



# **CERTIFICATION TEST REPORT**

**Report Number. :** R12663786-E6

**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 :** 802.15.4/BLE radio module

**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:**  
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## 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, FCC/IC IDs, and firmware	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.

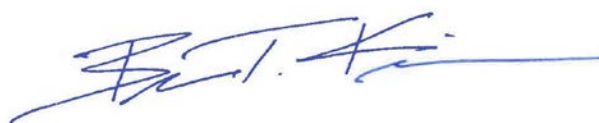
**Note:** The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL LLC and all revisions are duly noted in the revisions section. Any alteration of 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

## 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	
<input type="checkbox"/> Chamber A	<input type="checkbox"/> Chamber North
<input type="checkbox"/> Chamber C	<input checked="" type="checkbox"/> Chamber South

UL LLC (RTP) is accredited by NVLAP, Laboratory Code 200246-0

## 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)  
 $36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} = 28.9 \text{ dBuV/m}$

#### **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.  
 $36.5 \text{ dBuV} + 0 \text{ dB} + 10.1 \text{ dB} + 0 \text{ dB} = 46.6 \text{ dBuV}$

### 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%.

## 5. EQUIPMENT UNDER TEST

### 5.1. EUT DESCRIPTION

The EUT is a 802.15.4/BLE radio module. This report covers 802.15.4.

### 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)
2405 - 2480	802.15.4	5.27	3.37

### 5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The 802.15.4 radio utilize a Johanson 2450AT18B100 antenna, with a maximum gain of 0.5 dBi.

### 5.4. SOFTWARE AND FIRMWARE

The firmware used for 802.15.4 on the EUT during testing is:

For CH11 (2405MHz): Firmware name: "128RFR2\_MOD\_11.hex", Rev0

For CH18 (2440MHz): Firmware name: "128RFR2\_MOD\_18.hex", Rev0

For CH25 (2475MHz): Firmware name: "128RFR2\_MOD\_25.hex", Rev0

For CH26 (2480MHz): Firmware name: "TAL\_PRBS\_CH26\_1P2\_DBM\_FILT.hex", Rev0

### 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 and PSD 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 Z orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in Z orientation.



## 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-EP6

## 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

## 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.
<b>0.009-30MHz (Loop Ant.)</b>					
AT0079	Active Loop Antenna	ETS-Lindgren	6502	2019-01-24	2020-01-31
<b>30-1000 MHz</b>					
AT0074	Hybrid Broadband Antenna	Sunol Sciences Corp.	JB3	2018-07-24	2019-07-24
<b>1-18 GHz</b>					
AT0072	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2019-04-22	2020-04-22
<b>18-40 GHz</b>					
AT0076	Horn Antenna, 18-26.5GHz	ARA	MWH-1826/B	2018-11-08	2019-11-08
<b>Gain-Loss Chains</b>					
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
<b>Receiver &amp; Software</b>					
SA0025	Spectrum Analyzer	Agilent	N9030A	2019-05-15	2020-05-15
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA
<b>Additional Equipment used</b>					
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

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

c

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
PWM001 (PRE0137346)	RF Power Meter	Keysight Technologies	N1912A	2019-06-14	2020-06-14
PWS006 (PRE0126443)	Peak and Avg Power Sensor, 50MHz to 6GHz	Keysight Technologies	E1921A	2019-06-10	2020-06-10
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

## 8. ANTENNA PORT TEST RESULTS

### 8.1. ON TIME AND DUTY CYCLE

#### LIMITS

None; for reporting purposes only.

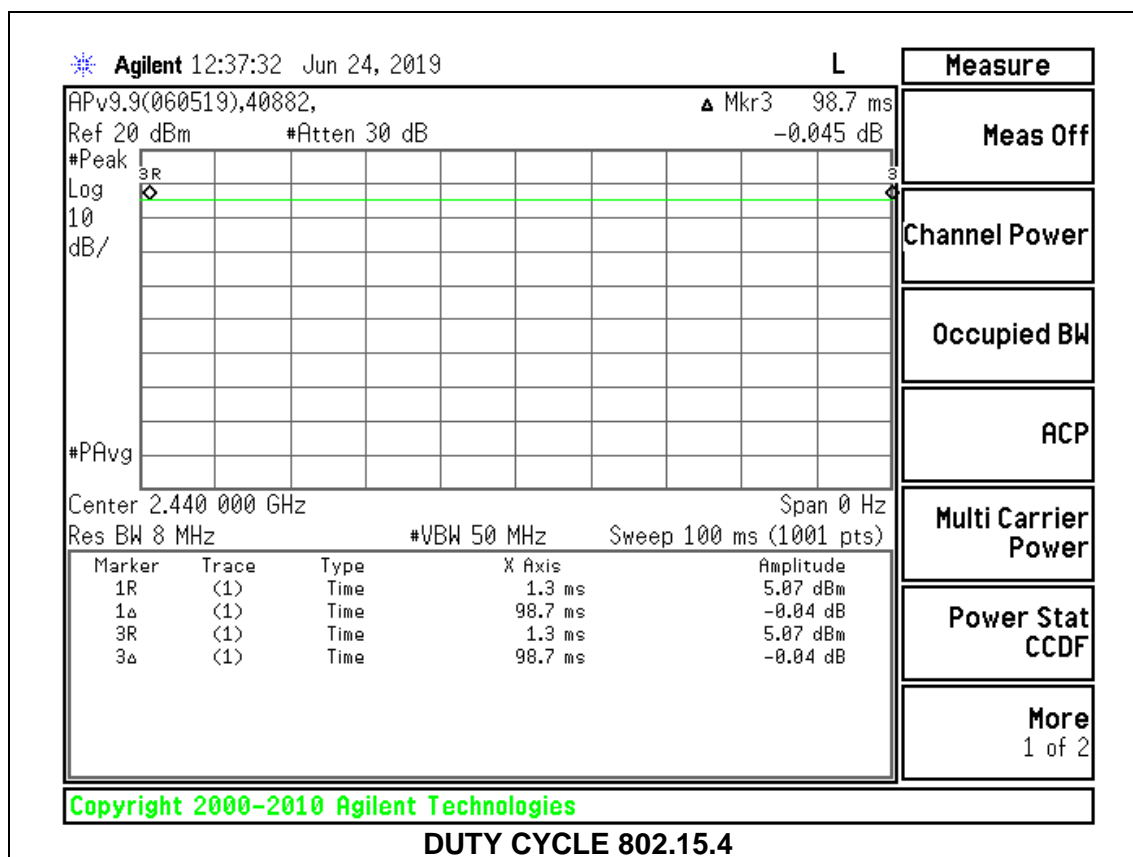
#### PROCEDURE

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						
802.15.4	98.700	98.700	1.000	100.00%	0.00	0.010

#### DUTY CYCLE PLOTS

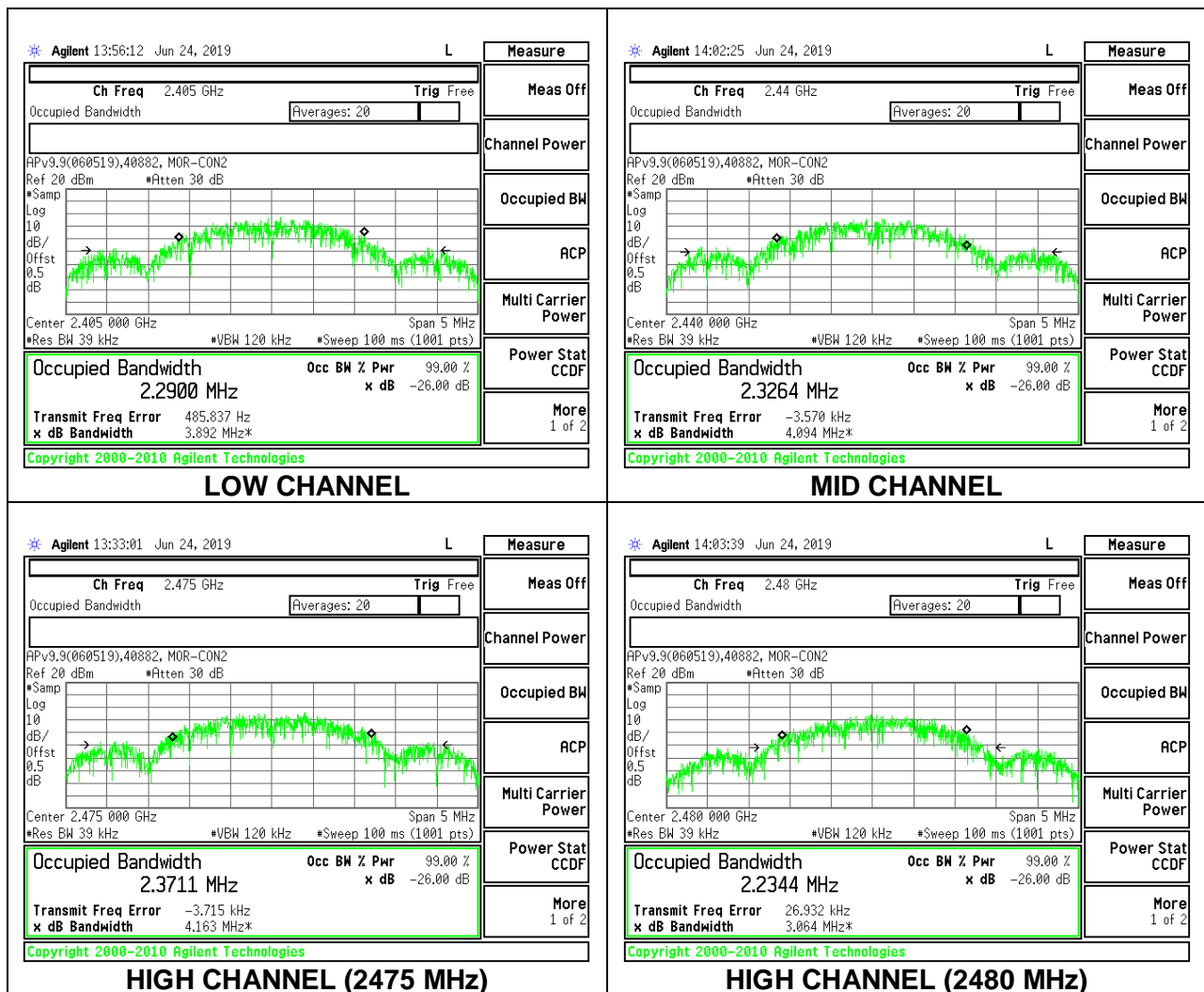


## 8.2. 99% BANDWIDTH

### LIMITS

None; for reporting purposes only.

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	2.2900
Middle	2440	2.3264
High	2475	2.3711
High	2480	2.2344



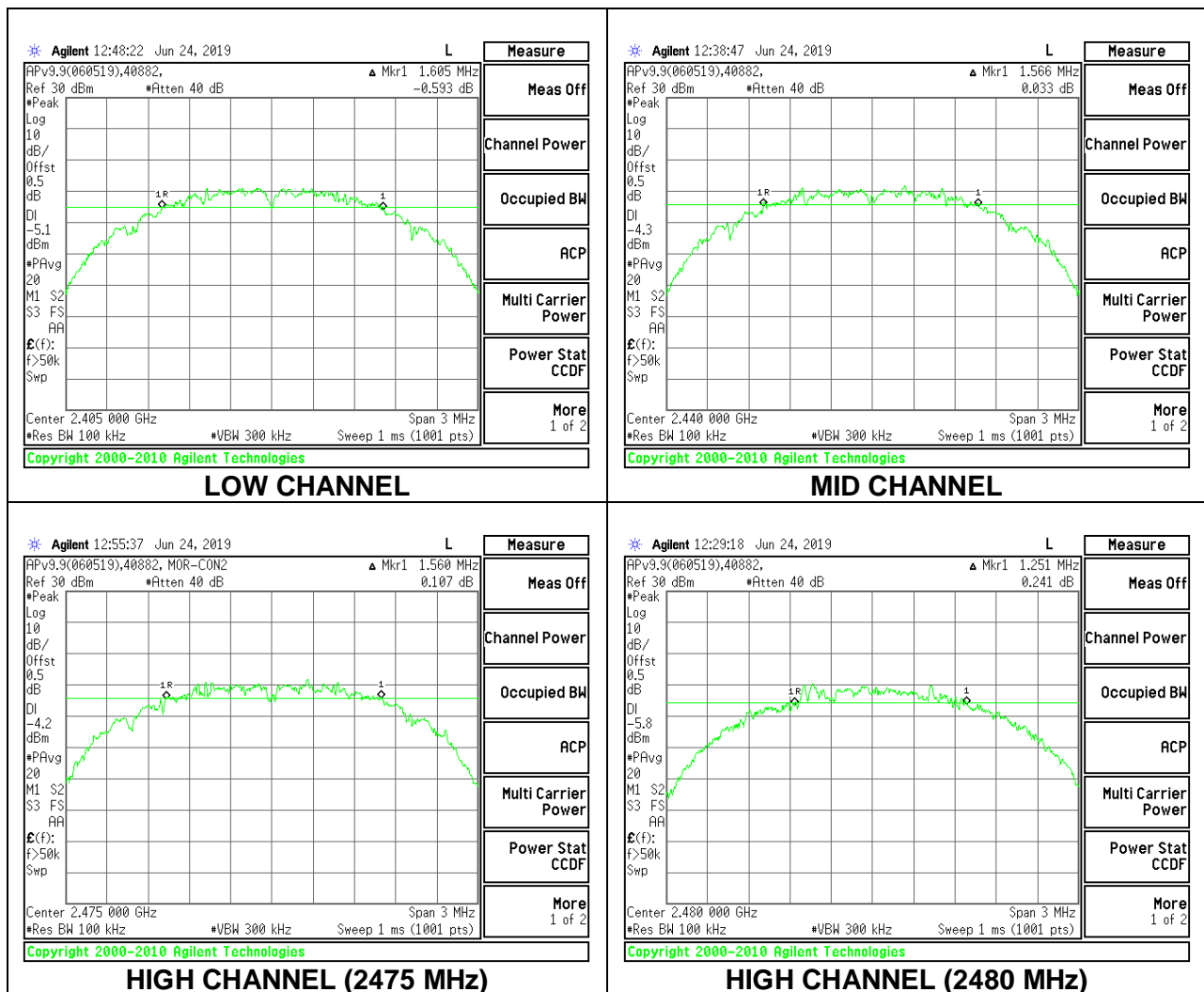
### 8.3. 6 dB BANDWIDTH

#### 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	1.605	0.5
Middle	2440	1.566	0.5
High	2475	1.560	0.5
High	2480	1.251	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 of 0.5 was entered as an offset in the power meter to allow for a peak reading of power.

<b>Tested By:</b>	40882
<b>Date:</b>	2019-06-21

<b>Channel</b>	<b>Frequency (MHz)</b>	<b>Peak Power Reading (dBm)</b>	<b>Limit (dBm)</b>	<b>Margin (dB)</b>
Low	2402	5.20	30	-24.80
Middle	2440	5.27	30	-24.73
High	2475	4.95	30	-25.05
High	2480	2.48	30	-27.52



## 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 0.5 dB was entered as an offset in the power meter to allow for a gated average reading of power.

<b>Tested By:</b>	40882
<b>Date:</b>	2019-06-21

<b>Channel</b>	<b>Frequency (MHz)</b>	<b>AV power (dBm)</b>
Low	2402	5.03
Middle	2440	5.1
High	2475	4.82
High	2480	2.25

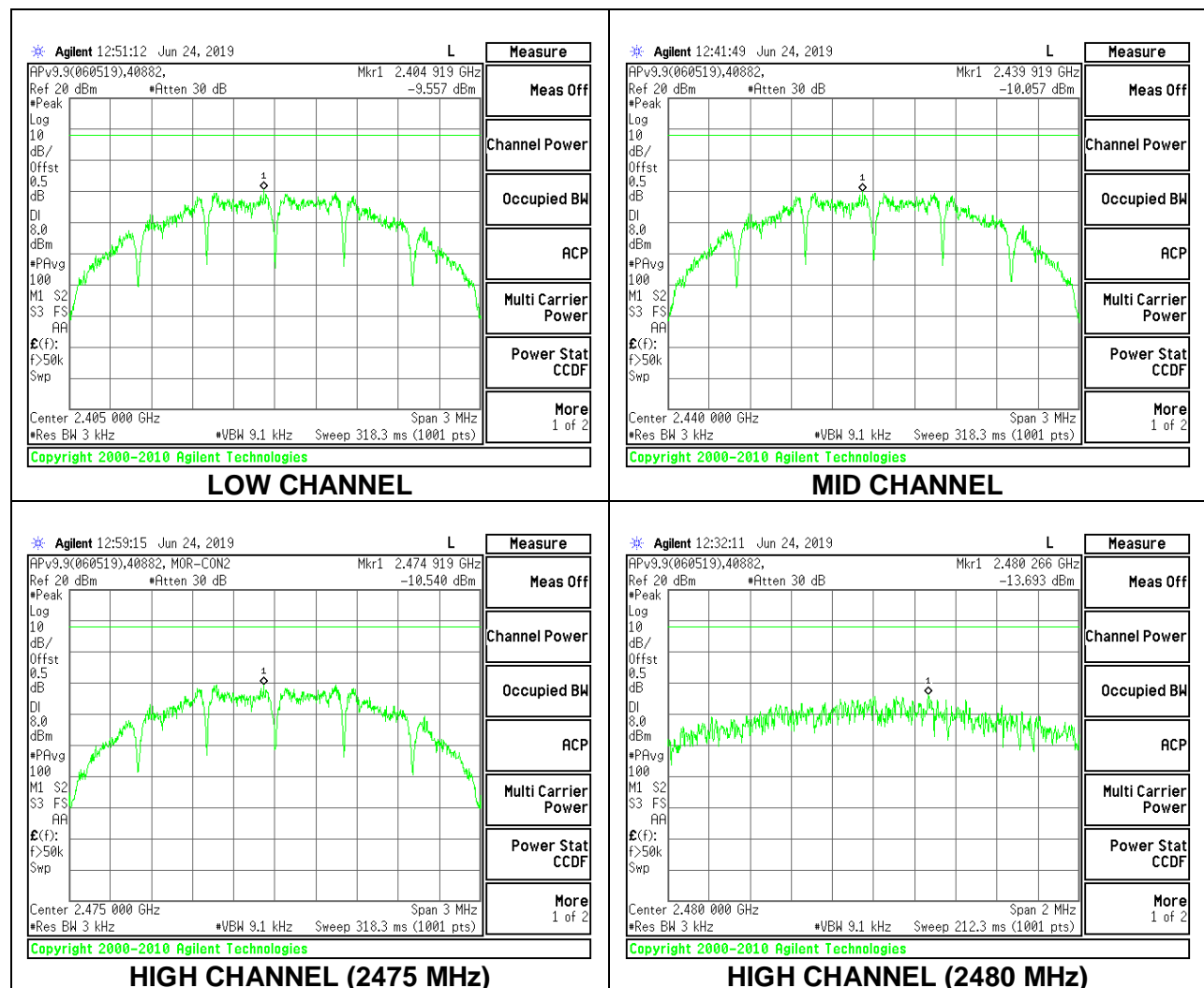
## 8.6. POWER SPECTRAL DENSITY

### 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	-9.557	8	-17.56
Middle	2440	-10.057	8	-18.06
High	2475	-10.540	8	-18.54
High	2480	-13.693	8	-21.69



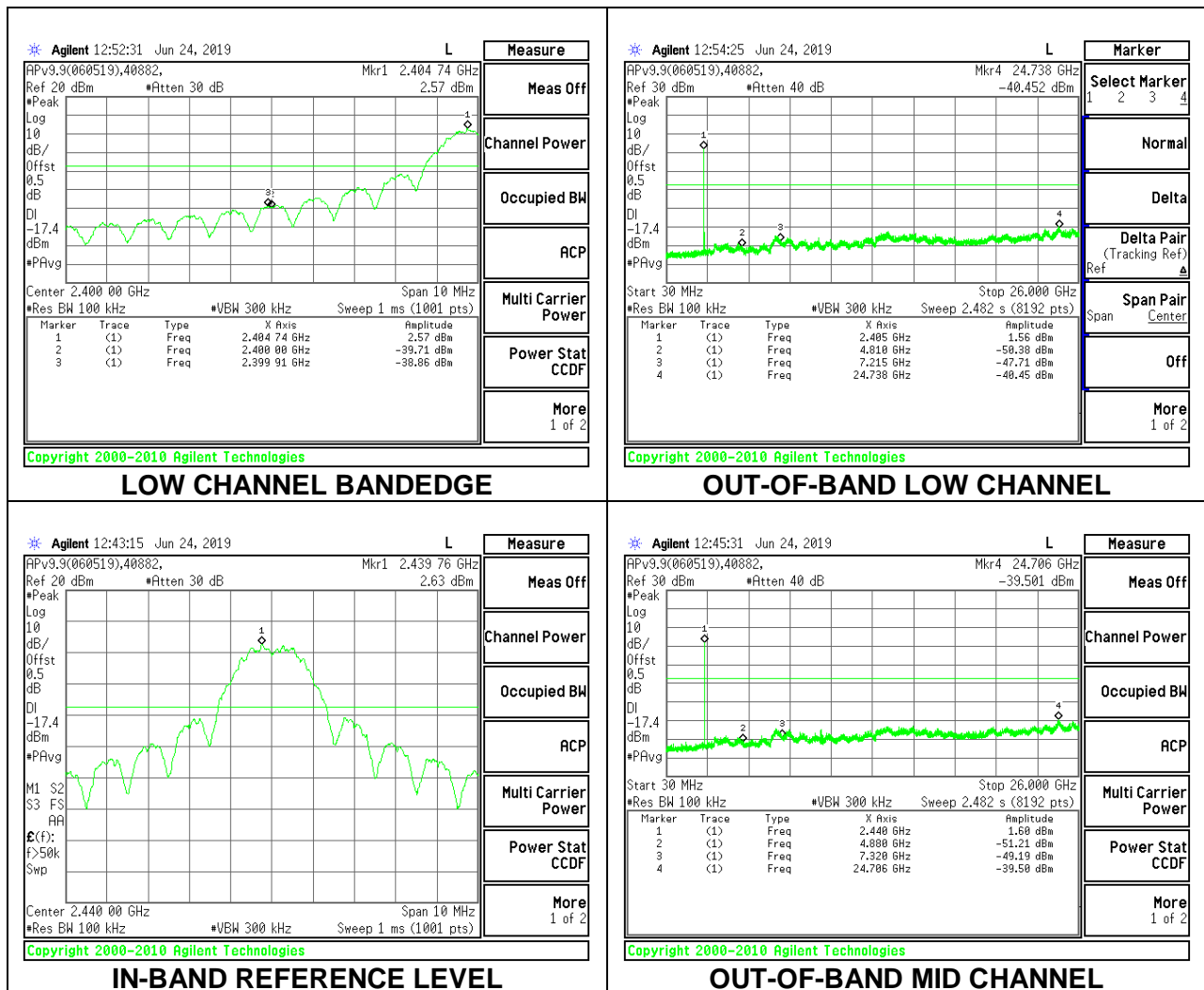
## 8.7. CONDUCTED SPURIOUS EMISSIONS

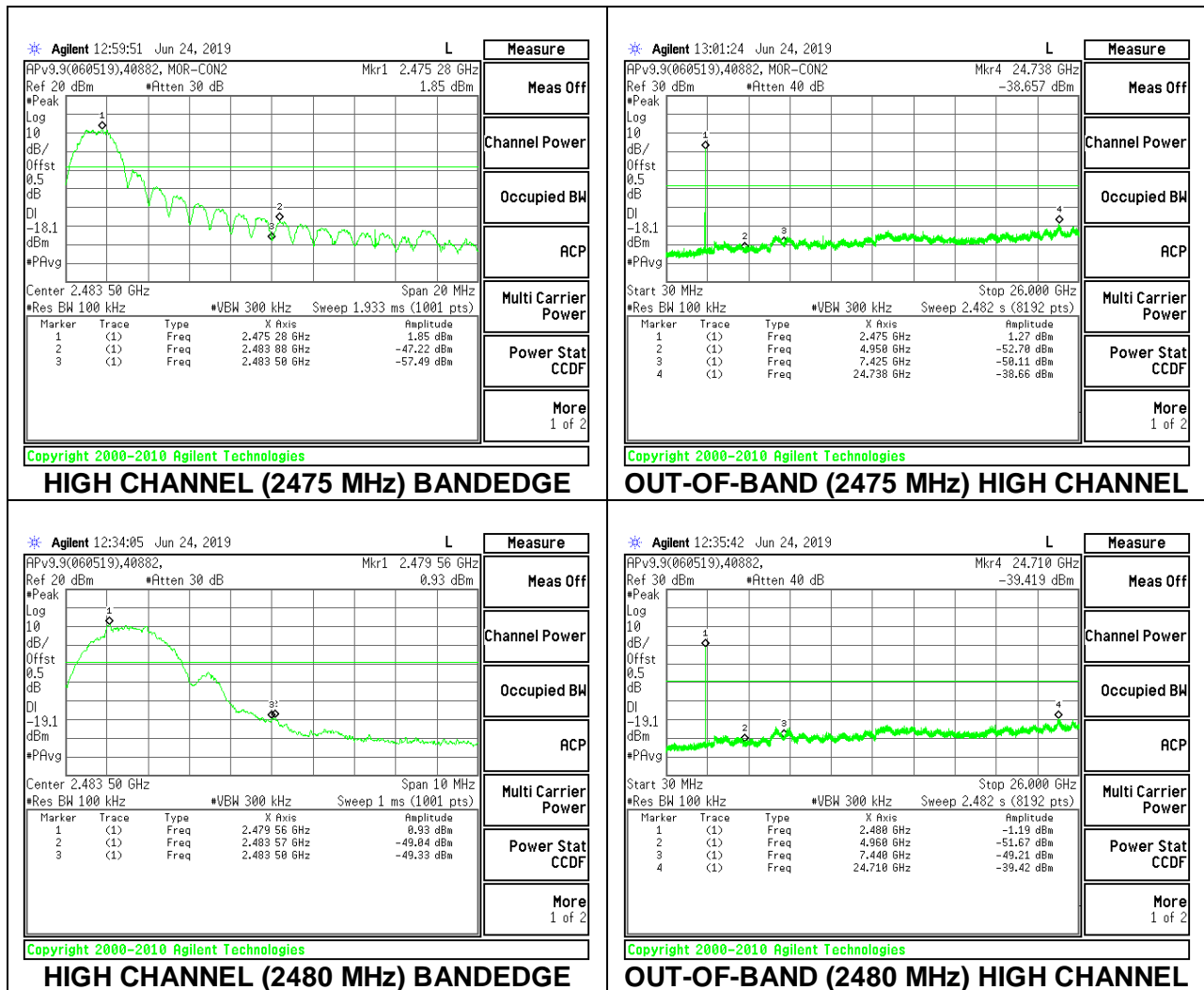
### LIMITS

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.





## 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).

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

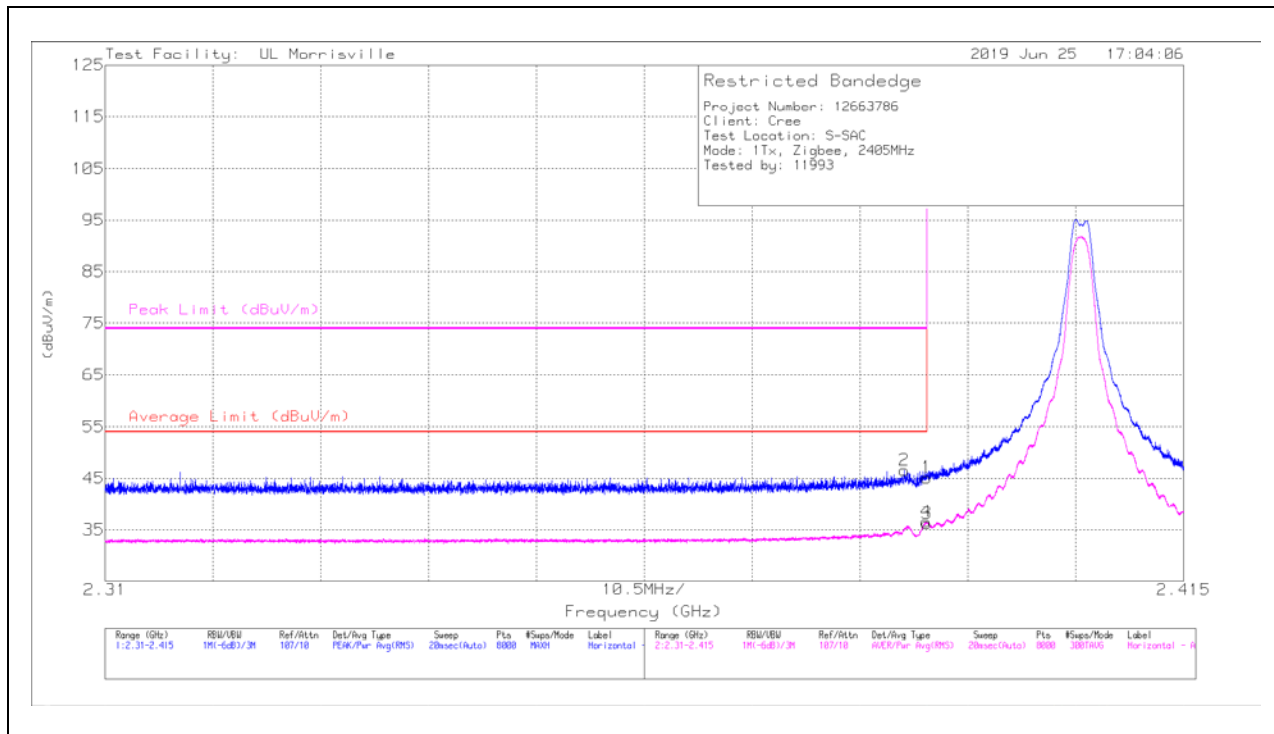
Base on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field.

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



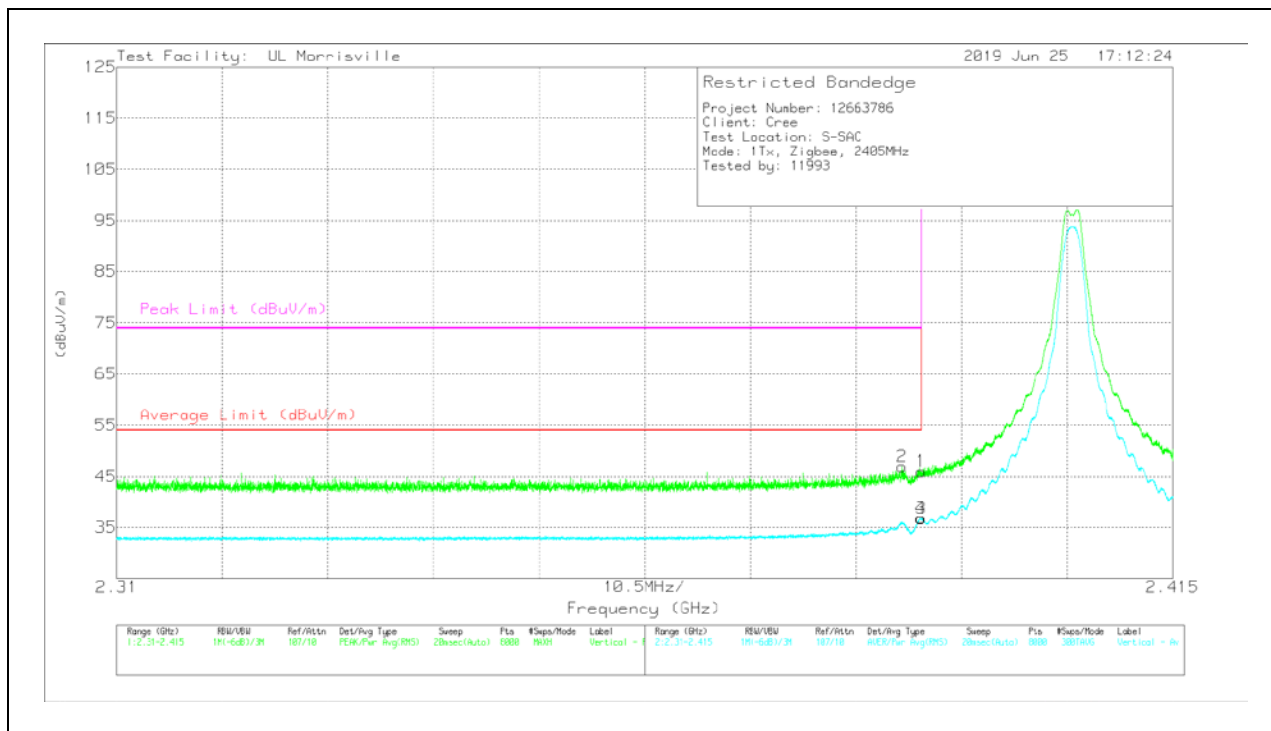
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	37.2	Pk	31.9	-24	45.1	-	-	74	-28.9	219	253	H
2	* 2.38778	38.6	Pk	31.9	-24	46.5	-	-	74	-27.5	219	253	H
3	* 2.39	28.36	RMS	31.9	-24	36.26	54	-17.74	-	-	219	253	H
4	* 2.3899	28.65	RMS	31.9	-24	36.55	54	-17.45	-	-	219	253	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	AT0072 (dB/m)	Amp/Cbl/Fitr/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	38.07	Pk	31.9	-24	45.97	-	-	74	-28.03	134	251	V
2	* 2.38813	38.97	Pk	31.9	-24	46.87	-	-	74	-27.13	134	251	V
3	* 2.39	28.88	RMS	31.9	-24	36.78	54	-17.22	-	-	134	251	V
4	* 2.38994	28.92	RMS	31.9	-24	36.82	54	-17.18	-	-	134	251	V

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

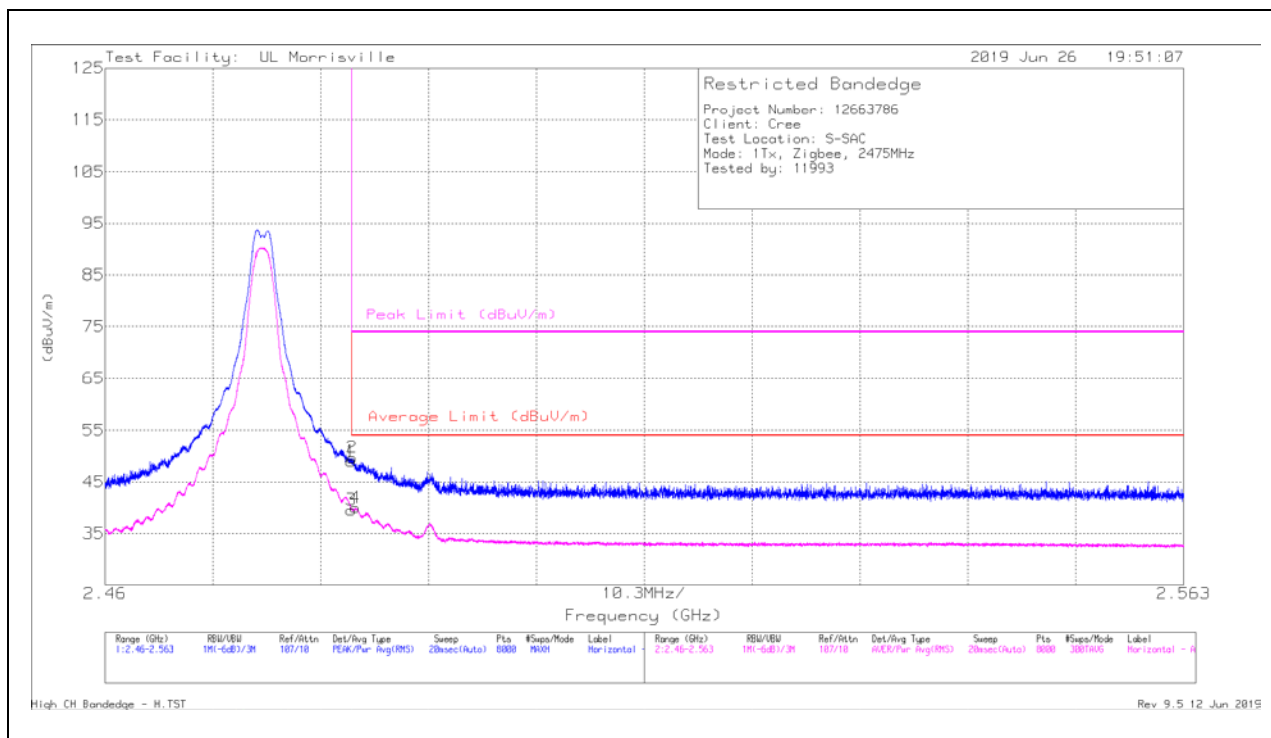
Pk - Peak detector

RMS - RMS detection



## BANDEDGE (2475MHz HIGH CHANNEL)

### HORIZONTAL RESULT



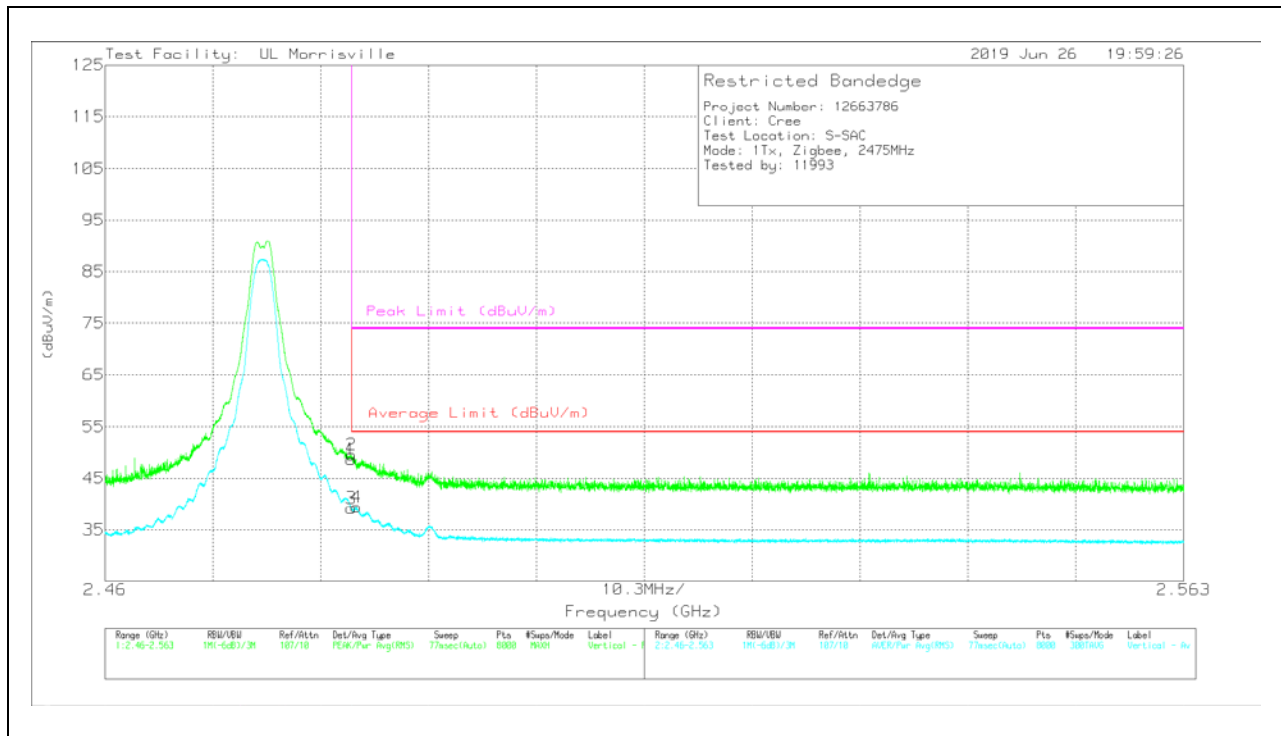
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.4835	41.16	Pk	32.3	-24.5	48.96	-	-	74	-25.04	110	163	H
2	* 2.48359	41.87	Pk	32.3	-24.5	49.67	-	-	74	-24.33	110	163	H
3	* 2.4835	31.79	RMS	32.3	-24.5	39.59	54	-14.41	-	-	110	163	H
4	* 2.48387	32.21	RMS	32.3	-24.5	40.01	54	-13.99	-	-	110	163	H

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

Pk - Peak detector

RMS - RMS detection

## VERTICAL RESULT

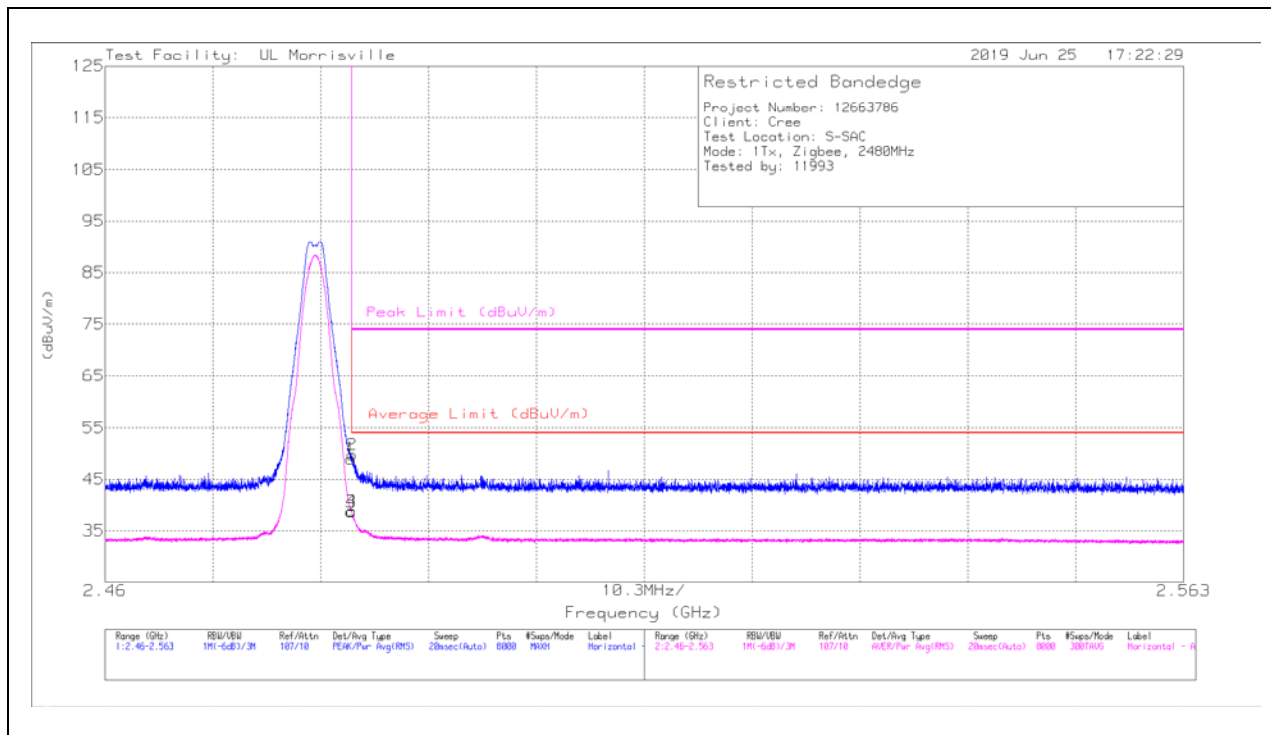


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.4835	40.8	Pk	32.3	-24.5	48.6	-	-	74	-25.4	84	163	V
2	* 2.48353	41.72	Pk	32.3	-24.5	49.52	-	-	74	-24.48	84	163	V
3	* 2.4835	31.4	RMS	32.3	-24.5	39.2	54	-14.8	-	-	84	163	V
4	* 2.48399	31.58	RMS	32.3	-24.5	39.38	54	-14.62	-	-	84	163	V

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

## BANDEDGE (2480MHz HIGH CHANNEL)

### HORIZONTAL RESULT



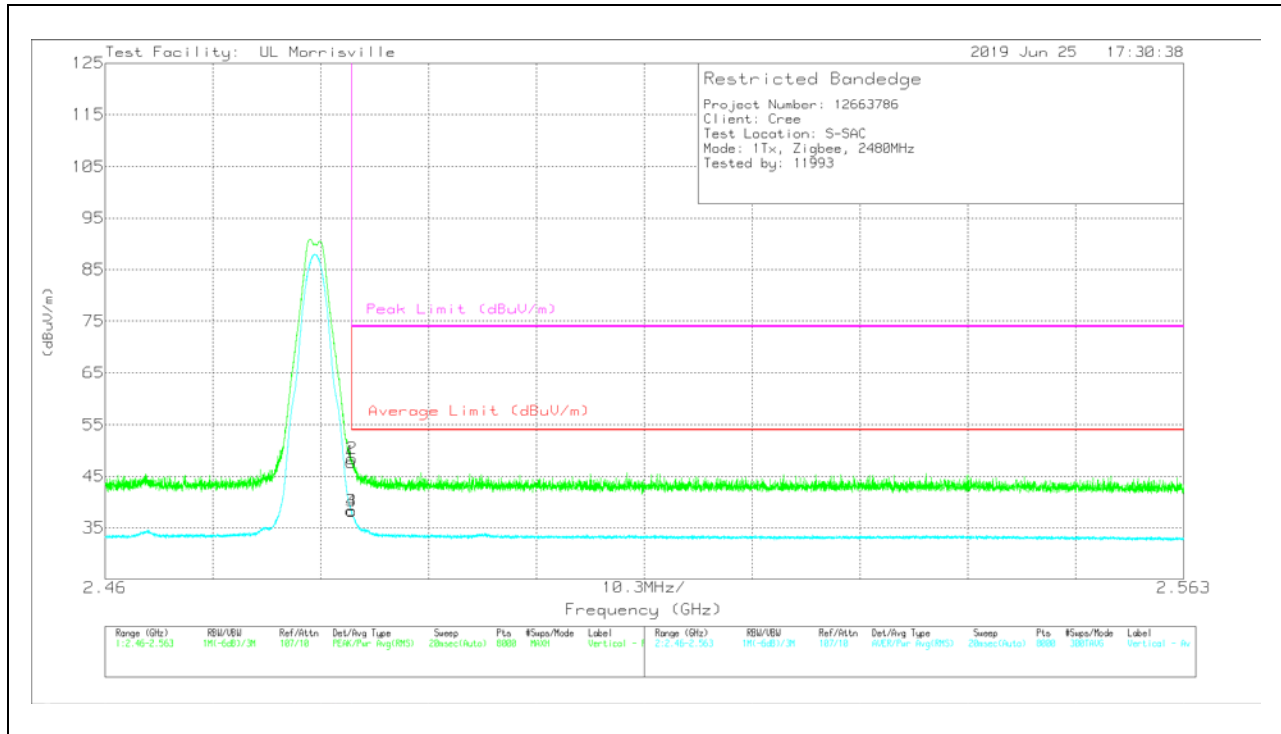
Marker	Frequency (GHz)	Meter Reading (dBUV)	Det	AT0072 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	Corrected Reading (dBUV/m)	Average Limit (dBUV/m)	Margin (dB)	Peak Limit (dBUV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.4835	41.11	Pk	32.3	-24.5	48.91	-	-	74	-25.09	229	249	H
2	* 2.48362	41.89	Pk	32.3	-24.5	49.69	-	-	74	-24.31	229	249	H
3	* 2.4835	30.92	RMS	32.3	-24.5	38.72	54	-15.28	-	-	229	249	H
4	* 2.48351	30.96	RMS	32.3	-24.5	38.76	54	-15.24	-	-	229	249	H

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

Pk - Peak detector

RMS - RMS detection

## VERTICAL RESULT

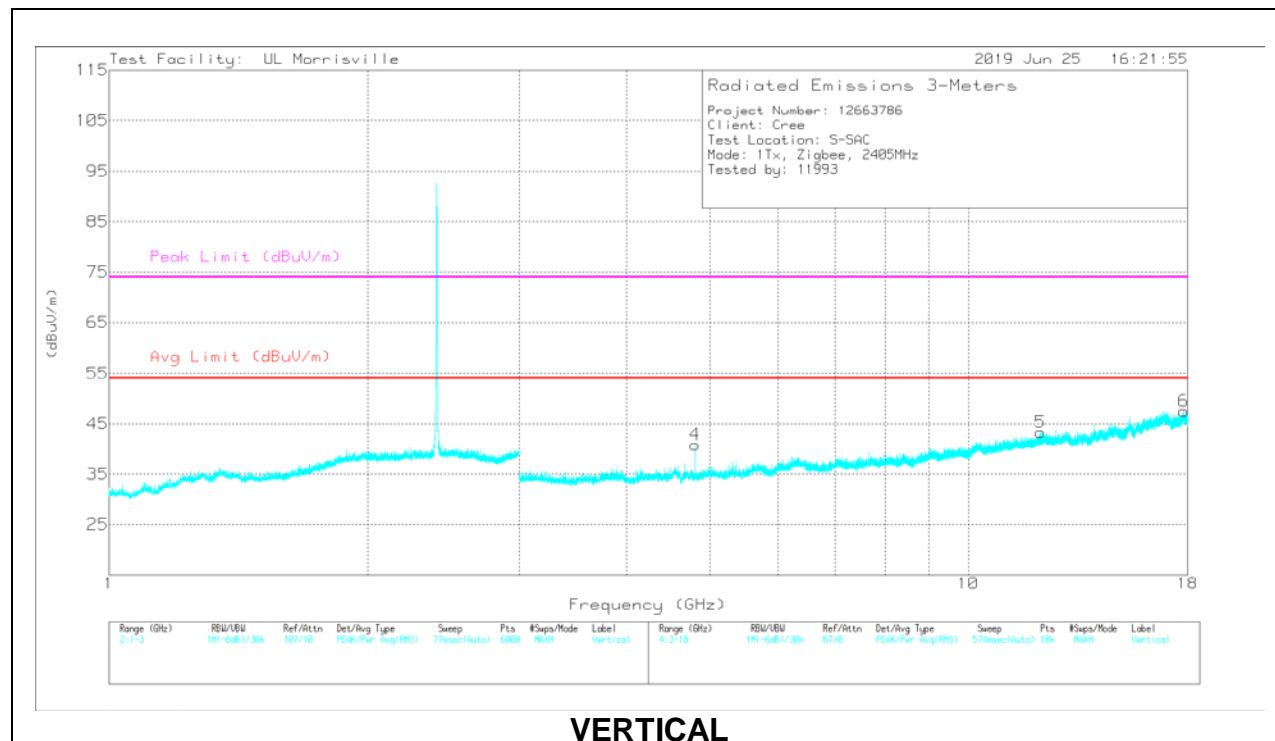
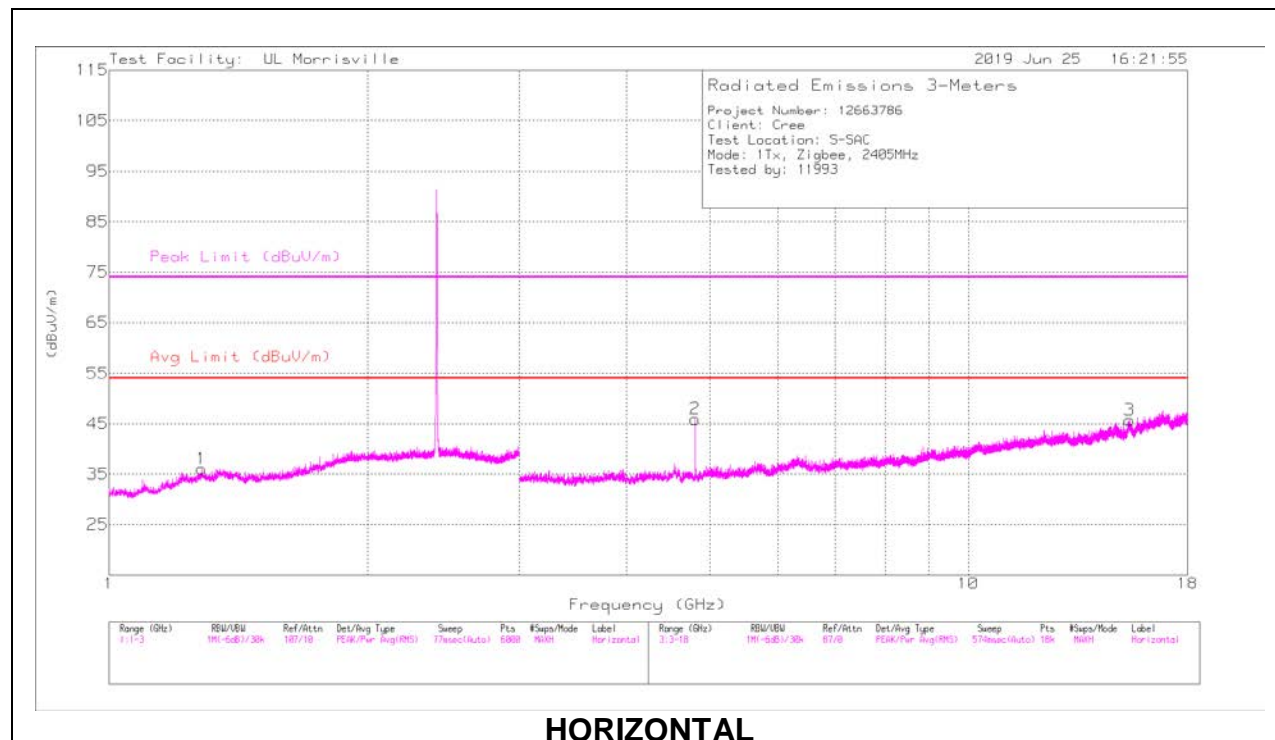


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.4835	39.92	Pk	32.3	-24.5	47.72	-	-	74	-26.28	212	234	V
2	* 2.48357	40.54	Pk	32.3	-24.5	48.34	-	-	74	-25.66	212	234	V
3	* 2.4835	30.51	RMS	32.3	-24.5	38.31	54	-15.69	-	-	212	234	V
4	* 2.48354	30.39	RMS	32.3	-24.5	38.19	54	-15.81	-	-	212	234	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

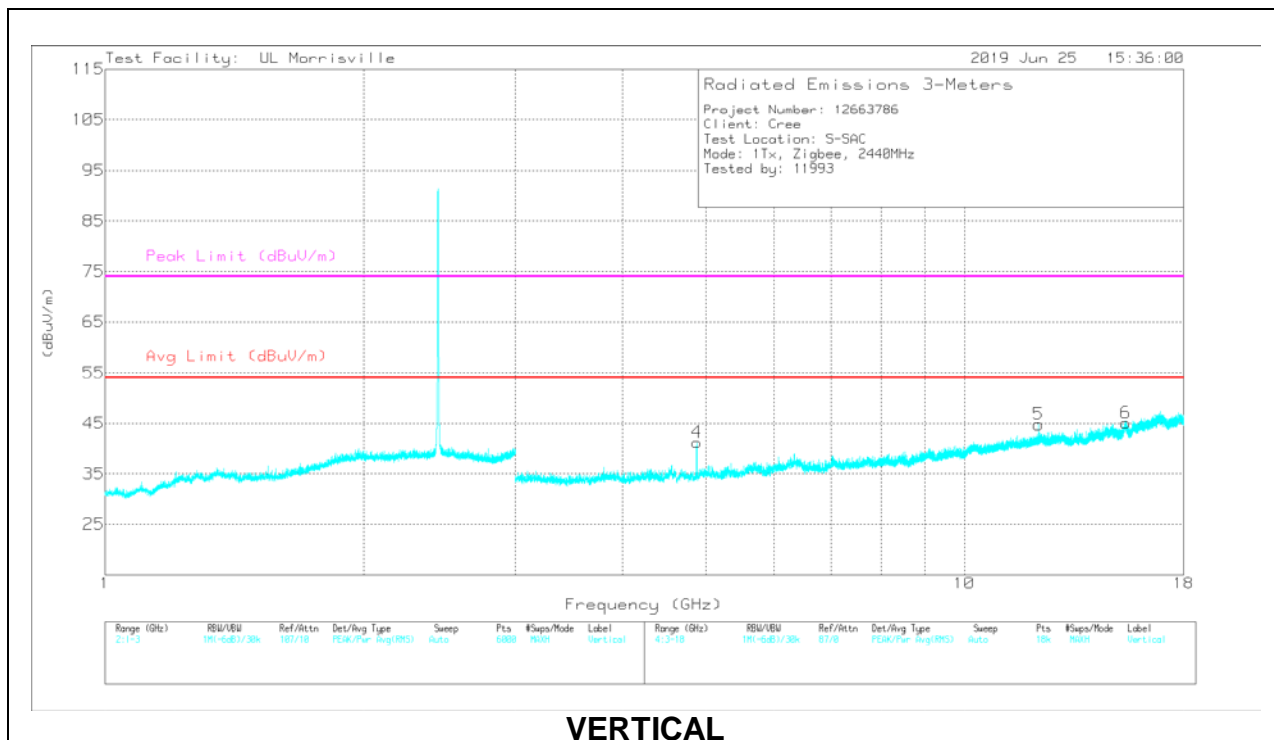
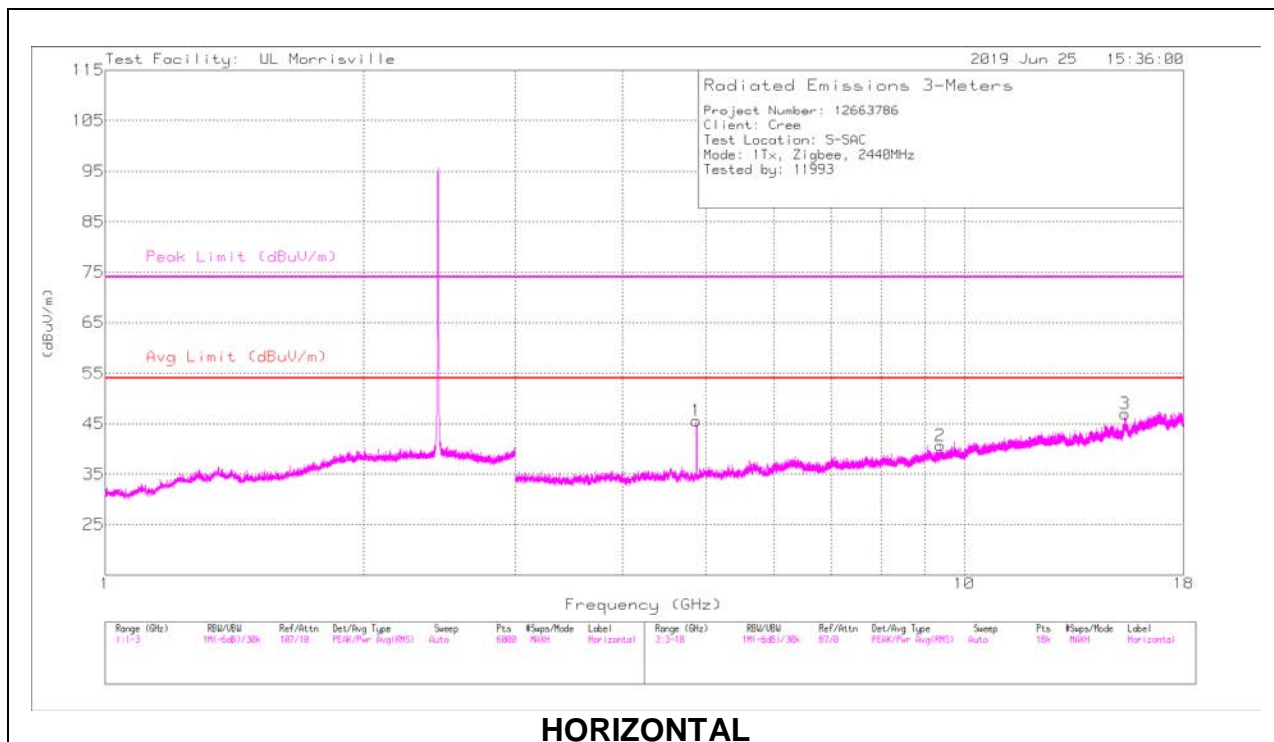
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.28186	36.26	PK2	29.2	-23.2	42.26	-	-	74	-31.74	123	332	H
	* 1.28246	23.81	MAv1	29.1	-23.2	29.71	54	-24.29	-	-	123	332	H
2	* 4.81097	45.69	PK2	34.2	-30.9	48.99	-	-	74	-25.01	351	121	H
	* 4.81098	38.36	MAv1	34.2	-30.9	41.66	54	-12.34	-	-	351	121	H
3	* 15.40239	33.07	PK2	39.9	-21.4	51.57	-	-	74	-22.43	261	218	H
	* 15.40431	21.87	MAv1	39.9	-21.5	40.27	54	-13.73	-	-	261	218	H
4	* 4.81092	43.05	PK2	34.2	-30.9	46.35	-	-	74	-27.65	71	112	V
	* 4.81098	33.87	MAv1	34.2	-30.9	37.17	54	-16.83	-	-	71	112	V
5	* 12.14483	34.63	PK2	38.8	-23.9	49.53	-	-	74	-24.47	261	304	V
	* 12.14451	22.32	MAv1	38.8	-23.9	37.22	54	-16.78	-	-	261	304	V
6	* 17.80356	33.46	PK2	41.2	-20.9	53.76	-	-	74	-20.24	128	244	V
	* 17.80168	22.23	MAv1	41.2	-20.9	42.53	54	-11.47	-	-	128	244	V

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

PK2 - Maximum Peak

MAv1 - Maximum RMS Average

## MID CHANNEL RESULTS



## RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Filtr/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	* 4.88099	47.28	PK2	34	-30.6	50.68	-	-	74	-23.32	0	109	H
	* 4.88102	40.06	MAv1	34	-30.6	43.46	54	-10.54	-	-	0	109	H
2	* 9.37829	36.32	PK2	36.8	-26.2	46.92	-	-	74	-27.08	59	362	H
	* 9.37839	23.44	MAv1	36.8	-26.2	34.04	54	-19.96	-	-	59	362	H
3	* 15.40004	33.9	PK2	39.9	-21.4	52.4	-	-	74	-21.6	155	145	H
	* 15.39986	21.8	MAv1	39.9	-21.4	40.3	54	-13.7	-	-	155	145	H
4	* 4.8791	43.51	PK2	34	-30.6	46.91	-	-	74	-27.09	147	105	V
	* 4.879	35.22	MAv1	34	-30.6	38.62	54	-15.38	-	-	147	105	V
5	* 12.20239	37.08	PK2	38.9	-23.8	52.18	-	-	74	-21.82	347	116	V
	* 12.20259	26.35	MAv1	38.9	-23.8	41.45	54	-12.55	-	-	347	116	V
6	* 15.4144	33.62	PK2	39.9	-21.7	51.82	-	-	74	-22.18	147	198	V
	* 15.41478	22.29	MAv1	39.9	-21.7	40.49	54	-13.51	-	-	147	198	V

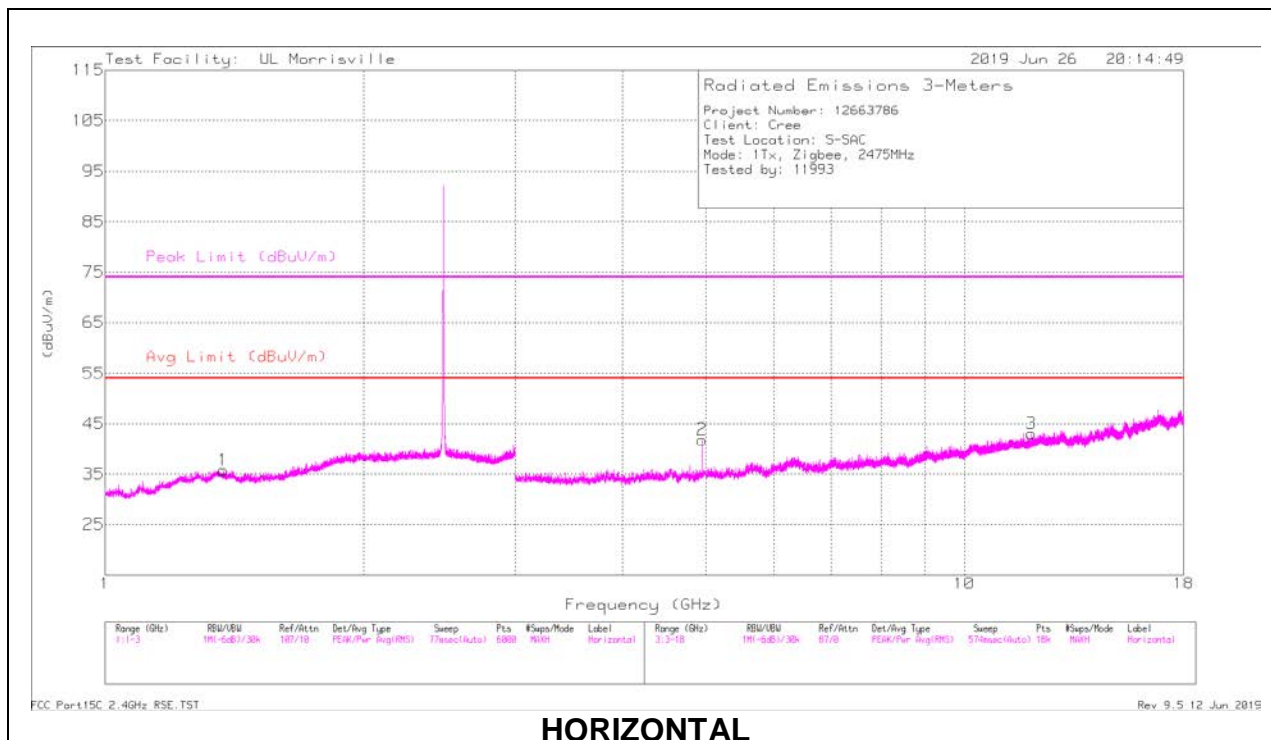
\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

PK2 - Maximum Peak

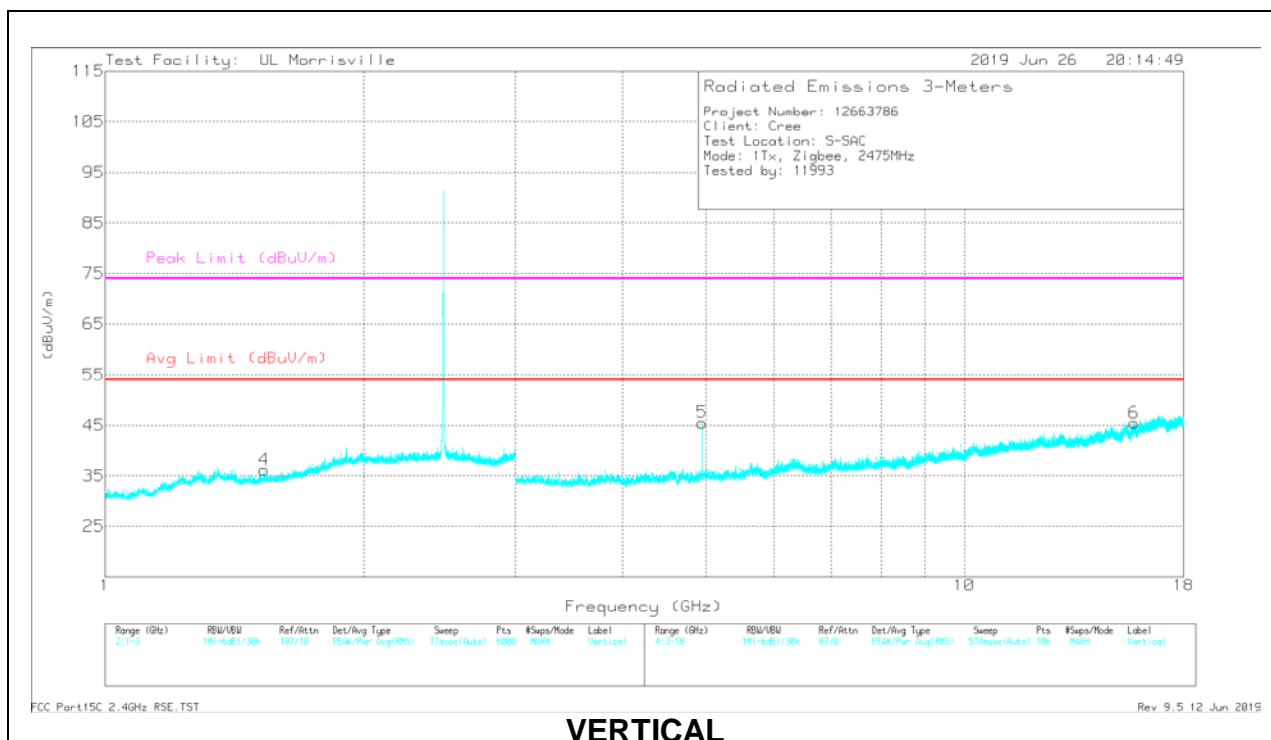
MAv1 - Maximum RMS Average



## HIGH CHANNEL 2475MHz RESULTS



**HORIZONTAL**



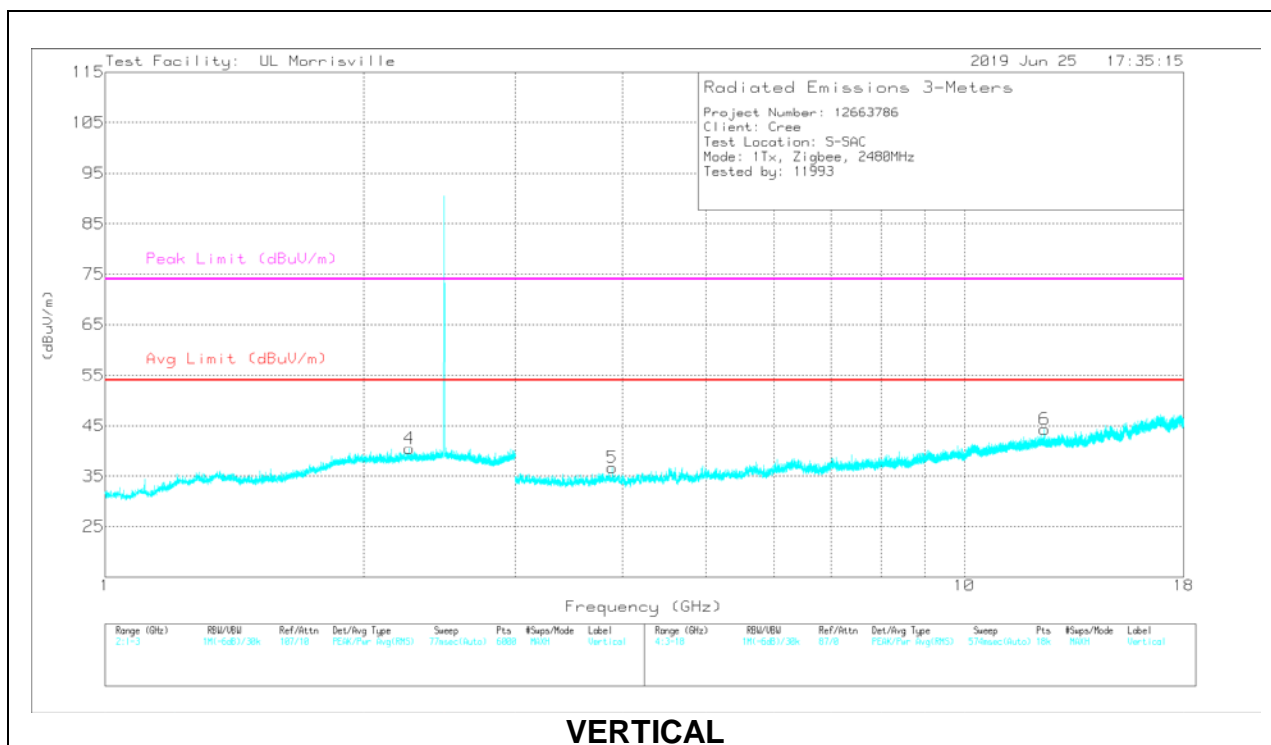
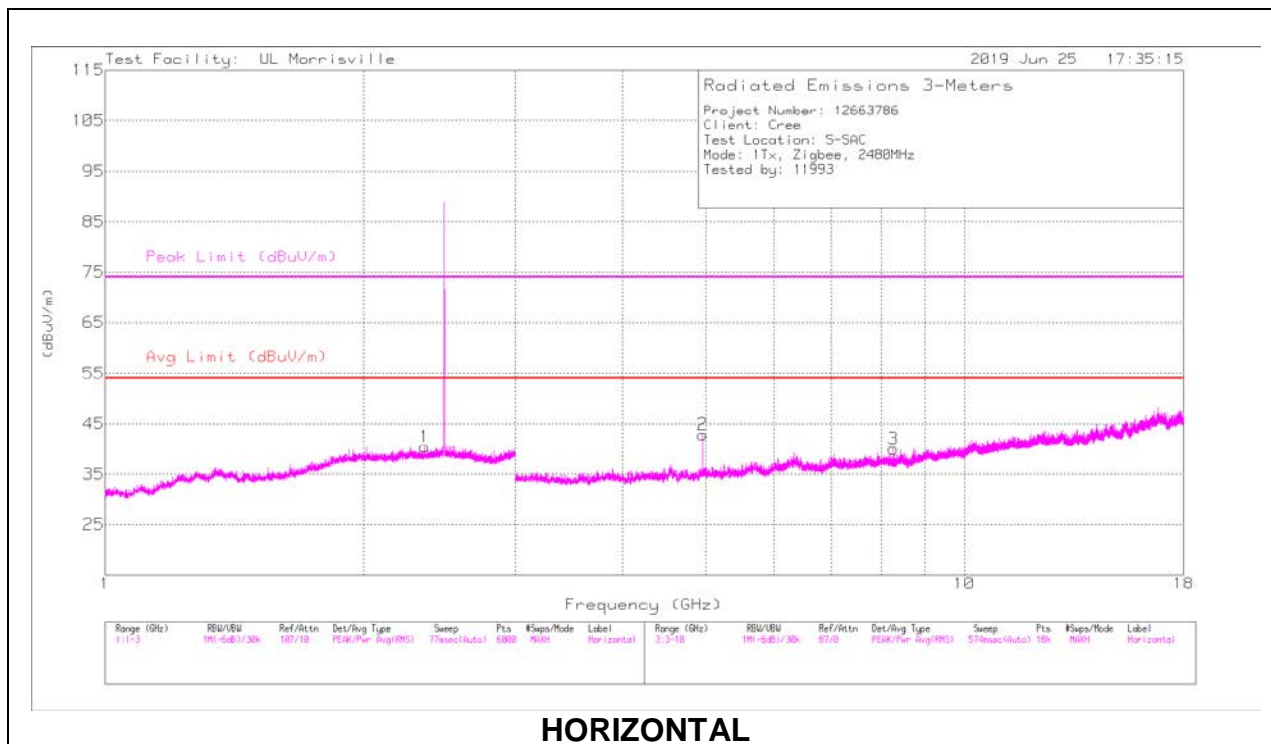
**VERTICAL**

## RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Filtr/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	* 1.37056	35.16	PK2	29.3	-22.8	41.66	-	-	74	-32.34	238	305	H
	* 1.37087	23.33	MAv1	29.3	-22.8	29.83	54	-24.17	-	-	238	305	H
4	* 1.5315	36.18	PK2	27.9	-22.4	41.68	-	-	74	-32.32	116	289	V
	* 1.53149	23.72	MAv1	27.9	-22.4	29.22	54	-24.78	-	-	116	289	V
2	* 4.94897	47	PK2	34.1	-30.8	50.3	-	-	74	-23.7	186	245	H
	* 4.94899	39.51	MAv1	34.1	-30.8	42.81	54	-11.19	-	-	186	245	H
3	* 11.97254	34.83	PK2	38.6	-23.8	49.63	-	-	74	-24.37	309	324	H
	* 11.97174	22.04	MAv1	38.6	-23.8	36.84	54	-17.16	-	-	309	324	H
5	* 4.94906	47.72	PK2	34.1	-30.8	51.02	-	-	74	-22.98	217	126	V
	* 4.94905	40.6	MAv1	34.1	-30.8	43.9	54	-10.1	-	-	217	126	V
6	* 15.76051	34.07	PK2	40.3	-22.3	52.07	-	-	74	-21.93	47	347	V
	* 15.76094	21.97	MAv1	40.3	-22.3	39.97	54	-14.03	-	-	47	347	V

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

## HIGH CHANNEL 2480MHz RESULTS



## RADIATED EMISSIONS

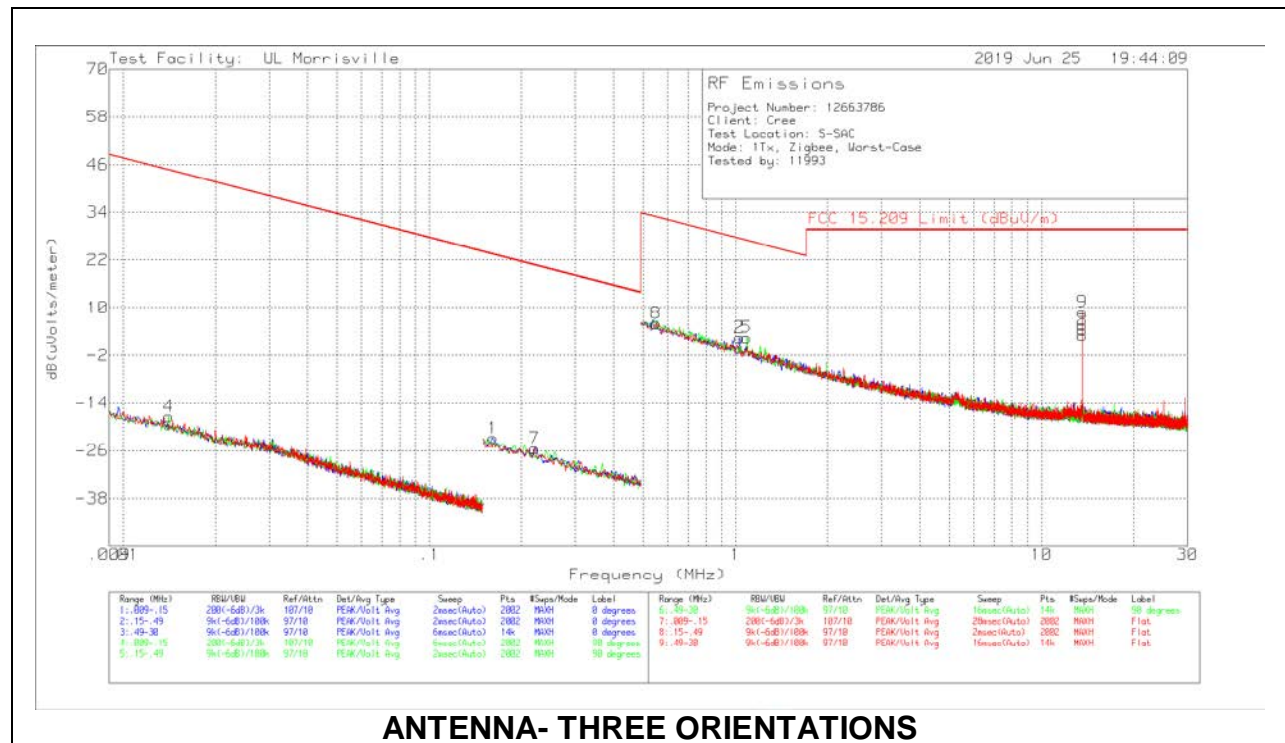
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.35545	37.3	PK2	31.7	-23.8	45.2	-	-	74	-28.8	359	342	H
	* 2.35567	25.21	MAv1	31.7	-23.8	33.11	54	-20.89	-	-	359	342	H
4	* 2.25788	36.88	PK2	31.7	-23.4	45.18	-	-	74	-28.82	193	288	V
	* 2.25801	24.76	MAv1	31.7	-23.4	33.06	54	-20.94	-	-	193	288	V
2	* 4.95918	45.37	PK2	34.1	-31	48.47	-	-	74	-25.53	0	108	H
	* 4.95909	36.86	MAv1	34.1	-31	39.96	54	-14.04	-	-	0	108	H
3	* 8.27128	36.39	PK2	36	-27.4	44.99	-	-	74	-29.01	225	352	H
	* 8.2716	24.2	MAv1	36	-27.4	32.8	54	-21.2	-	-	225	352	H
5	* 3.89257	40.33	PK2	33.4	-32	41.73	-	-	74	-32.27	65	105	V
	* 3.89215	28.6	MAv1	33.4	-32	30	54	-24	-	-	65	105	V
6	* 12.39794	36.73	PK2	38.8	-23.8	51.73	-	-	74	-22.27	0	210	V
	* 12.39797	25.7	MAv1	38.8	-23.8	40.7	54	-13.3	-	-	0	210	V

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

### 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).



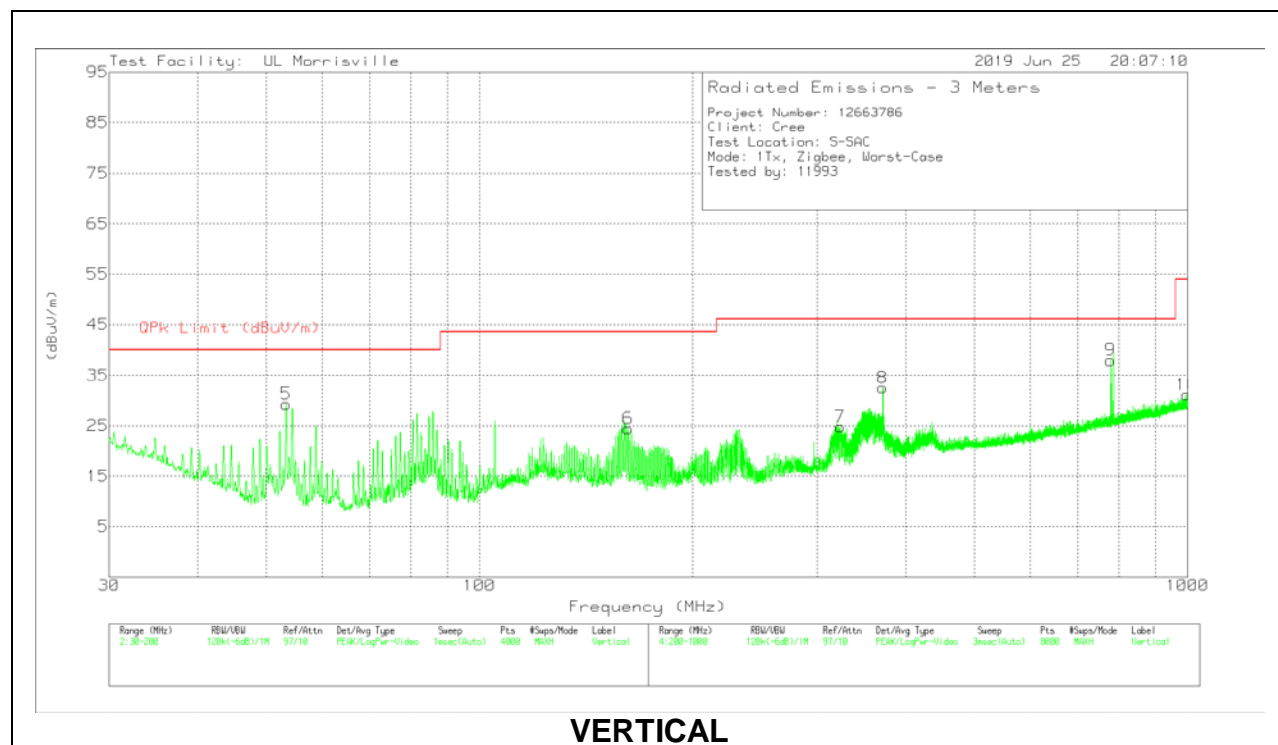
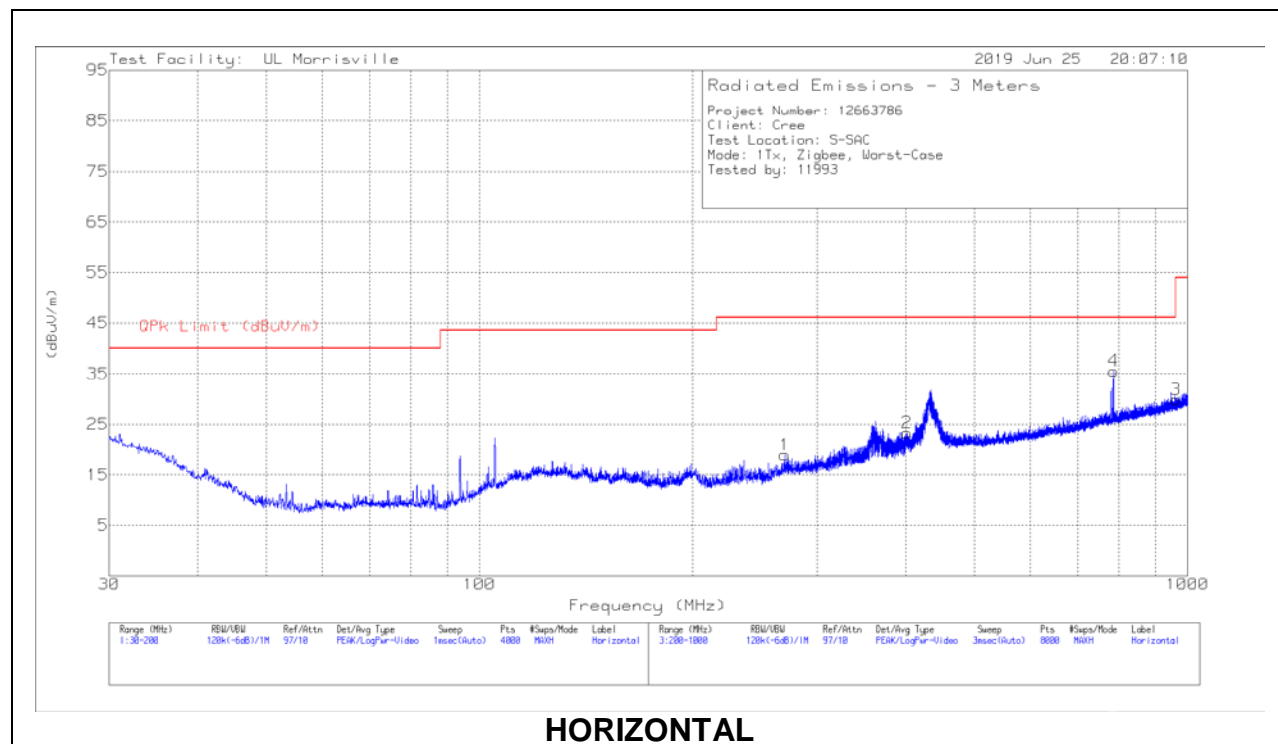
#### ANTENNA- THREE ORIENTATIONS

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	.01411	45.93	Pk	16.5	.1	-80	-17.47	-	44.61	64.61	-62.08	0-360	Off
1	.16122	46.32	Pk	10.7	.1	-80	-22.88	-	23.46	43.46	-46.34	0-360	On
7	.22047	43.78	Pk	10.7	.1	-80	-25.42	-	20.74	40.74	-46.16	0-360	Flat
8	.55113	35.09	Pk	10.8	.1	-40	5.99	32.78	-	-	-26.79	0-360	Flat
2	1.02965	31.23	Pk	11	.2	-40	2.43	27.35	-	-	-24.92	0-360	On
5	1.08867	31.25	Pk	11	.2	-40	2.45	26.87	-	-	-24.42	0-360	Off
3	13.5596	33.31	Pk	10.4	.6	-40	4.31	29.54	-	-	-25.23	0-360	On
6	13.56065	31.96	Pk	10.4	.6	-40	2.96	29.54	-	-	-26.58	0-360	Off
9	13.56065	37.93	Pk	10.4	.6	-40	8.93	29.54	-	-	-20.61	0-360	Flat

Pk - Peak detector

## 9.4. WORST CASE BELOW 1 GHZ

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

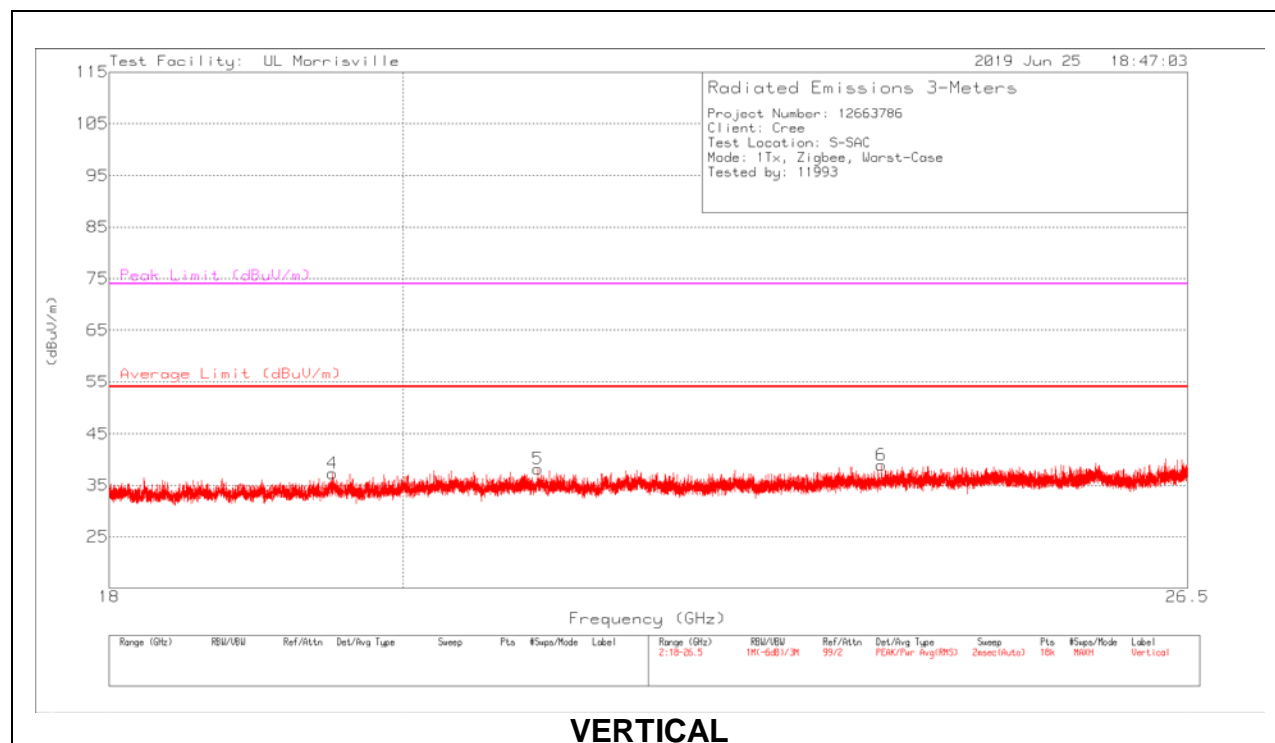
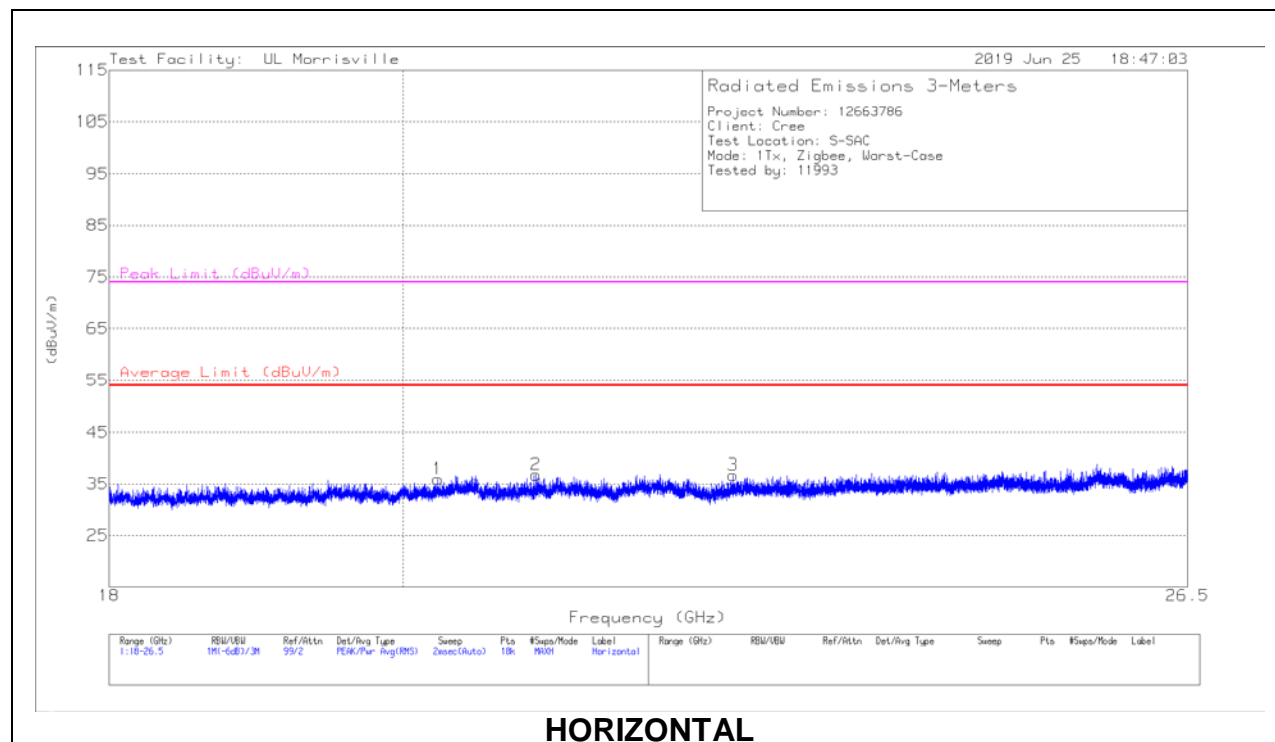


Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0074 AF (dB/m)	Cbl/Amp	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
6	* 162.1242	38.14	Pk	16.8	-30.5	24.44	43.52	-19.08	0-360	101	V
1	* 269.8091	30.79	Pk	17.8	-29.7	18.89	46.02	-27.13	0-360	199	H
2	* 401.7262	32.01	Pk	20.4	-29.1	23.31	46.02	-22.71	0-360	199	H
3	* 962.0991	28.54	Pk	27.6	-26.3	29.84	53.97	-24.13	0-360	199	H
7	* 323.216	35.52	Pk	18.7	-29.4	24.82	46.02	-21.2	0-360	101	V
10	* 997.5037	28.93	Pk	27.9	-25.7	31.13	53.97	-22.84	0-360	198	V
5	53.3385	48.66	Pk	12.1	-31.5	29.26	40	-10.74	0-360	101	V
8	371.2223	41.97	Pk	19.9	-29.4	32.47	46.02	-13.55	0-360	101	V
9	778.3752	40.27	Pk	25.8	-28.1	37.97	46.02	-8.05	0-360	101	V
4	786.0762	37.66	Pk	25.9	-28	35.56	46.02	-10.46	0-360	101	H

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

## 9.5. WORST CASE 18-26 GHZ

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





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	* 20.2531	41.35	Pk	33	-38.4	35.95	54	-18.05	74	-38.05	0-360	249	H
2	* 20.97611	41.93	Pk	33.2	-38.4	36.73	54	-17.27	74	-37.27	0-360	249	H
3	* 22.51233	41.29	Pk	33.5	-38.1	36.69	54	-17.31	74	-37.31	0-360	149	H
4	* 19.50033	43.28	Pk	32.8	-38.8	37.28	54	-16.72	74	-36.72	0-360	101	V
5	* 20.9898	43.22	Pk	33.2	-38.3	38.12	54	-15.88	74	-35.88	0-360	101	V
6	* 23.74395	42.14	Pk	34	-37.3	38.84	54	-15.16	74	-35.16	0-360	151	V

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

## 10. AC POWER LINE CONDUCTED EMISSIONS

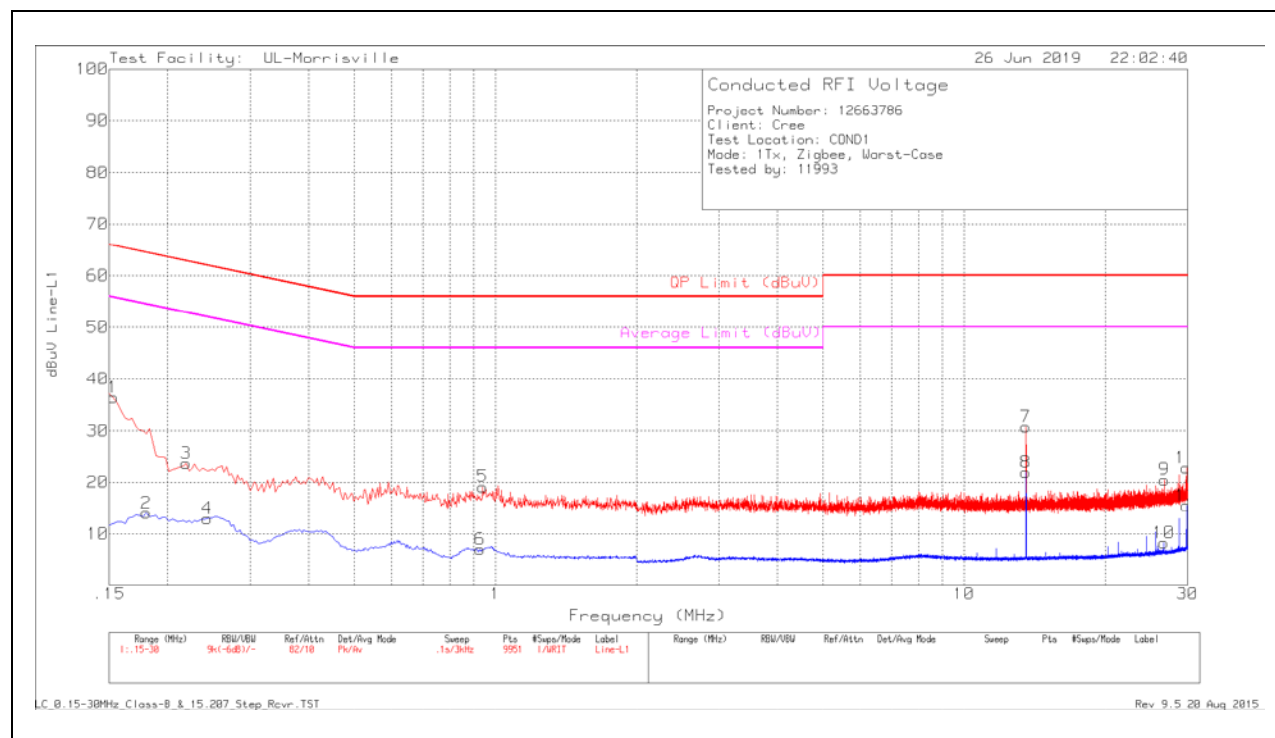
### LIMITS

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.

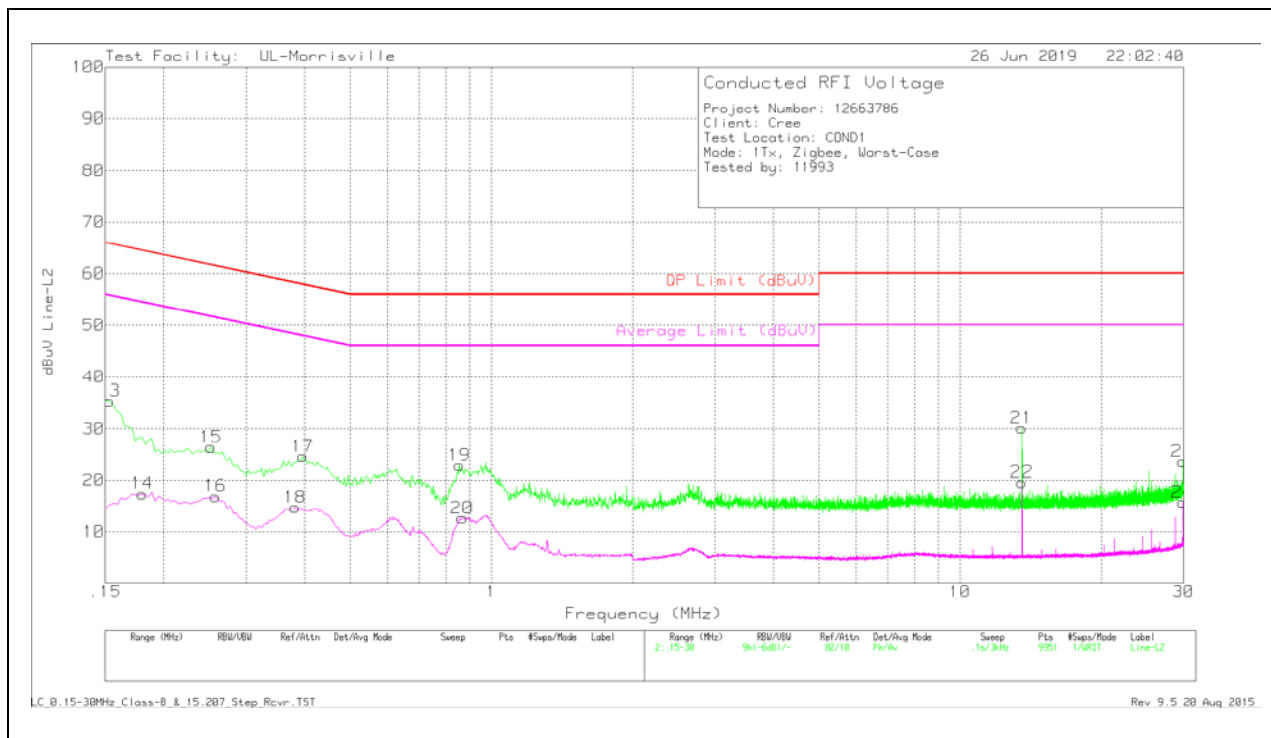
## LINE 1 RESULTS



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	26.19	Pk	.2	10	36.39	65.84	-29.45	-	-
2	.18	3.84	Av	.2	10	14.04	-	-	54.49	-40.45
3	.219	13.55	Pk	.1	10	23.65	62.86	-39.21	-	-
4	.243	2.88	Av	.1	10	12.98	-	-	51.99	-39.01
5	.939	9.14	Pk	0	10	19.14	56	-36.86	-	-
6	.927	-2.94	Av	0	10	7.06	-	-	46	-38.94
7	13.563	20.26	Pk	.1	10.4	30.76	60	-29.24	-	-
8	13.56	11.43	Av	.1	10.4	21.93	-	-	50	-28.07
9	26.754	9.49	Pk	.3	10.7	20.49	60	-39.51	-	-
10	26.655	-2.75	Av	.3	10.7	8.25	-	-	50	-41.75
11	29.85	11.64	Pk	.3	10.8	22.74	60	-37.26	-	-
12	29.85	4.4	Av	.3	10.8	15.5	-	-	50	-34.5

Av - Average  
Pk - Peak detector

## 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	25.14	Pk	.2	10	35.34	65.84	-30.5	-	-
14	.18	7.22	Av	.2	10	17.42	-	-	54.49	-37.07
15	.252	16.3	Pk	.1	10	26.4	61.69	-35.29	-	-
16	.258	6.82	Av	.1	10	16.92	-	-	51.5	-34.58
17	.396	14.47	Pk	.1	10	24.57	57.94	-33.37	-	-
18	.381	4.7	Av	.1	10	14.8	-	-	48.26	-33.46
19	.855	12.85	Pk	0	10	22.85	56	-33.15	-	-
20	.867	2.7	Av	0	10	12.7	-	-	46	-33.3
21	13.56	19.65	Pk	.1	10.4	30.15	60	-29.85	-	-
22	13.56	9.11	Av	.1	10.4	19.61	-	-	50	-30.39
23	29.859	12.55	Pk	.3	10.8	23.65	60	-36.35	-	-
24	29.856	4.65	Av	.3	10.8	15.75	-	-	50	-34.25

Av - Average  
Pk - Peak detector

## **11. SETUP PHOTOS**

Refer to UL Document R12663786-EP5

**END OF TEST REPORT**