

Emissions Test Report

EUT Name: Knocki Wireless Surface Controller

Model No.: KNC1

CFR 47 Part 15.247: 2017 and RSS 247: 2017

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Statement of Compliance

Manufacturer: Swan Solutions, Inc.
8300 Bissonnet Street Suite 215
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Requester / Applicant: Ohad Nezer
Name of Equipment: Knocki Wireless Surface Controller
Model No. KNC1
Type of Equipment: Intentional Radiator
Application of Regulations: CFR 47 Part 15.247: 2017 and RSS 247: 2017
Test Dates: 12 JUN 2017 to 16 JUN 2017

Guidance Documents:

Emissions: ANSI C63.10-2013

Test Methods:

Emissions: ANSI C63.10-2013

The electromagnetic compatibility test and documented data described in this report has been performed and recorded by TUV Rheinland, in accordance with the standards and procedures listed herein. As the responsible authorized agent of the EMC laboratory, I hereby declare that the equipment described above has been shown to be compliant with the EMC requirements of the stated regulations and standards based on these results. If any special accessories and/or modifications were required for compliance, they are listed in the Executive Summary of this report.

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Date June 26, 2017

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A2LA Signatory

Date June 26, 2017



Industry
Canada Industrie
Canada

Testing Cert #3331.02

US5254

2932M-1

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1 Executive Summary

1.1 Scope

This report is intended to document the status of conformance with the requirements of the CFR 47 Part 15.247: 2017 and RSS 247: 2017 based on the results of testing performed on 12 JUN 2017 to 16 JUN 2017 on the Knocki Wireless Surface Controller, Model KNC1 manufactured by Swan Solutions. This report only applies to the specific samples tested under the stated test conditions. It is the responsibility of the manufacturer to assure that additional production units of this model are manufactured with identical or EMI equivalent electrical and mechanical components. This report is further intended to document changes and modifications to the EUT throughout its life cycle. All documentation will be included as a supplement.

1.2 Purpose

Testing was performed to evaluate the EMC performance of the EUT in accordance with the applicable requirements, procedures, and criteria defined in the application of regulations and application of standards listed in this report. The 2412 MHz to 2462 MHz frequency band is covered in this document.

1.3 Summary of Test Results

Table 1: Summary of Test Results

Test	Test Method ANSI C63.10: 2013	Test Parameters (Measured)	Result
Spurious Emission in Transmitted Mode	CFR47 15.209, CFR47 15.247 (d) RSS-GEN Sect.8.9, RSS 247 Sect. 6.2.1.2	Class B	Complied
Restricted Bands of Operation	CFR47 15.205, RSS GEN Sect.8.10	Class B	Complied
AC Power Conducted Emission	CFR47 15.207, RSS-GEN Sect.8.8	Class B	N/A
Occupied Bandwidth	CFR47 15.247 (a1), RSS GEN Sect.6.6	See plots	Complied
Maximum Output Power	CFR47 15.247 (b), RSS 247 Sect. 5.4.4, 6.2.4.1	17.21 dBm (802.11b) 17.17 dBm (802.11g) 17.17 dBm (HT 20)	Complied
Peak Power Spectral Density	CFR47 15.247 (e), RSS 247 Sect. 5.2.2	< 8 dBm/3kHz	Complied
Out of Band Emission	CFR47 15.247 (d), RSS 247 Sect.5.5	30 MHz - 26 GHz < 30 dBm/100kHz	Complied
RF Exposure	CFR47 15.247 (i), 2.1093 RSS-102 Issue 5	General Population	N/A

Note: This test report covers 2400 MHz to 2483.5 MHz band.

1.4 Special Accessories

Würth ferrite (#742 715 4) were used in order to achieve compliance for 30-1000MHz radiated emission.

1.5 Equipment Modifications

None

2 Laboratory Information

2.1 Accreditations & Endorsements

2.1.1 US Federal Communications Commission



TUV Rheinland of North America at 1279 Quarry Ln, Pleasanton, CA 94566 is recognized by the commission for performing testing services for the general public on a fee basis. These laboratory test facilities have been fully described in reports submitted to and accepted by the FCC (US5254). The laboratory scope of accreditation includes: Title 47 CFR Parts 15, 18, and 90. The accreditation is updated every 3 years.

2.1.2 NIST / A2LA



TUV Rheinland of North America is accredited by the National Voluntary Laboratory Accreditation Program, which is administered under the auspices of the National Institute of Standards and Technology. The laboratory has been assessed and accredited in accordance with ISO Guide 17025:1999 and ISO 9002 (Lab Code Testing Cert #3331.02). The scope of laboratory accreditation includes emission and immunity testing. The accreditation is updated annually.

2.1.3 Canada – Industry Canada



TUV Rheinland of North America at the 1279 Quarry Ln, Pleasanton, CA 94566 address is accredited by Industry Canada for performing testing services for the general public on a fee basis. This laboratory test facilities have been fully described in reports submitted to and accepted by Industry Canada (File Number 2932M). This reference number is the indication to the Industry Canada Certification Officers that the site meets the requirements of RSS 212, Issue 1 (Provisional). The accreditation is updated every 3 years.

2.1.4 Japan – VCCI



The Voluntary Control Council for Interference by Information Technology Equipment (VCCI) is a group that consists of Information Technology Equipment (ITE) manufacturers and EMC test laboratories. The purpose of the Council is to take voluntary control measures against electromagnetic interference from Information Technology Equipment, and thereby contribute to the development of a socially beneficial and responsible state of affairs in the realm of Information Technology Equipment in Japan. TUV Rheinland of North America at 1279 Quarry Ln, Pleasanton, CA 94566 has been assessed and approved in accordance with the Regulations for Voluntary Control Measures.

VCCI Registration No. for Pleasanton: A-0031

VCCI Registration No. for Santa Clara: A-0032

2.1.5 Acceptance by Mutual Recognition Arrangement



The United States has an established agreement with specific countries under the Asia Pacific Laboratory Accreditation Corporation (APLAC) Mutual Recognition Arrangement. Under this agreement, all TUV Rheinland at 1279 Quarry Ln, Pleasanton, CA 94566 test results and test reports within the scope of the laboratory NIST / A2LA accreditation will be accepted by each member

country.

2.2 Test Facilities

All of the test facilities are located at 1279 Quarry Lane, Pleasanton, California 94566, USA. The 2305 Mission College, Santa Clara, 95054, USA location is considered a Pleasanton annex.

2.2.1 Emission Test Facility

The Semi-Anechoic chamber and AC Line Conducted measurement facility used to collect the radiated and conducted data has been constructed in accordance with ANSI C63.7:1992. The site has been measured in accordance with and verified to comply with the theoretical normalized site attenuation requirements of ANSI C63.4-2014, at a test distance of 3 and 5 meters. The site is listed with the FCC and accredited by A2LA (Lab Code Testing Cert #3331.02). The 3/5-meter semi-anechoic chamber used to collect the radiated data has been verified to comply with the theoretical normalized site attenuation requirements of ANSI C63.4-2014, at a test distance of 3 meter and 5 meters. A report detailing this site can be obtained from TUV Rheinland of North America.

2.2.2 Immunity Test Facility

ESD, EFT, Surge, PQF: These tests are performed in an environmentally controlled room with a 3.7 m x 4.8 m x 3.175 mm thick aluminum floor connected to PE ground.

For ESD testing, tabletop equipment is placed on an insulated mat with a surface resistivity of 10^9 Ohms/square on a 1.6 m x 0.8 m x 0.8 m high non-conductive table with a 3.175 mm aluminum top (Horizontal Coupling Plane). The HCP is connected to the main ground plane via a low impedance ground strap through two 470-k Ω resistors. The Vertical Coupling Plane consists of an aluminum plate 50 cm x 50 cm x 3.175 mm thick. The VCP is connected to the main ground plane via a low impedance ground strap through two 470-k Ω resistors.

For EFT, Surge, PQF, the HCP and VCP are removed.

RF Field Immunity testing is performed in a 7.3m x 4.3m x 4.1m anechoic chamber.

RF Conducted and Magnetic Field Immunity testing is performed on a 4.8m x 3.7m x 3.175mm thick aluminum ground plane.

All test areas allow a minimum distance of 1 meter from the EUT to walls or conducting objects.

2.3 Measurement Uncertainty

Two types of measurement uncertainty are expressed in this report, per *ISO Guide To The Expression Of Uncertainty In Measurement*, 1st Edition, 1995.

The Combined Standard Uncertainty is the standard uncertainty of the result of a measurement when that result is obtained from the values of a number of other quantities; it is equal to the positive square root of the sum of the variances or co-variances of these other quantities, weighted according to how the measurement result varies with changes in these quantities. The term *standard uncertainty* is the result of a measurement expressed as a standard deviation.

2.3.1 Sample Calculation – radiated & conducted emissions

The field strength is calculated by subtracting the Amplifier Gain and adding the Cable Loss and Antenna Correction Factor to the measured reading. The basic equation is as follows:

$$\text{Field Strength (dB}\mu\text{V/m)} = \text{RAW} - \text{AMP} + \text{CBL} + \text{ACF}$$

Where: RAW = Measured level before correction (dB μ V)

AMP = Amplifier Gain (dB)

CBL = Cable Loss (dB)

ACF = Antenna Correction Factor (dB/m)

$$\mu\text{V/m} = 10^{\frac{\text{dB}\mu\text{V} / \text{m}}{20}}$$

Sample radiated emissions calculation @ 30 MHz

Measurement +Antenna Factor–Amplifier Gain+Cable loss=Radiated Emissions (dB μ V/m)

$$25 \text{ dB}\mu\text{V/m} + 17.5 \text{ dB} - 20 \text{ dB} + 1.0 \text{ dB} = 23.5 \text{ dB}\mu\text{V/m}$$

2.3.2 Measurement Uncertainty

Per CISPR 16-4-2	U _{lab}	U _{cispr}
Radiated Disturbance @ 10 meters		
30 – 1,000 MHz	2.25 dB	4.51 dB
Radiated Disturbance @ 3 meters		
30 – 1,000 MHz	2.26 dB	4.52 dB
1 – 6 GHz	2.12 dB	4.25 dB
6 – 18 GHz	2.47 dB	4.93 dB
Conducted Disturbance @ Mains Terminals		

150 kHz – 30 MHz	1.09 dB	2.18 dB
Disturbance Power		
30 MHz – 300 MHz	3.92 dB	4.3 dB

Voltech PM6000A

The estimated combined standard uncertainty for harmonic current and flicker measurements is $\pm 5.0\%$.	Per CISPR 16-4-2 Methods
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2.3.3 Measurement Uncertainty Immunity

The estimated combined standard uncertainty for ESD immunity measurements is $\pm 8.2\%$.	Per IEC 61000-4-2
The estimated combined standard uncertainty for radiated immunity measurements is ± 4.10 dB.	Per IEC 61000-4-3
The estimated combined standard uncertainty for conducted immunity measurements with CDN is ± 3.66 dB	Per IEC 61000-4-6
The estimated combined standard uncertainty for power frequency magnetic field immunity is $\pm 2.9\%$.	Per IEC 61000-4-8

Thermo KeyTek EMC Pro

The estimated combined standard uncertainty for EFT fast transient immunity measurements is $\pm 2.6\%$.
The estimated combined standard uncertainty for surge immunity measurements is $\pm 2.6\%$.
The estimated combined standard uncertainty for voltage variation and interruption measurements is $\pm 1.74\%$.

The expanded uncertainty at a level of 95% confidence is obtained by multiplying the combined standard uncertainty by a coverage factor of 2. Compliance criteria are not based on measurement uncertainty.

2.4 Calibration Traceability

All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Measurement method complies with ANSI/NCSL Z540-1-1994 and ISO Standard 17025:2005. Equipment calibration records are kept on file at the test facility.

3 Product Information

3.1 Product Description

The Model KNC1, Knocki Wireless Surface Controller, is an IOT smart home sensor. A portable device capable of operating in the 2.4GHz frequency band. .

3.2 Equipment Configuration

A description of the equipment configuration is given in the Test Plan Section. The EUT was tested as called for in the test standard and was configured and operated in a manner consistent with its intended use. The EUT was battery (Alkaline) operated and allowed to reach intended operating conditions. The placement of the EUT system components was guided by the test standard and selected to represent typical installation conditions.

In the case of a EUT that can operate in more than one configuration, preliminary testing was performed to determine the configuration that produced maximum radiation.

The final configuration was selected to produce the worst case radiation for emissions testing and to place the EUT in the most susceptible state for immunity testing.

3.3 Operating Mode

A description of the operation mode is given in the Test Plan Section. In the case of an EUT that can operate in more than one state, preliminary testing was performed to determine the operating mode that produced maximum radiation.

The final operating mode was selected to produce the worst case radiation for emissions testing and to place the EUT in the most susceptible state for immunity testing.

3.4 Unique Antenna Connector

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. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of CFR47 Parts 15.211, 15.213, 15.217, 15.219, or 15.221.

3.4.1 Results

The Knocki Wireless Surface Controller employs a single antenna and has maximum gain + 1.9 dBi.

3.5 Duty Cycle

3.5.1 Results

Mode Worst case data rate	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/B Minimum VBW (kHz)
802.11b	0.262	0.544	0.482	48.16%	3.17	3.817
802.11g	0.160	0.338	0.473	47.34%	3.25	6.250
802.11n HT20	0.164	0.351	0.467	46.72%	3.30	6.098

4 Emissions

Testing was performed in accordance with CFR 47 Part 15.247: 2017 and RSS 247: 2017. These test methods are listed under the laboratory's A2LA Scope of Accreditation. This test measures the levels emanating from the EUT, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices. Procedures described in section 8 of the standard were used.

4.1 Output Power Requirements

The maximum output power requirement is the maximum equivalent isotropic radiated power delivering at the transmitting antenna under specified conditions of measurements in the presence of modulation.

The maximum output power and harmonics shall not exceed CFR47 Part 15.247 (b):2017 and RSS 247: 2017 Sect. 5.4.4, and Sect. 6.2.4.

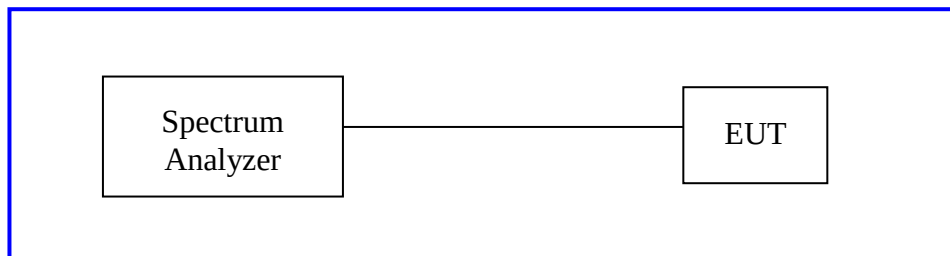
The maximum transmitted powers are

Band 2400-2483.5 MHz: 1 W

4.1.1 Test Method

The ANSI C63.10-2013 Section 11.9.2.2.2 conducted method was used to measure the channel power output. The measurements were conducted on 3 channels in each operating range per CFR47 Part 15.247(b): 2017 and RSS 247 Sect. 5.4.4; 2400 MHz to 2483.5 MHz

Test Setup:



The method described in section 9.2.2.6 of “KDB 558074 – DTS Measurement Guidance v03r05” applies and was used.

4.1.2 Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Table 2: RF Output Power at the Antenna Port – Test Results

Test Conditions: Conducted Measurement, Normal Temperature			
Antenna Type: Custom Integrated		Power Setting: See test plan	
Max. Directional Gain: + 1.9 dBi			
Signal State: Modulated			
Ambient Temp.: 22° C		Relative Humidity: 35%	
802.11b			
Operating Channel (MHz)	Limit [dBm]	Max Power [dBm]	Margin [dB]
2412.00	30.00	17.10	-12.90
2437.00	30.00	17.21	-12.79
2462.00	30.00	17.16	-12.84
Note: All insertion loss and corrections are accounted for in the measurement plots.			
802.11g			
Operating Channel (MHz)	Limit [dBm]	Max Power [dBm]	Margin [dB]
2412.00	30.00	17.10	-12.90
2437.00	30.00	17.17	-12.83
2462.00	30.00	17.10	-12.90
Note: All insertion loss and corrections are accounted for in the measurement plots.			

Table 3: RF Output Power at the Antenna Port – Test Results

Test Conditions: Conducted Measurement, Normal Temperature			
Antenna Type: Custom Integrated		Power Setting: See test plan	
Max. Directional Gain: + 1.9 dBi			
Signal State: Modulated			
Ambient Temp.: 22° C		Relative Humidity: 35%	
802.11n			
Operating Channel (MHz)	Limit [dBm]	Max Power [dBm]	Margin [dB]
2412.00	30.00	17.00	-13.00
2437.00	30.00	17.17	-12.83
2462.00	30.00	17.00	-13.00
Note: All insertion loss and corrections are accounted for in the measurement plots.			

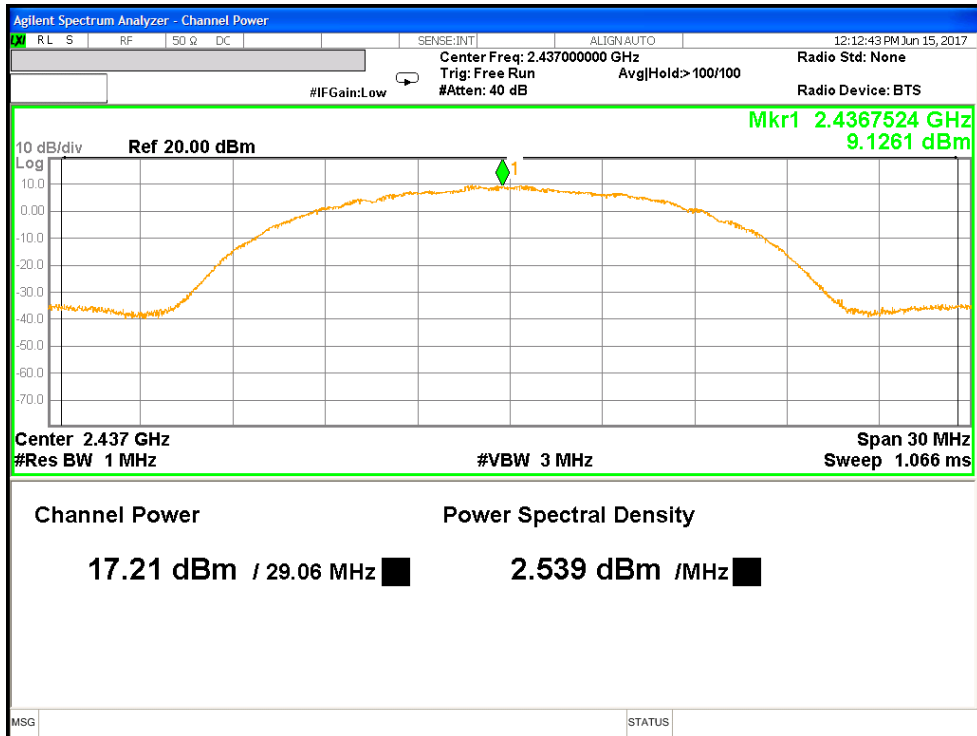


Figure 1: Maximum Transmitted Power, 2437 MHz 11b mode

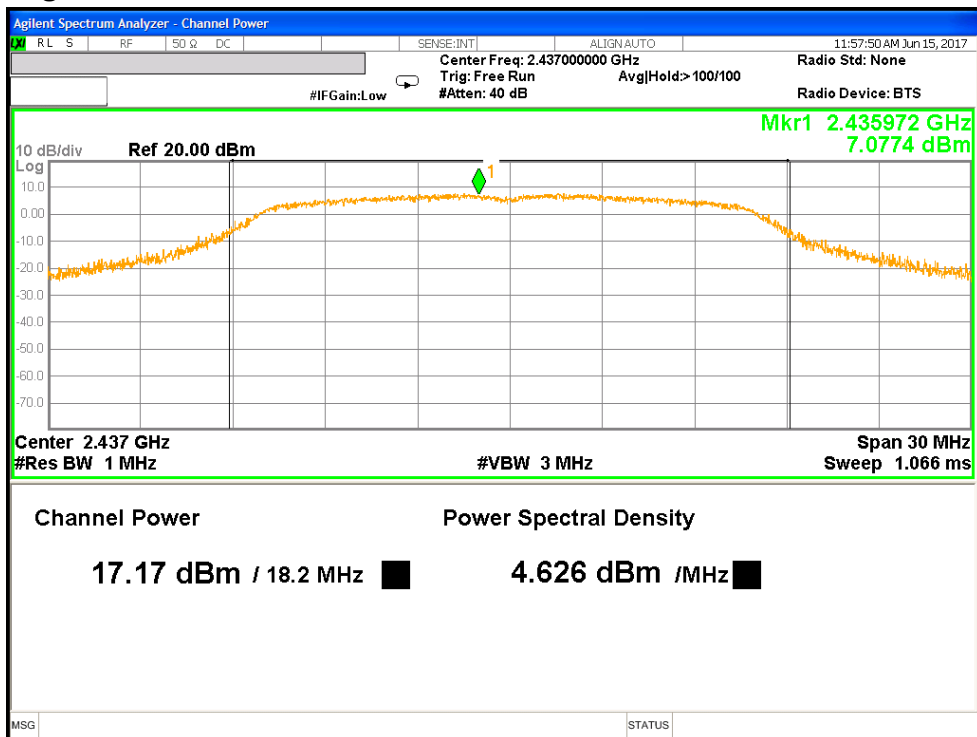


Figure 2: Maximum Transmitted Power, 2437 MHz at 11g mode

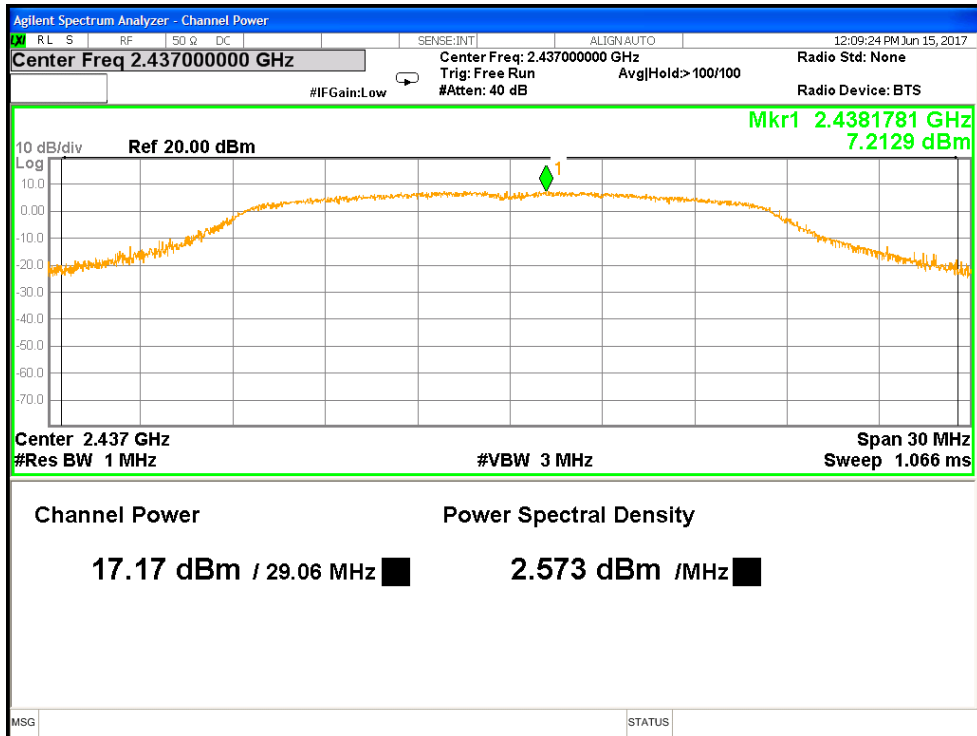


Figure 3: Maximum Transmitted Power, 2437 MHz at 11n HT20 mode

4.2 Occupied Bandwidth

The occupied bandwidth is measured at an amplitude level reduced from the reference level by a specified ratio. The reference level is the level of the highest amplitude signal observed from the transmitter at the fundamental frequency.

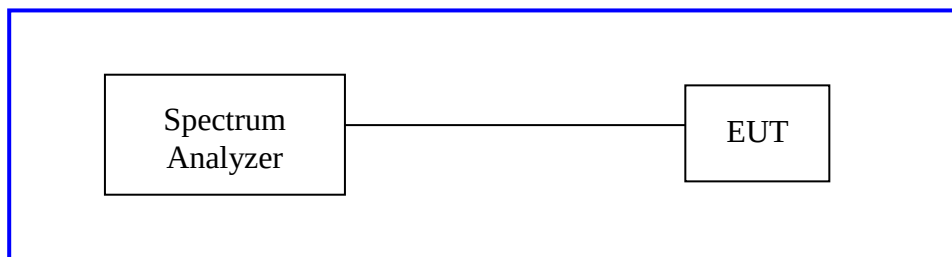
The 99% bandwidth is the bandwidth in which 99% of the transmitted power occupied.

The minimum 6 dB bandwidth shall be at least 500 kHz.

4.2.1 Test Method

The conducted method was used to measure the occupied bandwidth according to ANSI C63.10:2013 Section 11.8. The measurement was performed with modulation per CFR47 15.247(a) (2) 2017 and RSS 247 Sect. 5.2.1:2017. Measurements were performed on 3 channels in each operating frequency range; 2400 MHz to 2483.5 MHz, a 6 dB bandwidth was used.

Test Setup:



4.2.2 Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Table 4: Occupied Bandwidth – Test Results

Test Conditions: Conducted Measurement, Normal Temperature		
Antenna Type: Custom Integrated		Power Setting: See test plan
Max. Directional Gain: + 1.9 dBi		
Signal State: Modulated		
Ambient Temp.: 22° C		Relative Humidity: 35%
802.11b		
Frequency (MHz)	6dB Bandwidth (MHz)	99% Bandwidth (MHz)
2412	10.11	14.457
2437	10.09	14.431
2462	10.10	14.464
Note: None		
802.11g		
Frequency (MHz)	6dB Bandwidth (MHz)	99% Bandwidth (MHz)
2412	15.14	16.301
2437	15.14	16.776
2462	15.14	16.309
Note: None		

Table 5: Occupied Bandwidth – Test Results

Test Conditions: Conducted Measurement, Normal Temperature		
Antenna Type: Custom Integrated		Power Setting: See test plan
Max. Directional Gain: + 1.9 dBi		
Signal State: Modulated		
Ambient Temp.: 22° C		Relative Humidity: 35%
802.11n		
Frequency (MHz)	6dB Bandwidth (MHz)	99% Bandwidth (MHz)
2412	15.14	17.445
2437	15.14	17.690
2462	15.14	17.446
Note: None		

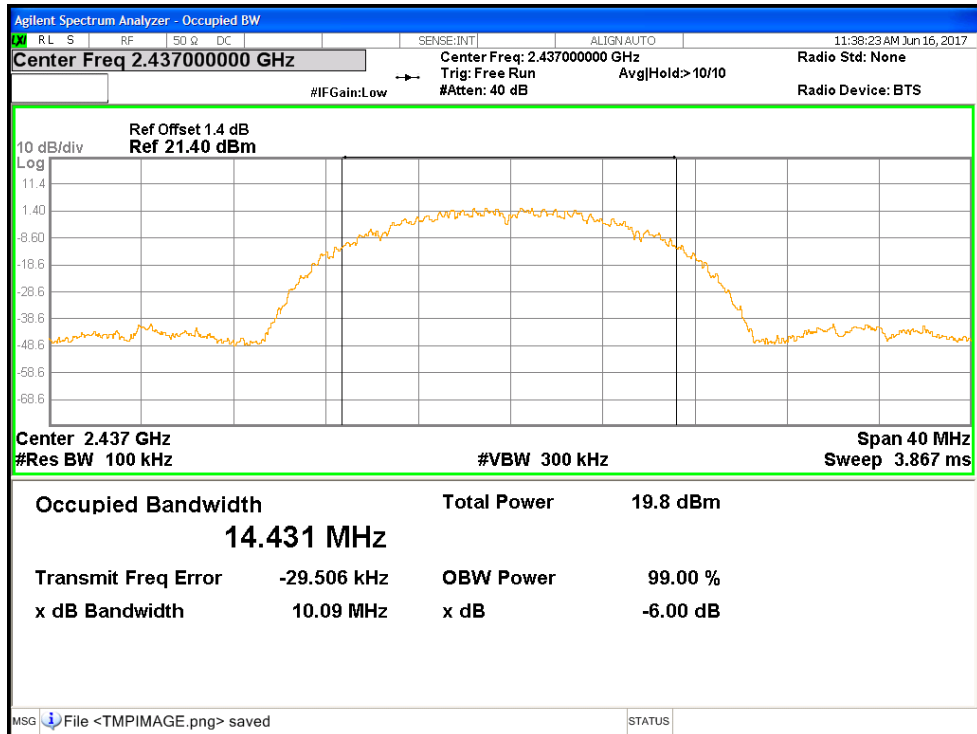


Figure 4: 6dB & 99% Occupied Bandwidth, 2437 MHz at 802.11b

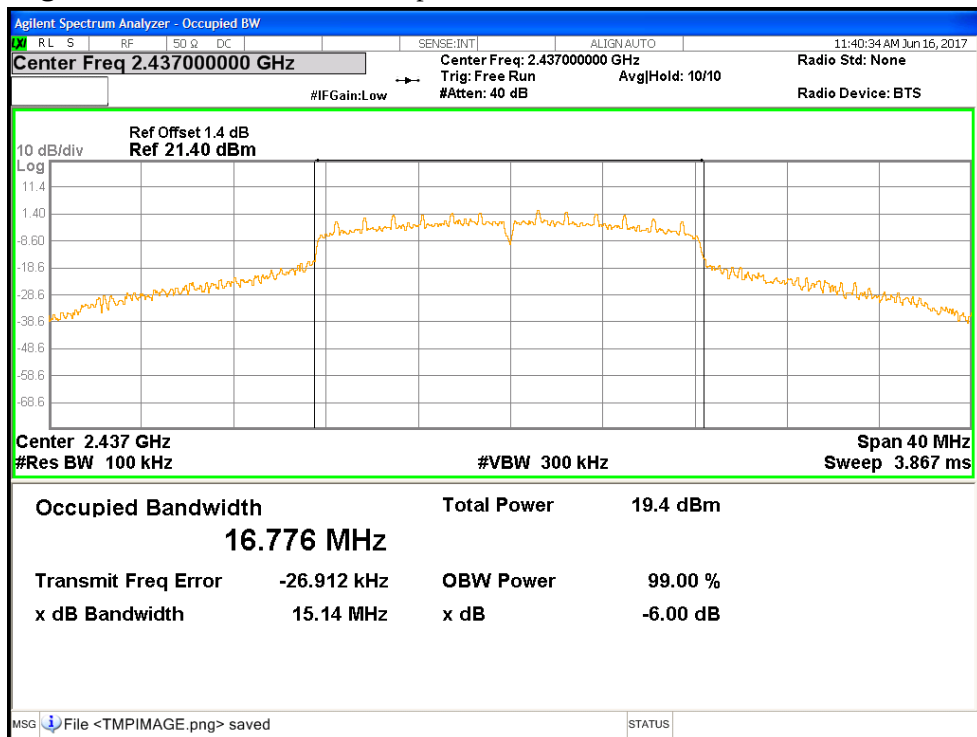


Figure 5: 6dB & 99% Occupied Bandwidth, 2437 MHz at 802.11g

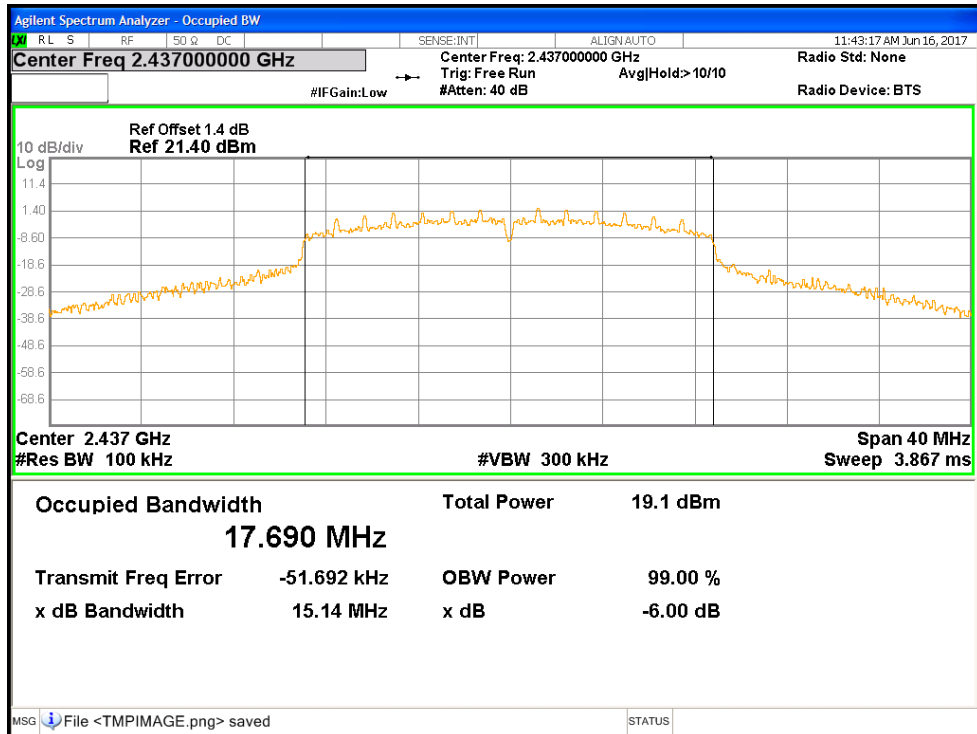


Figure 6: 6dB & 99% Occupied Bandwidth, 2437 MHz at HT20

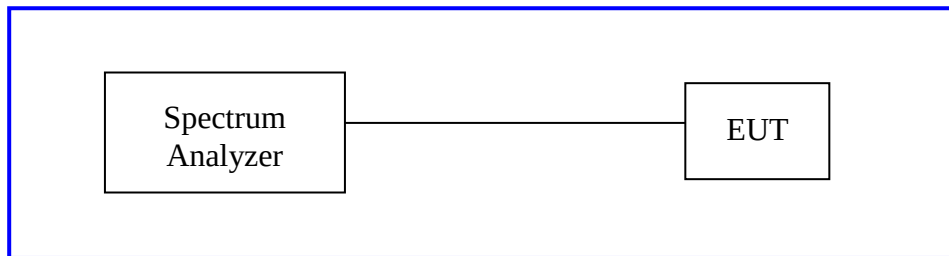
4.3 Peak Power Spectral Density

According to the CFR47 Part 15.247 (e) and RSS 247 Sect.5.2.2, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

4.3.1 Test Method

The conducted method was used to measure the channel power output per ANSI C63.10-2013 Section 11.10.3. The measurement was performed with modulation per CFR47 Part 15.247 (e) and RSS 247 Sect.5.2.2.

Test Setup:



4.3.2 Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Table 6: Peak Power Spectral Density – Test Results

Test Conditions: Conducted Measurement, Normal Temperature			
Antenna Type: Custom Integrated		Power Setting: See test plan	
Max. Directional Gain: + 1.9 dBi			
Signal State: Modulated			
Ambient Temp.: 22° C		Relative Humidity:35%	
802.11b			
Frequency (MHz)	Max PPSD [dBm]	Limit [dBm]	Margin [dB]
2412	-24.243	8.00	-16.243
2437	-21.580	8.00	-13.580
2462	-22.595	8.00	-14.595
Note: None			
802.11g			
Frequency (MHz)	Max PPSD [dBm]	Limit [dBm]	Margin [dB]
2412	-28.908	8.00	-20.908
2437	-24.754	8.00	-16.754
2462	-27.861	8.00	-19.861
Note: None			

Table 7: Peak Power Spectral Density – Test Results Continues

Test Conditions: Conducted Measurement, Normal Temperature			
Antenna Type:		Power Setting: See test plan	
Max. Directional Gain: + 1.9 dBi			
Signal State: Modulated			
Ambient Temp.: 22° C		Relative Humidity: 35%	
802.11n			
Frequency (MHz)	Max PPSD [dBm]	Limit [dBm]	Margin [dB]
2412	-28.949	8.00	-20.949
2437	-26.517	8.00	-18.517
2462	-27.866	8.00	-19.866
Note: None			

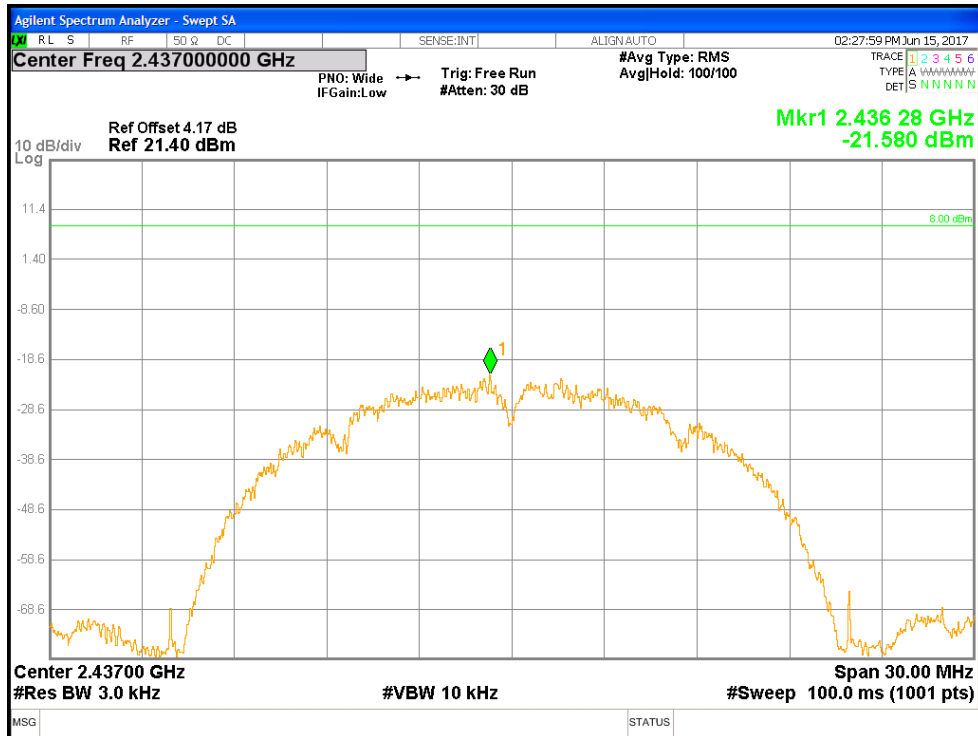


Figure 7: Power Spectral Density, 2437 MHz at 802.11b mode

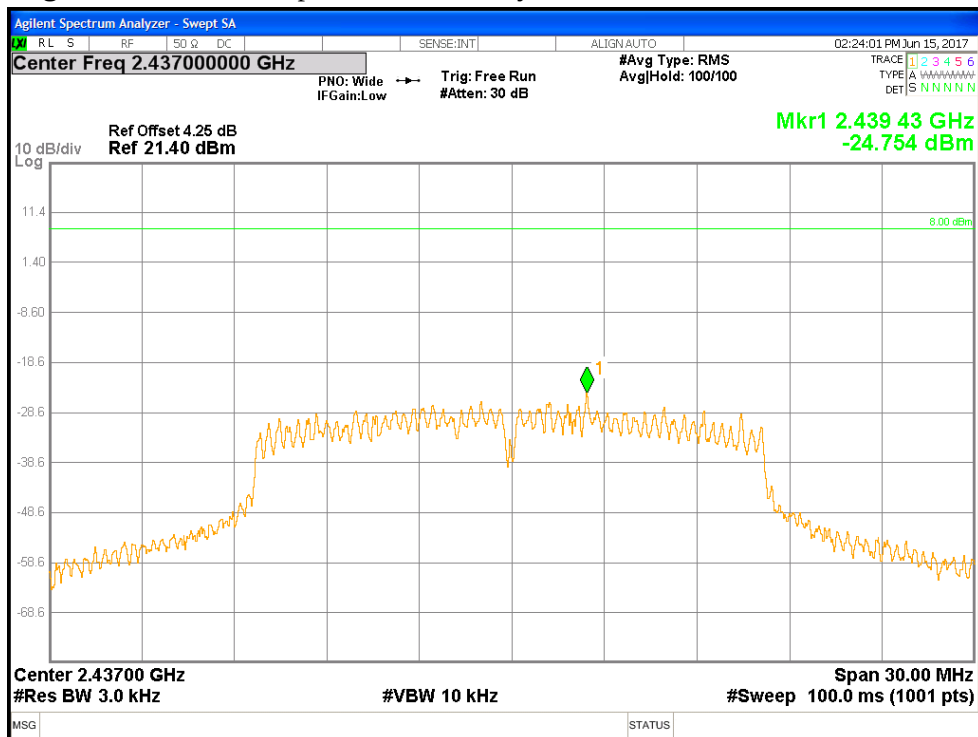


Figure 8: Power Spectral Density, 2437 MHz at 802.11g mode

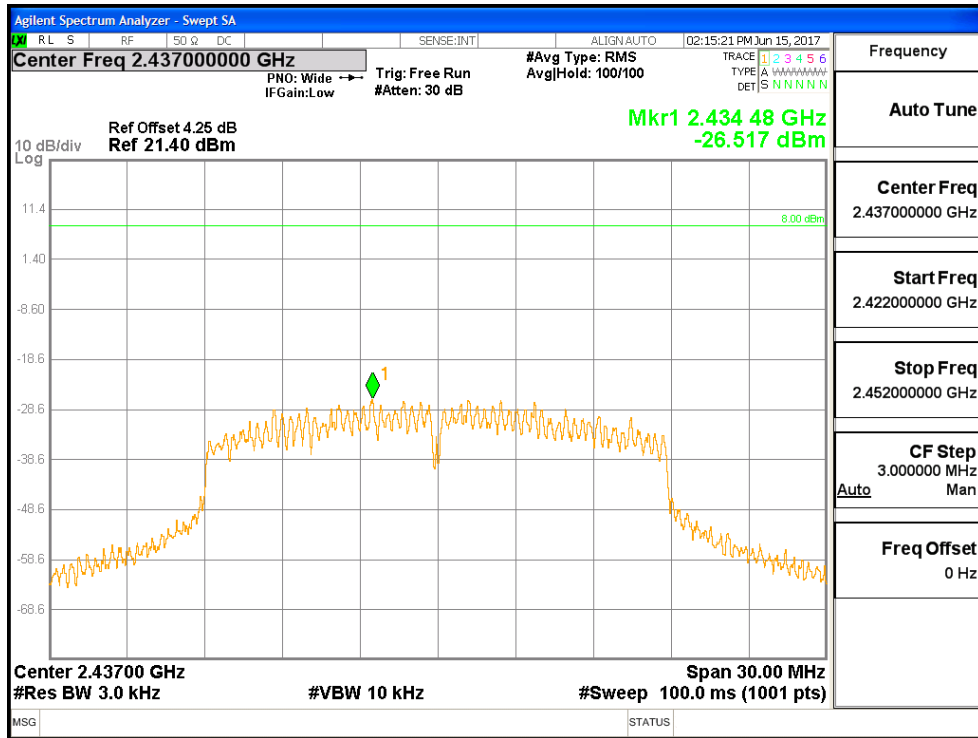


Figure 9: Power Spectral Density, 2437 MHz at HT20 mode

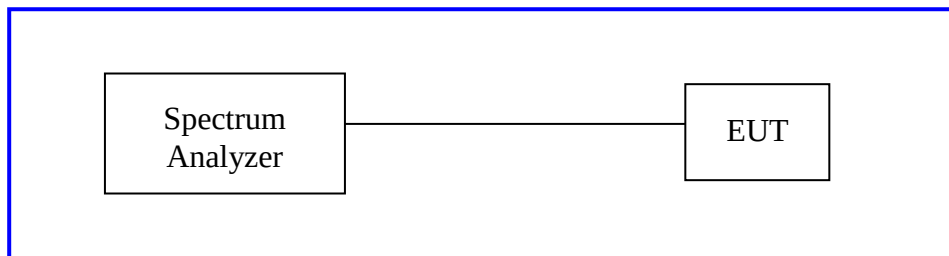
4.4 Out of Band Emissions

Transmitter spurious emissions are emissions outside the frequency range of the equipment when the equipment is in transmitting mode; per requirement of CFR47 15.205, 15.209, 15.247(d), RSS-247 Sect. 5.5.

4.4.1 Test Method

The conducted method was used to measure the undesirable emission requirement. The measurement was performed with modulation.

Test Setup:



4.4.2 Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Table 8: Emissions at the Band-Edge – Test Results

Test Conditions: Conducted Measurement, Normal Temperature					
Antenna Type: Custom Integrated			Power Setting: See test plan		
Max. Directional Gain: + 1.9 dBi					
Signal State: Modulated					
Ambient Temp.: 22° C			Relative Humidity: 35%		
Non-Restricted Frequency Band Emissions					
Freq. (MHz)	Mode	Measured (dBm)	Limit (dBm)	Plots	TX Freq. (MHz)
2400	11b mode	-43.950	-19.26	Fig. 13, 14	Pass
2483.5	11b mode	-46.546	-17.84	Fig. 15, 16	Pass
2400	11g mode	-30.433	-21.30	Fig. 17, 18	Pass
2483.5	11g mode	-46.877	-20.46	Fig. 19, 20	Pass
2400	11n HT20 mode	-32.927	-21.01	Fig. 21, 22	Pass
2483.5	11n HT20 mode	-47.354	-20.97	Fig. 23, 24	Pass
Note: 1. The worst case of each data rate is recorded.					

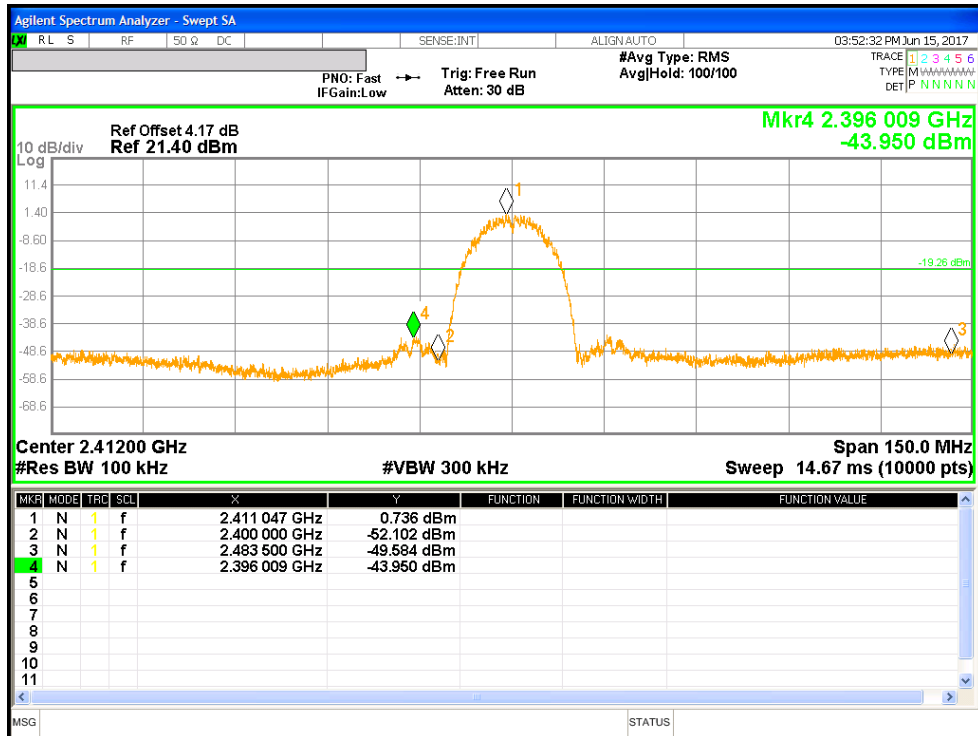


Figure 10: Measured Bandedge for 802.11b at 2412 MHz

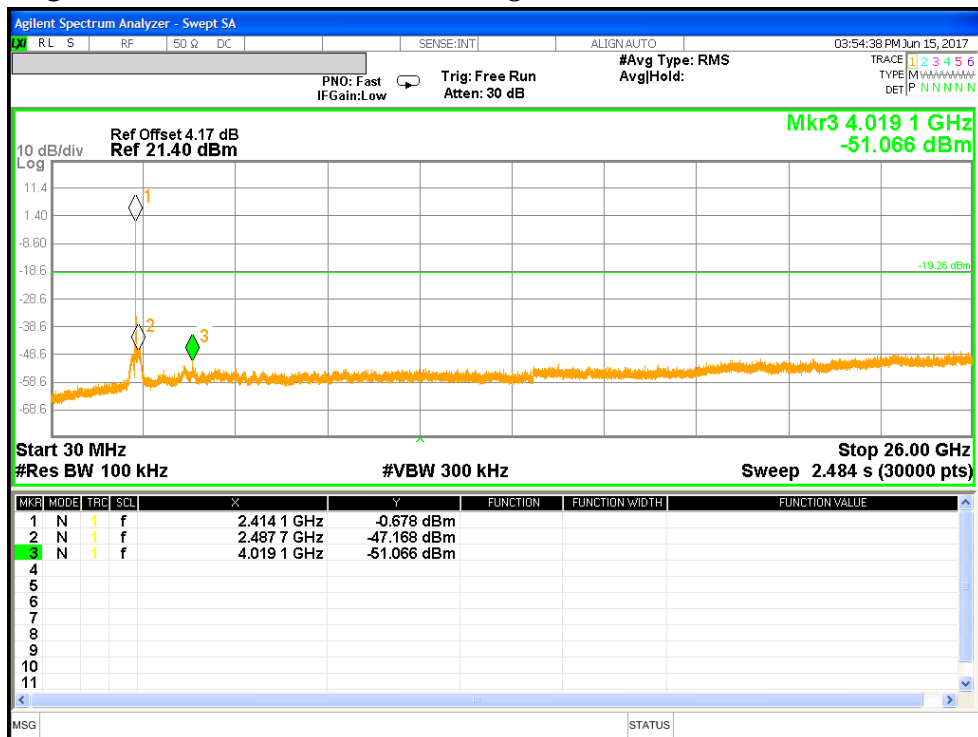


Figure 11: Out of Band Emissions for 802.11b at 2412 MHz

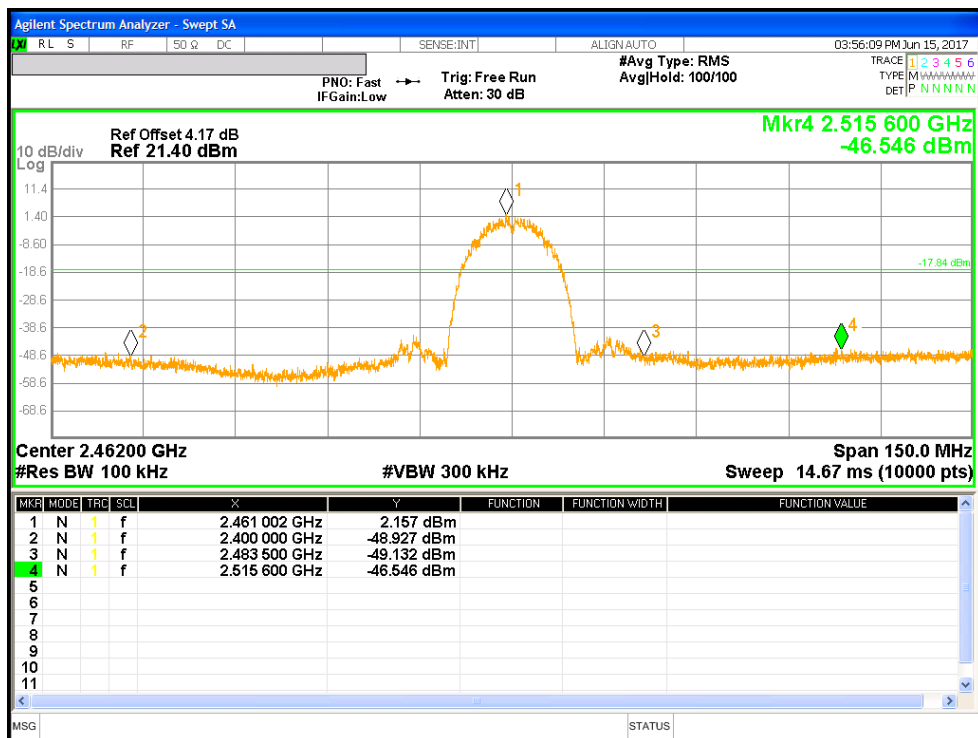


Figure 12: Measured Bandedge for 802.11b at 2462 MHz

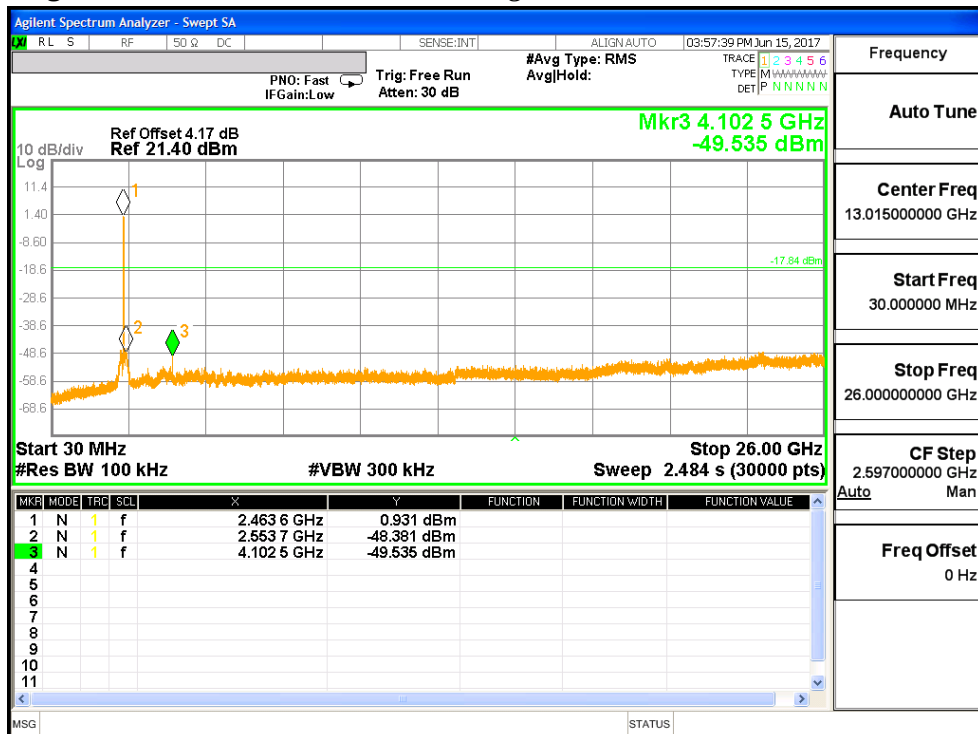


Figure 13: Out of Band Emissions for 802.11b at 2462 MHz

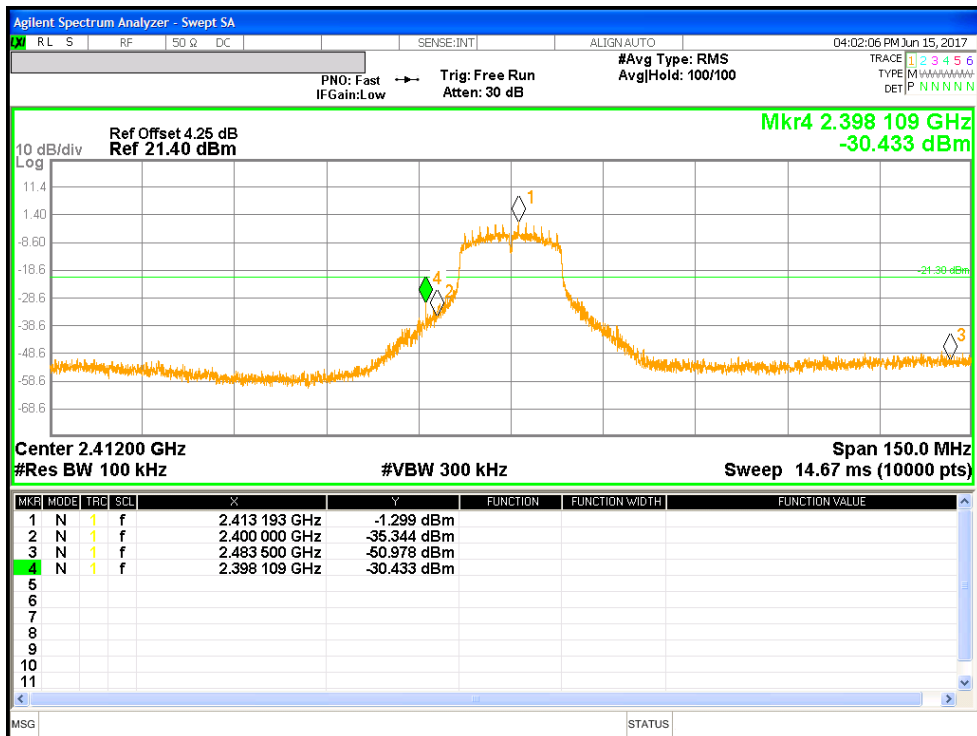


Figure 14: Measured Bandedge for 802.11g at 2412 MHz

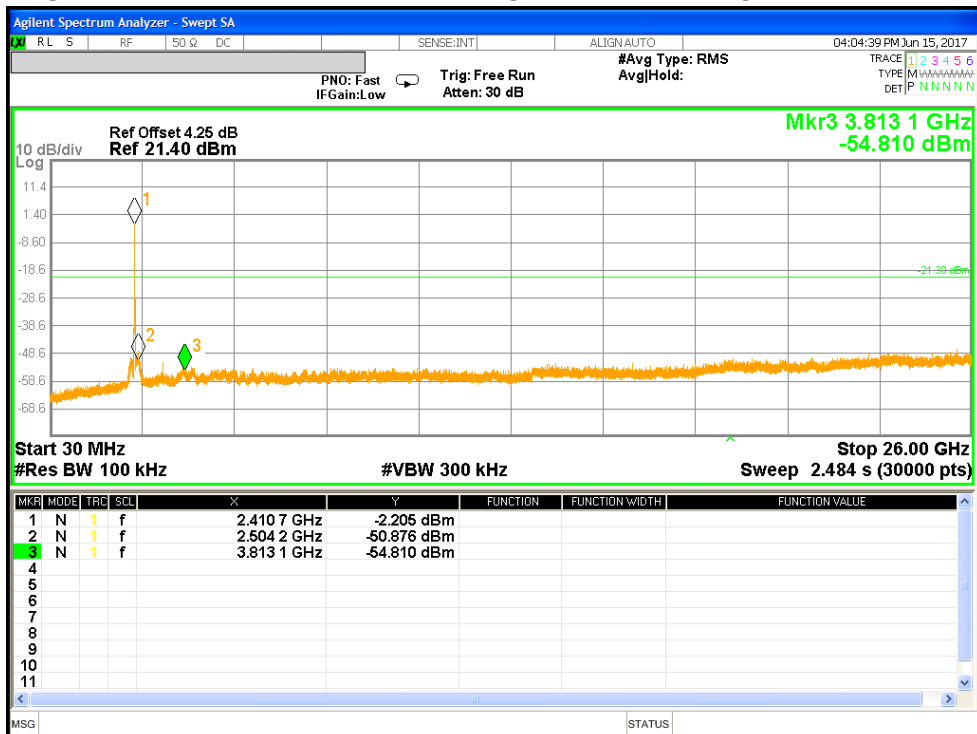


Figure 15: Out of Band Emissions for 802.11g at 2412 MHz

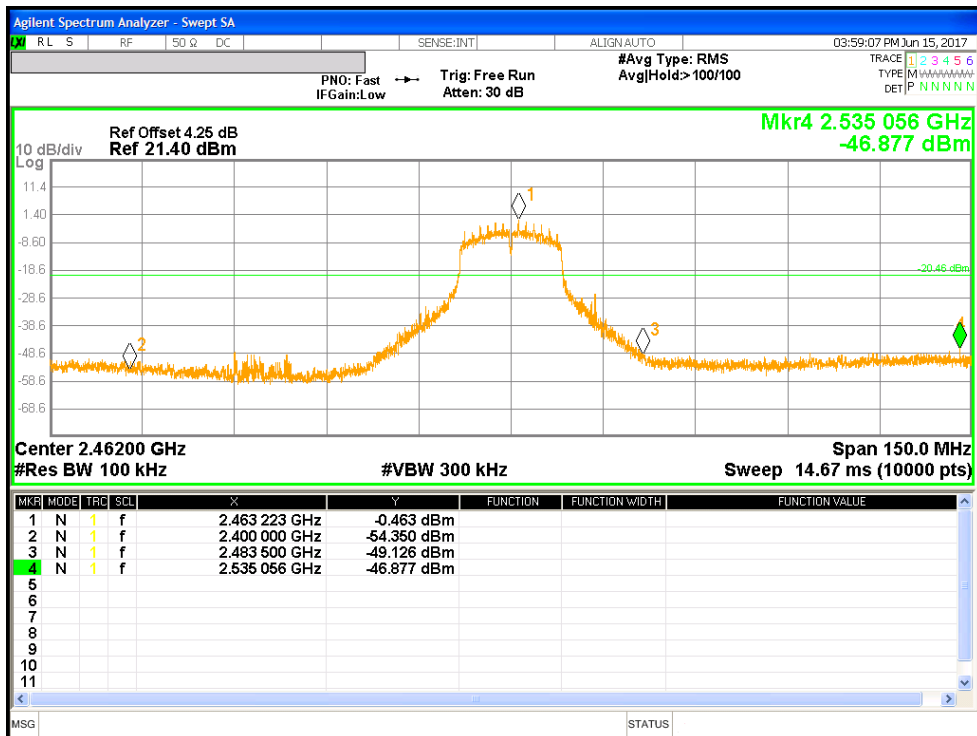


Figure 16: Measured Bandedge for 802.11g at 2462 MHz

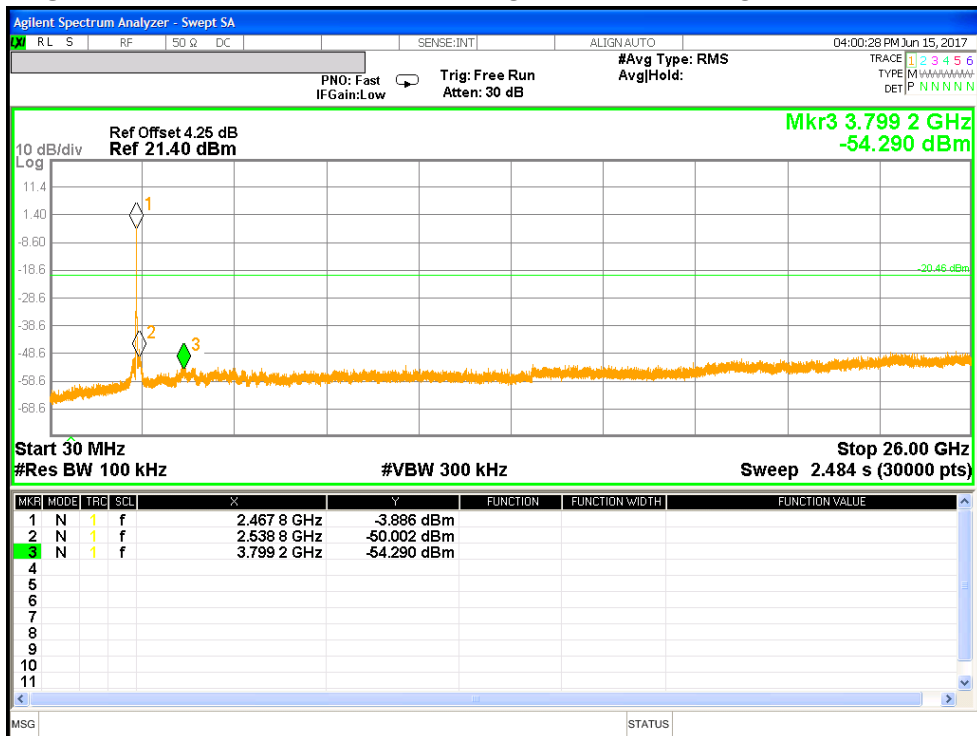


Figure 17: Out of Band Emissions for 802.11g at 2462 MHz

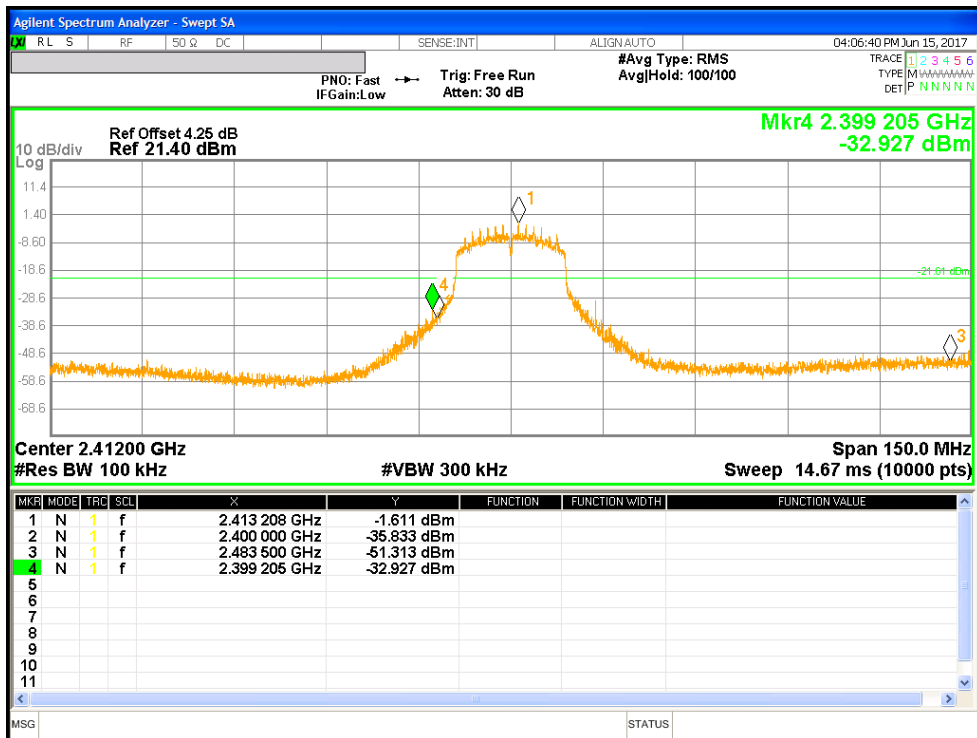


Figure 18: Measured Bandedge for HT20 at 2412 MHz

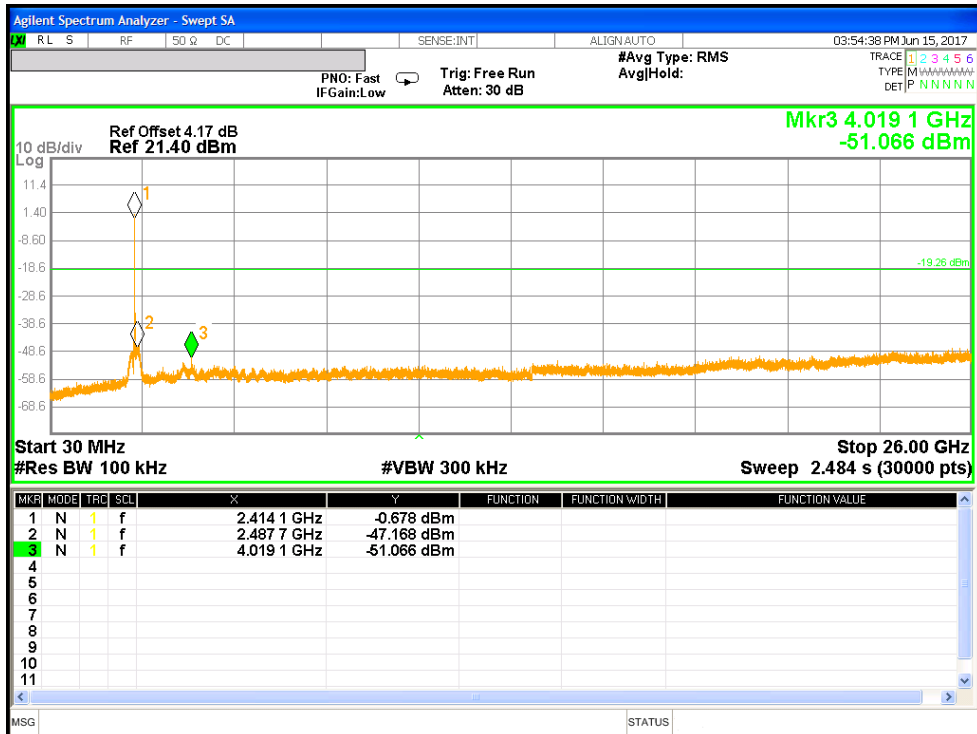


Figure 19: Out of Band Emissions for HT20 at 2412 MHz

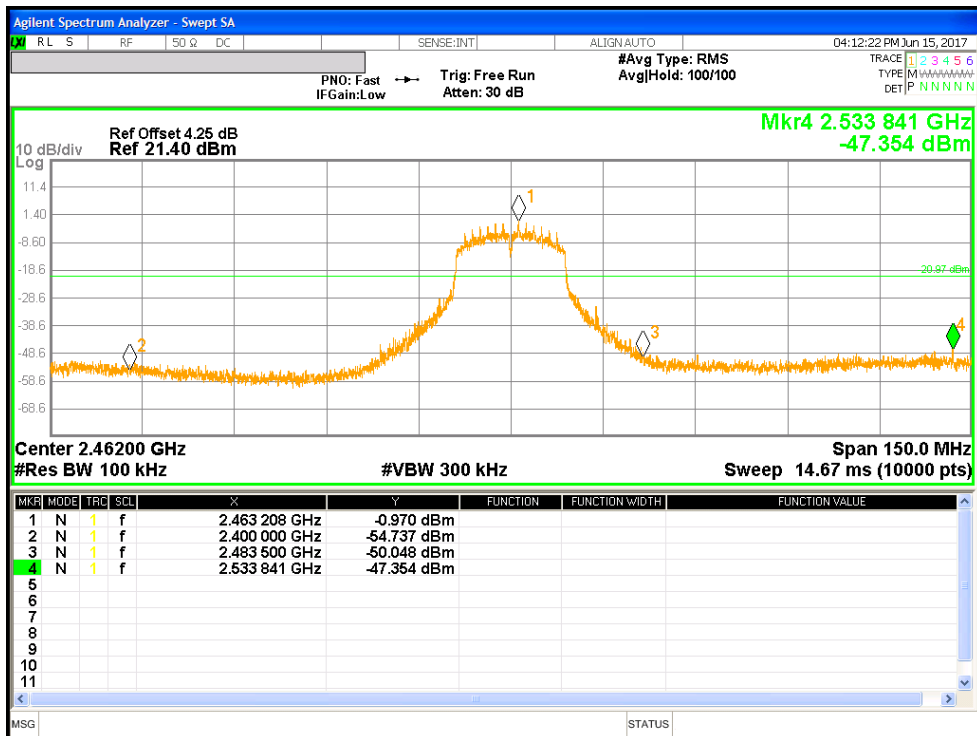


Figure 20: Measured Bandedge for HT20-MCS0 at 2462 MHz

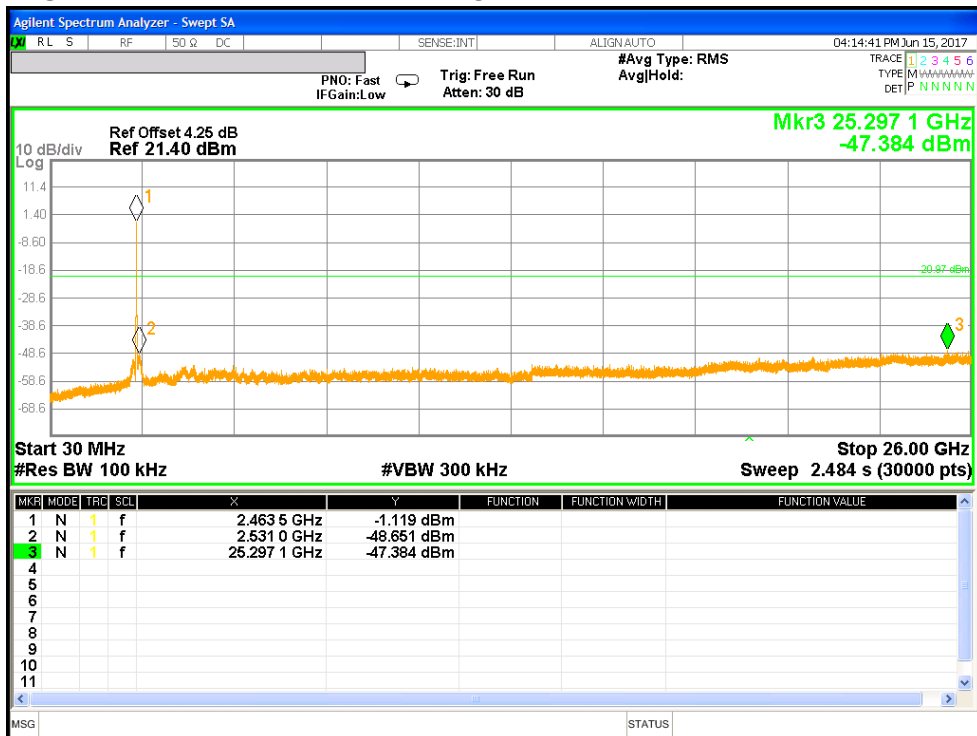


Figure 21: Out of Band Emissions for HT20-MCS0 at 2462 MHz

4.5 Transmit Spurious Emissions

Transmitter spurious emissions are emissions outside the frequency range of the equipment when the equipment is in transmit mode; per requirement of CFR47 15.205, 15.209, 15.247(d), RSS 247 Sect.5.5.

4.5.1 Test Methodology

4.5.1.1 Preliminary Test

A test program that controls instrumentation and data logging was used to automate the preliminary RF emission test procedure. The frequency range of interest was divided into sub-ranges to yield a frequency resolution of approximately 120 kHz and provide a reading at each frequency for no more than 12° of turntable rotation. For each frequency sub-range the turntable was rotated 360° while peak emission data was recorded and plotted over the frequency range of interest in horizontal and vertical antenna polarization's.

Preliminary emission profile testing was performed inside the anechoic chamber. The EUT was placed on a 1.0m x 1.5m non-conductive table 80cm (<1 GHz) and 150cm (>1 GHz) above the floor. The EUT was positioned as shown in the setup photographs. The receiving antenna was placed at a distance of 3m at a fixed height of 1m. Measurement equipment was located outside of the chamber. A video camera was placed inside the chamber to view the EUT.

4.5.1.2 Final Test

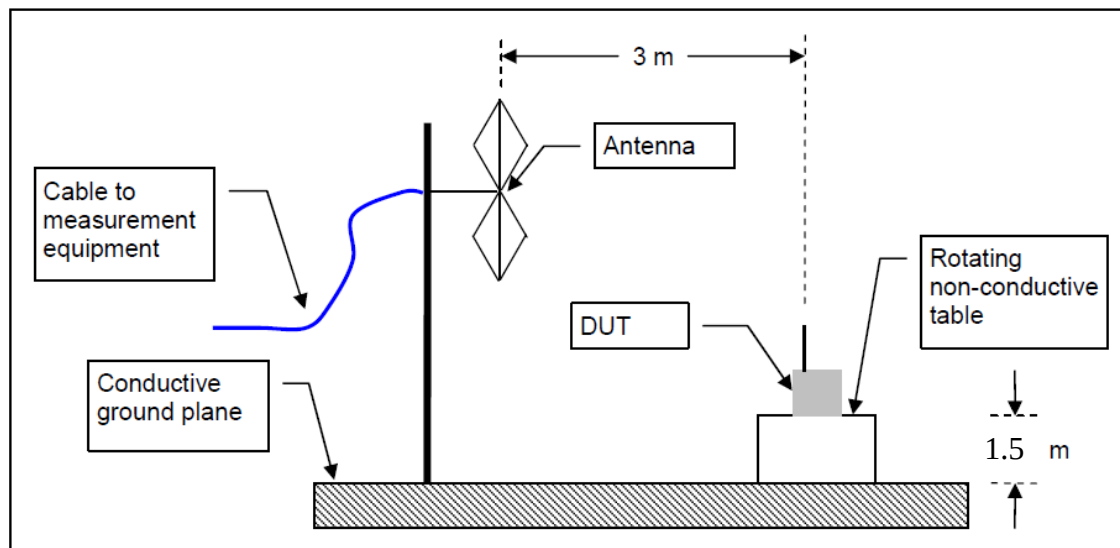
For each frequency measured, the peak emission was maximized by manipulating the receiving antenna from 1 to 4 meters above the ground plane and placing it at the position that produced the maximum signal strength reading. The turntable was then rotated through 360° while observing the peak signal and placing the EUT at the position that produced maximum radiation. The six highest emissions relative to the limit were measured unless such emissions were more than 20 dB below the limit. If less than six emissions are within 20 dB of the limit, then the noise level of the receiver is measured at frequencies where emissions are expected. Multiples of all oscillator and microprocessor frequencies were also checked.

Final testing was performed on an NSA compliant test site. The EUT was placed on a 1.0m x 1.5m non-conductive table 80cm (<1 GHz) and 150cm (>1 GHz) above the ground plane. The placement of EUT and cables were the same as for preliminary testing and is shown in the setup photographs.

4.5.1.3 Deviations

None.

Test Setup:



4.5.2 Transmitter Spurious Emission Limit

The spurious emissions of the transmitter shall not exceed the values in CFR47 Part 15.205, 15.209: 2015 and RSS Gen Sect. 8.10: 2014.

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490.....	2400/F (kHz)	300
0.490-1.705.....	24000/F (kHz)	30
1.705-30.0.....	30	30
30-88.....	100 **	3
88-216.....	150 **	3
216-960.....	200 **	3
Above 960.....	500	3

All harmonics and spurious emission which are outside of the restricted band shall be 20dB below the in-band emission.

4.5.3 Test Results

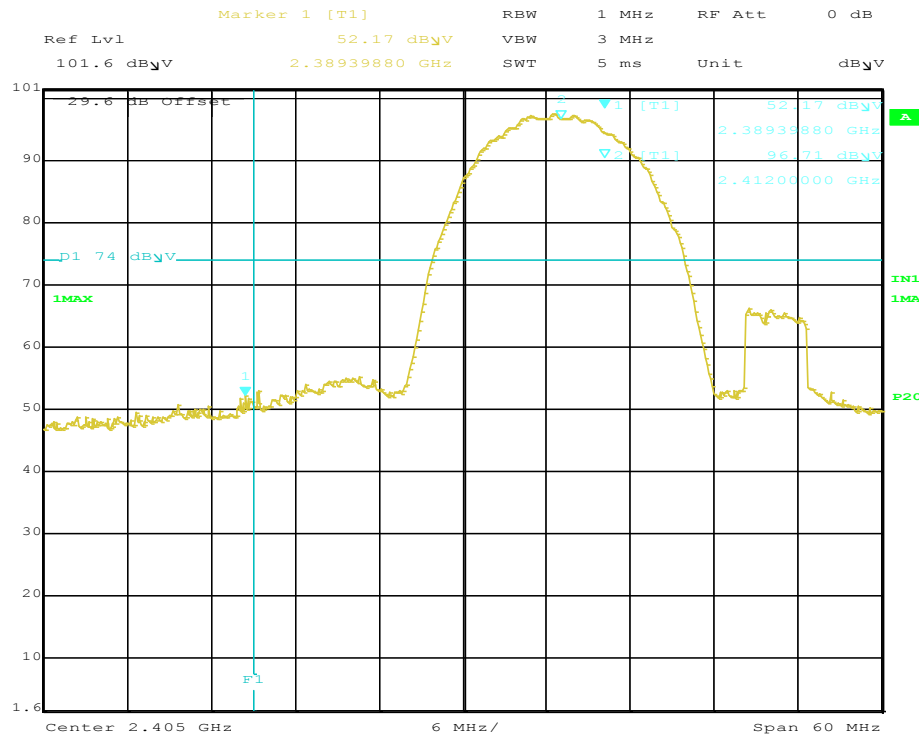
The final measurement data was taken under the worst case operating modes, configurations, and/or cable positions. It also reflects the results including any modifications and/or special accessories listed in Sections 1.4 and test plan.

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Table 9: Transmit Spurious Emission at Band-Edge Requirements

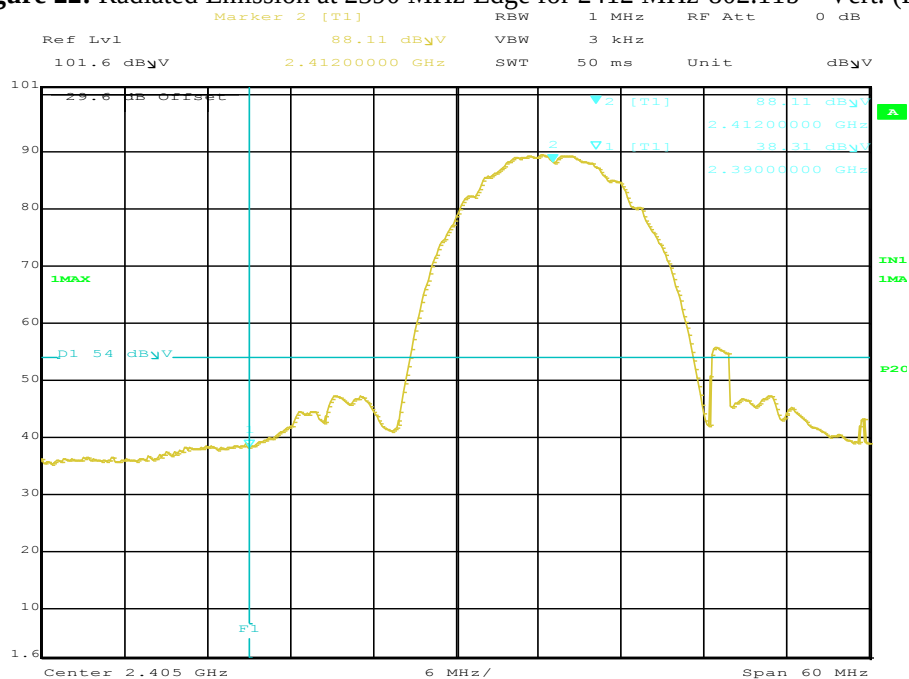
Test Conditions: Radiated Measurement								
Antenna Type: Custom Integrated					Power Setting: See test plan			
Max. Directional Gain: + 1.9 dBi								
Signal State: Modulated								
Ambient Temp.: 23° C					Relative Humidity:37%			
Band-Edge Results								
Freq. (MHz)	Level (dBu V/m)	Pol. (H/V)	Limit (dBuV/m)	Margin (dB)	Det.	Table Deg.	Tower (cm)	Note
2389.39	52.17	V	74	-21.83	Pk	282	206	PLOT 29
2390.00	38.31	V	54	-15.69	Ave	282	206	PLOT 30
2389.52	56.28	H	74	-17.72	Pk	209	326	PLOT 31
2390.00	40.20	H	54	-13.80	Ave	209	326	PLOT 32
2486.20	51.23	V	74	-22.77	Pk	105	202	PLOT 33
2487.31	38.87	V	54	-15.13	Ave	105	202	PLOT 34
2487.69	60.34	H	74	-13.66	Pk	108	204	PLOT 35
2488.10	47.06	H	54	-6.94	Ave	108	204	PLOT 36
2390.00	55.62	V	74	-18.38	Pk	334	352	PLOT 37
2390.00	38.82	V	54	-15.18	Ave	334	352	PLOT 38
2390.00	58.63	H	74	-15.37	Pk	344	353	PLOT 39
2390.00	40.90	H	54	-13.10	Ave	344	353	PLOT 40
2483.50	52.14	V	74	-21.86	Pk	327	347	PLOT 41
2483.50	38.75	V	54	-15.25	Ave	327	347	PLOT 42
2483.50	60.58	H	74	-13.42	Pk	334	345	PLOT 43
2483.50	45.24	H	54	-8.76	Ave	334	345	PLOT 44
2390.00	55.23	V	74	-18.77	Pk	116	215	PLOT 45
2390.00	37.13	V	54	-16.87	Ave	116	215	PLOT 46
2390.00	57.97	H	74	-16.03	Pk	114	210	PLOT 47
2390.00	41.01	H	54	-12.99	Ave	114	210	PLOT 48
Note: 1. The emissions were measured at the adjacent restricted band of the fundamental signal. 2. All the band-edge measurements met the restricted band requirements of CFR47 15.205.								

Band-Edge Results, continue								
Freq. (MHz)	Level (dBuV /m)	Pol. (H/V)	Limit (dBuV/m)	Margin (dB)	Det.	Table Deg.	Tower (cm)	Note
2483.50	51.62	V	74	-22.38	Pk	122	219	PLOT 49
2483.50	38.98	V	54	-15.02	Ave	122	219	PLOT 50
2483.50	61.02	H	74	-12.98	Pk	119	224	PLOT 51
2483.50	45.04	H	54	-8.96	Ave	119	224	PLOT 52
Note: 1. The emissions were measured at the adjacent restricted band of the fundamental signal. 2. All the band-edge measurements met the restricted band requirements of CFR47 15.205.								



Date: 19.JUN.2017 08:56:00

Figure 22: Radiated Emission at 2390 MHz Edge for 2412 MHz-802.11b – Vert. (Pk)



Date: 19.JUN.2017 08:54:09

Figure 23: Radiated Emission at 2390 MHz Edge for 2412 MHz-802.11b – Vert. (Ave)

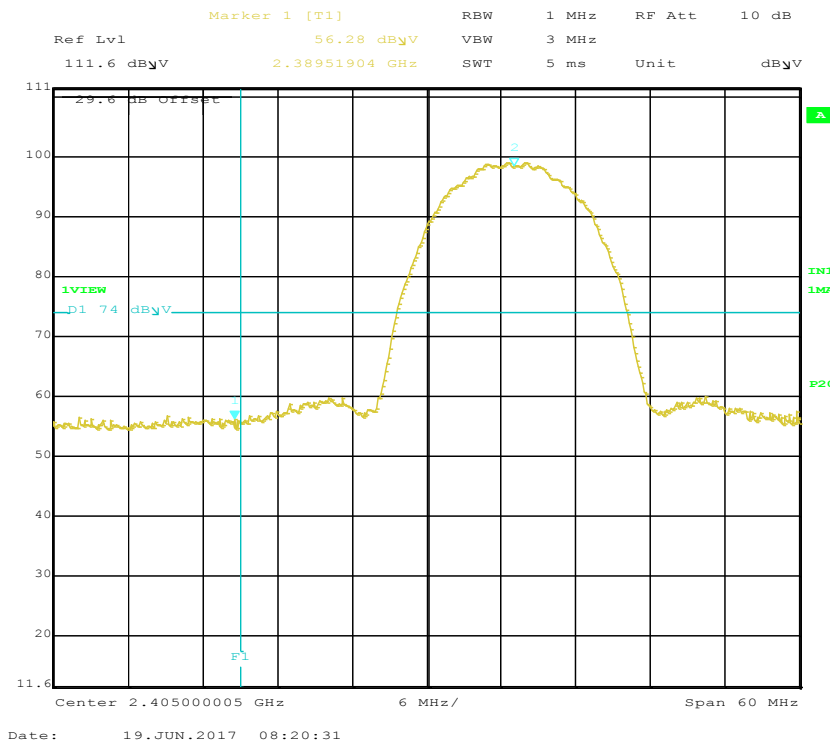


Figure 24: Radiated Emission at 2390 MHz Edge for 2412 MHz-802.11b – Horz. (Pk)

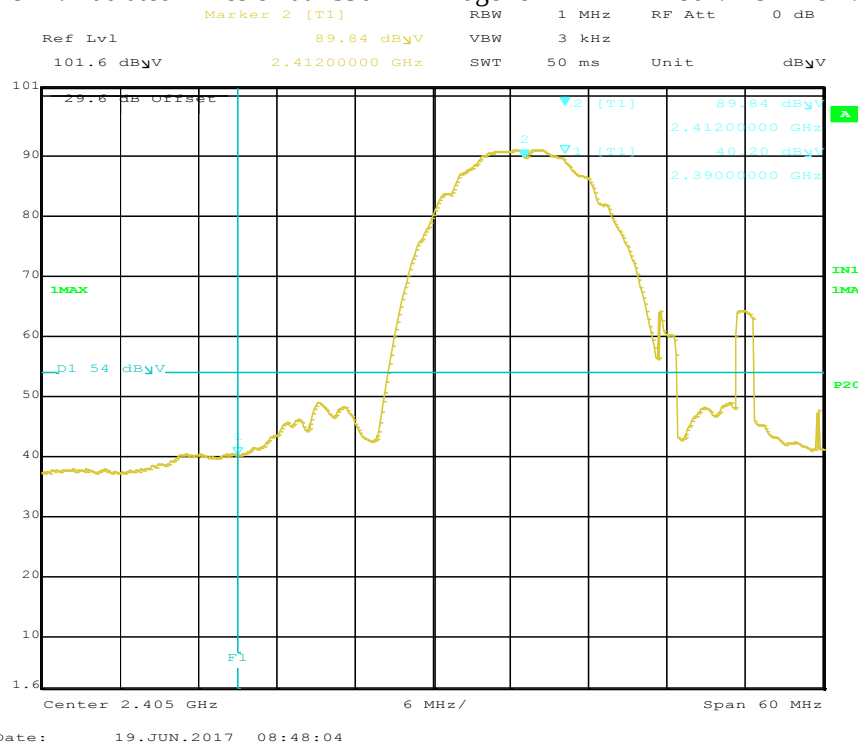


Figure 25: Radiated Emission at 2390 MHz Edge for 2412 MHz-802.11b – Horz. (Ave)

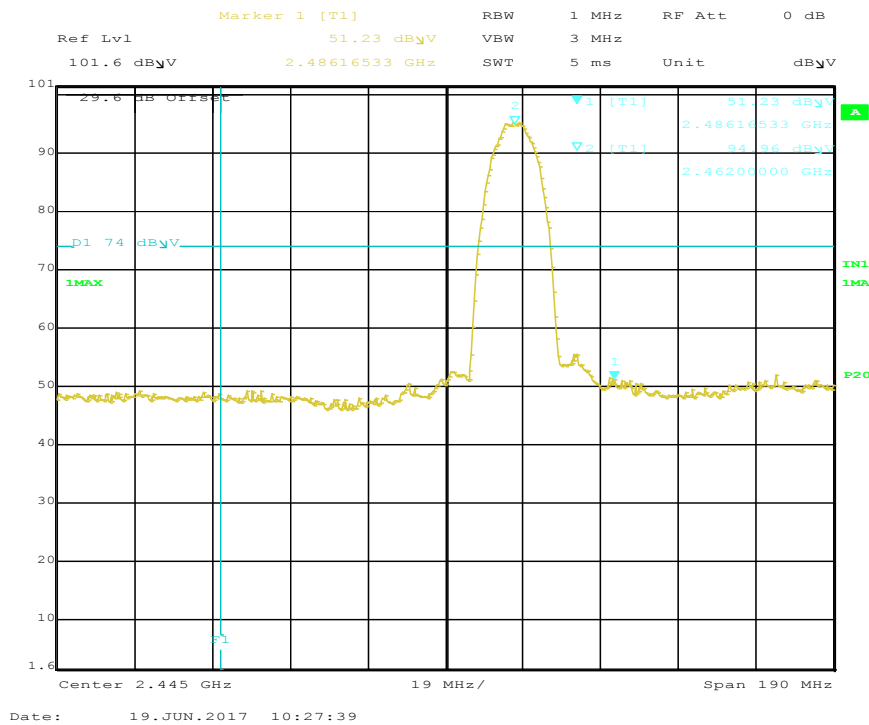


Figure 26: Radiated Emission at 2483.5 MHz Edge for 2462 MHz-802.11b – Vert. (Pk)

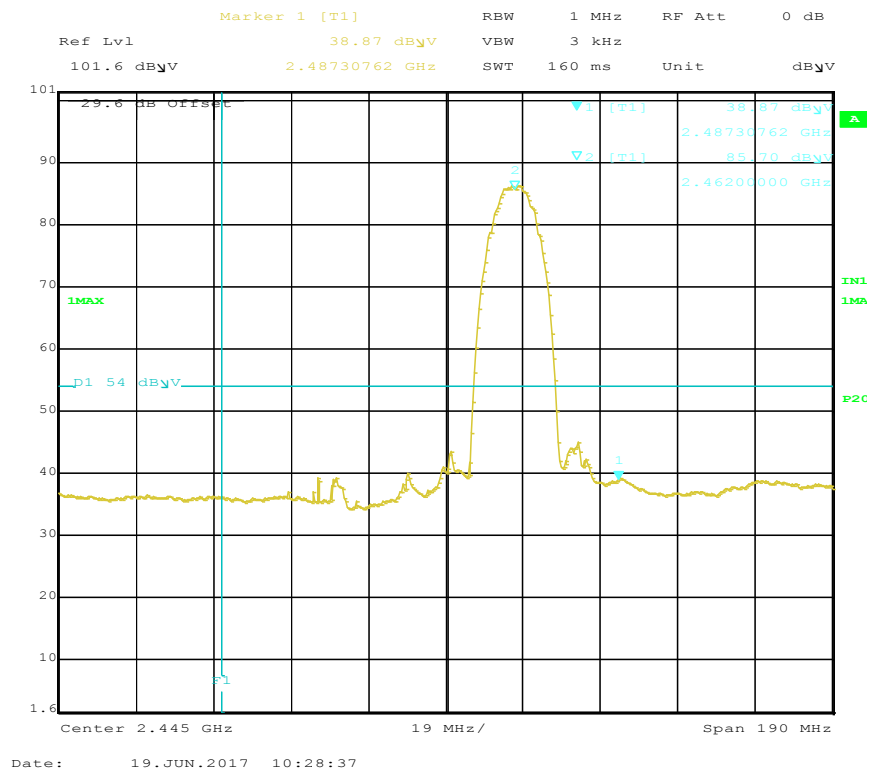


Figure 27: Radiated Emission at 2483.5 MHz Edge for 2462 MHz-802.11b – Vert. (Ave)

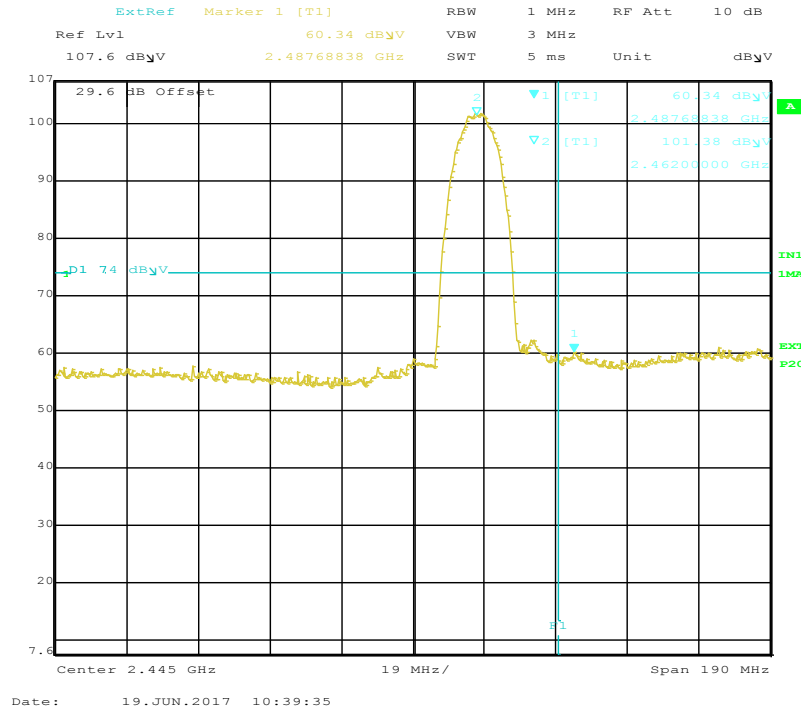


Figure 28: Radiated Emission at 2483.5 MHz Edge for 2462 MHz-802.11b – Horz. (Pk)

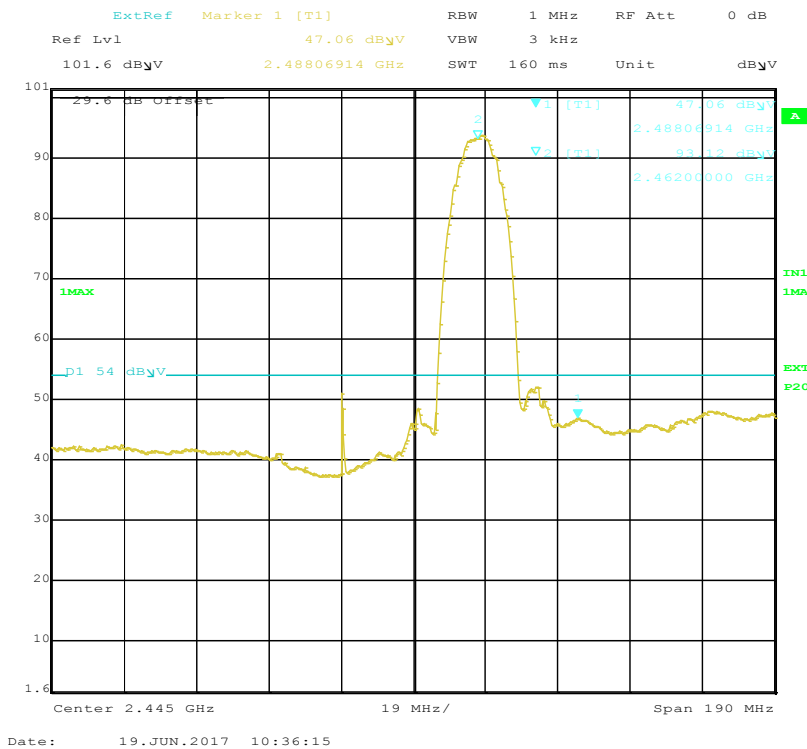


Figure 29: Radiated Emission at 2483.5 MHz Edge for 2462 MHz-802.11b – Horz. (Ave)

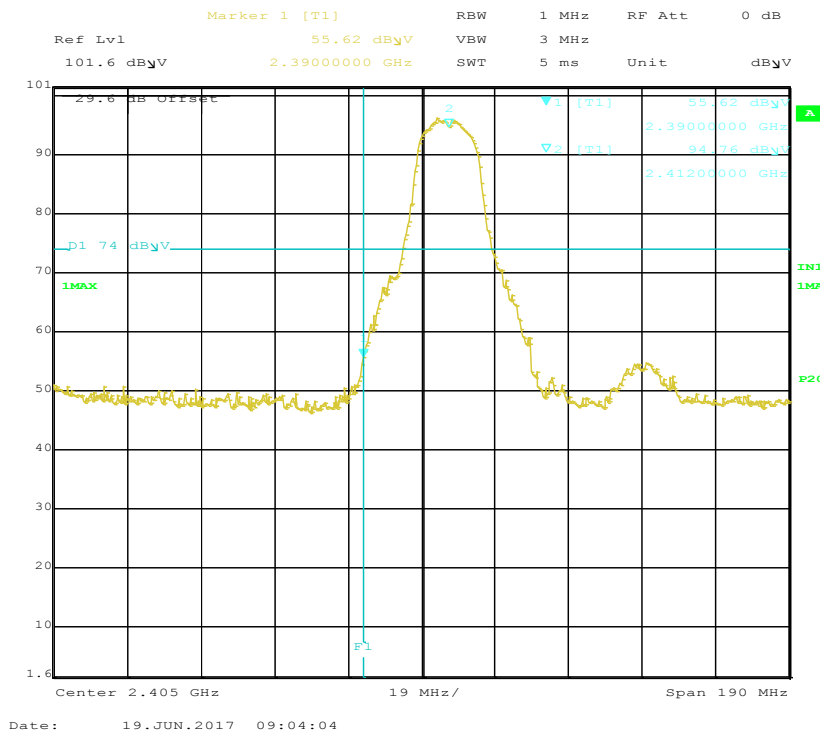


Figure 30: Radiated Emission at 2390 MHz Edge for 2412 MHz-802.11g – Vert. (Pk)

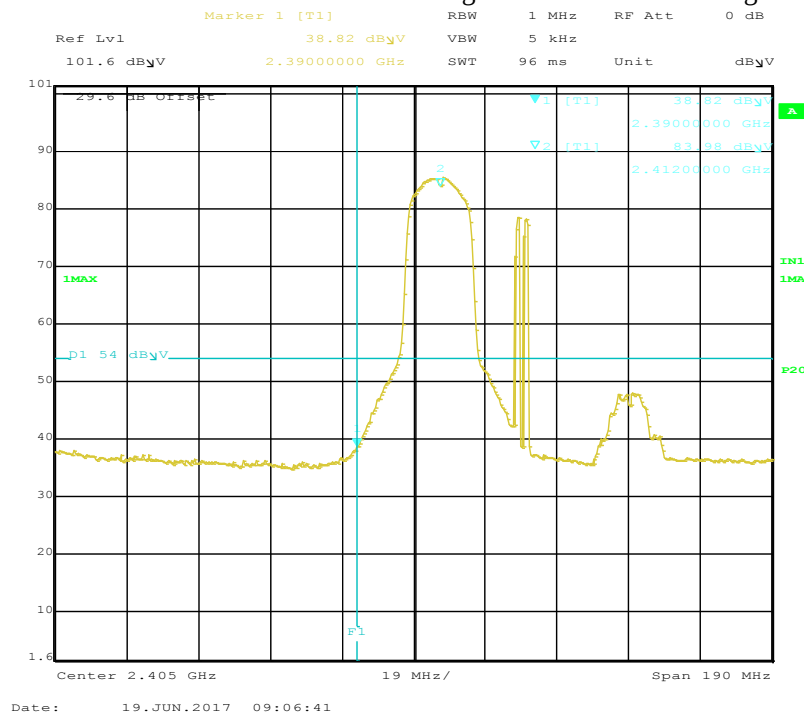


Figure 31: Radiated Emission at 2390 MHz Edge for 2412 MHz-802.11g – Vert. (Ave)

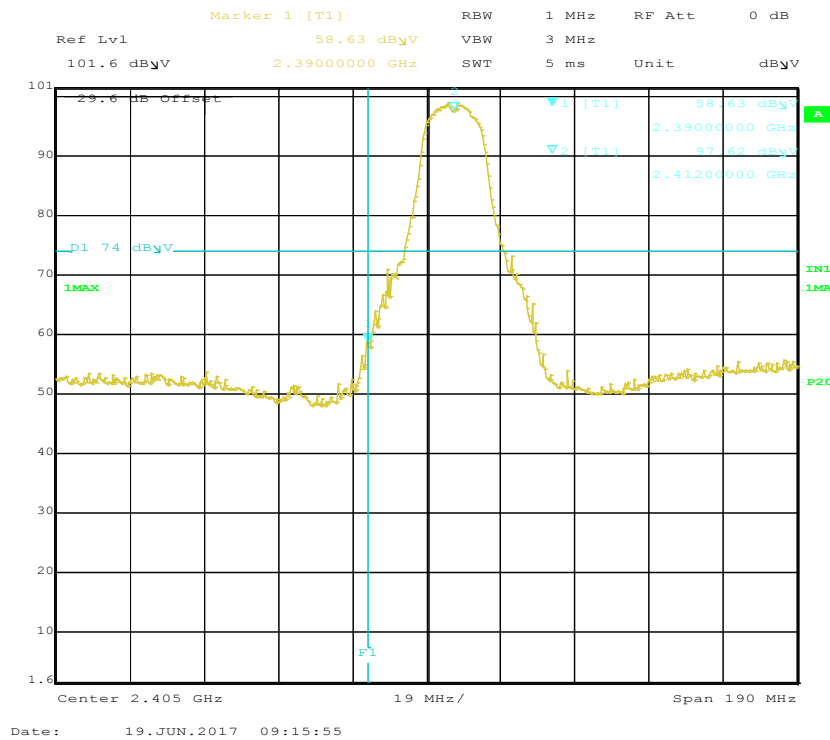


Figure 32: Radiated Emission at 2390 MHz Edge for 2412 MHz-802.11g – Horz. (Pk)

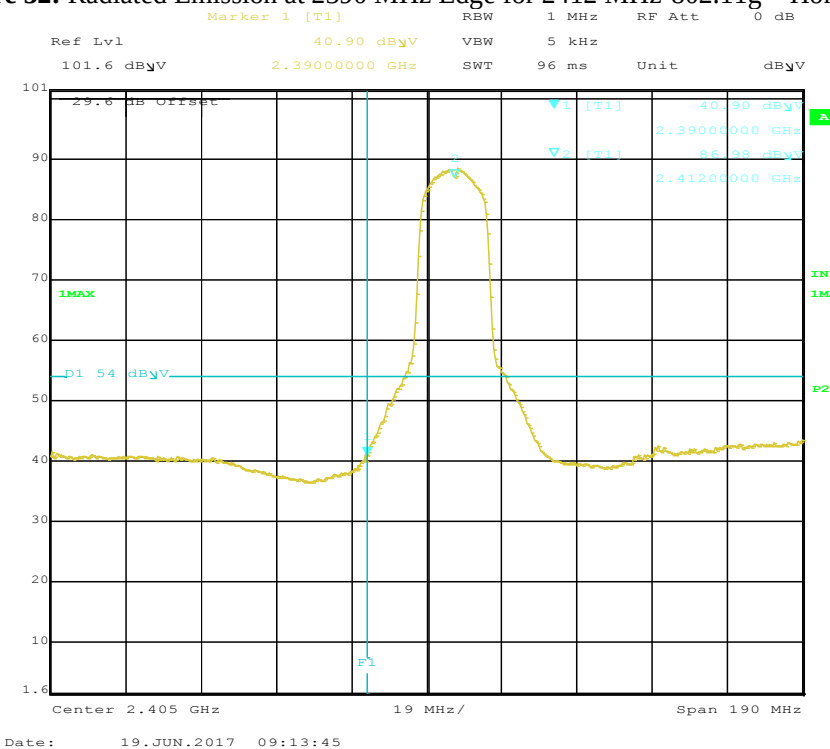


Figure 33: Radiated Emission at 2390 MHz Edge for 2412 MHz-802.11g – Horz. (Ave)

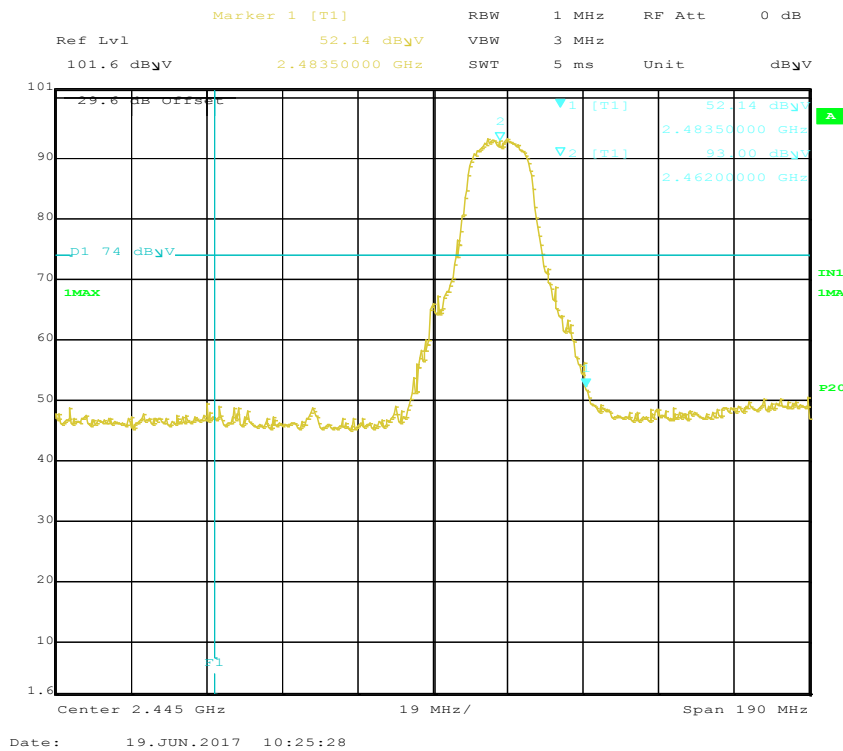


Figure 34: Radiated Emission at 2483.5 MHz Edge for 2462 MHz-802.11g – Vert. (Pk)

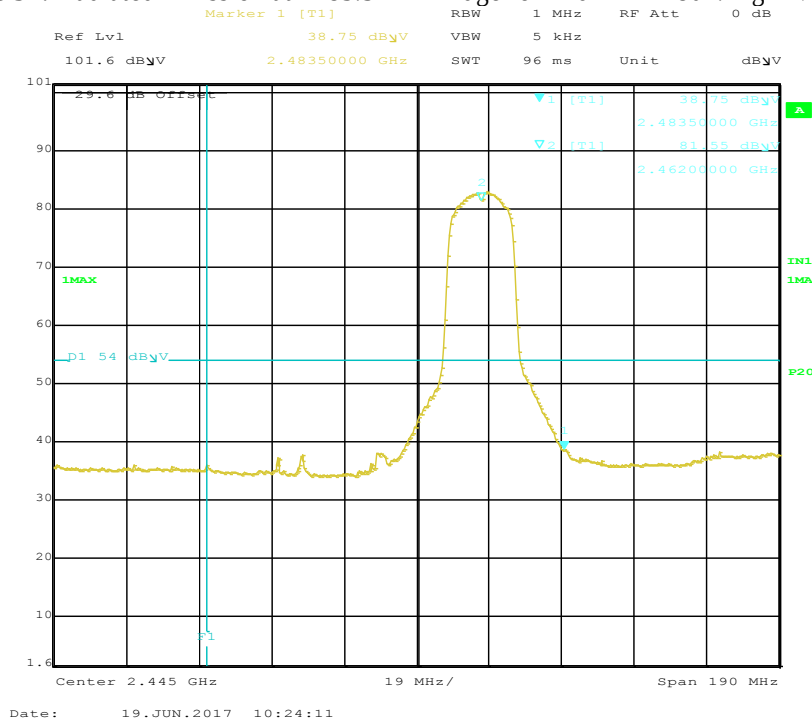
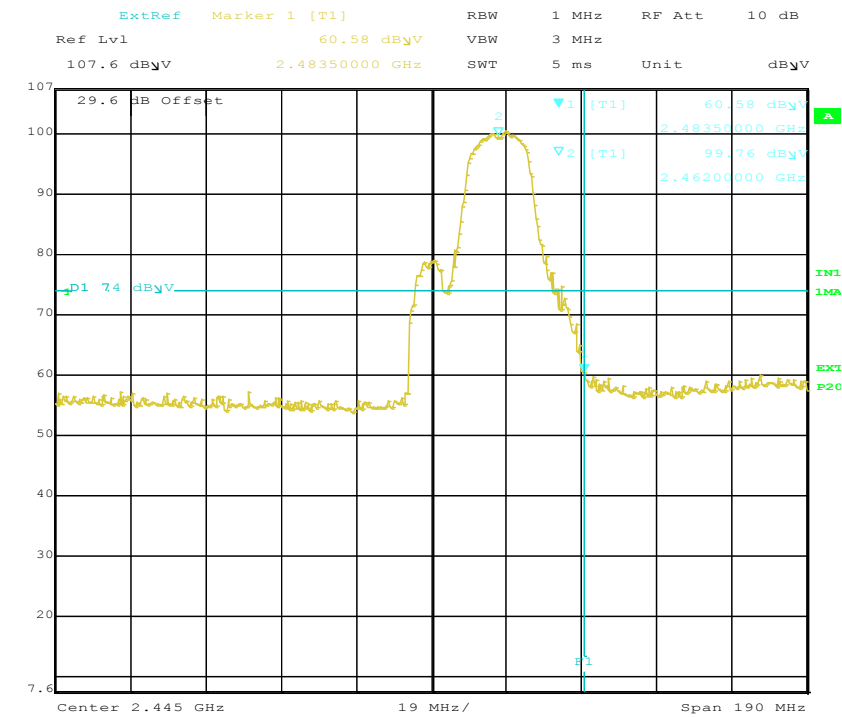
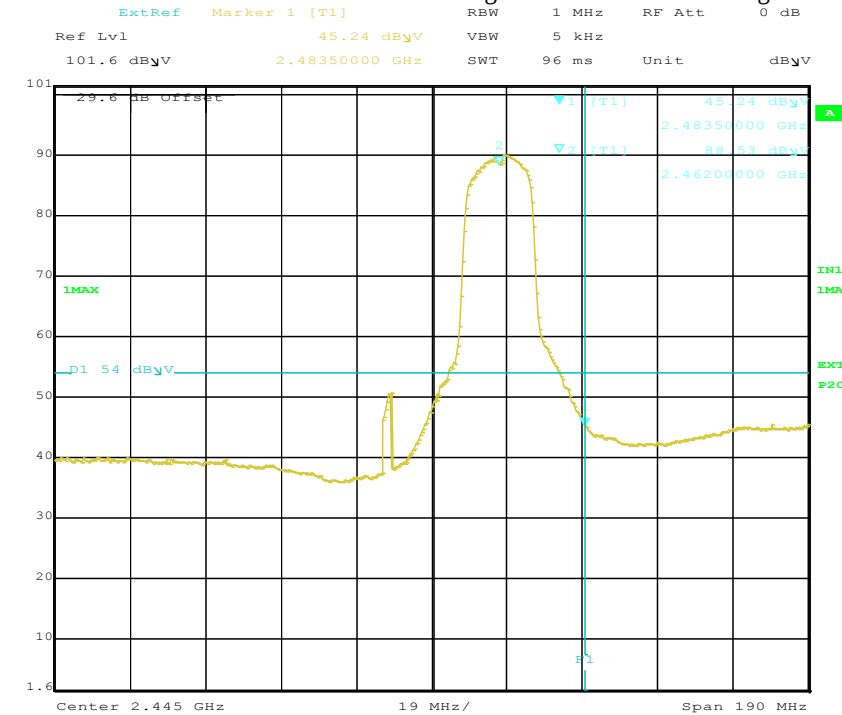


Figure 35: Radiated Emission at 2483.5 MHz Edge for 2462 MHz-802.11g – Vert. (Ave)



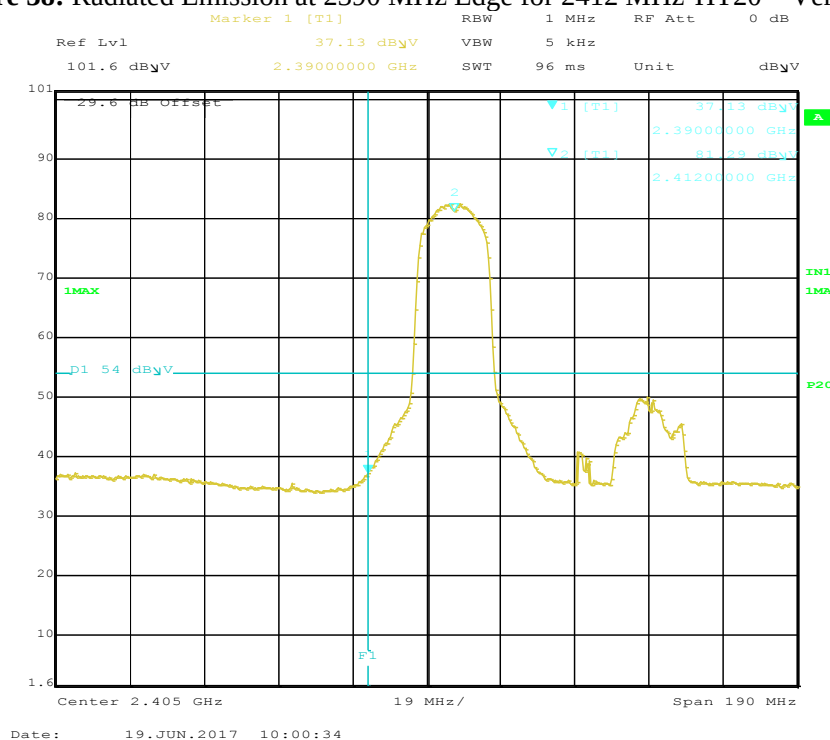
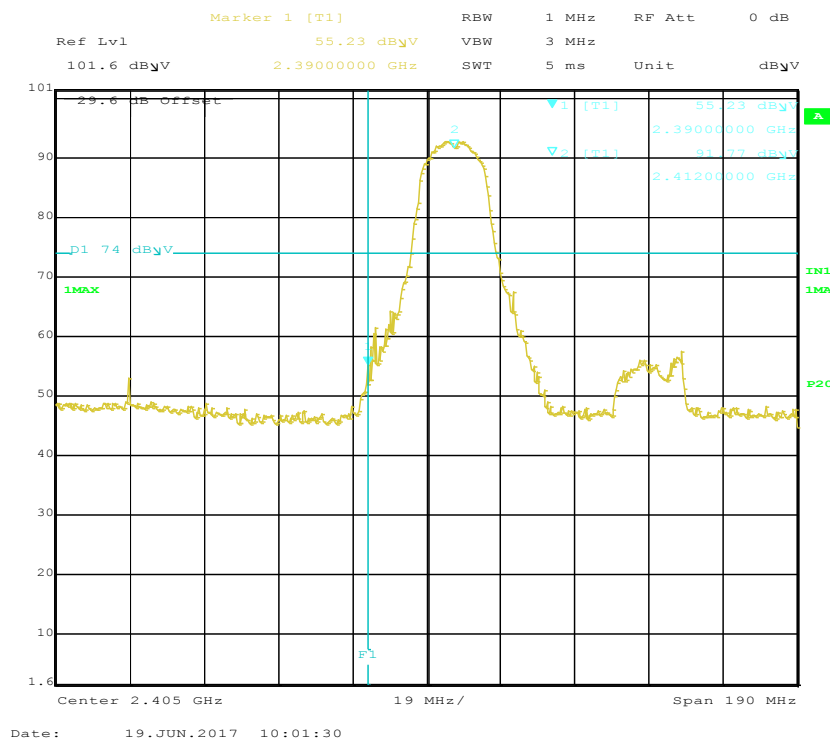
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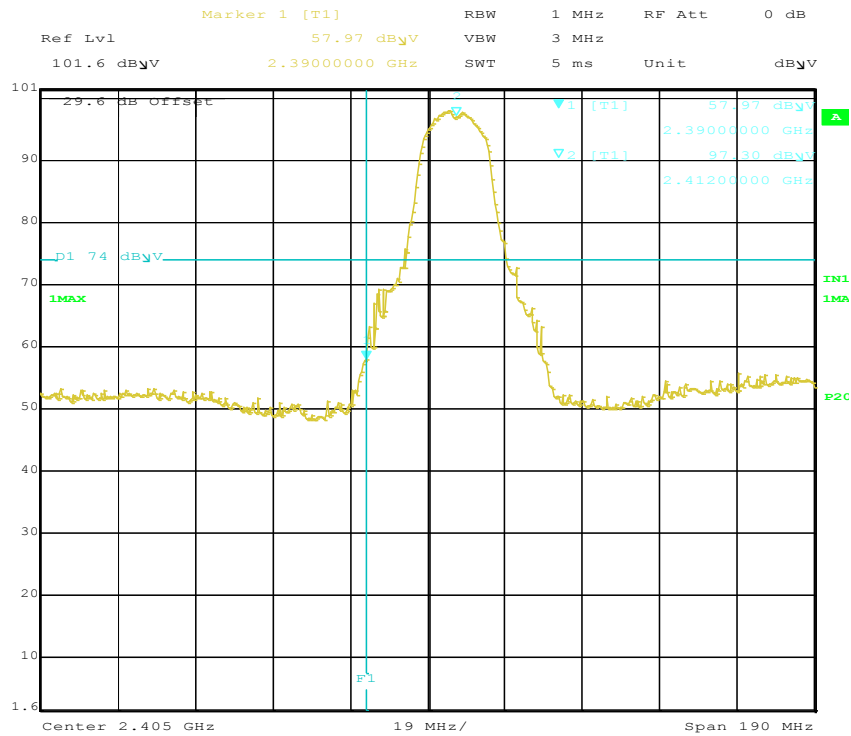
Figure 36: Radiated Emission at 2483.5 MHz Edge for 2462 MHz-802.11g – Horz. (Pk)



Date: 19.JUN.2017 10:44:51

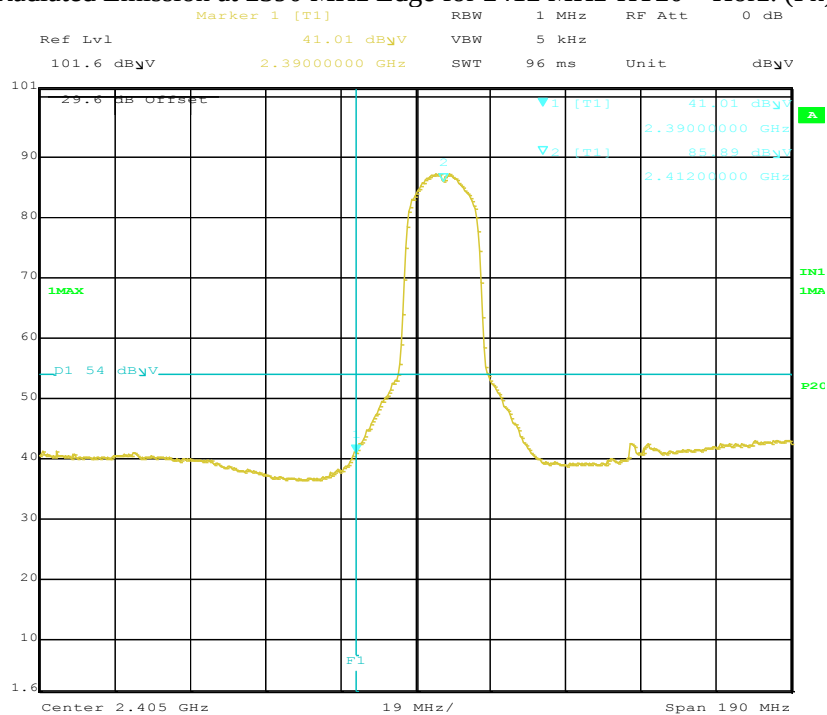
Figure 37: Radiated Emission at 2483.5 MHz Edge for 2462 MHz-802.11g – Horz. (Ave)





Date: 19.JUN.2017 09:20:35

Figure 40: Radiated Emission at 2390 MHz Edge for 2412 MHz-HT20 – Horz. (Pk)



Date: 19.JUN.2017 09:28:12

Figure 41: Radiated Emission at 2390 MHz Edge for 2412 MHz-HT20 – Horz. (Ave)

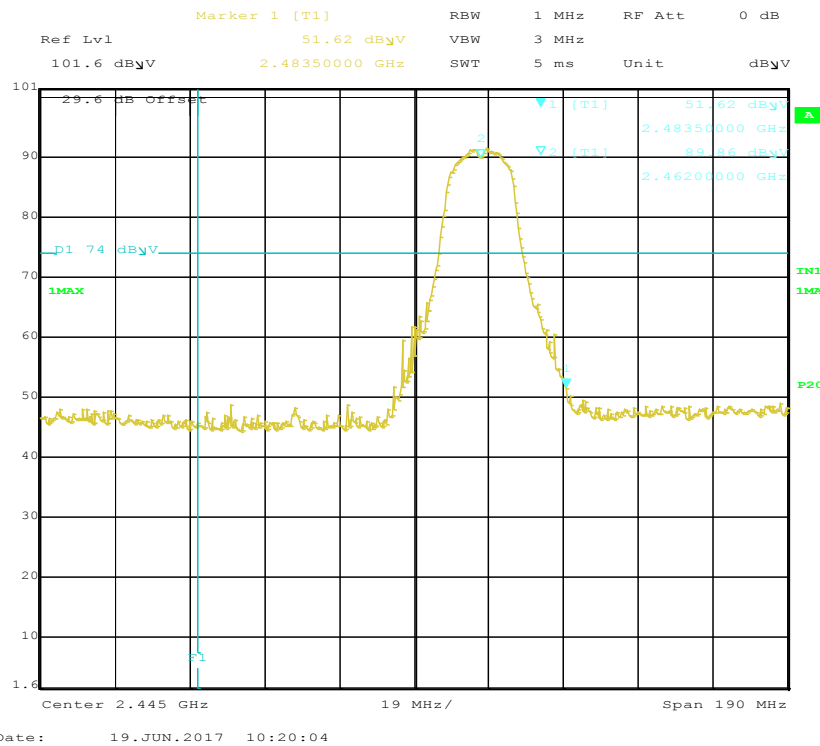


Figure 42: Radiated Emission at 2483.5 MHz Edge for 2462 MHz-HT20 – Vert. (Pk)

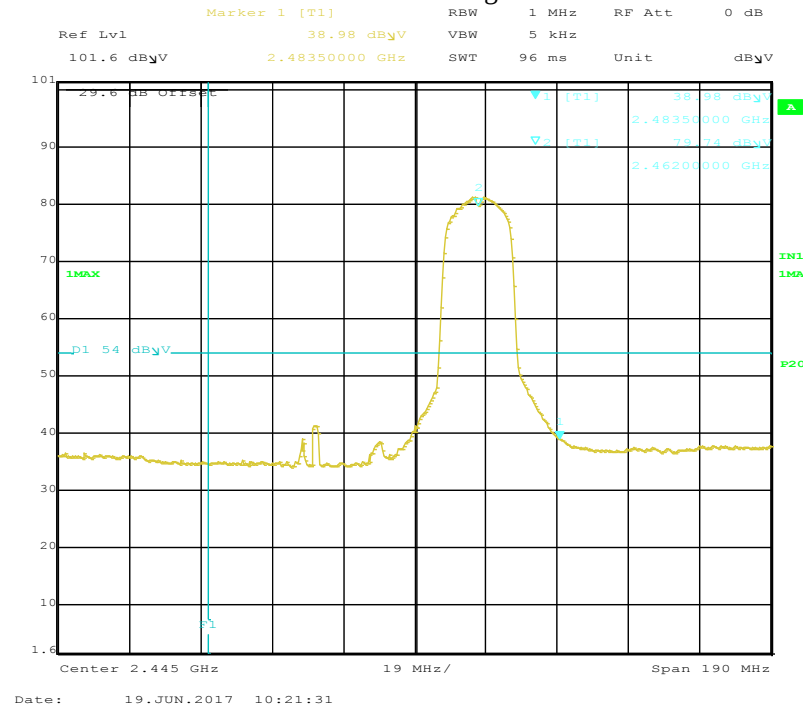
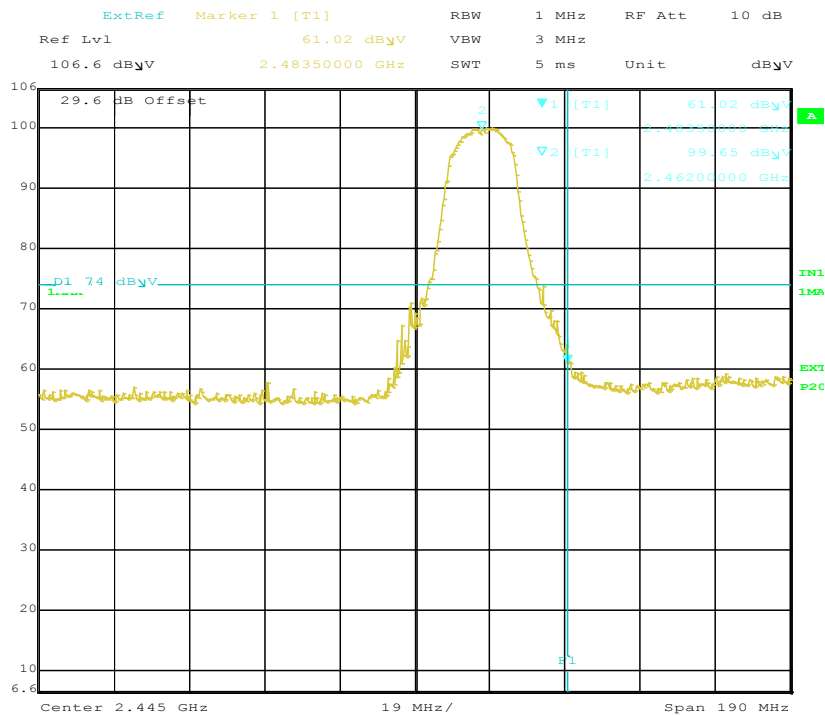
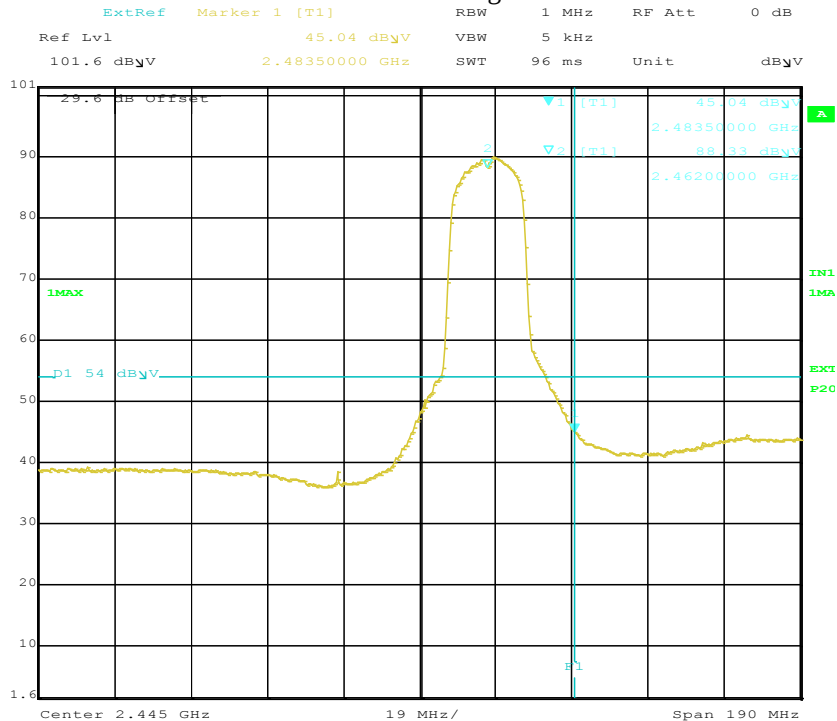


Figure 43: Radiated Emission at 2483.5 MHz Edge for 2462 MHz-HT20 – Vert. (Ave)



Date: 19.JUN.2017 10:48:26

Figure 44: Radiated Emission at 2483.5 MHz Edge for 2462 MHz-HT20 – Horz. (Pk)



Date: 19.JUN.2017 10:47:02

Figure 45: Radiated Emission at 2483.5 MHz Edge for 2462 MHz-HT20 – Horz. (Ave)

SOP 1 Radiated Emissions

Tracking #

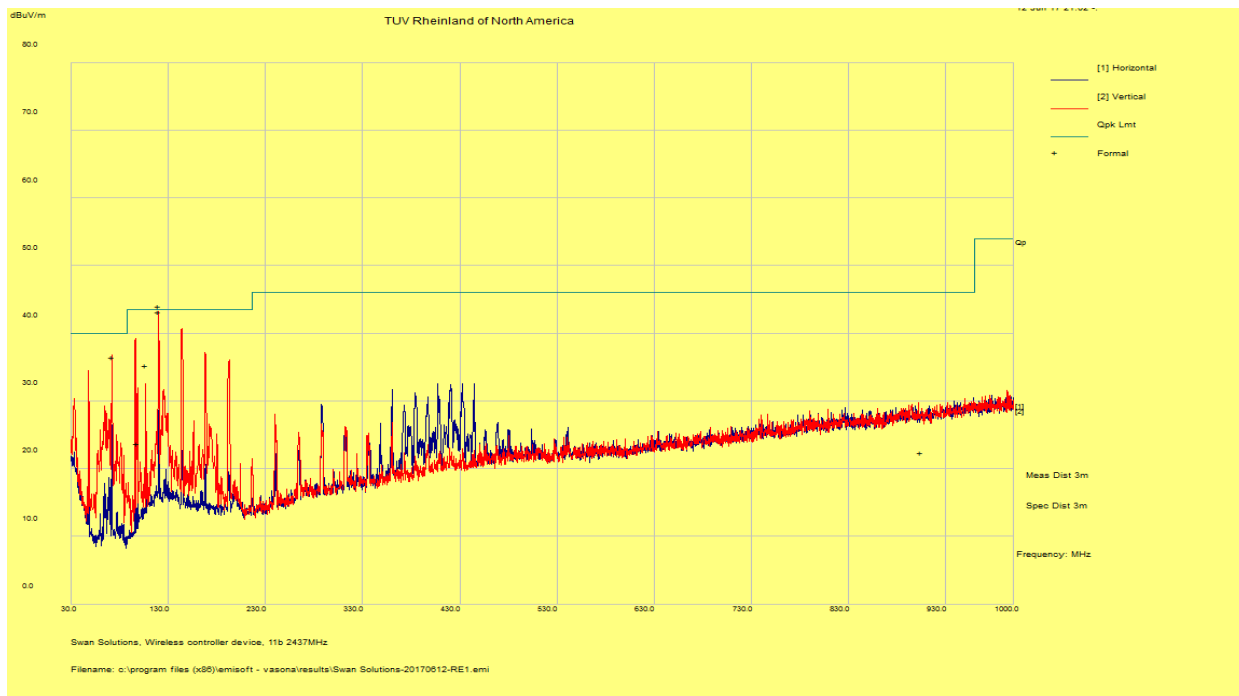
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Reference
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EUT Name	Knocki	Date	June 12, 2017
EUT Model	KNC1	Temp / Hum in	22° C / 40%rh
EUT Serial	KNC-A1W-00000032	Temp / Hum out	N/A
EUT Config.	802.11b mode	Line AC / Freq	3.3VDC
Standard	CFR47 Part 15 Subpart C, RSS-247, RSS-GEN	RBW / VBW	120kHz/300kHz
Dist/Ant Used	3m	Performed by	Rolly Alegre

30 MHz – 1 GHz Transmit at 2437 MHz

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
71.98	47.47	2.89	-20.11	30.25	QP	V	100	221	40.00	-9.75
107.11	22.80	3.11	-16.06	9.85	QP	V	152	162	43.50	-33.65
114.54	24.41	3.15	-14.93	12.63	QP	V	130	0	43.50	-30.87
120.02	48.54	3.17	-14.47	37.24	QP	V	100	40	43.50	-6.26
144.01	45.59	3.29	-15.36	33.52	QP	V	105	82	43.50	-9.98
168.03	50.22	3.40	-16.03	37.59	QP	V	110	290	43.50	-5.91



Spec Margin = E-Field QP - Limit, E-Field QP = FIM QP+ Total CF $\pm$ Uncertainty
Total CF= AF+ Cable Loss AF= Antenna factor + Preamp
Note: 1. Worst case was observed on Mid channel of 802.11b mode

SOP 1 Radiated Emissions

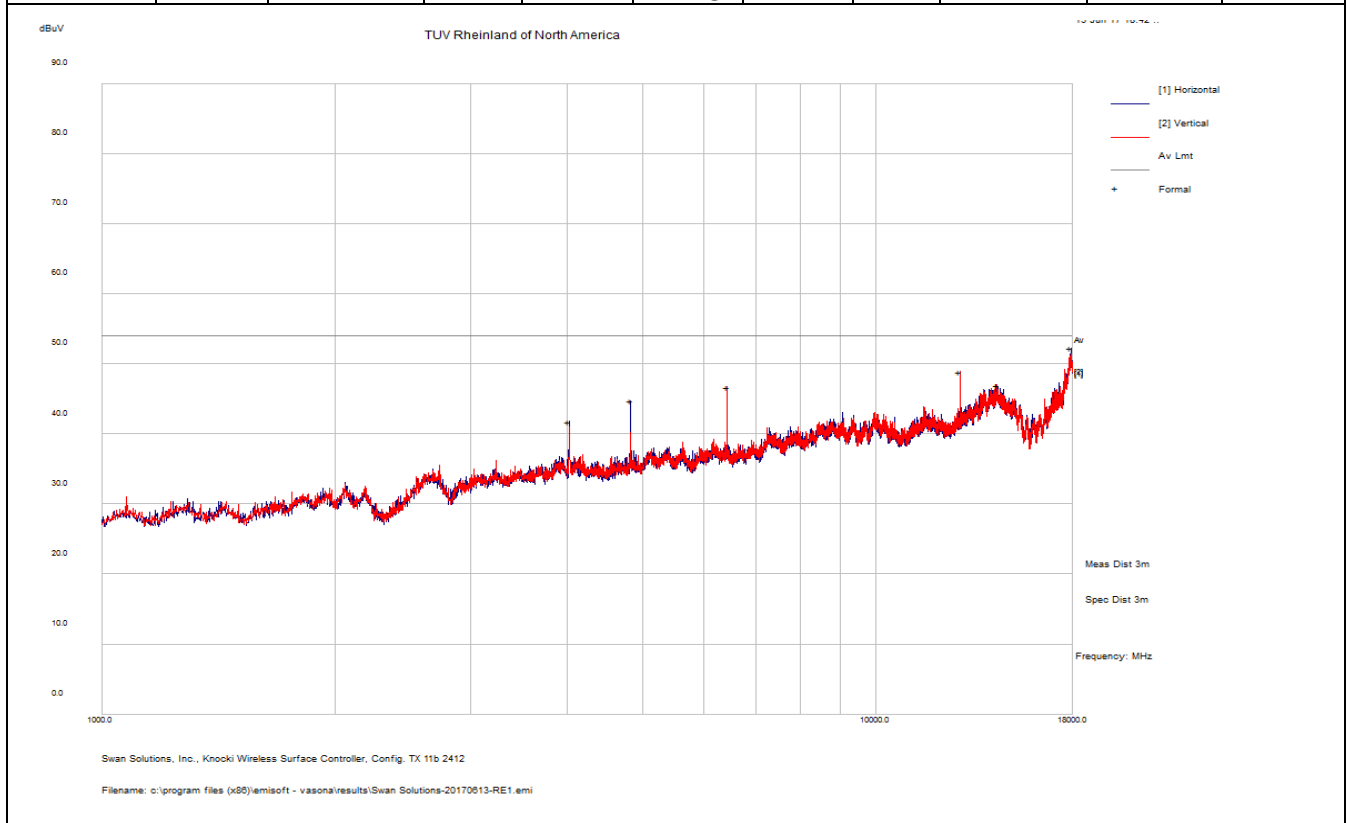
Tracking # Error! Page 2 of 11

Reference
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EUT Name	Knocki	Date	June 13, 2017
EUT Model	KNC1	Temp / Hum in	22° C / 40%rh
EUT Serial	KNC-A1W-00000032	Temp / Hum out	N/A
EUT Config.	802.11b mode	Line AC / Freq	3.3VDC
Standard	CFR47 Part 15 Subpart C, RSS-247, RSS-GEN	RBW / VBW	1MHz/3MHz
Dist/Ant Used	3m – EMCO3115 / 1m – AHA-840	Performed by	Rolly Alegre

1 – 18 GHz Transmit at 2412 MHz (Low Channel)

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
17893.75	40.85	3.72	-3.44	41.13	Average	H	199	250	54.00	-12.87
12862.81	48.55	3.08	-11.73	39.90	Average	V	238	162	54.00	-14.10
6432.0313	55.1	2.06	-18.5	38.66	Average	V	100	170	54	-15.34



Spec Margin = E-Field AVG - Limit, E-Field AVG = FIM AVG+ Total CF $\pm$ Uncertainty Total CF= AF+ Cable Loss AF= Antenna factor + Preamp
Note: None.

SOP 1 Radiated Emissions

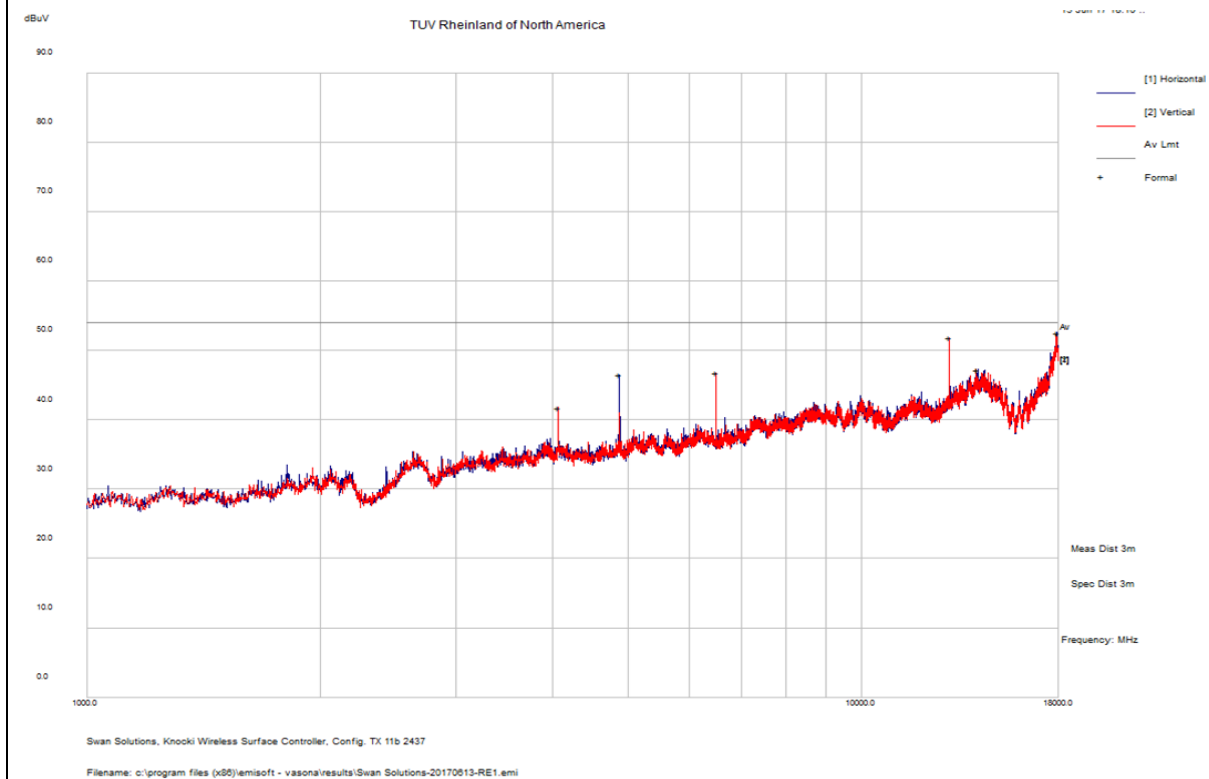
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source not
found.

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EUT Name	Knocki	Date	June 13, 2017
EUT Model	KNC1	Temp / Hum in	22° C / 40%rh
EUT Serial	KNC-A1W-00000032	Temp / Hum out	N/A
EUT Config.	802.11b mode	Line AC / Freq	3.3VDC
Standard	CFR47 Part 15 Subpart C, RSS-247, RSS-GEN	RBW / VBW	1MHz/3MHz
Dist/Ant Used	3m – EMCO3115 / 1m – AHA-840	Performed by	Rolly Alegre

1 – 18 GHz Transmit at 2437 MHz (Mid Channel)

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
17915.00	40.70	3.71	-3.45	40.96	Average	H	192	130	54.00	-13.04
12998.28	49.74	3.13	-11.39	41.48	Average	V	102	360	54.00	-12.52
6498.438	57.02	1.59	-20.93	41.74	Average	V	200	260	54.00	-16.32



Spec Margin = E-Field AVG - Limit, E-Field AVG = FIM AVG+ Total CF $\pm$ Uncertainty Total CF= AF+ Cable Loss AF= Antenna factor + Preamp
--

Note: None.

SOP 1 Radiated Emissions

Tracking #

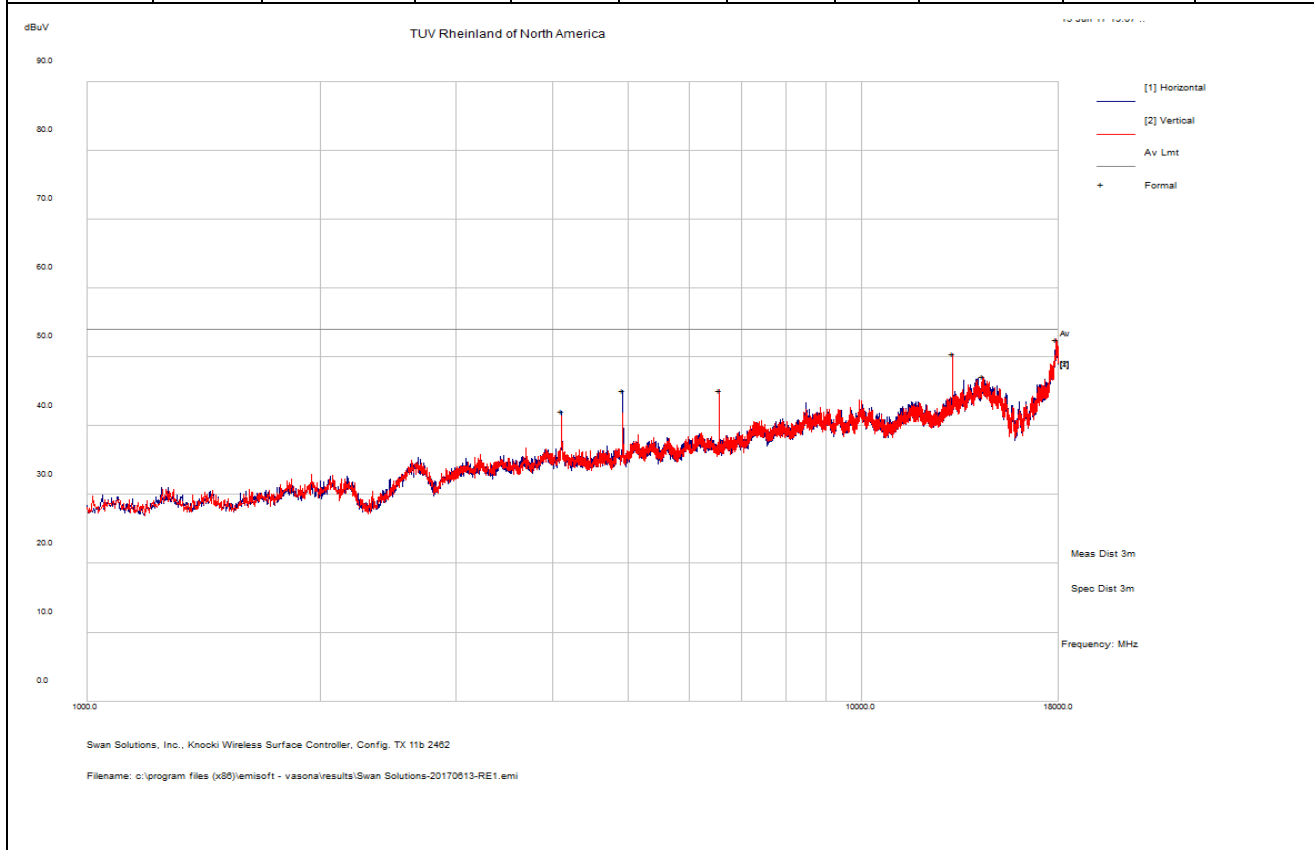
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EUT Name	Knocki	Date	June 13, 2017
EUT Model	KNC1	Temp / Hum in	22° C / 40%rh
EUT Serial	KNC-A1W-00000032	Temp / Hum out	N/A
EUT Config.	802.11b mode	Line AC / Freq	3.3VDC
Standard	CFR47 Part 15 Subpart C, RSS-247, RSS-GEN	RBW / VBW	1MHz/3MHz
Dist/Ant Used	3m – EMCO3115 / 1m – AHA-840	Performed by	Rolly Alegre

1 – 18 GHz Transmit at 2462 MHz (High Channel)

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
13129.09	40.19	3.12	-10.97	32.34	Average	V	160	176	54.00	-21.66
17877.59	40.54	3.71	-3.49	40.76	Average	V	101	360	54.00	-13.25



Spec Margin = E-Field AVG - Limit, E-Field AVG = FIM AVG+ Total CF ± Uncertainty

Total CF= AF+ Cable Loss AF= Antenna factor + Preamp

Note: Other than spectrum noise floor, emission at the limit is the fundamental frequency.

SOP 1 Radiated Emissions

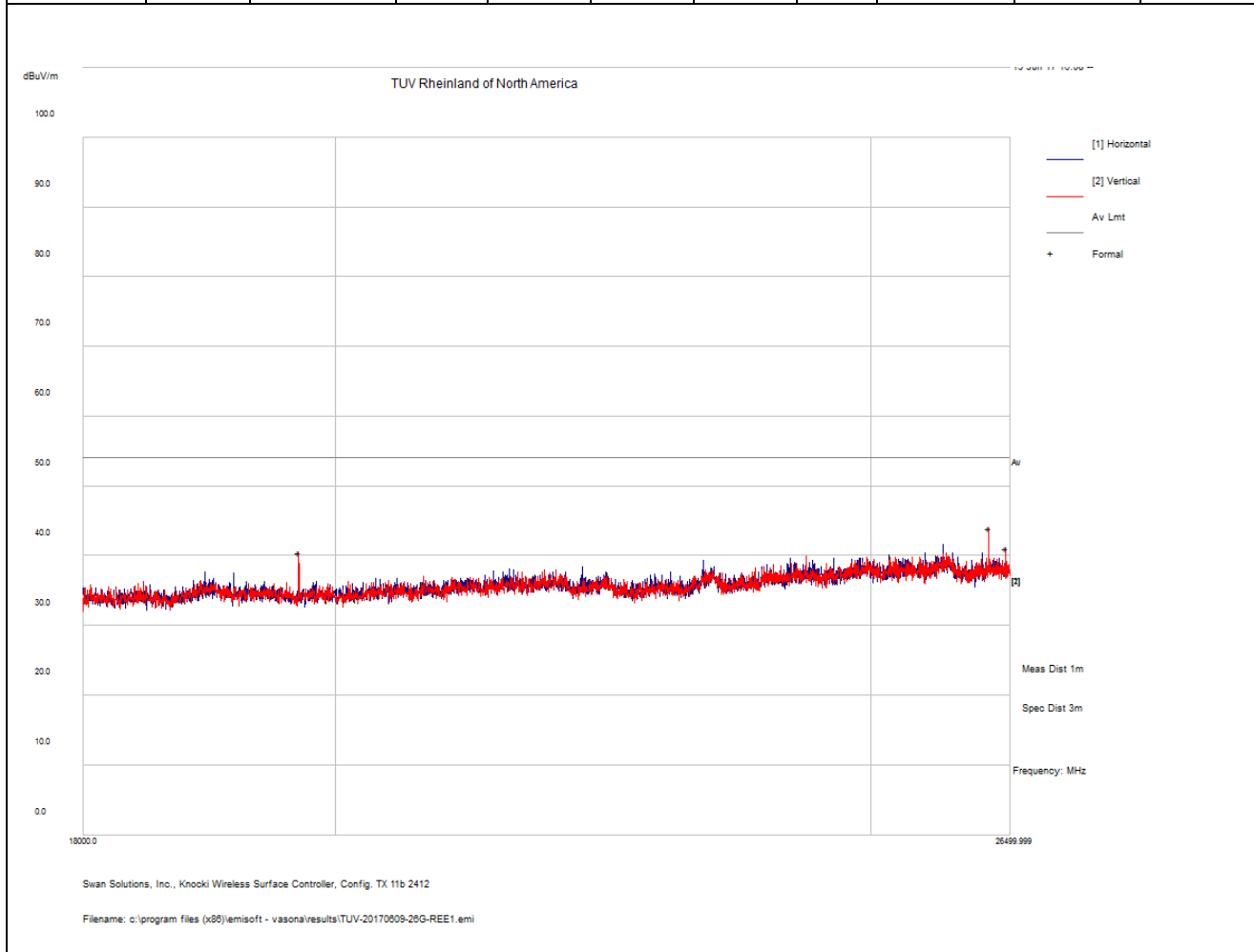
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EUT Name	Knocki	Date	June 19, 2017
EUT Model	KNC1	Temp / Hum in	22° C / 40%rh
EUT Serial	KNC-A1W-00000032	Temp / Hum out	N/A
EUT Config.	802.11b mode	Line AC / Freq	3.3VDC
Standard	CFR47 Part 15 Subpart C, RSS-247, RSS-GEN	RBW / VBW	1MHz/3MHz
Dist/Ant Used	3m – EMCO3115 / 1m – AHA-840	Performed by	Rolly Alegre

18 – 26 GHz Transmit at 2412 MHz (Low Channel)

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
26260.94	40.79	8.22	-5.05	43.97	Pk	V	150	116	54.00	-10.03



Spec Margin = E-Field AVG - Limit, E-Field AVG = FIM AVG+ Total CF $\pm$ Uncertainty
--

Total CF= AF+ Cable Loss AF= Antenna factor + Preamp
--

Note: No significant emissions was observed for 802.11b, 802.11g and 802.11n - HT20. Measured spectrum noise floor.
--

SOP 1 Radiated Emissions

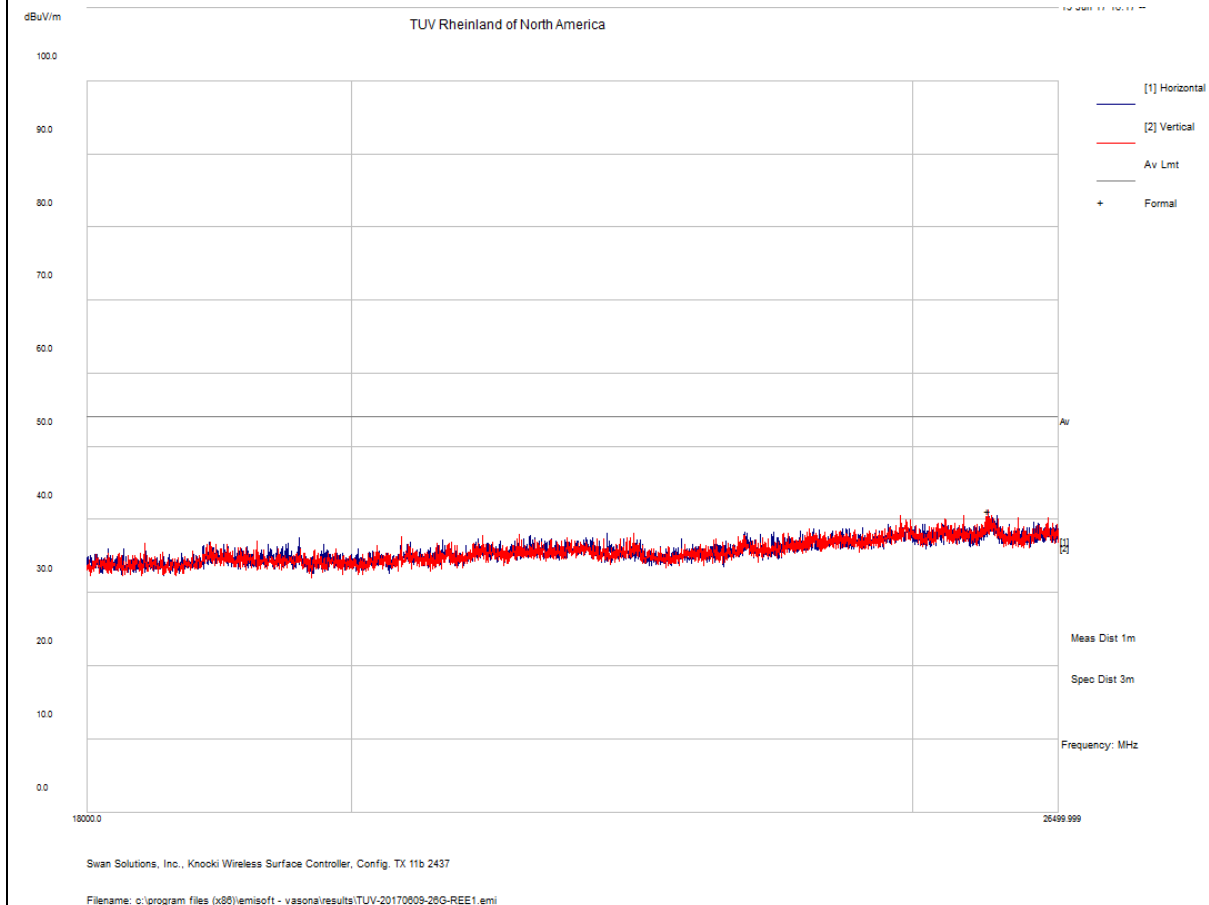
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EUT Name	Knocki	Date	June 19, 2017
EUT Model	KNC1	Temp / Hum in	22° C / 40%rh
EUT Serial	KNC-A1W-00000032	Temp / Hum out	N/A
EUT Config.	802.11b mode	Line AC / Freq	3.3VDC
Standard	CFR47 Part 15 Subpart C, RSS-247, RSS-GEN	RBW / VBW	1MHz/3MHz
Dist/Ant Used	3m – EMCO3115 / 1m – AHA-840	Performed by	Rolly Alegre

18 – 26 GHz Transmit at 2437 MHz (Mid Channel)

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
25769.53	38.97	8.12	-5.86	41.22	Pk	V	150	184	54.00	-12.78



Spec Margin = E-Field AVG - Limit, E-Field AVG = FIM AVG+ Total CF $\pm$ Uncertainty
--

Total CF= AF+ Cable Loss AF= Antenna factor + Preamp
--

Note: No significant emissions was observed for 802.11b, 802.11g and 802.11n - HT20. Measured spectrum noise floor.
--

SOP 1 Radiated Emissions

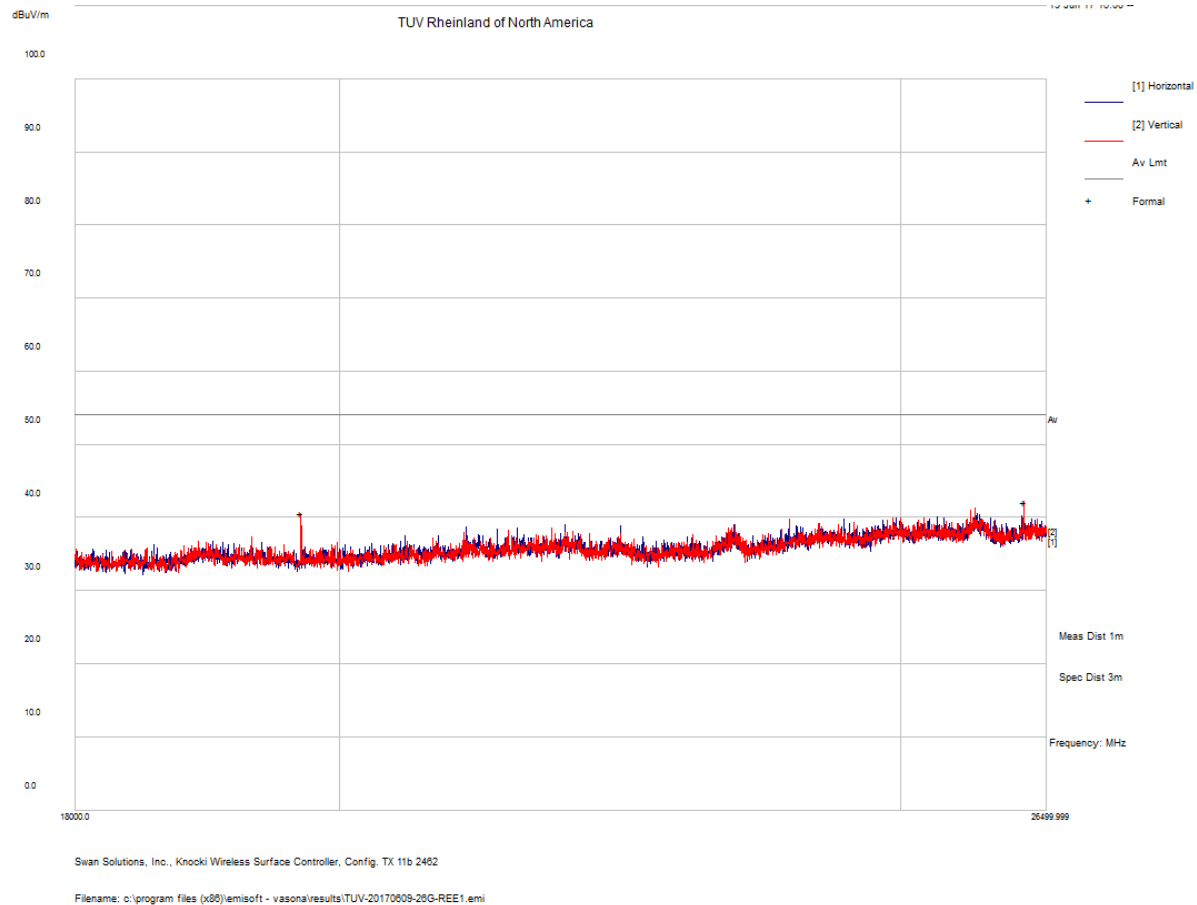
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EUT Name	Knocki	Date	June 19, 2017
EUT Model	KNC1	Temp / Hum in	22° C / 40%rh
EUT Serial	KNC-A1W-00000032	Temp / Hum out	N/A
EUT Config.	802.11b mode	Line AC / Freq	3.3VDC
Standard	CFR47 Part 15 Subpart C, RSS-247, RSS-GEN	RBW / VBW	1MHz/3MHz
Dist/Ant Used	3m – EMCO3115 / 1m – AHA-840	Performed by	Rolly Alegre

18 – 26 GHz Transmit at 2462 MHz (High Channel)

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
26260.94	38.96	8.22	-5.05	42.14	Pk	V	150	102	54.00	-11.87



Spec Margin = E-Field AVG - Limit, E-Field AVG = FIM AVG+ Total CF $\pm$ Uncertainty
--

Total CF= AF+ Cable Loss AF= Antenna factor + Preamp
--

Note: No significant emissions was observed for 802.11b, 802.11g and 802.11n - HT20. Measured spectrum noise floor.
--

SOP 1 Radiated Emissions

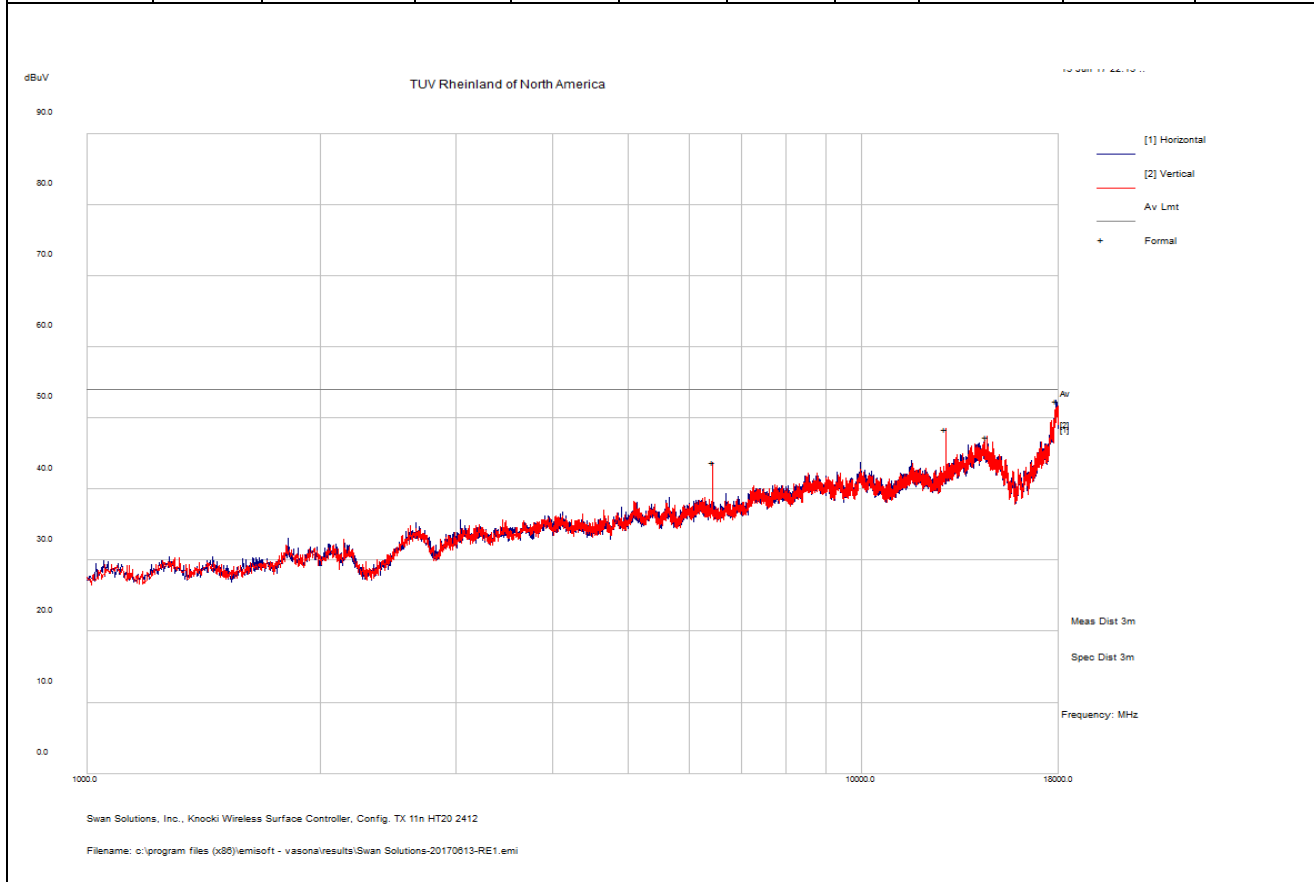
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EUT Name	Knocki	Date	June 13, 2017
EUT Model	KNC1	Temp / Hum in	22° C / 40%rh
EUT Serial	KNC-A1W-00000032	Temp / Hum out	N/A
EUT Config.	802.11n HT20	Line AC / Freq	3.3 VDC
Standard	CFR47 Part 15 Subpart C, RSS-247, RSS-GEN	RBW / VBW	1 MHz/ 3 MHz
Dist/Ant Used	3m – EMCO3115 / 1m – AHA-840	Performed by	Rolly Alegre

1 – 18 GHz Transmit at 2412 MHz (Low Channel)

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
17865.43	40.65	3.71	-3.56	40.80	Average	H	213	14	54.00	-13.20
12863.70	46.20	3.08	-11.73	37.55	Average	V	143	180	54.00	-16.45
6432.0313	56.15	2.06	-18.5	39.71	Average	V	100	145	54.00	-14.29



Spec Margin = E-Field AVG - Limit, E-Field AVG = FIM AVG+ Total CF $\pm$ Uncertainty Total CF= AF+ Cable Loss AF= Antenna factor + Preamp Note: None.

SOP 1 Radiated Emissions

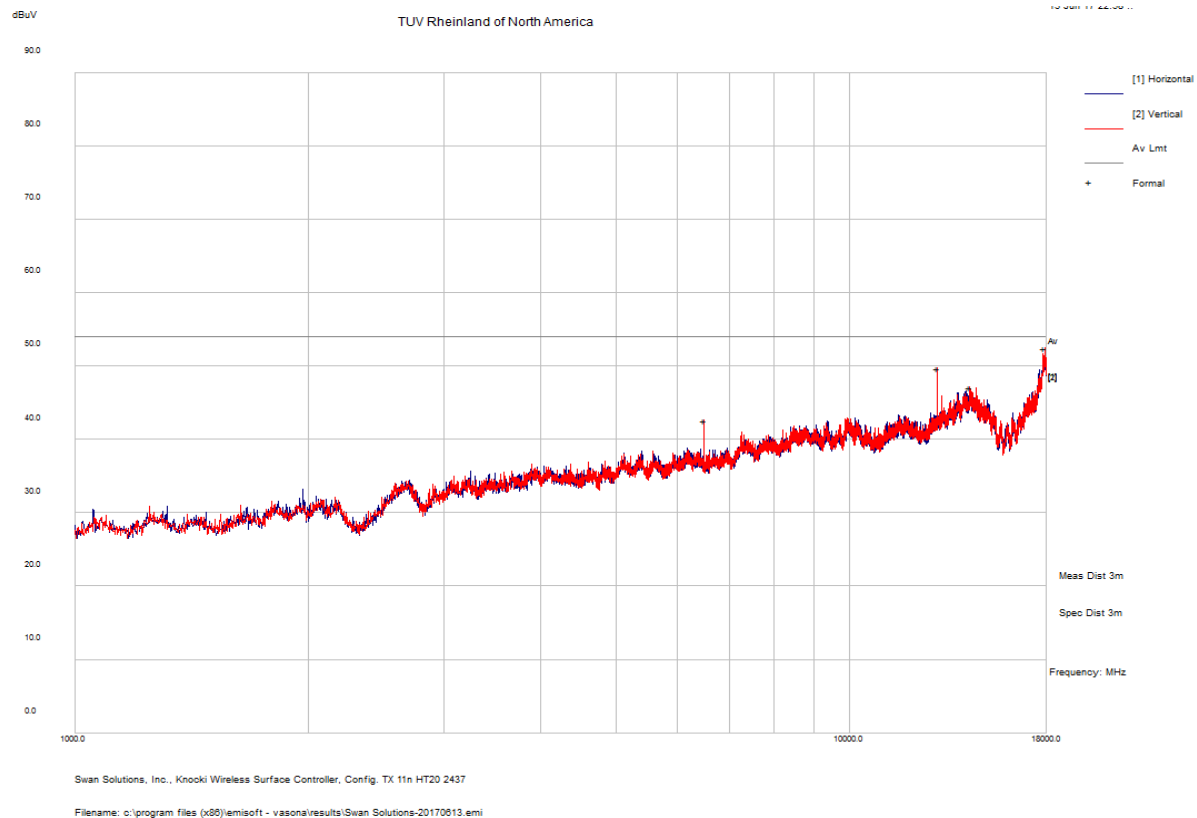
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EUT Name	Knocki	Date	June 13, 2017
EUT Model	KNC1	Temp / Hum in	22° C / 40%rh
EUT Serial	KNC-A1W-00000032	Temp / Hum out	N/A
EUT Config.	802.11n HT20	Line AC / Freq	3.3 VDC
Standard	CFR47 Part 15 Subpart C, RSS-247, RSS-GEN	RBW / VBW	1 MHz/ 3 MHz
Dist/Ant Used	3m – EMCO3115 / 1m – AHA-840	Performed by	Rolly Alegre

1 – 18 GHz Transmit at 2437 MHz (Mid Channel)

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
12996.91	49.28	3.13	-11.39	41.01	Average	V	114	360	54.00	-12.99
17904.81	40.47	3.72	-3.34	40.85	Average	V	126	92	54.00	-13.15
6498.4375	55.14	2.07	-18.6	38.61	Average	V	150	178	54	-15.39



Spec Margin = E-Field AVG - Limit, E-Field AVG = FIM AVG+ Total CF $\pm$ Uncertainty Total CF= AF+ Cable Loss AF= Antenna factor + Preamp
Note: None.

SOP 1 Radiated Emissions

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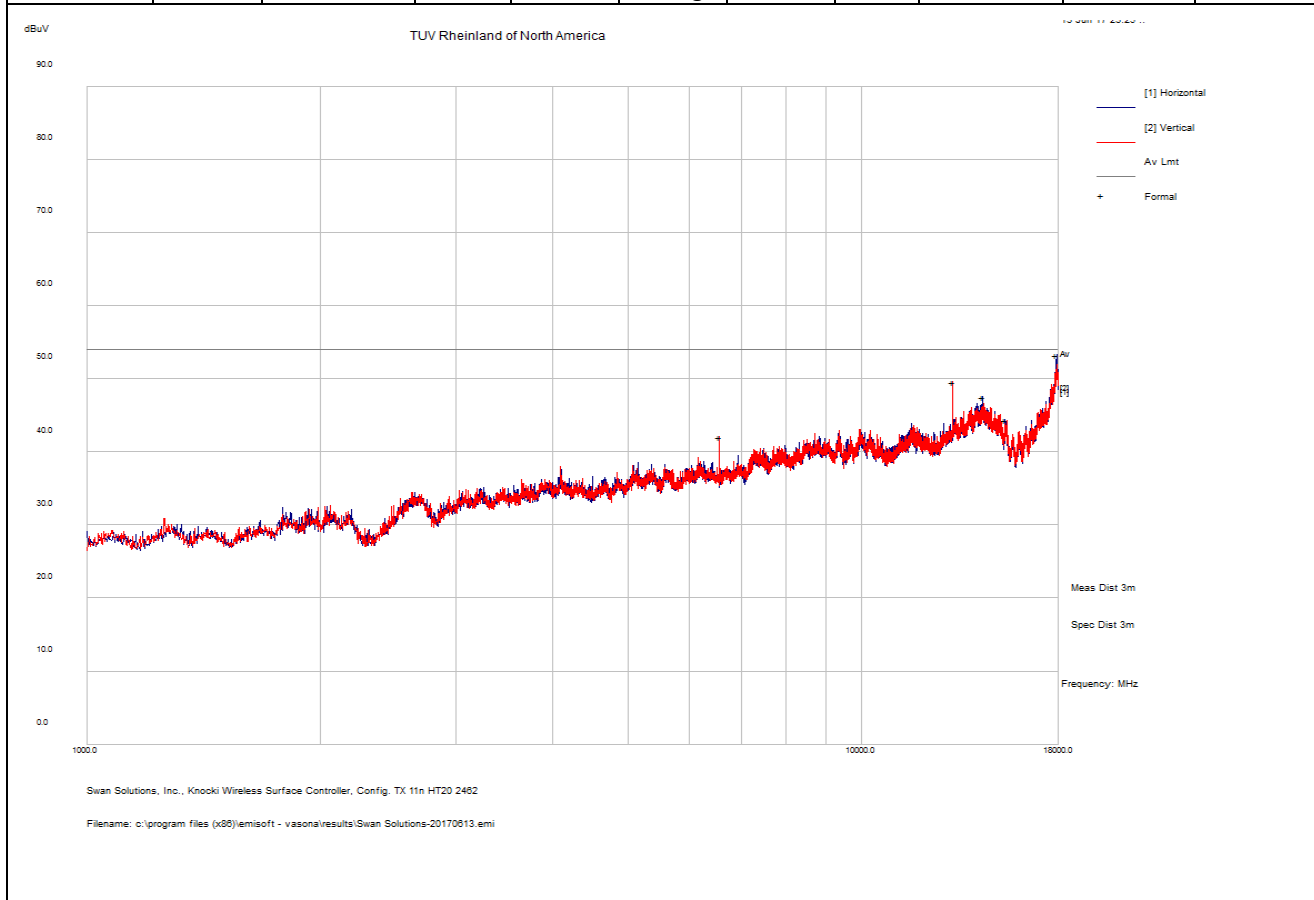
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EUT Name	Knocki	Date	June 13, 2017
EUT Model	KNC1	Temp / Hum in	22° C / 40%rh
EUT Serial	KNC-A1W-00000032	Temp / Hum out	N/A
EUT Config.	802.11n HT20	Line AC / Freq	3.3 VDC
Standard	CFR47 Part 15 Subpart C, RSS-247, RSS-GEN	RBW / VBW	1 MHz/ 3 MHz
Dist/Ant Used	3m – EMCO3115 / 1m – AHA-840	Performed by	Rolly Alegre

1 – 18 GHz Transmit at 2462 MHz (High Channel)

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
17897.52	40.77	3.72	-3.38	41.11	Average	H	186	164	54.00	-12.89
13130.51	49.19	3.12	-10.96	41.35	Average	V	248	156	54.00	-12.65



Spec Margin = E-Field AVG - Limit, E-Field AVG = FIM AVG+ Total CF ± Uncertainty
Total CF= AF+ Cable Loss AF= Antenna factor + Preamp

Note: No significant emissions was observed. **Measured spectrum noise floor.**

SOP 1 Radiated Emissions

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EUT Name Knocki

Date June 13, 2017

EUT Model KNC1

Temp / Hum in 22° C / 40%rh

EUT Serial KNC-A1W-00000032

Temp / Hum out N/A

EUT Config. 802.11n HT20

Line AC / Freq 3.3 VDC

Standard CFR47 Part 15 Subpart C, RSS-247, RSS-GEN

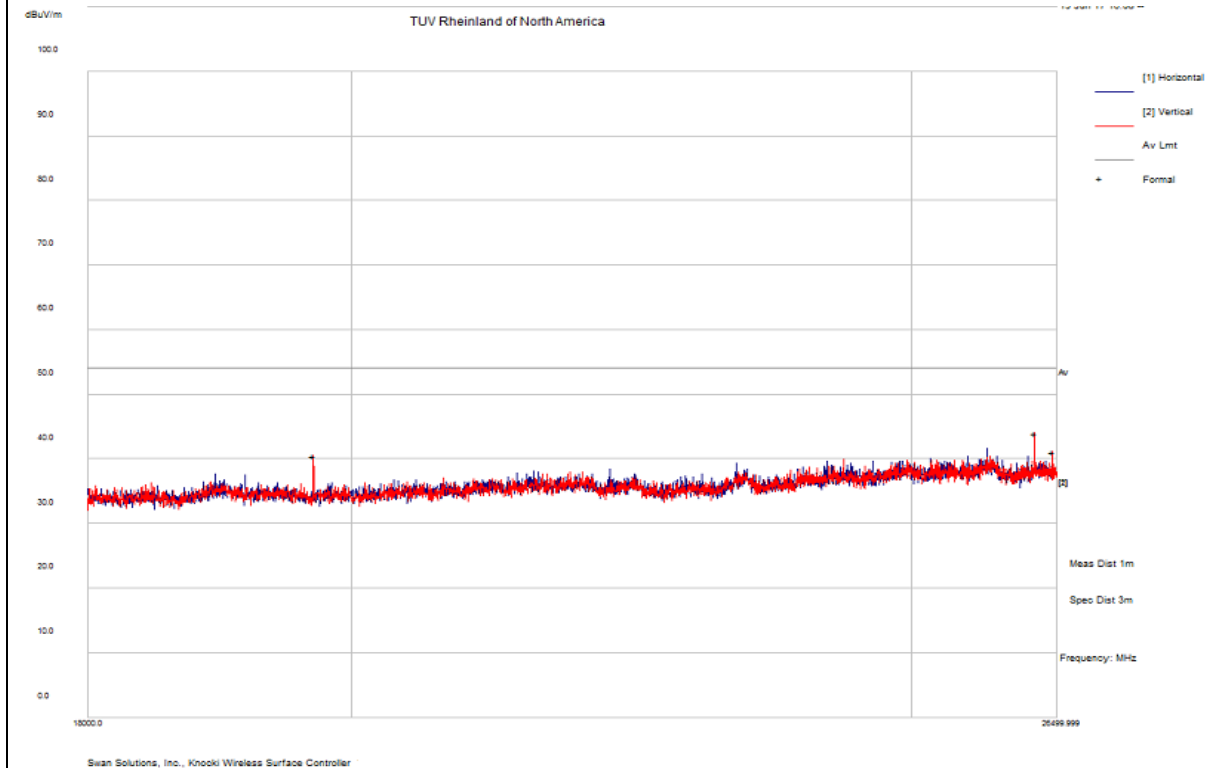
RBW / VBW 1 MHz/ 3 MHz

Dist/Ant Used 3m – EMCO3115 / 1m – AHA-840

Performed by Rolly Alegre

18 – 26 GHz Transmit at 2412 MHz (Low Channel)

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
19694.69	39.04	7.13	-5.70	40.47	Pk	V	150	285	54.00	-13.53
26260.94	40.79	8.22	-5.05	43.97	Pk	V	150	116	54.00	-10.03
26452.19	37.80	8.33	-5.07	41.07	Pk	V	150	250	54.00	-12.93



Spec Margin = E-Field AVG - Limit, E-Field AVG = FIM AVG+ Total CF $\pm$ Uncertainty Total CF= AF+ Cable Loss AF= Antenna factor + Preamp
--

Note: No significant emissions was observed. Measured spectrum noise floor.
--

SOP 1 Radiated Emissions

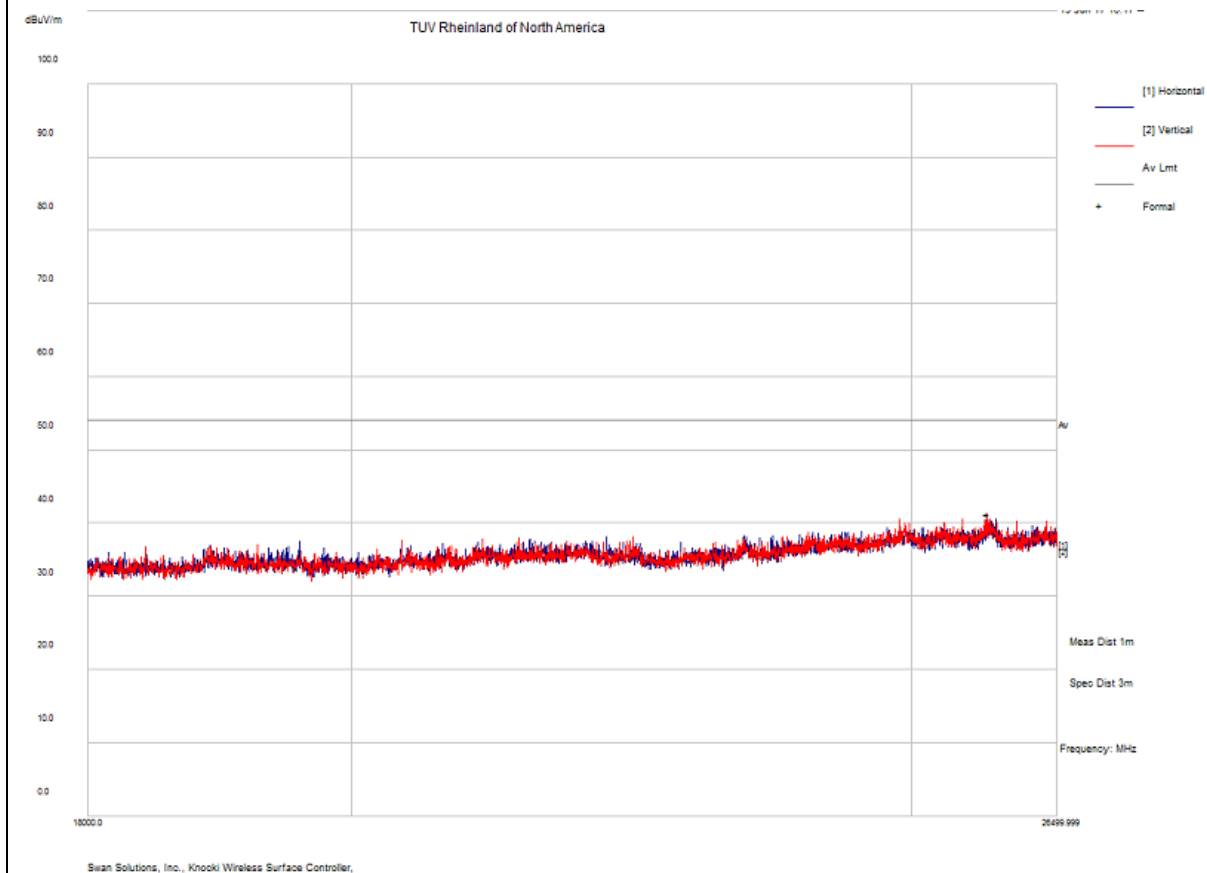
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EUT Name	Knocki	Date	June 13, 2017
EUT Model	KNC1	Temp / Hum in	22° C / 40%rh
EUT Serial	KNC-A1W-00000032	Temp / Hum out	N/A
EUT Config.	802.11n HT20	Line AC / Freq	3.3 VDC
Standard	CFR47 Part 15 Subpart C, RSS-247, RSS-GEN	RBW / VBW	1 MHz/ 3 MHz
Dist/Ant Used	3m – EMCO3115 / 1m – AHA-840	Performed by	Rolly Alegre

18 – 26 GHz Transmit at 2437 MHz (Mid Channel)

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
25769.53	38.97	8.12	-5.86	41.22	Pk	V	150	184	54.00	-12.78



Spec Margin = E-Field AVG - Limit, E-Field AVG = FIM AVG+ Total CF $\pm$ Uncertainty Total CF= AF+ Cable Loss AF= Antenna factor + Preamp
--

Note: No significant emissions was observed. Measured spectrum noise floor.
--

SOP 1 Radiated Emissions

Tracking #

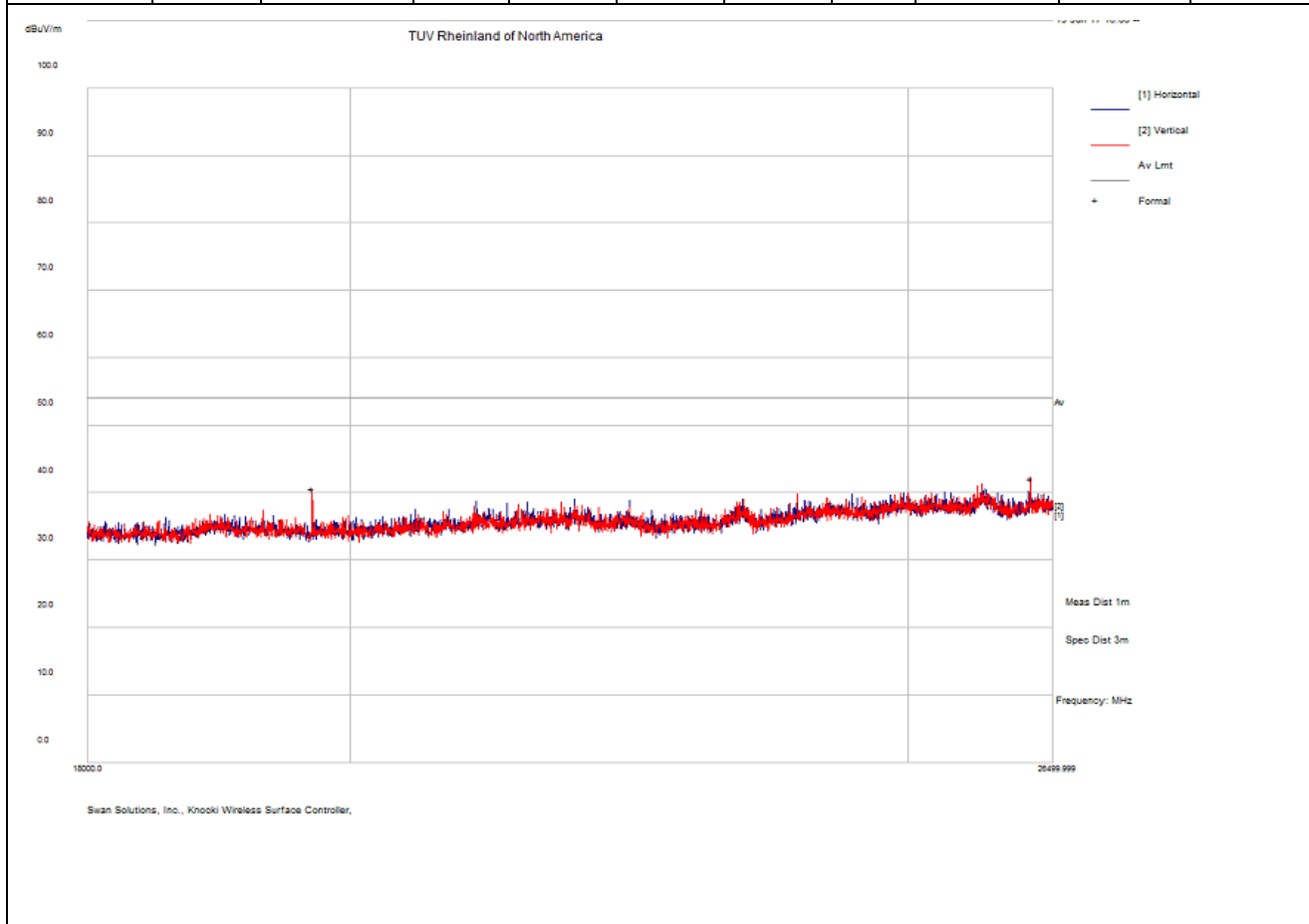
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EUT Name	Knocki	Date	June 13, 2017
EUT Model	KNC1	Temp / Hum in	22° C / 40%rh
EUT Serial	KNC-A1W-00000032	Temp / Hum out	N/A
EUT Config.	802.11n HT20	Line AC / Freq	3.3 VDC
Standard	CFR47 Part 15 Subpart C, RSS-247, RSS-GEN	RBW / VBW	1 MHz/ 3 MHz
Dist/Ant Used	3m – EMCO3115 / 1m – AHA-840	Performed by	Rolly Alegre

18 – 26 GHz Transmit at 2462 MHz (High Channel)

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
19694.69	39.11	7.13	-5.70	40.55	Pk	V	150	289	54.00	-13.46
26260.94	38.96	8.22	-5.05	42.14	Pk	V	150	102	54.00	-11.87



Spec Margin = E-Field AVG - Limit, E-Field AVG = FIM AVG+ Total CF $\pm$ Uncertainty Total CF= AF+ Cable Loss AF= Antenna factor + Preamp
--

Note: No significant emissions was observed. Measured spectrum noise floor.
--

4.6 AC Conducted Emissions

Testing was performed in accordance with ANSI C63.4: 2014. These test methods are listed under the laboratory's A2LA Scope of Accreditation.

This test measures the levels emanating from the EUT's AC input port, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices.

The AC conducted emissions of equipment under test shall not exceed the values in CFR47 Part 15.207: 2017 and RSS Gen: 2017 Sect. 8.8.

4.6.1 Test Methodology

A test program that controls instrumentation and data logging was used to automate the AC Power Line Conducted emission test procedure. The frequency range of interest was divided into sub-ranges such as to yield a frequency resolution of 9 kHz. Each phase and neutral of the AC power line were measured with respect to ground. Measurements were performed using a set of 50 μ H / 50 Ω LISNs.

Testing is performed in Lab 5. The setup photographs clearly identify which site was used. The vertical ground plane used in the semi-anechoic chamber is a 2m x 2m solid aluminum frame and panel, and it is bonded to the horizontal ground plane.

In the case of tabletop equipment, the EUT is placed on a 1.0m x 1.5m non-conductive table 80cm above the ground plane and 40cm from a vertical ground reference plane. The rear of the EUT was positioned flush with the backside of the table and directly over the LISNs. The power and I/O cables were routed over the edge of the table and bundled approximately 40cm from the ground plane. Support equipment was powered from a separate LISN.

4.6.1.1 Deviations

There were no deviations from this test methodology.

4.6.2 Test Results

No testing is required because EUT is battery (Alkaline) operated.

4.7 Maximum Permissible Exposure

4.7.1 Test Methodology

In this section, we try to prove the safety of radiation harmfulness to the human body for our product. The KDB 447498 D01v06 General RF Exposure Guidance is followed. The Gain of the antenna used in this calculation is declared by the manufacturer, and the maximum average power input to the antenna is measured. Using the general SAR test exclusion guidance in Section 4.3 of KDB 447498 D01v06, we show that the device meets the SAR exclusion threshold found in Appendix A of KDB 447498 D01v06 and the SAR exemption limits found in table 1 of RSS-102 Issue 5.

ISED accepts the KDB 447498 D01v06 Procedure.

4.7.2 FCC KDB 447498 D01v06 – General SAR Test Exclusion Guidance

The SAR exclusion threshold conditions are listed:

1) The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by the following formula:

$$\text{Exclusion Threshold} = [P / d] * [\sqrt{f}]$$

Where

P = max power of channel (including tune-up tolerance) in mW

d = min. test separation distance in mm

f = the RF channel transmit frequency in GHz

Power and distance are rounded to the nearest mW and mm before calculation

The result is rounded to one decimal place for comparison

Limits: ≤ 3.0 for 1-g SAR ≤ 7.5 for 10-g extremity SAR

The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.

4.7.3 EUT Operating Condition

The software provided by Manufacturer enabled the EUT to transmit data at lowest, middle and highest channel individually.

4.7.4 Classification

The antenna of the product, under normal condition, is less than 20cm away from the body of the user. This device is classified as a **Portable Device**.

4.7.5 Test Results

See SAR report for data results.

5 Test Equipment List

5.1 Equipment List

Equipment	Manufacturer	Model #	Serial/Inst #	Last Cal mm/dd/yyyy	Next Cal mm/dd/yyyy
Bilog Antenna	Sunol Sciences	JB3	A102606	06/15/2016	06/15/2018
Horn Ant. (1-18GHz)	EMCO	3115	9710-5301	10/08/2015	10/08/2017
Antenna (18-40 GHz)	Com-Power	AHA-840	105005	07/08/2015	07/08/2017
Spectrum Analyzer	Agilent	N9030A	MY52350885	05/17/2016	05/17/2018
EMI Receiver	Rohde & Schwarz	ESU	100364	04/21/2016	04/21/2018
Preamplifier	Sonoma Instruments	310	185516	01/10/2016	01/10/2018
Preamplifier	HP	8449B	3008A01014	01/20/2016	01/20/2018
Notch Filter	Micro-Tronics	BRM50716	037	07/29/2016	07/29/2017

6 EMC Test Plan

6.1 Introduction

This section provides a description of the Equipment Under Test (EUT), configurations, operating conditions, and performance acceptance criteria. It is an overview of information provided by the manufacturer so that the test laboratory may perform the requested testing.

6.2 Customer

Table 10: Customer Information

Company Name	Swan Solutions Inc. Error! Reference source not found.
Address	8300 Bissonnet Street Suite 215
City, State, Zip	Houston, TX 77074 Error! Reference source not found.
Country	USA
Phone	(832) 721 6127 Error! Reference source not found.

Table 11: Technical Contact Information

Name	John Boyd Error! Reference source not found.
E-mail	john@knocki.com
Phone	(817) 707 7211

6.3 Equipment Under Test (EUT)

Table 12: EUT Specifications

EUT Specifications	
Dimensions	90mm diameter / 25mm height
DC Input	Battery (Alkaline) 3.3VDC
Environment	Indoor
Operating Temperature Range:	-20C to +50 degrees C
Multiple Feeds:	☐ Yes and how many ☒ No
802.11-radio modules	
Operating Mode	802.11b, 802.11g, 802.11n HT20
Transmitter Frequency Band	2.4 GHz – 2.4835 GHz
Max. Rated Power Output	See Channel Planning Table.
Power Setting @ Operating Channel	See Channel Planning Table.
Antenna Type	Custom Integrated
Antenna Gain	+ 1.9 dBi
Modulation Type	☐ AM ☐ FM ☒ DSSS ☒ OFDM ☐ Other describe: 16QAM and 64 QAM
Data Rate	802.11b: 1, 2, 5.5, 11 Mbps 802.11g: 6, 9, 12, 18, 24, 36, 48, 54 Mbps 802.11n HT20: MCS 0, 1, 2, 3, 4, 5, 6, 7
TX/RX Chain (s)	Single; no beam forming
Directional Gain Type	☒ Uncorrelated ☐ Beam-Forming ☐ Other describe:
Type of Equipment	☒ Table Top ☒ Wall-mount ☐ Floor standing cabinet ☐ Other:
Note: None.	

Table 14: Interface Specifications

Interface Type	Cabled with what type of cable?	Is the cable shielded?	Maximum potential length of the cable?	Metallic (M), Coax (C), Fiber (F), or Not Applicable?
USB	USB to TTL cable	☒ No	☒ Metric: 1.5 m	☐ N/A

Table 15: Supported Equipment

Equipment	Manufacturer	Model	Serial	Used for
Laptop	Asus	X540L	00325-80427-62986-AAOEM	Setup EUT operating channel
Note: None.				

Table 16: Description of Sample used for Testing

Device	Serial	RF Connection	CFR47 Part 15.247
Knocki Wireless Surface Controller	KNC-A1W-00000032	Integrated Antenna	Radiated Emissions
	KNC-A1W-00000032	Integrated Antenna	Radiated Bandedge Emissions,
	KNC-A1W-00000060	Direct Connection	Peak Transmit Power, Peak Power Spectral Density, Occupied Bandwidth, Band-Edge, Out-of-Band Emissions

Table 17: Description of Test Configuration used for Radiated Measurement.

Device	Antenna	Mode	Setup Photo (X-Axis)	Setup Photo (Y-Axis)	Setup Photo (Z-Axis)
Knocki Wireless Surface Controller	Custom Integrated	Transmit	EUT laid flat.	N/A	N/A
Note: None.					

6.4 Test Specifications

Table 18: Test Specifications

Emissions and Immunity	
Standard	Requirement
CFR 47 Part 15.247: 2017	All
RSS 247 Issue 1, 2017	All

END OF REPORT