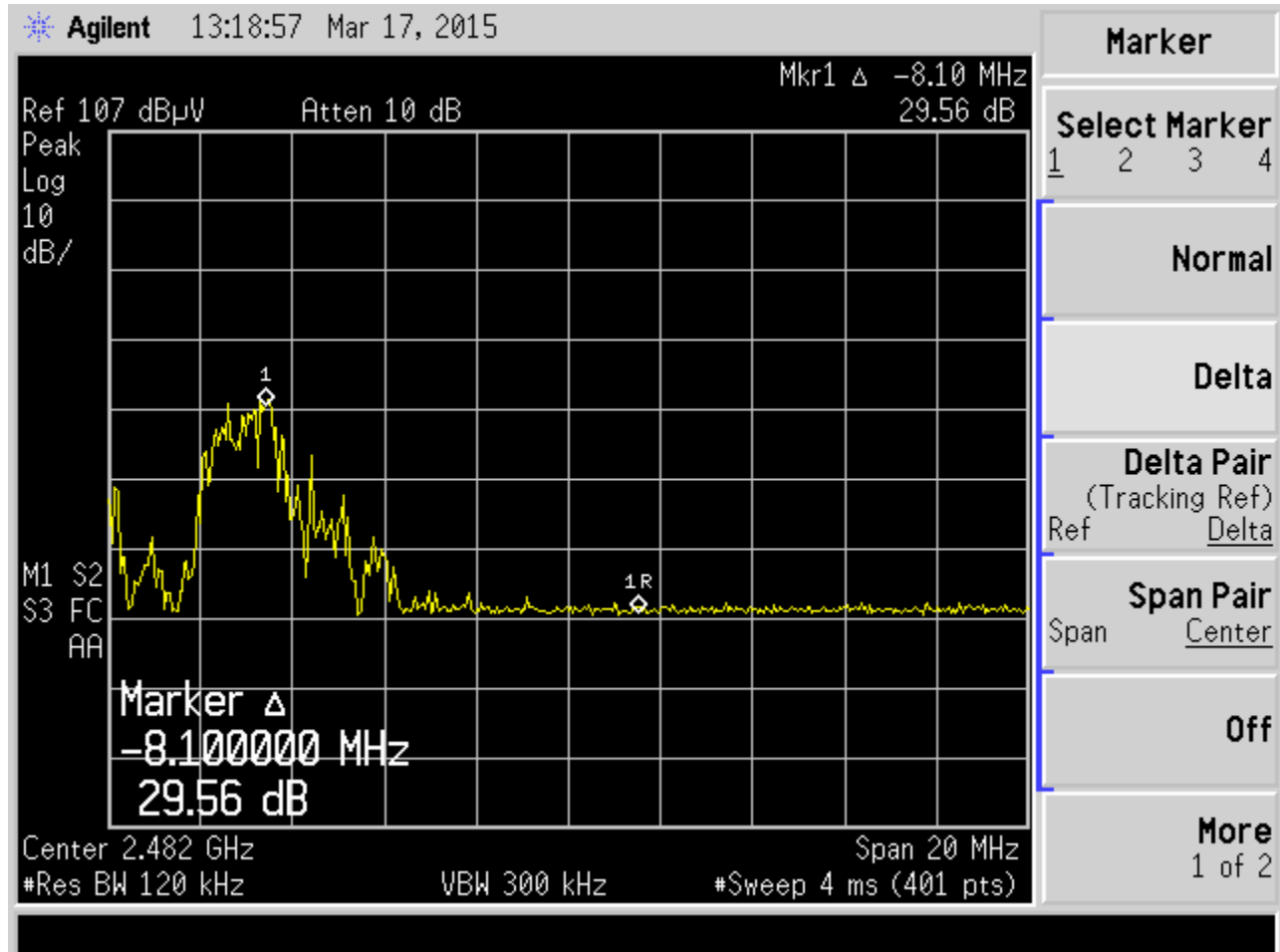
**Note:** EUT transmitting on channel 15.

Customer	IONX, LLC		
Test Sample	Train Consist Monitoring System		
Model Number	T6X		
Date: 3-25-15	Tech: D.Landers	Sheet 2 of 3	



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FHSS System set to continuously hop  
 RBW  $\geq$  1% of the span (120 kHz)  
 VBW  $\geq$  RBW (300 kHz)  
 Sweep = auto  
 Detector function = peak  
 Trace = max hold

Trace was allowed to stabilize. Marker set on the emission at the bandedge. Marker delta function was enabled, then used the marker-to-peak function to move the marker to the peak of the in-band emission.

**FCC Part 15, Subpart C, 15.247(d), Band-edge Compliance of RF Conducted Emissions**

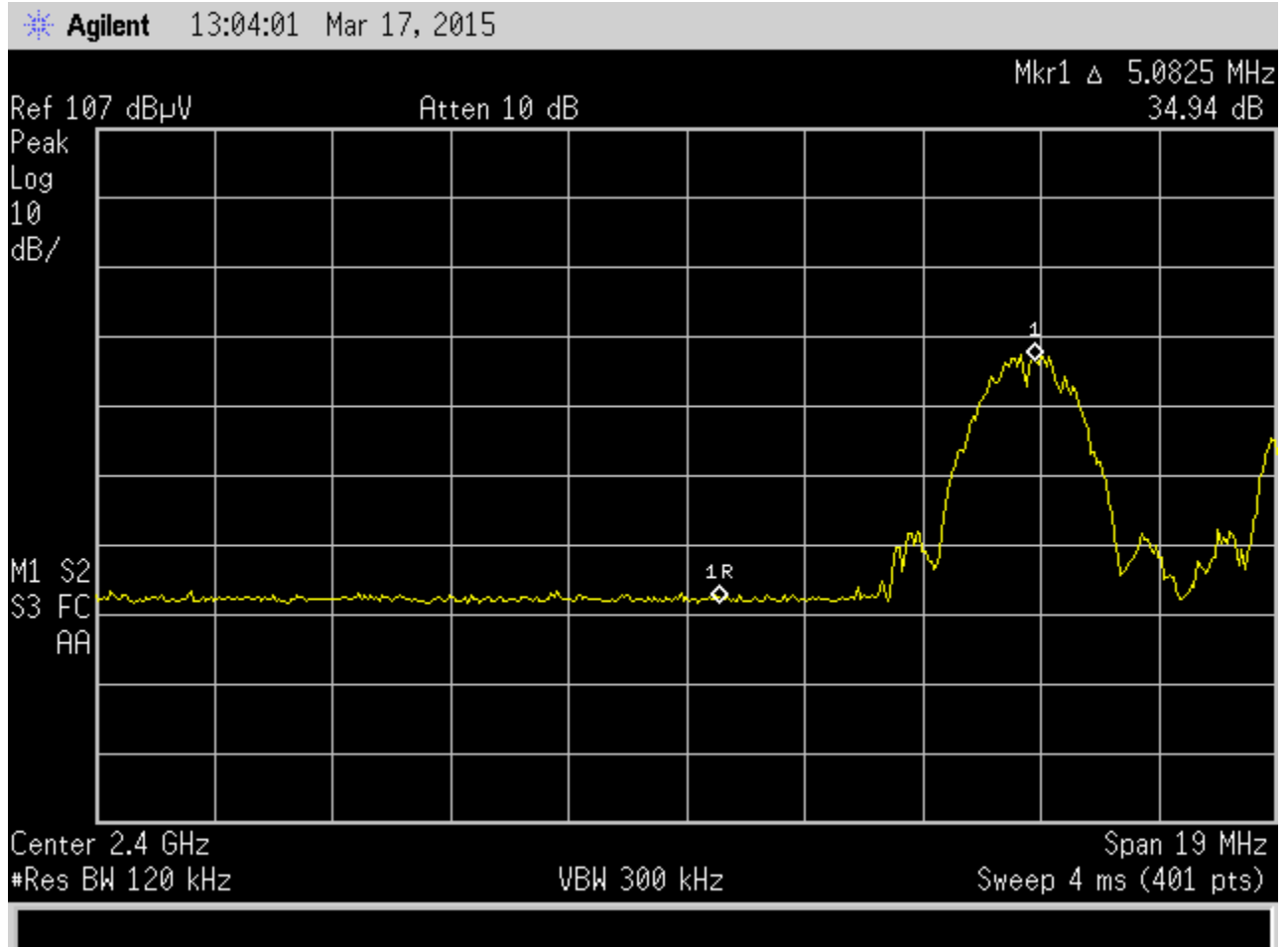
**Note:** EUT set to continuously hop .

Customer	IONX, LLC		
Test Sample	Train Consist Monitoring System		
Model Number	T6X		
Date: 3-17-15	Tech: D.Landers	Sheet 2 of 3	



**Retlif Testing Laboratories**

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FHSS System set to continuously hop  
 RBW  $\geq$  1% of the span (120 kHz)  
 VBW  $\geq$  RBW (300 kHz)  
 Sweep = auto  
 Detector function = peak  
 Trace = max hold

Trace was allowed to stabilize. Marker set on the emission at the bandedge. Marker delta function was enabled, then used the marker-to-peak function to move the marker to the peak of the in-band emission.

**FCC Part 15, Subpart C, 15.247(d), Band-edge Compliance of RF Conducted Emissions**

**Note:** EUT set to continuously hop .


Customer	IONX, LLC		
Test Sample	Train Consist Monitoring System		
Model Number	T6X		
Date: 3-17-15	Tech: D.Landers	Sheet 2 of 3	



**Retlif Testing Laboratories**

Report No. R-2058P, Rev. B

<b>Test Method:</b>	FCC Part 15, Subpart C, Section 15.247 (d), Band-edge Compliance						
<b>Customer:</b>	IONX, LLC				<b>Job No.</b>	R-2058P	
<b>Test Sample:</b>	Train Consist Location and Assist Monitoring System						
<b>Model No.:</b>	T6X						
<b>Operating Mode:</b>	Continuously transmitting on channel 1						
<b>Technician:</b>	D.Fiore				<b>Date:</b>	3/17/15	
<b>Notes:</b>	Test Distance: 3 Meters Detector: Peak RBW / VBW: 1 MHz / 3 MHz						
Test Freq.	Antenna Pol./Height	EUT Position	Meter Reading	Correction Factor	Corrected Reading	Converted Reading	Limit
GHz	(V/H) /	Degrees	dBuV	dB	dBuV/m	uV/M	uV/M
2.400	V/1.00	180.00	39.97	-5.19	34.78	54.83	500
2.400	H/1.00	180.00	39.00	-5.19	33.81	54.81	500



**Retlif Testing Laboratories**

Report No. R-2058P, Rev. B

<b>Test Method:</b>	FCC Part 15, Subpart C, Section 15.247 (d), Band-edge Compliance						
<b>Customer:</b>	IONX, LLC			<b>Job No.</b>	R-2058P		
<b>Test Sample:</b>	Train Consist Location and Assist Monitoring System						
<b>Model No.:</b>	T6X						
<b>Operating Mode:</b>	Continuously transmitting on channel 15						
<b>Technician:</b>	D.Fiore			<b>Date:</b>	3/17/15		
<b>Notes:</b>	Test Distance: 3 Meters Detector: Peak RBW / VBW: 1 MHz / 3 MHz						
<b>Test Freq.</b>	<b>Antenna Pol./Height</b>	<b>EUT Position</b>	<b>Meter Reading</b>	<b>Correction Factor</b>	<b>Corrected Reading</b>	<b>Converted Reading</b>	<b>Limit</b>
<b>GHz</b>	<b>(V/H) /</b>	<b>Degrees</b>	<b>dBuV</b>	<b>dB</b>	<b>dBuV/m</b>	<b>uV/M</b>	<b>uV/M</b>
2.4835	V/1.00	180.00	39.90	-5.19	34.71	54.38	500
2.4835	H/1.00	180.00	39.00	-5.19	33.81	54.81	500



**Retlif Testing Laboratories**

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<b>Test Method:</b>	FCC Part 15, Subpart C, Section 15.247 (d), Band-edge Compliance		
<b>Customer:</b>	IONX, LLC	<b>Job No.</b>	R-2058P
<b>Test Sample:</b>	Train Consist Location and Assist Monitoring System		
<b>Model No.:</b>	T6X		
<b>Operating Mode:</b>	Continuously Hopping		
<b>Technician:</b>	D.Fiore	<b>Date:</b>	3/17/15

**Notes:** Test Distance: 3 Meters  
 Detector: Peak  
 RBW / VBW: 1 MHz / 3 MHz

Test Freq.	Antenna Pol./Height	EUT Position	Meter Reading	Correction Factor	Corrected Reading	Converted Reading	Limit
GHz	(V/H) /	Degrees	dBuV	dB	dBuV/m	uV/M	uV/M
2.400	V/1.00	180.00	39.95	-5.19	34.76	54.70	500
2.400	H/1.00	180.00	39.00	-5.19	33.81	49.03	500
2.4835	V/1.00	180.00	39.93	-5.19	34.74	54.58	500
2.4835	H/1.00	180.00	39.00	-5.19	33.81	49.03	500





**FCC Section 15.247 (d) / 15.209(a) / IC Section A2.9(b)  
Field Strength of Spurious Emissions  
Test Data**



**Retlif Testing Laboratories**

Report No. R-2058P, Rev. B

<b>Test Method:</b>	<b>FCC Part 15, Subpart C, Radiated Emissions, 9 kHz to 25 GHz, Para:15.209</b>						
<b>Customer:</b>	IONX, LLC	<b>Job No.:</b>		R-2058P			
<b>Test Sample:</b>	2.4 GHz Transceiver						
<b>Model No.:</b>	T6X	<b>Serial No.:</b>		HA0000911A			
<b>Operating Mode:</b>	Continuously Monitoring WSN						
<b>Technician:</b>	D.Fiore	<b>Date:</b>		9/18/14			
<b>Notes:</b>	Test Distance: 3 Meters			Temp: 19.8°C		RH:48 %	
	Detector: Quasi-Peak Below 1 GHz, Peak above 1 GHz						
Frequency	Antenna Position	EUT Orientation	Meter Readings	Correction Factor	Corrected Reading	Converted Reading	Limit
MHz	(V/H) / Meters	Degrees	dBuV	dB	dBuV/m	uV/m	uV/m
0.032							75
0.490							4.8
0.490							49.97
1.705							14.07
1.705							30
30.00							30
30.00							100
*35.00	H/1.00	180.00	2.1	15.59	17.69	7.66	
88.00							100
88.00							150
*110.00	H/1.00	180.00	4.8	8.95	13.75	4.87	
*195.00	H/1.00	180.00	4.5	11.35	15.85	6.20	
*205.00	H/1.00	180.00	3.6	12.25	15.85	6.20	
216							150
216							200
*600.00	H/1.00	180.00	3.3	23.69	26.99	22.36	
960.00							200
960.00							500
*995.00	H/1.00	180.00	3.6	30.36	33.96	49.88	
1000.0							
*1.05	H/1.00	180.0	8.70	-2.13	6.57	2.13	
*3.50	H/1.00	180.0	15.6	3.81	19.41	9.34	
*4.95	H/1.00	180.0	12.0	5.42	17.42	7.43	
25000.00							500



**Retlif Testing Laboratories**

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	The frequency range was scanned from 9 kHz to 25 GHz.
	The emissions observed from the EUT do not exceed the specified limits.
	Emissions not recorded were more than 20dB under the specified limit.
	*Noise floor measurement, minimum sensitivity of measurement system EUT was scanned up to 25GHz, No signals detected from EUT.



**Retlif Testing Laboratories**

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