



## TEST REPORT

**Report Number:** 15312218-E3V1

**Applicant :** Sonos, Inc.  
301 Coromar Dr  
Goleta, CA 93117 USA

**Model :** S19

**Brand :** SONOS

**FCC ID :** SBVRM019

**IC :** 5373A-RM019

**EUT Description :** 802.11 a/b/g/n(HT20) Master device with BLE and NFC

**Test Standard(s) :** FCC 47 CFR PART 15 SUBPART C  
FCC 47 CFR PART 15 SUBPART E  
ISED RSS-247 ISSUE 3  
ISED RSS-GEN ISSUE 5 + A1 + A2

**Date of Issue:**

2024-08-16

**Prepared by:**

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## REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	2024-08-16	Initial Issue	---

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# 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** Sonos, Inc.  
301 Coromar Dr  
Goleta, CA 93117 USA

**EUT DESCRIPTION:** 802.11 a/b/g/n(HT20) Master device with BLE and NFC

**MODEL:** S19

**BRAND:** SONOS

**SERIAL NUMBER:** Radiated: 000E58710D8F0

**DATE TESTED:** 2024-07-15

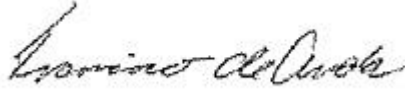
APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C	Complies
CFR 47 Part 15 Subpart E	Complies
ISED RSS-247 Issue 3	Complies
ISED RSS-GEN Issue 5 + A1 + A2	Complies

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. All samples tested were in good operating condition throughout the entire test program. Measurement Uncertainties are published for informational purposes only and were not taken into account unless noted otherwise.

This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by A2LA, NIST, any agency of the Federal Government, or any agency of the U.S. government.

Approved & Released For  
UL Verification Services Inc. By:



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Francisco de Anda  
Staff Engineer  
Consumer Technology Division  
UL Verification Services Inc.

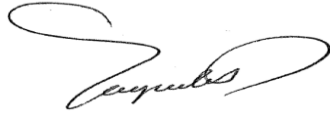
Prepared By:



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Gerardo Abrego  
Senior Test Engineer  
Consumer Technology Division  
UL Verification Services Inc.

Reviewed By:



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Vien Tran  
Senior Laboratory Engineer  
Consumer Technology Division  
UL Verification Services Inc.

## 2. TEST RESULTS SUMMARY

This report contains data provided by the customer which can impact the validity of results. UL Verification Services Inc. is only responsible for the validity of results after the integration of the data provided by the customer.

FCC Clause	ISED Clause	Requirement	Result	Comment
See Comment		Duty Cycle	Reporting purposes only	Per ANSI C63.10, Section 12.2.
15.209, 15.205, 15.407 (b) (1-4)	RSS-GEN 8.9, 8.10, RSS-247 6.2	Radiated Emissions	Complies	For colocation testing

## 3. TEST METHODOLOGY

The tests documented in this report were performed in accordance with:

- FCC CFR 47 Part 2
- FCC CFR 47 Part 15
- FCC KDB 662911 D01
- FCC KDB 905462 D02
- KDB 558074 D01 15.247 Meas Guidance
- FCC KDB 789033 D02
- KDB 414788 D01 Radiated Test Site
- ANSI C63.10-2013
- RSS-GEN Issue 5 + A1 + A2
- RSS-247 Issue 3

The scope of this report covers the simultaneous transmission testing in the 2.4GHz and 5GHz bands.

## 4. FACILITIES AND ACCREDITATION

UL Verification Services Inc. is accredited by A2LA, Certificate Number #0751.05, for all testing performed within the scope of this report. Testing was performed at the locations noted below.

	Address	ISED CABID	ISED Company Number	FCC Registration
<input checked="" type="checkbox"/>	Building 1: 47173 Benicia Street, Fremont, CA 94538, USA	US0104	2324A	550739
<input type="checkbox"/>	Building 2: 47266 Benicia Street, Fremont, CA 94538, USA			
<input type="checkbox"/>	Building 3: 843 Auburn Court, Fremont, CA 94538, USA			
<input checked="" type="checkbox"/>	Building 4: 47658 Kato Rd, Fremont, CA 94538, USA			
<input type="checkbox"/>	Building 5: 47670 Kato Rd, Fremont, CA 94538, USA			

## 5. DECISION RULES AND MEASUREMENT UNCERTAINTY

### 5.1. METROLOGICAL TRACEABILITY

All test and measuring equipment utilized to perform the tests documented in this report are calibrated on a regular basis, with a maximum time between calibrations of one year or the manufacturers' recommendation, whichever is less, and where applicable is traceable to recognized national standards.

### 5.2. DECISION RULES

The Decision Rule is based on Simple Acceptance in accordance with ISO Guide 98-4:2012 Clause 8.2. (Measurement uncertainty is not taken into account when stating conformity with a specified requirement.)

### 5.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	U <sub>Lab</sub>
Radio Frequency (Spectrum Analyzer)	141.16 Hz
Worst Case Conducted Disturbance, 9KHz to 0.15 MHz	1.22%
Power Spectral Density	2.47 dB
RF Power Measurement Direct Method Using Power Meter	1.3 dB (PK) / 0.45 dB (AV)
Unwanted Emissions, Conducted	1.94dB
Worst Case Conducted Disturbance, 9KHz to 0.15 MHz	3.78 dB
Worst Case Conducted Disturbance, 0.15 to 30 MHz	3.40 dB
Worst Case Radiated Disturbance, 9KHz to 30 MHz	2.87 dB
Worst Case Radiated Disturbance, 30 to 1000 MHz	6.01 dB
Worst Case Radiated Disturbance, 1000 to 18000 MHz	4.73 dB
Worst Case Radiated Disturbance, 18000 to 26000 MHz	4.51 dB
Worst Case Radiated Disturbance, 26000 to 40000 MHz	5.29 dB
Time Domain Measurements	3.39%
Temperature	0.57
Humidity	3.39%
DC Supply Voltages	0.57%

Uncertainty figures are valid to a confidence level of 95%.

### 5.4. SAMPLE CALCULATION

#### RADIATED EMISSIONS

Where relevant, the following sample calculation is provided:

$$\text{Field Strength (dBuV/m)} = \text{Measured Voltage (dBuV)} + \text{Antenna Factor (dB/m)} + \text{Cable Loss (dB)} - \text{Preamp Gain (dB)}$$

$$36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} = 28.9 \text{ dBuV/m.}$$

## **6. EQUIPMENT UNDER TEST**

### **6.1. EUT DESCRIPTION**

The EUT is a 802.11 a/b/g/n(HT20) Master device with BLE and NFC (Client device testing).

### **6.2. DESCRIPTION OF CLASS II PERMISSIVE CHANGE**

This is a request for the class II permissive change for FCC ID: SBVRM019 and IC Certification No: 5373A-RM019 to address the following proposed changes to the hardware/firmware for this device:

Client functionality for WiFi 5GHz (UNII-1:5180-5240MHZ, UNII-2A:5260-5320MHZ, UNII-2C:5500-5700MHZ, UNII-3:5745-5825MHZ) 802.11a and 802.11n20 modulations are enabled to Model S19 backhaul radio through only software change. Additional details are provided in the modified theory of operations and radio block diagram exhibits for this application.

The purpose of this change is to add the client functionality of the WiFi 5Ghz to S19 which already has the master functionality at 5GHz. It is relatively minor in scope and only adds backhaul connection capability at 5GHz and does not impact 2.4GHz. No impact on BLE certification.

### **6.3. MAXIMUM OUTPUT POWER & DESCRIPTION OF AVAILABLE ANTENNAS**

Refer to reports 12934025-E1V2 for BLE.

Refer to reports 12934025-E2V2 for WLAN 2.4GHz DTS.

Refer to reports 15312218-E1V1 for WLAN 5GHz UNII.

### **6.4. SOFTWARE AND FIRMWARE**

The EUT firmware installed during testing was 73.0-39020-diag-ci-1867-hwdiags\_apollo\_rel-065a2cc.



## 6.5. WORST-CASE CONFIGURATION AND MODE

The EUT can only be set up in desktop orientation; therefore, all radiated testing was performed with the EUT in desktop orientation.

### **For BLE**

Based on input from the radio manufacturer. The worst-case data rates were determined to be as follows:

BLE: 1 Mbps.

### **For WLAN 5GHz UNII**

802.11a mode: 6 Mbps  
802.11n HT20 mode: MCS0

## 6.6. SIMULTANEOUS TRANSMISSION CONFIGURATIONS

Simultaneous transmission of the following was investigated:

- BLE + WLAN 5GHz UNII

All test cases were identified based on the highest power in the band.

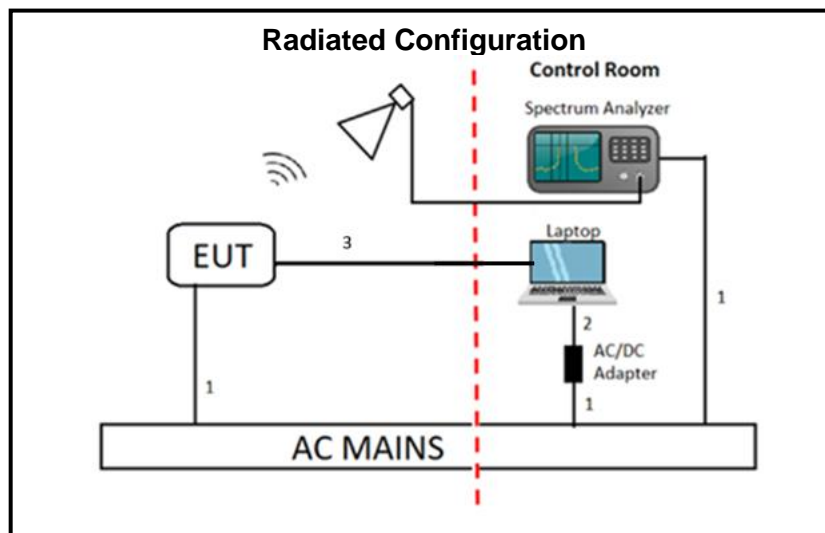
## 6.7. DESCRIPTION OF TEST SETUP

SUPPORT TEST EQUIPMENT						
Description	Manufacturer	Model	Serial Number	FCC ID/ DoC		
Laptop	Lenovo	T60S	PC0JCHLL	Doc		
Laptop AC/DC AC/DC Adapter	Lenovo	ADLX90NLC2A	11S45N0247Z1ZS9B54B8EJ	Doc		
I/O CABLES (CONDUCTED TEST)						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	AC	3	AC	Un-shielded	1.25	AC Mains to Spectrum Analyzer/AC/DC Adapter
2	DC	1	DC	Shielded	1	AC/DC Adapter to Laptop
3	Ethernet	1	RJ45	Un-shielded	1	Laptop to USB Ethernet Adapter
I/O CABLES (RADIATED TEST)						
Cable No.	Port	# Of Identical Ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	AC	3	AC	Un-shielded	1.25	AC Mains to Spectrum Analyzer/AC/DC Adapter
2	DC	1	DC	Shielded	1	AC/DC Adapter to Laptop
3	Ethernet	1	RJ45	Un-shielded	1	Laptop to USB Ethernet Adapter

### TEST SETUP

The EUT is a stand-alone unit, and the radio is exercised remotely by Sonos Compliance GUI test utility software via ethernet.

### SETUP DIAGRAMS



## 7. MEASUREMENT METHOD

Unwanted emissions in restricted bands:

KDB 789033 D02 v02r01, Sections G.3, G.4, G.5, and G.6.

Unwanted emissions in non-restricted bands:

KDB 789033 D02 v02r01, Sections G.3, G.4, and G.5.

## 8. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

TEST EQUIPMENT LIST					
Description	Manufacturer	Model	ID Num	Cal Due	Last Cal
Antenna, Horn 1-18GHz	ETS-Lindgren (Cedar Park, Texas)	3117	222741	2024-08-31	2022-08-31
RF Filter Box, 1-18GHz	FREMONT	n/a	171875	2025-03-31	2024-03-23
EMI TEST RECEIVER	Rohde & Schwarz	ESW44	230547	2025-02-28	2024-02-11
10dB Fixed Attenuator	Pasternack Enterprises	PE7087-10	N/A	Verified	Verified
UL TEST SOFTWARE LIST					
Radiated Software	UL	UL EMC	Ver 2023-01-18, 2016-08-23		

## 9. ON-TIME AND DUTY CYCLE

Refer to report 15312218-E1V1 for the UNII duty cycle data.

## 10. SIMULTANEOUS TRANSMISSION TEST RESULTS

### 10.1. LIMITS AND PROCEDURE

#### LIMITS

FCC §15.205 and §15.209 - Restricted bands

FCC §15.407(b)(1-4) - Un-Restricted bands

RSS-GEN, Section 8.9 and 8.10

RSS 247 Issue 3 Sections:

6.2.1.2 (for 5150-5250 MHz band)

6.2.2.2 (for 5250-5350 MHz band)

6.2.3.2 (for 5470-5600 MHz and 5650-5725 MHz bands)

6.2.4.2 (for 5725-5850 MHz band)

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
0.009-0.490	2400/F(kHz) @ 300 m	-
0.490-1.705	24000/F(kHz) @ 30 m	-
1.705 - 30	30 @ 30m	-
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

#### TEST PROCEDURE

The EUT is placed on a non-conducting table 1.5 m above the ground plane for measurement above 1GHz. The antenna to EUT distance is 3 meters. The EUT is configured in accordance with ANSI C63.10. The EUT is set to transmit in a continuous mode.

For pre-scans above 1 GHz, the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 30 KHz for peak measurements.

For final measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz for peak measurements and as applicable for average measurements.

The spectrum from 1 GHz to 18 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band.

The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated 360 degrees to maximize the emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

Based on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field.

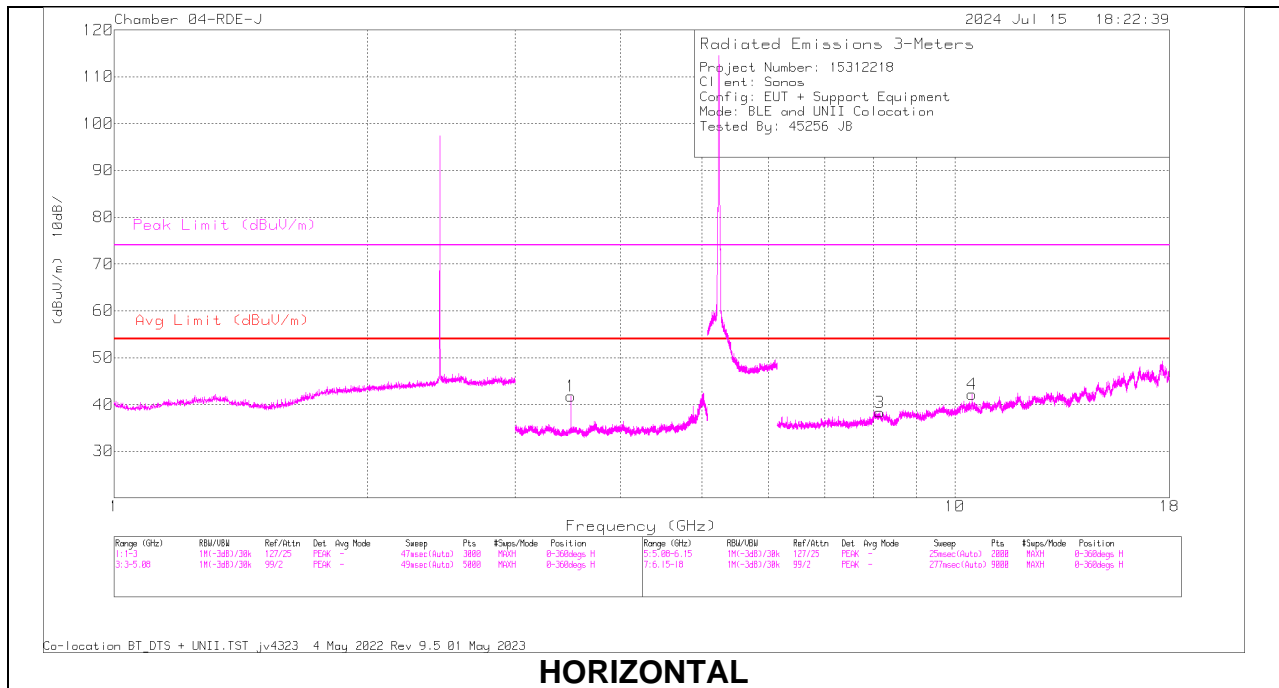
**KDB 558074 D01 15.247 Meas Guidance v05r02**

Use of a duty cycle correction factor (DCCF) is permitted for calculating average radiated field strength emission levels for an FHSS device in 15.247. This DCCF can be applied when the field strength limit (e.g., within a government-restricted band) and the conditions specified in Section 15.35(c) can be satisfied. The average radiated field strength is calculated by subtracting the DCCF from the maximum radiated field strength level as determined through measurement. The maximum radiated field strength level represents the worst-case (maximum amplitude) RMS measurement of the emission(s) during continuous transmission (i.e., not including any time intervals during which the transmitter is off or is transmitting at a reduced power level). It is also acceptable to apply the DCCF to a measurement performed with a peak detector instead of the specified RMS power averaging detector. Note that Section 15.35(c) specifies that the DCCF shall represent the worst-case (greatest duty cycle) over any 100 msec transmission period.

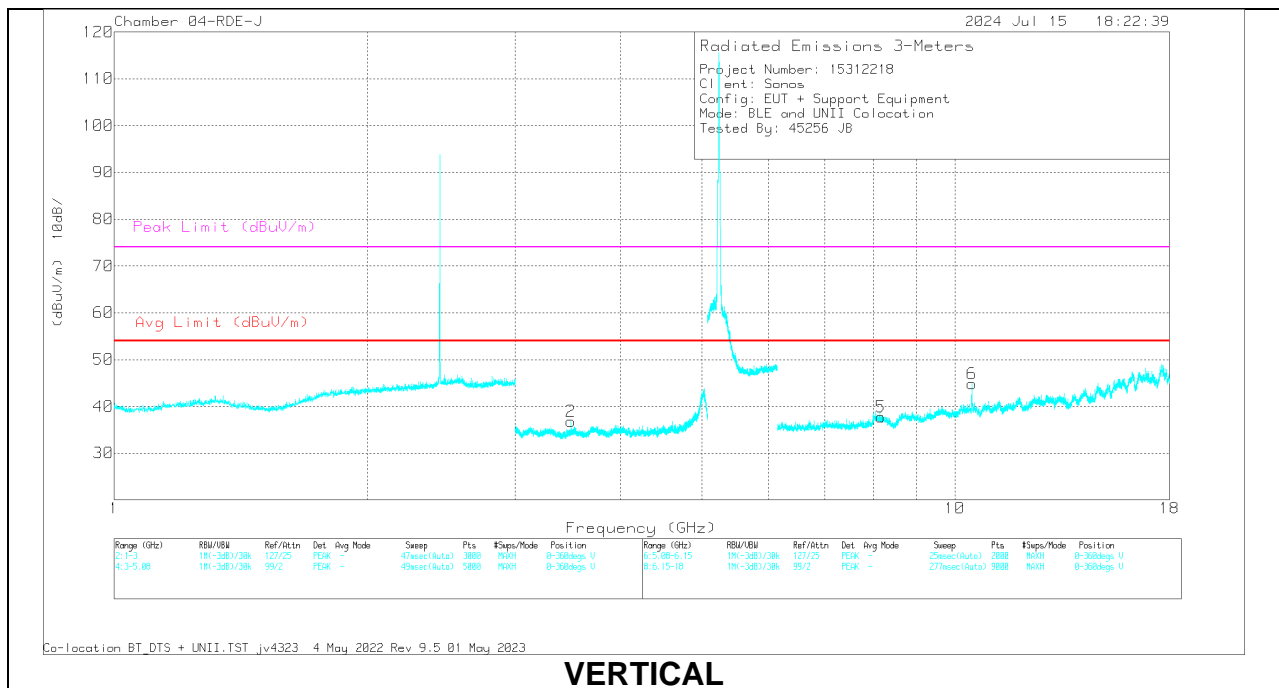
Note - For this test program, Peak detection was used. The DCCF was then subtracted from the peak value. The DCCF was calculated based on the worst-case on-time when the device transmits DH5 packets and operates on 20 channels (5/1600 s per hop = 3.125 ms per channel). In this mode, the device will have a maximum of 2 hops on a channel in 100ms or  $2 \times 3.125 \text{ ms} = 6.25 \text{ ms}$  on any channel. Therefore,  $\text{DCCF} = 20 \log(6.25 / 100) = -24 \text{ dB}$ .

### 10.1.1. TEST CASE

#### BLE (2402MHz) + WLAN UNII 5GHz (11n HT20 MHz-5240MHz)



**HORIZONTAL**



**VERTICAL**

**Radiated Emissions**

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	222741 ACF 3m (dB/m)	Amp/Cbl/Filtr (dB)	T769 BRF (dB)	DCCF (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	3.493163	58.46	PK-U	32.7	-44.4	1	0	47.76	-	-	74	-26.24	206	175	H
	3.493276	50.26	ADR	32.7	-44.4	1	1.03	40.59	53.97	-13.38	-	-	206	175	H
2	3.493226	56.27	PK-U	32.7	-44.4	1	0	45.57	-	-	74	-28.43	219	284	V
	3.493266	45.73	ADR	32.7	-44.4	1	1.03	36.06	53.97	-17.91	-	-	219	284	V

PK-U - U-NII: Maximum Peak  
 ADR - U-NII AD primary method, RMS average

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	222741 ACF 3m (dB/m)	Amp/Cbl/Filtr (dB)	DCCF (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
3	* 8.139809	52.74	PK-U	35.9	-40.9	0	47.74	-	-	74	-26.26	0	364	H
	* 8.140487	41.34	ADR	35.9	-40.9	1.03	37.37	53.97	-16.6	-	-	0	364	H
5	* 8.162408	53.28	PK-U	35.9	-41	0	48.18	-	-	74	-25.82	173	294	V
	* 8.164324	41.35	ADR	35.9	-41.1	1.03	37.18	53.97	-16.79	-	-	173	294	V
4	10.48039	44.03	ADR	37.4	-40.3	1.03	42.16	-53.97	-11.81	-	-	283	175	H
	10.480552	57.44	PK-U	37.4	-40.3	0	54.54	-	-	74	-19.46	283	175	H
6	10.480661	60.62	PK-U	37.4	-40.3	0	57.72	-	-	74	-16.28	253	400	V
	10.480839	46.3	ADR	37.4	-40.3	1.03	44.43	53.97	-9.54	-	-	253	400	V

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band  
 PK-U - U-NII: Maximum Peak  
 ADR - U-NII AD primary method, RMS average