CERTIFICATION TEST REPORT

Report Number. : R12931061-E2

Applicant	:	Danfoss A/S Bldg E14-S1A Nordborgvej 81 Nordborg, 6430 Denmark
Model	:	AK-UI55 Bluetooth
FCC ID	:	2ATXJ-RAC01
IC	:	25253-RAC01
EUT Description	:	BLE Display
Test Standard(s)	:	FCC 47 CFR PART 15 SUBPART C ISED RSS-247 ISSUE 2 ISED RSS-GEN ISSUE 5

Date Of Issue:
2019-09-17

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
--	--	Initial Issue	--
2	2019-08-30	Updated model and support equipment	Niklas Haydon
3	2019-09-17	Updated test methodology and added calibration note	Niklas Haydon

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TABLE OF CONTENTS

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Danfoss A/S
Bldg E14-S1A
Nordborgvej 81
Nordborg, 6430
Denmark

EUT DESCRIPTION: BLE Display

MODEL: AK-UI55 Bluetooth

SERIAL NUMBER: P0882, P1059

DATE TESTED: 2019-07-15 to 2019-08-28

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.

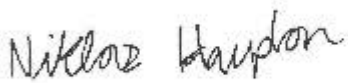
The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. 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:

Bob DeLisi
Principal Engineer
Consumer Technology Division
UL LLC

Prepared By:



Niklas Haydon
Engineer
Consumer Technology Division
UL LLC

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2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, ANSI C63.10-2013, 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 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.

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

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

4.2. SAMPLE CALCULATION

RADIATED EMISSIONS

Where relevant, the following sample calculation is provided:
Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)
36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m

MAINS CONDUCTED EMISSIONS

Where relevant, the following sample calculation is provided:
Final Voltage (dBuV) = Measured Voltage (dBuV) + Cable Loss (dB) + Limiter Factor (dB) + LISN Insertion Loss.
36.5 dBuV + 0 dB +10.1 dB+ 0 dB = 46.6 dBuV

4.3. MEASUREMENT UNCERTAINTY

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

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

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

5. EQUIPMENT UNDER TEST

5.1. EUT DESCRIPTION

The EUT is a BLE display.

5.2. MAXIMUM OUTPUT POWER

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

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
2402 - 2480	BLE	-0.71	0.85

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an PCB trace antenna, with a maximum gain of 5.3 dBi.

5.4. SOFTWARE AND FIRMWARE

The EUT firmware installed during testing was 3.2.

5.5. WORST-CASE CONFIGURATION AND MODE

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

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

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

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5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
Controller	Danfoss	AK-CC55 Single coil	NA	NA
Laptop	Lenovo	L470	PF0ZV674	NA
JLink Adaptor	Danfoss	Prototype	NA	NA
Dev Kit	Texas Instruments	CC2640R2	NA	NA

I/O CABLES

I/O Cable List						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	Display	1	Hardwired	RJ14	<3m	Other lengths available
2	Mains	1	Terminal Connector	Mains	<3m	Provides AC power to support controller

TEST SETUP

The EUT is connected to a test laptop during the tests. Test software exercised the radio card.

SETUP DIAGRAMS

Please refer to R12931061-EP2 for setup diagrams

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6. MEASUREMENT METHOD

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

6 dB BW: ANSI C63.10 Subclause 11.8.1

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

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

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

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

Out-of-band emissions in restricted bands: ANSI C63.10-2013 Section 11.12.1, 6.10.5 and KDB 558074 D01 15.247 Section 11. FAQ 3c

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

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7. TEST AND MEASUREMENT EQUIPMENT

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

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

Equip. ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
	0.009-30MHz	**(Loop Ant.)**			
AT0079	Active Loop Antenna	ETS-Lindgren	6502	2019-08-08	2020-08-08
	30-1000 MHz				
AT0066	Hybrid Broadband Antenna	Sunol Sciences Corp.	JB1	2018-12-11	2019-12-11
	1-18 GHz				
AT0072	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2019-04-22	2020-04-22
	18-40 GHz				
AT0076	Horn Antenna, 18-26.5GHz	ARA	MWH-1826/B	2018-11-08	2019-11-08
	Gain-Loss Chains				
S-SAC01	Gain-loss string: 0.009-30MHz	Various	Various	2019-05-02	2020-05-02
S-SAC02	Gain-loss string: 25-1000MHz	Various	Various	2019-05-02	2020-05-02
S-SAC03	Gain-loss string: 1-18GHz	Various	Various	2019-03-13	2020-03-13
S-SAC04	Gain-loss string: 18-40GHz	Various	Various	2018-09-30	2019-09-30
	Receiver & Software				
SA0025	Spectrum Analyzer	Agilent	N9030A	2019-02-28	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

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

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
CBL087	Coax cable, RG223, N-male to BNC-male, 20-ft.	Pasternack	PE3W06143-240	2019-05-29	2020-05-29
s/n 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

Test Equipment Used - Wireless Conducted Measurement Equipment (Morrisville Conducted 2)

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
	Conducted Room 2				
72822 (PRE0100902)	Spectrum Analyzer	Agilent Technologies	E4446A	2018-11-19	2019-11-19
PWM004 (MY55116003)	RF Power Meter	Keysight Technologies	N1911A	2018-07-30	2019-07-30
PWS005 (MY55090030)	Peak and Avg Power Sensor, 50MHz to 6GHz	Keysight Technologies	N1921A	2019-05-06	2020-05-06
SN 161024885	Environmental Meter	Fisher Scientific	15-077-963	2019-06-17	2019-06-17

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.

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8. ANTENNA PORT TEST RESULTS

8.1. ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

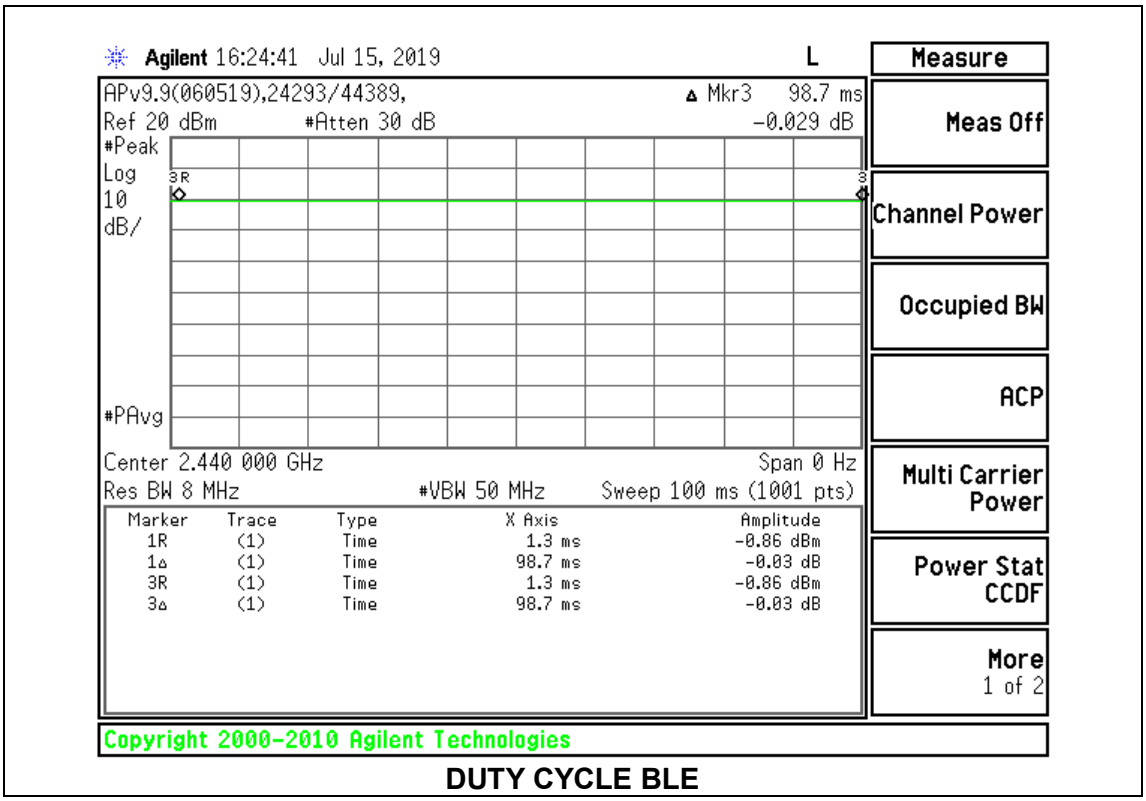
PROCEDURE

KDB 558074 Zero-Span Spectrum Analyzer Method.

ON TIME AND DUTY CYCLE RESULTS

Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/B Minimum VBW (kHz)
2.4GHz Band						
BLE	98.70	98.70	1.000	100.00%	0.00	0.010

DUTY CYCLE PLOTS



DUTY CYCLE BLE

8.2. 99% BANDWIDTH

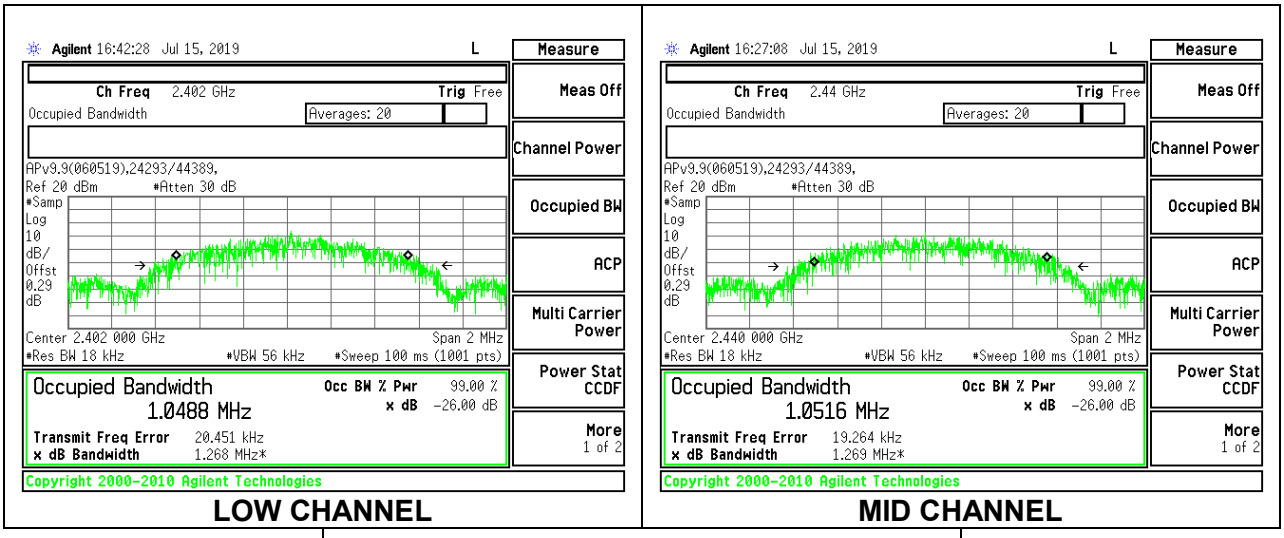
LIMITS

None; for reporting purposes only.

RESULTS

8.2.1. BLE (1Mbps)

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	1.049
Middle	2440	1.052
High	2480	1.057



8.3. 6 dB BANDWIDTH

LIMITS

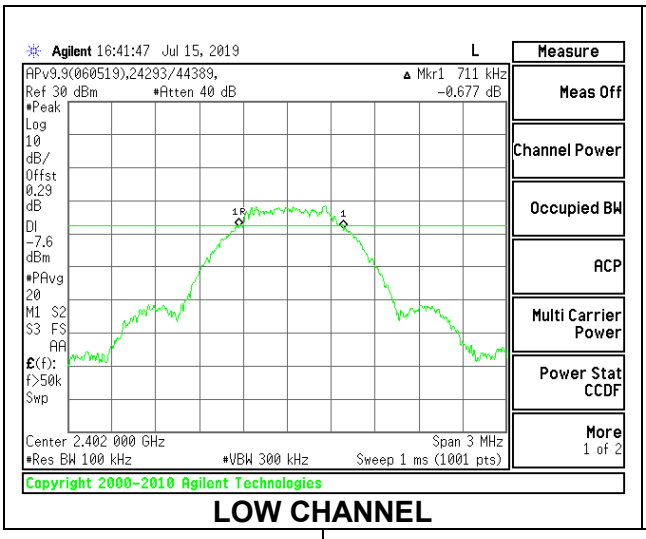
FCC §15.247 (a) (2)
RSS-247 5.2 (a)

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

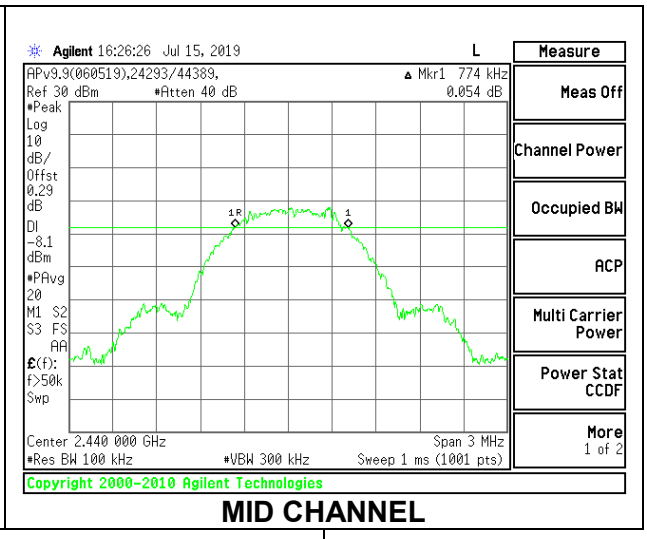
RESULTS

8.3.1. BLE (1Mbps)

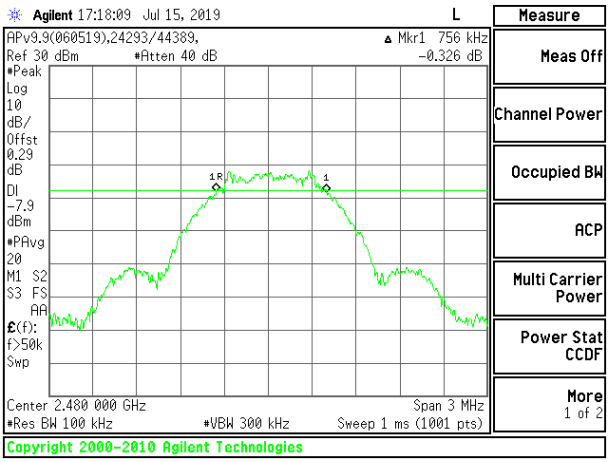
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2402	0.7110	0.5
Middle	2440	0.7740	0.5
High	2480	0.7560	0.5



LOW CHANNEL



MID CHANNEL



HIGH CHANNEL

8.4. OUTPUT POWER

LIMITS

FCC §15.247 (b) (3)
RSS-247 5.4 (d)

The maximum antenna gain is less than or equal to 6 dBi, therefore the limit is 30 dBm.

TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 0.29 dB was entered as an offset in the power meter to allow for a peak reading of power.

RESULTS

8.4.1. BLE (1Mbps)

Tested By:	24293/44389
Date:	2019-07-15

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	-1.07	30	-31.07
Middle	2440	-0.71	30	-30.71
High	2480	-0.86	30	-30.86

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8.5. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 0.29dB was entered as an offset in the power meter to allow for a gated average reading of power.

RESULTS

8.5.1. BLE (1Mbps)

Tested By:	24293/44389
Date:	2019-07-15

Channel	Frequency (MHz)	AV power (dBm)
Low	2402	-1.12
Middle	2440	-0.79
High	2480	-0.86

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8.6. POWER SPECTRAL DENSITY

LIMITS

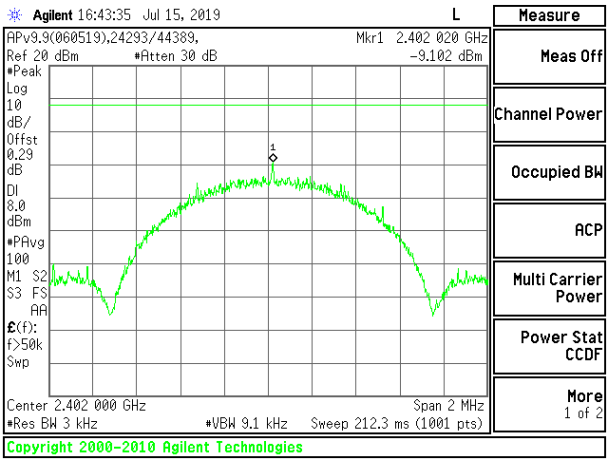
FCC §15.247 (e)
RSS-247 (5.2) (b)

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

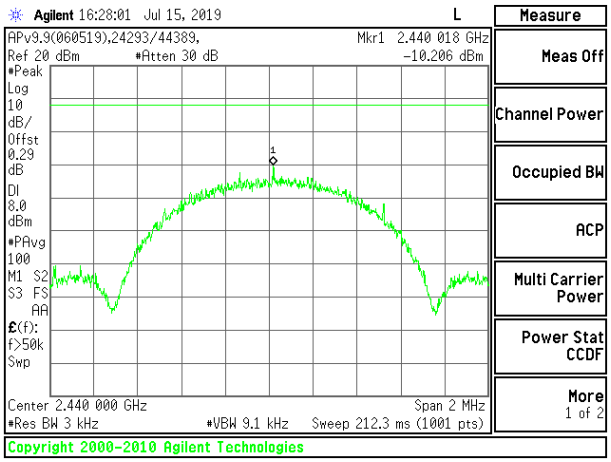
RESULTS

8.6.1. BLE (1Mbps)

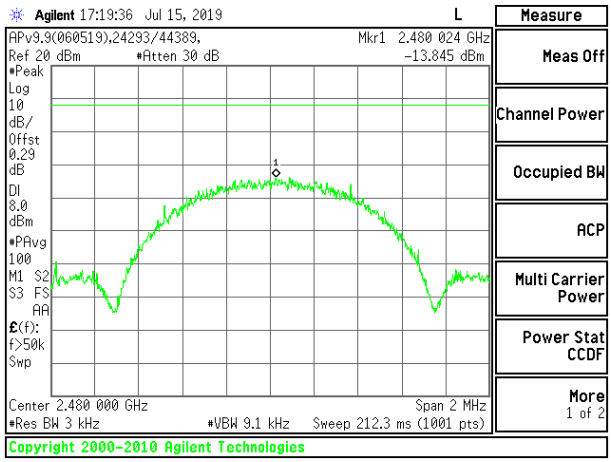
Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Low	2402	-9.10	8	-17.10
Middle	2440	-10.21	8	-18.21
High	2480	-13.85	8	-21.85



LOW CHANNEL



MID CHANNEL



HIGH CHANNEL

8.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

RSS-247 5.5

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

RESULTS

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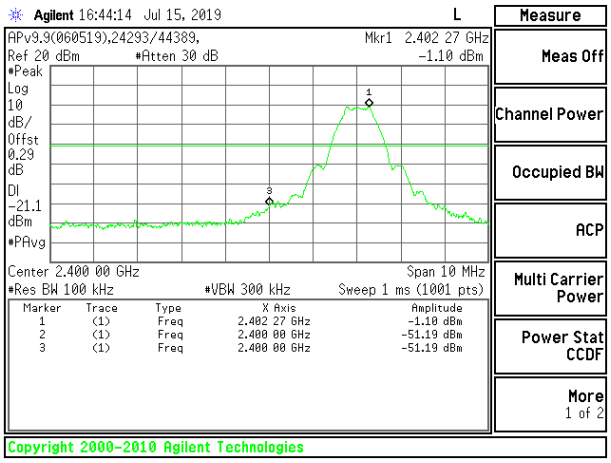
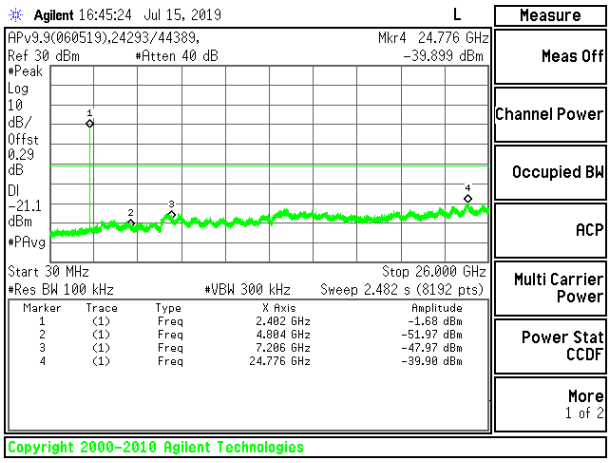
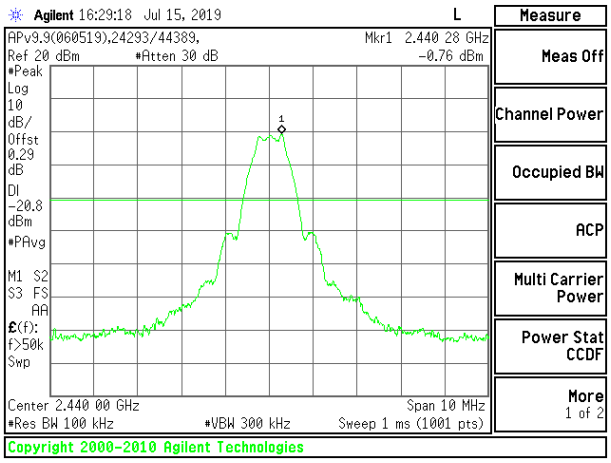
8.7.1. BLE (1Mbps)



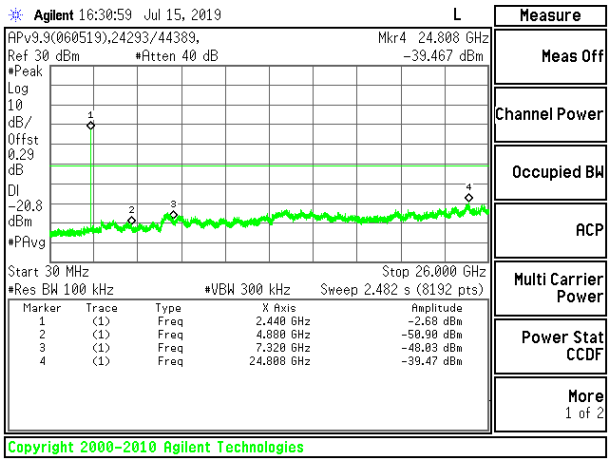
LOW CHANNEL BANDEDGE



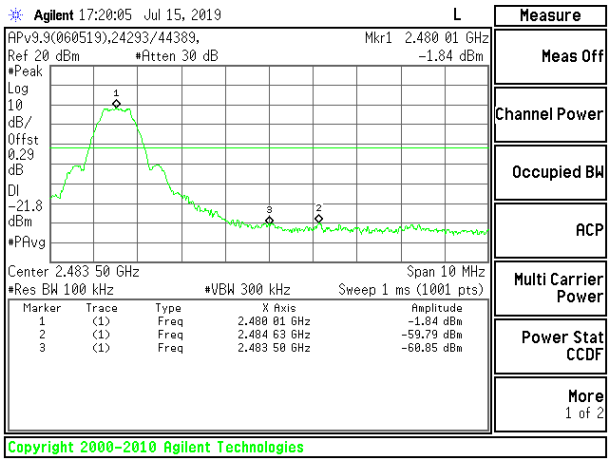
OUT-OF-BAND LOW CHANNEL



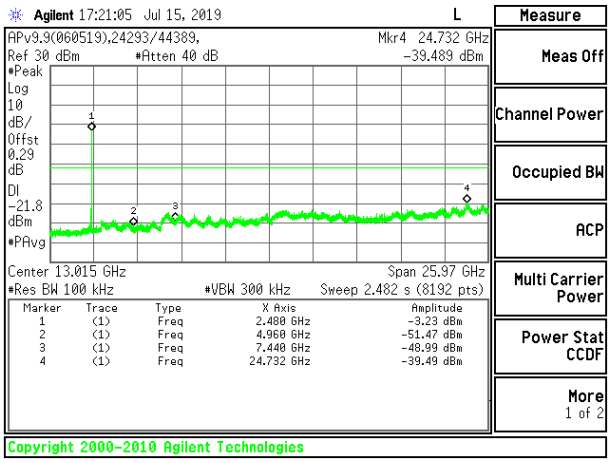
IN-BAND REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL



HIGH CHANNEL BANDEDGE



OUT-OF-BAND HIGH CHANNEL

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9. RADIATED TEST RESULTS

9.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205 and §15.209
RSS-GEN, Section 8.9 and 8.10.

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
0.009-0.490	2400/F(kHz) @ 300 m	-
0.490-1.705	24000/F(kHz) @ 30 m	-
1.705 - 30	30 @ 30m	-
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane for measurement below 1GHz; 1.5 m above the ground plane for measurement above 1GHz. The antenna to EUT distance is 3 meters. The EUT is configured in accordance with ANSI C63.10. The EUT is set to transmit in a continuous mode.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For pre-scans above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 30 KHz for peak measurements.

For final measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz for peak measurements and as applicable for average measurements.

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).

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

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

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

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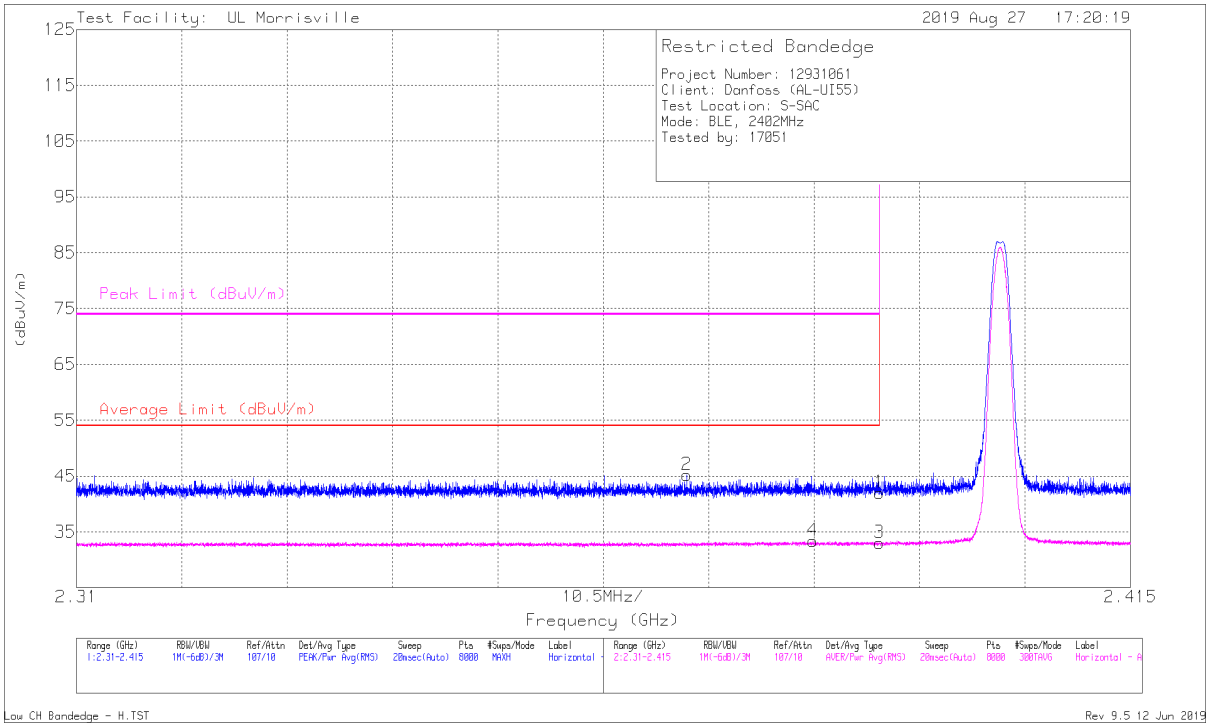
9.2. TRANSMITTER ABOVE 1 GHz

9.2.1. BLE (1Mbps)

Antenna 1

BANDEDGE (LOW CHANNEL)

HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	34.07	Pk	31.9	-24	41.97	-	-	74	-32.03	353	153	H
2	* 2.37079	37.4	Pk	31.8	-24	45.2	-	-	74	-28.8	353	153	H
3	* 2.39	25.12	RMS	31.9	-24	33.02	54	-20.98	-	-	353	153	H
4	* 2.38335	25.37	RMS	31.9	-23.9	33.37	54	-20.63	-	-	353	153	H

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

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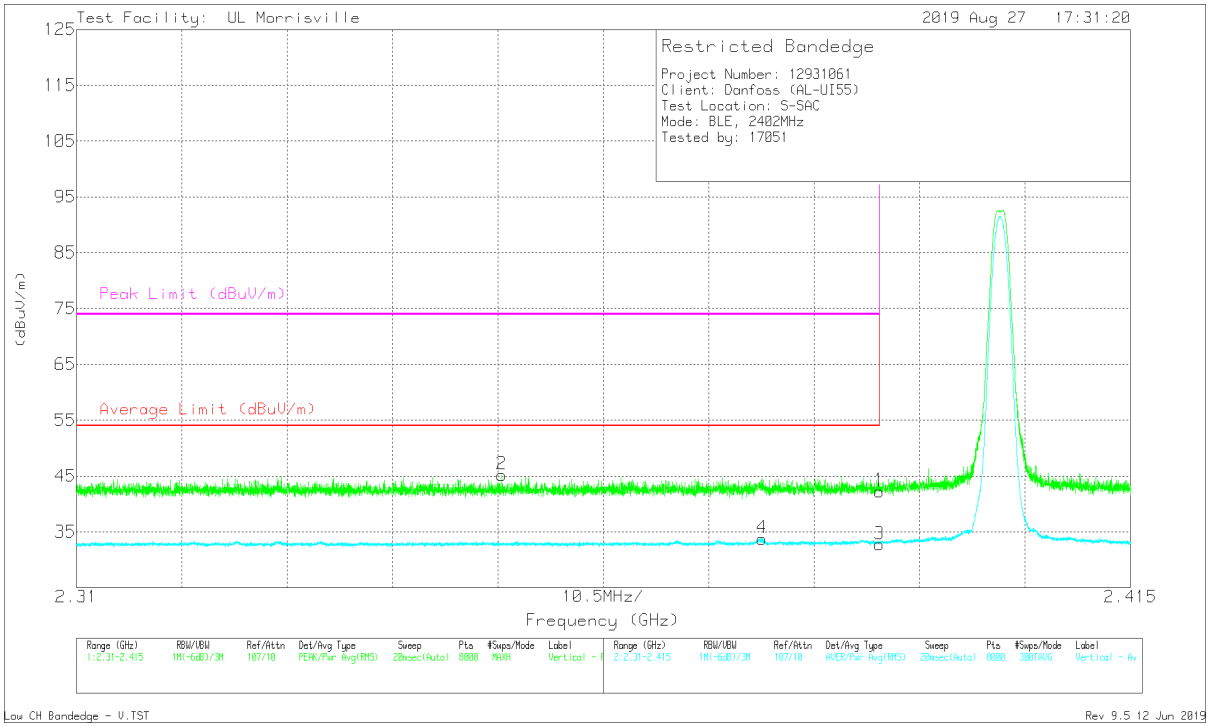
VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	34.38	Pk	31.9	-24	42.28	-	-	74	-31.72	22	127	V
2	* 2.35237	37.34	Pk	31.7	-23.8	45.24	-	-	74	-28.76	22	127	V
3	* 2.39	24.86	RMS	31.9	-24	32.76	54	-21.24	-	-	22	127	V
4	* 2.37829	26.01	RMS	31.8	-24	33.81	54	-20.19	-	-	22	127	V

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

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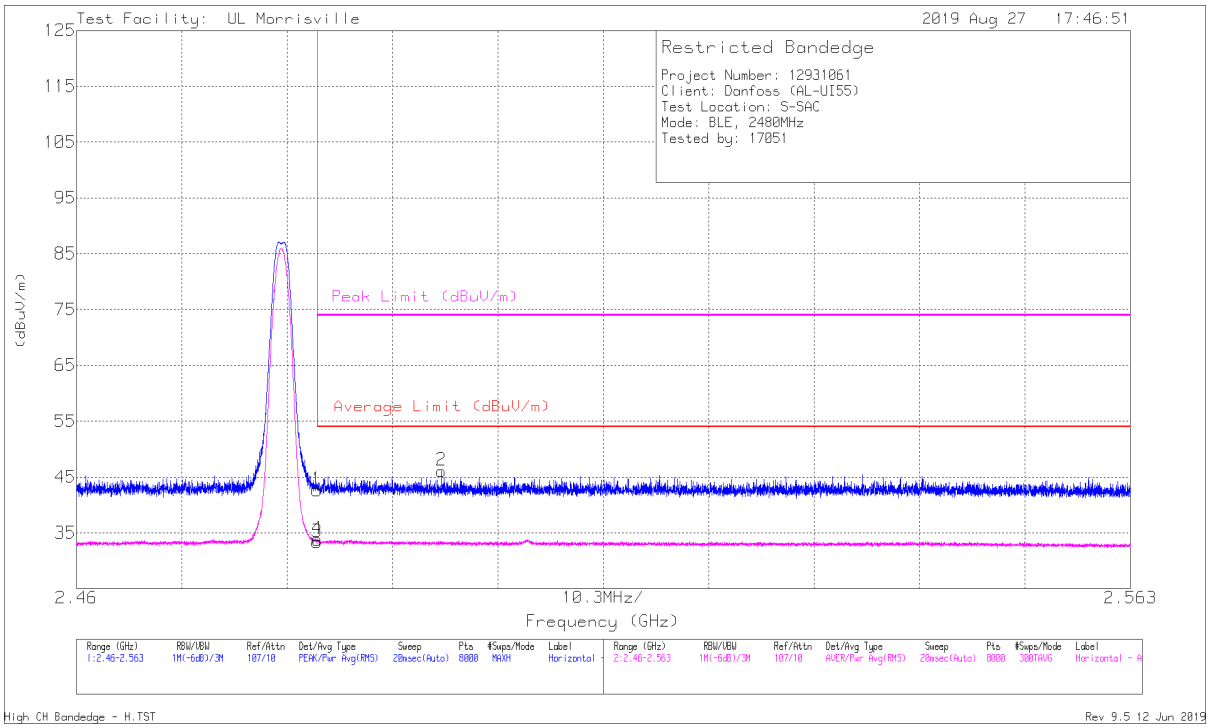
BANDEDGE (HIGH CHANNEL)

HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.4835	34.87	Pk	32.3	-24.5	42.67	-	-	74	-31.33	66	150	H
2	* 2.49566	38.4	Pk	32.3	-24.6	46.1	-	-	74	-27.9	66	150	H
3	* 2.4835	25.6	RMS	32.3	-24.5	33.4	54	-20.6	-	-	66	150	H
4	* 2.48354	26.03	RMS	32.3	-24.5	33.83	54	-20.17	-	-	66	150	H

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

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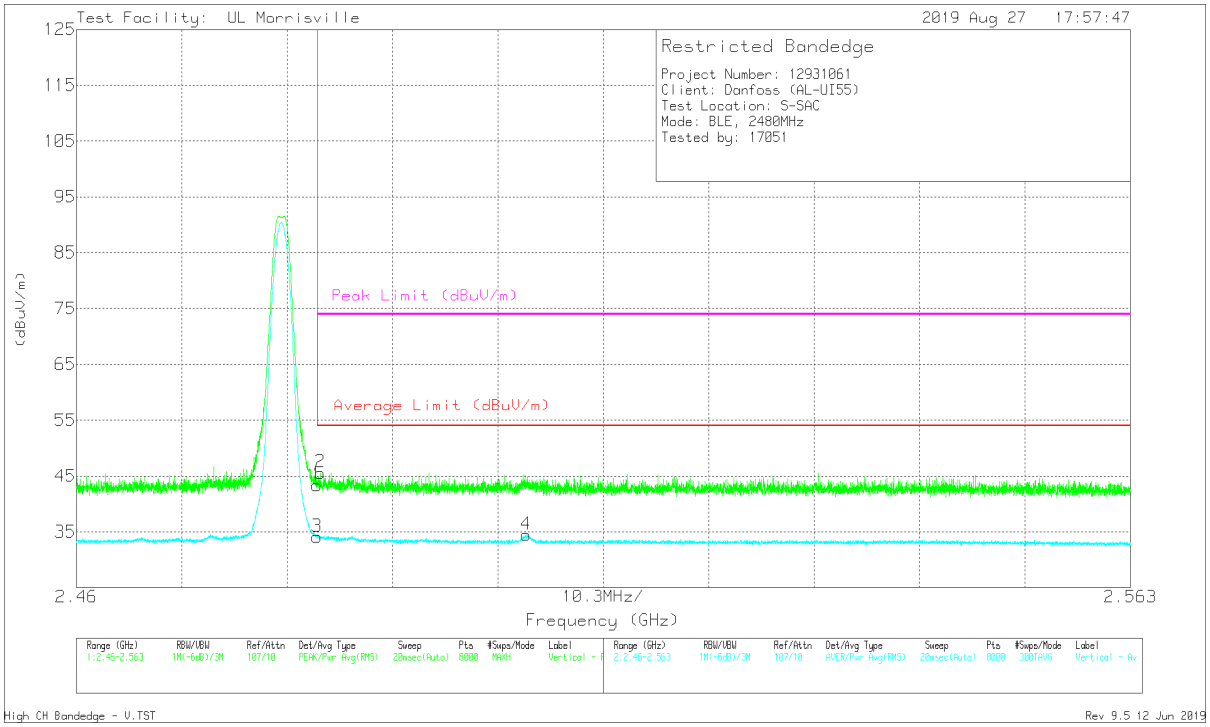
VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.4835	35.5	Pk	32.3	-24.5	43.3	-	-	74	-30.7	3	106	V
2	* 2.48382	37.81	Pk	32.3	-24.5	45.61	-	-	74	-28.39	3	106	V
3	* 2.4835	26.31	RMS	32.3	-24.5	34.11	54	-19.89	-	-	3	106	V
4	2.50392	26.68	RMS	32.4	-24.6	34.48	54	-19.52	-	-	3	106	V

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

UL LLC
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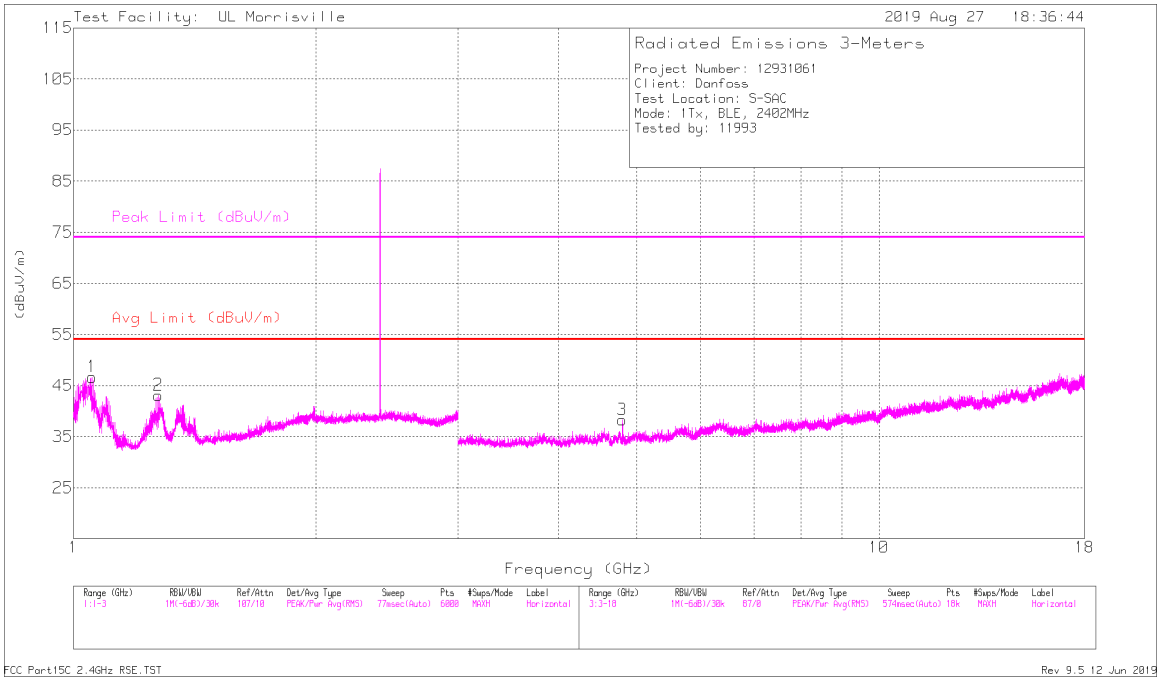
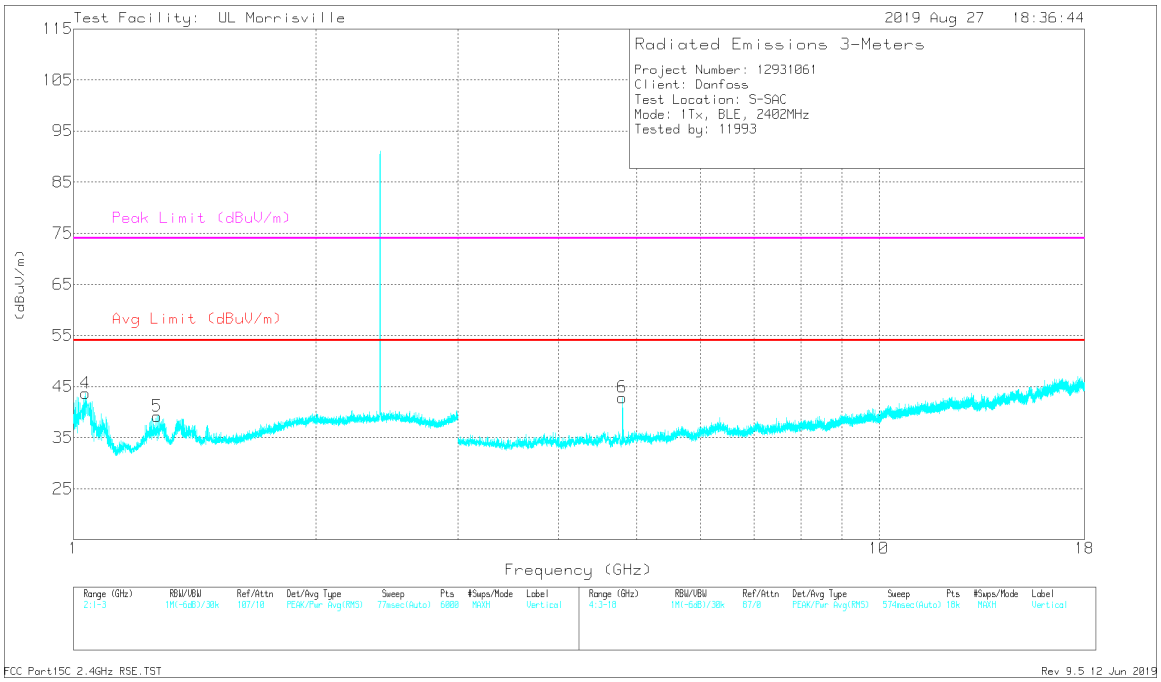
HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



HORIZONTAL



VERTICAL

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RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.05375	46.6	PK2	27	-24.5	49.1	-	-	74	-24.9	82	101	H
	* 1.05391	43.11	MAv1	27	-24.5	45.61	54	-8.39	-	-	82	101	H
2	* 1.2741	42.45	PK2	29.2	-23.3	48.35	-	-	74	-25.65	278	154	H
	* 1.27408	36.84	MAv1	29.2	-23.3	42.74	54	-11.26	-	-	278	154	H
4	* 1.03412	44.98	PK2	27.1	-24.6	47.48	-	-	74	-26.52	319	206	V
	* 1.0341	39.96	MAv1	27.1	-24.6	42.46	54	-11.54	-	-	319	206	V
5	* 1.2699	39.59	PK2	29.2	-23.2	45.59	-	-	74	-28.41	245	193	V
	* 1.26993	32.66	MAv1	29.2	-23.2	38.66	54	-15.34	-	-	245	193	V
3	* 4.80423	41.87	PK2	34.2	-31	45.07	-	-	74	-28.93	352	101	H
	* 4.80439	32.26	MAv1	34.2	-31	35.46	54	-18.54	-	-	352	101	H
6	* 4.80361	45.32	PK2	34.2	-31	48.52	-	-	74	-25.48	108	232	V
	* 4.80373	37.91	MAv1	34.2	-31	41.11	54	-12.89	-	-	108	232	V

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

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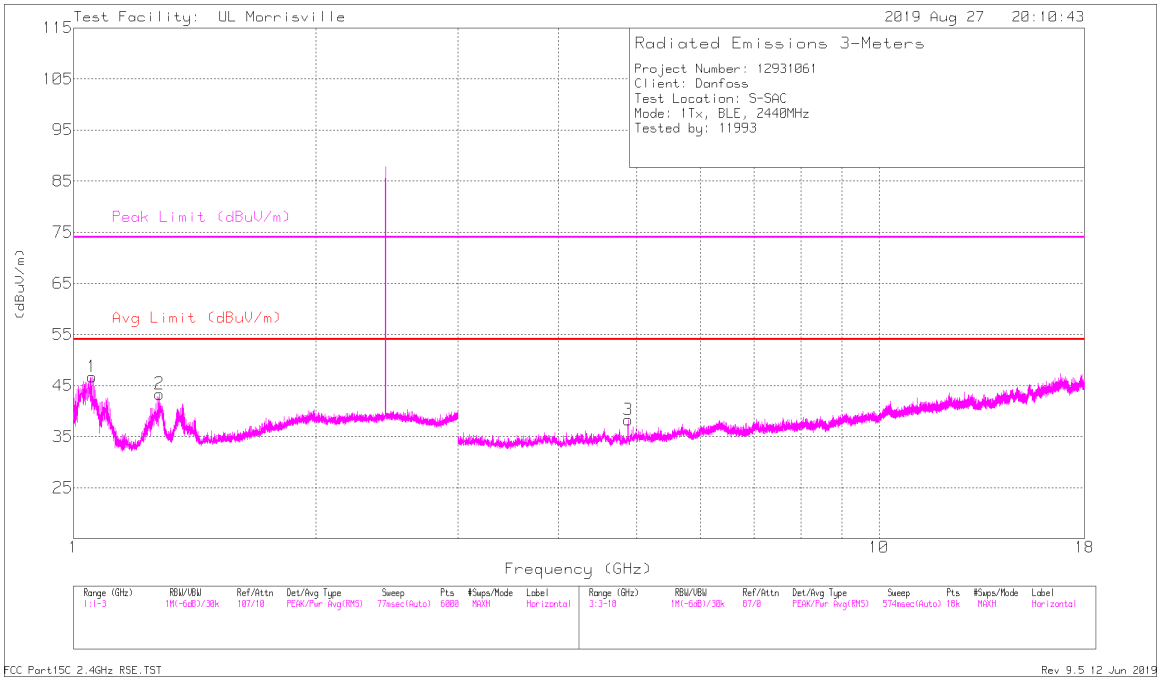
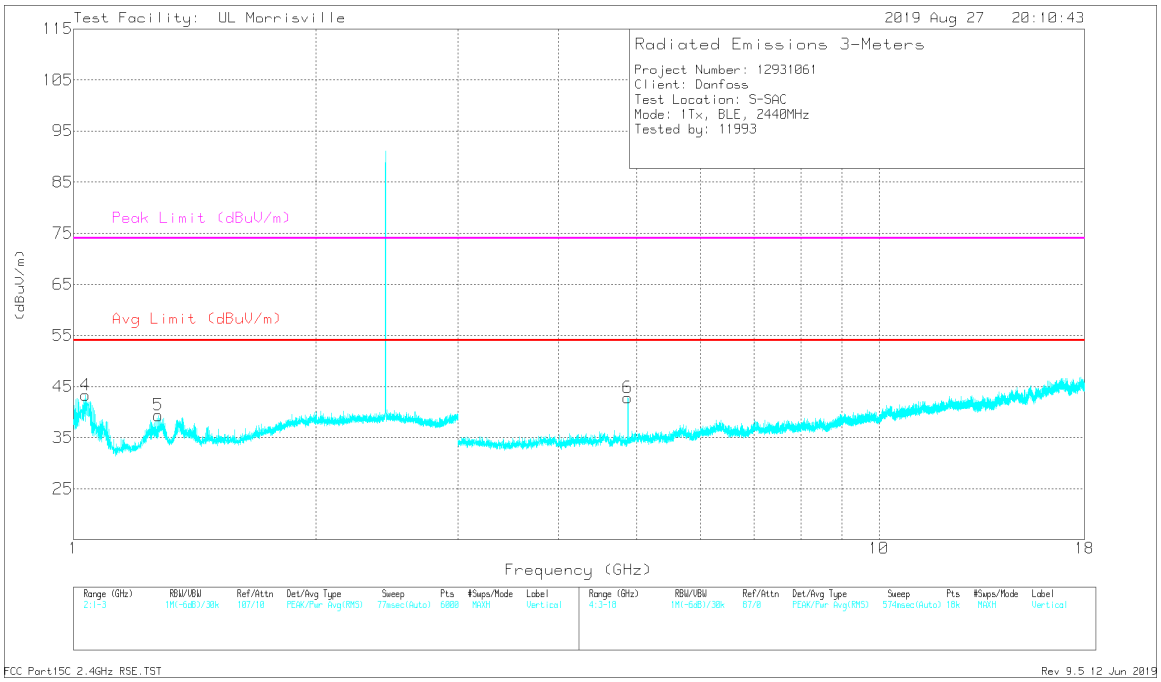
MID CHANNEL RESULTS



HORIZONTAL



VERTICAL

UL LLC
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RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.05388	46.94	PK2	27	-24.5	49.44	-	-	74	-24.56	78	107	H
	* 1.05391	43.12	MAv1	27	-24.5	45.62	54	-8.38	-	-	78	107	H
2	* 1.27848	42.03	PK2	29.2	-23.2	48.03	-	-	74	-25.97	294	155	H
	* 1.2783	35.83	MAv1	29.2	-23.2	41.83	54	-12.17	-	-	294	155	H
4	* 1.03388	45.06	PK2	27.1	-24.6	47.56	-	-	74	-26.44	312	209	V
	* 1.0341	39.8	MAv1	27.1	-24.6	42.3	54	-11.7	-	-	312	209	V
5	* 1.27389	40.3	PK2	29.2	-23.3	46.2	-	-	74	-27.8	251	193	V
	* 1.27407	32.9	MAv1	29.2	-23.3	38.8	54	-15.2	-	-	251	193	V
3	* 4.8794	41.11	PK2	34	-30.6	44.51	-	-	74	-29.49	26	105	H
	* 4.87975	30.18	MAv1	34	-30.6	33.58	54	-20.42	-	-	26	105	H
6	* 4.88041	44.95	PK2	34	-30.6	48.35	-	-	74	-25.65	342	247	V
	* 4.87967	37.99	MAv1	34	-30.6	41.39	54	-12.61	-	-	342	247	V

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

UL LLC
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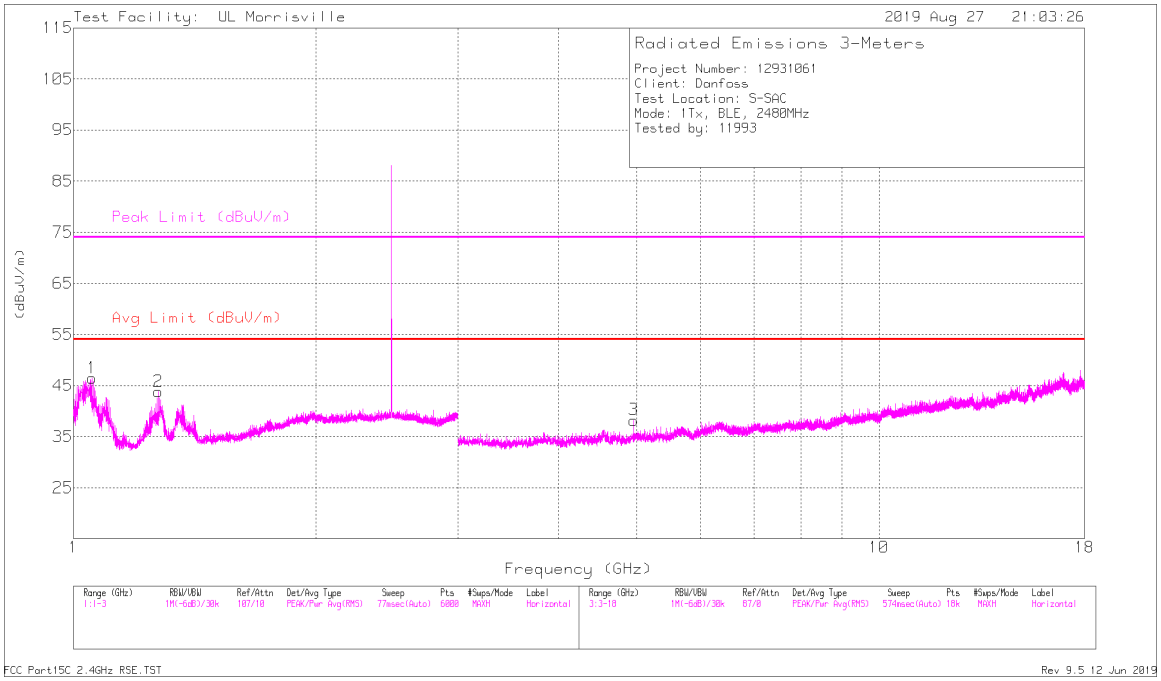
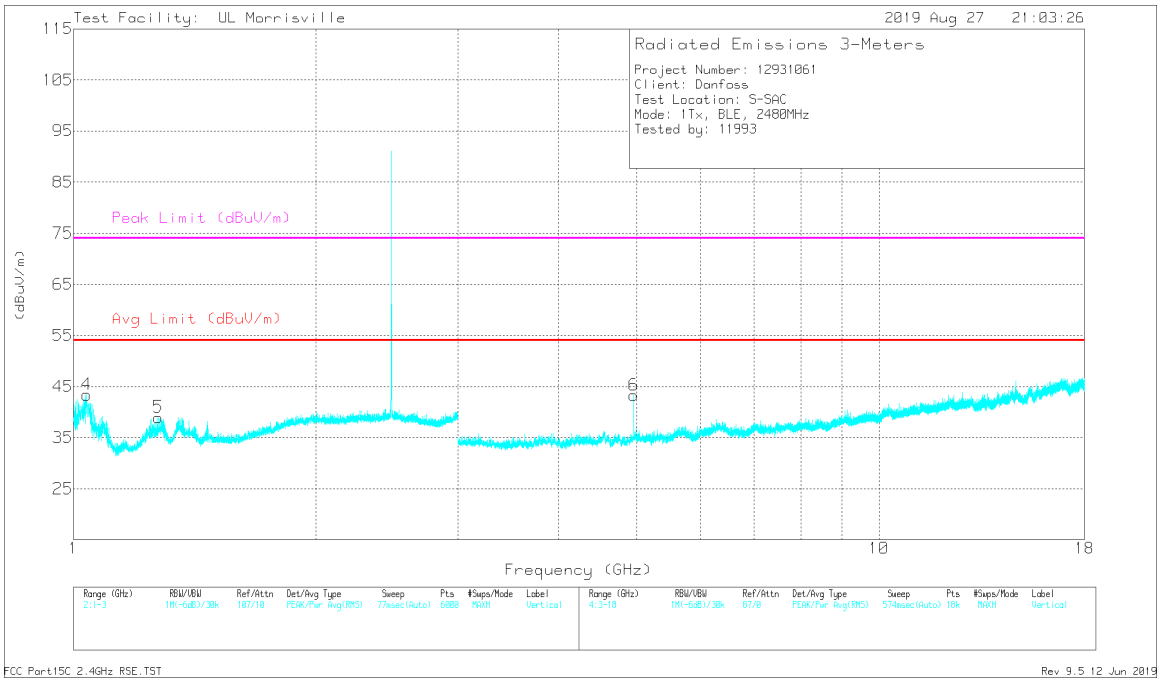
HIGH CHANNEL RESULTS



HORIZONTAL



VERTICAL

UL LLC
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RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.05371	47.09	PK2	27	-24.5	49.59	-	-	74	-24.41	81	104	H
	* 1.05392	42.97	MAv1	27	-24.5	45.47	54	-8.53	-	-	81	104	H
2	* 1.27412	42.07	PK2	29.2	-23.3	47.97	-	-	74	-26.03	273	146	H
	* 1.27404	36.61	MAv1	29.2	-23.3	42.51	54	-11.49	-	-	273	146	H
4	* 1.03834	44.63	PK2	27	-24.6	47.03	-	-	74	-26.97	305	195	V
	* 1.03826	39.03	MAv1	27.1	-24.6	41.53	54	-12.47	-	-	305	195	V
5	* 1.27407	39.55	PK2	29.2	-23.3	45.45	-	-	74	-28.55	245	184	V
	* 1.27407	32.77	MAv1	29.2	-23.3	38.67	54	-15.33	-	-	245	184	V
3	* 4.96045	40.53	PK2	34.1	-31.1	43.53	-	-	74	-30.47	0	358	H
	* 4.96039	31.27	MAv1	34.1	-31.1	34.27	54	-19.73	-	-	0	358	H
6	* 4.95949	45.8	PK2	34.1	-31	48.9	-	-	74	-25.1	326	235	V
	* 4.9597	38.54	MAv1	34.1	-31	41.64	54	-12.36	-	-	326	235	V

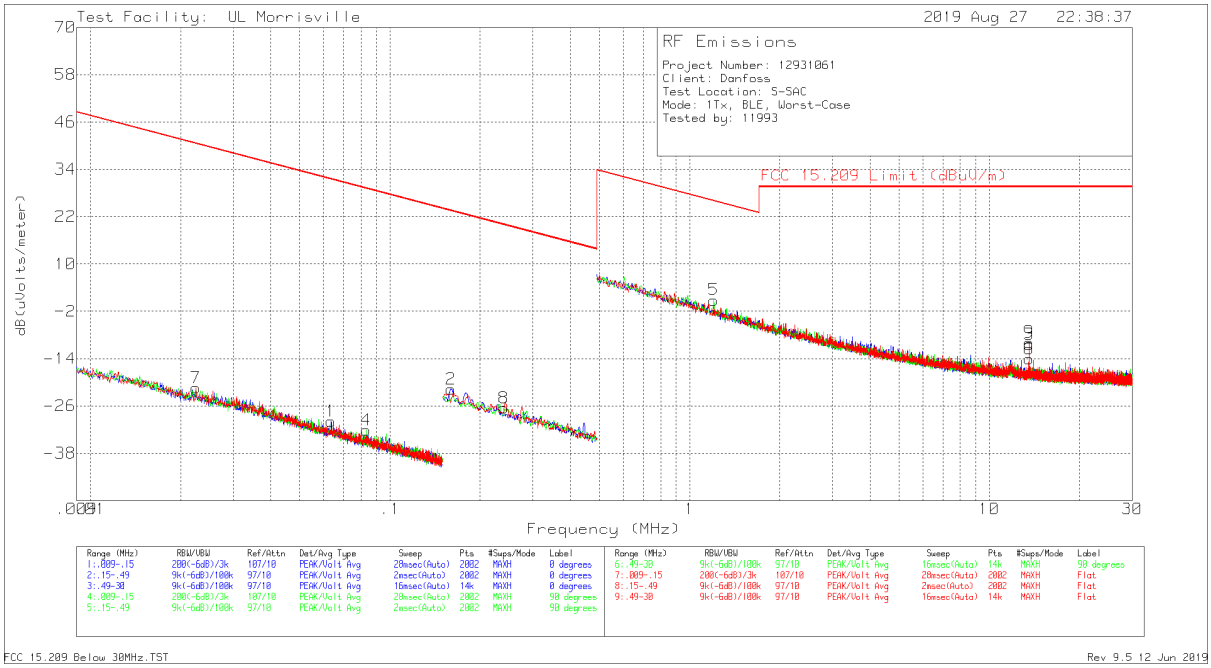
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PK2 - Maximum Peak
MAv1 - Maximum RMS Average

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

9.3. WORST CASE BELOW 30MHZ

SPURIOUS EMISSIONS BELOW 30 MHz (WORST-CASE CONFIGURATION)

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



ANTENNA- THREE ORIENTATIONS

Below 30MHz Data

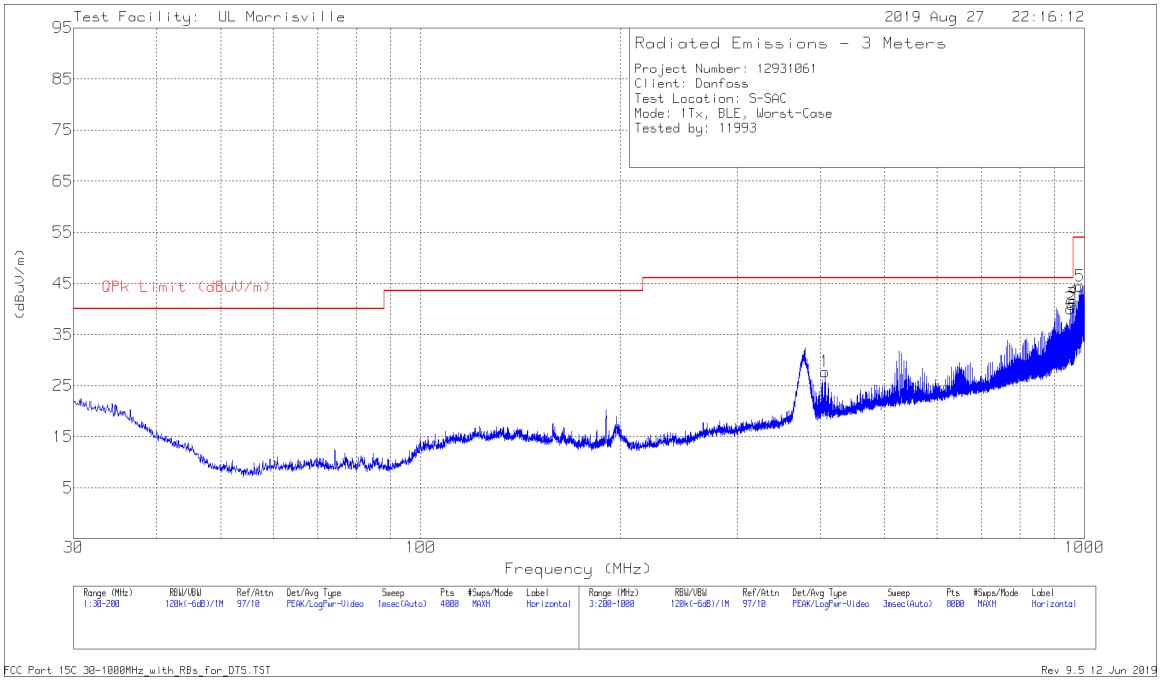
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0079 AF (dB/m)	Cbl (dB)	Dist. Corr. Factor (dB)	Corrected Reading dB(uVolts/meter)	FCC 15.209 Avg and QP Limit (dBuV/m)	FCC 15.209 Avg and QP Limit (dBuV/m)	Worst-Case Margin (dB)	Azimuth (Degs)	Antenna Face
7	.02251	44.69	Pk	13.8	.1	-80	-21.41	40.56	60.56	-61.97	0-360	Flat
1	.06367	38.67	Pk	11.3	.1	-80	-29.93	31.53	51.53	-61.46	0-360	On
4	.0832	36.59	Pk	11.2	.1	-80	-32.11	29.2	49.2	-61.31	0-360	Off
2	.16012	47.16	Pk	11	.1	-80	-21.74	23.52	43.52	-45.26	0-360	On
8	.24027	42.37	Pk	11	.1	-80	-26.53	19.99	39.99	-46.52	0-360	Flat
5	1.2025	29.55	Pk	11.1	.2	-40	.85	26	-	-25.15	0-360	Off
3	13.5596	19	Pk	10	.6	-40	-10.4	29.54	-	-39.94	0-360	On
6	13.5596	15.27	Pk	10	.6	-40	-14.13	29.54	-	-43.67	0-360	Off
9	13.5596	19.53	Pk	10	.6	-40	-9.87	29.54	-	-39.41	0-360	Flat

Pk - Peak detector

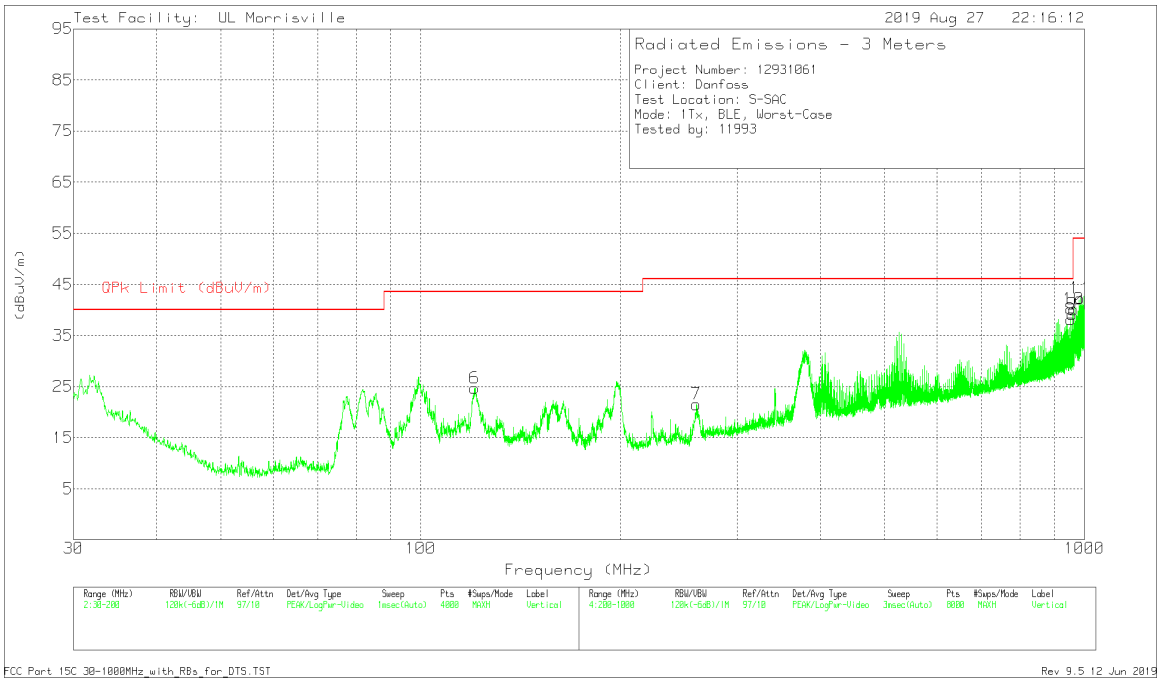
UL LLC
12 Laboratory Dr., RTP, NC 27709; USA TEL:(919)549-1400

9.4. 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	AT0066 AF (dB/m)	Cbl/Amp	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
6	* 120.5484	37.8	Pk	17.7	-30.8	24.7	43.52	-18.82	0-360	101	V
1	* 406.4268	36.54	Pk	20.4	-29.2	27.74	46.02	-18.28	0-360	298	H
4	* 962.0991	40.45	Pk	27.4	-26.3	41.55	53.97	-12.42	0-360	199	H
5	* 986.1022	42.76	Pk	27.6	-25.9	44.46	53.97	-9.51	0-360	199	H
7	* 260.3078	34.51	Pk	16.8	-29.8	21.51	46.02	-24.51	0-360	198	V
10	* 962.0991	39.01	Pk	27.4	-26.3	40.11	53.97	-13.86	0-360	102	V
11	* 986.1022	40.56	Pk	27.6	-25.9	42.26	53.97	-11.71	0-360	102	V
2	953.698	39.09	Pk	27.5	-26.5	40.09	46.02	-5.93	0-360	101	H
8	953.798	37.16	Pk	27.5	-26.5	38.16	46.02	-7.86	0-360	102	V
3	957.8985	39.74	Pk	27.5	-26.3	40.94	46.02	-5.08	0-360	199	H
9	957.8985	37.94	Pk	27.5	-26.3	39.14	46.02	-6.88	0-360	102	V

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

Pk - Peak detector

UL LLC
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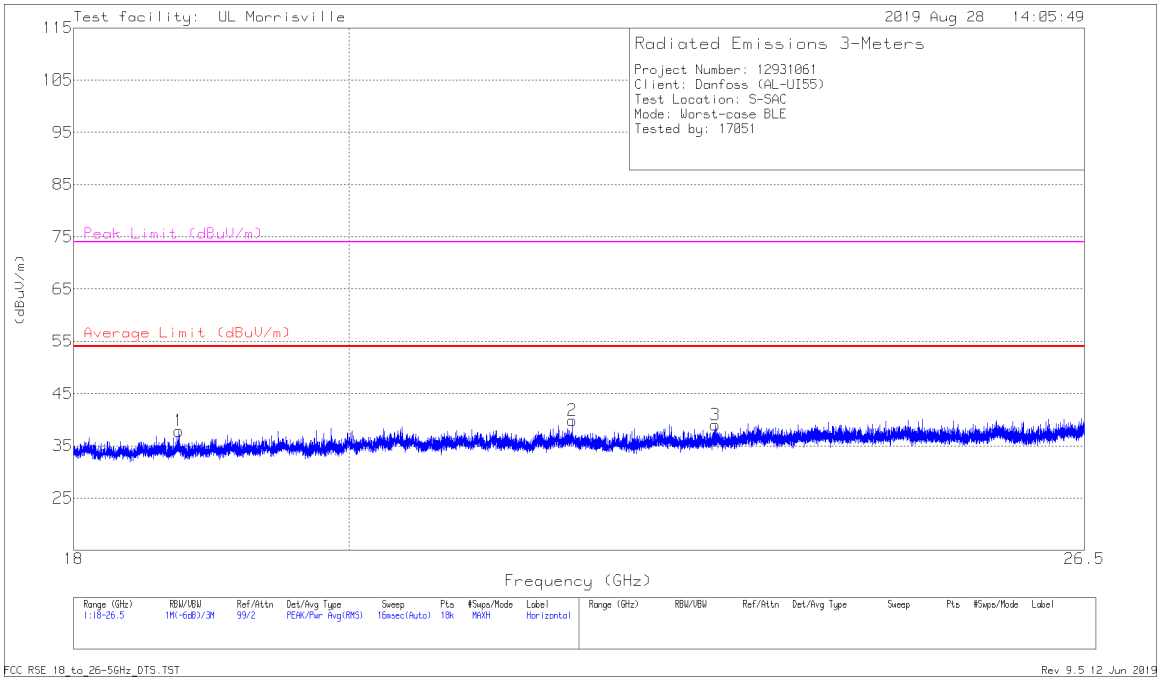
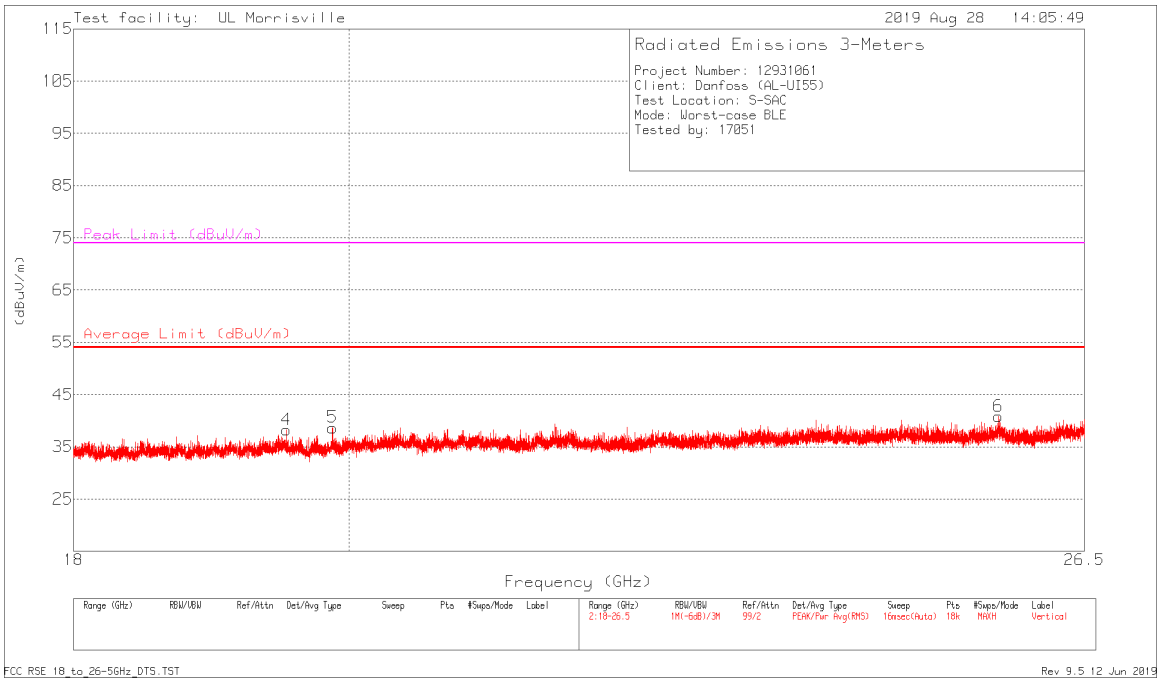
9.5. WORST CASE 18-26 GHZ

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



HORIZONTAL



VERTICAL

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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	* 18.74096	44.14	Pk	32.5	-38.8	37.84	54	-16.16	74	-36.16	0-360	148	H
3	* 23.00866	42.97	Pk	33.7	-37.7	38.97	54	-15.03	74	-35.03	0-360	248	H
4	* 19.52678	44.25	Pk	32.8	-38.8	38.25	54	-15.75	74	-35.75	0-360	252	V
5	* 19.87483	44.48	Pk	32.7	-38.5	38.68	54	-15.32	74	-35.32	0-360	298	V
2	21.7846	44.31	Pk	33.4	-37.9	39.81	54	-14.19	74	-34.19	0-360	198	H
6	25.64145	42.75	Pk	34.3	-36.2	40.85	54	-13.15	74	-33.15	0-360	298	V

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

Pk - Peak detector

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

10. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

RSS-Gen 8.8

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

* Decreases with the logarithm of the frequency.

RESULTS

UL LLC
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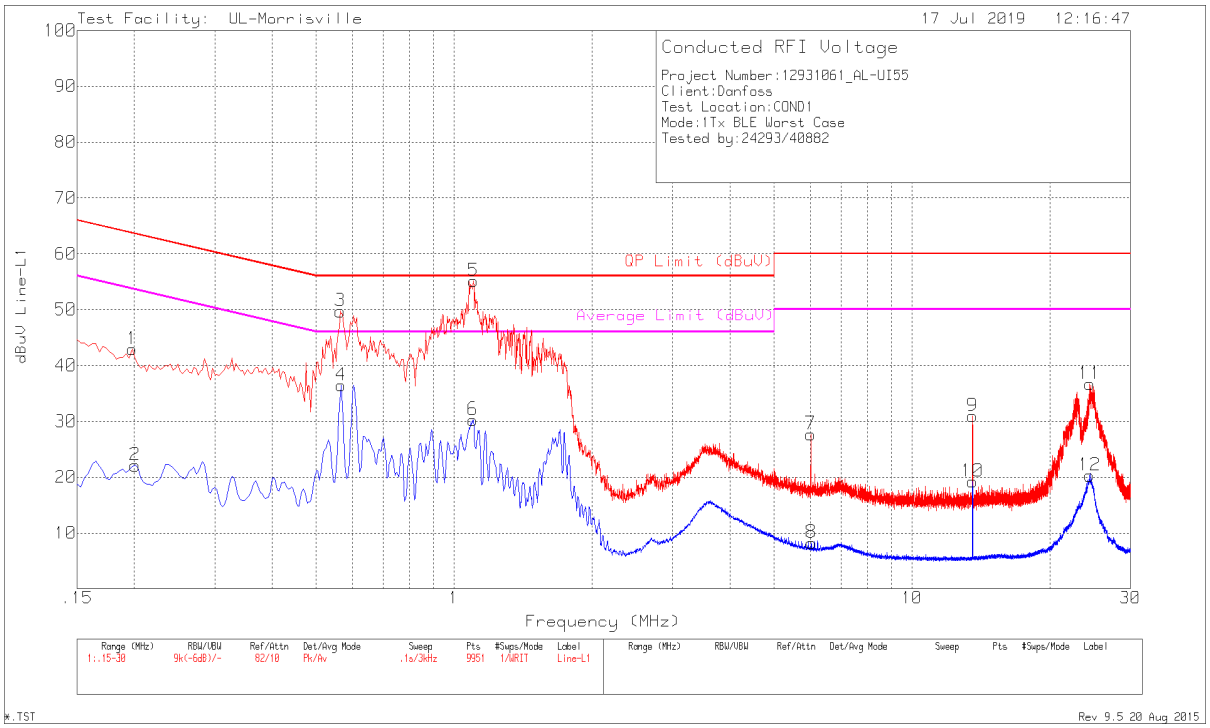
10.1.1. AC Power Line Norm

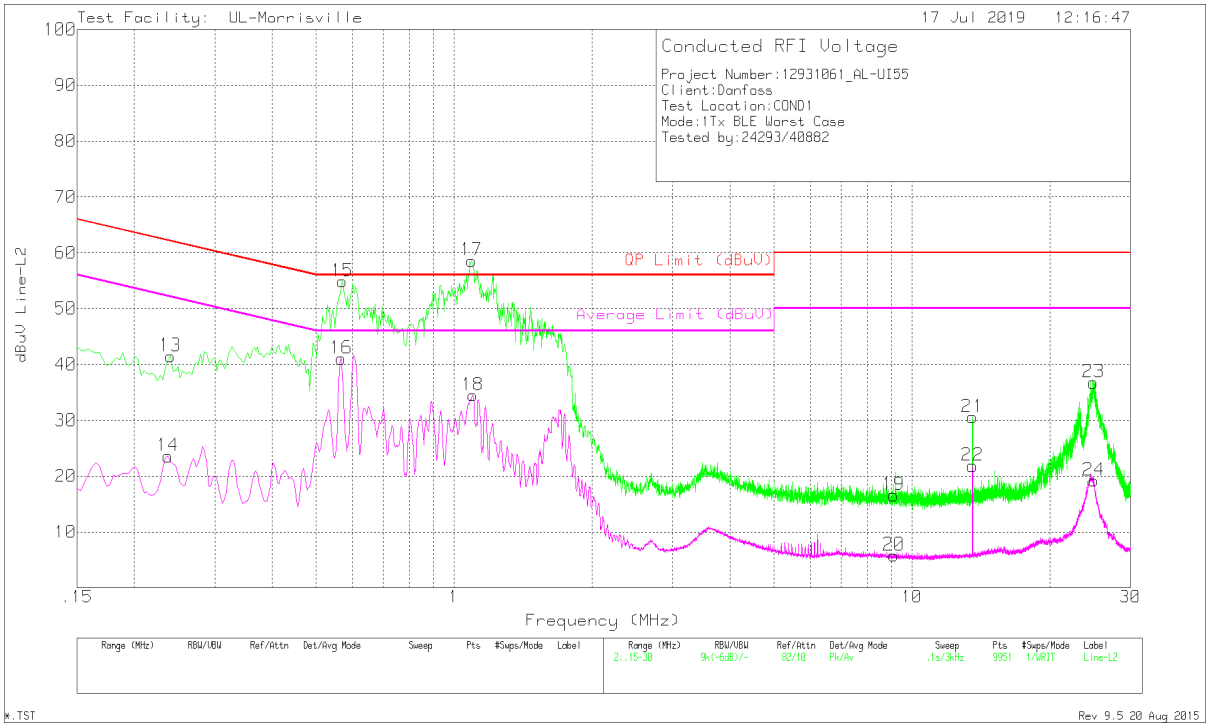
LINE 1 RESULTS



Range 1: Line-L1 .15 - 30MHz										
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN VCF (dB)	Cbl/Limiter (dB)	Corrected Reading dBuV	QP Limit (dBuV)	Margin (dB)	Average Limit (dBuV)	Margin (dB)
1	.198	32.8	Pk	.1	10	42.9	63.69	-20.79	-	-
2	.201	12	Av	.1	10	22.1	-	-	53.57	-31.47
3	.564	39.72	Pk	0	10	49.72	56	-6.28	-	-
4	.567	26.41	Av	0	10	36.41	-	-	46	-9.59
5	1.0942	38.87	Qp	0	10	48.87	56	-7.13	-	-
6	1.098	20.24	Av	0	10	30.24	-	-	46	-15.76
7	6.009	17.39	Pk	.1	10.2	27.69	60	-32.31	-	-
8	6.03	-2.05	Av	.1	10.2	8.25	-	-	50	-41.75
9	13.56	20.42	Pk	.1	10.4	30.92	60	-29.08	-	-
10	13.56	8.72	Av	.1	10.4	19.22	-	-	50	-30.78
11	24.465	25.79	Pk	.2	10.7	36.69	60	-23.31	-	-
12	24.447	9.38	Av	.2	10.7	20.28	-	-	50	-29.72

Pk - Peak detector
Av – Average detector
Qp – Quasi-peak detector

LINE 2 RESULTS



Range 2: Line-L2 .15 - 30MHz										
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN VCF (dB)	Cbl/Limiter (dB)	Corrected Reading dBuV	QP Limit (dBuV)	Margin (dB)	Average Limit (dBuV)	Margin (dB)
13	.24	31.38	Pk	.1	10	41.48	62.1	-20.62	-	-
14	.237	13.47	Av	.1	10	23.57	-	-	52.2	-28.63
15	.56865	35.37	Qp	0	10	45.37	56	-10.63	-	-
16	.567	31.05	Av	0	10	41.05	-	-	46	-4.95
17	1.092	38.6	Qp	0	10	48.6	56	-7.4	-	-
18	1.098	24.47	Av	0	10	34.47	-	-	46	-11.53
19	9.114	6.2	Pk	.1	10.3	16.6	60	-43.4	-	-
20	9.132	-4.6	Av	.1	10.3	5.8	-	-	50	-44.2
21	13.56	20.07	Pk	.1	10.4	30.57	60	-29.43	-	-
22	13.56	11.36	Av	.1	10.4	21.86	-	-	50	-28.14
23	24.915	25.87	Pk	.2	10.7	36.77	60	-23.23	-	-
24	24.948	8.31	Av	.2	10.7	19.21	-	-	50	-30.79

Pk - Peak detector
Av – Average detector
Qp – Quasi-peak detector

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11. SETUP PHOTOS

Please refer to R12931061-EP2 for setup photos.

END OF TEST REPORT

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