

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 C, paragraphs 15.207, 15.209 and 15.249

And

IC Radio Standards Specification: RSS-210 Issue 8, Annex A 2.9

For the

Inventek Systems

Model: ISM4334X-M4G-L44

FCC ID: O7P-341

IC:10147A-341

UST Project: 15-0187

Issue Date: November 18, 2015

Total Pages in This Report: 40


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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: Alan Ghasiani

Name: 

Title: Compliance Engineer – President

Date November 18, 2015



NVLAP LAB CODE 200162-0

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Inventek Systems
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MEASUREMENT TECHNICAL REPORT

COMPANYS NAME: Inventek Systems

MODEL: ISM4334X-M4G-L44

FCC ID: O7P-341

IC: 10147A-341

DATE: November 18, 2015

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

Equipment type: 2.4 GHz FHSS 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:

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3505 Francis Circle
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Agency Agreement
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Equipment Label(s)
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Test Configuration Photographs
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Theory of Operation
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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 247 and IC RSS 247 Issue 1.

1.2 Characterization of Test Sample

The sample used for testing was received by US Tech on June 18, 2015 in good operating condition.

1.3 Product Description

The Equipment under Test (EUT) is the Inventek Systems Model ISM4334X-M4G-L44 Module. The ISM4334X-M4G-L44 Module is an embedded wireless internet connectivity module that operates in the 2.4 and 5.0 GHz spectrum. The Wi-Fi modules' hardware consists of an ARM Cortex M4 host processor, Broadcom BCM43341/0 Dual-Band 802.11 g/n MAC/Baseband/Radio with integrated Bluetooth 4.0 and NFC support.

The Model Numbers to be included in the approval are:

ISM43340-M4G-L44-C
ISM43340-M4G-L44-U
ISM43341-M4G-L44-C
ISM43341-M4G-L44-U
ISM43340-M4G-L44-10CFH
ISM43340-M4G-L44-10UFH
ISM43341-M4G-L44-10CFH
ISM43341-M4G-L44-10UFH
ISM341-USB

The different model numbers for are marketing purposes: The ISM4330 does not support NFC; the ISM43341 supports NFC. The C or U is for the antenna to be used, either the chip (C) or the external antenna path (U). The F is for an optional external Flash memory, and the H is for Apple HomeKit. The final part number, ISM341-USB, is for a specific customer and includes the NFC filter circuit.

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The EUT has two antenna options, a dual band chip antenna or a U.FL connector for use with an approved external antenna.

The 5.0 GHz Wi-Fi, 2.4 GHz Wi-Fi, and NFC radio features have been tested and the results detailed in a separate report.

Antenna Gain: 1.4 dBi (Chip-AA077); 2.6 dBi (u.fl external antenna-W2.4-5P-U)
Modulation: Bluetooth 4.0 low energy (GFSK)
Maximum Field Strength:

1.4 Configuration of Tested System

The Test Sample was tested per *ANSI C63.4:2009/2014, Methods of Measurement of Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (2009/2014)* for FCC subpart A Digital equipment Verification requirements and per FCC Public Notice DA 00-705 released March 30, 2000 Under section 15.247. Also, FCC, KDB Publication No. DA 00-705 was used as a test procedure guide.

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. Its designation number is 186022. 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 15.247 as a transmitter.
- b) Verification under 15.101 as a digital device and receiver.
- c) Certification under section 15.249 as a transmitter.
- d) Certification under section 15.225 as a transmitter.
- e) Certification under section 15.407 as a transmitter

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Table 1. EUT and Peripherals

PERIPHERAL MANUFACTURER.	MODEL NUMBER	SERIAL NUMBER	FCC ID:	CABLES P/D
Inventek Systems	ISM4334X- M4G-L44 Module	Engineering Sample	FCC ID: O7P-341 (pending) IC: 10147A-341 (pending)	N/A
Antenna See antenna details	--	--	--	--

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

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.

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Table 2. Test Instruments

TEST INSTRUMENT	MODEL NUMBER	MANUFACTURER	SERIAL NUMBER	DATE OF LAST CALIBRATION
SPECTRUM ANALYZER	8566B	HEWLETT-PACKARD	2747A05665	5/7/2015
SPECTRUM ANALYZER	E4407B	AGILENT	US41442935	1/28/2015
LOOP ANTENNA	SAS-200/562	A.H. Systems	142	9/28/2015 2 yr.
BICONICAL ANTENNA	3110B	EMCO	9306-1708	11/24/2014 2 yr.
LOG PERIODIC ANTENNA	3146	EMCO	9110-3236	11/19/2014 2 yr.
LOG PERIODIC ANTENNA	3146	EMCO	9305-3600	7/1/2014 2 yr.
HORN ANTENNA	SAS-571	A.H. Systems	605	8/25/15 2 yr.
HORN ANTENNA	3115	EMCO	9107-3723	7/8/2014 2 yr.
HORN ANTENNA	3116	EMO	9505-2255	1/27/2015 2 yr.
PRE-AMPLIFIER	8449B	HEWLETT-PACKARD	3008A00480	12/5/2014
PRE-AMPLIFIER	8477E	HEWLETT-PACKARD	1145A00307	11/21/2014
PRE-AMPLIFIER	8447D	HEWLETT-PACKARD	1937A02980	12/4/2014
LISN x 2	9247-50-TS-50-N	SOLAR ELECTRONICS	955824 and 955825	12/30/2014

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

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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 (15.31(m))

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 from 2400 MHz to 2483.5 MHz, 3 test frequencies were used.

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2.4 Frequency Range of Radiated Measurements (Part 15.33)

2.4.1 Intentional Radiator

The spectrum shall be investigated for the intentional radiator from the lowest RF signal generated in the EUT, without going below 9 kHz to the 10th 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 shall be 30 MHz to 1000 MHz, or up to 5 times the highest internal clock frequency.

2.5 Measurement Detector Function and Bandwidth (CFR 15.35)

The radiated and conducted emissions limits shown herein are based on the following:

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.

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.

Pulsed Transmitter Averaging:

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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)

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 module.

Table 4. Allowed Antenna(s)

REPORT REFERENCE	MANUFACTURER	TYPE OF ANTENNA	MODEL	GAIN dB _i	TYPE OF CONNECTOR
1	Unictron Technologies Corp.	Chip	AA077	1.4	Chip
2	Inventek Systems	U.FL	W2.4-5P-U	2.6	U.FL

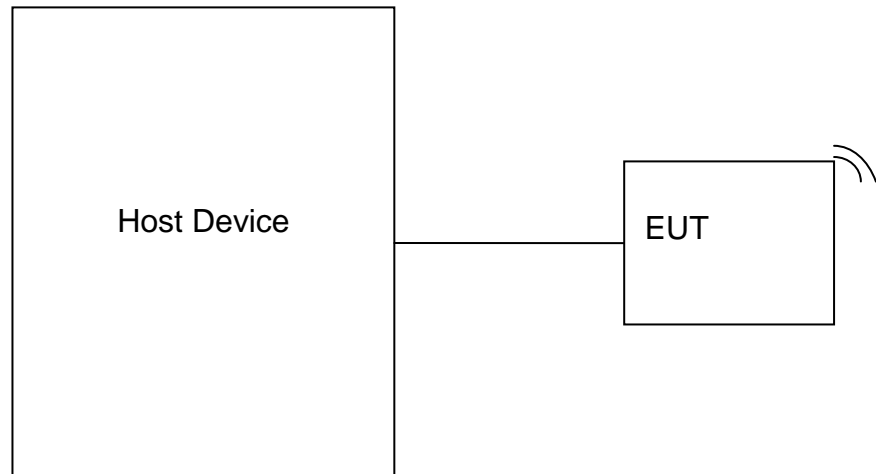


Figure 1. Block Diagram of Test Configuration

2.7 Restricted Bands of Operation (Part 15.205)

Only spurious emissions can fall in the frequency bands of CFR 15.205. The field strength of these spurious cannot exceed the limits of 15.209. Radiated harmonics and other spurious are examined for this requirement see paragraph 2.13

2.8 Transmitter Duty Cycle (CFR 35 (c))

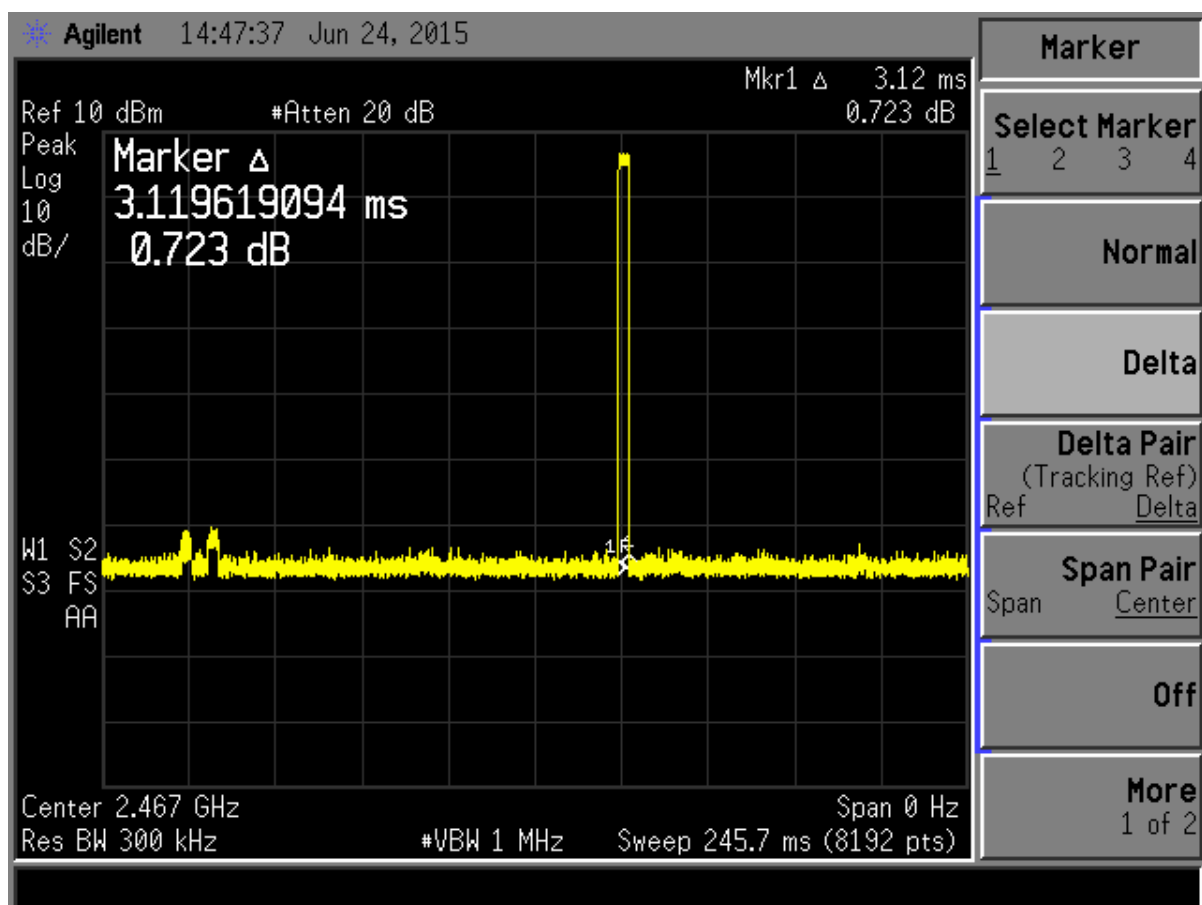


Figure 2. Transmitter Pulse Width

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Total Time On from Figure 3 = 3.11 ms (Transmitter Pulse Width)

(3.11 ms Total Time On)/(100 ms Total Pulse Train) = .0311 Numeric Duty Cycle
Duty Cycle = 20 Log (A/B) = -30.14 dB

Since the Duty cycle is < -20 dB, the Duty cycle Applied in this test report is -20 dB.

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

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2.9 Intentional Radiator, Power Line Conducted Emissions (CFR 15.207)

The EUT is powered by 3.3 VDC and gets the voltage from a host device. Since the host device was connected to the AC mains, power line conducted emissions testing was performed to ensure that with the EUT in operation (exercising all transmitter functions), the complete system continues to meet the applicable requirements for CFR 15.207. These measurements were completed and results are tabulated following.

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

150KHz to 30 MHz with Class B Limits						
Test: Power Line Conducted Emissions				Client: Inventek Systems		
Project: 15-0187				Model: ISM4334X-M4G-L44		
Frequency (MHz)	Test Data (dBuV)	LISN+CL-PA (dB)	Results (dBuV)	AVG Limits (dBuV)	Margin (dB)	Detector PK, QP, or AVG
120 VAC, 60 Hz Phase						
0.21	50.70	0.88	51.58	63.1*	11.5	QP
0.21	46.80	0.88	47.68	53.1	5.4	AVG
0.53	39.80	0.42	40.22	46.0	5.8	AVG
1.94	39.00	0.36	39.36	46.0	6.6	AVG
6.03	42.70	0.47	43.17	50.0	6.8	AVG
19.35	42.30	0.61	42.91	50.0	7.1	AVG
20.26	42.00	0.62	42.62	50.0	7.4	AVG
120VAC, 60 Hz Neutral						
0.1511	61.30	1.41	62.71	65.9*	3.2	QP
0.1511	44.30	1.41	45.71	55.9	10.2	AVG
0.5992	40.40	0.39	40.79	46.0	5.2	AVG
1.1920	39.00	0.35	39.35	46.0	6.6	AVG
5.2000	41.10	0.44	41.54	50.0	8.5	AVG
12.7600	40.80	0.64	41.44	50.0	8.6	AVG
22.4800	40.90	0.65	41.55	50.0	8.4	AVG

Note: * denotes QP Limits

SAMPLE CALCULATION at 0.21 MHz:

Magnitude of Measured Frequency	50.70	dBuV
+ Cable Loss+ LISN Loss	0.88	dB
=Corrected Result	51.58	dBuV
Limit	63.10	dBuV
-Corrected Result	51.58	dBuV
Margin	11.5	dB

Test Date: August 3, 2015

Tested By

Signature: Sina Sobhaniyan Name: Sina Sobhaniyan

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2.10 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d)) (IC RSS 247, 5.4)

Radiated Spurious measurements: The EUT was placed into a continuous transmit mode of operation (>98% duty cycle) and tested per FCC Public Notice DA 00-705 and 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. A preliminary scan was performed on the EUT to find the 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 operate 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 per CFR 15.209, General requirements for unwanted spurious emissions. The conducted spurious method as described below was used to investigate all other emissions emanating from the antenna port.

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Table 6. Peak Radiated Fundamental & Harmonic Emissions with Chip Antenna

Test: FCC Part 15, Para 15.209, 15.249(a)					Client: Inventek Systems			
Project: 15-0187					Model: ISM4334X-M4G-L44			
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
Low Channel								
2402.00	59.18		31.78	90.96	114.0	3.0m./VERT	23.0	PK
4804.00	58.55	-9.50	3.22	52.27	74.0	1.0m./VERT	21.7	PK
Mid Channel								
2426.00	62.73		31.78	94.51	114.0	3.0m./VERT	19.5	PK
4852.00	57.67	-9.50	2.74	50.91	74.0	1.0m./VERT	23.1	PK
High Channel								
2480.00	66.51		31.78	98.29	114.0	3.0m./HORZ	15.7	PK
No harmonics found.								

1. (*) Falls within the restricted bands of CFR 15.205. Limits based on CFR15.209 & 20 dB relaxation for peak measurements of CFR 15.35.
2. No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10th harmonic
3. (~) Measurements taken at 1 meter were extrapolated to 3 meters using a factor of (-9.5 dB).
4. The EUT was placed in three orthogonal positions and the transmitter was in constant broadcast mode, with a duty cycle of greater than 98%. 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 MHz:

Magnitude of Measured Frequency	58.55	dBuV
+Antenna Factor + Cable Loss+ Amplifier Gain	3.22	dB/m
1 meter to 3 meters extrapolation	-9.50	dB
Corrected Result	52.27	dBuV/m

Test Date: June 29, 2015

Tested By

Signature: 

Name: Carrie Ingram

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Table 7. Average Radiated Fundamental & Harmonic Emissions with Chip Antenna

Test: FCC Part 15, Para 15.209, 15.249(a)					Client: Inventek Systems			
Project: 15-0187					Model: ISM4334X-M4G-L44			
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
Low Channel								
2402.00	59.18	-20.00	10.96	70.96	94.0	3.0m./HORZ	23.0	PK
4804.00	50.87	-9.50	-16.78	24.59	54.0	1.0m./HORZ	29.4	AVG
Mid Channel								
2426.00	62.73	-20.00	10.96	74.51	94.0	3.0m./HORZ	19.5	PK
4852.00	49.84	-9.50	-17.26	23.08	54.0	1.0m./HORZ	30.9	AVG
High Channel								
2480.00	66.51	-20.00	12.24	78.29	94.0	3.0m./HORZ	15.7	PK
4960.00	36.29	-	-16.80	19.49	54.0	3.0m./HORZ	34.5	AVG

1. (*) Falls within the restricted bands of CFR 15.205. Limits based on CFR15.209 & 20 dB relaxation for **peak** measurements of CFR 15.35.
2. No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10th harmonic
3. (~) Measurements taken at 1 meter were extrapolated to 3 meters using a factor of (-9.5 dB).
4. The EUT was placed in three orthogonal positions and the transmitter was in constant broadcast mode, with a duty cycle of greater than 98%. The emissions were measured with the receive antenna in vertical and horizontal polarizations. The data listed in the above table was worst case.
5. An additional factor of -20 dB to correct for duty cycle has been taken from the fundamental PK measurements.

Sample Calculation at 4804 MHz:

Magnitude of Measured Frequency	50.87	dBuV
+Antenna Factor + Cable Loss+ Amplifier Gain – Duty Cycle	-16.78	dB/m
1 meter to 3 meter extrapolation	-9.50	dB
Corrected Result	24.59	dBuV/m

Test Date: June 29, 2015

Tested By

Signature: 

Name: Carrie Ingram

US Tech Test Report:
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Table 8. Peak Radiated Fundamental & Harmonic Emissions with U.FL Antenna

Test: FCC Part 15, Para 15.209, 15.249(a)					Client: Inventek Systems			
Project: 15-0187					Model: ISM4334X-M4G-L44			
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
Low Channel								
2402.00	69.29	-	31.78	101.07	114.0	3.0m./HORZ	12.9	PK
4804.00	51.12	-	3.56	54.68	74.0	3.0m./HORZ	19.3	PK
Mid Channel								
2426.00	69.21	-	31.78	100.99	114.0	3.0m./HORZ	13.0	PK
4852.00	49.26	-	3.53	52.79	74.0	3.0m./HORZ	21.2	PK
High Channel								
2480.00	69.79	-	31.78	101.57	114.0	3.0m./HORZ	12.4	PK
4960.00	47.32	-	2.71	50.03	74.0	3.0m./HORZ	23.9	PK

1. (*) Falls within the restricted bands of CFR 15.205. Limits based on CFR15.209 & 20 dB relaxation for peak measurements of CFR 15.35.
2. No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10th harmonic
3. (-) Measurements taken at 1 meter were extrapolated to 3 meters using a factor of (-9.5 dB).
4. The EUT was placed in three orthogonal positions and the transmitter was in constant broadcast mode, with a duty cycle of greater than 98%. 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	51.12	dBuV
+Antenna Factor + Cable Loss+ Amplifier Gain	3.56	dB/m
Corrected Result	54.68	dBuV/m

Test Date: September 16, 2015

Tested By

Signature: 

Name: Carrie Ingram

Table 9. Average Radiated Fundamental & Harmonic Emissions with U.FL

US Tech Test Report:
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 ISM4334X-M4G-L44

Antenna

Test: FCC Part 15, Para 15.209, 15.249(a)					Client: Inventek Systems			
Project: 15-0187					Model: ISM4334X-M4G-L44			
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
Low Channel								
2402.00	69.29	-20.00	31.78	81.07	94.0	3.0m./HORZ	12.9	AVG
4804.00	43.08	--	-16.44	26.64	54.0	3.0m./HORZ	27.3	AVG
Mid Channel								
2426.00	69.21	-20.00	31.78	80.99	94.0	3.0m./HORZ	13.0	AVG
4852.00	40.64	--	-16.47	24.17	54.0	3.0m./HORZ	29.8	AVG
High Channel								
2480.00	69.79	-20.00	31.78	81.57	94.0	3.0m./HORZ	12.4	AVG
4960.00	37.13	--	-17.29	19.84	54.0	3.0m./HORZ	34.1	AVG

- (*) Falls within the restricted bands of CFR 15.205. Limits based on CFR15.209 & 20 dB relaxation for **peak** measurements of CFR 15.35.
- No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10th harmonic
- (~) Measurements taken at 1 meter were extrapolated to 3 meters using a factor of (-9.5 dB).
- The EUT was placed in three orthogonal positions and the transmitter was in constant broadcast mode, with a duty cycle of greater than 98%. The emissions were measured with the receive antenna in vertical and horizontal polarizations. The data listed in the above table was worst case.
- An additional factor of -20 dB to correct for duty cycle has been taken from the fundamental PK measurements.

Sample Calculation at 4804 MHz:

Magnitude of Measured Frequency	43.08	dBuV
+Antenna Factor + Cable Loss+ Amplifier Gain – Duty Cycle	-16.44	dB/m
Corrected Result	26.64	dBuV/m

Test Date: September 16, 2015

Tested By

Signature:



Name: Carrie Ingram

2.11 Band Edge Measurements – (CFR 15.249 (d))

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Band Edge measurements are made with the EUT initially operating on the Lowest Channel and then operating on the Highest Channel within its band of operation. Antenna port or radiated measurements are performed to demonstrate compliance with the requirements of 15.249(d) that all Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

In this case radiated emissions measurements were performed.

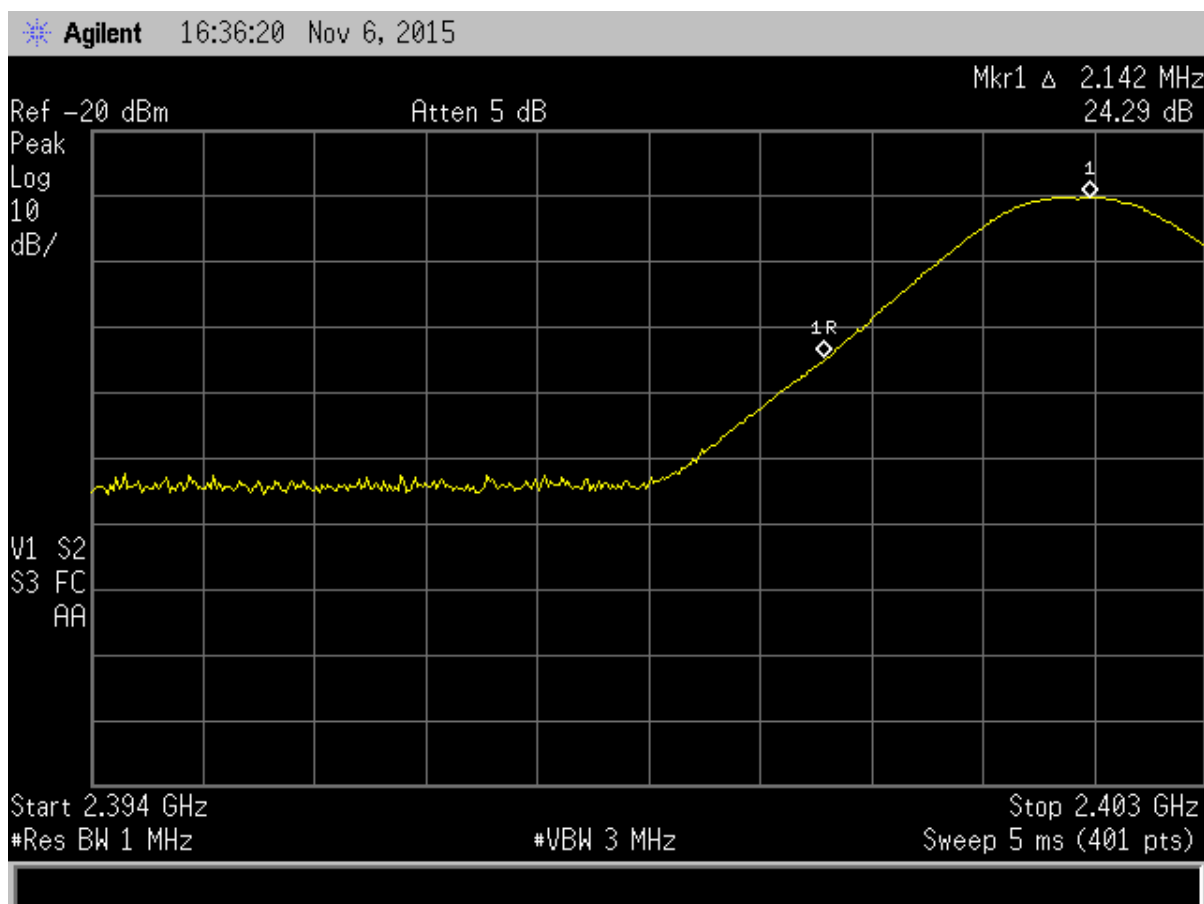


Figure 3. Band Edge Compliance, Low Channel Delta – (CHIP antenna)

Calculation of worst case lower band edge measurement:

Peak value (from Table 6 above)	90.96 dBuV/m
-Delta from Figure above	24.29 dB
Bandedge Value	66.67 dBuV/m

66.67 dBuV/m – 20 dB (duty cycle factor)= 46.67 dBuV/m

Peak passing margin= 74.0 dBuV/m - 66.67 dBuV/m= 7.33 dB

AVG passing margin= 54.0 dBuV/m – 46.67 dBuV/m= 7.33 dB

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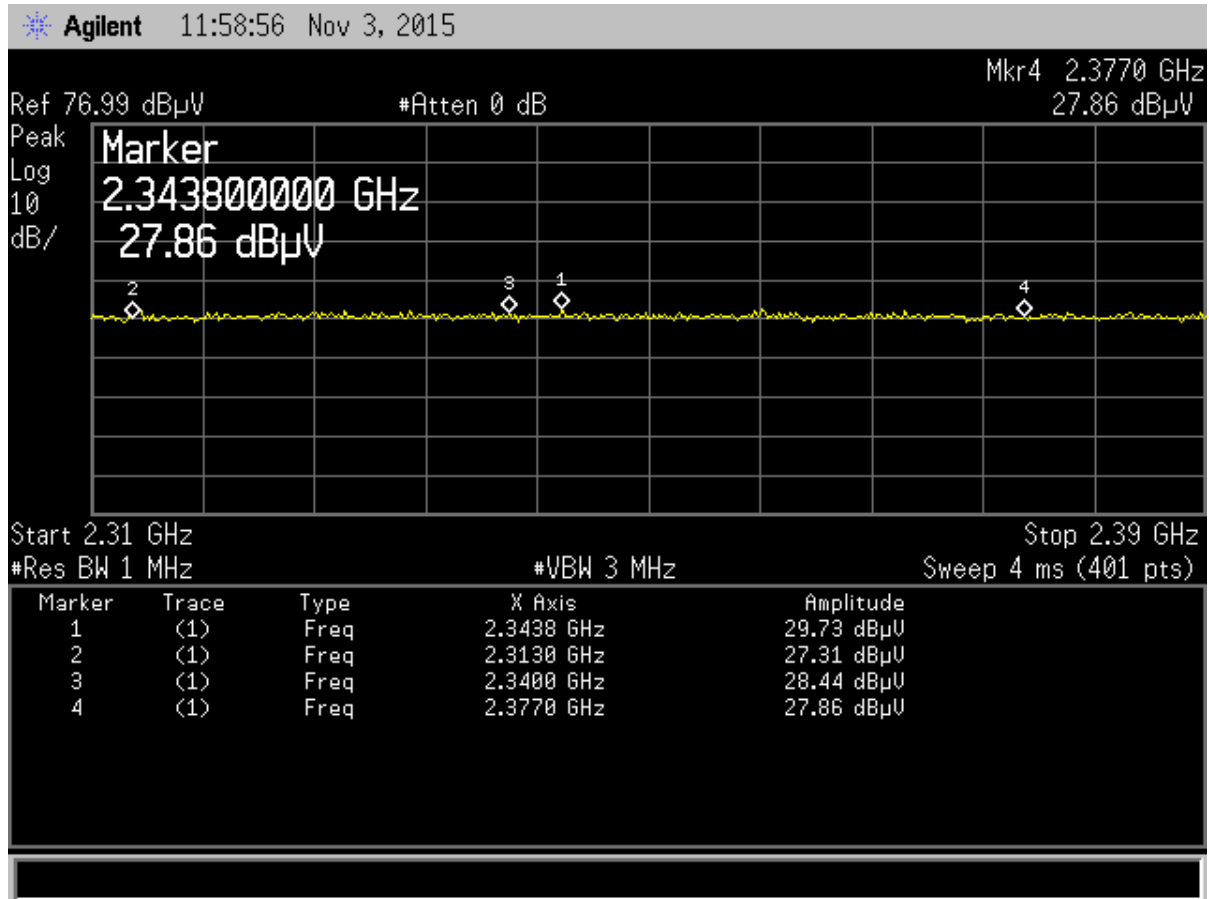


Figure 4. Conducted Restricted Band Measurements PK, 2.31 GHz to 2.39 GHz, CHIP Antenna

Table 10. Conducted Restricted Band Measurements PK, 2.31 GHz to 2.39 GHz

Frequency (MHz)	Test Data	Additional Factor	AF+CA+AMP+DC (dB/m)	Results (dBuV)	Limit (dBuV)	Margin (dB)
No spurious emissions seen.						

Test Date: October 23, 2015

Tested By

Signature: 

Name: Carrie Ingram

US Tech Test Report:
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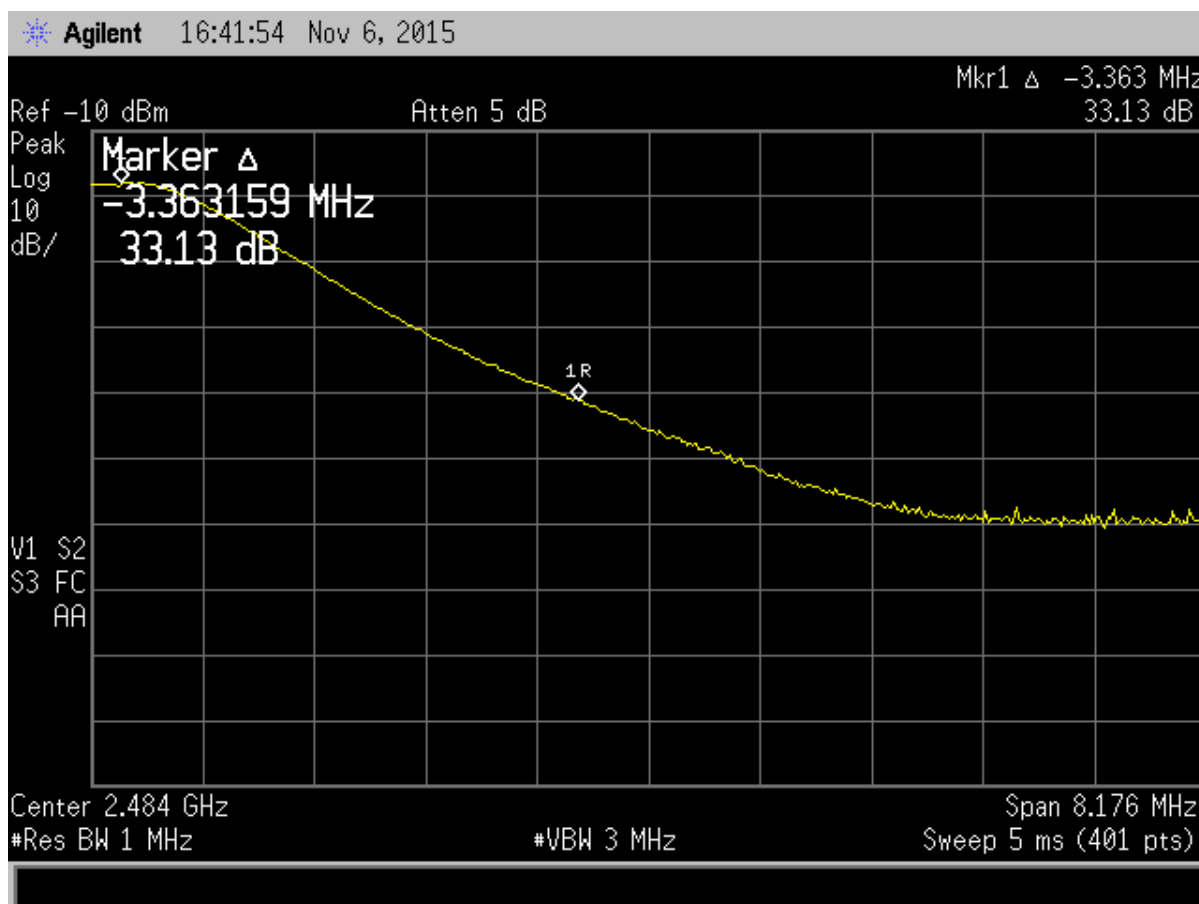


Figure 5. Band Edge Compliance, High Channel Delta – Peak

Calculation of worst case lower band edge measurement:

Peak value (from Table 6 above)	98.29 dBuV/m
-Delta from Figure above	33.13 dB
Bandedge Value	65.16 dBuV/m

65.16 dBuV/m – 20 dB (duty cycle factor)= 45.16 dBuV/m

Peak passing margin= 74.0 dBuV/m – 65.16 dBuV/m= 8.84 dB

AVG passing margin= 54.0 dBuV/m – 45.16 dBuV/m= 8.84 dB

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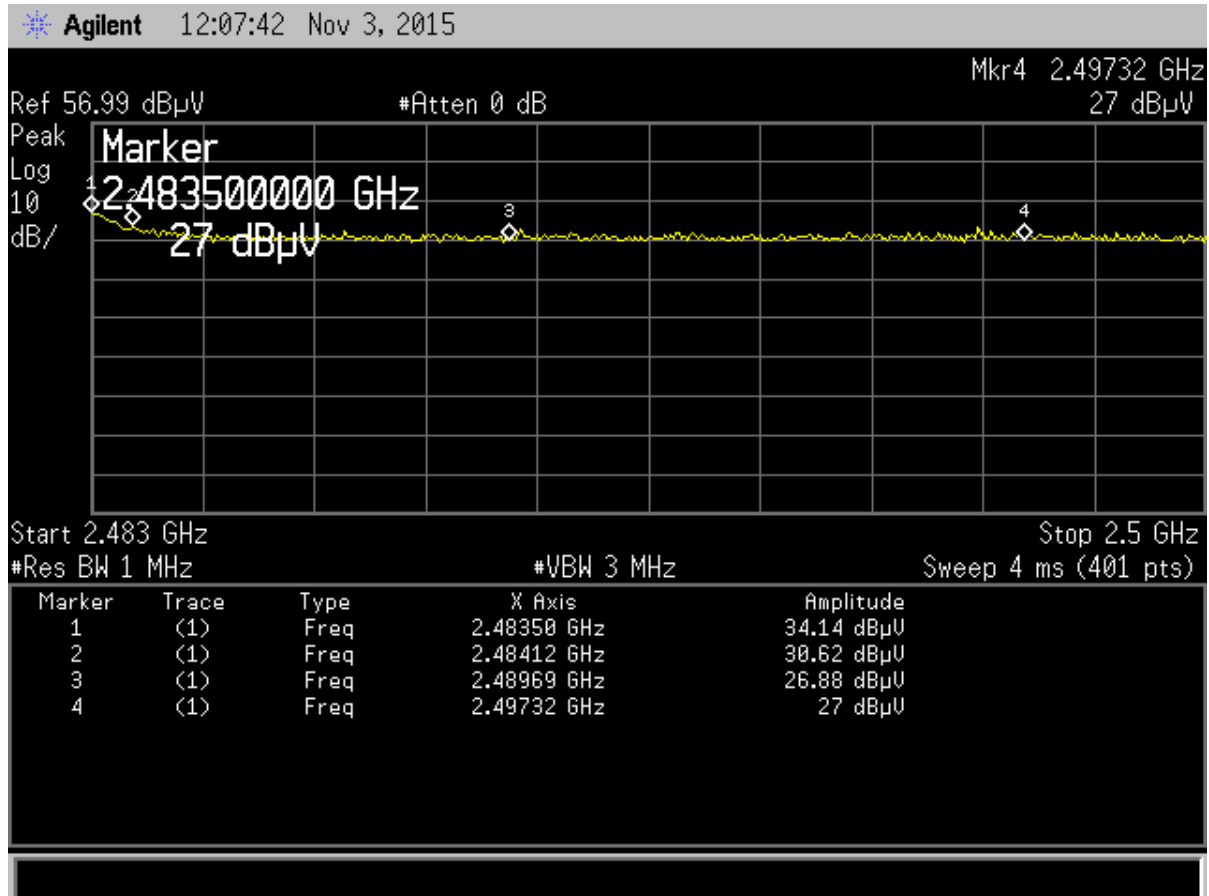


Figure 6. Conducted Restricted Band Measurements PK, 2.4835 GHz to 2.5 GHz

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Table 11. Conducted Restricted Band Measurements PK, 2.4835 GHz to 2.5 GHz

Frequency (MHz)	Test Data (dBuV)	Additional Factor (dB)	AF+CA+AMP+DC (dB/m)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2483.50	34.14	--	32.74	66.88	74.0	7.1
2484.12	30.62	--	32.74	63.36	74.0	10.6
2489.69	26.88	--	32.74	59.62	74.0	14.4
2497.32	27.00	--	32.74	59.74	74.0	14.3
2483.50	34.14	-20	32.74	46.88	54.0	7.1
2484.12	30.62	-20	32.74	43.36	54.0	10.6
2489.69	26.88	-20	32.74	39.62	54.0	14.4
2497.32	27.00	-20	32.74	39.74	54.0	14.3

Sample calculation: at 2483.50 MHz, 34.14 dBuV + 32.74 (dB)= 66.88 dBuV/m

Test Date: October 23, 2015

Tested By

Signature: 

Name: Carrie Ingram

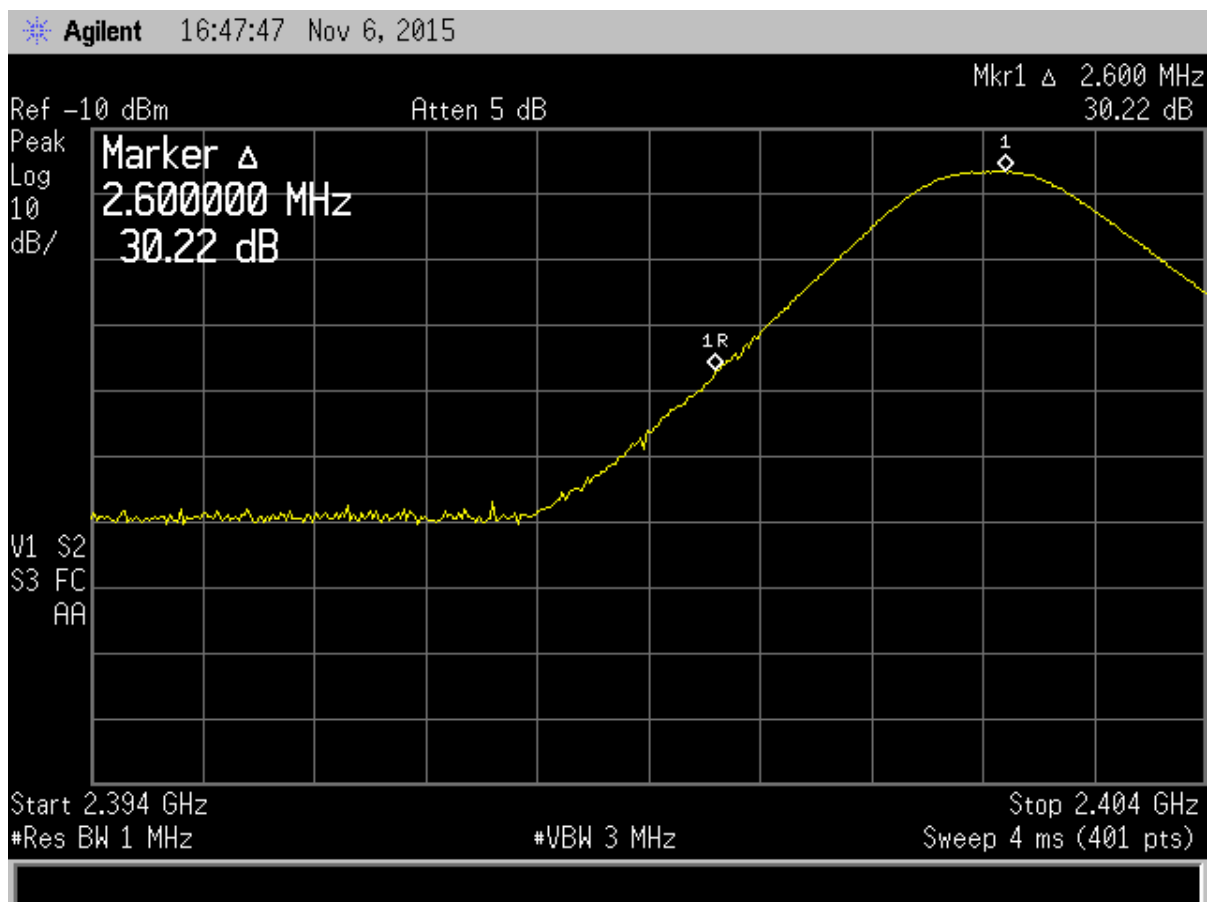


Figure 7. Band Edge Compliance, Low Channel Delta – Peak (u.fl antenna)

Calculation of worst case lower band edge measurement:

Peak value (from Table 8 above)	101.07 dBuV/m
-Delta from Figure above	30.22 dB
Bandedge Value	70.85 dBuV/m

66.67 dBuV/m – 20 dB (duty cycle factor)= 46.67 dBuV/m

Peak passing margin= 74.0 dBuV/m – 70.85 dBuV/m= 3.15 dB

AVG passing margin= 54.0 dBuV/m – 50.85 dBuV/m= 3.15 dB

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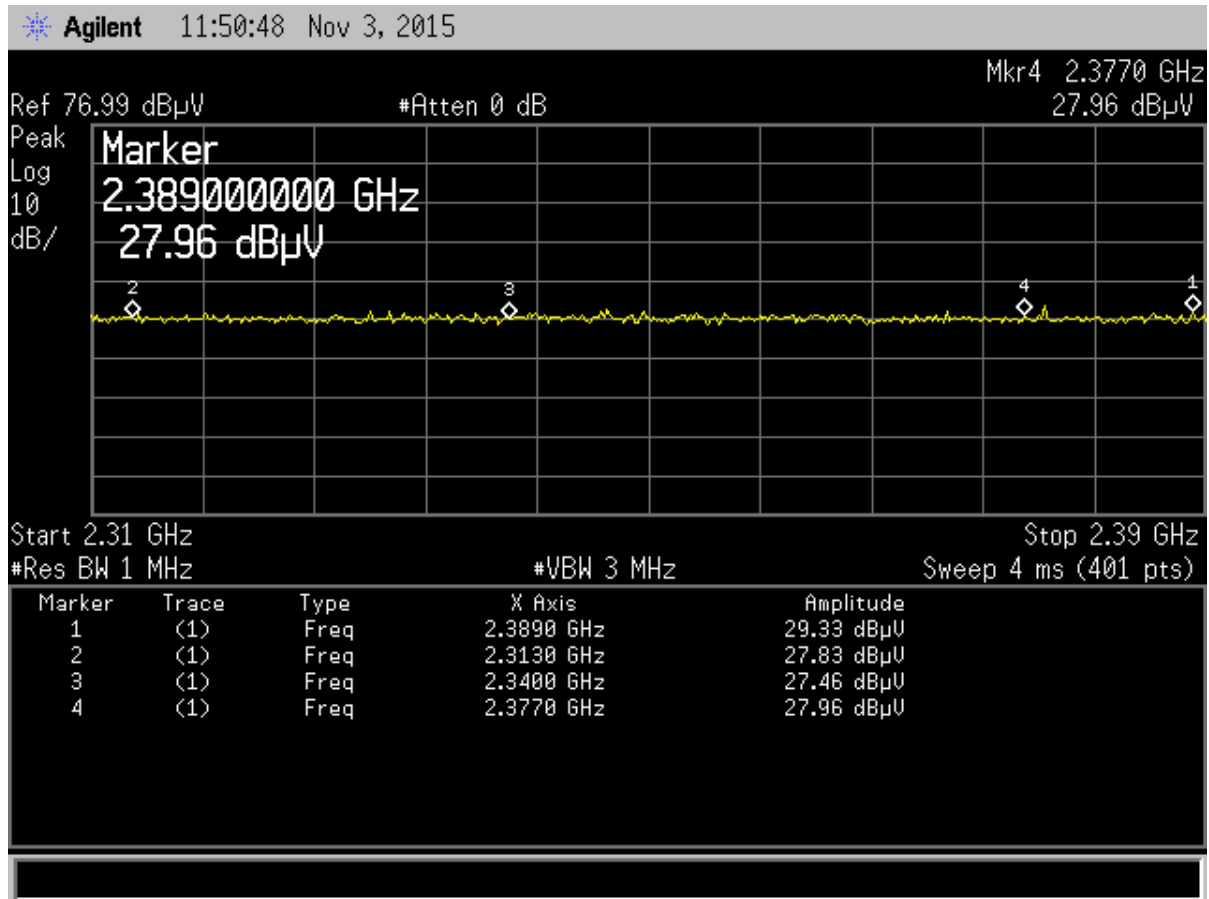


Figure 8. Conducted Restricted Band Measurements PK, 2.31 GHz to 2.39 GHz, u.fl antenna

Table 12. Conducted Restricted Band Measurements PK, 2.31 GHz to 2.39 GHz

Frequency (MHz)				Results (dBuV)	Limit (dBuV)	Margin (dB)
No spurious emissions seen.						

Test Date: October 23, 2015

Tested By

Signature: 

Name: Carrie Ingram

US Tech Test Report:
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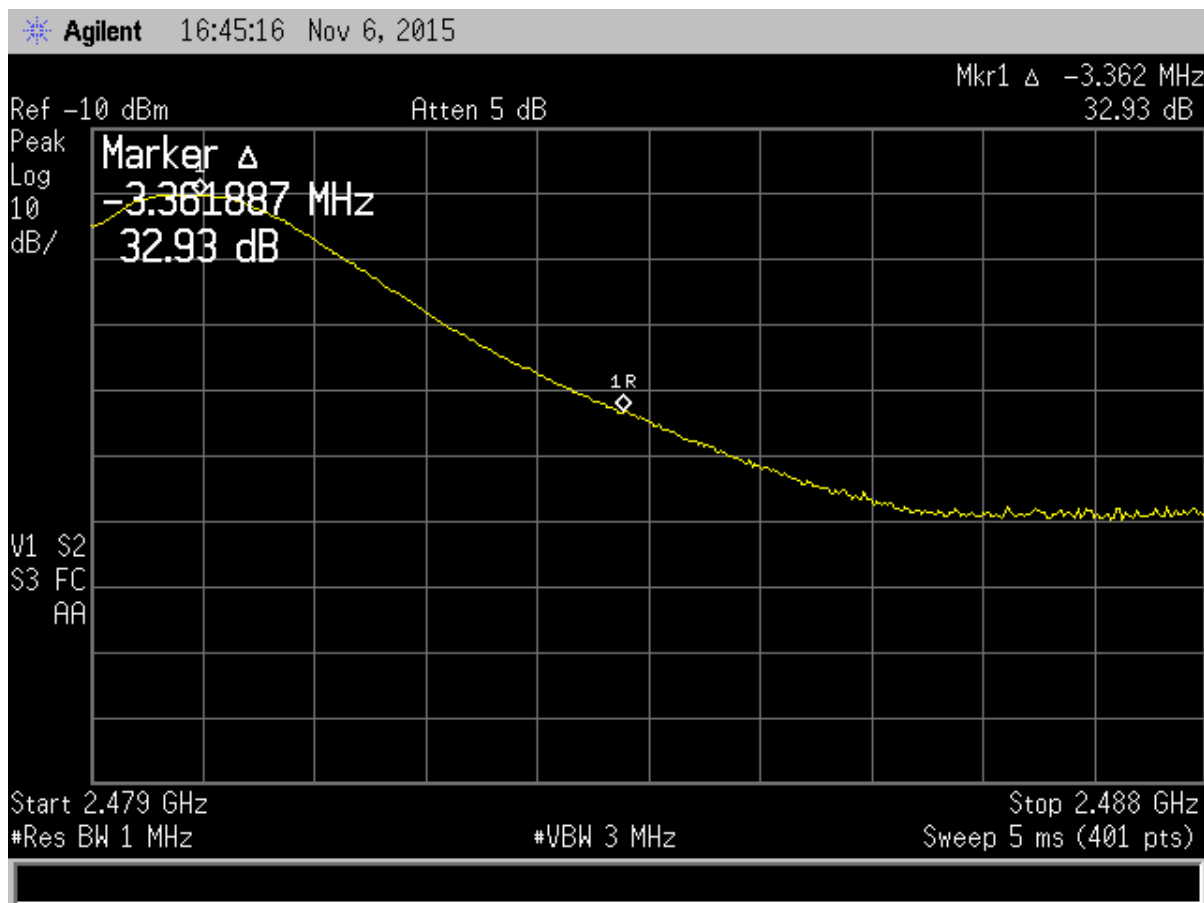


Figure 9. Band Edge Compliance, High Channel Delta – Peak (u.fl antenna)

Calculation of worst case lower band edge measurement:

Peak value (from Table 8 above)	101.57 dBuV/m
-Delta from Figure above	32.93 dB
Bandedge value	68.64 dBuV/m

66.67 dBuV/m – 20 dB (duty cycle factor)= 46.67 dBuV/m

Peak passing margin= 74.0 dBuV/m – 68.64 dBuV/m= 5.36 dB

AVG passing margin= 54.0 dBuV/m – 48.64 dBuV/m= 5.36 dB

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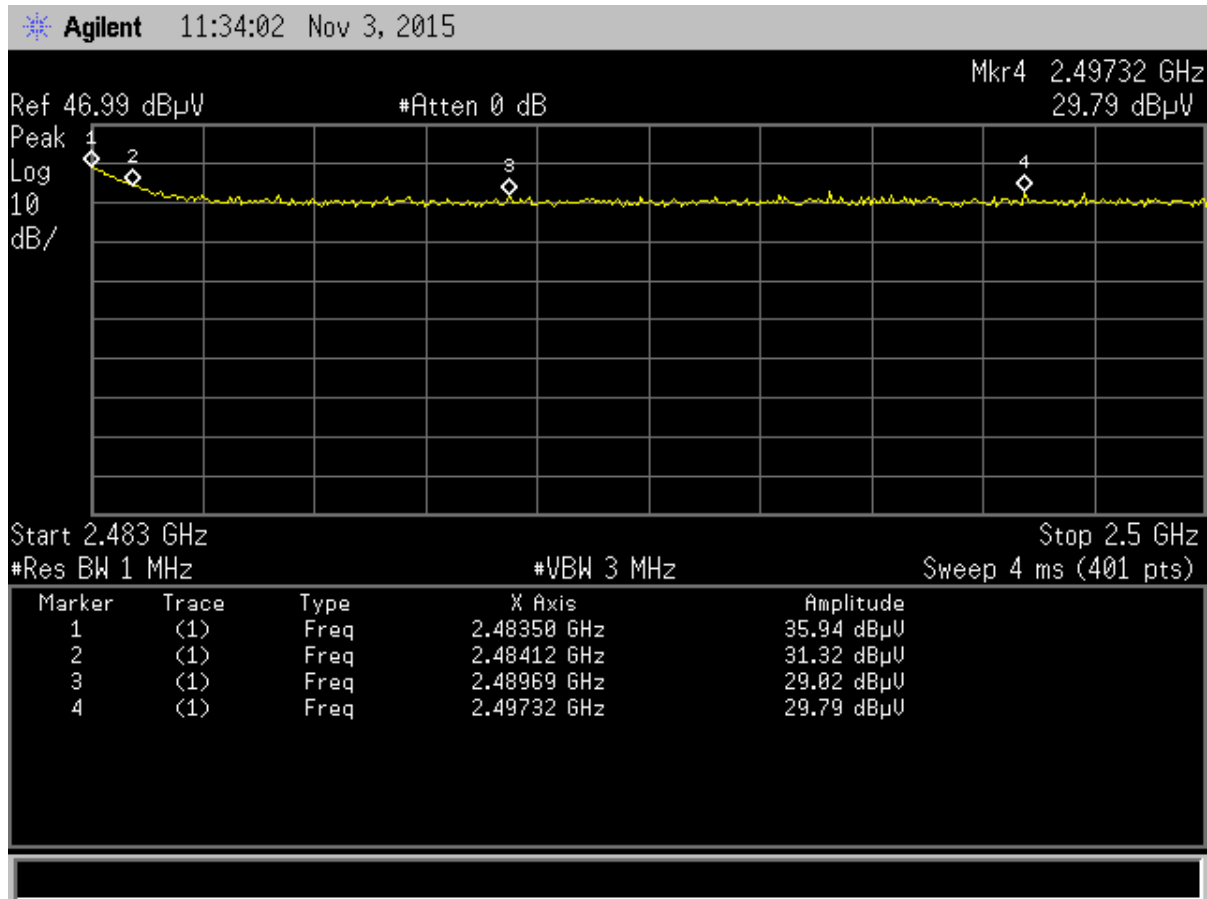


Figure 10. Conducted Restricted Band Measurements PK, 2.4835 GHz to 2.5 GHz

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Table 13. Conducted Restricted Band Measurements PK, 2.4835 GHz to 2.5 GHz

Frequency (MHz)	Test Data (dBuV)	Additional Factor (dB)	AF+CA+AMP+DC (dB/m)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2483.50	35.94	--	32.74	68.68	74.0	5.3
2484.12	31.32	--	32.74	64.06	74.0	9.9
2489.69	29.02	--	32.74	61.76	74.0	12.2
2497.32	29.79	--	32.74	62.53	74.0	11.5
2483.50	35.94	-20.00	32.74	48.68	54.0	5.3
2484.12	31.32	-20.00	32.74	44.06	54.0	9.9
2489.69	29.02	-20.00	32.74	41.76	54.0	12.2
2497.32	29.79	-20.00	32.74	42.53	54.0	11.5

Sample calculation: at 2483.50 MHz, 35.94 dBuV + 32.74 (dB) = 68.68 dBuV/m

Test Date: September 17, 2015

Tested By

Signature: 

Name: Carrie Ingram

US Tech Test Report:
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2.12 99% Occupied Bandwidth (IC RSS 247, 5.1 & 5.2)

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 12 and Figures 21-23.

Table 14. 20 dB Bandwidth and 99% Occupied Bandwidth

Frequency (MHz)	6 dB Bandwidth (kHz)	99% Occupied Bandwidth (kHz)
2402	491.6	990.7
2426	488.1	987.4
2480	485.7	990.7

Test Date: September 17, 2015

Tested By

Signature: 

Name: Carrie Ingram

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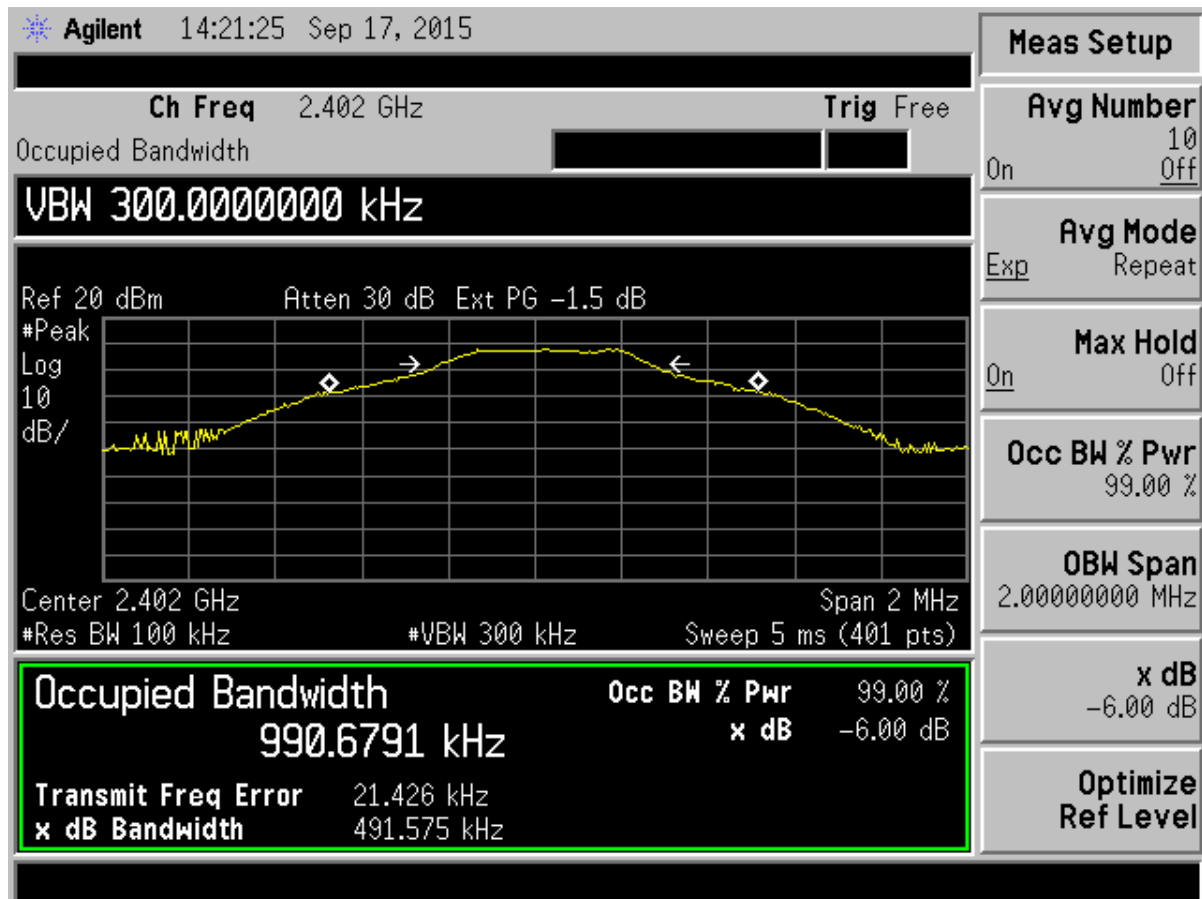


Figure 11. Twenty dB Bandwidth - IC RSS 247, A8.1– Low Channel

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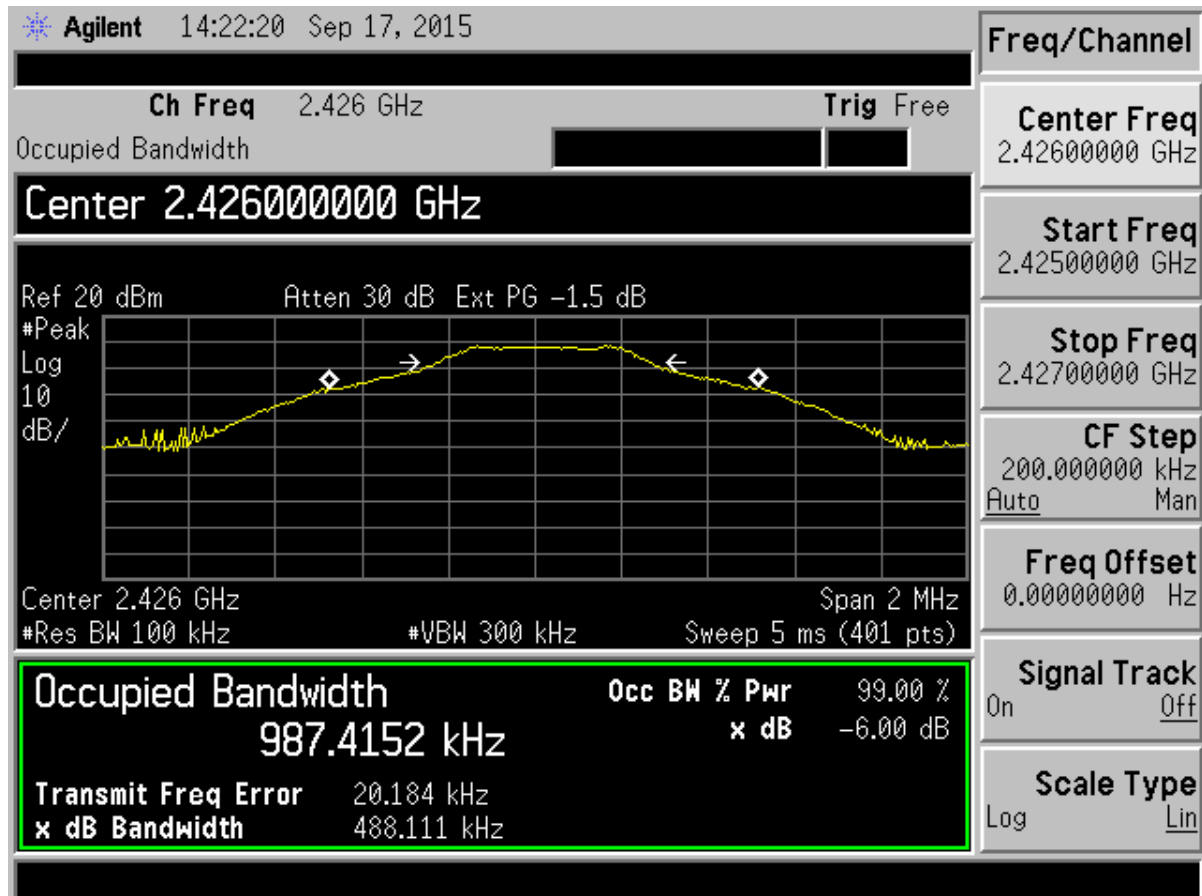


Figure 12. Twenty dB Bandwidth -IC RSS 247, A8.1 – Mid Channel

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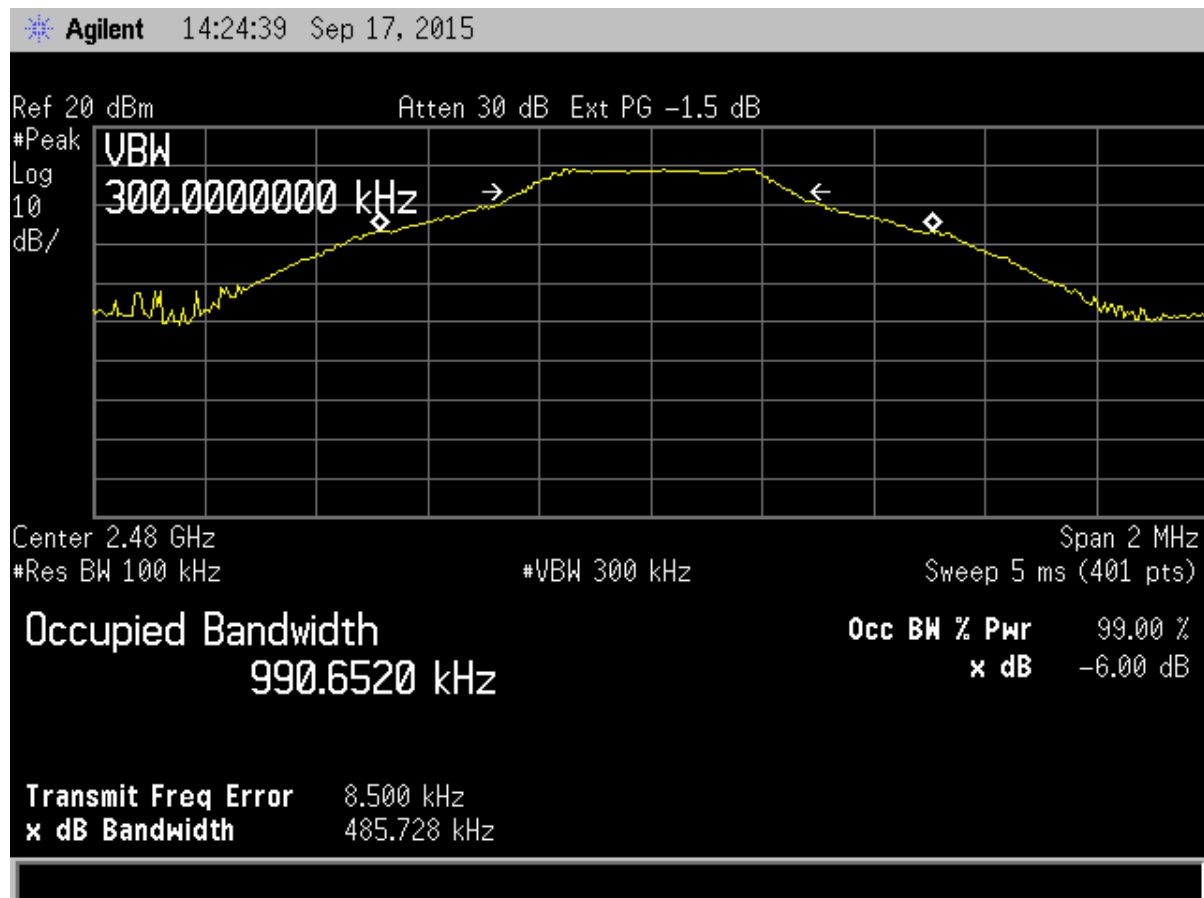


Figure 13. Twenty dB Bandwidth -IC RSS 247, A8.1 – High Channel

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2.13 Unintentional Radiator, Powerline Emissions (CFR 15.107)

The power line conducted voltage emission measurements have been carried out in accordance with CFR 15.107, per ANSI C63.4:2009, Paragraph 7, with a spectrum analyzer connected to a LISN and the EUT placed into a continuous mode of transmission.

This Test Data is included in US Tech report 15-0108.

2.14 Unintentional Radiator, Radiated Emissions (CFR 15.109)

Radiated emissions disturbance Measurements were performed with an instrument having both peak and quasi-peak detectors over the frequency range of 30 MHz to 25 GHz. Measurements of the radiated emissions were made with the receiver antenna at a distance of 3 m from the boundary of the test unit.

The test antenna was varied from 1 m to 4 m in height while watching the analyzers' display for the maximum magnitude of the signal at the test frequency. The antenna polarization (horizontal or vertical) and test sample azimuth were varied during the measurements to find the maximum field strength readings to record.

This Test Data is included in US Tech report 15-0108.

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2.15 Measurement Uncertainty

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

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 ± 5.39 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 ± 5.18 dB.

The measurement uncertainty (with a 95% confidence level) for this test using a Horn Antenna is ± 5.21 dB.