CERTIFICATION TEST REPORT

Report Number. : R12663786-E5

Applicant	:	Ideal Industries Lighting LLC, DBA CREE Lighting 4401 Silicon Drive Durham, NC 27703, USA
Model	:	WIM-CMB-OEM
FCC ID	:	2ACQ6-WMB
IC	:	11481A-WMB
EUT Description	:	Wireless Integration Module with Bluetooth
Test Standard(s)	:	FCC 47 CFR PART 15 SUBPART C ISED RSS-247 ISSUE 2 ISED RSS-GEN ISSUE 5

Date Of Issue:
2019-07-17

Prepared by:
UL LLC
12 Laboratory Dr.
Research Triangle Park, NC 27709 U.S.A.
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NVLAP TESTING
ilac-MRA
NVLAP Lab code: 200246-0

REPORT REVISION HISTORY

Ver.	Issue Date	Revisions	Revised By
1	2019-06-28	Initial Issue	Brian T. Kiewra
2	2019-07-17	Updated applicant name and FCC/IC IDs	Niklas Haydon

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Ideal Industries Lighting LLC, DBA CREE Lighting
4401 Silicon Drive
Durham, NC 27703, USA

EUT DESCRIPTION: 802.15.4/BLE radio module

MODEL: WIM-CMB-OEM

SERIAL NUMBER: Radiated: WRC-2, JN251C78092, JN251C78096
Conducted: JN251C78093, JN251C78096 (LC)

DATE TESTED: 2019-06-21 to 2019-06-26

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 Part 15 Subpart C	Compliant
ISED RSS-247 Issue 2	Compliant
ISED RSS-GEN Issue 5	Compliant

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

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL LLC and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL LLC will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the U.S. Government.

Approved & Released
For UL LLC By:

Jeffrey Moser
Operations Leader
UL – Consumer Technology Division

Prepared By:

Brian T. Kiewra
Project Engineer
UL – Consumer Technology Division

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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, 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 12 Laboratory Drive, Research Triangle Park, NC 27709, USA and 2800 Perimeter Park Dr., Suite B, Morrisville, NC 27560, USA. 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.

12 Laboratory Dr.	2800 Suite Perimeter Park Dr.
ISED Site Code: 2180C	
☐ Chamber A	☐ Chamber North
☐ Chamber C	☒ Chamber South

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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
Radio Frequency (Spectrum Analyzer)	141.2 Hz
Occupied Channel Bandwidth	2.00%
RF output power, conducted	1.3 dB (PK) 0.45 dB (AV)
RF output power, radiated (SAC)	4.52 dB
Power Spectral Density, conducted	2.47 dB
Unwanted Emissions, conducted	2.50 dB
All emissions, radiated	4.88 dB
Temperature	2.26°C
Humidity	6.79%
DC Supply voltages	1.70%
Time	3.39%

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 a 802.15.4/BLE radio module. This report covers BLE.

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	3.28	2.13

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The BLE radio utilize a Johanson 2450AT18B100 antenna, with a maximum gain of 0.5 dBi.

5.4. SOFTWARE AND FIRMWARE

The Firmware used for Bluetooth on the EUT during testing is common F/W for all Bluetooth channels - UART commands based “radio_test_pca10040.hex”, Rev 0

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,Z, it was determined that X orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in X orientation.

All testing done at power setting of 3dBm, except for power. Power will be set to 3dBm for 2402-2478MHz. 2480MHz will be set to 0dbm.

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5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
DC power supply	Circuit Specialists	CSI3005X5	Non-Serialized	NA

I/O CABLES

I/O Cable List						
Cable No.	**Port**	**# of Identical Ports**	**Connector Type**	**Cable Type**	**Cable Length (m)**	**Remarks**
1	DC	1	Terminal	Unshielded	<3m	Provides DC power to EUT

SETUP DIAGRAMS

Refer to UL Document R12663786-EP5

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6. MEASUREMENT METHOD

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

6 dB BW: ANSI C63.10 Subclause 11.8.1

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

Output Power: ANSI C63.10 Subclause 11.9.1.3 (PKPM1)

PSD: ANSI C63.10 Subclause 11.10.2 (Peak PSD)

Out-of-band emissions in non-restricted bands: ANSI C63.10-2013 Section 11.11 & 6.10.4

Out-of-band emissions in restricted bands: ANSI C63.10-2013 Section 11.12.1 & 6.10.5

General Radiated Emissions: ANSI C63.10:2013 Sections 6.3 – 6.6

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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 Used - Radiated Disturbance Emissions Test Equipment (Morrisville - South Chamber)

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
0.009-30MHz (Loop Ant.)					
AT0079	Active Loop Antenna	ETS-Lindgren	6502	2019-01-24	2020-01-31
30-1000 MHz					
AT0074	Hybrid Broadband Antenna	Sunol Sciences Corp.	JB3	2018-07-24	2019-07-24
1-18 GHz					
AT0072	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2019-04-22	2020-04-22
18-40 GHz					
AT0076	Horn Antenna, 18-26.5GHz	ARA	MWH-1826/B	2018-11-08	2019-11-08
Gain-Loss Chains					
S-SAC01	Gain-loss string: 0.009-30MHz	Various	Various	2019-05-02	2020-05-02
S-SAC02	Gain-loss string: 25-1000MHz	Various	Various	2019-05-02	2020-05-02
S-SAC03	Gain-loss string: 1-18GHz	Various	Various	2019-03-13	2020-03-13
S-SAC04	Gain-loss string: 18-40GHz	Various	Various	2018-09-30	2019-09-30
Receiver & Software					
SA0025	Spectrum Analyzer	Agilent	N9030A	2019-05-15	2020-05-15
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA
Additional Equipment used					
s/n 181474409	Environmental Meter	Fisher Scientific	15-077-963	2018-07-27	2020-07-27
76022	DC Regulated Power Supply	Circuit Specialists	CSI3005X5	N/A	N/A

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Test Equipment Used - Line-Conducted Emissions – Voltage (Morrisville – Conducted 1)

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
CBL087	Coax cable, RG223, N-male to BNC-male, 20-ft.	Pasternack	PE3W06143-240	2019-05-29	2020-05-29
s/n 181562858	Environmental Meter	Fisher Scientific	14-650-118	2018-09-04	2020-09-04
LISN003	LISN, 50-ohm/50-uH, 2-conductor, 25A	Fischer Custom	FCC-LISN-50-25-2-01-550V	2018-08-21	2019-08-21
75141 (PRE0101521)	EMI Test Receiver 9kHz-7GHz	Rohde & Schwarz	ESCI 7	2018-08-22	2019-08-22
TL001	Transient Limiter, 0.009-30MHz	Com-Power	LIT-930A	2019-05-29	2020-05-29
PS214	AC Power Source	Elgar	CW2501M (s/n 1523A02396)	NA	NA
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA
76021	DC Regulated Power Supply	Circuit Specialists	CSI3005X5	N/A	N/A

Test Equipment Used - Wireless Conducted Measurement Equipment

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal
72822 (PRE0100902)	Spectrum Analyzer	Agilent Technologies	E4446A	2018-11-19	2019-11-19
PWM002 (PRE0137346)	RF Power Meter	Keysight Technologies	N1911A	2018-07-30	2019-07-30
PWS002 (PRE0126443)	Peak and Avg Power Sensor, 50MHz to 6GHz	Keysight Technologies	E9323A	2018-07-30	2019-07-30
76023 (EC0225)	Temp/Humid Chamber	Cincinnati Sub-Zero	ZPH-8-3.5-SCT/AC	2019-06-14	2020-06-14
SN 181474341	Environmental Meter	Fisher Scientific	15-077-963	2018-07-27	2020-07-27
76021	DC Regulated Power Supply	Circuit Specialists	CSI3005X5	N/A	N/A

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8. ANTENNA PORT TEST RESULTS

8.1. ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

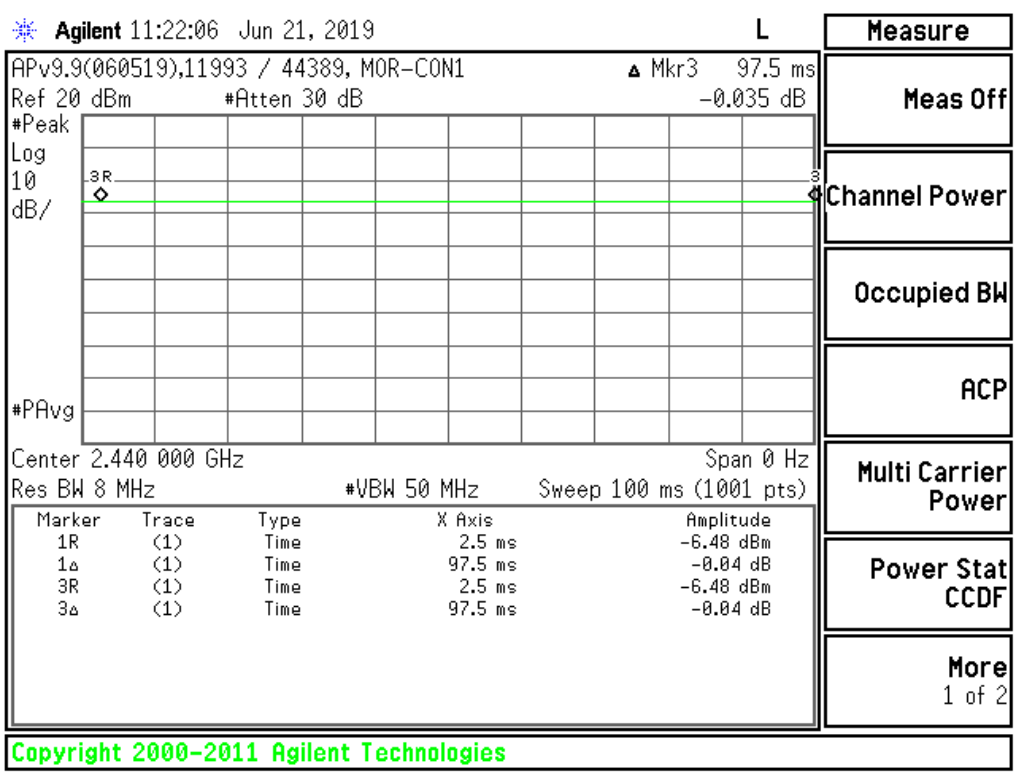
PROCEDURE

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)
2.4GHz Band						
BLE	97.500	97.500	1.000	100.00%	0.00	0.010

DUTY CYCLE PLOTS



DUTY CYCLE BLE

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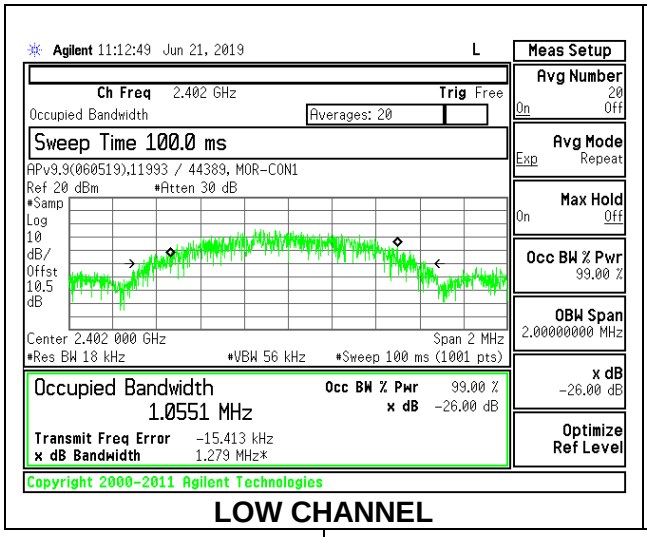
8.2. 99% BANDWIDTH

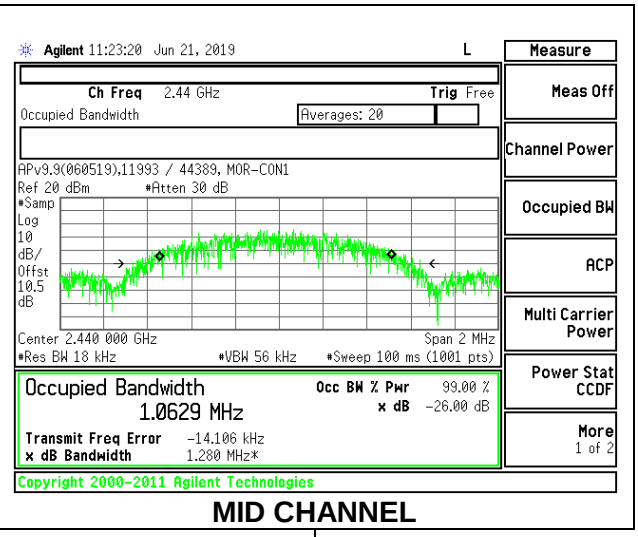
LIMITS

None; for reporting purposes only.

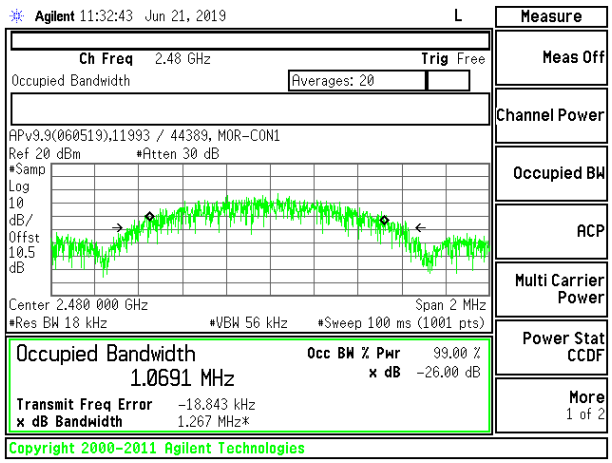
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	1.0551
Middle	2440	1.0629
High	2480	1.0691



LOW CHANNEL



MID CHANNEL



HIGH CHANNEL

Note - All testing done at power setting of 3dBm, except for power. Power will be set to 3dBm for 2402-2478MHz. 2480MHz will be set to 0dbm.

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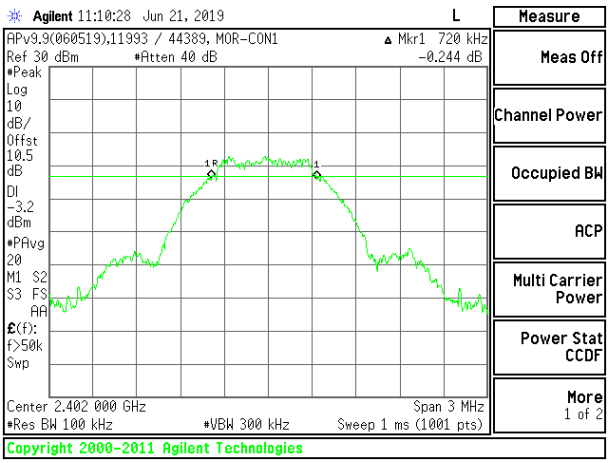
8.3. 6 dB BANDWIDTH

LIMITS

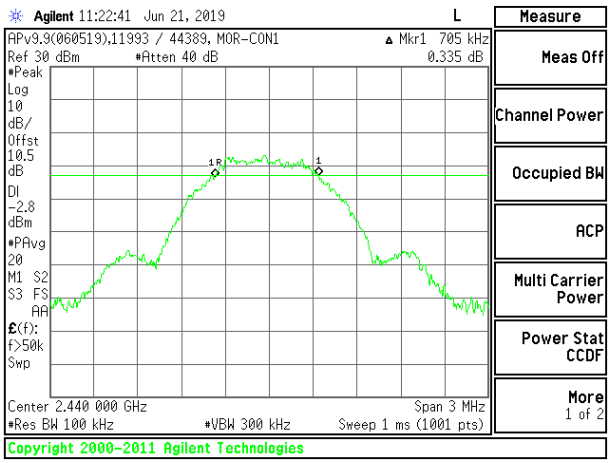
FCC §15.247 (a) (2)
RSS-247 5.2 (a)

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

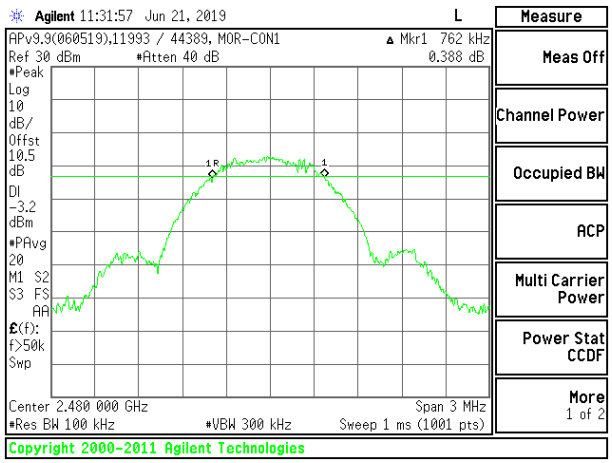
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2402	0.720	0.5
Middle	2440	0.705	0.5
High	2480	0.762	0.5



LOW CHANNEL



MID CHANNEL



HIGH CHANNEL

Note - All testing done at power setting of 3dBm, except for power. Power will be set to 3dBm for 2402-2478MHz. 2480MHz will be set to 0dbm.

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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 10.5 dB (including 10 dB pad and 0.5 dB cable) was entered as an offset in the power meter to allow for a peak reading of power.

Tested By:	11993/44389
Date:	2019-06-26

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	2.88	30	-27.12
Middle	2440	2.99	30	-27.01
High	2478	3.28	30	-26.72
High	2480	0.99	30	-29.01

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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 10.5 dB (including 10 dB pad and 0.5 dB cable) was entered as an offset in the power meter to allow for a gated average reading of power.

Tested By:	11993/44389
Date:	2019-06-26

Channel	Frequency (MHz)	AV power (dBm)
Low	2402	2.68
Middle	2440	2.77
High	2478	3.09
High	2480	0.67

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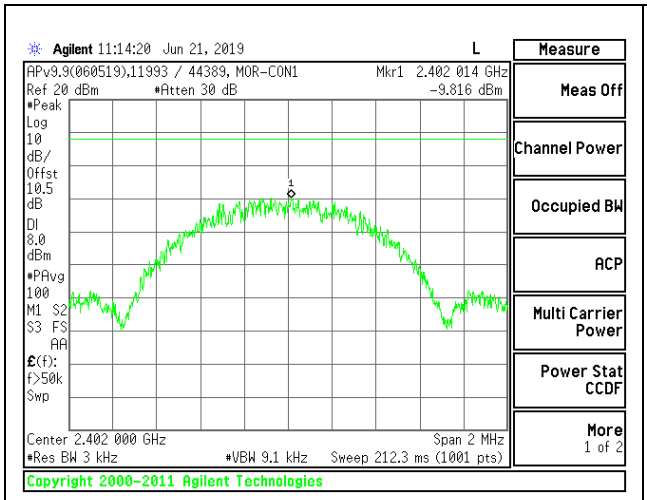
8.6. POWER SPECTRAL DENSITY

LIMITS

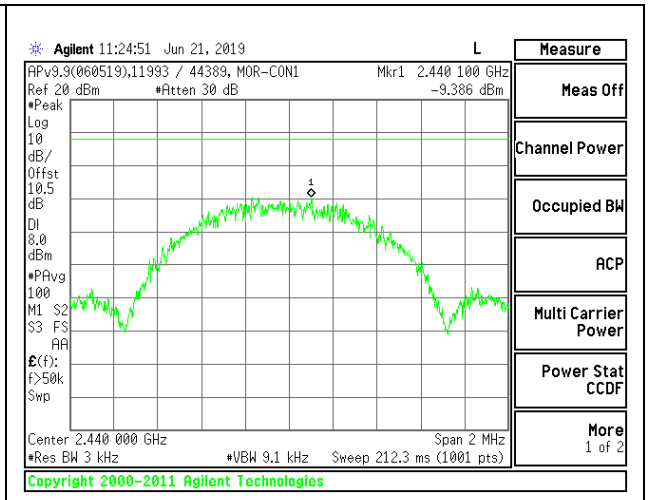
FCC §15.247 (e)
RSS-247 (5.2) (b)

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.

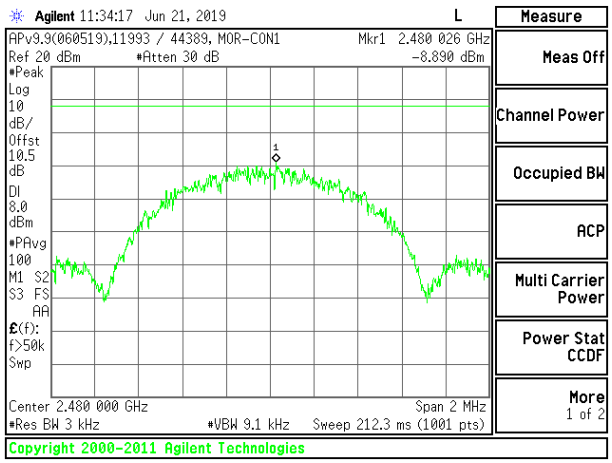
Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Low	2402	-9.816	8	-17.82
Middle	2440	-9.386	8	-17.39
High	2480	-8.890	8	-16.89



LOW CHANNEL



MID CHANNEL



HIGH CHANNEL

Note - All testing done at power setting of 3dBm, except for power. Power will be set to 3dBm for 2402-2478MHz. 2480MHz will be set to 0dbm.

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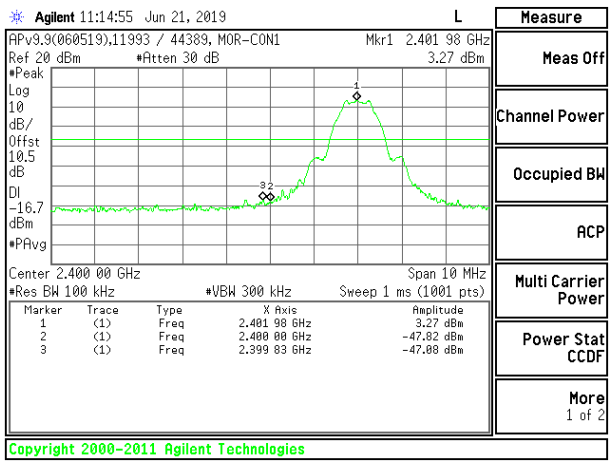
8.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

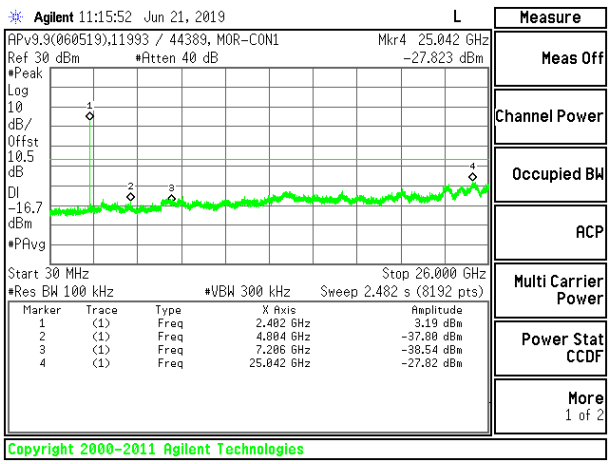
FCC §15.247 (d)

RSS-247 5.5

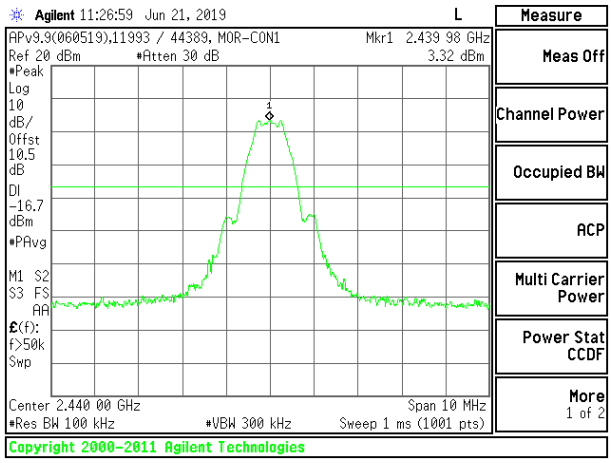
Output power was measured based on the use of a peak measurement, therefore the required attenuation is 20 dB.



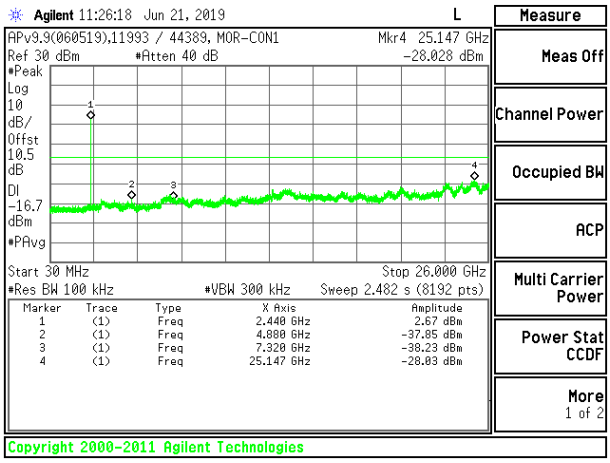
LOW CHANNEL BANDEDGE



OUT-OF-BAND LOW CHANNEL



IN-BAND REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL

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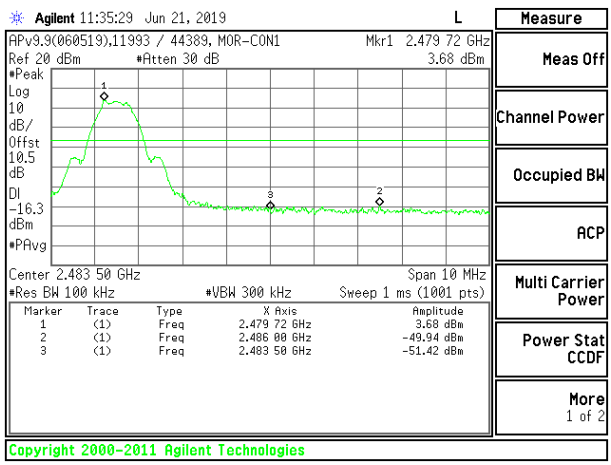
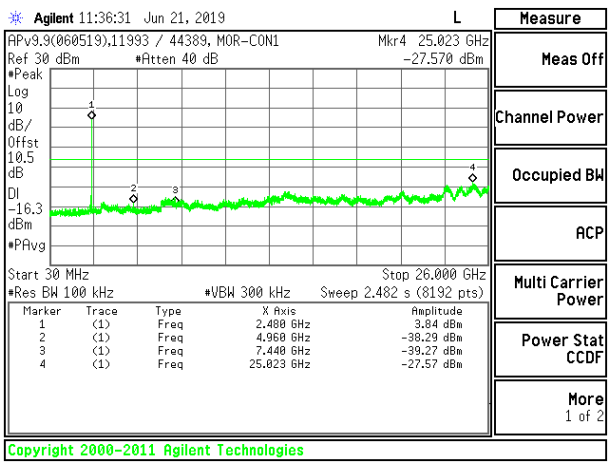


HIGH CHANNEL BANDEDGE



OUT-OF-BAND HIGH CHANNEL

Note - All testing done at power setting of 3dBm, except for power. Power will be set to 3dBm for 2402-2478MHz. 2480MHz will be set to 0dbm.

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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. In this case RMS averaging was used.

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 and PSD 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.

3D antenna use - For below 30MHz testing, investigation was done on three antenna orientations (parallel, perpendicular, and ground-parallel).

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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.

Note - All testing done at power setting of 3dBm, except for power. Power will be set to 3dBm for 2402-2478MHz. 2480MHz will be set to 0dbm.

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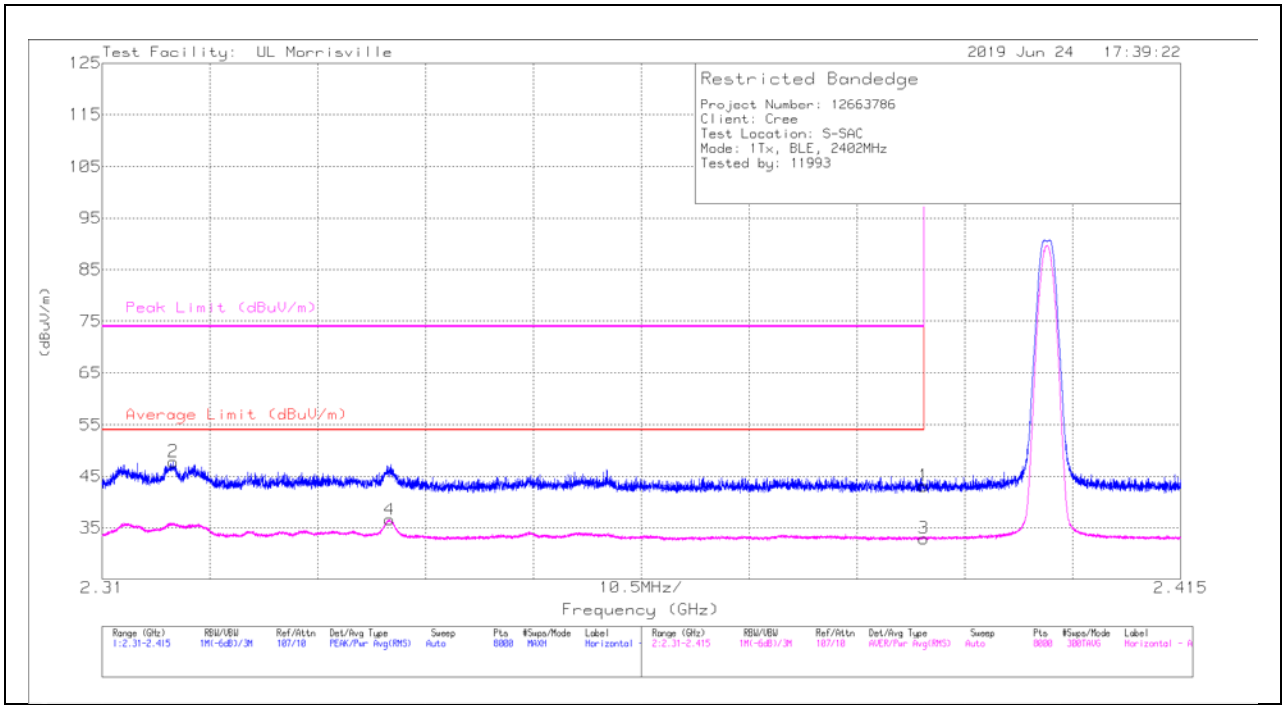
9.2. TRANSMITTER ABOVE 1 GHz

BANDEDGE (LOW CHANNEL)

HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (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	35.23	Pk	31.9	-24	43.13	-	-	74	-30.87	2	112	H
2	* 2.31692	39.8	Pk	31.7	-23.7	47.8	-	-	74	-26.2	2	112	H
3	* 2.39	25.05	RMS	31.9	-24	32.95	54	-21.05	-	-	2	112	H
4	* 2.33797	28.64	RMS	31.6	-23.7	36.54	54	-17.46	-	-	2	112	H

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

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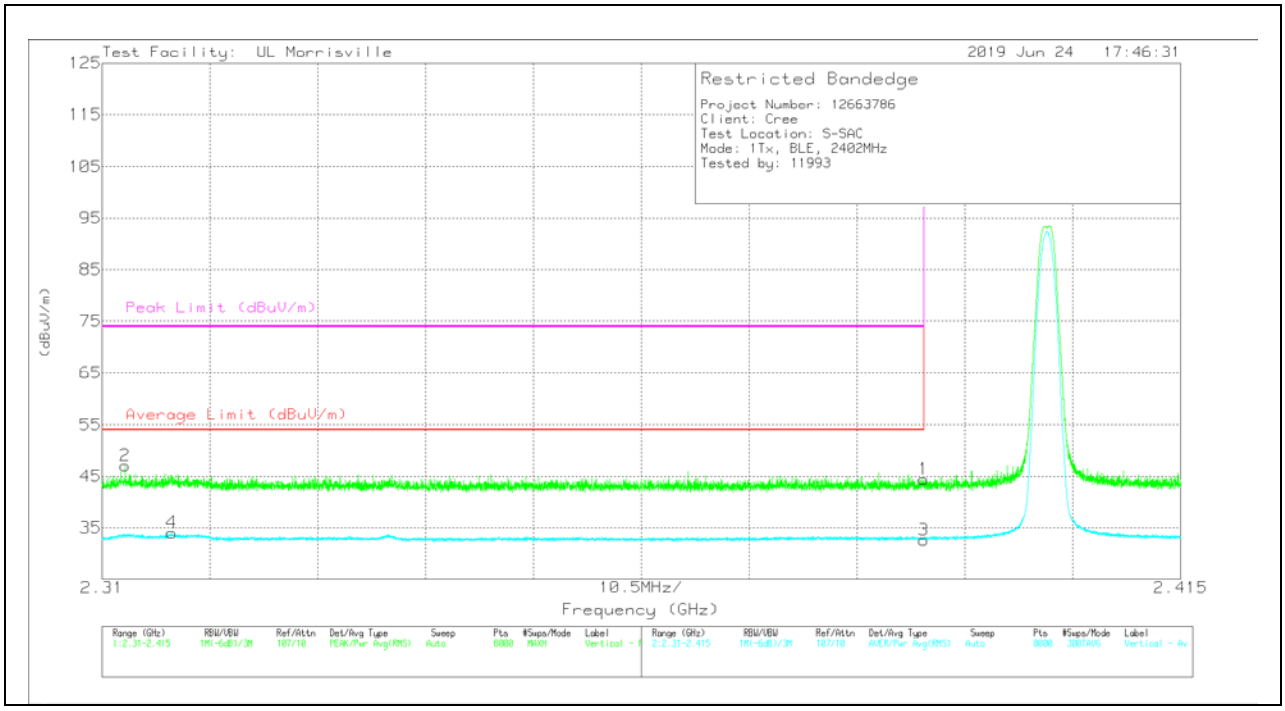
VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (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	36.55	Pk	31.9	-24	44.45	-	-	74	-29.55	214	353	V
2	* 2.31222	39.03	Pk	31.7	-23.7	47.03	-	-	74	-26.97	214	353	V
3	* 2.39	24.73	RMS	31.9	-24	32.63	54	-21.37	-	-	214	353	V
4	* 2.31677	26.04	RMS	31.7	-23.7	34.04	54	-19.96	-	-	214	353	V

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

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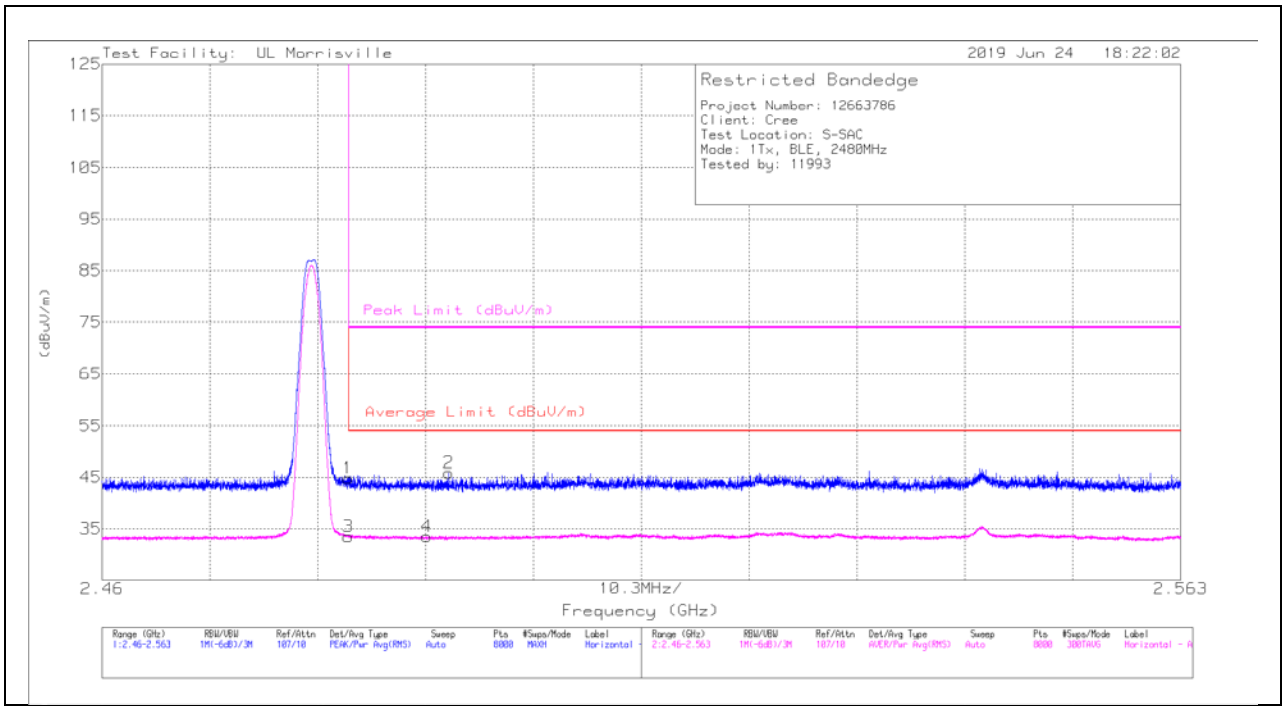
BANDEDGE (HIGH CHANNEL)

HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (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	36.99	Pk	32.3	-24.5	44.79	-	-	74	-29.21	21	349	H
2	* 2.49312	38.03	Pk	32.3	-24.5	45.83	-	-	74	-28.17	21	349	H
3	* 2.4835	25.69	RMS	32.3	-24.5	33.49	54	-20.51	-	-	21	349	H
4	* 2.49102	25.68	RMS	32.3	-24.5	33.48	54	-20.52	-	-	21	349	H

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

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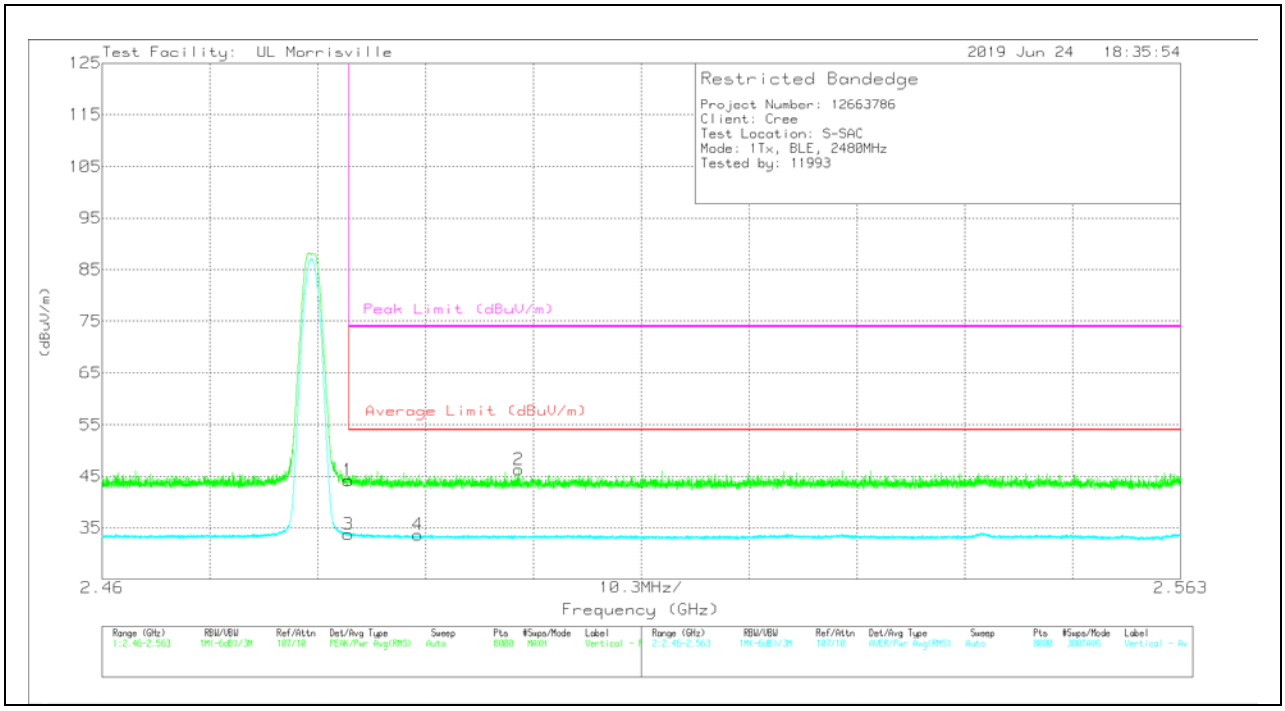
VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (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	36.43	Pk	32.3	-24.5	44.23	-	-	74	-29.77	108	227	V
2	* 2.49979	38.58	Pk	32.3	-24.6	46.28	-	-	74	-27.72	108	227	V
3	* 2.4835	25.98	RMS	32.3	-24.5	33.78	54	-20.22	-	-	108	227	V
4	* 2.49017	25.86	RMS	32.3	-24.5	33.66	54	-20.34	-	-	108	227	V

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

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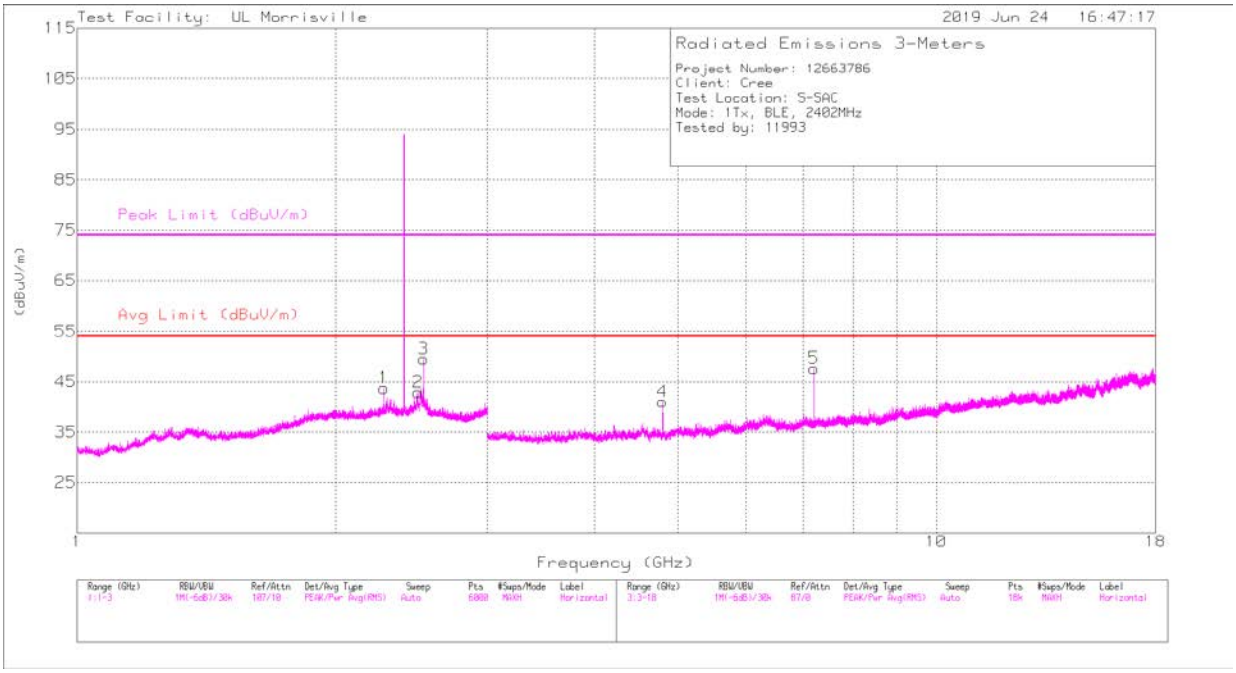
HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



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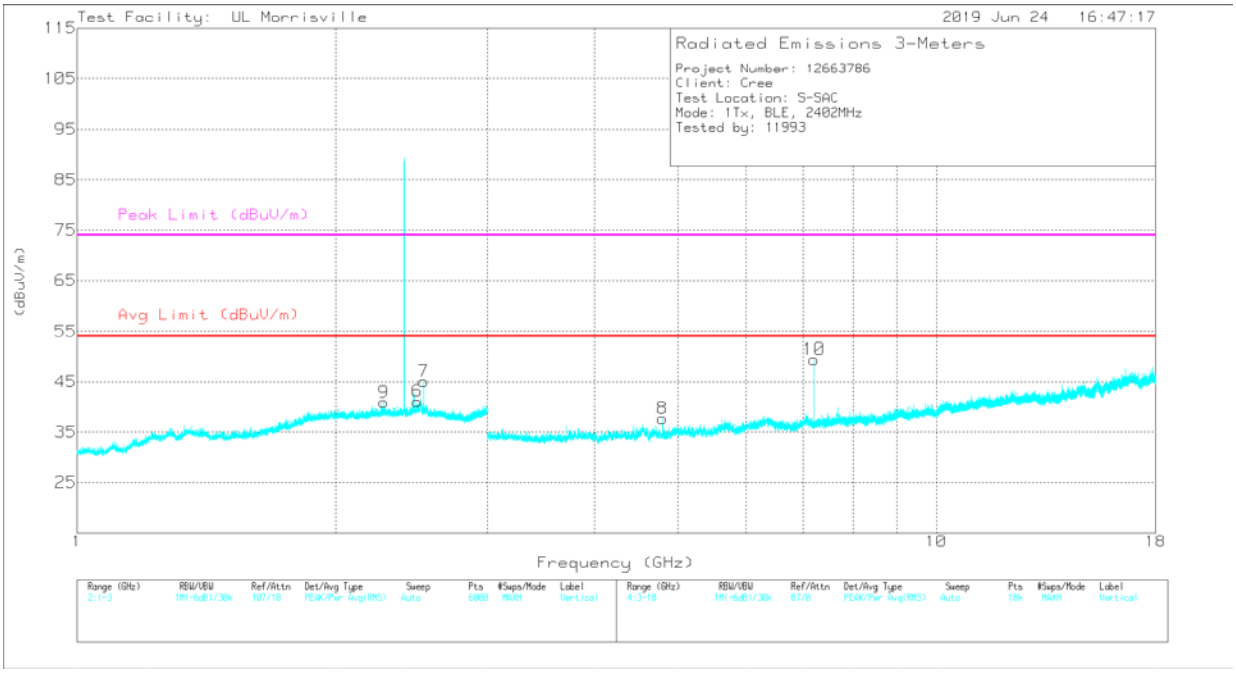

VERTICAL

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RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2	* 2.27423	41.93	PK2	31.8	-23.5	50.23	-	-	74	-23.77	14	202	H
	* 2.27398	32.72	MAv1	31.8	-23.5	41.02	54	-12.98	-	-	14	202	H
3	* 2.49173	43.13	PK2	32.3	-24.5	50.93	-	-	74	-23.07	290	202	H
	* 2.4917	31.77	MAv1	32.3	-24.5	39.57	54	-14.43	-	-	290	202	H
6	* 2.48738	41.36	PK2	32.3	-24.5	49.16	-	-	74	-24.84	229	101	V
	* 2.48728	28.28	MAv1	32.3	-24.5	36.08	54	-17.92	-	-	229	101	V
9	* 2.2743	39.5	PK2	31.8	-23.5	47.8	-	-	74	-26.2	201	288	V
	* 2.27394	29.62	MAv1	31.8	-23.5	37.92	54	-16.08	-	-	201	288	V
4	* 4.8044	43.48	PK2	34.2	-31	46.68	-	-	74	-27.32	296	187	H
	* 4.80434	34.84	MAv1	34.2	-31	38.04	54	-15.96	-	-	296	187	H
8	* 4.80451	42.31	PK2	34.2	-31	45.51	-	-	74	-28.49	121	105	V
	* 4.80431	33.09	MAv1	34.2	-31	36.29	54	-17.71	-	-	121	105	V
7	2.52992	37.5	Pk	32.4	-24.8	45.1	-	-	-	-	0-360	199	V
3	2.53026	41.84	Pk	32.4	-24.8	49.44	-	-	-	-	0-360	199	H
10	7.2044	41.69	Pk	35.7	-28	49.39	-	-	-	-	0-360	101	V
5	7.20607	39.93	Pk	35.7	-28	47.63	-	-	-	-	0-360	101	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PK2 - Maximum Peak
MAv1 - Maximum RMS Average
Pk - Peak detector

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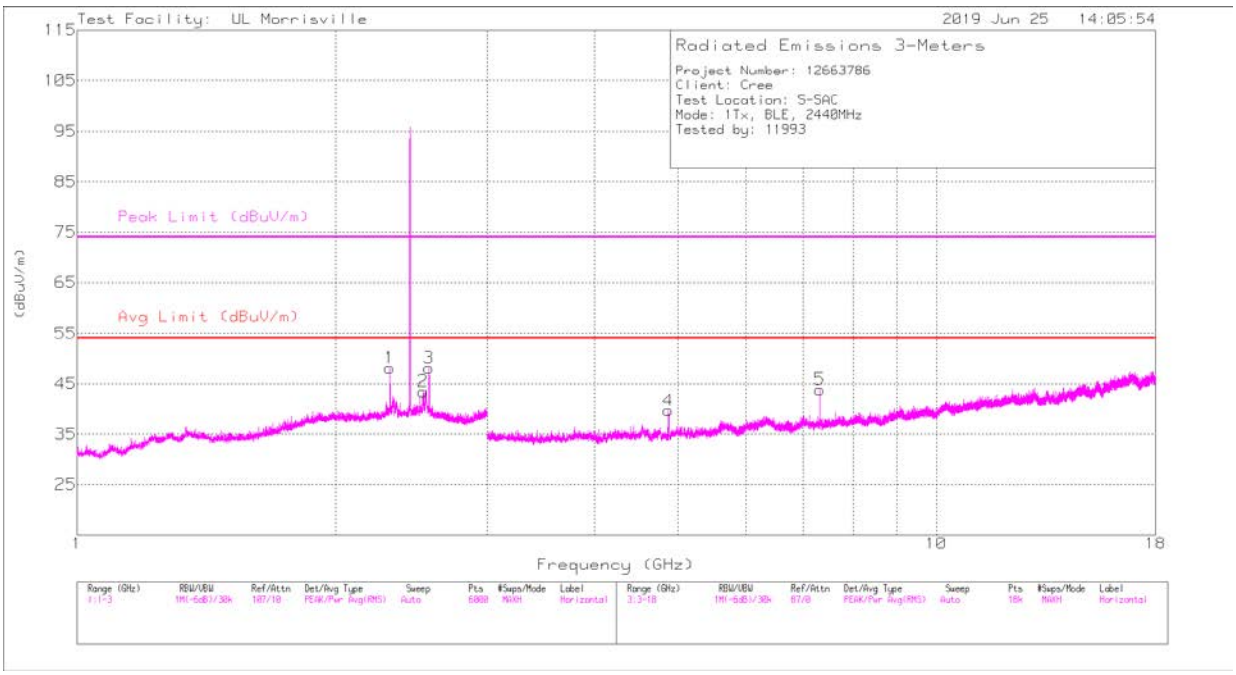
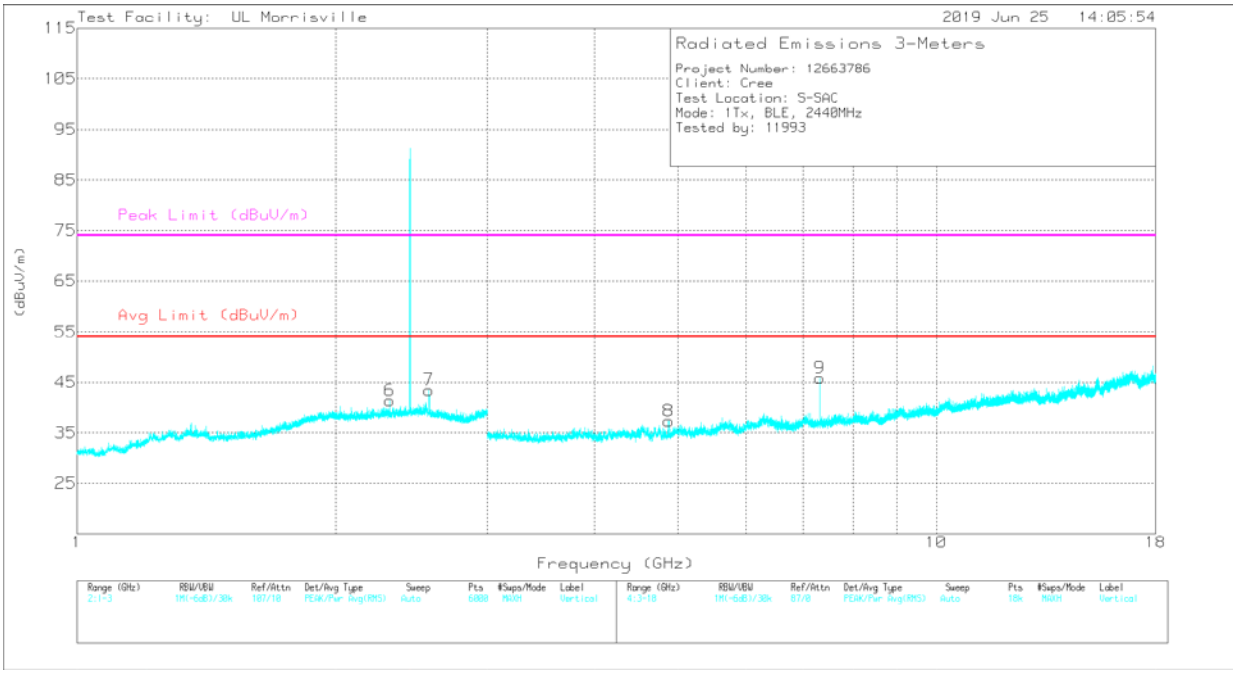
MID CHANNEL RESULTS



HORIZONTAL



VERTICAL

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RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.31217	45.01	PK2	31.7	-23.7	53.01	-	-	74	-20.99	354	106	H
	* 2.31201	37.63	MAv1	31.7	-23.7	45.63	54	-8.37	-	-	354	106	H
6	* 2.31199	41.74	PK2	31.7	-23.7	49.74	-	-	74	-24.26	273	393	V
	* 2.31196	32.79	MAv1	31.7	-23.7	40.79	54	-13.21	-	-	273	393	V
4	* 4.8796	43.17	PK2	34	-30.6	46.57	-	-	74	-27.43	146	205	H
	* 4.87958	32.74	MAv1	34	-30.6	36.14	54	-17.86	-	-	146	205	H
5	* 7.31923	42.24	PK2	35.7	-27.5	50.44	-	-	74	-23.56	73	109	H
	* 7.31925	34.69	MAv1	35.7	-27.5	42.89	54	-11.11	-	-	73	109	H
8	* 4.8794	41.17	PK2	34	-30.6	44.57	-	-	74	-29.43	337	197	V
	* 4.87966	30.47	MAv1	34	-30.6	33.87	54	-20.13	-	-	337	197	V
9	* 7.31925	41.98	PK2	35.7	-27.5	50.18	-	-	74	-23.82	120	103	V
	* 7.31928	34.72	MAv1	35.7	-27.5	42.92	54	-11.08	-	-	120	103	V
2	2.52526	35.79	Pk	32.4	-24.7	43.49	-	-	-	-	0-360	101	H
7	2.56793	36.19	Pk	32.3	-25	43.49	-	-	-	-	0-360	199	V
3	2.56826	40.81	Pk	32.3	-25	48.11	-	-	-	-	0-360	101	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PK2 - Maximum Peak
MAv1 - Maximum RMS Average
Pk - Peak detector

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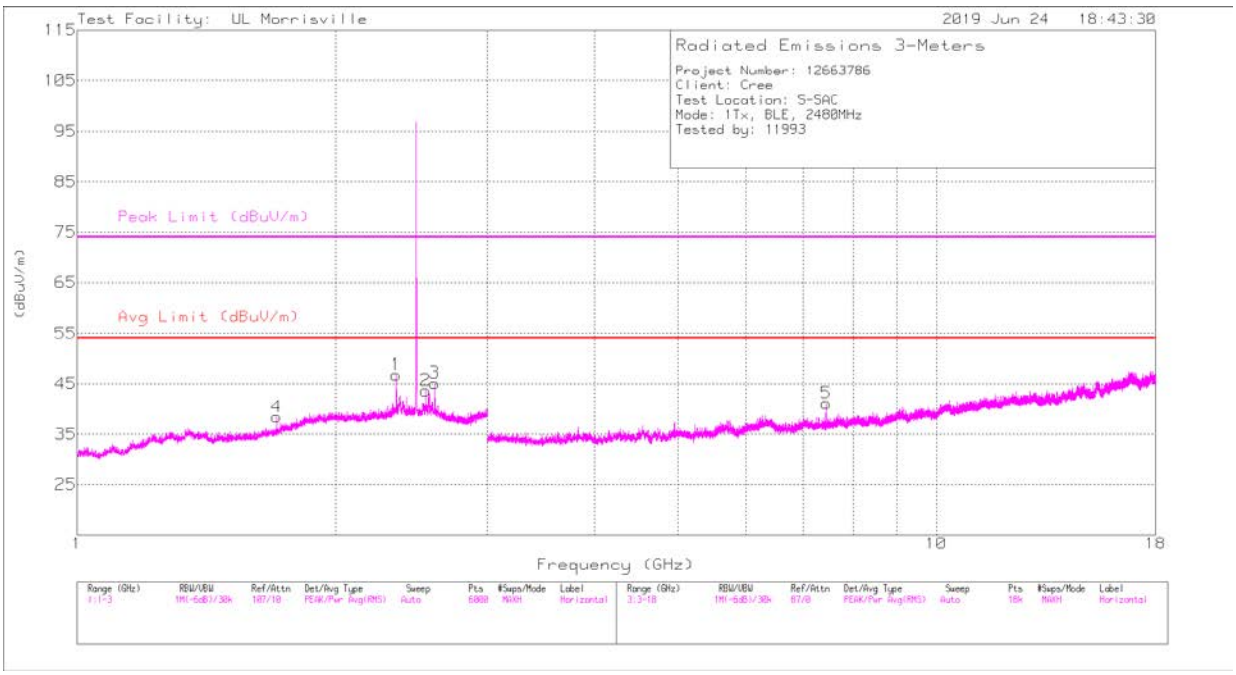
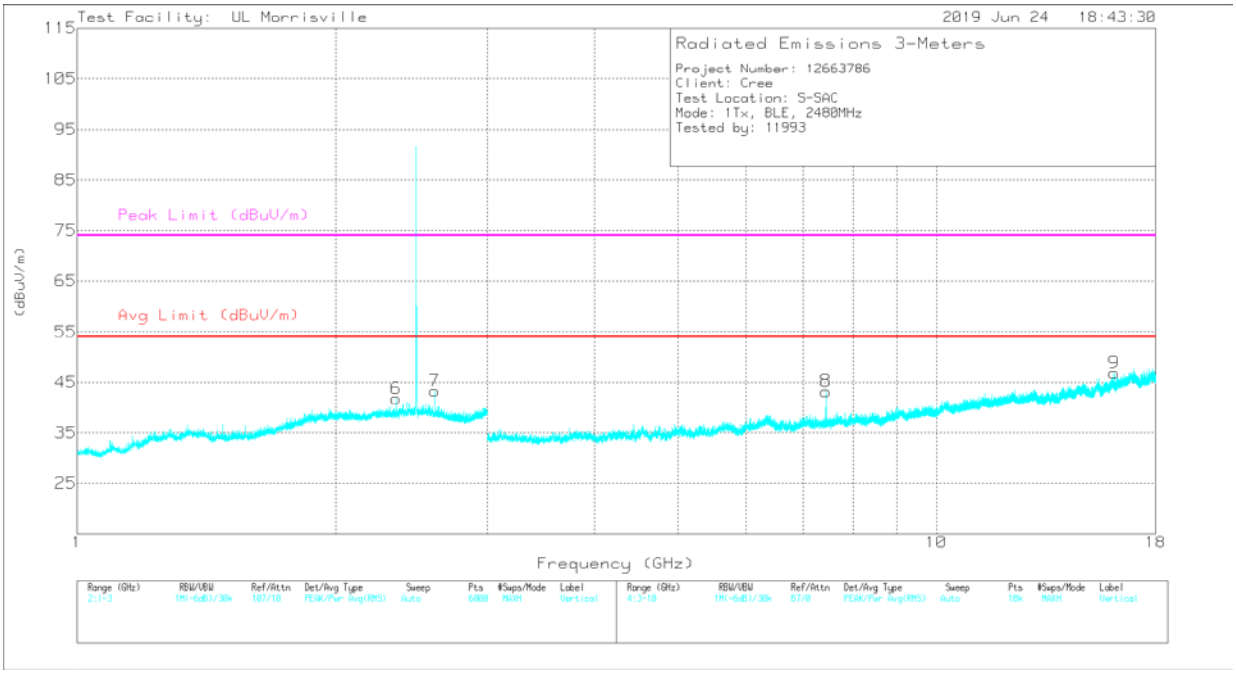
HIGH CHANNEL RESULTS



HORIZONTAL



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RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.35181	44.61	PK2	31.7	-23.8	52.51	-	-	74	-21.49	350	104	H
	* 2.35199	37.13	MAv1	31.7	-23.8	45.03	54	-8.97	-	-	350	104	H
4	* 1.70704	36.04	PK2	29	-22.1	42.94	-	-	74	-31.06	22	200	H
	* 1.70619	23.73	MAv1	28.9	-22.1	30.53	54	-23.47	-	-	22	200	H
6	* 2.35201	41.69	PK2	31.7	-23.8	49.59	-	-	74	-24.41	187	387	V
	* 2.35198	32.72	MAv1	31.7	-23.8	40.62	54	-13.38	-	-	187	387	V
5	* 7.4392	39.36	PK2	35.8	-27.8	47.36	-	-	74	-26.64	91	101	H
	* 7.44059	30.14	MAv1	35.8	-27.8	38.14	54	-15.86	-	-	91	101	H
8	* 7.44073	41.03	PK2	35.8	-27.8	49.03	-	-	74	-24.97	123	104	V
	* 7.44066	33.28	MAv1	35.8	-27.8	41.28	54	-12.72	-	-	123	104	V
9	* 16.10618	35.24	PK2	40.9	-23.6	52.54	-	-	74	-21.46	317	354	V
	* 16.10653	22.99	MAv1	40.9	-23.6	40.29	54	-13.71	-	-	317	354	V
2	2.54392	36.05	Pk	32.4	-24.8	43.65	-	-	-	-	0-360	199	H
3	2.60794	37.94	Pk	32.4	-25.2	45.14	-	-	-	-	0-360	101	H
7	2.60794	36.12	Pk	32.4	-25.2	43.32	-	-	-	-	0-360	101	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PK2 - Maximum Peak
MAv1 - Maximum RMS Average
Pk - Peak detector

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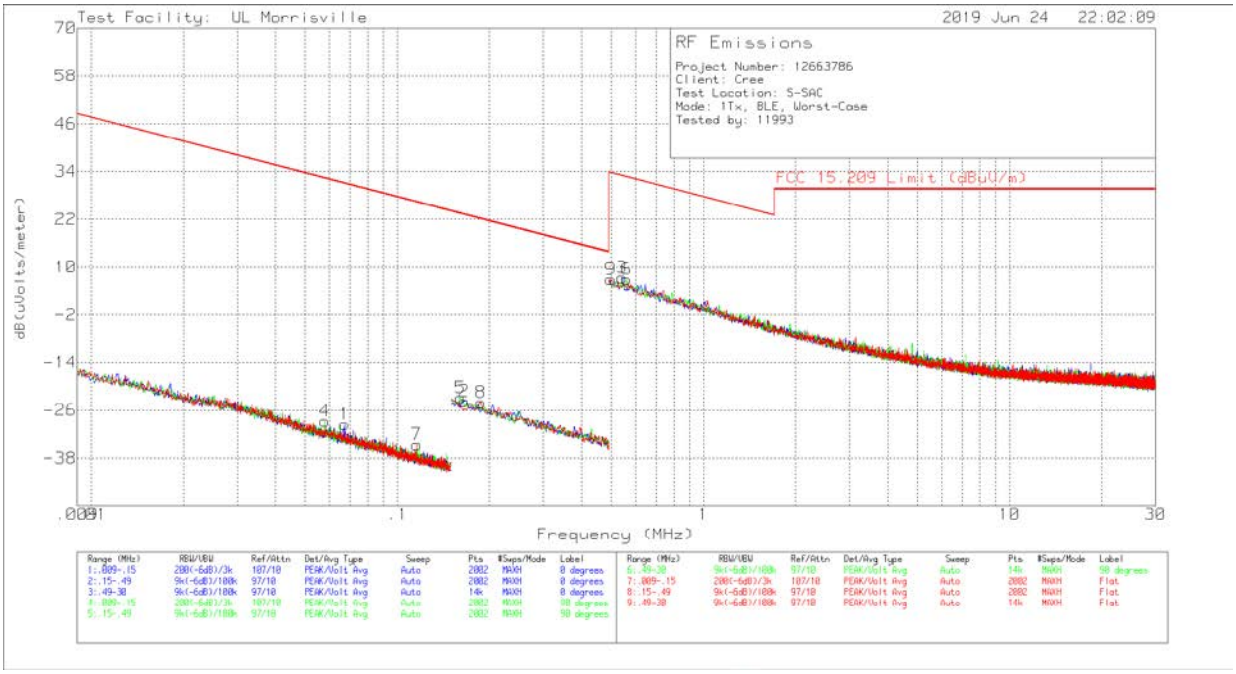
9.3. WORST CASE BELOW 30MHZ

SPURIOUS EMISSIONS BELOW 30 MHz (WORST-CASE CONFIGURATION)

Note: All measurements were made at a test distance of 3 m. The measured data was extrapolated from the test distance (3m) to the specification distance (300 m from 9-490 kHz and 30 m from 490 kHz – 30 MHz) to clearly show the relative levels of fundamental and spurious emissions and demonstrate compliance with the requirement that the level of any spurious emissions be below the level of the intentionally transmitted signal. The extrapolation factor for the limits were 40*Log (test distance / specification distance).



ANTENNA- THREE ORIENTATIONS

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0079 AF (dB/m)	Cbl (dB)	Dist. Corr. Factor (dB)	Corrected Reading dB(uV/m)	FCC 15.209 QP Limit (dBuV/m)	FCC 15.209 AV Limit (dBuV/m)	FCC 15.209 PK Limit (dBuV/m)	Worst-Case Margin (dB)	Azimuth (Degs)	Antenna Face
4	.05793	39.61	Pk	11.5	.1	-80	-28.79	-	32.35	52.35	-61.14	0-360	Off
1	.06724	39.05	Pk	11.3	.1	-80	-29.55	-	31.05	51.05	-60.6	0-360	On
7	.11547	34.48	Pk	10.8	.1	-80	-34.62	-	26.35	46.35	-60.97	0-360	Flat
5	.16029	46.34	Pk	10.7	.1	-80	-22.86	-	23.51	43.51	-46.37	0-360	Off
2	.16547	45.43	Pk	10.7	.1	-80	-23.77	-	23.23	43.23	-47	0-360	On
8	.18723	45.13	Pk	10.7	.1	-80	-24.07	-	22.16	42.16	-46.23	0-360	Flat
9	.49843	36.01	Pk	10.8	.1	-40	6.91	33.65	-	-	-26.74	0-360	Flat
3	.5427	36.36	Pk	10.8	.1	-40	7.26	32.91	-	-	-25.65	0-360	On
6	.56062	36.02	Pk	10.8	.1	-40	6.92	32.63	-	-	-25.71	0-360	Off

Pk - Peak detector

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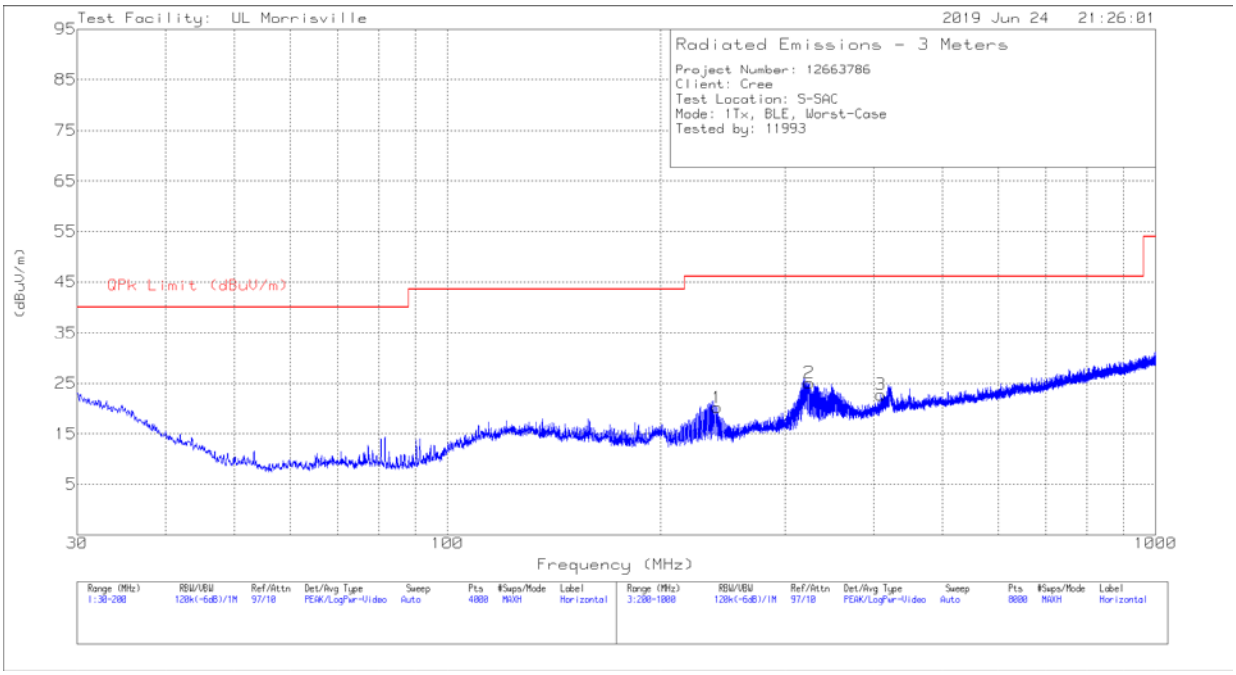
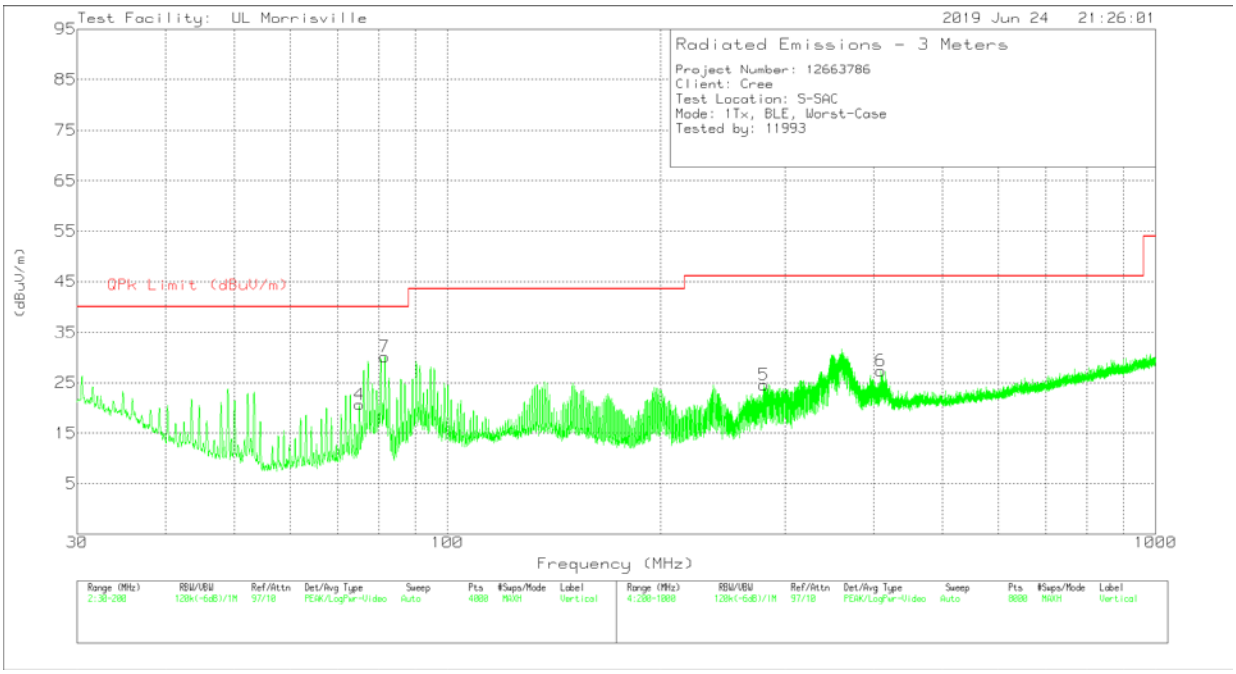
9.4. WORST CASE BELOW 1 GHZ

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



HORIZONTAL



VERTICAL

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Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0074 AF (dB/m)	Cbl/Amp	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
4	* 75.1042	39.48	Pk	12.4	-31.2	20.68	40	-19.32	0-360	102	V
1	* 240.4053	33.89	Pk	16.3	-30	20.19	46.02	-25.83	0-360	299	H
2	* 324.2161	35.76	Pk	18.7	-29.4	25.06	46.02	-20.96	0-360	102	H
3	* 409.0272	31.27	Pk	20.7	-29.2	22.77	46.02	-23.25	0-360	198	H
5	* 279.6103	36.47	Pk	17.9	-29.8	24.57	46.02	-21.45	0-360	101	V
6	* 409.1272	35.81	Pk	20.7	-29.2	27.31	46.02	-18.71	0-360	101	V
7	81.5658	49.43	Pk	11.9	-31.2	30.13	40	-9.87	0-360	102	V

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

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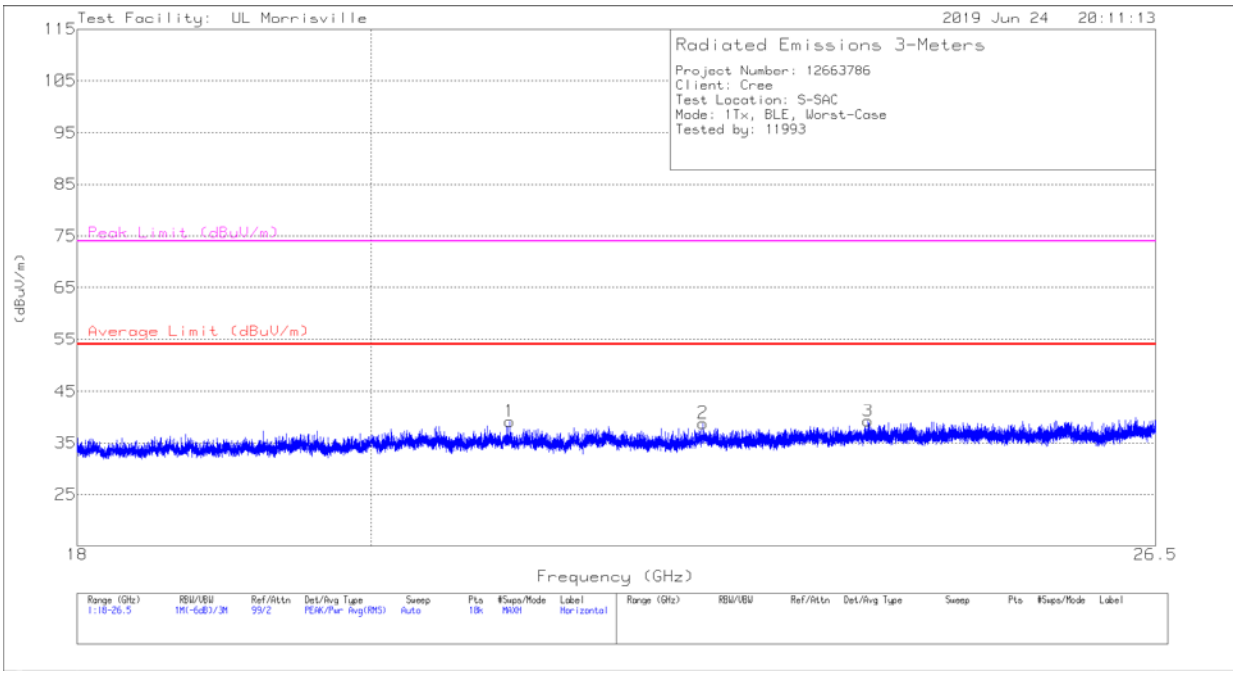
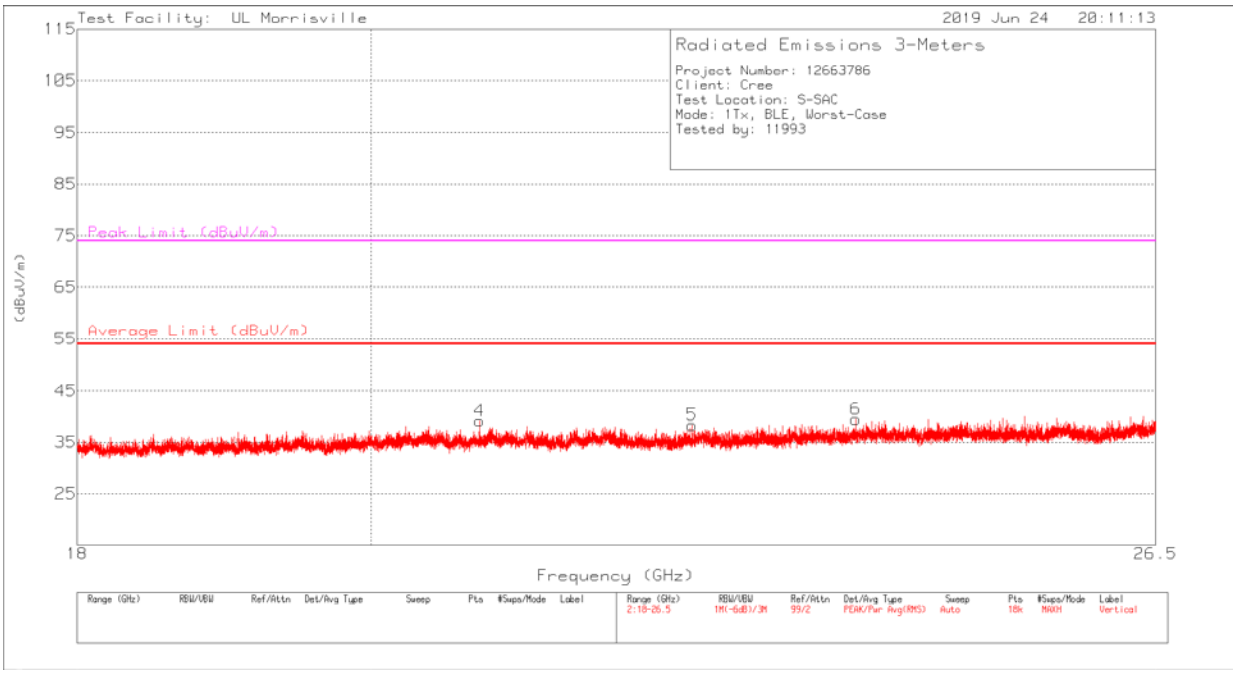
9.5. WORST CASE 18-26 GHZ

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



HORIZONTAL



VERTICAL

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Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0076 AF (dB/m)	Cbl/Amp (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 21.0205	44.06	Pk	33.2	-38.1	39.16	54	-14.84	74	-34.84	0-360	249	H
2	* 22.52744	43.29	Pk	33.5	-38	38.79	54	-15.21	74	-35.21	0-360	199	H
3	* 23.90452	42.5	Pk	34	-37.3	39.2	54	-14.8	74	-34.8	0-360	299	H
4	* 20.79335	44.3	Pk	33	-38.2	39.1	54	-14.9	74	-34.9	0-360	299	V
5	* 22.44055	42.81	Pk	33.5	-38	38.31	54	-15.69	74	-35.69	0-360	201	V
6	* 23.79732	42.73	Pk	34	-37.3	39.43	54	-14.57	74	-34.57	0-360	299	V

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

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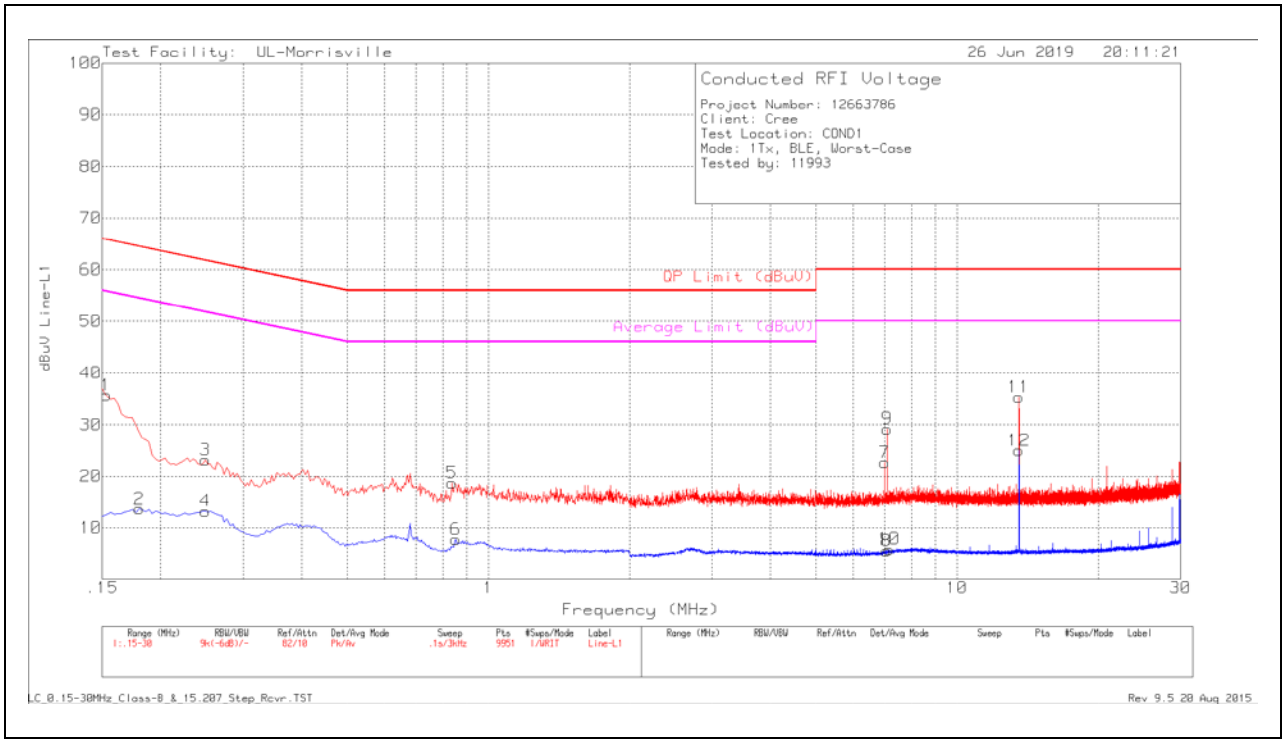
LINE 1 RESULTS



Range 1: Line-L1 .15 - 30MHz										
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN VCF (dB)	Cbl/Limiter (dB)	Corrected Reading dBuV	QP Limit (dBuV)	Margin (dB)	Average Limit (dBuV)	Margin (dB)
1	.153	25.43	Pk	.2	10	35.63	65.84	-30.21	-	-
2	.18	3.45	Av	.2	10	13.65	-	-	54.49	-40.84
3	.249	13.01	Pk	.1	10	23.11	61.79	-38.68	-	-
4	.249	3.14	Av	.1	10	13.24	-	-	51.79	-38.55
5	.837	8.7	Pk	0	10	18.7	56	-37.3	-	-
6	.852	-2.21	Av	0	10	7.79	-	-	46	-38.21
7	7.008	12.31	Pk	.1	10.2	22.61	60	-37.39	-	-
8	7.071	-4.78	Av	.1	10.2	5.52	-	-	50	-44.48
9	7.101	18.9	Pk	.1	10.2	29.2	60	-30.8	-	-
10	7.164	-4.44	Av	.1	10.2	5.86	-	-	50	-44.14
11	13.56	24.79	Pk	.1	10.4	35.29	60	-24.71	-	-
12	13.56	14.5	Av	.1	10.4	25	-	-	50	-25

Av - Average
Pk - Peak detector

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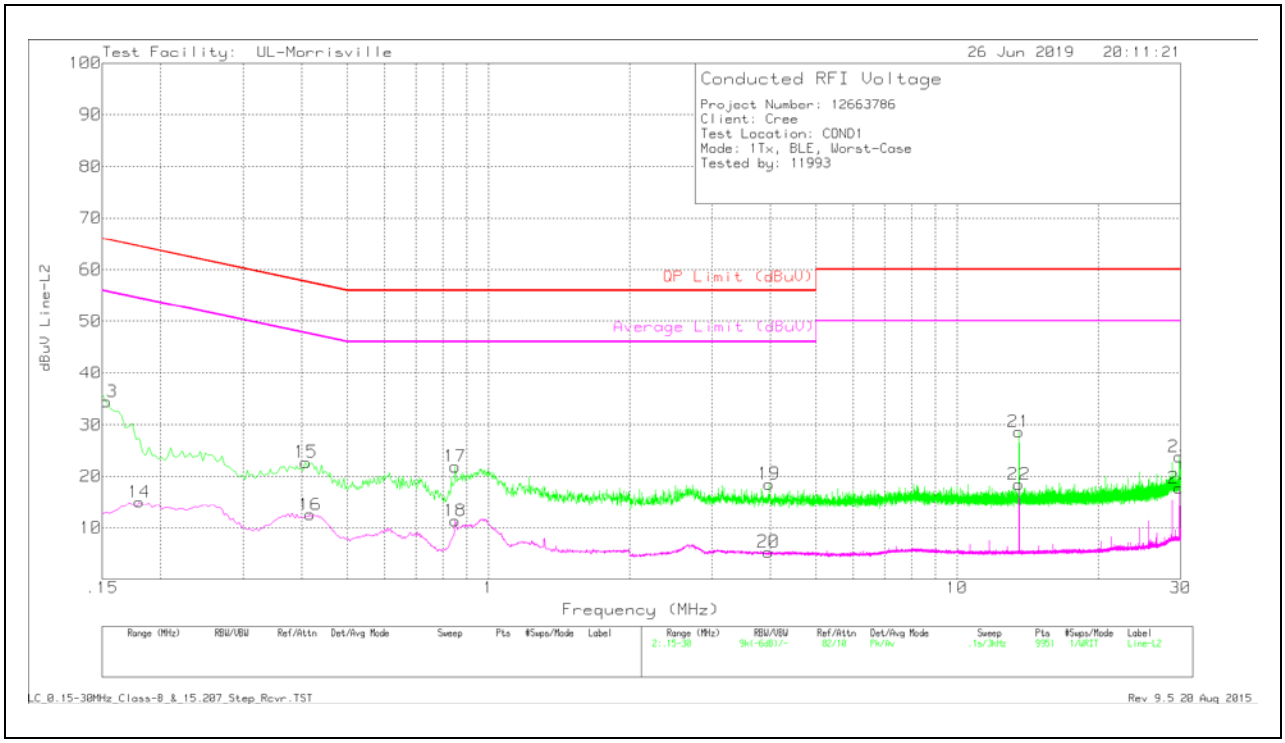
LINE 2 RESULTS



Range 2: Line-L2 .15 - 30MHz										
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN VCF (dB)	Cbl/Limiter (dB)	Corrected Reading dBuV	QP Limit (dBuV)	Margin (dB)	Average Limit (dBuV)	Margin (dB)
13	.153	24.22	Pk	.2	10	34.42	65.84	-31.42	-	-
14	.18	4.79	Av	.2	10	14.99	-	-	54.49	-39.5
15	.408	12.59	Pk	.1	10	22.69	57.69	-35	-	-
16	.417	2.46	Av	.1	10	12.56	-	-	47.51	-34.95
17	.849	11.85	Pk	0	10	21.85	56	-34.15	-	-
18	.849	1.38	Av	0	10	11.38	-	-	46	-34.62
19	3.969	8.41	Pk	0	10.1	18.51	56	-37.49	-	-
20	3.957	-4.75	Av	0	10.1	5.35	-	-	46	-40.65
21	13.56	18.12	Pk	.1	10.4	28.62	60	-31.38	-	-
22	13.563	7.95	Av	.1	10.4	18.45	-	-	50	-31.55
23	29.841	12.61	Pk	.3	10.8	23.71	60	-36.29	-	-
24	29.841	6.59	Av	.3	10.8	17.69	-	-	50	-32.31

Av - Average
Pk - Peak detector

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11. SETUP PHOTOS

Refer to UL Document R12663786-EP5

END OF TEST REPORT

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