



CERTIFICATION TEST REPORT

Report Number. : R12663786-E1

Applicant : Cree Inc.
4600 Silicon Drive
Durham, NC 27703, USA

Model : WIM-CMA-OEM

FCC ID : 2ACQ6-WIM

IC : 11481A-WIM

EUT Description : 802.15.4 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:
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REPORT REVISION HISTORY

Ver.	Issue Date	Revisions	Revised By
1	2019-02-06	Initial Issue	Brian T. Kiewra
2	2019-02-13	Revised frequency range in Sections 5.2 and 5.4 Revised subsection numbering in Section 9.	Brian T. Kiewra
3	2019-02-28	Revised OATS to OFS in Section 9.	Brian T. Kiewra

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Cree Inc.
4600 Silicon Drive
Durham, NC 27703, USA

EUT DESCRIPTION: 802.15.4 radio module

MODEL: WIM

SERIAL NUMBER: 44, 45

DATE TESTED: 2019-01-07 to 2019-01-25

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. 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.

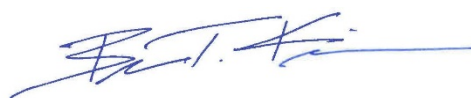
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Approved & Released
For UL LLC By:



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, North Carolina, USA and 2800 Suite Perimeter Park Dr., Morrisville, North Carolina, 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.
☐ Chamber A (ISED:2180C-1)	☒ Chamber North (ISED:2180C-3)
☐ Chamber C (ISED:2180C-2)	☐ Chamber South (ISED:2180C-4)

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
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 radio module.

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	4.93	3.11

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

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

5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was following:

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 X orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in X 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	Single Strand	<3m	Provides DC power to EUT

TEST SETUP

The EUT is configured as a standalone device.

SETUP DIAGRAMS

Please refer to R12663786-EP1 for setup diagrams

6. 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 - North Chamber)

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
0.009-30MHz (Loop Ant.)					
AT0059	Active Loop Antenna	EMCO	6502	2018-07-20	2019-07-20
30-1000 MHz					
AT0073	Hybrid Broadband Antenna	Sunol Sciences Corp.	JB3	2018-08-06	2019-08-06
1-18 GHz					
AT0072	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2018-04-30	2019-04-30
18-40 GHz					
AT0076	Horn Antenna, 18-26.5GHz	ARA	MWH-1826/B	2018-11-08	2019-11-08
Gain-Loss Chains					
N-SAC01	Gain-loss string: 0.009-30MHz	Various	Various	2018-09-06	2019-09-06
N-SAC02	Gain-loss string: 25-1000MHz	Various	Various	2018-05-20	2019-05-20
N-SAC03	Gain-loss string: 1-18GHz	Various	Various	2018-03-23	2019-03-23
N-SAC04	Gain-loss string: 18-40GHz	Various	Various	2018-09-30	2019-03-31
Receiver & Software					
SA0027	Spectrum Analyzer	Agilent	N9030A	2018-04-04	2019-04-04
SA0025 (18-40GHz RSE)	Spectrum Analyzer	Agilent	N9030A	2018-11-20	2019-11-20
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA
Additional Equipment used					
76021	DC Power Supply	Circuit Specialists	CSI3005X5	NA	NA

Test Equipment Used - Wireless Conducted Measurement Equipment

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
T177 (PRE0079253)	Spectrum Analyzer	Agilent Technologies	E4446A	2018-04-12	2019-04-12
PWM004 (PRE0137346)	RF Power Meter	Keysight Technologies	N1911A	2018-07-30	2019-07-30
PWS002 (PRE0137348)	Peak and Avg Power Sensor, 50MHz to 18GHz	Keysight Technologies	N1921A	2018-07-30	2019-07-30
SN 181562858	Environmental Meter	fisherbrand	14-650-118	2016-12-21	2018-12-21
76021	DC Regulated Power Supply	CircuitSpecialist s.Com	CSI3005X5	N/A	N/A

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	2018-06-19	2019-06-19
LISN003	LISN, 50-ohm/50-uH, 2-conductor, 25A	Fischer Custom Com.	FCC-LISN-50-25-2-01-550V	2018-08-21	2019-08-21
PRE0101521 (75141)	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	2018-06-13	2019-06-13
PS215	AC Power Source	Elgar	CW2501M (s/n 1523A02397)	NA	NA
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA

7. 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

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

8. ANTENNA PORT TEST RESULTS

8.1. ON TIME AND DUTY CYCLE

LIMITS

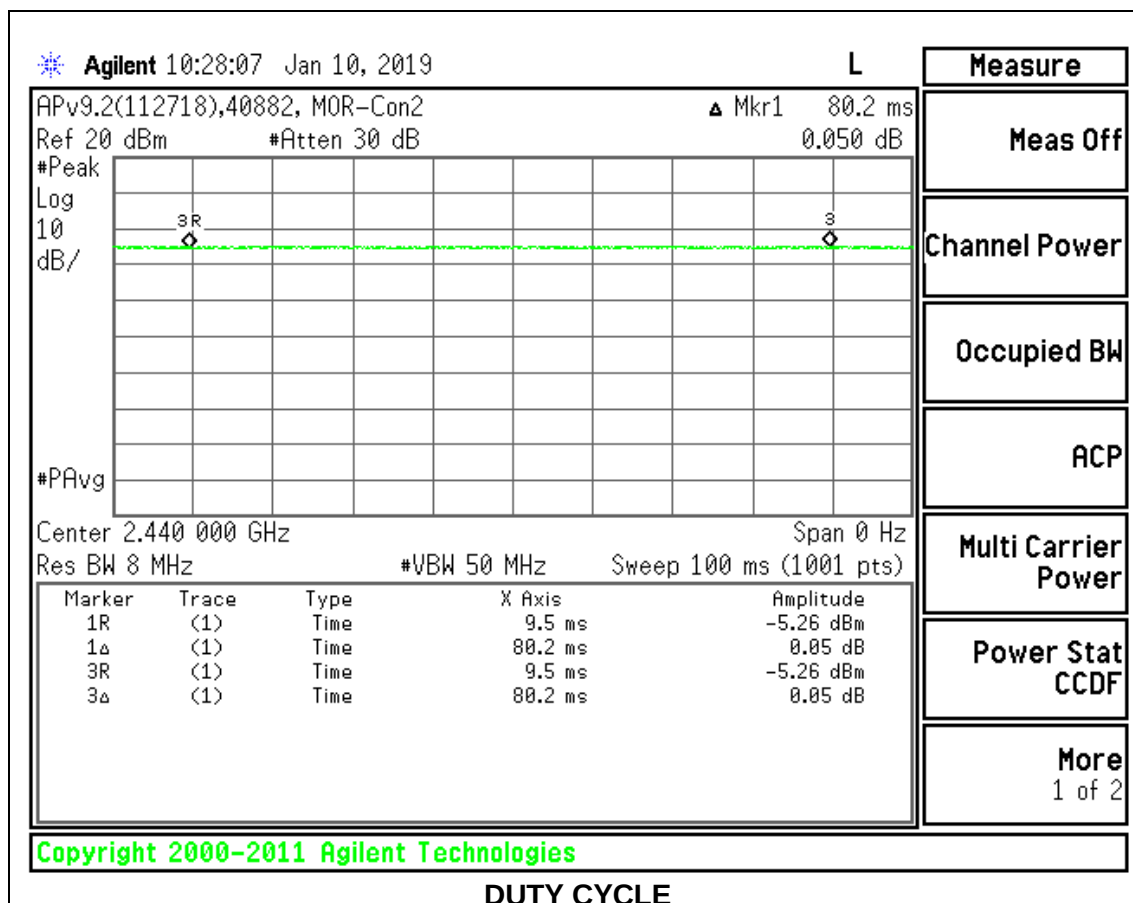
None; for reporting purposes only.

PROCEDURE

ON TIME AND DUTY CYCLE RESULTS

	B (msec)	(msec)	x (linear)	Cycle (%)	Correction Factor (dB)	Minimum VBW (kHz)
2.4GHz Band						
ZigBee	80.200	80.200	1.000	100.00%	0.00	0.010

DUTY CYCLE PLOTS



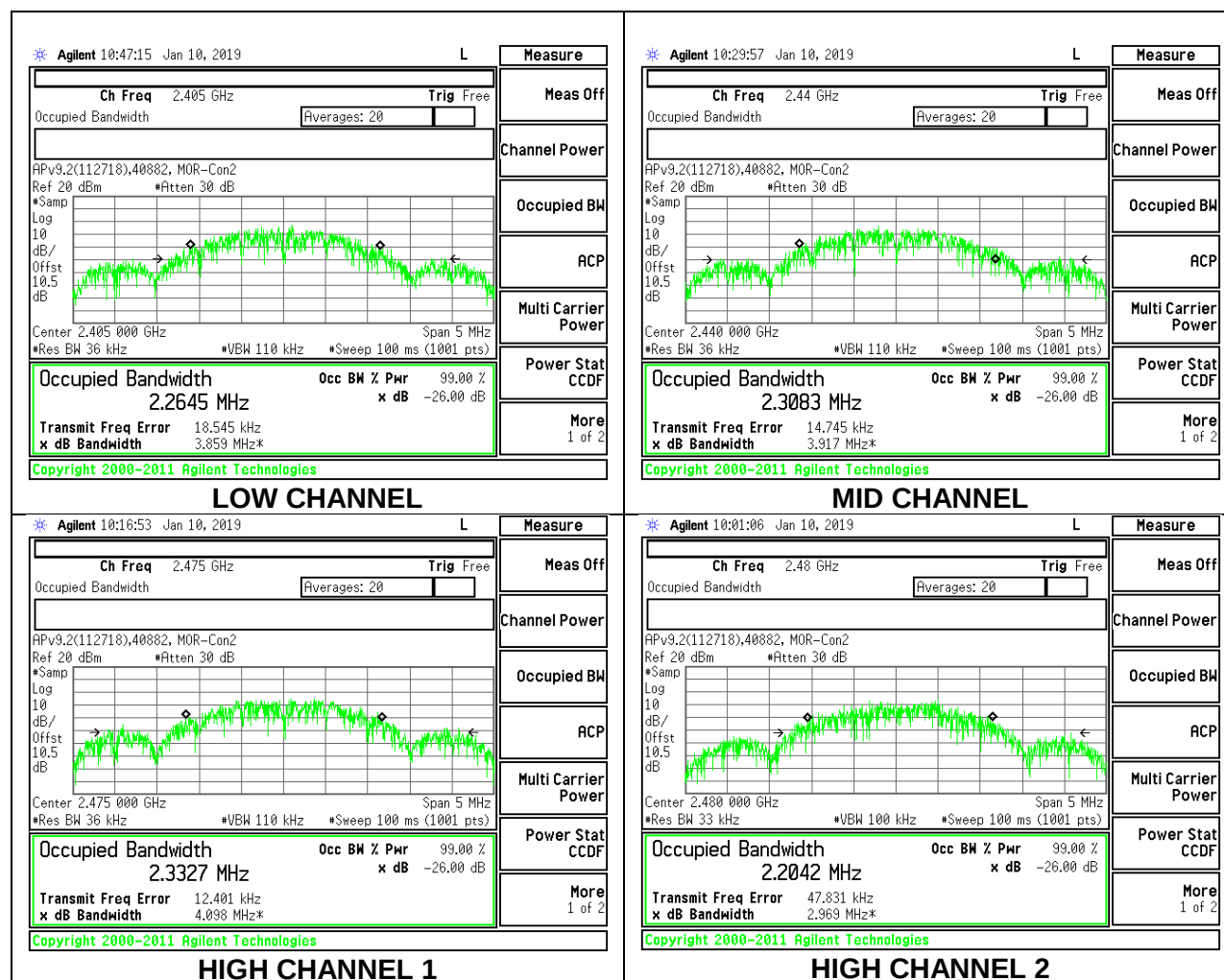
8.2. 99% BANDWIDTH LIMITS

None; for reporting purposes only.

RESULTS

8.2.1. 802.15.4

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2405	2.2645
Middle	2440	2.3083
High 1	2480	2.3327
High 2	2480	2.2042



8.3. 6 dB BANDWIDTH

LIMITS

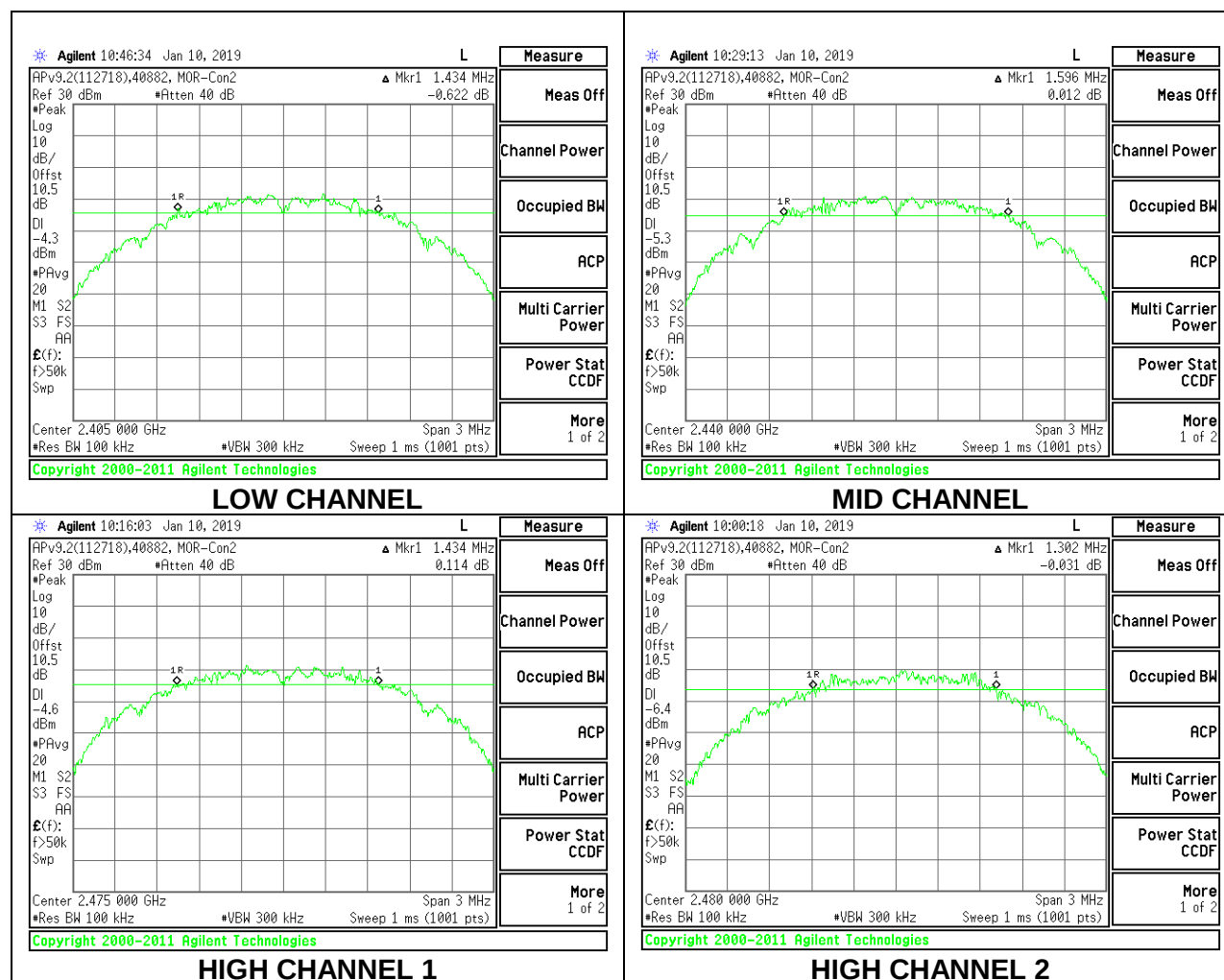
FCC §15.247 (a) (2)
RSS-247 5.2 (a)

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

RESULTS

8.3.1. 802.15.4

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2405	1.434	0.5
Middle	2440	1.596	0.5
High 1	2475	1.434	0.5
High 2	2480	1.302	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 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 peak reading of power.

RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2405	4.93	30	-25.07
Middle	2440	4.84	30	-25.16
High	2475	4.85	30	-25.15
High	2480	2.36	30	-27.64

TEST INFORMATION

Test Date: 2019-01-07
Project: 12663786
Tested By: 40882

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.

RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2405	4.83	30	-25.17
Middle	2440	4.72	30	-25.28
High	2475	4.71	30	-25.29
High	2480	2.16	30	-27.84

TEST INFORMATION

Test Date: 2019-01-07
Project: 12663786
Tested By: 40882

8.6. POWER SPECTRAL DENSITY

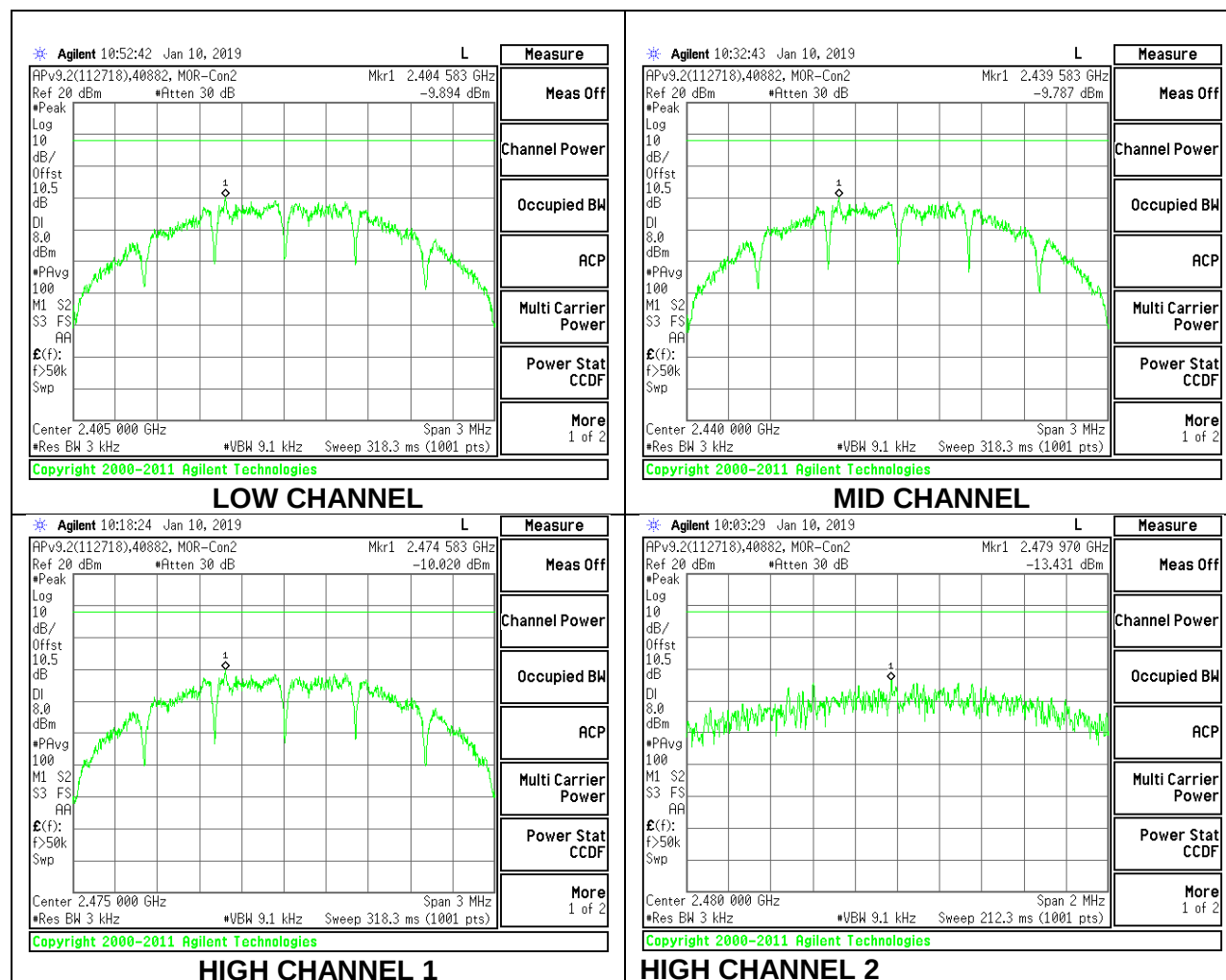
LIMITS

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.

8.6.1. 802.15.4

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Low	2405	-9.894	8	-17.89
Middle	2440	-9.787	8	-17.79
High 1	2475	-10.020	8	-18.02
High 2	2480	-13.431	8	-21.43



8.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

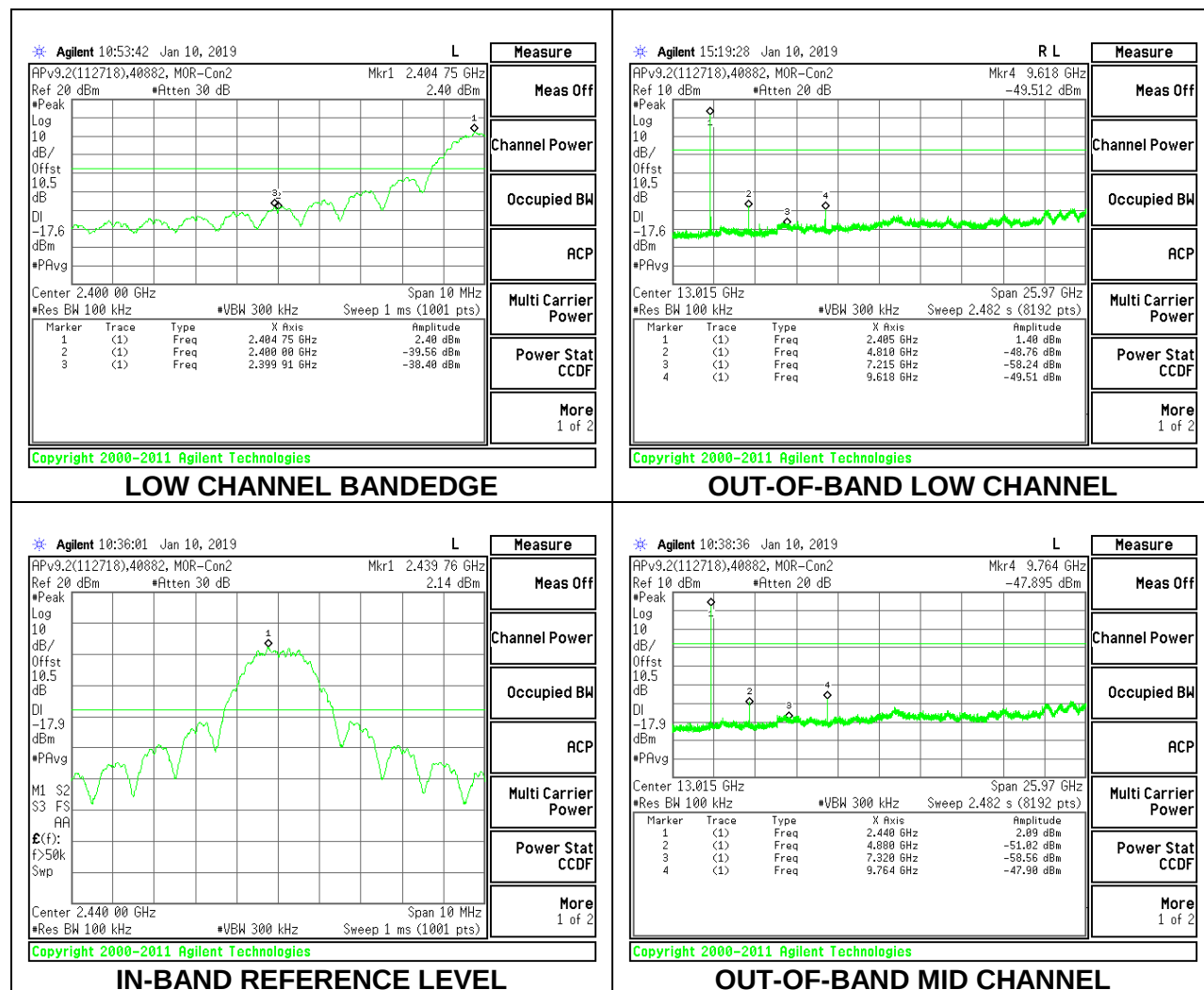
FCC §15.247 (d)

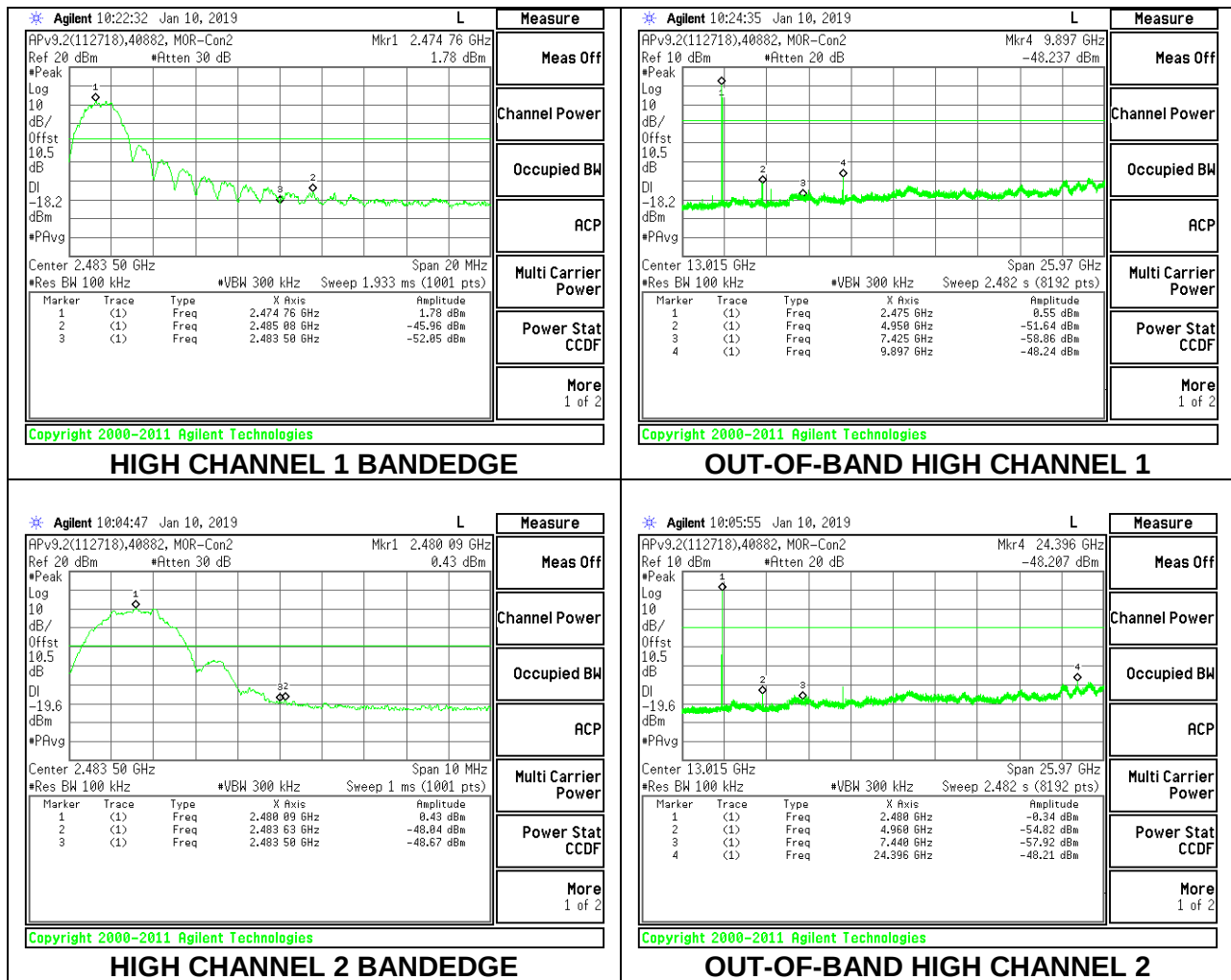
RSS-247 5.5

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

RESULTS

8.7.1. 802.15.4





9. RADIATED TEST RESULTS

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 120 kHz for peak and/or quasi-peak detection measurements in the 30-1000MHz range, 9kHz for peak and/or quasi-peak detection measurements in the 0.15-30MHz range and 200Hz for peak and/or quasi-peak detection measurements in the 9 to 150kHz range. 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. For average measurements above 1GHz, the resolution bandwidth and video bandwidth are set as described in ANSI C63.10:2013 for the applicable measurement. The particular averaging method used for this test program was RMS.

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.

KDB 414788 OFS and Chamber Correlation Justification

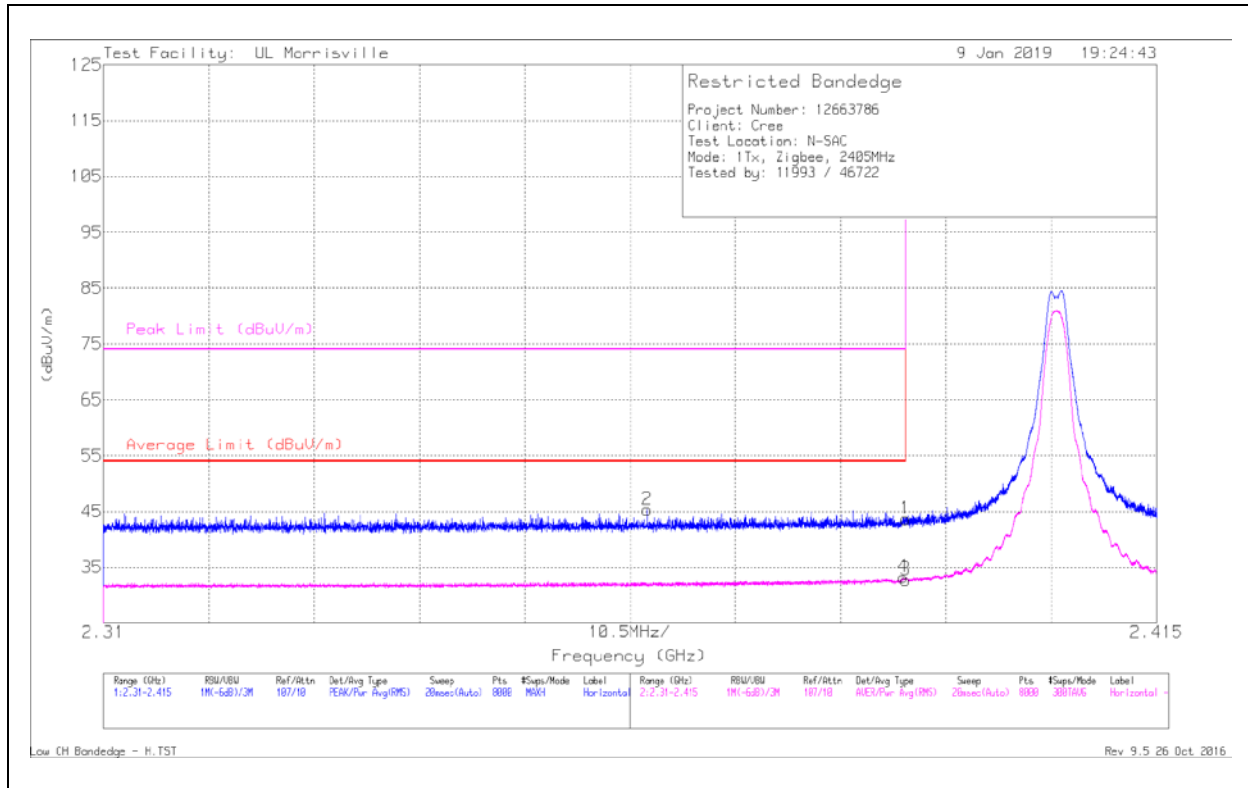
Based on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field. OFS and chamber correlation testing had been performed and chamber measured test result is the worst case test result.

9.1. TRANSMITTER ABOVE 1 GHz

9.1.1. 802.15.4

BANDEDGE (LOW CHANNEL)

HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 AF (dB/m)	Amp/Cbl/Ftr/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	36.19	Pk	32	-24.5	43.69	-	-	74	-30.31	133	225	H
2	*** 2.364	38.02	Pk	31.8	-24.5	45.32	-	-	74	-28.68	133	225	H
3	*** 2.39	25.26	RMS	32	-24.5	32.76	54	-21.24	-	-	133	225	H
4	*** 2.39	25.69	RMS	32	-24.5	33.19	54	-20.81	-	-	133	225	H

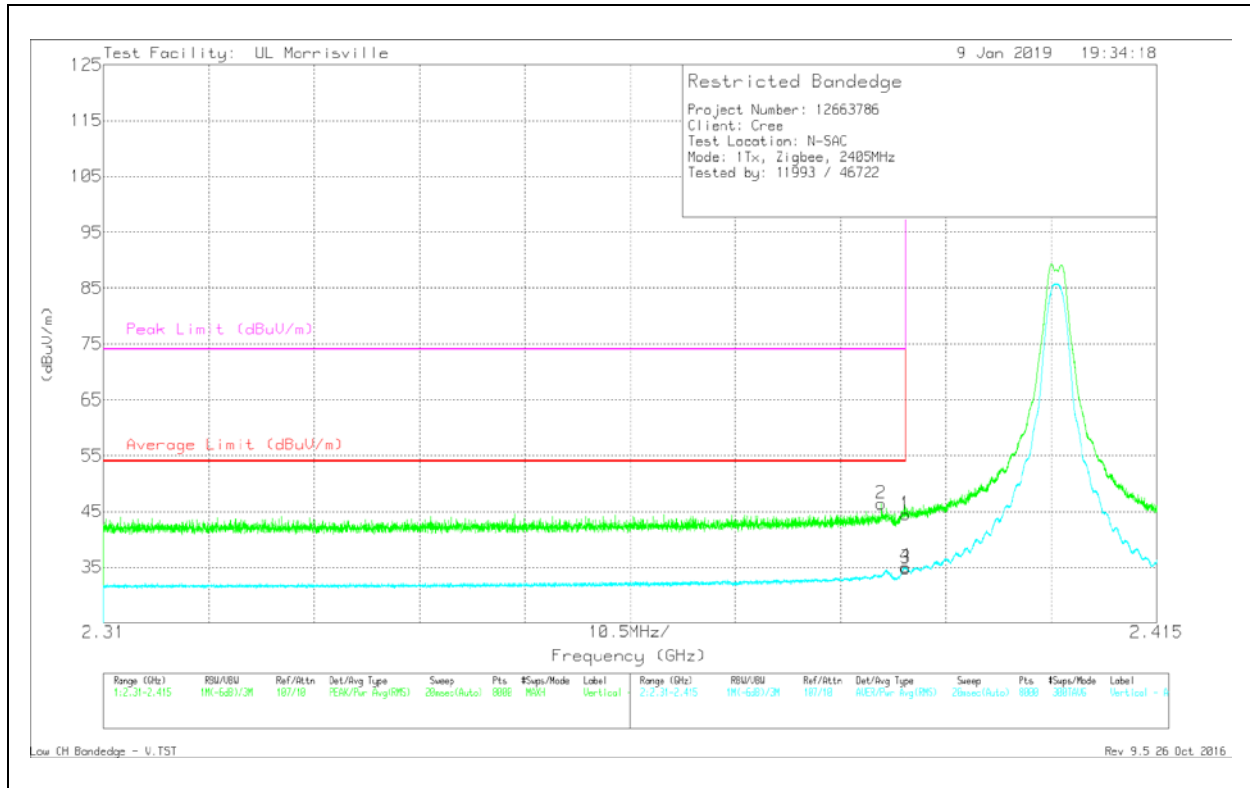
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

RMS - RMS detection

VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 AF (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	36.98	Pk	32	-24.5	44.48	-	-	74	-29.52	189	238	V
2	*** 2.388	38.91	Pk	32	-24.5	46.41	-	-	74	-27.59	189	238	V
3	*** 2.39	27.34	RMS	32	-24.5	34.84	54	-19.16	-	-	189	238	V
4	*** 2.39	27.6	RMS	32	-24.5	35.1	54	-18.9	-	-	189	238	V

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

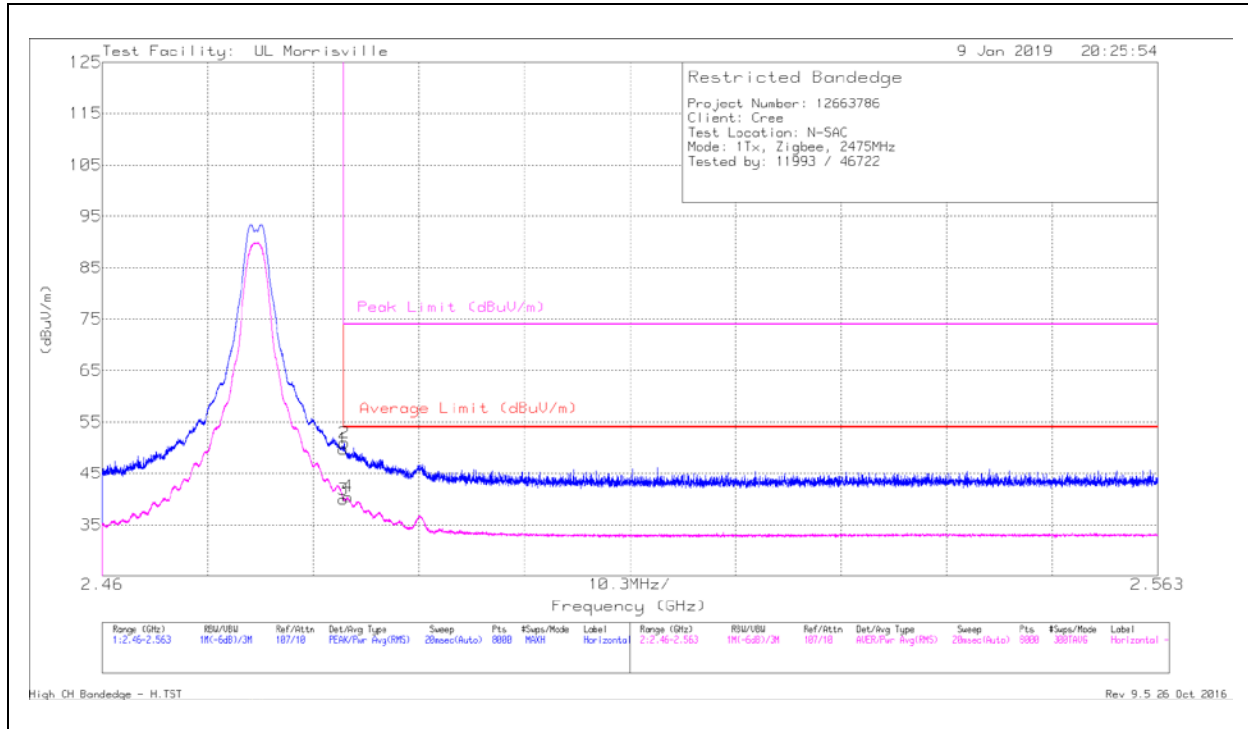
** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

RMS - RMS detection

BANDEDGE (HIGH CHANNEL 1)

HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBUV)	Det	AT0072 AF (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	* ** 2.484	41.78	Pk	32.4	-24.4	49.78	-	-	74	-24.22	257	373	H
2	* ** 2.484	42.95	Pk	32.4	-24.4	50.95	-	-	74	-23.05	257	373	H
3	* ** 2.484	31.92	RMS	32.4	-24.4	39.92	54	-14.08	-	-	257	373	H
4	* ** 2.484	32.49	RMS	32.4	-24.4	40.49	54	-13.51	-	-	257	373	H

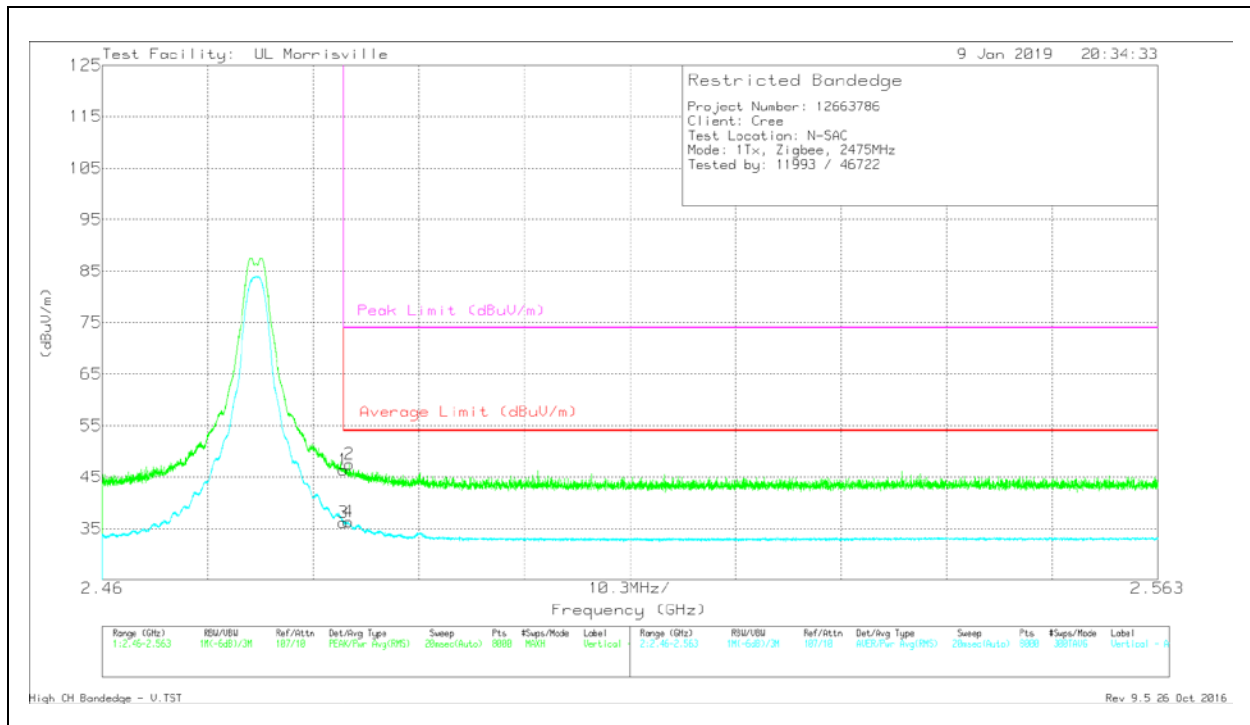
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

RMS - RMS detection

VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 AF (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	* ** 2.484	38.38	Pk	32.4	-24.4	46.38	-	-	74	-27.62	188	101	V
2	* ** 2.484	39.51	Pk	32.4	-24.4	47.51	-	-	74	-26.49	188	101	V
3	* ** 2.484	28.12	RMS	32.4	-24.4	36.12	54	-17.88	-	-	188	101	V
4	* ** 2.484	28.29	RMS	32.4	-24.4	36.29	54	-17.71	-	-	188	101	V

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

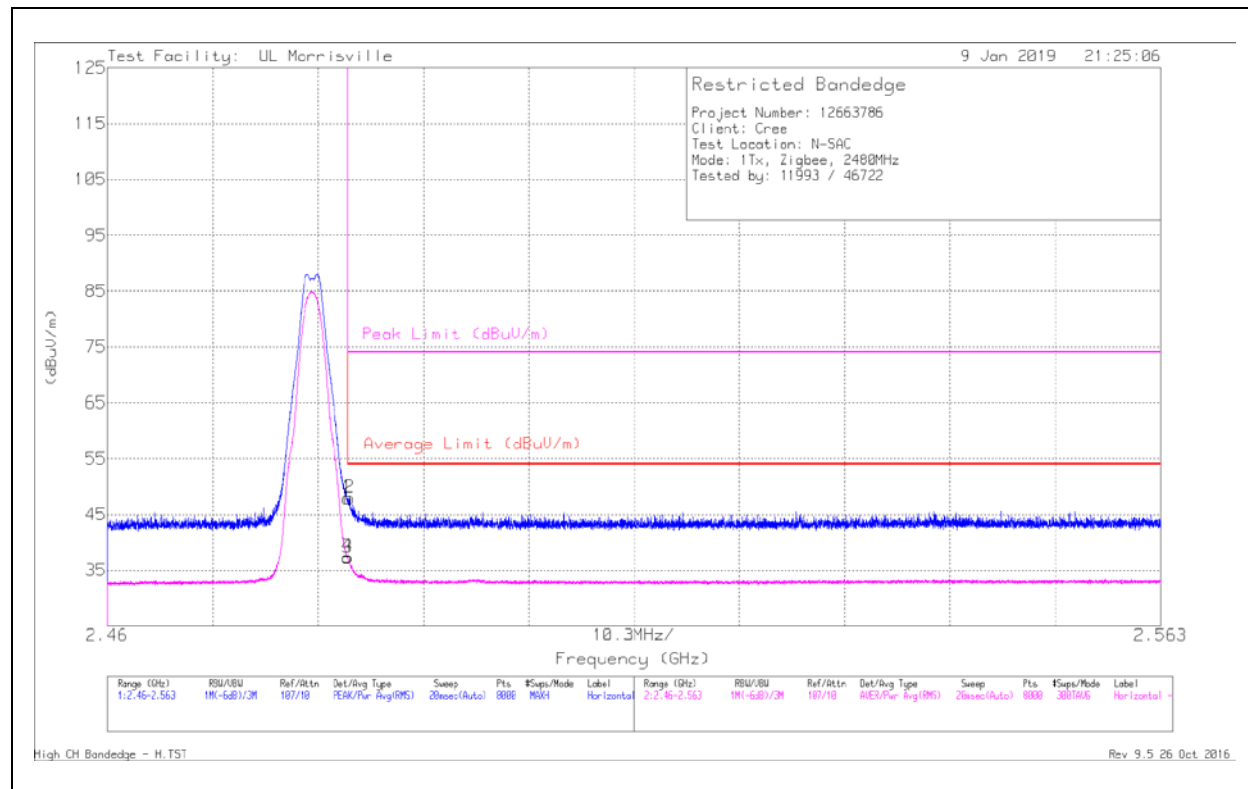
** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

RMS - RMS detection

BANDEDGE (HIGH CHANNEL 2)

HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 AF (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	* ** 2.484	39.95	Pk	32.4	-24.4	47.95	-	-	74	-26.05	260	260	H
2	* ** 2.484	39.96	Pk	32.4	-24.4	47.96	-	-	74	-26.04	260	260	H
3	* ** 2.484	29.28	RMS	32.4	-24.4	37.28	54	-16.72	-	-	260	260	H
4	* ** 2.484	29.43	RMS	32.4	-24.4	37.43	54	-16.57	-	-	260	260	H

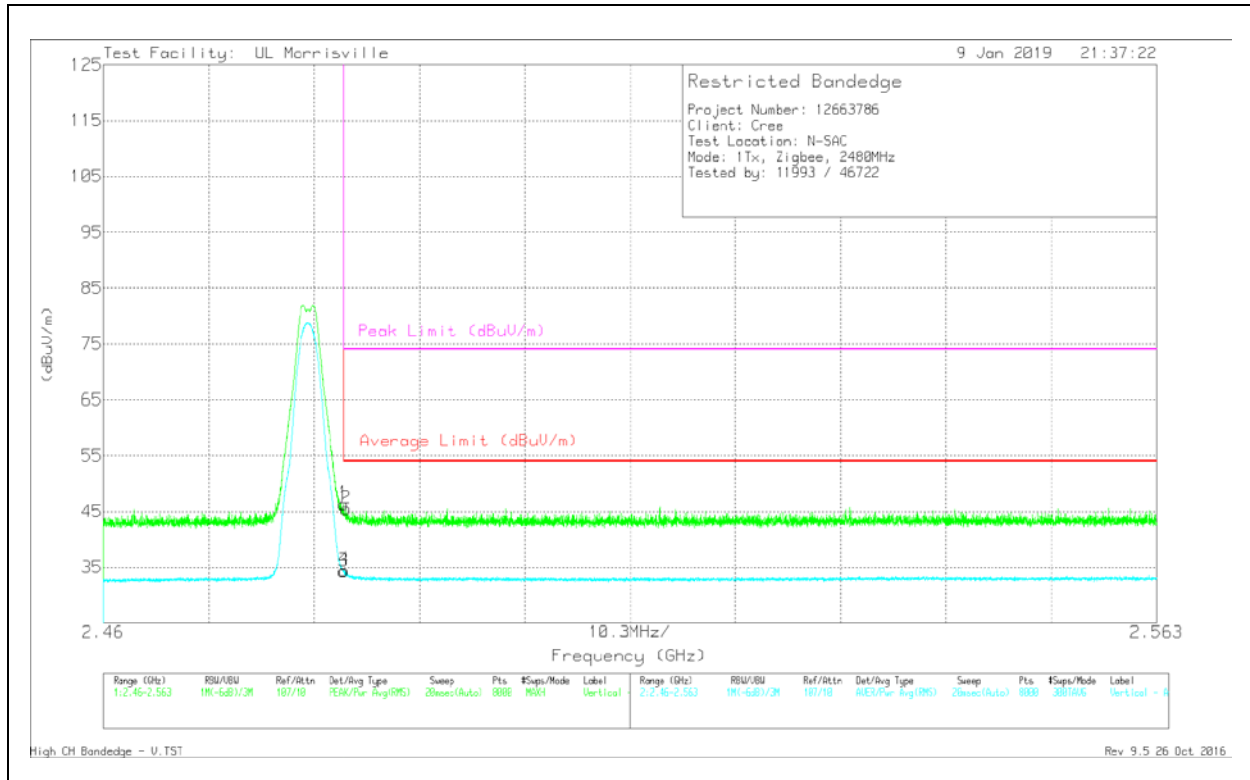
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

RMS - RMS detection

VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 AF (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	* ** 2.484	38.36	Pk	32.4	-24.4	46.36	-	-	74	-27.64	161	147	V
2	* ** 2.484	37.52	Pk	32.4	-24.4	45.52	-	-	74	-28.48	161	147	V
3	* ** 2.484	26.35	RMS	32.4	-24.4	34.35	54	-19.65	-	-	161	147	V
4	* ** 2.484	26.49	RMS	32.4	-24.4	34.49	54	-19.51	-	-	161	147	V

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

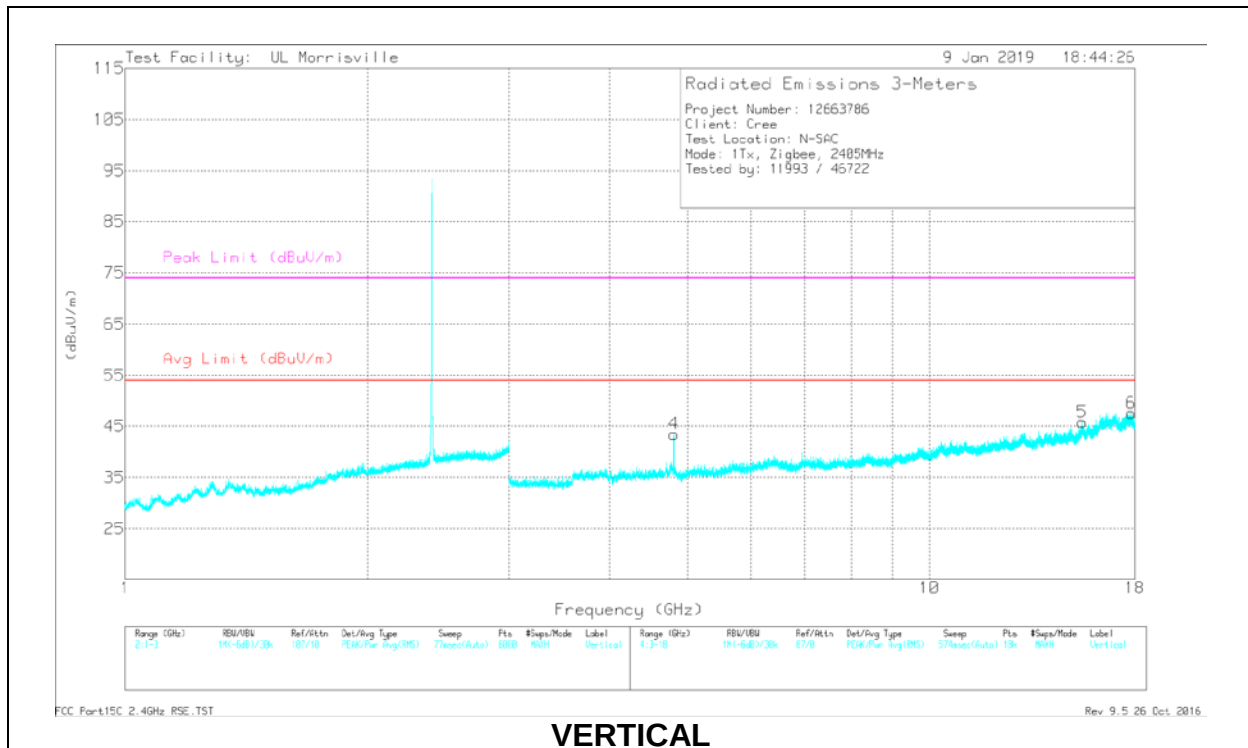
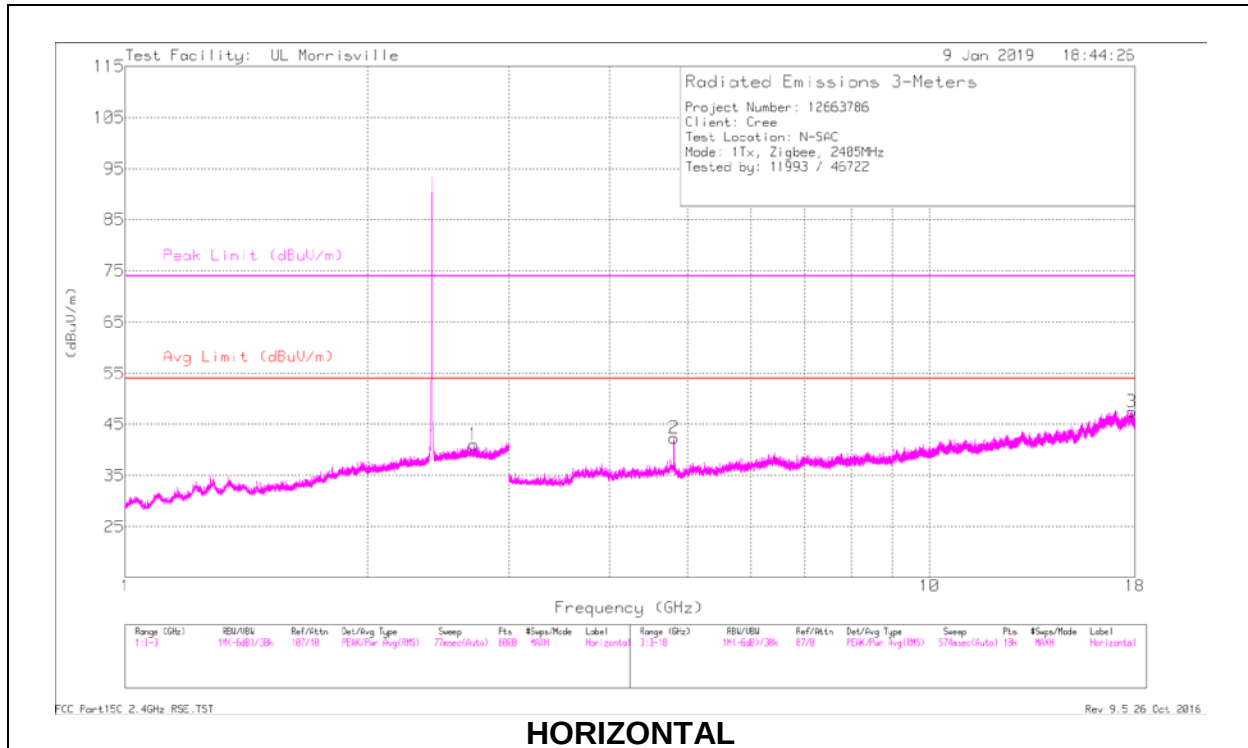
** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

RMS - RMS detection

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 AF (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	* ** 2.713	37.11	PK2	32.4	-24	45.51	-	-	74	-28.49	170	190	H
	* ** 2.712	25.22	MAv1	32.4	-24	33.62	54	-20.38	-	-	170	190	H
2	* ** 4.811	46.1	PK2	34.1	-31.8	48.4	-	-	74	-25.6	46	116	H
	* ** 4.811	37.05	MAv1	34.1	-31.8	39.35	54	-14.65	-	-	46	116	H
3	* ** 17.839	34.82	PK2	41.6	-22.9	53.52	-	-	74	-20.48	176	263	H
	* ** 17.839	22.89	MAv1	41.6	-22.9	41.59	54	-12.41	-	-	176	263	H
4	* ** 4.809	47.25	PK2	34.1	-31.8	49.55	-	-	74	-24.45	119	178	V
	* ** 4.811	39.22	MAv1	34.1	-31.8	41.52	54	-12.48	-	-	119	178	V
5	* ** 15.477	36.45	PK2	40.2	-24.1	52.55	-	-	74	-21.45	191	242	V
	* ** 15.476	23.75	MAv1	40.2	-24.1	39.85	54	-14.15	-	-	191	242	V
6	* ** 17.813	35.39	PK2	41.6	-22.8	54.19	-	-	74	-19.81	288	338	V
	* ** 17.812	23.06	MAv1	41.6	-22.9	41.76	54	-12.24	-	-	288	338	V

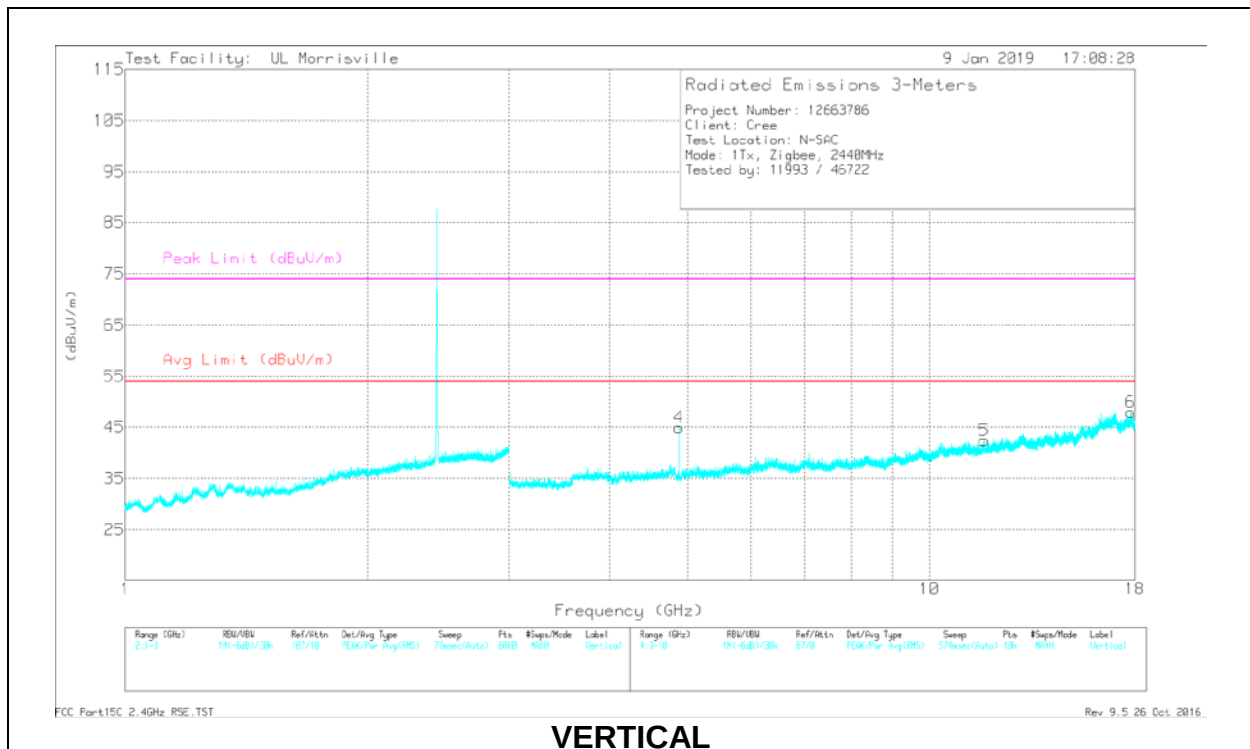
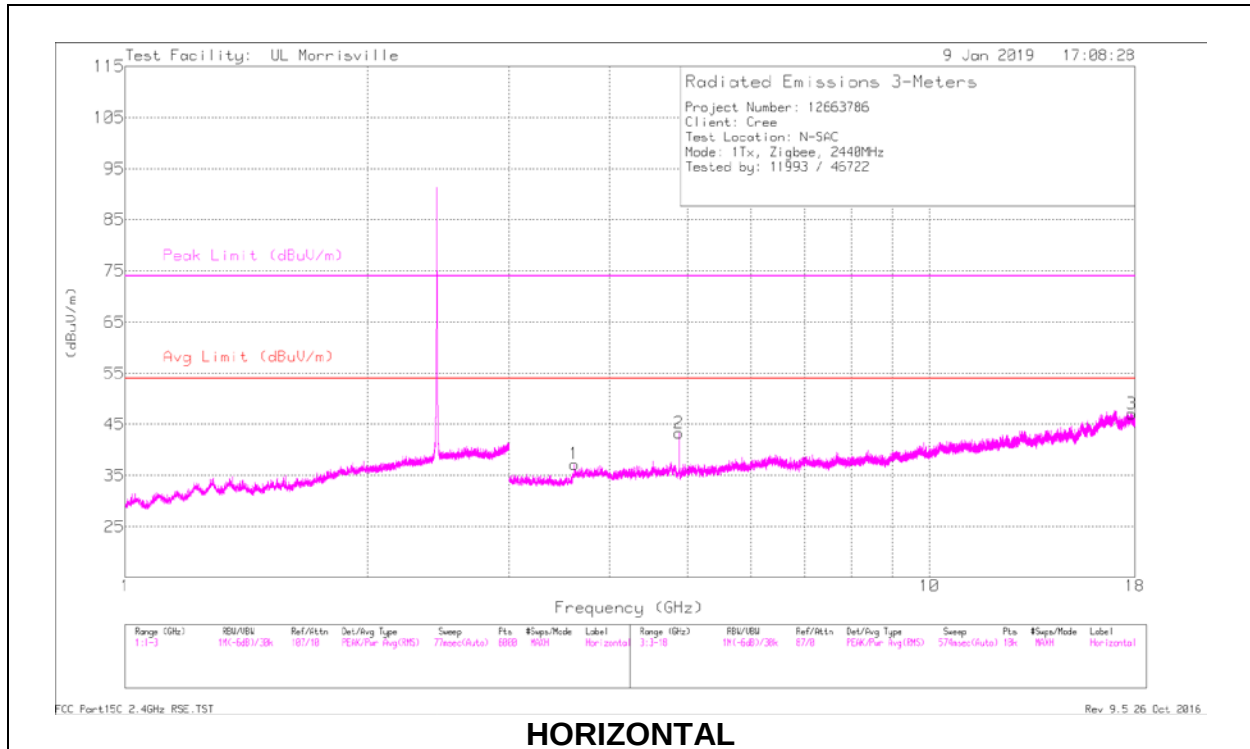
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

PK2 - Maximum Peak

MAv1 - Maximum RMS Average

MID CHANNEL RESULTS



RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 AF (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	* ** 3.621	41.38	PK2	32.9	-31.8	42.48	-	-	74	-31.52	82	341	H
	* ** 3.62	29.31	MAv1	32.9	-31.8	30.41	54	-23.59	-	-	82	341	H
2	* ** 4.879	46.81	PK2	34.1	-31.6	49.31	-	-	74	-24.69	45	119	H
	* ** 4.881	38.88	MAv1	34.1	-31.6	41.38	54	-12.62	-	-	45	119	H
3	* ** 17.839	34.95	PK2	41.6	-22.9	53.65	-	-	74	-20.35	346	202	H
	* ** 17.839	22.91	MAv1	41.6	-22.9	41.61	54	-12.39	-	-	346	202	H
4	* ** 4.881	47.1	PK2	34.1	-31.6	49.6	-	-	74	-24.4	105	196	V
	* ** 4.881	39.46	MAv1	34.1	-31.6	41.96	54	-12.04	-	-	105	196	V
5	* ** 11.69	34.67	PK2	38.3	-25.7	47.27	-	-	74	-26.73	220	265	V
	* ** 11.69	23.76	MAv1	38.3	-25.7	36.36	54	-17.64	-	-	220	265	V
6	* ** 17.773	35.64	PK2	41.5	-23.3	53.84	-	-	74	-20.16	98	292	V
	* ** 17.773	23.55	MAv1	41.5	-23.3	41.75	54	-12.25	-	-	98	292	V

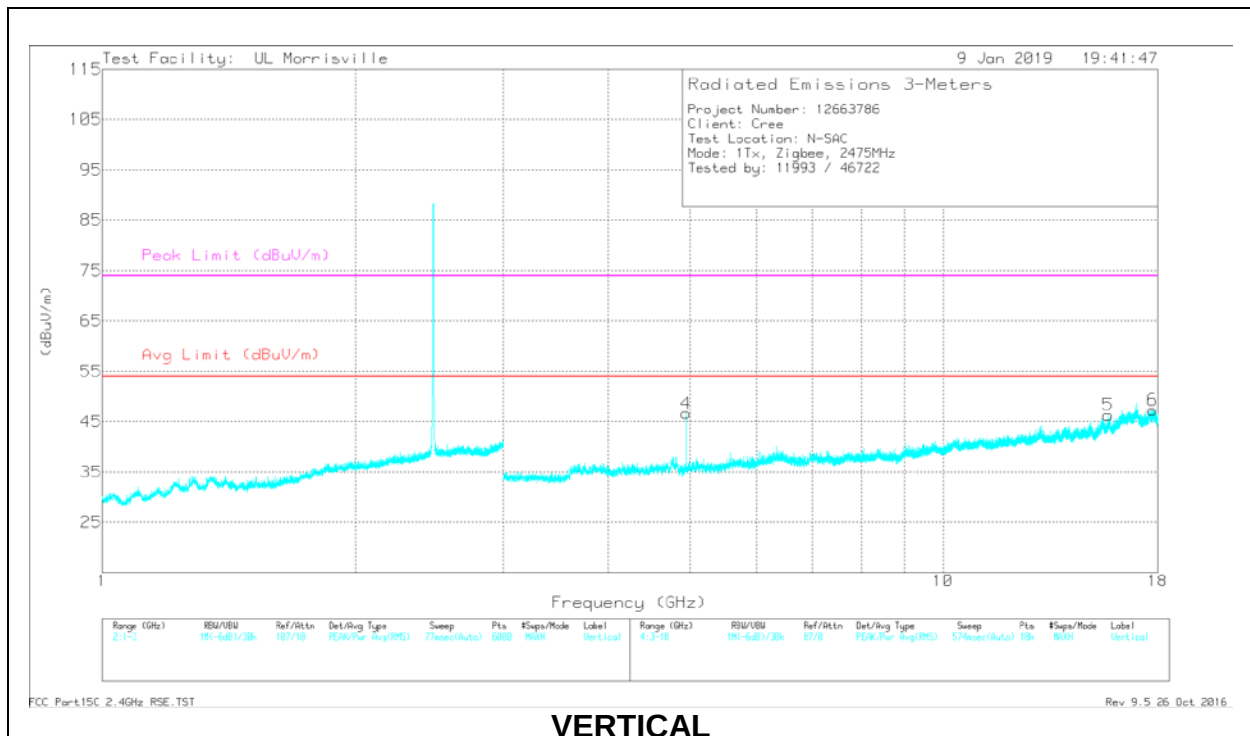
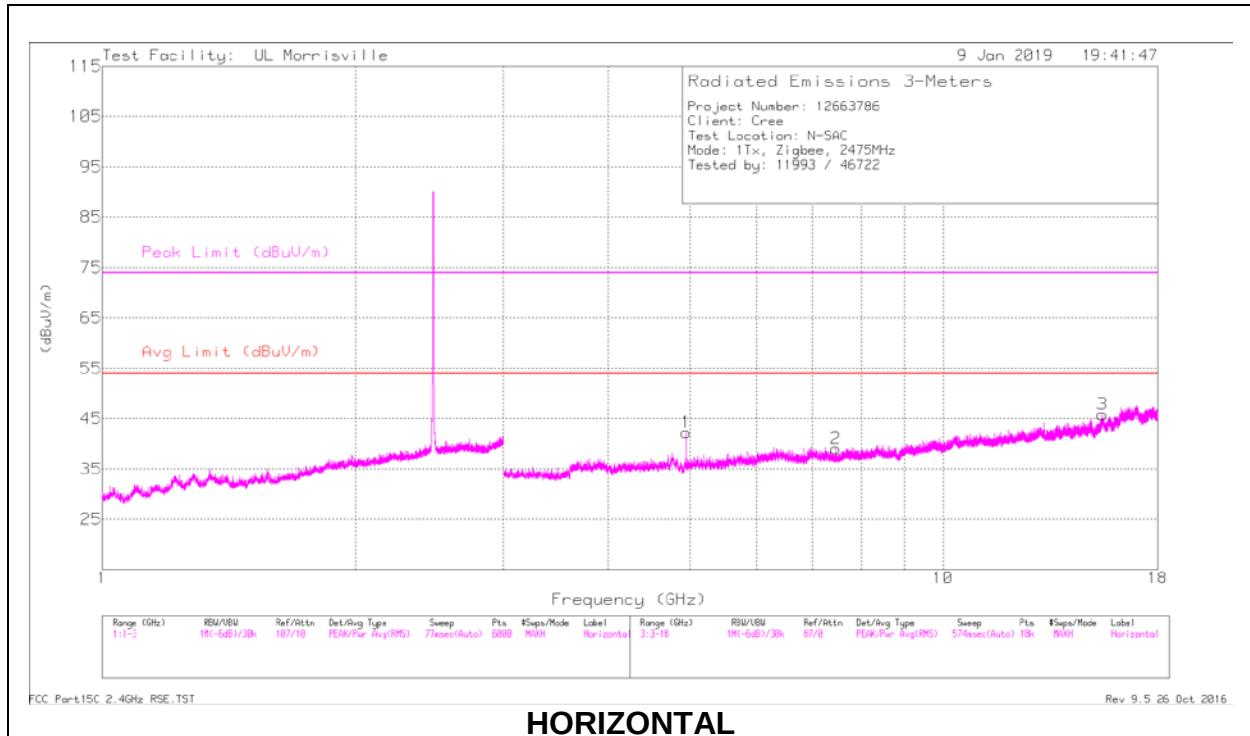
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

PK2 - Maximum Peak

MAv1 - Maximum RMS Average

HIGH CHANNEL 1 RESULTS



RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 AF (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	* ** 4.949	45.95	PK2	34.1	-32.4	47.65	-	-	74	-26.35	77	218	H
	* ** 4.949	37.89	MAv1	34.1	-32.4	39.59	54	-14.41	-	-	77	218	H
2	* ** 7.451	38.89	PK2	35.6	-29.3	45.19	-	-	74	-28.81	236	271	H
	* ** 7.453	26.3	MAv1	35.6	-29.3	32.6	54	-21.4	-	-	236	271	H
3	* ** 15.477	36.16	PK2	40.2	-24.1	52.26	-	-	74	-21.74	119	232	H
	* ** 15.477	23.87	MAv1	40.2	-24.1	39.97	54	-14.03	-	-	119	232	H
4	* ** 4.951	49.52	PK2	34.1	-32.4	51.22	-	-	74	-22.78	137	208	V
	* ** 4.951	42.25	MAv1	34.1	-32.4	43.95	54	-10.05	-	-	137	208	V
5	* ** 15.72	37.18	PK2	40.2	-24.8	52.58	-	-	74	-21.42	289	220	V
	* ** 15.72	24.85	MAv1	40.2	-24.8	40.25	54	-13.75	-	-	289	220	V
6	* ** 17.756	35.86	PK2	41.5	-23.6	53.76	-	-	74	-20.24	322	102	V
	* ** 17.756	23.67	MAv1	41.5	-23.6	41.57	54	-12.43	-	-	322	102	V

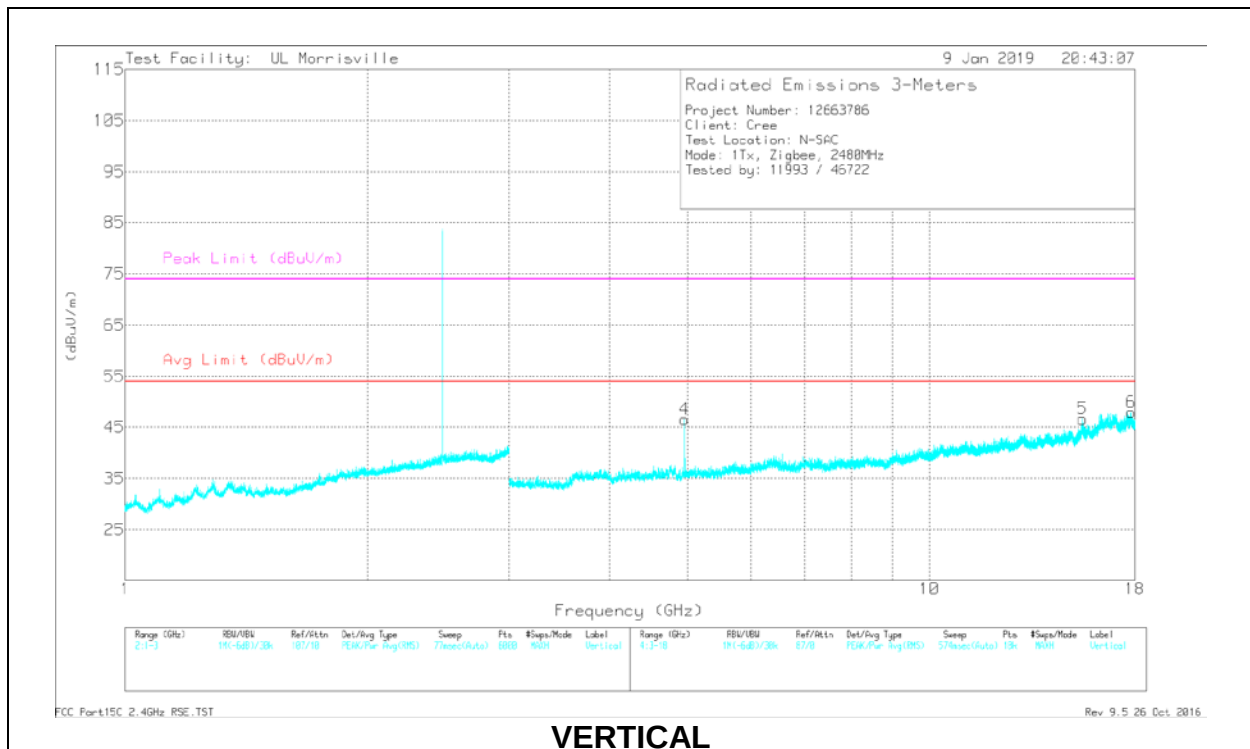
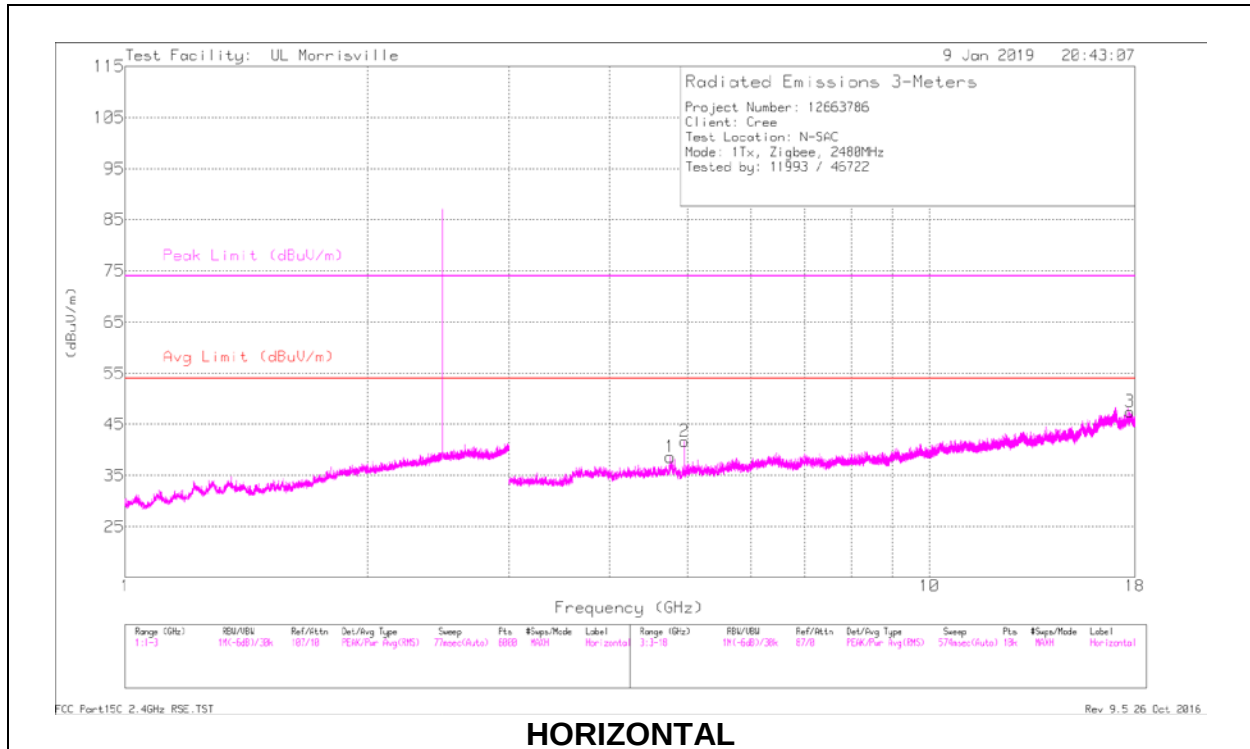
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

PK2 - Maximum Peak

MAv1 - Maximum RMS Average

HIGH CHANNEL 2 RESULTS



RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 AF (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	* ** 4.761	42.21	PK2	34.1	-32.1	44.21	-	-	74	-29.79	83	258	H
	* ** 4.761	30.69	MAv1	34.1	-32.1	32.69	54	-21.31	-	-	83	258	H
2	* ** 4.959	45.15	PK2	34.1	-32.5	46.75	-	-	74	-27.25	84	194	H
	* ** 4.959	36.23	MAv1	34.1	-32.5	37.83	54	-16.17	-	-	84	194	H
3	* ** 17.74	35.63	PK2	41.5	-23.7	53.43	-	-	74	-20.57	84	248	H
	* ** 17.74	23.51	MAv1	41.5	-23.7	41.31	54	-12.69	-	-	84	248	H
4	* ** 4.959	48.49	PK2	34.1	-32.5	50.09	-	-	74	-23.91	130	109	V
	* ** 4.959	41.41	MAv1	34.1	-32.5	43.01	54	-10.99	-	-	130	109	V
5	* ** 15.494	36.51	PK2	40.2	-24.1	52.61	-	-	74	-21.39	107	226	V
	* ** 15.493	23.79	MAv1	40.2	-24.1	39.89	54	-14.11	-	-	107	226	V
6	* ** 17.814	35.02	PK2	41.6	-22.8	53.82	-	-	74	-20.18	149	147	V
	* ** 17.812	23.11	MAv1	41.6	-22.9	41.81	54	-12.19	-	-	149	147	V

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

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

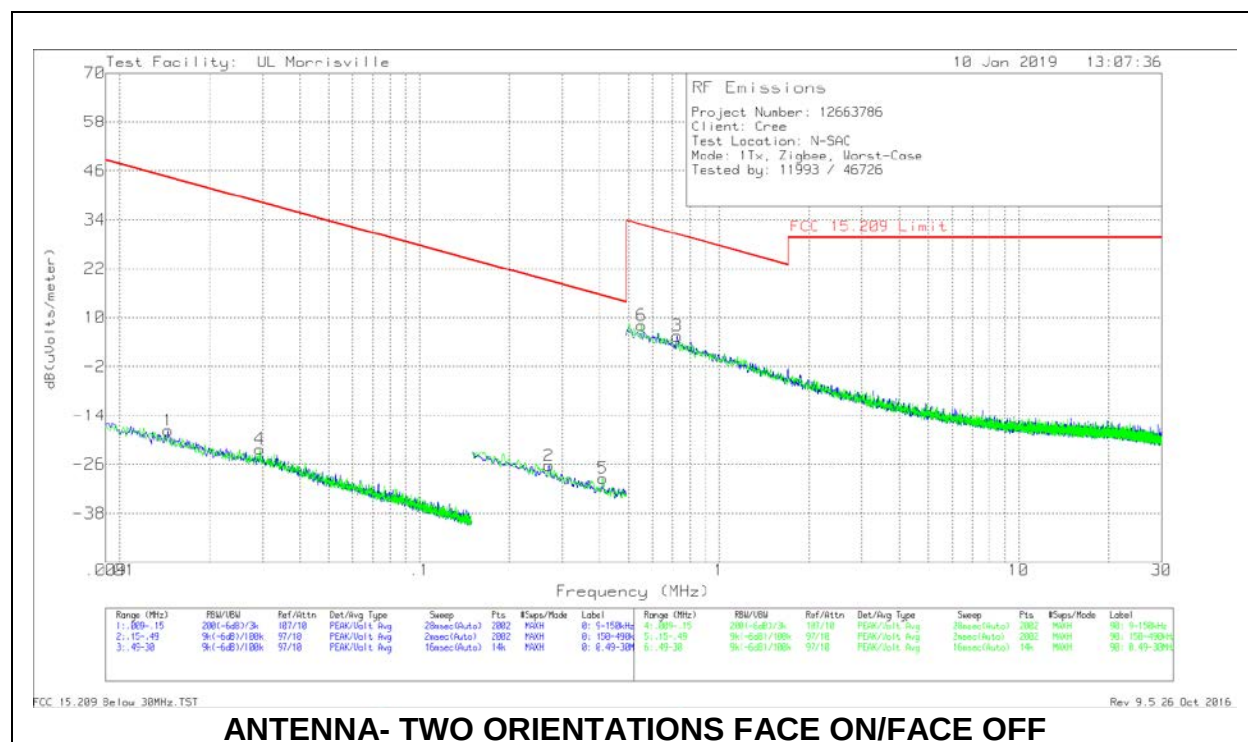
PK2 - Maximum Peak

MAv1 - Maximum RMS Average

9.2. 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 $40 \cdot \log(\text{test distance} / \text{specification distance})$.



ANTENNA- TWO ORIENTATIONS FACE ON/FACE OFF

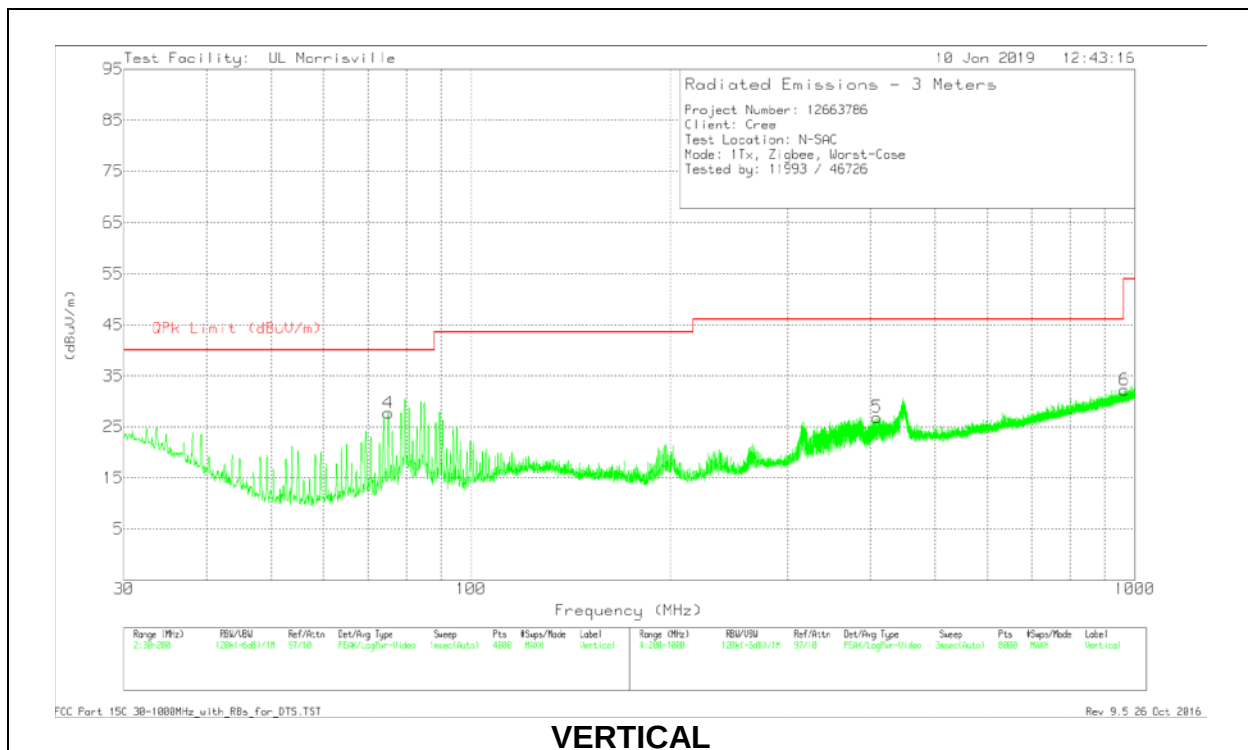
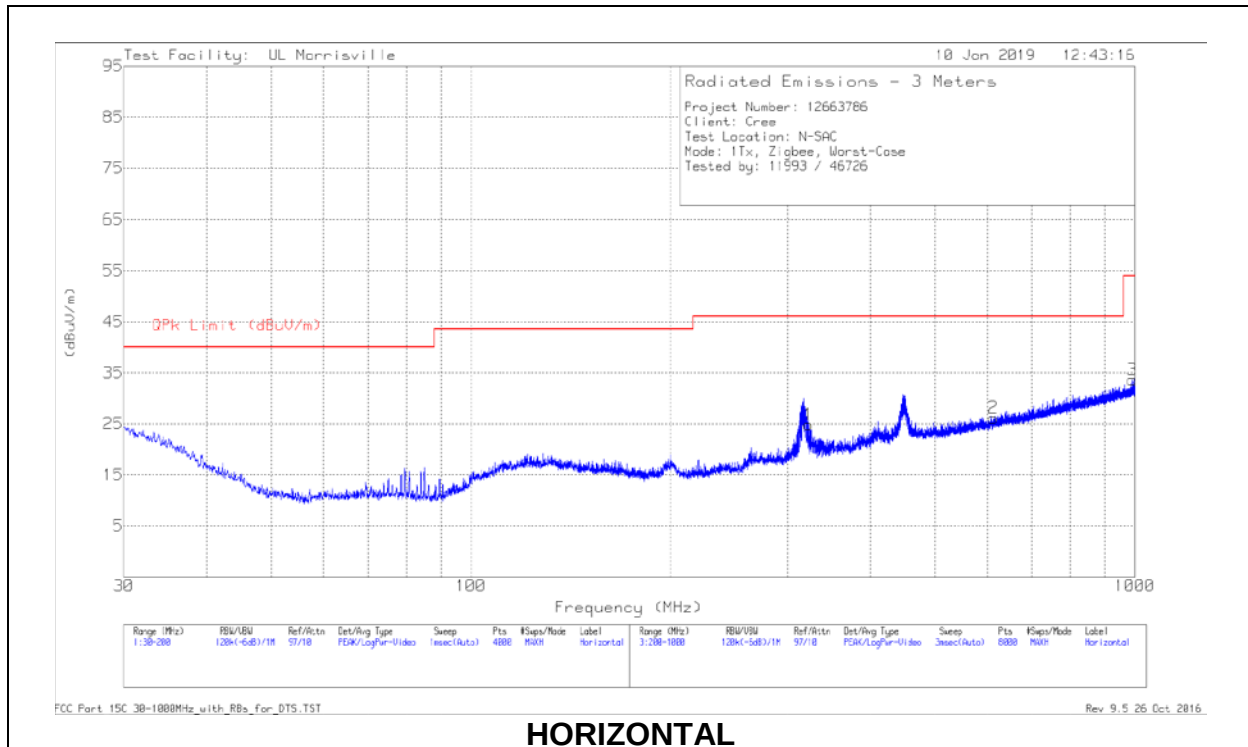
BELOW 30MHz DATA

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0059 (dB/m)	Cbl (dB)	Dist. Corr. Factor (dB)	Corrected Reading dB(uV/m)	FCC 15.209 QP Limit	FCC 15.209 AV Limit	FCC 15.209 PK Limit	Worst-Case Margin (dB)	Azimuth (Degs)
1	.01453	45.13	Pk	17.1	.1	-80	-17.67	-	44.36	44.36	-62.03	0-360
4	.02937	43.96	Pk	13.7	.1	-80	-22.24	-	38.25	38.25	-60.49	0-360
2	.27062	43.36	Pk	10.2	.1	-80	-26.34	-	18.96	18.96	-45.3	0-360
5	.40951	40.34	Pk	10.2	.1	-80	-29.36	-	15.36	15.36	-44.72	0-360
6	.55324	37.57	Pk	10.4	.1	-40	8.07	32.75	-	-	-24.68	0-360
3	.7261	35.05	Pk	10.4	.1	-40	5.55	30.38	-	-	-24.83	0-360

Pk - Peak detector

9.3. WORST-CASE 30 TO 1000MHz

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



30 TO 1000 MHz DATA

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0073 ACF (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
4	* ** 75.0617	44.61	Pk	14.3	-31.2	27.71	40	-12.29	0-360	102	V
1	* ** 322.5159	33.42	Pk	20.7	-29.3	24.82	46.02	-21.2	0-360	102	H
2	* ** 611.7535	28.84	Pk	25.5	-28.2	26.14	46.02	-19.88	0-360	199	H
3	* ** 991.6029	28.89	Pk	29.8	-25.1	33.59	53.97	-20.38	0-360	299	H
5	* ** 408.9272	33.09	Pk	22.6	-28.8	26.89	46.02	-19.13	0-360	102	V
6	* ** 964.3994	28.27	Pk	29.5	-25.5	32.27	53.97	-21.7	0-360	102	V

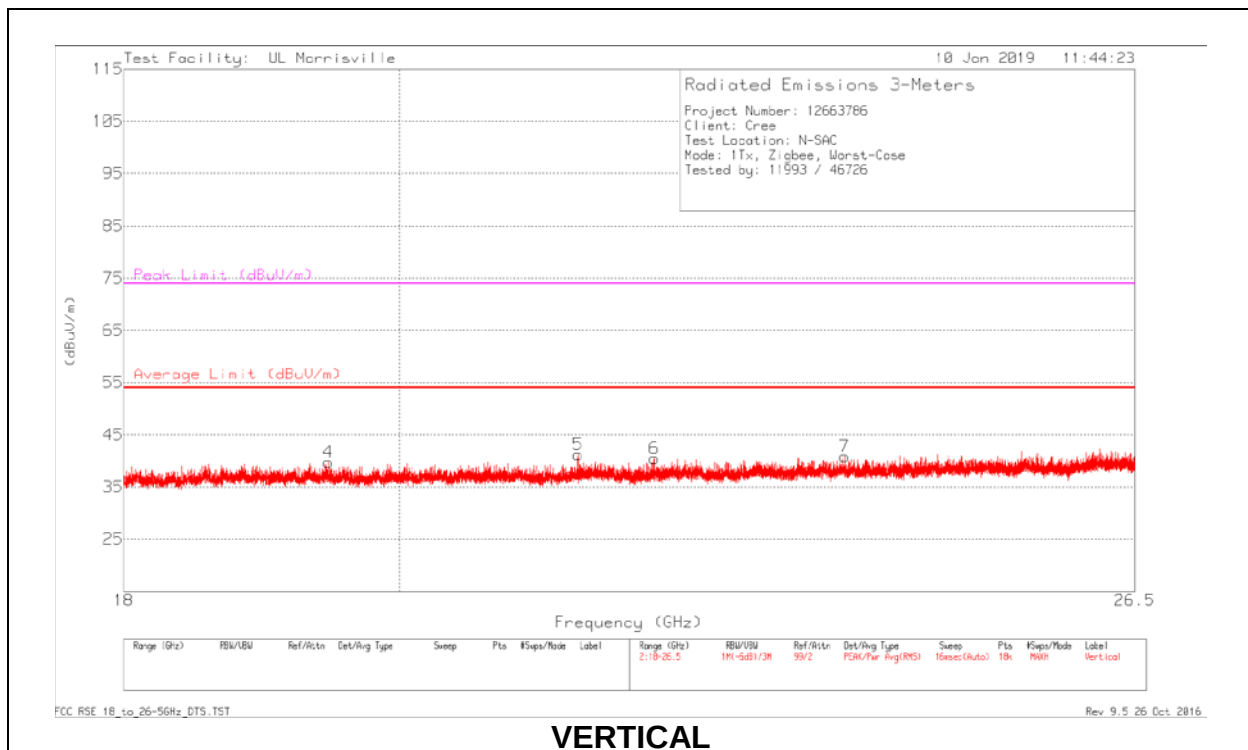
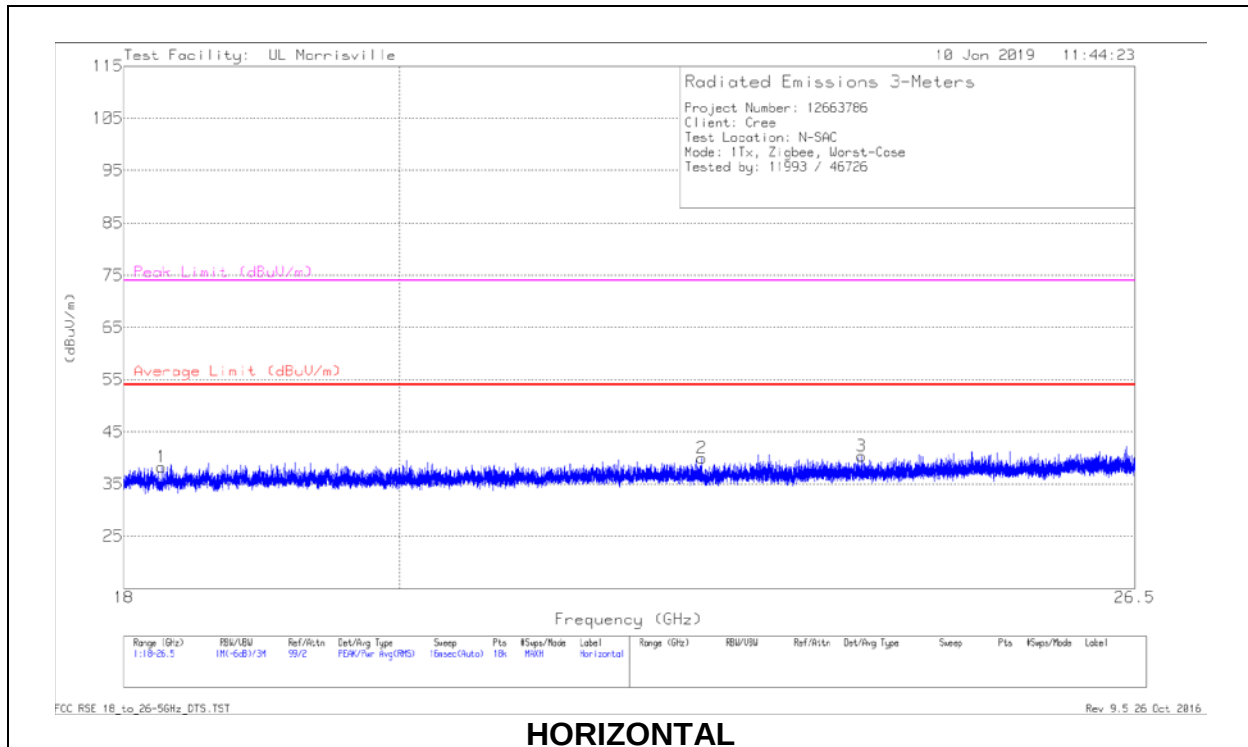
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

9.4. WORST-CASE 18 TO 26GHz

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



18 TO 26GHz DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0076 AF (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 18.262	45.26	Pk	32.3	-39.3	38.26	54	-15.74	74	-35.74	0-360	299	H
2	* ** 22.454	45.65	Pk	33.5	-39.2	39.95	54	-14.05	74	-34.05	0-360	299	H
3	* ** 23.868	45.32	Pk	34	-39	40.32	54	-13.68	74	-33.68	0-360	299	H
4	* ** 19.466	46.55	Pk	32.7	-39.5	39.75	54	-14.25	74	-34.25	0-360	202	V
6	* ** 22.05	46.48	Pk	33.4	-39.4	40.48	54	-13.52	74	-33.52	0-360	152	V
7	* ** 23.714	45.95	Pk	34	-39.1	40.85	54	-13.15	74	-33.15	0-360	252	V
5	21.416	47.62	Pk	33.2	-39.6	41.22	54	-12.78	74	-32.78	0-360	152	V

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

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

10. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

RSS-Gen 8.8

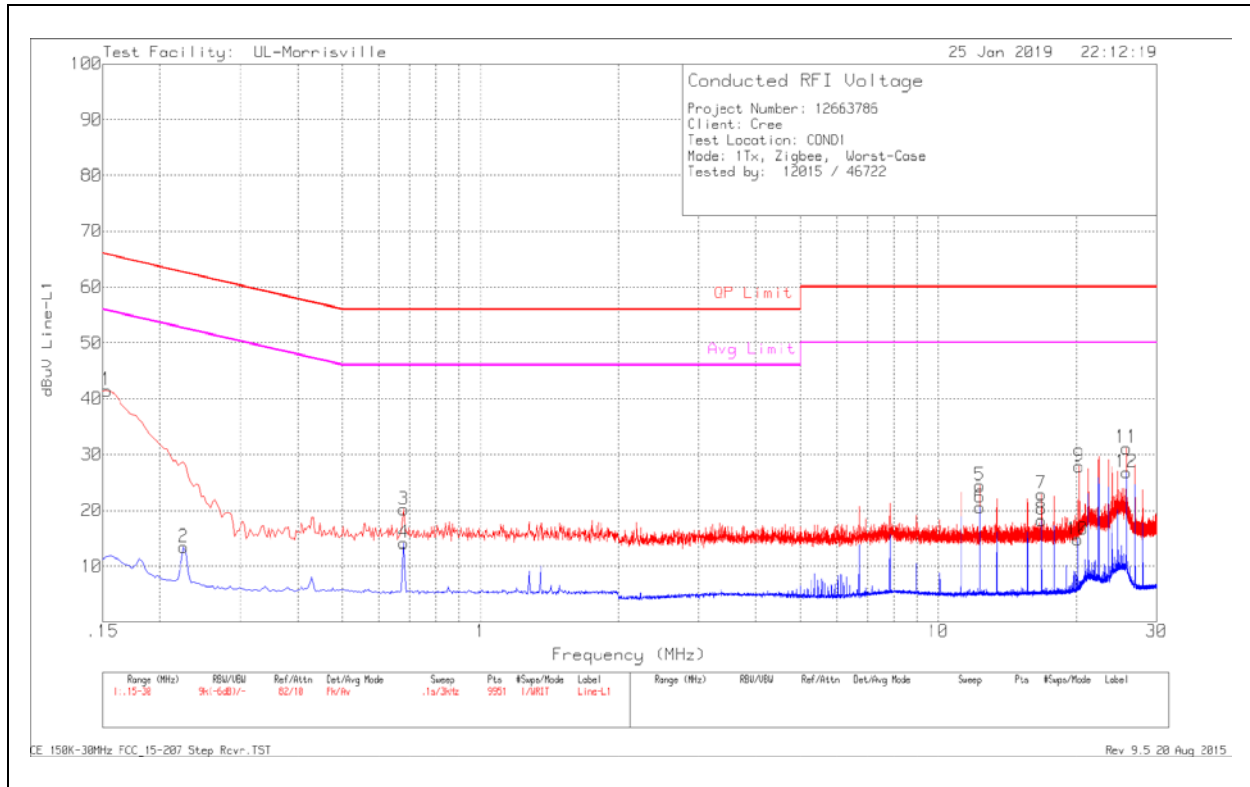
Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.

RESULTS

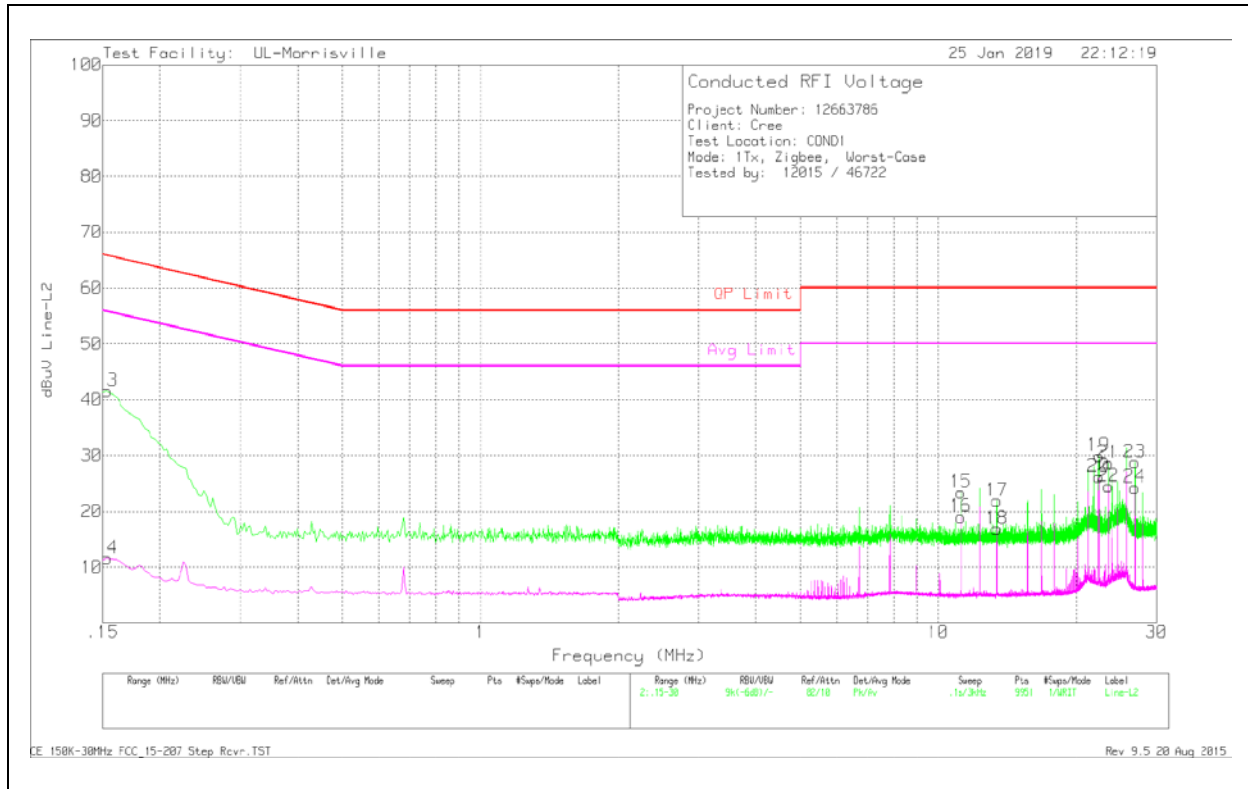
10.1.1. AC Power Line Norm

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	Margin (dB)	Avg Limit	Margin (dB)
1	.153	31.31	Pk	.2	10	41.51	65.84	-24.33	-	-
2	.225	3.31	Av	.1	10	13.41	-	-	52.63	-39.22
3	.681	10.18	Pk	0	10	20.18	56	-35.82	-	-
4	.681	4.13	Av	0	10	14.13	-	-	46	-31.87
5	12.321	13.93	Pk	.1	10.4	24.43	60	-35.57	-	-
6	12.321	10.08	Av	.1	10.4	20.58	-	-	50	-29.42
7	16.806	12.35	Pk	.1	10.5	22.95	60	-37.05	-	-
8	16.8	7.68	Av	.1	10.5	18.28	-	-	50	-31.72
9	20.31	17.25	Pk	.2	10.5	27.95	60	-32.05	-	-
10	20.163	4.09	Av	.2	10.5	14.79	-	-	50	-35.21
11	25.761	20.28	Pk	.2	10.7	31.18	60	-28.82	-	-
12	25.764	15.94	Av	.2	10.7	26.84	-	-	50	-23.16

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	Margin (dB)	Avg Limit	Margin (dB)
13	.153	31.36	Pk	.2	10	41.56	65.84	-24.28	-	-
14	.153	1.35	Av	.2	10	11.55	-	-	55.84	-44.29
15	11.202	13.01	Pk	.1	10.3	23.41	60	-36.59	-	-
16	11.202	8.62	Av	.1	10.3	19.02	-	-	50	-30.98
17	13.44	11.43	Pk	.1	10.4	21.93	60	-38.07	-	-
18	13.44	6.34	Av	.1	10.4	16.84	-	-	50	-33.16
19	22.407	19.13	Pk	.2	10.6	29.93	60	-30.07	-	-
20	22.407	15.42	Av	.2	10.6	26.22	-	-	50	-23.78
21	23.523	17.84	Pk	.2	10.6	28.64	60	-31.36	-	-
22	23.523	13.69	Av	.2	10.6	24.49	-	-	50	-25.51
23	26.886	17.88	Pk	.2	10.7	28.78	60	-31.22	-	-
24	26.889	13.39	Av	.2	10.7	24.29	-	-	50	-25.71

11. SETUP PHOTOS

Please refer to R12663786-EP1 for setup photos

END OF TEST REPORT