



**SELECTED PORTIONS OF  
FCC 47 CFR PART SUBPART C §15.249  
AND  
ISED RSS-310 ISSUE 4**

**CERTIFICATION TEST REPORT**

**FOR**

**SMART DISPLAY**

**MODEL NUMBER: 1843**

**FCC ID: C3K1843**

**ISED: 3048A-1843**

**REPORT NUMBER: 12805347-E1V1**

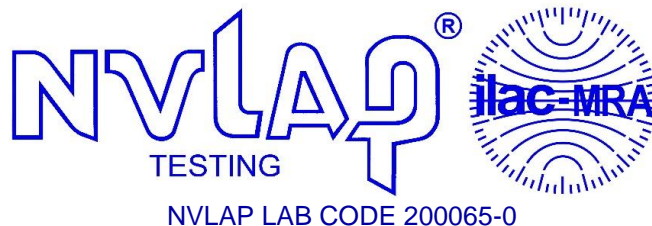
**ISSUE DATE: APRIL 25, 2019**

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NVLAP LAB CODE 200065-0

Revision History

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# 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** MICROSOFT CORP  
ONE MICROSOFT WAY  
EDMOND, WA 98052-7329, USA

**EUT DESCRIPTION:** 24 GHZ SENSOR

**MODEL:** 1843

**SERIAL NUMBER:** 17829180

**DATE TESTED:** APRIL 5 - 25, 2019


APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
SELECTED PORTIONS OF FCC PART 15.249	Pass
SELECTED PORTIONS OF ISED RSS-310 ISSUE 4	Pass

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Verification Services Inc. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

**Note:** The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. 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 NVLAP, NIST, or any agency of the Federal Government.

Approved & Released For  
UL Verification Services Inc. By:

Tested By:



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PRINCIPAL ENGINEER  
UL Verification Services Inc.

STEVE AGUILAR  
TEST ENGINEER  
UL Verification Services Inc.

## 2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.10-2013, FCC CFR 47 Part 2, FCC CFR 47 Part 15.249, and ISED RSS-GEN Issue 5 Amendment 1 as referenced by ISED RSS-310 Issue 4.

## 3. SCOPE OF REPORT

This report only covers radiated emissions measurement results from 40 GHz to 100 GHz.

## 4. REFERENCE DOCUMENTS

Some data from Microsoft Test Report No. R-TR525-FCCISED-SRD-24G-1 is used in this report. The Microsoft Laboratory is accredited by A2LA, Testing Cert # 3472.01.

## 5. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, California, USA.

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, Fremont, California, USA. Line conducted emissions are measured only at the 47173 address. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

47173 Benicia Street	47266 Benicia Street	47658 Kato Rd.
<input type="checkbox"/> Chamber A (ISED:2324B-1)	<input type="checkbox"/> Chamber D (ISED:22541-1)	<input type="checkbox"/> Chamber I (ISED: 2324A-5)
<input type="checkbox"/> Chamber B (ISED:2324B-2)	<input type="checkbox"/> Chamber E (ISED:22541-2)	<input type="checkbox"/> Chamber J (ISED: 2324A-6)
<input type="checkbox"/> Chamber C (ISED:2324B-3)	<input type="checkbox"/> Chamber F (ISED:22541-3)	<input type="checkbox"/> Chamber K (ISED: 2324A-1)
	<input type="checkbox"/> Chamber G (ISED:22541-4)	<input type="checkbox"/> Chamber L (ISED: 2324A-3)
	<input type="checkbox"/> Chamber H (ISED:22541-5)	

The above test sites and facilities are covered under FCC Test Firm Registration # 208313. Chambers above are covered under Industry Canada company address and respective code

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0.

## 6. CALIBRATION AND UNCERTAINTY

### 6.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

### 6.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

$$\begin{aligned} \text{Field Strength (dBuV/m)} &= \text{Measured Voltage (dBuV)} + \text{Antenna Factor (dB/m)} + \\ &\text{Cable Loss (dB)} - \text{Preamp Gain (dB)} \\ 36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} &= 28.9 \text{ dBuV/m} \end{aligned}$$

### 6.3. MEASUREMENT UNCERTAINTY

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

PARAMETER	UNCERTAINTY
Radiated RF power (above 40 up to 110 GHz)	±5.4 dB

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

## **7. EQUIPMENT UNDER TEST**

### **7.1. DESCRIPTION OF EUT**

See Microsoft Test Report No. R-TR525-FCCISED-SRD-24G-1.

### **7.2. SOFTWARE AND FIRMWARE**

Calvin tool 1.37.137.0  
Version 2.243.139  
Firmware version 5.9.139

### **7.3. WORST-CASE CONFIGURATION**

The EUT was placed in a test mode for Radiated Emissions testing. Both Horizontal and Vertical polarization was used to find the worst case emissions detected.

## 7.4. DESCRIPTION OF TEST SETUP

### SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST			
Description	Manufacturer	Model #	Serial # if applicable
USB Hub	Kingwin	--	--
Optical Mouse	--	--	--
USB Keyboard	SIGG Inc.	JK-US0312-S1	--

### I/O CABLES

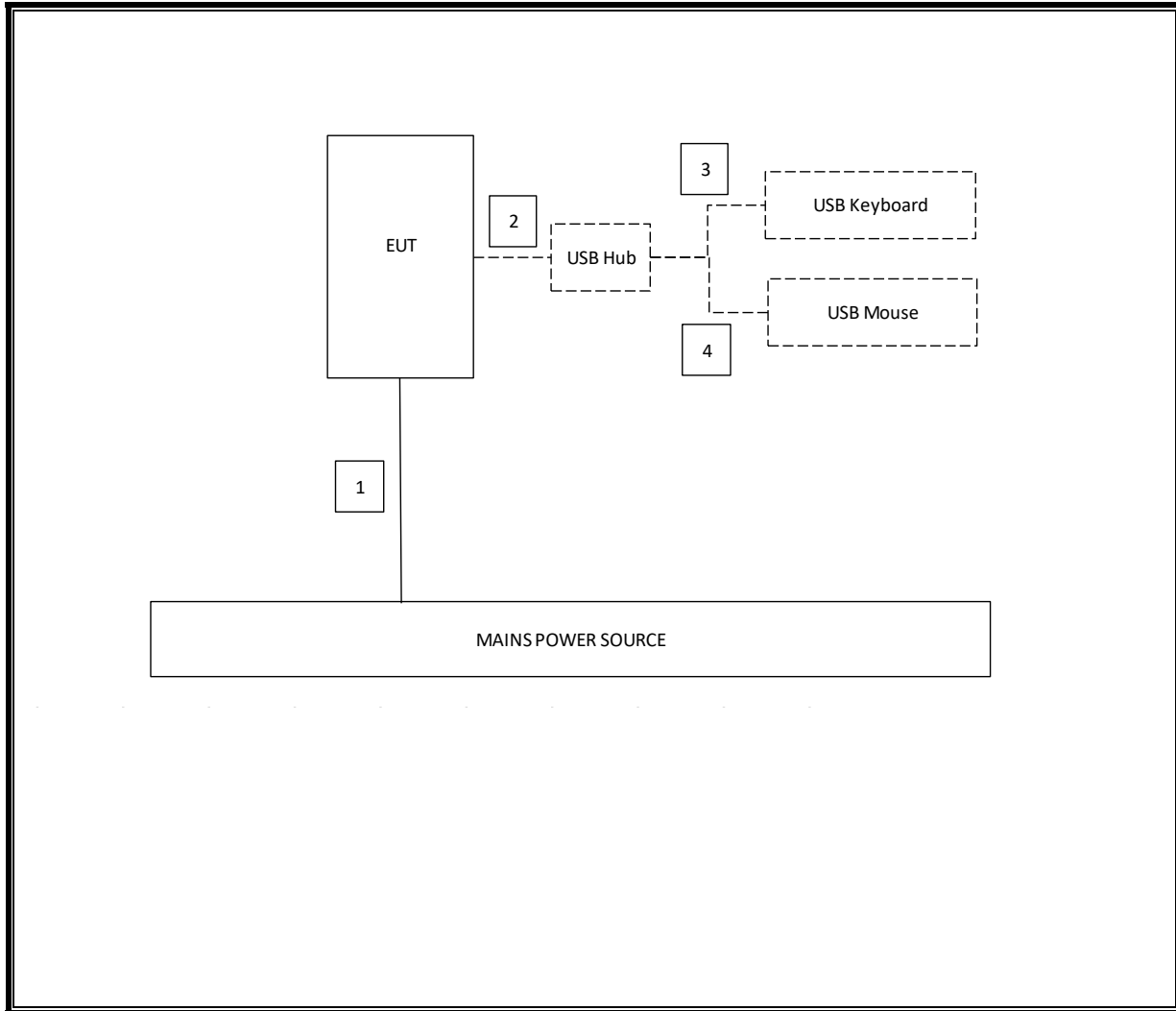
I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	AC	1	3-Prong	Unshielded	1.5	--
2	USB	1	USB	Shielded	1.5	Hub
3	USB	1	USB	Shielded	1.5	Keyboard
4	USB	1	USB	Shielded	1.5	Mouse

### TEST SETUP

The EUT was placed in a test mode which transmits the 24 GHz sensor signal continuously.



**SETUP DIAGRAM FOR TESTS**



Lines and devices in dotted lines are not part of the EUT. Items used for placing EUT into test mode

## 7.5. 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	S/N or Local ID	Cal Due
PXA Signal Analyzer 50 GHz	Agilent	N9030A	T313	1/25/2020
PSG Analog Signal Generator	Keysight	E8257D	T1839	8/13/2019
.01 – 26.5 GHz Amplifier	Agilent	83006A	12020	9/25/2019
Horn antenna, 33-50 GHz	CMI	HO22R	--	CNR
LNA, 40-50 GHz	Spacek Labs	SL4510-33-4W	14J05	9/24/2019
50-75 GHz Horn	CMI	HO15R	H15-1	9/20/2019
50-75 GHz LNA	Vivatech	VTLNBA-15-6018-FB	2014051	9/24/2019
50-75 GHz Downconverter	OML	C15H1DC01	PRE0180075	CNR
75-110 GHz Horn	CMI	HO10R	H10-1	9/20/2019
LNA, 75-110 GHz	Spacek	SLW-22-5	15J04	CNR
50-80 GHz Smart Mixer	Agilent	M1970V-002	T994	2/19/2020
75-110 GHz Smart Mixer	Agilent	M1970W	T993	2/19/2020

All horn antennas at and above the 33-50 GHz band are standard gain horns. In accordance with ANSI C63.10 clause 4.4.3 (a) Standard gain horns need not be periodically recalibrated, unless damage or deterioration is suspected or known to have occurred. If a standard gain horn is not periodically recalibrated, then its critical dimensions (see IEEE Std 1309-2005) shall be verified and documented on an annual basis.

UL measures the critical dimensions on an annual basis and checks for damage and deterioration before each test.

## 8. RADIATED EMISSION TEST RESULTS

### 8.1. LIMITS AND PROCEDURES

#### LIMITS

#### **§15.33 Frequency range of radiated measurements**

(2) If the intentional radiator operates at or above 10 GHz and below 30 GHz: to the fifth harmonic of the highest fundamental frequency or to 100 GHz, whichever is lower

#### **§15.209 Radiated emission limits; general requirements.**

(a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

<b>Frequency (MHz)</b>	<b>Field strength (microvolts/meter)</b>	<b>Measurement distance (meters)</b>
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

**§15.249**

(a) Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

<b>Fundamental frequency</b>	<b>Field strength of fundamental (millivolts/meter)</b>	<b>Field strength of harmonics (microvolts/meter)</b>
902-928 MHz	50	500
2400-2483.5 MHz	50	500
5725-5875 MHz	50	500
24.0-24.25 GHz	250	2500

§15.249 ( d ) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

(e) As shown in § 15.35(b), for frequencies above 1000 MHz, the field strength limits in paragraphs (a) and (b) of this section are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

**RSS-GEN Clause 6.13.2 (b)**

(b) If the equipment operates at or above 10 GHz and below 30 GHz: to the fifth harmonic of the highest fundamental frequency or to 100 GHz, whichever is lower.

**RSS-310 Clause 3.10 Band 24-24.25 GHz**

Emissions radiated outside the specified frequency band shall be attenuated by at least 50 dB below the level of the fundamental or to the general field strength limits listed in RSS-Gen, whichever is the less stringent.

The peak field strength of any emission shall not exceed the maximum permitted average limit specified above by more than 20 dB under any condition of modulation.

## **TEST PROCEDURES**

ANSI C63.10

### **47 CFR 15.35 (c)**

(c) Unless otherwise specified, e.g., §15.255(b), and 15.256(l)(5), when the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value.

### **PROCEDURE FOR 40 TO 100 GHz**

External harmonic mixers or downconverters with Standard Gain horn antennas are utilized.

## 8.2. RESULTS

### 8.2.1. APPLICABLE LIMIT

Fundamental field strength is referenced from the Microsoft report.

The field strength of the fundamental is 94.41 dBuV/m at 3 meters, average.  
An attenuation of 50 dB yields 44.41 dBuV/m at 3 meters.

The §15.209 average limit above 960 MHz is 500 uV/m at 3 meters, equivalent to 54 dBuV/m at 3 meters.

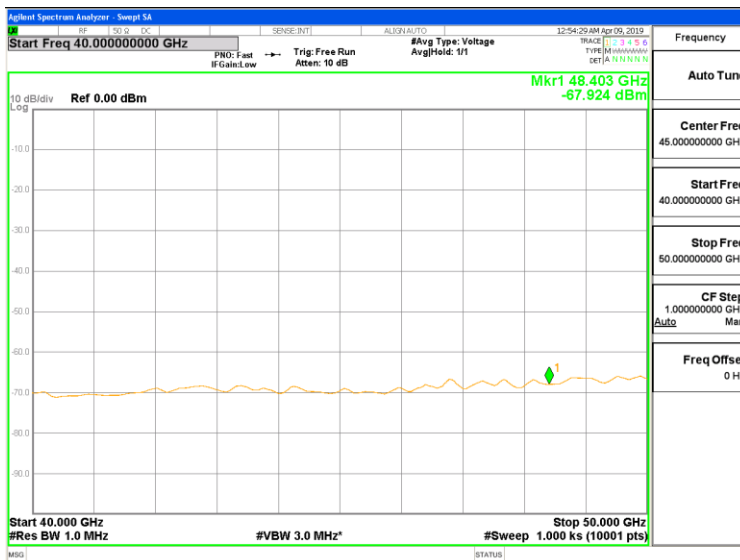
The field strength of the fundamental is 96.89 dBuV/m at 3 meters, peak.  
An attenuation of 50 dB yields 46.89 dBuV/m at 3 meters.

The §15.209 peak limit above 960 MHz is 5000 uV/m at 3 meters, equivalent to 74 dBuV/m at 3 meters.

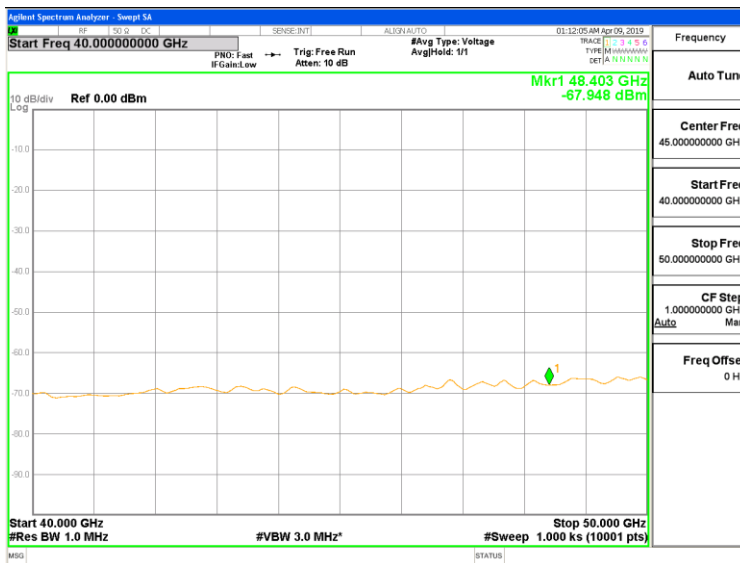
The §15.209 limits correspond to the lesser attenuation, for both peak and average emissions.

### 8.2.1. EMISSIONS 40-50 GHz

HORIZONTAL



VERTICAL



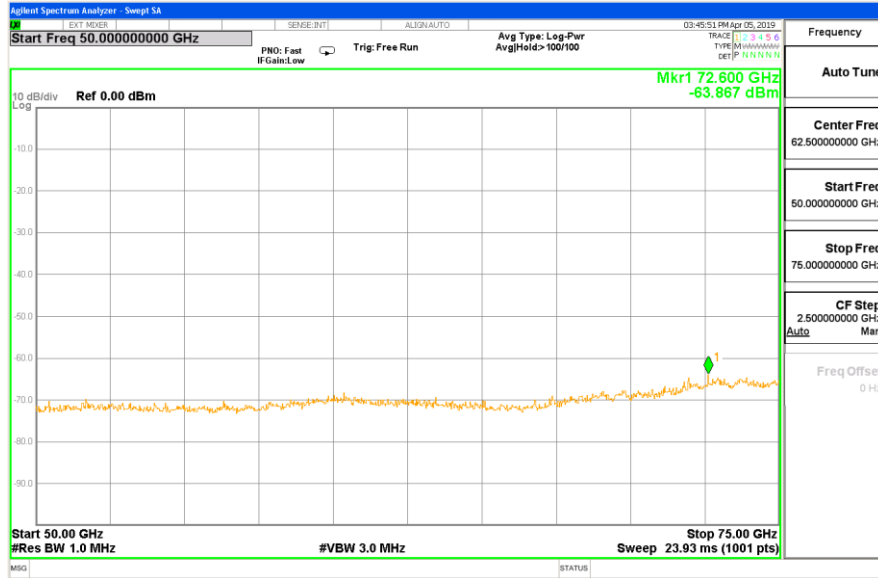
### RESULTS

No emissions detected above the noise floor at 1.5 meters; marker indicates frequency of second harmonic.

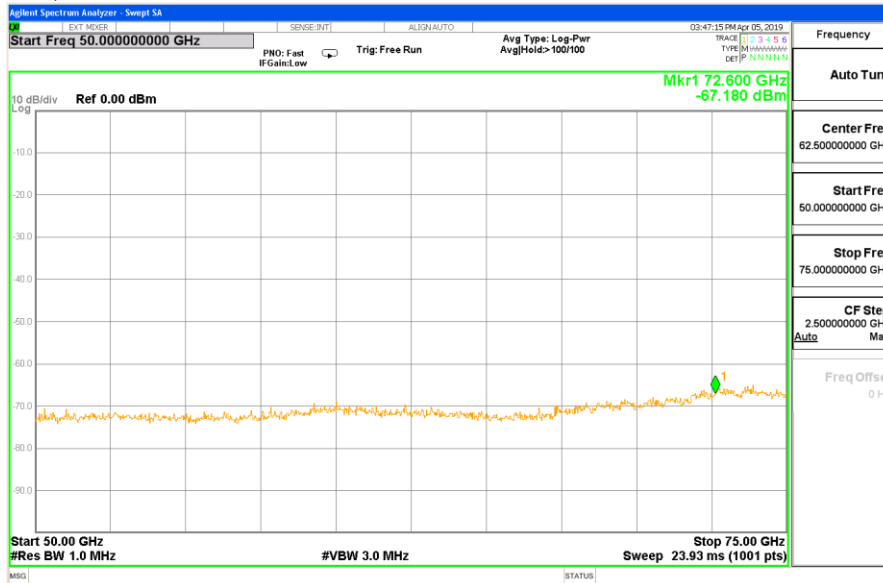
### 8.2.2. EMISSIONS FROM 50-75 GHz

#### WIDEBAND INITIAL SCAN RESULTS

##### HORIZONTAL



##### NOISE FLOOR, REPRESENTATIVE OF OBERVATION IN VERTICAL POLARIZATION



Except for third harmonic, no emissions detected above the noise floor at 1.0 meters.

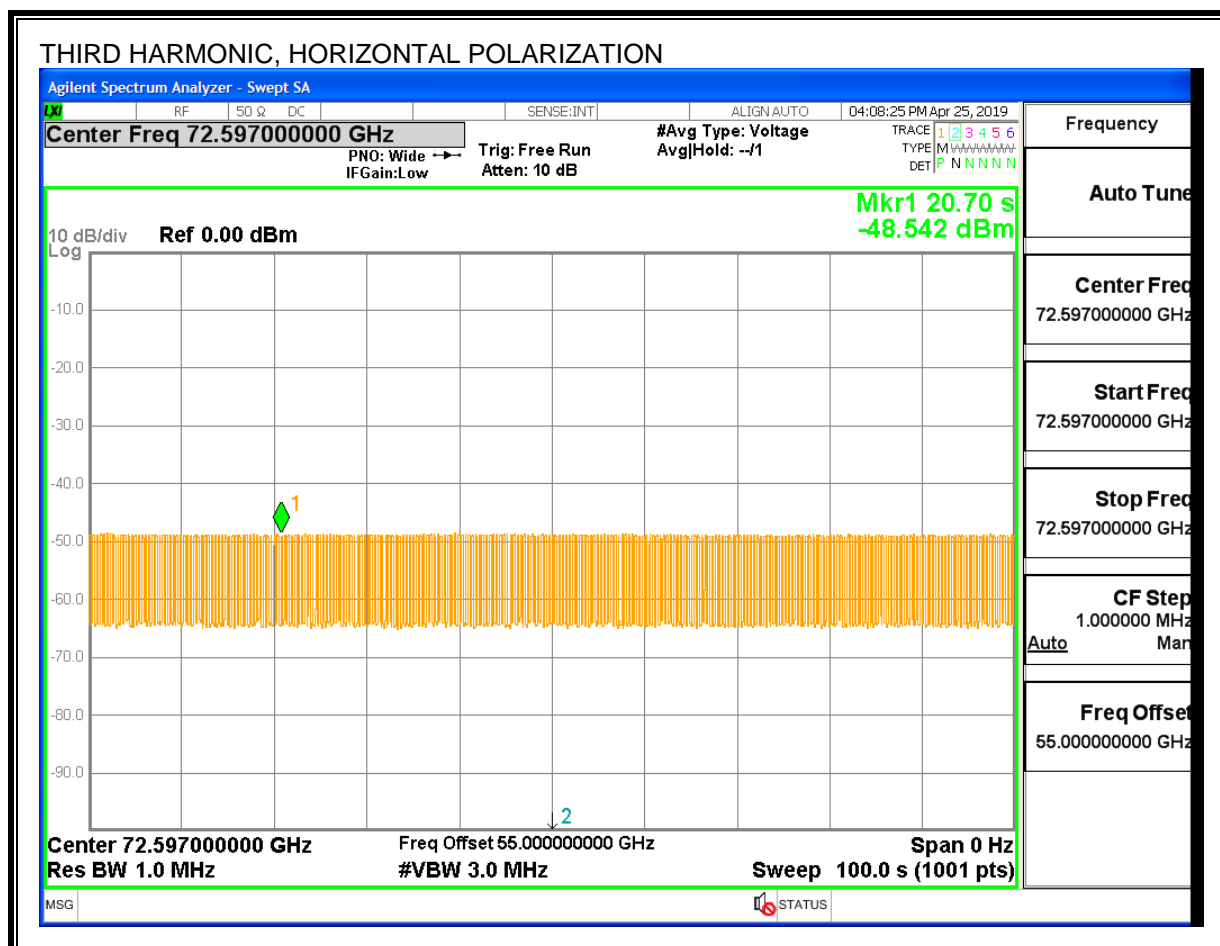


**NARROWBAND FINAL SCAN RESULTS**

The only emission detected in this band is the third harmonic. The worst-case polarization is Horizontal. The worst-case frequency is 72.597 GHz. Peak detection measurements are corrected by the duty cycle relative to the specified 100 ms observation period, to calculate the worst-possible-case average emissions levels.

Duty Cycle Correction Factor for 100 ms observation interval = -2.48 dB, reference Microsoft Report.

Frequency (GHz)	Meas. Peak Pwr (dBm)	Meas. Dist. (m)	Pre-Amp Gain (dB)	Rx Ant. Gain (dBi)	Downconv. +IF Gain (dB)	Total Rx Gain (dB)	EIRP Pwr (dBm EIRP)	Duty Cycle Factor (dB)	Conversion to dBuV/m @ 3m	FCC/ISED Limit dBuV/m	FCC/ISED Margin (dB)	Detector	Polarity
72.597	-48.542	1.5	17	23.4	10.24	50.64	-26.00		69.20	88	-18.80	Peak	H
72.597								-2.48	66.72	68	-1.28	Average	H



### 8.2.3. EMISSIONS FROM 75-100 (110) GHz

## RESULTS



No emissions detected above the noise floor at 0.5 meters.