



NCC LP0002: 2018
CERTIFICATION TEST REPORT
FOR
BATTERY POWERED ROLLER SHADE
MODEL NUMBER: QSFC-Q-EDU-R2
FCC ID: JPZ0095
REPORT NUMBER: R12390745-E1
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Prepared for
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Revision History

Ver.	Issue Date	Revisions	Revised By
1	2018-08-28	Initial Issue	Brian T. Kiewra
2	2018-09-12	Revised restricted bands referenced in Sections 8.1 and 8.2 of this report (LP0002 Section 2.7) and revised to include NCC references.	Brian T. Kiewra

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Lutron Electronics Co., Inc.
7200 Suter Road
Coopersburg, PA 18036, USA

EUT DESCRIPTION: Battery Powered Roller Shade

MODEL: QSFC-Q-EDU-R2

SERIAL NUMBER: 012043B3

DATE TESTED: 2018-07-20 to 2018-08-15

Clause Number	Description	Result	Comment
2	General Requirements		
2.7	Restricted Bands	Compliant	None.
2.8	General Radiated Emissions	Compliant	None.
3.4.2	Intermittent or Periodic Devices		
3.4.2.1	Operating Band	Compliant	Operates in the 433 MHz band.
3.4.2.2	Occupied Bandwidth	Compliant	None.
3.4.2.3	Frequency Tolerance	NA	The EUT operates in the 433 MHz band.
3.4.2.4 (1A)	Manually Operated Devices	Compliant	None.
3.4.2.4 (1B)		Compliant	3.4.2.4 B applies.
3.4.2.4 (1C)	Automatically Operated Devices	NA	The device is a manual transmission device.
3.4.2.4 (1D)	Polling	NA	The EUT does not transmit at regular predetermined intervals.
3.4.2.4 (2)	Automatic Control Mechanisms	NA	Section 3.4.2.4 (1) applies. The EUT is a motor shade drive with wireless control capability that is powered by an external battery pack.
3.4.2.5	Field strength of fundamental emissions	Compliant	None.
5.15.3	Duty Cycle Calculation	-	For reporting purposes.

UL LLC tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL LLC based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

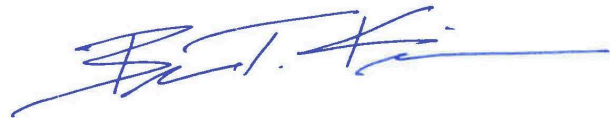
Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL LLC and all revisions are duly noted in the revisions section. Any alteration of this 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:



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Prepared By:



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2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.10-2013, and NCC LP0002 : 2018.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 12 Laboratory Dr., Research Triangle Park, NC 27709, USA and 2800 Perimeter Park Dr., Suite B, Morrisville, NC 27560, USA

12 Laboratory Dr., RTP, NC 27709, USA
☐ Chamber A
☐ Chamber C

2800 Perimeter Park Dr., Suite B, Morrisville, NC 27560, USA
☒ Chamber NORTH
☒ Chamber SOUTH

UL LLC (RTP) is accredited by NVLAP, Laboratory Code 200246-0. The full scope of accreditation can be viewed at <http://www.nist.gov/nvlap/>.

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

Where relevant, the following sample calculation is provided:

$$\begin{aligned} \text{Field Strength (dBuV/m)} &= \text{Measured Voltage (dBuV)} + \text{Antenna Factor (dB/m)} + \\ &\text{Cable Loss (dB)} - \text{Preamplifier Gain (dB)} \\ 36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} &= 28.9 \text{ dBuV/m} \end{aligned}$$

4.3. MEASUREMENT UNCERTAINTY

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

PARAMETER	UNCERTAINTY
Radio Frequency (Spectrum Analyzer)	141.2 Hz
Occupied Channel Bandwidth	2.00%
RF output power, conducted	1.3 dB (PK) 0.45 dB (AV)
RF output power, radiated (SAC)	4.52 dB
Power Spectral Density, conducted	2.47 dB
Unwanted Emissions, conducted	3.05 dB (Note 1)
All emissions, radiated	5.36 dB
Temperature	2.26°C
Humidity	6.79%
DC Supply voltages	1.70%
Time	3.39%
Note 1: Supply Voltage Variation - Modern power supply topology is such that the regulation of the final RF output stage is sufficient to reduce the value of this contributor to zero.	

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

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is motor shade drive with wireless (433.6-434.2MHz) control capability that is powered by an external battery pack.

5.2. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an integral monopole flexible wire antenna.

5.3. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was Godwit 4.08 Rev. A.

5.4. WORST-CASE CONFIGURATION AND MODE

Testing was conducted on the lowest and highest channels for all tests. The EUT was investigated in three orientations, X, Y, and Z, and with the antenna straight and rotated at a 90 degree angle to EUT. It was determined that Z orientation was worst-case with the antenna straight. Therefore all radiated testing done with EUT in the Z orientation with the antenna straight.

5.5. MODIFICATIONS

No modifications were made during testing.

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
None				

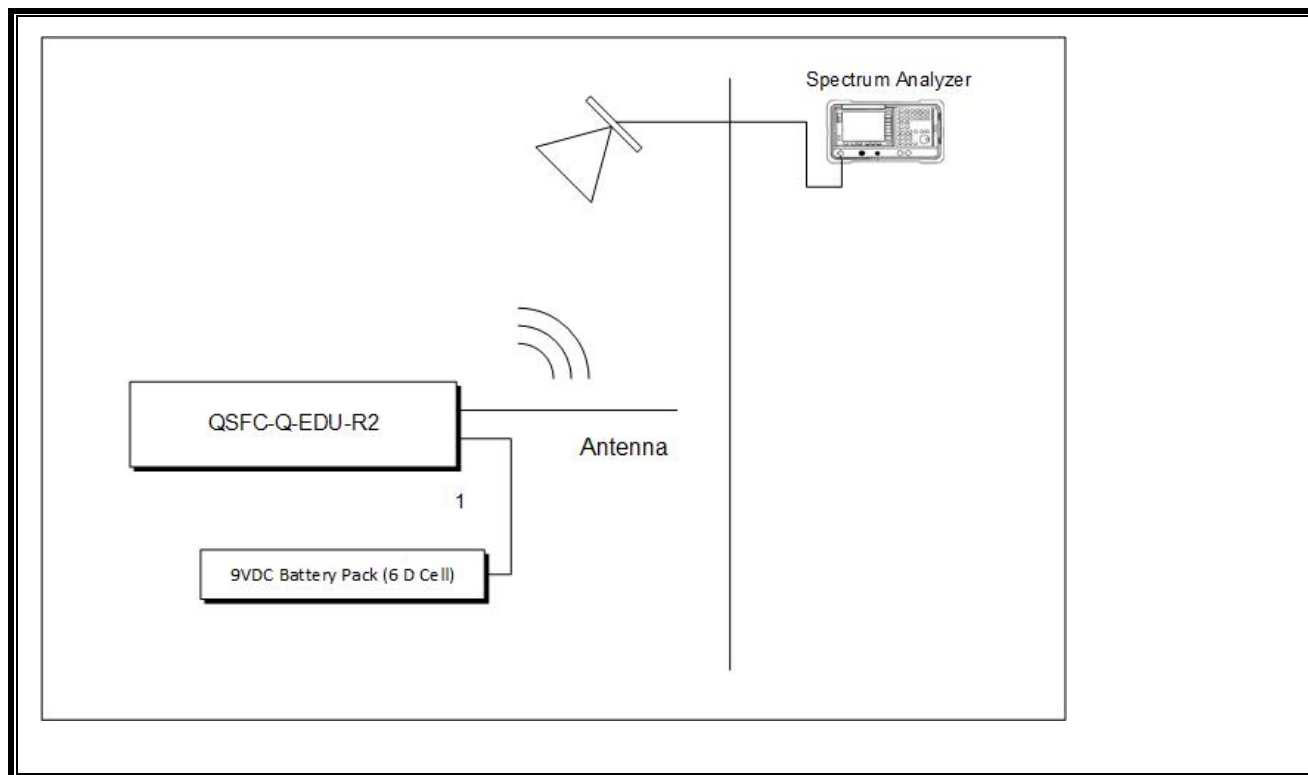
I/O CABLES

I/O Cable List						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	DC	1	Plug In	Unshielded	<1m	Connects to battery pack

TEST SETUP

The EUT is installed as a standalone device. Connected to battery pack (9V – 6 D Cell)

SETUP DIAGRAM FOR TESTS



6. TEST AND MEASUREMENT EQUIPMENT

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

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

Equip. ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
	0.009-30MHz	(Loop Ant.)			
AT0079	Active Loop Antenna	ETS-Lindgren	6502	2018-01-02	2019-01-02
	30-1000 MHz				
AT0075	Hybrid Broadband Antenna	Sunol Sciences Corp.	JB3	2017-09-05	2018-09-30
	1-18 GHz				
AT0072	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2018-04-30	2019-04-30
	Gain-Loss Chains				
N-SAC01	Gain-loss string: 0.009-30MHz	Various	Various	2017-09-15	2018-09-15
N-SAC02	Gain-loss string: 25-1000MHz	Various	Various	2018-05-20	2019-05-20
N-SAC03	Gain-loss string: 1-18GHz	Various	Various	2018-03-23	2019-03-23
	Receiver & Software				
SA0027	Spectrum Analyzer	Agilent	N9030A	2018-04-04	2019-04-04
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA
	Additional Equipment used				
s/n 161024690	Environmental Meter	Fisher Scientific	15-077-963	2016-12-21	2018-12-21

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	2018-01-02	2019-01-02
	1-18 GHz				
AT0069	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2018-04-30	2019-04-30
	Gain-Loss Chains				
S-SAC01	Gain-loss string: 0.009-30MHz	Various	Various	2017-09-15	2018-09-15
S-SAC03	Gain-loss string: 1-18GHz	Various	Various	2018-03-20	2019-03-20
	Receiver & Software				
SA0026	Spectrum Analyzer	Agilent	N9030A	2018-03-20	2019-03-20
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA
	Additional Equipment used				
s/n 161024887	Environmental Meter	Fisher Scientific	15-077-963	2016-12-23	2018-12-23

Test Equipment Used - Wireless Conducted Measurement Equipment

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
Conducted Room 1					
T177 (PRE0079253)	Spectrum Analyzer	Agilent Technologies	E4446A	2018-04-12	2019-04-12
SN 161024885	Environmental Meter	Fisher Scientific	15-077-963	2016-12-23	2018-12-23

7. ANTENNA PORT TEST RESULTS

7.1.20 dB AND 99% BW

LIMITS

LP0002 §3.4.2.2

The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. The bandwidth indicates the upper and lower sides of the central frequency of modulation carrier, relative to lower 20 dB at the maximum power of a modulated carrier.

TEST PROCEDURE

ANSI C63.10, Section 6.9.2

The transmitter output is coupled to the spectrum analyzer via an antenna connected to the spectrum analyzer.

The RBW is set to 1% to 5% of the 20dB bandwidth. The VBW is set to approximately 3 times the RBW. The sweep time is coupled. The detection mode is set to peak and the trace mode to max hold. The spectrum analyzer's internal 20dB bandwidth function is utilized.

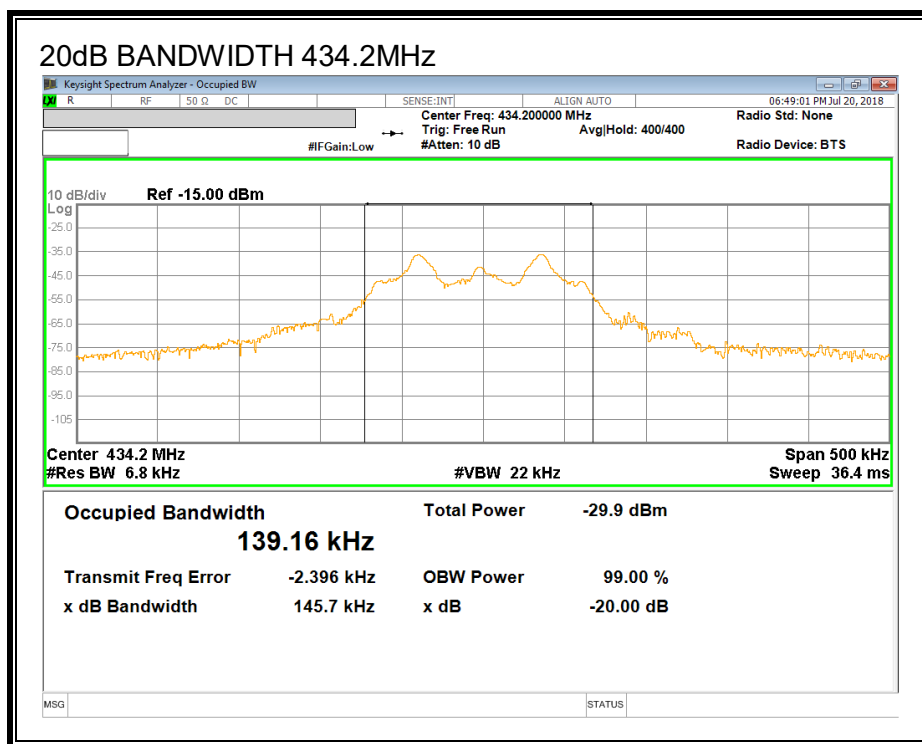
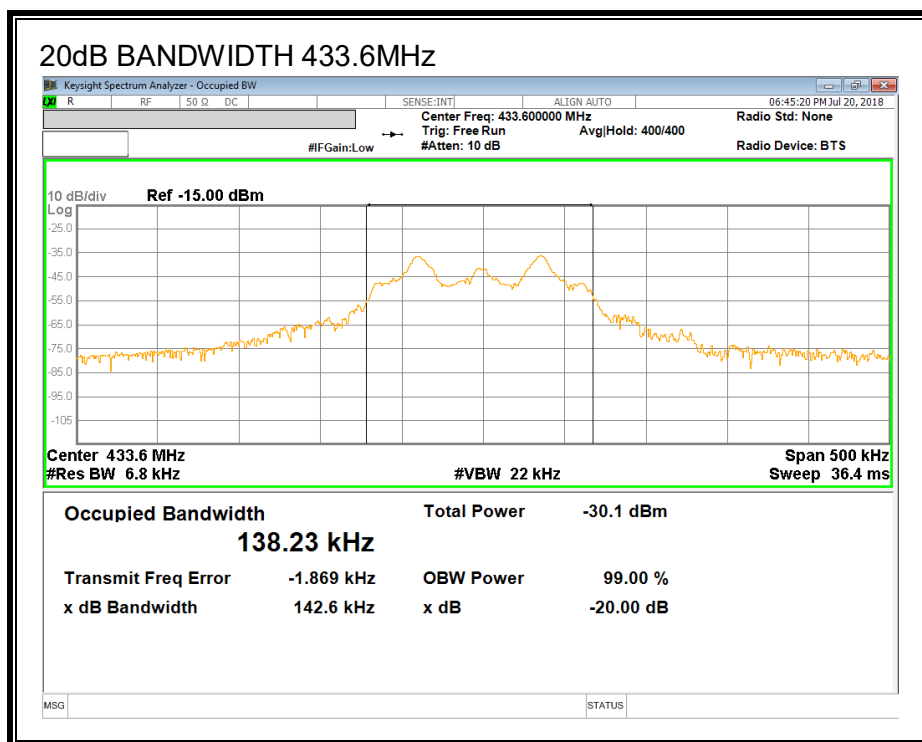
RESULTS

No non-compliance noted:

20dB Bandwidth

Frequency (MHz)	20dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)
433.6	142.6	1084	-941.4
434.2	145.7	1085.5	-939.8

20dB BANDWIDTH



7.2.DUTY CYCLE

LIMITS

LP0002 §5.15.3

Unless otherwise specified, when the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value. The exact method of calculating the average field strength shall be submitted with the test report.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer or radiated field strength. The RBW is set to 300 kHz and the VBW is set to 300 kHz. The sweep time is coupled and the span is set to 0 Hz. The number of pulses is measured and calculated in a 100 ms scan.

CALCULATION

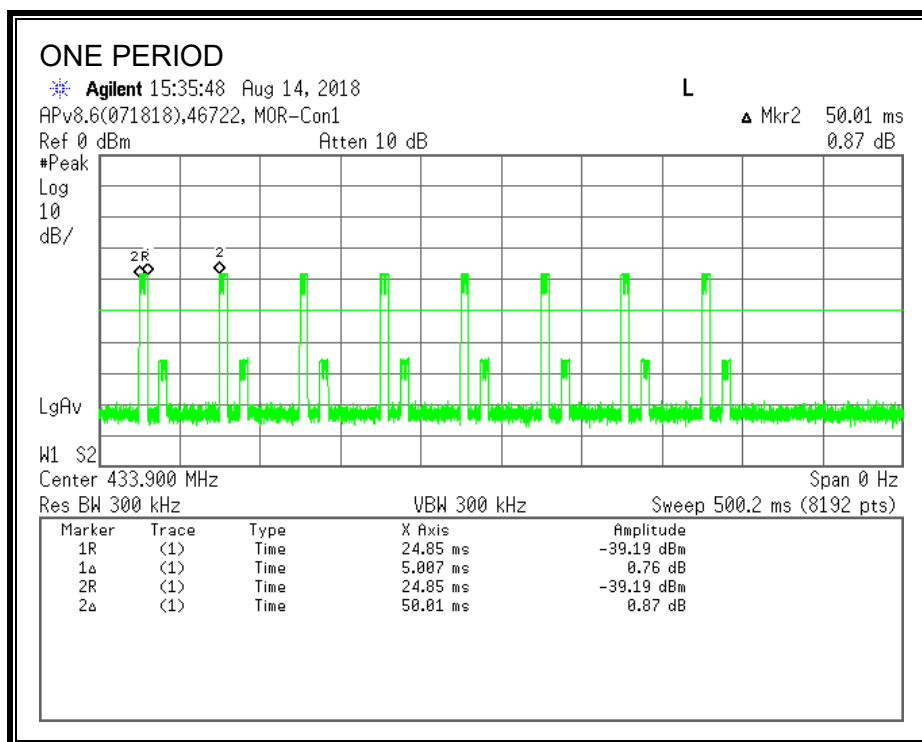
Average Reading = Peak Reading (dBuV/m) + 20log (Duty Cycle), Where Duty Cycle is (# of long pulses * long pulse width) + (# of short pulses * short pulse width) / 100

RESULTS

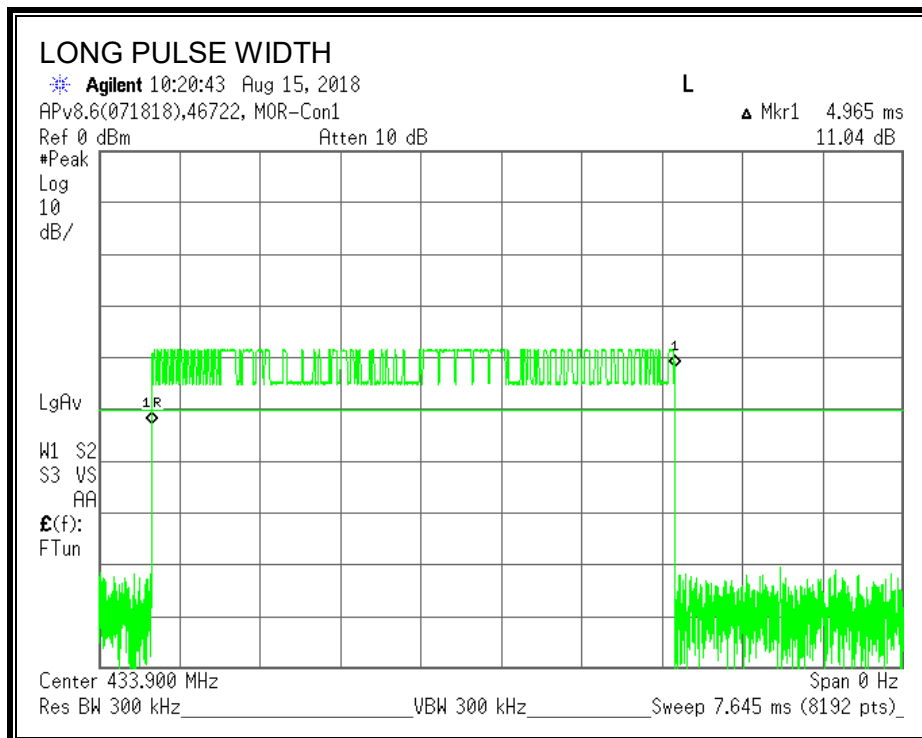
For reporting purposes only. To be used for calculating average values of a pulsed signal.

One Period (ms)	Long Pulse Width (ms)	# of Long Pulses	Duty Cycle	20*Log Duty Cycle (dB)
100	4.965	2	0.099	-20.06

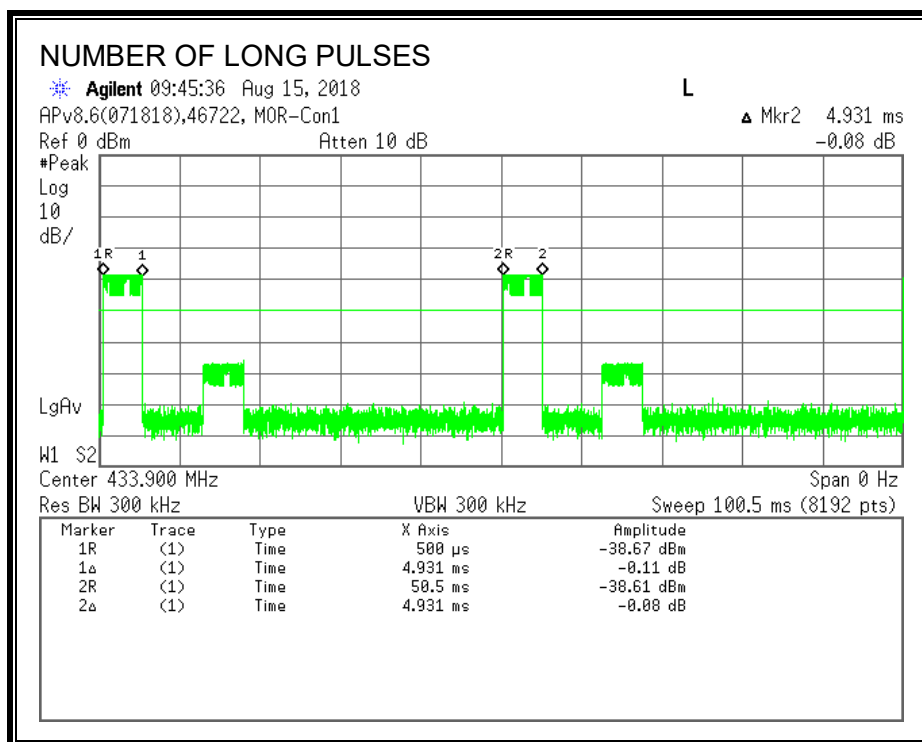
ONE PERIOD



LONG PULSE WIDTH



NUMBER OF LONG PULSES



7.3. TRANSMISSION TIME

LIMITS

LP0002 §3.4.2.4 (A)

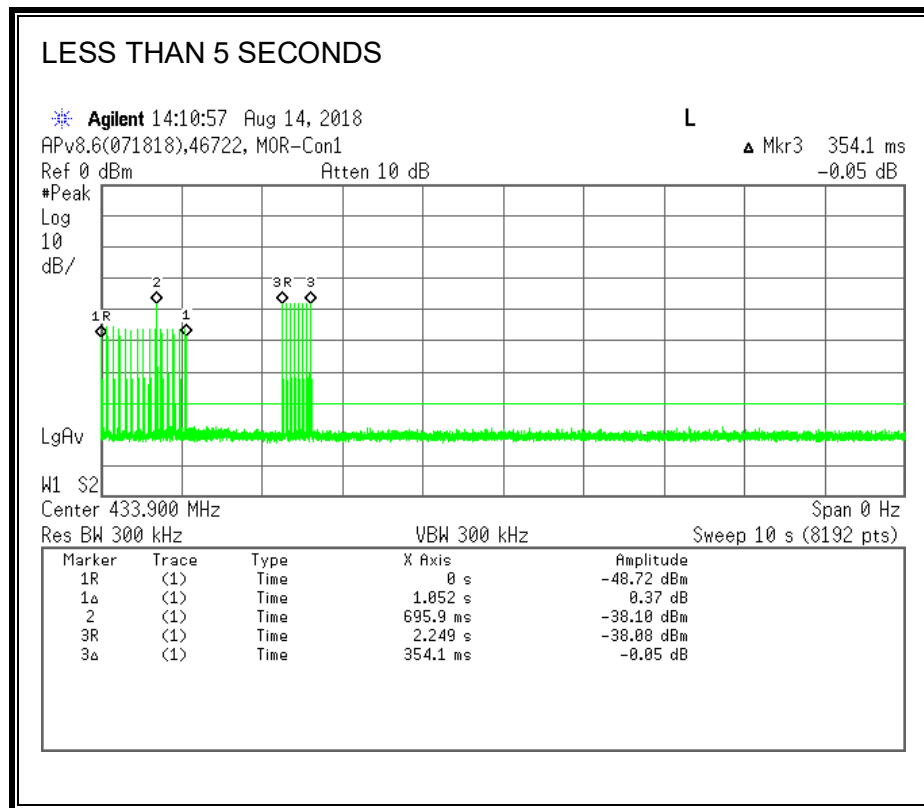
A transmitter activated automatically shall cease transmission within 5 seconds after activation.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer or radiated field strength. The RBW is set to 100 kHz and the VBW is set to 100 kHz. The sweep time is set to 10 seconds and the span is set to 0 Hz.

RESULTS

No non-compliance noted:



8. RADIATED EMISSION TEST RESULTS

8.1. TX RADIATED SPURIOUS EMISSION

LIMITS

LP0002 §3.4.2.5 (1)

In addition to the provisions of Section 2.7, the field strength of emissions from intentional radiators at 3 meters operated under this section 3.4.2.4(1) shall not exceed limits in the table below (measurement instrumentation employing an average detector, CISPR quasi-peak detector is accepted as well): The tighter limit applies at the band edges.

Fundamental Frequency (MHz)	Field Strength of Fundamental Frequency (microvolts/meter)	Field Strength of Spurious Emissions (microvolts/meter)
40.66 - 40.70	2,250	225
70 - 130	1,250	125
130 - 174	1,250 to 3,750 ^{1,2}	125 to 375 ^{1,2}
174 - 260	3,750	375
260 - 470	3,750 to 12,500 ^{1,2}	375 to 1,250 ^{1,2}
Above 470	12,500	1,250

¹ Linear interpolation

² The maximum permitted unwanted emission level is 20dB below the maximum permitted fundamental level, or meets the requirement of Section 2.8, whichever is less. If the field strength is based on measurement instrumentation employing an average detector, it must meet the peak emissions of Section 5.15.2

§2.7 There are additional regulations except for this standard. The fundamental frequency of any low-power radio-frequency devices are restricted in any of the operation bands listed below; The spurious emissions are permitted in any of frequency band listed below and shall meet the field strength requirement of 2.8:

Frequency (MHz)	Frequency (MHz)	Frequency (MHz)
0.090 ~ 0.110	322.00 ~ 335.40	3500.0 ~ 4400.0
0.490 ~ 0.510	399.90 ~ 410.00	4500.0 ~ 5250.0
2.172 ~ 2.198	485.00 ~ 510.00	5350.0 ~ 5460.0
3.013 ~ 3.033	608.00 ~ 614.00	7250.0 ~ 7750.0
4.115 ~ 4.198	703.00 ~ 748.00	8025.0 ~ 8500.0
5.670 ~ 5.690	758.00 ~ 803.00	9000.0 ~ 9200.0
6.200 ~ 6.300	825.00 ~ 915.00	9300.0 ~ 9500.0
8.230 ~ 8.400	930.00 ~ 1240.0	10600 ~ 12700
12.265 ~ 12.600	1300.0 ~ 1427.0	13250 ~ 13400
13.340 ~ 13.430	1435.0 ~ 1626.5	14470 ~ 14500
14.965 ~ 15.020	1660.0 ~ 1785.0	15350 ~ 16200

16.700 ~ 16.755	1805.0 ~ 1880.0	17700 ~ 21400
19.965 ~ 20.020	1885.0 ~ 1900.0	22010 ~ 23120
25.500 ~ 25.700	1905.0 ~ 1985.0	23600 ~ 24000
37.475 ~ 38.275	2010.0 ~ 2025.0	31200 ~ 31800
73.500 ~ 75.400	2110.0 ~ 2170.0	36430 ~ 36500
108.00 ~ 138.00	2200.0 ~ 2300.0	38600 +
149.90 ~ 150.05	2310.0 ~ 2390.0	
156.70 ~ 156.90	2483.5 ~ 2900.0	
162.01 ~ 167.17	3260.0 ~ 3267.0	
167.72 ~ 173.20	3332.0 ~ 3339.0	
240.00 ~ 285.00	3345.8 ~ 3358.0	)

§2.8 There are additional regulations except for this standard, the emissions from the low-power radio-frequency devices shall be less than or equal the field strength levels specified in the following table and the level of any unwanted emissions shall not exceed the level of the fundamental emission. The tighter limit applies at the band edges.

Frequency (MHz)	Field strength (micro-volts/meter)	Measurement distance (meters)
0.009 - 0.490 (included)	2,400/Freq.(kHz)	300
0.490 (excluded) - 1.705 (included)	24,000/Freq.(kHz)	30
1.705 (excluded) - 30 (excluded)	30	30
30 (included) - 88 (included)	100	3
88 (excluded) -216 (included)	150	3
216 (excluded) -960 (included)	200	3
above 960 (excluded)	500	3

PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane for below 1GHz measurements and 1.5 meters above the ground plane for above 1 GHz measurements. The antenna to EUT distance is 3 meters.

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

For peak measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz. For average measurements, the resolution and video bandwidths are set as described in ANSI 63.10:2013 for the applicable average measurement. For this test program, duty cycle correction was applied to the Peak data, per 5.15.3.

The spectrum from 9 kHz to 4 GHz is investigated with the transmitter on.

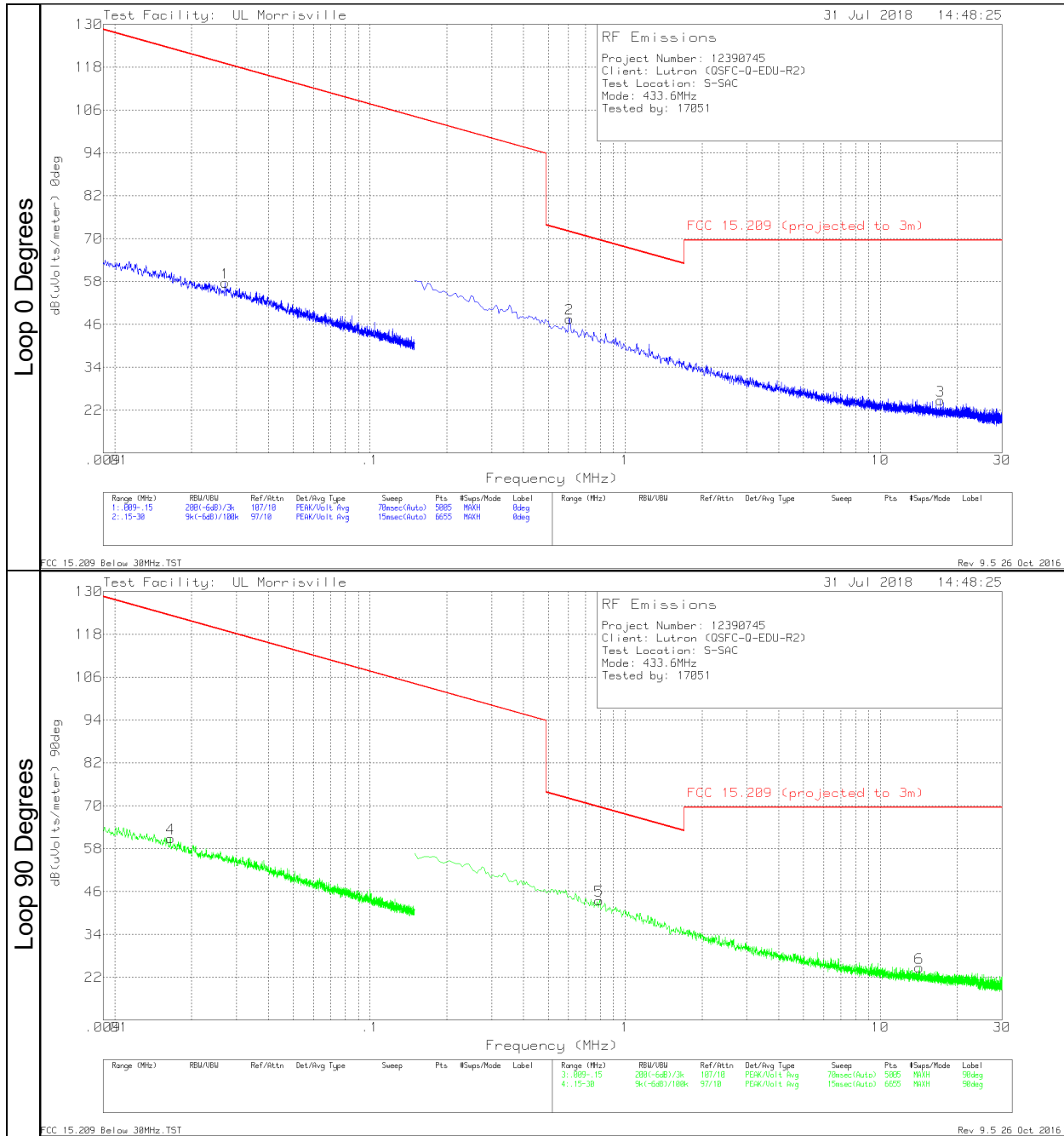
The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

FUNDAMENTAL, HARMONICS AND TX SPURIOUS EMISSION (9kHz - 30 MHz)

Note: All measurements were made at a test distance of 3 m. The limits in the plots and tabular data are the FCC/IC limits extrapolated from the specification distance (300 m from 9-490 kHz and 30 m from 490 kHz – 30 MHz) to the measurement distance to clearly show the relative levels of fundamental and spurious emissions and demonstrate compliance with the requirement that the level of any spurious emissions be below the level of the intentionally transmitted signal. The extrapolation factor for the limits were $40 \cdot \log(\text{specification distance} / \text{test distance})$.

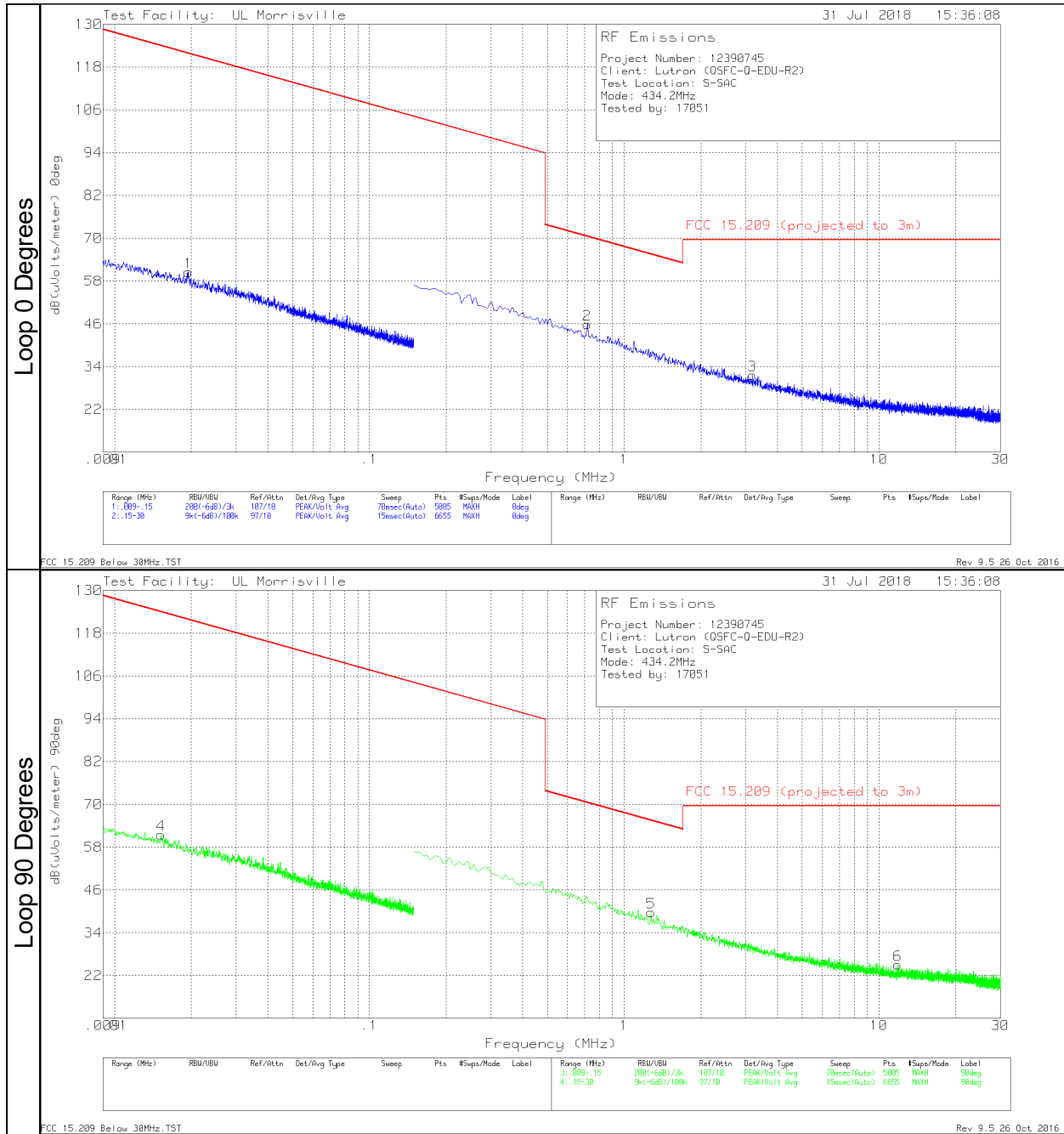
Although these tests were performed at a test site other than an open area test site, adequate comparison measurements were confirmed against an open area test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788.

433.6MHz



The above plots demonstrate there were no EUT-related emissions of interest relative to the LP0002 §2.8 limit below 30MHz.

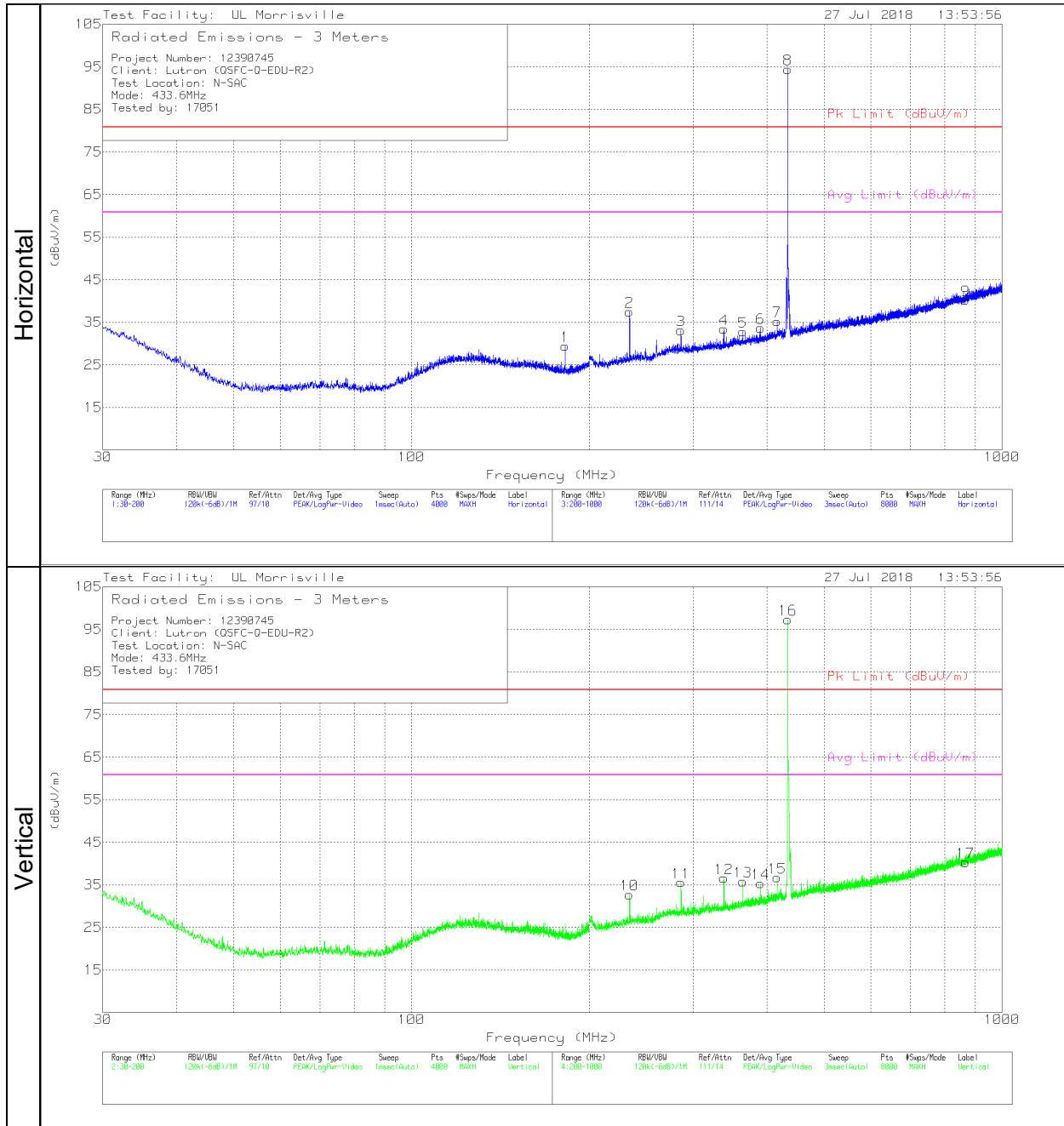
434.2MHz



The above plots demonstrate there were no EUT-related emissions of interest relative to the FCC 15.209 limit below 30MHz.

FUNDAMENTAL, HARMONICS AND TX SPURIOUS EMISSION (30 – 1000 MHz)

433.6MHz



Freq (MHz)	Meter Reading [dBuV]	Detector	Antenna Factor [dB/m]	Gain/Loss [dB]	Pad (dB)	Peak Field Strength [dBuV/m]	NCC (b) Peak Limit ¹ [dBuV/m]	Margin [dB]	DCCF (dB)	Average Field Strength ² [dBuV/m]	NCC Average Limit [dBuV/m]	Margin [dB]	Antenna Polarity	In FCC Restricted Band*?	In NCC Restricted Band**?
433.6370	89.53	Pk	21.60	-28.70	9.90	92.33	100.81	-8.48	-20.06	72.27	80.81	-8.54	H	N	N
867.2562	25.00	Qp	27.30	-26.70	10.00	35.60	46.02	-10.42	-	-	-	-	H	N	Y

433.6376	94.51	Pk	21.60	-28.70	9.90	97.31	100.81	-3.50	-20.06	77.25	80.81	-3.56	V	N	N
867.2653	27.04	Qp	27.30	-26.70	10.00	37.64	46.02	-8.38	-	-	-	-	V	N	Y

PK = Peak, QP = Quasi-Peak

Note 1: Limit is QP Limit if frequency within a restricted band.

Note 2: Average Field Strength computed as follows for the above fundamental and harmonics: PK + DCCF

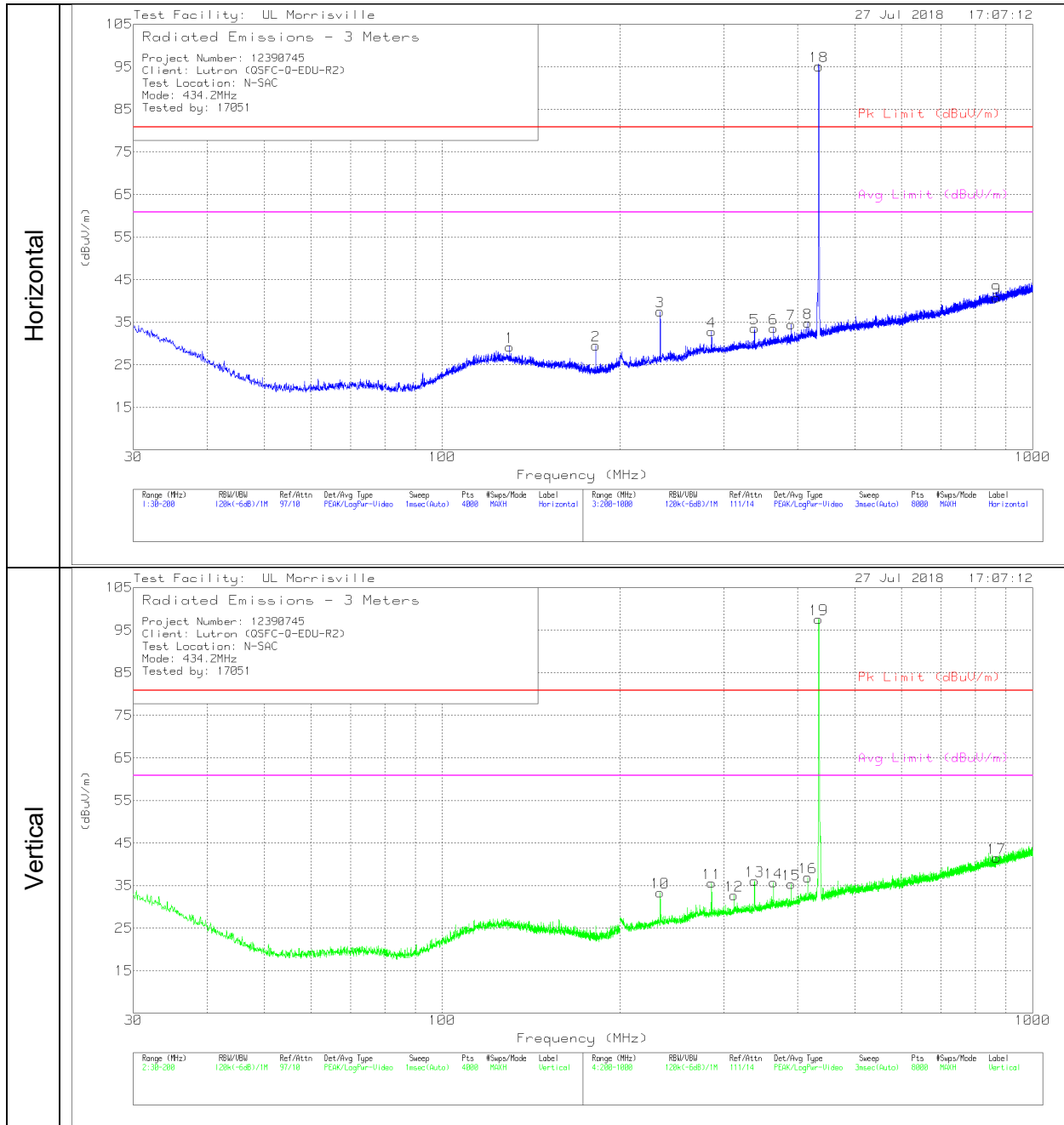
181.977	33.66	Pk	16.10	-30.20	9.90	29.46	80.81	-51.35	-	-	60.81	-31.35	H	N	N
234.004	40.41	Pk	17.00	-29.80	9.90	37.51	80.81	-43.30	-	-	60.81	-23.30	H	N	N
286.011	33.94	Pk	18.80	-29.50	9.90	33.14	80.81	-47.67	-	-	60.81	-27.67	H	N	N
338.018	33.26	Pk	19.50	-29.20	9.90	33.46	80.81	-47.35	-	-	60.81	-27.35	H	N	N
364.021	31.59	Pk	20.30	-29.00	9.90	32.79	80.81	-48.02	-	-	60.81	-28.02	H	N	N
390.025	32.05	Pk	20.60	-28.90	9.90	33.65	80.81	-47.16	-	-	60.81	-27.16	H	N	N
416.028	32.65	Pk	21.50	-28.80	9.90	35.25	80.81	-45.56	-	-	60.81	-25.56	H	N	N
234.004	35.66	Pk	17.00	-29.80	9.90	32.76	80.81	-48.05	-	-	60.81	-28.05	V	N	N
286.011	36.39	Pk	18.80	-29.50	9.90	35.59	80.81	-45.22	-	-	60.81	-25.22	V	N	N
338.018	36.42	Pk	19.50	-29.20	9.90	36.62	80.81	-44.19	-	-	60.81	-24.19	V	N	N
364.021	34.59	Pk	20.30	-29.00	9.90	35.79	80.81	-45.02	-	-	60.81	-25.02	V	N	N
390.025	33.77	Pk	20.60	-28.90	9.90	35.37	80.81	-45.44	-	-	60.81	-25.44	V	N	N
416.028	34.09	Pk	21.50	-28.80	9.90	36.69	80.81	-44.12	-	-	60.81	-24.12	V	N	N

PK = Peak, Qp = Quasi-Peak

Note 1: Limit is QP Limit if frequency within a restricted band.

- * - indicates frequency in FCC 15.205 Restricted Band
- ** - indicates frequency in Taiwan NCC LP0002 Restricted Band

434.2MHz



Freq (MHz)	Meter Reading [dBuV]	Detector	Antenna Factor [dB/m]	Gain/Loss [dB]	Pad (dB)	Peak Field Strength [dBuV/m]	NCC (b) Peak Limit ¹ [dBuV/m]	Margin [dB]	DCCF (dB)	Average Field Strength ² [dBuV/m]	NCC Average Limit [dBuV/m]	Margin [dB]	Antenna Polarity	In FCC Restricted Band*?	In NCC Restricted Band**?
434.2358	89.70	Pk	21.60	-28.70	9.90	92.50	100.83	-8.334	-20.06	72.44	80.83	-8.39	H	N	N
868.4716	25.48	Qp	27.30	-26.70	10.00	36.08	46.02	-9.940	-	-	-	-	H	N	Y

434.2372	94.73	Pk	21.60	-28.70	9.90	97.53	100.83	-3.304	-20.06	77.47	80.83	-3.36	V	N	N
868.4666	27.25	Qp	27.30	-26.70	10.00	37.85	46.02	-8.170	-	-	-	-	V	N	Y

PK = Peak, QP = Quasi-Peak

Note 1: Limit is QP Limit if frequency within a restricted band.

Note 2: Average Field Strength computed as follows for the above fundamental and harmonics: PK + DCCF

130.028	31.02	Pk	19.00	-30.70	9.90	29.2	43.50	-14.28	-	-	-	-	H	Y	Y
182.019	33.70	Pk	16.10	-30.20	9.90	29.5	80.83	-51.33	-	-	60.83	-31.33	H	N	N
234.004	40.44	Pk	17.00	-29.80	9.90	37.5	80.83	-43.29	-	-	60.83	-23.29	H	N	N
286.011	33.60	Pk	18.80	-29.50	9.90	32.8	80.83	-48.03	-	-	60.83	-28.03	H	N	N
338.018	33.39	Pk	19.50	-29.20	9.90	33.6	80.83	-47.24	-	-	60.83	-27.24	H	N	N
364.021	32.36	Pk	20.30	-29.00	9.90	33.6	80.83	-47.27	-	-	60.83	-27.27	H	N	N
390.025	32.92	Pk	20.60	-28.90	9.90	34.5	80.83	-46.31	-	-	60.83	-26.31	H	N	N
416.028	32.26	Pk	21.50	-28.80	9.90	34.9	80.83	-45.97	-	-	60.83	-25.97	H	N	N
234.004	36.29	Pk	17.00	-29.80	9.90	33.4	80.83	-47.44	-	-	60.83	-27.44	V	N	N
286.011	36.37	Pk	18.80	-29.50	9.90	35.6	80.83	-45.26	-	-	60.83	-25.26	V	N	N
312.015	32.88	Pk	19.20	-29.30	9.90	32.7	80.83	-48.15	-	-	60.83	-28.15	V	N	N
338.018	35.92	Pk	19.50	-29.20	9.90	36.1	80.83	-44.71	-	-	60.83	-24.71	V	N	N
364.021	34.54	Pk	20.30	-29.00	9.90	35.7	80.83	-45.09	-	-	60.83	-25.09	V	N	N
390.025	33.73	Pk	20.60	-28.90	9.90	35.3	80.83	-45.50	-	-	60.83	-25.50	V	N	N
416.028	34.31	Pk	21.50	-28.80	9.90	36.9	80.83	-43.92	-	-	60.83	-23.92	V	N	N

PK = Peak, Qp = Quasi-Peak

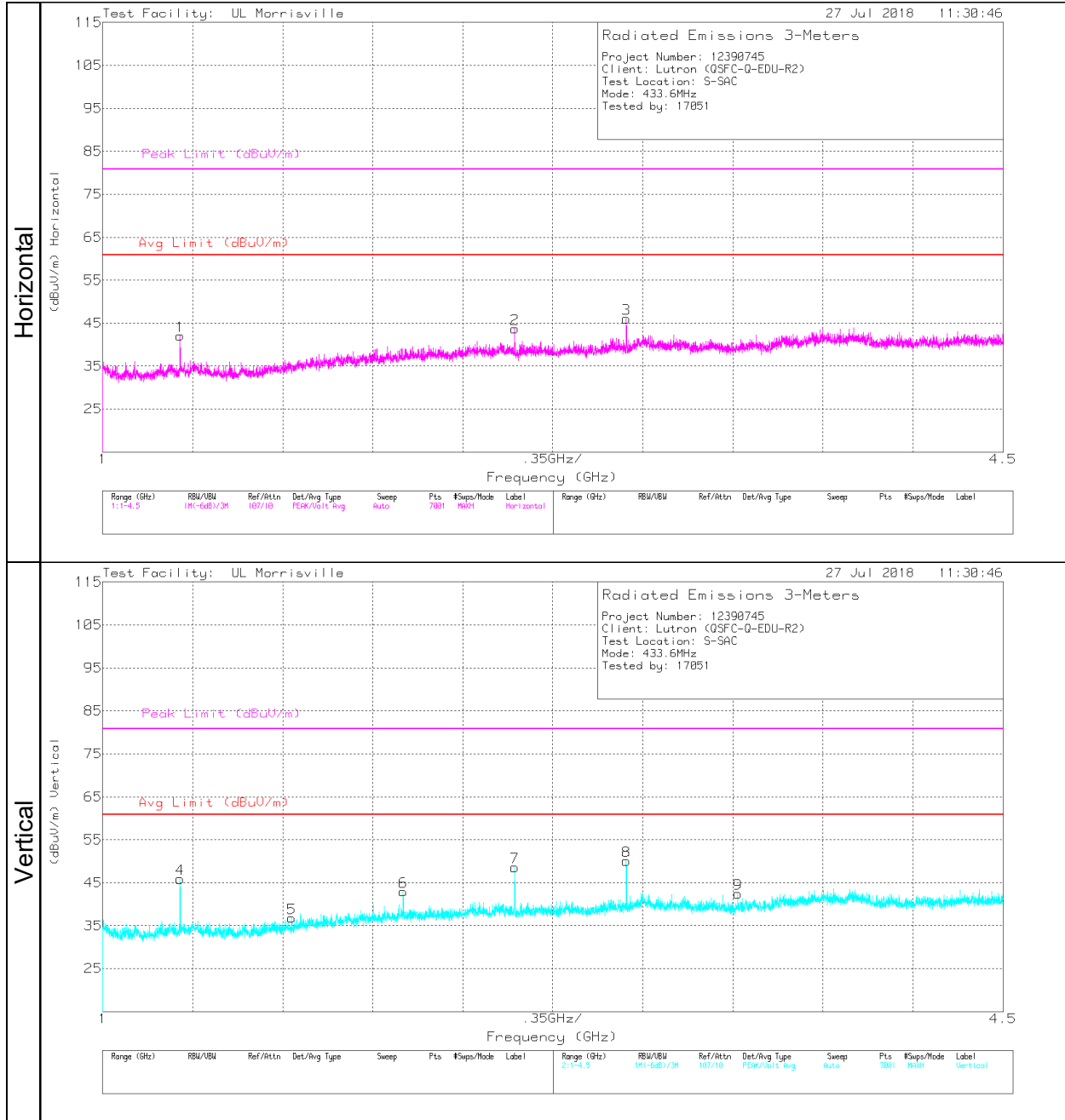
Note 1: Limit is QP Limit if frequency within a restricted band.

* - indicates frequency in FCC 15.205 Restricted Band

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

HARMONICS AND TX SPURIOUS EMISSIONS ABOVE 1GHz

433.6MHz



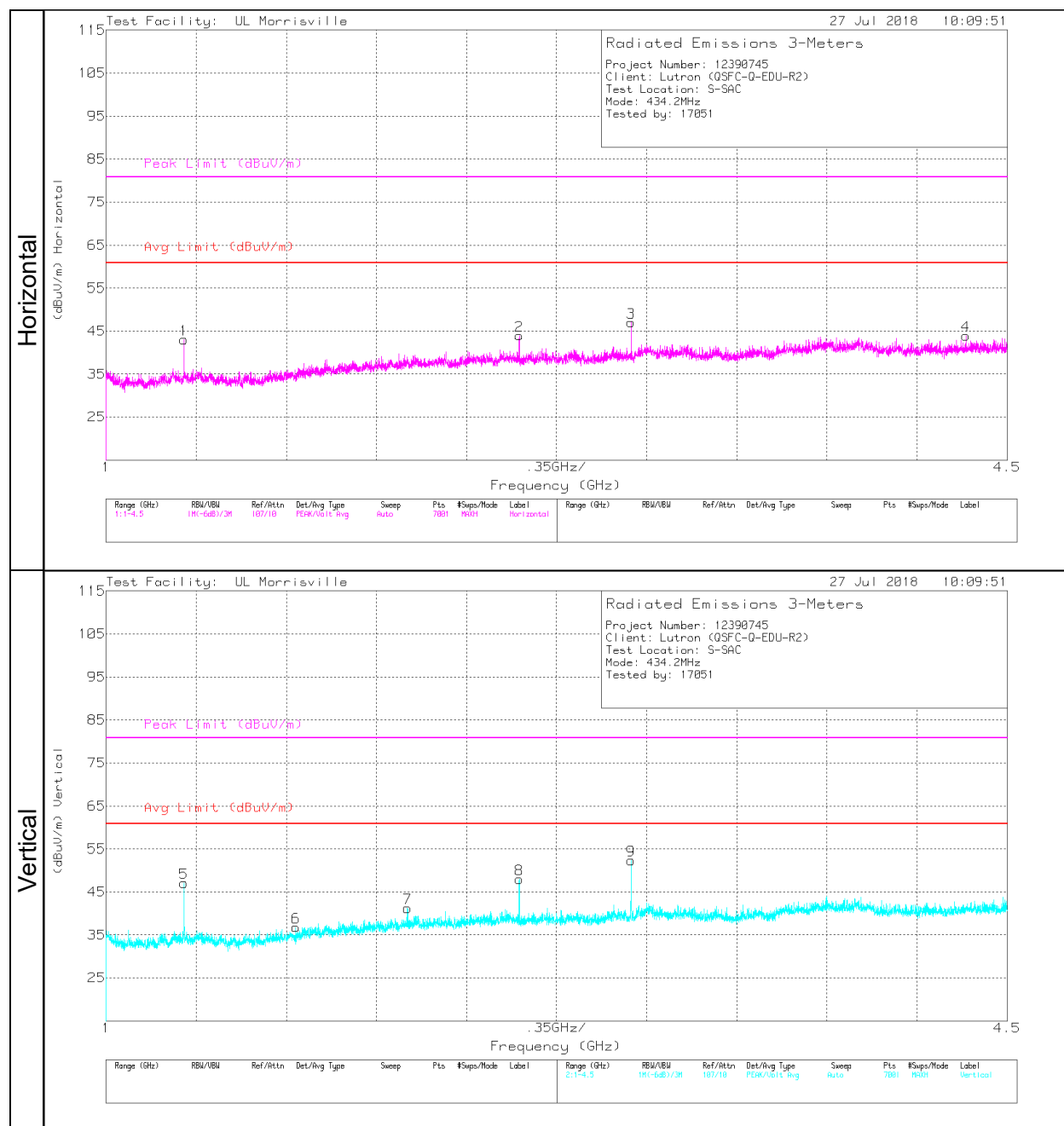
Freq (GHz)	Meter Reading [dBuV]	Detector	Antenna Factor [dB/m]	Gain/Loss [dB]	Filter (dB)	Peak Field Strength [dBuV/m]	NCC Peak Limit [dBuV/m]	Margin [dB]	DCF (dB)	Average Field Strength [dBuV/m]	NCC Average Limit [dBuV/m]	Margin [dB]	Antenna Polarity	In FCC Restricted Band*?	In NCC Restricted Band**?
1.301	51.18	Pk	28.8	-35	0.5	45.48	74.00	-28.52	-20.06	25.42	54.00	-28.58	H	Y	Y
2.602	45.12	Pk	32.3	-34.1	0.4	43.72	74.00	-30.28	-20.06	23.7	54.00	-30.34	H	N	Y
3.035	49.68	Pk	32.90	-33.80	0.40	49.2	80.81	-31.63	-20.06	29.1	60.81	-31.69	H	N	N

1.301	54.26	Pk	28.80	-35.00	0.50	48.6	74.00	-25.44	-20.06	28.5	54.00	-25.50	V	Y	Y
1.734	41.67	Pk	29.30	-34.70	0.50	36.8	74.00	-37.23	-20.06	16.7	54.00	-37.29	V	N	Y
2.168	45.31	Pk	31.50	-34.30	0.40	42.9	74.00	-31.10	-20.06	22.9	54.00	-31.16	V	N	Y
2.602	53.64	Pk	32.30	-34.10	0.40	52.2	74.00	-21.76	-20.06	32.2	54.00	-21.82	V	N	Y
3.035	53.00	Pk	32.90	-33.80	0.40	52.5	80.81	-28.31	-20.06	32.4	60.81	-28.37	V	N	N
3.469	42.50	Pk	32.70	-33.30	0.50	42.4	80.81	-38.41	-20.06	22.3	60.81	-38.47	V	N	N

PK = Peak

Average Field Strength computed as follows for the above fundamental, harmonics, and Spurious: PK + DCF

434.2MHz



Freq (GHz)	Meter Reading [dBuV]	Detector	Antenna Factor [dB/m]	Gain/Loss [dB]	Filter (dB)	Peak Field Strength [dBuV/m]	NCC Peak Limit [dBuV/m]	Margin [dB]	DCF (dB)	Average Field Strength [dBuV/m]	NCC Average Limit [dBuV/m]	Margin [dB]	Antenna Polarity	In FCC Restricted Band* **?	In NCC Restricted Band* **?
1.303	51.05	Pk	28.8	-35	0.5	45.35	74.00	-28.65	-20.06	25.29	54.00	-28.71	H	Y	Y
2.605	48.56	Pk	32.3	-34.1	0.4	47.16	74.00	-26.84	-20.06	27.1	54.00	-26.90	H	N	Y
3.040	50.55	Pk	32.90	-33.80	0.40	50.1	80.83	-30.78	-20.06	30.0	60.83	-30.84	H	N	N
4.342	43.14	Pk	33.40	-32.40	0.50	44.6	74.00	-29.36	-20.06	24.6	54.00	-29.42	H	Y	Y
1.302	54.86	Pk	28.80	-35.00	0.50	49.2	74.00	-24.84	-20.06	29.1	54.00	-24.90	V	Y	Y
1.737	41.59	Pk	29.40	-34.70	0.50	36.8	74.00	-37.21	-20.06	16.7	54.00	-37.27	V	N	Y
2.171	43.64	Pk	31.50	-34.30	0.40	41.2	80.83	-39.59	-20.06	21.2	60.83	-39.65	V	N	N
2.605	51.94	Pk	32.30	-34.10	0.40	50.5	74.00	-23.46	-20.06	30.5	54.00	-23.52	V	N	Y
3.039	53.86	Pk	32.90	-33.80	0.40	53.4	80.83	-27.47	-20.06	33.3	60.83	-27.53	V	N	N
Average Field Strength computed as follows for the above fundamental, harmonics, and Spurious: PK + DCF															

8.2. RX RADIATED SPURIOUS EMISSIONS

LP0002 §2.11

If transmitter and receiver of the low-power radio-frequency device are sold in one set, the corresponding type approval review documents should be presented; otherwise the transmitter and receiver should be applied for approval together. The receiver radiated field strength must not exceed the emission specified in Section 2.8 and receiver shall not receive, demodulate frequency listed in Section 2.7.

§2.7 There are additional regulations except for this standard. The fundamental frequency of any low-power radio-frequency devices are restricted in any of the operation bands listed below; The spurious emissions are permitted in any of frequency band listed below and shall meet the field strength requirement of 2.8:

Frequency (MHz)	Frequency (MHz)	Frequency (MHz)
0.090 ~ 0.110	322.00 ~ 335.40	3500.0 ~ 4400.0
0.490 ~ 0.510	399.90 ~ 410.00	4500.0 ~ 5250.0
2.172 ~ 2.198	485.00 ~ 510.00	5350.0 ~ 5460.0
3.013 ~ 3.033	608.00 ~ 614.00	7250.0 ~ 7750.0
4.115 ~ 4.198	703.00 ~ 748.00	8025.0 ~ 8500.0
5.670 ~ 5.690	758.00 ~ 803.00	9000.0 ~ 9200.0
6.200 ~ 6.300	825.00 ~ 915.00	9300.0 ~ 9500.0
8.230 ~ 8.400	930.00 ~ 1240.0	10600 ~ 12700
12.265 ~ 12.600	1300.0 ~ 1427.0	13250 ~ 13400
13.340 ~ 13.430	1435.0 ~ 1626.5	14470 ~ 14500
14.965 ~ 15.020	1660.0 ~ 1785.0	15350 ~ 16200

16.700 ~ 16.755	1805.0 ~ 1880.0	17700 ~ 21400
19.965 ~ 20.020	1885.0 ~ 1900.0	22010 ~ 23120
25.500 ~ 25.700	1905.0 ~ 1985.0	23600 ~ 24000
37.475 ~ 38.275	2010.0 ~ 2025.0	31200 ~ 31800
73.500 ~ 75.400	2110.0 ~ 2170.0	36430 ~ 36500
108.00 ~ 138.00	2200.0 ~ 2300.0	38600 +
149.90 ~ 150.05	2310.0 ~ 2390.0	
156.70 ~ 156.90	2483.5 ~ 2900.0	
162.01 ~ 167.17	3260.0 ~ 3267.0	
167.72 ~ 173.20	3332.0 ~ 3339.0	
240.00 ~ 285.00	3345.8 ~ 3358.0	)

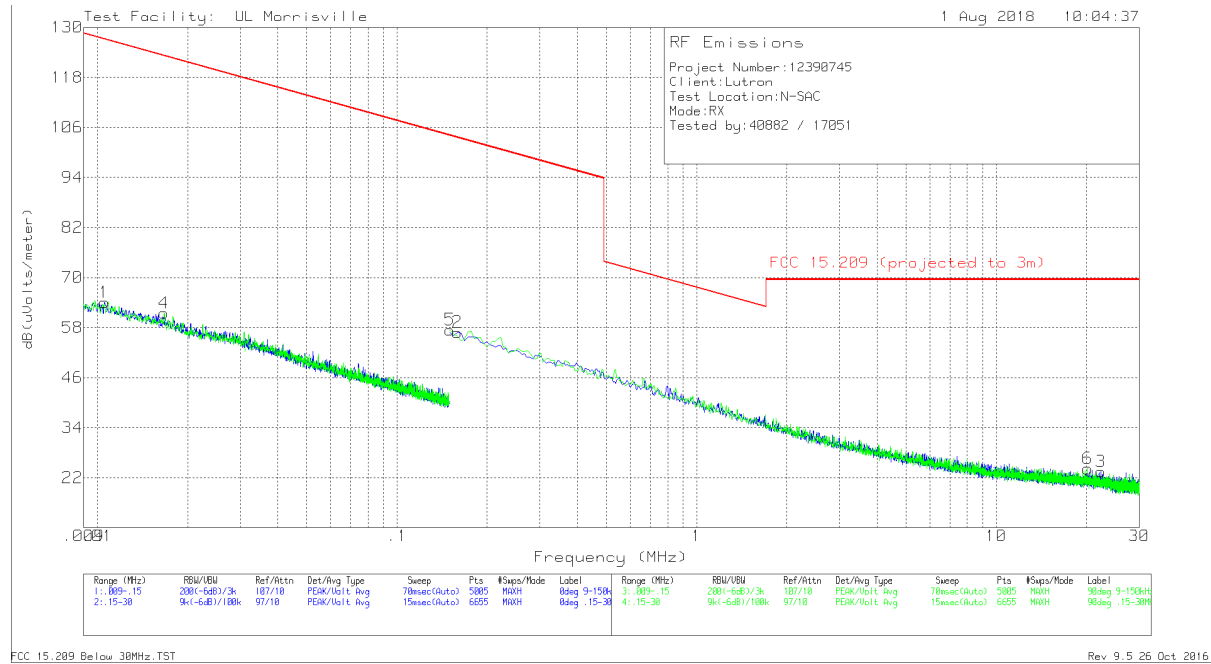
§2.8 There are additional regulations except for this standard, the emissions from the low-power radio-frequency devices shall be less than or equal the field strength levels specified in the following table and the level of any unwanted emissions shall not exceed the level of the fundamental emission. The tighter limit applies at the band edges.

Frequency (MHz)	Field strength (micro-volts/meter)	Measurement distance (meters)
0.009 - 0.490 (included)	2,400/Freq.(kHz)	300
0.490 (excluded) - 1.705 (included)	24,000/Freq.(kHz)	30
1.705 (excluded) - 30 (excluded)	30	30
30 (included) - 88 (included)	100	3
88 (excluded) -216 (included)	150	3
216 (excluded) -960 (included)	200	3
above 960 (excluded)	500	3

RX SPURIOUS EMISSION (WORST-CASE 9kHz - 30 MHz)

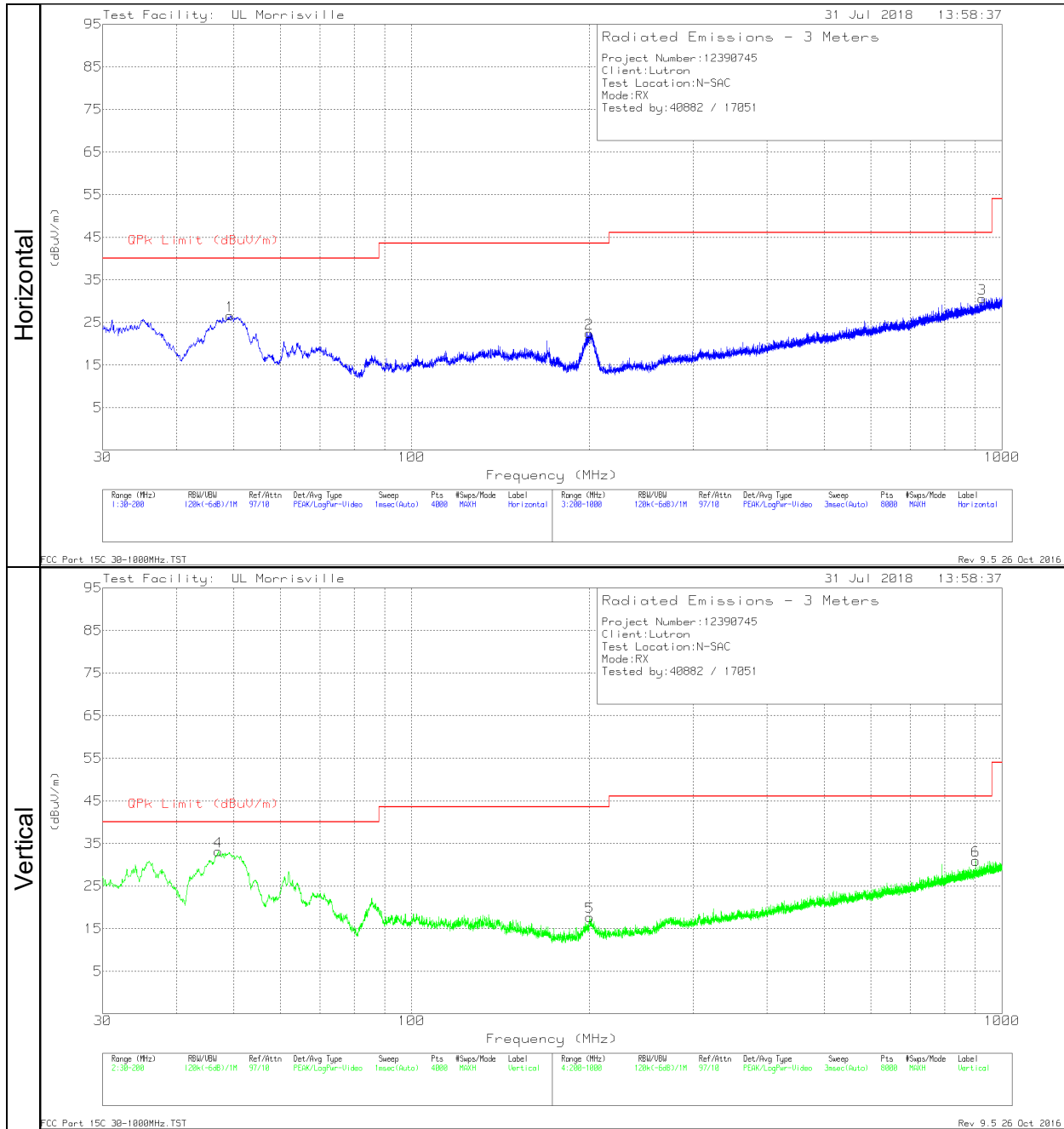
Note: All measurements were made at a test distance of 3 m. The limits in the plots and tabular data are the FCC/IC limits extrapolated from the specification distance (300 m from 9-490 kHz and 30 m from 490 kHz – 30 MHz) to the measurement distance to clearly show the relative levels of fundamental and spurious emissions and demonstrate compliance with the requirement that the level of any spurious emissions be below the level of the intentionally transmitted signal. The extrapolation factor for the limits were $40 \cdot \log(\text{specification distance} / \text{test distance})$.

Although these tests were performed at a test site other than an open area test site, adequate comparison measurements were confirmed against an open area test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788.



The above plots demonstrate there were no EUT-related emissions of interest relative to the LP0002 §2.8 limit below 30MHz.

RX SPURIOUS EMISSION (WORST-CASE 30 – 1000 MHz)

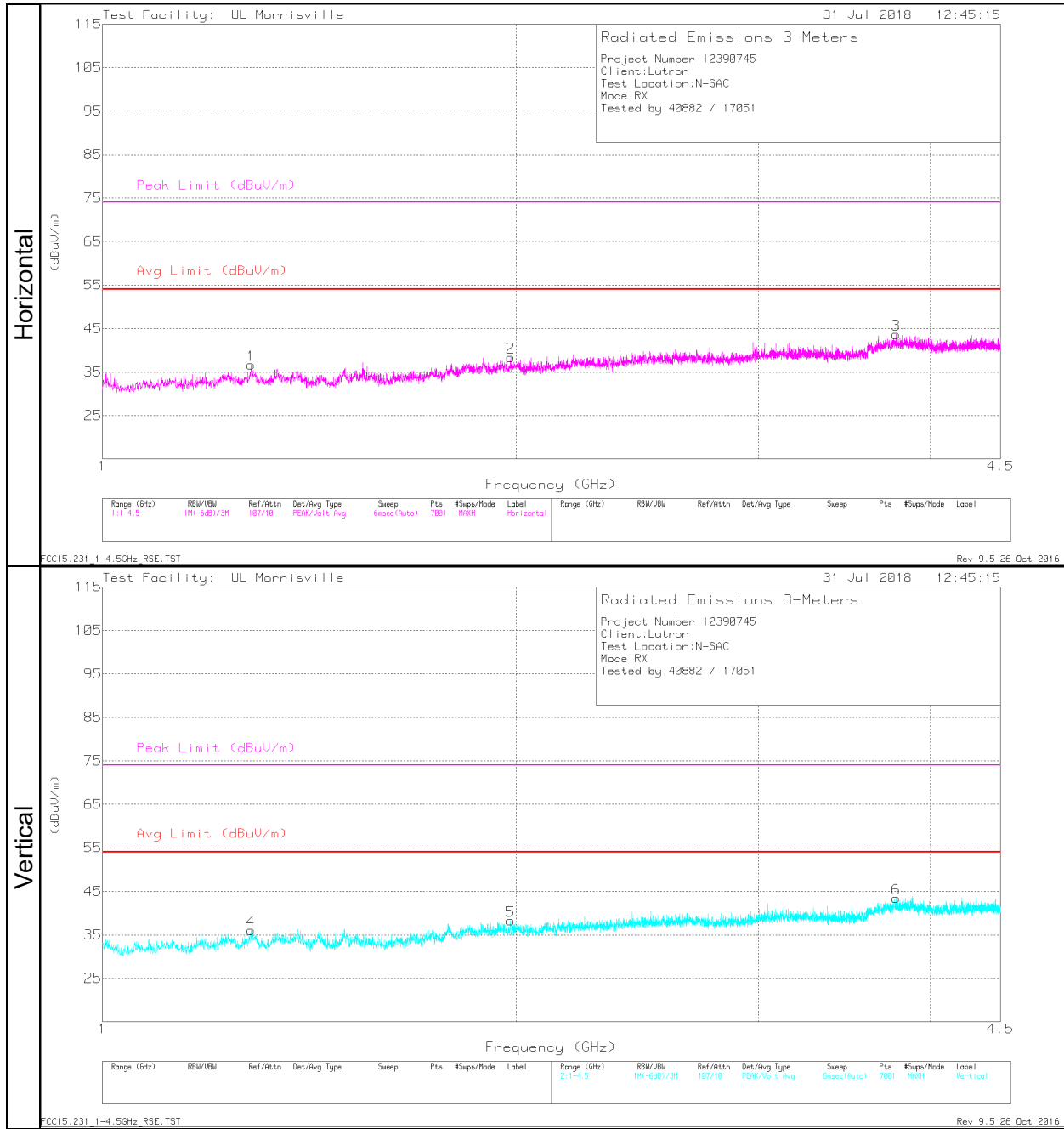


Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0075 AF (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
4	47.0894	50.8	Pk	13.8	-31.5	33.1	40	-6.9	0-360	102	V
1	49.3	45.16	Pk	12.9	-31.5	26.56	40	-13.44	0-360	199	H
2	200	34.86	Pk	17.8	-30.2	22.46	43.52	-21.06	0-360	98	H
5	200.3	30.13	Pk	17.8	-30.2	17.73	43.52	-25.79	0-360	199	V
6	903.0914	30.44	Pk	26.9	-26.4	30.94	46.02	-15.08	0-360	199	V
3	925.7943	29.53	Pk	27.1	-26	30.63	46.02	-15.39	0-360	399	H

Pk - Peak detector

Note – Compared all frequencies to the restricted band limit as this is worst-case.

RX SPURIOUS EMISSION (WORST-CASE ABOVE 1GHz)

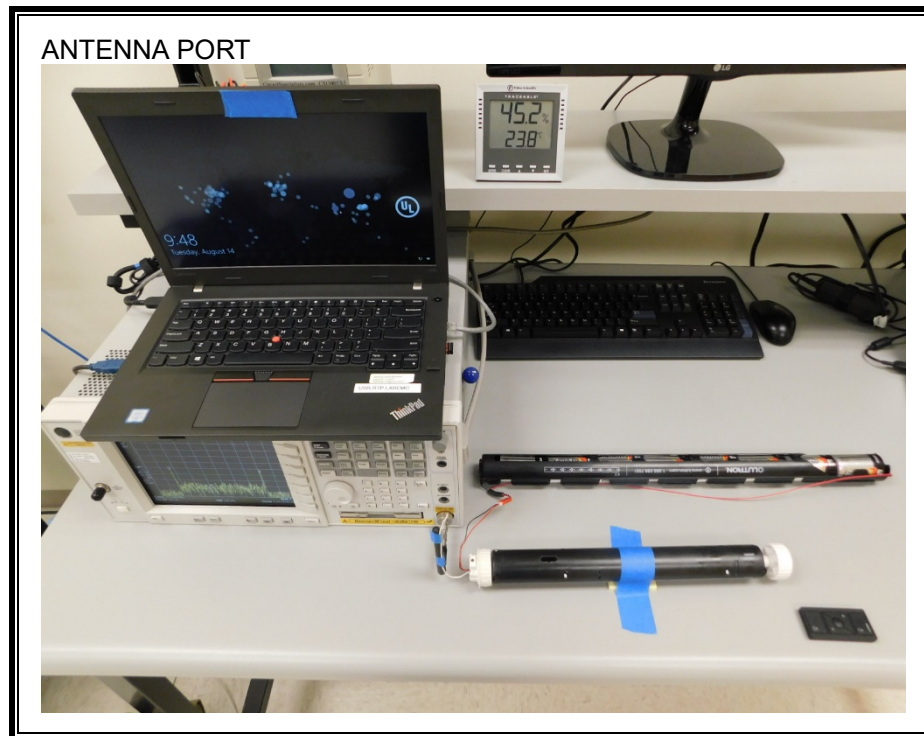


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 AF (dB/m)	Amp/Cbl/Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	AV Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
4	1.282	43.54	Pk	29.4	-36.9	36.04	-	-	-	-	0-360	400	V
1	1.283	44.25	Pk	29.3	-36.9	36.65	-	-	-	-	0-360	399	H
5	1.981	42.42	Pk	31.2	-35.4	38.22	54	-15.78	74	-35.78	0-360	400	V
2	1.982	42.62	Pk	31.2	-35.4	38.42	54	-15.58	74	-35.58	0-360	103	H
6	3.778	43.12	Pk	33.5	-33.2	43.42	54	-10.58	74	-30.58	0-360	202	V
3	3.779	43.41	Pk	33.5	-33.2	43.71	54	-10.29	74	-30.29	0-360	199	H

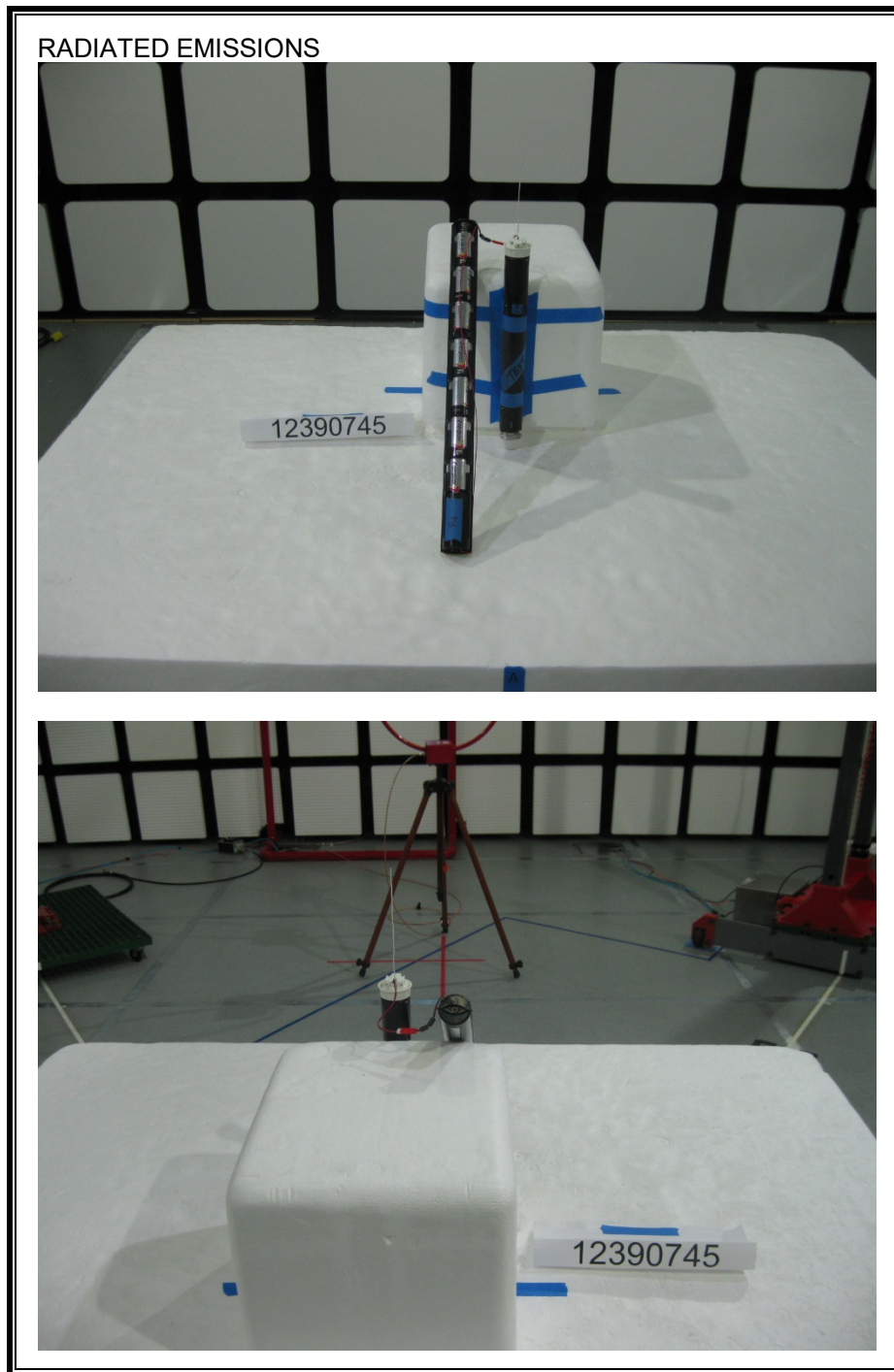
Pk - Peak detector

9. SETUP PHOTOS

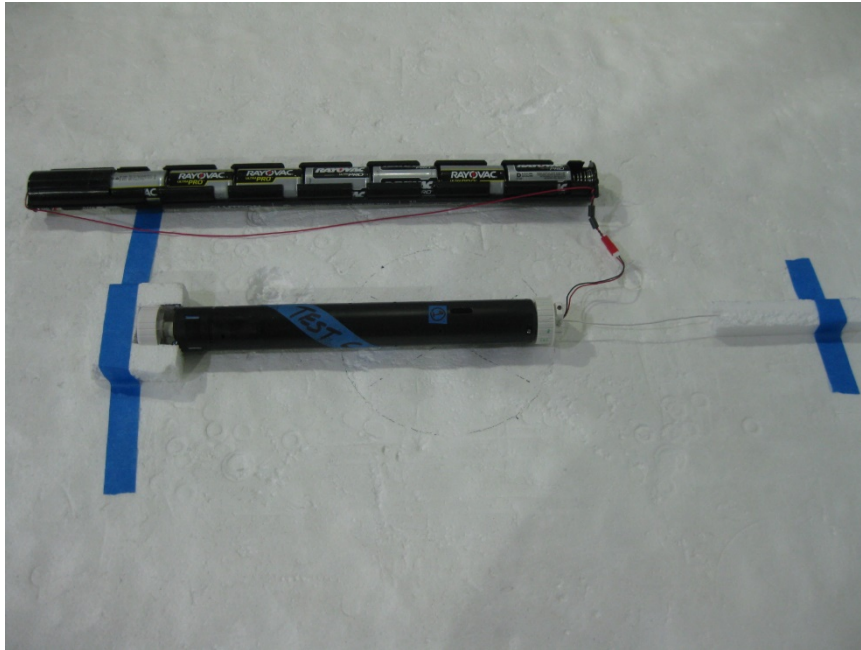
ANTENNA PORT



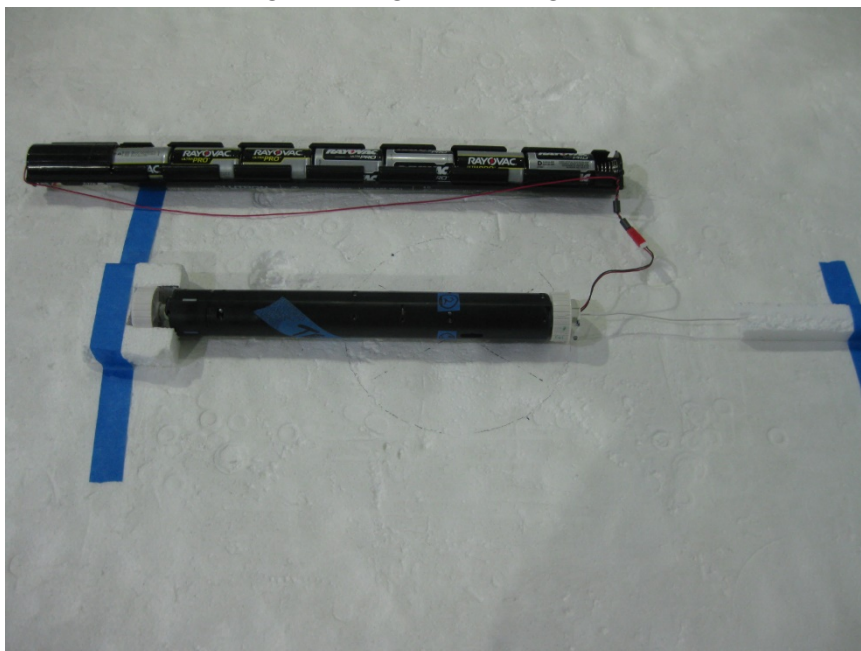
RADIATED EMISSIONS

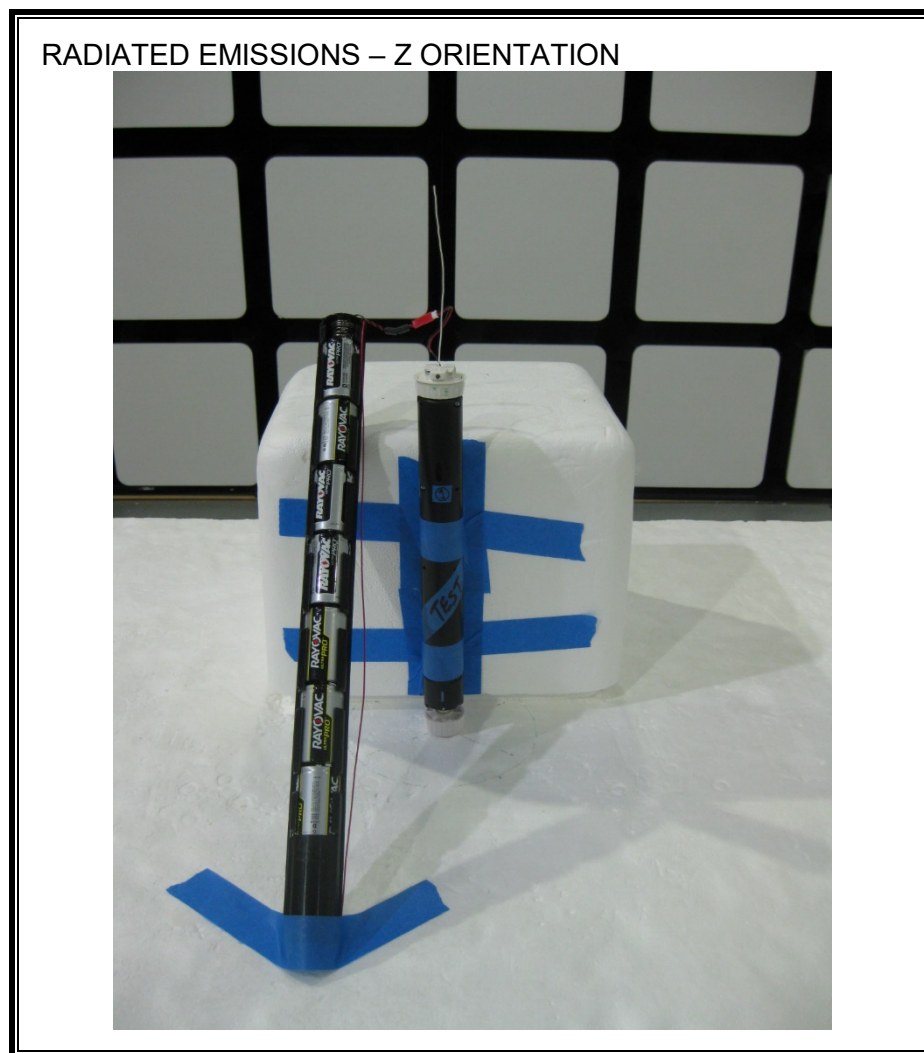


RADIATED EMISSIONS– X ORIENTATION



RADIATED EMISSIONS – Y ORIENTATION





END OF REPORT