CERTIFICATION TEST REPORT

Report Number. : R12935938-E1

Applicant	:	Microsoft Corporation One Microsoft Way Redmond, WA 98052-6399 USA
Model	:	1868
FCC ID	:	C3K1868
IC	:	3048A-1868
EUT Description	:	Portable Computing Device
Test Standard(s)	:	FCC 47 CFR PART 15 SUBPART C ISED RSS-247 ISSUE 2 ISED RSS-GEN ISSUE 5

Date Of Issue:
2019-09-16

Prepared by:
UL LLC
12 Laboratory Dr.
Research Triangle Park, NC 27709 U.S.A.
TEL: (919) 549-1400

NVLAP TESTING

NVLAP Lab code: 200246-0

REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	--	Initial Issue	
2	2019-09-10	Added AC power adaptor to support equipment. Revised 99%BW results in Section 9.2. Added model similarity explanation to Section 4.	Brian T. Kiewra
3	2019-09-16	Revised test date range in Section 1.	Brian T. Kiewra

UL LLC
12 Laboratory Dr., RTP, NC 27709; USA TEL:(919) 549-1400

TABLE OF CONTENTS

UL LLC
12 Laboratory Dr., RTP, NC 27709; USA TEL:(919) 549-1400

1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Microsoft Corporation
One Microsoft Way
Redmond, WA 98052-6399
USA

EUT DESCRIPTION: Portable Computing Device

MODEL: 1868

SERIAL NUMBER: See section 6.4

DATE TESTED: 2019-07-17 to 2019-09-10

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

UL 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.

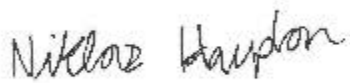
This document may not be altered or revised in any way unless done so by UL LLC and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL LLC will constitute fraud and shall nullify the document. This report must not be used by the client to claim 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
Consumer Technology Division
UL LLC

Brian T. Kiewra
Project Engineer
Consumer Technology Division
UL LLC

Prepared By:



Niklas Haydon
Engineer
Consumer Technology Division
UL LLC

UL LLC
12 Laboratory Dr., RTP, NC 27709; USA TEL:(919) 549-1400

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, ANSI C63.10-2013, KDB 558074 D01 15.247 Meas Guidance v05r02, 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 Perimeter Park Dr. Suite B, 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 Perimeter Park Dr. Suite B
ISED Site Code: 2180C	
☐ Chamber A	☒ Chamber North
☐ Chamber C	☒ Chamber South

The above test sites and facilities are covered under FCC Test Firm Registration # 703469. Chambers above are covered under Industry Canada company address and respective code.

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

4. SCOPE OF REPORT

This test report covers the radiated emissions, antenna port conducted emissions, and AC power line conducted emissions data for model 1868. Antenna port conducted emissions data in this report is leveraged by model 1867. For model 1867, radiated emissions and AC power line conducted emissions can be found in UL report number R12922855-E1.

Models 1867 and 1868 are electrically and RF equivalent as they use the same motherboard, radio module and on-board RF components. Both models share a common WiFi and BT power table. The radio-related firmware and driver versions are the same for the two models. The peak antenna gains are in the antenna gain section of the report. Antenna port conducted emissions measurements are done on model 1868 (FCC ID: C3K1868, IC: 3048A-1868) and the data is leveraged for model 1867 (FCC ID: C3K1867, IC: 3048A-1867). Highest antenna gain across the two models in each band has been considered while doing the conducted emissions measurements. Separate radiated & SAR measurements are done on each model.

5. CALIBRATION AND UNCERTAINTY

5.1. 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.

5.2. 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

5.3. 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%.

6. EQUIPMENT UNDER TEST

6.1. EUT DESCRIPTION

The EUT is a Portable Computing Device that contains 802.11 a/ac/ax/b/g/n 20/40/80/160MHz 2x2 dual band and BT/BLE radios.

6.2. MAXIMUM OUTPUT POWER

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

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
2402 - 2480	BLE	2.45	1.76

6.3. DESCRIPTION OF AVAILABLE ANTENNAS

Frequency Range (GHz)	Antenna Type	Peak Gain (dBi) Chain 0 (Right)	Peak Gain (dBi) Chain 1 (Left)
Model 1867			
2.4 to 2.48	PIFA	0.7	2.6
5.15 to 5.25		4.9	4.4
5.25 to 5.35		6.1	5.0
5.47 to 5.72		7.2	5.5
5.725 to 5.85		9.4	5.6
Model 1868			
2.4 to 2.48	PIFA	0.4	1.0
5.15 to 5.25		3.6	2.2
5.25 to 5.35		5.2	3.5
5.47 to 5.72		6.4	4.7
5.725 to 5.85		7.8	4.5

The BLE radio utilizes Chain 0.

UL LLC
12 Laboratory Dr., RTP, NC 27709; USA TEL:(919) 549-1400

6.4. SOFTWARE AND FIRMWARE

EUT	Serial Number	DRTU Version	OS Version	BT Driver Version	WiFi Driver Version	EUT's Power Supply (s/n)
R-557-1868-FCC-CONDUCTED-02	005210692757	11.1916.0 -09531	MTEOS 1.652.0	21.0.19157.20088	99.0.43.8	0D130P01P9596
R-557-1868-FCC-CONDUCTED-03	005216792757	11.1916.0 -09531	MTEOS 1.652.0	21.0.19157.20088	99.0.43.8	0D130P03GE596
R-557-1868-FCC-RADIATED-10	013886292757	11.1916.0 -09531	MTEOS 1.652.0	21.0.19157.20088	99.0.43.8	0D130P02KC596
R-557-1868-FCC-RADIATED-11	013891692757	11.1916.0 -09531	MTEOS 1.652.0	21.0.19157.20088	99.0.43.8	0D130P01S7596

6.5. WORST-CASE CONFIGURATION AND MODE

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

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

The EUT has one intended orientations, X; therefore, all final radiated testing was performed with the EUT in X orientation.

All radios that can transmit simultaneously have been evaluated for radiated for all possible combinations of transmission and found to be in compliance.

6.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
USB Hub	J5 Create	JCA374	AY2A1904000477 / AY6A1903004261	N/A
Earbuds	Sony	MDR-EX14AP	Non-serialized	N/A
USB Flash Drive	Kingston	DataTraveler G4	Non-serialized	N/A
AC power adaptor	Microsoft	1706	0D130P02KC596	N/A

I/O CABLES

I/O Cable List						
Cable No	**Port**	**# of identical ports**	**Connector Type**	**Cable Type**	**Cable Length (m)**	**Remarks**
1	Mains	1	12-pin	Mains	<3	None
2	USB-A	1	USB-A	USB	<3	None
3	USB-C	1	USB-C	USB	<3	None
4	Aux	1	Aux	Aux	<3	None

TEST SETUP

The test utility software was located on the EUT during the tests and was used to exercised the radios.

SETUP DIAGRAMS

Please refer to R12935938-EP1 for setup diagrams

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 Method PKPM1 Peak-reading power meter

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

Conducted emissions non-restricted frequency bands: ANSI C63.10 Subclause -11.11, 6.10.4

Radiated emissions restricted frequency bands: ANSI C63.10 Subclause -11.12.1, 6.10.5

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

Radiated Emissions Requirements: ANSI C63.10-2013 Section 6.3-6.6

UL LLC
12 Laboratory Dr., RTP, NC 27709; USA TEL:(919) 549-1400

8. 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)

Equip. ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
	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-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	2019-02-28	2020-02-28
SA0027 (18-40GHz RSE)	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

NOTES:

1. For equipment listed above that was calibrated during the testing period, please note the equipment was used for testing after calibration.
2. For equipment listed above that has a calibration due date during the testing period, the testing was completed before the equipment expiration date.

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 161016511	Environmental Meter	Fisher Scientific	14-650-118	2018-09-04	2020-09-04
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
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
PS215	AC Power Source	Elgar	CW2501M (s/n 1523A02397)	NA	NA
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA

NOTES:

1. For equipment listed above that was calibrated during the testing period, please note the equipment was used for testing after calibration.
2. For equipment listed above that has a calibration due date during the testing period, the testing was completed before the equipment expiration date.

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

Equip. ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
	0.009-30MHz	**(Loop Ant.)**			
AT0059	Active Loop Antenna	ETS-Lindgren	6502	2018-07-20	2019-07-31
	30-1000 MHz				
AT0073	Hybrid Broadband Antenna	Sunol Sciences Corp.	JB3	2018-08-06	2019-08-31
	Gain-Loss Chains				
N-SAC01	Gain-loss string: 0.009-30MHz	Various	Various	2019-05-02	2020-05-02
N-SAC02	Gain-loss string: 25-1000MHz	Various	Various	2019-05-02	2020-05-02
	Receiver & Software				
SA0026	Spectrum Analyzer	Agilent	N9030A	2019-03-19	2020-03-19
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA
	Additional Equipment used				
s/n 181474341	Environmental Meter	Fisher Scientific	15-077-963	2018-07-27	2020-07-27

NOTES:

1. For equipment listed above that was calibrated during the testing period, please note the equipment was used for testing after calibration.
2. For equipment listed above that has a calibration due date during the testing period, the testing was completed before the equipment expiration date.

Test Equipment Used – Antenna Port Conducted Testing (Morrisville – RP)

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
SA0027	PXA Signal Analyzer	Keysight Technologies	MY54490254	2019-05-15	2020-05-15
s/n 160938893	Environmental Meter	Fisher Scientific	14-650-118	2019-06-17	2020-06-17
224604-002	Coaxial Testing Cable	Uti-flex	UFA147A-0-0180-200200	NA	NA
Antenna Port	Antenna Port Software	Antenna	Version 10.0.1	NA	NA
126431 (PRE0128068)	RF Power Meter	Anritsu	ML2495A	2019-04-30	2020-04-30
126430 (PRE0128067)	Pulse Power Sensor, 300MHz to 40GHz	Anritsu	MA2411B	2019-04-30	2020-04-30
PWM001 (PRE0136343)	RF Power Meter	Keysight Technologies	N1912A	2019-06-14	2020-06-14
PWS001 (PRE0137347)	Peak and Avg Power Sensor, 50MHz to 18GHz	Keysight Technologies	N1921A	2019-05-06	2020-05-06

NOTES:

1. For equipment listed above that was calibrated during the testing period, please note the equipment was used for testing after calibration.
2. For equipment listed above that has a calibration due date during the testing period, the testing was completed before the equipment expiration date.

9. ANTENNA PORT TEST RESULTS

9.1. ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

PROCEDURE

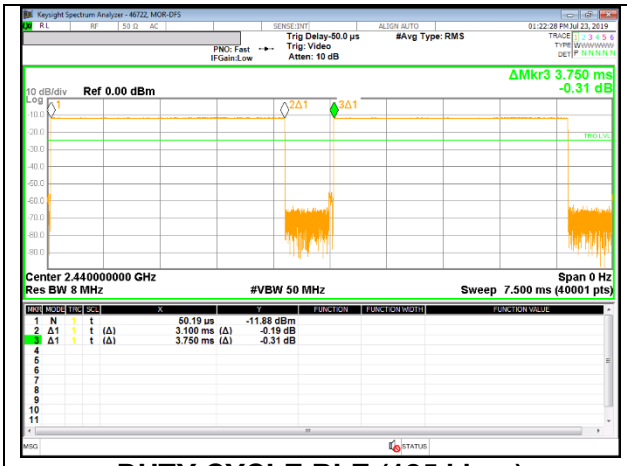
KDB 558074 Zero-Span Spectrum Analyzer Method.

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 (125 kbps)	3.100	3.750	0.827	82.67%	0.83	0.323
BLE (500 kbps)	1.067	1.875	0.569	56.91%	2.45	0.937
BLE (1 Mbps)	0.388	0.625	0.621	62.12%	2.07	2.575
BLE (2 Mbps)	0.206	0.625	0.329	32.91%	4.83	4.861

UL LLC
12 Laboratory Dr., RTP, NC 27709; USA TEL:(919) 549-1400

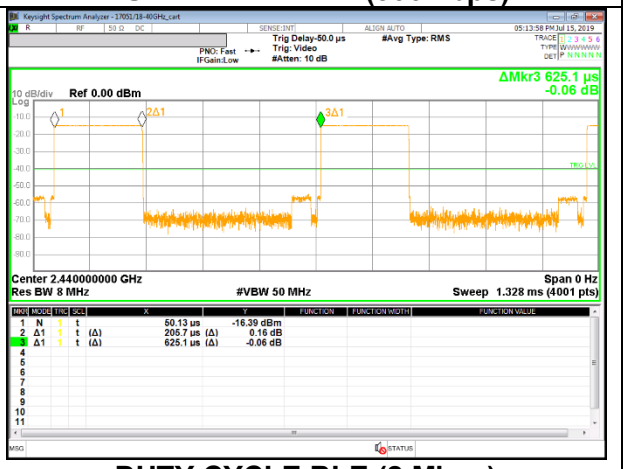
DUTY CYCLE PLOTS



DUTY CYCLE BLE (125 kbps)

DUTY CYCLE BLE (500 kbps)

DUTY CYCLE BLE (1 Mbps)



DUTY CYCLE BLE (2 Mbps)

9.2. 99% BANDWIDTH

LIMITS

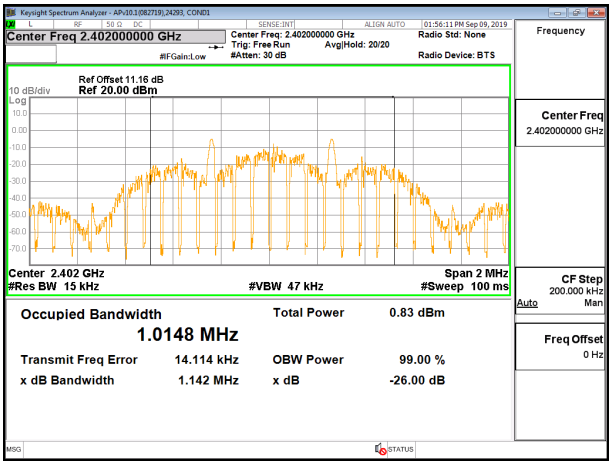
None; for reporting purposes only.

RESULTS

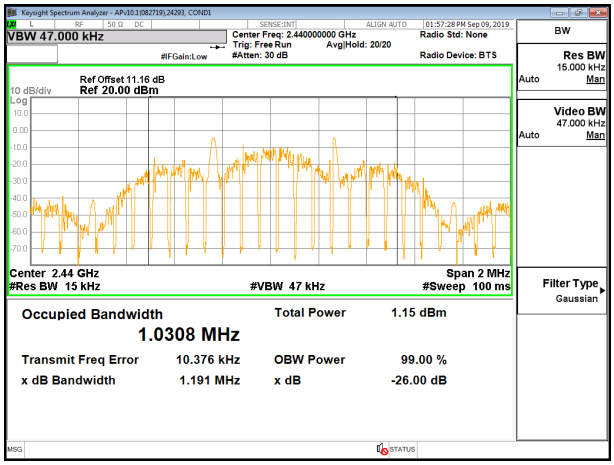
UL LLC
12 Laboratory Dr., RTP, NC 27709; USA TEL:(919) 549-1400

9.2.1. BLE (125 kbps)

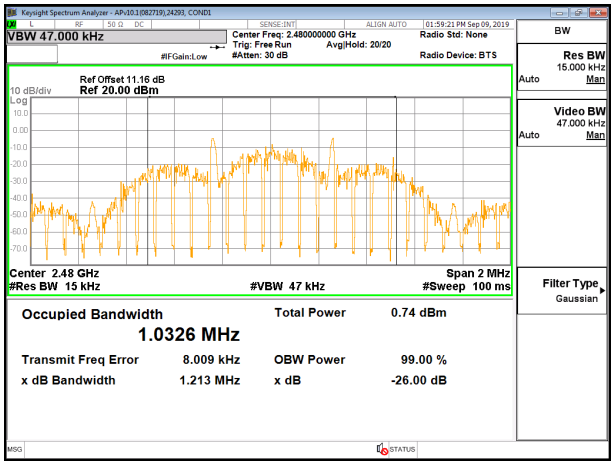
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	1.0148
Middle	2440	1.0308
High	2480	1.0326



LOW CHANNEL



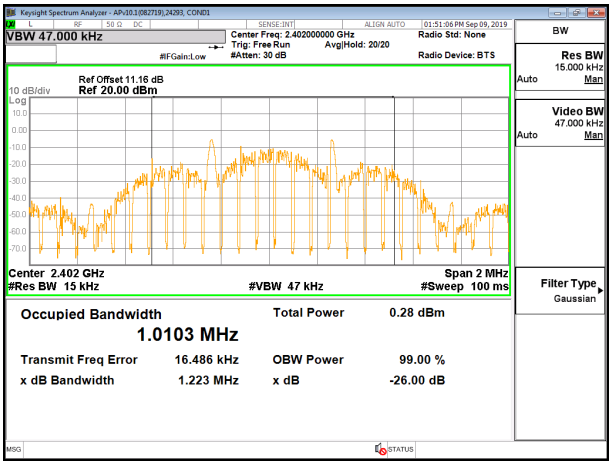
MID CHANNEL



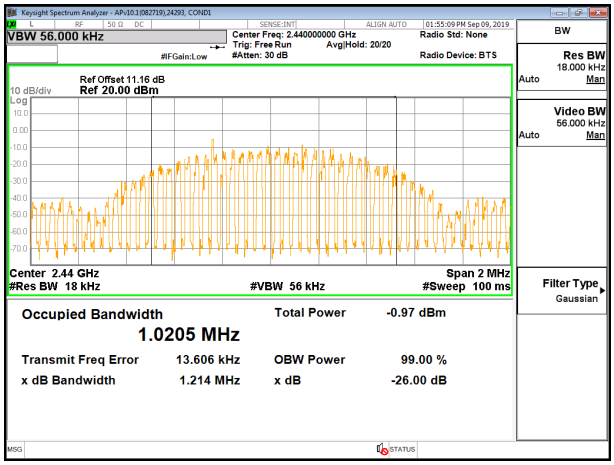
HIGH CHANNEL

9.2.2. BLE (500 kbps)

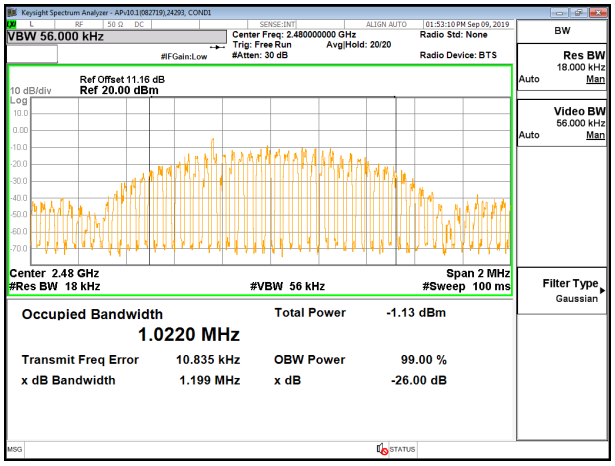
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	1.0103
Middle	2440	1.0205
High	2480	1.0220



LOW CHANNEL



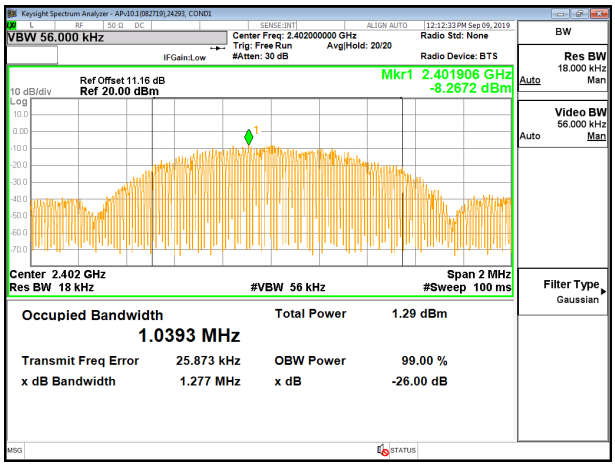
MID CHANNEL



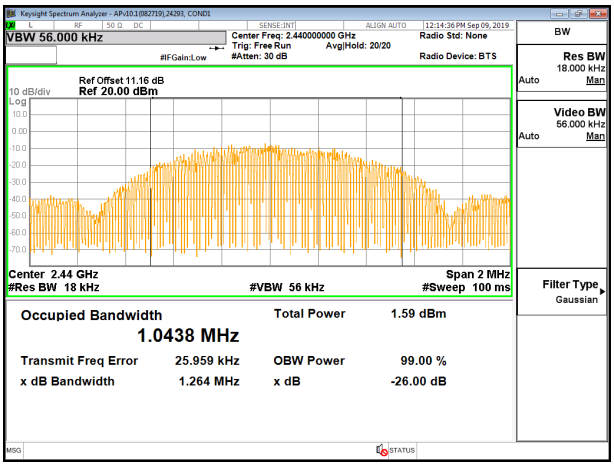
HIGH CHANNEL

9.2.3. BLE (1Mbps)

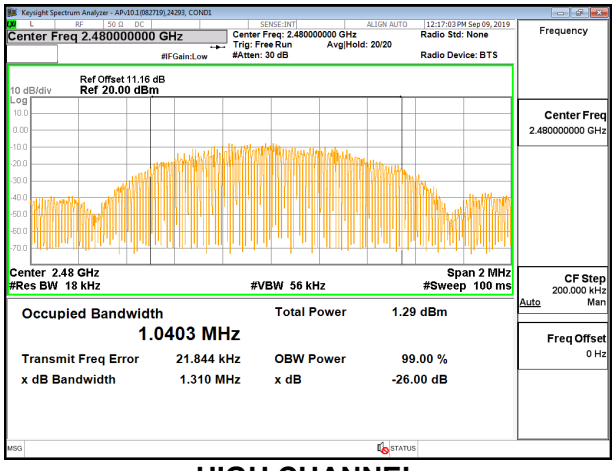
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	1.0393
Middle	2440	1.0438
High	2480	1.0403



LOW CHANNEL



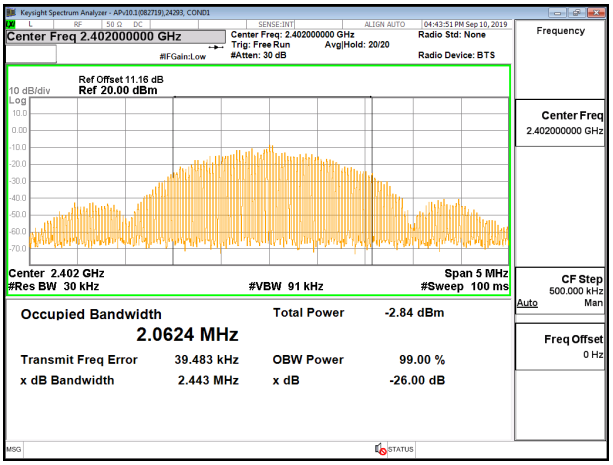
MID CHANNEL



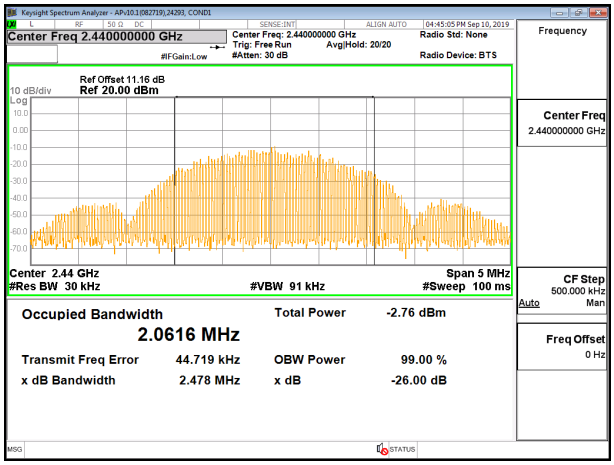
HIGH CHANNEL

9.2.4. BLE (2Mbps)

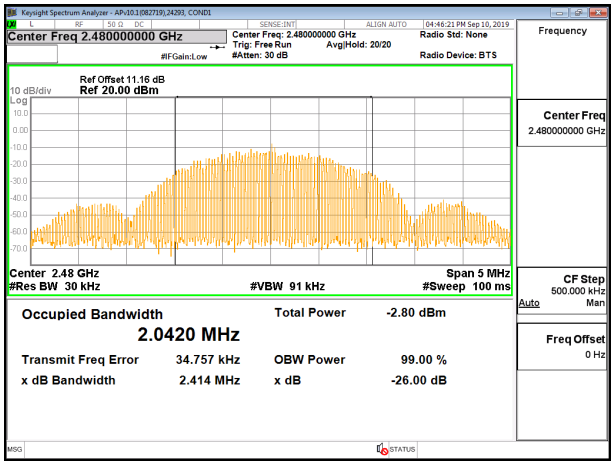
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	2.0624
Middle	2440	2.0616
High	2480	2.0420



LOW CHANNEL



MID CHANNEL



HIGH CHANNEL

9.3. 6 dB BANDWIDTH

LIMITS

FCC §15.247 (a) (2)

RSS-247 5.2 (a)

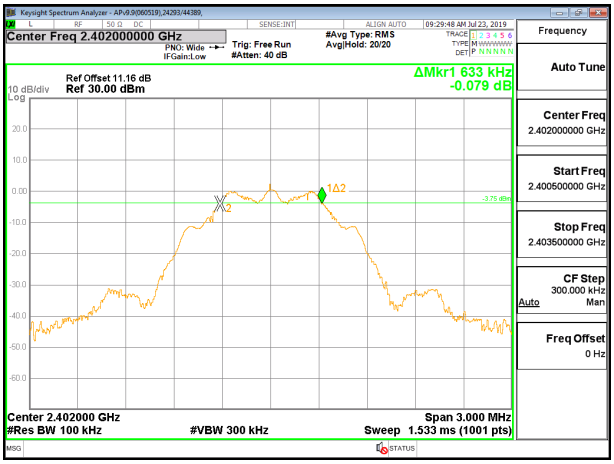
The minimum 6 dB bandwidth shall be at least 500 kHz.

RESULTS

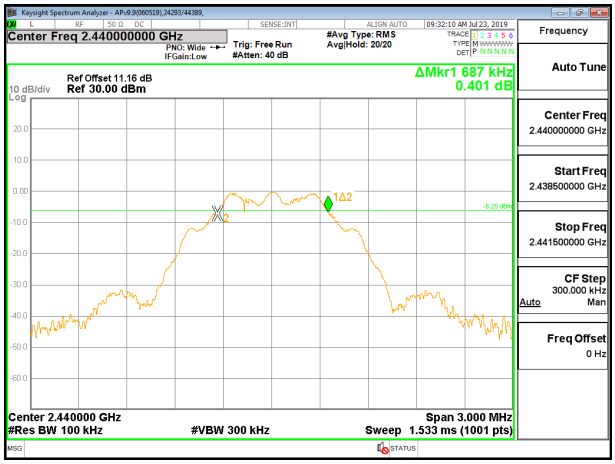
UL LLC
12 Laboratory Dr., RTP, NC 27709; USA TEL:(919) 549-1400

9.3.1. BLE (125 kbps)

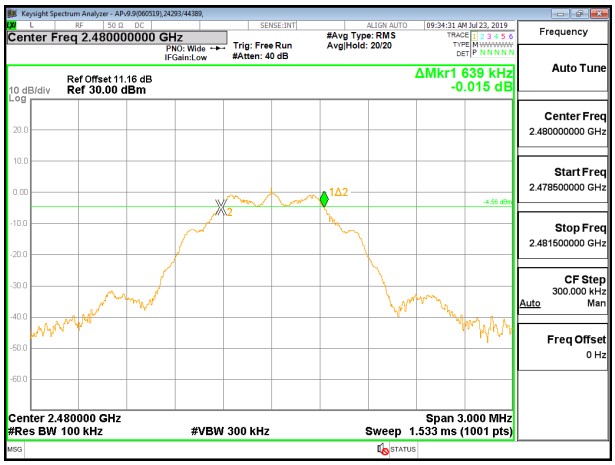
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2402	0.6330	0.5
Middle	2440	0.6870	0.5
High	2480	0.6390	0.5



LOW CHANNEL



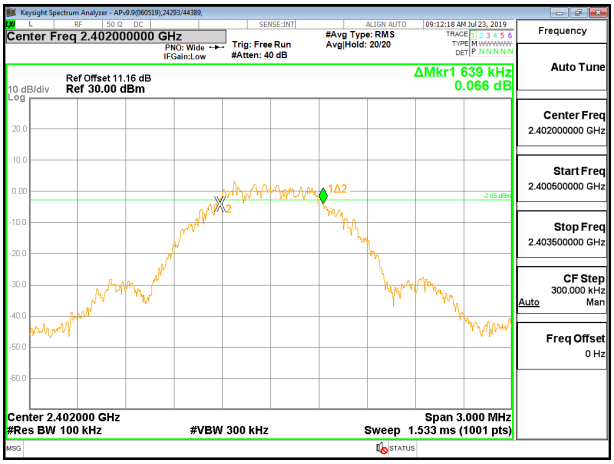
MID CHANNEL



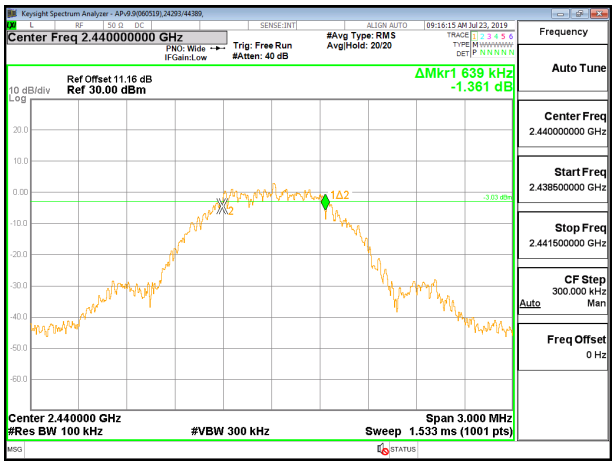
HIGH CHANNEL

9.3.2. BLE (500 kbps)

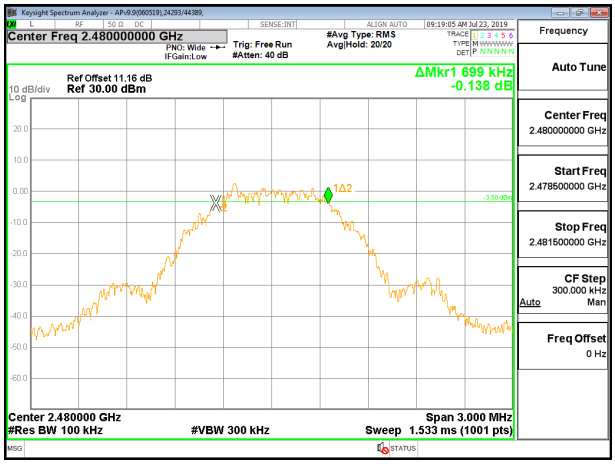
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2402	0.6390	0.5
Middle	2440	0.6390	0.5
High	2480	0.6990	0.5



LOW CHANNEL



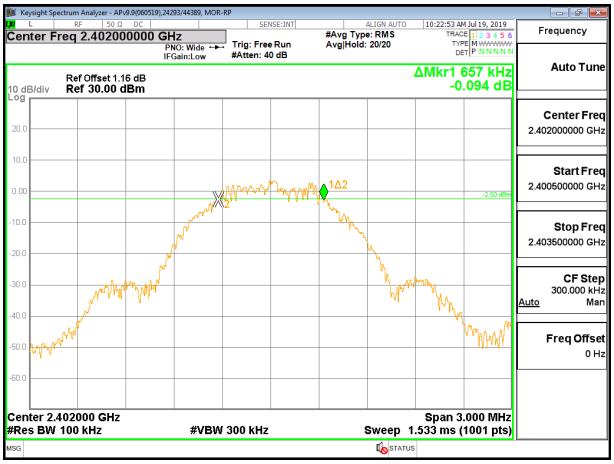
MID CHANNEL



HIGH CHANNEL

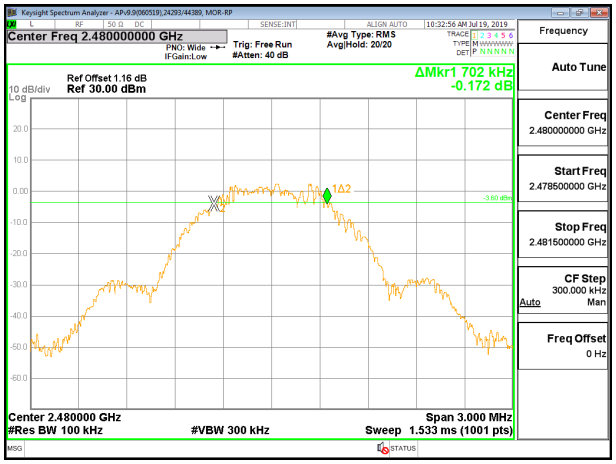
9.3.3. BLE (1Mbps)

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2402	0.6570	0.5
Middle	2440	0.6900	0.5
High	2480	0.7020	0.5



LOW CHANNEL

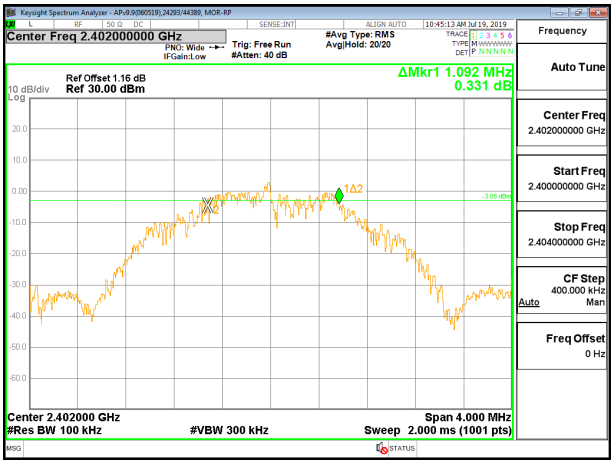
MID CHANNEL



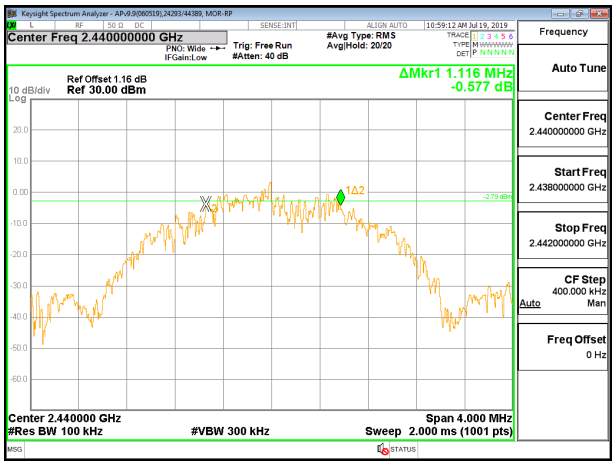
HIGH CHANNEL

9.3.4. BLE (2Mbps)

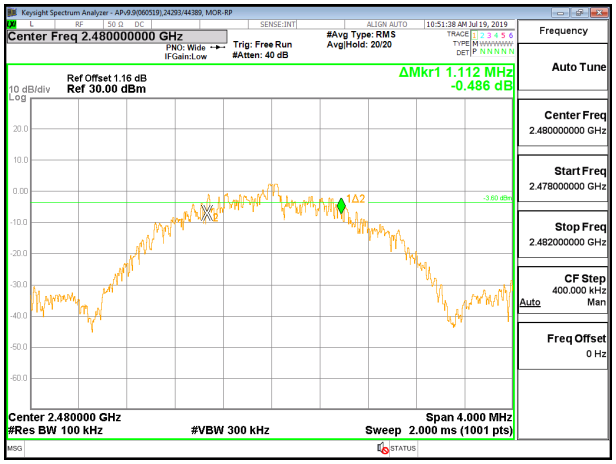
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2402	1.0920	0.5
Middle	2440	1.1160	0.5
High	2480	1.1120	0.5



LOW CHANNEL



MID CHANNEL



HIGH CHANNEL

9.4. 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 10.7 dB (including 10 dB pad and 0.7 dB cable) was entered as an offset in the power meter to allow for a peak reading of power.

RESULTS

UL LLC
12 Laboratory Dr., RTP, NC 27709; USA TEL:(919) 549-1400

9.4.1. BLE (125 kbps)

Tested By:	11993
Date:	2019-08-22

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	2.35	30	-27.650
Middle	2440	2.29	30	-27.710
High	2480	2.40	30	-27.600

9.4.2. BLE (500 kbps)

Tested By:	11993
Date:	2019-08-22

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	2.36	30	-27.640
Middle	2440	2.14	30	-27.860
High	2480	2.45	30	-27.550

9.4.3. BLE (1Mbps)

Tested By:	11993
Date:	2019-08-22

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	2.38	30	-27.620
Middle	2440	2.34	30	-27.660
High	2480	2.09	30	-27.910

9.4.4. BLE (2Mbps)

Tested By:	11993
Date:	2019-08-22

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	2.35	30	-27.650
Middle	2440	2.15	30	-27.850
High	2480	2.07	30	-27.930

UL LLC
12 Laboratory Dr., RTP, NC 27709; USA TEL:(919) 549-1400

9.5. 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 10.7 dB (including 10 dB pad and 0.7 dB cable) was entered as an offset in the power meter to allow for a gated average reading of power.

RESULTS

UL LLC
12 Laboratory Dr., RTP, NC 27709; USA TEL:(919) 549-1400

9.5.1. BLE (125 kbps)

Tested By:	11993
Date:	2019-08-22

Channel	Frequency (MHz)	AV power (dBm)
Low	2402	2.05
Middle	2440	2.00
High	2480	1.94

UL LLC
12 Laboratory Dr., RTP, NC 27709; USA TEL:(919) 549-1400

9.5.2. BLE (500 kbps)

Tested By:	11993
Date:	2019-08-22

Channel	Frequency (MHz)	AV power (dBm)
Low	2402	2.09
Middle	2440	1.92
High	2480	2.13

UL LLC
12 Laboratory Dr., RTP, NC 27709; USA TEL:(919) 549-1400

9.5.3. BLE (1Mbps)

Tested By:	11993
Date:	2019-08-22

Channel	Frequency (MHz)	AV power (dBm)
Low	2402	2.17
Middle	2440	2.13
High	2480	1.87

9.5.4. BLE (2Mbps)

Tested By:	11993
Date:	2019-08-22

Channel	Frequency (MHz)	AV power (dBm)
Low	2402	2.16
Middle	2440	1.93
High	2480	1.88

UL LLC
12 Laboratory Dr., RTP, NC 27709; USA TEL:(919) 549-1400

9.6. POWER SPECTRAL DENSITY

LIMITS

FCC §15.247 (e)

RSS-247 (5.2) (b)

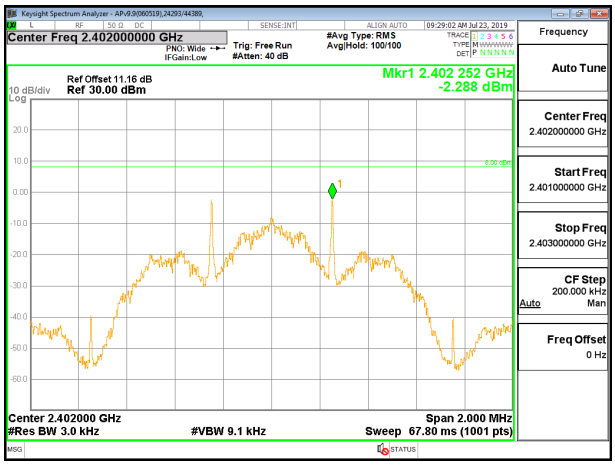
The power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

RESULTS

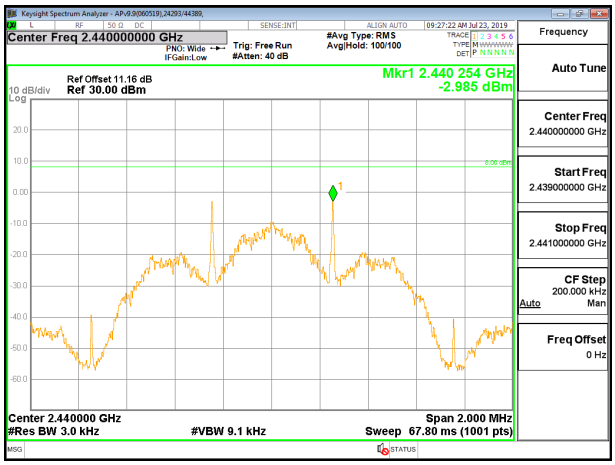
UL LLC
12 Laboratory Dr., RTP, NC 27709; USA TEL:(919) 549-1400

9.6.1. BLE (125 kbps)

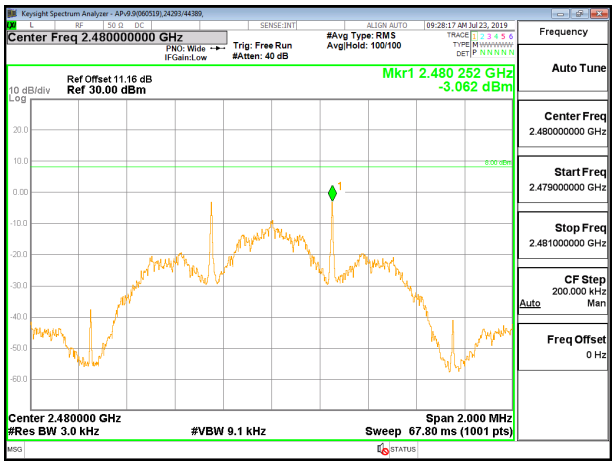
Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Low	2402	-2.29	8	-10.29
Middle	2440	-2.98	8	-10.98
High	2480	-3.06	8	-11.06



LOW CHANNEL



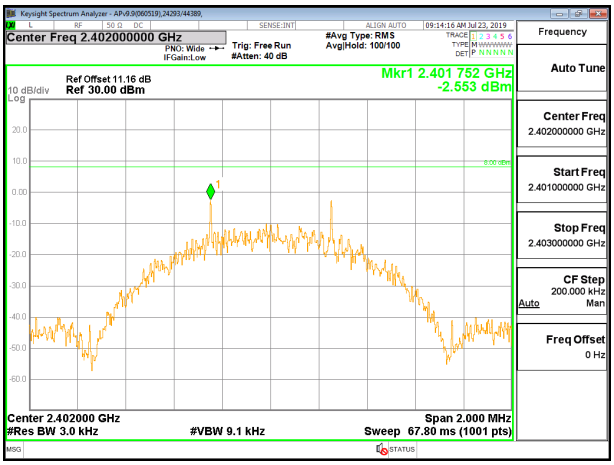
MID CHANNEL



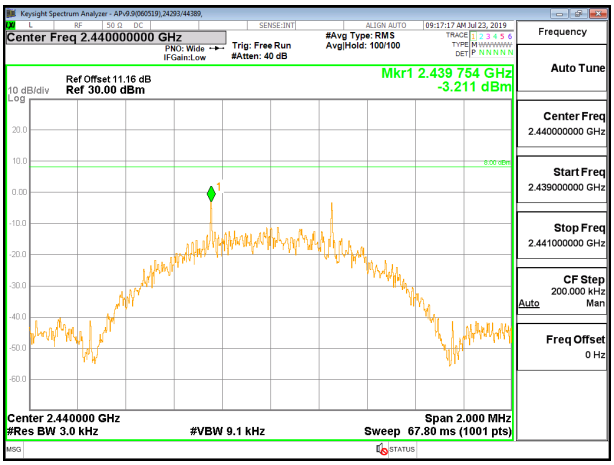
HIGH CHANNEL

9.6.2. BLE (500 kbps)

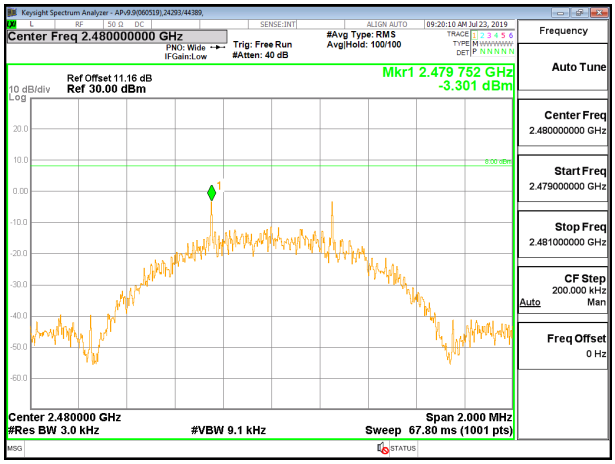
Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Low	2402	-2.55	8	-10.55
Middle	2440	-3.21	8	-11.21
High	2480	-3.30	8	-11.30



LOW CHANNEL



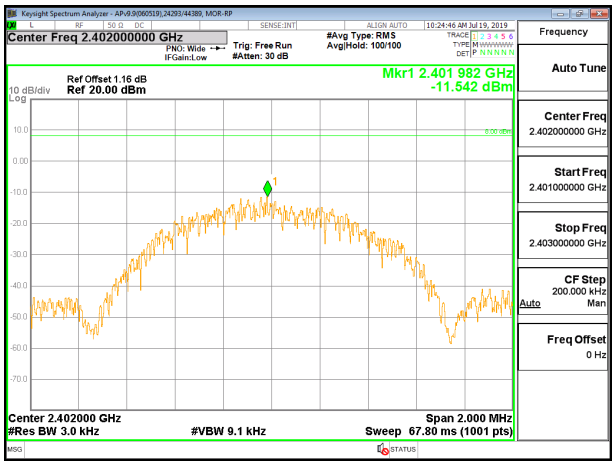
MID CHANNEL



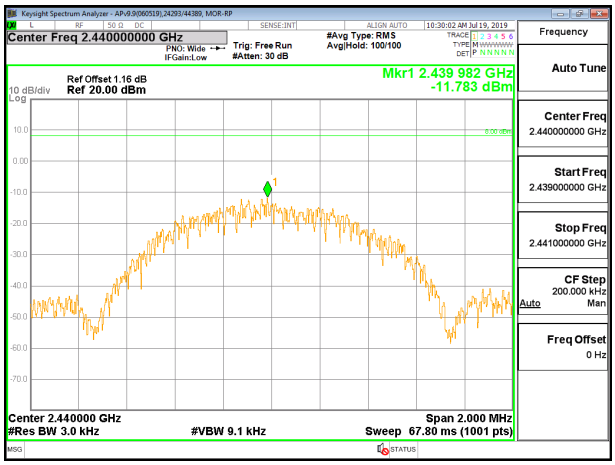
HIGH CHANNEL

9.6.3. BLE (1Mbps)

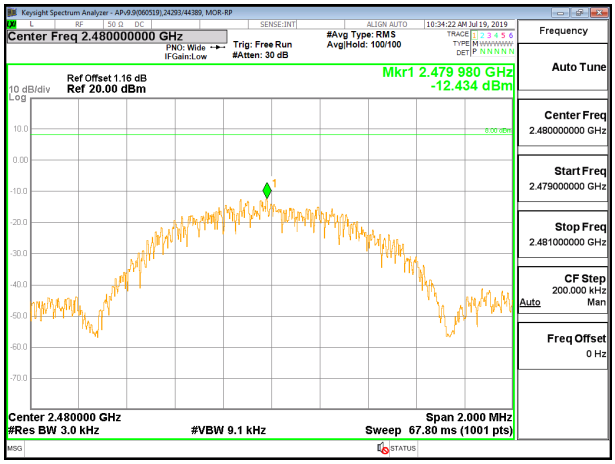
Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Low	2402	-11.54	8	-19.54
Middle	2440	-11.78	8	-19.78
High	2480	-12.43	8	-20.43



LOW CHANNEL



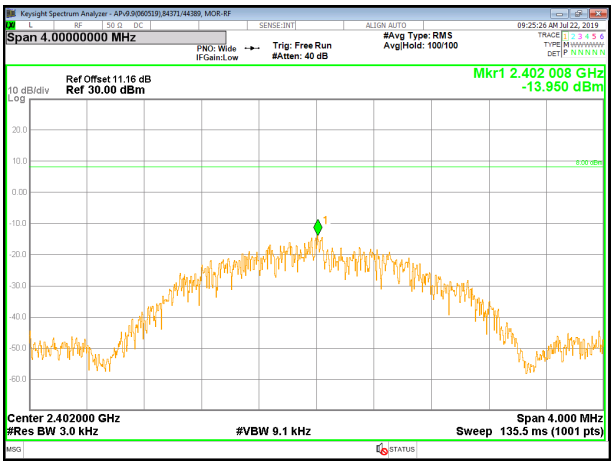
MID CHANNEL



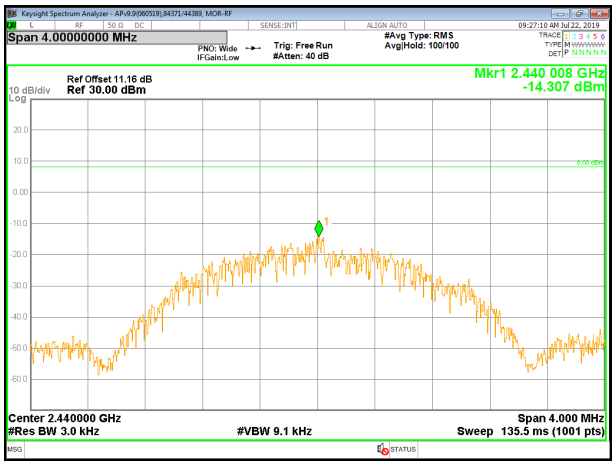
HIGH CHANNEL

9.6.4. BLE (2Mbps)

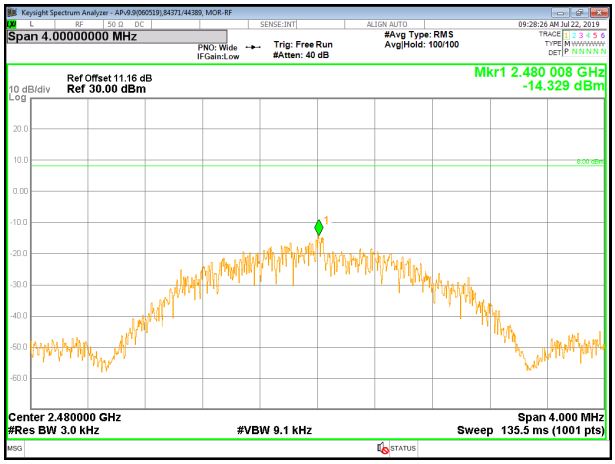
Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Low	2402	-13.95	8	-21.95
Middle	2440	-14.31	8	-22.31
High	2480	-14.33	8	-22.33



LOW CHANNEL



MID CHANNEL



HIGH CHANNEL

9.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

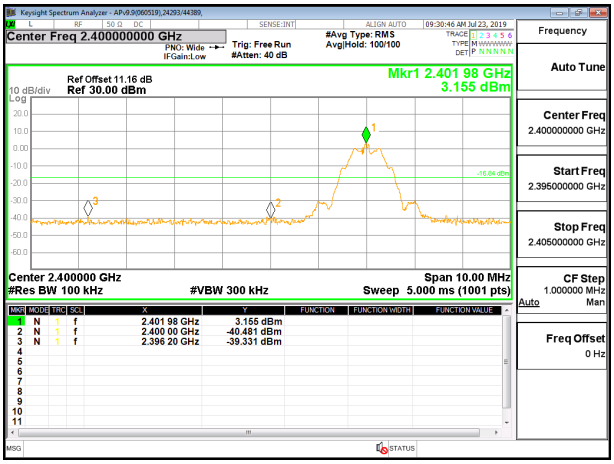
RSS-247 5.5

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

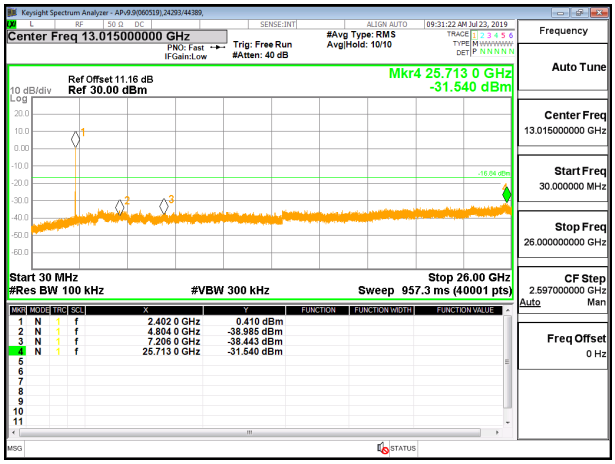
RESULTS

UL LLC
12 Laboratory Dr., RTP, NC 27709; USA TEL:(919) 549-1400

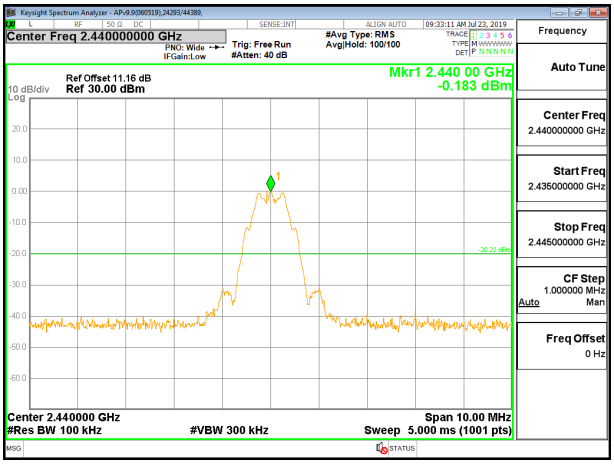
9.7.1. BLE (125 kbps)



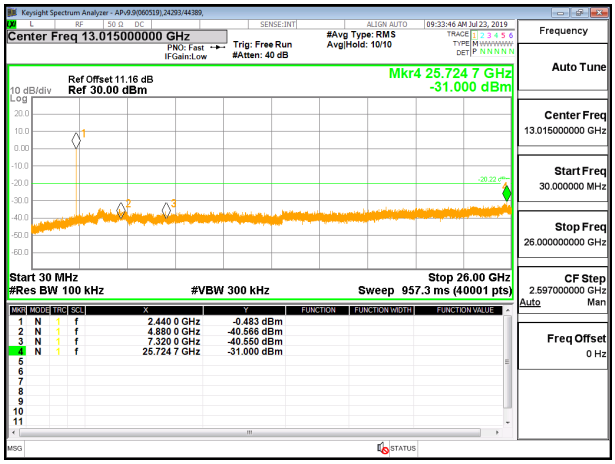
LOW CHANNEL BANDEDGE



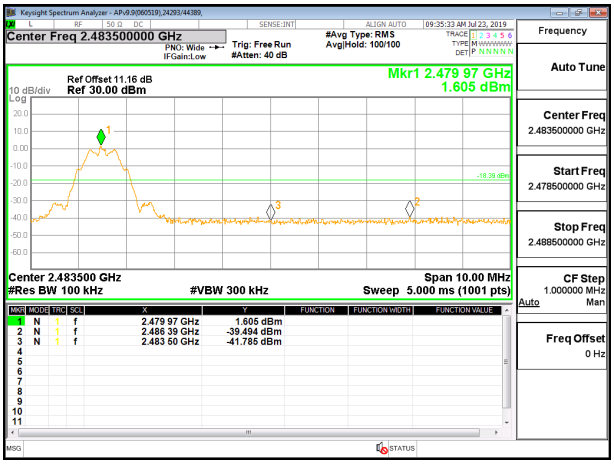
OUT-OF-BAND LOW CHANNEL



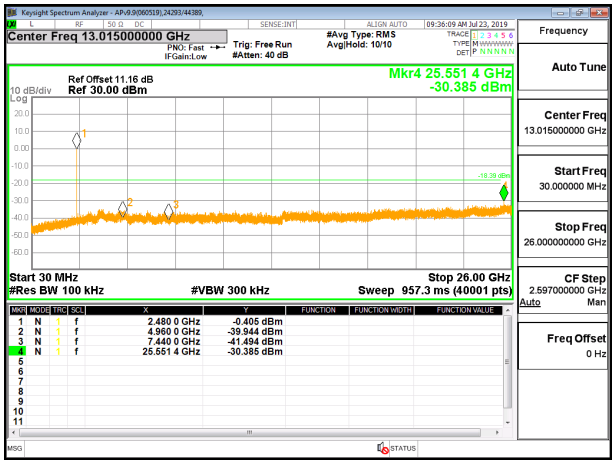
IN-BAND REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL

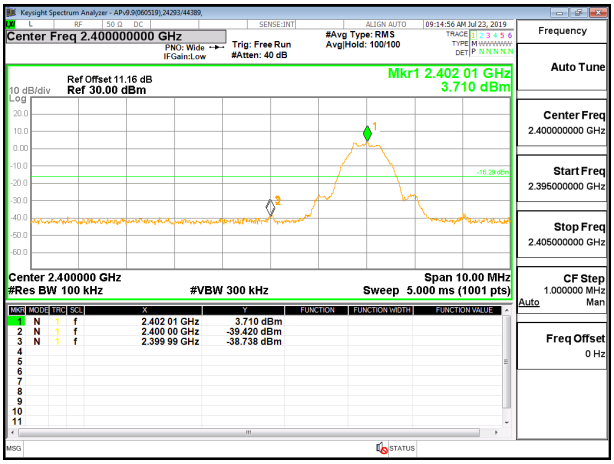


HIGH CHANNEL BANDEDGE

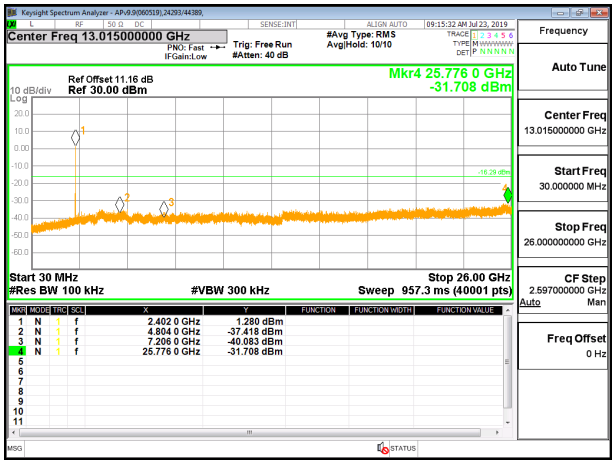


OUT-OF-BAND HIGH CHANNEL

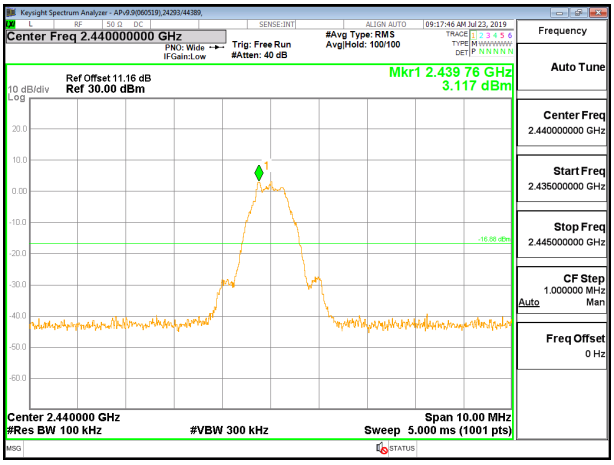
9.7.2. BLE (500 kbps)



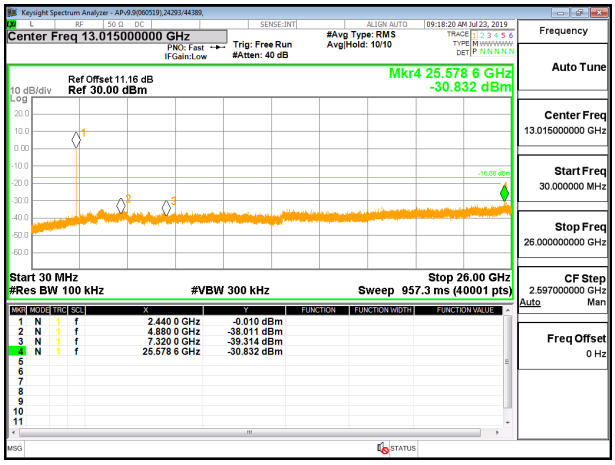
LOW CHANNEL BANDEDGE



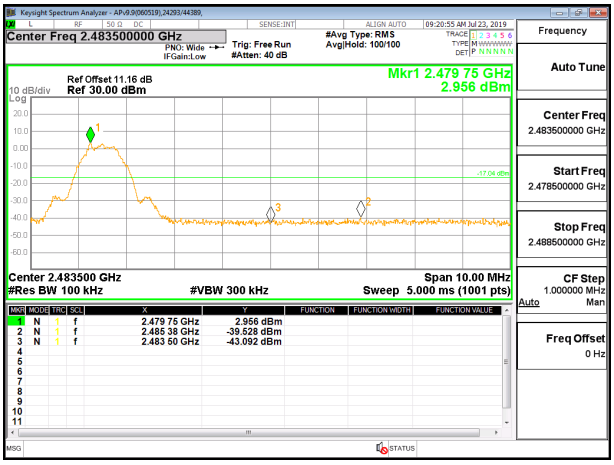
OUT-OF-BAND LOW CHANNEL



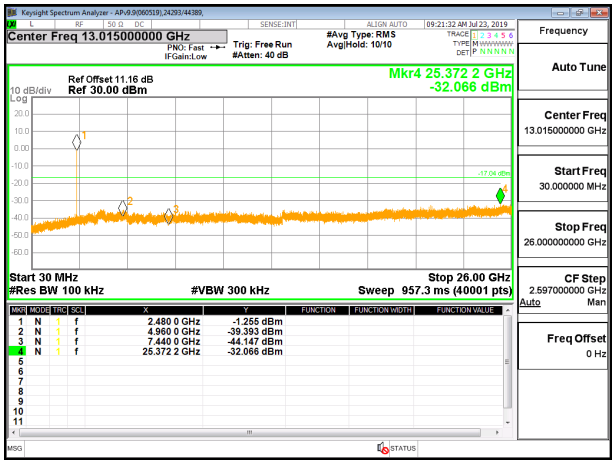
IN-BAND REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL

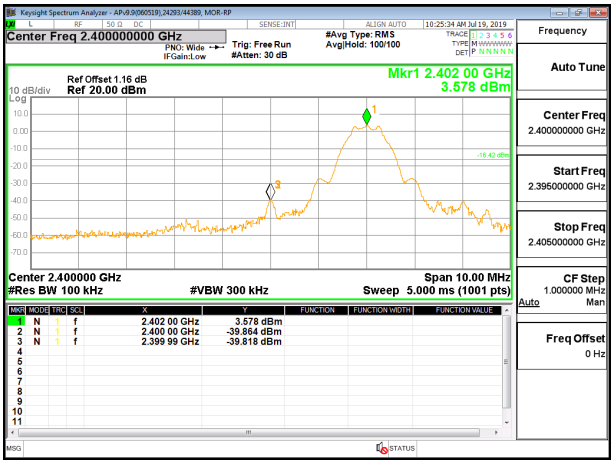


HIGH CHANNEL BANDEDGE

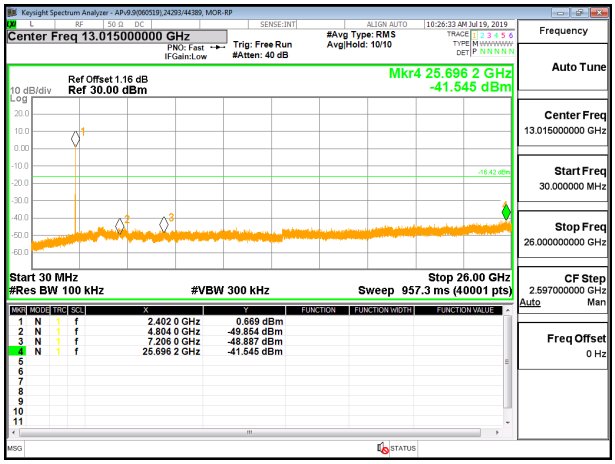


OUT-OF-BAND HIGH CHANNEL

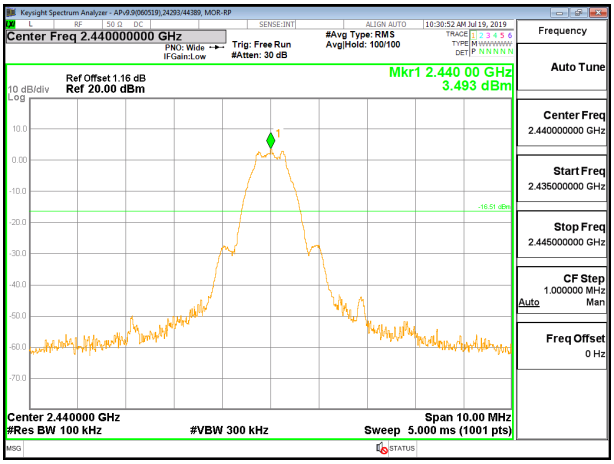
9.7.3. BLE (1Mbps)



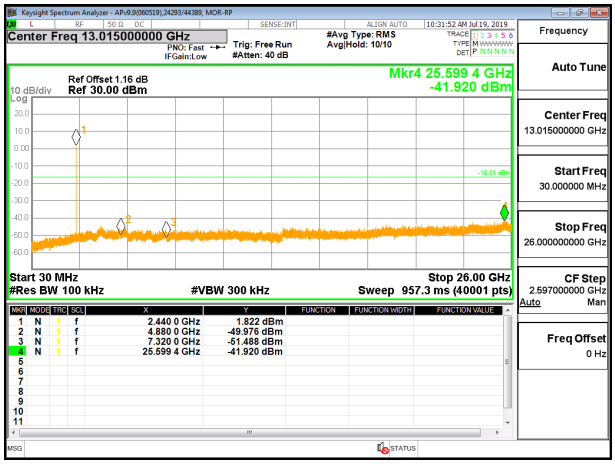
LOW CHANNEL BANDEDGE



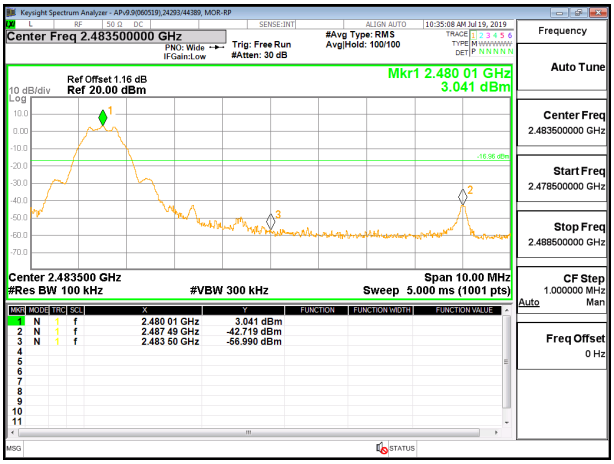
OUT-OF-BAND LOW CHANNEL



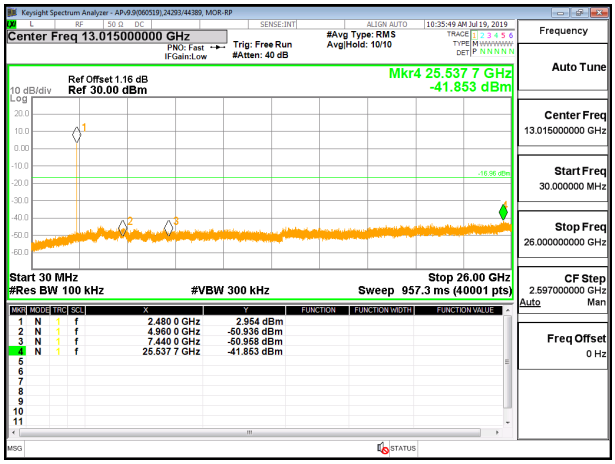
IN-BAND REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL

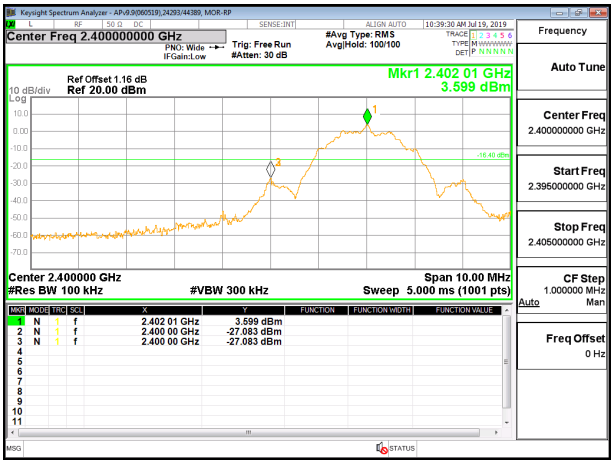


HIGH CHANNEL BANDEDGE

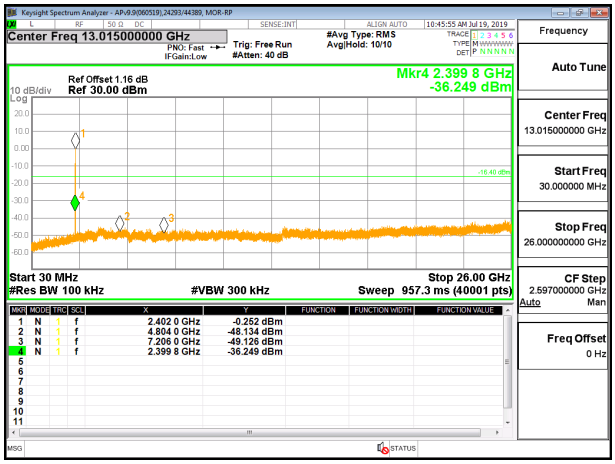


OUT-OF-BAND HIGH CHANNEL

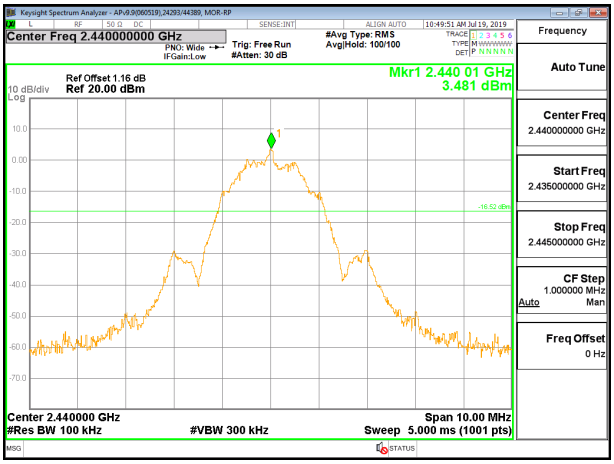
9.7.4. BLE (2Mbps)



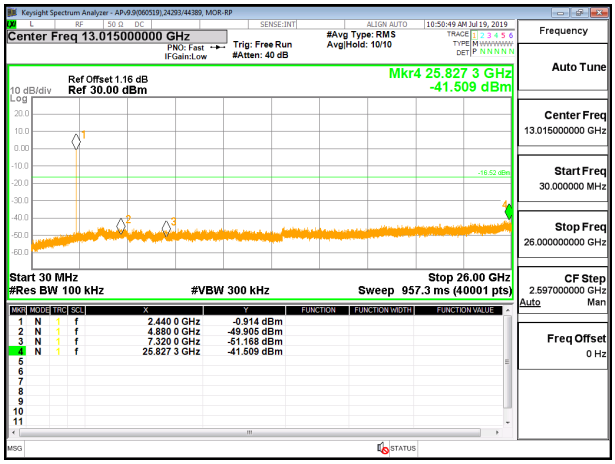
LOW CHANNEL BANDEDGE



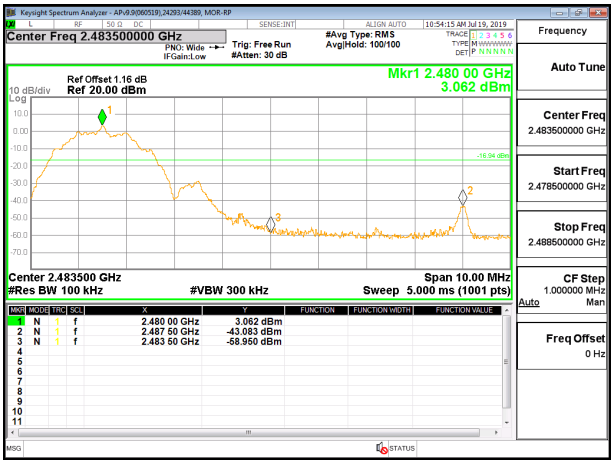
OUT-OF-BAND LOW CHANNEL



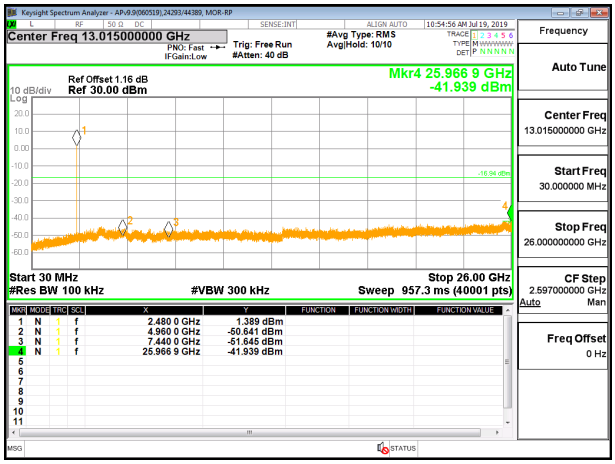
IN-BAND REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL



HIGH CHANNEL BANDEDGE



OUT-OF-BAND HIGH CHANNEL

10. RADIATED TEST RESULTS

10.1. 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 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.

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.

UL LLC
12 Laboratory Dr., RTP, NC 27709; USA TEL:(919) 549-1400

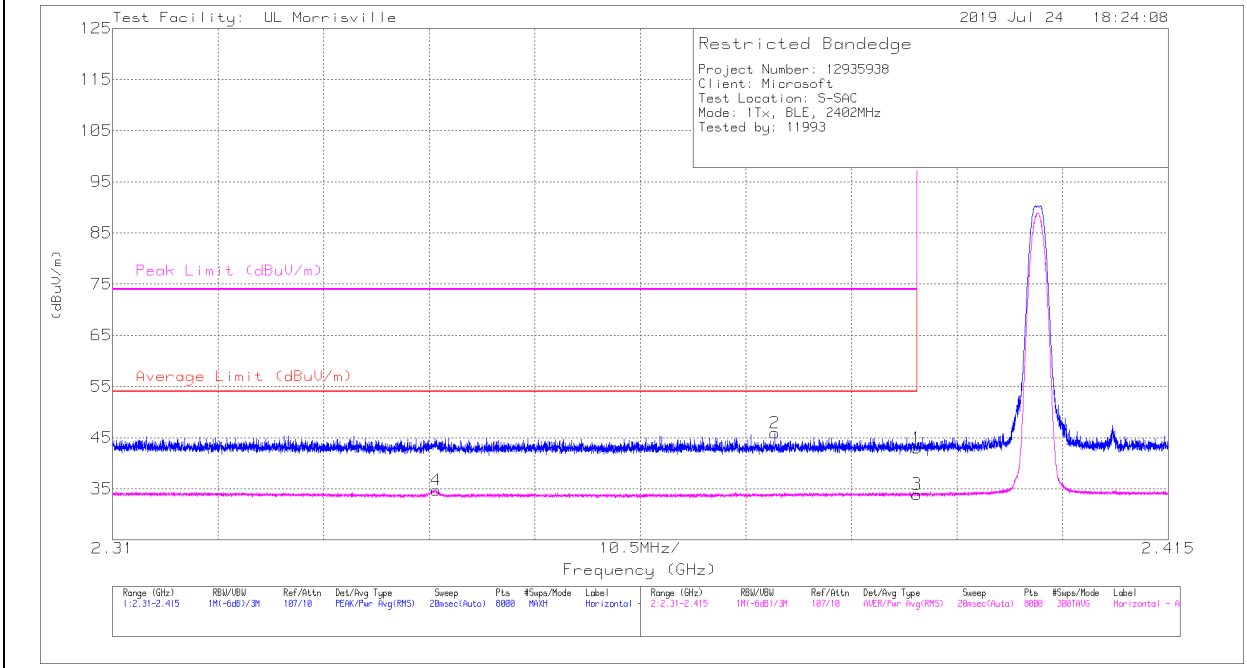
10.2. TRANSMITTER ABOVE 1 GHz

10.2.1. BLE (125 kbps)

Antenna 1

BANDEDGE (LOW CHANNEL)

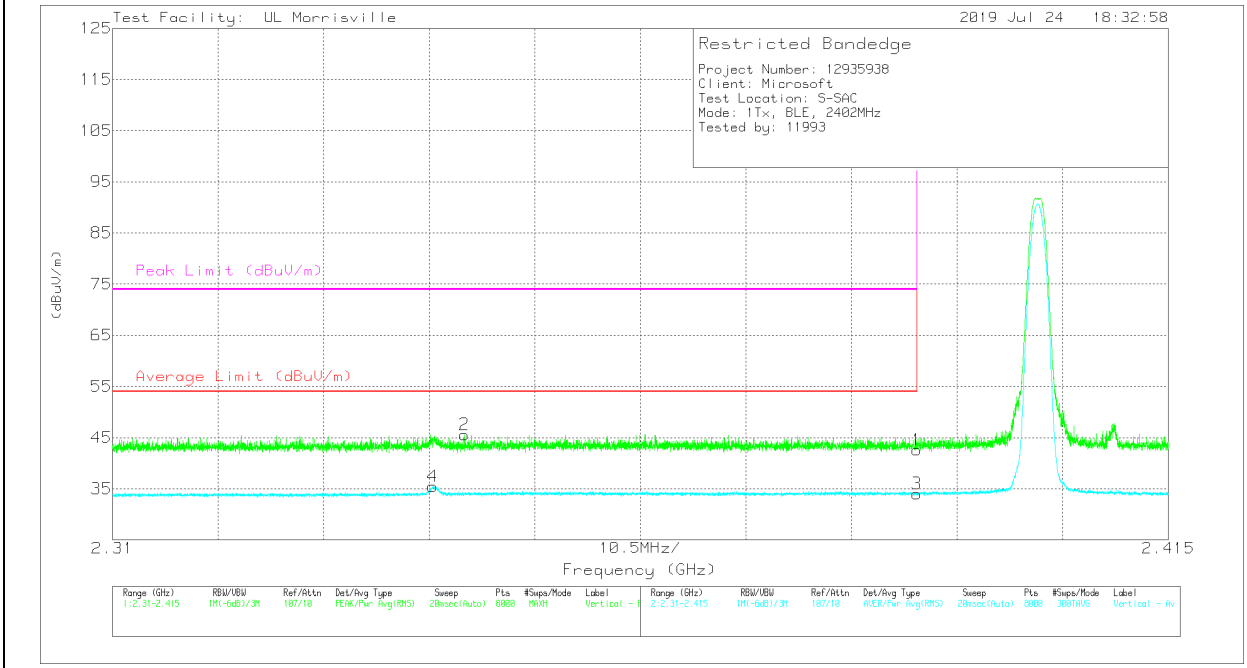
HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.39	35.04	Pk	31.9	-24	0	42.94	-	-	74	-31.06	270	387	H
2	* ** 2.37587	38.12	Pk	31.8	-24	0	45.92	-	-	74	-28.08	270	387	H
3	* ** 2.39	25.19	RMS	31.9	-24	.83	33.92	54	-20.08	-	-	270	387	H
4	* ** 2.34216	26.02	RMS	31.6	-23.7	.83	34.75	54	-19.25	-	-	270	387	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



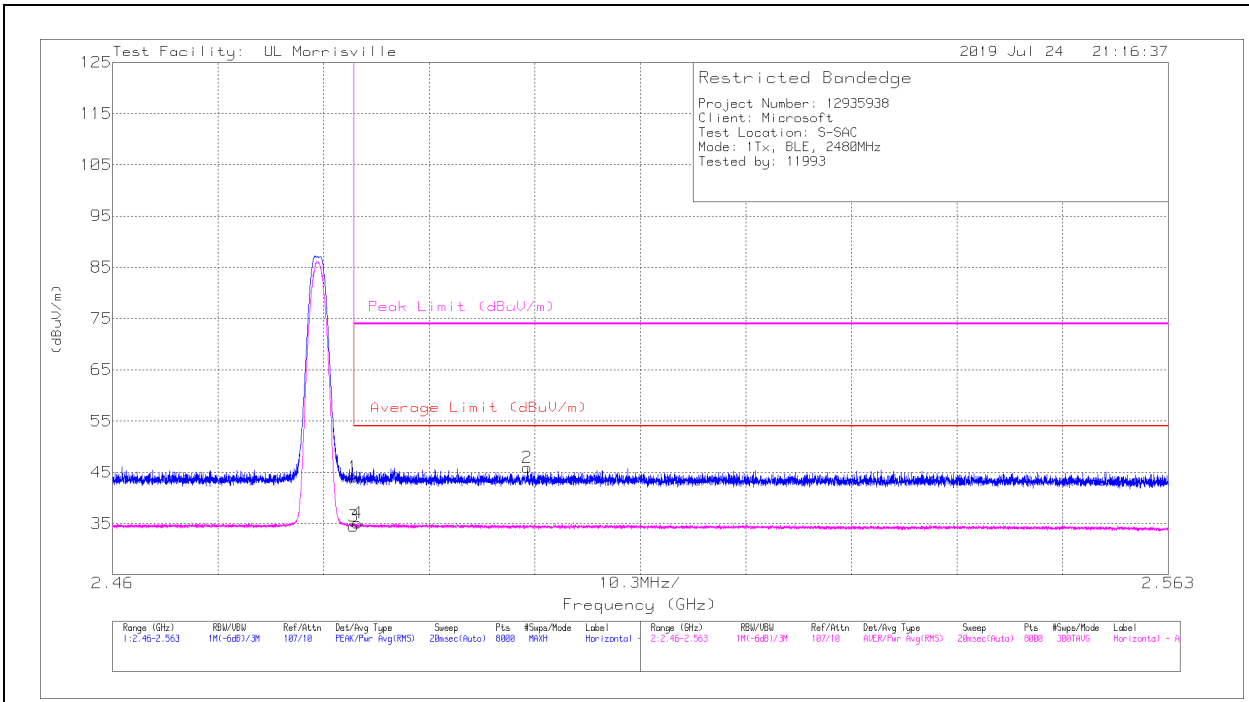
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.39	34.72	Pk	31.9	-24	0	42.62	-	-	74	-31.38	248	182	V
2	* ** 2.34501	37.69	Pk	31.6	-23.7	0	45.59	-	-	74	-28.41	248	182	V
3	* ** 2.39	25.3	RMS	31.9	-24	.83	34.03	54	-19.97	-	-	248	182	V
4	* ** 2.34183	26.76	RMS	31.6	-23.7	.83	35.49	54	-18.51	-	-	248	182	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

UL LLC
12 Laboratory Dr., RTP, NC 27709; USA TEL:(919) 549-1400

BANDEDGE (HIGH CHANNEL)

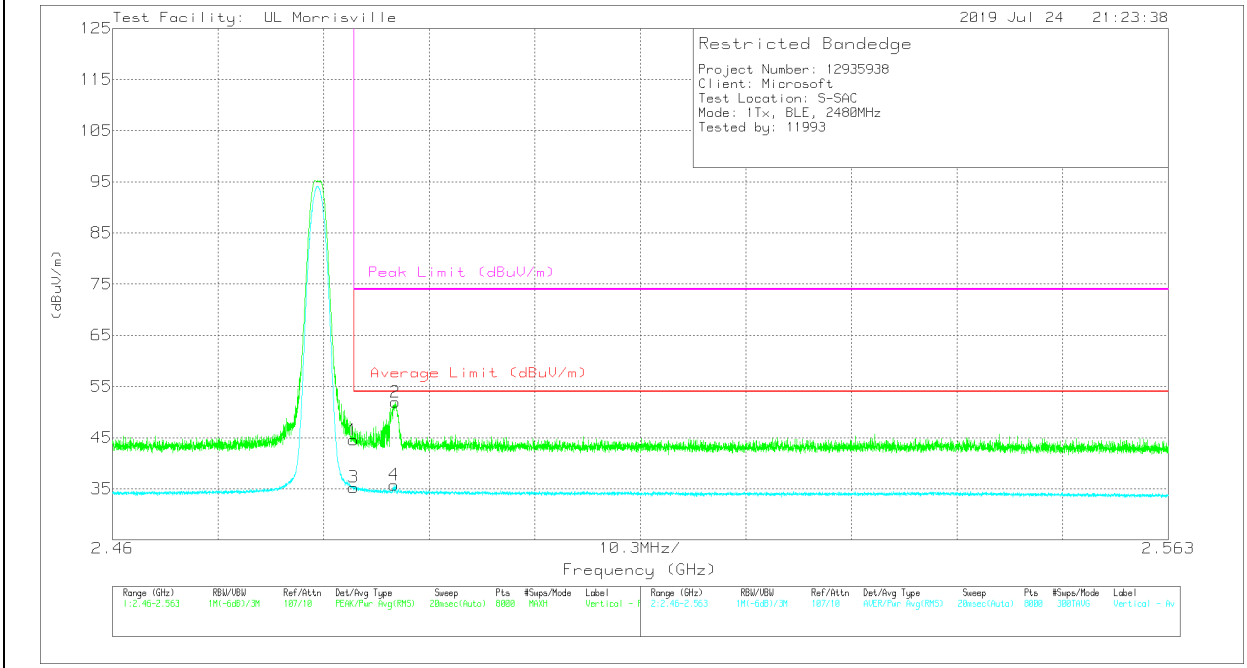
HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.4835	36.28	Pk	32.3	-24.5	0	44.08	-	-	74	-29.92	58	111	H
2	** 2.50047	38.09	Pk	32.4	-24.6	0	45.89	-	-	74	-28.11	58	111	H
3	* ** 2.4835	25.86	RMS	32.3	-24.5	.83	34.49	54	-19.51	-	-	58	111	H
4	* ** 2.48387	26.5	RMS	32.3	-24.5	.83	35.13	54	-18.87	-	-	58	111	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



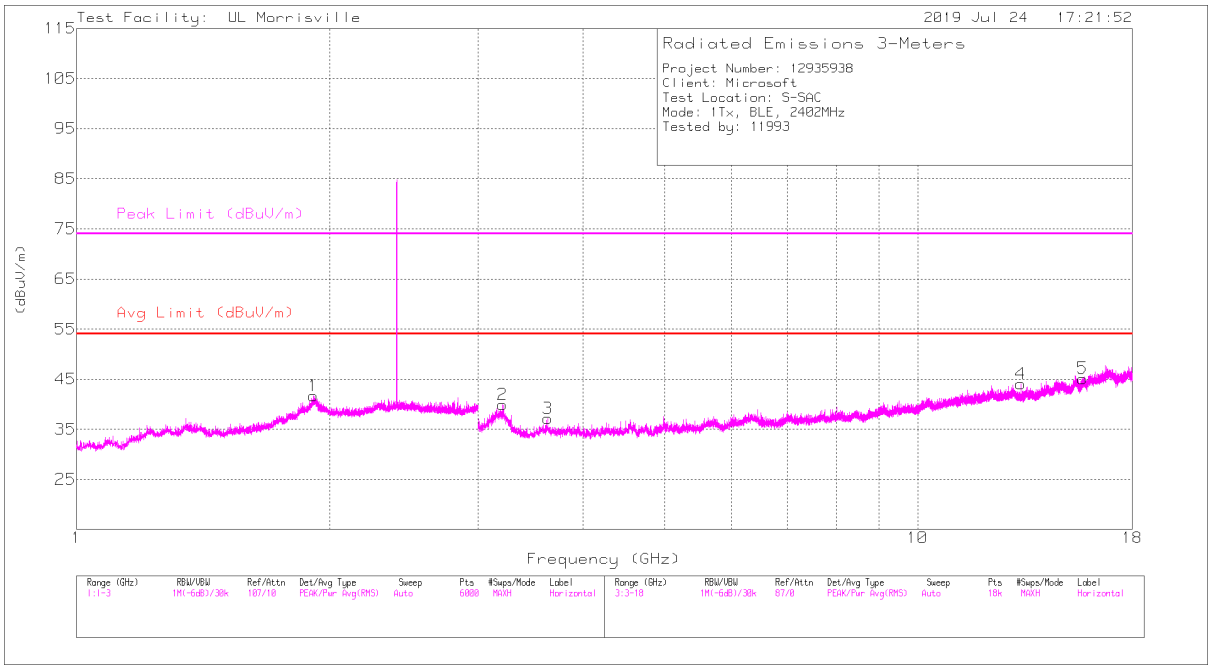
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.4835	36.77	Pk	32.3	-24.5	0	44.57	-	-	74	-29.43	226	245	V
2	* ** 2.48756	44.11	Pk	32.3	-24.5	0	51.91	-	-	74	-22.09	226	245	V
3	* ** 2.4835	26.66	RMS	32.3	-24.5	.83	35.29	54	-18.71	-	-	226	245	V
4	* ** 2.48745	27.14	RMS	32.3	-24.5	.83	35.77	54	-18.23	-	-	226	245	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

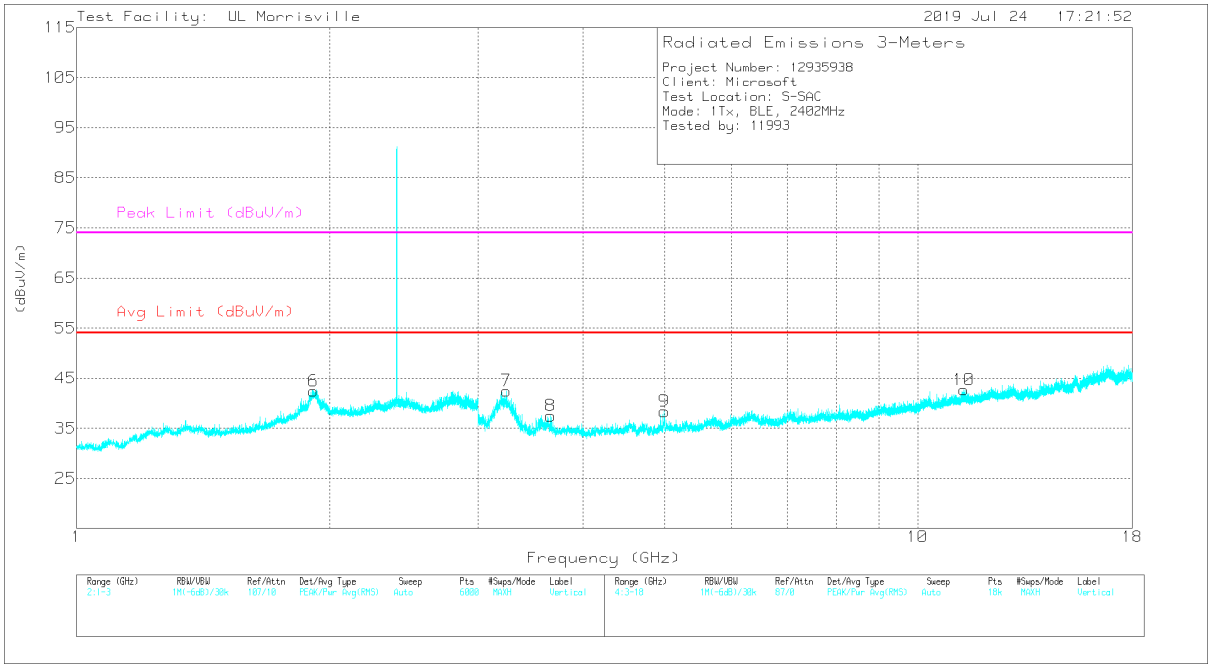
UL LLC
12 Laboratory Dr., RTP, NC 27709; USA TEL:(919) 549-1400

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



HORIZONTAL



VERTICAL

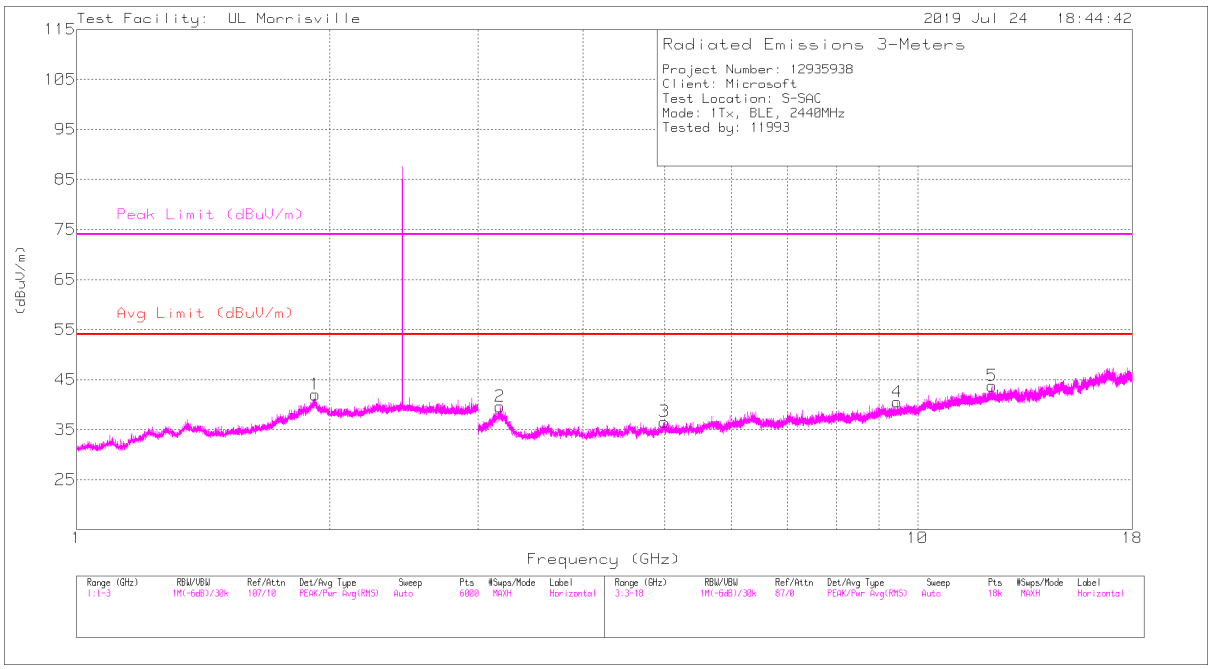
RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	** 1.91217	39.64	PK2	31.1	-22.4	0	48.34	-	-	74	-25.66	275	152	H
	** 1.91233	27.69	MAv1	31.1	-22.4	.83	37.22	54	-16.78	-	-	275	152	H
6	** 1.9116	42.25	PK2	31.1	-22.4	0	50.95	-	-	74	-23.05	97	224	V
	** 1.91097	30.31	MAv1	31.1	-22.4	.83	39.84	54	-14.16	-	-	97	224	V
3	* ** 3.63186	43.4	PK2	32.9	-31.9	0	44.4	-	-	74	-29.6	291	140	H
	* ** 3.63285	31.54	MAv1	32.9	-31.9	.83	33.37	54	-20.63	-	-	291	140	H
4	* ** 13.25957	34.28	PK2	39	-24.7	0	48.58	-	-	74	-25.42	91	273	H
	* ** 13.25964	22.51	MAv1	39	-24.7	.83	37.64	54	-16.36	-	-	91	273	H
5	* ** 15.70333	34.5	PK2	40.2	-22.4	0	52.3	-	-	74	-21.7	161	240	H
	* ** 15.70299	21.83	MAv1	40.2	-22.4	.83	40.46	54	-13.54	-	-	161	240	H
8	* ** 3.65768	43.25	PK2	32.9	-32	0	44.15	-	-	74	-29.85	106	221	V
	* ** 3.65989	31.61	MAv1	32.9	-32.1	.83	33.24	54	-20.76	-	-	106	221	V
9	* ** 4.99944	43.5	PK2	34.2	-31.1	0	46.6	-	-	74	-27.4	102	101	V
	* ** 4.99938	29.08	MAv1	34.2	-31.1	.83	33.01	54	-20.99	-	-	102	101	V
10	* ** 11.34782	33.52	PK2	38	-23	0	48.52	-	-	74	-25.48	227	244	V
	* ** 11.34827	21.34	MAv1	38	-23	.83	37.17	54	-16.83	-	-	227	244	V
2	3.21168	39.64	Pk	33.1	-32.8	0	39.94	-	-	-	-	0-360	101	H
7	3.24251	42.3	Pk	33.1	-32.9	0	42.5	-	-	-	-	0-360	199	V

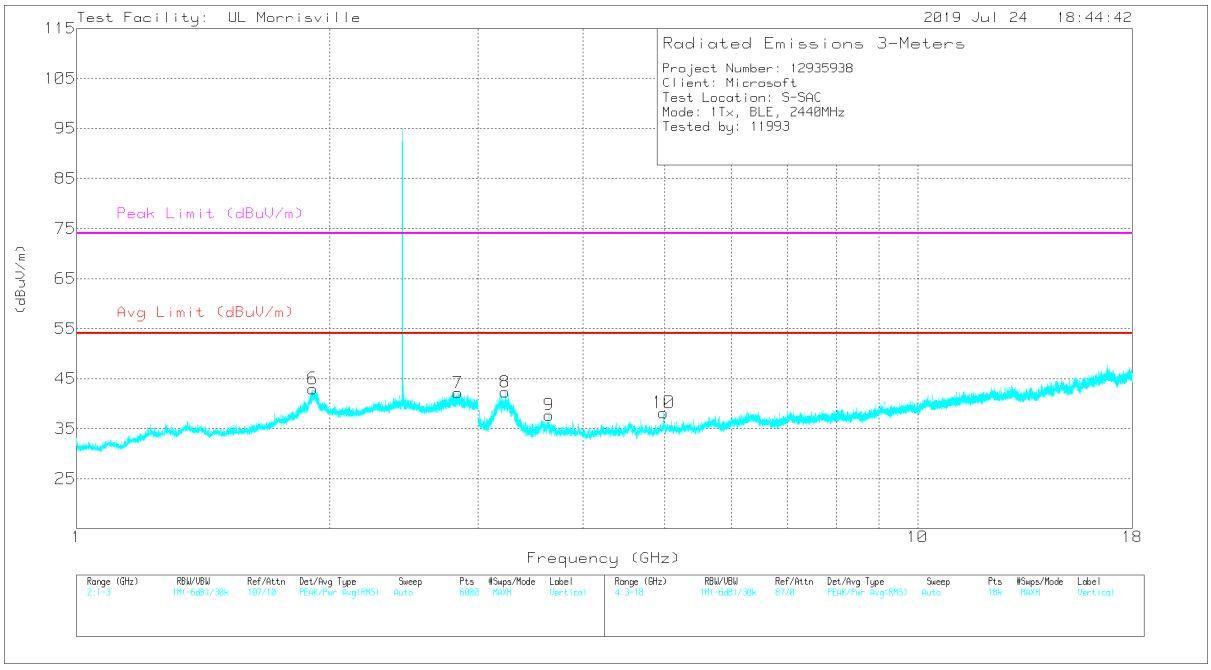
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
PK2 - Maximum Peak
MAv1 - Maximum RMS Average
Pk - Peak detector

UL LLC
12 Laboratory Dr., RTP, NC 27709; USA TEL:(919) 549-1400

MID CHANNEL RESULTS



HORIZONTAL



VERTICAL

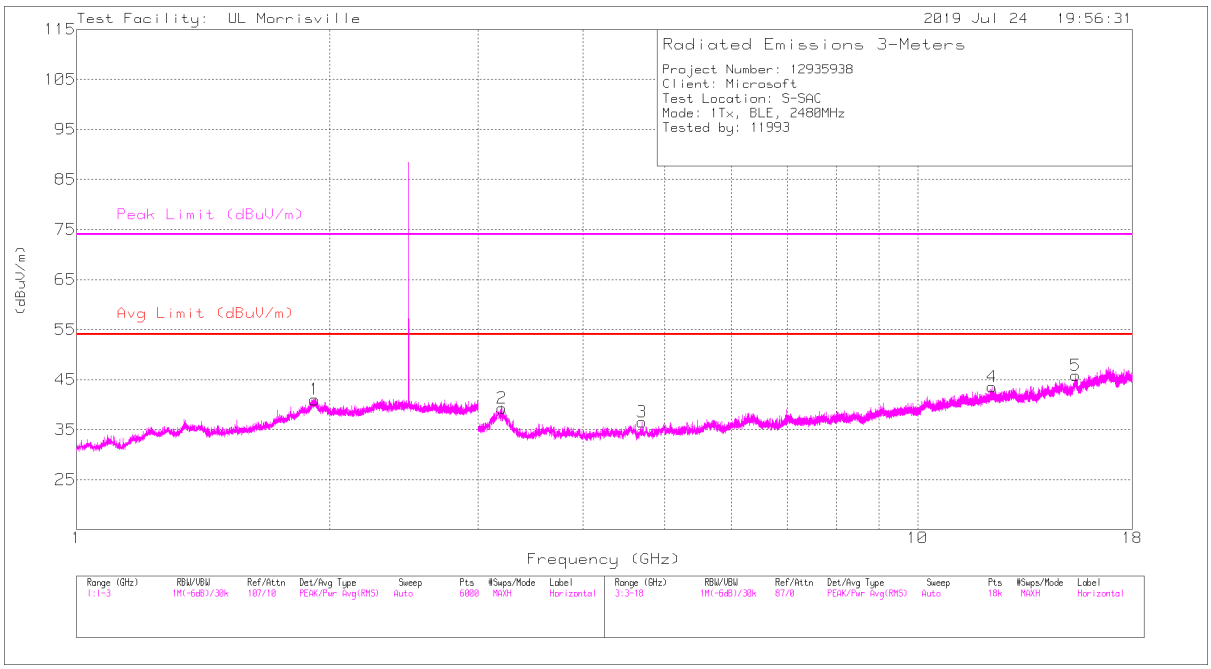
RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	** 1.92071	39.19	PK2	31.2	-22.4	0	47.99	-	-	74	-26.01	324	160	H
	** 1.91992	27.03	MAv1	31.2	-22.4	.83	36.66	54	-17.34	-	-	324	160	H
6	** 1.91079	42.77	PK2	31.1	-22.4	0	51.47	-	-	74	-22.53	96	230	V
	** 1.91061	30.51	MAv1	31.1	-22.4	.83	40.04	54	-13.96	-	-	96	230	V
7	* ** 2.84059	43.29	PK2	32.1	-25.8	0	49.59	-	-	74	-24.41	105	191	V
	* ** 2.84063	31.02	MAv1	32.1	-25.8	.83	38.15	54	-15.85	-	-	105	191	V
3	* ** 4.9984	39.59	PK2	34.2	-31.1	0	42.69	-	-	74	-31.31	201	175	H
	* ** 4.99823	27.51	MAv1	34.2	-31.1	.83	31.44	54	-22.56	-	-	201	175	H
4	* ** 9.46224	35.28	PK2	37	-26.2	0	46.08	-	-	74	-27.92	68	337	H
	* ** 9.46223	23.37	MAv1	37	-26.2	.83	35	54	-19	-	-	68	337	H
5	* ** 12.25985	34.68	PK2	38.9	-23.7	0	49.88	-	-	74	-24.12	17	325	H
	* ** 12.25982	22.36	MAv1	38.9	-23.7	.83	38.39	54	-15.61	-	-	17	325	H
9	* ** 3.64763	40.24	PK2	32.9	-31.9	0	41.24	-	-	74	-32.76	222	309	V
	* ** 3.64777	28.22	MAv1	32.9	-31.9	.83	30.05	54	-23.95	-	-	222	309	V
10	* ** 4.98877	39.13	PK2	34.1	-31.1	0	42.13	-	-	74	-31.87	114	262	V
	* ** 4.98965	27.52	MAv1	34.1	-31.1	.83	31.35	54	-22.65	-	-	114	262	V
2	3.19001	39.03	Pk	33.1	-32.5	0	39.63	-	-	-	-	0-360	199	H
8	3.23001	42.01	Pk	33.1	-32.8	0	42.31	-	-	-	-	0-360	199	V

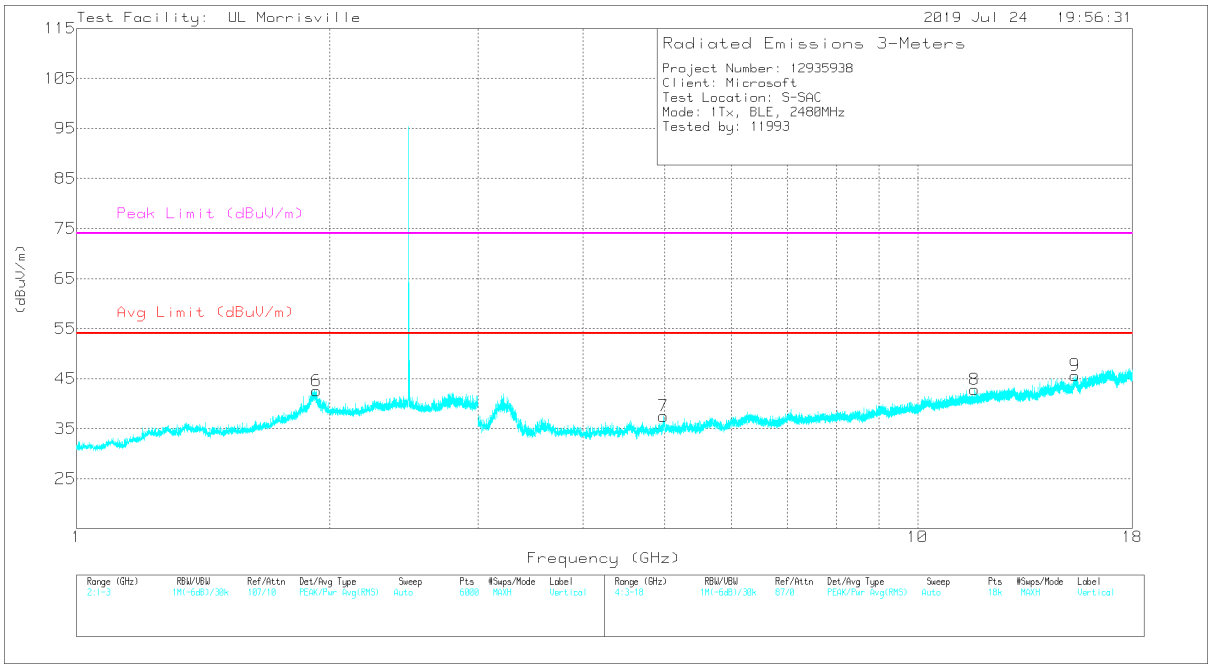
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
PK2 - Maximum Peak
MAv1 - Maximum RMS Average
Pk - Peak detector

UL LLC
12 Laboratory Dr., RTP, NC 27709; USA TEL:(919) 549-1400

HIGH CHANNEL RESULTS



HORIZONTAL



VERTICAL

UL LLC
12 Laboratory Dr., RTP, NC 27709; USA TEL:(919) 549-1400

RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	** 1.91854	40.16	PK2	31.2	-22.4	0	48.96	-	-	74	-25.04	332	101	H
	** 1.9185	28.07	MAv1	31.2	-22.4	.83	37.7	54	-16.3	-	-	332	101	H
6	** 1.92849	40.34	PK2	31.2	-22.4	0	49.14	-	-	74	-24.86	98	227	V
	** 1.92806	29.32	MAv1	31.2	-22.4	.83	38.95	54	-15.05	-	-	98	227	V
3	* ** 4.7036	39.63	PK2	34	-31.7	0	41.93	-	-	74	-32.07	92	126	H
	* ** 4.70196	27.65	MAv1	34	-31.7	.83	30.78	54	-23.22	-	-	92	126	H
4	* ** 12.2604	34.36	PK2	38.9	-23.7	0	49.56	-	-	74	-24.44	113	170	H
	* ** 12.26068	22.24	MAv1	38.9	-23.7	.83	38.27	54	-15.73	-	-	113	170	H
5	* ** 15.41641	34.03	PK2	39.9	-21.7	0	52.23	-	-	74	-21.77	270	223	H
	* ** 15.41661	21.65	MAv1	39.9	-21.7	.83	40.68	54	-13.32	-	-	270	223	H
7	* ** 4.98853	41.11	PK2	34.1	-31.1	0	44.11	-	-	74	-29.89	91	253	V
	* ** 4.98878	28.6	MAv1	34.1	-31.1	.83	32.43	54	-21.57	-	-	91	253	V
8	* ** 11.68576	33.92	PK2	38.4	-24	0	48.32	-	-	74	-25.68	85	283	V
	* ** 11.6856	21.8	MAv1	38.4	-24	.83	37.03	54	-16.97	-	-	85	283	V
9	* ** 15.37808	33.6	PK2	39.9	-21.7	0	51.8	-	-	74	-22.2	86	306	V
	* ** 15.37861	21.38	MAv1	39.9	-21.7	.83	40.41	54	-13.59	-	-	86	306	V
2	3.20585	38.93	Pk	33.1	-32.7	0	39.33	-	-	-	-	0-360	199	H

* - 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
Pk - Peak detector

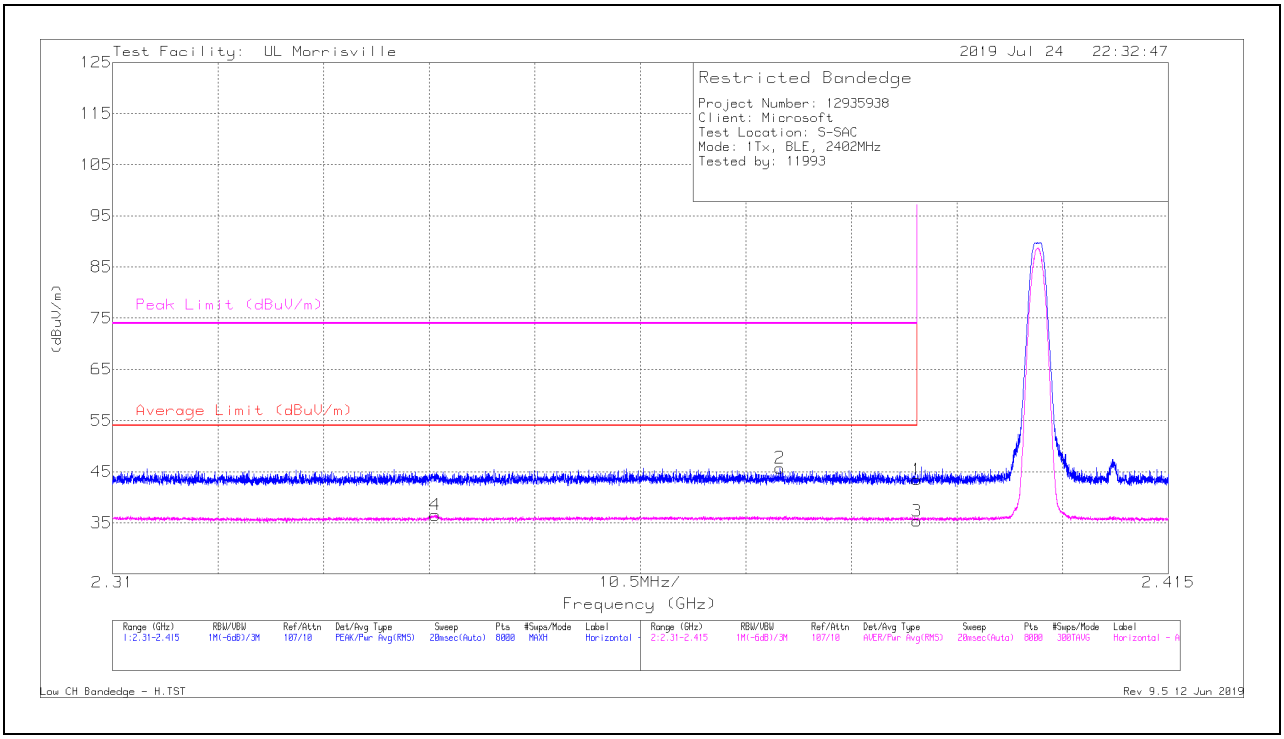
UL LLC
12 Laboratory Dr., RTP, NC 27709; USA TEL:(919) 549-1400

10.2.2. BLE (500 kbps)

Antenna 1

BANDEDGE (LOW CHANNEL)

HORIZONTAL RESULT

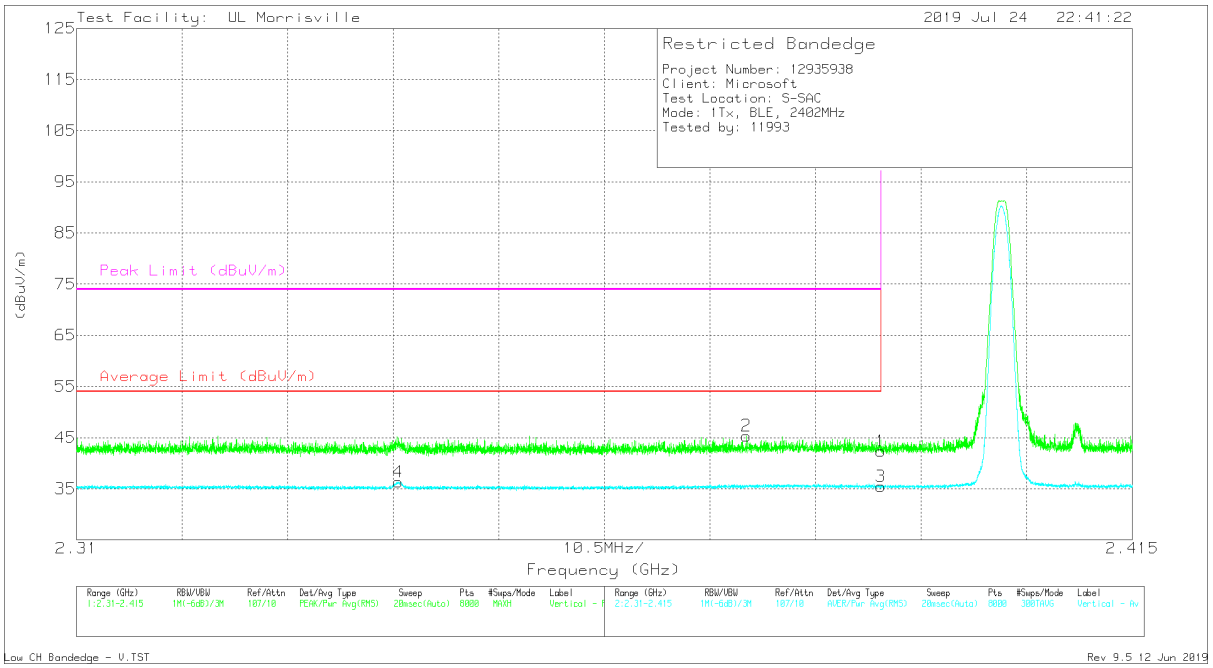


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.39	35.59	Pk	31.9	-24	0	43.49	-	-	74	-30.51	338	397	H
2	* ** 2.37637	37.91	Pk	31.8	-24	0	45.71	-	-	74	-28.29	338	397	H
3	* ** 2.39	24.98	RMS	31.9	-24	2.45	35.33	54	-18.67	-	-	338	397	H
4	* ** 2.34208	26.18	RMS	31.6	-23.7	2.45	36.53	54	-17.47	-	-	338	397	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

UL LLC
12 Laboratory Dr., RTP, NC 27709; USA TEL:(919) 549-1400

VERTICAL RESULT

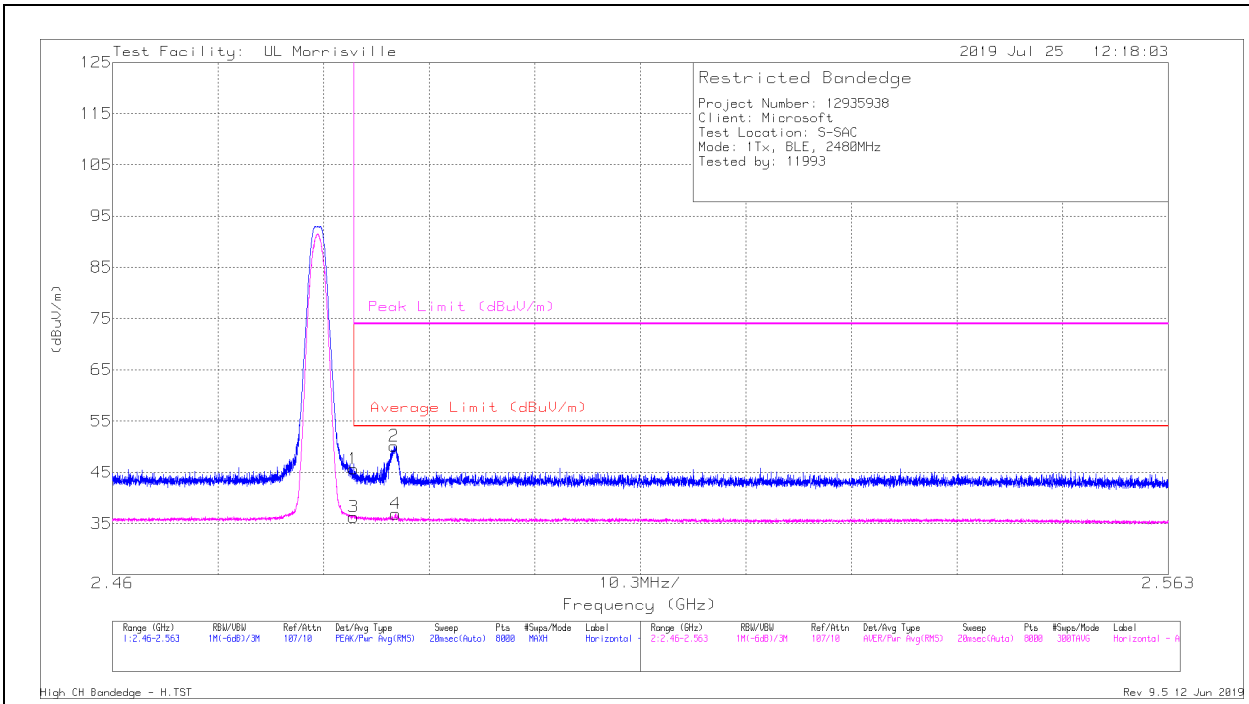


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.39	34.45	Pk	31.9	-24	0	42.35	-	-	74	-31.65	357	346	V
2	* ** 2.37661	37.54	Pk	31.8	-24	0	45.34	-	-	74	-28.66	357	346	V
3	* ** 2.39	25.12	RMS	31.9	-24	2.45	35.47	54	-18.53	-	-	357	346	V
4	* ** 2.34199	25.98	RMS	31.6	-23.7	2.45	36.33	54	-17.67	-	-	357	346	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)

HORIZONTAL RESULT

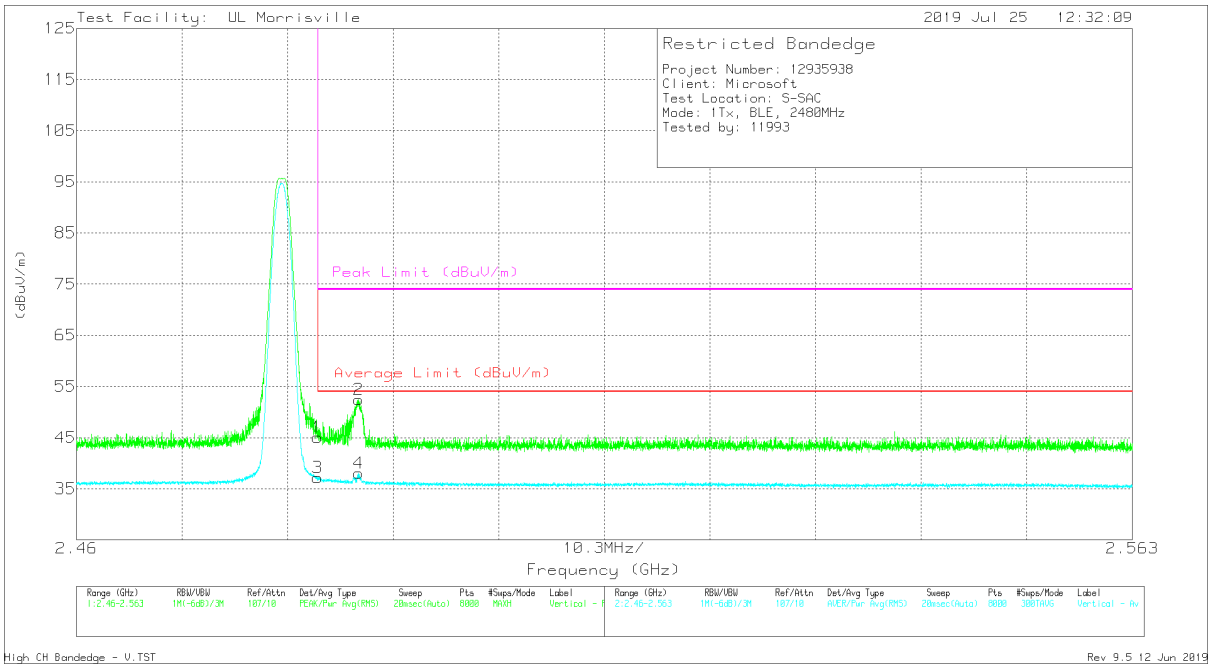


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.4835	37.89	Pk	32.3	-24.5	0	45.69	-	-	74	-28.31	253	397	H
2	* ** 2.48748	42.33	Pk	32.3	-24.5	0	50.13	-	-	74	-23.87	253	397	H
3	* ** 2.4835	26.03	RMS	32.3	-24.5	2.45	36.28	54	-17.72	-	-	253	397	H
4	* ** 2.48761	26.65	RMS	32.3	-24.5	2.45	36.9	54	-17.1	-	-	253	397	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

UL LLC
12 Laboratory Dr., RTP, NC 27709; USA TEL:(919) 549-1400

VERTICAL RESULT



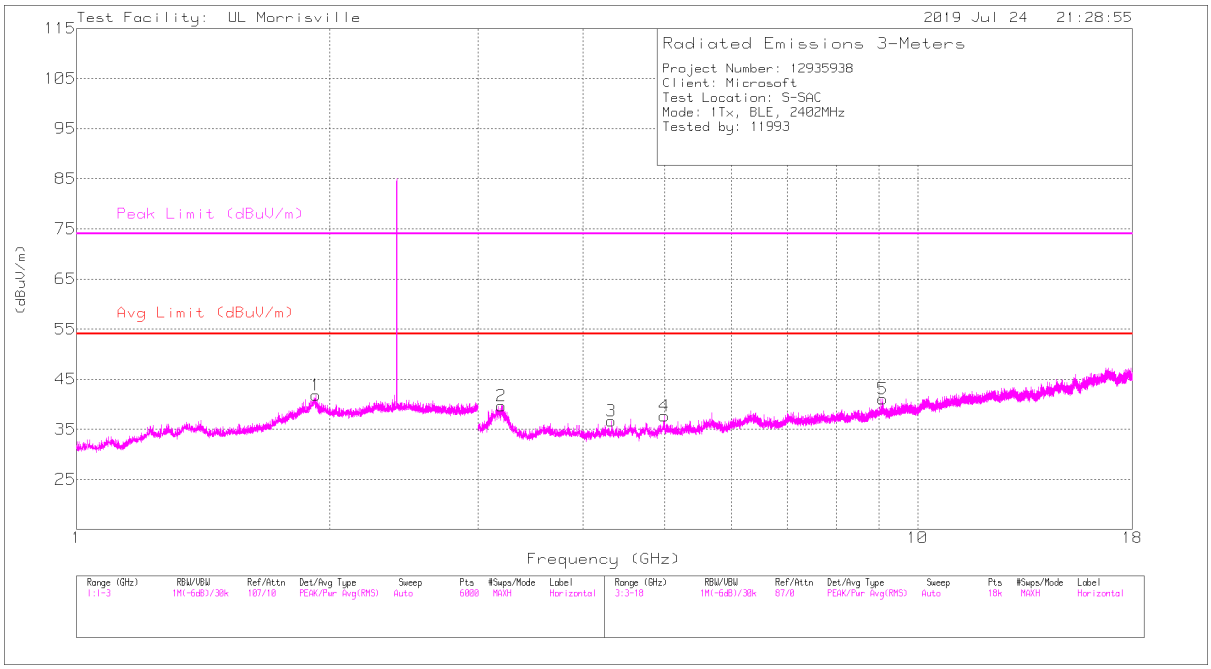
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.4835	37.22	Pk	32.3	-24.5	0	45.02	-	-	74	-28.98	244	171	V
2	* ** 2.48751	44.62	Pk	32.3	-24.5	0	52.42	-	-	74	-21.58	244	171	V
3	* ** 2.4835	26.93	RMS	32.3	-24.5	2.45	37.18	54	-16.82	-	-	244	171	V
4	* ** 2.48751	27.78	RMS	32.3	-24.5	2.45	38.03	54	-15.97	-	-	244	171	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

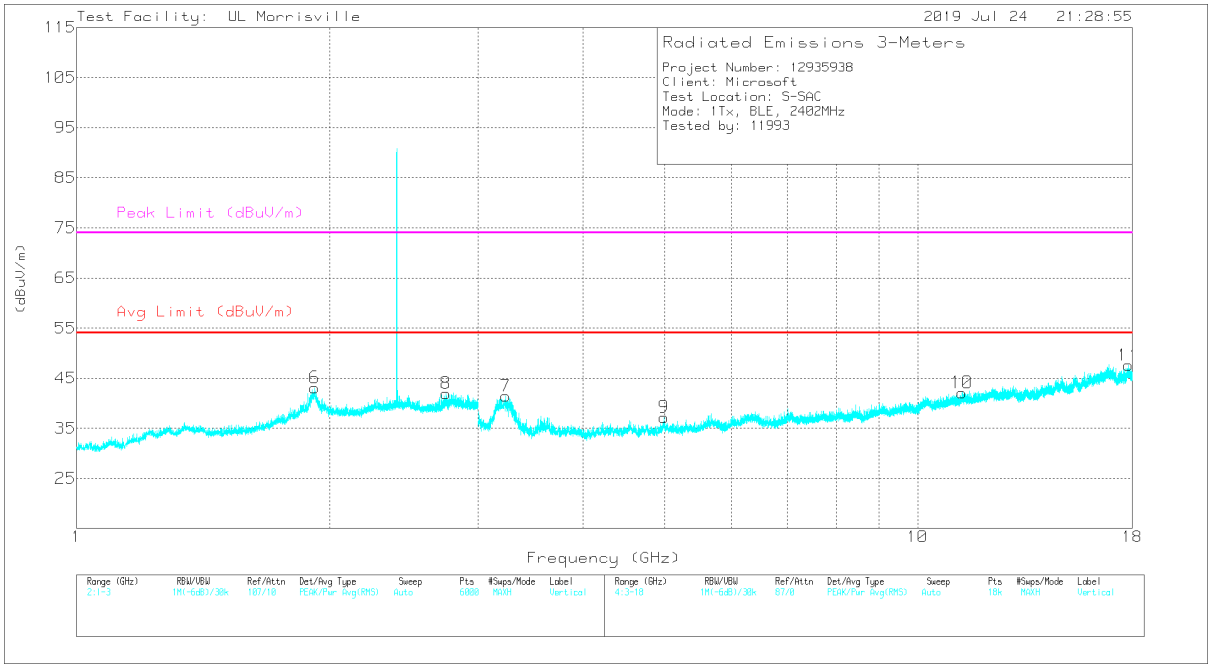
UL LLC
12 Laboratory Dr., RTP, NC 27709; USA TEL:(919) 549-1400

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



HORIZONTAL



VERTICAL

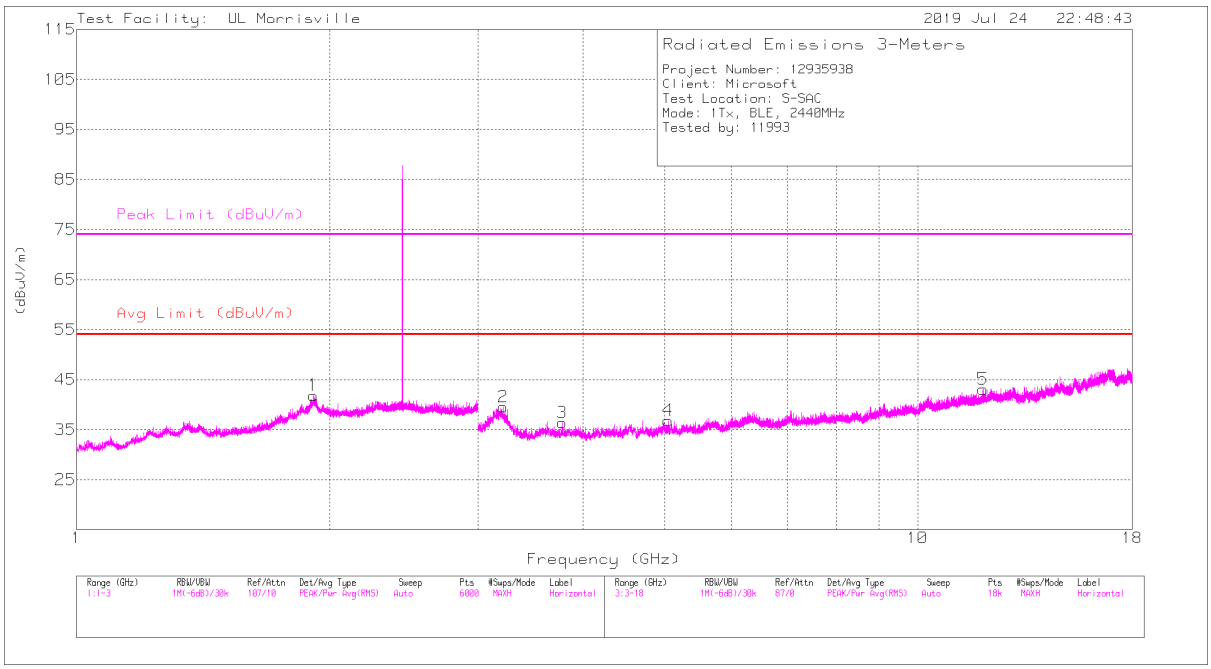
RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	** 1.92379	39.15	PK2	31.2	-22.4	0	47.95	-	-	74	-26.05	329	117	H
	** 1.92208	27.85	MAv1	31.2	-22.4	2.45	39.1	54	-14.9	-	-	329	117	H
6	** 1.91841	42.22	PK2	31.2	-22.4	0	51.02	-	-	74	-22.98	91	230	V
	** 1.9188	30.45	MAv1	31.2	-22.4	2.45	41.7	54	-12.3	-	-	91	230	V
8	* ** 2.74904	42.23	PK2	32.3	-25.8	0	48.73	-	-	74	-25.27	107	217	V
	* ** 2.74915	29.96	MAv1	32.3	-25.8	2.45	38.91	54	-15.09	-	-	107	217	V
3	* ** 4.32238	40.46	PK2	33.6	-31.9	0	42.16	-	-	74	-31.84	73	278	H
	* ** 4.32222	28.25	MAv1	33.6	-31.9	2.45	32.4	54	-21.6	-	-	73	278	H
4	* ** 4.99832	41.74	PK2	34.2	-31.1	0	44.84	-	-	74	-29.16	338	163	H
	* ** 4.99842	28.21	MAv1	34.2	-31.1	2.45	33.76	54	-20.24	-	-	338	163	H
5	* ** 9.09324	35.56	PK2	36.6	-25.7	0	46.46	-	-	74	-27.54	303	145	H
	* ** 9.0932	23.38	MAv1	36.6	-25.7	2.45	36.73	54	-17.27	-	-	303	145	H
9	* ** 4.99552	42.91	PK2	34.2	-31.1	0	46.01	-	-	74	-27.99	93	228	V
	* ** 4.99569	29.13	MAv1	34.2	-31.1	2.45	34.68	54	-19.32	-	-	93	228	V
10	* ** 11.29004	33.85	PK2	38	-23	0	48.85	-	-	74	-25.15	47	295	V
	* ** 11.2897	21.36	MAv1	38	-23	2.45	38.81	54	-15.19	-	-	47	295	V
11	* ** 17.81142	33.71	PK2	41.2	-20.8	0	54.11	-	-	74	-19.89	23	282	V
	* ** 17.81083	21.81	MAv1	41.2	-20.8	2.45	44.66	54	-9.34	-	-	23	282	V
2	3.19668	39.09	Pk	33.1	-32.5	0	39.69	-	-	-	-	0-360	199	H
7	3.23751	41.23	Pk	33.1	-32.9	0	41.43	-	-	-	-	0-360	199	V

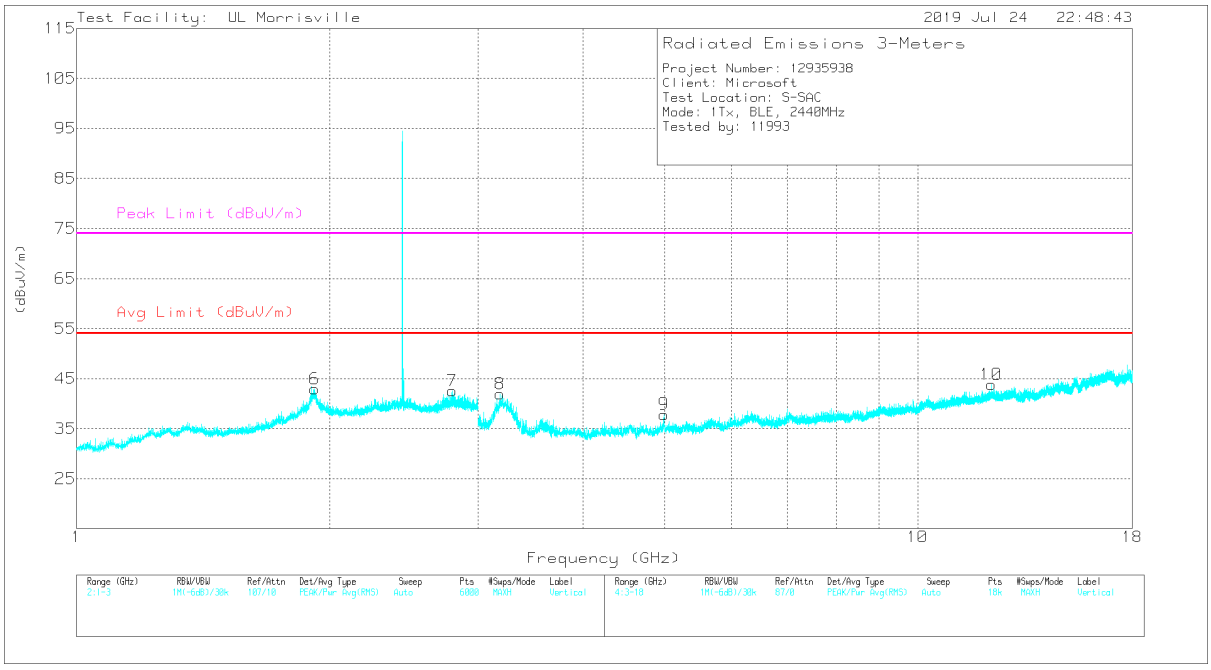
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
PK2 - Maximum Peak
MAv1 - Maximum RMS Average
Pk - Peak detector

UL LLC
12 Laboratory Dr., RTP, NC 27709; USA TEL:(919) 549-1400

MID CHANNEL RESULTS



HORIZONTAL



VERTICAL

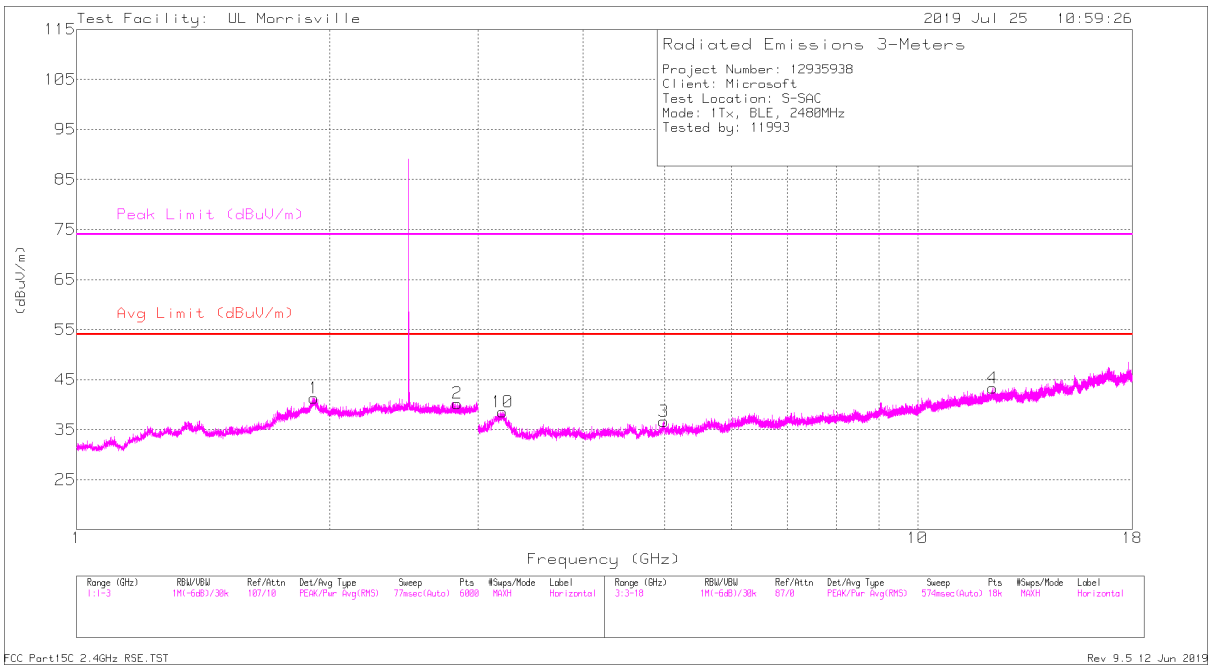
RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	** 1.91461	40.82	PK2	31.1	-22.4	0	49.52	-	-	74	-24.48	332	118	H
	** 1.91373	28.41	MAv1	31.1	-22.4	2.45	39.56	54	-14.44	-	-	332	118	H
6	** 1.91915	42.86	PK2	31.2	-22.4	0	51.66	-	-	74	-22.34	90	237	V
	** 1.91896	30.32	MAv1	31.2	-22.4	2.45	41.57	54	-12.43	-	-	90	237	V
7	* ** 2.79602	43.65	PK2	32.2	-25.8	0	50.05	-	-	74	-23.95	102	212	V
	* ** 2.79624	31.72	MAv1	32.2	-25.8	2.45	40.57	54	-13.43	-	-	102	212	V
3	* ** 3.77848	40.95	PK2	33.4	-32.7	0	41.65	-	-	74	-32.35	117	387	H
	* ** 3.7786	28.95	MAv1	33.4	-32.7	2.45	32.1	54	-21.9	-	-	117	387	H
4	* ** 5.05067	40.1	PK2	34.2	-31.1	0	43.2	-	-	74	-30.8	39	126	H
	* ** 5.05082	27.51	MAv1	34.2	-31.1	2.45	33.06	54	-20.94	-	-	39	126	H
5	* ** 11.95987	33.71	PK2	38.6	-23.8	0	48.51	-	-	74	-25.49	241	277	H
	* ** 11.96113	21.9	MAv1	38.6	-23.8	2.45	39.15	54	-14.85	-	-	241	277	H
9	* ** 4.99114	40.63	PK2	34.1	-31.1	0	43.63	-	-	74	-30.37	74	111	V
	* ** 4.99256	28.51	MAv1	34.1	-31.1	2.45	33.96	54	-20.04	-	-	74	111	V
10	* ** 12.23108	33.68	PK2	38.9	-23.7	0	48.88	-	-	74	-25.12	266	173	V
	* ** 12.23034	22.25	MAv1	38.9	-23.7	2.45	39.9	54	-14.1	-	-	266	173	V
8	3.18584	41.32	Pk	33.1	-32.5	0	41.92	-	-	-	-	0-360	199	V
2	3.21585	39.26	Pk	33.1	-32.8	0	39.56	-	-	-	-	0-360	199	H

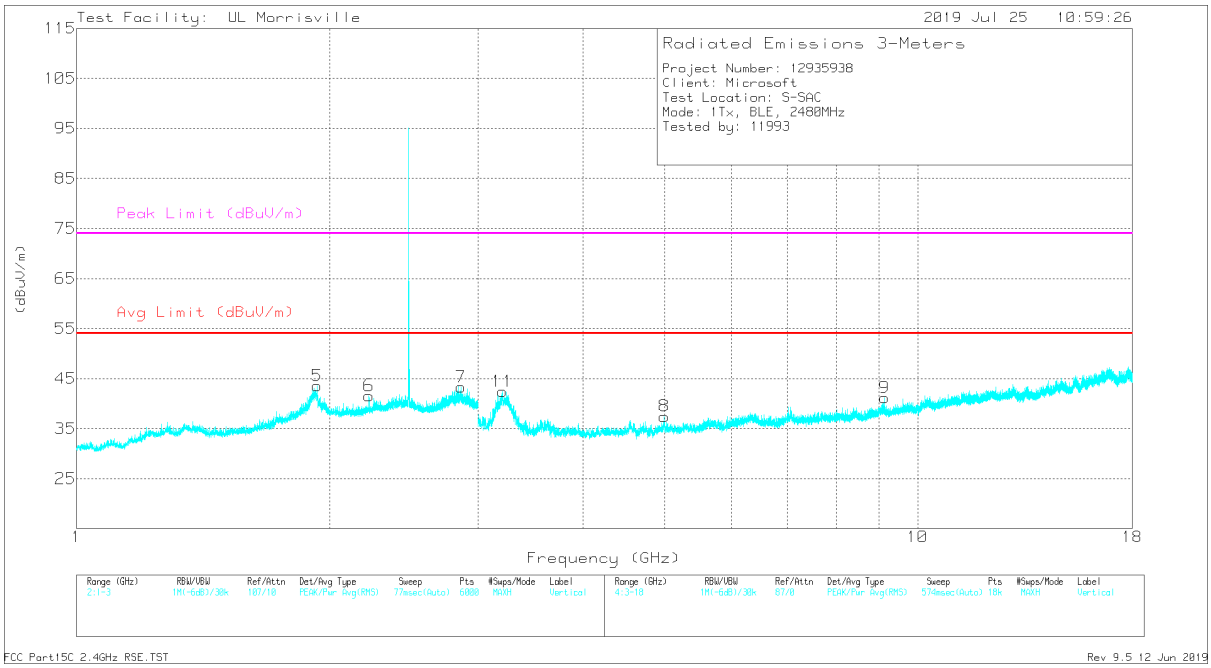
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
PK2 - Maximum Peak
MAv1 - Maximum RMS Average
Pk - Peak detector

UL LLC
12 Laboratory Dr., RTP, NC 27709; USA TEL:(919) 549-1400

HIGH CHANNEL RESULTS



HORIZONTAL



VERTICAL

RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	** 1.91767	40.25	PK2	31.2	-22.4	0	49.05	-	-	74	-24.95	151	104	H
	** 1.91758	28.14	MAv1	31.2	-22.4	2.45	39.39	54	-14.61	-	-	151	104	H
2	* ** 2.83589	40.81	PK2	32.1	-25.8	0	47.11	-	-	74	-26.89	8	110	H
	* ** 2.83588	28.6	MAv1	32.1	-25.8	2.45	37.35	54	-16.65	-	-	8	110	H
5	** 1.93165	41.98	PK2	31.2	-22.4	0	50.78	-	-	74	-23.22	87	218	V
	** 1.93051	29.42	MAv1	31.2	-22.4	2.45	40.67	54	-13.33	-	-	87	218	V
6	* ** 2.22567	38.09	PK2	31.6	-23.3	0	46.39	-	-	74	-27.61	106	201	V
	* ** 2.22588	25.87	MAv1	31.6	-23.3	2.45	36.62	54	-17.38	-	-	106	201	V
7	* ** 2.86313	43.82	PK2	32.3	-25.9	0	50.22	-	-	74	-23.78	105	223	V
	* ** 2.86099	32.12	MAv1	32.3	-25.9	2.45	40.97	54	-13.03	-	-	105	223	V
3	* ** 4.989	40.86	PK2	34.1	-31.1	0	43.86	-	-	74	-30.14	333	122	H
	* ** 4.98869	28.32	MAv1	34.1	-31.1	2.45	33.77	54	-20.23	-	-	333	122	H
4	* ** 12.28594	33.42	PK2	38.9	-23.7	0	48.62	-	-	74	-25.38	14	360	H
	* ** 12.28476	22.25	MAv1	38.9	-23.7	2.45	39.9	54	-14.1	-	-	14	360	H
8	* ** 4.99926	42.18	PK2	34.2	-31.1	0	45.28	-	-	74	-28.72	94	101	V
	* ** 4.99902	28.78	MAv1	34.2	-31.1	2.45	34.33	54	-19.67	-	-	94	101	V
9	* ** 9.13204	35.55	PK2	36.7	-25.7	0	46.55	-	-	74	-27.45	234	393	V
	* ** 9.13168	23.03	MAv1	36.7	-25.7	2.45	36.48	54	-17.52	-	-	234	393	V
10	3.20835	38.15	Pk	33.1	-32.7	0	38.55	-	-	-	-	0-360	101	H
11	3.21001	42.14	Pk	33.1	-32.8	0	42.44	-	-	-	-	0-360	199	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
Pk - Peak detector

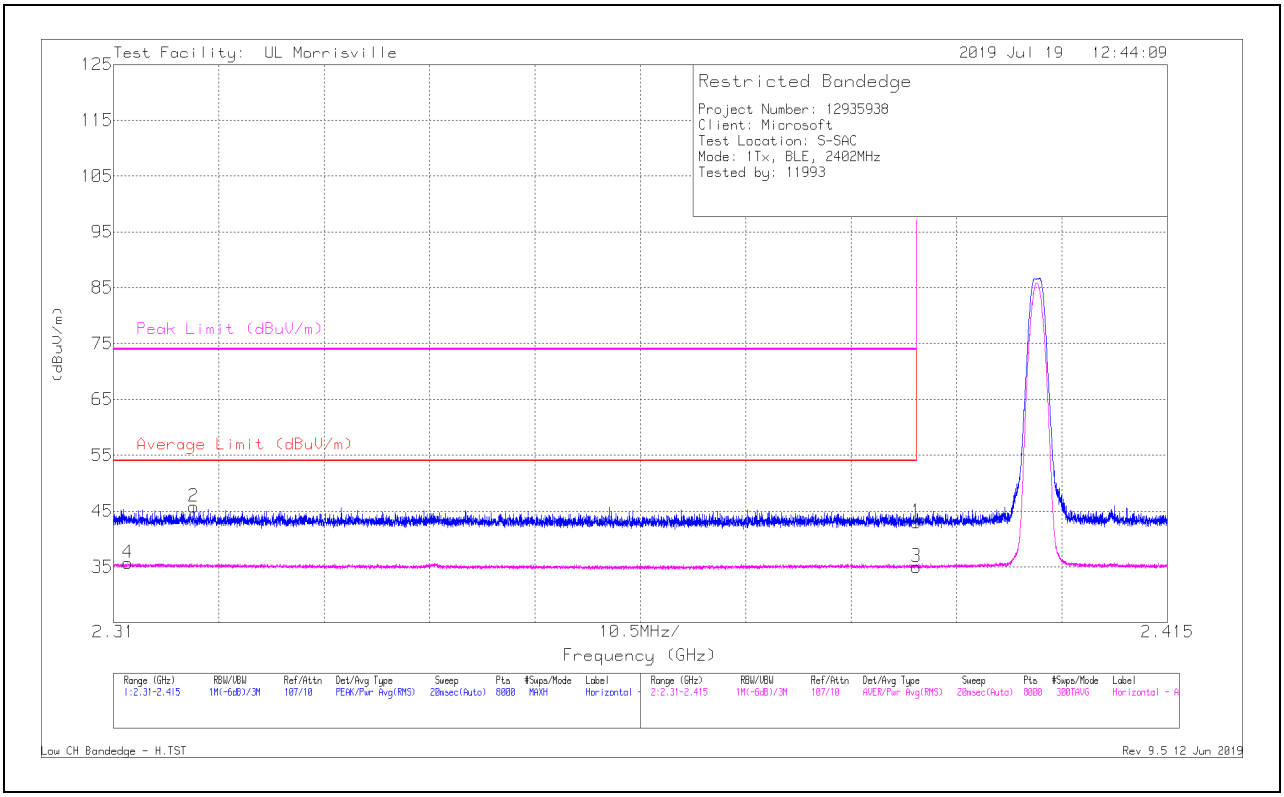
UL LLC
12 Laboratory Dr., RTP, NC 27709; USA TEL:(919) 549-1400

10.2.3. BLE (1Mbps)

Antenna 1

BANDEDGE (LOW CHANNEL)

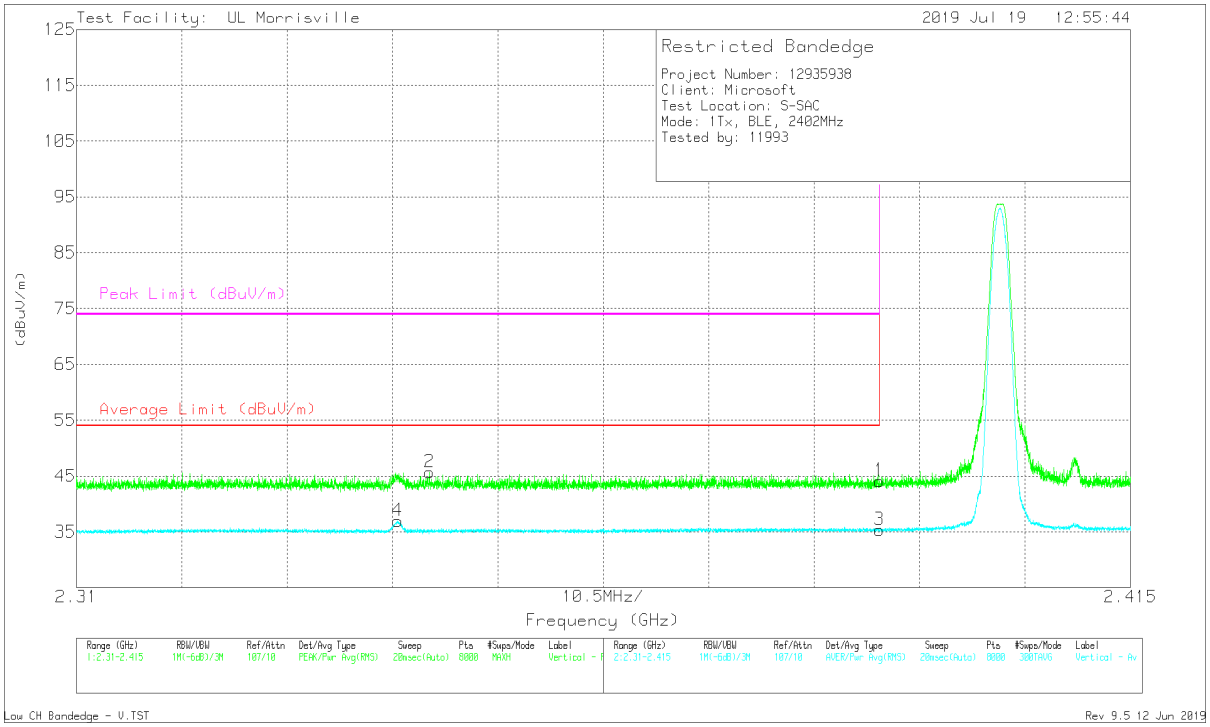
HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.39	35.11	Pk	31.9	-24	0	43.01	-	-	74	-30.99	75	104	H
2	* ** 2.31799	37.78	Pk	31.7	-23.7	0	45.78	-	-	74	-28.22	75	104	H
3	* ** 2.39	25.05	RMS	31.9	-24	2.07	35.02	54	-18.98	-	-	75	104	H
4	* ** 2.31144	25.64	RMS	31.7	-23.7	2.07	35.71	54	-18.29	-	-	75	104	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



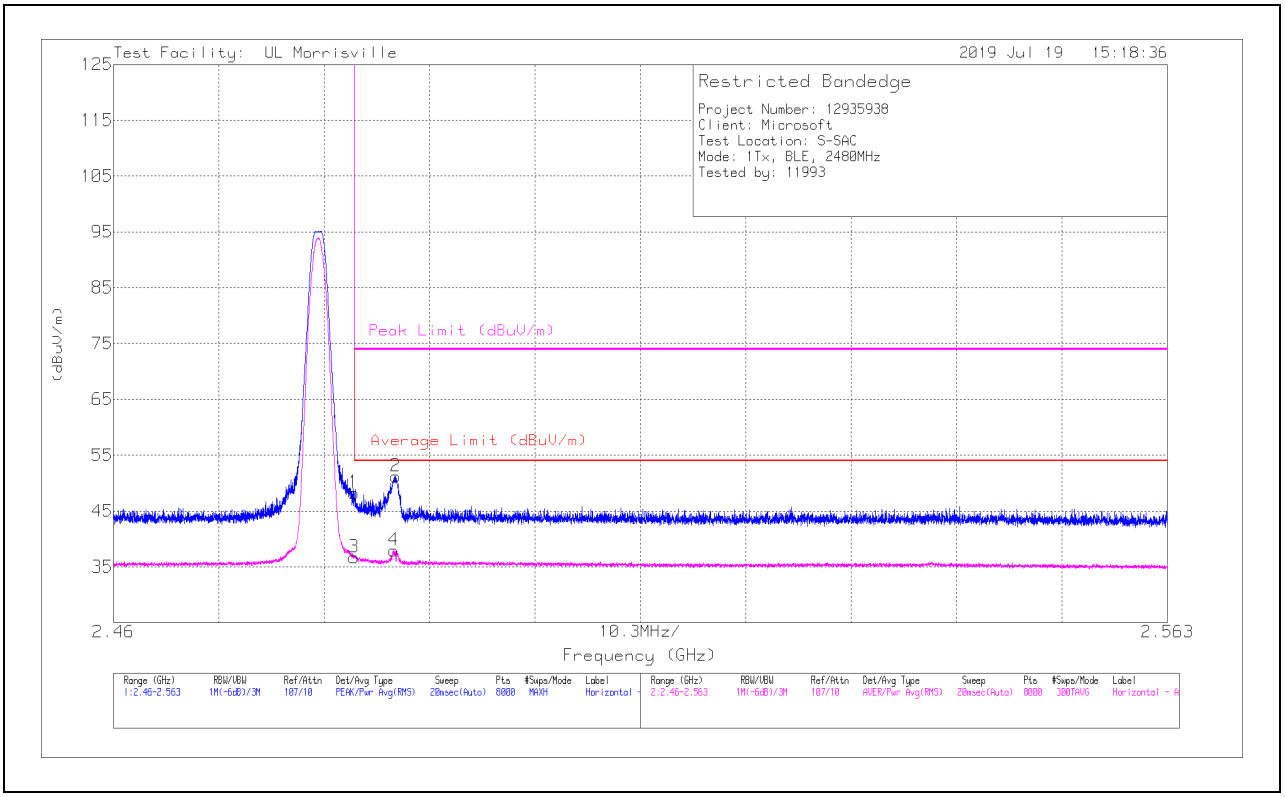
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.39	36.21	Pk	31.9	-24	0	44.11	-	-	74	-29.89	241	120	V
2	* ** 2.34518	37.76	Pk	31.6	-23.7	0	45.66	-	-	74	-28.34	241	120	V
3	* ** 2.39	25.34	RMS	31.9	-24	2.07	35.31	54	-18.69	-	-	241	120	V
4	* ** 2.34202	26.99	RMS	31.6	-23.7	2.07	36.96	54	-17.04	-	-	241	120	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

UL LLC
12 Laboratory Dr., RTP, NC 27709; USA TEL:(919) 549-1400

BANDEDGE (HIGH CHANNEL)

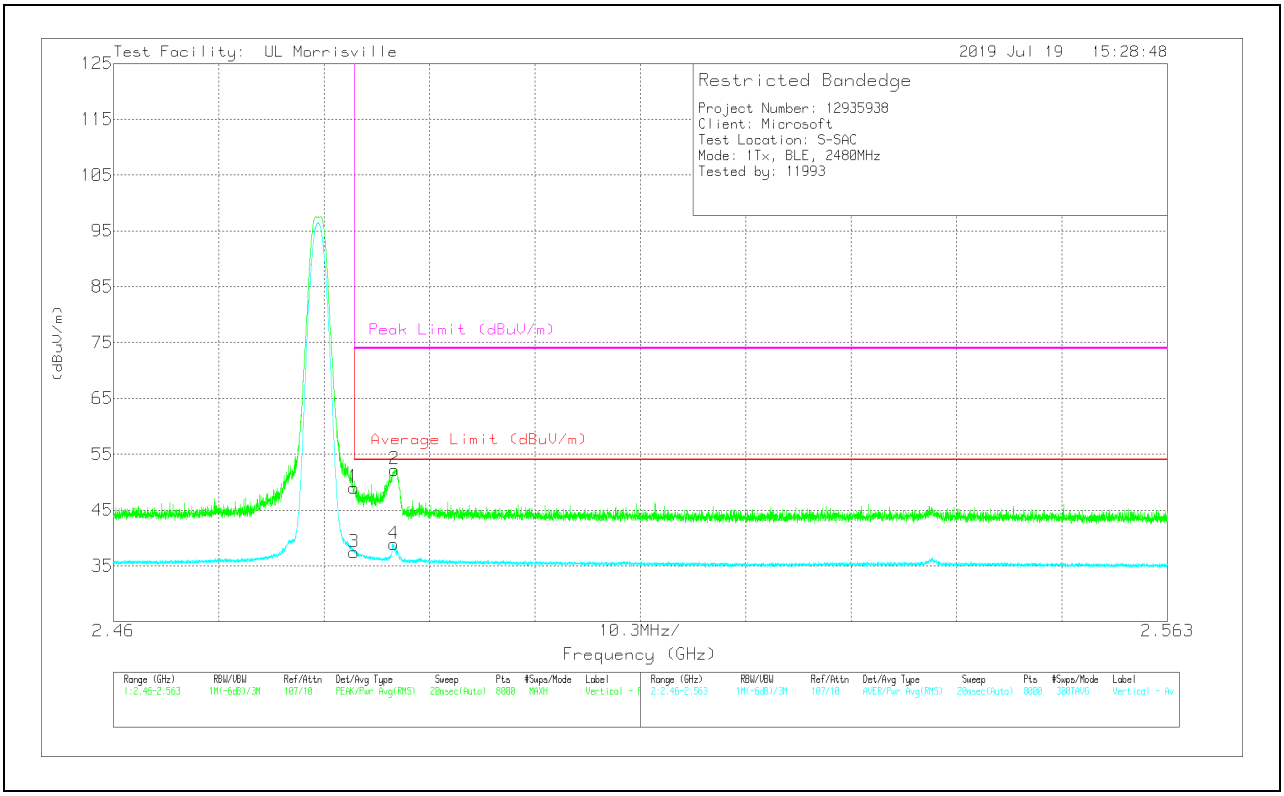
HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.4835	40.47	Pk	32.3	-24.5	0	48.27	-	-	74	-25.73	259	356	H
2	* ** 2.4876	43.43	Pk	32.3	-24.5	0	51.23	-	-	74	-22.77	259	356	H
3	* ** 2.4835	26.83	RMS	32.3	-24.5	2.07	36.7	54	-17.3	-	-	259	356	H
4	* ** 2.4874	28.03	RMS	32.3	-24.5	2.07	37.9	54	-16.1	-	-	259	356	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



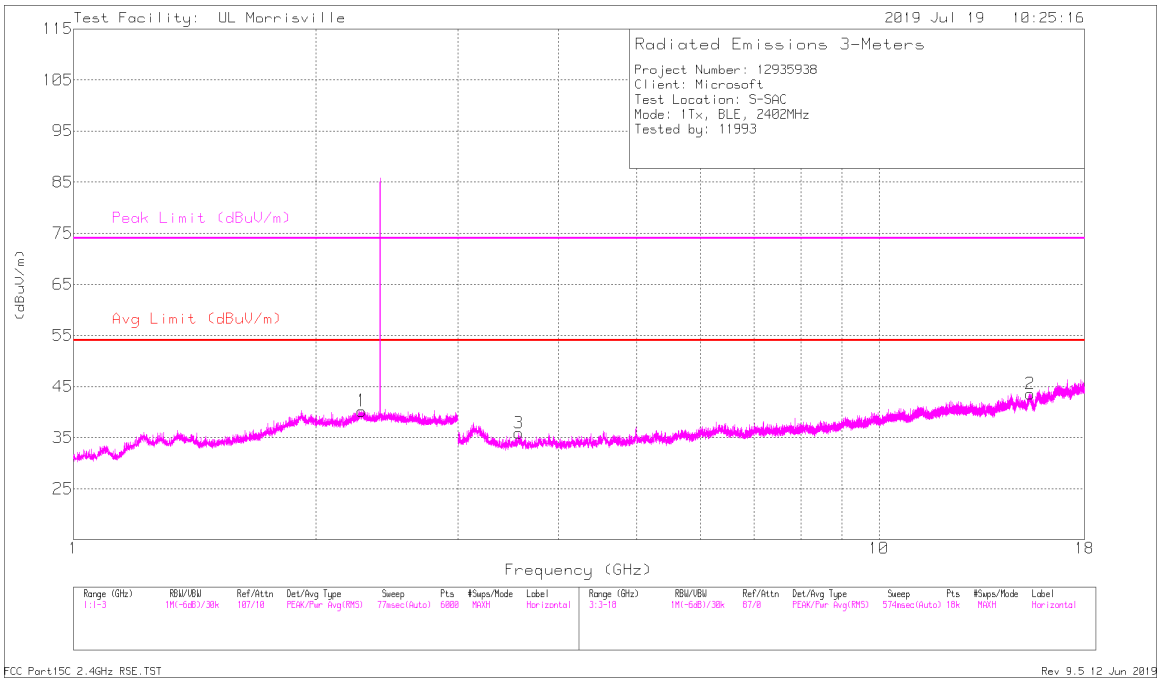
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.4835	41.23	Pk	32.3	-24.5	0	49.03	-	-	74	-24.97	249	316	V
2	* ** 2.48748	44.45	Pk	32.3	-24.5	0	52.25	-	-	74	-21.75	249	316	V
3	* ** 2.4835	27.57	RMS	32.3	-24.5	2.07	37.44	54	-16.56	-	-	249	316	V
4	* ** 2.48739	29.02	RMS	32.3	-24.5	2.07	38.89	54	-15.11	-	-	249	316	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

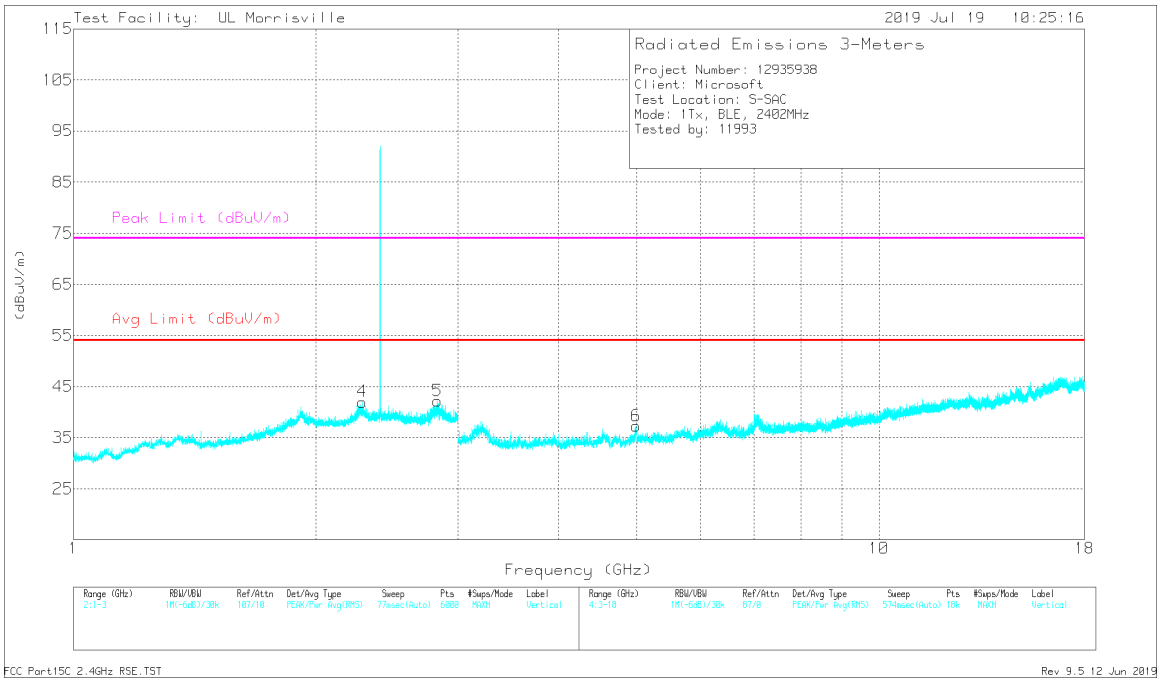
UL LLC
12 Laboratory Dr., RTP, NC 27709; USA TEL:(919) 549-1400

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



HORIZONTAL



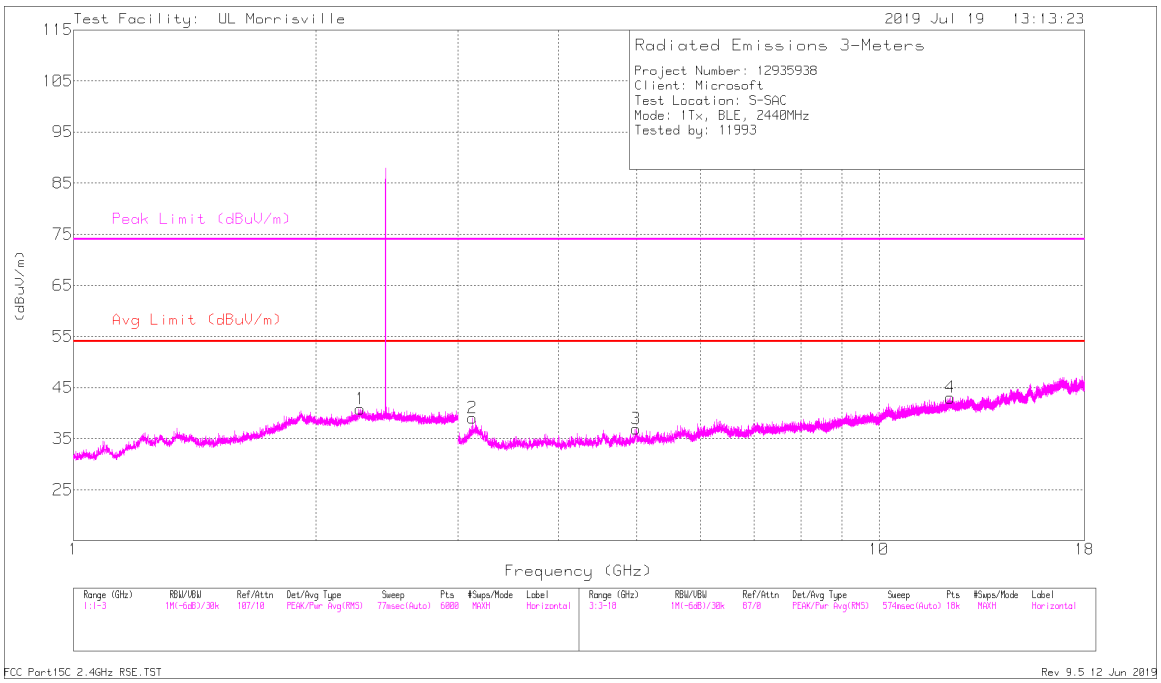
VERTICAL

RADIATED EMISSIONS

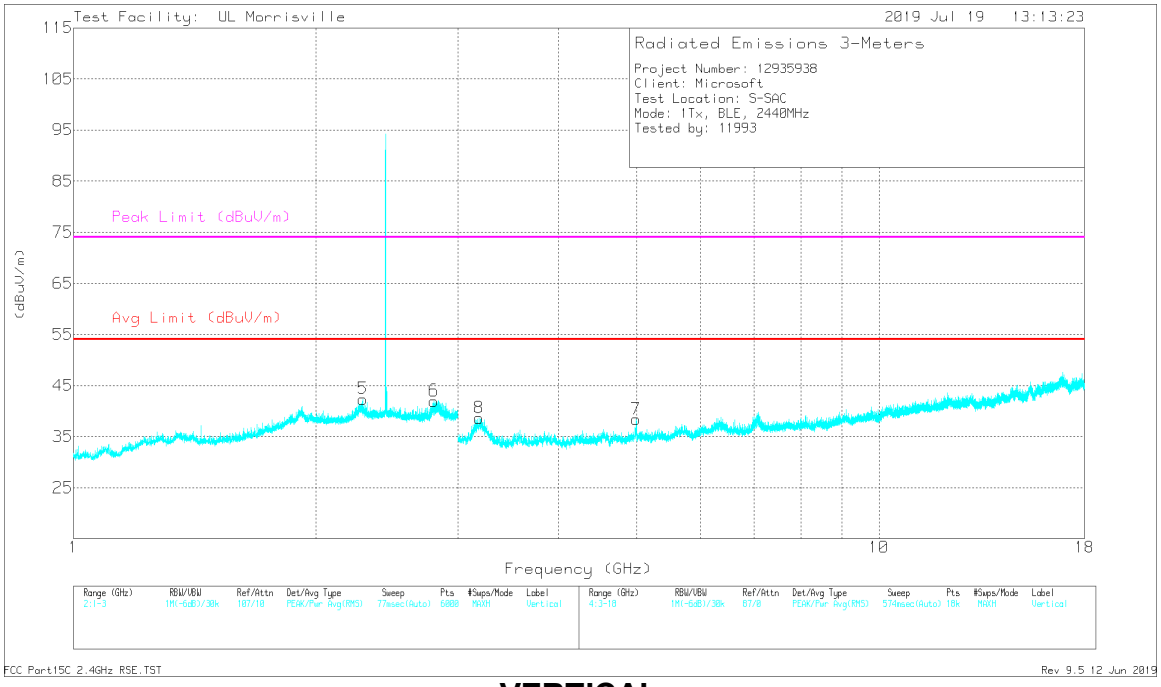
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.27946	38.34	PK2	31.8	-23.5	0	46.64	-	-	74	-27.36	149	115	H
	* ** 2.27962	26.68	MAv1	31.8	-23.5	2.07	37.05	54	-16.95	-	-	149	115	H
4	* ** 2.28098	41.03	PK2	31.8	-23.5	0	49.33	-	-	74	-24.67	105	219	V
	* ** 2.28139	28.47	MAv1	31.8	-23.5	2.07	38.84	54	-15.16	-	-	105	219	V
5	* ** 2.8303	45.08	PK2	32.1	-25.9	0	51.28	-	-	74	-22.72	102	255	V
	* ** 2.83039	32.76	MAv1	32.1	-25.9	2.07	41.03	54	-12.97	-	-	102	255	V
2	* ** 15.40946	33.57	PK2	39.9	-21.6	0	51.87	-	-	74	-22.13	138	216	H
	* ** 15.4093	21.5	MAv1	39.9	-21.6	2.07	41.87	54	-12.13	-	-	138	216	H
3	* ** 3.57228	41.24	PK2	32.9	-32.1	0	42.04	-	-	74	-31.96	261	370	H
	* ** 3.57167	29.01	MAv1	32.9	-32.1	2.07	31.88	54	-22.12	-	-	261	370	H
6	* ** 4.99541	42.66	PK2	34.2	-31.1	0	45.76	-	-	74	-28.24	294	112	V
	* ** 4.9951	28.9	MAv1	34.2	-31.1	2.07	34.07	54	-19.93	-	-	294	112	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



HORIZONTAL



VERTICAL

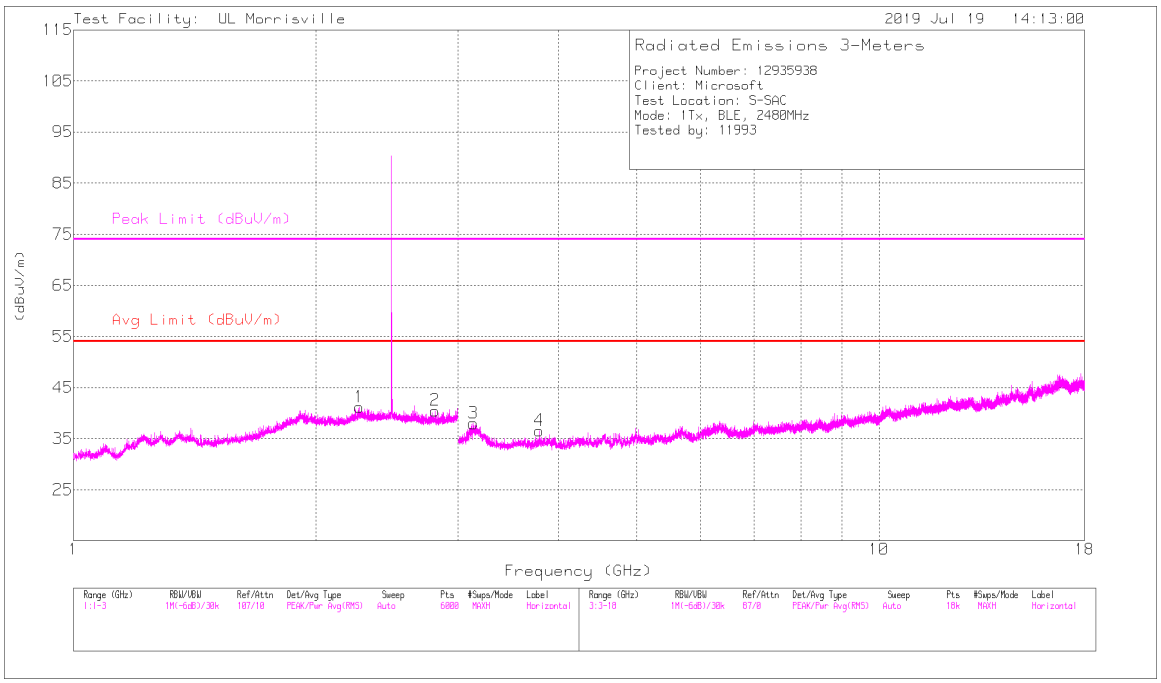
RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.2713	38.88	PK2	31.8	-23.4	0	47.28	-	-	74	-26.72	176	198	H
	* ** 2.27185	26.81	MAv1	31.8	-23.4	2.07	37.28	54	-16.72	-	-	176	198	H
5	* ** 2.28749	40.72	PK2	31.8	-23.5	0	49.02	-	-	74	-24.98	99	226	V
	* ** 2.28735	29.08	MAv1	31.8	-23.5	2.07	39.45	54	-14.55	-	-	99	226	V
6	* ** 2.80028	43.88	PK2	32.2	-25.8	0	50.28	-	-	74	-23.72	102	263	V
	* ** 2.80141	32.31	MAv1	32.2	-25.8	2.07	40.78	54	-13.22	-	-	102	263	V
3	* ** 4.99585	42.28	PK2	34.2	-31.1	0	45.38	-	-	74	-28.62	287	179	H
	* ** 4.99579	28.4	MAv1	34.2	-31.1	2.07	33.57	54	-20.43	-	-	287	179	H
4	* ** 12.25298	33.69	PK2	38.9	-23.7	0	48.89	-	-	74	-25.11	149	180	H
	* ** 12.25464	22.22	MAv1	38.9	-23.7	2.07	39.49	54	-14.51	-	-	149	180	H
7	* ** 4.99687	42.55	PK2	34.2	-31.1	0	45.65	-	-	74	-28.35	301	108	V
	* ** 4.996	28.96	MAv1	34.2	-31.1	2.07	34.13	54	-19.87	-	-	301	108	V
2	3.12751	38.51	Pk	33.2	-32.7	0	39.01	-	-	-	-	0-360	199	H
8	3.18584	38.03	Pk	33.1	-32.5	0	38.63	-	-	-	-	0-360	199	V

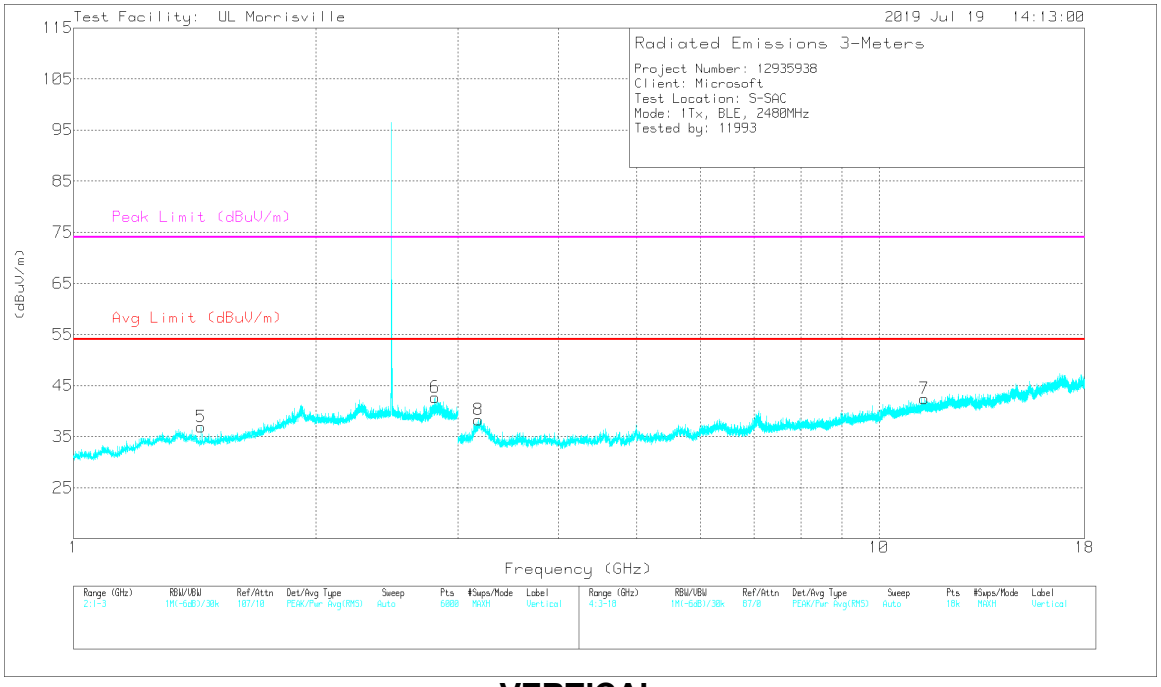
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
PK2 - Maximum Peak
MAv1 - Maximum RMS Average
Pk - Peak detector

UL LLC
12 Laboratory Dr., RTP, NC 27709; USA TEL:(919) 549-1400

HIGH CHANNEL RESULTS



HORIZONTAL



VERTICAL

RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.26454	39.67	PK2	31.8	-23.3	0	48.17	-	-	74	-25.83	175	188	H
	* ** 2.26412	26.58	MAv1	31.7	-23.3	2.07	37.05	54	-16.95	-	-	175	188	H
2	* ** 2.81029	40.45	PK2	32.1	-25.9	0	46.65	-	-	74	-27.35	172	236	H
	* ** 2.8095	28.37	MAv1	32.1	-25.9	2.07	36.64	54	-17.36	-	-	172	236	H
5	* ** 1.4399	37.27	PK2	28.1	-22.7	0	42.67	-	-	74	-31.33	306	220	V
	* ** 1.44005	28.89	MAv1	28.1	-22.7	2.07	36.36	54	-17.64	-	-	306	220	V
6	* ** 2.81241	44.64	PK2	32.1	-25.9	0	50.84	-	-	74	-23.16	98	251	V
	* ** 2.81261	33.01	MAv1	32.1	-25.9	2.07	41.28	54	-12.72	-	-	98	251	V
4	* ** 3.78784	41.45	PK2	33.4	-32.6	0	42.25	-	-	74	-31.75	308	365	H
	* ** 3.78746	28.99	MAv1	33.4	-32.6	2.07	31.86	54	-22.14	-	-	308	365	H
7	* ** 11.3894	34.56	PK2	38.1	-23.3	0	49.36	-	-	74	-24.64	75	230	V
	* ** 11.38995	21.71	MAv1	38.1	-23.3	2.07	38.58	54	-15.42	-	-	75	230	V
3	3.13584	37.4	Pk	33.2	-32.6	0	38	-	-	-	-	0-360	101	H
8	3.18334	37.67	Pk	33.1	-32.5	0	38.27	-	-	-	-	0-360	199	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
Pk - Peak detector

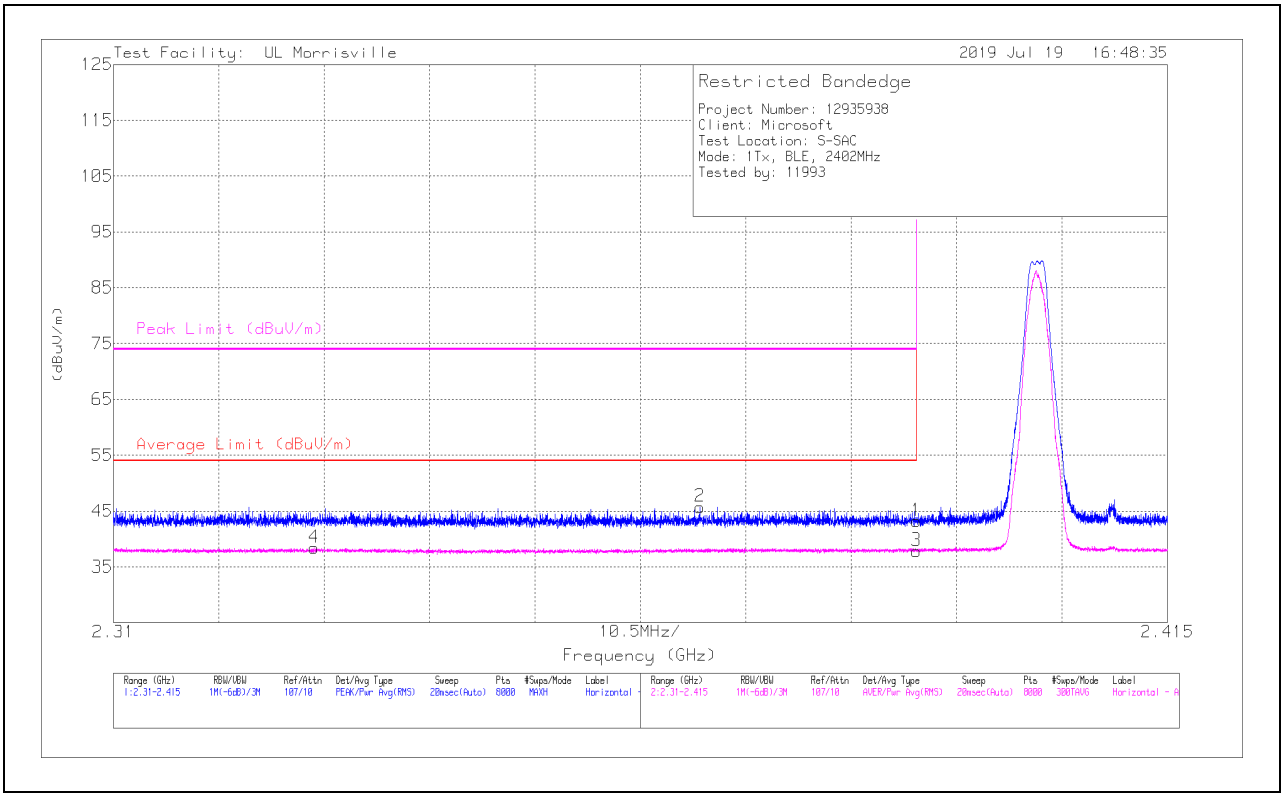
UL LLC
12 Laboratory Dr., RTP, NC 27709; USA TEL:(919) 549-1400

10.2.4. BLE (2Mbps)

Antenna 1

BANDEDGE (LOW CHANNEL)

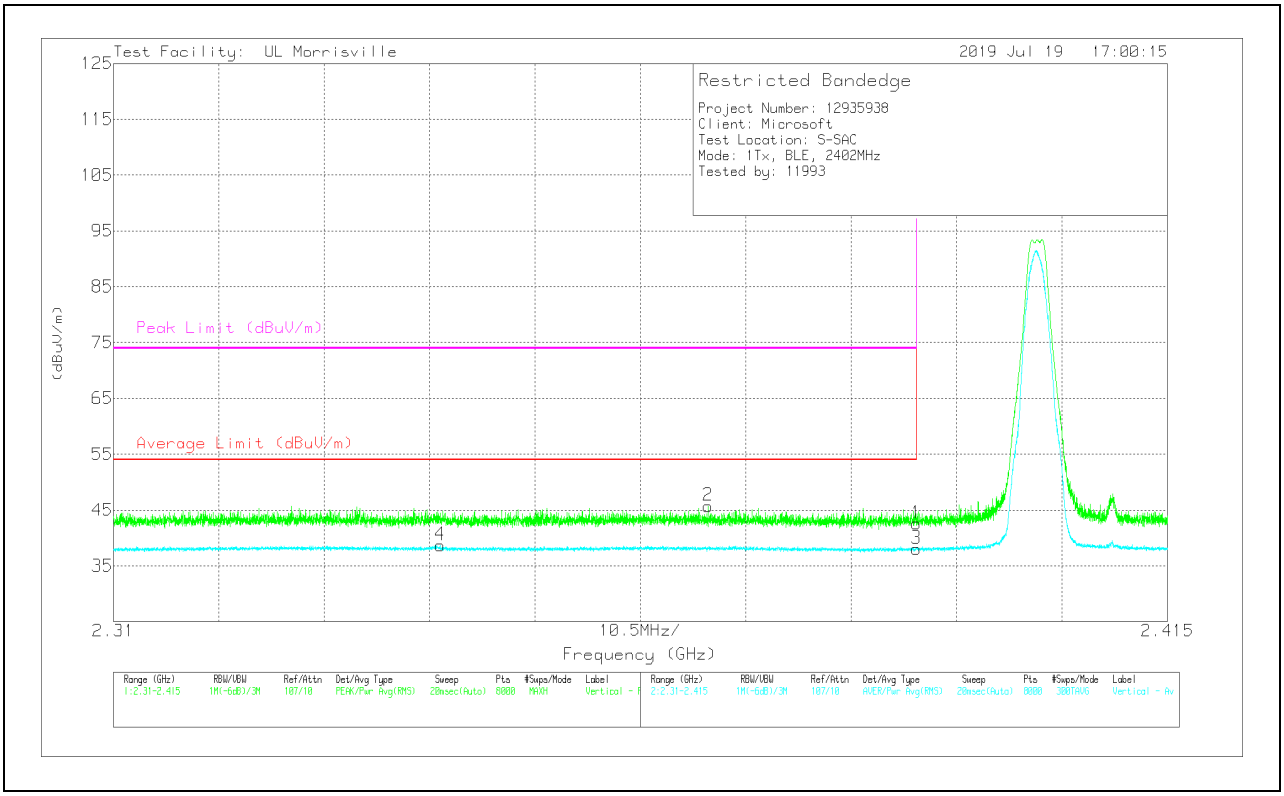
HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.39	35.34	Pk	31.9	-24	0	43.24	-	-	74	-30.76	267	335	H
2	* ** 2.3684	37.93	Pk	31.8	-24	0	45.73	-	-	74	-28.27	267	335	H
3	* ** 2.39	25.11	RMS	31.9	-24	4.83	37.84	54	-16.16	-	-	267	335	H
4	* ** 2.32997	25.56	RMS	31.7	-23.7	4.83	38.39	54	-15.61	-	-	267	335	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



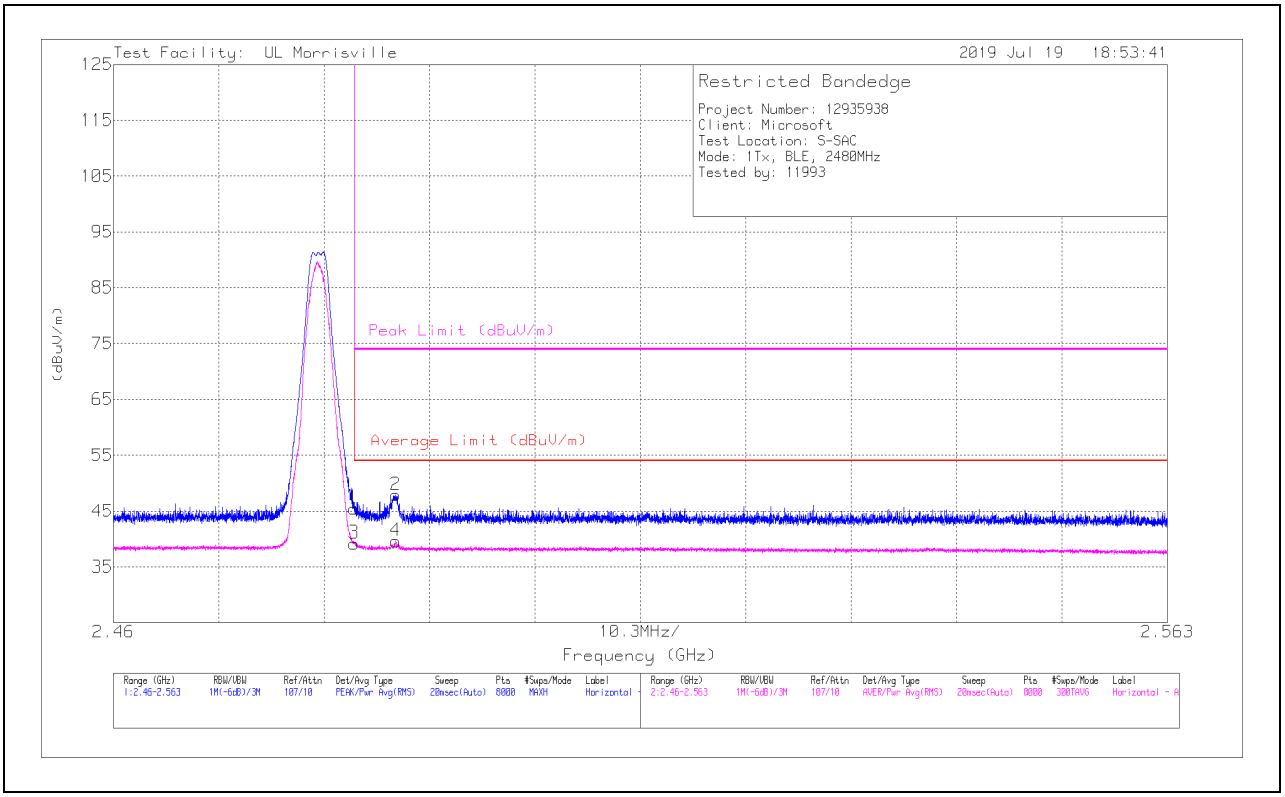
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.39	34.69	Pk	31.9	-24	0	42.59	-	-	74	-31.41	244	337	V
2	* ** 2.36926	37.93	Pk	31.8	-24	0	45.73	-	-	74	-28.27	244	337	V
3	* ** 2.39	25.36	RMS	31.9	-24	4.83	38.09	54	-15.91	-	-	244	337	V
4	* ** 2.34257	25.99	RMS	31.6	-23.7	4.83	38.72	54	-15.28	-	-	244	337	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

UL LLC
12 Laboratory Dr., RTP, NC 27709; USA TEL:(919) 549-1400

BANDEDGE (HIGH CHANNEL)

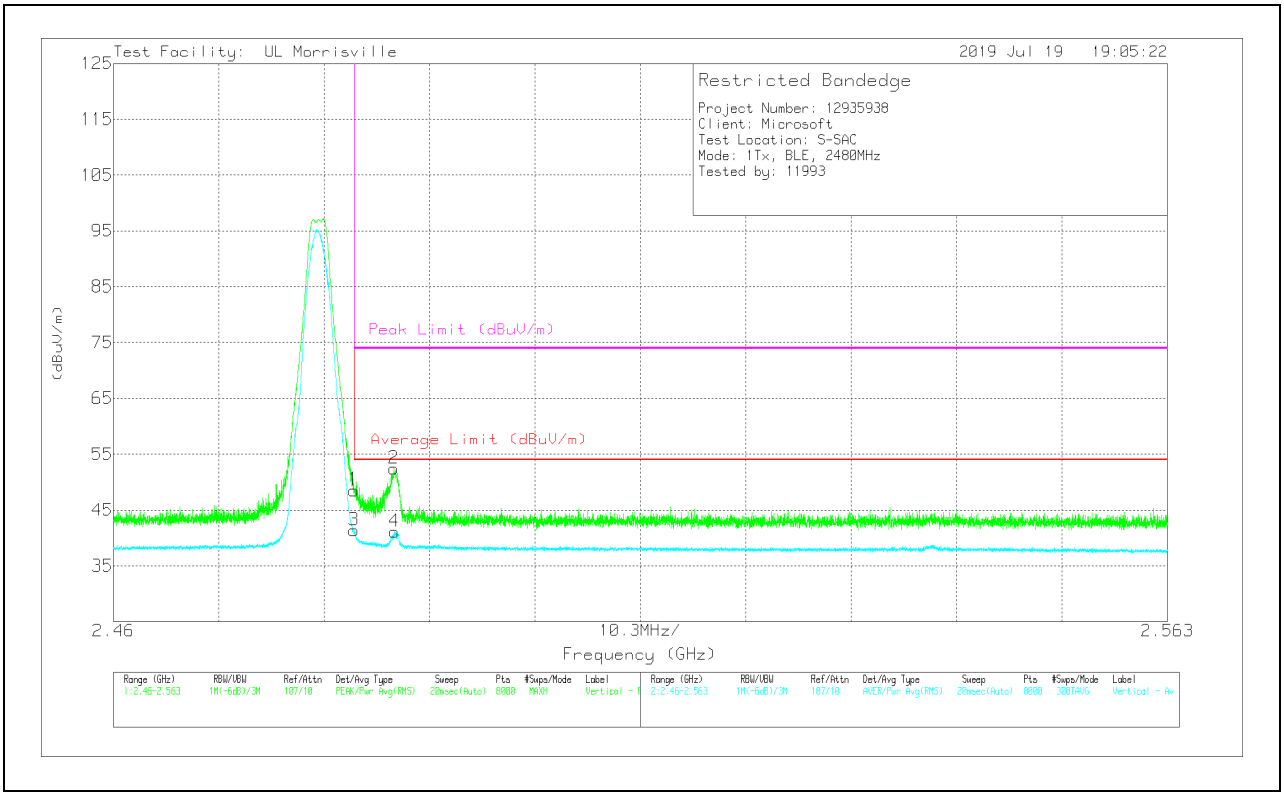
HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.4835	37.66	Pk	32.3	-24.5	0	45.46	-	-	74	-28.54	95	126	H
2	* ** 2.48756	40.11	Pk	32.3	-24.5	0	47.91	-	-	74	-26.09	95	126	H
3	* ** 2.4835	26.58	RMS	32.3	-24.5	4.83	39.21	54	-14.79	-	-	95	126	H
4	* ** 2.48758	26.97	RMS	32.3	-24.5	4.83	39.6	54	-14.4	-	-	95	126	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



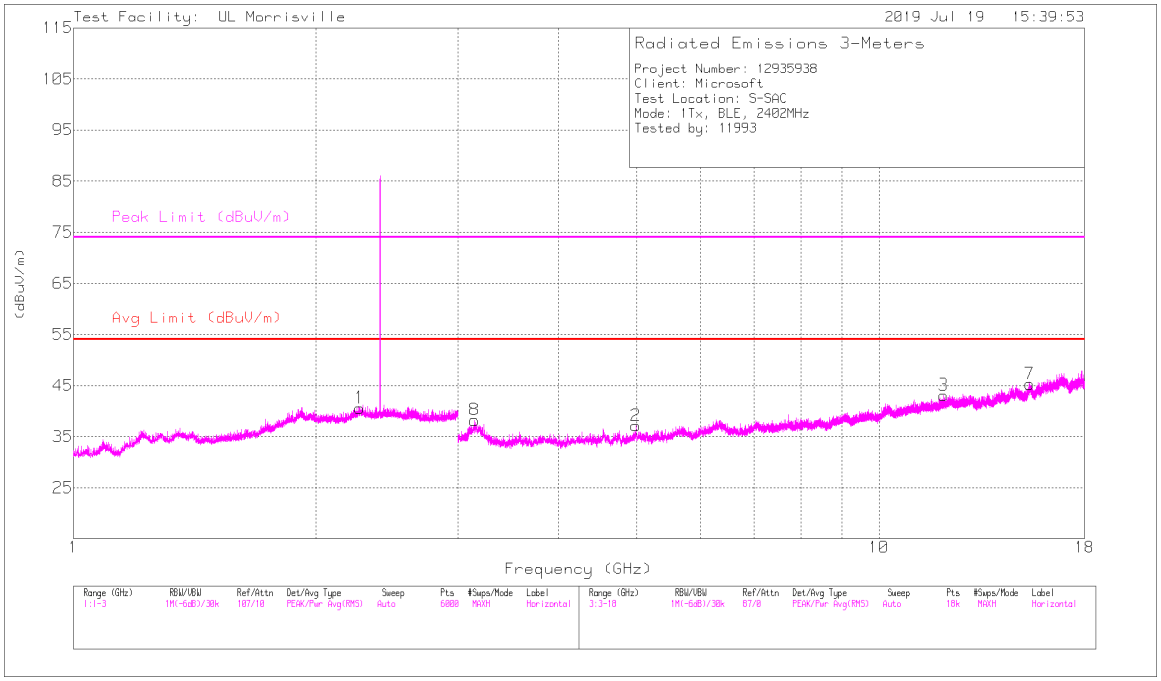
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.4835	40.74	Pk	32.3	-24.5	0	48.54	-	-	74	-25.46	233	129	V
2	* ** 2.48738	44.66	Pk	32.3	-24.5	0	52.46	-	-	74	-21.54	233	129	V
3	* ** 2.4835	28.71	RMS	32.3	-24.5	4.83	41.34	54	-12.66	-	-	233	129	V
4	* ** 2.48748	28.47	RMS	32.3	-24.5	4.83	41.1	54	-12.9	-	-	233	129	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

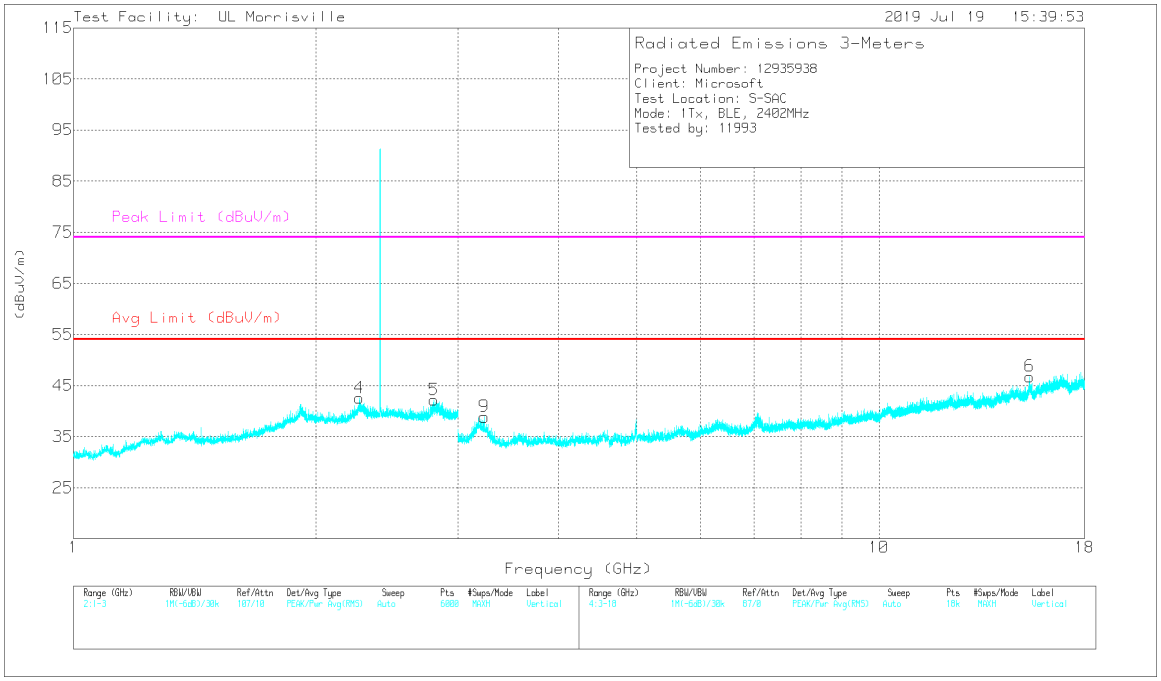
UL LLC
12 Laboratory Dr., RTP, NC 27709; USA TEL:(919) 549-1400

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



HORIZONTAL



VERTICAL

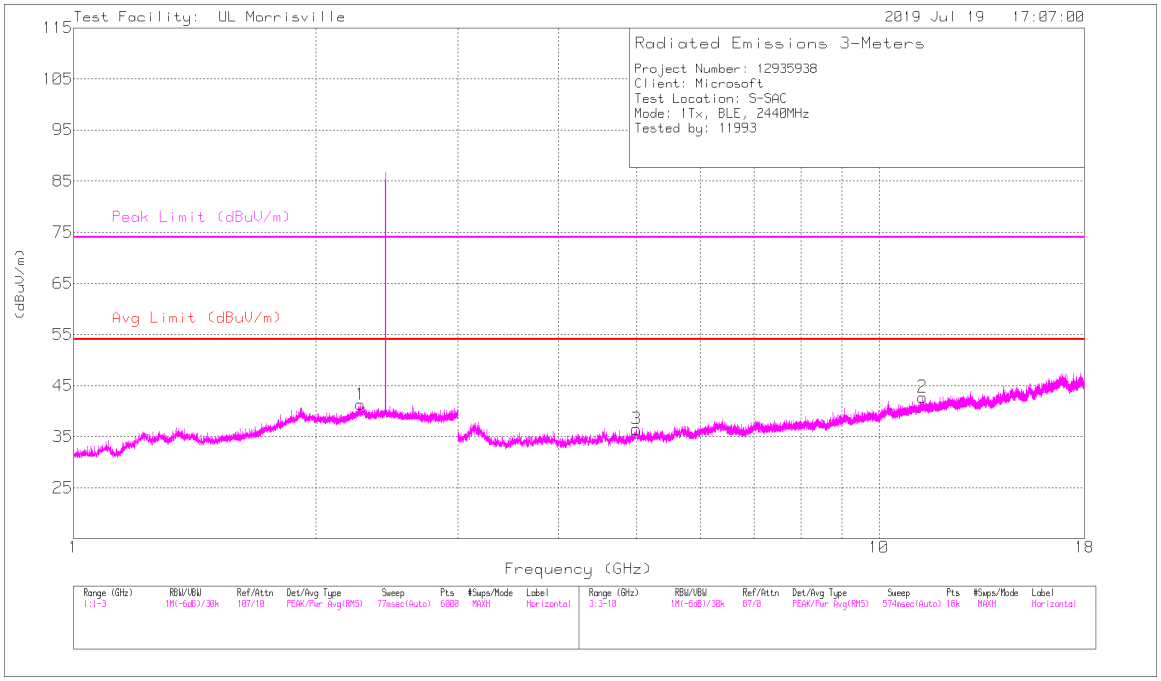
RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.26463	39.36	PK2	31.8	-23.3	0	47.86	-	-	74	-26.14	235	222	H
	* ** 2.26414	27.06	MAv1	31.7	-23.3	4.83	40.29	54	-13.71	-	-	235	222	H
4	* ** 2.2654	40.94	PK2	31.8	-23.3	0	49.44	-	-	74	-24.56	103	233	V
	* ** 2.26454	28.91	MAv1	31.8	-23.3	4.83	42.24	54	-11.76	-	-	103	233	V
5	* ** 2.80358	44.13	PK2	32.2	-25.9	0	50.43	-	-	74	-23.57	105	233	V
	* ** 2.80334	32.42	MAv1	32.2	-25.9	4.83	43.55	54	-10.45	-	-	105	233	V
2	* ** 4.99399	41.78	PK2	34.2	-31.1	0	44.88	-	-	74	-29.12	353	130	H
	* ** 4.99297	28.77	MAv1	34.1	-31.1	4.83	36.6	54	-17.4	-	-	353	130	H
3	* ** 12.02445	34.59	PK2	38.7	-23.5	0	49.79	-	-	74	-24.21	33	152	H
	* ** 12.02523	21.79	MAv1	38.7	-23.5	4.83	41.82	54	-12.18	-	-	33	152	H
7	* ** 15.38413	33.95	PK2	39.9	-21.5	0	52.35	-	-	74	-21.65	179	271	H
	* ** 15.38428	21.71	MAv1	39.9	-21.5	4.83	44.94	54	-9.06	-	-	179	271	H
6	* ** 15.38697	33.15	PK2	39.9	-21.5	0	51.55	-	-	74	-22.45	244	334	V
	* ** 15.38653	21.39	MAv1	39.9	-21.5	4.83	44.62	54	-9.38	-	-	244	334	V
8	3.14668	37.54	Pk	33.2	-32.5	0	38.24	-	-	-	-	0-360	101	H
9	3.23501	38.67	Pk	33.1	-32.9	0	38.87	-	-	-	-	0-360	199	V

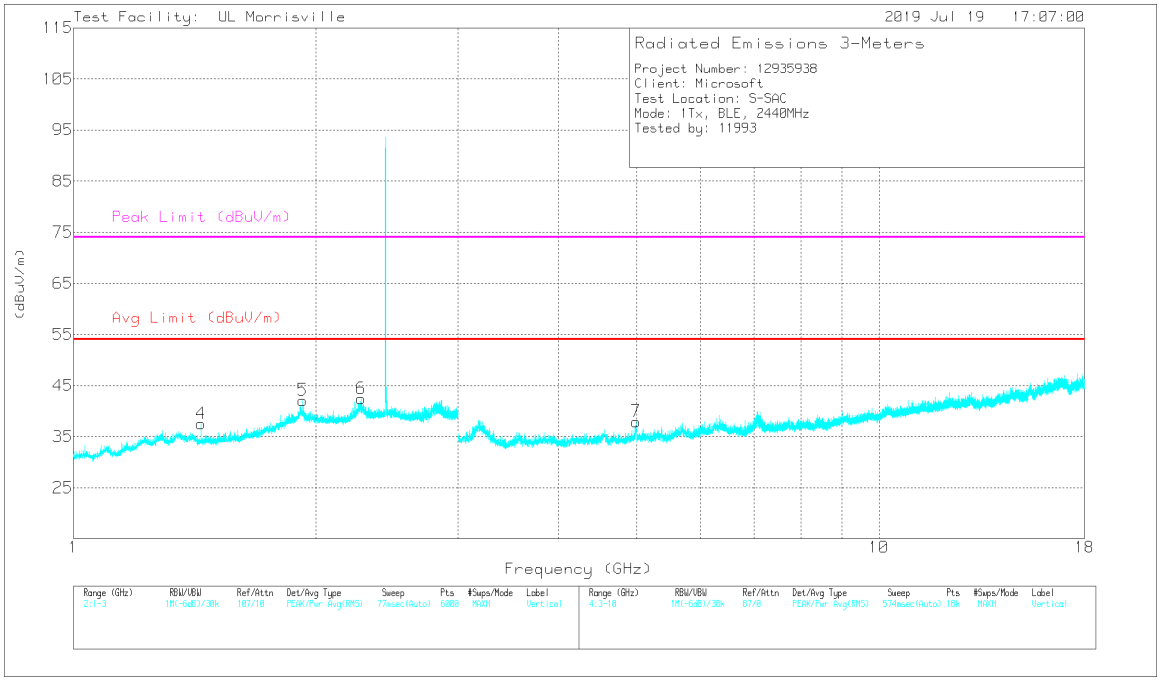
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
PK2 - Maximum Peak
MAv1 - Maximum RMS Average
Pk - Peak detector

UL LLC
12 Laboratory Dr., RTP, NC 27709; USA TEL:(919) 549-1400

MID CHANNEL RESULTS



HORIZONTAL



VERTICAL

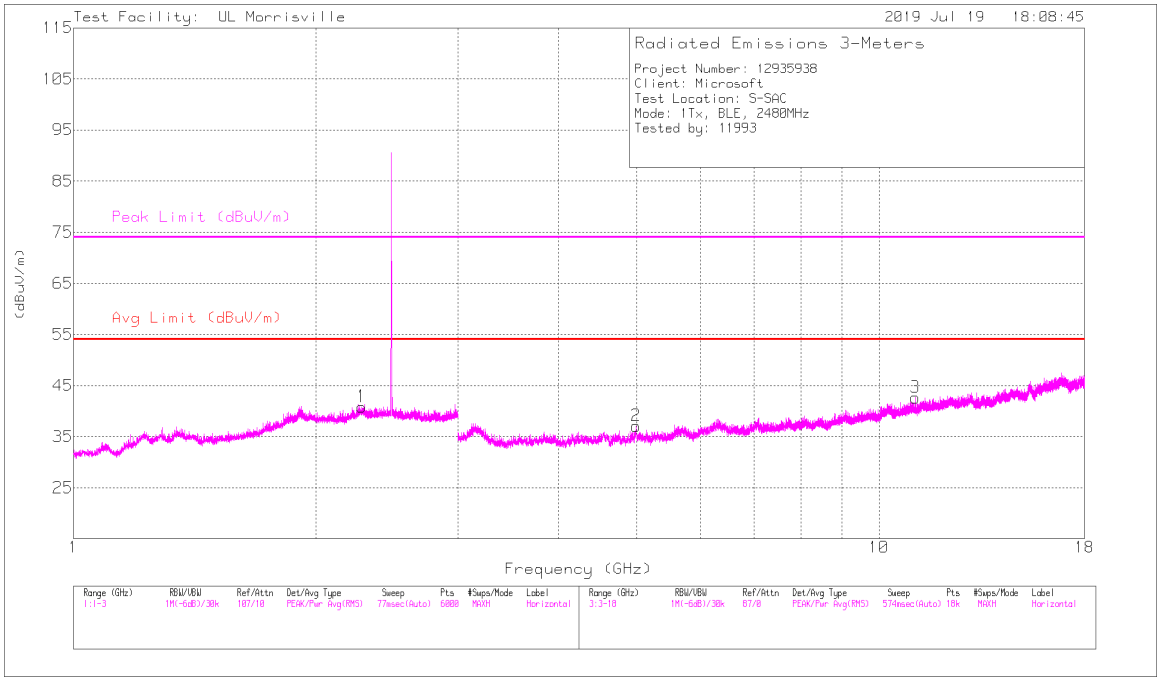
RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.2705	39.03	PK2	31.8	-23.4	0	47.43	-	-	74	-26.57	233	211	H
	* ** 2.27039	26.89	MAv1	31.8	-23.4	4.83	40.12	54	-13.88	-	-	233	211	H
4	* ** 1.43975	37.92	PK2	28.1	-22.7	0	43.32	-	-	74	-30.68	314	238	V
	* ** 1.4401	28.47	MAv1	28.1	-22.7	4.83	38.7	54	-15.3	-	-	314	238	V
5	** 1.923	40.35	PK2	31.2	-22.4	0	49.15	-	-	74	-24.85	97	223	V
	** 1.92292	28.11	MAv1	31.2	-22.4	4.83	41.74	54	-12.26	-	-	97	223	V
6	* ** 2.275	41.33	PK2	31.8	-23.5	0	49.63	-	-	74	-24.37	102	202	V
	* ** 2.27521	29.06	MAv1	31.8	-23.5	4.83	42.19	54	-11.81	-	-	102	202	V
2	* ** 11.32482	34.63	PK2	38	-22.8	0	49.83	-	-	74	-24.17	301	207	H
	* ** 11.32504	21.28	MAv1	38	-22.8	4.83	41.31	54	-12.69	-	-	301	207	H
3	* ** 4.99904	42.12	PK2	34.2	-31.1	0	45.22	-	-	74	-28.78	325	107	H
	* ** 4.99897	28.57	MAv1	34.2	-31.1	4.83	36.5	54	-17.5	-	-	325	107	H
7	* ** 4.99671	43.31	PK2	34.2	-31.1	0	46.41	-	-	74	-27.59	299	101	V
	* ** 4.99642	29.07	MAv1	34.2	-31.1	4.83	37	54	-17	-	-	299	101	V

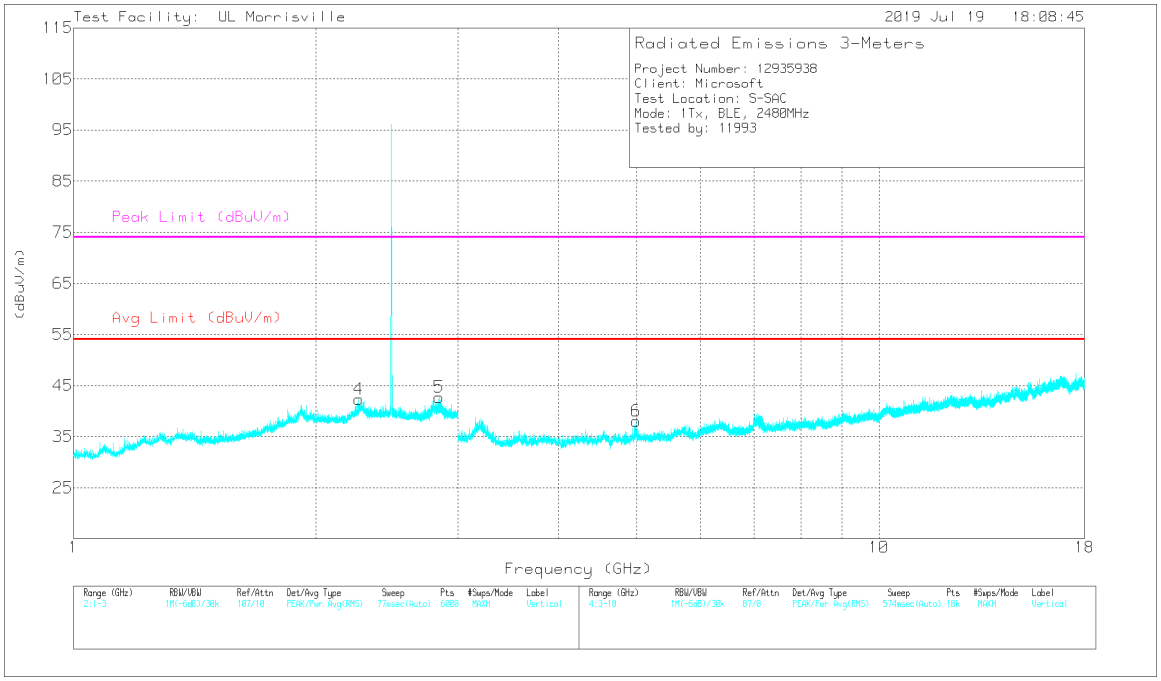
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
PK2 - Maximum Peak
MAv1 - Maximum RMS Average

UL LLC
12 Laboratory Dr., RTP, NC 27709; USA TEL:(919) 549-1400

HIGH CHANNEL RESULTS



HORIZONTAL



VERTICAL

RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.27906	37.83	PK2	31.8	-23.5	0	46.13	-	-	74	-27.87	40	344	H
	* ** 2.27916	25.92	MAv1	31.8	-23.5	4.83	39.05	54	-14.95	-	-	40	344	H
4	* ** 2.25789	40.17	PK2	31.7	-23.4	0	48.47	-	-	74	-25.53	108	176	V
	* ** 2.25935	28.13	MAv1	31.7	-23.4	4.83	41.26	54	-12.74	-	-	108	176	V
5	* ** 2.84441	43.93	PK2	32.1	-25.8	0	50.23	-	-	74	-23.77	104	230	V
	* ** 2.84441	32.36	MAv1	32.1	-25.8	4.83	43.49	54	-10.51	-	-	104	230	V
2	* ** 4.996	42.53	PK2	34.2	-31.1	0	45.63	-	-	74	-28.37	284	122	H
	* ** 4.99572	28.74	MAv1	34.2	-31.1	4.83	36.67	54	-17.33	-	-	284	122	H
3	* ** 11.10267	34.12	PK2	37.9	-24	0	48.02	-	-	74	-25.98	124	122	H
	* ** 11.10234	22.17	MAv1	37.9	-24	4.83	40.9	54	-13.1	-	-	124	122	H
6	* ** 4.99061	42.76	PK2	34.1	-31.1	0	45.76	-	-	74	-28.24	294	108	V
	* ** 4.98988	28.91	MAv1	34.1	-31.1	4.83	36.74	54	-17.26	-	-	294	108	V

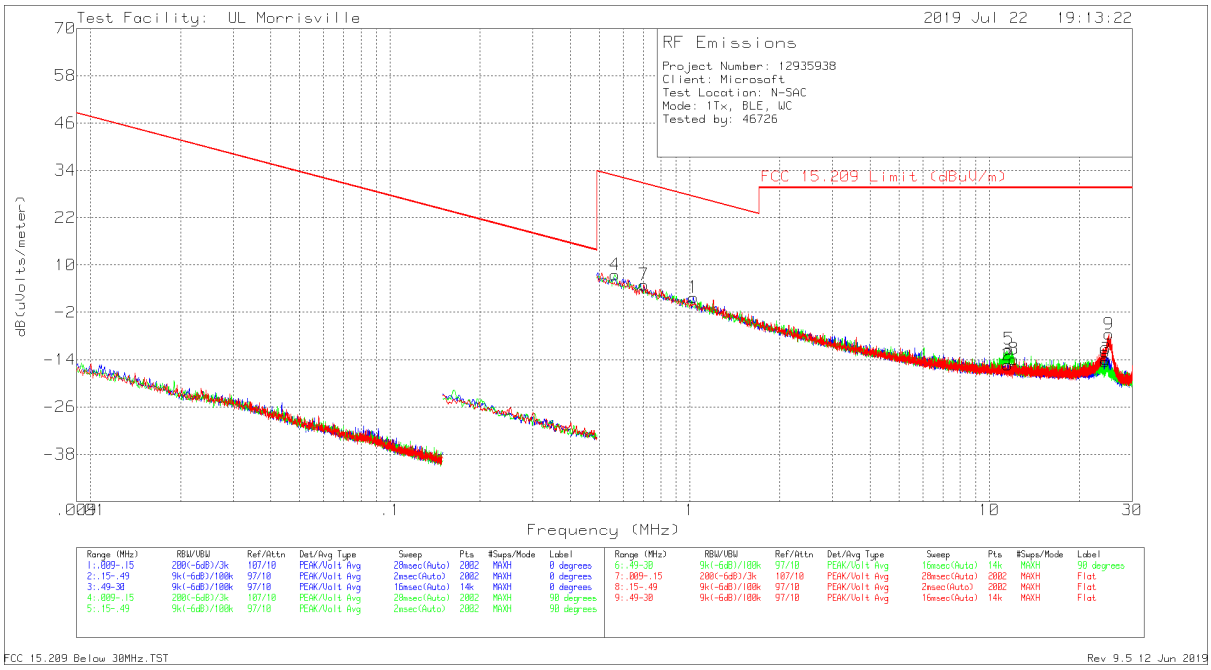
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
PK2 - Maximum Peak
MAv1 - Maximum RMS Average

UL LLC
12 Laboratory Dr., RTP, NC 27709; USA TEL:(919) 549-1400

10.3. 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

Below 30MHz Data

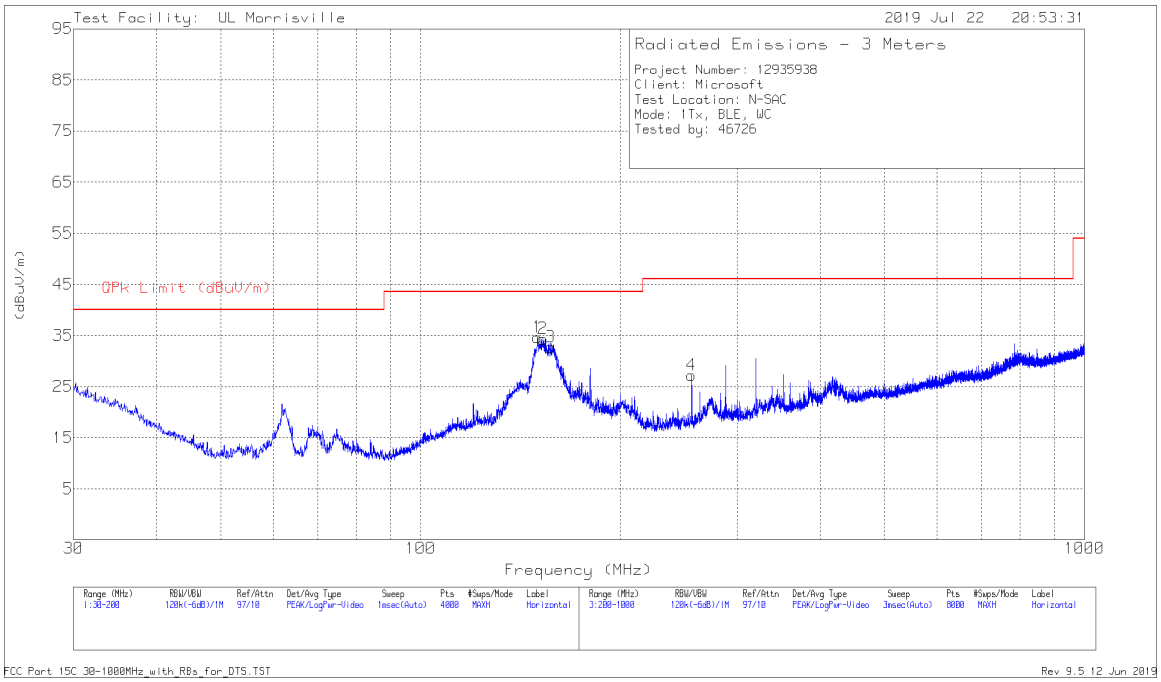
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0059 (dB/m)	Cbl (dB)	Dist. Corr. Factor (dB)	Corrected Reading dB(uVolts/meter)	FCC 15.209 Avg/QP Limit (dBuV/m)	FCC 15.209 Pk Limit (dBuV/m)	Worst-Case Margin (dB)	Azimuth (Degs)
4	.56273	37.04	Pk	10.4	.1	-40	7.54	32.6	-	-25.06	0-360
7	.70291	34.5	Pk	10.4	.1	-40	5	30.67	-	-25.67	0-360
1	1.02965	30.99	Pk	10.6	.2	-40	1.79	27.35	-	-25.56	0-360
2	11.5296	13.23	Pk	10.8	.6	-40	-15.37	29.54	-	-44.91	0-360
5	11.65818	17.3	Pk	10.8	.6	-40	-11.3	29.54	-	-40.84	0-360
8	12.09243	14.74	Pk	10.8	.6	-40	-13.86	29.54	-	-43.4	0-360
6	24.39472	15.1	Pk	9.5	.8	-40	-14.6	29.54	-	-44.14	0-360
3	24.4938	15.86	Pk	9.5	.8	-40	-13.84	29.54	-	-43.38	0-360
9	25.06085	22.27	Pk	9.3	.9	-40	-7.53	29.54	-	-37.07	0-360

Pk - Peak detector

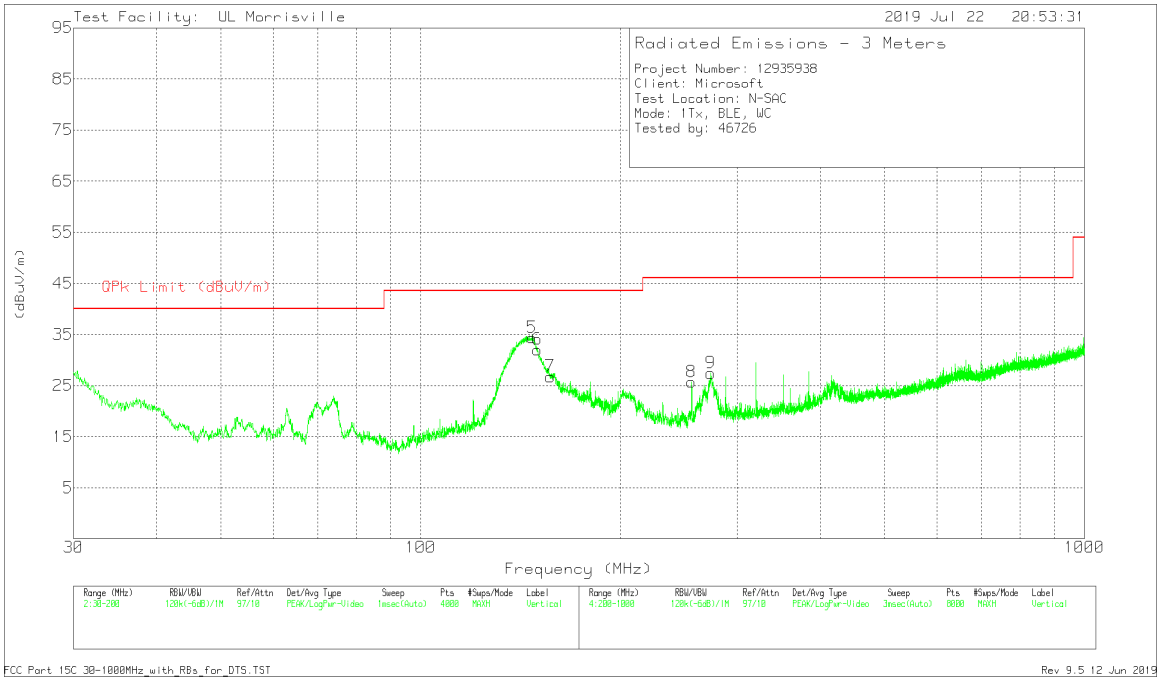
UL LLC
12 Laboratory Dr., RTP, NC 27709; USA TEL:(919) 549-1400

10.4. WORST CASE BELOW 1 GHZ

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



HORIZONTAL



VERTICAL

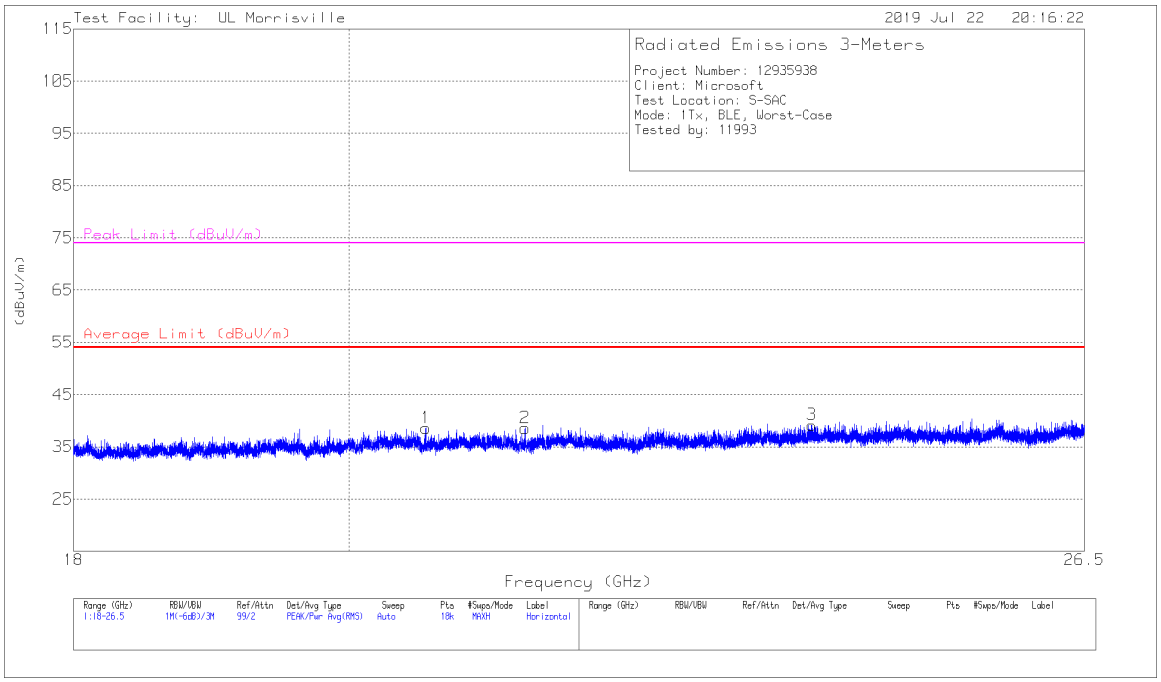
Below 1GHz Data

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
1	* ** 149.966	46.12	Pk	19	-30.5	34.62	43.52	-8.9	0-360	199	H
3	* ** 156.8528	44.29	Pk	18.8	-30.4	32.69	43.52	-10.83	0-360	199	H
6	* ** 149.966	43.56	Pk	19	-30.5	32.06	43.52	-11.46	0-360	102	V
7	* ** 156.8103	38.38	Pk	18.8	-30.4	26.78	43.52	-16.74	0-360	102	V
4	* ** 256.0073	38.51	Pk	18.4	-29.7	27.21	46.02	-18.81	0-360	102	H
8	* ** 256.0073	37.04	Pk	18.4	-29.7	25.74	46.02	-20.28	0-360	199	V
9	* ** 273.7096	37.12	Pk	19.8	-29.5	27.42	46.02	-18.6	0-360	102	V
5	147.1178	45.77	Pk	19.1	-30.5	34.37	43.52	-9.15	0-360	102	V
2	152.8568	45.83	Pk	18.9	-30.4	34.33	43.52	-9.19	0-360	199	H

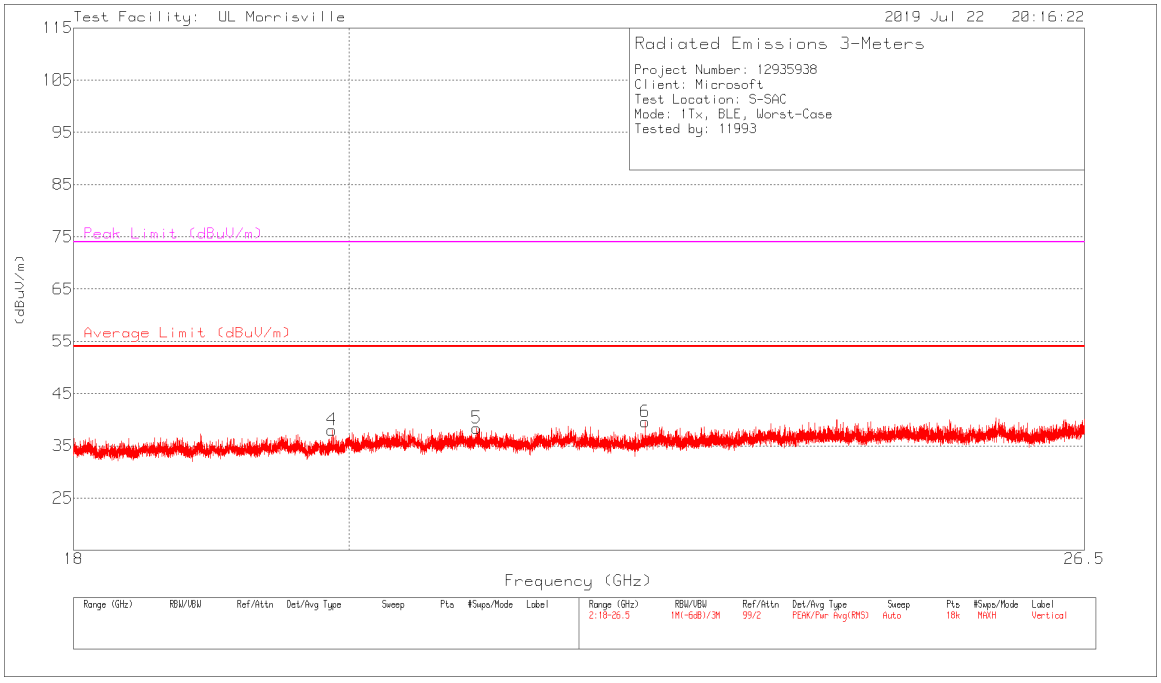
Pk - Peak detector

10.5. WORST CASE 18-26 GHZ

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



HORIZONTAL



VERTICAL

18 – 26GHz DATA

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	* ** 20.59689	43.88	Pk	32.9	-38.2	38.58	54	-15.42	74	-35.42	0-360	199	H
2	* ** 21.39405	43.77	Pk	33.1	-38.3	38.57	54	-15.43	74	-35.43	0-360	149	H
3	* ** 23.87288	42.48	Pk	34	-37.3	39.18	54	-14.82	74	-34.82	0-360	149	H
4	* ** 19.8701	43.86	Pk	32.7	-38.5	38.06	54	-15.94	74	-35.94	0-360	201	V
5	* ** 21.00114	43.41	Pk	33.2	-38.2	38.41	54	-15.59	74	-35.59	0-360	251	V
6	* ** 22.39946	44.08	Pk	33.5	-38	39.58	54	-14.42	74	-34.42	0-360	251	V

Pk - Peak detector

UL LLC
12 Laboratory Dr., RTP, NC 27709; USA TEL:(919) 549-1400

11. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

RSS-Gen 8.8

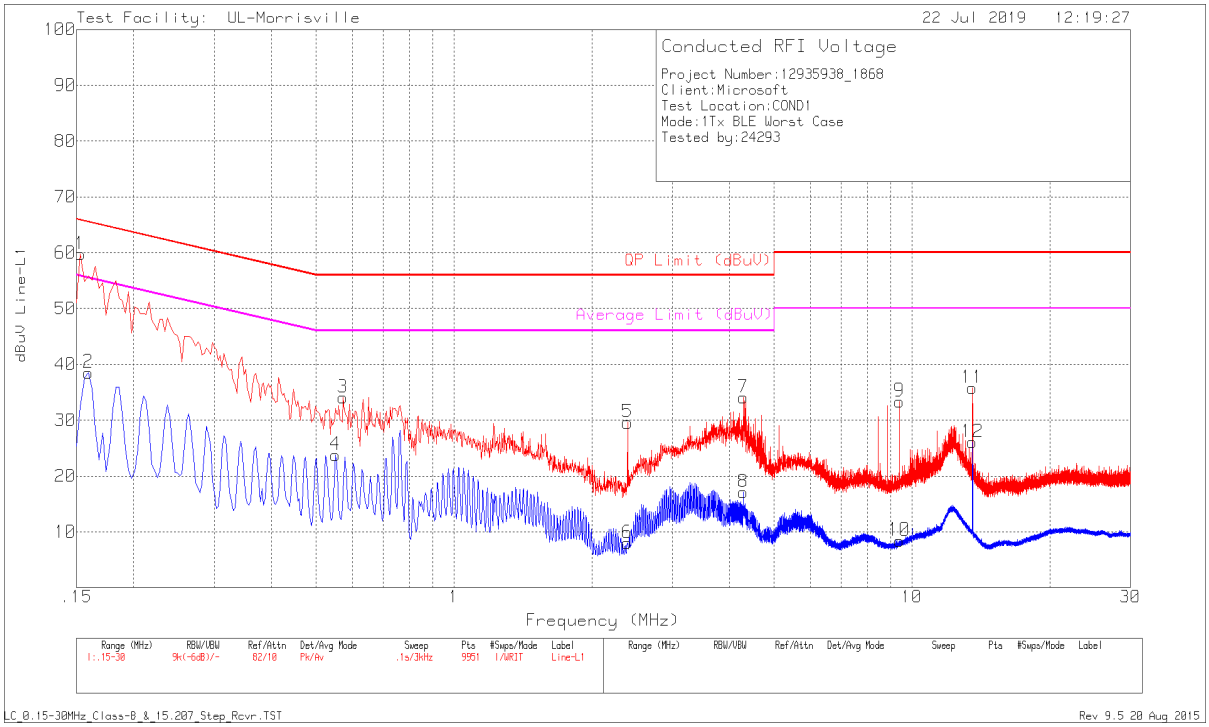
Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.

RESULTS

11.1.1. AC Power Line Norm

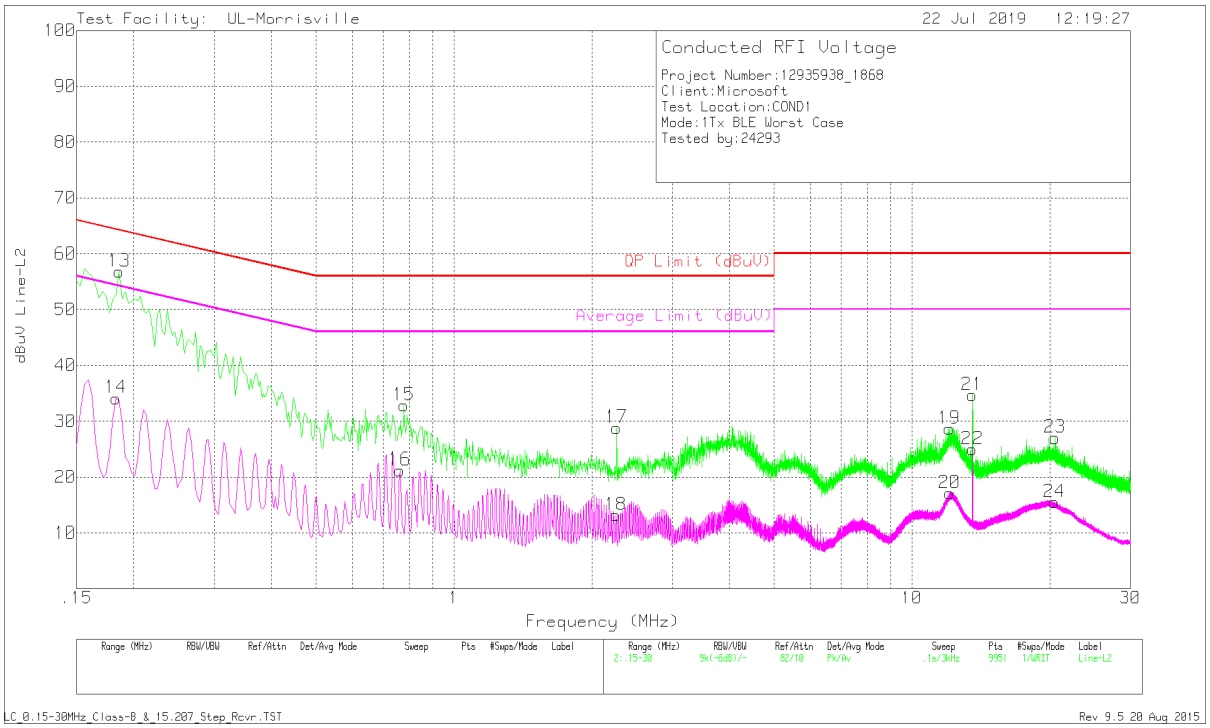
LINE 1 RESULTS



Range 1: Line-L1 .15 - 30MHz										
Marker	**Frequency (MHz)**	**Meter Reading (dBuV)**	**Det**	**LISN VCF (dB)**	**Cbl/Limiter (dB)**	**Corrected Reading dBuV**	**QP Limit (dBuV)**	**Margin (dB)**	**Average Limit (dBuV)**	**Margin (dB)**
1	.153	49.58	Pk	.2	10	59.78	65.84	-6.06	-	-
2	.159	28.35	Av	.2	10	38.55	-	-	55.52	-16.97
3	.573	24.05	Pk	0	10	34.05	56	-21.95	-	-
4	.552	13.8	Av	0	10	23.8	-	-	46	-22.2
5	2.394	19.5	Pk	0	10.1	29.6	56	-26.4	-	-
6	2.388	-2.11	Av	0	10.1	7.99	-	-	46	-38.01
7	4.284	23.88	Pk	0	10.2	34.08	56	-21.92	-	-
8	4.284	6.87	Av	0	10.2	17.07	-	-	46	-28.93
9	9.399	22.97	Pk	.1	10.3	33.37	60	-26.63	-	-
10	9.387	-1.97	Av	.1	10.3	8.43	-	-	50	-41.57
11	13.56	25.26	Pk	.1	10.4	35.76	60	-24.24	-	-
12	13.56	15.54	Av	.1	10.4	26.04	-	-	50	-23.96

Pk - Peak detector
Av – Average 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	.186	46.61	Pk	.2	10	56.81	64.21	-7.4	-	-
14	.183	23.93	Av	.2	10	34.13	-	-	54.35	-20.22
15	.777	22.86	Pk	0	10	32.86	56	-23.14	-	-
16	.762	11.21	Av	0	10	21.21	-	-	46	-24.79
17	2.268	18.72	Pk	0	10.1	28.82	56	-27.18	-	-
18	2.259	3.04	Av	0	10.1	13.14	-	-	46	-32.86
19	12.075	18.16	Pk	.1	10.4	28.66	60	-31.34	-	-
20	12.096	6.6	Av	.1	10.4	17.1	-	-	50	-32.9
21	13.56	24.18	Pk	.1	10.4	34.68	60	-25.32	-	-
22	13.56	14.45	Av	.1	10.4	24.95	-	-	50	-25.05
23	20.556	16.22	Pk	.2	10.6	27.02	60	-32.98	-	-
24	20.49	4.79	Av	.1	10.6	15.49	-	-	50	-34.51

Pk - Peak detector
Av – Average detector

12. SETUP PHOTOS

Please refer to R12935938-EP1 for setup photos

END OF TEST REPORT

UL LLC
12 Laboratory Dr., RTP, NC 27709; USA TEL:(919) 549-1400