CERTIFICATION TEST REPORT

Report Number. : R12777555-E2

Applicant	:	LEA Professional 635 S. Lafayette Blvd, Building 113, Suite 109 South Bend, IN 46601, USA
Model	:	Connect Series 704D
FCC ID	:	2ADHKATWILC1000U
IC	:	20266-ATWILC1000UB
EUT Description	:	Internet of Things Amplifier Connection Series
Test Standard(s)	:	FCC 47 CFR PART 15 SUBPART C ISED RSS-247 ISSUE 2 ISED RSS-GEN ISSUE 5

Date Of Issue:
2020-02-28

Prepared by:
UL LLC
12 LABORATORY DR.
RESEARCH TRIANGLE PARK, NC 27709 USA
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NVLAP TESTING

NVLAP Lab code: 200246-0

REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	2020-02-28	Initial Issue	

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: LEA Professional
635 S. Lafayette Blvd, Building 113, Suite 109
South Bend, IN 46601, USA

EUT DESCRIPTION: Internet of Things Amplifier Connection Series

MODEL: Connect Series 704D

Serial Number: 298190007

RECEIVED DATE: 2020-02-04

DATE TESTED: 2020-02-26 to 2020-02-27

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

Note: Report covers radiated spot checks only to verify radio module still compliant in host unit. It is the host manufacturer's responsibility to provide the module documentation upon request.

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.

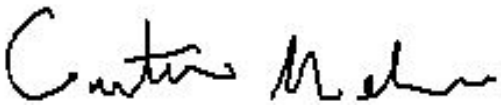
The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components.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

Brian Kiewra
Project Engineer
UL – Consumer Technology Division

Prepared By:



Cristian Melara
Engineer
UL – Consumer Technology Division

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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 996369 D04 Module Integration Guide v01, 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, 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.
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
Worst Case Radiated Disturbance	± 4.88dB

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

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5. EQUIPMENT UNDER TEST

5.1. EUT DESCRIPTION

The EUT is an internet of things amplifier connection series. The EUT contains a 2.4GHz WLAN radio.

5.2. MAXIMUM OUTPUT POWER

Power not measured in this report. Radiated spurious spot checks performed to ensure radio module remains compliant when installed in host EUT. For the testing contained in this report, the transmission power levels of the radio module was set at the levels intended to be used by the end product manufacturer. It is the responsibility of the end product manufacturer to ensure the end product power levels are the same or lower than the power levels found in the module report and to provide the radio module test reports upon request.

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a FlexPIFA antenna with antenna gain of 2.0 dBi.

5.4. SOFTWARE AND FIRMWARE

The test utility software used during testing was Microchip serial bridge “MCHPRT” V1.4.6.4.

5.5. WORST-CASE CONFIGURATION AND MODE

Radiated emissions spot checks, 1GHz to 18GHz, were performed to verify the radio module is still compliant in host unit when operating in worst-case mode and channel that the end product manufacturer intends to use. It is the manufacturer’s responsibility to provide module documentation upon request.

The selected EUT configuration was chosen to maximize emissions. EUT intended to operate in only one orientation. Therefore, all testing performed with the EUT in its intended orientation

Worst-case data rates as provided by the client were:

802.11n HT20mode: MCS0

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5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Use	Product Type	Manufacturer	Model	Comments
EUT	Amplifier	LEA Professional	DANTE Enabled	Covers Non-DANTE enabled models by similarity
AE	Computer	Dell	XPS13	None
AE	Analog Signal Generator	Agilent	33120A	None
AE	Analog Signal Amplifier	Radio Design Labs	FP-UBC2	None
AE	Amplifier output Loads (x2)	Custom LEA designed and sourced	-	2 channel 4 Ohm 600W non inductive load
AE	USB to Ethernet adapter	Startech	USB31000S	None
AE	DHCP server	GL-iNet	GL-MT300N-V2	None
AE	Network Switch	Netgear	GS105PE	None
AE	POE Injector	Intellinetsolutions	524179	None

Note: **EUT** - Equipment Under Test, **AE** - Auxiliary/Associated Equipment, or **SIM** - Simulator (Not Subjected to Test)

I/O CABLES

Port #	Name	Type*	Cable Max. >3m (Y/N)	Cable Shielded (Y/N)	Comments
0	Enclosure	N/E	—	—	None
1	Mains	AC	N	N	None
2	Ethernet (10/100Mbps)	I/O	Y	N	RJ45
3	Amplifier Output	I/O	Y	N	Barrier Block
4	Audio Input	I/O	Y	N	Barrier Block
5	GPIO	I/O	Y	N	Barrier Block
6	DANTE (10/100/1000Mbps)	I/O	Y	N	RJ45; Two Ports – Pri and Sec

*Note:
AC = AC Power Port DC = DC Power Port N/E = Non-Electrical
I/O = Signal Input or Output Port (Not Involved in Process Control)
TP = Telecommunication Ports

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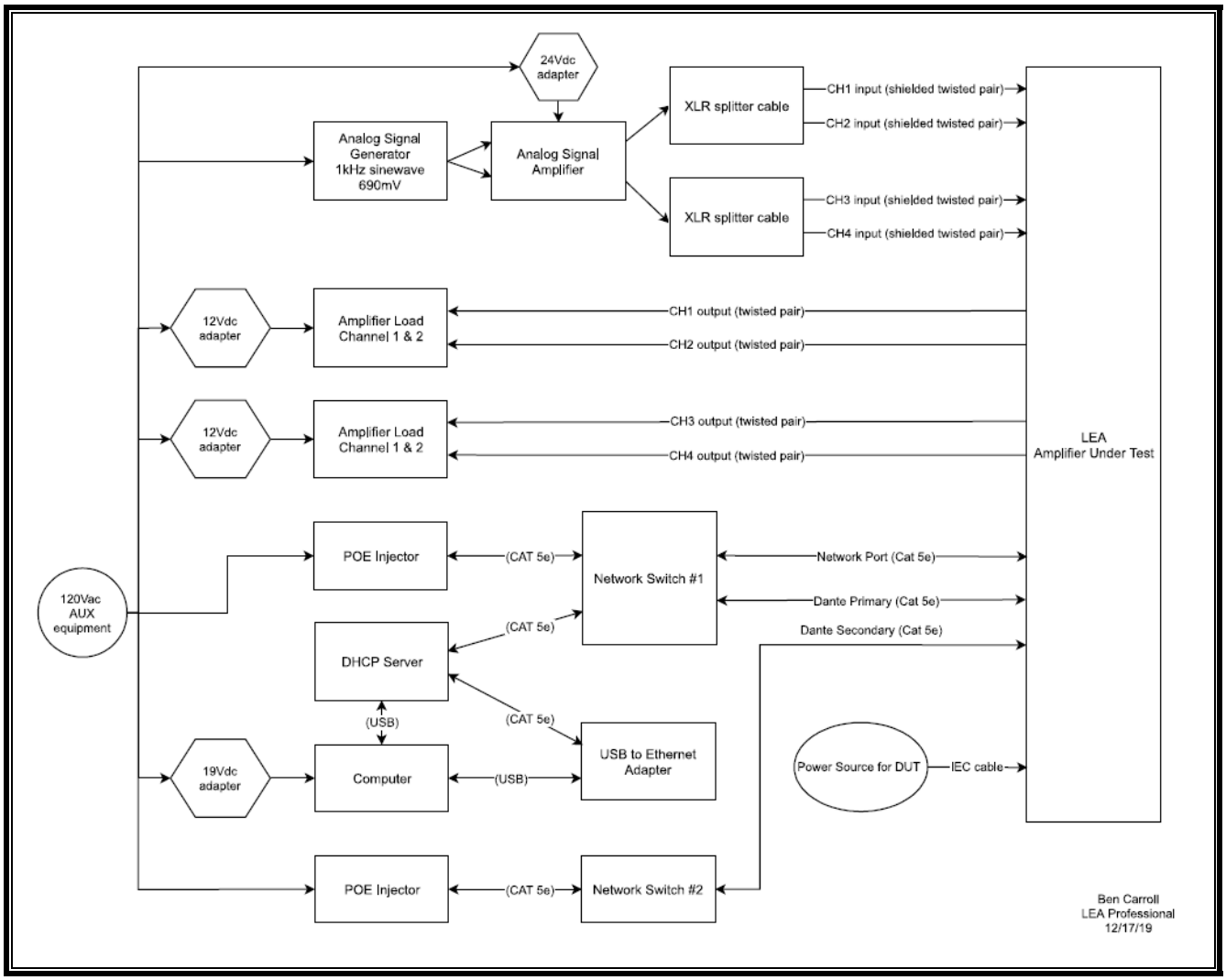
TEST SETUP

The EUT is configured as a standalone device.

SETUP DIAGRAM FOR TESTS



6. MEASUREMENT METHOD

Duty Cycle: ANSI C63.10-2013 Section 11.6

Radiated Spurious Emissions: ANSI C63.10-2013 Sections 6.3, 6.5, and 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.
	1-18 GHz				
AT0072	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2019-04-22	2020-04-22
	Gain-Loss Chains				
S-SAC03	Gain-loss string: 1-18GHz	Various	Various	2019-03-13	2020-03-13
	Receiver & Software				
SA0025	Spectrum Analyzer	Agilent	N9030A	2019-02-28	2020-02-28
SOFTEMI	EMI Software	UL	Version 9.5 June 15, 2019	NA	NA
	Additional Equipment used				
s/n 181474409	Environmental Meter	Fisher Scientific	15-077-963	2018-07-27	2020-07-27

8. ON TIME AND DUTY CYCLE RESULTS

LIMITS

None; for reporting purposes only.

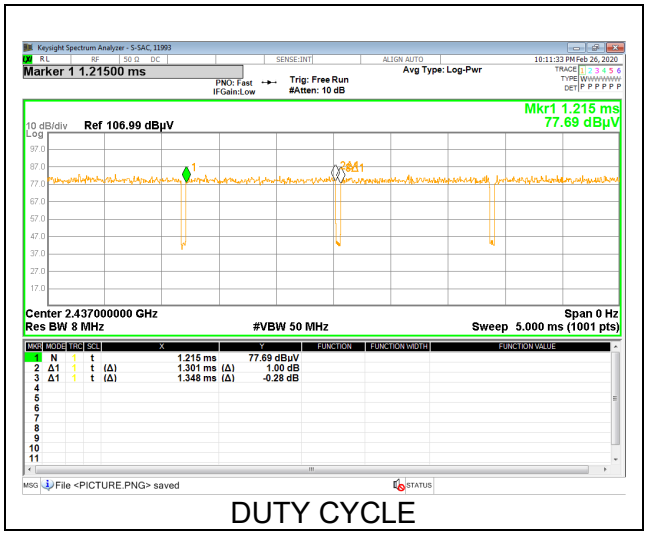
PROCEDURE

ANSI C63.10 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)
802.11n HT20	1.301	1.348	0.965	96.51%	0.31

DUTY CYCLE PLOTS



DUTY CYCLE

9. RADIATED TEST RESULTS

LIMITS

FCC §15.205 and §15.209

RSS-GEN, Section 8.9 and 8.10

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

TEST PROCEDURE

The EUT is placed 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 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 average measurement method used is voltage averaging.

The spectrum from 1 GHz to 18 GHz is investigated with the transmitter set to 2412 MHz and 2437MHz.

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.

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.

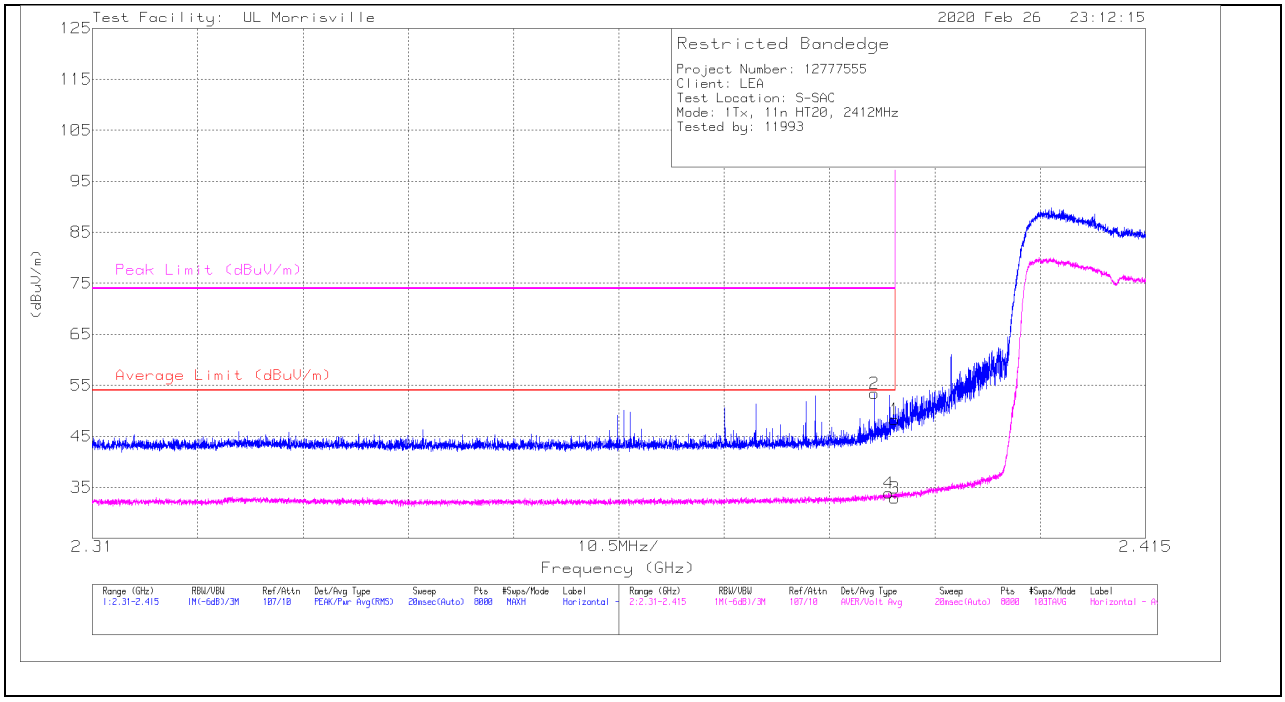
9.1. TRANSMITTER ABOVE 1 GHz

9.1.1. TX ABOVE 1 GHz 802.11n HT20 MODE IN THE 2.4 GHz BAND

1TX Antenna 1 MODE

BANDEDGE (LOW CHANNEL, CH 1)

HORIZONTAL RESULT



RADIATED EMISSIONS

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	40.39	Pk	31.9	-24	0	48.29	-	-	74	-25.71	337	204	H
2	* ** 2.38796	45.52	Pk	31.9	-24	0	53.42	-	-	74	-20.58	337	204	H
3	* ** 2.39	24.72	ADV	31.9	-24	.31	32.93	54	-21.07	-	-	337	204	H
4	* ** 2.38938	25.68	ADV	31.9	-24	.31	33.89	54	-20.11	-	-	337	204	H

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

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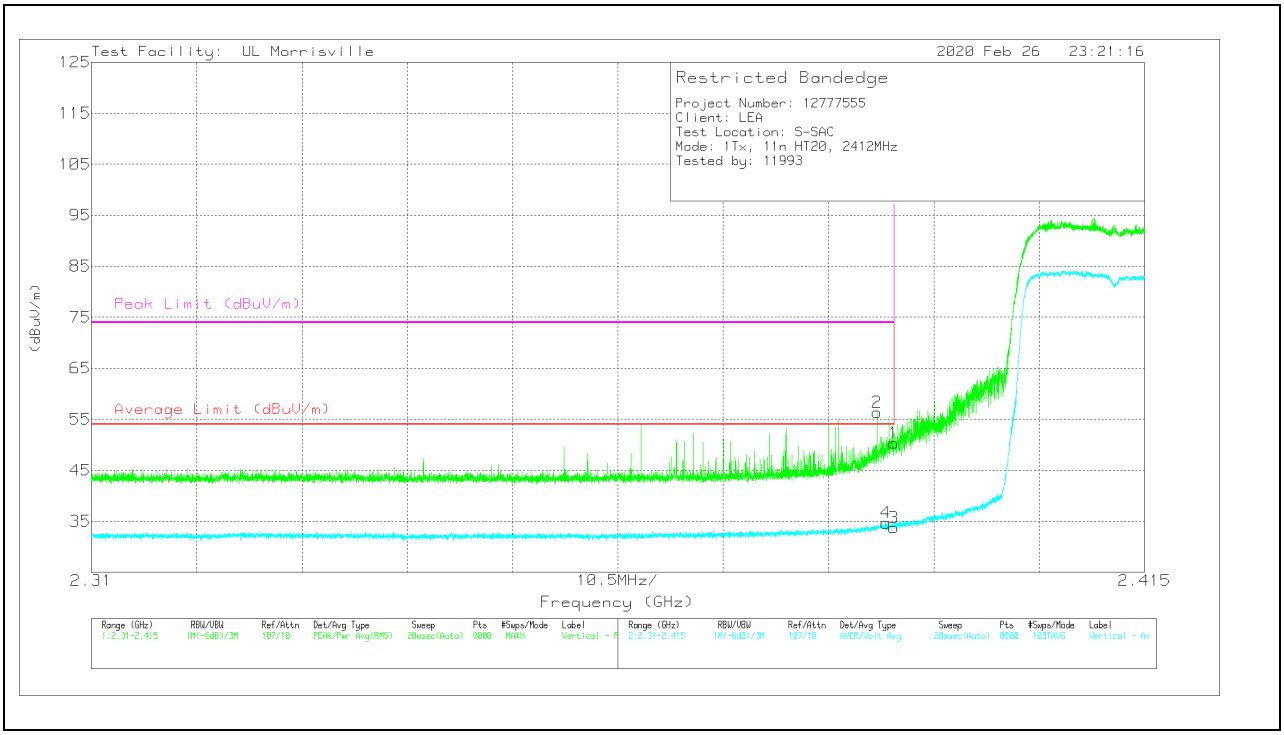
VERTICAL RESULT



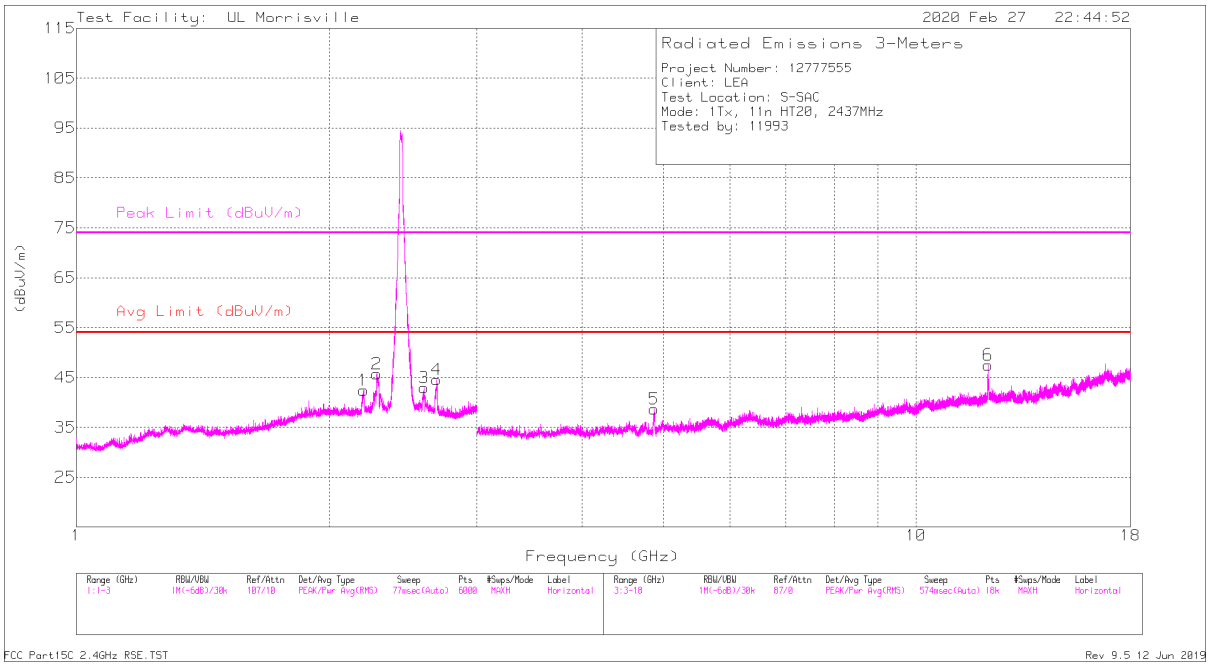
RADIATED EMISSIONS

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	42.46	Pk	31.9	-24	0	50.36	-	-	74	-23.64	44	195	V
2	* ** 2.38833	48.43	Pk	31.9	-24	0	56.33	-	-	74	-17.67	44	195	V
3	* ** 2.39	25.54	ADV	31.9	-24	.31	33.75	54	-20.25	-	-	44	195	V
4	* ** 2.38922	26.48	ADV	31.9	-24	.31	34.69	54	-19.31	-	-	44	195	V

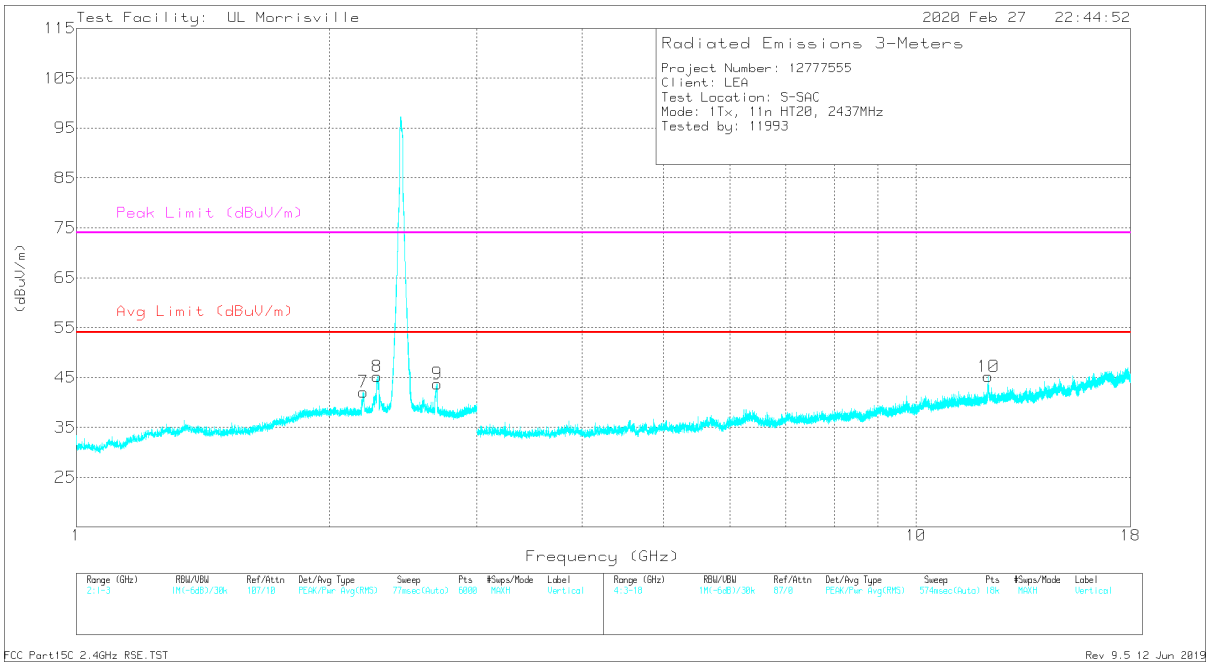
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
Pk - Peak detector
ADV - Linear Voltage Average

HARMONICS AND SPURIOUS EMISSIONS

MID CHANNEL, CH 6 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
2	* ** 2.27902	44.88	PK2	31.8	-23.5	0	53.18	-	-	74	-20.82	96	130	H
	* ** 2.27993	33.67	ADV	31.8	-23.5	.31	42.28	54	-11.72	-	-	96	130	H
3	** 2.59328	41.84	PK2	32.3	-25.1	0	49.04	-	-	74	-24.96	104	106	H
	** 2.59332	29.69	ADV	32.3	-25.1	.31	37.2	54	-16.8	-	-	104	106	H
4	* ** 2.68555	43.67	PK2	32.3	-25.6	0	50.37	-	-	74	-23.63	55	103	H
	* ** 2.68714	31.99	ADV	32.3	-25.6	.31	39	54	-15	-	-	55	103	H
8	* ** 2.28019	45.41	PK2	31.8	-23.5	0	53.71	-	-	74	-20.29	43	144	V
	* ** 2.27973	33.54	ADV	31.8	-23.5	.31	42.15	54	-11.85	-	-	43	144	V
9	* ** 2.68502	46.52	PK2	32.3	-25.6	0	53.22	-	-	74	-20.78	36	240	V
	* ** 2.68834	34.85	ADV	32.3	-25.6	.31	41.86	54	-12.14	-	-	36	240	V
5	* ** 4.87238	42.48	PK2	34	-30.7	0	45.78	-	-	74	-28.22	27	133	H
	* ** 4.87189	29.56	ADV	34	-30.7	.31	33.17	54	-20.83	-	-	27	133	H
6	* ** 12.18248	36.18	PK2	38.9	-23.9	0	51.18	-	-	74	-22.82	297	243	H
	* ** 12.18279	22.44	ADV	38.9	-23.9	.31	37.75	54	-16.25	-	-	297	243	H
10	* ** 12.19141	38.55	PK2	38.9	-23.9	0	53.55	-	-	74	-20.45	173	161	V
	* ** 12.19141	24.88	ADV	38.9	-23.9	.31	40.19	54	-13.81	-	-	173	161	V
7	2.19787	33.92	Pk	31.4	-23.2	0	42.12	-	-	-	-	0-360	101	V
1	2.1982	34.14	Pk	31.5	-23.2	0	42.44	-	-	-	-	0-360	99	H

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

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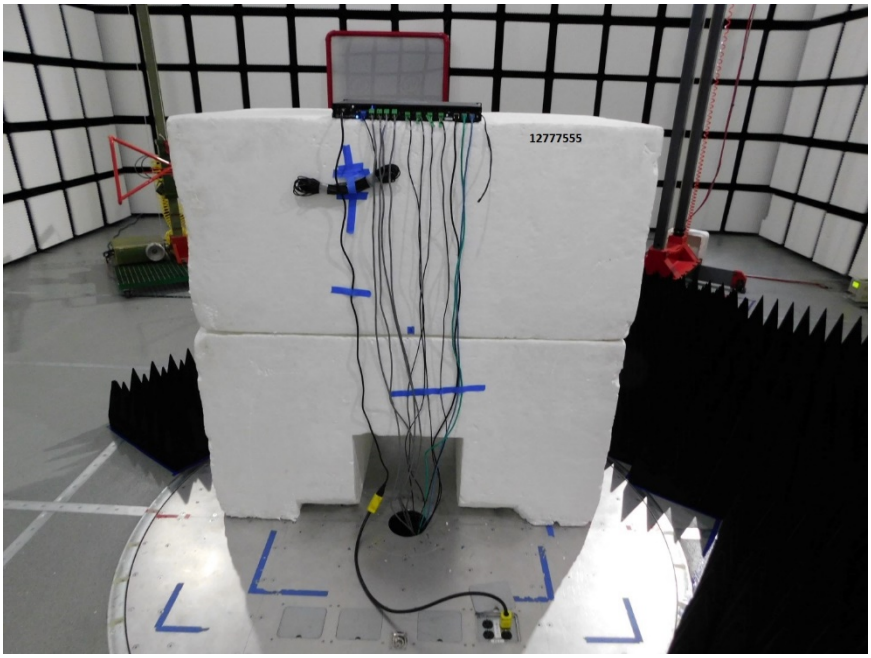
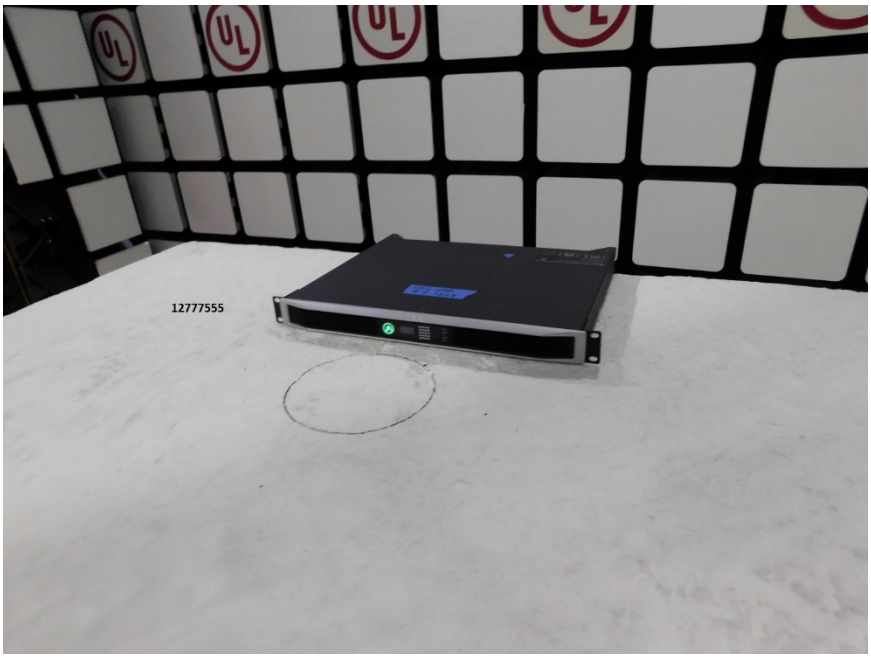
10. SETUP PHOTOS

RADIATED SPURIOUS EMISSIONS

RADIATED SPURIOUS BACK PHOTO ABOVE 1GHz





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END OF TEST REPORT

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