TEST REPORT

Report Number: R13359833-E2

Applicant	:	Oxford Nanopore Technologies Ltd Gosling Building, Edmund Halley Road Oxford Science Park Oxford, OX4 4DQ United Kingdom
Model	:	ONT-07-01191-00
FCC ID	:	2ARGS-P3310
IC	:	26200-P3310
EUT Description	:	BT/BLE/WLAN (2.4GHz and 5GHz) Radio Module
Test Standard(s)	:	FCC 47 CFR PART 15 SUBPART C ISED RSS-247 ISSUE 2 ISED RSS-GEN ISSUE 5 +A1:2019

Date of Issue:
2020-08-28

Prepared by:
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NVLAP TESTING
NVLAP Lab code: 200246-0

cREPORT REVISION HISTORY

Ver.	Issue Date	Revisions	Revised By
1	2020-08-28	Initial Issue	Brian T. Kiewra

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Oxford Nanopore Technologies Ltd
Gosling Building, Edmund Halley Road
Oxford Science Park
Oxford, OX4 4DQ
United Kingdom

EUT DESCRIPTION: BT/BLE/WLAN (2.4GHz and 5GHz) Radio Module

MODEL: ONT-07-01191-00

SERIAL NUMBER: 03251171923

DATE TESTED: 2020-08-03 to 2020-08-17

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 Part 15 Subpart C	Complies
ISED RSS-247 Issue 2	Complies
ISED RSS-GEN Issue 5 +A1:2019	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.

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Approved & Released
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2. TEST RESULTS SUMMARY

FCC Clause	ISED Clause	Requirement	Result	Comment
See Comment		Duty Cycle	Reporting purposes only	ANSI C63.10 Section 11.6.
-	RSS-GEN 6.7	99% OBW	See Comment	Refer to Section 6
15.247 (a) (2)	RSS-247 5.2 (a)	6dB BW		
15.247 (b) (3)	RSS-247 5.4 (d)	Output Power		
See Comment		Average power		
15.247 (e)	RSS-247 5.2 (b)	PSD		
15.247 (d)	RSS-247 5.5	Conducted Spurious Emissions		
15.209, 15.205	RSS-GEN 8.9, 8.10	Radiated Emissions	Compliant	None
15.207	RSS-Gen 8.8	AC Mains Conducted Emissions		

3. 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, KDB 414788 D01 Radiated Test Site v01r01, RSS-GEN Issue 5 +A:2019, and RSS-247 Issue 2.

4. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 12 Laboratory Drive, Research Triangle Park, NC 27709, USA and 2800 Perimeter Park Dr., Suite B, Morrisville, NC 27560, USA. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

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

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.

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5. DECISION RULES AND MEASUREMENT UNCERTAINTY

5.1. METROLOGICAL TRACEABILITY

All test and measuring equipment utilized to perform the tests documented in this report are calibrated on a regular basis, with a maximum time between calibrations of one year or the manufacturers' recommendation, whichever is less, and where applicable is traceable to recognized national standards.

5.2. DECISION RULES

The Decision Rule is based on Simple Acceptance in accordance with ISO Guide 98-4:2012 Clause 8.2. (Measurement uncertainty is not taken into account when stating conformity with a specified requirement.)

5.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	U_{Lab}
Worst Case Conducted Disturbance, 0.15 to 30 MHz	±3.07 dB
Worst Case Radiated Disturbance, 9kHz to 26GHz	±4.88 dB

Uncertainty figures are valid to a confidence level of 95%.

5.4. 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

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6. DESCRIPTION OF C2PC

The purpose of this class 2 permission change report is to demonstrate that the radio module maintains compliancy when used with an antenna different from the original submission. Therefore, full radiated and AC mains testing performed.

7. EQUIPMENT UNDER TEST

7.1. EUT DESCRIPTION

The EUT is a BT/BLE/WLAN (2.4GHz and 5GHz) Radio Module.
This report covers BT.

7.2. MAXIMUM OUTPUT POWER

The purpose of this class 2 permission change report is to demonstrate that the radio module maintains compliancy when used with an antenna different from the original submission. Therefore, power measurements not covered in this report. It is the responsibility of the manufacturer to ensure that the power settings used under this evaluation and in the field, yield the same or less maximum power as in the report.

7.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes 2 identical PCB patch antennas, with a maximum gain of 3.73 dBi in 2.4GHz band and 5.18 dBi in 5GHz band.

7.4. SOFTWARE AND FIRMWARE

The EUT firmware installed during testing was fw_bcmdhd_mfg_7.35.221.18.bin.
The test utility software used during testing was wl for WiFi, hcitool for Bluetooth & Bluetooth Low-Energy.

7.5. 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.

BT/BLE radio transmits on EUT chain 0 antenna.

The fundamental of the EUT was investigated with the chain 0 antenna in three orthogonal orientations X,Y,Z, it was determined that Z orientation was worst-case orientation; therefore, all final radiated testing was performed with the chain 0 antenna in Z orientation.

EUT tested using a 100% duty cycle as worst-case over DH5.

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7.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
Laptop	Dell	E6330	59R7PX1	NA
AC Adapter	FSP	FSP065-10AABA	H9221000252	NA

I/O CABLES

I/O Cable List						
Cable No.	**Port**	**# of Identical Ports**	**Connector Type**	**Cable Type**	**Cable Length (m)**	**Remarks**
1	Mains	1	Barrel	Mains	<3m	Connected to DC power supply
2	ENET	1	RJ45	I/O	<3m	Connected to laptop outside chamber

SETUP DIAGRAM

Please refer to R13359833-EP1 for setup diagram

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8. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment were utilized for the tests documented in this report:

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

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
0.009-30MHz (Loop Ant.)					
AT0059	Active Loop Antenna	EMCO	6502	2020-08-06	2021-08-06
30-1000 MHz					
AT0081	Hybrid Broadband Antenna	Sunol Sciences Corp.	JB3	2019-11-20	2020-11-20
1-18 GHz					
AT0067	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2020-04-28	2021-04-28
18-40 GHz					
AT0076	Horn Antenna, 18-26.5GHz	ARA	MWH-1826/B	2019-11-07	2020-11-07
AT0077	Horn Antenna, 26-40GHz	ARA	MWH-2640/B	2019-11-07	2020-11-07
Gain-Loss Chains					
S-SAC01	Gain-loss string: 0.009-30MHz	Various	Various	2020-07-10	2021-07-10
S-SAC02	Gain-loss string: 25-1000MHz	Various	Various	2020-07-10	2021-07-10
S-SAC03	Gain-loss string: 1-18GHz	Various	Various	2020-07-06	2020-07-06
S-SAC04	Gain-loss string: 18-40GHz	Various	Various	2020-07-07	2021-07-07
Receiver & Software					
SA0025	Spectrum Analyzer	Agilent	N9030A	2020-03-17	2021-03-17
SA0026	Spectrum Analyzer	Agilent	N9030A	2020-06-24	2021-06-24
SOFTEMI	EMI Software	UL	Version 9.5 (2019-06-12)		
Additional Equipment used					
s/n 200037635	Environmental Meter	Fisher Scientific	06-662-4	2020-1-22	2022-01-22
PS215	AC Power Source	Elgar	CW2501M (s/n 1523A02397)	NA	NA
BRF004	5.5GHz notch filter, 2W, F_{high} =18GHz	Micro-Tronics	BRM50716-01	2020-02-19	2021-02-19

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

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
CBL087	Coax cable, RG223, N-male to BNC-male, 20-ft.	Pasternack	PE3W06143-240	2020-03-26	2021-03-26
HI0090	Environmental Meter	Fisher Scientific	15-077-963	2020-06-26	2021-06-26
LISN003	LISN, 50-ohm/50-uH, 2-conductor, 25A	Fischer Custom Com.	FCC-LISN-50-25-2-01-550V	2019-08-19	2020-08-19
75141 (PRE0101521)	EMI Test Receiver 9kHz-7GHz	Rohde & Schwarz	ESCI 7	2019-08-20	2020-08-20
ATA222 (In service 03/26/2020)	Transient Limiter, 0.009-100MHz	Electro-Metrics	EM-7600	2020-03-26	2021-03-26
PS215	AC Power Source	Elgar	CW2501M (s/n 1523A02397)	NA	NA
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA
Miscellaneous (if needed)					
LISN008	LISN, 50-ohm/50-uH, 2-conductor, 25A (For support gear only.)	Solar Electronics	8012-50-R-24-BNC	2020-08-08	2021-08-08

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9. MEASUREMENT METHODS

On Time and Duty Cycle: ANSI C63.10-2013 Section 11.6

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

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

Radiated Band-edge: ANSI C63.10-2013 Section 6.10.5

AC Power line conducted emissions: ANSI C63.10-2013, Section 6.2.

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10. ON TIME AND DUTY CYCLE

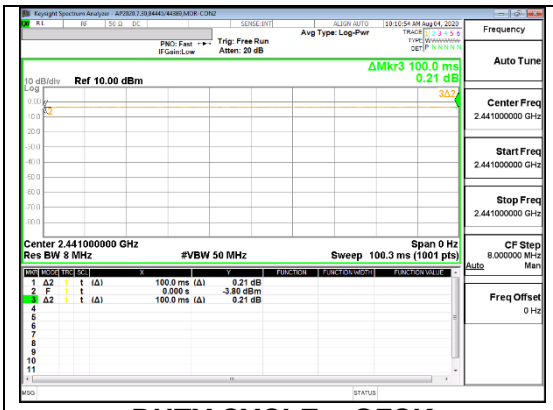
LIMITS

None; for reporting purposes only.

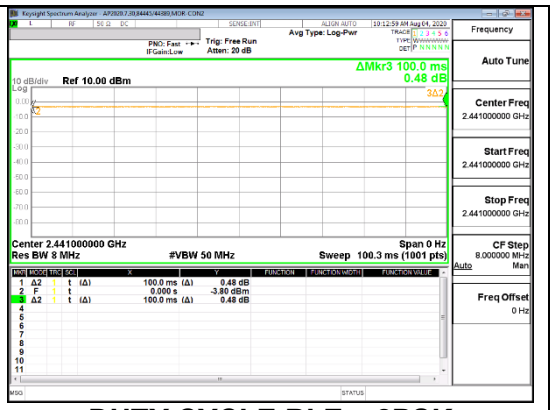
PROCEDURE

ANSI C63.10 Zero-Span Spectrum Analyzer Method.

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						
BT - GFSK	100.00	100.00	1.000	100.00%	0.00	0.010
BT - 8PSK	100.00	100.00	1.000	100.00%	0.00	0.010



DUTY CYCLE – GFSK



DUTY CYCLE BLE – 8PSK

Note: VBW = 1kHz used for detection using VBW = $1/T_{ON}$ as worst-case.

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11. 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 100 kHz for peak detection measurements or 120 kHz for 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 and 1 MHz resolution bandwidth with 1/T video bandwidth with peak detector for average measurements.

The spectrum from 1 GHz to 18 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band. Below 1GHz and above 18GHz emissions, the channel with the highest output power was tested.

The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

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

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.

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

OFS and chamber correlation testing had been performed and chamber measured test result is the worst-case test result.

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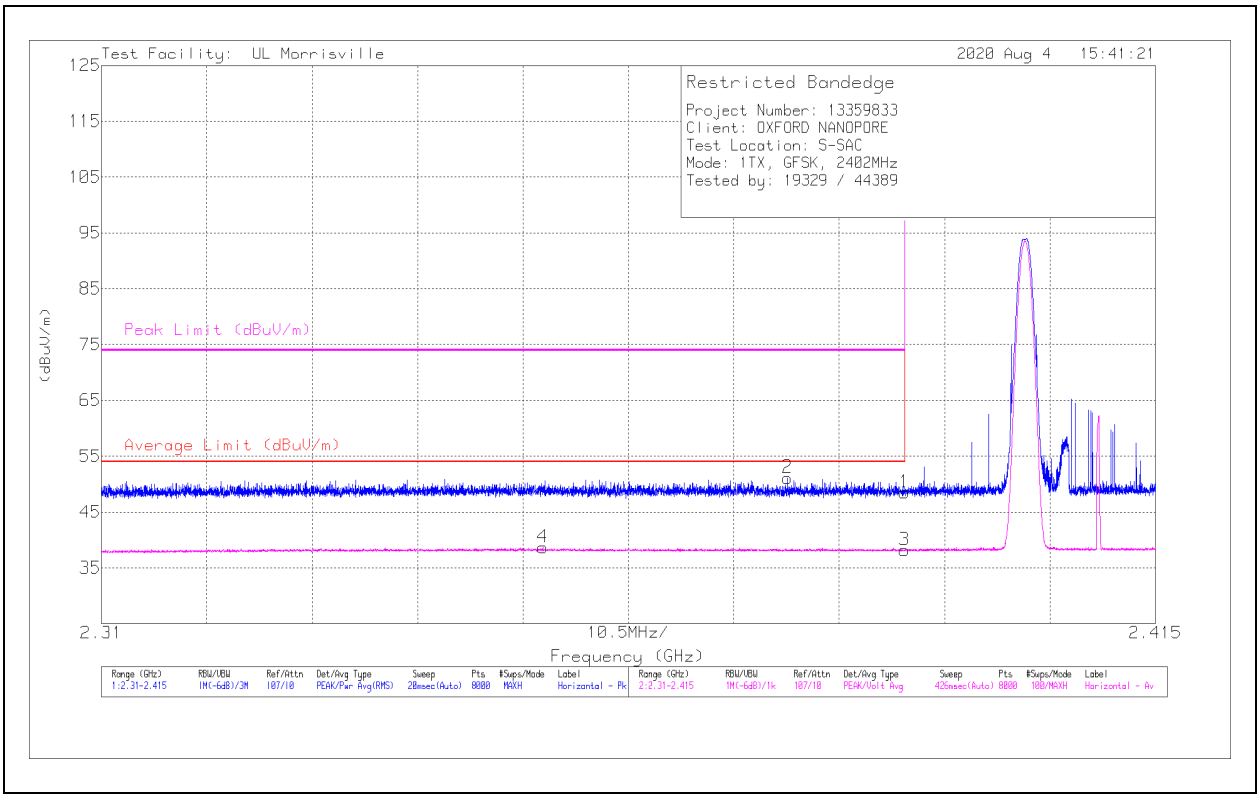
11.1. TRANSMITTER ABOVE 1 GHz

11.1.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

BANDEDGE (LOW CHANNEL)

HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.39	40.57	Pk	32.1	-24.2	48.47	-	-	74	-25.53	91	396	H
2	* ** 2.37835	43.22	Pk	32.2	-24.3	51.12	-	-	74	-22.88	91	396	H
3	* ** 2.39	30.28	V1TV	32.1	-24.2	38.18	54	-15.82	-	-	91	396	H
4	* ** 2.35398	30.74	V1TV	32.2	-24.3	38.64	54	-15.36	-	-	91	396	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
Pk - Peak detector
V1TV - VB=1/Ton, Linear Voltage Average where: Ton is packet duration

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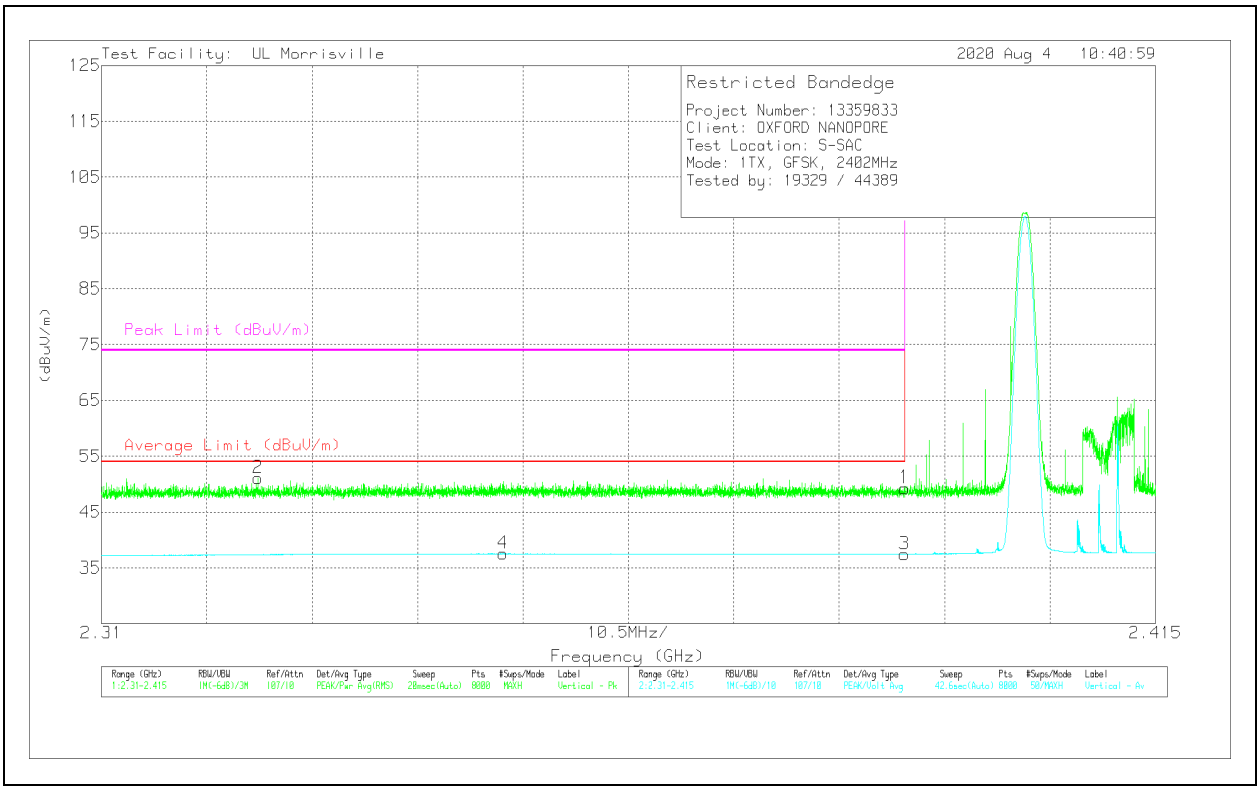
VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.39	41.39	Pk	32.1	-24.2	49.29	-	-	74	-24.71	268	287	V
2	* ** 2.32559	43.25	Pk	32.1	-24.3	51.05	-	-	74	-22.95	268	287	V
3	* ** 2.39	29.54	V1TV	32.1	-24.2	37.44	54	-16.56	-	-	268	287	V
4	* ** 2.35	29.54	V1TV	32.3	-24.3	37.54	54	-16.46	-	-	268	287	V

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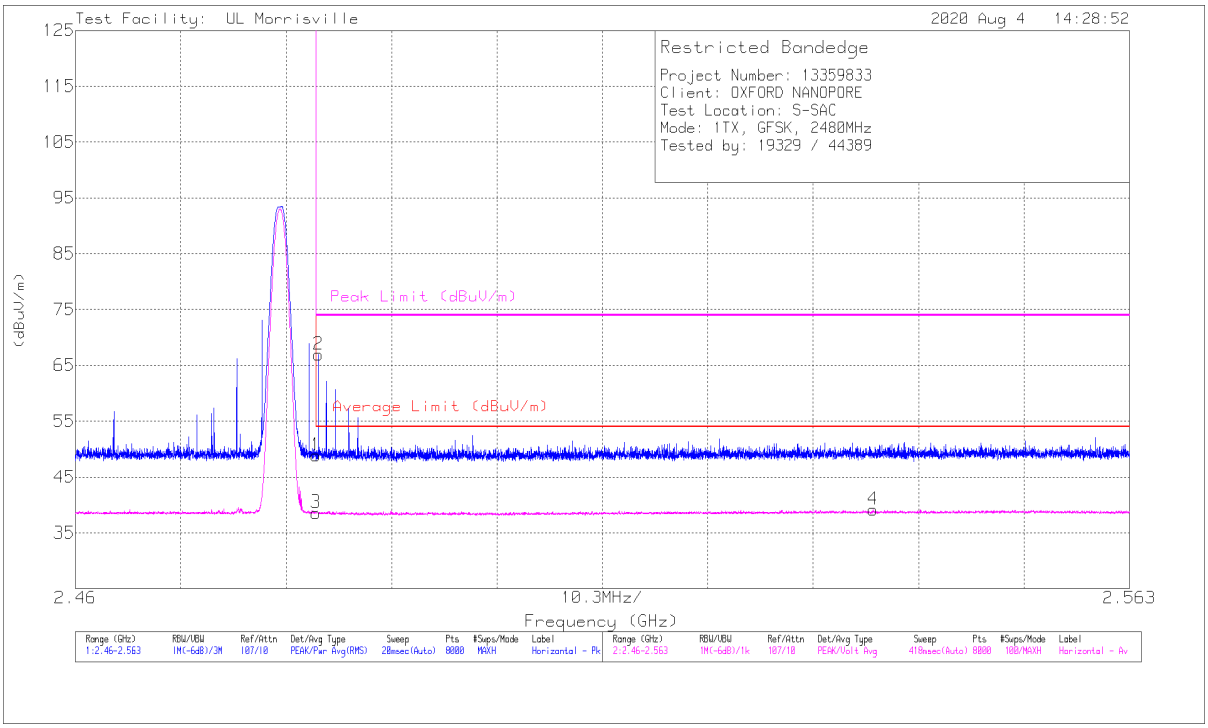
BANDEDGE (HIGH CHANNEL)

HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.4835	40.59	Pk	32.4	-24.1	48.89	-	-	74	-25.11	243	235	H
2	* ** 2.48373	58.65	Pk	32.4	-24.1	66.95	-	-	74	-7.05	243	235	H
3	* ** 2.4835	30.28	V1TV	32.4	-24.1	38.58	54	-15.42	-	-	243	235	H
4	** 2.53794	30.68	V1TV	32.6	-24.1	39.18	54	-14.82	-	-	243	235	H

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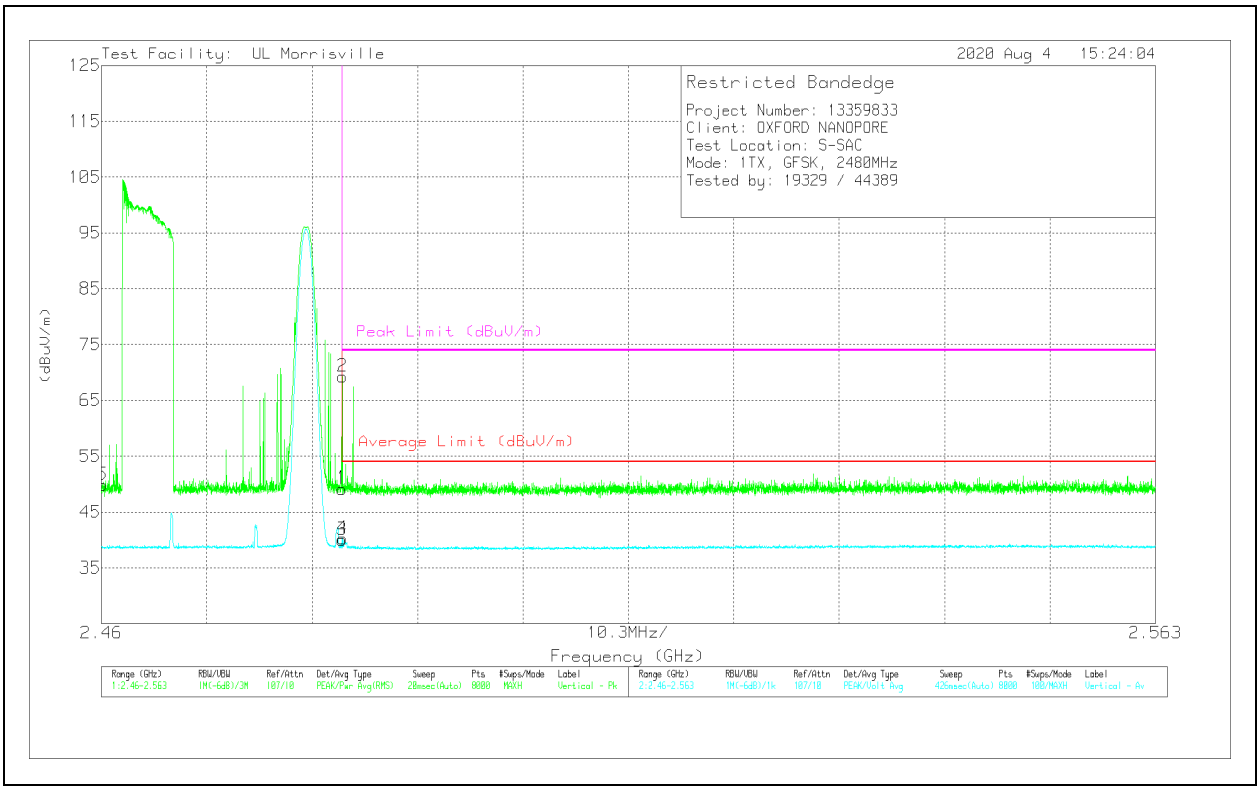
VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.4835	40.87	Pk	32.4	-24.1	49.17	-	-	74	-24.83	115	399	V
2	* ** 2.48355	60.93	Pk	32.4	-24.1	69.23	-	-	74	-4.77	115	399	V
3	* ** 2.4835	31.73	V1TV	32.4	-24.1	40.03	54	-13.97	-	-	115	399	V
4	* ** 2.48358	31.94	V1TV	32.4	-24.1	40.24	54	-13.76	-	-	115	399	V
5	2.46013	41.54	Pk	32.5	-24.2	49.84	-	-	-	-	115	399	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
Pk - Peak detector
V1TV - VB=1/Ton, Linear Voltage Average where: Ton is packet duration

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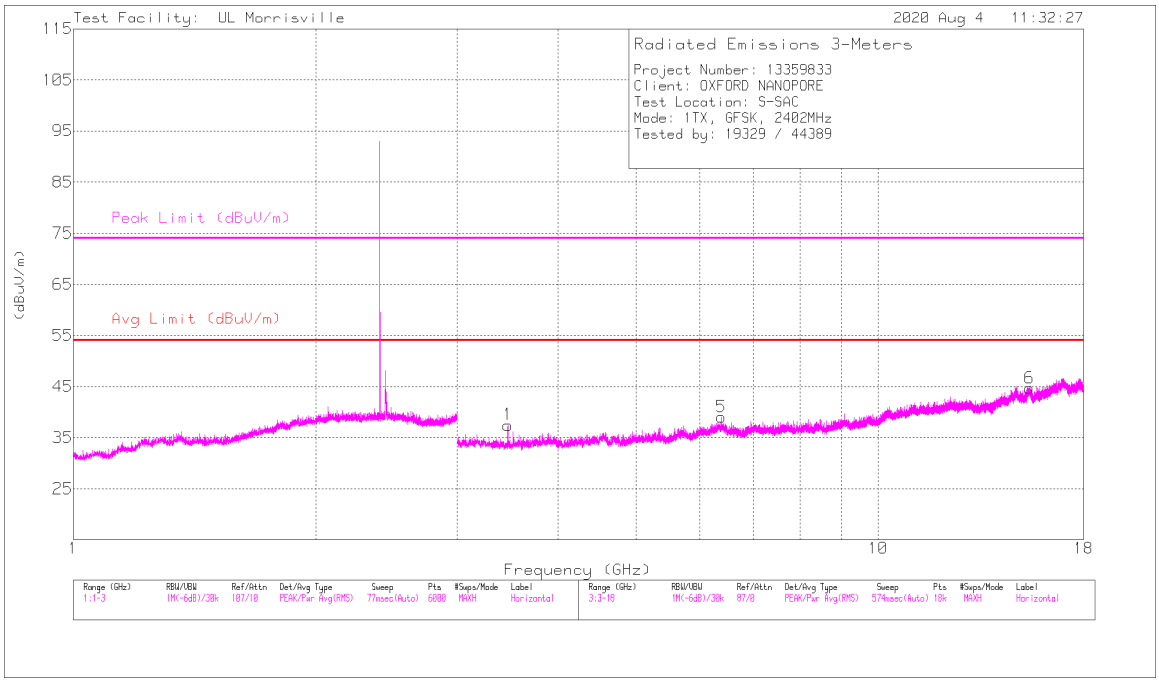
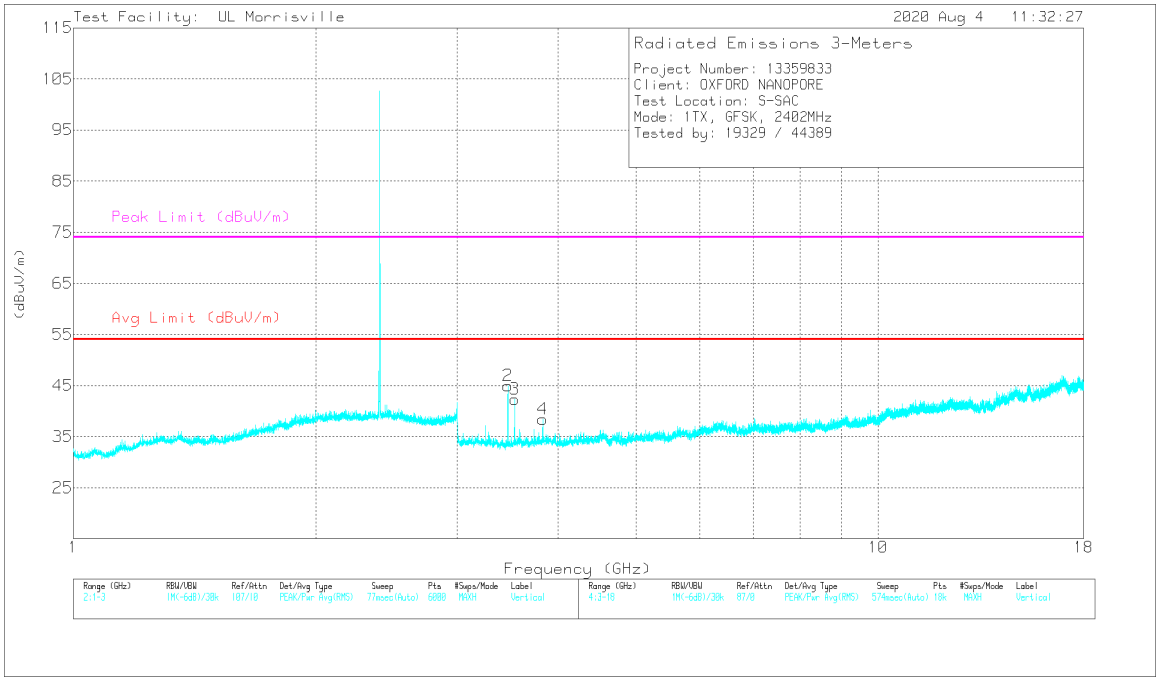
HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



HORIZONTAL



VERTICAL

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RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
6	* ** 15.42661	33.35	PK2	40.3	-22	51.65	-	-	74	-22.35	345	341	H
	* ** 15.42671	20.13	V1TV	40.3	-22	38.43	54	-15.57	-	-	345	341	H
3	* ** 3.53313	46.29	PK2	32.8	-32.6	46.49	-	-	74	-27.51	144	208	V
	* ** 3.5329	27.94	V1TV	32.8	-32.6	28.14	54	-25.86	-	-	144	208	V
4	* ** 3.83002	44.57	PK2	33.3	-32.2	45.67	-	-	74	-28.33	41	285	V
	* ** 3.83007	38.32	V1TV	33.3	-32.2	39.42	54	-14.58	-	-	41	285	V
1	3.46669	37.58	Pk	32.8	-32.9	37.48	-	-	-	-	0-360	199	H
2	3.46669	45.02	Pk	32.8	-32.9	44.92	-	-	-	-	0-360	101	V
5	6.38852	31.66	Pk	35.6	-28.2	39.06	-	-	-	-	0-360	101	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
PK2 - Maximum Peak
V1TV - VB=1/Ton, Linear Voltage Average where: Ton is packet duration
Pk - Peak detector

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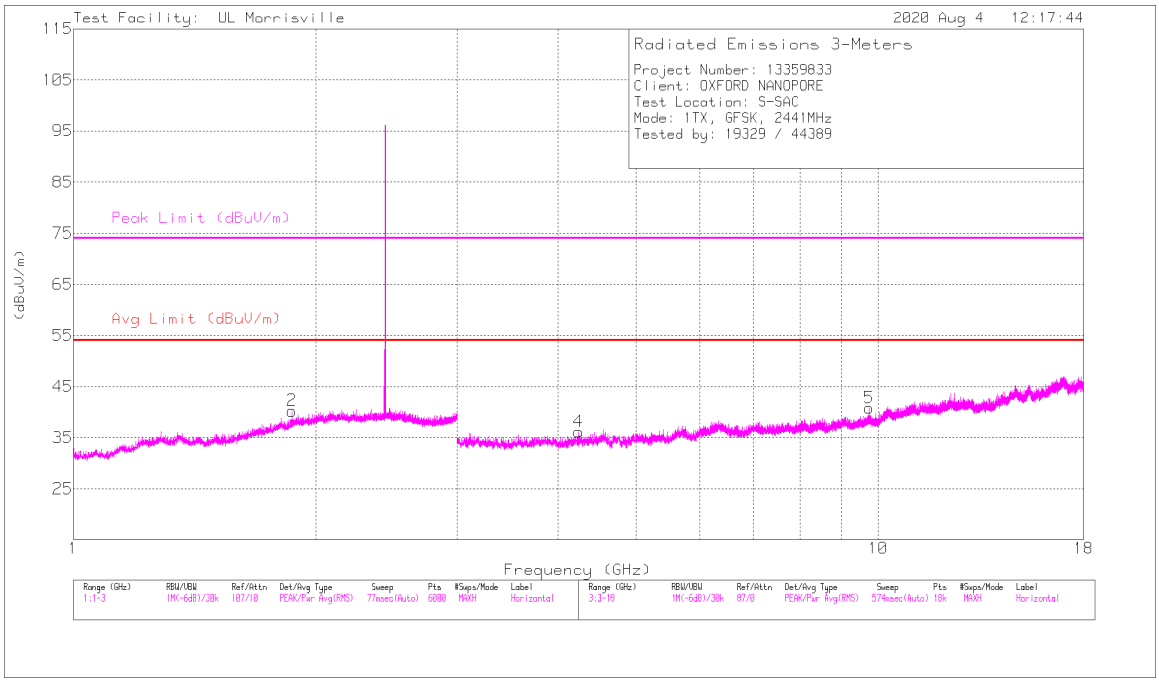
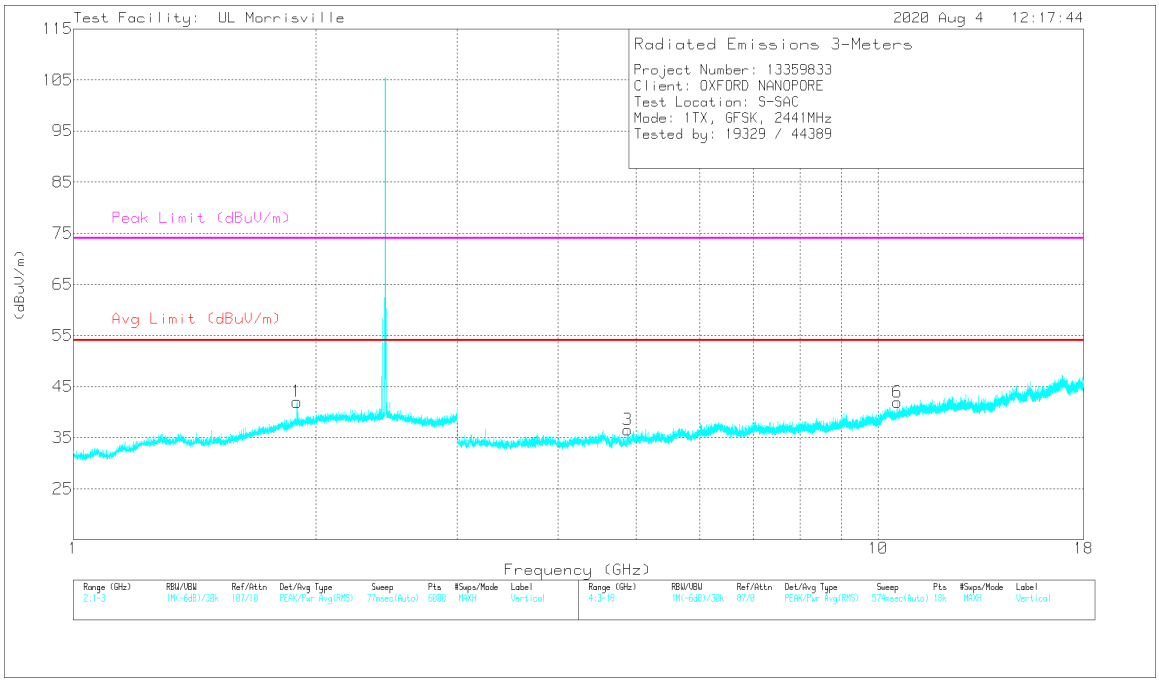
MID CHANNEL RESULTS



HORIZONTAL



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RADIATED EMISSIONS

	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2	** 1.87635	36.51	PK2	31	-22.4	45.11	-	-	74	-29.89	15	227	H
	** 1.87654	23.02	V1TV	31	-22.4	31.62	54	-22.38	-	-	15	227	H
1	** 1.89609	35.78	PK2	31.3	-22.3	44.78	-	-	74	-29.22	262	370	V
	** 1.89583	23.11	V1TV	31.3	-22.3	32.11	54	-21.89	-	-	262	370	V
4	* ** 4.24968	39.57	PK2	33.4	-30.9	42.07	-	-	74	-31.93	258	257	H
	* ** 4.24998	26.68	V1TV	33.4	-30.9	29.18	54	-24.82	-	-	258	257	H
3	* ** 4.88158	40.08	PK2	34	-30.8	43.28	-	-	74	-30.72	356	199	V
	* ** 4.882	33.58	V1TV	34	-30.8	36.78	54	-17.22	-	-	356	199	V
5	9.74121	29.92	Pk	36.7	-25.8	40.82	-	-	-	-	0-360	101	H
6	10.56042	28.83	Pk	37.8	-24.7	41.93	-	-	-	-	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
V1TV - VB=1/Ton, Linear Voltage Average where: Ton is packet duration
Pk - Peak detector

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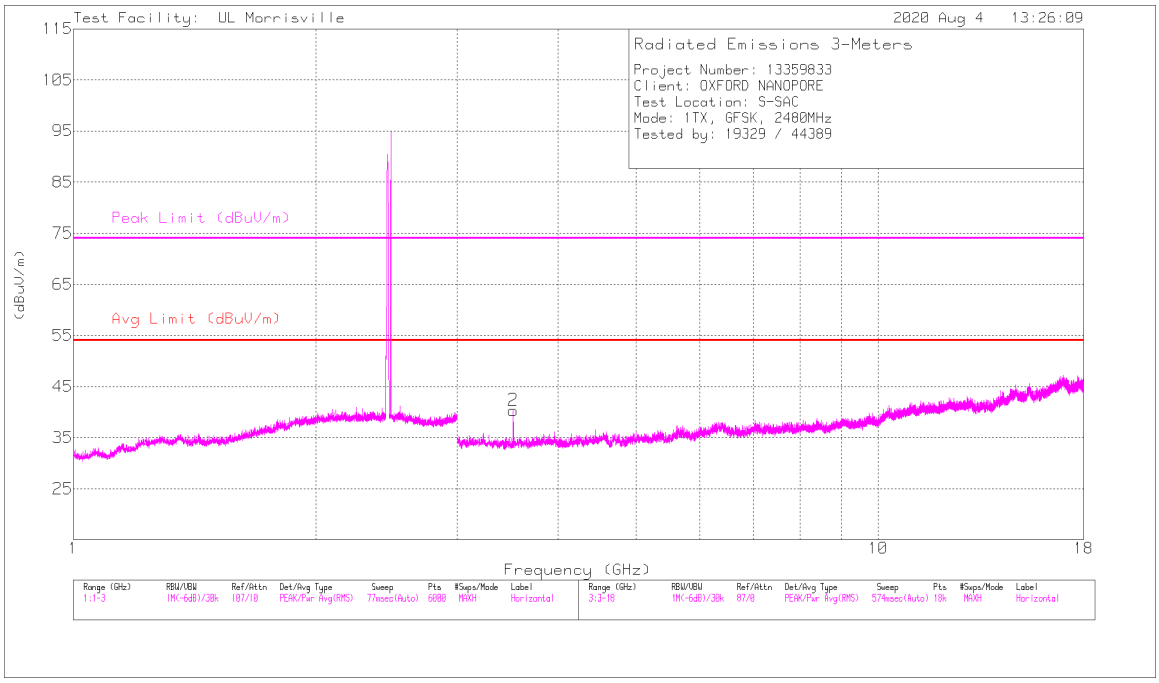
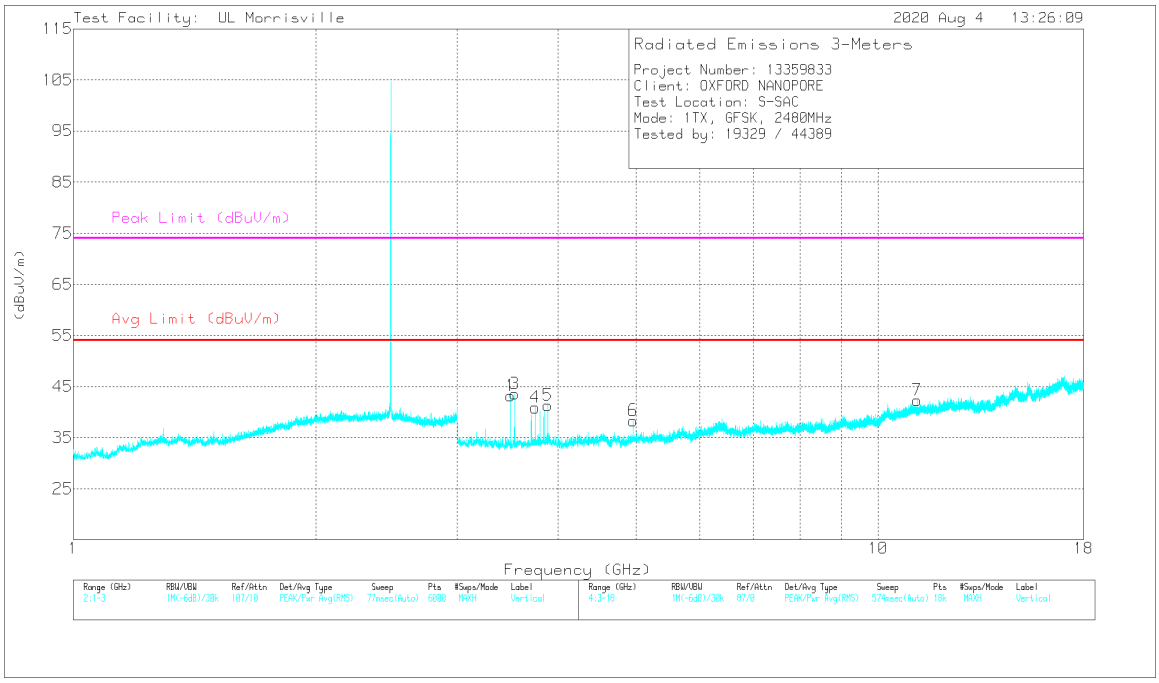
HIGH CHANNEL RESULTS



HORIZONTAL



VERTICAL

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RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2	* ** 3.51986	42.91	PK2	32.8	-32.8	42.91	-	-	74	-31.09	236	253	H
	* ** 3.51987	34.52	V1TV	32.8	-32.8	34.52	54	-19.48	-	-	236	253	H
3	* ** 3.53332	42.7	PK2	32.8	-32.6	42.9	-	-	74	-31.1	179	243	V
	* ** 3.53295	27.97	V1TV	32.8	-32.6	28.17	54	-25.83	-	-	179	243	V
4	* ** 3.75008	42.38	PK2	33.2	-32.7	42.88	-	-	74	-31.12	350	236	V
	* ** 3.75004	29.92	V1TV	33.2	-32.7	30.42	54	-23.58	-	-	350	236	V
5	* ** 3.88329	40.02	PK2	33.4	-32	41.42	-	-	74	-32.58	299	394	V
	* ** 3.88277	27.03	V1TV	33.4	-32	28.43	54	-25.57	-	-	299	394	V
6	* ** 4.95959	46.32	PK2	33.9	-31	49.22	-	-	74	-24.78	354	276	V
	* ** 4.95997	34.67	V1TV	33.9	-31	37.57	54	-16.43	-	-	354	276	V
7	* ** 11.17975	34.12	PK2	38.1	-24.2	48.02	-	-	74	-25.98	57	236	V
	* ** 11.18016	20.66	V1TV	38.1	-24.2	34.56	54	-19.44	-	-	57	236	V
1	3.49336	43.28	Pk	32.8	-32.9	43.18	-	-	-	-	0-360	101	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
PK2 - Maximum Peak
V1TV - VB=1/Ton, Linear Voltage Average where: Ton is packet duration
Pk - Peak detector

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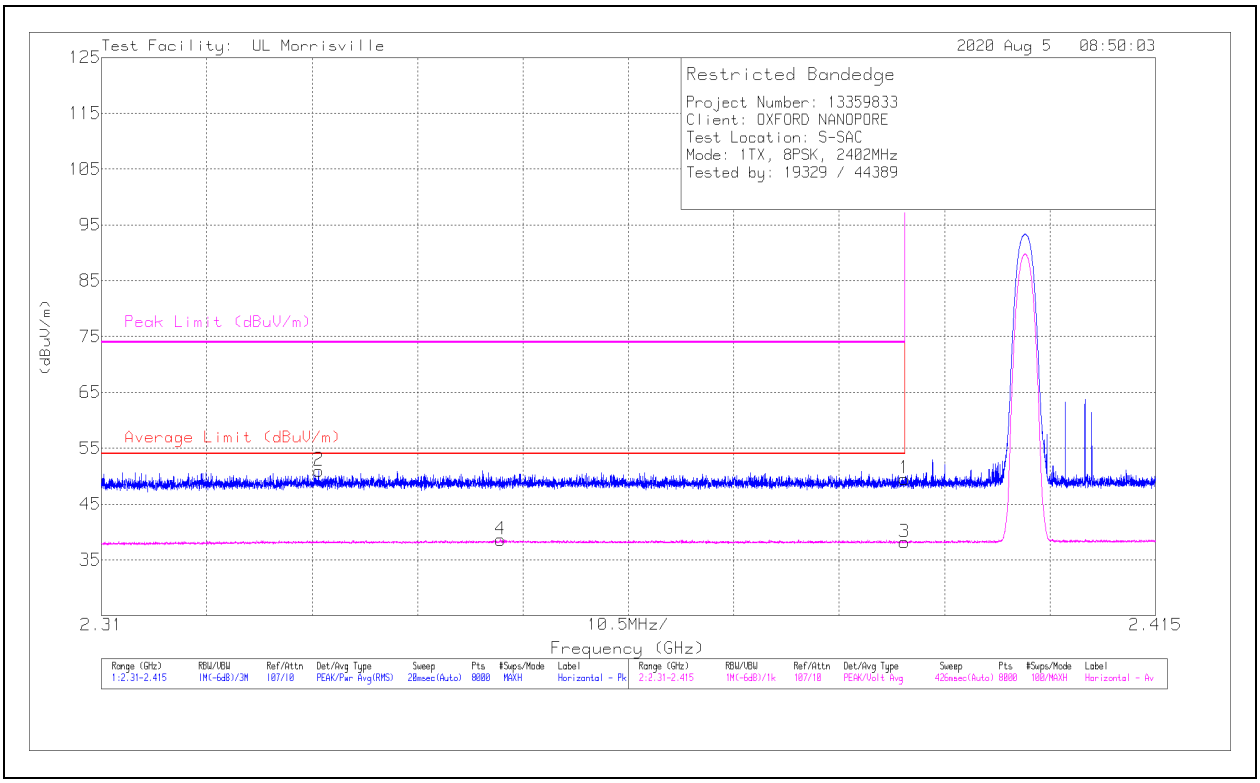
11.1.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

BANDEDGE (LOW CHANNEL)

HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.39	41.64	Pk	32.1	-24.2	49.54	-	-	74	-24.46	84	126	H
2	* ** 2.33165	43.21	Pk	32.1	-24.3	51.01	-	-	74	-22.99	84	126	H
3	* ** 2.39	30.28	V1TV	32.1	-24.2	38.18	54	-15.82	-	-	84	126	H
4	* ** 2.34974	30.72	V1TV	32.2	-24.3	38.62	54	-15.38	-	-	84	126	H

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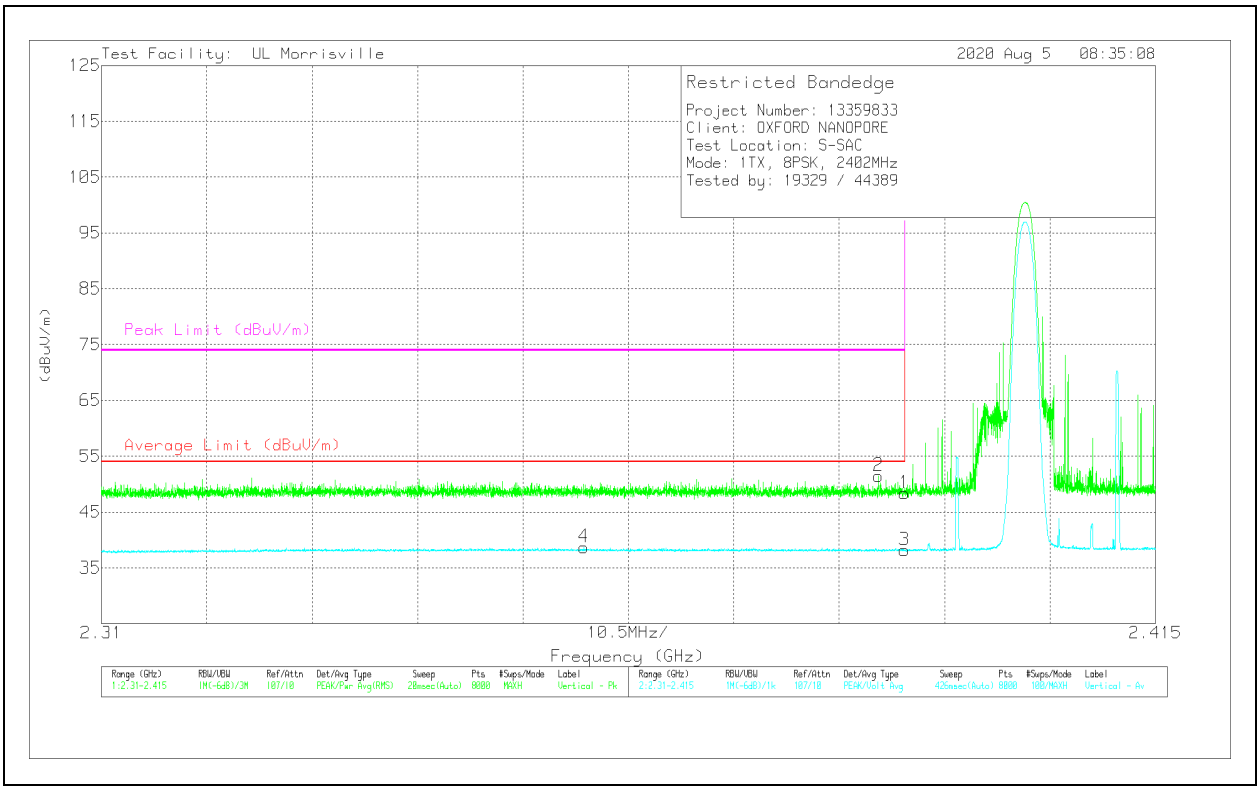
VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.39	40.48	Pk	32.1	-24.2	48.38	-	-	74	-25.62	107	137	V
2	* ** 2.38742	43.58	Pk	32.2	-24.3	51.48	-	-	74	-22.52	107	137	V
3	* ** 2.39	30.27	V1TV	32.1	-24.2	38.17	54	-15.83	-	-	107	137	V
4	* ** 2.35806	30.8	V1TV	32.2	-24.3	38.7	54	-15.3	-	-	107	137	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
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Pk - Peak detector
V1TV - VB=1/Ton, Linear Voltage Average where: Ton is packet duration

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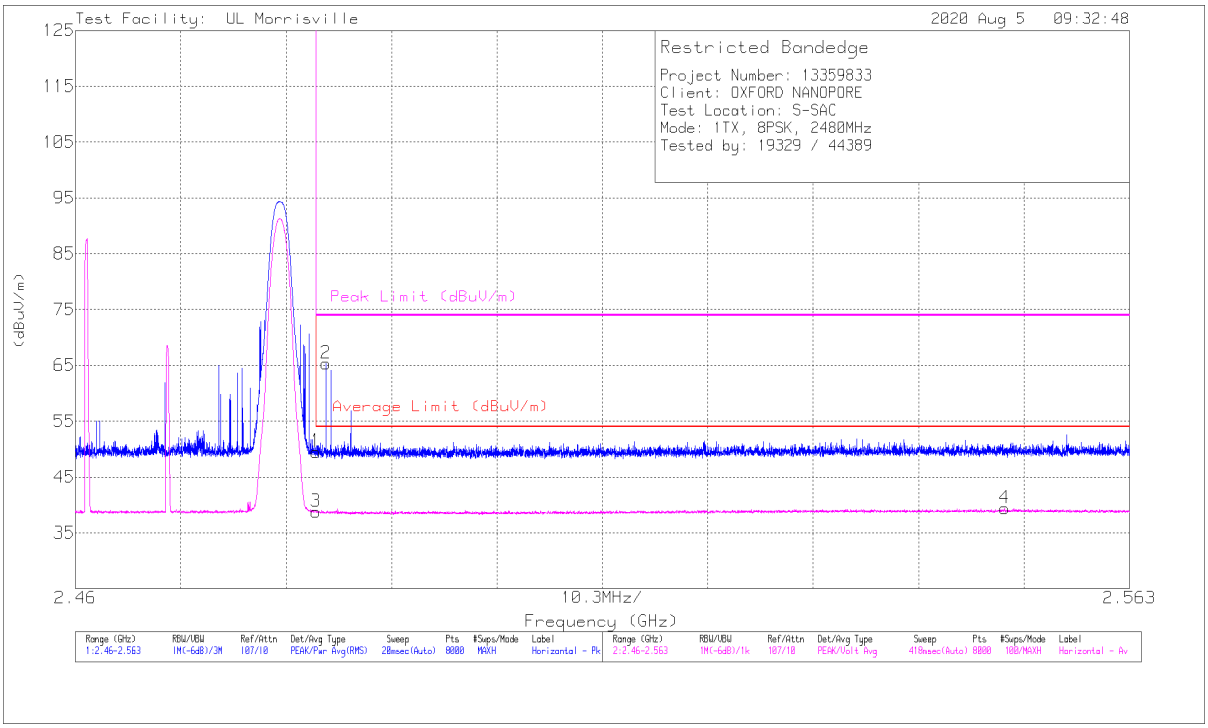
BANDEDGE (HIGH CHANNEL)

HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.4835	41.23	Pk	32.4	-24.1	49.53	-	-	74	-24.47	87	135	H
2	* ** 2.48447	57.04	Pk	32.4	-24.1	65.34	-	-	74	-8.66	87	135	H
3	* ** 2.4835	30.49	V1TV	32.4	-24.1	38.79	54	-15.21	-	-	87	135	H
4	** 2.5508	30.78	V1TV	32.7	-24.1	39.38	54	-14.62	-	-	87	135	H

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V1TV - VB=1/Ton, Linear Voltage Average where: Ton is packet duration

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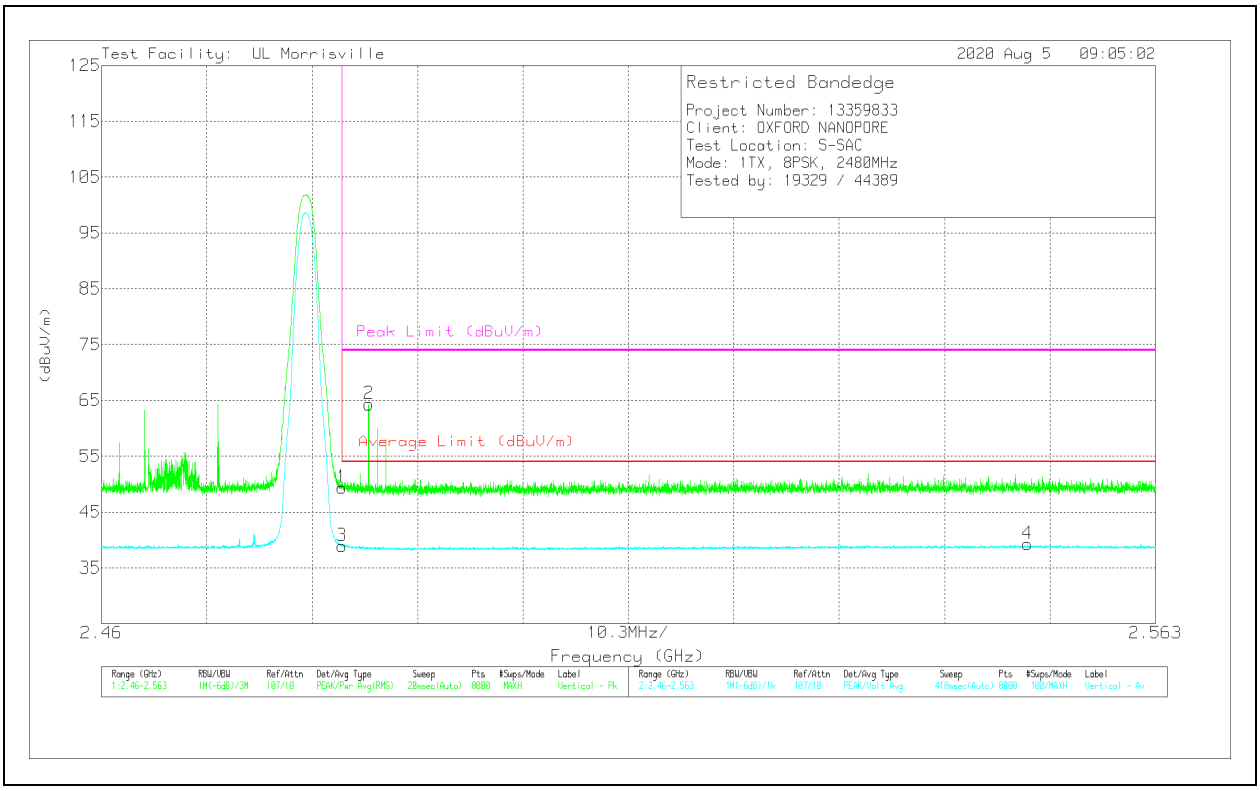
VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.4835	41.08	Pk	32.4	-24.1	49.38	-	-	74	-24.62	120	142	V
2	* ** 2.48611	56.01	Pk	32.4	-24.1	64.31	-	-	74	-9.69	120	142	V
3	* ** 2.4835	30.58	V1TV	32.4	-24.1	38.88	54	-15.12	-	-	120	142	V
4	** 2.5505	30.66	V1TV	32.7	-24.1	39.26	54	-14.74	-	-	120	142	V

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V1TV - VB=1/Ton, Linear Voltage Average where: Ton is packet duration

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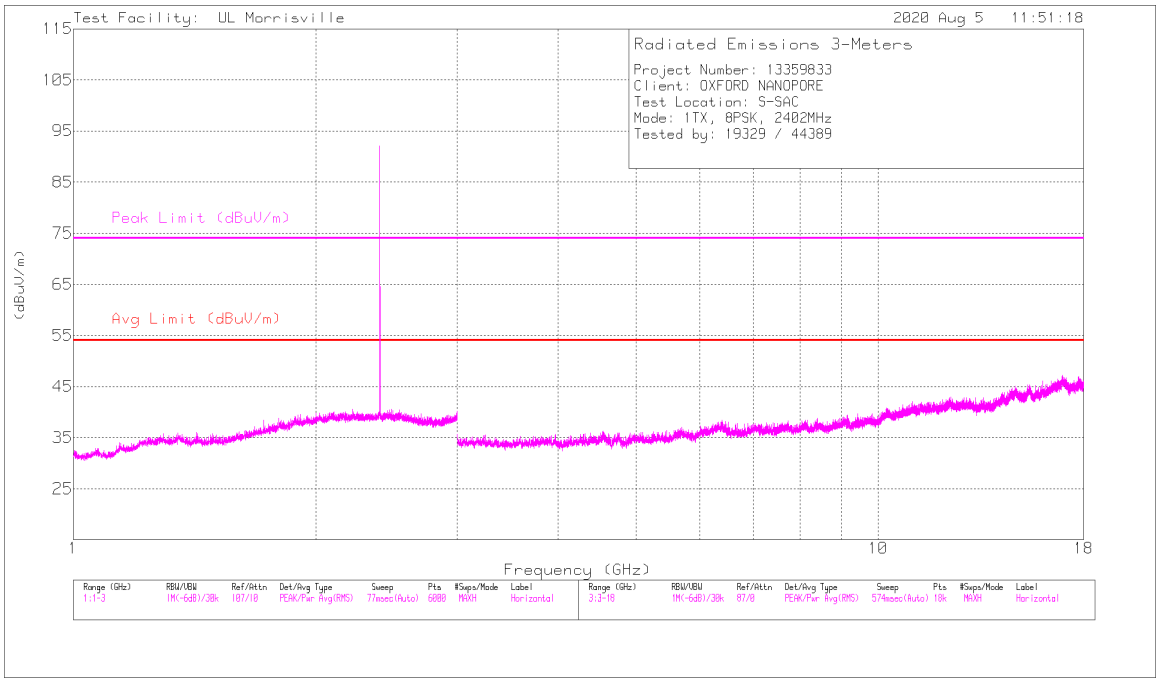
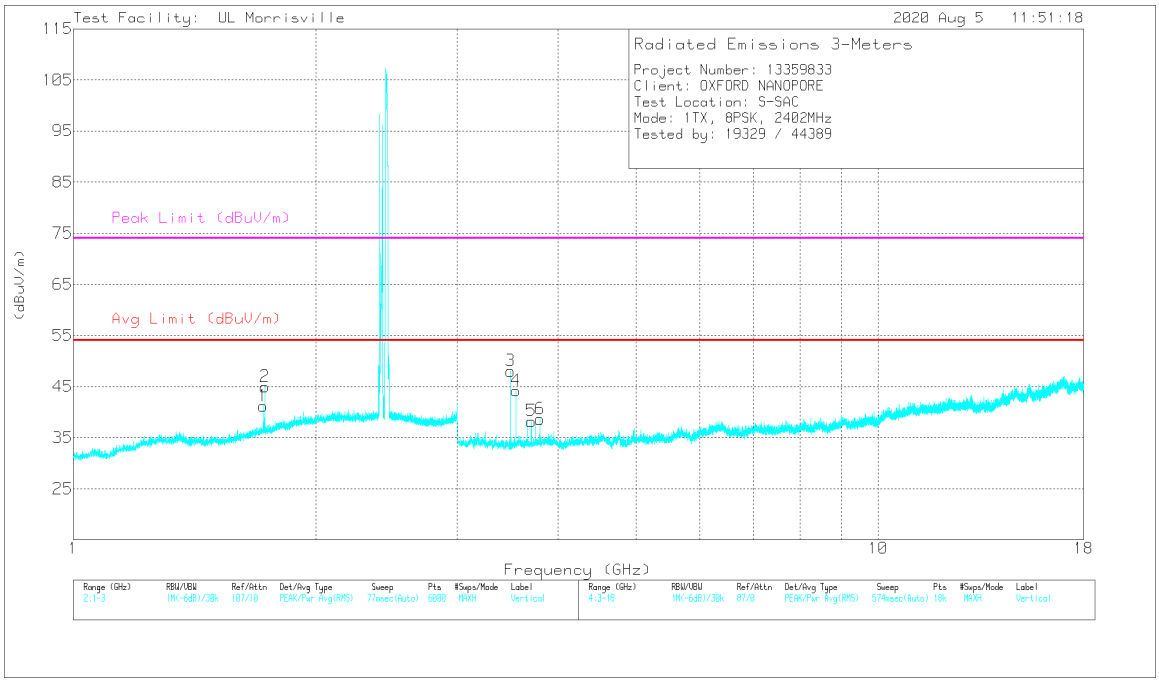
HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



HORIZONTAL



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RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	** 1.72285	35.97	PK2	29.6	-22.2	43.37	-	-	74	-30.63	61	334	V
	** 1.72331	22.56	V1TV	29.6	-22.2	29.96	54	-24.04	-	-	61	334	V
2	** 1.7288	36.3	PK2	29.7	-22.2	43.8	-	-	74	-30.2	95	141	V
	** 1.72938	22.58	V1TV	29.7	-22.2	30.08	54	-23.92	-	-	95	141	V
4	* ** 3.5466	43.28	PK2	32.9	-32.4	43.78	-	-	74	-30.22	103	289	V
	* ** 3.5466	37.01	V1TV	32.9	-32.4	37.51	54	-16.49	-	-	103	289	V
5	* ** 3.70692	41.63	PK2	33.1	-32.5	42.23	-	-	74	-31.77	269	238	V
	* ** 3.70708	27.58	V1TV	33.1	-32.5	28.18	54	-25.82	-	-	269	238	V
6	* ** 3.79901	41.47	PK2	33.3	-32.5	42.27	-	-	74	-31.73	143	330	V
	* ** 3.79846	27.52	V1TV	33.3	-32.5	28.32	54	-25.68	-	-	143	330	V
3	3.49336	48.14	Pk	32.8	-32.9	48.04	-	-	-	-	0-360	199	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
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PK2 - Maximum Peak
V1TV - VB=1/Ton, Linear Voltage Average where: Ton is packet duration
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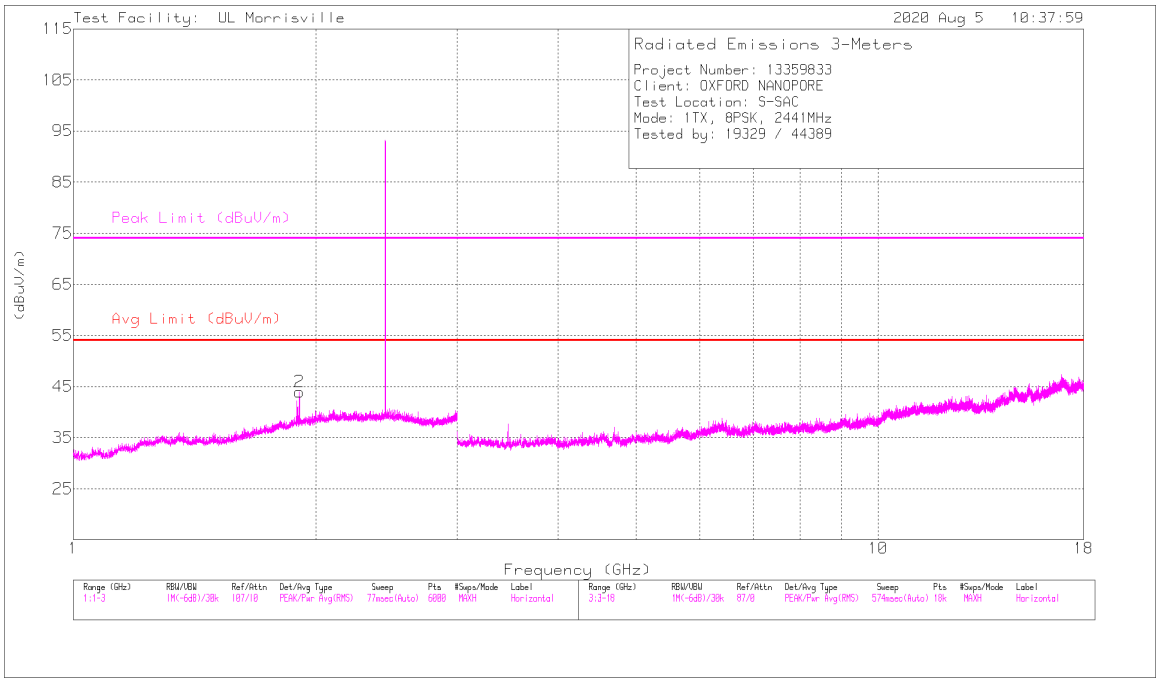
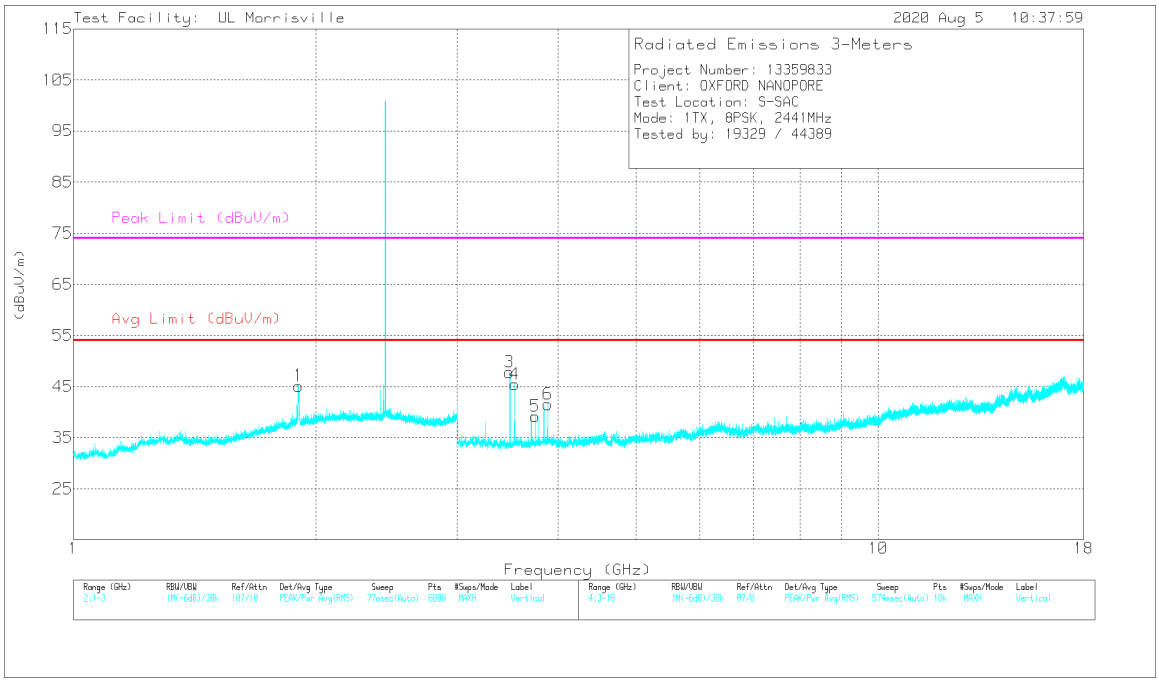
MID CHANNEL RESULTS



HORIZONTAL



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RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2	** 1.90872	36.13	PK2	31.3	-22.4	45.03	-	-	74	-28.97	102	214	H
	** 1.90873	24.44	V1TV	31.3	-22.4	33.34	54	-20.66	-	-	102	214	H
4	* ** 3.53371	42.1	PK2	32.8	-32.6	42.3	-	-	74	-31.7	141	231	V
	* ** 3.53301	39.25	V1TV	32.8	-32.6	39.45	54	-14.55	-	-	141	231	V
5	* ** 3.75034	42.55	PK2	33.2	-32.7	43.05	-	-	74	-30.95	354	327	V
	* ** 3.75008	29.62	V1TV	33.2	-32.7	30.12	54	-23.88	-	-	354	327	V
6	* ** 3.89259	40.81	PK2	33.4	-32.1	42.11	-	-	74	-31.89	122	325	V
	* ** 3.89212	27.34	V1TV	33.4	-32.1	28.64	54	-25.36	-	-	122	325	V
1	1.90448	36.23	Pk	31.3	-22.4	45.13	-	-	-	-	0-360	199	V
3	3.48003	47.9	Pk	32.8	-32.9	47.8	-	-	-	-	0-360	200	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
PK2 - Maximum Peak
V1TV - VB=1/Ton, Linear Voltage Average where: Ton is packet duration
Pk - Peak detector

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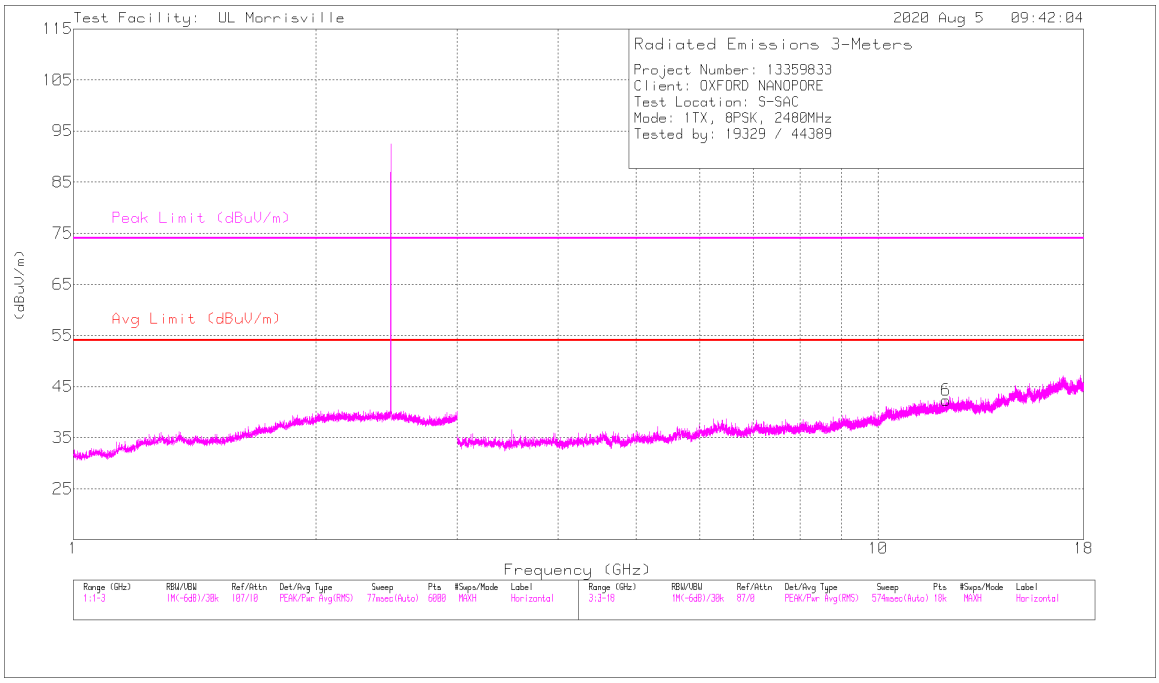
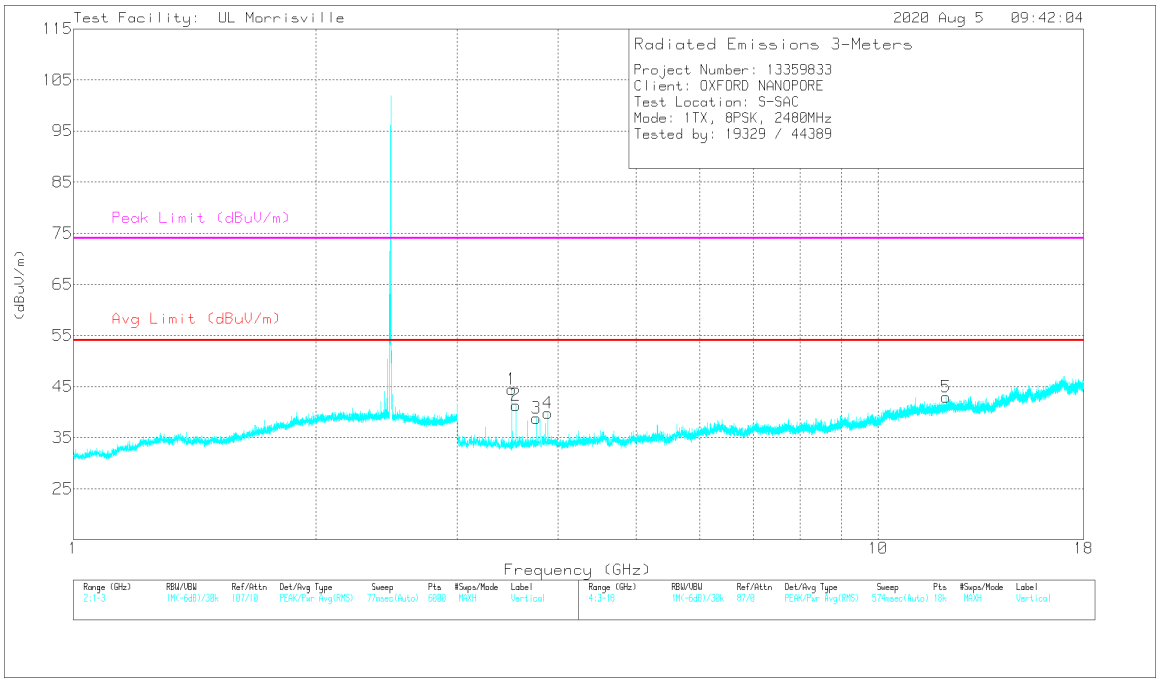
HIGH CHANNEL RESULTS



HORIZONTAL



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RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
6	* ** 12.14776	34.38	PK2	38.8	-24.3	48.88	-	-	74	-25.12	337	126	H
	* ** 12.14825	20.75	V1TV	38.8	-24.3	35.25	54	-18.75	-	-	337	126	H
1	* ** 3.50612	41.54	PK2	32.8	-32.9	41.44	-	-	74	-32.56	309	271	V
	* ** 3.50704	34.77	V1TV	32.8	-32.9	34.67	54	-19.33	-	-	309	271	V
2	* ** 3.53938	40.84	PK2	32.8	-32.6	41.04	-	-	74	-32.96	2	277	V
	* ** 3.53983	27.77	V1TV	32.8	-32.6	27.97	54	-26.03	-	-	2	277	V
3	* ** 3.75976	41.56	PK2	33.2	-32.7	42.06	-	-	74	-31.94	353	281	V
	* ** 3.75955	27.76	V1TV	33.2	-32.7	28.26	54	-25.74	-	-	353	281	V
4	* ** 3.88316	40.42	PK2	33.4	-32	41.82	-	-	74	-32.18	317	126	V
	* ** 3.88296	27.13	V1TV	33.4	-32	28.53	54	-25.47	-	-	317	126	V
5	* ** 12.13703	34.36	PK2	38.8	-24.2	48.96	-	-	74	-25.04	8	225	V
	* ** 12.13701	20.76	V1TV	38.8	-24.2	35.36	54	-18.64	-	-	8	225	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
PK2 - Maximum Peak
V1TV - VB=1/Ton, Linear Voltage Average where: Ton is packet duration
Pk - Peak detector

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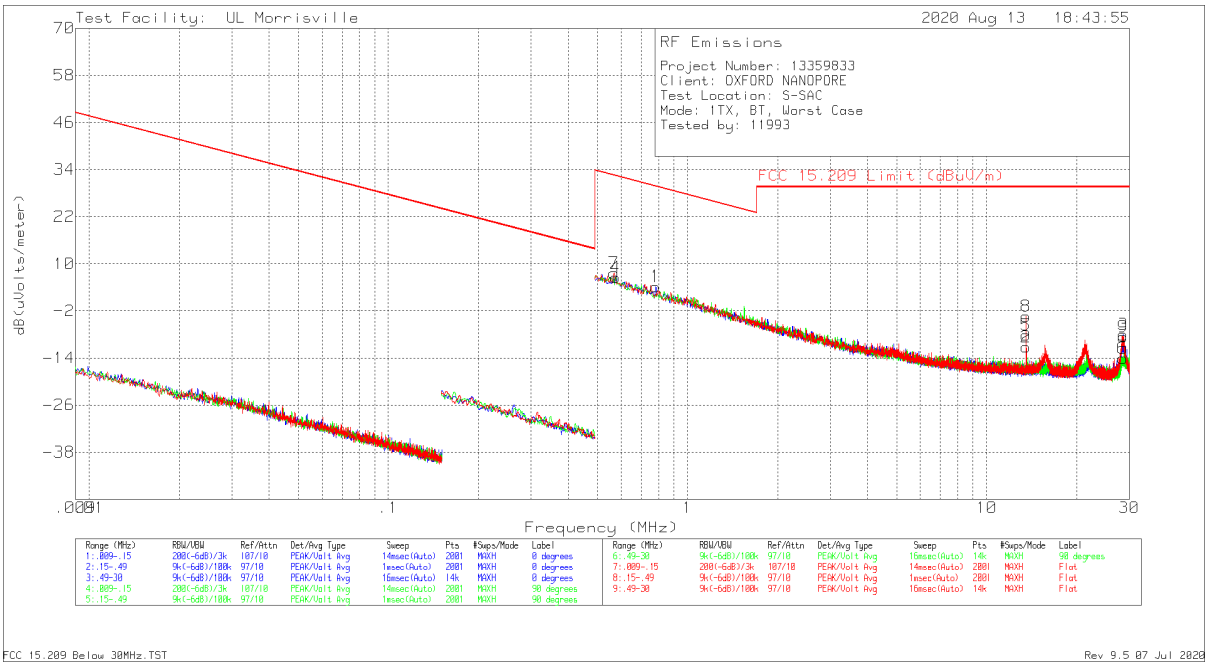
11.2. WORST CASE RADIATED

SPURIOUS EMISSIONS BELOW 30 MHz (WORST-CASE CONFIGURATION)

Note for below 30 MHz scans: 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).

The below 30 MHz limits in CFR 47, Part 15, Subpart C, paragraph 15.209 (a), are identical to those in RSS-GEN Section 8.9, Table 6, since the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as reported in the table) using the free space impedance of 377Ω. For example, the measurement frequency 783.01 kHz resulted in a level of 4.18 dBuV/m, which is equivalent to 4.18 - 51.5 = -47.32 dBuA/m, which has the same margin, -25.55 dB, to the corresponding RSS-GEN Table 6 limit as it has to be 15.209(a) limit.



ANTENNA- THREE ORIENTATIONS

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0059 (dB/m)	Cbl (dB)	Dist. Corr. Factor (dB)	Corrected Reading dB(uVolts/meter)	FCC 15.209 QP/AV Limit (dBuV/m)	FCC 15.209 PK Limit (dBuV/m)	Worst-Case Margin (dB)	Azimuth (Degs)	Antenna Face
1	.78301	33.68	Pk	10.3	.2	-40	4.18	29.73	-	-25.55	0-360	On
2	13.56065	17.25	Pk	10.8	.7	-40	-11.25	29.54	-	-40.79	0-360	On
3	28.55802	22.63	Pk	8.2	1.1	-40	-8.07	29.54	-	-37.61	0-360	On
4	.57432	36.04	Pk	10.4	.1	-40	6.54	32.42	-	-25.88	0-360	Off
5	13.5596	20.29	Pk	10.8	.7	-40	-8.21	29.54	-	-37.75	0-360	Off
6	28.52851	16.69	Pk	8.2	1.1	-40	-14.01	29.54	-	-43.55	0-360	Off
7	.568	37.09	Pk	10.4	.1	-40	7.59	32.52	-	-24.93	0-360	Flat
8	13.5596	25.08	Pk	10.8	.7	-40	-3.42	29.54	-	-32.96	0-360	Flat
9	28.62758	22.09	Pk	8.2	1.1	-40	-8.61	29.54	-	-38.15	0-360	Flat

Pk - Peak detector

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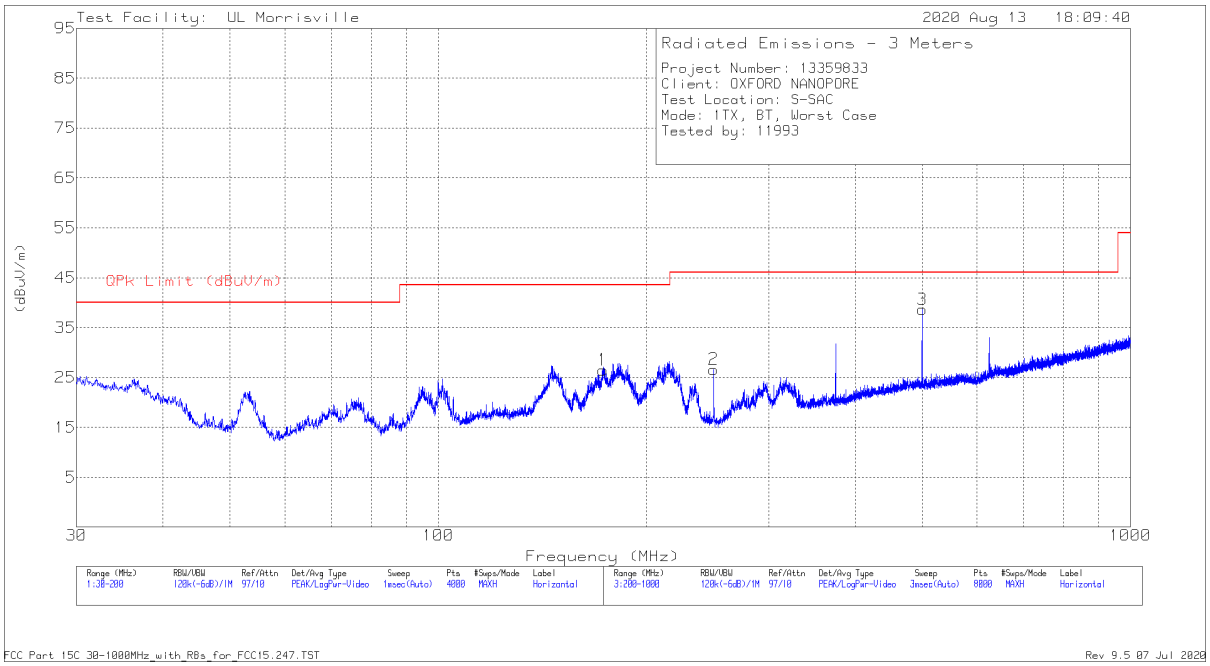
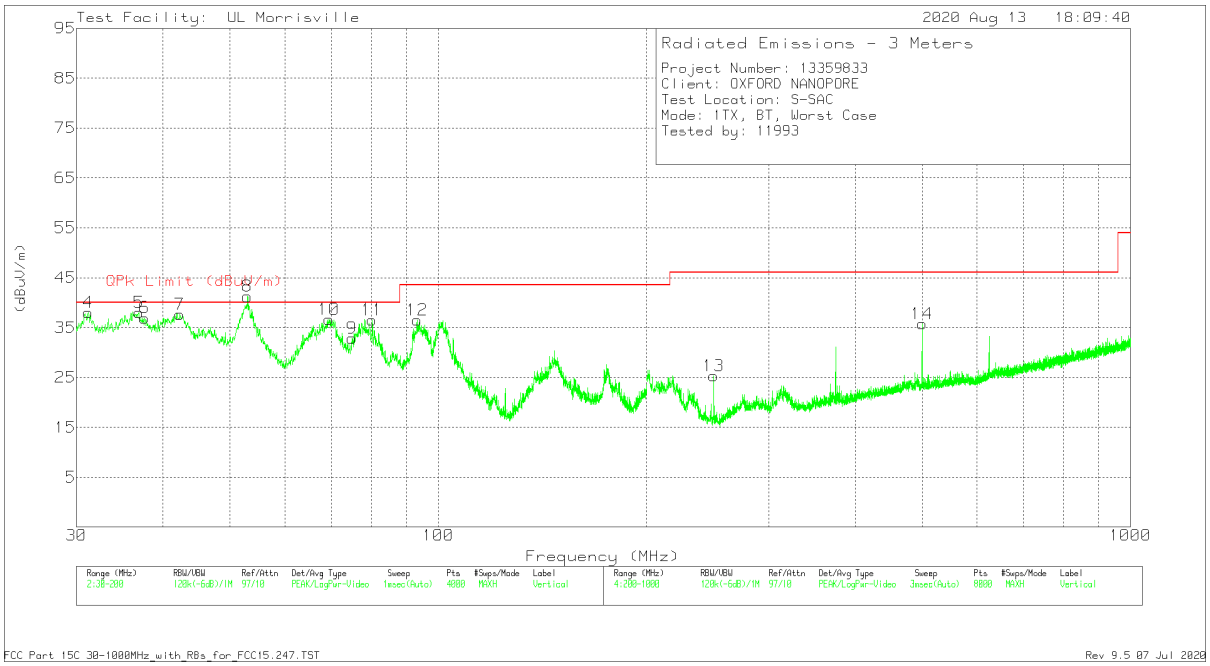
SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION)



HORIZONTAL



VERTICAL

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Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0081 AF (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 172.9645	38.62	Pk	17.7	-29.8	26.52	43.52	-17	0-360	300	H
6	** 37.4864	42.32	Qp	22	-31.4	32.92	40	-7.08	80	106	V
9	* ** 75.0191	49.45	Pk	14.3	-30.9	32.85	40	-7.15	0-360	101	V
2	* ** 250.0065	38.14	Pk	17.6	-29.1	26.64	46.02	-19.38	0-360	200	H
3	** 500.039	42.64	Pk	23.7	-27.7	38.64	46.02	-7.38	0-360	200	H
13	* ** 250.0065	36.85	Pk	17.6	-29.1	25.35	46.02	-20.67	0-360	200	V
14	** 500.039	39.77	Pk	23.7	-27.7	35.77	46.02	-10.25	0-360	101	V
4	31.1903	43.34	Pk	26.2	-31.5	38.04	-	-	0-360	101	V
5	36.9293	47.02	Pk	22.4	-31.4	38.02	-	-	0-360	101	V
7	42.3282	50.51	Pk	18.4	-31.3	37.61	-	-	0-360	101	V
8	52.9985	58.94	Pk	13.5	-31.2	41.24	-	-	0-360	101	V
10	69.4927	53.23	Pk	14.4	-31	36.63	-	-	0-360	101	V
11	80.2905	53.55	Pk	13.8	-30.8	36.55	-	-	0-360	101	V
12	93.1713	52.39	Pk	14.7	-30.6	36.49	-	-	0-360	101	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
Pk - Peak detector
Qp - Quasi-Peak detector

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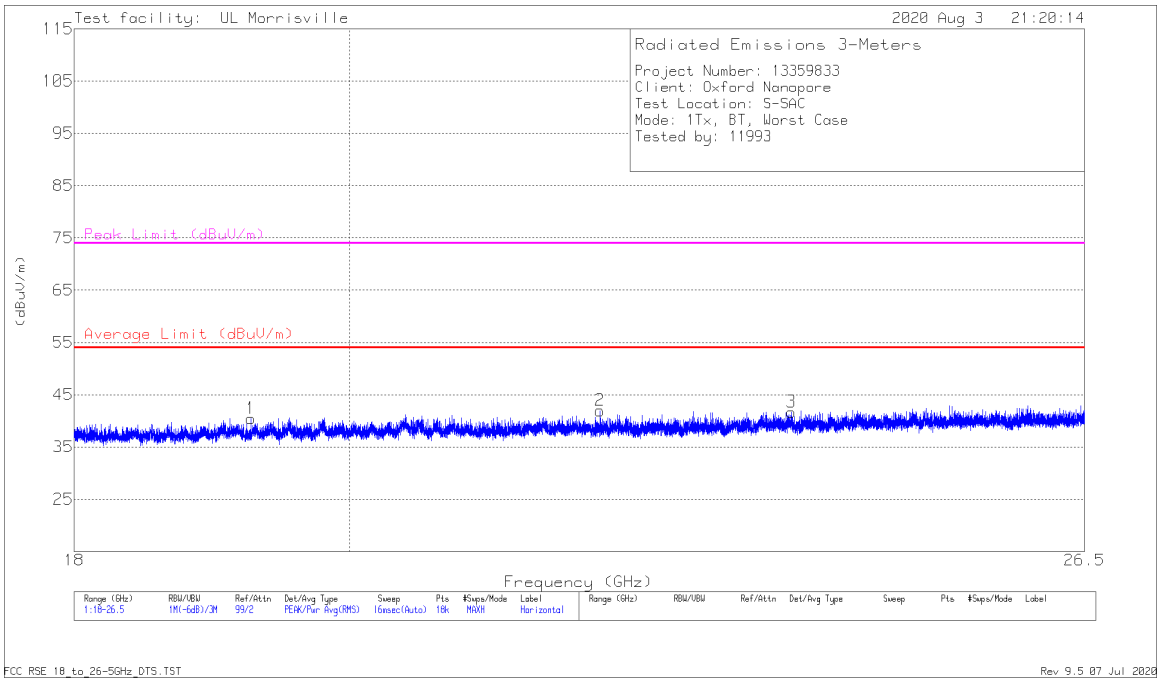
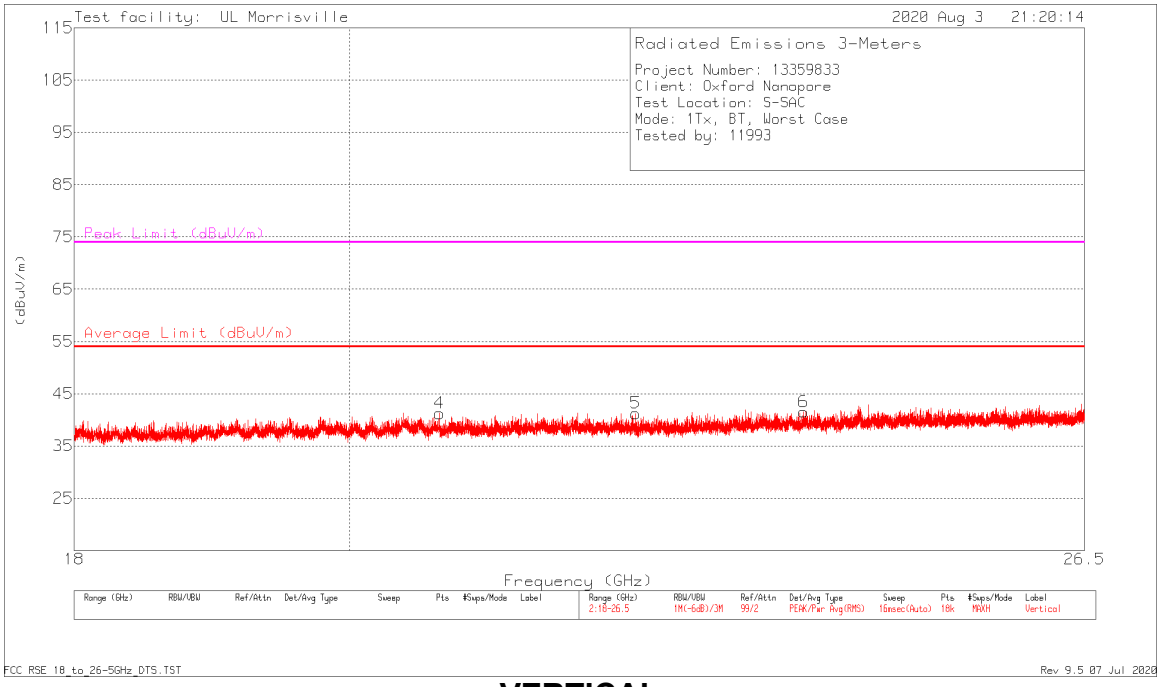
SPURIOUS EMISSIONS 18-26 GHz (WORST-CASE CONFIGURATION)



HORIZONTAL



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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	* ** 19.25901	46.75	Pk	32.8	-39.1	40.45	54	-13.55	74	-33.55	0-360	249	H
2	* ** 22.01364	47.57	Pk	33.6	-39.2	41.97	54	-12.03	74	-32.03	0-360	200	H
3	* ** 23.68775	46.19	Pk	34	-38.5	41.69	54	-12.31	74	-32.31	0-360	299	H
4	* ** 20.70268	47.45	Pk	33	-39.2	41.25	54	-12.75	74	-32.75	0-360	299	V
5	* ** 22.31729	47.14	Pk	33.6	-39.5	41.24	54	-12.76	74	-32.76	0-360	200	V
6	* ** 23.79873	45.92	Pk	34	-38.4	41.52	54	-12.48	74	-32.48	0-360	200	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
Pk - Peak detector

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12. 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.

TEST PROCEDURE

The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.4.

The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

Line conducted data is recorded for both lines.

RESULTS

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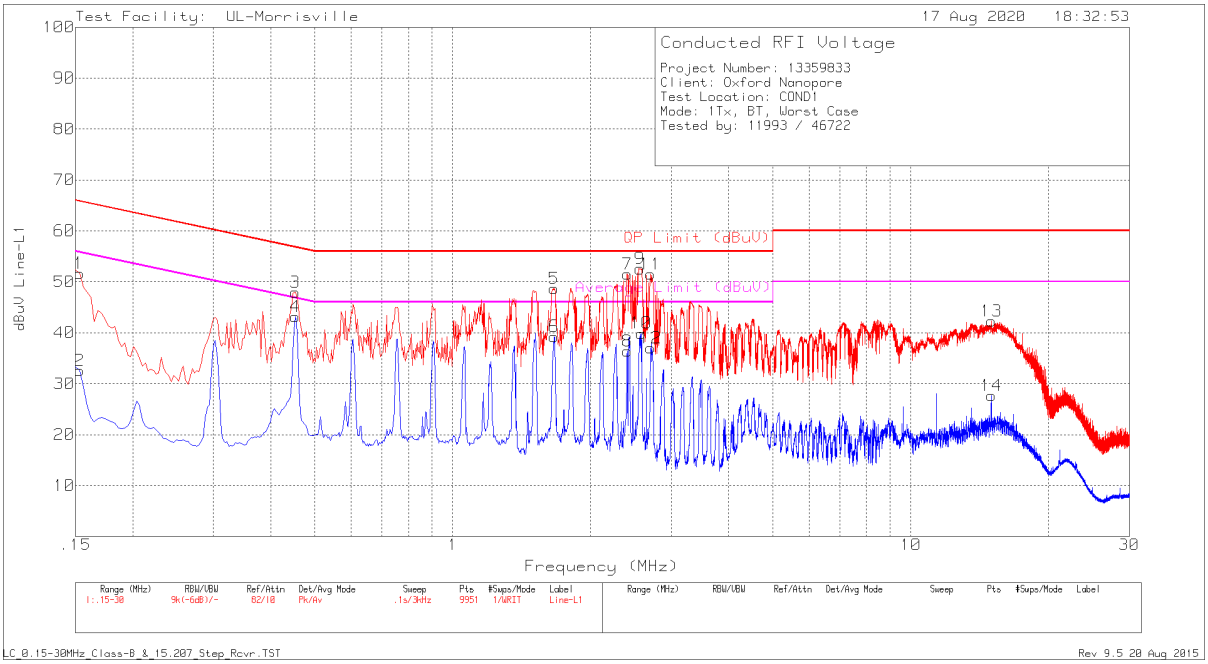
12.1.1. AC POWER LINE NORM

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	41.78	Pk	.2	9.7	51.68	65.84	-14.16	-	-
2	.153	22.71	Av	.2	9.7	32.61	-	-	55.84	-23.23
3	.453	38.06	Pk	.1	9.8	47.96	56.82	-8.86	-	-
4	.4548	27.75	Av	.1	9.8	37.65	-	-	46.79	-9.14
5	1.665	38.92	Pk	0	9.8	48.72	56	-7.28	-	-
6	1.665	29.47	Av	0	9.8	39.27	-	-	46	-6.73
7	2.4182	34.4	Qp	0	9.8	44.2	56	-11.8	-	-
8	2.403	26.62	Av	0	9.8	36.42	-	-	46	-9.58
9	2.55865	35.55	Qp	0	9.8	45.35	56	-10.65	-	-
10	2.58	30.11	Av	0	9.8	39.91	-	-	46	-6.09
11	2.69057	31.7	Qp	0	9.8	41.5	56	-14.5	-	-
12	2.706	27.2	Av	0	9.8	37	-	-	46	-9
13	15.003	32.07	Pk	.1	10.1	42.27	60	-17.73	-	-
14	15	17.5	Av	.1	10.1	27.7	-	-	50	-22.3

Pk - Peak detector
Av - Average detection
Qp - Quasi-Peak detector

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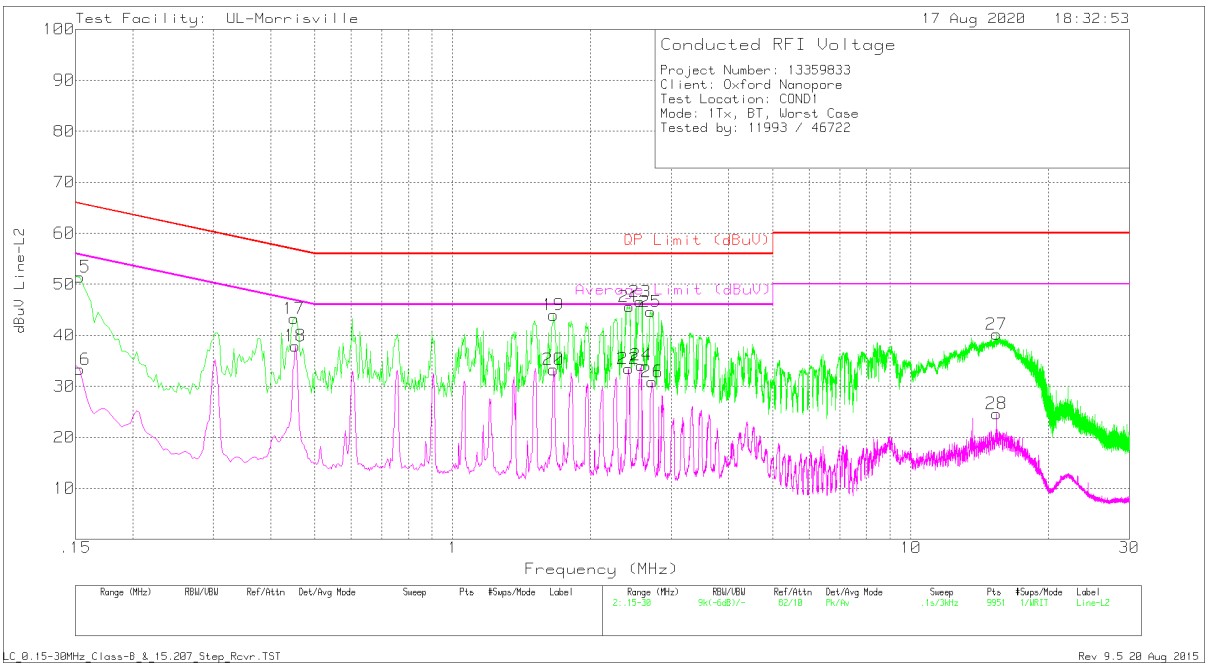
LINE 2 RESULTS



Range 2: Line-L2 .15 - 30MHz										
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN VCF (dB)	Cbl/Limiter (dB)	Corrected Reading dBuV	QP Limit (dBuV)	Margin (dB)	Average Limit (dBuV)	Margin (dB)
15	.153	41.55	Pk	.2	9.7	51.45	65.84	-14.39	-	-
16	.153	23.46	Av	.2	9.7	33.36	-	-	55.84	-22.48
17	.45	33.39	Pk	.1	9.8	43.29	56.88	-13.59	-	-
18	.453	28.03	Av	.1	9.8	37.93	-	-	46.82	-8.89
19	1.659	34.18	Pk	0	9.8	43.98	56	-12.02	-	-
20	1.659	23.48	Av	0	9.8	33.28	-	-	46	-12.72
21	2.427	35.85	Pk	0	9.8	45.65	56	-10.35	-	-
22	2.418	23.62	Av	0	9.8	33.42	-	-	46	-12.58
23	2.565	36.83	Pk	0	9.8	46.63	56	-9.37	-	-
24	2.577	24.33	Av	0	9.8	34.13	-	-	46	-11.87
25	2.7	34.8	Pk	0	9.8	44.6	56	-11.4	-	-
26	2.724	21.11	Av	0	9.8	30.91	-	-	46	-15.09
27	15.384	30.04	Pk	.1	10.1	40.24	60	-19.76	-	-
28	15.381	14.44	Av	.1	10.1	24.64	-	-	50	-25.36

Pk - Peak detector
Av - Average detection

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13. SETUP PHOTOS

Please refer to R13359833-EP1 for setup photos

END OF TEST REPORT

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