

Venstar, Inc.

TEST REPORT FOR

**Wifi Thermostat
Model: OnePlus**

Tested to The Following Standards:

FCC Part 15 Subpart C Section(s)

**15.207 & 15.247
(DTS 2400-2483.5 MHz)**

Report No.: 102105-6

Date of issue: March 20, 2019



Test Certificate # 803.02

This test report bears the accreditation symbol indicating that the testing performed herein meets the test and reporting requirements of ISO/IEC 17025 under the applicable scope of testing for CKC Laboratories, Inc.

We strive to create long-term, trust based relationships by providing sound, adaptive, customer first testing services. We embrace each of our customers' unique EMC challenges, not as an interruption to set processes, but rather as the reason we are in business.

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ADMINISTRATIVE INFORMATION

Test Report Information

REPORT PREPARED FOR:

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Representative: Alex Garashin

REPORT PREPARED BY:

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Project Number: 102105

DATE OF EQUIPMENT RECEIPT:

January 10, 2019

DATE(S) OF TESTING:

January 10, 2019

Report Authorization

The test data contained in this report documents the observed testing parameters pertaining to and are relevant for only the equipment provided by the client, tested in the agreed upon operational mode(s) and configuration(s) as identified herein. Compliance assessment remains the client's responsibility. This report may not be used to claim product endorsement by A2LA or any government agencies. This test report has been authorized for release under quality control from CKC Laboratories, Inc.

A handwritten signature in black ink, reading "Steve Behm", is positioned above a horizontal line.

Steve Behm
Director of Quality Assurance & Engineering Services
CKC Laboratories, Inc.

Test Facility Information



Our laboratories are configured to effectively test a wide variety of product types. CKC utilizes first class test equipment, anechoic chambers, data acquisition and information services to create accurate, repeatable and affordable test results.

TEST LOCATION(S):
CKC Laboratories, Inc.
110 Olinda Place
Brea, CA 92823

Software Versions

CKC Laboratories Proprietary Software	Version
EMITest Emissions	5.03.11

Site Registration & Accreditation Information

Location	*NIST CB #	FCC	JAPAN
Brea D, CA	US0060	US1025	A-0147

*CKC's list of NIST designated countries can be found at: <https://standards.gov/cabs/designations.html>

SUMMARY OF RESULTS

Standard / Specification: FCC Part 15 Subpart C - 15.247 (DTS)

Test Procedure	Description	Modifications	Results
15.247(a)(2)	6dB Bandwidth	NA	NP
15.247(b)(3)	Output Power	NA	NP
15.247(e)	Power Spectral Density	NA	NP
15.247(d)	RF Conducted Emissions & Band Edge	NA	NP
15.247(d)	Radiated Emissions & Band Edge	NA	Pass
15.207	AC Conducted Emissions	NA	NP

NA = Not Applicable

NP = CKC Laboratories was not contracted to perform test.

ISO/IEC 17025 Decision Rule

The declaration of pass or fail herein is based upon assessment to the specification(s) listed above, including where applicable, assessment of measurement uncertainties. For performance related tests, equipment was monitored for specified criteria identified in that section of testing.

Modifications During Testing

This list is a summary of the modifications made to the equipment during testing.

Summary of Conditions

No modifications were made during testing.

Modifications listed above must be incorporated into all production units.

Conditions During Testing

This list is a summary of the conditions noted to the equipment during testing.

Summary of Conditions

None

EQUIPMENT UNDER TEST (EUT)

During testing, numerous configurations may have been utilized. The configurations listed below support compliance to the standard(s) listed in the Summary of Results section.

Configuration 1

Equipment Tested:

Device	Manufacturer	Model #	S/N
Wifi Thermostat	Venstar, Inc.	OnePlus	23
Power Supply	Generic	MKA-412400200	NA

Support Equipment:

Device	Manufacturer	Model #	S/N
None			

General Product Information:

Product Information	Manufacturer-Provided Details
Equipment Type:	Stand-Alone Equipment
Type of Wideband System:	802.11b/g/n20
Operating Frequency Range:	2412-2462MHz
Modulation Type(s):	QBPSK, OFDM
Maximum Duty Cycle:	98%
Number of TX Chains:	1
Antenna Type(s) and Gain:	Integral Inverted (IFA) -0.97dBi
Beamforming Type:	NA
Antenna Connection Type:	Integral
Nominal Input Voltage:	24Vac
Firmware / Software used for Test:	1.1.0

FCC Part 15 Subpart C

15.247(d) Radiated Emissions & Band Edge

Test Setup / Conditions / Data

Test Location: CKC Laboratories, Inc. • 110 N. Olinda Place • Brea, CA 92821 • 714 993- 6112
 Customer: **Venstar, Inc.**
 Specification: **15.247(d) / 15.209 Radiated Spurious Emissions**
 Work Order #: **102105** Date: 1/10/2019
 Test Type: **Radiated Scan** Time: 09:47:04
 Tested By: E. Wong Sequence#: 4
 Software: EMITest 5.03.11

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

The EUT is placed on Styrofoam block, orientated per intended installation; all data and Aux port are connected to section of unterminated cable.

The EUT has a 2.4 GHz Limited Modular Approved radio installed.

This is a PCII evaluation, based on worst case emission from original test report under FCCID:VPYLB1DX, original grantee Murata.

PCI for: New antenna, Co-Location, Specific host.

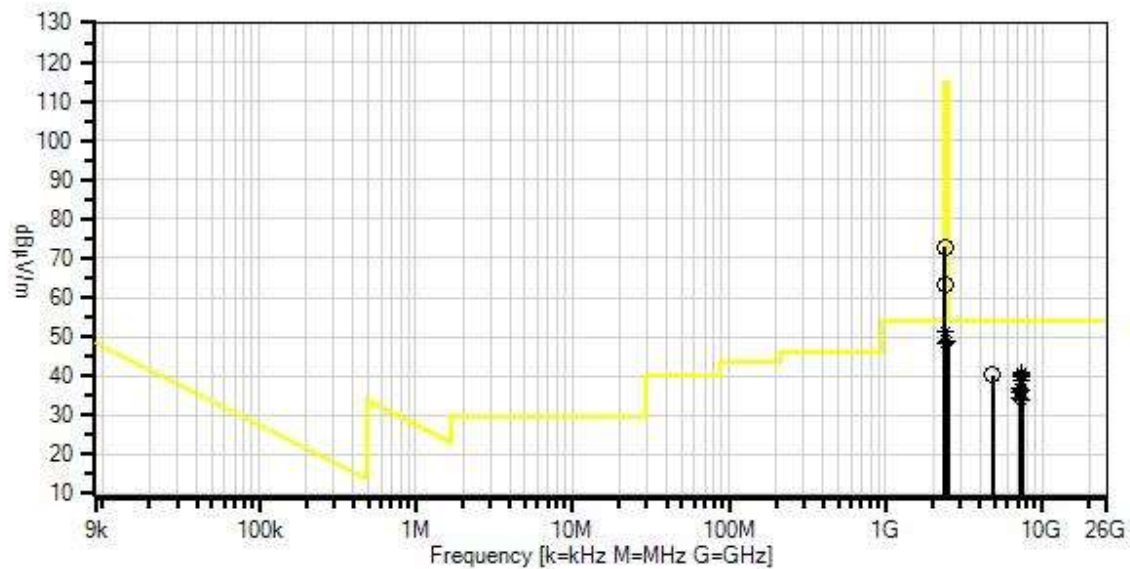
Frequency; 2412, 2440MHz, 2437MHz, 2462MHz
 Modulation:802.11b 1 mbps, 802.11N20 6.5 mbps

Frequency range of measurement = 1GHz- 25GHz.
 1000 MHz-25000 MHz;RBW=1 MHz,VBW=1 MHz.

Test environment conditions:
 Temperature: 18.3°C, 45.7% Relative humidity, Pressure: 100.9kPa

Site D
 ANSI C63.10-2013

Venstar, Inc. W/O#: 102105 Sequence#: 4 Date: 1/10/2019
15.247(d) / 15.209 Radiated Spurious Emissions Test Distance: 3 Meters Horiz



— Readings
× QP Readings
▼ Ambient
○ Peak Readings
* Average Readings
Software Version: 5.03.11
1 - 15.247(d) / 15.209 Radiated Spurious Emissions

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN02672	Spectrum Analyzer	E4446A	3/2/2017	3/2/2019
T2	ANP04382	Cable	LDF-50	6/2/2018	6/2/2020
T3	AN01646	Horn Antenna	3115	3/14/2018	3/14/2020
T4	ANP07247	Cable	32022-29094K-29094K-24TC	7/5/2018	7/5/2020
T5	AN00787	Preamp	83017A	6/9/2017	6/9/2019
T6	ANP07138	Cable	ANDL1-PNMNM-60	3/1/2017	3/1/2019
T7	AN03385	High Pass Filter	11SH10-3000/T10000-O/O	6/2/2017	6/2/2019
	AN01413	Horn Antenna-ANSI C63.5 (dB/m)	84125-80008	10/17/2018	10/17/2020
	AN03367	Horn Antenna-ANSI C63.5 Calibration	62-GH-62-25.	8/24/2017	8/24/2019

Measurement Data:

Reading listed by margin.

Test Distance: 3 Meters

#	Freq MHz	Rdng dBμV	T1 T5 dB	T2 T6 dB	T3 T7 dB	T4 dB	Dist Table	Corr dBμV/m	Spec dBμV/m	Margin dB	Polar Ant
1	2400.000M	74.8	+0.0 -40.0	+5.4 +4.0	+28.3 +0.0	+0.3	+0.0	72.8	74.9 802.11n20_100kHz	-2.1	Horiz
2	2390.000M Ave	53.3	+0.0 -40.0	+5.4 +4.0	+28.3 +0.0	+0.3	+0.0	51.3	54.0 802.11b	-2.7	Horiz
3	2483.500M Ave	50.4	+0.0 -40.2	+5.5 +4.1	+28.5 +0.0	+0.3	+0.0	48.6	54.0 802.11b	-5.4	Horiz
^	2483.500M	62.0	+0.0 -40.2	+5.5 +4.1	+28.5 +0.0	+0.3	+0.0	60.2	54.0 802.11b	+6.2	Horiz
5	2390.000M Ave	50.3	+0.0 -40.0	+5.4 +4.0	+28.3 +0.0	+0.3	+0.0	48.3	54.0 802.11n20	-5.7	Horiz
^	2390.000M	67.9	+0.0 -40.0	+5.4 +4.0	+28.3 +0.0	+0.3	+0.0	65.9	54.0 802.11n20	+11.9	Horiz
^	2390.000M	63.9	+0.0 -40.0	+5.4 +4.0	+28.3 +0.0	+0.3	+0.0	61.9	54.0 802.11b	+7.9	Horiz
8	7311.417M Ave	25.8	+0.0 -39.8	+10.8 +7.6	+36.2 +0.2	+0.1	+0.0	40.9	54.0 802.11b	-13.1	Horiz
^	7311.417M	38.1	+0.0 -39.8	+10.8 +7.6	+36.2 +0.2	+0.1	+0.0	53.2	54.0 802.11b	-0.8	Horiz
10	7385.900M Ave	24.8	+0.0 -39.8	+11.0 +7.7	+36.4 +0.2	+0.2	+0.0	40.5	54.0 802.11b	-13.5	Vert
^	7385.900M	38.1	+0.0 -39.8	+11.0 +7.7	+36.4 +0.2	+0.2	+0.0	53.8	54.0 802.11b	-0.2	Vert

12	4824.000M	32.0	+0.0 -39.8	+8.0 +6.1	+33.2 +0.3	+0.4	+0.0	40.2	54.0 802.11b	-13.8	Vert
13	7385.900M Ave	24.1	+0.0 -39.8	+11.0 +7.7	+36.4 +0.2	+0.2	+0.0	39.8	54.0 802.11b	-14.2	Horiz
^	7385.900M	36.9	+0.0 -39.8	+11.0 +7.7	+36.4 +0.2	+0.2	+0.0	52.6	54.0 802.11b	-1.4	Horiz
15	2400.000M	65.2	+0.0 -40.0	+5.4 +4.0	+28.3 +0.0	+0.3	+0.0	63.2	77.9 802.11b	-14.7	Horiz
16	7311.117M Ave	23.7	+0.0 -39.8	+10.8 +7.6	+36.2 +0.2	+0.1	+0.0	38.8	54.0 802.11b	-15.2	Vert
^	7311.117M	36.6	+0.0 -39.8	+10.8 +7.6	+36.2 +0.2	+0.1	+0.0	51.7	54.0 802.11b	-2.3	Vert
18	7386.000M Ave	23.2	+0.0 -39.8	+11.0 +7.7	+36.4 +0.0	+0.2	+0.0	38.7	54.0 802.11n20	-15.3	Vert
^	7386.000M	34.2	+0.0 -39.8	+11.0 +7.7	+36.4 +0.0	+0.2	+0.0	49.7	54.0 802.11n20	-4.3	Vert
20	7236.000M Ave	22.1	+0.0 -39.7	+10.7 +7.5	+35.9 +0.2	+0.1	+0.0	36.8	54.0 802.11b	-17.2	Horiz
^	7236.000M	34.4	+0.0 -39.7	+10.7 +7.5	+35.9 +0.2	+0.1	+0.0	49.1	54.0 802.11b	-4.9	Horiz
22	7386.000M Ave	21.0	+0.0 -39.8	+11.0 +7.7	+36.4 +0.0	+0.2	+0.0	36.5	54.0 802.11n20	-17.5	Horiz
^	7386.000M	33.9	+0.0 -39.8	+11.0 +7.7	+36.4 +0.0	+0.2	+0.0	49.4	54.0 802.11n20	-4.6	Horiz
24	7236.000M Ave	21.3	+0.0 -39.7	+10.7 +7.5	+35.9 +0.2	+0.1	+0.0	36.0	54.0 802.11b	-18.0	Vert
^	7236.000M	33.7	+0.0 -39.7	+10.7 +7.5	+35.9 +0.2	+0.1	+0.0	48.4	54.0 802.11b	-5.6	Vert
26	7220.333M Ave	19.6	+0.0 -39.6	+10.7 +7.5	+35.9 +0.0	+0.1	+0.0	34.2	54.0 802.11n20	-19.8	Vert
^	7220.333M	32.4	+0.0 -39.6	+10.7 +7.5	+35.9 +0.0	+0.1	+0.0	47.0	54.0 802.11n20	-7.0	Vert
28	7220.333M Ave	19.6	+0.0 -39.6	+10.7 +7.5	+35.9 +0.0	+0.1	+0.0	34.2	54.0 802.11n20	-19.8	Horiz
^	7220.333M	33.1	+0.0 -39.6	+10.7 +7.5	+35.9 +0.0	+0.1	+0.0	47.7	54.0 802.11n20	-6.3	Horiz
30	7320.250M Ave	19.2	+0.0 -39.8	+10.8 +7.6	+36.2 +0.0	+0.1	+0.0	34.1	54.0 802.11n20	-19.9	Vert
^	7320.250M	31.6	+0.0 -39.8	+10.8 +7.6	+36.2 +0.0	+0.1	+0.0	46.5	54.0 802.11n20	-7.5	Vert
32	7320.000M Ave	18.8	+0.0 -39.8	+10.8 +7.6	+36.2 +0.0	+0.1	+0.0	33.7	54.0 802.11n20	-20.3	Horiz
^	7320.000M	30.8	+0.0 -39.8	+10.8 +7.6	+36.2 +0.0	+0.1	+0.0	45.7	54.0 802.11n20	-8.3	Horiz

Band Edge

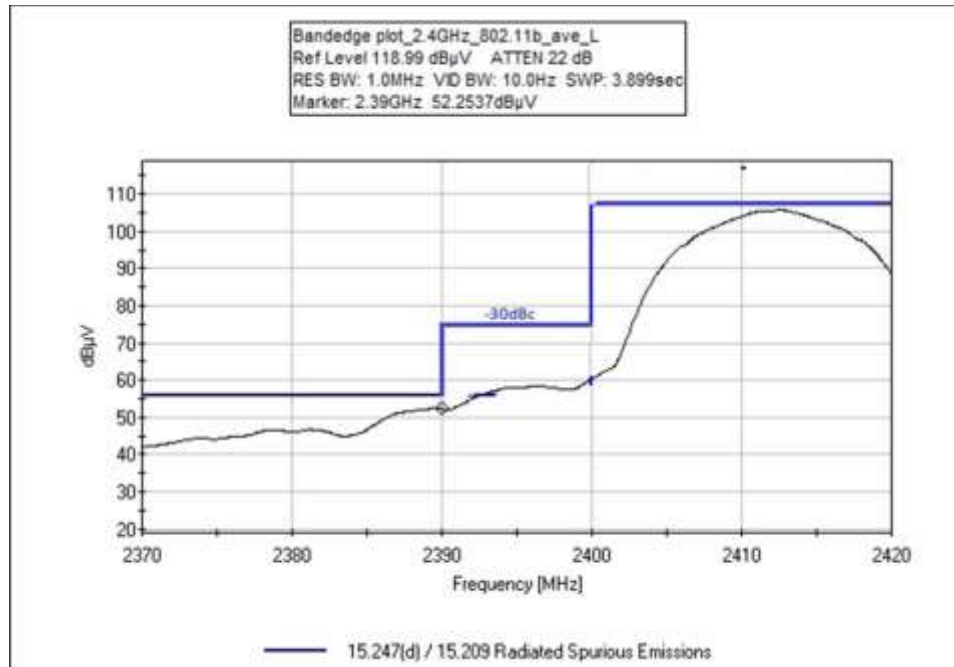
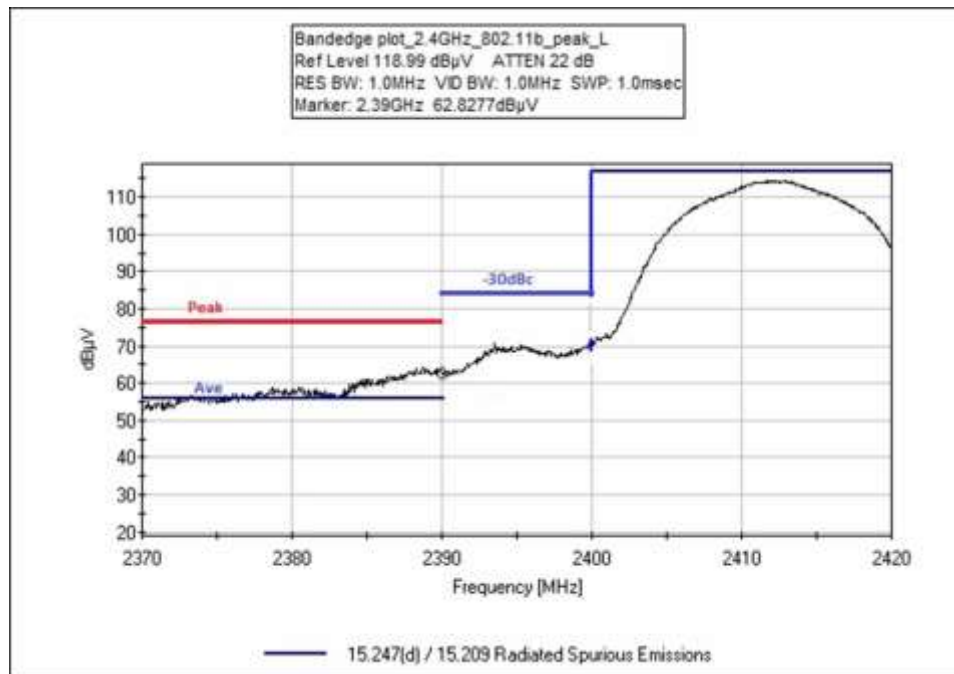
Band Edge Summary					
Frequency (MHz)	Modulation	Ant. Type	Field Strength (dBuV/m @3m)	Limit (dBuV/m @3m)	Results
802.11b					
2390.0	802.11b	Integral IFA	51.3 *	<54	Pass
2400.0	802.11b	Integral IFA	63.2	< 77.9	Pass
2483.5	802.11b	Integral IFA	48.6*	<54	Pass
802.11n20					
2390.0	802.11n20	Integral IFA	48.3*	<54	Pass
2400.0	802.11n20	Integral IFA	72.8	<74.5	Pass
2483.5	802.11n20	Integral IFA	48*	<54	Pass

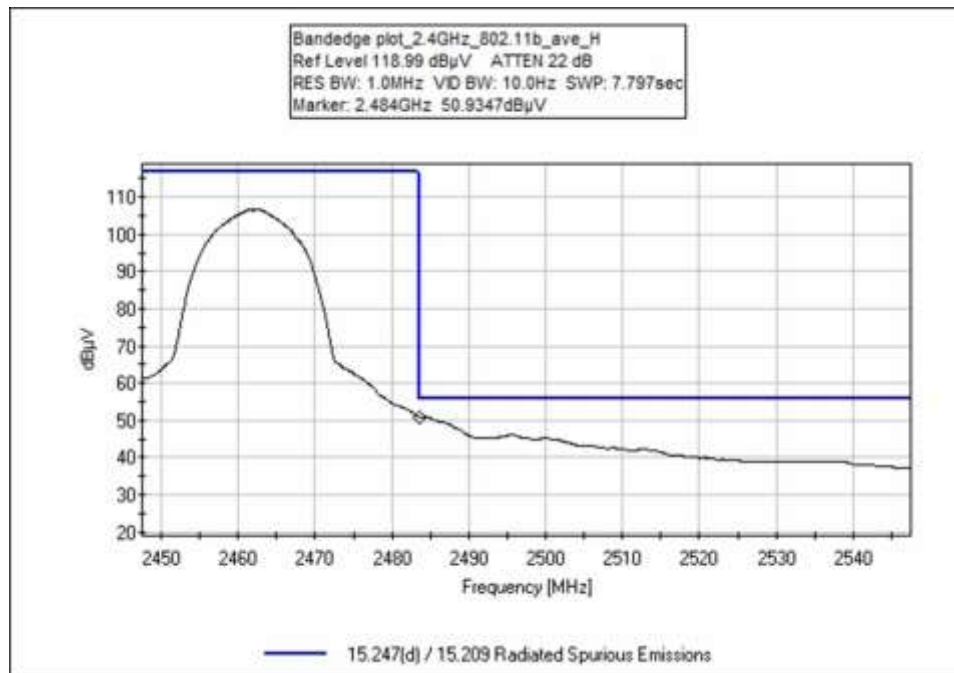
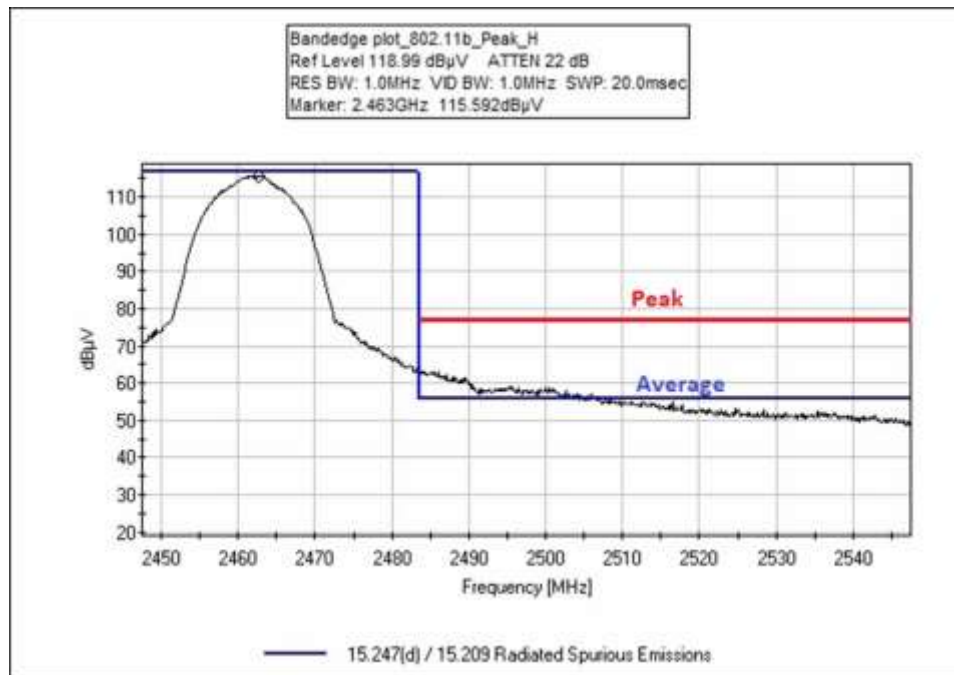
*average

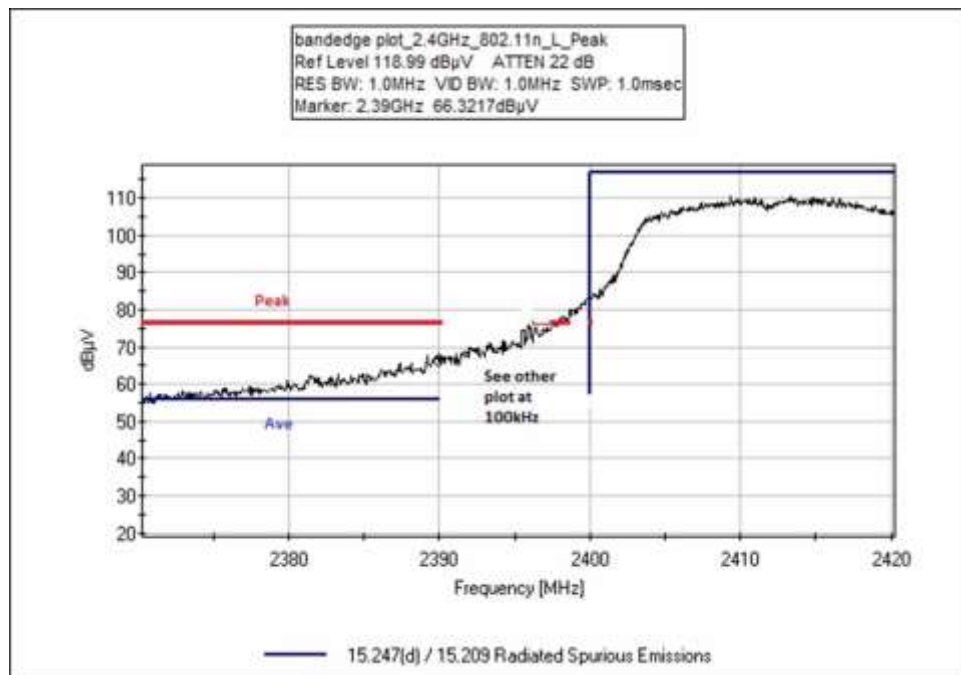
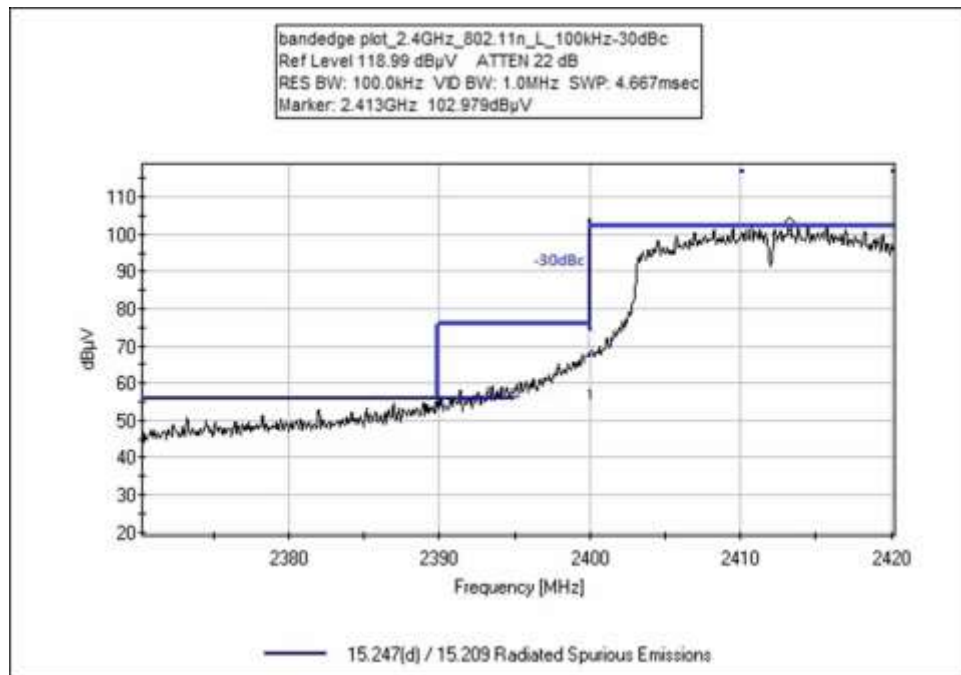
802.11b, power set at 17dBm

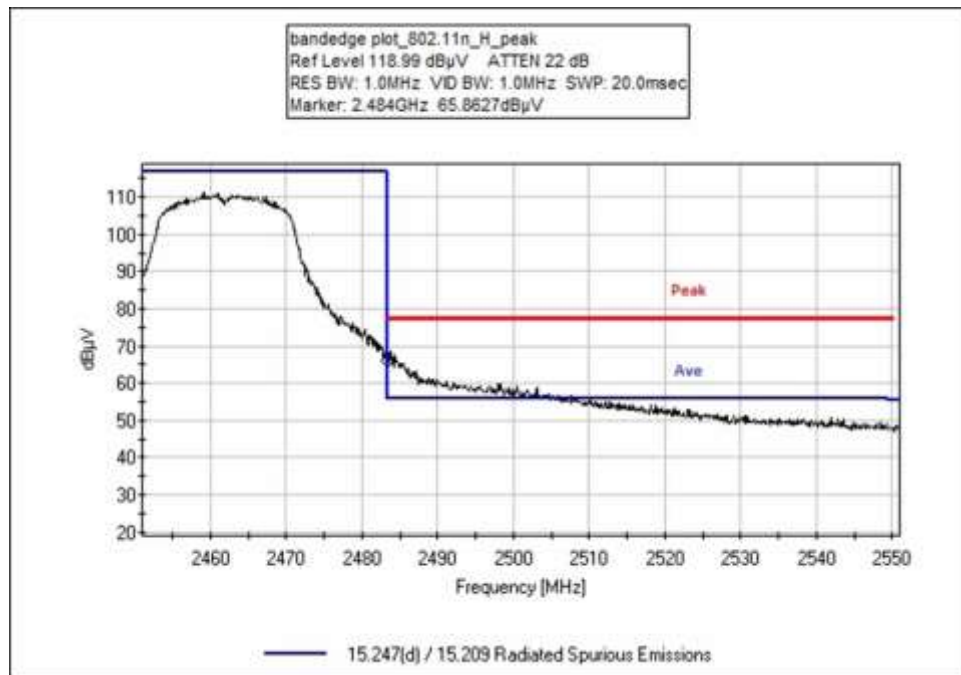
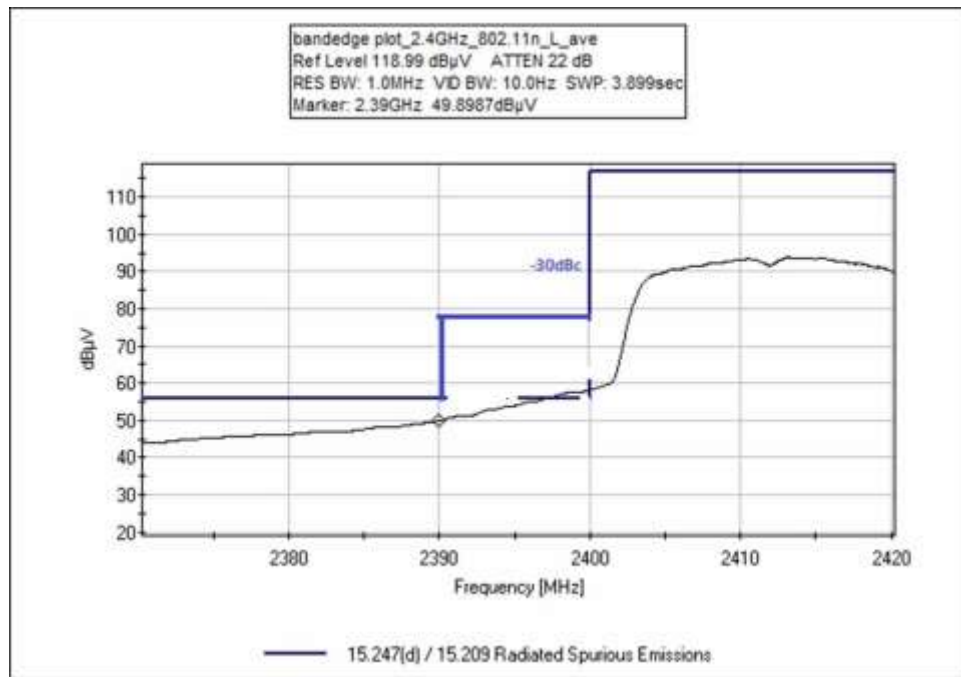
802.11n20 power set at 12dBm

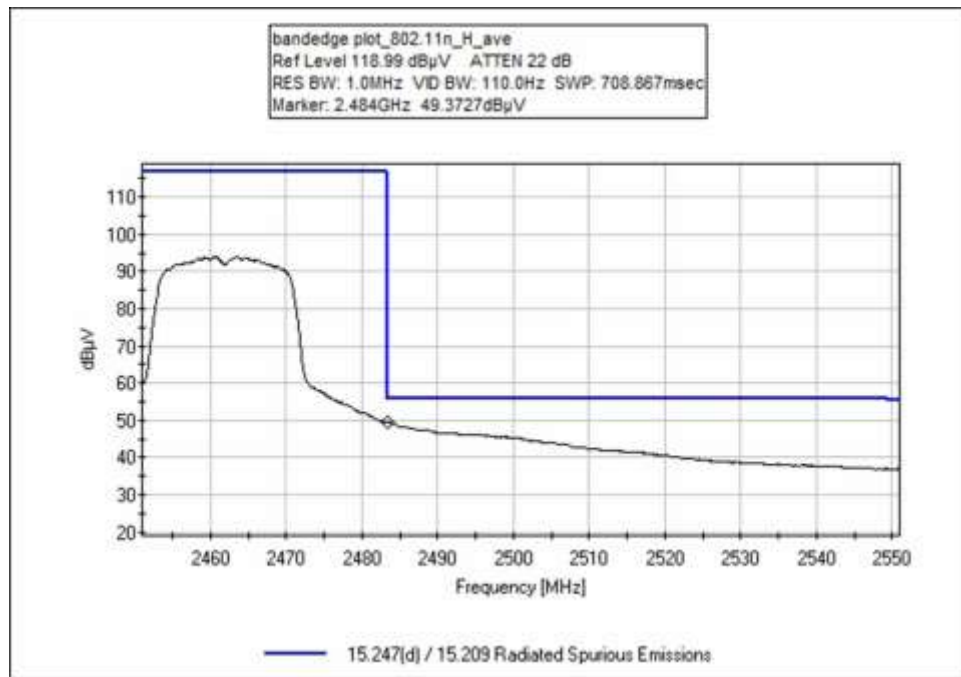
Band Edge Plots











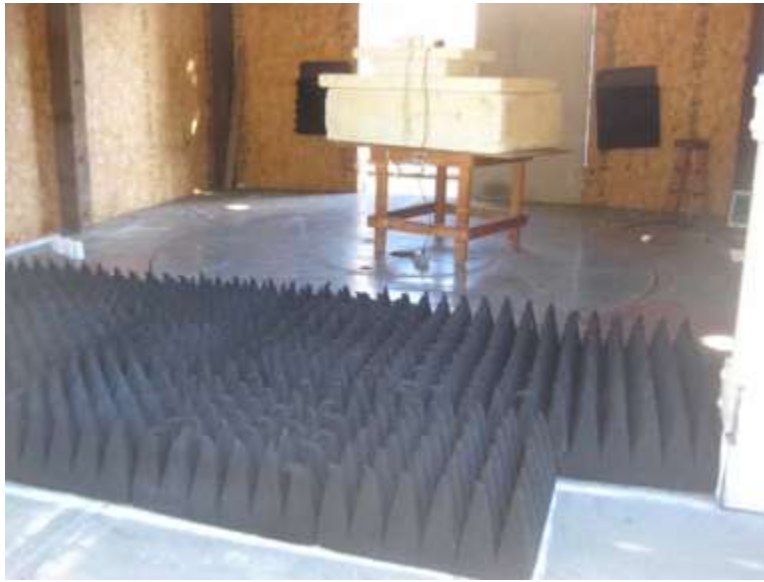
Test Setup Photo(s)



Below 1GHz



Below 1GHz



Above 1GHz, Cone placement

SUPPLEMENTAL INFORMATION

Measurement Uncertainty

Uncertainty Value	Parameter
4.73 dB	Radiated Emissions
3.34 dB	Mains Conducted Emissions
3.30 dB	Disturbance Power

Uncertainties reported are worst case for all CKC Laboratories' sites and represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of $k=2$. Compliance is deemed to occur provided measurements are below the specified limits.

Emissions Test Details

TESTING PARAMETERS

Unless otherwise indicated, the following configuration parameters are used for equipment setup: The cables were routed consistent with the typical application by varying the configuration of the test sample. Interface cables were connected to the available ports of the test unit. The effect of varying the position of the cables was investigated to find the configuration that produced maximum emissions. Cables were of the type and length specified in the individual requirements. The length of cable that produced maximum emissions was selected.

The equipment under test (EUT) was set up in a manner that represented its normal use, as shown in the setup photographs. Any special conditions required for the EUT to operate normally are identified in the comments that accompany the emissions tables.

The emissions data was taken with a spectrum analyzer or receiver. Incorporating the applicable correction factors for distance, antenna, cable loss and amplifier gain, the data was reduced as shown in the table below. The corrected data was then compared to the applicable emission limits. Preliminary and final measurements were taken in order to ensure that all emissions from the EUT were found and maximized.

CORRECTION FACTORS

The basic spectrum analyzer reading was converted using correction factors as shown in the highest emissions readings in the tables. For radiated emissions in $\text{dB}\mu\text{V}/\text{m}$, the spectrum analyzer reading in $\text{dB}\mu\text{V}$ was corrected by using the following formula. This reading was then compared to the applicable specification limit. Individual measurements were compared with the displayed limit value in the margin column. The margin was calculated based on subtracting the limit value from the corrected measurement value; a positive margin represents a measurement exceeding the limit, while a negative margin represents a measurement less than the limit.

SAMPLE CALCULATIONS		
	Meter reading	($\text{dB}\mu\text{V}$)
+	Antenna Factor	(dB/m)
+	Cable Loss	(dB)
-	Distance Correction	(dB)
-	Preamplifier Gain	(dB)
=	Corrected Reading	($\text{dB}\mu\text{V}/\text{m}$)

TEST INSTRUMENTATION AND ANALYZER SETTINGS

The test instrumentation and equipment listed were used to collect the emissions data. A spectrum analyzer or receiver was used for all measurements. Unless otherwise specified, the following table shows the measuring equipment bandwidth settings that were used in designated frequency bands. For testing emissions, an appropriate reference level and a vertical scale size of 10 dB per division were used.

MEASURING EQUIPMENT BANDWIDTH SETTINGS PER FREQUENCY RANGE			
TEST	BEGINNING FREQUENCY	ENDING FREQUENCY	BANDWIDTH SETTING
CONDUCTED EMISSIONS	150 kHz	30 MHz	9 kHz
RADIATED EMISSIONS	9 kHz	150 kHz	200 Hz
RADIATED EMISSIONS	150 kHz	30 MHz	9 kHz
RADIATED EMISSIONS	30 MHz	1000 MHz	120 kHz
RADIATED EMISSIONS	1000 MHz	>1 GHz	1 MHz

SPECTRUM ANALYZER/RECEIVER DETECTOR FUNCTIONS

The notes that accompany the measurements contained in the emissions tables indicate the type of detector function used to obtain the given readings. Unless otherwise noted, all readings were made in the "positive peak" detector mode. Whenever a "quasi-peak" or "average" reading was recorded, the measurement was annotated with a "QP" or an "Ave" on the appropriate rows of the data sheets. In cases where quasi-peak or average limits were employed and data exists for multiple measurement types for the same frequency then the peak measurement was retained in the report for reference, however the numbering for the affected row was removed and an arrow or caret ("^") was placed in the far left-hand column indicating that the row above takes precedence for comparison to the limit. The following paragraphs describe in more detail the detector functions and when they were used to obtain the emissions data.

Peak

In this mode, the spectrum analyzer or receiver recorded all emissions at their peak value as the frequency band selected was scanned. By combining this function with another feature called "peak hold," the measurement device had the ability to measure intermittent or low duty cycle transient emission peak levels. In this mode the measuring device made a slow scan across the frequency band selected and measured the peak emission value found at each frequency across the band.

Quasi-Peak

Quasi-peak measurements were taken using the quasi-peak detector when the true peak values exceeded or were within 2 dB of a quasi-peak specification limit. Additional QP measurements may have been taken at the discretion of the operator.

Average

Average measurements were taken using the average detector when the true peak values exceeded or were within 2 dB of an average specification limit. Additional average measurements may have been taken at the discretion of the operator. If the specification or test procedure requires trace averaging, then the averaging was performed using 100 samples or as required by the specification. All other average measurements are performed using video bandwidth averaging. To make these measurements, the test engineer reduces the video bandwidth on the measuring device until the modulation of the signal is filtered out. At this point, the measuring device is set into the linear mode and the scan time is reduced.