



# RADIO TEST REPORT

For

MODEL NO.: 1964

FCC ID: C3K1964

IC ID: 3048A-1964

Test Report No. R-TR735-FCC/ISED-NFC-1

Issue Date: July 8<sup>th</sup>, 2021

FCC CFR47 Part 15 Subpart C

*Prepared by*

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TESTING CERT #3472.01



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# Test Report Attestation

**Microsoft Corporation**  
**Model: 1964**  
**FCC ID: C3K1964**

## Applicable Standards

Specification	Test Result
FCC 47CFR Rule Parts 15.207, 15.209, 15.225	Pass

Microsoft EMC Laboratory attests that the product model identified in this report has been tested to and meets the requirements identified in the above standards. The test results in this report solely pertains to the specific sample tested, under the conditions and operating modes as provided by the customer.

This report shall not be used to claim product certification, approval, or endorsement by A2LA or any agency of any Government. Reproduction, duplication or publication of extracts from this test report is prohibited and requires prior written approval of Microsoft EMC Laboratory.



Reviewed By: Pooja Akhoury

RF Test engineer



Written/ Issued By: Daniel Salinas

RF Lab Technical Manager

## 2 Deviations from Standards

None.

## 3 Facilities and Accreditations

### 3.1 Test Facility

All test facilities used to collect the test data are located at Microsoft EMC Laboratory,  
17760 NE 67<sup>th</sup> Ct,  
Redmond WA, 98052, USA

### 3.2 Accreditations

The lab is established and follows procedures as outlined in IEC/ISO 17025 and A2LA accreditation requirements.  
A2LA Accredited Testing Certificate Number: 3472.01  
FCC Registration Number: US1141

### 3.3 Test Equipment

The site and related equipment are constructed in conformance with the requirements of ANSI C63.4:2014 and other equivalent applicable standards. The test site for measurements below 30 MHz has been demonstrated to correlate with an open field site per KDB 414788. Test site requirements for measurements above 1 GHz are in accordance with ANSI C63.4:2014. ANSI C63.10:2013 and the appropriate KDB test methods were followed.

## 4 Measurement Uncertainty

The following measurement uncertainty levels have been estimated for tests performed on the product, as specified in ETSI TR 100 028. This represents an expanded uncertainty expressed at 95% confidence level using a coverage factor k=2. These levels are for reference only and not included to determine product compliance. Expanded uncertainty calculations are available upon request.

Test item	Uncertainty	Unit
Radiated disturbance (9 kHz to 1 GHz)	5.99	dB
Conducted Disturbance at Mains Port	3.31	dB
Uncertainty for Conducted Power test	1.277	dB
Uncertainty for Conducted Spurious emission test	2.742	dB
Uncertainty for Bandwidth test	4.98	kHz
Uncertainty for DC power test	0.05	%
Uncertainty for test site temperature	0.5	°C
Uncertainty for test site Humidity	3	%
Uncertainty for time	0.189	%

## 5 Product Description

Company Name:	Microsoft Corporation
Address:	One Microsoft Way
City, State, Zip:	Redmond, WA 98052-6399
Customer Contact:	Mike Boucher
Functional Description of the EUT:	Portable Computing Device
Model:	1964
FCC ID:	C3K1964
IC ID:	3048A-1964
Radio under test:	NFC (13.110-14.010 MHz)
Modulation(s):	ASK/CW
Antenna Information:	Integral coil
Equipment Design State:	Prototype/Production Equivalent (EV3)
Equipment Condition:	Good

### 5.1 Test Configurations

Test firmware provided by the customer was used to program the EUT to transmit continuously. With this firmware, the device can operate in single tone carrier and ASK modulation modes. Measurements with a companion device acting as a load were also performed.

### 5.2 Environmental Conditions

Ambient air temperature of the test site was within the range of 10 °C to 40 °C (50 °F to 104 °F) unless the EUT specified testing over a different temperature range. Humidity levels were in the range of 10% to 90% relative humidity. Testing conditions were within tolerance, and any deviations required from the EUT are reported.

### 5.3 Antenna Requirements

The antenna/coil is permanently attached and there are no provisions for connection to an external antenna.

### 5.4 Equipment Modifications

No modifications were made during testing.

## 5.5 Dates of Testing

Testing was performed from May 7<sup>th</sup> to June 30<sup>th</sup>, 2021.

## 5.6 Test Samples Details

Serial Number	Internal Lab ID	Test Cases
'0F00053211300C	R-735-EV3-CERT-02	Conducted/Near Field Probe
'0F000DC211300C	R-735-EV3-CERT-01	Radiated, AC Conducted Line Emissions

## 5.7 Test Engineers

Name	Test Cases
Daniel Salinas	Conducted/Near Field Probe
Akshay Landge	Radiated
Reza Abbasi	AC Conducted Line Emissions



## 6 Test Results Summary

Test Description	FCC CFR 47/RSS	Limit	Test Result
20 dB Bandwidth	FCC 15.215 (c)	Reporting & Measurement Purposes only	N/A
Occupied Bandwidth	RSS-Gen [6.7]	Reporting & Measurement Purposes only	N/A
Frequency Stability	FCC 15.225 (e) RSS-210 (B6)	within $\pm 0.01\%$	Pass
Carrier Mask	FCC 15.225 (a)(b)(c) RSS-210 (B6)	FCC CFR 47 15.225 Limits	Pass
Radiated Spurious Emissions	15.205, 15.209 RSS-Gen [8.9], [8.10]	FCC CFR 47 15.209 limits	Pass

## 7 Test Equipment List

Equipment used for Radiated and Conducted Measurements				
Manufacturer	Description	Model #	Asset #	Calibration Due
Rohde & Schwarz	EMI Test Receiver	ESU40	RF-192	04/05/2022
Rohde & Schwarz	EMI Test Receiver	ESR26	RF-568	03/30/2022
Sunol Sciences	Antenna - Broadband	JB6	RF-039	1/13/2022
ETS-Lindgren	Antenna - Passive Loop	6512	RF-202	2/26/2023
Pasternack	6dB attenuator	PE7004-6	EMC-949	1/13/2022
Rohde & Schwarz	Open Switch and Control Unit	OSP130	RF-018	12/10/2021
Rohde & Schwarz	Open Switch and Control Unit	OSP150	RF-019	12/10/2021
Teledyne	RF Cable	PR90-198-276	RF-1036	12/10/2021
Micro-Coax	RF Cable	UtiFlex	RF-359	12/10/2021
Micro-Coax	RF Cable	UFB311A-1-0787-50U50U (2 meter)	EMC-351	12/10/2021
Micro-Coax	RF Cable	UtiFlex	RF-867	6/23/2022
Madge Tech	Environmental (THP) meter	PRHTemp2000	EMC-678	1/29/2022
Madge Tech	TCTemp2000	Thermocouple-based temp data logger	RF-299	11/04/2021
Langer	Near Field Probe Set	NA	EMC-643	N/A
PCE	Environmental (THP) meter	PCE-THB 40	EMC-1313	12/17/2021
Fluke	Multimeter	87V	EMC-839	12/17/2021
Agilent	DC Power Supply	E3632A	EMC-1152	N/A
Test Equity	Temperature Chamber	1007S	EMC-591	N/A

Equipment used for AC Line Conducted Emissions Measurement				
Manufacturer	Description	Model #	Asset #	Calibration Due
Rohde & Schwarz	EMI Test Receiver	ESR3	EMC-911	04/04/2022
Teseq	LISN	NNB 51	EMC-187	11/19/2021
Fluke	Multimeter	87V	EMC-650	09/01/2021
Madge Tech	THP Monitor	PRHTemp2000	EMC-170	11/16/2021
Micro-Coax	RF Cable	UFB311A-0-0787-5005G0	EMC-872	12/10/2021
California Instruments	AC Power Source	1251P	EMC-269	11/16/2021
ETS-Lindgren	TILE- Software License/USB	--	EMC-1386	N/A

Note: Items with Calibration Due date marked as N/A are characterized before use, where applicable.

Note\*: All equipment used was within calibration during applicable measurements.

## 8 Test Site Description

### 8.1 Radiated Emissions Test Site

Radiated measurements are performed in a 3m semi-anechoic chamber, which meets NSA requirements for the frequency range of 30MHz to 1000MHz in accordance with ANSI C63.4:2017.

#### 8.1.1 Radiated Measurements in 9kHz- 30 MHz

The EUT is positioned on a turntable at a height of 80cm using a non-conducting table. A loop antenna is positioned at 3m from the EUT periphery at 1m height from the ground. The turntable is rotated 360 degrees to determine the highest emissions. This is repeated for three orientations of the measurement antenna- parallel, perpendicular and ground-parallel. All possible orientations of the EUT were investigated for emissions.

#### 8.1.2 Radiated Measurements in 30 MHz - 1000 MHz

The EUT is positioned on a turntable at a height of 80cm using a non-conducting table. A linearly polarized broadband antenna is positioned at 3m from the EUT periphery. The turntable is rotated 360 degrees, and the antenna height varied from 1m to 4m to determine the highest emissions. This is repeated for both horizontal and vertical polarizations of the measurement antenna. All possible orientations of the EUT were investigated for emissions.

### 8.2 Antenna port conducted measurements.

All antenna port conducted measurements were performed on a bench-top setup consisting of a spectrum analyzer, attenuators, and pre-characterized RF cables. Only relative measurements were taken with this setup.

### 8.3 Test Setup Diagrams

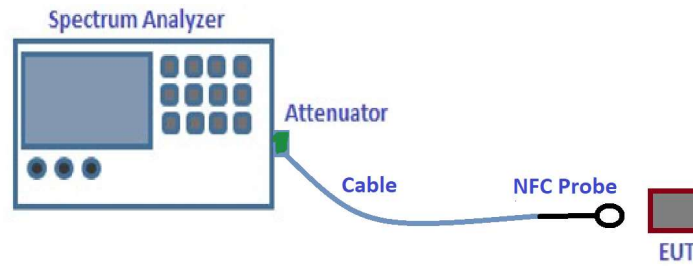


Figure 8-1 Test Setup for Antenna Port Coupled Measurements

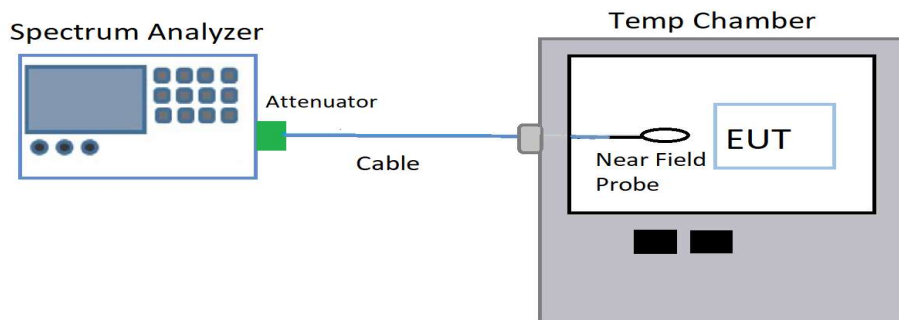


Figure 8-2 Test Setup for Antenna Port Coupled Frequency Stability Measurements

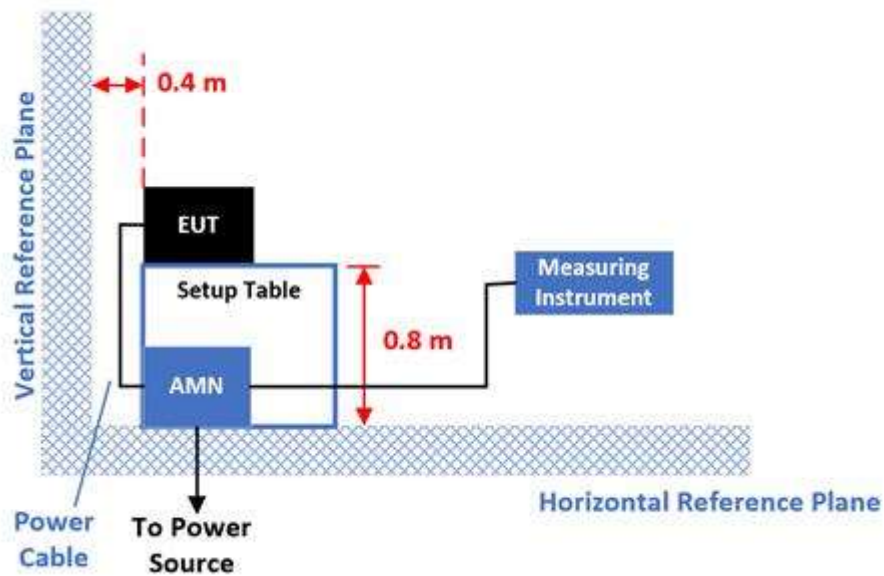


Figure 8-3 AC Line Conducted Emissions

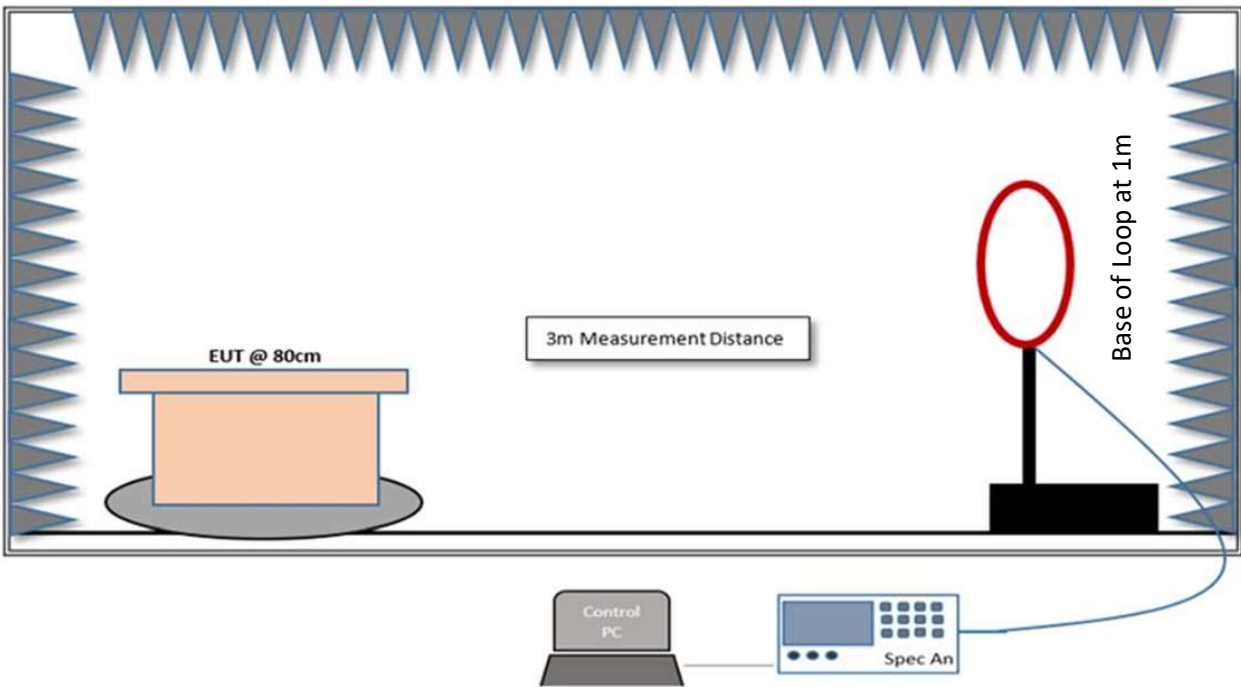


Figure 8-4 Test Setup for Radiated measurements in 9kHz - 30MHz Range

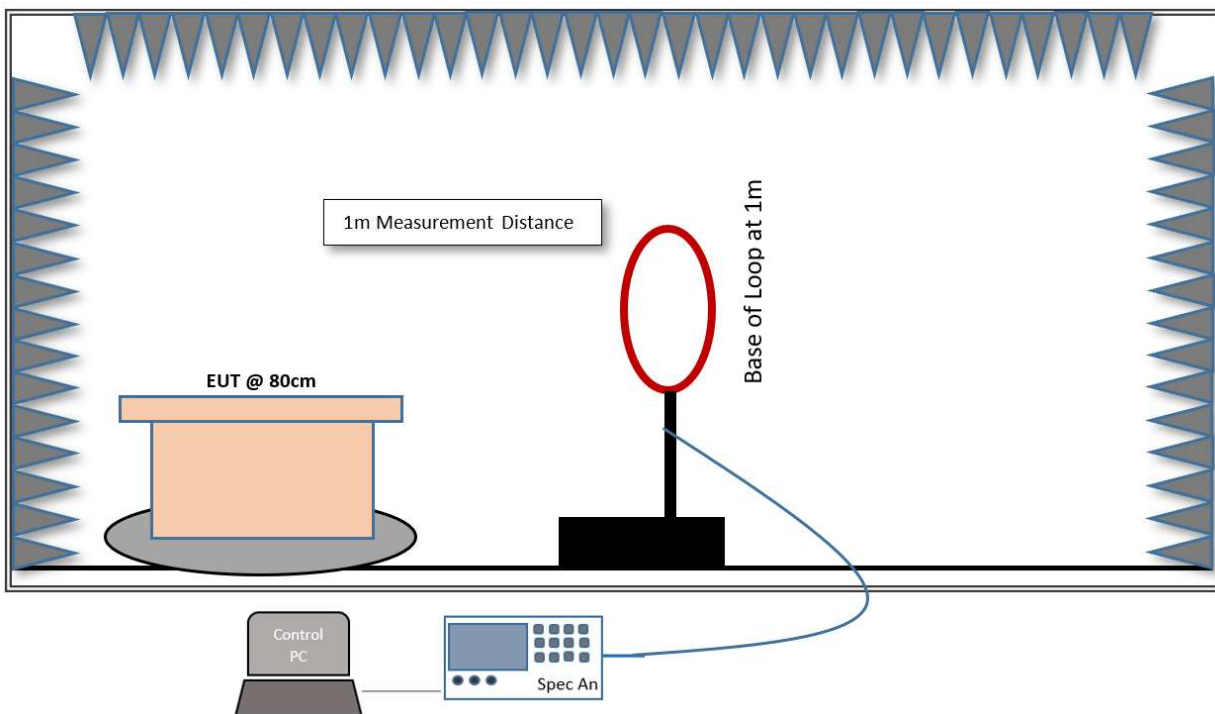


Figure 8-5 Test Setup for Radiated Fundamental measurements in 9kHz - 30MHz Range

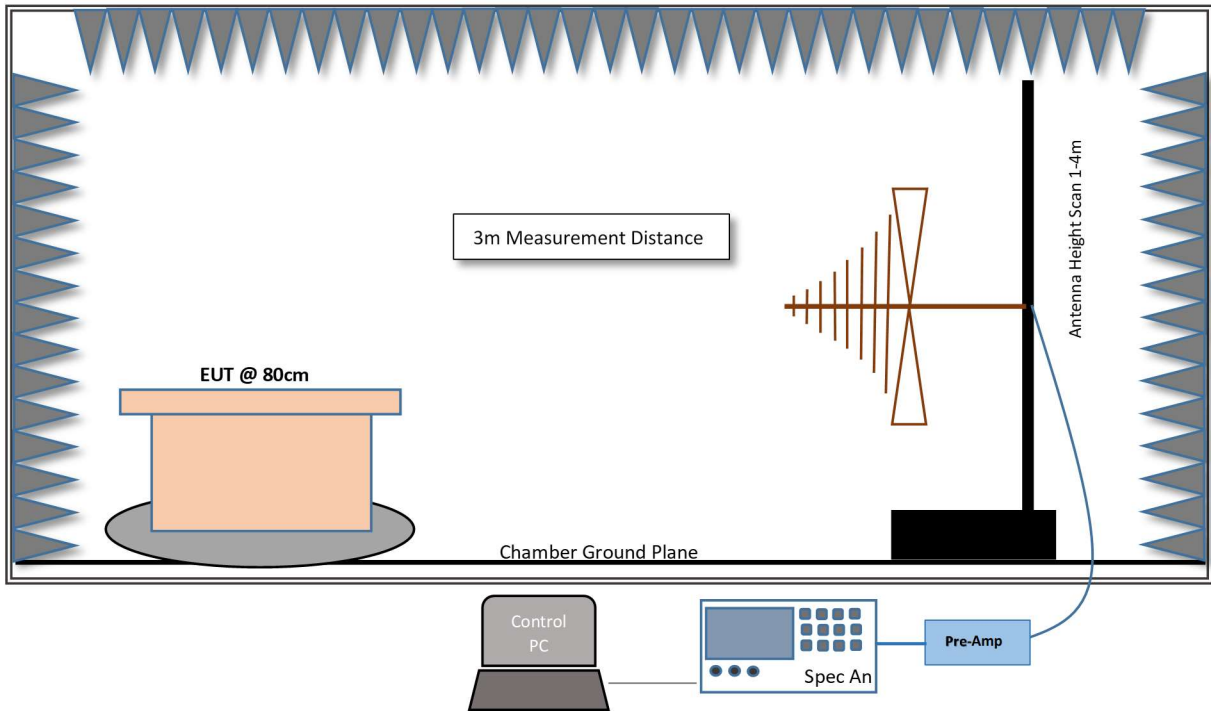


Figure 8-6 Test Setup for Radiated measurements in 30MHz- 1GHz Range

## 9 Test Results- Conducted

### 9.1 20 dB Occupied Bandwidth

#### 9.1.1 Test Requirement:

The 20 dB Occupied Bandwidth is measured as the width of the spectral envelope of the modulated signal, at an amplitude level reduced 20 dB from maximum value of the spectral envelope. This test is performed for reporting and measurement purposes only.

FCC CFR Title 47 Rule Part 15.215 (c)

#### 9.1.2 Test Method:

Measurements are performed according to ANSI C63.10: 2013 section 6.9.

#### Spectrum Analyzer settings:

Set analyzer center frequency to the nominal EUT channel frequency

Span is set to between 2 and 5 times the OBW bandwidth

RBW: 1% to 5% of the OBW= 30 kHz

VBW  $\geq$  3 RBW= 100 kHz

Detector = Peak

Sweep time = Auto Couple

Trace mode = max hold

Place two markers, one at the lowest frequency and the other at the highest frequency of the Spectral envelope 20 dB below the maximum value. The 20 dB bandwidth is the difference in frequency between these two markers.

#### 9.1.3 Limits:

For reporting purpose only.

#### 9.1.4 Test Results:

Frequency (MHz)	Test Mode	20 dB Occupied Bandwidth (kHz)
13.56	ASK	445.70



9.1.5 Test Data:

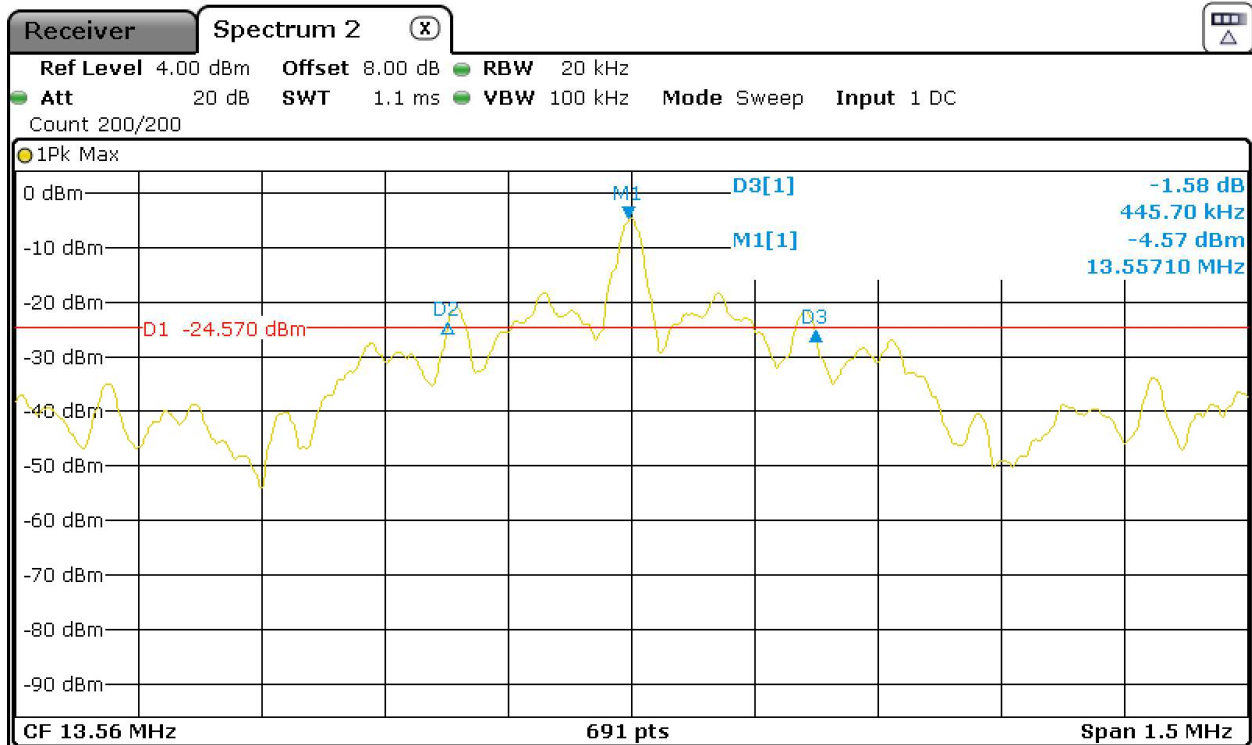


Figure 9-1 20 dB Occupied Bandwidth

9.2 99% Occupied Bandwidth

9.2.1 Test Requirement:

The 99% Occupied Channel Bandwidth is the bandwidth that contains 99% of the power of the signal. This test is performed for reporting and measurement purposes only.

ISED RSS-Gen [6.7]

9.2.2 Test Method:

Measurements are performed according to ANSI C63.10: 2013 section 6.9.

**Spectrum Analyzer settings:**

Set analyzer center frequency to the nominal EUT channel frequency

Span is set to between 2 and 5 times the OBW bandwidth

RBW: 1% to 5% of the OBW= 30 kHz

VBW  $\geq$  3 RBW= 100 kHz

Detector = Peak

Sweep time = Auto Couple

Trace mode = max hold

Use the 99% power bandwidth function of the instrument.

9.2.3 Limits:

For reporting purpose only.

#### 9.2.4 Test Results:

Frequency (MHz)	Test Mode	99% Bandwidth (kHz)
13.56	ASK	685.962

### 9.2.5 Test Data:

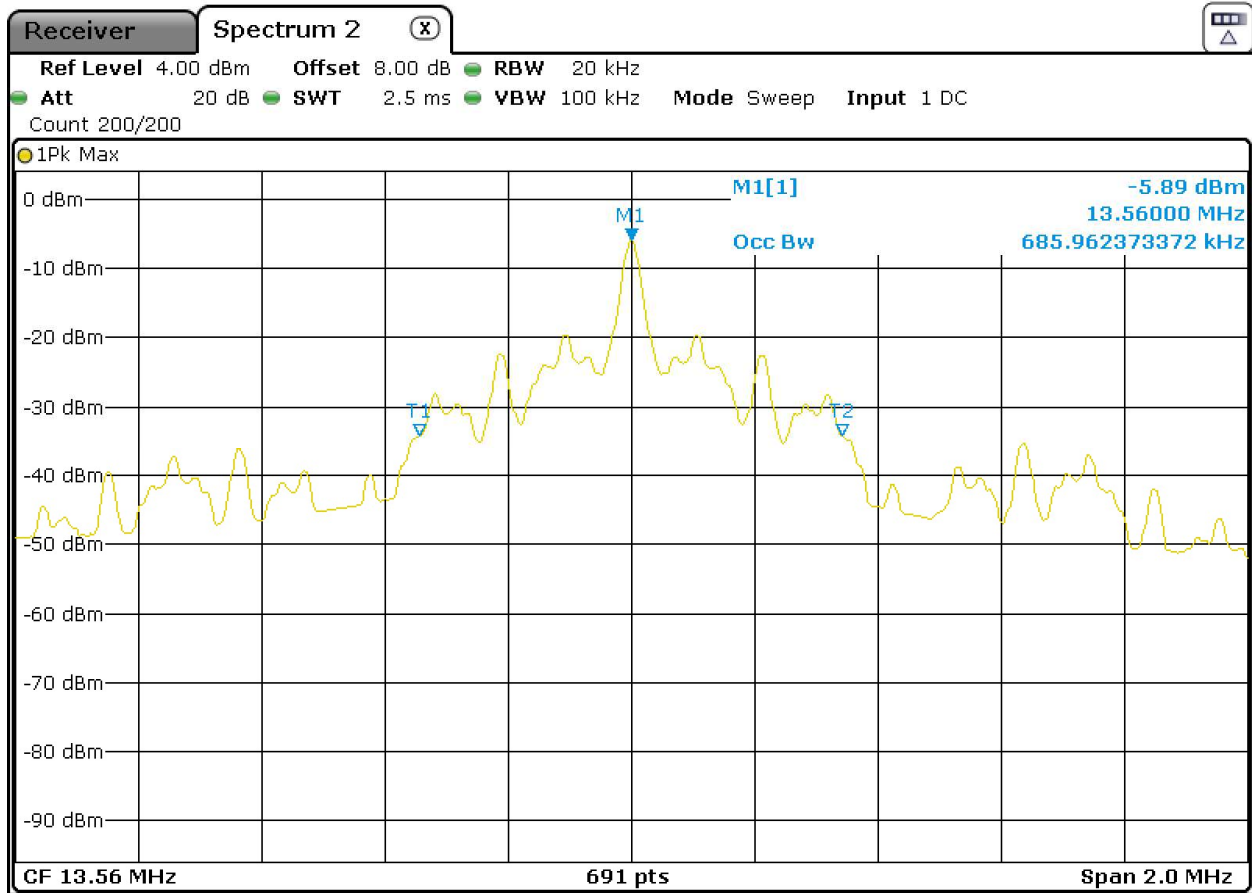


Figure 9-2 99% Bandwidth

## 9.3 Frequency Stability

### 9.3.1 Test Requirement:

FCC CFR 47 Rule Part 15.225 (e)  
ISED RSS-210 (B6)

### 9.3.2 Test Method:

Measurements were performed according to the procedure defined in ANSI C63.10: 2013 Section 6.8.

#### **Spectrum Analyzer settings:**

RBW= 100 Hz

VBW = 300 Hz

Span = 10 kHz

Detector = Peak

Sweep Points = 32001

Sweep Time = Auto

Sweep Mode = Continuous

First capture the reference frequency at nominal voltage (from EUT spec) and nominal temperature (20°C).

- o After power on, use trace 1 on the spectrum analyzer. Select view to freeze the plot.
- o Use marker → peak search to establish the reference frequency. Marker 1 will now be the reference frequency.
- o Record the reference frequency M1(1)

Once the reference frequency has been established, use trace 2 to compare the frequency shift during the rest of the voltage and temperature values as defined in ANSI C63.10 section 6.8.

- o Select Trace → 2, Clear write
- o Select Marker → 2, Delta
- o Select Marker to Trace → 2
- o Select Trace → Max hold (ensure trace 2 is selected)
- o Select Marker → Peak Search
- o Record the frequency shift D2[2]

Repeat step 2 for the remaining voltage and temperature values as defined in ANSI C63.10 section 6.8.

- o Select Trace → 2, Clear write
- o Select Trace → Max hold (ensure trace 2 is selected)
- o Select Marker → Peak Search
- o Record the frequency shift D2[2]

### 9.3.3 Limits:

15.225 (e): The frequency tolerance of the carrier signal shall be maintained within  $\pm 0.01\%$  of the operating frequency over a temperature variation of  $-20$  degrees to  $+ 50$  degrees C at normal supply voltage, and for a variation in the primary supply voltage from  $85\%$  to  $115\%$  of the rated supply voltage at a temperature of  $20$  degrees C.

### 9.3.4 Test Results:

Pass.

#### 1.) Results with varying temperature

Power Supply (Vdc)= 11.5 V

Temperature (°c)	Startup (MHz)	Startup Frequency Shift (Hz)	Startup Delta (ppm)	Frequency Shift (Hz) at 2 mins	2 mins (MHz)	2 mins Delta (ppm)
50.00	13.5598696	-72.4000000	5.339	-72.4000000	13.5598696	5.33925588
40.00	13.5598841	-57.9000000	4.270	-50.7000000	13.5598913	3.73895405
30.00	13.5599058	-36.2000000	2.670	-36.2000000	13.5599058	2.66962794
20.00	13.5599420	0.0000000	0.000	0.0000000	13.5599420	0.00000000
10.00	13.5599492	7.2000000	-0.531	7.2000000	13.5599492	-0.53097572
0.00	13.5599637	21.7000000	-1.600	21.7000000	13.5599637	-1.60030183
-10.00	13.5599420	7.2000000	0.000	7.2000000	13.5599492	-0.53097572
-20.00	13.5599420	-50.7000000	0.000	-50.7000000	13.5598913	3.73895405

Frequency Shift (Hz) at 5 mins	5 mins (MHz)	5 mins Delta (ppm)	Frequency Shift (Hz) at 10mins	10 mins (MHz)	10 mins Delta (ppm)	Limit (ppm)	Result
-72.4000000	13.5598696	5.33925588	-72.4000000	13.5598696	5.3393	$\pm 100$	Pass
-50.7000000	13.5598913	3.73895405	-50.7000000	13.5598913	3.73895405	$\pm 100$	Pass
-36.2000000	13.5599058	2.66962794	-36.2000000	13.5599058	2.66962794	$\pm 100$	Pass
0.8000000	13.5599428	-0.05899730	1.2000000	13.5599432	-0.08849595	$\pm 100$	Pass
7.2000000	13.5599492	-0.53097572	7.2000000	13.5599492	-0.53097572	$\pm 100$	Pass
21.7000000	13.5599637	-1.60030183	21.7000000	13.5599637	-1.60030183	$\pm 100$	Pass
7.2000000	13.5599492	-0.53097572	7.2000000	13.5599492	-0.53097572	$\pm 100$	Pass
-50.7000000	13.5598913	3.73895405	-50.7000000	13.5598913	3.73895405	$\pm 100$	Pass

2.) Results with varying Supply voltage

Ambient temperature: 20 °c

Power Supply (VDC)	Startup (MHz)	Frequency Shift (Hz)	Delta (ppm)	Frequency Shift (Hz) at 2mins	2 mins (MHz)	Delta (ppm)
13.2	20.00	13.5599420	0.0000	0.000	0.00000000	13.5599420
9.8	20.00	13.5599420	0.0000	0.000	0.00000000	13.5599420

Frequency Shift (Hz) at 5mins	5 mins (MHz)	Delta (ppm)	Frequency Shift (Hz) at 10mins	10 mins (MHz)	Delta (ppm)	Limit (ppm)	Result
0.00000000	13.5599420	0.00000000	0.00000000	13.5599420	0.00000000	±100	Pass
-21.70000000	13.5599203	1.60030183	-21.70000000	13.5599203	1.60030183	±100	Pass

## 9.4 Radiated Spurious and Carrier Mask

### 9.4.1 Test Requirement:

FCC CFR 47 Rule Part 15.225 (a)(b)(c)(d) and 15.209  
ISED RSS-210 [B6]

### 9.4.2 Test Method:

Radiated spurious measurements were made from 9kHz to the 10th harmonic of the transmit fundamental frequency following ANSI C63.10:2013 procedures. The limit for radiated spurious emissions is per 15.209. Emissions observed in the restricted bands listed in 15.205 and RSS-Gen were tested for compliance per limits in 15.209. Limits for Carrier Mask are as defined in 15.225.

Guidelines in ANSI C63.10:2013 were followed with respect to maximizing the emissions. Carrier Mask Measurements were performed at 1m measurement distance to improve SNR.

A pre-amp was required for this test, to provide the measuring system with sufficient sensitivity. The peak reading of the emission, after being corrected by the antenna factor, cable loss, pre-amp gain, etc., is the peak field strength.

Parallel, perpendicular, and ground parallel loop orientations were investigated. Worst-case maximized data for all loop orientations is shown in this test report.

### **Radiated Spurious Emissions**

#### **Spectrum Analyzer Settings:**

##### **9 kHz – 150 kHz**

RBW= 1 kHz

VBW= 3 kHz

Trace Mode: Peak Detector (Max Hold)

Span= 1 - 150 kHz

Sweep time= Auto

Sweep points  $\geq 2 \times \text{Span}/\text{RBW}$

##### **150 kHz – 30 MHz**

RBW= 10 kHz

VBW= 30 kHz

Trace Mode: Peak Detector (Max Hold)

Span= 150 kHz – 30 MHz

Sweep time= Auto

Sweep points  $\geq 2 \times \text{Span}/\text{RBW}$

##### **30 MHz - 1 GHz:**

RBW = 120 kHz

VBW  $\geq 3 \times \text{RBW}$

Trace Mode: Peak Detector (Max Hold). Final measurements performed using QP Detector.

Span= 30 MHz - 1 GHz

Sweep time= Auto

Sweep points  $\geq 2 \times \text{Span}/\text{RBW}$

**Final Peak Measurements**

RBW = 10 kHz

VBW  $\geq$  30 kHz

Detector = Peak

IF filter = 6dB

Sweep time = auto

Trace mode = max hold. Allow sweeps to continue until the trace stabilizes

**Final Quasi-Peak Measurements**

RBW = 200 Hz; 9 kHz

IF filter = 6dB

Detector = Quasi-Peak

Measurement Time = 15s

**Final Average Measurements (9 kHz – 90 kHz, 110 kHz – 490 kHz)**

RBW = 1 kHz

VBW  $\geq$  3 kHz

Detector = Average

IF filter = 6dB

Measurement time = 0.1 to 1s

Trace mode = max hold. Allow sweeps to continue until the trace stabilizes

**Sample Calculation:**

Field Strength Level: Amplitude (Analyzer level) + AFCL (Antenna Factor and Cable losses) –  
Amplifier Gain = 50dBuV + 33 dB – 25 dB = 58dBuV/m



9.4.3 Limits:

Frequency (MHz)	Field Strength ( $\mu\text{V}/\text{m}$ )	Measurement Distance (meters)	Field Strength Limit ( $\text{dB}\mu\text{V}/\text{m}$ )
13.110 -13.410	106	30	40.51
13.410-13.533	334	30	50.47
13.553-13.567	15,848	30	84
13.567-13.710	334	30	50.47
13.710-14.010	106	30	40.51

Frequency (MHz)	Field Strength ( $\mu\text{V}/\text{m}$ )	Measurement Distance (meters)	Field Strength Limit ( $\text{dB}\mu\text{V}/\text{m}$ )
0.009-0.490	2400/F (kHz)	300	48.5 - 13.8
0.490-1.705	24000/F (kHz)	30	33.8- 23.0
1.705-30	30	30	29.5
30-88	100	3	40
88-216	150	3	43.5
216-960	200	3	46
960-1000	500	3	54
Above 1000 (Restricted Frequency Bands)	500	3	54 (Average) 74 (Peak)

9.4.4 Test Result:

Pass.

9.4.5 Test Data:

9.4.5.1 Carrier Mask Emission

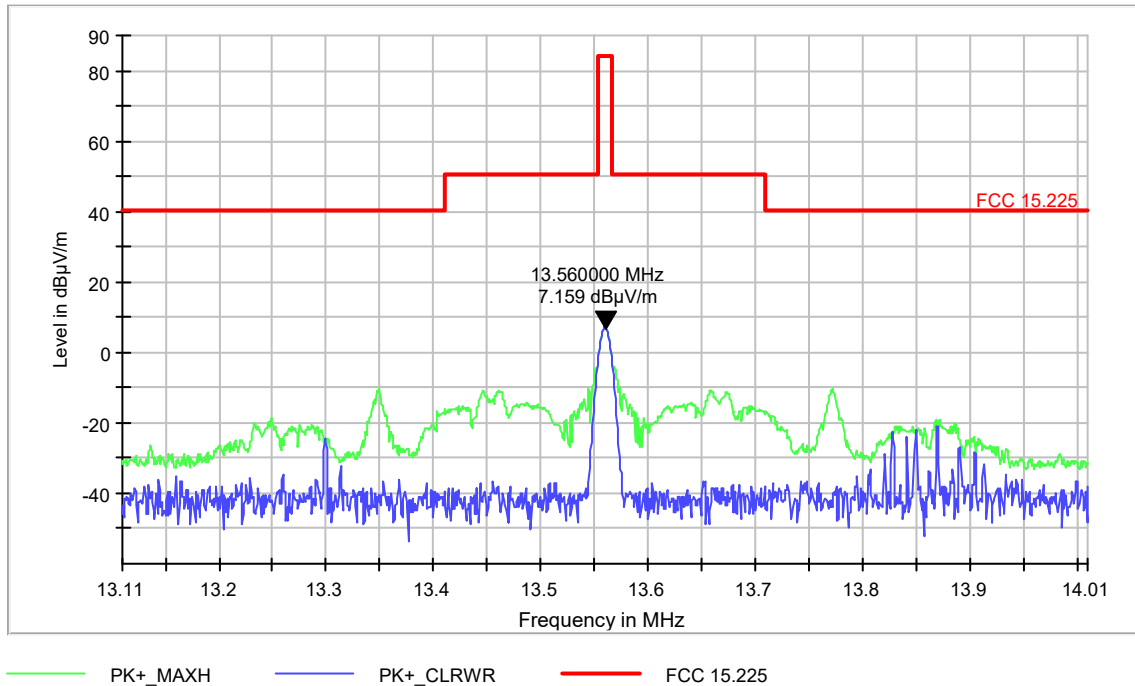


Figure 9-3 Carrier Mask ASK Modulation – Upright Posture (13.56 MHz)

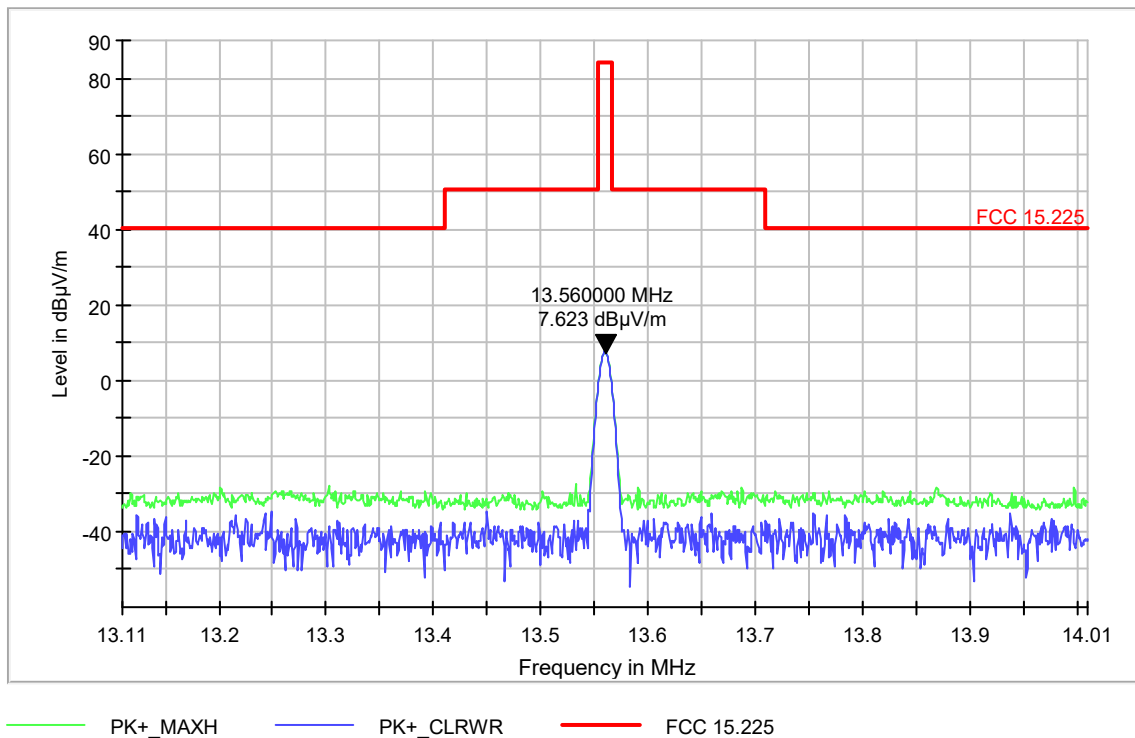


Figure 9-4 Carrier Mask CW Mode – Upright Posture (13.56 MHz)

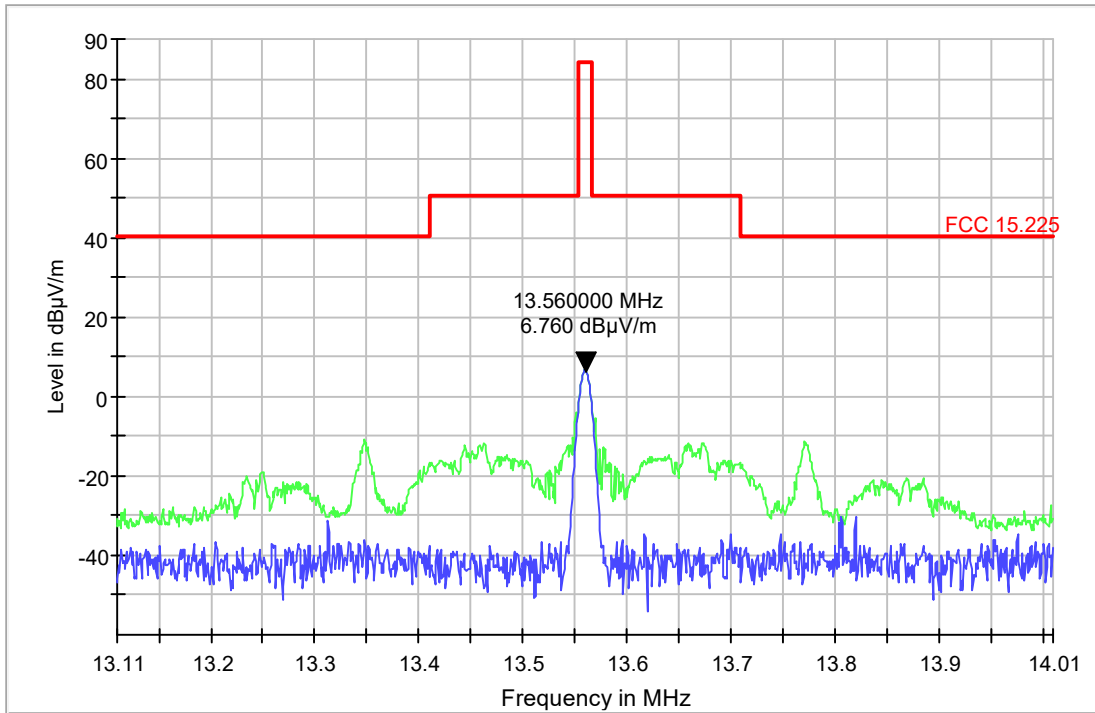


Figure 9-5 Carrier Mask ASK Modulation – Flat Posture– X (13.56 MHz)

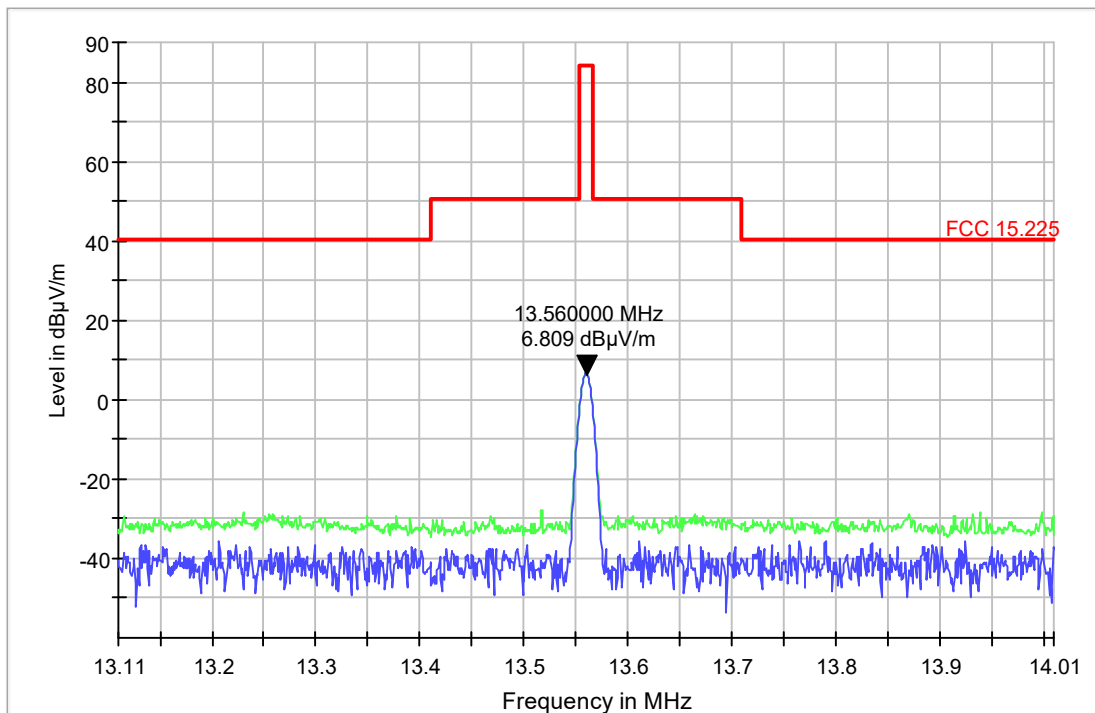
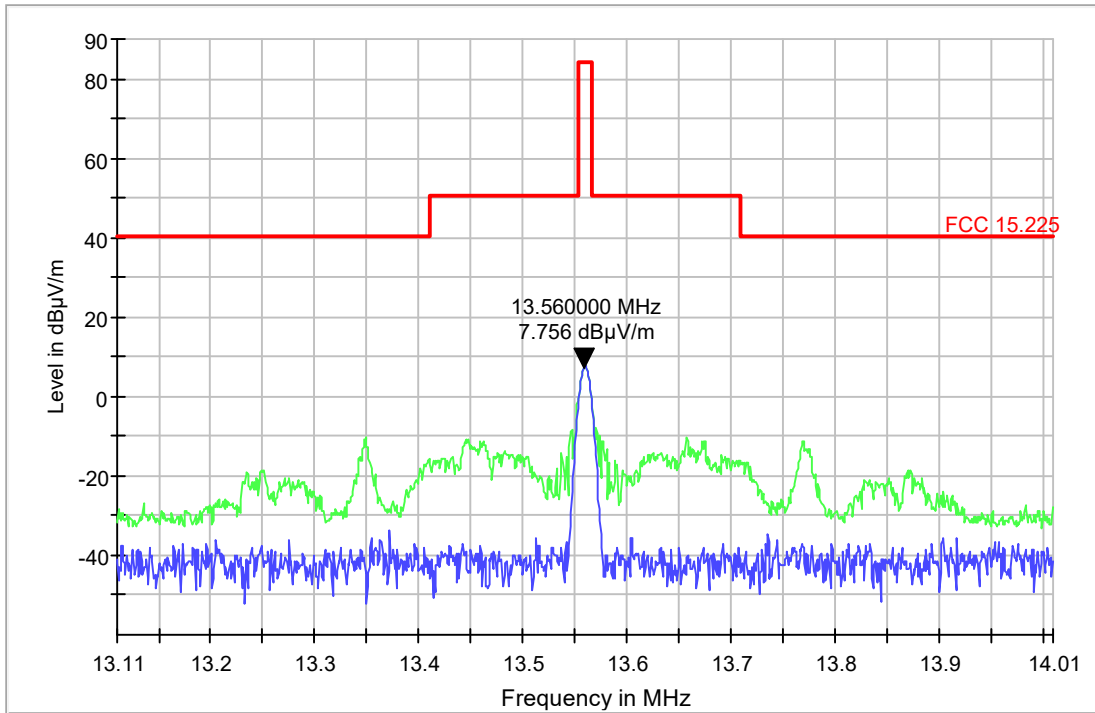
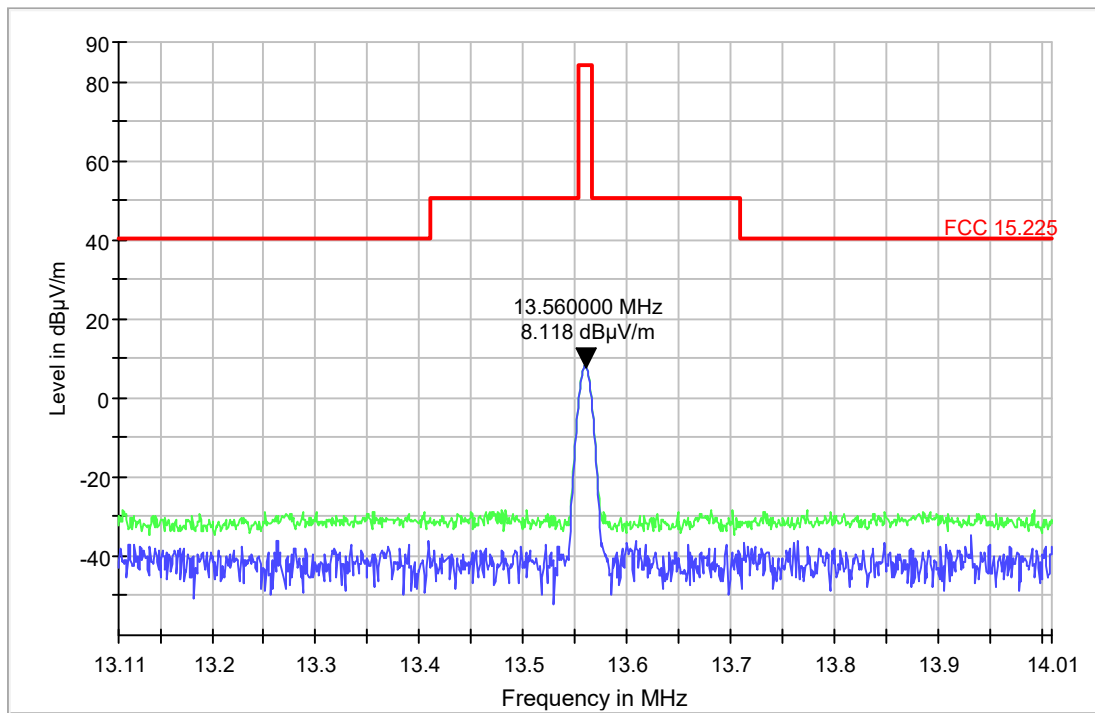


Figure 9-6 Carrier Mask CW Mode – Flat Posture - X (13.56 MHz)



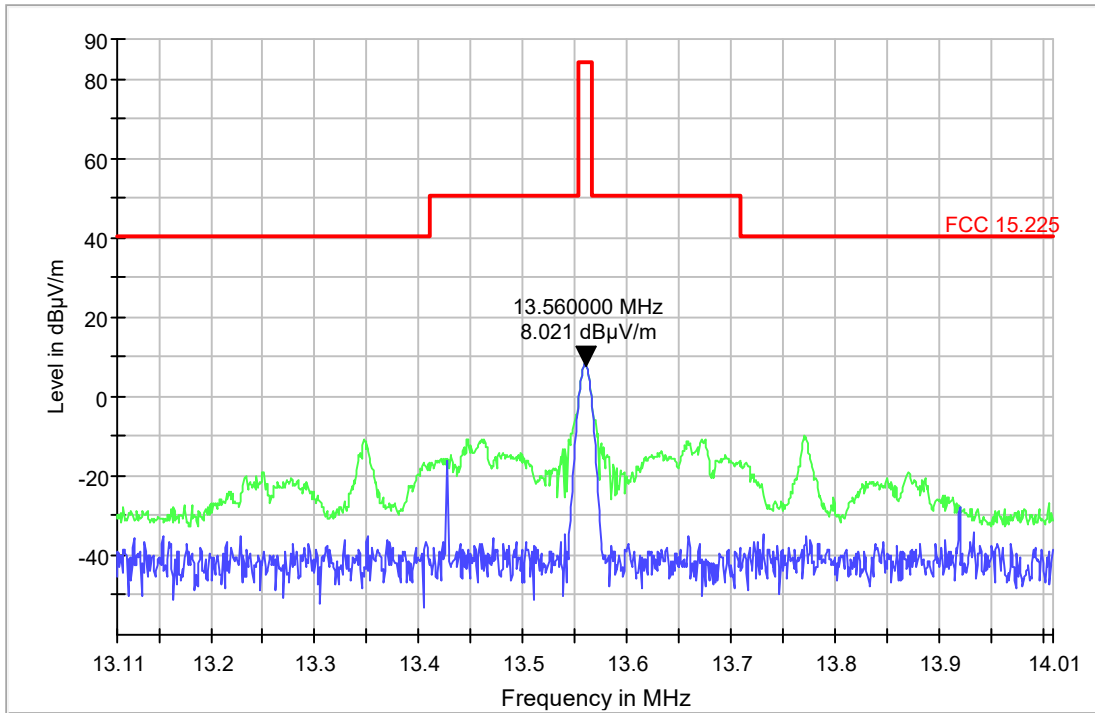
PK+\_MAXH    PK+\_CLRWR    FCC 15.225

Figure 9-7 Carrier Mask ASK Modulation – Flat Posture - Y (13.56 MHz)



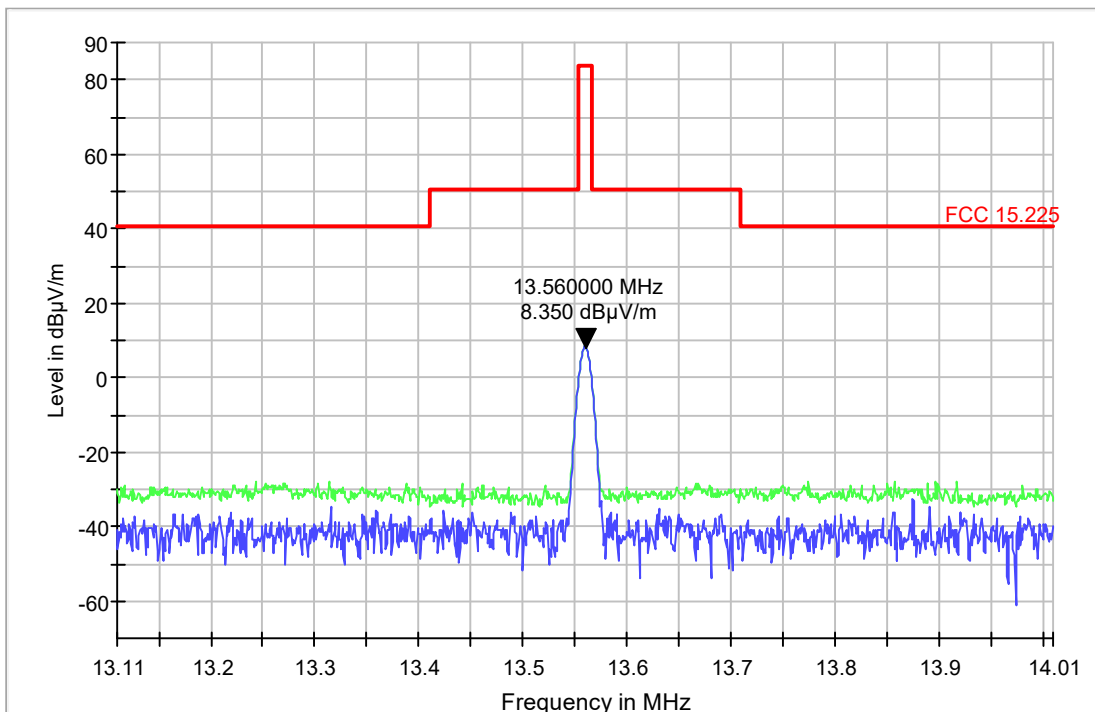
PK+\_MAXH    PK+\_CLRWR    FCC 15.225

Figure 9-8 Carrier Mask CW Mode – Flat Posture - Y (13.56 MHz)



PK+\_MAXH PK+\_CLRWR FCC 15.225

Figure 9-9 Carrier Mask ASK Modulation – Flat Posture - Z (13.56 MHz)



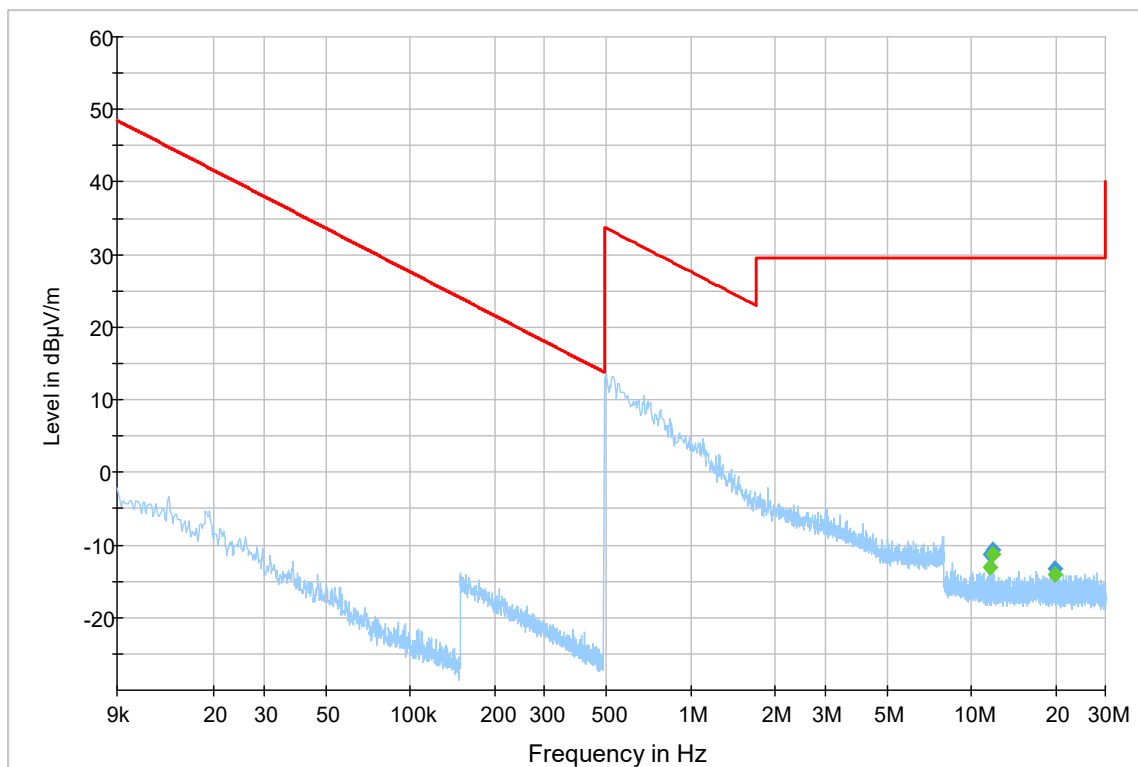
PK+\_MAXH PK+\_CLRWR FCC 15.225

Figure 9-10 Carrier Mask CW Mode – Flat Posture - Z (13.56 MHz)

9.4.5.2 Emissions in 9 kHz – 30 MHz

EUT in all modes and antenna in all orientation were tested and worst-case results are reported below:

RSE 9 kHz – 30 MHz – Ambient						
Carrier Frequency (MHz)	Emission Frequency (MHz)	Raw Quasi-Peak Amplitude (dBµV/m)	Correction Factor (dB)	Corrected Quasi-Peak Field Strength (dBµV/m)	Quasi-Peak Limit (dBµV/m)	Quasi-Peak Margin (dB)
Ambient	11.635	-8.02	-5.10	-13.12	29.54	42.66
Ambient	11.900	-6.05	-5.20	-11.25	29.54	40.79
Ambient	19.760	-8.60	-5.50	-14.10	29.54	43.64



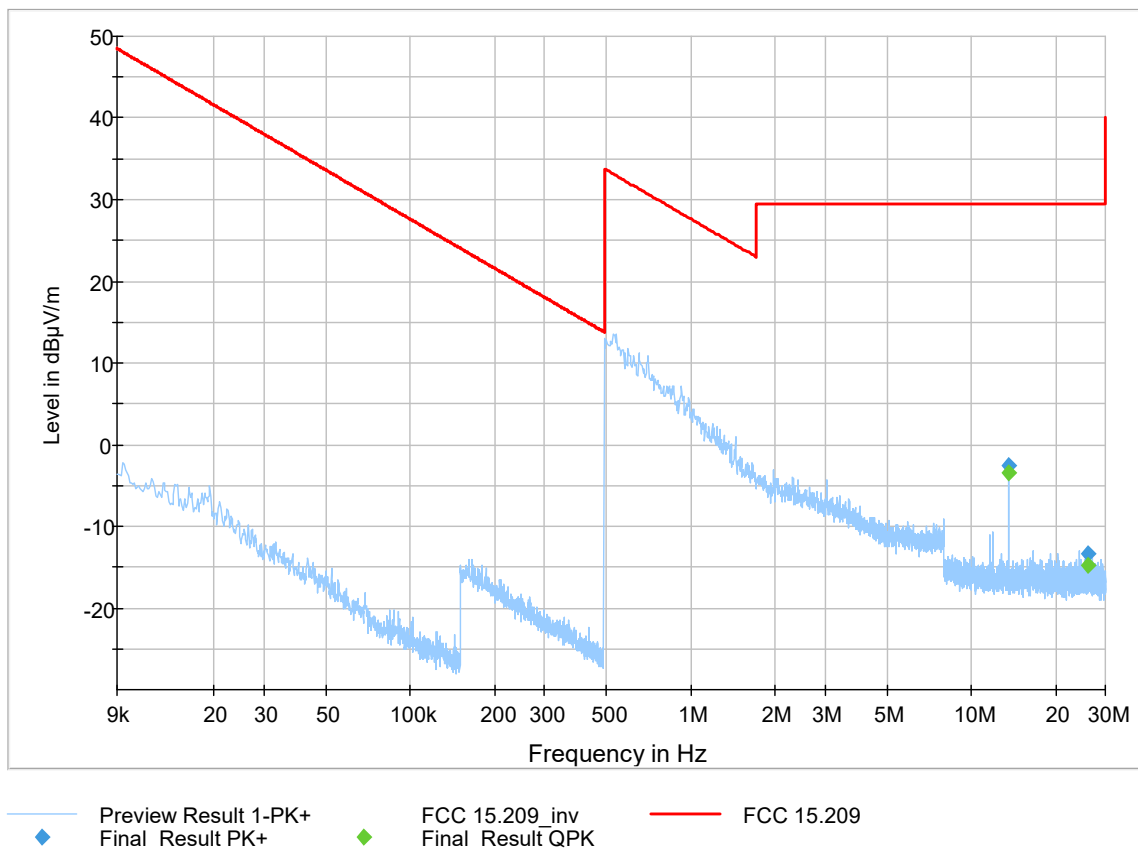
◆ Preview Result 1-PK+ Final\_Result PK+    
 ◆ FCC 15.209\_inv Final\_Result QPK    
 — FCC 15.209

**Figure 9-11 Radiated Spurious Emissions 9 kHz – 30 MHz – Ambient.**

i) Antenna in parallel orientation and EUT in Upright Posture with ASK modulation:

RSE 9 kHz – 30 MHz – (Upright Posture – ASK)						
Carrier Frequency (MHz)	Emission Frequency (MHz)	Raw Quasi-Peak Amplitude (dB $\mu$ V/m)	Correction Factor (dB)	Corrected Quasi-Peak Field Strength (dB $\mu$ V/m)	Quasi-Peak Limit (dB $\mu$ V/m)	Quasi-Peak Margin (dB)
13.56	13.56*	3.20	-5.30	-2.10	29.54	-31.64
13.56	26.00	-9.30	-5.50	-14.80	29.54	-44.34

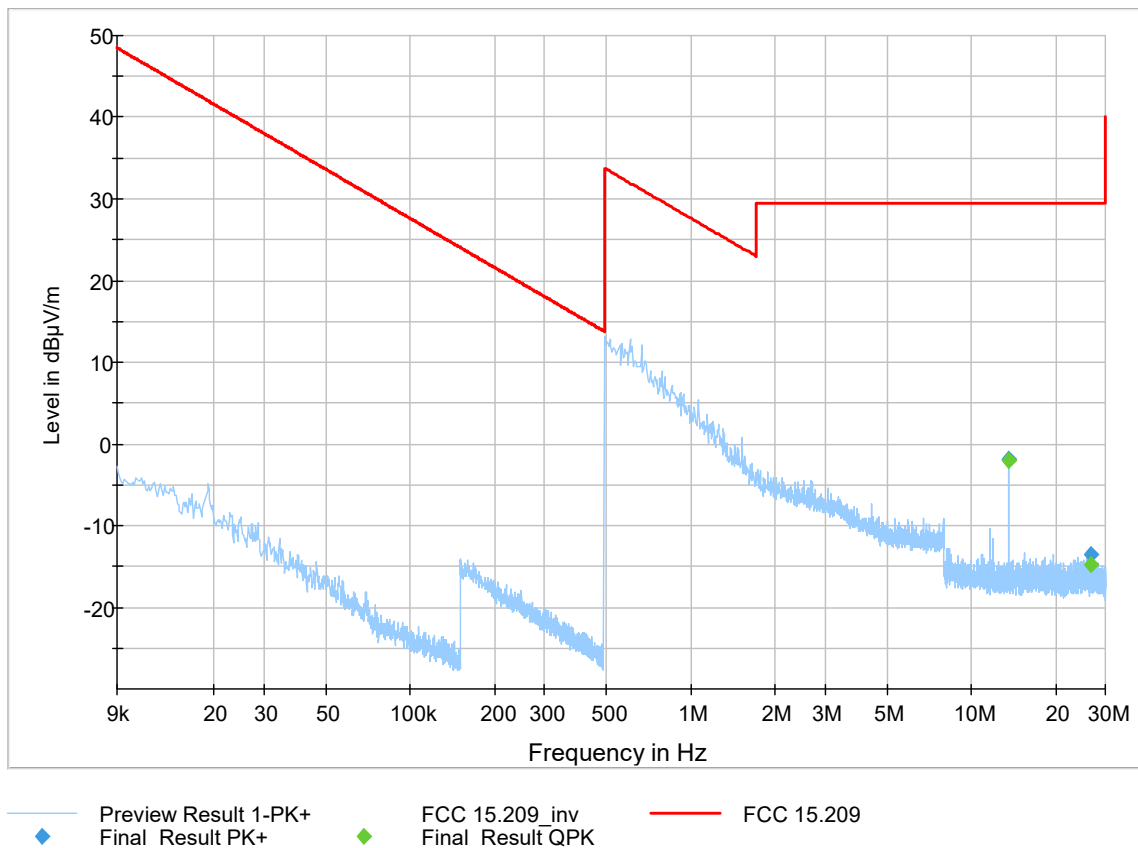
\*Fundamental



**Figure 9-12 Radiated Spurious Emissions 9 kHz – 30 MHz – Upright Posture – ASK Modulation**

ii) Antenna in parallel orientation and EUT in Upright Posture mode with CW modulation:

RSE 9 kHz – 30 MHz – (Upright Posture – CW)						
Carrier Frequency (MHz)	Emission Frequency (MHz)	Raw Quasi-Peak Amplitude (dBµV/m)	Correction Factor (dB)	Corrected Quasi-Peak Field Strength (dBµV/m)	Quasi-Peak Limit (dBµV/m)	Quasi-Peak Margin (dB)
13.56	13.56*	3.20	-5.30	-2.10	29.54	-31.64
13.56	26.59	-9.20	-5.60	-14.80	29.54	-44.34

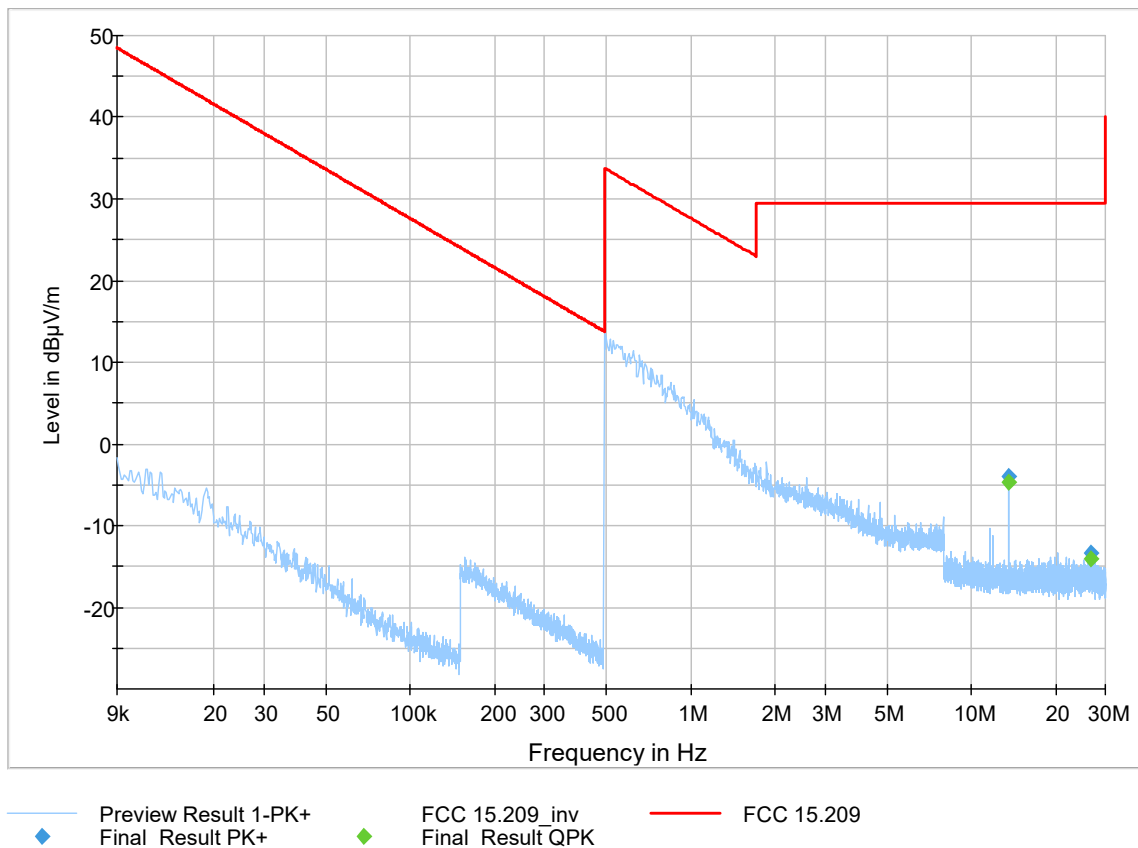


**Figure 9-13 Radiated Spurious Emissions 9 kHz – 30 MHz - Upright Posture – CW**



iii) Antenna in parallel orientation and EUT in Flat Posture in X orientation with ASK modulation:

RSE 9 kHz – 30 MHz – (Flat Posture - X - ASK)						
Carrier Frequency (MHz)	Emission Frequency (MHz)	Raw Quasi-Peak Amplitude (dBµV/m)	Correction Factor (dB)	Corrected Quasi-Peak Field Strength (dBµV/m)	Quasi-Peak Limit (dBµV/m)	Quasi-Peak Margin (dB)
13.56	13.56*	0.55	-5.30	-4.75	29.54	-34.29
13.56	26.50	-8.40	-5.60	-14.00	29.54	-43.54



**Figure 9-14 Radiated Spurious Emissions 9 kHz – 30 MHz - Flat Posture – X – ASK Modulation**

iv) Antenna in parallel orientation and EUT in Flat Posture in X orientation with CW modulation:

RSE 9 kHz – 30 MHz – (Flat Posture - X - CW)						
Carrier Frequency (MHz)	Emission Frequency (MHz)	Raw Quasi-Peak Amplitude (dBμV/m)	Correction Factor (dB)	Corrected Quasi-Peak Field Strength (dBμV/m)	Quasi-Peak Limit (dBμV/m)	Quasi-Peak Margin (dB)
13.56	13.56*	-0.33	-5.30	-5.63	29.54	-35.17
13.56	26.31	-9.20	-5.50	-14.70	29.54	-44.24

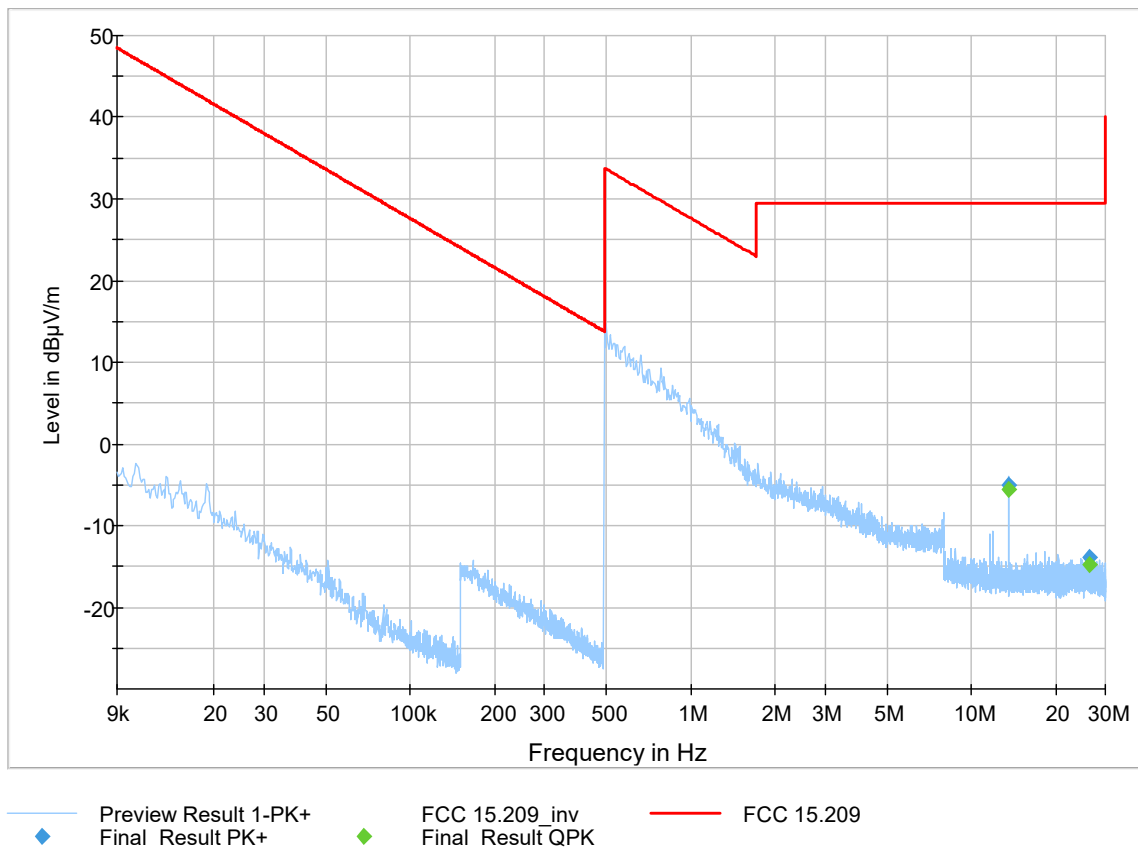
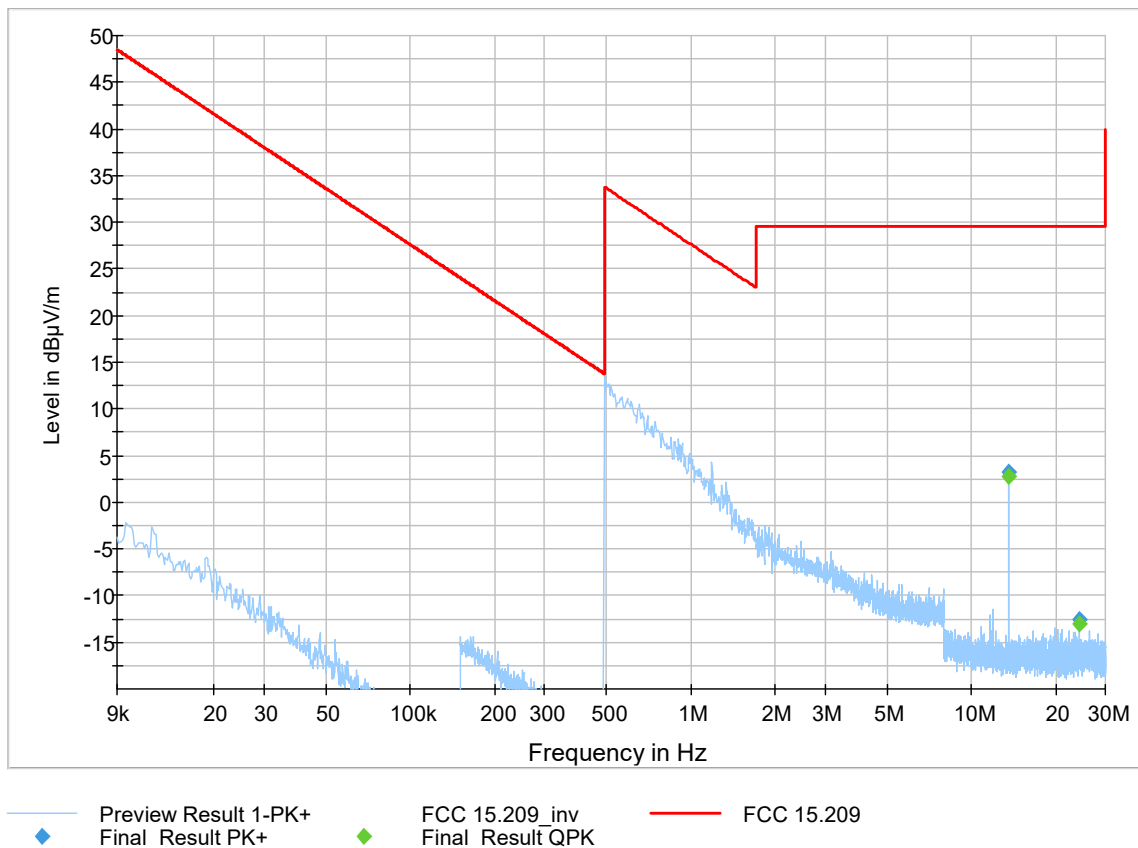


Figure 9-15 Radiated Spurious Emissions 9 kHz – 30 MHz –Flat Posture – X - CW

v) Antenna in parallel orientation and EUT in Flat Posture in Y orientation with ASK modulation:

RSE 9 kHz – 30 MHz – (Flat Posture - Y - ASK)						
Carrier Frequency (MHz)	Emission Frequency (MHz)	Raw Quasi-Peak Amplitude (dB $\mu$ V/m)	Correction Factor (dB)	Corrected Quasi-Peak Field Strength (dB $\mu$ V/m)	Quasi-Peak Limit (dB $\mu$ V/m)	Quasi-Peak Margin (dB)
13.56	13.56*	8.10	-5.30	2.80	29.54	-26.74
13.56	24.31	-7.70	-5.40	-13.10	29.54	-42.64



**Figure 9-16 Radiated Spurious Emissions 9 kHz – 30 MHz –Flat Posture – Y – ASK Modulation**

vi) Antenna in parallel orientation and EUT in Flat Posture in Y orientation with CW modulation:

RSE 9 kHz – 30 MHz – (Flat Posture - Y - CW)						
Carrier Frequency (MHz)	Emission Frequency (MHz)	Raw Quasi-Peak Amplitude (dBμV/m)	Correction Factor (dB)	Corrected Quasi-Peak Field Strength (dBμV/m)	Quasi-Peak Limit (dBμV/m)	Quasi-Peak Margin (dB)
13.56	13.56*	8.70	-5.30	3.40	29.54	-26.14
13.56	28.07	-8.35	-5.90	-14.25	29.54	-43.79

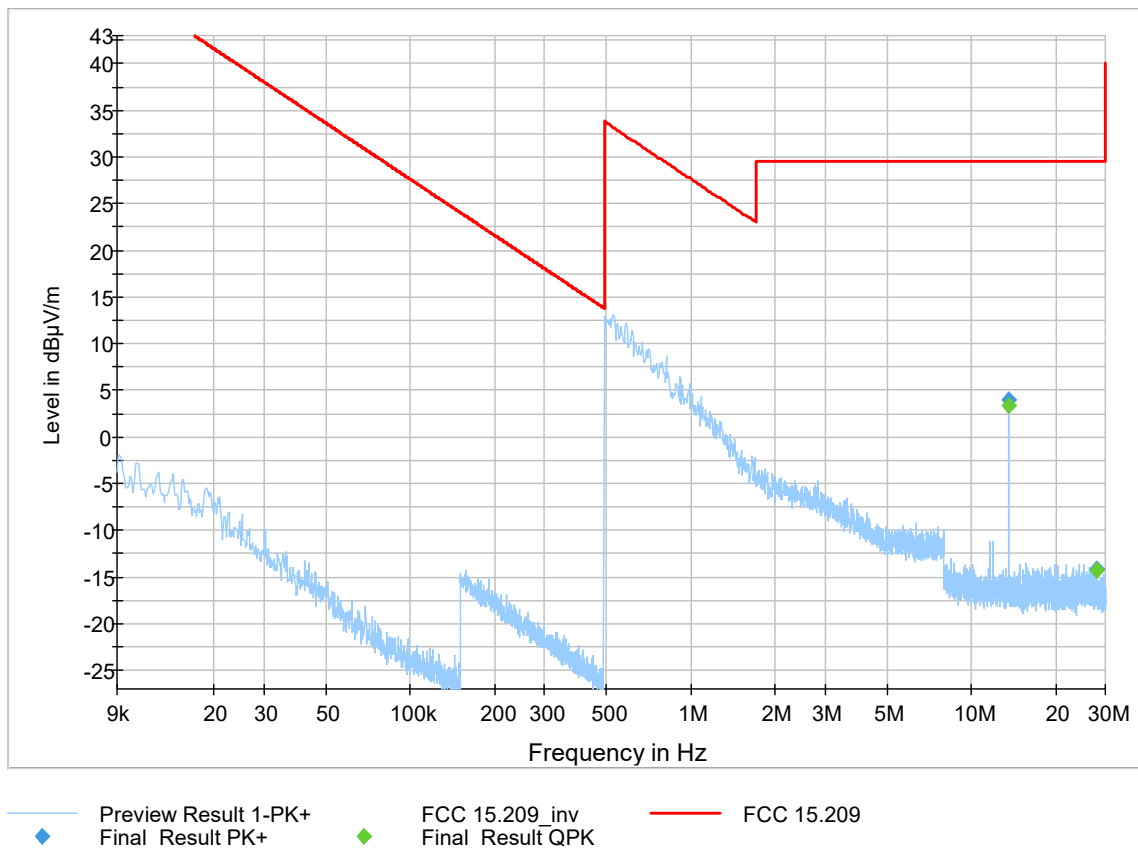
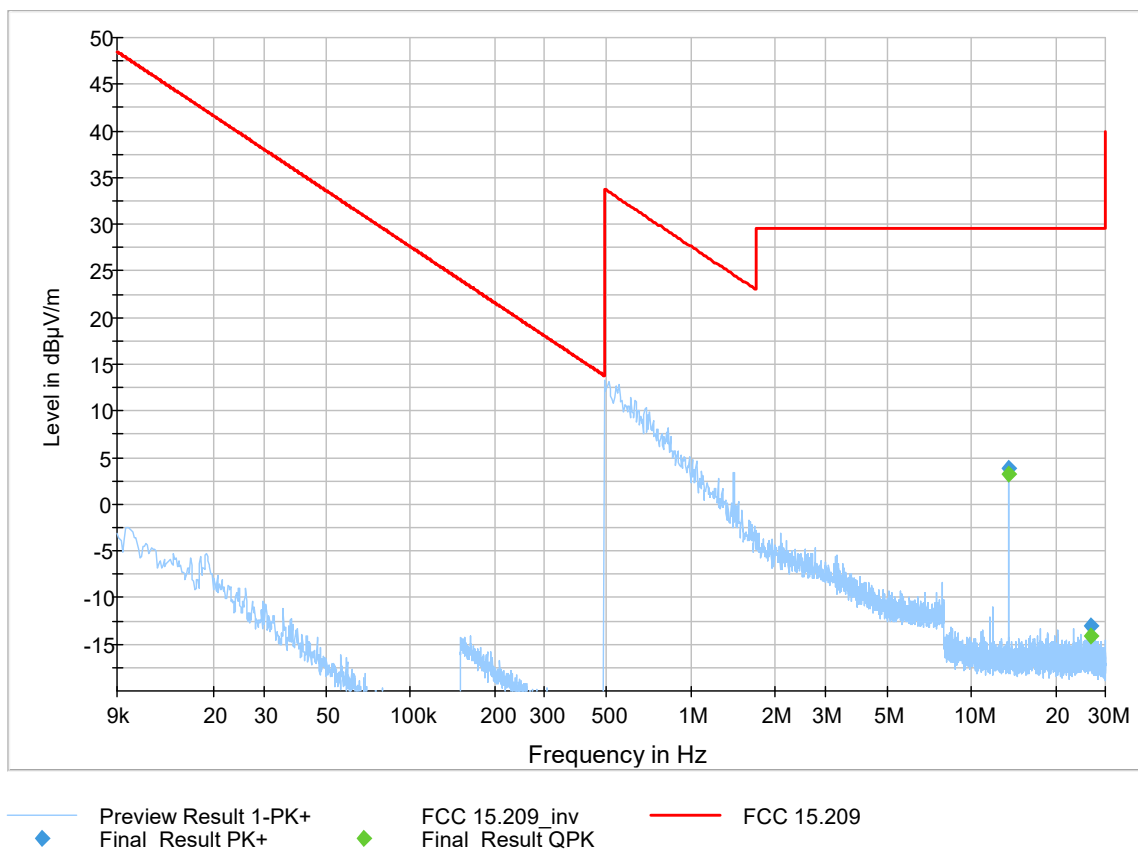


Figure 9-17 Radiated Spurious Emissions 9 kHz – 30 MHz –Flat Posture – Y - CW

vii) Antenna in parallel orientation and EUT in Flat Posture in Z orientation with ASK modulation:

RSE 9 kHz – 30 MHz – (Flat Posture - Z - ASK)						
Carrier Frequency (MHz)	Emission Frequency (MHz)	Raw Quasi-Peak Amplitude (dB $\mu$ V/m)	Correction Factor (dB)	Corrected Quasi-Peak Field Strength (dB $\mu$ V/m)	Quasi-Peak Limit (dB $\mu$ V/m)	Quasi-Peak Margin (dB)
13.56	13.56*	8.50	-5.30	3.20	29.54	-26.34
13.56	26.52	-8.50	-5.60	-14.10	29.54	-43.64



**Figure 9-18 Radiated Spurious Emissions 9 kHz – 30 MHz – Flat Posture – Z – ASK Modulation**

viii) Antenna in parallel orientation and EUT in Flat Posture in Z orientation with CW modulation:

RSE 9 kHz – 30 MHz – (Flat Posture- Z - CW)						
Carrier Frequency (MHz)	Emission Frequency (MHz)	Raw Quasi-Peak Amplitude (dB $\mu$ V/m)	Correction Factor (dB)	Corrected Quasi-Peak Field Strength (dB $\mu$ V/m)	Quasi-Peak Limit (dB $\mu$ V/m)	Quasi-Peak Margin (dB)
13.56	13.56*	8.17	-5.30	2.87	29.54	-26.67
13.56	26.98	-8.86	-5.70	-14.56	29.54	-44.10

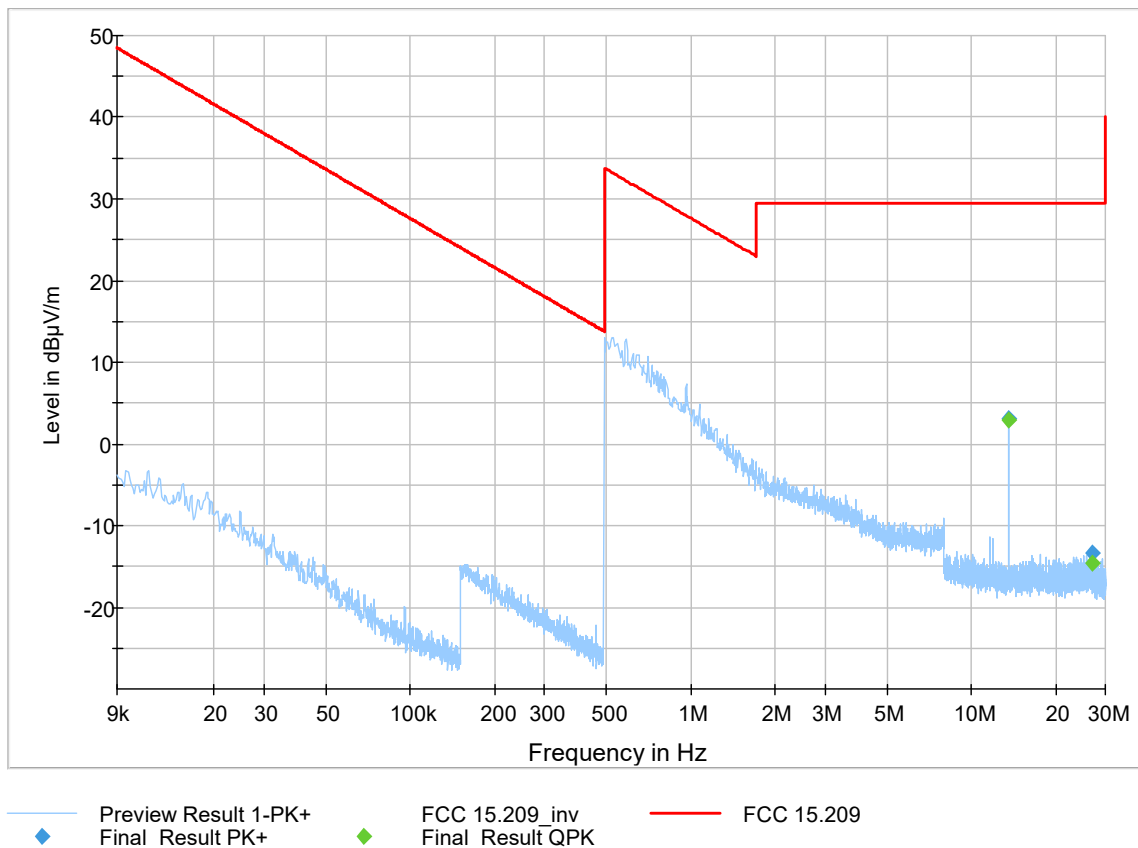


Figure 9-19 Radiated Spurious Emissions 9 kHz – 30 MHz – Flat Posture - Z - CW

9.4.5.3 Emissions in 30 MHz- 1 GHz range

All modes were tested, and worst-case results are reported.

RSE 30-1000 MHz – (Ambient)						
Carrier Frequency (MHz)	Emission Frequency (MHz)	Raw Quasi-Peak Amplitude (dBµV/m)	Correction Factor (dB)	Corrected Quasi-Peak Field Strength (dBµV/m)	Quasi-Peak Limit (dBµV/m)	Quasi-Peak Margin (dB)
Ambient	36.398	7.19	23.10	30.29	40.00	-9.71
Ambient	42.764	6.80	18.50	25.30	40.00	-14.71
Ambient	161.611	3.32	19.60	22.92	43.52	-20.60
Ambient	244.484	4.68	19.10	23.78	46.02	-22.24
Ambient	303.976	2.35	21.40	23.75	46.02	-22.27

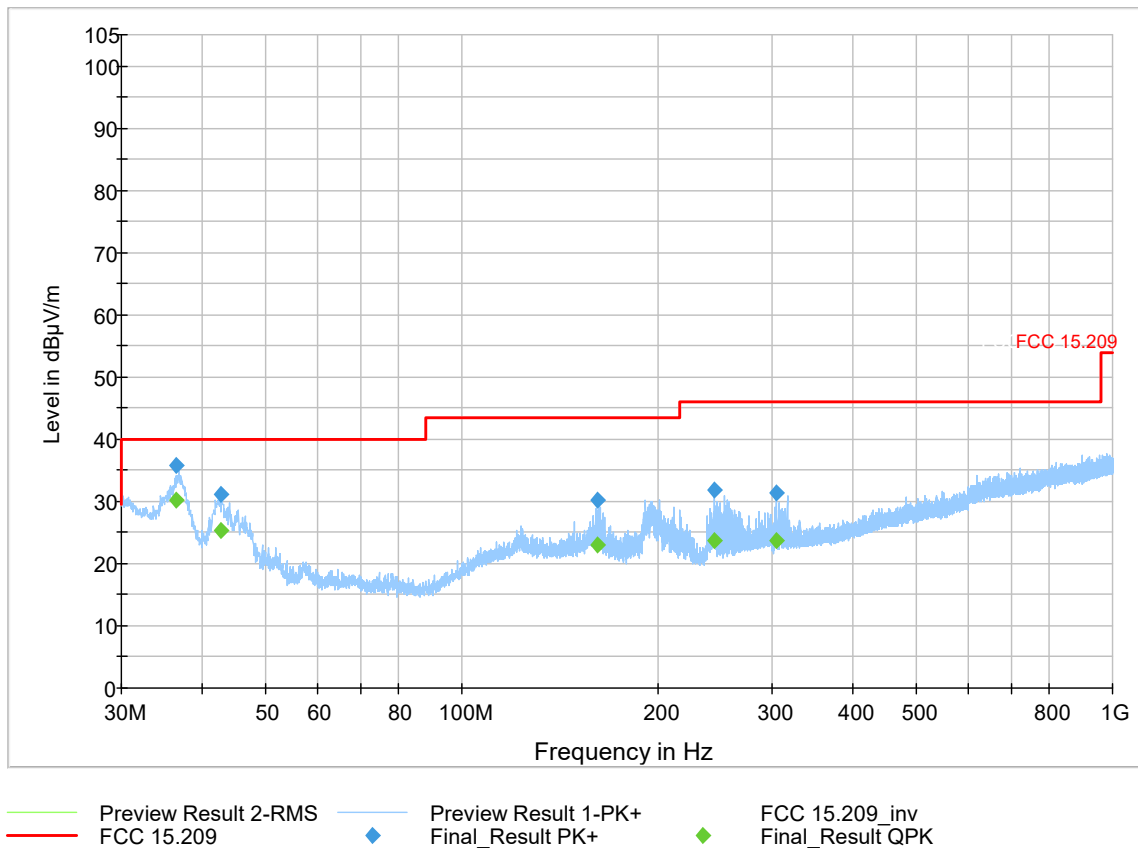
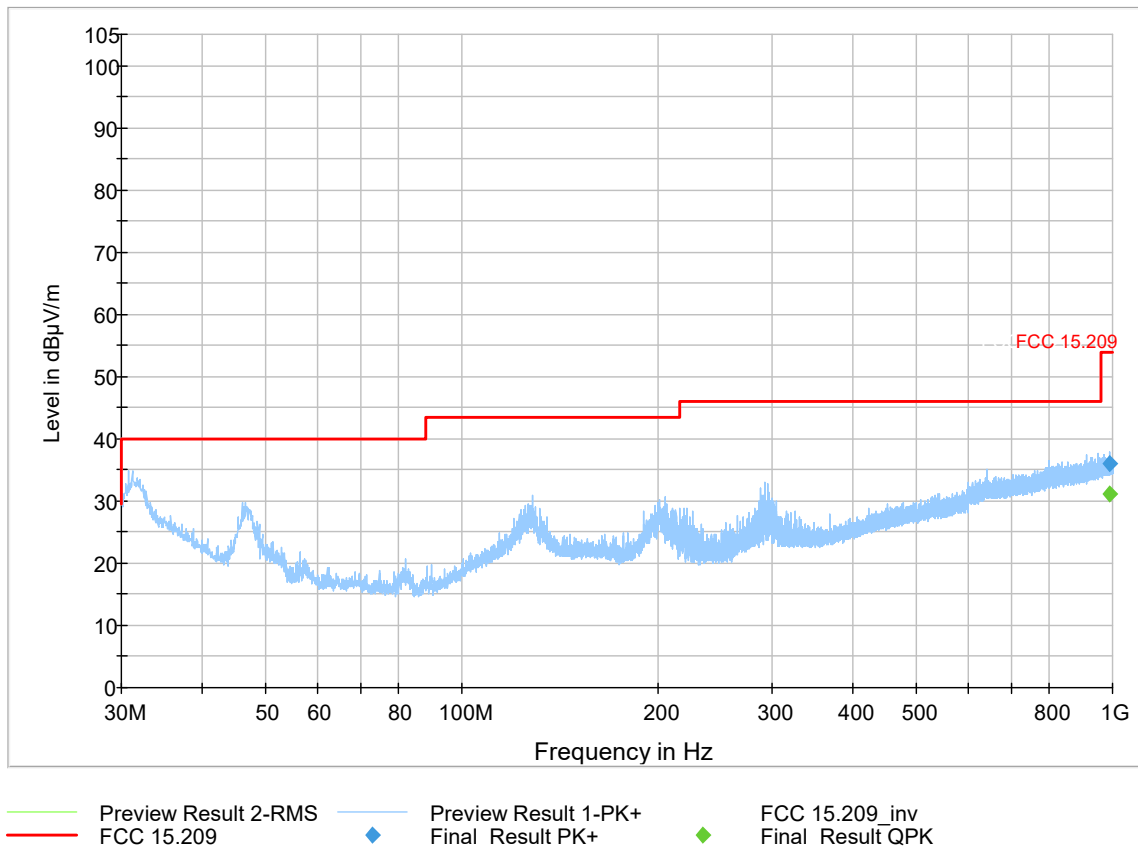


Figure 9-20 Radiated Spurious Emissions 30MHz – 1 GHz– Ambient.

i) EUT in Upright Posture and with ASK modulation.

RSE 30-1000 MHz – (Upright Posture - ASK)						
Carrier Frequency (MHz)	Emission Frequency (MHz)	Raw Quasi-Peak Amplitude (dBμV/m)	Correction Factor (dB)	Corrected Quasi-Peak Field Strength (dBμV/m)	Quasi-Peak Limit (dBμV/m)	Quasi-Peak Margin (dB)
13.56	989.03	-0.87	32.1	31.23	54.00	-22.77

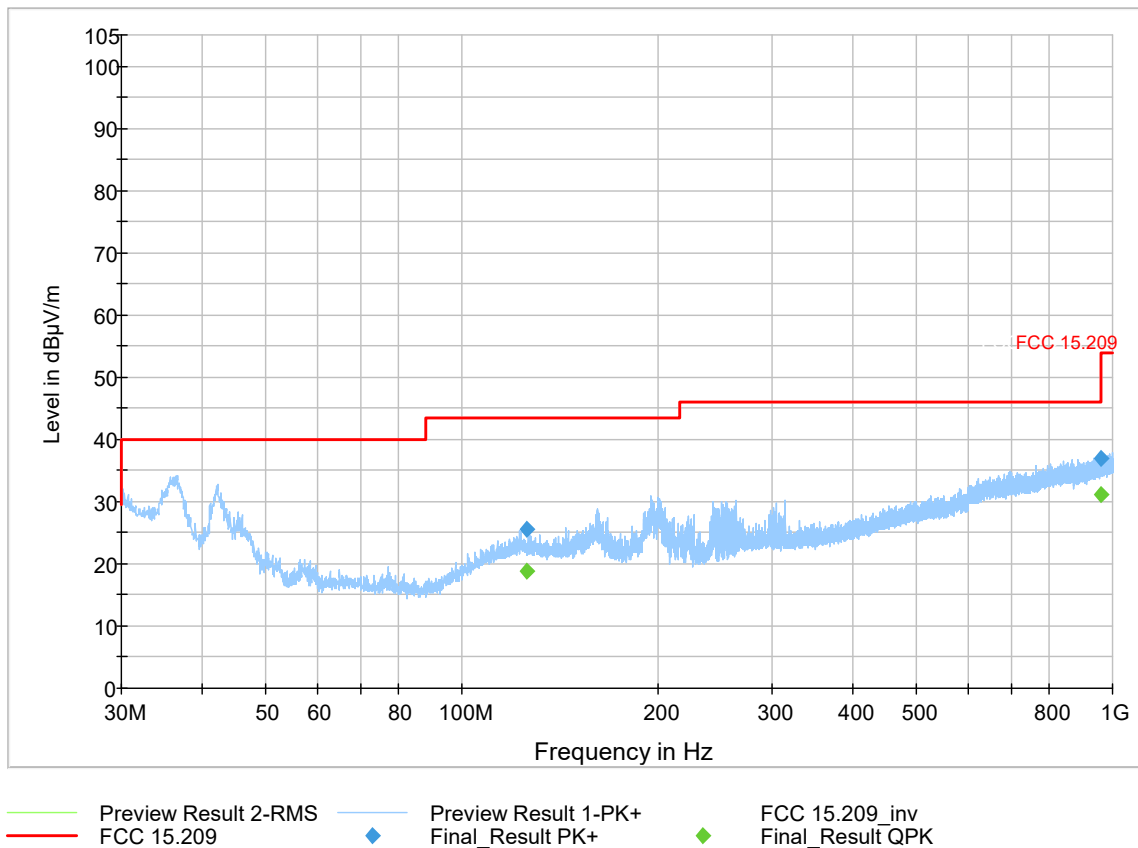


**Figure 9-21 Radiated Spurious Emissions 30MHz – 1 GHz– Upright Posture – ASK (13.56MHz)**



ii) EUT in Upright Posture and with CW.

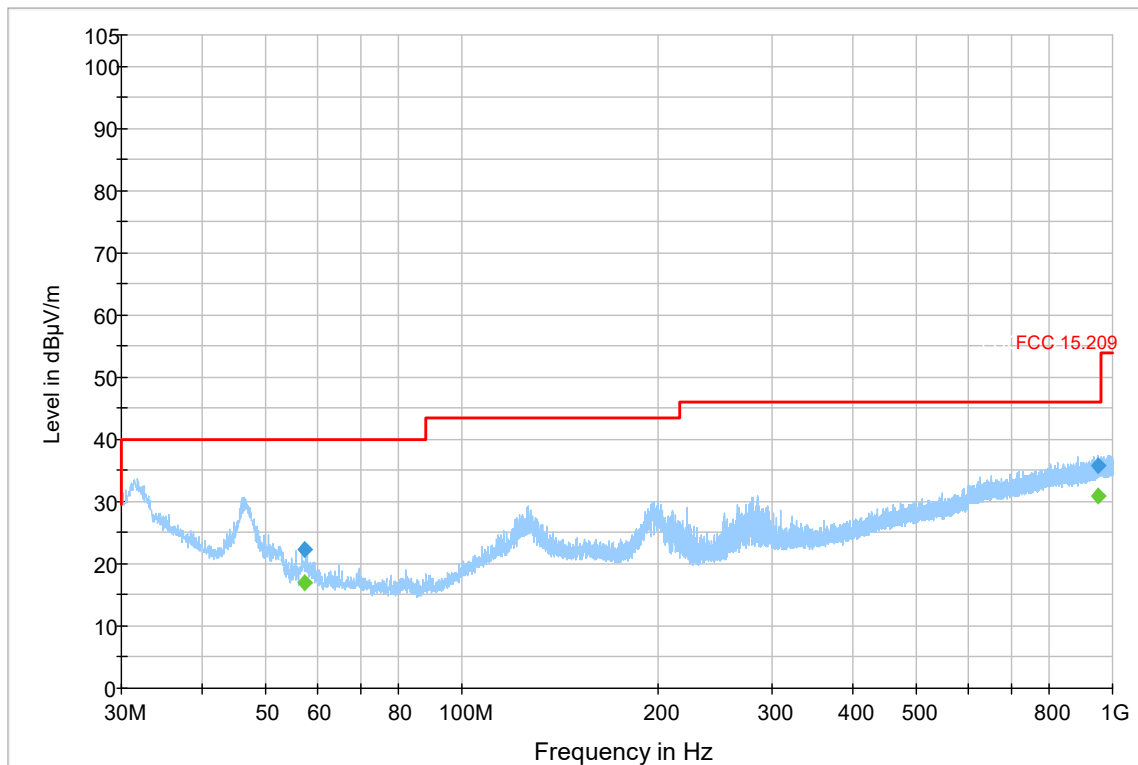
RSE 30-1000 MHz – (Upright Posture - CW)						
Carrier Frequency (MHz)	Emission Frequency (MHz)	Raw Quasi-Peak Amplitude (dBµV/m)	Correction Factor (dB)	Corrected Quasi-Peak Field Strength (dBµV/m)	Quasi-Peak Limit (dBµV/m)	Quasi-Peak Margin (dB)
13.56	126.04	-1.80	20.60	18.80	43.52	-24.72
13.56	960.78	-0.78	31.90	31.12	54.00	-22.88



**Figure 9-22 Radiated Spurious Emissions 30MHz – 1 GHz– Upright Posture – CW (13.56MHz)**

iii) EUT in Flat Posture in X – orientation and with ASK Modulation.

RSE 30-1000 MHz – (Flat Posture – X - ASK)						
Carrier Frequency (MHz)	Emission Frequency (MHz)	Raw Quasi-Peak Amplitude (dBμV/m)	Correction Factor (dB)	Corrected Quasi-Peak Field Strength (dBμV/m)	Quasi-Peak Limit (dBμV/m)	Quasi-Peak Margin (dB)
13.56	57.41	2.94	14	16.94	40.00	-23.06
13.56	951.79	-0.94	31.8	30.86	46.02	-15.16

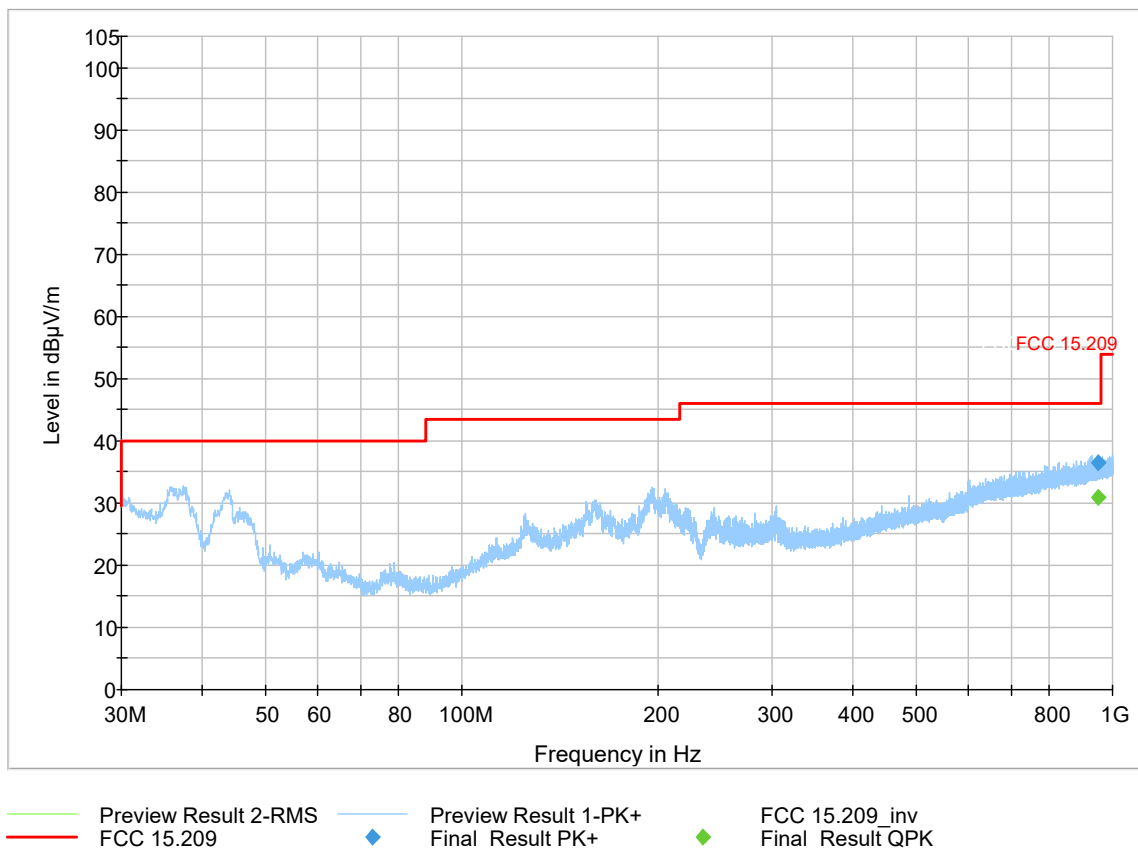


— Preview Result 2-RMS     — Preview Result 1-PK+     — FCC 15.209  
◆ Final\_Result PK+     ◆ FCC 15.209\_inv Final\_Result QPK

**Figure 9-23 Radiated Spurious Emissions 30MHz – 1 GHz– Flat Posture – X - CW (13.56MHz)**

iv) EUT in Flat Posture in X – orientation and with CW.

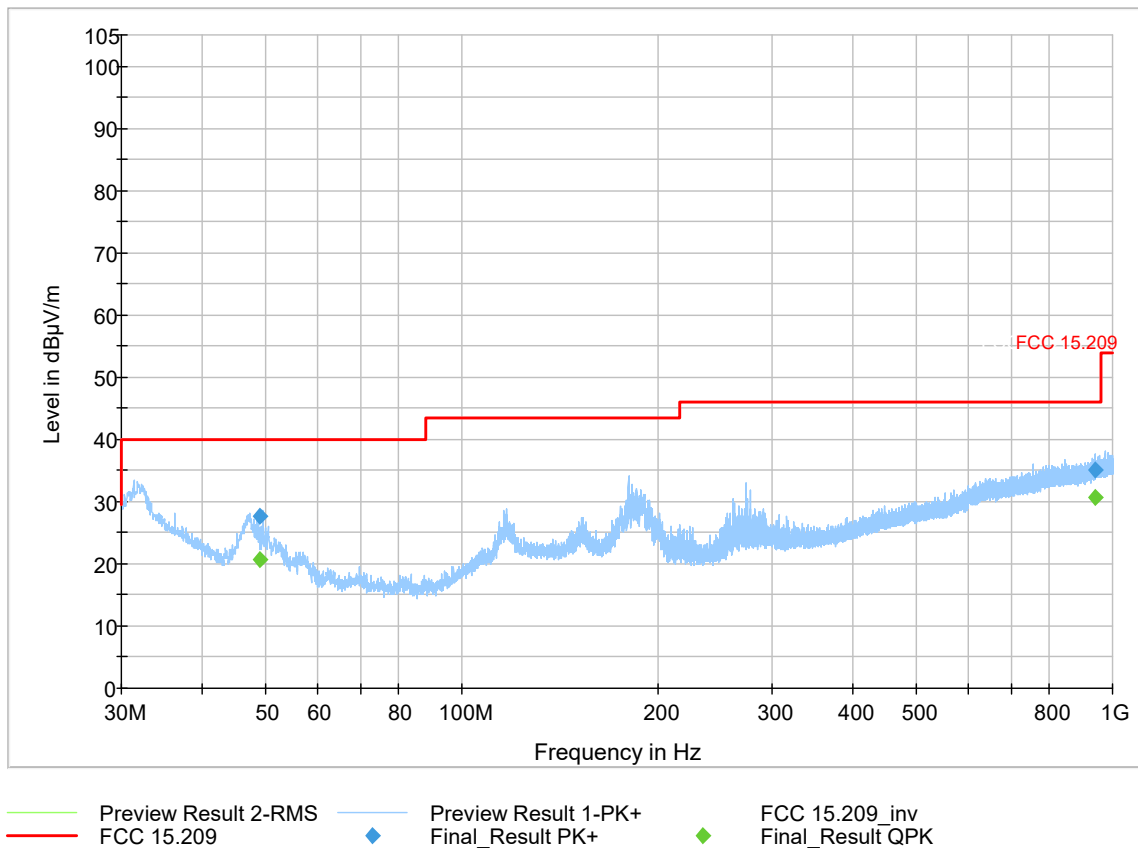
RSE 30-1000 MHz – (Flat Posture – X - CW)						
Carrier Frequency (MHz)	Emission Frequency (MHz)	Raw Quasi-Peak Amplitude (dB $\mu$ V/m)	Correction Factor (dB)	Corrected Quasi-Peak Field Strength (dB $\mu$ V/m)	Quasi-Peak Limit (dB $\mu$ V/m)	Quasi-Peak Margin (dB)
13.56	951.10	-0.83	31.8	30.97	46.02	-15.05



**Figure 9-24 Radiated Spurious Emissions 30MHz – 1 GHz– Flat Posture – X - CW (13.56MHz)**

v) EUT in Flat Posture in Y – orientation and with ASK modulation.

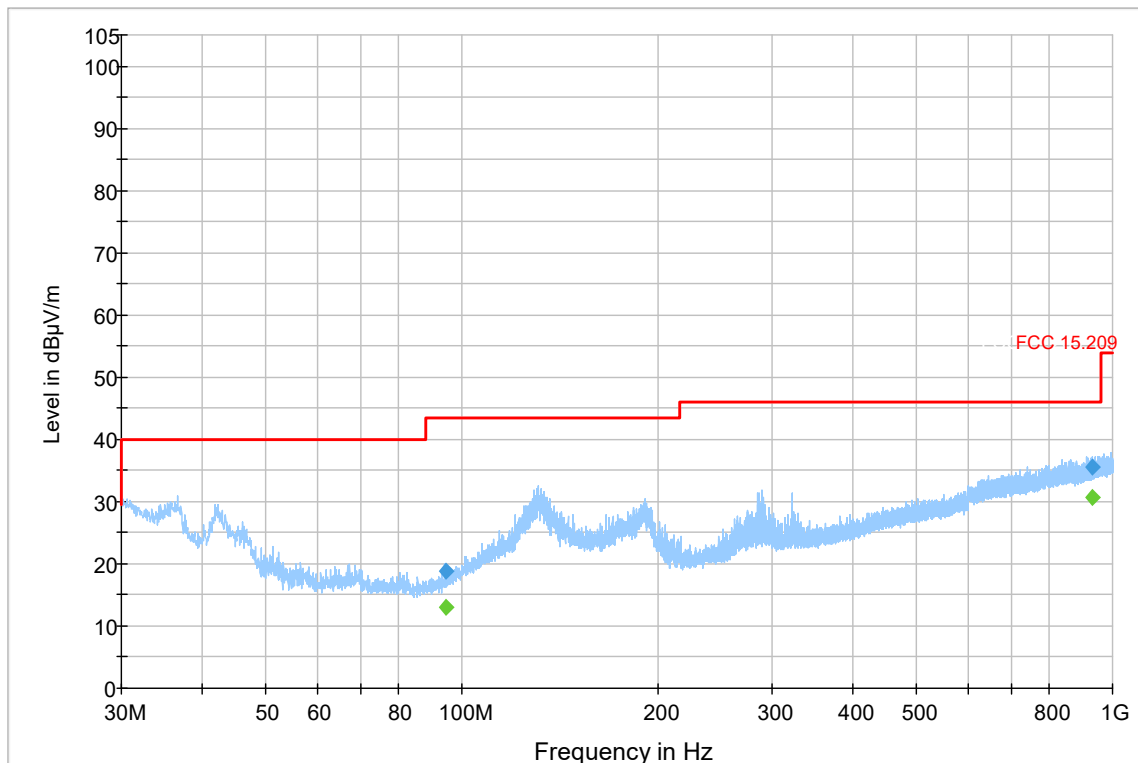
RSE 30-1000 MHz – (Flat Posture – Y - ASK)						
Carrier Frequency (MHz)	Emission Frequency (MHz)	Raw Quasi-Peak Amplitude (dBμV/m)	Correction Factor (dB)	Corrected Quasi-Peak Field Strength (dBμV/m)	Quasi-Peak Limit (dBμV/m)	Quasi-Peak Margin (dB)
13.56	48.88	5.51	15.10	20.61	40.00	-19.39
13.56	941.65	-0.95	31.60	30.65	46.02	-15.37



**Figure 9-25 Radiated Spurious Emissions 30MHz – 1 GHz– Flat Posture – Y - ASK (13.56MHz)**

vi) EUT in Flat Posture in Y – orientation and with CW.

RSE 30-1000 MHz – (Flat Posture – Y - CW)						
Carrier Frequency (MHz)	Emission Frequency (MHz)	Raw Quasi-Peak Amplitude (dBμV/m)	Correction Factor (dB)	Corrected Quasi-Peak Field Strength (dBμV/m)	Quasi-Peak Limit (dBμV/m)	Quasi-Peak Margin (dB)
13.56	94.40	-2.75	15.7	12.95	43.52	-30.57
13.56	932.36	-0.95	31.5	30.55	46.02	-15.47

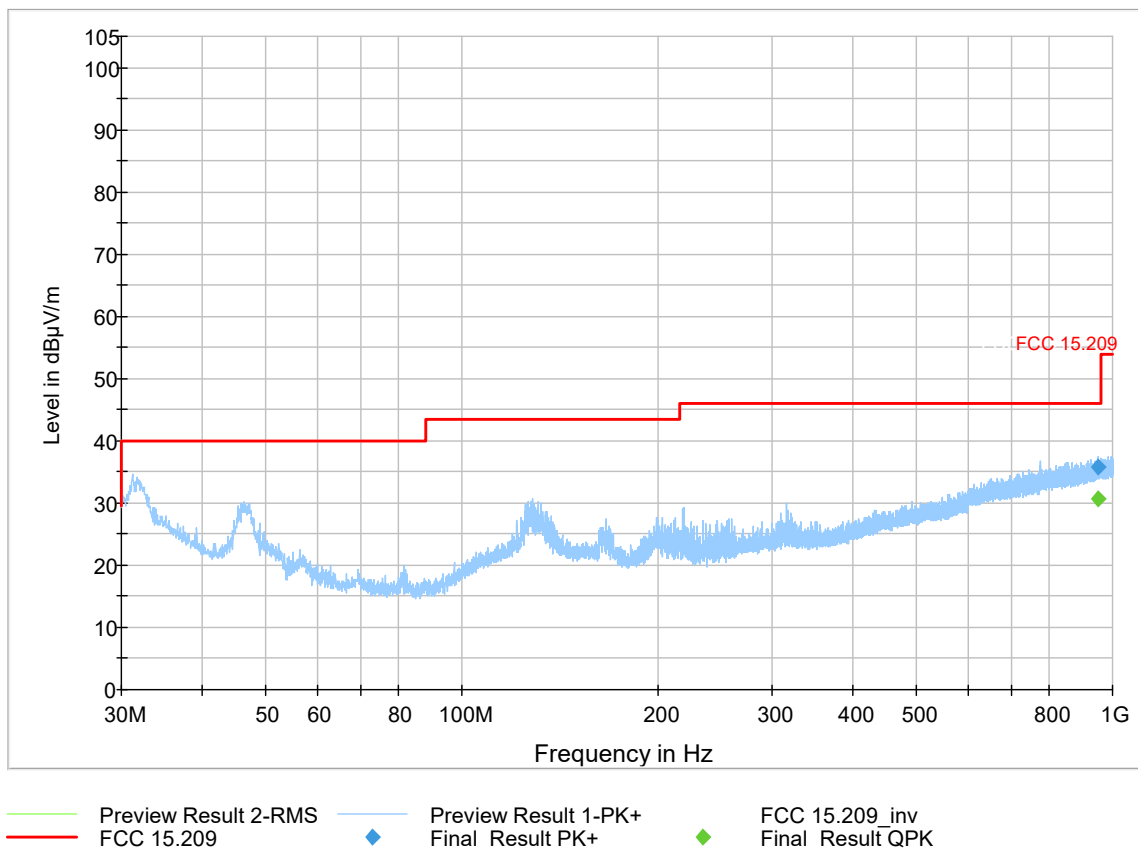


— Preview Result 2-RMS     — Preview Result 1-PK+     — FCC 15.209\_inv  
— FCC 15.209     ◆ Final\_Result PK+     ◆ Final\_Result QPK

**Figure 9-26 Radiated Spurious Emissions 30MHz – 1 GHz– Flat Posture – Y - CW (13.56MHz)**

vii) EUT in Flat Posture in Z – orientation and with ASK modulation.

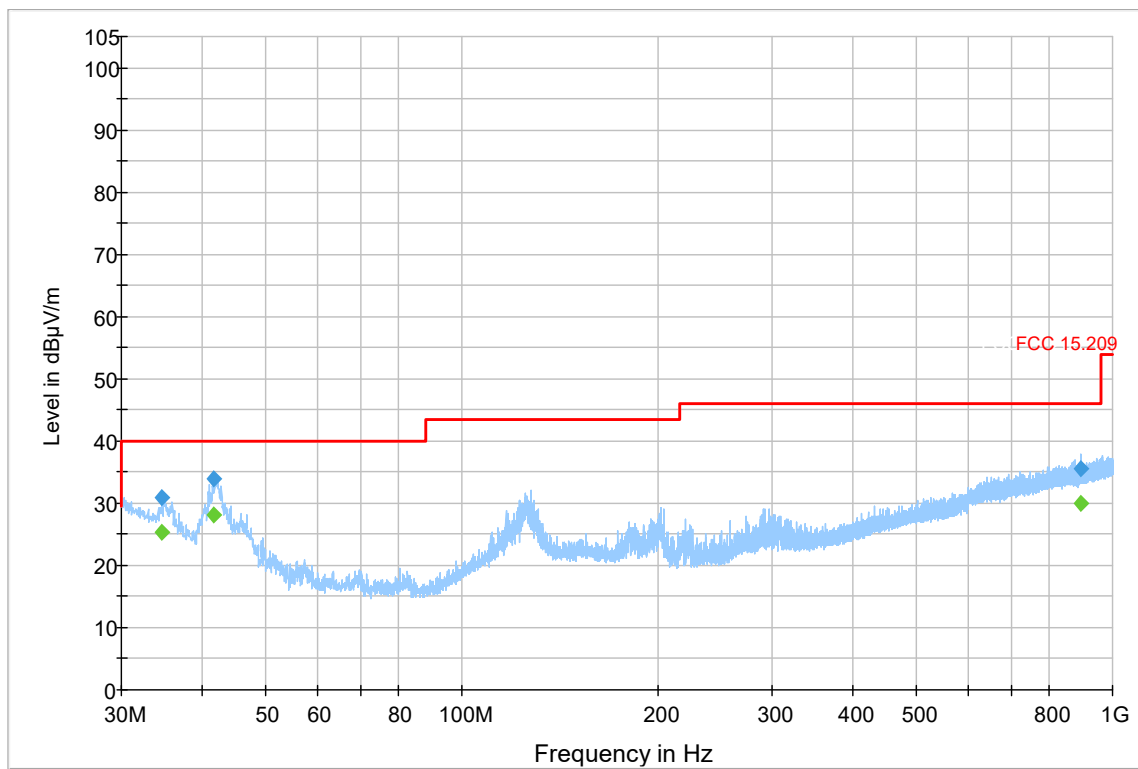
RSE 30-1000 MHz – (Flat Posture – Z - ASK)						
Carrier Frequency (MHz)	Emission Frequency (MHz)	Raw Quasi-Peak Amplitude (dBµV/m)	Correction Factor (dB)	Corrected Quasi-Peak Field Strength (dBµV/m)	Quasi-Peak Limit (dBµV/m)	Quasi-Peak Margin (dB)
13.56	948.35	-0.93	31.7	30.77	46.02	-15.25



**Figure 9-27 Radiated Spurious Emissions 30MHz – 1 GHz– Flat Posture – Z - ASK (13.56MHz)**

viii) EUT in Flat Posture in Z – orientation and with CW.

RSE 30-1000 MHz – (Flat Posture – Z - CW)						
Carrier Frequency (MHz)	Emission Frequency (MHz)	Raw Quasi-Peak Amplitude (dBμV/m)	Correction Factor (dB)	Corrected Quasi-Peak Field Strength (dBμV/m)	Quasi-Peak Limit (dBμV/m)	Quasi-Peak Margin (dB)
13.56	34.65	1.11	24.3	25.41	40.00	-14.59
13.56	41.60	8.79	19.3	28.09	40.00	-11.91
13.56	894.76	-1.10	31.1	30	46.02	-16.02



— Preview Result 2-RMS     — Preview Result 1-PK+     — FCC 15.209\_inv  
— FCC 15.209     ◆ Final\_Result PK+     ◆ Final\_Result QPK

**Figure 9-28 Radiated Spurious Emissions 30MHz – 1 GHz– Flat Posture – Z - CW (13.56MHz)**

## 9.5 AC Line Conducted Emissions

### 9.5.1 Test Requirements

FCC CFR 47 Rule Part 15.207 (a)

ISED RSS Gen [8.8]

### 9.5.2 Test Method

Conducted power line measurements are made, unless otherwise specified, over the frequency range from 150 kHz to 30 MHz to determine the Unsymmetric radio-noise voltage that is conducted from the EUT power-input terminals that are directly (or indirectly via separate transformer or power supplies) connected to a public power network. Equipment is tested with the power cords that are used under normal operating conditions. These measurements are made using a LISN (Line Impedance Stabilization Network). AC powered peripherals are attached to a second LISN with the 50-ohm measuring port terminated by a 50-ohm resistive load.

Worst case results were recorded when the EUT was transmitting continuously with a passive tag load.

#### EMI Receiver Settings:

**150 kHz – 30 MHz:**

RBW= 9 kHz

VBW  $\geq$  3 X RBW

Trace Mode: Peak Detector (Max Hold).

Final measurements were performed using Quasi-Peak and Average Detectors.

Span= 150 kHz – 30 MHz

Sweep time= Auto

### 9.5.3 Limit

Frequency of emission (MHz)	Conducted limit (dB $\mu$ V)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

### 9.5.4 Test Result:

Pass



9.5.5 Test Data:

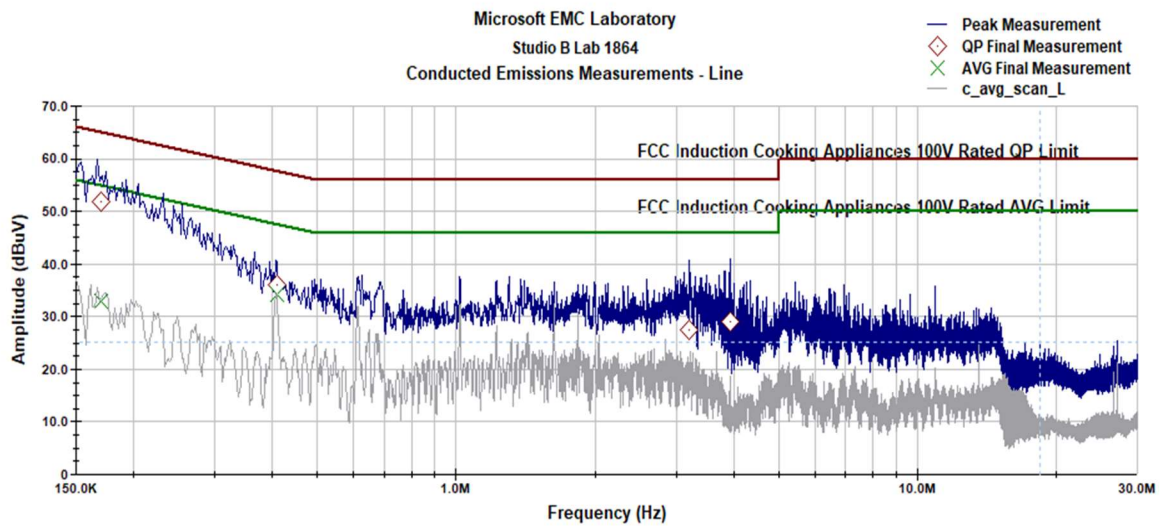


Figure 9-29 AC Line Conducted Emissions - Line (150 kHz - 30 MHz) – ASK with Load

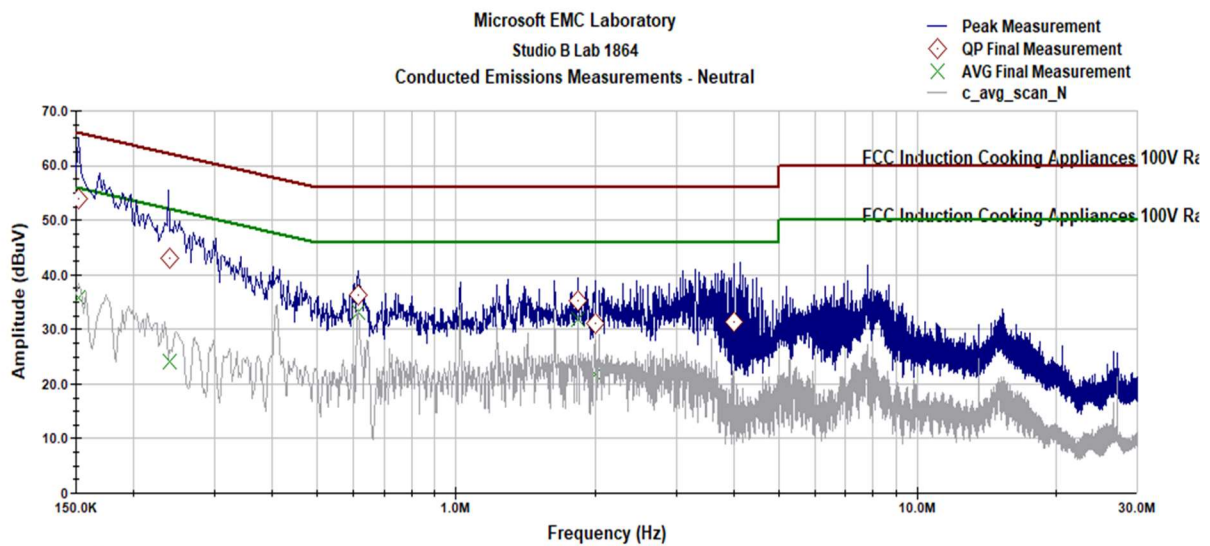
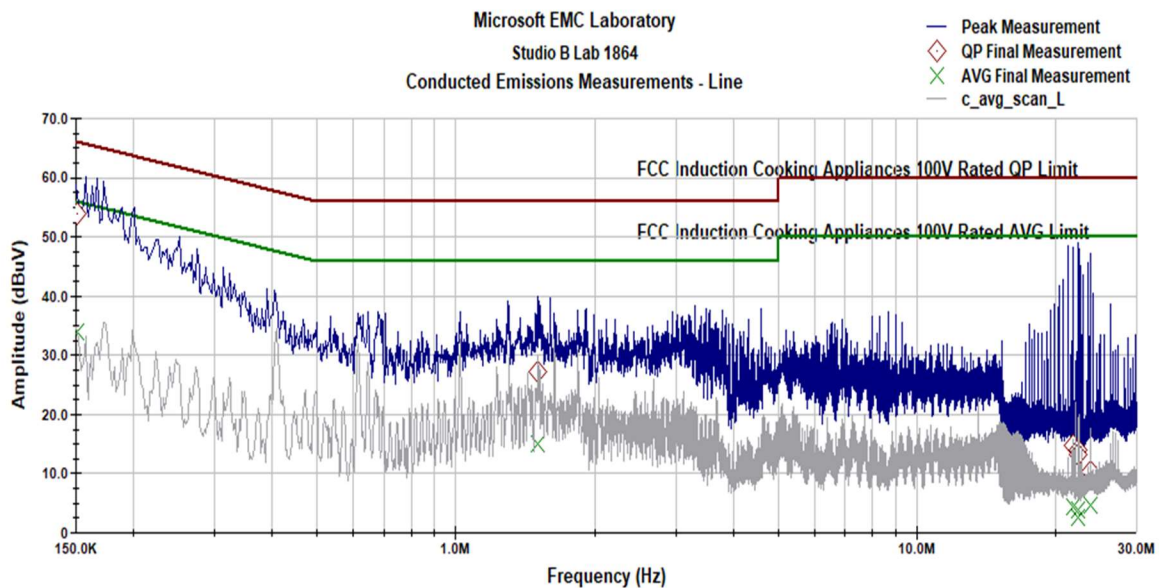


Figure 9-30 AC Line Conducted Emissions - Neutral (150 kHz - 30 MHz) – ASK with Load

AC Conducted Line Emissions Data – ASK with Load							
Frequency (MHz)	QP Amplitude (dB $\mu$ V)	AVG Amplitude (dB $\mu$ V)	Quasi-Peak Limit (dB $\mu$ V)	Average Limit (dB $\mu$ V)	Line Tested (L or N)	Quasi-Peak Margin (dB)	Average Margin (dB)
0.170	51.74	56.305	55.0	64.97	L	-21.99	-13.23
0.409	36.06	39.893	47.7	57.68	L	-13.52	-21.62
3.921	28.96	38.787	46.0	56.00	L	-35.34	-27.04
3.199	27.54	32.695	46.0	56.00	L	-27.90	-28.46
0.152	53.89	64.891	55.9	65.90	N	-20.21	-12.00
0.240	43.05	48.089	52.1	62.10	N	-28.02	-19.06
0.614	36.19	40.228	46.0	56.00	N	-12.84	-19.81
1.840	35.20	39.307	46.0	56.00	N	-14.05	-20.80
3.997	31.37	41.613	46.0	56.00	N	-31.18	-24.63
2.001	31.09	39.006	46.0	56.00	N	-24.25	-24.91

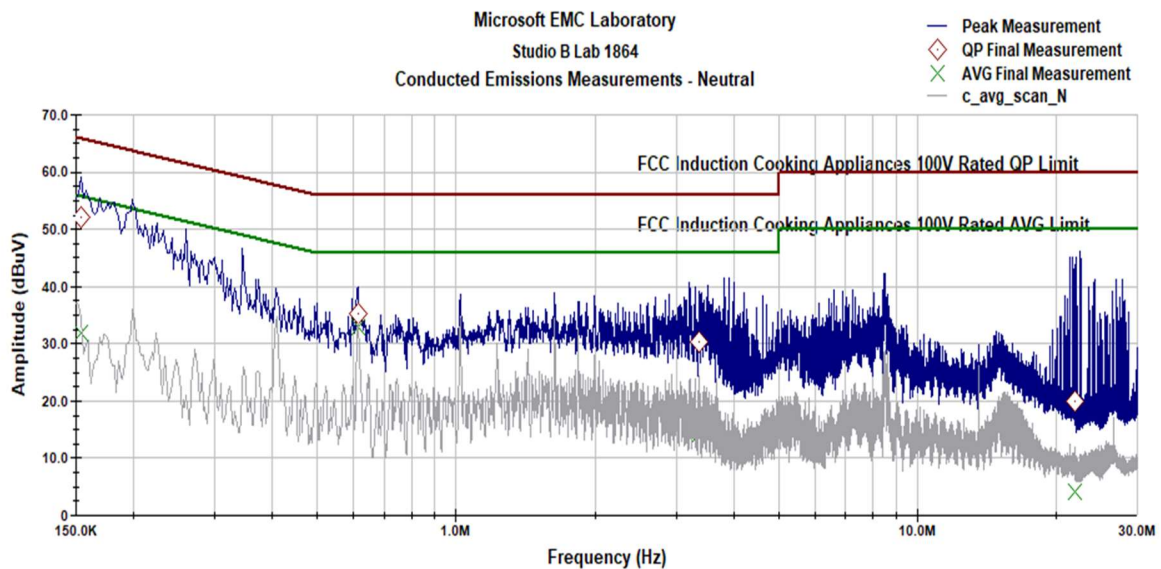


Operator: Reza

Last Data Update 12:05:04 PM, Wednesday, June 30, 2021

CE Profile V2.2

**Figure 9-31 AC Line Conducted Emissions - Line (150 kHz - 30 MHz) – ASK without Load**



Operator: Reza

Last Data Update 12:22:12 PM, Wednesday, June 30, 2021

CE Profile V2.2

**Figure 9-32 AC Line Conducted Emissions - Neutral (150 kHz - 30 MHz) – ASK without Load**

AC Conducted Line Emissions Data – ASK without Load							
Frequency (MHz)	QP Amplitude (dB $\mu$ V)	AVG Amplitude (dB $\mu$ V)	Quasi-Peak Limit (dB $\mu$ V)	Average Limit (dB $\mu$ V)	Line Tested (L or N)	Quasi-Peak Margin (dB)	Average Margin (dB)
0.151	53.99	56.544	55.9	65.92	L	-22.03	-11.93
1.504	27.29	32.071	46.0	56.00	L	-31.09	-28.72
21.896	14.89	48.338	50.0	60.00	L	-45.73	-45.11
22.379	14.05	47.085	50.0	60.00	L	-46.08	-45.95
22.452	13.18	48.919	50.0	60.00	L	-47.30	-46.82
23.818	10.47	47.106	50.0	60.00	L	-45.44	-49.53
0.154	52.16	59.132	55.8	65.80	N	-23.86	-13.64
0.613	35.16	39.328	46.0	56.00	N	-13.03	-20.84
3.365	30.37	38.388	46.0	56.00	N	-31.67	-25.63
21.997	19.98	43.752	50.0	60.00	N	-45.83	-40.02

# End of Report