



TEST REPORT

Report Number. : 12875574-E1V1

Applicant : SONOS, INC.
614 CHAPALA STREET
SANTA BARBARA, CA 93101, U.S.A

Model : S24

FCC ID : SBVRM024

IC : 5373A-RM024

EUT Description : 802.11 a/b/g/n 4x4 (HT20) Client Device

Test Standard(s) : FCC 47 CFR PART 15 SUBPART C
ISED RSS-247 ISSUE 2
ISED RSS-GEN ISSUE 5

Date Of Issue:
January 30, 2020

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NVLAP Lab code: 200065-0

REPORT REVISION HISTORY

| Rev. | Issue Date | Revisions | Revised By |
|------|------------|---------------|------------|
| V1 | 1/30/2020 | Initial Issue | |

TABLE OF CONTENTS

| | |
|--|-----------|
| REPORT REVISION HISTORY | 2 |
| TABLE OF CONTENTS | 3 |
| 1. ATTESTATION OF TEST RESULTS | 5 |
| 2. TEST METHODOLOGY | 7 |
| 3. FACILITIES AND ACCREDITATION | 7 |
| 4. CALIBRATION AND UNCERTAINTY | 8 |
| 4.1. MEASURING INSTRUMENT CALIBRATION | 8 |
| 4.2. SAMPLE CALCULATION | 8 |
| 4.3. MEASUREMENT UNCERTAINTY | 8 |
| 5. EQUIPMENT UNDER TEST | 9 |
| 5.1. EUT DESCRIPTION | 9 |
| 5.2. MAXIMUM OUTPUT POWER | 9 |
| 5.3. DESCRIPTION OF AVAILABLE ANTENNAS | 9 |
| 5.4. SOFTWARE | 9 |
| 5.5. WORST-CASE CONFIGURATION AND MODE | 9 |
| 5.6. DESCRIPTION OF TEST SETUP | 10 |
| 6. MEASUREMENT METHOD | 12 |
| 7. TEST AND MEASUREMENT EQUIPMENT | 13 |
| 8. ANTENNA PORT TEST RESULTS | 14 |
| 8.1. ON TIME AND DUTY CYCLE | 14 |
| 8.2. 99% BANDWIDTH | 15 |
| 8.3. 6 dB BANDWIDTH | 16 |
| 8.4. OUTPUT POWER | 17 |
| 8.5. AVERAGE POWER | 18 |
| 8.6. POWER SPECTRAL DENSITY | 19 |
| 8.7. CONDUCTED SPURIOUS EMISSIONS | 20 |
| 9. RADIATED TEST RESULTS | 22 |
| 9.1. LIMITS AND PROCEDURE | 22 |
| 9.2. TRANSMITTER ABOVE 1 GHz | 24 |
| 9.3. WORST CASE BELOW 30MHZ | 34 |
| 9.4. WORST CASE BELOW 1 GHZ | 36 |

| | | |
|------|---|----|
| 9.5. | WORST CASE 18-26 GHZ | 38 |
| 10. | AC POWER LINE CONDUCTED EMISSIONS | 40 |
| 11. | SETUP PHOTOS | 43 |

1. ATTESTATION OF TEST RESULTS

COMPANY NAME: SONOS, INC.
614 CHAPALA STREET
SANTA BARBARA, CA 93101, U.S.A.

EUT DESCRIPTION: 802.11 a/b/g/n 4x4 (HT20) Client Device

MODEL: S24

SERIAL NUMBER: D100 1909CP 34-7E-5C-D0-02-60-7 (Conducted Sample)
D100 1909CP 34-7E-5C-D0-02-5C-3 (Radiated Sample)
D100 1909CP 34-7E-5C-D0-02-7E-3(Radiated Sample)

DATE TESTED: November 13 – November 22, 2019

| APPLICABLE STANDARDS | |
|--------------------------|--------------|
| STANDARD | TEST RESULTS |
| CFR 47 Part 15 Subpart C | Complies |
| ISED RSS-247 Issue 2 | Complies |
| ISED RSS-GEN Issue 5 | 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.

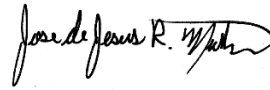
This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This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

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2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, ANSI C63.10-2013, KDB 558074 D01 15.247 Meas Guidance v05r02, KDB 414788 D01 Radiated Test Site v01r0, RSS-GEN Issue 5, and RSS-247 Issue 2.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, and 47658 Kato Road, 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 checked="" type="checkbox"/> Chamber A | <input type="checkbox"/> Chamber D | <input checked="" type="checkbox"/> Chamber I |
| <input type="checkbox"/> Chamber B | <input type="checkbox"/> Chamber E | <input type="checkbox"/> Chamber J |
| <input type="checkbox"/> Chamber C | <input type="checkbox"/> Chamber F | <input type="checkbox"/> Chamber K |
| | <input type="checkbox"/> Chamber G | <input type="checkbox"/> Chamber L |
| | <input type="checkbox"/> Chamber H | |

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: 2324A.

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

4. CALIBRATION AND UNCERTAINTY

4.1. 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.

4.2. SAMPLE CALCULATION

RADIATED EMISSIONS

Where relevant, the following sample calculation is provided:

Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)

36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m

MAINS CONDUCTED EMISSIONS

Where relevant, the following sample calculation is provided:

Final Voltage (dBuV) = Measured Voltage (dBuV) + Cable Loss (dB) + Limiter Factor (dB) + LISN Insertion Loss.

36.5 dBuV + 0 dB + 10.1 dB + 0 dB = 46.6 dBuV

4.3. MEASUREMENT UNCERTAINTY

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

| PARAMETER | UNCERTAINTY |
|---|-------------|
| Worst Case Conducted Disturbance, 9KHz to 0.15 MHz | 3.39 dB |
| Worst Case Conducted Disturbance, 0.15 to 30 MHz | 3.07 dB |
| Worst Case Radiated Disturbance, 9KHz to 30 MHz | 2.52 dB |
| Worst Case Radiated Disturbance, 30 to 1000 MHz | 4.88 dB |
| Worst Case Radiated Disturbance, 1000 to 18000 MHz | 4.24 dB |
| Worst Case Radiated Disturbance, 18000 to 26000 MHz | 4.37 dB |
| Worst Case Radiated Disturbance, 26000 to 40000 MHz | 5.17 dB |

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

5. EQUIPMENT UNDER TEST

5.1. EUT DESCRIPTION

The EUT is an 802.11 a/b/g/n 4x4 (HT20) Client Device.

5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum peak conducted output power as follows:

| Frequency Range (MHz) | Mode | Output Power (dBm) | Output Power (mW) |
|-----------------------|------|--------------------|-------------------|
| 2402 - 2480 | BLE | -0.11 | 0.97 |

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an antenna with a maximum gain of 2.95 dBi.

5.4. SOFTWARE

The test utility software used during testing was:
Sonos build 55.0-70090_mainline_integ_int_release

5.5. WORST-CASE CONFIGURATION AND MODE

Radiated emissions below 1GHz, above 18GHz, and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

Band edge and radiated emissions between 1GHz and 18GHz were performed with the EUT set to transmit at the highest power on low, middle and high channels.

The fundamental of the EUT was investigated in three orthogonal orientations X,Y Left, Y Right, it was determined that Y Right orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in Y Right orientation.

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

| Support Equipment List | | | | |
|------------------------|--------------|-------------|------------------------|--------|
| Description | Manufacturer | Model | Serial Number | FCC ID |
| Laptop | Lenovo | T440p | SON-00008522 | N/A |
| AC Adapter | Lenovo | ADLX90NDC2A | 11S36200285ZZ3004758D2 | N/A |

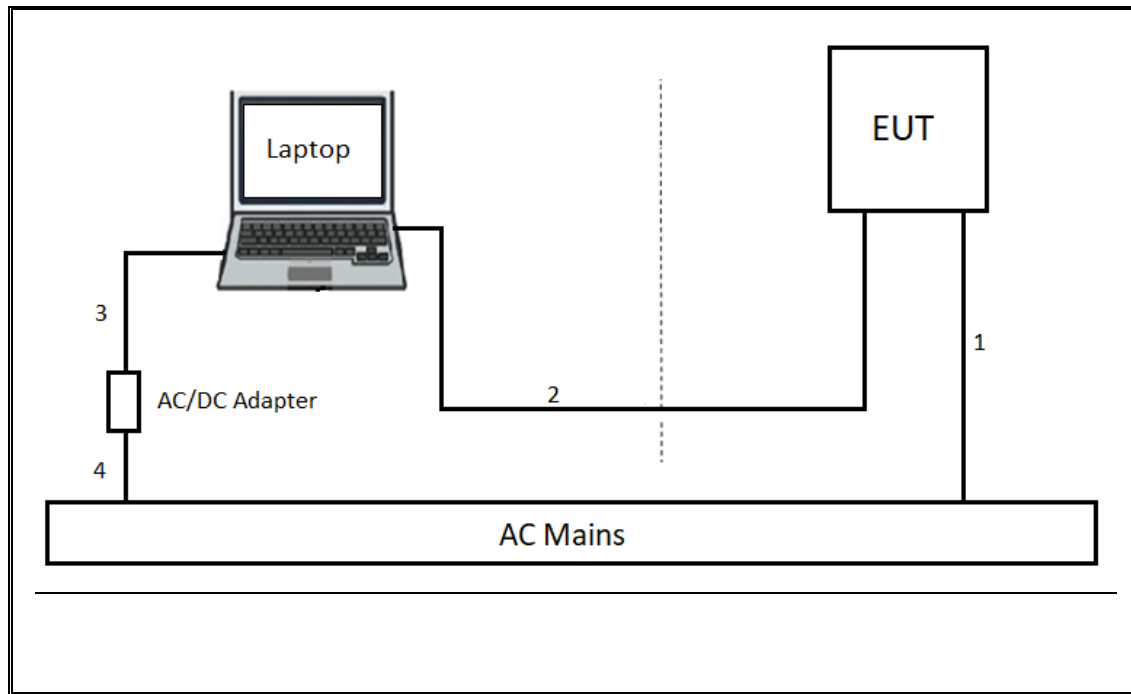
I/O CABLES

| I/O Cable List | | | | | | |
|----------------|----------|----------------|----------------|------------|------------------|---------------------------|
| Cable No | Port | # of identical | Connector Type | Cable Type | Cable Length (m) | Remarks |
| 1 | AC Power | 1 | AC | Unshielded | 2 | AC Mains to EUT |
| 2 | Ethernet | 1 | RJ45 | Unshielded | 10 | EUT to Laptop |
| 3 | DC Power | 1 | DC | Shielded | 1.2 | AC/DC Adapter to Laptop |
| 4 | AC Power | 1 | AC | Unshielded | 1 | AC Mains to AC/DC Adapter |

TEST SETUP

The EUT connected to support laptop via the ethernet cable during testing.
The test utility software on support laptop exercised the radio card.
For radiated testing, the support laptop was set up outside the chamber.

SETUP DIAGRAMS



6. MEASUREMENT METHOD

On Time and Duty Cycle: ANSI C63.10-2013 Section 11.6.

6 dB BW: ANSI C63.10 Section 11.8.1

Occupied BW (99%): ANSI C63.10-2013 Section 6.9.3

Output Power: ANSI C63.10 Section 11.9.1.3 Method PKPM1 (Peak-reading power meter).

Output Power: ANSI C63.10 Section 11.9.2.3.2 Method AVGPM-G (Measurement using a gated RF average-reading power meter)

Power Spectral Density: ANSI C63.10 Section 11.10.2 Method PKPSD (peak PSD)

Band-edge: ANSI C63.10 Section 11.13.3.4 Trace averaging across ON and OFF times of the EUT transmissions followed by duty cycle correction factor

Radiated emissions non-restricted frequency bands: ANSI C63.10 Section 11.11

Radiated emissions restricted frequency bands: ANSI C63.10 Section 11.12.1

Radiated Spurious Emissions Below 30MHz: ANSI C63.10-2013 Section 6.4

Conducted emissions in restricted frequency bands: ANSI C63.10 Section 11.12.

AC Power Line Conducted Emissions: ANSI C63.10-2013, Section 6.2.

7. 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 |
| Spectrum Analyzer, PXA, 3Hz to 44GHz | Keysight Technologies (Formerly Agilent) | N9030A | T908 | 01/23/2020 | 01/23/2019 |
| RF Amplifier, 1-18GHz | MITEQ | AFS42-00101800-25-S-42 | T1165 | 11/06/2020 | 11/06/2019 |
| Antenna, Horn 1-18GHz | ETS-Lindgren | 3117 | T346 | 05/14/2020 | 05/14/2019 |
| EMI TEST RECEIVER | Rohde & Schwarz | ESW44 | PRE0179376 | 02/14/2020 | 02/14/2019 |
| Amplifier, 9KHz to 1GHz, 32dB | SONOMA INSTRUMENT | 310 | PRE0180175 | 05/29/2020 | 06/29/2019 |
| Antenna, Broadband Hybrid, 30MHz to 3GHz | Sunol Sciences Corp. | JB3 | PRE0184052 | 11/12/2020 | 11/12/2019 |
| RF Amplifier, 1-18GHz | MITEQ | AFS42-00101800-25-S-42 | 171460 | 08/24/2020 | 08/24/2019 |
| Antenna, Horn 1-18GHz | ETS-Lindgren | 3117 | T862 | 06/05/2020 | 06/05/2019 |
| Antenna, Active Loop 9KHz to 30MHz | COM-POWER | AL-130R | PRE0165308 | 04/11/2020 | 04/11/2019 |
| Antenna, Horn 18 to 26.5GHz | ARA | MWH-1826/B | T447 | 08/13/2020 | 08/13/2019 |
| Rf Amplifier, 18-26.5GHz, 60dB gain | AMPLICAL | Rf Amplifier, 18-26.5GHz, 60dB gain | PRE0181238 | 05/01/2020 | 05/01/2019 |
| Power Meter, P-series single channel | Agilent (Keysight) Technologies | N1911A | T1265 | 01/29/2020 | 01/29/2019 |
| Power Sensor, P-series, 50MHz to 18GHz, Wideband | Agilent (Keysight) Technologies | N1921A | T1227 | 02/05/2020 | 02/05/2019 |
| Spectrum Analyzer, PXA, 3Hz to 44GHz | Keysight Technologies (Formerly Agilent) | N9030A | T917 | 01/24/2020 | 01/24/2019 |
| Spectrum Analyzer, PSA, 3Hz to 26.5GHz | Keysight Technologies (Formerly Agilent) | E4440A | T200 | 01/28/2020 | 01/28/2019 |
| AC Line Conducted | | | | | |
| EMI Receiver | Rohde & Schwarz | ESR | T1436 | 02/14/2020 | 02/14/2019 |
| LISN for Conducted Emissions CISPR-16 | FCC INC. | FCC LISN 50/250 | T1310 | 01/24/2020 | 01/24/2019 |
| Test Software List | | | | | |
| Radiated Software | UL | UL EMC | Ver 9.5, September 24, 2019 | | |
| Antenna Port Software | UL | UL RF | Ver 2019.10.18, October 18, 2019 | | |
| AC Line Conducted Software | UL | UL EMC | Ver 9.5, May 26, 2015 | | |

8. ANTENNA PORT TEST RESULTS

8.1. ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

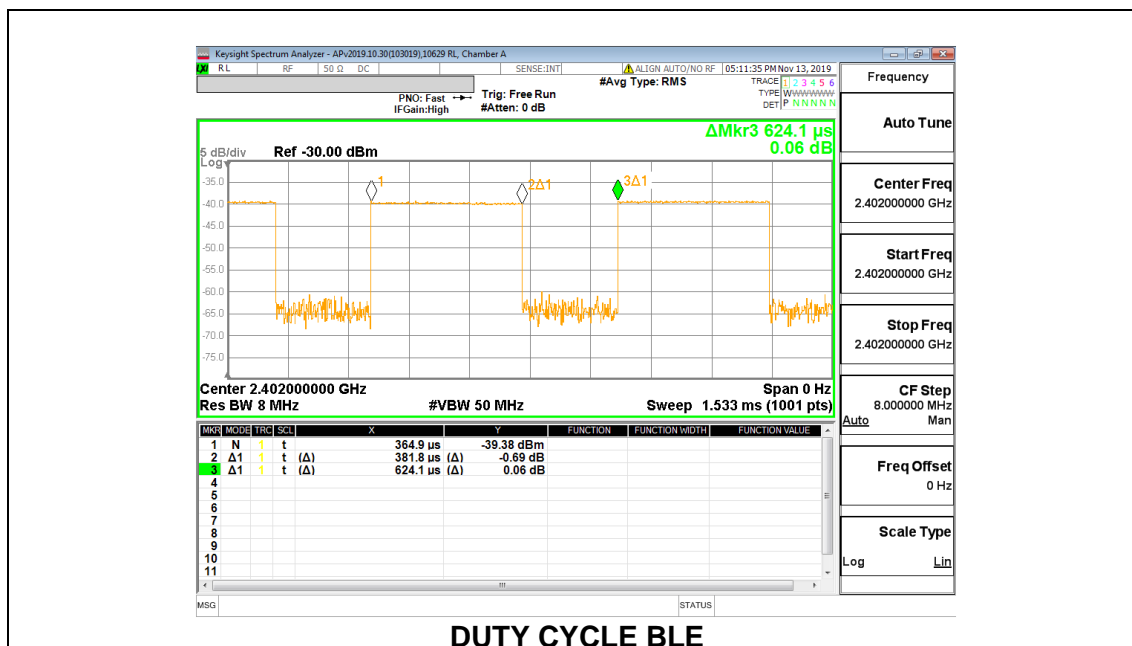
PROCEDURE

KDB 558074 Zero-Span Spectrum Analyzer Method.

ON TIME AND DUTY CYCLE RESULTS

| Mode | ON Time B (msec) | Period (msec) | Duty Cycle x (linear) | Duty Cycle (%) | Duty Cycle Correction Factor (dB) | 1/B Minimum VBW (kHz) |
|------|------------------------|------------------|-----------------------------|----------------------|---|-----------------------------|
| BLE | 0.382 | 0.624 | 0.612 | 61.18 | 2.13 | 2.619 |

DUTY CYCLE PLOTS



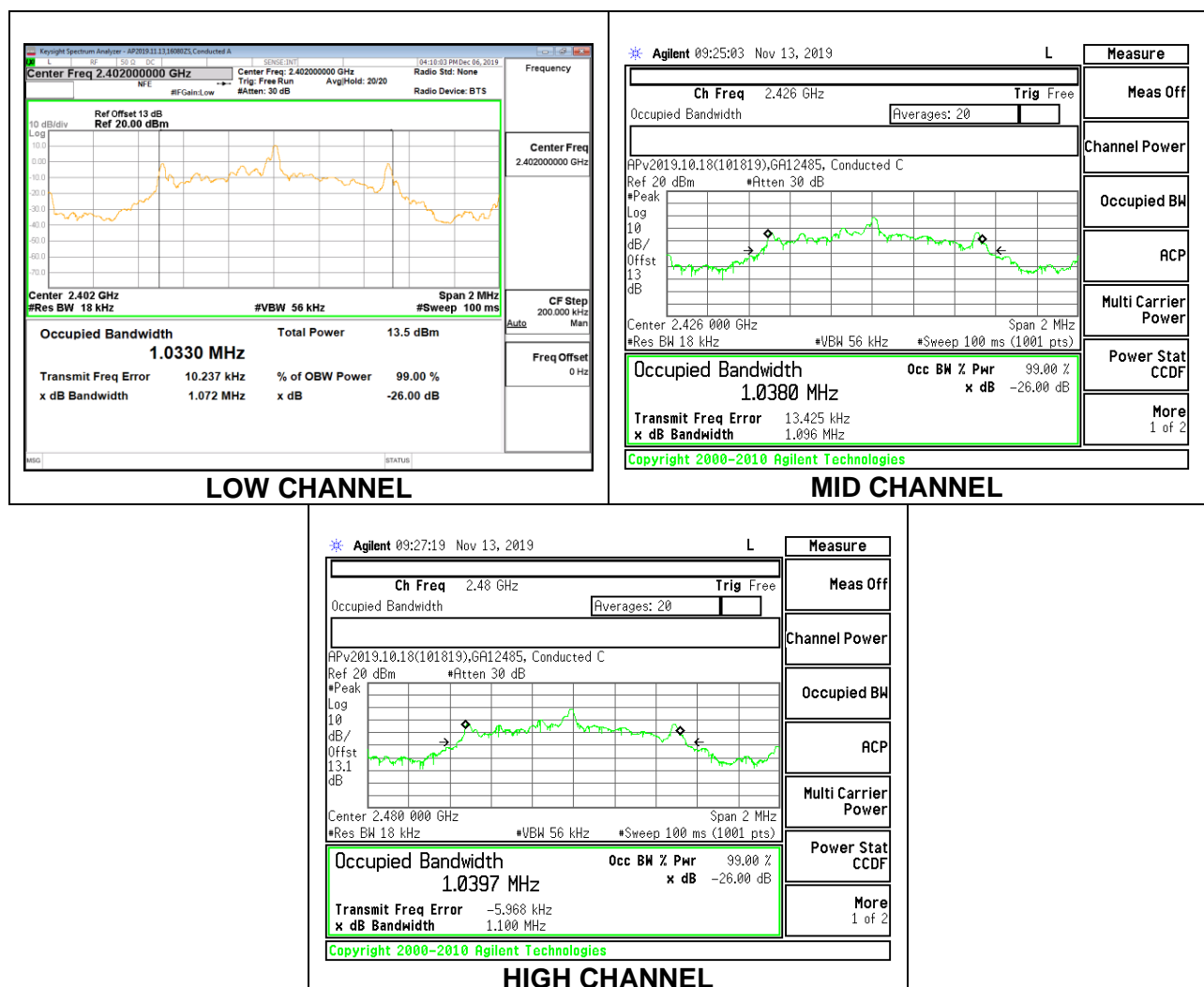
8.2. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

RESULTS

| Channel | Frequency (MHz) | 99% Bandwidth (MHz) |
|---------|-----------------|---------------------|
| Low | 2402 | 1.033 |
| Middle | 2426 | 1.038 |
| High | 2480 | 1.040 |



8.3. 6 dB BANDWIDTH

LIMITS

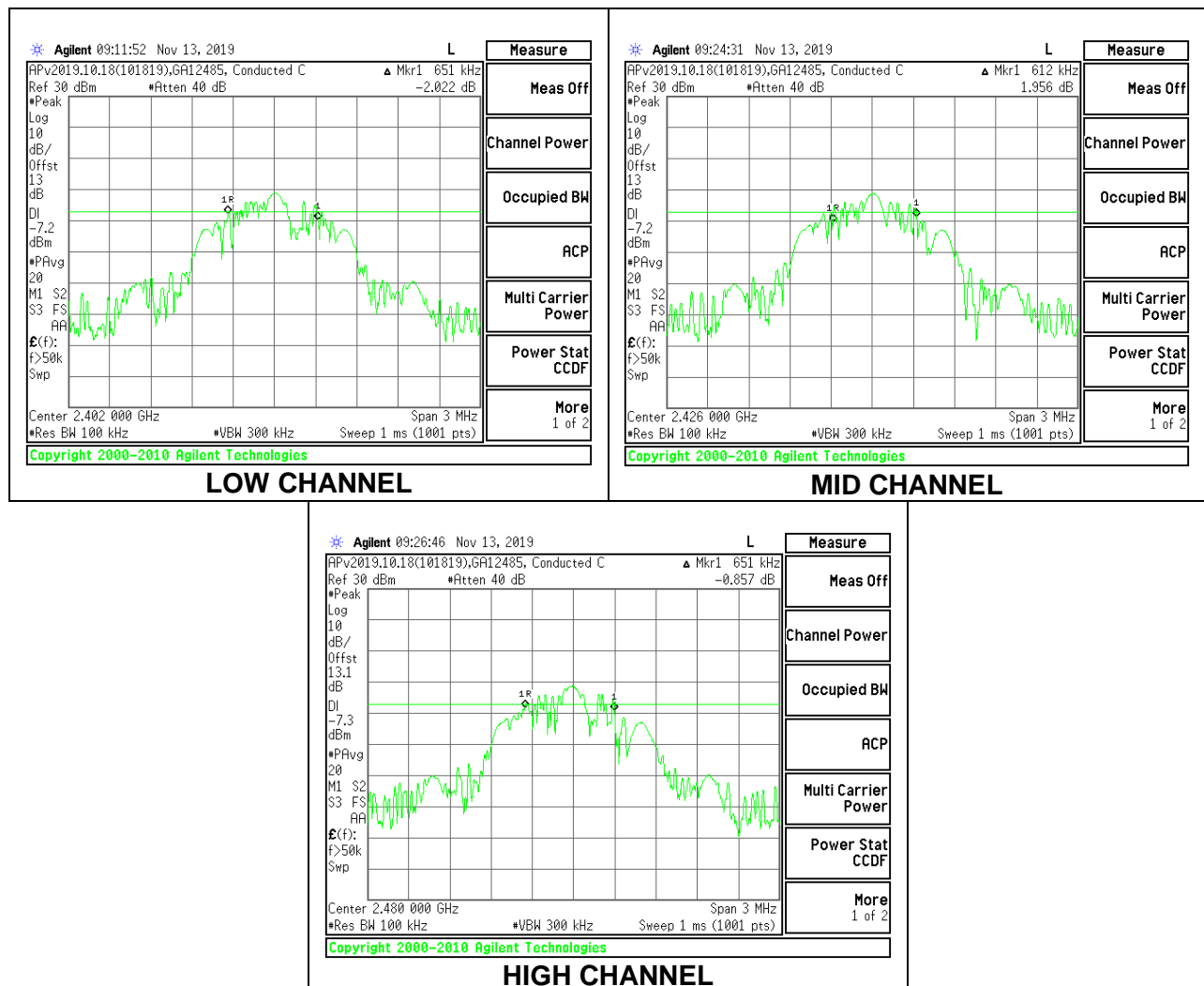
FCC §15.247 (a) (2)

RSS-247 5.2 (a)

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

RESULTS

| Channel | Frequency (MHz) | 6 dB Bandwidth (MHz) | Minimum Limit (MHz) |
|---------|-----------------|----------------------|---------------------|
| Low | 2402 | 0.651 | 0.5 |
| Middle | 2426 | 0.612 | 0.5 |
| High | 2480 | 0.651 | 0.5 |



8.4. OUTPUT POWER

LIMITS

FCC §15.247 (b) (3)

RSS-247 5.4 (d)

The maximum antenna gain is less than or equal to 6 dBi, therefore the limit is 30 dBm.

TEST PROCEDURE

The transmitter output is connected to a power meter. The cable assembly insertion loss was entered as an offset in the power meter to allow for a gated RF peak reading of power.

RESULTS

| | |
|-------------------|------------|
| Tested By: | 12485 GA |
| Date: | 11/13/2019 |

| Channel | Frequency (MHz) | Peak Power Reading (dBm) | Limit (dBm) | Margin (dB) |
|----------------|----------------------------|---|------------------------|------------------------|
| Low | 2402 | -0.28 | 30 | -30.280 |
| Middle | 2440 | -0.11 | 30 | -30.110 |
| High | 2480 | -0.13 | 30 | -30.132 |

8.5. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss was entered as an offset in the power meter to allow for a gated average reading of power.

RESULTS

| | |
|-------------------|------------|
| Tested By: | 12485 GA |
| Date: | 11/13/2019 |

| Channel | Frequency (MHz) | AV power (dBm) |
|----------------|----------------------------|---------------------------|
| Low | 2402 | -0.86 |
| Middle | 2426 | -0.70 |
| High | 2480 | -0.66 |

8.6. POWER SPECTRAL DENSITY

LIMITS

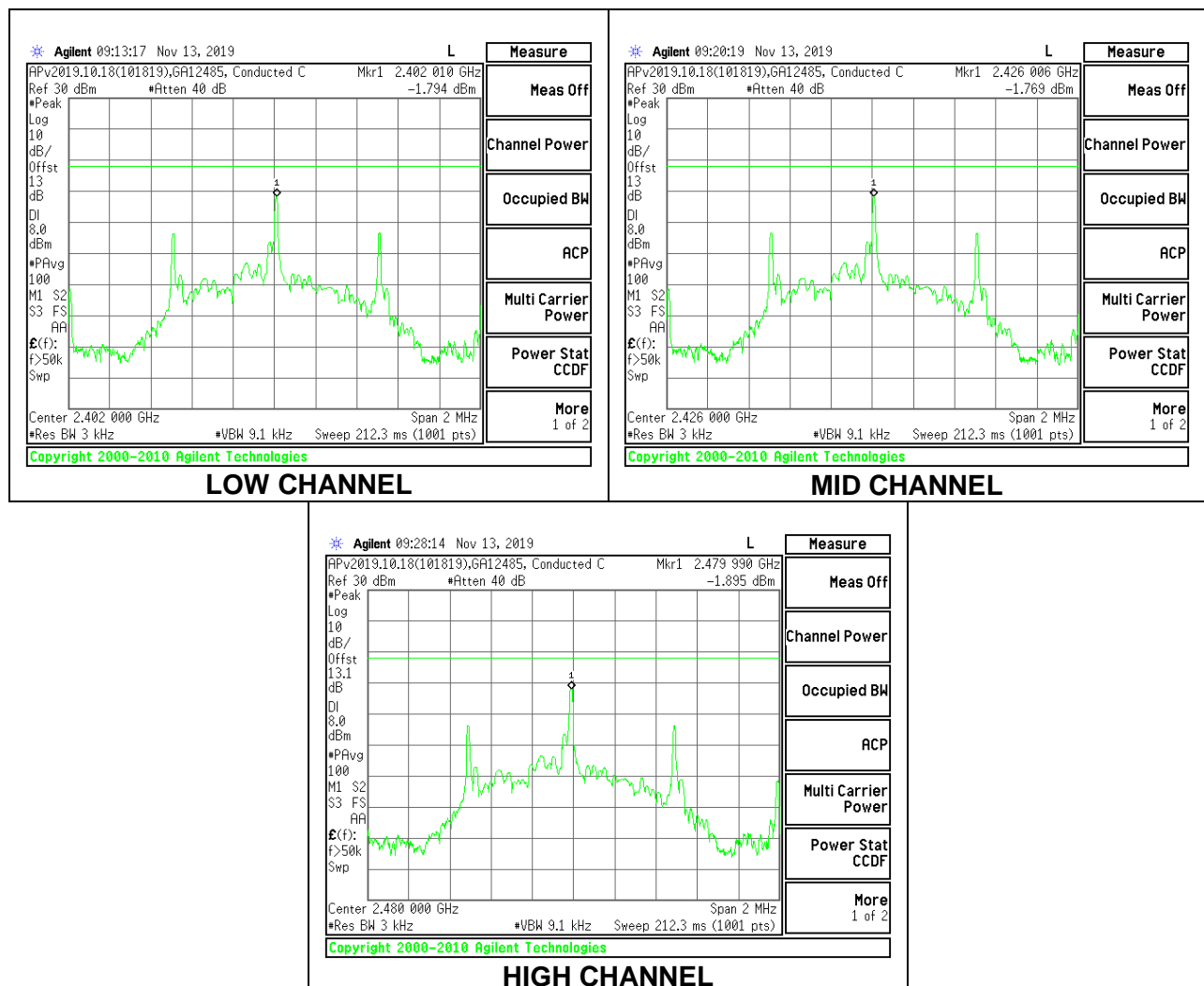
FCC §15.247 (e)

RSS-247 (5.2) (b)

The power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

RESULTS

| Channel | Frequency (MHz) | PSD (dBm/3kHz) | Limit (dBm/3kHz) | Margin (dB) |
|---------|-----------------|----------------|------------------|-------------|
| Low | 2402 | -1.79 | 8 | -9.79 |
| Middle | 2426 | -1.77 | 8 | -9.77 |
| High | 2480 | -1.90 | 8 | -9.90 |



8.7. CONDUCTED SPURIOUS EMISSIONS

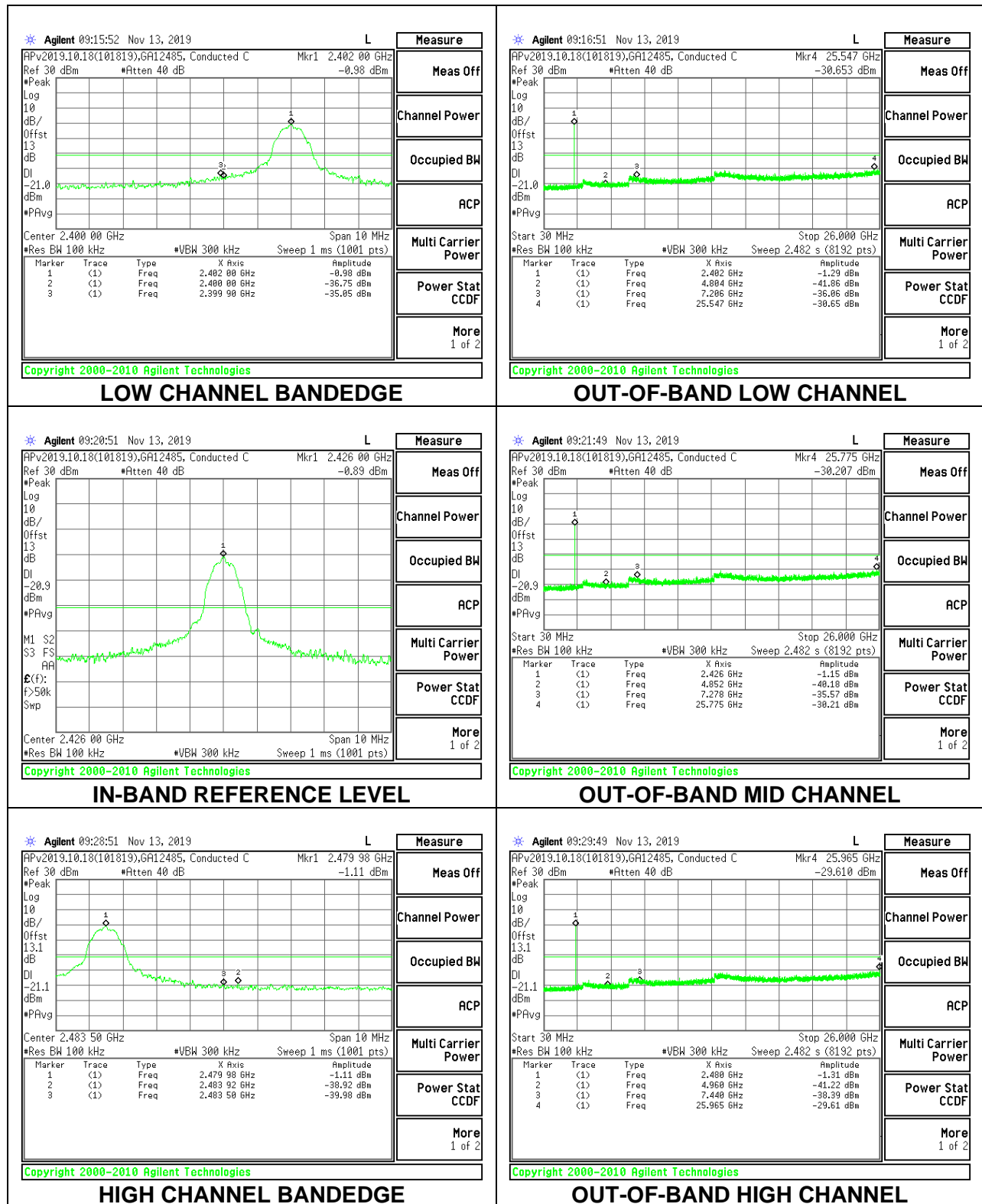
LIMITS

FCC §15.247 (d)

RSS-247 5.5

Output power was measured based on the use of a peak measurement, therefore the required attenuation is 20 dB.

RESULTS



9. RADIATED TEST RESULTS

9.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205 and §15.209

RSS-GEN, Section 8.9 and 8.10.

| 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 80 cm above the ground plane for measurement below 1GHz; 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 measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

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. Below 1GHz and above 18GHz emissions, the channel with the highest output power was tested.

The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize 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.

2D antenna use - For below 30MHz testing, investigation was done on three antenna orientations (parallel, perpendicular, and ground-parallel), parallel and perpendicular are the worst orientations, therefore testing was performed on these two orientations only.

KDB 414788 Open Field Site(OFS) and Chamber Correlation Justification

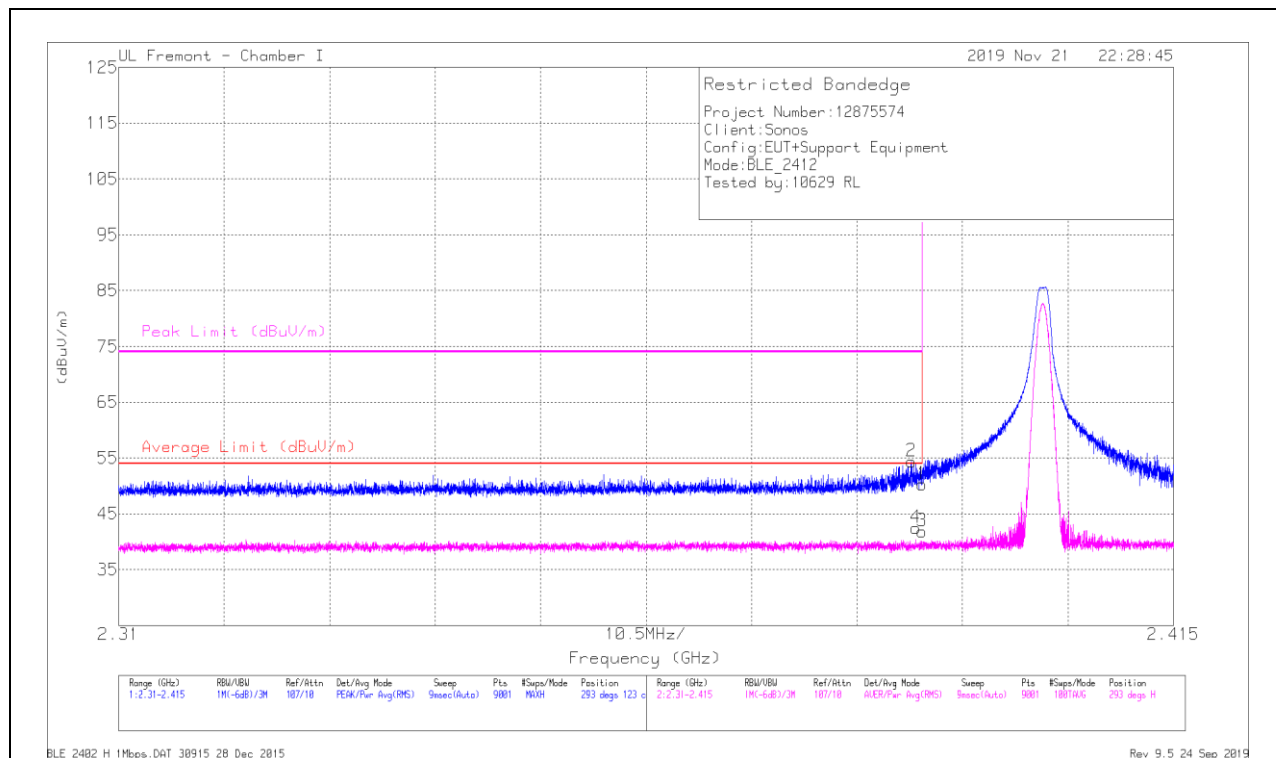
Base on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field.

OFS and chamber correlation testing had been performed and chamber measured test result is the worst case test result.

9.2. TRANSMITTER ABOVE 1 GHz

BANDEDGE (LOW CHANNEL)

HORIZONTAL RESULT



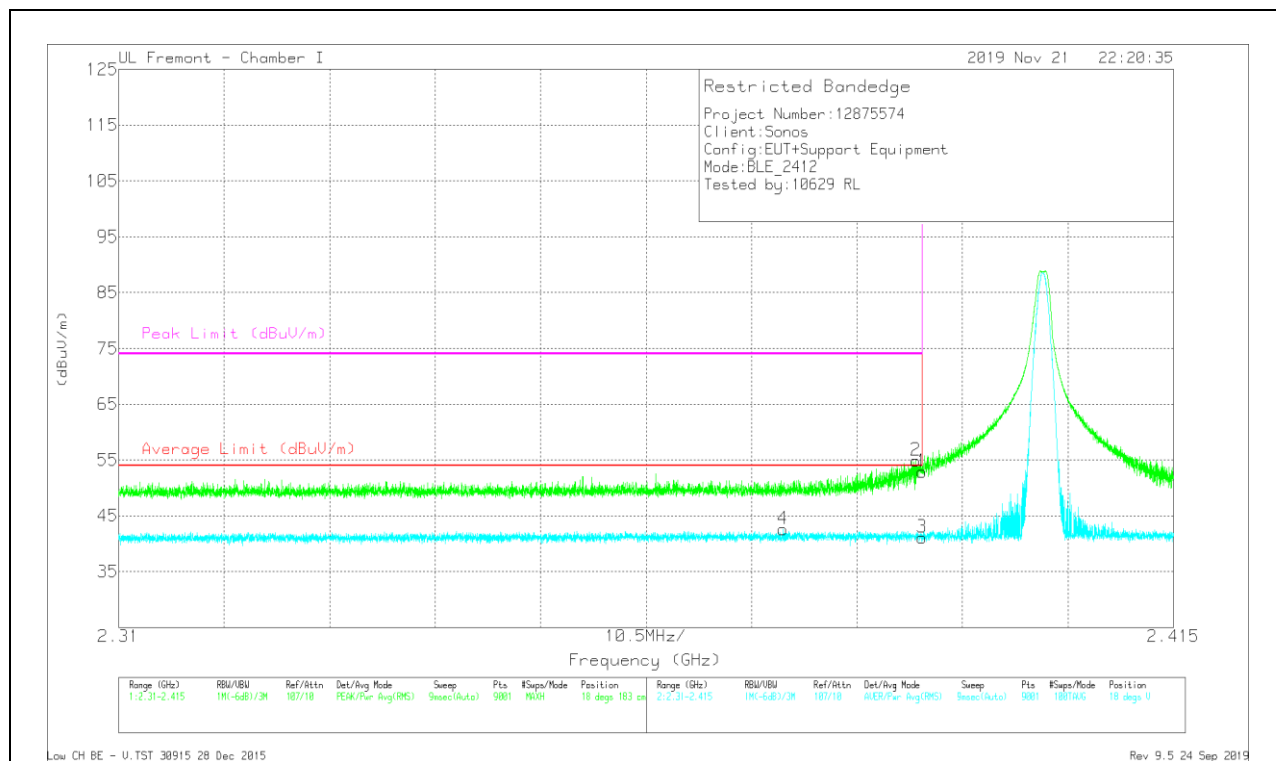
| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AF T602 (dBm) | Amp/Cat/Ret/Pad (dB) | DC Corr (dB) | Corrected Reading (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|---------------|----------------------|--------------|----------------------------|------------------------|-------------|---------------------|----------------|----------------|-------------|----------|
| 1 | * 2.38999 | 38.14 | Pk | 31.9 | -19.7 | 0 | 50.34 | - | - | 74 | -23.66 | 293 | 123 | H |
| 2 | * 2.3899 | 42.18 | Pk | 31.9 | -19.7 | 0 | 54.38 | - | - | 74 | -19.62 | 293 | 123 | H |
| 3 | * 2.38999 | 27.52 | RMS | 31.9 | -19.7 | 2.13 | 41.85 | 54 | -12.15 | - | - | 293 | 123 | H |
| 4 | * 2.38937 | 28.11 | RMS | 31.9 | -19.7 | 2.13 | 42.44 | 54 | -11.56 | - | - | 293 | 123 | H |

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

RMS - RMS detection

VERTICAL RESULT



| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AF T862 (dBm) | Amplifier/Filter Pad (dB) | DC Corr (dB) | Corrected Reading (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Acimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|---------------|---------------------------|--------------|----------------------------|------------------------|-------------|---------------------|----------------|----------------|-------------|----------|
| 1 | * 2.38999 | 40.74 | Pk | 31.9 | -19.7 | 0 | 52.94 | - | - | 74 | -21.06 | 18 | 183 | V |
| 2 | * 2.38935 | 42.69 | Pk | 31.9 | -19.7 | 0 | 54.89 | - | - | 74 | -19.11 | 18 | 183 | V |
| 3 | * 2.38999 | 26.83 | RMS | 31.9 | -19.7 | 2.13 | 41.16 | 54 | -12.84 | - | - | 18 | 183 | V |
| 4 | * 2.37615 | 28.21 | RMS | 31.9 | -19.7 | 2.13 | 42.54 | 54 | -11.46 | - | - | 18 | 183 | V |

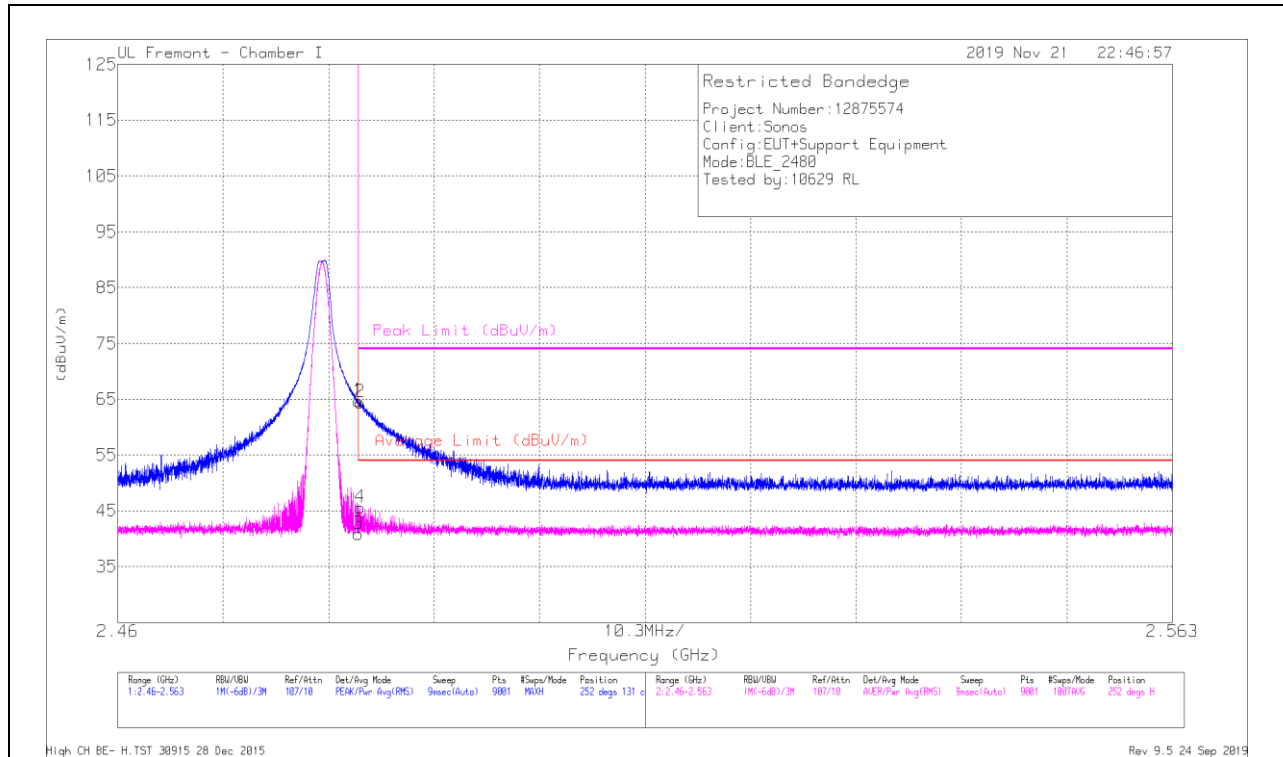
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

RMS - RMS detection

BANDEDGE (HIGH CHANNEL)

HORIZONTAL RESULT



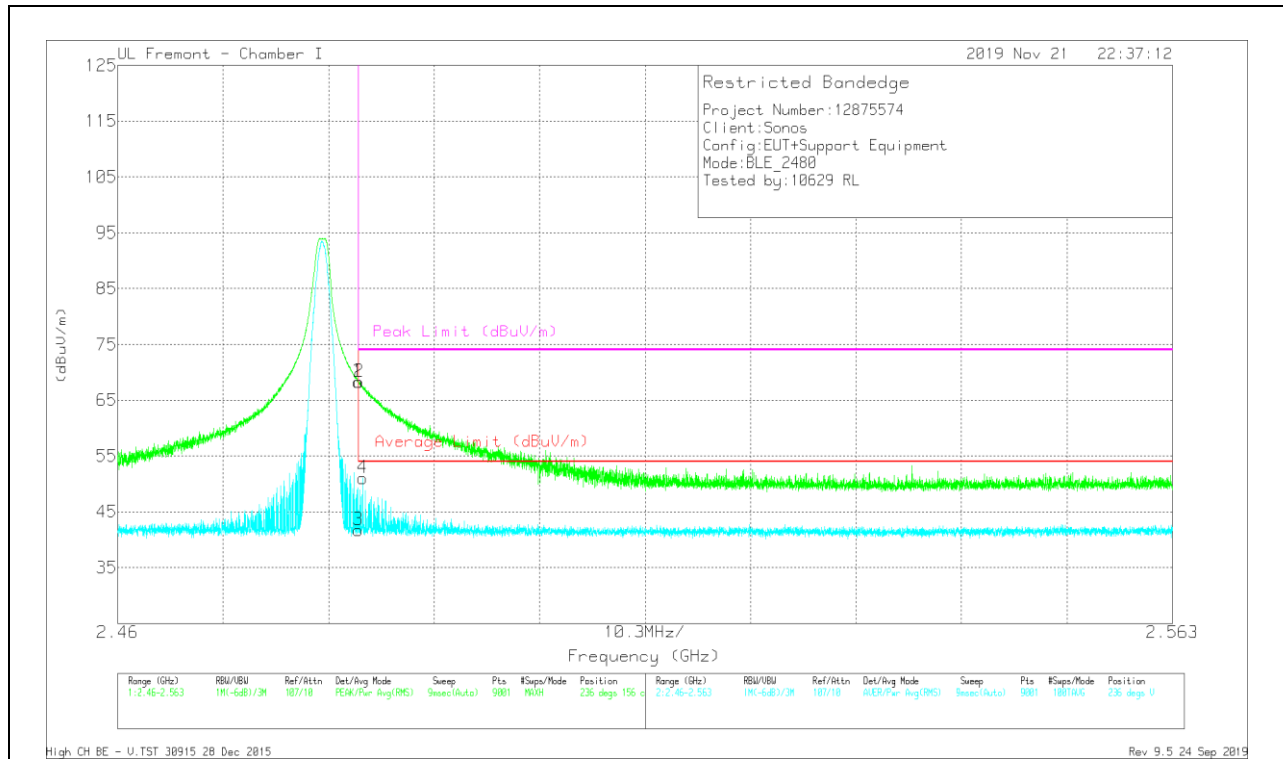
| Marker | Frequency (GHz) | Meter Reading (dBUV) | Det | AF T862 (dBm) | Amp/Cd/F1tr/Pad (dB) | DC Corr (dB) | Corrected Reading (dBUV/m) | Average Limit (dBUV/m) | Margin (dB) | Peak Limit (dBUV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|---------------|----------------------|--------------|----------------------------|------------------------|-------------|---------------------|----------------|----------------|-------------|----------|
| 1 | * 2.48351 | 52.24 | Pk | 32.4 | -20 | 0 | 64.64 | - | - | 74 | -9.36 | 252 | 131 | H |
| 2 | * 2.48365 | 52.09 | Pk | 32.4 | -20 | 0 | 64.49 | - | - | 74 | -9.51 | 252 | 131 | H |
| 3 | * 2.48351 | 26.29 | RMS | 32.4 | -20 | 2.13 | 40.82 | 54 | -13.18 | - | - | 252 | 131 | H |
| 4 | * 2.48365 | 31.1 | RMS | 32.4 | -20 | 2.13 | 45.63 | 54 | -8.37 | - | - | 252 | 131 | H |

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

RMS - RMS detection

VERTICAL RESULT



| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AF T862 (dBm) | Ampl/Clm/Fltr/Pad (dB) | DC Corr (dB) | Corrected Reading (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Altitude (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|---------------|------------------------|--------------|----------------------------|------------------------|-------------|---------------------|----------------|-----------------|-------------|----------|
| 1 | * 2.48351 | 55.93 | Pk | 32.4 | -20 | 0 | 68.33 | - | - | 74 | -5.67 | 236 | 156 | V |
| 2 | * 2.48354 | 55.89 | Pk | 32.4 | -20 | 0 | 68.29 | - | - | 74 | -5.71 | 236 | 156 | V |
| 3 | * 2.48351 | 27.24 | RMS | 32.4 | -20 | 2.13 | 41.77 | 54 | -12.23 | - | - | 236 | 156 | V |
| 4 | * 2.48392 | 36.46 | RMS | 32.4 | -20 | 2.13 | 50.99 | 54 | -3.01 | - | - | 236 | 156 | V |

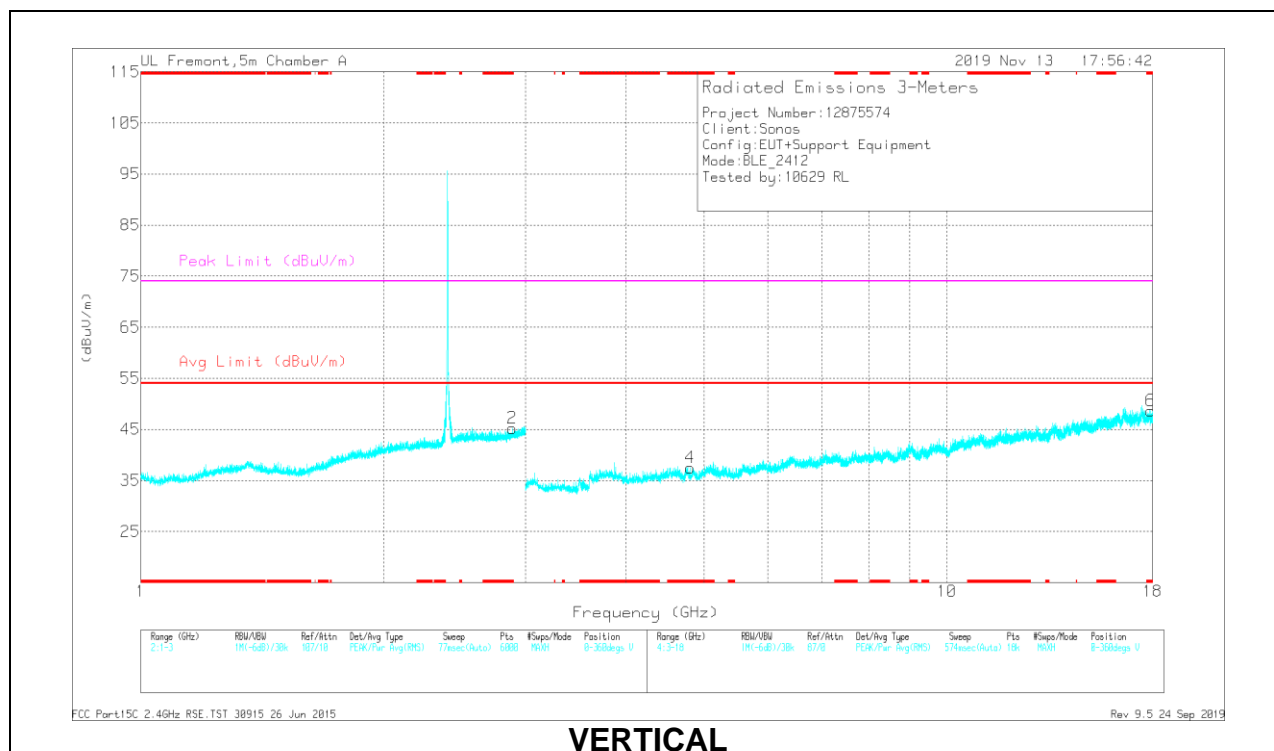
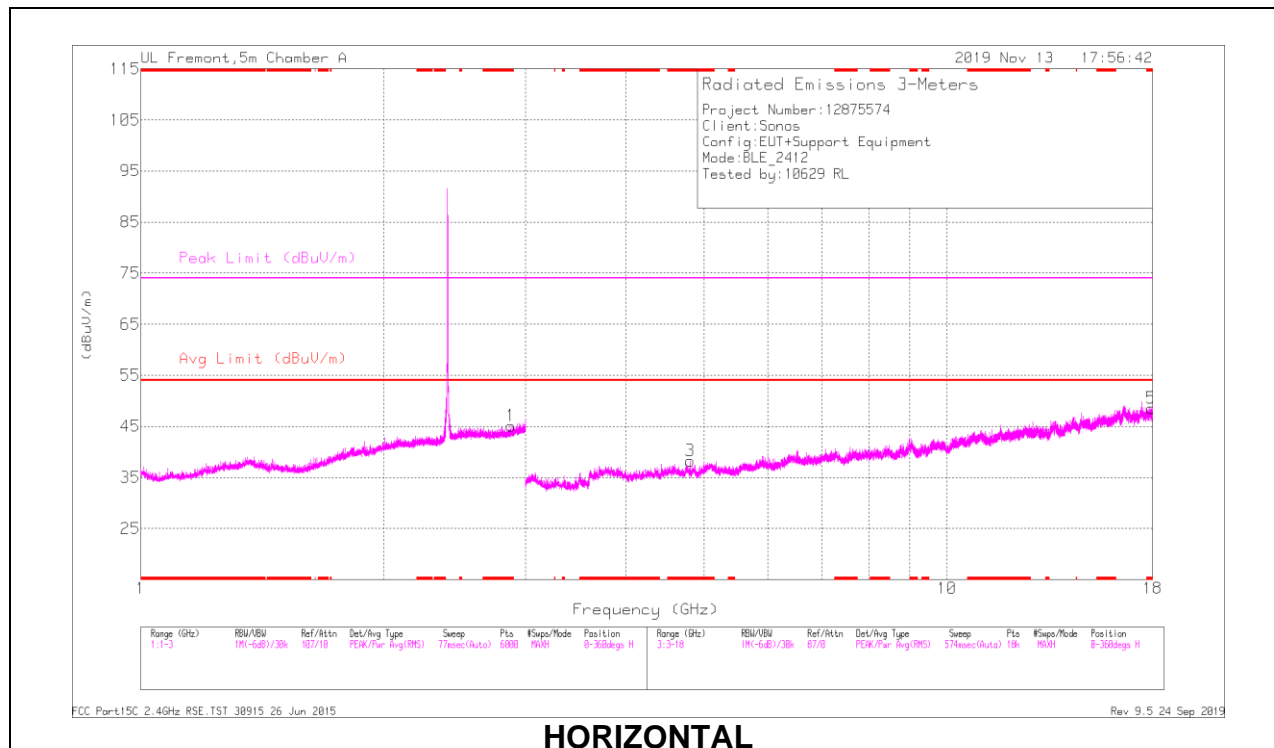
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

RMS - RMS detection

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



RADIATED EMISSIONS

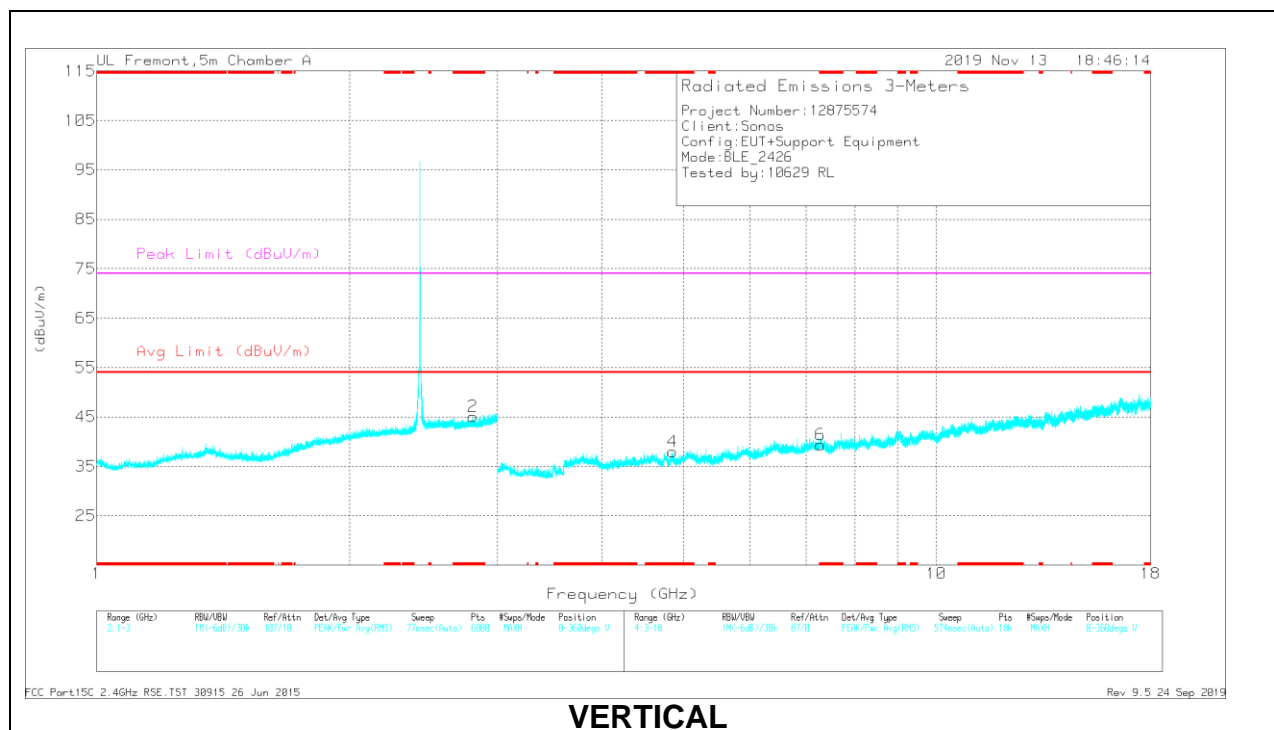
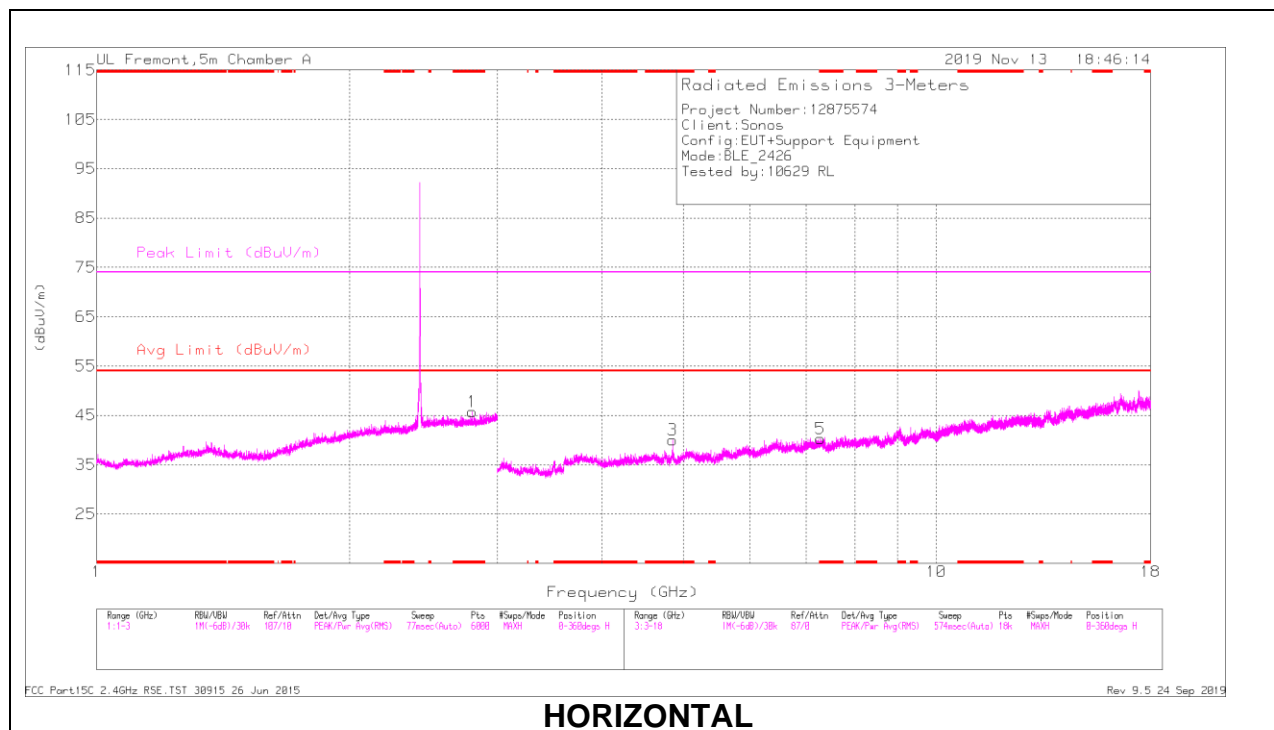
| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AF T346 (dB/m) | Amp/Cbl/Fitr/Pad (dB) | DC Corr (dB) | Corrected Reading (dBuV/m) | Avg Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|------|----------------|-----------------------|--------------|----------------------------|--------------------|-------------|---------------------|----------------|----------------|-------------|----------|
| 1 | * 2.87976 | 40.33 | PK2 | 32.6 | -22.3 | 0 | 50.63 | - | - | 74 | -23.37 | 241 | 126 | H |
| | * 2.87695 | 28.49 | MAv1 | 32.6 | -22.3 | 2.13 | 40.92 | 54 | -13.08 | - | - | 241 | 126 | H |
| 2 | * 2.89057 | 40.52 | PK2 | 32.6 | -22.3 | 0 | 50.82 | - | - | 74 | -23.18 | 87 | 120 | V |
| | * 2.88761 | 28.61 | MAv1 | 32.6 | -22.3 | 2.13 | 41.04 | 54 | -12.96 | - | - | 87 | 120 | V |
| 3 | * 4.8036 | 38.47 | PK2 | 34.3 | -27.5 | 0 | 45.27 | - | - | 74 | -28.73 | 335 | 177 | H |
| | * 4.80398 | 29.25 | MAv1 | 34.4 | -27.5 | 2.13 | 38.28 | 54 | -15.72 | - | - | 335 | 177 | H |
| 5 | * 17.93125 | 32.92 | PK2 | 41 | -19 | 0 | 54.92 | - | - | 74 | -19.08 | 56 | 135 | H |
| | * 17.92915 | 20.81 | MAv1 | 41 | -18.9 | 2.13 | 45.04 | 54 | -8.96 | - | - | 56 | 135 | H |
| 4 | * 4.8039 | 38.33 | PK2 | 34.4 | -27.5 | 0 | 45.23 | - | - | 74 | -28.77 | 205 | 193 | V |
| | * 4.8039 | 28.68 | MAv1 | 34.4 | -27.5 | 2.13 | 37.71 | 54 | -16.29 | - | - | 205 | 193 | V |
| 6 | * 17.90721 | 32.65 | PK2 | 40.9 | -18.6 | 0 | 54.95 | - | - | 74 | -19.05 | 351 | 102 | V |
| | * 17.90888 | 20.87 | MAv1 | 41 | -18.5 | 2.13 | 45.5 | 54 | -8.5 | - | - | 351 | 102 | V |

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

PK2 - KDB558074 Method: Maximum Peak

MAv1 - KDB558074 Option 1 Maximum RMS Average

MID CHANNEL RESULTS



RADIATED EMISSIONS

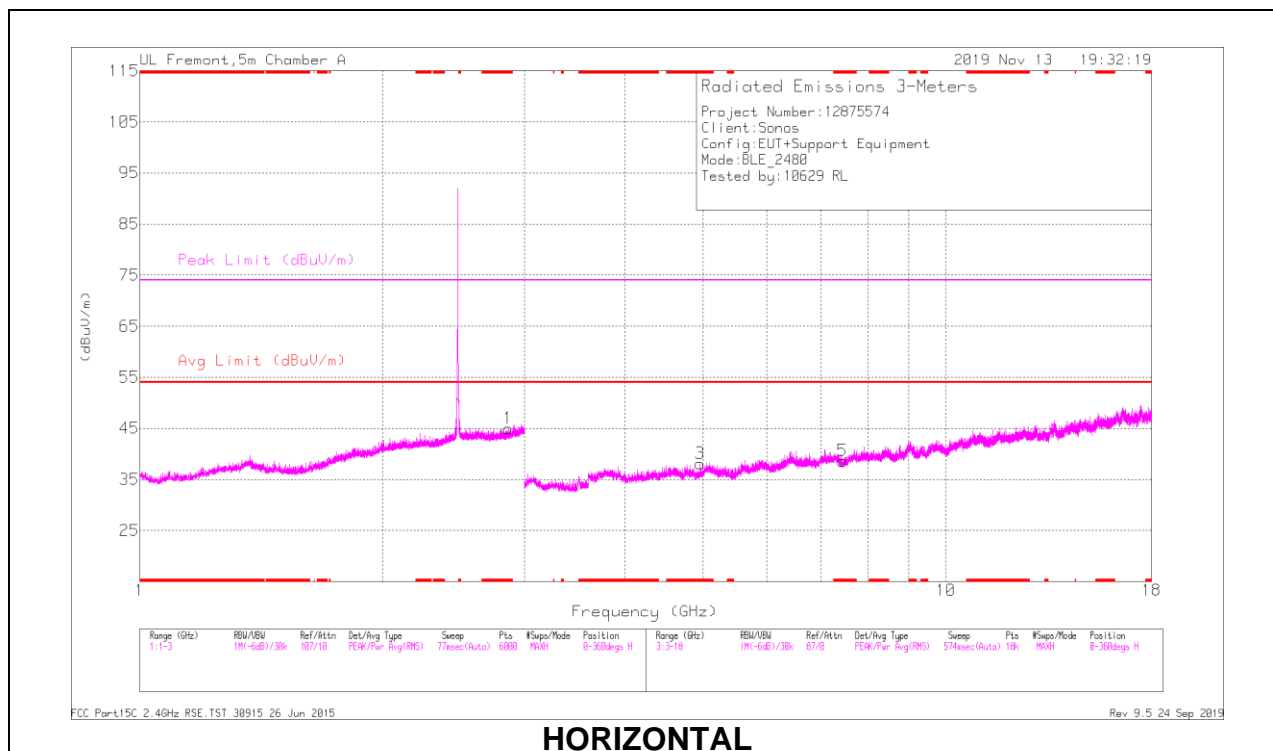
| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AF T346 (dB/m) | Amp/Cb/Filt/Pad (dB) | DC Corr (dB) | Corrected Reading (dBuV/m) | Avg Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|------|----------------|----------------------|--------------|----------------------------|--------------------|-------------|---------------------|----------------|----------------|-------------|----------|
| 1 | * 2.80506 | 40.44 | PK2 | 32.5 | -22.7 | 0 | 50.24 | - | - | 74 | -23.76 | 341 | 169 | H |
| | * 2.80251 | 28.74 | MAv1 | 32.6 | -22.7 | 2.13 | 40.77 | 54 | -13.23 | - | - | 341 | 169 | H |
| 2 | * 2.80595 | 40.47 | PK2 | 32.6 | -22.7 | 0 | 50.37 | - | - | 74 | -23.63 | 187 | 102 | V |
| | * 2.80451 | 28.7 | MAv1 | 32.5 | -22.7 | 2.13 | 40.63 | 54 | -13.37 | - | - | 187 | 102 | V |
| 3 | * 4.85217 | 40.88 | PK2 | 34.2 | -28.2 | 0 | 46.88 | - | - | 74 | -27.12 | 335 | 178 | H |
| | * 4.85196 | 31.2 | MAv1 | 34.2 | -28.2 | 2.13 | 39.33 | 54 | -14.67 | - | - | 335 | 178 | H |
| 5 | * 7.27455 | 33.98 | PK2 | 35.8 | -23.4 | 0 | 46.38 | - | - | 74 | -27.62 | 113 | 141 | H |
| | * 7.27566 | 22.46 | MAv1 | 35.8 | -23.4 | 2.13 | 36.99 | 54 | -17.01 | - | - | 113 | 141 | H |
| 4 | * 4.85205 | 38.96 | PK2 | 34.2 | -28.2 | 0 | 44.96 | - | - | 74 | -29.04 | 207 | 196 | V |
| | * 4.85193 | 29.09 | MAv1 | 34.2 | -28.2 | 2.13 | 37.22 | 54 | -16.78 | - | - | 207 | 196 | V |
| 6 | * 7.27745 | 34.09 | PK2 | 35.7 | -23.4 | 0 | 46.39 | - | - | 74 | -27.61 | 202 | 175 | V |
| | * 7.27782 | 22.3 | MAv1 | 35.7 | -23.4 | 2.13 | 36.73 | 54 | -17.27 | - | - | 202 | 175 | V |

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

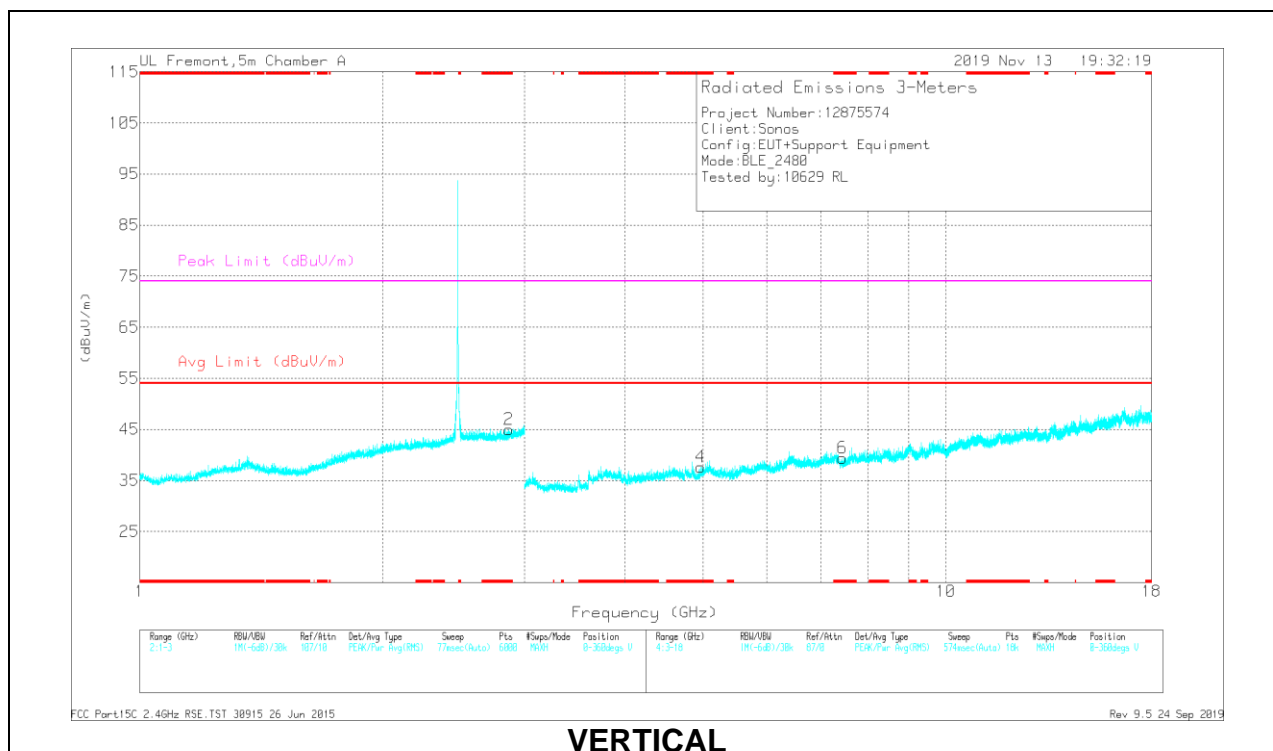
PK2 - KDB558074 Method: Maximum Peak

MAv1 - KDB558074 Option 1 Maximum RMS Average

HIGH CHANNEL RESULTS



HORIZONTAL



VERTICAL

RADIATED EMISSIONS

| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AF T346 (dB/m) | Amp/Cb/Filt/Pad (dB) | DC Corr (dB) | Corrected Reading (dBuV/m) | Avg Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|------|----------------|----------------------|--------------|----------------------------|--------------------|-------------|---------------------|----------------|----------------|-------------|----------|
| 1 | * 2.86835 | 40.7 | PK2 | 32.5 | -22.3 | 0 | 50.9 | - | - | 74 | -23.1 | 243 | 205 | H |
| | * 2.86871 | 28.59 | MAv1 | 32.5 | -22.3 | 2.13 | 40.92 | 54 | -13.08 | - | - | 243 | 205 | H |
| 2 | * 2.87219 | 40.4 | PK2 | 32.5 | -22.3 | 0 | 50.6 | - | - | 74 | -23.4 | 290 | 198 | V |
| | * 2.87169 | 28.57 | MAv1 | 32.5 | -22.3 | 2.13 | 40.9 | 54 | -13.1 | - | - | 290 | 198 | V |
| 5 | * 7.44723 | 34.26 | PK2 | 35.7 | -24.4 | 0 | 45.56 | - | - | 74 | -28.44 | 65 | 124 | H |
| | * 7.44567 | 22.32 | MAv1 | 35.7 | -24.4 | 2.13 | 35.75 | 54 | -18.25 | - | - | 65 | 124 | H |
| 3 | * 4.95919 | 39.4 | PK2 | 34.2 | -28.5 | 0 | 45.1 | - | - | 74 | -28.9 | 334 | 180 | H |
| | * 4.96003 | 29.56 | MAv1 | 34.2 | -28.5 | 2.13 | 37.39 | 54 | -16.61 | - | - | 334 | 180 | H |
| 6 | * 7.44521 | 34.02 | PK2 | 35.7 | -24.4 | 0 | 45.32 | - | - | 74 | -28.68 | 43 | 108 | V |
| | * 7.44763 | 22.31 | MAv1 | 35.7 | -24.4 | 2.13 | 35.74 | 54 | -18.26 | - | - | 43 | 108 | V |
| 4 | * 4.96077 | 38.81 | PK2 | 34.2 | -28.5 | 0 | 44.51 | - | - | 74 | -29.49 | 206 | 197 | V |
| | * 4.95981 | 29.39 | MAv1 | 34.2 | -28.5 | 2.13 | 37.22 | 54 | -16.78 | - | - | 206 | 197 | V |

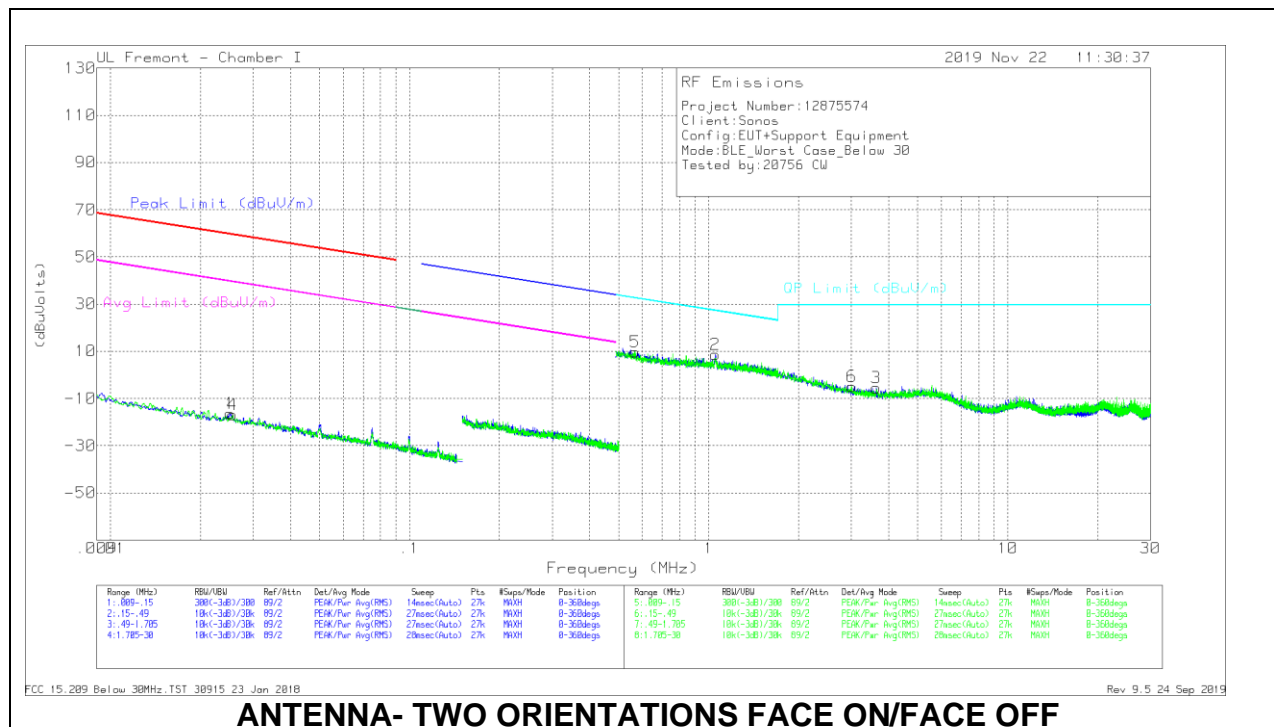
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

PK2 - KDB558074 Method: Maximum Peak

MAv1 - KDB558074 Option 1 Maximum RMS Average

9.3. WORST CASE BELOW 30MHZ

SPURIOUS EMISSIONS BELOW 30 MHz (WORST-CASE CONFIGURATION)



Below 30MHz Data

| Marker | Frequency (MHz) | Meter Reading (dBuV) | Det | Loop Antenna (dB/m) | Cables (dB) | Dist Corr 300m | Corrected Reading (dBuVolts) | Peak Limit (dBuV/m) | Margin (dB) | Avg Limit (dBuV/m) | Margin (dB) | Azimuth (Degs) |
|--------|-----------------|----------------------|-----|---------------------|-------------|----------------|------------------------------|---------------------|-------------|--------------------|-------------|----------------|
| 1 | .02516 | 48.46 | Pk | 15.1 | 0 | -80 | -16.44 | 59.57 | -76.01 | 39.57 | -56.01 | 0-360 |
| 4 | .02559 | 47.92 | Pk | 15.1 | 0 | -80 | -16.98 | 59.43 | -76.41 | 39.43 | -56.41 | 0-360 |

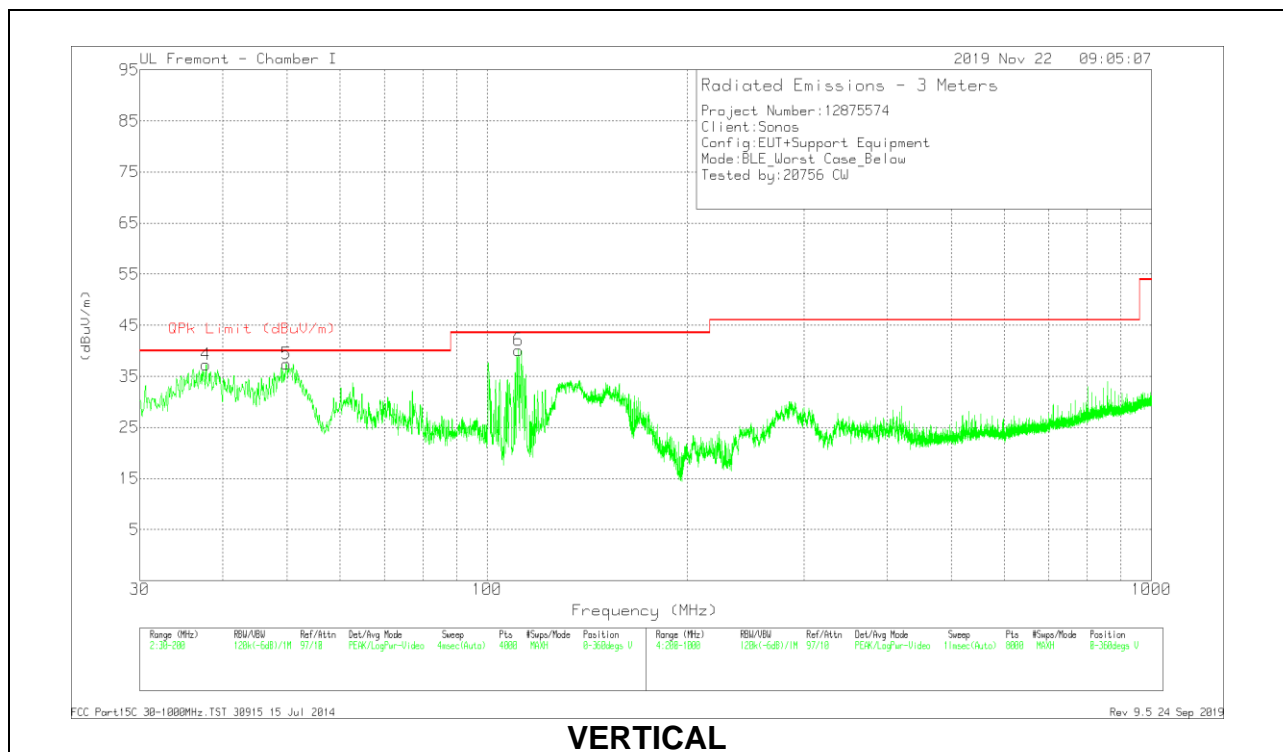
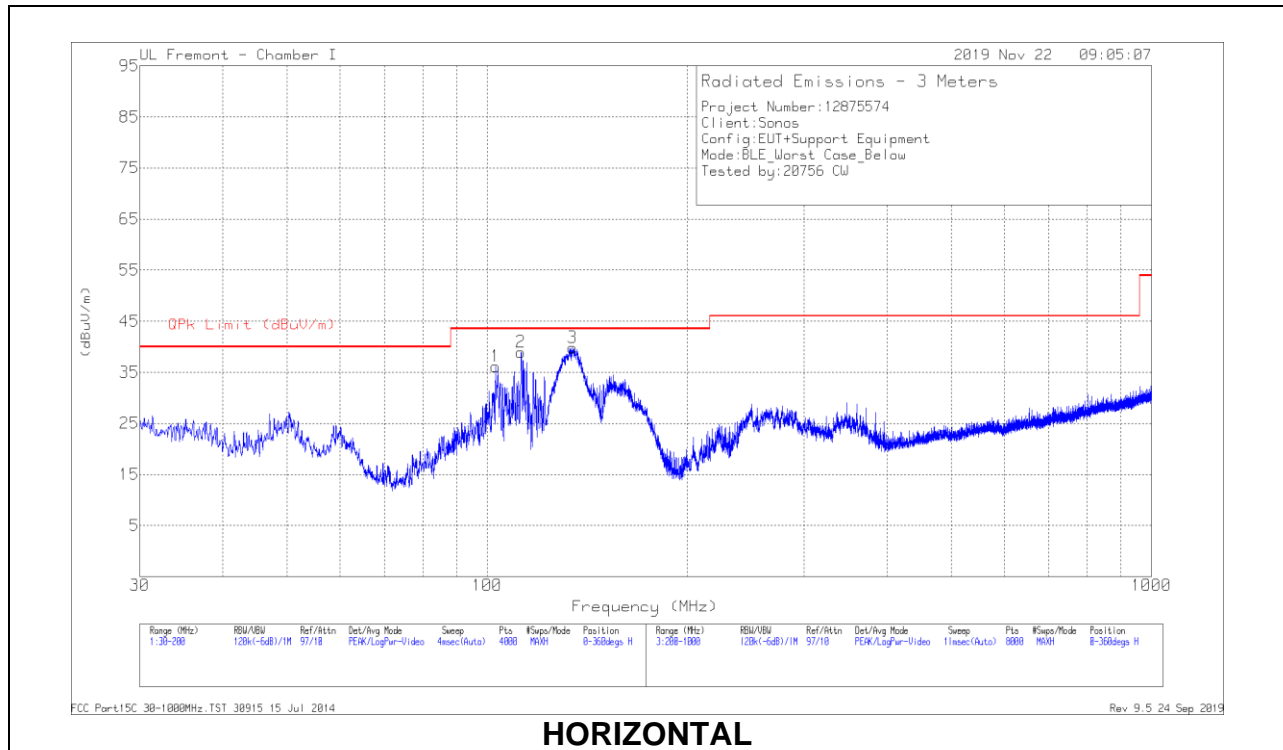
Pk - Peak detector

| Marker | Frequency (MHz) | Meter Reading (dBuV) | Det | Loop Antenna (dB/m) | Cables (dB) | Dist Corr 30m (dB) 40Log | Corrected Reading (dBuVolts) | QP Limit (dBuV/m) | Margin (dB) | Azimuth (Degs) |
|--------|-----------------|----------------------|-----|---------------------|-------------|--------------------------|------------------------------|-------------------|-------------|----------------|
| 2 | 1.05315 | 34.09 | Pk | 14.4 | .1 | -40 | 8.59 | 27.17 | -18.58 | 0-360 |
| 3 | 3.63856 | 19.41 | Pk | 14.8 | .2 | -40 | -5.59 | 29.5 | -35.09 | 0-360 |
| 5 | .56837 | 35.56 | Pk | 14.1 | .1 | -40 | 9.76 | 32.51 | -22.75 | 0-360 |
| 6 | 3.00347 | 20.06 | Pk | 14.7 | .2 | -40 | -5.04 | 29.5 | -34.54 | 0-360 |

Pk - Peak detector

9.4. WORST CASE BELOW 1 GHZ

SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION)



Below 1GHz Data

| Marker | Frequency (MHz) | Meter Reading (dBuV) | Det | AF PRE0184052 (dB/m) | Amp Cbl (dB) | Corrected Reading (dBuV/m) | QPk Limit (dBuV/m) | Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|----------------------|--------------|----------------------------|--------------------|-------------|----------------|-------------|----------|
| 1 | 102.9914 | 50.15 | Pk | 16.8 | -30.8 | 36.15 | 43.52 | -7.37 | 0-360 | 299 | H |
| 2 | 112.4713 | 50.89 | Pk | 18.7 | -30.7 | 38.89 | 43.52 | -4.63 | 0-360 | 299 | H |
| 3 | 134.3645 | 51.32 | Pk | 19.2 | -30.7 | 39.82 | 43.52 | -3.7 | 0-360 | 199 | H |
| 4 | 37.737 | 47.12 | Pk | 21.5 | -31.3 | 37.32 | 40 | -2.68 | 0-360 | 102 | V |
| 5 | 49.8526 | 54.97 | Pk | 13.7 | -31.3 | 37.37 | 40 | -2.63 | 0-360 | 102 | V |
| 6 | 111.4511 | 52.23 | Pk | 18.6 | -30.7 | 40.13 | 43.52 | -3.39 | 0-360 | 102 | V |

Pk - Peak detector

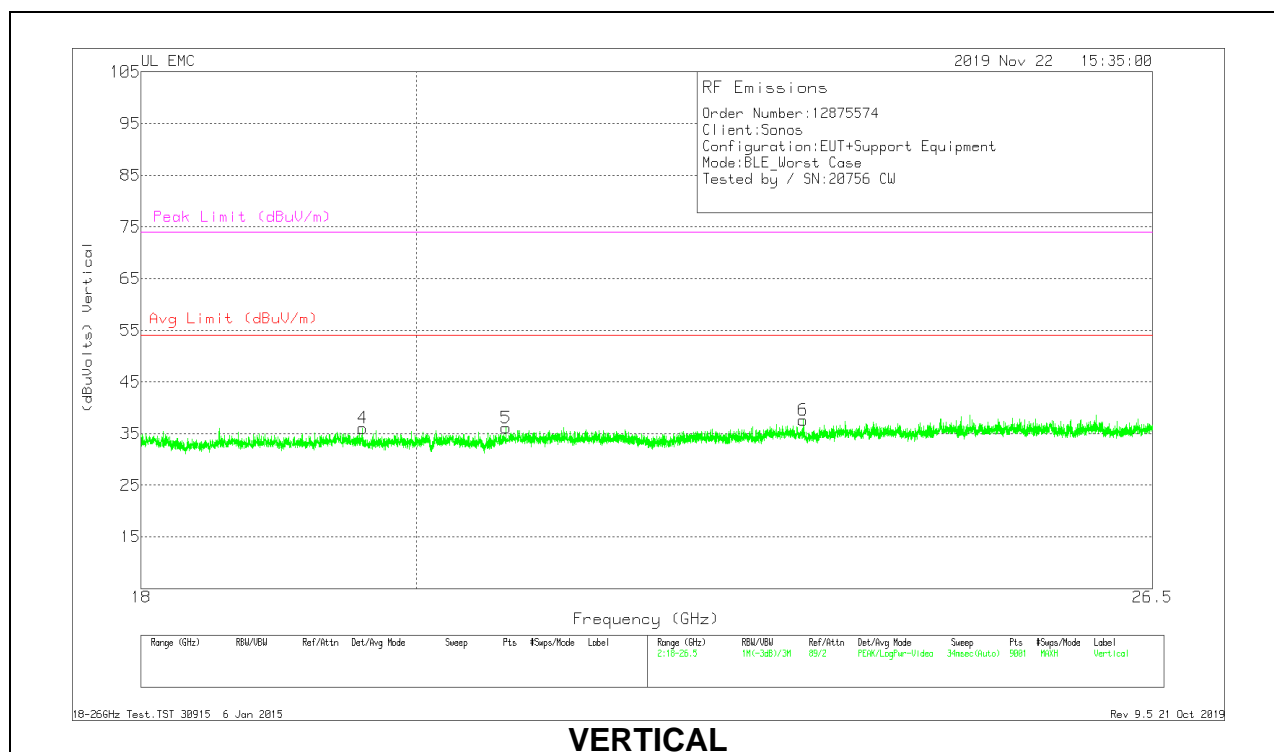
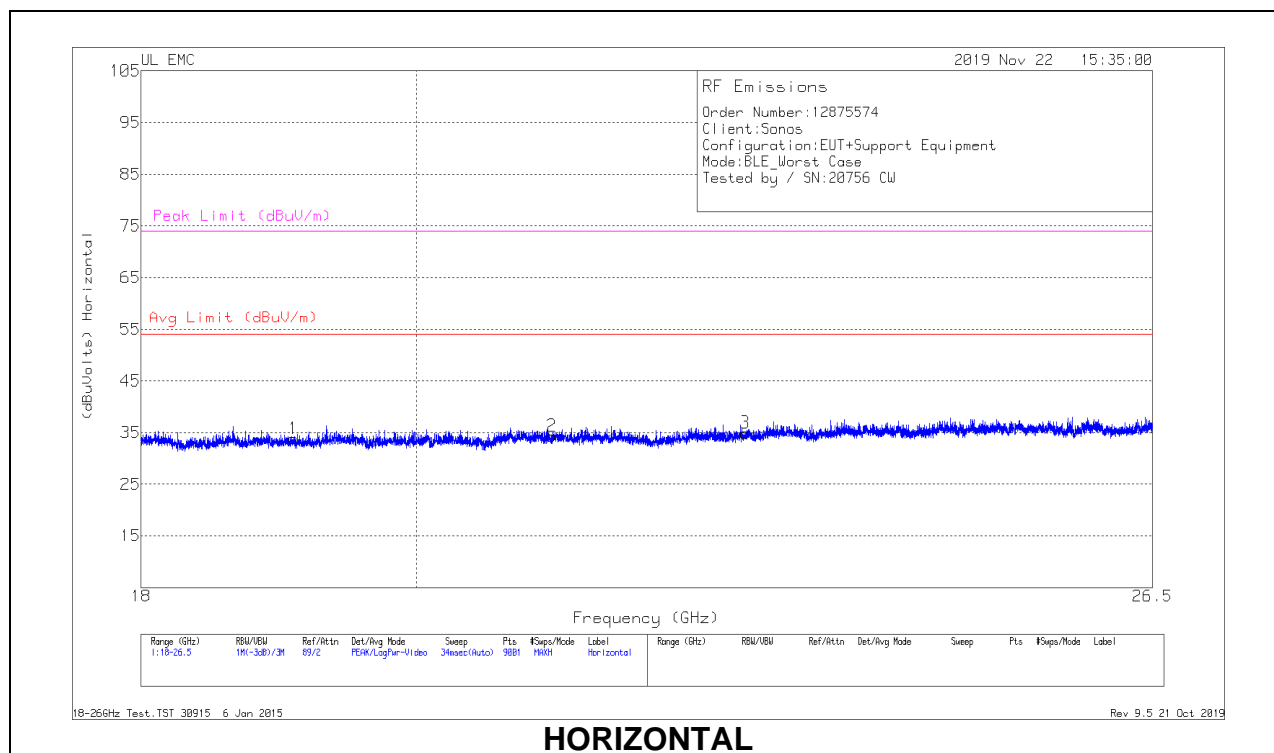
Radiated Emissions

| Frequency (MHz) | Meter Reading (dBuV) | Det | AF PRE0184052 (dB/m) | Amp Cbl (dB) | Corrected Reading (dBuV/m) | QPk Limit (dBuV/m) | Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|-----------------|----------------------|-----|----------------------|--------------|----------------------------|--------------------|-------------|----------------|-------------|----------|
| 110.817 | 38.55 | Qp | 18.5 | -30.8 | 26.25 | 43.52 | -17.27 | 358 | 317 | H |
| 132.7465 | 47.04 | Qp | 19.3 | -30.7 | 35.64 | 43.52 | -7.88 | 351 | 205 | H |
| 37.7889 | 45.57 | Qp | 21.4 | -31.3 | 35.67 | 40 | -4.33 | 23 | 105 | V |
| 50.432 | 52.92 | Qp | 13.6 | -31.3 | 35.22 | 40 | -4.78 | 77 | 103 | V |
| 111.6007 | 33.03 | Qp | 18.6 | -30.7 | 20.93 | 43.52 | -22.59 | 350 | 105 | V |

Qp - Quasi-Peak detector

9.5. WORST CASE 18-26 GHZ

SPURIOUS EMISSIONS 18-26 GHz (WORST-CASE CONFIGURATION)



18 – 26GHz DATA

| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | T447 AF (dB/m) | Amp/Cbl (dB) | Dist Corr (dB) | Corrected Reading (dBuVolts) | Avg Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) |
|--------|-----------------|----------------------|-----|----------------|--------------|----------------|------------------------------|--------------------|-------------|---------------------|----------------|
| 1 | 19.08044 | 68.46 | Pk | 32.6 | -57.7 | -9.5 | 33.86 | 54 | -20.14 | 74 | -40.14 |
| 2 | 21.05905 | 67.63 | Pk | 33.2 | -57 | -9.5 | 34.33 | 54 | -19.67 | 74 | -39.67 |
| 3 | 22.67689 | 68.54 | Pk | 33.6 | -57.7 | -9.5 | 34.94 | 54 | -19.06 | 74 | -39.06 |
| 4 | 19.59139 | 69.7 | Pk | 32.8 | -57 | -9.5 | 36 | 54 | -18 | 74 | -38 |
| 5 | 20.69544 | 69.71 | Pk | 33.1 | -57.2 | -9.5 | 36.11 | 54 | -17.89 | 74 | -37.89 |
| 6 | 23.18594 | 70.4 | Pk | 33.8 | -57.1 | -9.5 | 37.6 | 54 | -16.4 | 74 | -36.4 |

Pk - Peak detector

10. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

RSS-Gen 8.8

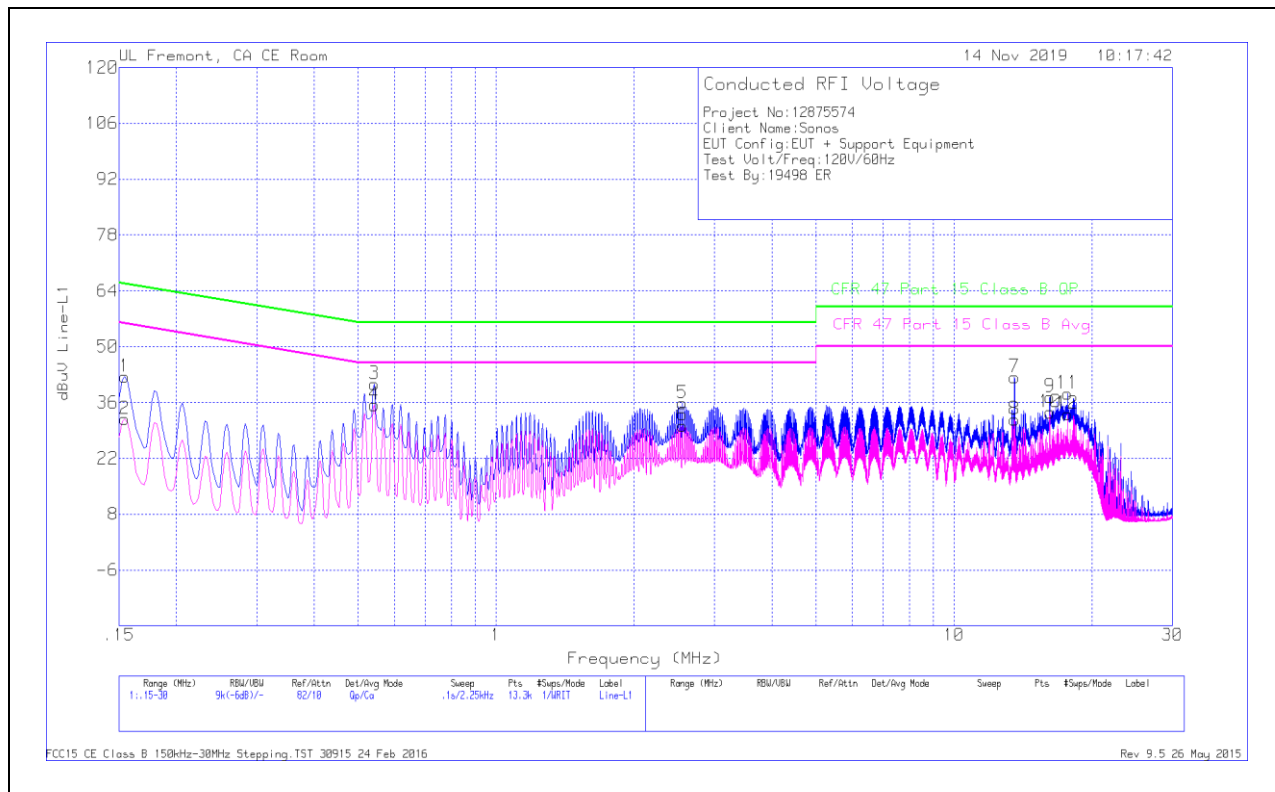
| Frequency of Emission (MHz) | Conducted Limit (dBuV) | |
|-----------------------------|------------------------|------------|
| | Quasi-peak | Average |
| 0.15-0.5 | 66 to 56 * | 56 to 46 * |
| 0.5-5 | 56 | 46 |
| 5-30 | 60 | 50 |

* Decreases with the logarithm of the frequency.

RESULTS

AC Power Line Norm

LINE 1 RESULTS



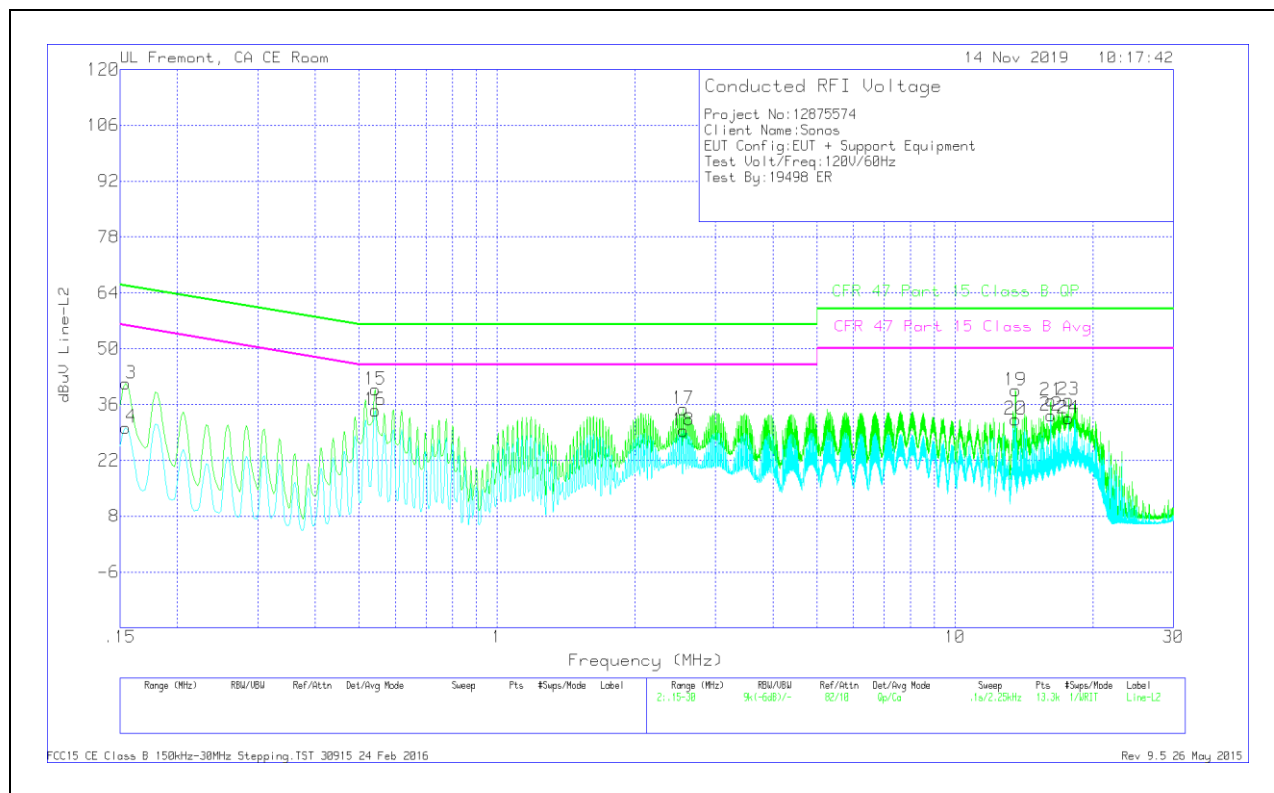
| Range 1: Line-L1 .15 - 30MHz | | | | | | | | | | | |
|------------------------------|-----------------|----------------------|-----|---------|-----------------|--------------|------------------------|---------------------------|----------------|----------------------------|----------------------|
| Marker | Frequency (MHz) | Meter Reading (dBuV) | Det | LISN L1 | LC Cables C1&C3 | Limiter (dB) | Corrected Reading dBuV | CFR 47 Part 15 Class B QP | QP Margin (dB) | CFR 47 Part 15 Class B Avg | Av(CISPR)Margin (dB) |
| 1 | .1545 | 32.24 | Qp | .1 | 0 | 10.1 | 42.44 | 65.75 | -23.31 | - | - |
| 2 | .1545 | 21.67 | Ca | .1 | 0 | 10.1 | 31.87 | - | - | 55.75 | -23.88 |
| 3 | .5415 | 30.56 | Qp | 0 | 0 | 10.1 | 40.66 | 56 | -15.34 | - | - |
| 4 | .5415 | 25.32 | Ca | 0 | 0 | 10.1 | 35.42 | - | - | 46 | -10.58 |
| 5 | 2.55075 | 25.61 | Qp | 0 | .1 | 10.1 | 35.81 | 56 | -20.19 | - | - |
| 6 | 2.55075 | 20.04 | Ca | 0 | .1 | 10.1 | 30.24 | - | - | 46 | -15.76 |
| 7 | 13.56 | 31.83 | Qp | .1 | .2 | 10.2 | 42.33 | 60 | -17.67 | - | - |
| 8 | 13.56 | 21.24 | Ca | .1 | .2 | 10.2 | 31.74 | - | - | 50 | -18.26 |
| 9 | 16.2285 | 26.7 | Qp | .1 | .3 | 10.3 | 37.4 | 60 | -22.6 | - | - |
| 10 | 16.2285 | 22.83 | Ca | .1 | .3 | 10.3 | 33.53 | - | - | 50 | -16.47 |
| 11 | 17.6932 | 27.56 | Qp | .1 | .3 | 10.3 | 38.26 | 60 | -21.74 | - | - |
| 12 | 17.6932 | 22.46 | Ca | .1 | .3 | 10.3 | 33.16 | - | - | 50 | -16.84 |

Qp - Quasi-Peak detector

Ca - CISPR average detection

NOTE: Markers 7 and 8, 13.56MHz is an external NFC signal unrelated to the EUT.

LINE 2 RESULTS



| Range 2: Line-L2 .15 - 30MHz | | | | | | | | | | | |
|------------------------------|-----------------|----------------------|-----|---------|-----------------|--------------|------------------------|---------------------------|----------------|----------------------------|----------------------|
| Marker | Frequency (MHz) | Meter Reading (dBuV) | Det | LISN L2 | LC Cables C2&C3 | Limiter (dB) | Corrected Reading dBuV | CFR 47 Part 15 Class B QP | QP Margin (dB) | CFR 47 Part 15 Class B Avg | Av(CISPR)Margin (dB) |
| 13 | .1545 | 31.08 | Qp | .1 | 0 | 10.1 | 41.28 | 65.75 | -24.47 | - | - |
| 14 | .1545 | 20.03 | Ca | .1 | 0 | 10.1 | 30.23 | - | - | 55.75 | -25.52 |
| 15 | .5415 | 29.64 | Qp | 0 | 0 | 10.1 | 39.74 | 56 | -16.26 | - | - |
| 16 | .5415 | 24.44 | Ca | 0 | 0 | 10.1 | 34.54 | - | - | 46 | -11.46 |
| 17 | 2.55075 | 24.7 | Qp | 0 | .1 | 10.1 | 34.9 | 56 | -21.1 | - | - |
| 18 | 2.55075 | 19.23 | Ca | 0 | .1 | 10.1 | 29.43 | - | - | 46 | -16.57 |
| 19 | 13.56 | 29.03 | Qp | .1 | .2 | 10.2 | 39.53 | 60 | -20.47 | - | - |
| 20 | 13.56 | 21.74 | Ca | .1 | .2 | 10.2 | 32.24 | - | - | 50 | -17.76 |
| 21 | 16.2285 | 26.3 | Qp | .1 | .3 | 10.3 | 37 | 60 | -23 | - | - |
| 22 | 16.2285 | 22.57 | Ca | .1 | .3 | 10.3 | 33.27 | - | - | 50 | -16.73 |
| 23 | 17.6932 | 26.43 | Qp | .1 | .3 | 10.3 | 37.13 | 60 | -22.87 | - | - |
| 24 | 17.6932 | 21.84 | Ca | .1 | .3 | 10.3 | 32.54 | - | - | 50 | -17.46 |

Qp - Quasi-Peak detector

Ca - CISPR average detection

NOTE: Markers 19 and 20, 13.56MHz is an external NFC signal unrelated to the EUT.