TEST REPORT

Report Number. : 12934025-E1V2

Applicant	:	SONOS INC. 614 CHAPALA STREET SANTA BARBARA, CA, 93101, U.S.A
Model	:	S19
FCC ID	:	SBVRM019
IC	:	5373A-RM019
EUT Description	:	802.11 a/b/g/n (HT20) 4x4 master device with BLE and NFC
Test Standard(s)	:	FCC 47 CFR PART 15 SUBPART C ISED RSS-247 ISSUE 2 ISED RSS-GEN ISSUE 5

Date Of Issue:
January 16, 2020

Prepared by:
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NVLAP Lab code: 200065-0

REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	1/10/2020	Initial Issue	
V2	1/16/2020	Updated Section 9.2	K.Kedida

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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 (HT20) 4x4 master device with BLE and NFC

MODEL: S19

SERIAL NUMBER: A100 1908W 48-A6-B8-00-03-60:B (Conducted Sample)
A100 1908W 48-A6-B8-B0-05-FD:6 (Radiated Sample)

DATE TESTED: October 17 – October 24, 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 414788 D01 Radiated Test Site v01r01, KDB 558074 D01 15.247 Meas Guidance v05r02 and 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.
☒ Chamber A	☐ Chamber D	☒ Chamber I
☐ Chamber B	☐ Chamber E	☐ Chamber J
☐ Chamber C	☐ Chamber F	☐ Chamber K
	☐ Chamber G	☐ Chamber L
	☐ 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

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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	3.84 dB
Worst Case Conducted Disturbance, 0.15 to 30 MHz	3.65 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%.

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5. EQUIPMENT UNDER TEST

5.1. EUT DESCRIPTION

The EUT is an 802.11 a/b/g/n (HT20) 4x4 master device with BLE and NFC.

The model S19 is a high performance wireless smart speaker.

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	-2.28	0.59

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a PCB antenna, with a maximum gain of 4.41 dBi.

5.4. SOFTWARE AND FIRMWARE

The EUT software/firmware installed during testing was version 11.0 Build 55070020.

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

Worst-case data rate as provided by the client was 1Mbps.

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5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
Laptop	Lenovo	T450s	PC-06YXZP 15/08	PD97265NGU
AC Adapter	Lenovo	ADLX90NLC2A	11S45N0247Z1ZS9B58BA9G	

I/O CABLES

I/O Cable List						
Cable No	**Port**	**# of identical ports**	**Connector Type**	**Cable Type**	**Cable Length (m)**	**Remarks**
1	AC Power	1	AC	Unhsielded	2	AC Mains to EUT
2	Ethernet	1	RJ45	Unshielded	10	Ethernet to Ethernet Converter
3	Ethernet to USB	1	RJ45 to USB	Unshielded	0.2	USB to Ethernet Adapter
5	DC Power	1	DC	Unshielded	1.2	AC/DC Adapter to Laptop
6	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.

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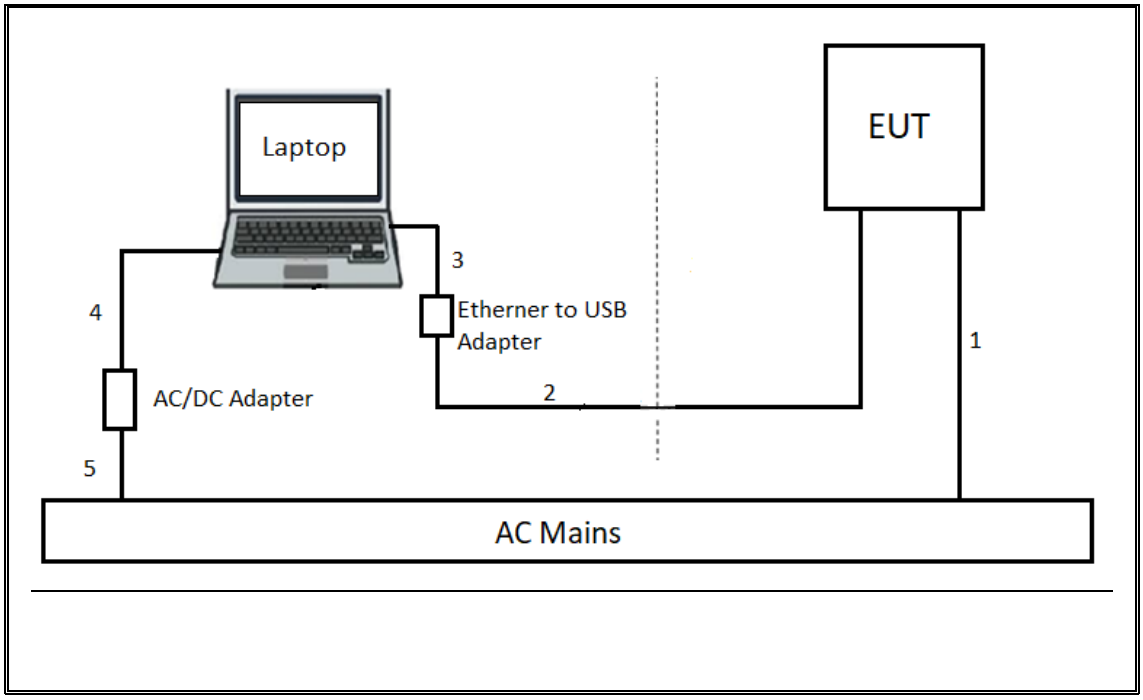
SETUP DIAGRAMS



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6. MEASUREMENT METHOD

On Time and Duty Cycle: ANSI C63.10 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).

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

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 11.12.2.

Band-edge: ANSI C63.10 Subclause - 6.10

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

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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**
Amplifier, 100KHz to 1GHz, 32dB	Keysight Technologies (Formerly Agilent)	8447D	T15	10/26/2019	10/26/2018
Antenna, Broadband Hybrid, 30MHz to 3GHz	Sunol Sciences Corp.	JB3	PRE0181575	09/05/2020	09/05/2019
RF Amplifier, 1-18GHz	MITEQ	AFS42-00101800-25-S-42	T1165	05/24/2020	06/24/2019
Antenna, Horn 1-18GHz	ETS-Lindgren	3117	T346	05/14/2020	05/14/2019
Spectrum Analyzer, PXA, 3Hz to 44GHz	Keysight Technologies (Formerly Agilent)	N9030A	T908	01/23/2020	01/23/2019
Antenna, Passive Loop 30Hz to 1MHz	ELETRO METRICS	EM-6871	PRE0179465	05/31/2020	05/31/2019
Antenna, Passive Loop 100kHz to 30MHz	ELETRO METRICS	EM-6872	PRE0179467	05/31/2020	05/31/2019
Amplifier, 9KHz to 1GHz, 32dB	SONOMA INSTRUMENT	310	PRE0180175	05/29/2020	06/29/2019
EMI TEST RECEIVER	Rohde & Schwarz	ESW44	PRE0179376	02/14/2020	02/14/2019
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, PSA, 3Hz to 44GHz	Keysight Technologies (Formerly Agilent)	E4446A	T146	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 10.4, October 10, 2019	
AC Line Conducted Software	UL	UL EMC		Ver 9.5, May 26, 2015	

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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	0.380	0.625	0.608	60.80%	2.16	2.632

DUTY CYCLE PLOTS

DUTY CYCLE BLE

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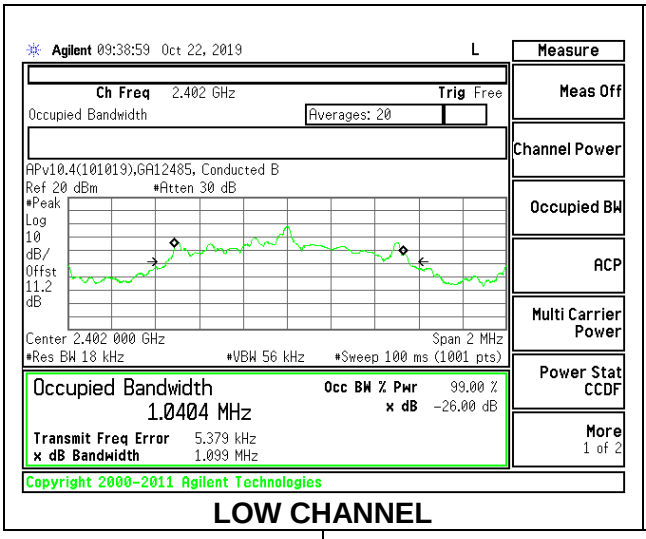
8.2. 99% BANDWIDTH

LIMITS

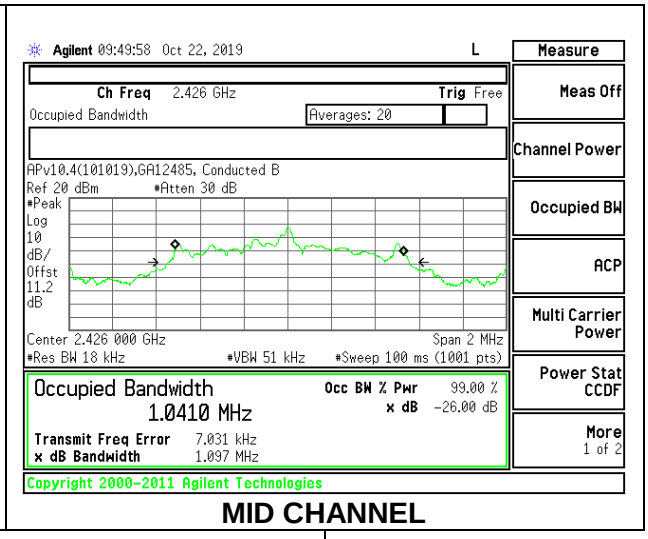
None; for reporting purposes only.

RESULTS

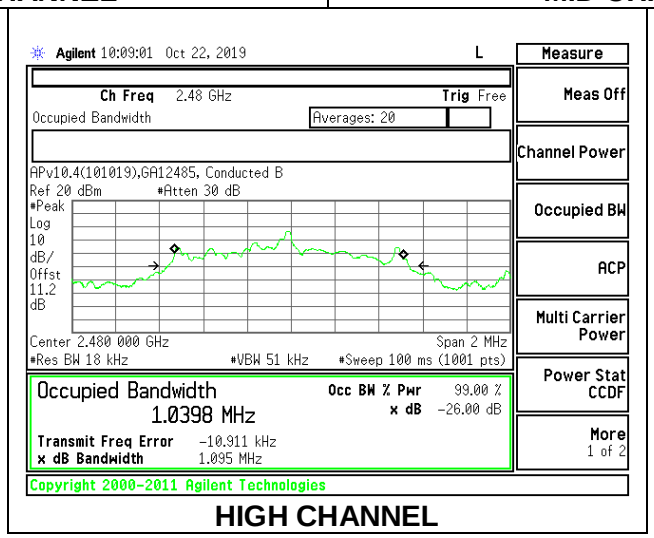
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	1.040
Middle	2426	1.041
High	2480	1.040



LOW CHANNEL



MID CHANNEL



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8.3. 6 dB BANDWIDTH

LIMITS

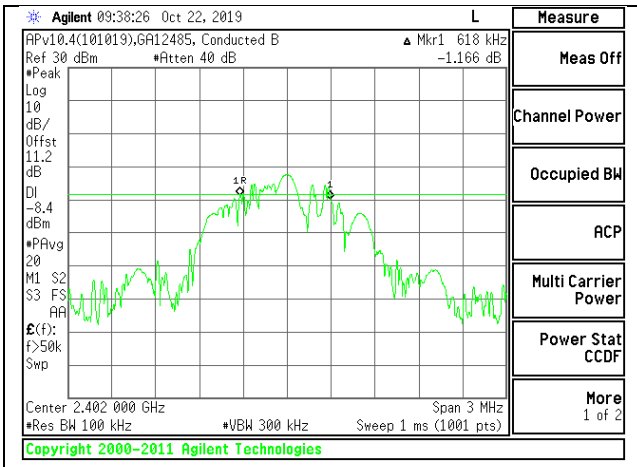
FCC §15.247 (a) (2)

RSS-247 5.2 (a)

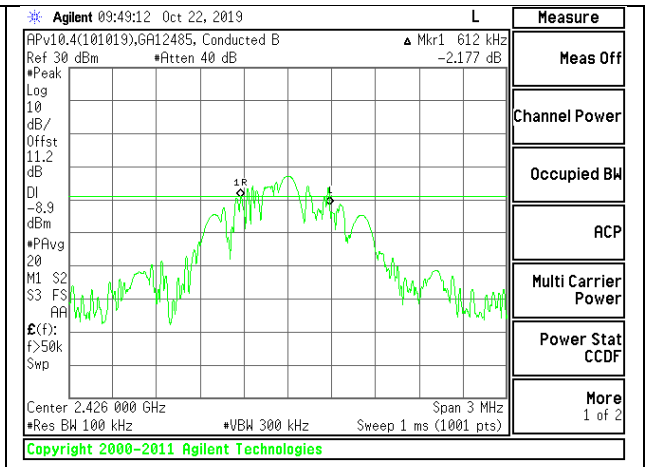
The minimum 6 dB bandwidth shall be at least 500 kHz.

RESULTS

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2402	0.618	0.5
Middle	2426	0.612	0.5
High	2480	0.645	0.5



LOW CHANNEL



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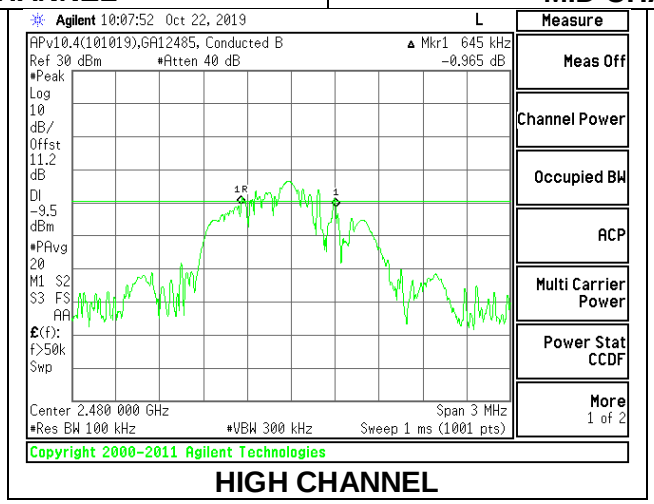

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8.4. OUTPUT POWER

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 of 11.2 dB (including 10 dB pad and 1.2 dB cable) was entered as an offset in the power meter to allow for a gated peak reading of power.

RESULTS

Tested By:	12485 GA
Date:	10/17/2019

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	-2.52	30	-32.52
Middle	2426	-2.33	30	-32.33
High	2480	-2.28	30	-32.28

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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 of 11.2 dB (including 10 dB pad and 1.2 dB cable) was entered as an offset in the power meter to allow for a gated RF average reading of power.

RESULTS

Tested By:	12485 GA
Date:	10/17/2019

Channel	Frequency (MHz)	AV power (dBm)
Low	2402	-3.00
Middle	2426	-2.77
High	2480	-2.76

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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

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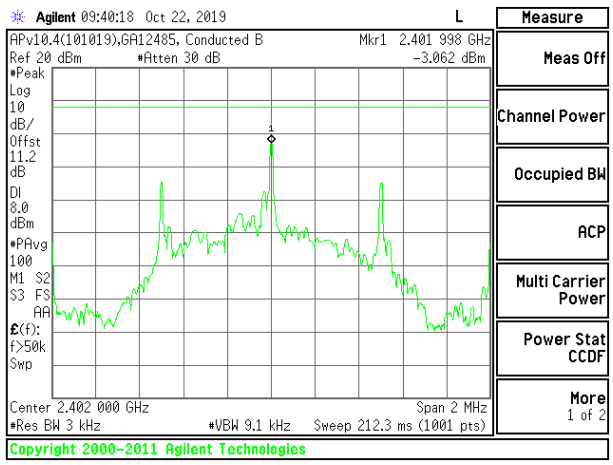
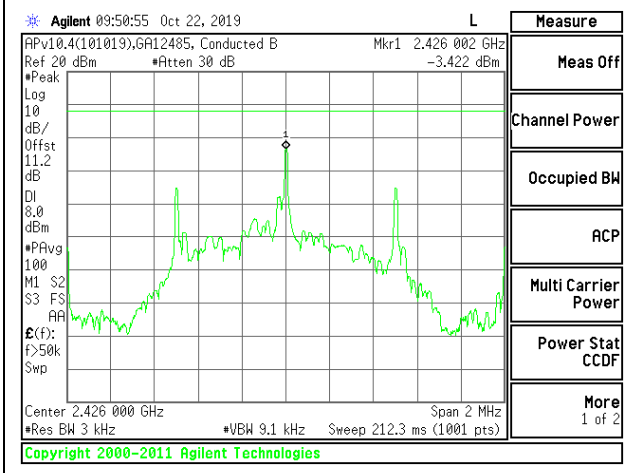
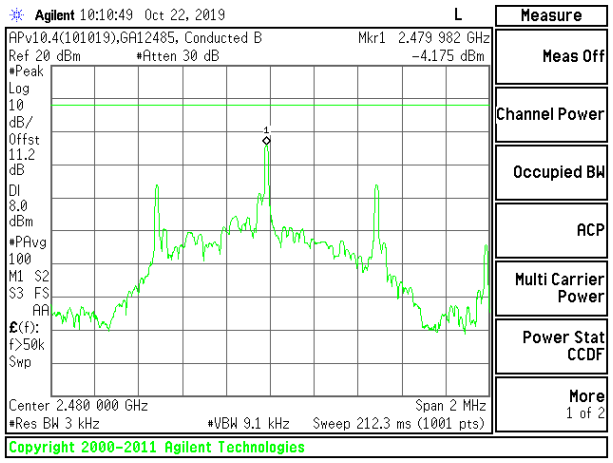
Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Low	2402	-3.06	8	-11.06
Middle	2426	-3.42	8	-11.42
High	2480	-4.18	8	-12.18



LOW CHANNEL



MID CHANNEL



HIGH CHANNEL

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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

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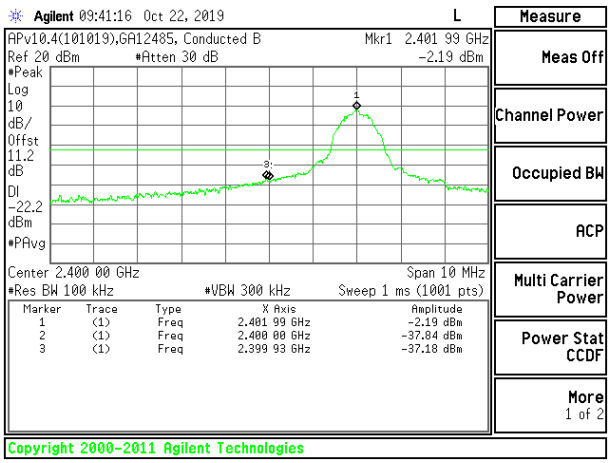
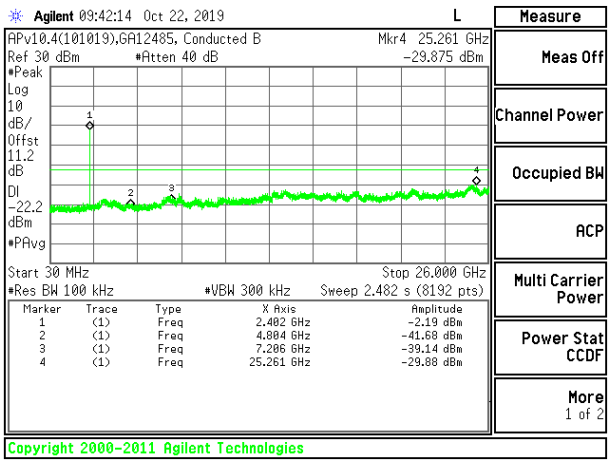
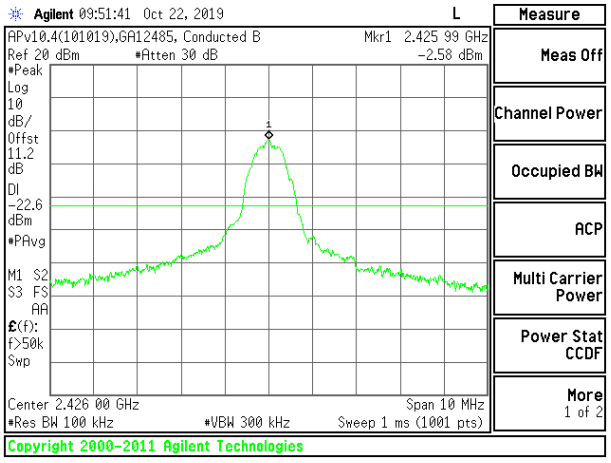


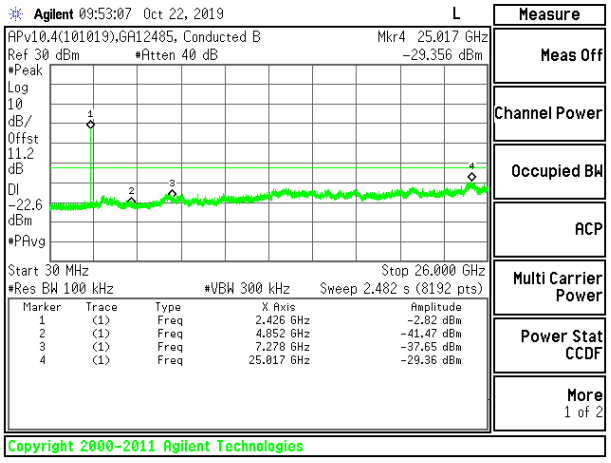
LOW CHANNEL BANDEDGE



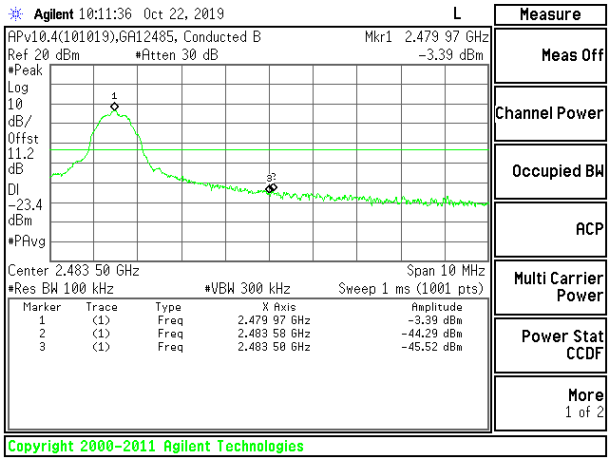
OUT-OF-BAND LOW CHANNEL



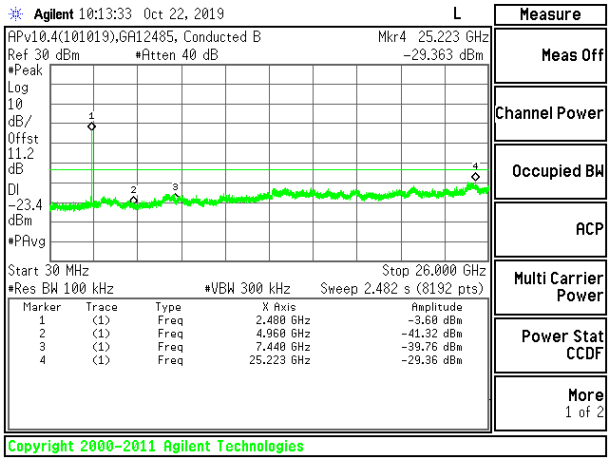
IN-BAND REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL



HIGH CHANNEL BANDEDGE



OUT-OF-BAND HIGH CHANNEL

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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.

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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.

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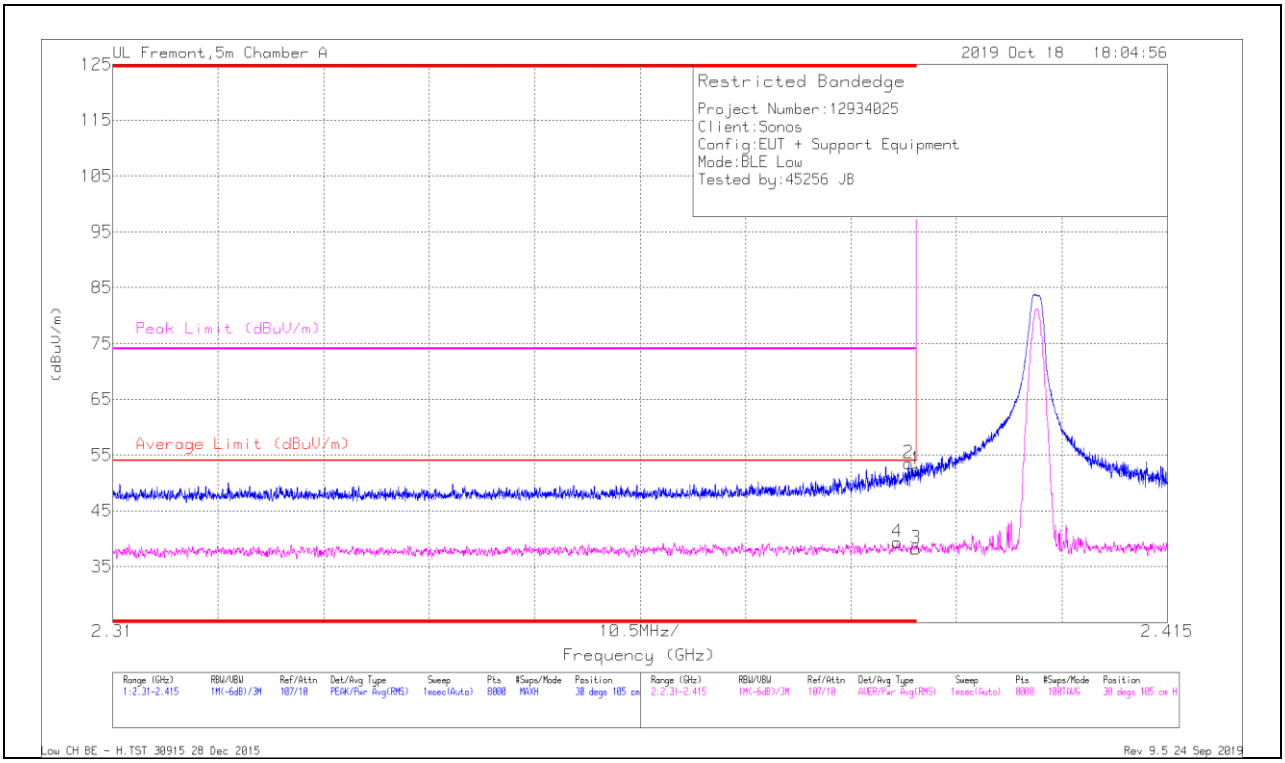
9.2. TRANSMITTER ABOVE 1 GHz

BANDEDGE (LOW CHANNEL)

HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T346 (dB/m)	Amp/Cbl/Fltr/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	* 2.39	42.49	Pk	32.2	-22.3	0	52.39	-	-	74	-21.61	30	105	H
2	* 2.38922	43.58	Pk	32.2	-22.3	0	53.48	-	-	74	-20.52	30	105	H
3	* 2.39	28.39	RMS	32.2	-22.3	2.16	40.45	54	-13.55	-	-	30	105	H
4	* 2.38811	29.45	RMS	32.2	-22.3	2.16	41.51	54	-12.49	-	-	30	105	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
RMS - RMS detection

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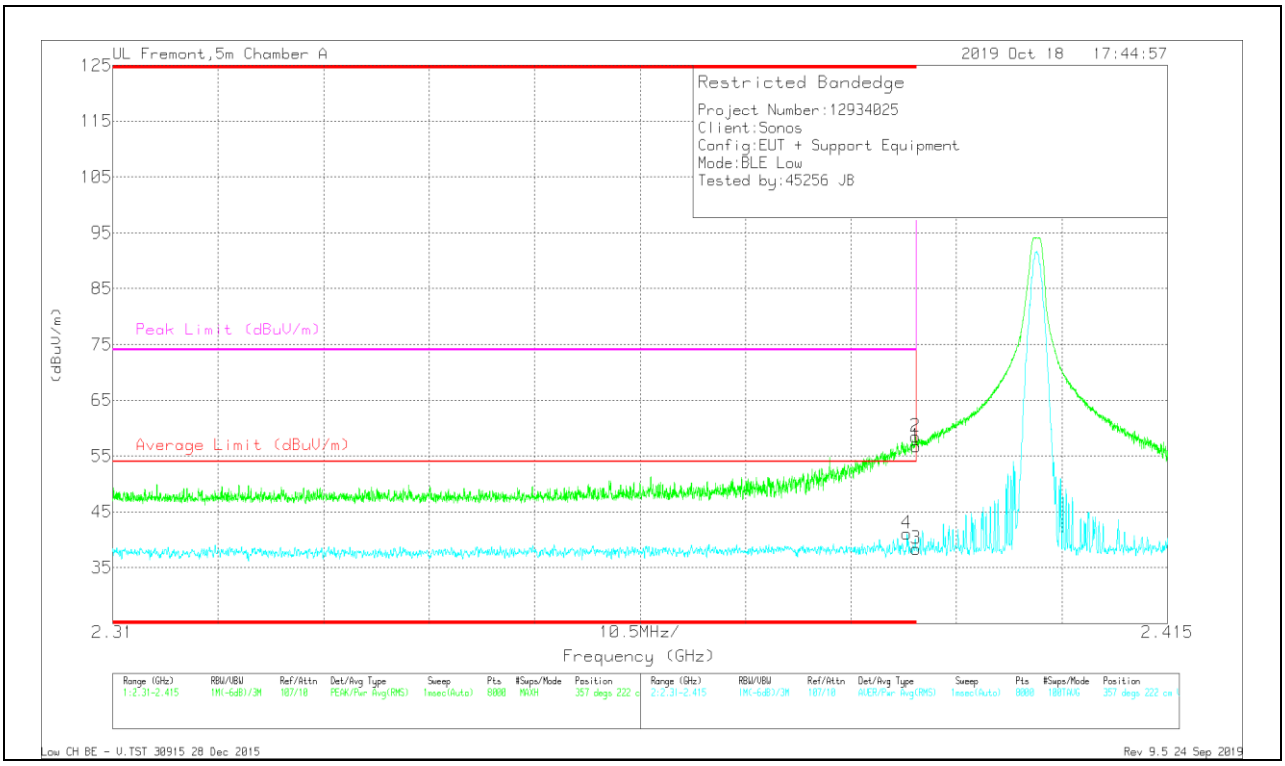
VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T346 (dB/m)	Amp/Cbl/Fltr/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	* 2.39	46.84	Pk	32.2	-22.3	0	56.74	-	-	74	-17.26	357	222	V
2	* 2.38993	48.63	Pk	32.2	-22.3	0	58.53	-	-	74	-15.47	357	222	V
3	* 2.39	28.46	RMS	32.2	-22.3	2.16	40.52	54	-13.48	-	-	357	222	V
4	* 2.38906	31.22	RMS	32.2	-22.3	2.16	43.28	54	-10.72	-	-	357	222	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
RMS - RMS detection

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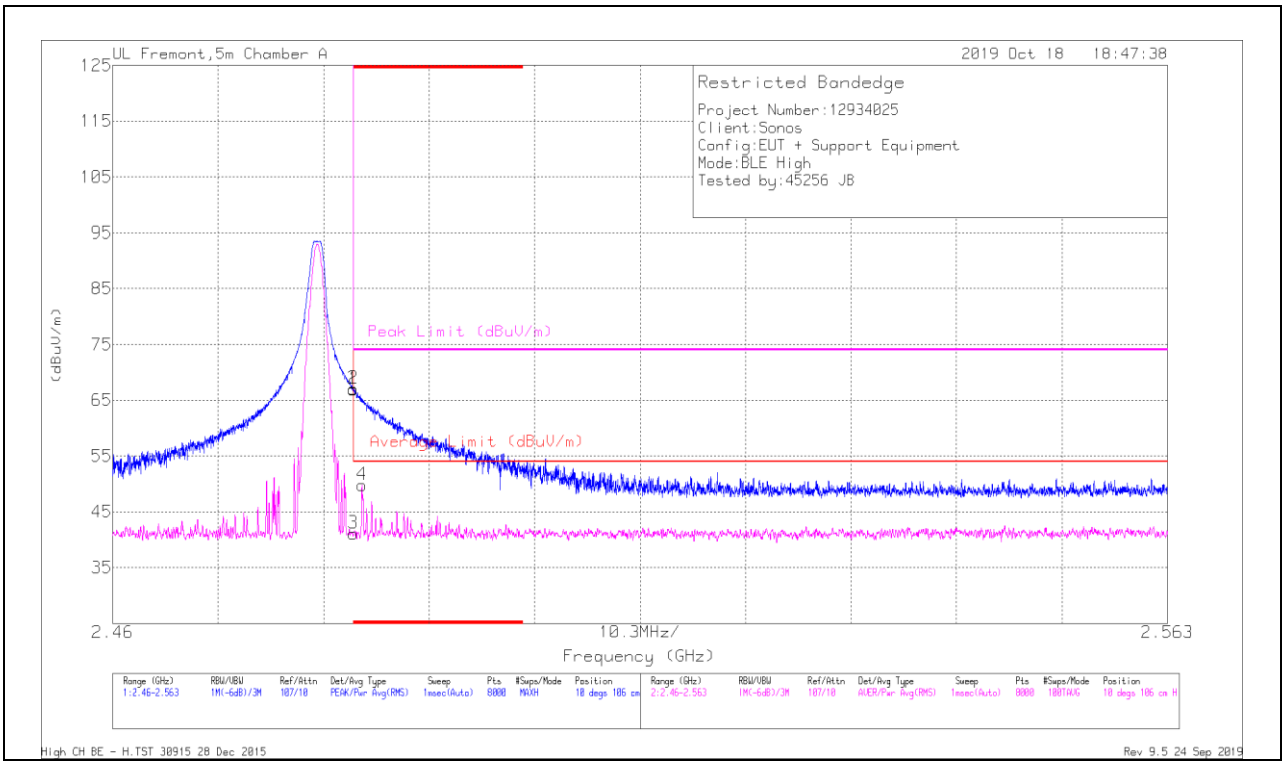
BANDEDGE (HIGH CHANNEL)

HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T346 (dB/m)	Amp/Cbl/Fltr/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	* 2.4835	56.38	Pk	32.6	-22.1	0	66.88	-	-	74	-7.12	10	106	H
3	* 2.4835	28.42	RMS	32.6	-22.1	2.16	41.08	54	-12.92	-	-	10	106	H
2	* 2.48351	56.52	Pk	32.6	-22.1	0	67.02	-	-	74	-6.98	10	106	H
4	* 2.48434	37.14	RMS	32.6	-22.1	2.16	49.8	54	-4.2	-	-	10	106	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
RMS - RMS detection

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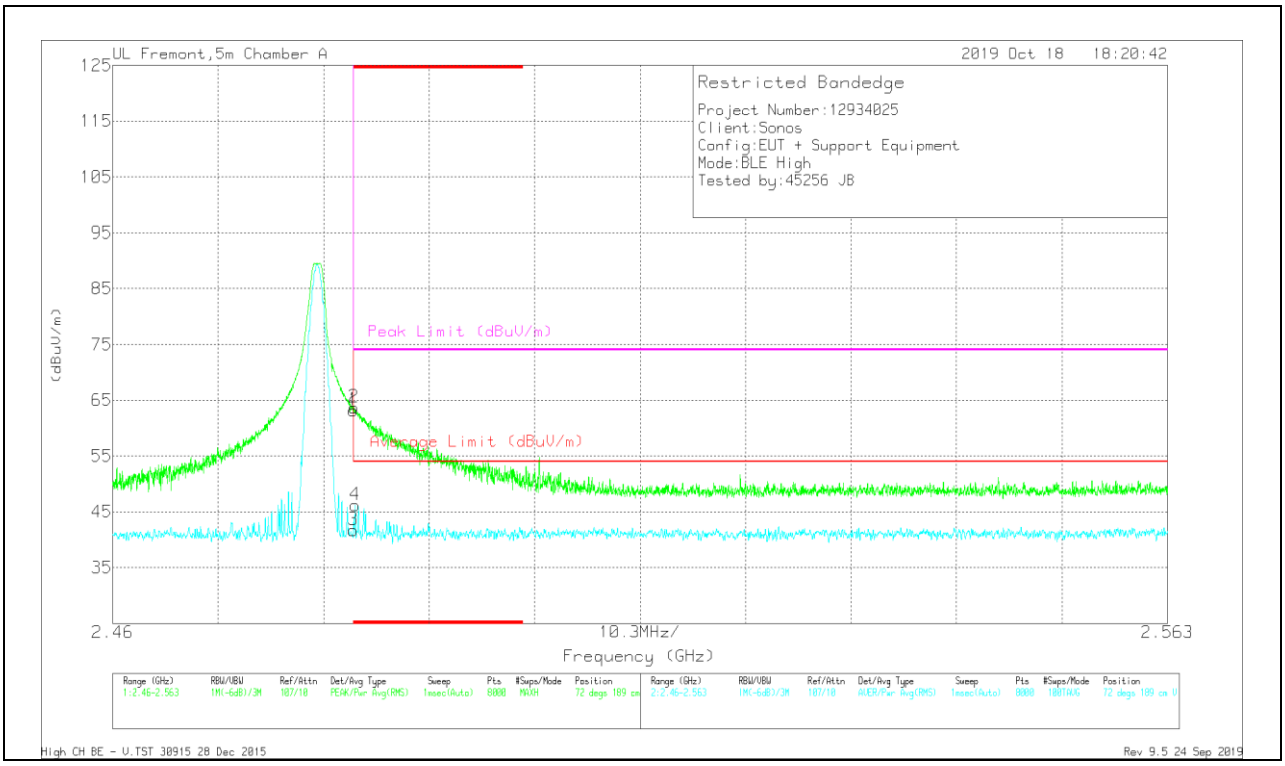
VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T346 (dB/m)	Amp/Cbl/Fltr/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	* 2.4835	52.71	Pk	32.6	-22.1	0	63.21	-	-	74	-10.79	72	189	V
3	* 2.4835	29.01	RMS	32.6	-22.1	2.16	41.67	54	-12.33	-	-	72	189	V
2	* 2.48354	53.16	Pk	32.6	-22.1	0	63.66	-	-	74	-10.34	72	189	V
4	* 2.48368	33.52	RMS	32.6	-22.1	2.16	46.18	54	-7.82	-	-	72	189	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
RMS - RMS detection

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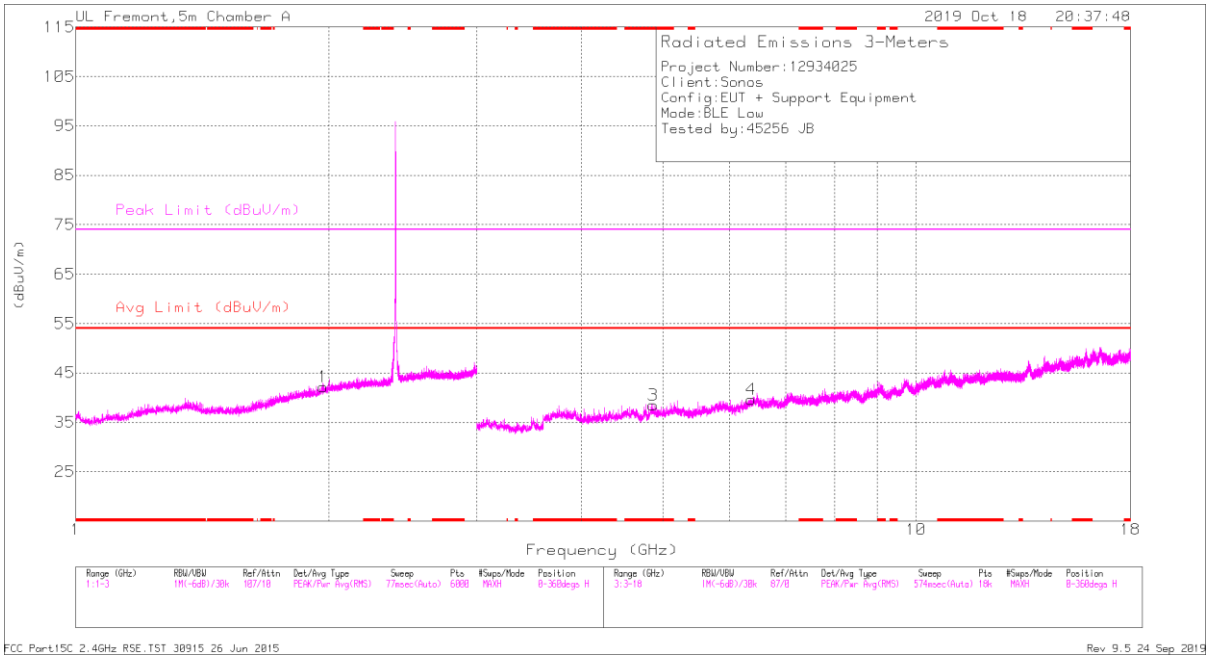
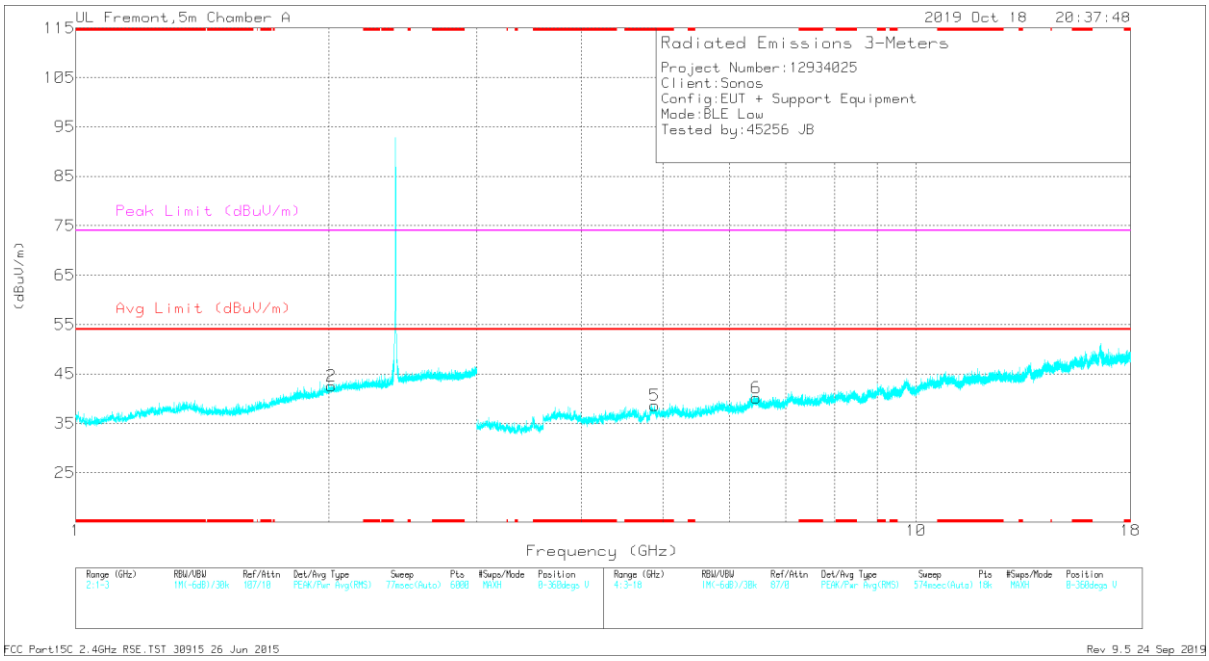
HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



HORIZONTAL



VERTICAL

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RADIATED EMISSIONS

Frequency (GHz)	Meter Reading (dBuV)	Det	AF T346 (dB/m)	Amp/Cbl/Fltr/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
* 4.86656	36.3	PK2	34.1	-26.2	0	44.2	-	-	74	-29.8	54	230	H
* 4.86478	24.66	MAv1	34.1	-26.3	2.16	34.62	54	-19.38	-	-	54	230	H
* 4.8861	36.39	PK2	34.1	-26.2	0	44.29	-	-	74	-29.71	200	127	V
* 4.8854	24.69	MAv1	34.1	-26.2	2.16	34.75	54	-19.25	-	-	200	127	V
1.97116	33.93	Pk	31.4	-23.2	0	42.13	-	-	-	-	0-360	101	H
2.0145	33.9	Pk	31.6	-23	0	42.5	-	-	-	-	0-360	101	V
6.37102	28.79	Pk	35.8	-24.9	0	39.69	-	-	-	-	0-360	101	H
6.46103	28.3	Pk	35.9	-24	0	40.2	-	-	-	-	0-360	101	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PK2 - KDB558074 Method: Maximum Peak
MAv1 - KDB558074 Option 1 Maximum RMS Average

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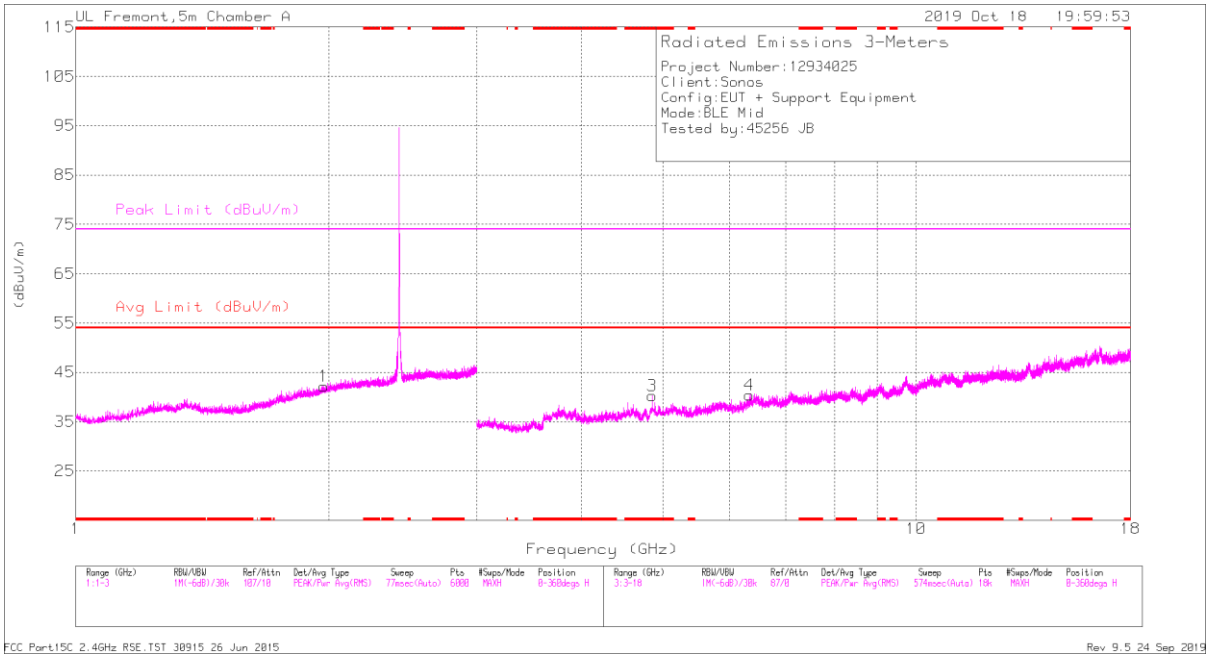
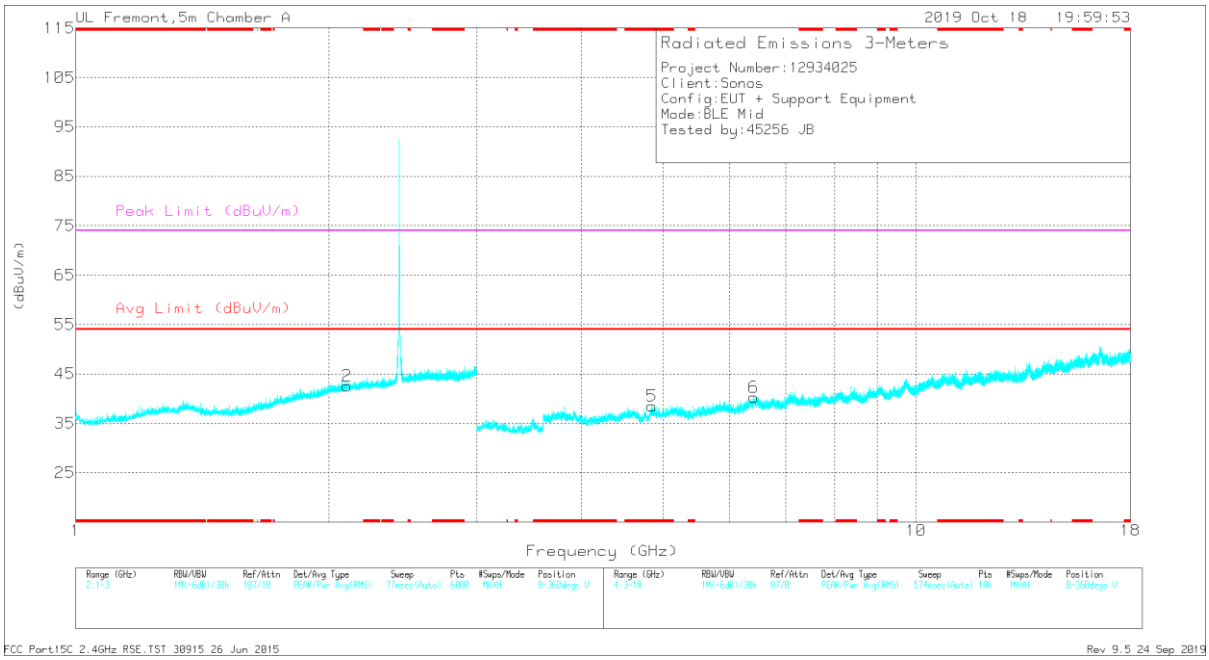
MID CHANNEL RESULTS



HORIZONTAL



VERTICAL

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RADIATED EMISSIONS

Frequency (GHz)	Meter Reading (dBuV)	Det	AF T346 (dB/m)	Amp/Cbl/Fltr/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
* 4.85346	36.07	PK2	34.2	-26.4	0	43.87	-	-	74	-30.13	6	221	H
* 4.85169	24.96	MAv1	34.2	-26.4	2.16	34.92	54	-19.08	-	-	6	221	H
* 4.85149	36.19	PK2	34.2	-26.4	0	43.99	-	-	74	-30.01	47	246	V
* 4.85194	25	MAv1	34.2	-26.4	2.16	34.96	54	-19.04	-	-	47	246	V
1.97416	33.92	Pk	31.5	-23.2	0	42.22	-	-	-	-	0-360	199	H
2.10385	33.4	Pk	31.7	-22.5	0	42.6	-	-	-	-	0-360	199	V
6.33269	29.82	Pk	35.7	-25.1	0	40.42	-	-	-	-	0-360	199	H
6.40852	28.72	Pk	35.8	-24.3	0	40.22	-	-	-	-	0-360	101	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PK2 - KDB558074 Method: Maximum Peak
MAv1 - KDB558074 Option 1 Maximum RMS Average

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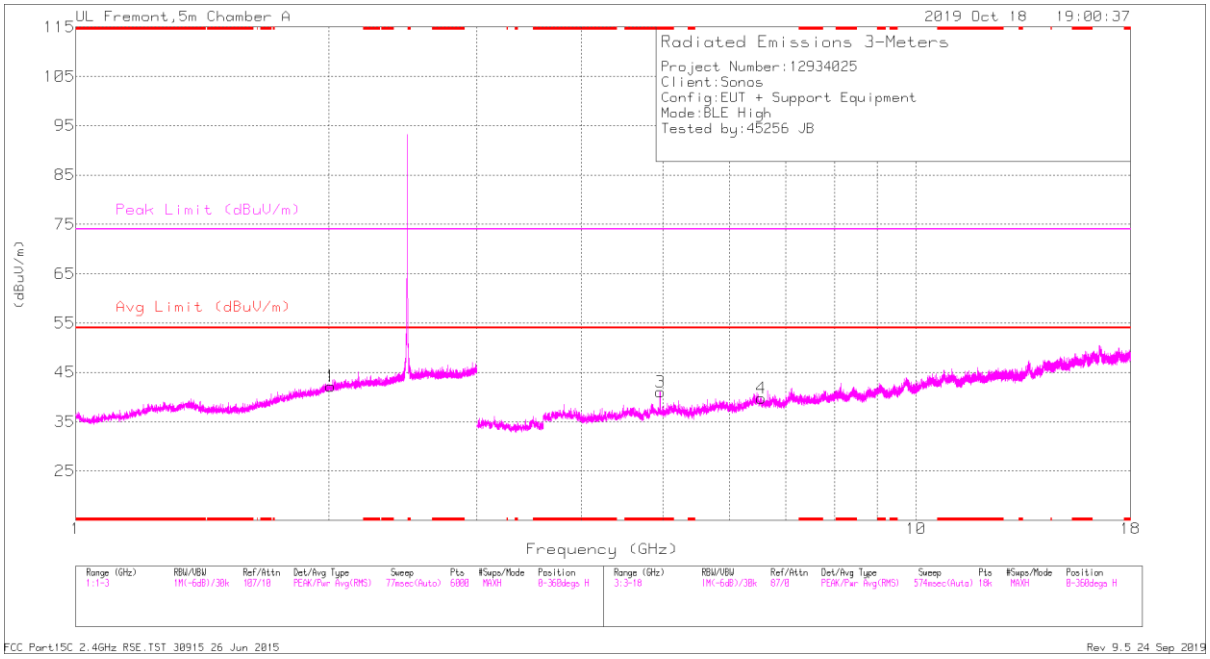
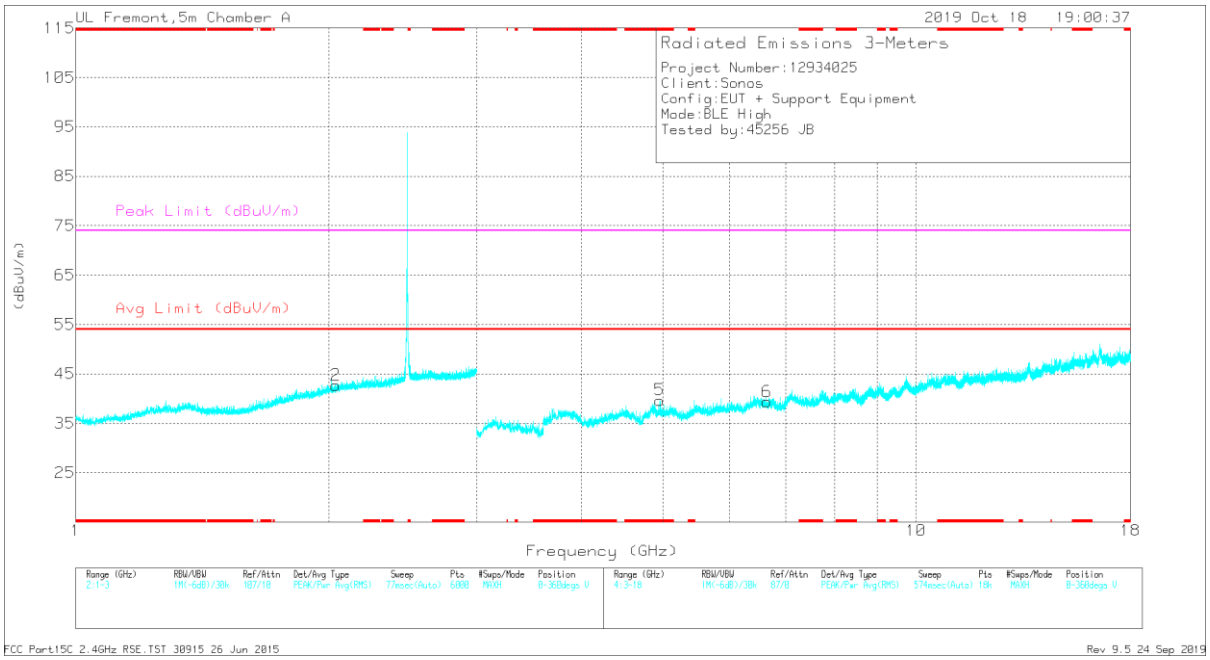
HIGH CHANNEL RESULTS



HORIZONTAL



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RADIATED EMISSIONS

Frequency (GHz)	Meter Reading (dBuV)	Det	AF T346 (dB/m)	Amp/Cbl/Fltr/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
* 4.96131	37.02	PK2	34.2	-27.4	0	43.82	-	-	74	-30.18	6	114	H
* 4.96003	25.54	MAv1	34.2	-27.3	2.16	34.6	54	-19.4	-	-	6	114	H
* 4.95933	37.79	PK2	34.2	-27.3	0	44.69	-	-	74	-29.31	0	177	V
* 4.9598	26.57	MAv1	34.2	-27.3	2.16	35.63	54	-18.37	-	-	0	177	V
2.01284	33.56	Pk	31.6	-23	0	42.16	-	-	-	-	0-360	102	H
2.04084	34.04	Pk	31.6	-22.9	0	42.74	-	-	-	-	0-360	199	V
6.54603	28.48	Pk	35.9	-24.6	0	39.78	-	-	-	-	0-360	199	H
6.6427	28.37	Pk	35.9	-24.9	0	39.37	-	-	-	-	0-360	199	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PK2 - KDB558074 Method: Maximum Peak
MAv1 - KDB558074 Option 1 Maximum RMS Average

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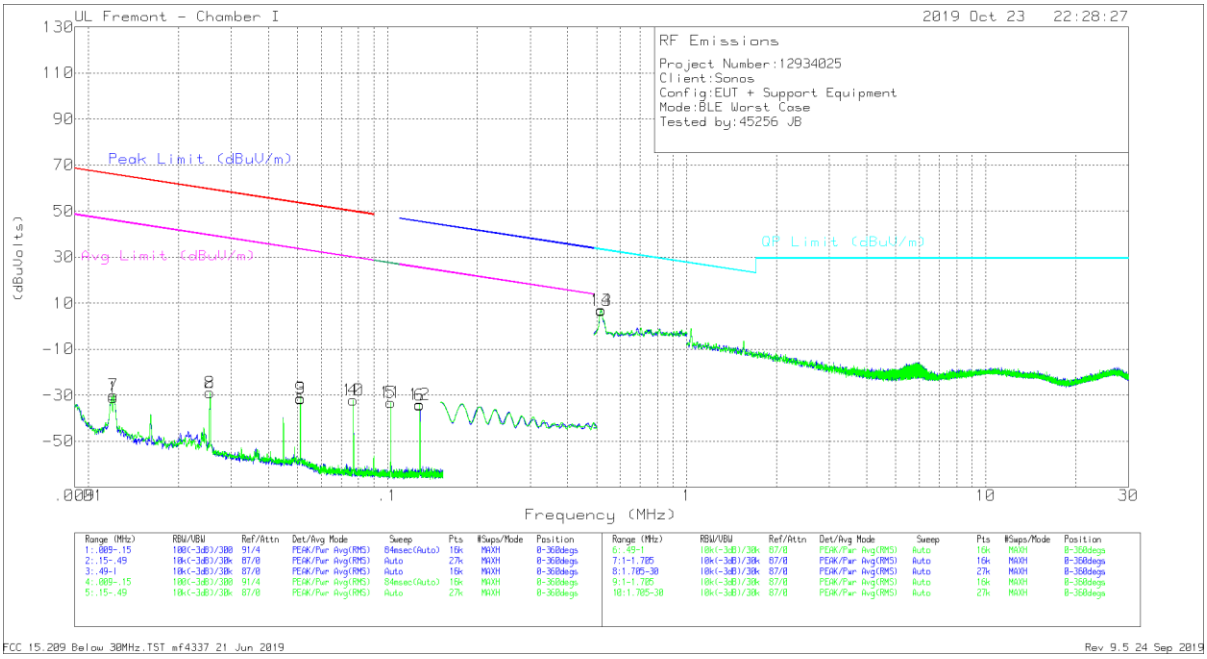
9.3. WORST CASE BELOW 30MHZ

SPURIOUS EMISSIONS BELOW 30 MHz (WORST-CASE CONFIGURATION)



ANTENNA- TWO ORIENTATIONS FACE ON/FACE OFF

Below 30MHz Data

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (ACF)	Cables w/ PRE0180175 (dB)	Dist Corr 300m	Corrected Reading (dBuVolts)	Peak Limit (dBuV/m)	Margin (dB)	Avg Limit (dBuV/m)	Margin (dB)	QP Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
1	.01214	21.55	Pk	59.9	-32.4	-80	-30.95	65.9	-96.85	45.9	-76.85	-	-	0-360
2	.0255	25.2	Pk	58.2	-32.3	-80	-28.9	59.46	-88.36	39.46	-68.36	-	-	0-360
3	.05115	23.89	Pk	56.8	-32.1	-80	-31.41	53.41	-84.82	33.41	-64.82	-	-	0-360
4	.07687	24.29	Pk	55.6	-32	-80	-32.11	49.87	-81.98	29.87	-61.98	-	-	0-360
5	.10257	23.38	Pk	55.4	-31.9	-80	-33.12	-	-	-	-	27.39	-60.51	0-360
6	.12821	21.92	Pk	55.6	-31.9	-80	-34.38	45.47	-79.85	25.47	-59.85	-	-	0-360
7	.01215	22.63	Pk	59.9	-32.4	-80	-29.87	65.89	-95.76	45.89	-75.76	-	-	0-360
8	.0255	25.32	Pk	58.2	-32.3	-80	-28.78	59.46	-88.24	39.46	-68.24	-	-	0-360
9	.05115	23.83	Pk	56.8	-32.1	-80	-31.47	53.41	-84.88	33.41	-64.88	-	-	0-360
10	.07687	24.28	Pk	55.6	-32	-80	-32.12	49.87	-81.99	29.87	-61.99	-	-	0-360
11	.10256	23.33	Pk	55.4	-31.9	-80	-33.17	-	-	-	-	27.39	-60.56	0-360
12	.1282	22.34	Pk	55.6	-31.9	-80	-33.96	45.47	-79.43	25.47	-59.43	-	-	0-360

Pk - Peak detector

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (ACF)	Cables w/ PRE0180175 (dB)	Dist Corr 30m (dB) 40Log	Corrected Reading (dBuVolts)	QP Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
13	.51773	22.52	Pk	56	-31.8	-40	6.72	33.32	-26.6	0-360
14	.51779	22.91	Pk	56	-31.8	-40	7.11	33.32	-26.21	0-360

Pk - Peak detector

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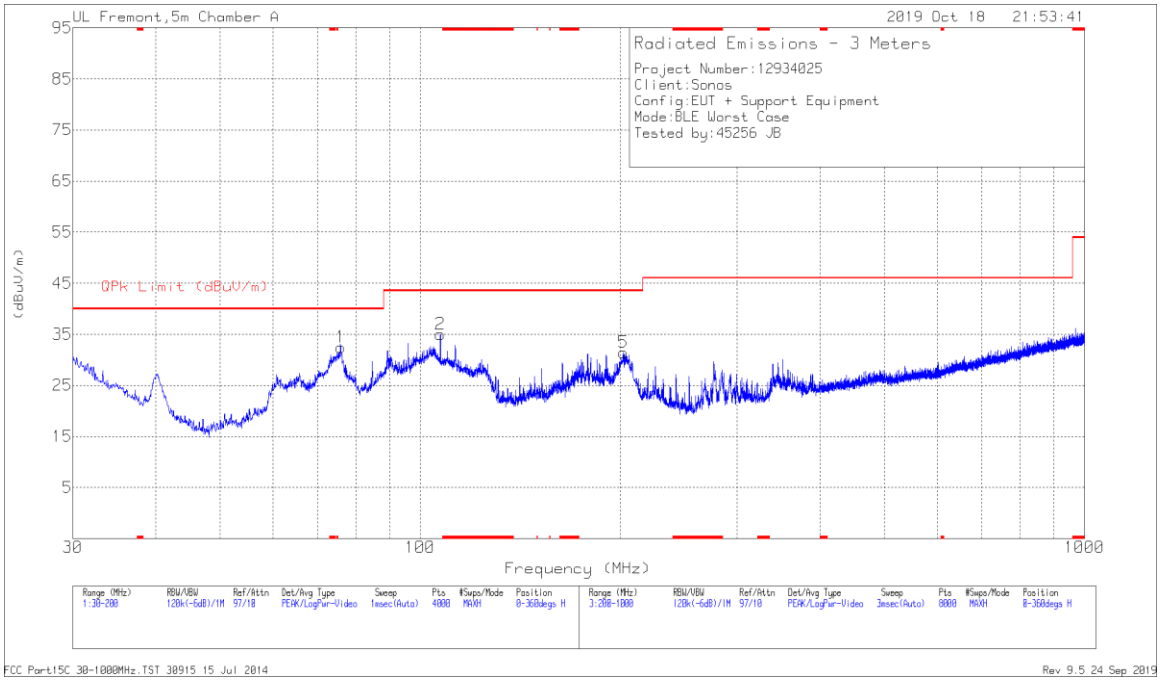
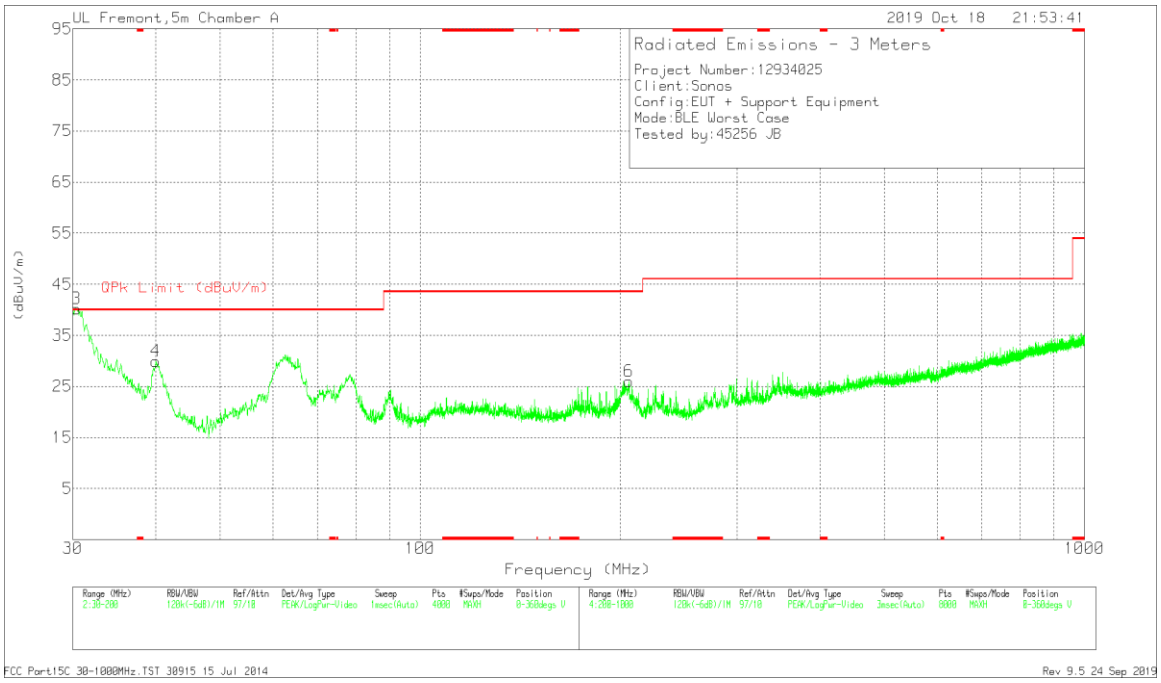
9.4. WORST CASE BELOW 1 GHZ

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



HORIZONTAL



VERTICAL

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Below 1GHz Data

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF PRE0181575 (dB)	Amp/Cbl (dB/m)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
3	30.3826	40.92	Pk	26.5	-27.2	40.22	-	-	0-360	100	V
	30.2141	36.08	Qp	26.6	-27.2	35.48	40	-4.52	229	120	V
4	39.9901	37.52	Pk	19.5	-27.1	29.92	40	-10.08	0-360	100	V
1	75.9119	45.31	Pk	13.8	-26.6	32.51	40	-7.49	0-360	200	H
2	107.2425	43.24	Pk	18	-26.2	35.04	43.52	-8.48	0-360	200	H
5	202.4003	38.78	Pk	17.8	-25.1	31.48	43.52	-12.04	0-360	100	H
6	206.2008	34.5	Pk	16.5	-25	26	43.52	-17.52	0-360	300	V

Pk - Peak detector

Qp - Quasi-Peak detector

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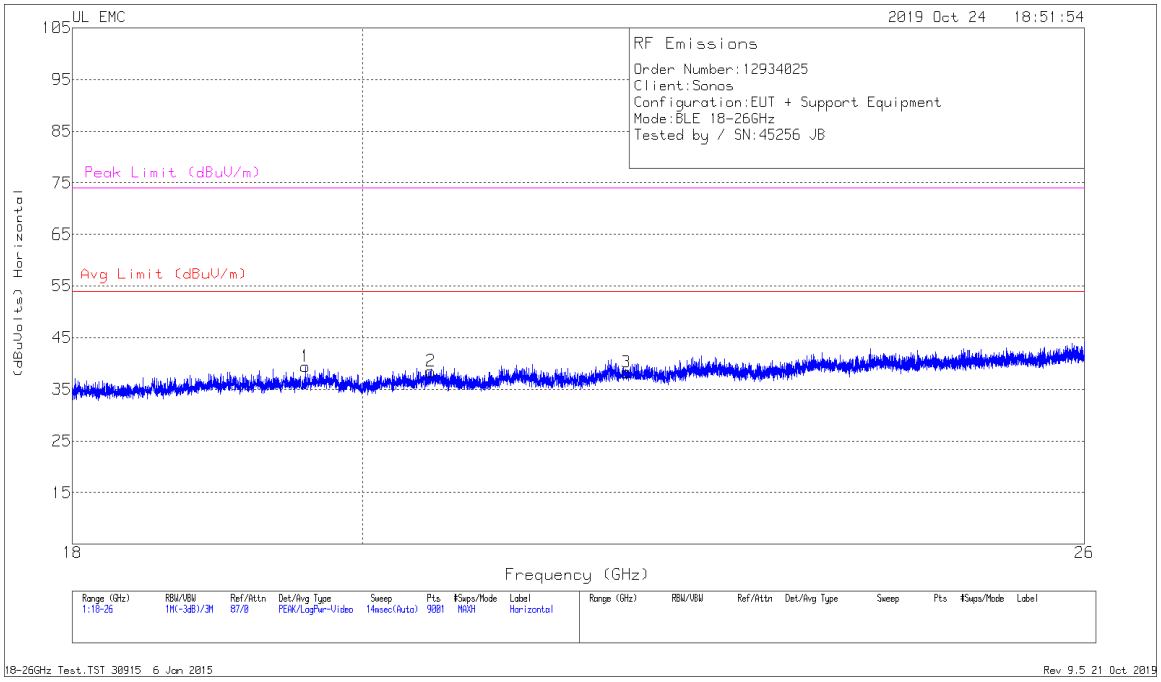
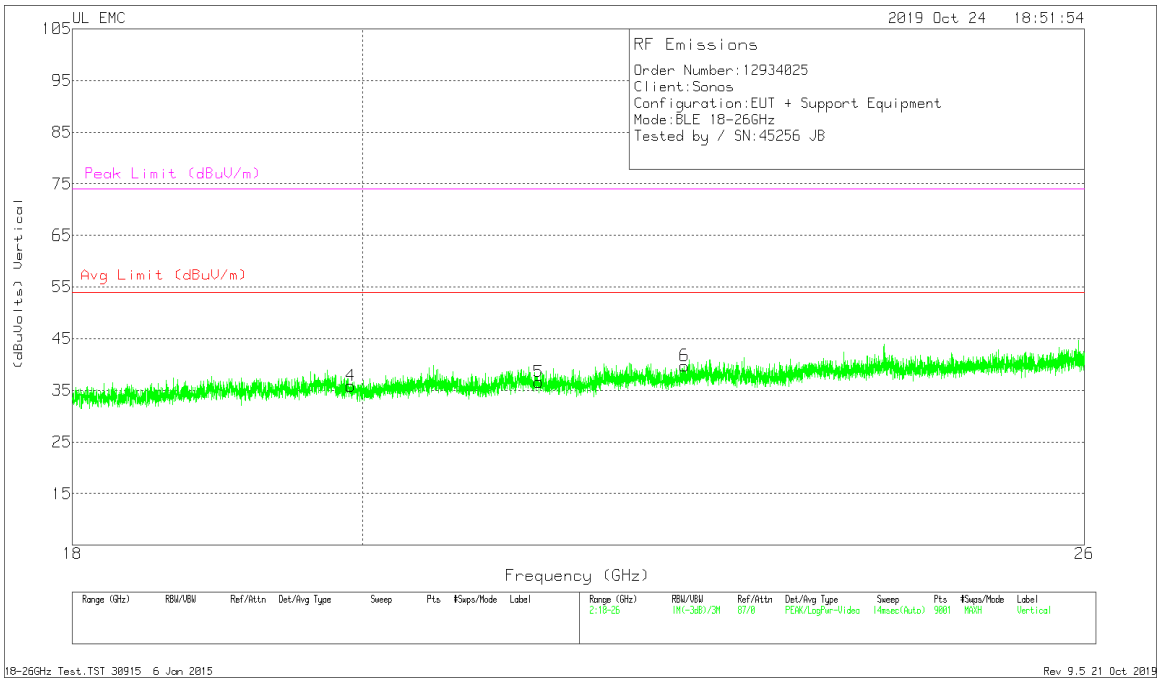
9.5. WORST CASE 18-26 GHZ

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



HORIZONTAL



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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	19.59111	37.5	Pk	32.8	-21.4	-9.5	39.4	54	-14.6	74	-34.6
2	20.50222	36.46	Pk	33	-21.5	-9.5	38.46	54	-15.54	74	-35.54
3	22.01333	35.09	Pk	33.3	-20.6	-9.5	38.29	54	-15.71	74	-35.71
4	19.91467	34.16	Pk	32.7	-21.5	-9.5	35.86	54	-18.14	74	-38.14
5	21.32444	34.32	Pk	33	-21.2	-9.5	36.62	54	-17.38	74	-37.38
6	22.48178	36.01	Pk	33.5	-20.3	-9.5	39.71	54	-14.29	74	-34.29

Pk - Peak detector

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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

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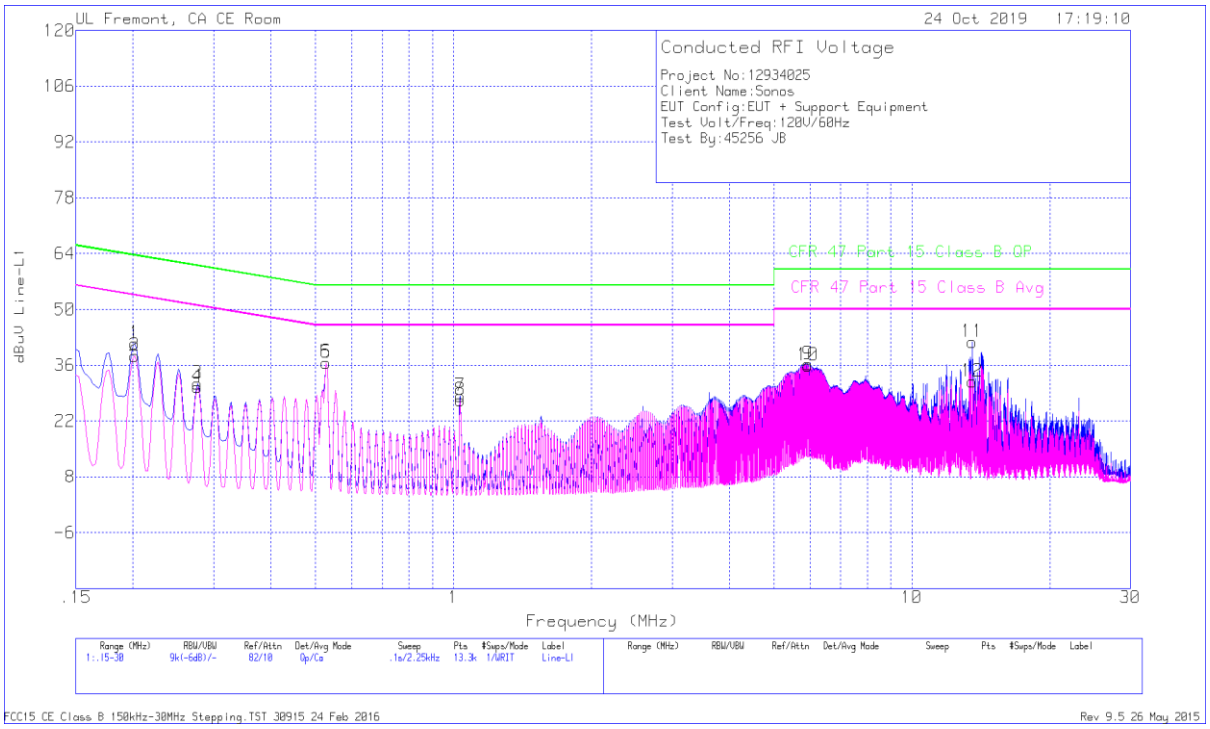
AC Power Line Norm

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	.20175	31.37	Qp	0	0	10.1	41.47	63.54	-22.07	-	-
2	.20175	28.33	Ca	0	0	10.1	38.43	-	-	53.54	-15.11
3	.276	21.33	Qp	0	0	10.1	31.43	60.94	-29.51	-	-
4	.276	20.47	Ca	0	0	10.1	30.57	-	-	50.94	-20.37
5	.528	26.58	Qp	0	0	10.1	36.68	56	-19.32	-	-
6	.528	26.6	Ca	0	0	10.1	36.7	-	-	46	-9.3
7	1.03425	18.11	Qp	0	.1	10.1	28.31	56	-27.69	-	-
8	1.03425	16.98	Ca	0	.1	10.1	27.18	-	-	46	-18.82
9	5.9325	25.82	Qp	0	.2	10.2	36.22	60	-23.78	-	-
10	5.9325	25.45	Ca	0	.2	10.2	35.85	-	-	50	-14.15
11	13.56	31.27	Qp	.1	.2	10.2	41.77	60	-18.23	-	-
12	13.56	21.47	Ca	.1	.2	10.2	31.97	-	-	50	-18.03

Qp - Quasi-Peak detector
Ca - CISPR average detection
NOTE: Markers 11 and 12, 13.56MHz is an external NFC signal unrelated to the EUT.

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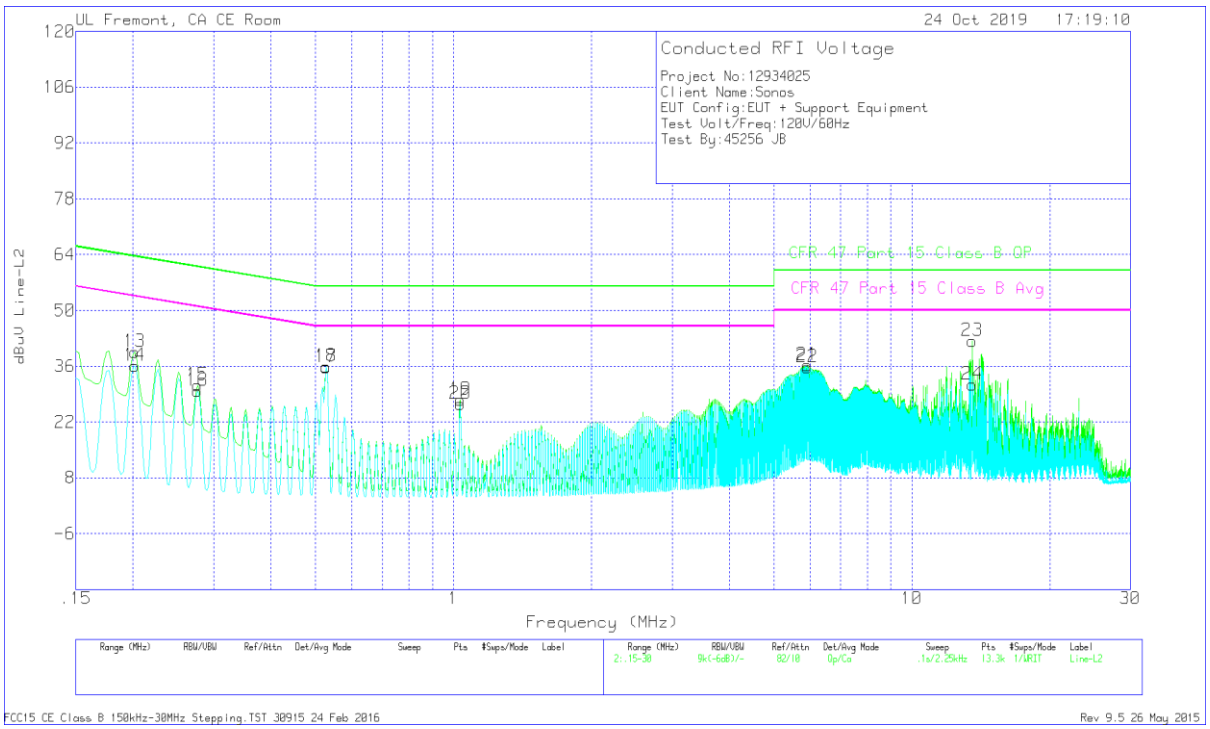
LINE 2 RESULTS



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	.20175	29.52	Qp	0	0	10.1	39.62	63.54	-23.92	-	-
14	.20175	25.98	Ca	0	0	10.1	36.08	-	-	53.54	-17.46
15	.276	21.11	Qp	0	0	10.1	31.21	60.94	-29.73	-	-
16	.276	19.81	Ca	0	0	10.1	29.91	-	-	50.94	-21.03
17	.528	25.67	Qp	0	0	10.1	35.77	56	-20.23	-	-
18	.528	25.74	Ca	0	0	10.1	35.84	-	-	46	-10.16
19	1.03425	17.42	Qp	0	.1	10.1	27.62	56	-28.38	-	-
20	1.03425	16.27	Ca	0	.1	10.1	26.47	-	-	46	-19.53
21	5.90775	25.8	Qp	0	.2	10.2	36.2	60	-23.8	-	-
22	5.90775	25.4	Ca	0	.2	10.2	35.8	-	-	50	-14.2
23	13.56	31.78	Qp	.1	.2	10.2	42.28	60	-17.72	-	-
24	13.56	20.84	Ca	.1	.2	10.2	31.34	-	-	50	-18.66

Qp - Quasi-Peak detector
Ca - CISPR average detection
NOTE: Markers 23 and 24, 13.56MHz is an external NFC signal unrelated to the EUT.

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