



*Testing Tomorrow's Technology*

## **Application**

**For**

**Part 2, Subpart J, Paragraph 2.907 Equipment Authorization of Certification for an Intentional Radiator per Part 15, Subpart B, paragraph 15.109, Subpart C, paragraphs 15.207, 15.209 and 15.249**

**And**

**Innovation Science and Economic Development Canada  
Certification Per  
IC RSS-Gen General Requirements for Radio Apparatus (Issue 5)  
And  
RSS-210, License Exempt Radio Apparatus Category I Equipment (Issue 9)**

**For the**

**Inventek Systems  
Model: ISM4343-X**

**FCC ID: O7P-4343  
IC ID: 10147A-4343**

**UST Project: 18-0330  
Issue Date: November 6, 2018**

Total Pages in This Report: 35

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PH: 770-740-0717 Fax: 770-740-1508  
[www.ustech-lab.com](http://www.ustech-lab.com)**



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I certify that I am authorized to sign for the Test Agency and that all of the statements in this report and in the Exhibits attached hereto are true and correct to the best of my knowledge and belief:

US TECH (Agent Responsible For Test):

By: George Yang

Name: 

Title: Laboratory Manager

Date November 6, 2018



TESTING

NVLAP LAB CODE 200162-0

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FCC ID:  
IC:  
Test Report Number:  
Issue Date:  
Customer:  
Model:

FCC Part 15 Certification/ RSS 210  
O7P-4343  
10147A-4343  
18-0330  
November 6, 2018  
Inventek  
ISM4343-X

## MEASUREMENT TECHNICAL REPORT

**COMPANY NAME:** Inventek Systems

**MODEL:** ISM4343-X

**FCC ID:** O7P-4343

**IC ID:** 10147A-4343

**DATE:** November 6, 2018

This report concerns (check one): Original grant ☒  
Class II change

Equipment type: 2402 – 2480 MHz Transmitter Module

Deferred grant requested per 47 CFR 0.457(d)(1)(ii)? Yes \_\_\_\_\_ No X

If yes, defer until: N/A  
date

agrees to notify the Commission by N/A  
date

of the intended date of announcement of the product so that the grant can be issued on that date.

Report prepared by:

US Tech  
3505 Francis Circle  
Alpharetta, GA 30004  
Phone Number: (770) 740-0717  
Fax Number: (770) 740-1508

US Tech Test Report:  
FCC ID:  
IC:  
Test Report Number:  
Issue Date:  
Customer:  
Model:

FCC Part 15 Certification/ RSS 210  
O7P-4343  
10147A-4343  
18-0330  
November 6, 2018  
Inventek  
ISM4343-X

## Table of Contents

<u>Paragraph</u>	<u>Title</u>	<u>Page</u>
<b>1</b>	<b>General Information.....</b>	<b>7</b>
1.1	Purpose of this Report .....	7
1.2	Characterization of Test Sample.....	7
1.3	Product Description .....	7
1.4	Configuration of Tested System.....	8
1.5	Test Facility.....	8
1.6	Related Submittals.....	8
<b>2</b>	<b>Tests and Measurements .....</b>	<b>10</b>
2.1	Test Equipment.....	10
2.2	Modifications to EUT Hardware .....	11
2.3	Number of Measurements for Intentional Radiators (15.31(m)).....	11
2.4	Frequency Range of Radiated Measurements (Part 15.33).....	11
2.4.1	Intentional Radiator .....	11
2.4.2	Unintentional Radiator .....	12
2.5	Measurement Detector Function and Bandwidth (CFR 15.35) .....	12
2.5.1	Detector Function and Associated Bandwidth .....	12
2.5.2	Corresponding Peak and Average Requirements .....	12
2.5.3	Pulsed Transmitter Averaging .....	12
2.6	EUT Antenna Requirements (CFR 15.203) .....	13
2.7	Restricted Bands of Operation (Part 15.205) .....	14
2.8	Pulsed Operation, Average value (CFR 15.35 (c)) ..... <b>Error! Bookmark not defined.</b>	
2.9	Intentional Radiator, Power Line Conducted Emissions (CFR 15.207).....	14
2.10	Intentional Radiator, Radiated Emissions (CFR 15.209, 15.249(a),(c)) (IC RSS 210, A2.9 (a)) .....	15
2.11	Band Edge Measurements – (CFR 15.249 (d)) .....	22
2.12	99% Occupied Bandwidth (Part 2.1049).....	31
2.13	Measurement Uncertainty .....	35
2.13.1	Conducted Emissions Measurement Uncertainty .....	35
2.13.2	Radiated Emissions Measurement Uncertainty .....	35
<b>3</b>	<b>Conclusions .....</b>	<b>35</b>

US Tech Test Report:  
FCC ID:  
IC:  
Test Report Number:  
Issue Date:  
Customer:  
Model:

FCC Part 15 Certification/ RSS 210  
O7P-4343  
10147A-4343  
18-0330  
November 6, 2018  
Inventek  
ISM4343-X

## **List of Figures**

<b><u>Figures</u></b>	<b><u>Title</u></b>	<b><u>Page</u></b>
Figure 1.	Block Diagram of Test Configuration .....	13
Figure 2.	Band Edge Compliance (Chip Antenna) Low Channel Delta - Peak.....	23
Figure 3.	Radiated Restricted Band 2310 MHz to 2390 MHz (Chip Antenna) Peak	24
Figure 4.	Band Edge Compliance (Chip Antenna) High Channel Delta – Peak.....	25
Figure 5.	Radiated Restricted Band 2483.5 MHz to 2500 MHz (Chip Antenna) Peak .....	26
Figure 6.	Band Edge Compliance (External Antenna) Low Channel Delta - Peak...	27
Figure 7.	Radiated Restricted Band 2310 MHz to 2390 MHz (External Antenna) Peak.....	28
Figure 8.	Band Edge Compliance (External Antenna) High Channel Delta – Peak	29
Figure 9.	Radiated Restricted Band 2483.5 MHz to 2500 MHz (External Antenna) Peak.....	30
Figure 10.	99% Occupied Bandwidth – Low Channel.....	32
Figure 11.	99% Occupied Bandwidth – Mid Channel.....	33
Figure 12.	99% Occupied Bandwidth – High Channel .....	34

US Tech Test Report:  
FCC ID:  
IC:  
Test Report Number:  
Issue Date:  
Customer:  
Model:

FCC Part 15 Certification/ RSS 210  
O7P-4343  
10147A-4343  
18-0330  
November 6, 2018  
Inventek  
ISM4343-X

## **List of Tables**

<b><u>Table</u></b>	<b><u>Title</u></b>	<b><u>Page</u></b>
Table 1.	EUT and Peripherals.....	9
Table 2.	Test Instruments .....	10
Table 3.	Number of Test Frequencies for Intentional Radiators.....	11
Table 4.	Allowed Antenna(s).....	13
Table 5.	Power Line Conducted Emissions Test Data, Part 15.207.....	14
Table 6.	Spurious Radiated Emissions Below 30 MHz .....	16
Table 7.	Spurious Radiated Emissions (other than Fundamental & Harmonics) .....	17
Table 8.	Fundamental Emissions – Chip Antenna (Peak & AVG).....	18
Table 9.	Harmonics Emissions – Chip Antenna (Peak & AVG) .....	19
Table 10.	Fundamental Emissions – External Antenna (Peak & AVG) .....	20
Table 11.	Harmonics Emissions – External Antenna (Peak & AVG).....	21
Table 12.	Radiated Restricted Band 2310 MHz to 2390 MHz, Peak.....	24
Table 13.	Radiated Restricted Band 2483.5 MHz to 2500 MHz, Peak.....	26
Table 14.	Radiated Restricted Band 2310 MHz to 2390 MHz, Peak.....	28
Table 15.	Radiated Restricted Band 2483.5 MHz to 2500 MHz, Peak.....	30
Table 16.	20 dB Bandwidth and 99% Occupied Bandwidth .....	31

## **List of Attachments**

Agency Agreement  
Application Forms  
Letter of Confidentiality  
Equipment Label(s)  
Block Diagram(s)  
Schematic(s)  
Test Configuration Photographs  
Internal Photographs  
External Photographs  
Theory of Operation  
User's Manual

US Tech Test Report:  
FCC ID:  
IC:  
Test Report Number:  
Issue Date:  
Customer:  
Model:

FCC Part 15 Certification/ RSS 210  
O7P-4343  
10147A-4343  
18-0330  
November 6, 2018  
Inventek  
ISM4343-X

---

## **1 General Information**

### **1.1 Purpose of this Report**

This report is prepared as a means of conveying test results and information concerning the suitability of this exact product for public distribution according to the FCC Rules and Regulations Part 15, Section 249 and RSS-210 Issue 9.

### **1.2 Characterization of Test Sample**

The sample used for testing was received by US Tech on September 15, 2018 in good operating condition.

### **1.3 Product Description**

The Equipment Under Test (EUT) is the Inventek 2.4 GHz e-BLE SIP Module Model: ISM4343-WBM-L54. The EUT is an embedded wireless Bluetooth low energy (BLE) connectivity device, based on the Renesas ISM4343-WBM-L54 microcomputer incorporating the WBM-L54 CPU core and low power consumption RF transceiver supporting the Bluetooth ver.4.1 (Low Energy Single mode) specifications. The Inventek ISM4343 offers a WBM-L54 CPU core is 3-stage pipeline CISC architecture with an integrated BLE Radio, on-board chip antenna, and 256 KB ROM. The module provides a number of features and standard peripheral interfaces, enabling connection to an embedded design. The low cost, small foot print, 11mm x 13mm 31-Pin LGA package and ease of design-in make it ideal for a range of embedded applications. The module provides UART, I<sup>2</sup>C.

Radio: Bluetooth v4.1 Spec. (Low Energy, Single mode)  
Range: 2400-2500 MHz ISM Band  
Modulation: GFSK  
RF Output Power (EIRP): +0 dBm  
Data Rate: Mbps (Max): 1 Mbps  
Channels: 40

US Tech Test Report:  
FCC ID:  
IC:  
Test Report Number:  
Issue Date:  
Customer:  
Model:

FCC Part 15 Certification/ RSS 210  
O7P-4343  
10147A-4343  
18-0330  
November 6, 2018  
Inventek  
ISM4343-X

---

## **1.4 Configuration of Tested System**

The Test Sample was tested per *ANSI C63.4:2014, Methods of Measurement of Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (2014)*, and *ANSI C63.10.2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices*.

A list of EUT and Peripherals is found in Table 1 below. A block diagram of the tested system is shown in Figure 1. Test configuration photographs are provided in separate Appendices

## **1.5 Test Facility**

Testing was performed at US Tech's measurement facility at 3505 Francis Circle, Alpharetta, GA 30004. This site has been fully described and registered with the FCC under designation number US5301. Additionally, this site has also been fully described and submitted to Industry Canada (IC), and has been approved under file number 9900A-1.

## **1.6 Related Submittals**

The EUT is subject to the following FCC authorizations:

- a) Certification under section 15.249 as a transmitter.



US Tech Test Report:  
FCC ID:  
IC:  
Test Report Number:  
Issue Date:  
Customer:  
Model:

FCC Part 15 Certification/ RSS 210  
O7P-4343  
10147A-4343  
18-0330  
November 6, 2018  
Inventek  
ISM4343-X

**Table 1. EUT and Peripherals**

PERIPHERAL MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	FCC/IC ID	CABLES P/D
Inventek	ISM4343-X	Engineering Sample	FCC ID: O7P-4343 IC ID: 10147A-4343 (pending)	UD
Hewlett-Packard (Laptop)	EliteBook 8530p	2CE010000 TG	Unknown	-
Hewlett-Packard (Power Supply Adapter)	384020-001	PA-1900- 08H2	Not Applicable	3.0 m UP
Antenna See antenna details	--	--	--	--

U= Unshielded  
S= Shielded  
P= Power  
D= Data

US Tech Test Report:  
FCC ID:  
IC:  
Test Report Number:  
Issue Date:  
Customer:  
Model:

FCC Part 15 Certification/ RSS 210  
O7P-4343  
10147A-4343  
18-0330  
November 6, 2018  
Inventek  
ISM4343-X

## 2 Tests and Measurements

### 2.1 Test Equipment

The table below lists test equipment used to evaluate this product. Model numbers, serial numbers and their calibration status are indicated.

**Table 2. Test Instruments**

TEST INSTRUMENT	MODEL NUMBER	MANUFACTURER	SERIAL NUMBER	CALIBRATION DUE DATE
SPECTRUM ANALYZER	E4407B	AGILENT	US41442935	8/17/2020
SPECTRUM ANALYZER	8593E	HEWLETT-PACKARD	3205A00124	01/25/2019
LOOP ANTENNA	SAS-200/562	A. H. Systems	142	1/22/2020 2 yr.
BICONICAL ANTENNA	3110B	EMCO	9307-1431	5/2/2019 2 yr
LOG PERIODIC ANTENNA	3146	EMCO	9305-3600	5/1/2019 2 yr
HORN ANTENNA	3115	EMCO	9107-3723	12/22/2018
RF PREAMP 100 kHz to 1.3 GHz	8447D	HEWLETT-PACKARD	1937A02980	3/7/2019
PREAMP 1.0 GHz to 26.0 GHz	8449B	HEWLETT-PACKARD	3008A00480	2/28/2019
HIGH PASS FILTER	H3R020G2	MICROWAVE CHIRCUITS	001DC9528	3/8/2019
8 dB ATTENUATOR	VAT-8 15542	MINI-CIRCUITS	30519	3/8/2019

Note: The calibration interval of the above test instruments are 12 months unless stated otherwise and all calibrations are traceable to NIST/USA.

## 2.2 Modifications to EUT Hardware

No physical modifications were made by US Tech in order to bring the EUT into compliance with FCC Part 15, Subpart C Intentional Radiator Limits for the transmitter portion of the EUT or the Subpart B Unintentional Radiator Limits (Receiver and Digital Device) Requirements.

## 2.3 Number of Measurements for Intentional Radiators (CFR 15.31(m), RSS-Gen 6.8)

Measurements of intentional radiators or receivers shall be performed and reported for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in Table 3 below.

**Table 3. Number of Test Frequencies for Intentional Radiators**

Frequency Range over which the device operates	Number of Frequencies	Location in the Range of Operation
1 MHz or less	1	Middle
1 to 10 MHz	2	1 near the top 1 near the bottom
Greater than 10 MHz	3	1 near top 1 near middle 1 near bottom

Because the EUT operates at 2402 MHz to 2480 MHz, 3 test frequencies were used.

## 2.4 Frequency Range of Radiated Measurements (CFR 15.33, RSS-Gen 6.13)

### 2.4.1 Intentional Radiator

The spectrum was investigated for the intentional radiator from the lowest RF signal generated in the EUT, without going below 9 kHz to the 10<sup>th</sup> harmonic of the highest fundamental frequency generated or 40 GHz, whichever is the lowest.

## **2.4.2 Unintentional Radiator**

For the digital device, an unintentional radiator, the frequency range tested was 30 MHz to 1000 MHz, or to 5 times the highest internal clock frequency.

## **2.5 Measurement Detector Function and Bandwidth (CFR 15.35, RSS-Gen 6.9, 6.13)**

The radiated and conducted emissions limits shown herein are based on the parameters listed below.

### **2.5.1 Detector Function and Associated Bandwidth**

On frequencies below 1000 MHz, the limits herein are based upon measurement equipment employing a CISPR Quasi-peak detector function and related measurement bandwidths (i.e. 9 kHz from 150 kHz to 30 MHz and 120 kHz from 30 MHz to 1000 MHz). Alternatively, measurements may be made with equipment employing a peak detector function as long as the same bandwidths specified for the Quasi-peak device are used.

### **2.5.2 Corresponding Peak and Average Requirements**

Above 1000 MHz, radiated limits are based on measuring instrumentation employing an average detector function. When average radiated emissions are specified there is also a corresponding Peak requirement, as measured using a peak detector, of 20 dB greater than the average limit. For all measurements above 1000 MHz the Resolution Bandwidth shall be at least 1 MHz.

### **2.5.3 Pulsed Transmitter Averaging**

When the radiated emissions limit is expressed as an average value, and the transmitter is pulsed, the measured field strength shall be determined by applying a Duty Cycle Correction Factor based upon dividing the total ON time during the first 100 ms period by 100 ms (or by the period if less than 100 ms). The duty cycle may be expressed logarithmically in dB.

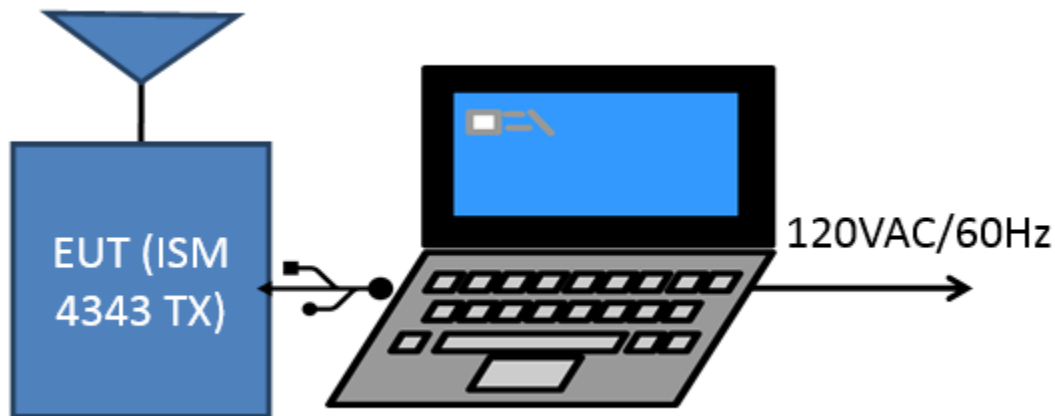
NOTE: If the transmitter was programmed to transmit at >98% duty cycle, then, wherever applicable (where the detection mode was AVG), the duty cycle factor calculated will be applied.

## 2.6 EUT Antenna Requirements (CFR 15.203, RSS-Gen 6.7)

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. Only the antenna(s) listed in Table 4 will be used with this device.

**Table 4. Allowed Antenna(s)**

REPORT REFERENCE	MANUFACTURER	TYPE OF ANTENNA	MODEL	GAIN dB <sub>i</sub>	TYPE OF CONNECTOR
Chip Antenna	Inventek Systems	Chip	W245-SC	+1.4	U.FL
External Antenna	Inventek Systems	Trace	W24P-U	+3.2	U.FL



**Figure 1. Block Diagram of Test Configuration**

**Note: The laptop is used for programming the radio module only.**

US Tech Test Report:  
 FCC ID:  
 IC:  
 Test Report Number:  
 Issue Date:  
 Customer:  
 Model:

FCC Part 15 Certification/ RSS 210  
 O7P-4343  
 10147A-4343  
 18-0330  
 November 6, 2018  
 Inventek  
 ISM4343-X

## 2.7 Restricted Bands of Operation (CFR 15.205, RSS-Gen 8.10)

Only spurious emissions can fall in the frequency bands of CFR 15.205. The field strength of these spurious emissions cannot exceed the limits of 15.209. Radiated harmonics and other spurious emissions are examined for this requirement see paragraph 2.1

## 2.9 Intentional Radiator, Power Line Conducted Emissions (CFR 15.207, RSS-8.8)

The EUT was evaluated for compliance to 15.207 emissions.

**Table 5. Power Line Conducted Emissions Test Data, Part 15.207**

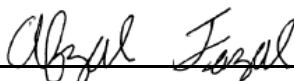
150KHz to 30 MHz						
Test: Power Line Conducted Emissions				Client: Inventek Systems		
Project: 18-0330				Model: ISM4343-X		
Frequency (MHz)	Test Data (dBuV)	LISN+CL-PA (dB)	Results (dBuV)	AVG Limits (dBuV)	Margin (dB)	Detector PK, QP, or AVG
Phase						
0.1535	49.35	0.48	49.83	55.8	6.0	PK
0.5000	33.93	0.15	34.08	46.0	11.9	PK
4.7200	33.13	0.23	33.36	46.0	12.6	PK
9.7750	37.03	0.39	37.42	50.0	12.6	PK
12.8300	37.04	0.52	37.56	50.0	12.4	PK
24.2000	30.88	0.73	31.61	50.0	18.4	PK
Neutral						
0.1553	48.72	0.58	49.30	55.7	6.4	PK
0.6200	30.01	0.28	30.29	46.0	15.7	PK
4.5200	36.12	0.38	36.50	46.0	9.5	PK
8.7370	34.49	0.48	34.97	50.0	15.0	PK
12.5300	35.86	0.62	36.48	50.0	13.5	PK
20.2000	34.08	0.72	34.80	50.0	15.2	PK

Sample Calculation at: 0.1535 MHz

Magnitude of Measured Frequency	49.35	dBuV
+Antenna Factor + Cable Loss	0.48	dB
Corrected Result	49.83	dBuV/m

Test Date: November 6, 2018

Tested By

Signature:  Name: Afzal Fazal

US Tech Test Report:  
FCC ID:  
IC:  
Test Report Number:  
Issue Date:  
Customer:  
Model:

FCC Part 15 Certification/ RSS 210  
O7P-4343  
10147A-4343  
18-0330  
November 6, 2018  
Inventek  
ISM4343-X

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## **2.10 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.249(a),(c), RSS 210, A2.9 (a))**

Radiated Spurious measurements: the EUT was placed into a continuous transmit mode of operation transmitting at >98% duty cycle and tested per ANSI C63.10:2013. A preliminary scan was performed on the EUT to find signal frequencies that were caused by the transmitter part of the device. To obtain worse case results the EUT was tested in X, Y and Z axes or in the orientation of normal operation if the device is designed to operation in a fixed position.

Radiated measurements were then conducted between the frequency range of 9 KHz (or lowest frequency used/generated by the device) up to the tenth harmonic of the device (no greater than 40 GHz). In the band below 30 MHz a resolution bandwidth (RBW) of 9 kHz was used; emissions below 1 GHz were tested with a RBW of 120 KHz and emissions above 1 GHz were tested with a RBW of 1 MHz. All video bandwidth settings were at least three times the RBW value.

The EUT was investigated to CFR 15.209, General requirements for unwanted spurious emissions.

US Tech Test Report:  
FCC ID:  
IC:  
Test Report Number:  
Issue Date:  
Customer:  
Model:

FCC Part 15 Certification/ RSS 210  
O7P-4343  
10147A-4343  
18-0330  
November 6, 2018  
Inventek  
ISM4343-X

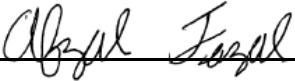
**Table 6. Spurious Radiated Emissions Below 30 MHz**

9 kHz to 30 MHz, 15.209 limits							
Test: Radiated Emissions				Client: Inventek Systems			
Project: 18-0330				Model: ISM4343-X			
Frequency (MHz)	Test Data (dBuV)	AF+CA- AMP (dB/m)	Results (dBuV/m)	QP Limits (dBuV/m)	Antenna Distance/ Polarization	Margin (dB)	Detector PK, or AVG
No emissions seen greater than 20 dB from the applicable limit.							

Sample Calculation: N/A

Test Date: November 1, 2018

Tested By

Signature:  Name: Afzal Fazal



US Tech Test Report:  
 FCC ID:  
 IC:  
 Test Report Number:  
 Issue Date:  
 Customer:  
 Model:

FCC Part 15 Certification/ RSS 210  
 O7P-4343  
 10147A-4343  
 18-0330  
 November 6, 2018  
 Inventek  
 ISM4343-X

**Table 7. Spurious Radiated Emissions (other than Fundamental & Harmonics)**

Test: FCC Part 15, Paragraph 15.209, 15.249(a)					Client: Inventek Systems			
Project: 18-0330					Model: ISM4343-X			
Frequency (MHz)	Test Data (dBuV)	Factor (dB)	AF+CA -AMP (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Antenna Distance/ Polarization	Margin (dB)	Detector Mode
69.44	39.10	-	-17.57	21.53	40.0	3m./HORZ	18.5	PK
139.20	47.45	-	-13.79	33.66	43.5	3m./HORZ	9.8	PK
200.96	37.87	-	-13.59	24.28	43.5	3m./HORZ	19.2	PK
710.00	41.75	-	-2.04	39.71	46.0	3m./HORZ	6.3	PK
1005.00	49.79	-	-10.63	39.16	54.0	3m./HORZ	14.8	PK
3143.00	47.76	-	-0.95	46.81	54.0	3m./HORZ	7.2	PK
11411.00	28.45	-	14.16	42.61	54.0	1m./HORZ	11.4	AVG
69.44	47.85	-	-18.37	29.48	40.0	3m./VERT	10.5	PK
139.00	47.43	-	-13.39	34.04	43.5	3m./VERT	9.5	PK
501.90	35.03	-	-6.12	28.91	46.0	3m./VERT	17.1	PK
1242.00	50.82	-	-8.76	42.06	54.0	3m./VERT	11.9	PK
3225.00	47.46	-	-0.46	47.00	54.0	3m./VERT	7.0	PK
8235.00	39.81	-	8.17	47.98	54.0	1m./VERT	6.0	PK

Notes:


1. No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10<sup>th</sup> harmonic
2. The EUT was placed in three orthogonal positions and the transmitter was in constant broadcast mode, with the duty cycle programmed for >98% ON time in continuous transmit mode.
3. The emissions were measured with the receive antenna in vertical and horizontal polarizations. The data listed in the above table was worst case.

Sample Calculation at: 69.44 MHz

Magnitude of Measured Frequency	39.10	dBuV
+Antenna Factor + Cable Loss+ Amplifier Gain	-17.57	dB/m
Duty Cycle Correction Factor	None	dB
Corrected Result	21.53	dBuV/m

Test Date: November 1, 2018

Tested By

Signature:  Name: Afzal Fazal

US Tech Test Report:  
 FCC ID:  
 IC:  
 Test Report Number:  
 Issue Date:  
 Customer:  
 Model:

FCC Part 15 Certification/ RSS 210  
 O7P-4343  
 10147A-4343  
 18-0330  
 November 6, 2018  
 Inventek  
 ISM4343-X

**Table 8. Fundamental Emissions – Chip Antenna (Peak & AVG)**

Test: FCC Part 15, Paragraph 15.209, 15.249(a)					Client: Inventek Systems			
Project: 18-0330					Model: ISM4343-X			
Frequency (MHz)	Test Data (dBuV)	Factor (dB)	AF+CA -AMP (dB/m)	Results (dBuV/m)	AVG Limits (dBuV/m)	Antenna Distance/ Polarization	Margin (dB)	Detector Mode
<b>Low - Channel</b>								
2402.00	58.45	-	30.35	88.80	114.0	3.0m./HORZ	25.2	<b>PK</b>
2402.00	42.54	-	30.35	72.89	94.0	3.0m./HORZ	21.1	<b>AVG</b>
<b>Mid - Channel</b>								
2426.00	62.63	-	30.35	92.98	114.0	3.0m./HORZ	21.0	<b>PK</b>
2426.00	46.23	-	30.35	76.58	94.0	3.0m./HORZ	17.4	<b>AVG</b>
<b>High - Channel</b>								
2480.00	69.13	-	30.38	99.51	114.0	3.0m./HORZ	14.5	<b>PK</b>
2480.00	51.53	-	30.38	81.91	94.0	3.0m./HORZ	12.1	<b>AVG</b>

**Notes:**


1. No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10<sup>th</sup> harmonic
2. The EUT was placed in three orthogonal positions and the transmitter was in constant broadcast mode, with the duty cycle programmed for >98% ON time in continuous transmit mode.
3. The emissions were measured with the receive antenna in vertical and horizontal polarizations. The data listed in the above table was worst case.

**Sample Calculation at: 2402.00**

Magnitude of Measured Frequency	58.45	dBuV
+Antenna Factor + Cable Loss - Amplifier Gain	30.35	dB/m
Corrected Result	88.80	dBuV/m

Test Date: October 29, 2018

Tested By

Signature:  Name: Afzal Fazal

US Tech Test Report:  
 FCC ID:  
 IC:  
 Test Report Number:  
 Issue Date:  
 Customer:  
 Model:

FCC Part 15 Certification/ RSS 210  
 O7P-4343  
 10147A-4343  
 18-0330  
 November 6, 2018  
 Inventek  
 ISM4343-X

**Table 9. Harmonics Emissions – Chip Antenna (Peak & AVG)**

Test: FCC Part 15, Paragraph 15.209, 15.249(a)					Client: Inventek Systems			
Project: 18-0330					Model: ISM4343-X			
Frequency (MHz)	Test Data (dBuV)	Factor (dB)	AF+CA -AMP (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Antenna Distance/ Polarization	Margin (dB)	Detector Mode
<b>Low - Channel</b>								
4804.00	48.90	-	2.80	51.70	74.0	3.0m./HORZ	22.3	<b>PK</b>
4804.00	27.01	-	2.80	29.81	54.0	3.0m./HORZ	24.2	<b>AVG</b>
7206.00	49.80	-	8.21	58.01	74.0	3.0m./HORZ	16.0	<b>PK</b>
7206.00	27.54	-	8.21	35.75	54.0	3.0m./HORZ	18.2	<b>AVG</b>
<b>Mid – Channel</b>								
4852.00	49.66	-	1.26	50.92	74.0	3.0m./HORZ	23.1	<b>PK</b>
4852.00	28.34	-	1.26	29.60	54.0	3.0m./HORZ	24.4	<b>AVG</b>
7278.00	49.16	-	9.08	58.24	74.0	3.0m./HORZ	15.8	<b>PK</b>
7278.00	28.07	-	9.08	37.15	54.0	3.0m./HORZ	16.9	<b>AVG</b>
<b>High – Channel</b>								
4960.00	49.82	-	2.39	52.21	74.0	3.0m./HORZ	21.8	<b>PK</b>
4960.00	28.27	-	2.39	30.66	54.0	3.0m./HORZ	23.3	<b>AVG</b>
7440.00	50.33	-	9.36	59.69	74.0	3.0m./HORZ	14.3	<b>PK</b>
7440.00	28.56	-	9.36	37.92	54.0	3.0m./HORZ	16.1	<b>AVG</b>

Notes:

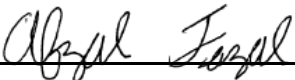
1. No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10<sup>th</sup> harmonic
2. The EUT was placed in three orthogonal positions and the transmitter was in constant broadcast mode, with the duty cycle programmed for >98% ON time in continuous transmit mode.
3. The emissions were measured with the receive antenna in vertical and horizontal polarizations. The data listed in the above table was worst case.

Sample Calculation at: 4804.00 MHz

Magnitude of Measured Frequency	48.90	dBuV
+Antenna Factor + Cable Loss+ Amplifier Gain – Duty Cycle	2.80	dB/m
Duty Cycle Correction Factor	None	dB
Corrected Result	51.70	dBuV/m

Test Date: October 29, 2018

Tested By

Signature:  Name: Afzal Fazal

US Tech Test Report:  
 FCC ID:  
 IC:  
 Test Report Number:  
 Issue Date:  
 Customer:  
 Model:

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 O7P-4343  
 10147A-4343  
 18-0330  
 November 6, 2018  
 Inventek  
 ISM4343-X

**Table 10. Fundamental Emissions – External Antenna (Peak & AVG)**

Test: FCC Part 15, Paragraph 15.209, 15.249(a)					Client: Inventek Systems			
Project: 18-0330					Model: ISM4343-X			
Frequency (MHz)	Test Data (dBuV)	Factor (dB)	AF+CA -AMP (dB/m)	Results (dBuV/m)	AVG Limits (dBuV/m)	Antenna Distance/ Polarization	Margin (dB)	Detector Mode
<b>Low - Channel</b>								
2402.00	71.67	-	30.54	102.21	114.0	3.0m./VERT	11.8	<b>PK</b>
2402.00	54.27	-	30.54	84.81	94.0	3.0m./VERT	9.2	<b>AVG</b>
<b>Mid - Channel</b>								
2426.00	73.10	-	30.54	103.64	114.0	3.0m./VERT	10.4	<b>PK</b>
2426.00	55.26	-	30.54	85.80	94.0	3.0m./VERT	8.2	<b>AVG</b>
<b>High - Channel</b>								
2480.00	74.16	-	30.56	104.72	114.0	3.0m./VERT	9.3	<b>PK</b>
2480.00	55.76	-	30.56	86.32	94.0	3.0m./VERT	7.7	<b>AVG</b>

**Notes:**

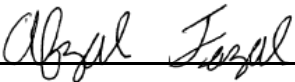
1. No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10<sup>th</sup> harmonic
2. The EUT was placed in three orthogonal positions and the transmitter was in constant broadcast mode, with the duty cycle programmed for >98% ON time in continuous transmit mode.
3. The emissions were measured with the receive antenna in vertical and horizontal polarizations. The data listed in the above table was worst case.

Sample Calculation at: 2402.00

Magnitude of Measured Frequency	71.67	dBuV
+Antenna Factor + Cable Loss - Amplifier Gain	30.54	dB/m
Corrected Result	102.21	dBuV/m

Test Date: October 29, 2018

Tested By

Signature:  Name: Afzal Fazal

US Tech Test Report:  
 FCC ID:  
 IC:  
 Test Report Number:  
 Issue Date:  
 Customer:  
 Model:

FCC Part 15 Certification/ RSS 210  
 O7P-4343  
 10147A-4343  
 18-0330  
 November 6, 2018  
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 ISM4343-X

**Table 11. Harmonics Emissions – External Antenna (Peak & AVG)**

Test: FCC Part 15, Paragraph 15.209, 15.249(a)					Client: Inventek Systems			
Project: 18-0330					Model: ISM4343-X			
Frequency (MHz)	Test Data (dBuV)	Factor (dB)	AF+CA -AMP (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Antenna Distance/ Polarization	Margin (dB)	Detector Mode
<b>Low - Channel</b>								
4804.00	48.67	-	2.82	51.49	74.0	3.0m./VERT	22.5	<b>PK</b>
4804.00	27.76	-	2.82	30.58	54.0	3.0m./VERT	23.4	<b>AVG</b>
7206.00	48.96	-	8.25	57.21	74.0	3.0m./VERT	16.8	<b>PK</b>
7206.00	27.96	-	8.25	36.21	54.0	3.0m./VERT	17.8	<b>AVG</b>
<b>Mid – Channel</b>								
4852.00	49.21	-	1.29	50.50	74.0	3.0m./VERT	23.5	<b>PK</b>
4852.00	28.01	-	1.29	29.30	54.0	3.0m./VERT	24.7	<b>AVG</b>
7278.00	49.07	-	9.12	58.19	74.0	3.0m./VERT	15.8	<b>PK</b>
7278.00	27.92	-	9.12	37.04	54.0	3.0m./VERT	17.0	<b>AVG</b>
<b>High – Channel</b>								
4960.00	49.56	-	2.33	51.89	74.0	3.0m./VERT	22.1	<b>PK</b>
4960.00	28.08	-	2.33	30.41	54.0	3.0m./VERT	23.6	<b>AVG</b>
7440.00	49.74	-	9.37	59.11	74.0	3.0m./VERT	14.9	<b>PK</b>
7440.00	28.16	-	9.37	37.53	54.0	3.0m./VERT	16.5	<b>AVG</b>

Notes:

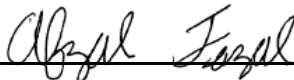
1. No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10<sup>th</sup> harmonic
2. The EUT was placed in three orthogonal positions and the transmitter was in constant broadcast mode, with the duty cycle programmed for >98% ON time in continuous transmit mode.
3. The emissions were measured with the receive antenna in vertical and horizontal polarizations. The data listed in the above table was worst case.

Sample Calculation at: 4804.00 MHz

Magnitude of Measured Frequency	48.67	dBuV
+Antenna Factor + Cable Loss+ Amplifier Gain – Duty Cycle	2.82	dB/m
<u>Duty Cycle Correction Factor</u>	<u>None</u>	<u>dB</u>
Corrected Result	51.49	dBuV/m

Test Date: October 29, 2018

Tested By

Signature:  Name: Afzal Fazal

US Tech Test Report:  
FCC ID:  
IC:  
Test Report Number:  
Issue Date:  
Customer:  
Model:

FCC Part 15 Certification/ RSS 210  
O7P-4343  
10147A-4343  
18-0330  
November 6, 2018  
Inventek  
ISM4343-X

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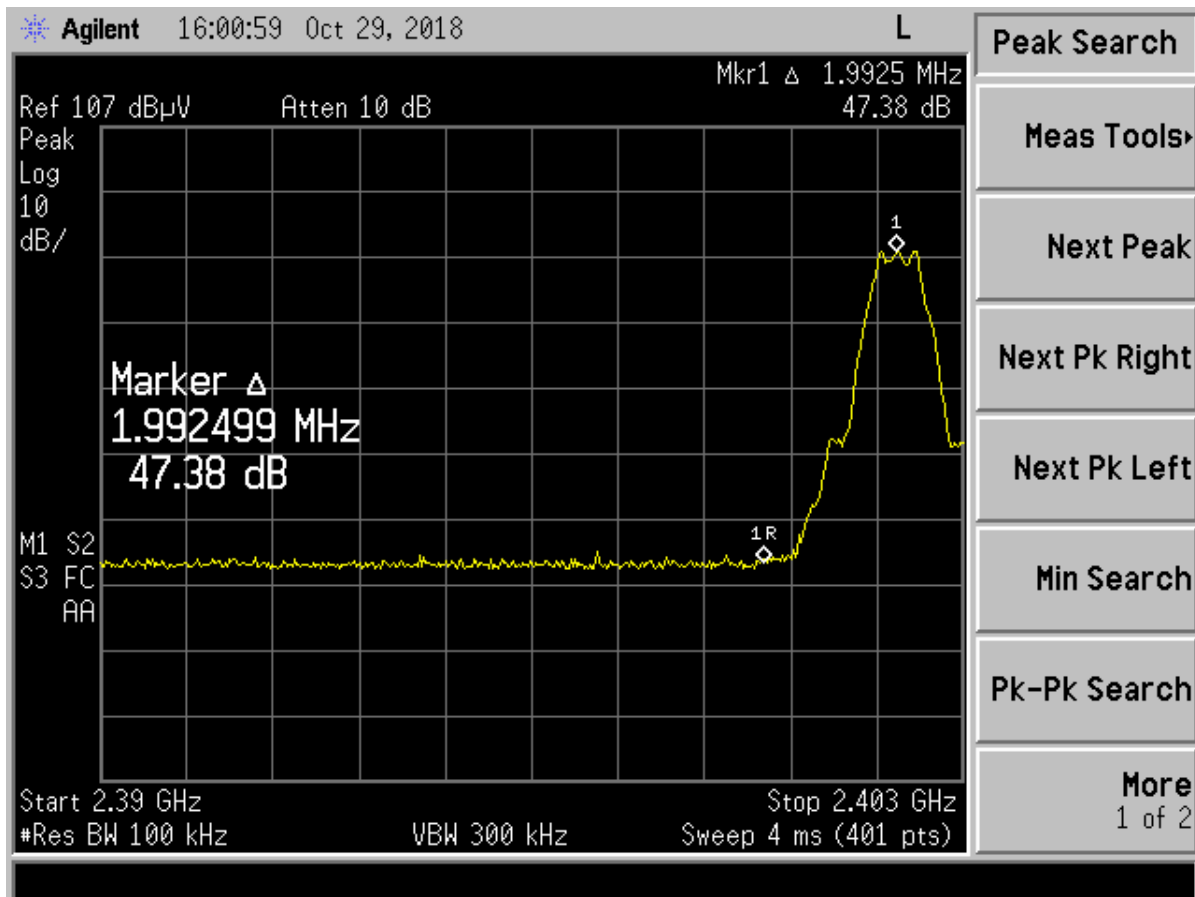
## **2.11 Band Edge Measurements (CFR 15.249(d), RSS-Gen 8.10)**

Band Edge measurements are made following the guidelines in FCC KDB Publication No. 558074 with the EUT initially operating on the Lowest Channel and then operating on the Highest Channel within its band of operation. Radiated measurements are performed to demonstrate compliance with the requirement of 15.249(d) that all emissions outside of the band edges be attenuated by at least 50 dB or 15.209 limits, when compared to its highest in-band value (contained in a 100 kHz band).

To capture the band edge, set the Spectrum Analyzer frequency span to 2 MHz to capture the peak level of the emission operating on the channel closest to the band edge as well as any modulation products falling outside of the authorized band of operation. See figure and calculations following for more detail.

US Tech Test Report:  
 FCC ID:  
 IC:  
 Test Report Number:  
 Issue Date:  
 Customer:  
 Model:

FCC Part 15 Certification/ RSS 210  
 O7P-4343  
 10147A-4343  
 18-0330  
 November 6, 2018  
 Inventek  
 ISM4343-X



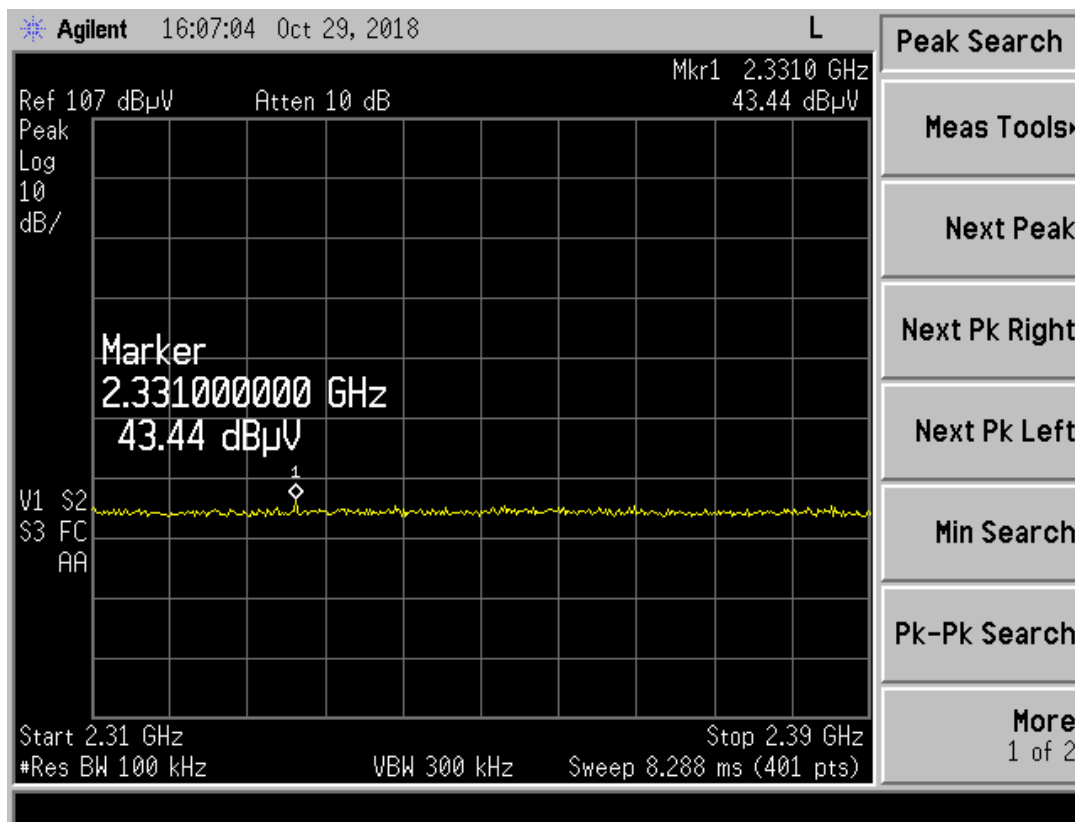
**Figure 2. Band Edge Compliance (Chip Antenna) Low Channel Delta - Peak**

Low Channel Corrected Measured Value from Table 8	88.80	dBuV
Low Channel Band Edge Delta from Figure 4	-47.38	dB
Calculated Result	41.42	dBuV/m
Band Edge Limit	54.00	dBuV/m
Calculated Result	41.42	dBuV/m
Band Edge Margin	12.58	dBuV/m

Peak value meets AVG limit.

US Tech Test Report:  
 FCC ID:  
 IC:  
 Test Report Number:  
 Issue Date:  
 Customer:  
 Model:

FCC Part 15 Certification/ RSS 210  
 O7P-4343  
 10147A-4343  
 18-0330  
 November 6, 2018  
 Inventek  
 ISM4343-X



**Figure 3. Radiated Restricted Band 2310 MHz to 2390 MHz (Chip Antenna) Peak**

**Table 12. Radiated Restricted Band 2310 MHz to 2390 MHz, Peak**

2310 MHz to 2390 MHz Restricted Band Peak Measurements							
Test: Radiated Emissions				Client: Inventek Systems			
Project: 18-0330				Model: ISM4343-X			
Frequency (MHz)	Test Data (dBuV)	AF+CA-AMP (dB/m)	Results (dBuV/m)	PK Limits (dBuV/m)	Antenna Distance/ Polarization	Margin (dB)	Detector PK, or AVG
2331.00	43.44	-4.65	38.79	54.0	3.0m./HORZ	15.2	PK

Test Date: October 29, 2018

Tested By

Signature: Afzal Fazal

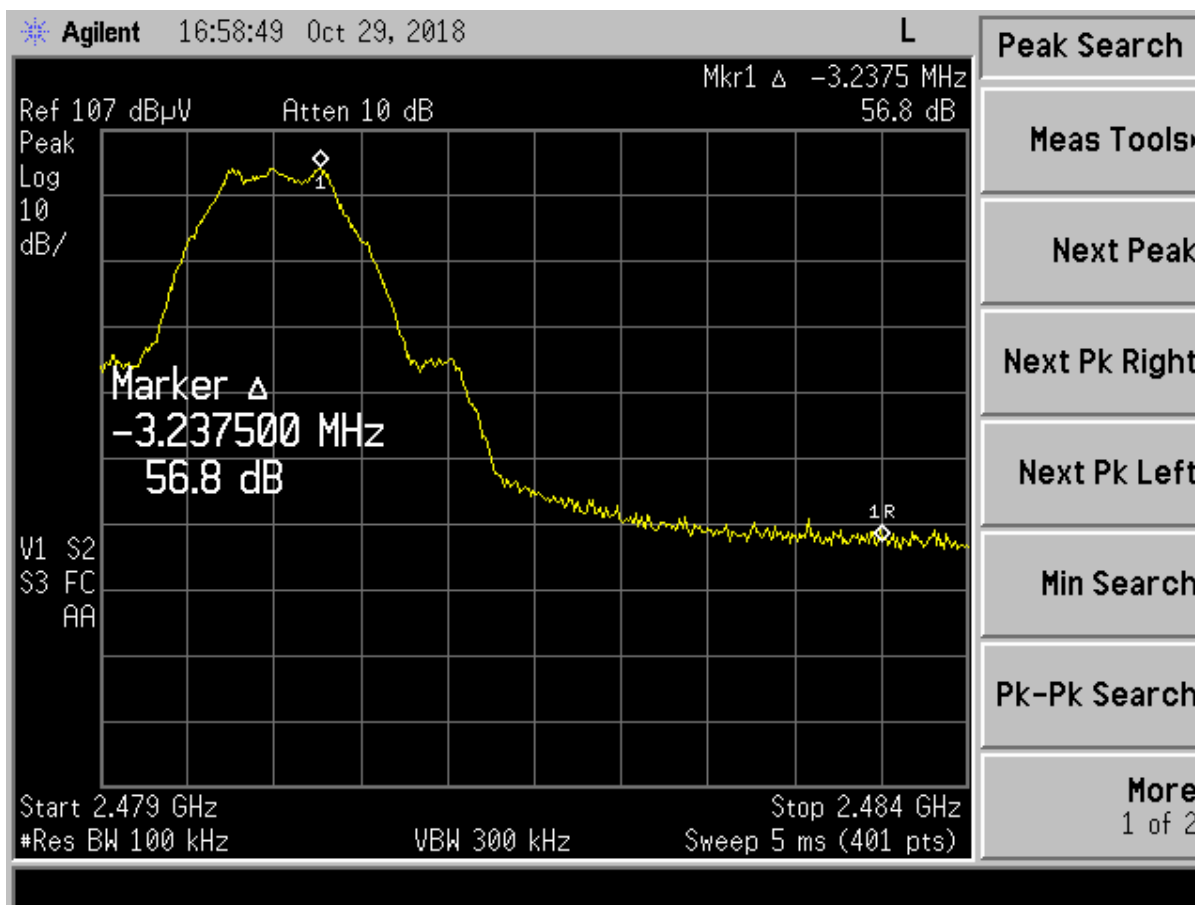
Name: Afzal Fazal

Peak value meets AVG limit.



US Tech Test Report:  
 FCC ID:  
 IC:  
 Test Report Number:  
 Issue Date:  
 Customer:  
 Model:

FCC Part 15 Certification/ RSS 210  
 O7P-4343  
 10147A-4343  
 18-0330  
 November 6, 2018  
 Inventek  
 ISM4343-X



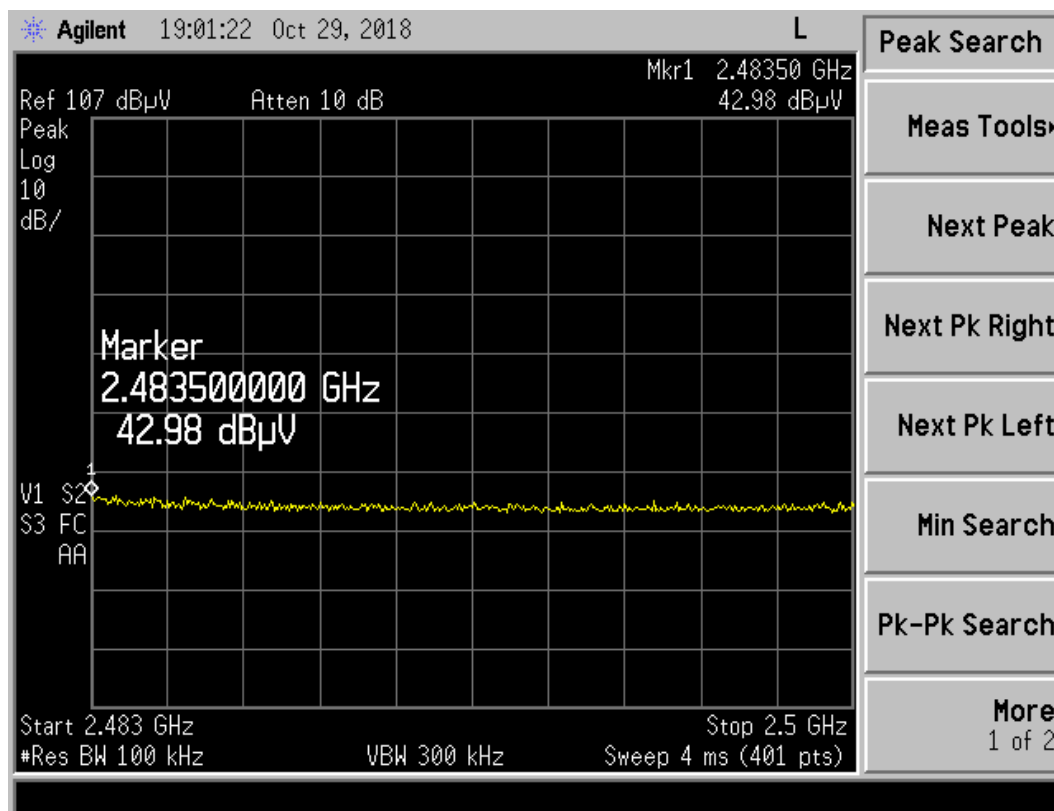
**Figure 4. Band Edge Compliance (Chip Antenna) High Channel Delta – Peak**

High Channel Corrected Measured Value from Table 8	99.51	dBuV
High Channel Band Edge Delta from Figure 7	-56.80	dB
Calculated Result	42.71	dBuV/m
Band Edge Limit	54.00	dBuV/m
Calculated Result	42.71	dBuV/m
Band Edge Margin	11.29	dBuV/m

Peak value meets AVG limit.

US Tech Test Report:  
FCC ID:  
IC:  
Test Report Number:  
Issue Date:  
Customer:  
Model:

FCC Part 15 Certification/ RSS 210  
O7P-4343  
10147A-4343  
18-0330  
November 6, 2018  
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ISM4343-X



**Figure 5. Radiated Restricted Band 2483.5 MHz to 2500 MHz (Chip Antenna) Peak**

**Table 13. Radiated Restricted Band 2483.5 MHz to 2500 MHz, Peak**

2483.5 MHz to 2500 MHz Restricted Band Peak Measurements							
Test: Radiated Emissions				Client: Inventek Systems			
Project: 18-0330				Model: ISM4343-X			
Frequency (MHz)	Test Data (dBuV)	AF+CA-AMP (dB/m)	Results (dBuV/m)	PK Limits (dBuV/m)	Antenna Distance/ Polarization	Margin (dB)	Detector PK, or AVG
2484.00	45.55	-1.03	45.03	54.0	3.0m./HORZ	9.0	PK

Test Date: October 29, 2018

Tested By

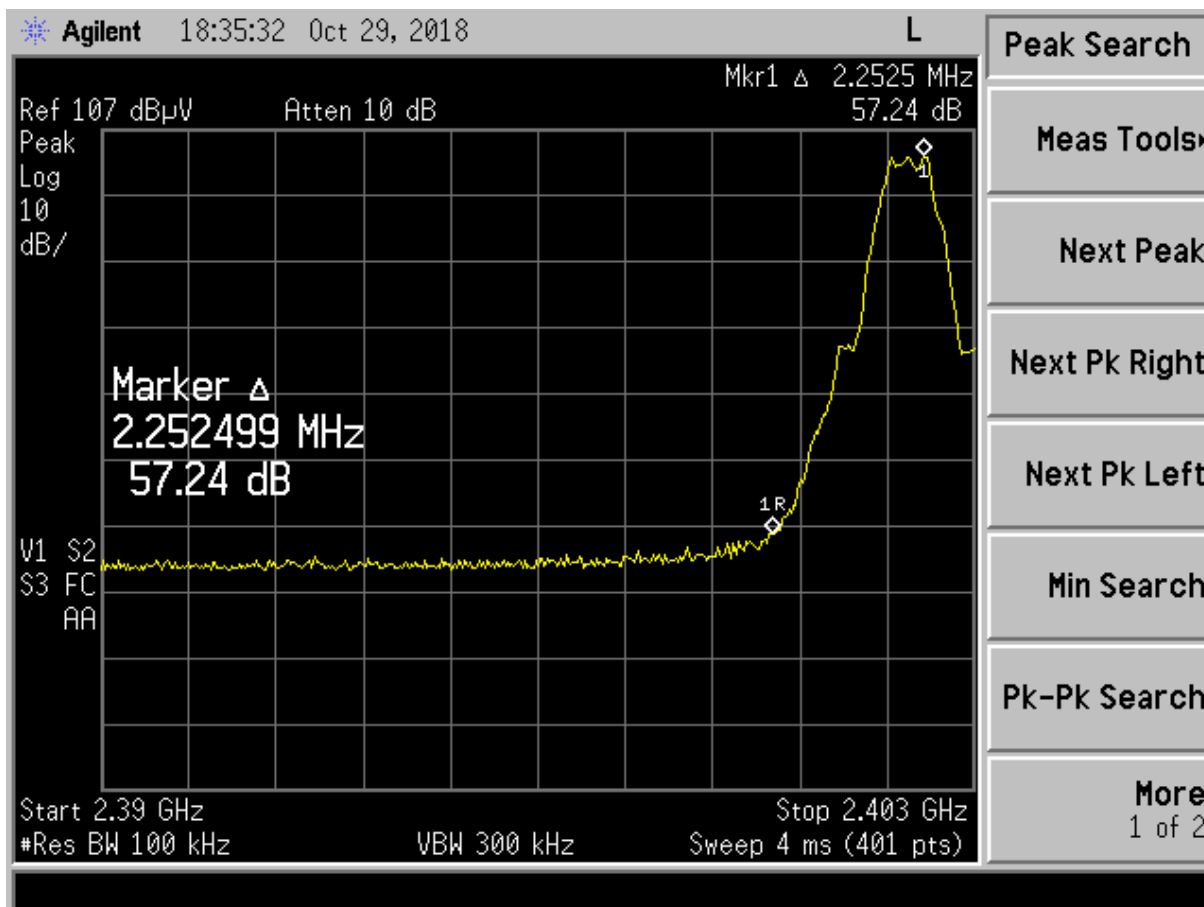
Signature: Afzal Fazal

Name: Afzal Fazal

Peak value meets AVG limit.

US Tech Test Report:  
 FCC ID:  
 IC:  
 Test Report Number:  
 Issue Date:  
 Customer:  
 Model:

FCC Part 15 Certification/ RSS 210  
 O7P-4343  
 10147A-4343  
 18-0330  
 November 6, 2018  
 Inventek  
 ISM4343-X



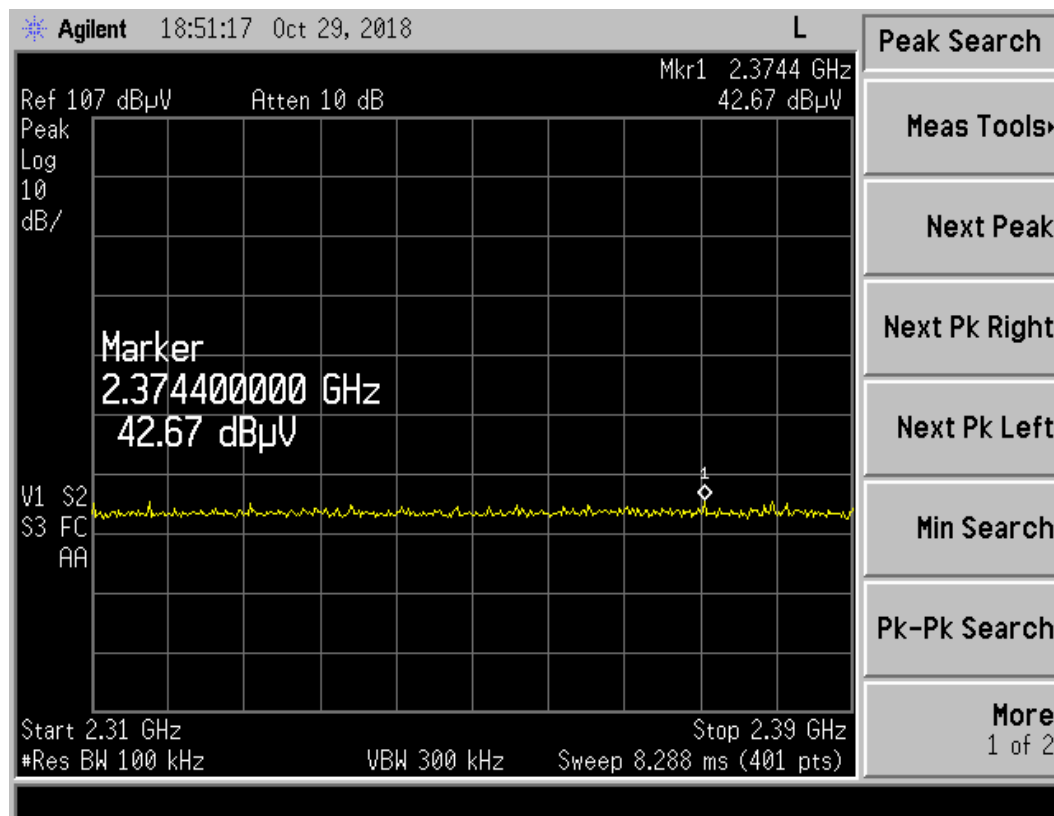
**Figure 6. Band Edge Compliance (External Antenna) Low Channel Delta - Peak**

Low Channel Corrected Measured Value from Table 10	102.21	dBuV
Low Channel Band Edge Delta from Figure 10	-57.24	dB
Calculated Result	44.97	dBuV/m
Band Edge Limit	54.00	dBuV/m
Calculated Result	44.97	dBuV/m
Band Edge Margin	9.03	dBuV/m

Peak value meets AVG limit.

US Tech Test Report:  
 FCC ID:  
 IC:  
 Test Report Number:  
 Issue Date:  
 Customer:  
 Model:

FCC Part 15 Certification/ RSS 210  
 O7P-4343  
 10147A-4343  
 18-0330  
 November 6, 2018  
 Inventek  
 ISM4343-X



**Figure 7. Radiated Restricted Band 2310 MHz to 2390 MHz (External Antenna) Peak**

**Table 14. Radiated Restricted Band 2310 MHz to 2390 MHz, Peak**

2310 MHz to 2390 MHz Restricted Band Peak Measurements							
Test: Radiated Emissions				Client: Inventek Systems			
Project: 18-0330				Model: ISM4343-X			
Frequency (MHz)	Test Data (dBuV)	AF+CA-AMP (dB/m)	Results (dBuV/m)	PK Limits (dBuV/m)	Antenna Distance/ Polarization	Margin (dB)	Detector PK, or AVG
2374.40	42.90	-5.36	37.54	54.0	3.0m./VERT	16.5	PK

Test Date: October 29, 2018

Tested By

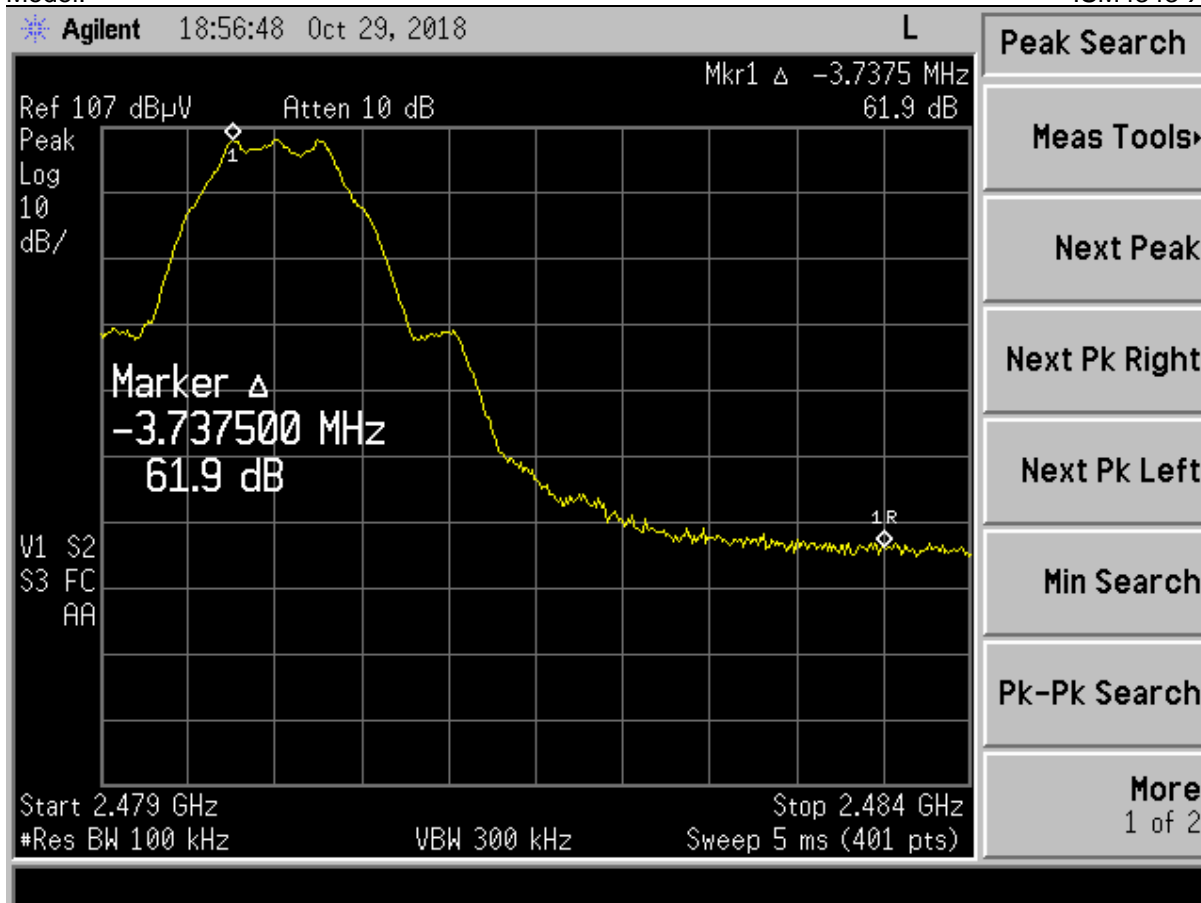
Signature: Afzal Fazal

Name: Afzal Fazal

Peak value meets AVG limit.

US Tech Test Report:  
 FCC ID:  
 IC:  
 Test Report Number:  
 Issue Date:  
 Customer:  
 Model:

FCC Part 15 Certification/ RSS 210  
 O7P-4343  
 10147A-4343  
 18-0330  
 November 6, 2018  
 Inventek  
 ISM4343-X



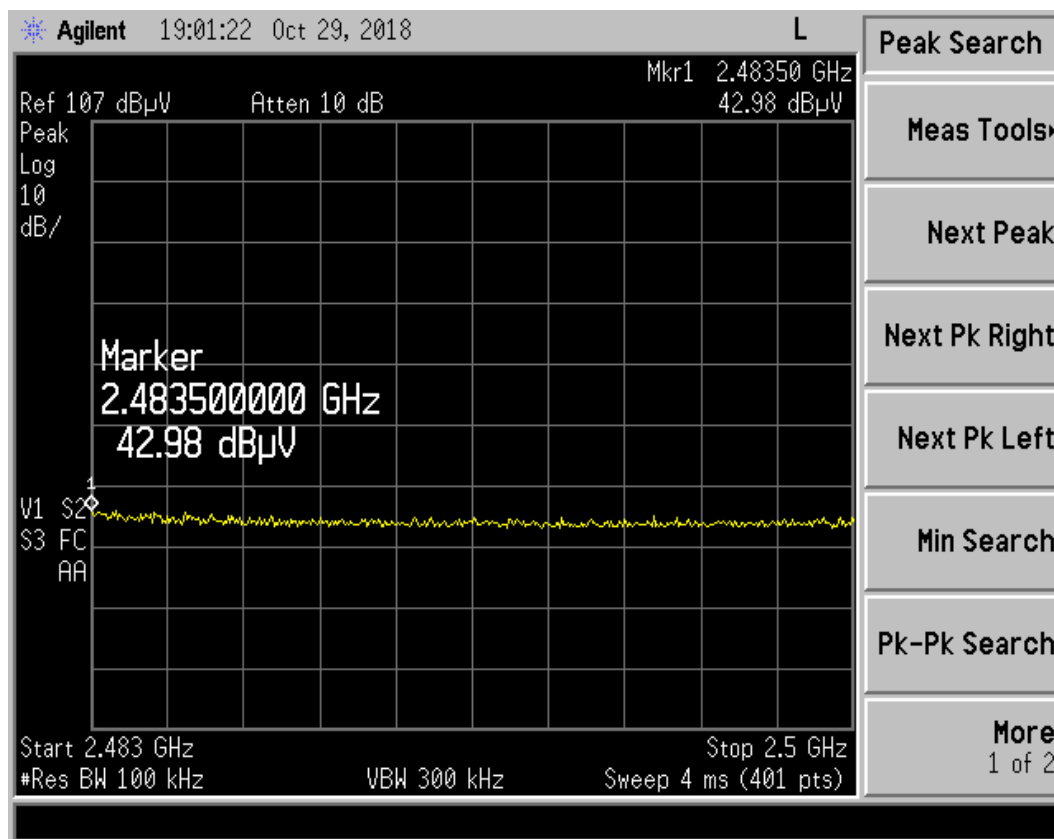
**Figure 8. Band Edge Compliance (External Antenna) High Channel Delta – Peak**

High Channel Corrected Measured Value from Table 10	104.72	dBuV
High Channel Band Edge Delta from Figure 13	-61.90	dB
Calculated Result	42.82	dBuV/m
Band Edge Limit	54.00	dBuV/m
Calculated Result	42.82	dBuV/m
Band Edge Margin	11.18	dBuV/m

Peak value meets AVG limit.

US Tech Test Report:  
 FCC ID:  
 IC:  
 Test Report Number:  
 Issue Date:  
 Customer:  
 Model:

FCC Part 15 Certification/ RSS 210  
 O7P-4343  
 10147A-4343  
 18-0330  
 November 6, 2018  
 Inventek  
 ISM4343-X



**Figure 9. Radiated Restricted Band 2483.5 MHz to 2500 MHz (External Antenna) Peak**

**Table 15. Radiated Restricted Band 2483.5 MHz to 2500 MHz, Peak**

2483.5 MHz to 2500 MHz Restricted Band Peak Measurements							
Test: Radiated Emissions				Client: Inventek Systems			
Project: 18-0330				Model: ISM4343-X			
Frequency (MHz)	Test Data (dBuV)	AF+CA-AMP (dB/m)	Results (dBuV/m)	PK Limits (dBuV/m)	Antenna Distance/ Polarization	Margin (dB)	Detector PK, or AVG
2483.50	42.98	-4.04	38.94	54.0	3.0m./VERT	15.1	PK

Test Date: October 29, 2018

Tested By

Signature: Afzal Fazal

Name: Afzal Fazal

Peak value meets AVG limit.

US Tech Test Report:  
FCC ID:  
IC:  
Test Report Number:  
Issue Date:  
Customer:  
Model:

FCC Part 15 Certification/ RSS 210  
O7P-4343  
10147A-4343  
18-0330  
November 6, 2018  
Inventek  
ISM4343-X

## 2.12 99% Occupied Bandwidth (CFR 2.1049, RSS-Gen 6.6)

These measurements were performed while the EUT was in a constant transmit mode. A method similar to the marker delta method was used to capture the points. The RBW was set to approximately 1/100 of the manufacturers claimed RBW and with the VBW  $\geq$  RBW. The results of this test are given in Table 20 and Figures 16-18.

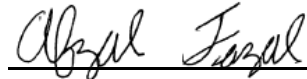
**Table 16. 20 dB Bandwidth and 99% Occupied Bandwidth**

Frequency (MHz)	20 dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)
2402	1.266	1.096
2426	1.257	1.094
2480	1.269	1.095

Test Date: October 31, 2018

Tested By

Signature:



Name: Afzal Fazal

US Tech Test Report:  
FCC ID:  
IC:  
Test Report Number:  
Issue Date:  
Customer:  
Model:

FCC Part 15 Certification/ RSS 210  
O7P-4343  
10147A-4343  
18-0330  
November 6, 2018  
Inventek  
ISM4343-X

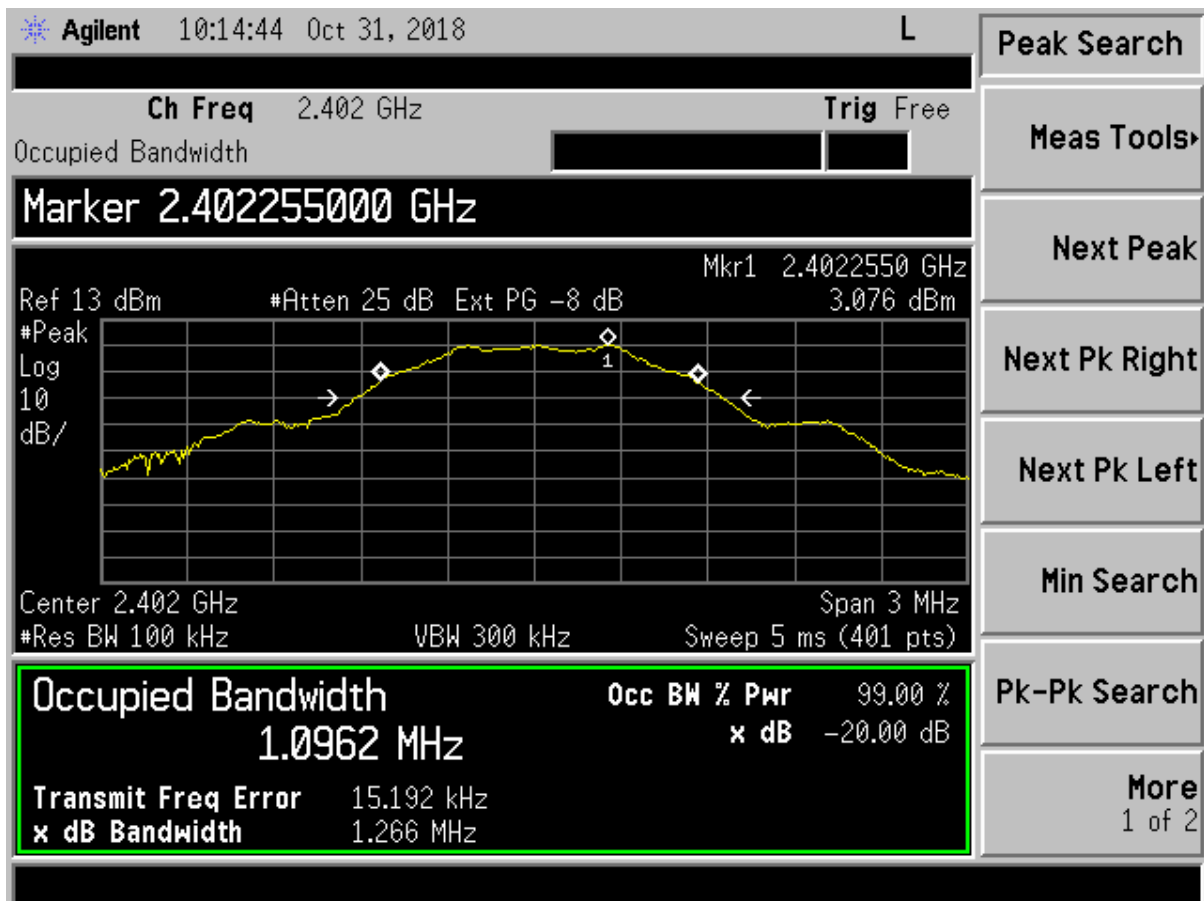


Figure 10. 99% Occupied Bandwidth – Low Channel



US Tech Test Report:  
FCC ID:  
IC:  
Test Report Number:  
Issue Date:  
Customer:  
Model:

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O7P-4343  
10147A-4343  
18-0330  
November 6, 2018  
Inventek  
ISM4343-X

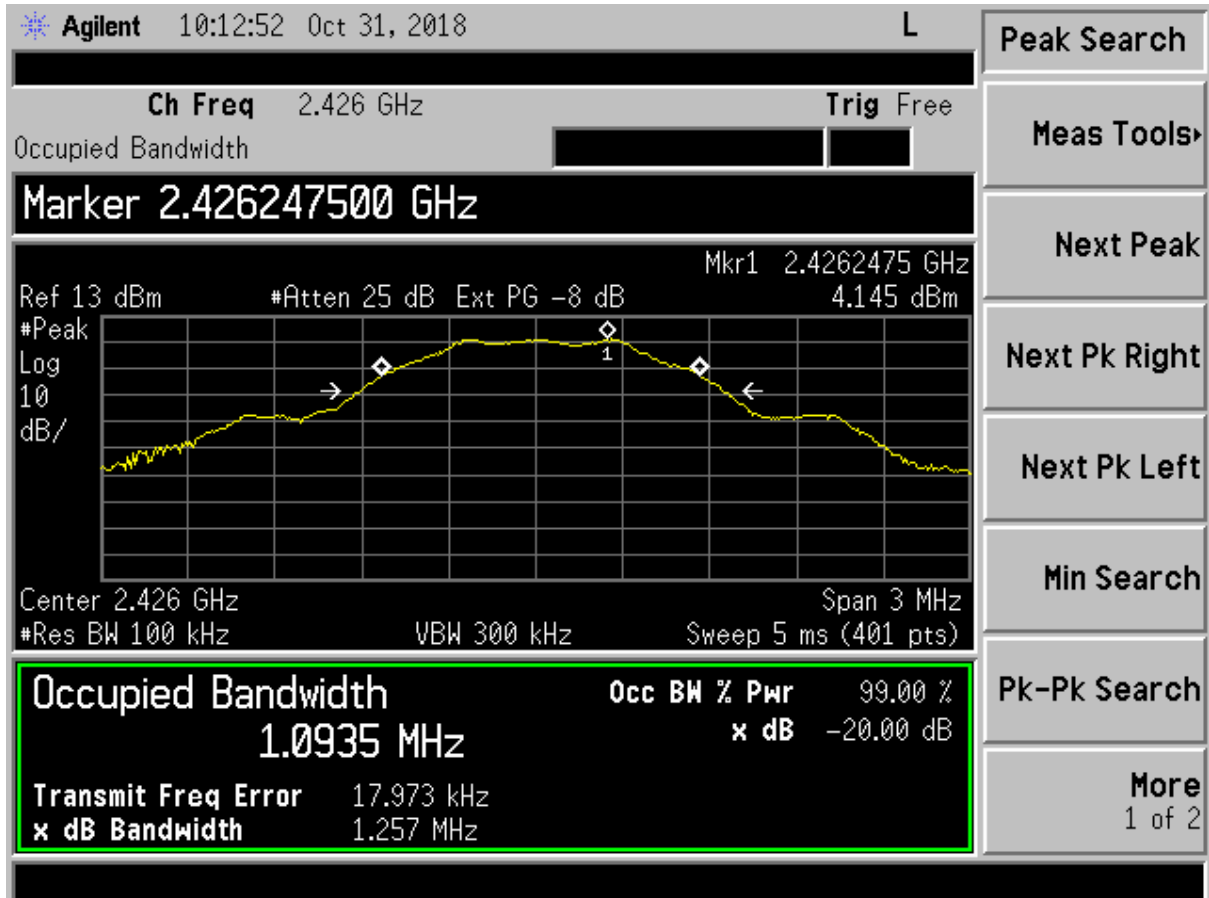


Figure 11. 99% Occupied Bandwidth – Mid Channel

US Tech Test Report:  
FCC ID:  
IC:  
Test Report Number:  
Issue Date:  
Customer:  
Model:

FCC Part 15 Certification/ RSS 210  
O7P-4343  
10147A-4343  
18-0330  
November 6, 2018  
Inventek  
ISM4343-X

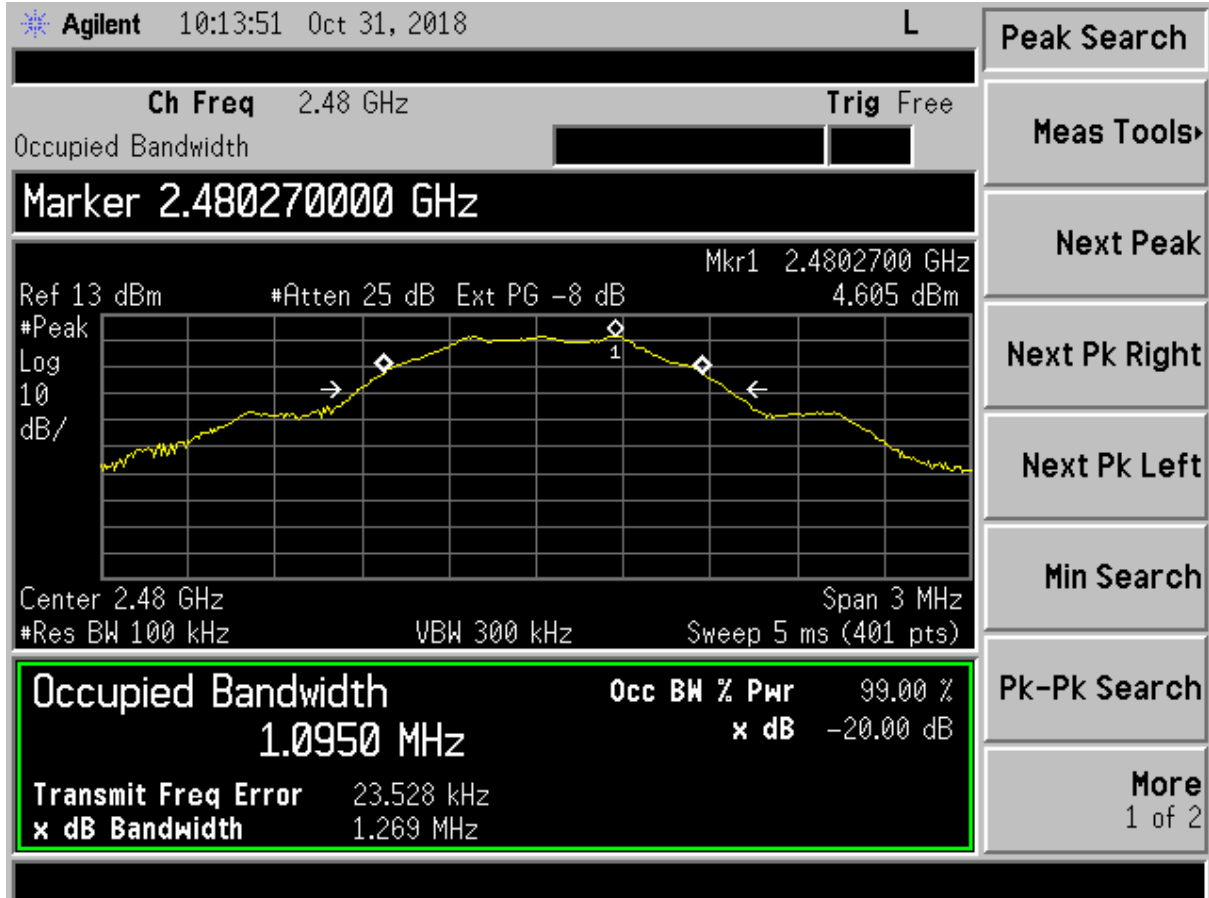


Figure 12. 99% Occupied Bandwidth – High Channel

US Tech Test Report:  
FCC ID:  
IC:  
Test Report Number:  
Issue Date:  
Customer:  
Model:

FCC Part 15 Certification/ RSS 210  
O7P-4343  
10147A-4343  
18-0330  
November 6, 2018  
Inventek  
ISM4343-X

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## **2.13 Measurement Uncertainty**

The measurement uncertainties given were calculated using the method detailed in CISPR 16-4-2:2011. A coverage factor of  $k=2$  was used to give a level of confidence of approximately 95%.

### **2.13.1 Conducted Emissions Measurement Uncertainty**

Measurement Uncertainty (within a 95% confidence level) for this test is  $\pm 2.78$  dB.

### **2.13.2 Radiated Emissions Measurement Uncertainty**

For a measurement distance of 3 m the measurement uncertainty (with a 95% confidence level) for this test using a Biconical Antenna (30 MHz to 200 MHz) is  $\pm 5.3$  dB. This value includes all elements of measurement.

The measurement uncertainty (with a 95% confidence level) for this test using a Log Periodic Antenna (200 MHz to 1000 MHz) is  $\pm 5.1$  dB.

The measurement uncertainty (with a 95% confidence level) for this test using a Horn Antenna is  $\pm 5.1$  dB.

## **3 Conclusions**

The EUT is deemed to meet the requirements of the test standards cited herein when tested in the configuration detailed in this test report.