



TEST REPORT

Report Number : 11719486-E2V2

Applicant : Metric Systems Corp.
3055 Enterprise Ct.
Vista, CA 92081

Model : RaptorXR

FCC ID : 2ABCU-50911-U

EUT Description : TVWS Fixed Wireless Networking Radio System

Test Standard(s) : FCC 47 CFR PART 15 SUBPART B

Date of Issue:
October 11, 2017

Prepared by:
UL Verification Services Inc.
47173 Benicia Street
Fremont, CA 94538, U.S.A.
TEL: (510) 771-1000
FAX: (510) 661-0888



NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
V1	07/11/17	Initial release	---
V2	10/11/17	Updated section 6.2.1 and 6.2.2 with above 1GHz data	C. Susa

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Metric Systems
3055 Enterprise Ct.
Vista, CA 92081

EUT DESCRIPTION: TVWS Fixed Wireless Networking Radio System

MODEL: RaptorXR

SERIAL NUMBER: XR001 (UHF); XR002 (UHF); XR007 (VHF)

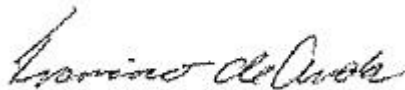
DATE TESTED: May 8th, 2017 – May 9th 2017

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
FCC 47 CFR PART 15 SUBPART B	Pass

UL Verification Services Inc. 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 Verification Services Inc. 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 Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. 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 Verification Services Inc. By:



Francisco de Anda
CONSUMER TECHNOLOGY DIVISION
Program Manager
UL Verification Services Inc.

Prepared By:



Clifford Susa
CONSUMER TECHNOLOGY DIVISION
Lab Engineer
UL Verification Services Inc.

2. TEST METHODOLOGY

All tests were performed in accordance with the procedures documented in ANSI C63.4-2014.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, Fremont, California, USA. Line conducted emissions are measured only at the 47173 address. 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.

47173 Benicia Street	47266 Benicia Street
☒ Chamber A	☐ Chamber D
☐ Chamber B	☐ Chamber E
☒ Chamber C	☐ Chamber F
	☐ Chamber G
	☐ Chamber H

The above test sites and facilities are covered under FCC Test Firm Registration # 208313.

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0.

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

Where relevant, the following sample calculation is provided:

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

4.3. MEASUREMENT UNCERTAINTY

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

PARAMETER	UNCERTAINTY
Conducted Disturbance, 9KHz to 0.15 MHz	3.84 dB
Conducted Disturbance, 0.15 to 30 MHz	3.65 dB
Radiated Disturbance, 9KHz to 30 MHz	3.15 dB
Radiated Disturbance, 30 to 1000 MHz	5.36 dB
Radiated Disturbance, 1000 to 18000 MHz	4.32 dB
Radiated Disturbance, 18000 to 26000 MHz	4.45 dB
Radiated Disturbance, 26000 to 40000 MHz	5.24 dB

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

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a TV whitespace fixed wireless networking radio system. The EUT is a software-defined full-duplex broadband radio operating in the VHF and UHF bands.

GENERAL INFORMATION

Power Requirements	100-240Vac 50/60Hz
Highest frequency generated or used by the EUT	695MHz

5.2. TEST CONFIGURATIONS

The following configuration was tested:

EUT Configuration	Description
Typical	Ethernet traffic exercised the Ethernet ports and the radio is set to receive mode

5.3. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was version 4.4.0.

5.4. MODIFICATIONS

No modifications were made during testing.

5.5. DETAILS OF TESTED SYSTEM

SUPPORT EQUIPMENT & PERIPHERALS

SUPPORT EQUIPMENT & PERIPHERALS LIST			
Description	Manufacturer	Model	Serial Number
EUT AC Adapter	Cincon Electronics	TRH100A280	100280-000607
Switch	Netgear	GS108Tv2	29SA3C5T00E79
Switch AC Adapter	Netgear	DSA-12R-12AUS	332-10006-01

I/O CABLES

I/O CABLE LIST						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length m	Remarks
1	AC	1	3-Prong	shielded	2	
2	DC	1	barrel	shielded	0.67	
3	Ant	1	N	shielded	1.3	
4	Ethernet	3	RJ45	Unshielded	2	
5	DC	1	Barrel	Unshielded	1.83	

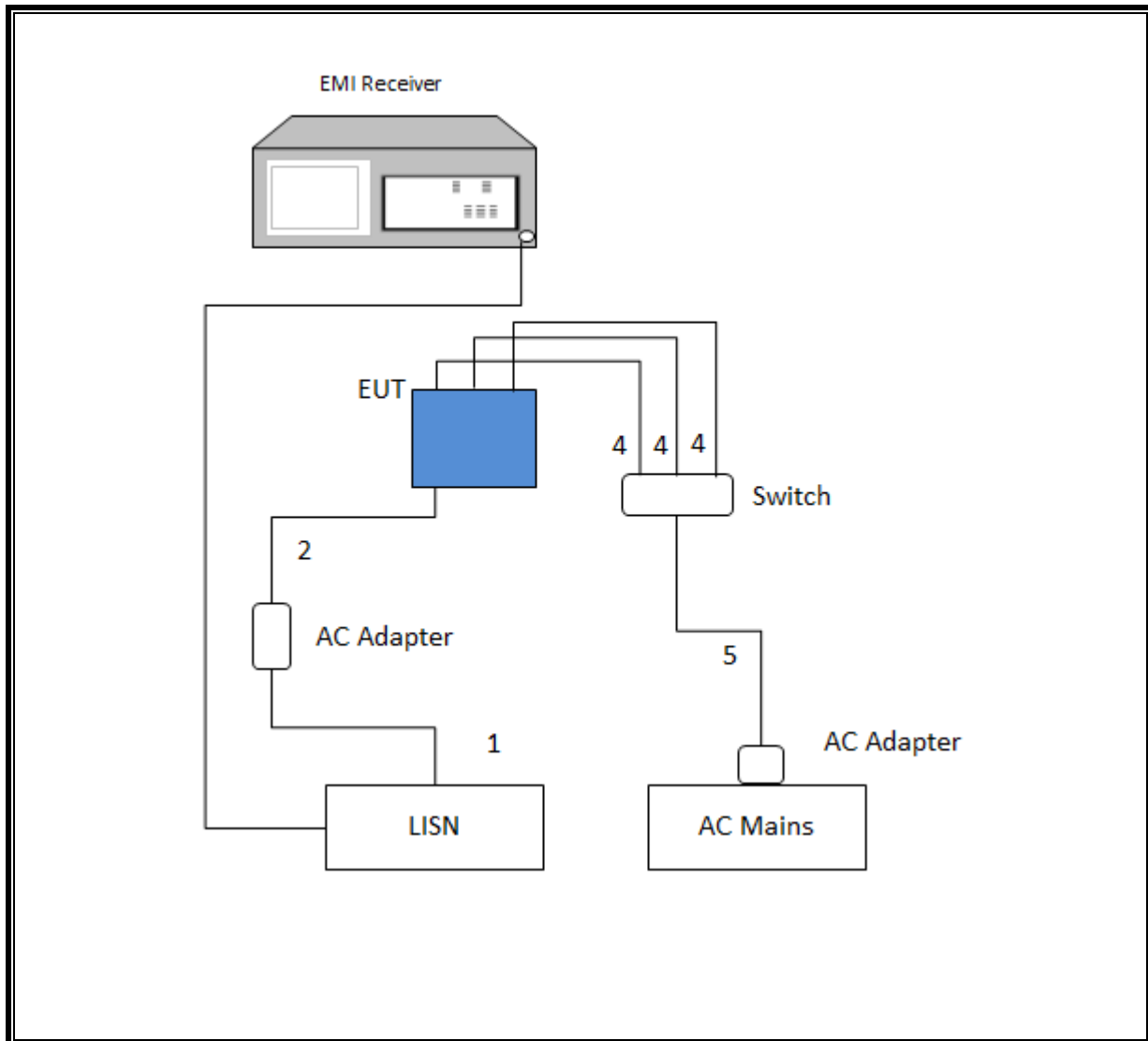
TEST SETUP

The EUT was installed in a typical configuration. The customer provided test software to exercise the EUT during test.

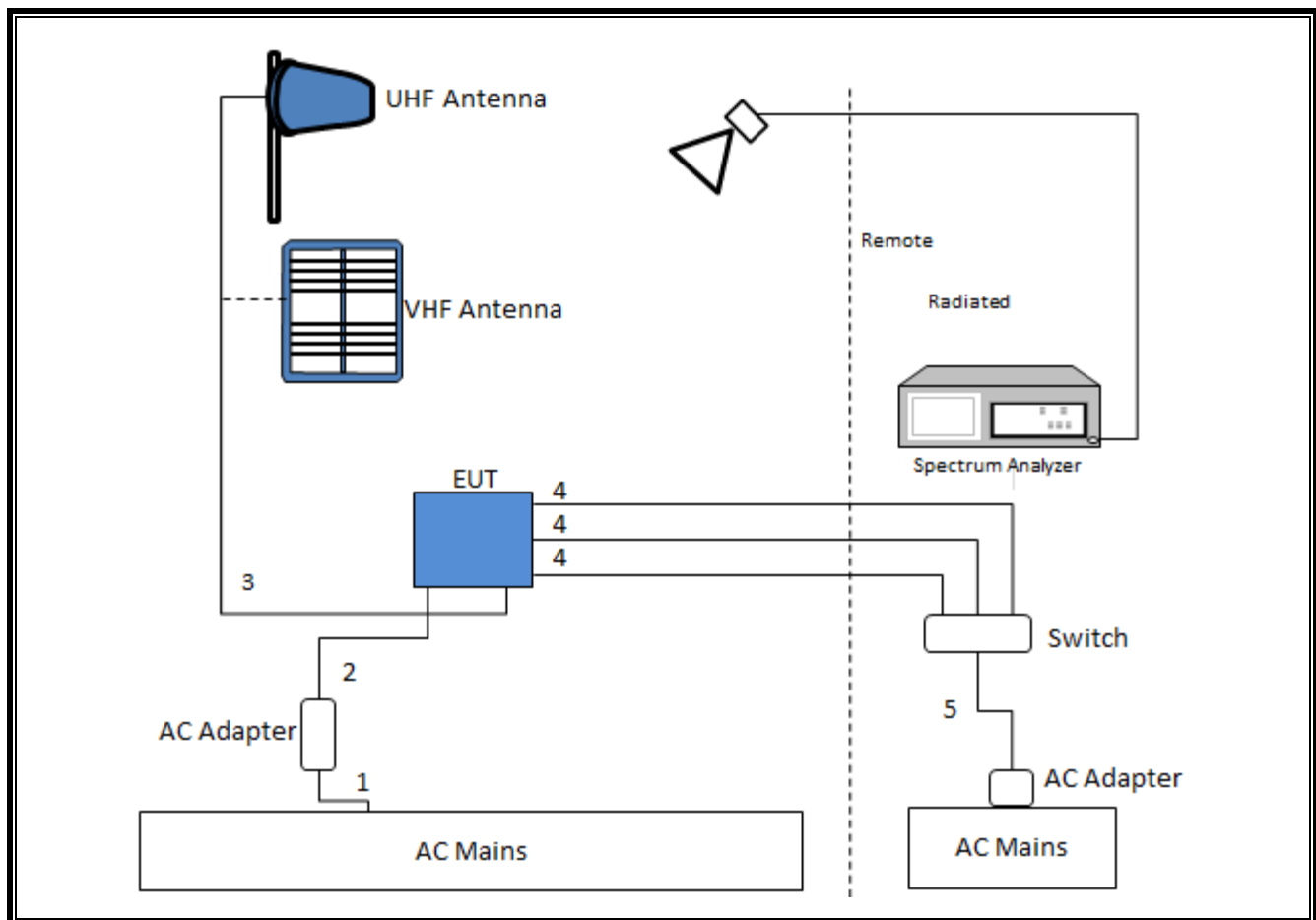
The USB ports are considered by the manufacturer as service and maintenance ports.

Refer to the following diagram.

SETUP DIAGRAM FOR LINE CONDUCTED TESTS



SETUP DIAGRAM FOR RADIATED TESTS



6. APPLICABLE EMISSIONS LIMITS AND TEST RESULTS

6.1. EMISSIONS TEST AND MEASUREMENT EQUIPMENT

Radiated Emissions

Test Equipment List					
Description	Manufacturer	Model	Local ID (T No.)	Cal Date	Cal Due
Antenna, Biconolog, 30MHz-1 GHz	Sunol Sciences	JB3	T477	06/22/16	06/22/17
RF Preamplifier, 10kHz - 1GHz	HP	8447D	T10	02/15/17	02/15/18
Spectrum Analyzer	Keysight	N9030A	T907	01/23/17	01/23/18
Antenna, Biconolog, 30MHz-1 GHz	Sunol Sciences	JB1	T408	11/10/16	11/10/17
RF Preamplifier, 10kHz - 1GHz	Sonoma	310N	T15	08/26/16	08/26/17
Spectrum Analyzer	Keysight	N9030A	T905	01/11/17	01/11/18
Radiated Software	UL	UL EMC	Ver 9.5, December 01, 2016		

Line Conducted Emissions

Test Equipment List					
Description	Manufacturer	Model	Local ID (T No.)	Cal Date	Cal Due
EMI Receiver	Rohde & Schwarz	ESR	T1436	01/06/17	01/06/18
LISN	Fischer Custom Communications	FCC-LISN-50/250-25-2-01	T1310	06/08/16	06/08/17
Conducted Software	UL	UL EMC	Ver 9.5, May 26 2015		

6.2. RADIATED EMISSIONS LIMITS AND RESULTS

LIMIT

FCC Part 15 Subpart B Class B

Class B Limits below 1 GHz

Limits for radiated disturbance of Class B ITE at measuring distance of 3m	
Frequency range (MHz)	Quasi-peak limits (dB μ V/m)
30 to 88	40
88 to 216	43.5
216 to 960	46
Note: The lower limit shall apply at the transition frequency.	

Class B Limits above 1 GHz

Limits for radiated disturbance of Class B ITE at measuring distance of 3m		
Frequency range (MHz)	Average limit (dB μ V/m)	Peak limit (dB μ V/m)
Above 1000	54	74

TEST PROCEDURE

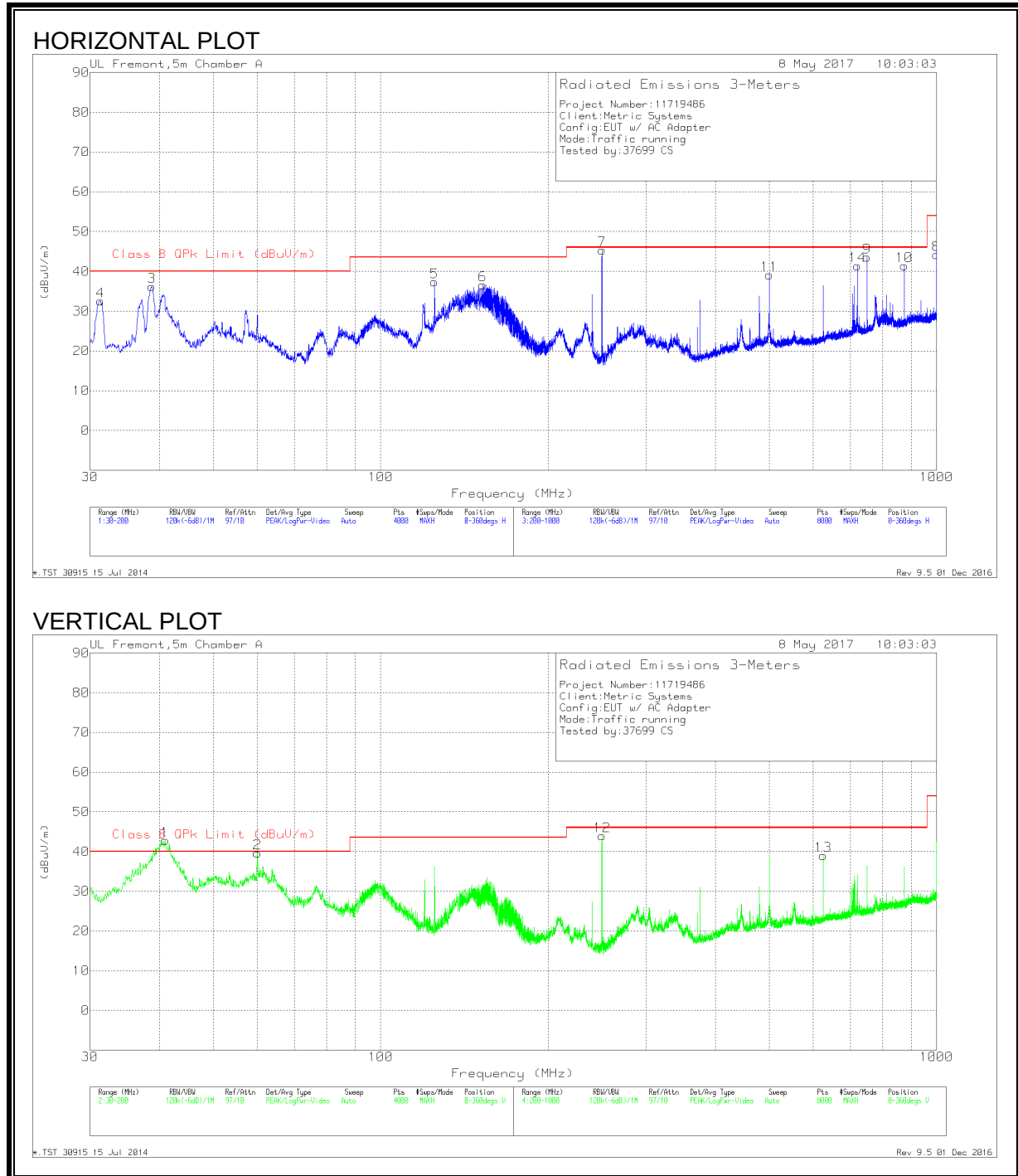
ANSI C63.4

The highest clock frequency generated or used in the EUT was 695MHz. The frequency range was investigated from 30 MHz to 7 GHz

Highest frequency generated or used in the device or on which the device operates or tunes (MHz)	Upper frequency of measurement range (MHz)
Below 108	1000
108-500	2000
500-1000	5000
Above 1000	5 th harmonic of the highest frequency or 40 GHz, whichever is lower for FCC

6.2.1. RESULTS FOR VHF CONFIGURATION

3 m RADIATED EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION)



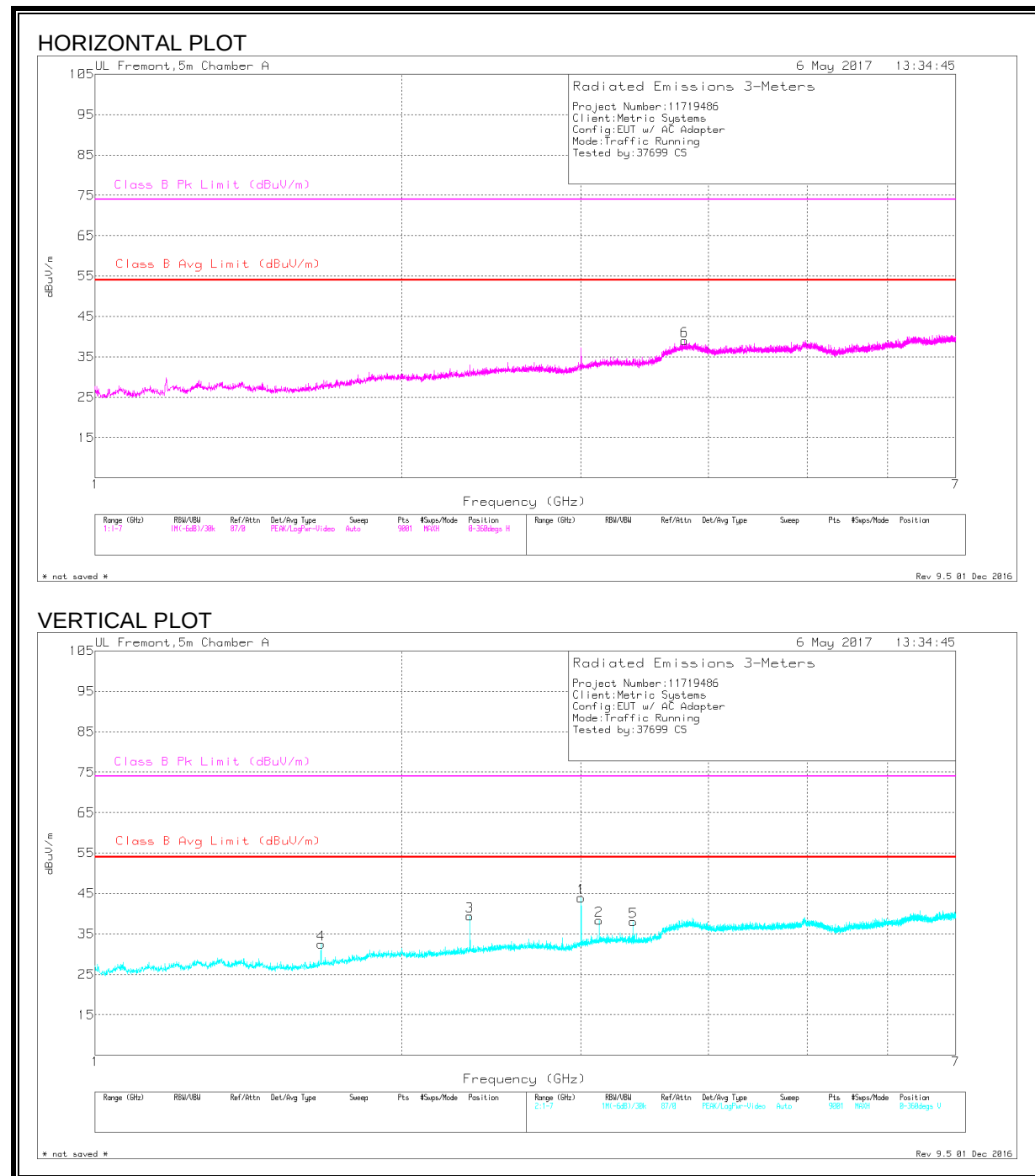
3 m WORST CASE EMISSIONS – DATA FOR 30 TO 1000 MHz

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T130 (dB/m)	Amp/Cbl (dB/m)	Corrected Reading (dBuV/m)	Class B QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
3	38.9075	36.73	Qp	18.8	-31.1	24.43	40	-15.57	151	375	H
1	40.5928	52.77	Qp	17.6	-31.1	39.27	40	-.73	244	107	V
2	59.997	57.5	Qp	11.6	-30.9	38.2	40	-1.8	279	110	V
12	250.0046	56.54	Qp	15.5	-29.6	42.44	46.02	-3.58	66	225	V
7	250.0185	58.24	Qp	15.5	-29.6	44.14	46.02	-1.88	314	102	H
14	720.0089	41.32	Qp	24.5	-28.2	37.62	46.02	-8.4	26	103	H
9	750.0233	45.47	Qp	24.8	-28.3	41.97	46.02	-4.05	32	112	H
10	875.0002	42.29	Qp	25.9	-27.5	40.69	46.02	-5.33	146	102	H
8	999.9802	44.13	Qp	27.4	-26.5	45.03	53.97	-8.94	26	208	H
4	31.3178	40.66	Pk	23.1	-31.2	32.56	40	-7.44	0-360	400	H
5	125.0121	49.87	Pk	17.9	-30.4	37.37	43.52	-6.15	0-360	200	H
6	152.5167	50.45	Pk	16.4	-30.2	36.65	43.52	-6.87	0-360	200	H
11	500.039	46.14	Pk	21.7	-28.7	39.14	46.02	-6.88	0-360	200	H
13	624.9552	44.05	Pk	23.4	-28.5	38.95	46.02	-7.07	0-360	101	V

Qp - Quasi-Peak detector

Pk - Peak detector

3 m RADIATED EMISSIONS 1 TO 7 GHz (WORST-CASE CONFIGURATION)



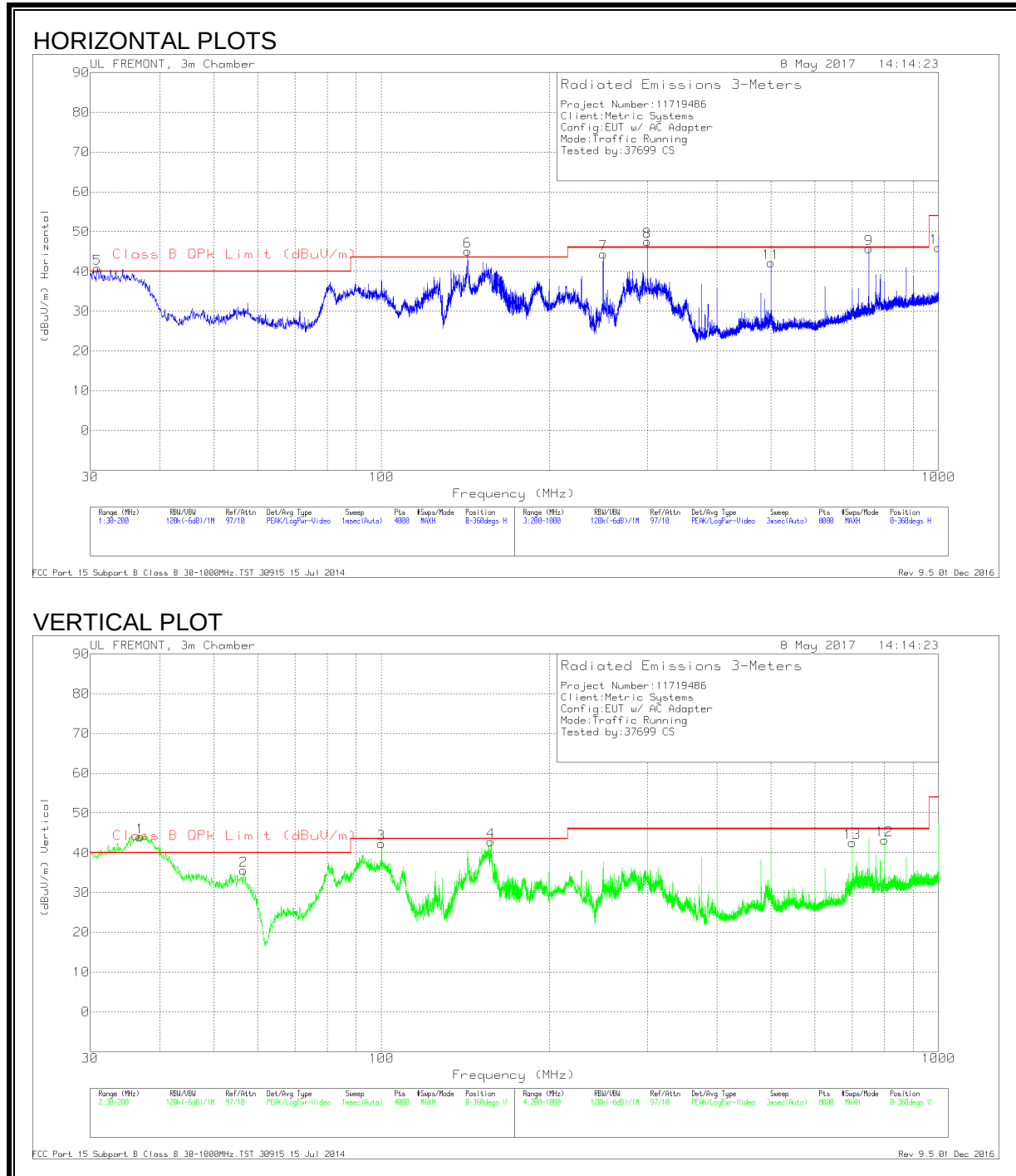
3 m WORST CASE EMISSIONS – DATA FOR 1 TO 7GHz

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T711 (dB/m)	Amp/Cbl/Fitr/Pad (dB)	Corrected Reading dBuV/m	Class B Avg Limit (dBuV/m)	Av Margin (dB)	Class B Pk Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	1.667	34.8	Pk	28.9	-23.7	40	-	-	74	-34	303	126	V
	1.667	30.27	Av	28.9	-23.7	35.47	54	-18.53	-	-	303	126	V
2	2.333	37.14	Pk	32	-23.8	45.34	-	-	74	-28.66	131	276	V
	2.333	33.55	Av	32	-23.8	41.75	54	-12.25	-	-	131	276	V
3	3	36.49	Pk	32.7	-22.1	47.09	-	-	74	-26.91	97	213	V
	3	31.8	Av	32.7	-22.1	42.4	54	-11.6	-	-	97	213	V
4	3.125	33.61	Pk	33	-21.4	45.21	-	-	74	-28.79	104	195	V
	3.125	24.4	Av	33	-21.4	36	54	-18	-	-	104	195	V
5	3.375	30.05	Pk	32.8	-20.3	42.55	-	-	74	-31.45	99	115	V
	3.375	22.18	Av	32.8	-20.3	34.68	54	-19.32	-	-	99	115	V
6	3.825	28.46	Pk	33.2	-18	43.66	-	-	74	-30.34	234	242	H
	3.825	18.21	Av	33.2	-18	33.41	54	-20.59	-	-	234	242	H

Pk - Peak detector
Av - Average detection

6.2.2. RESULTS FOR UHF CONFIGURATION

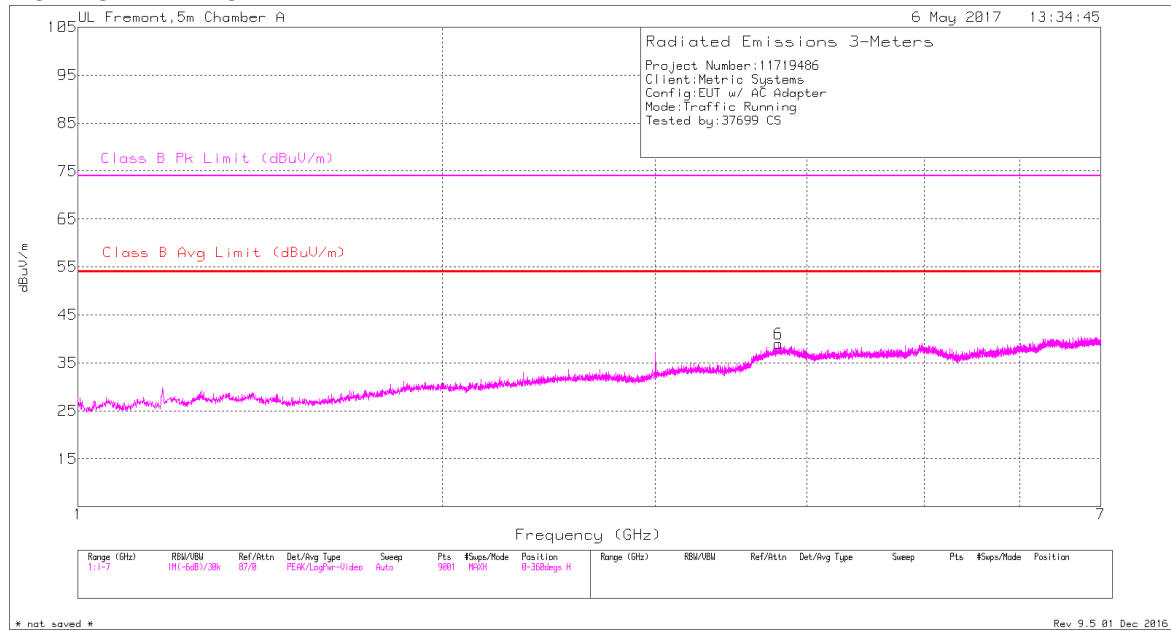
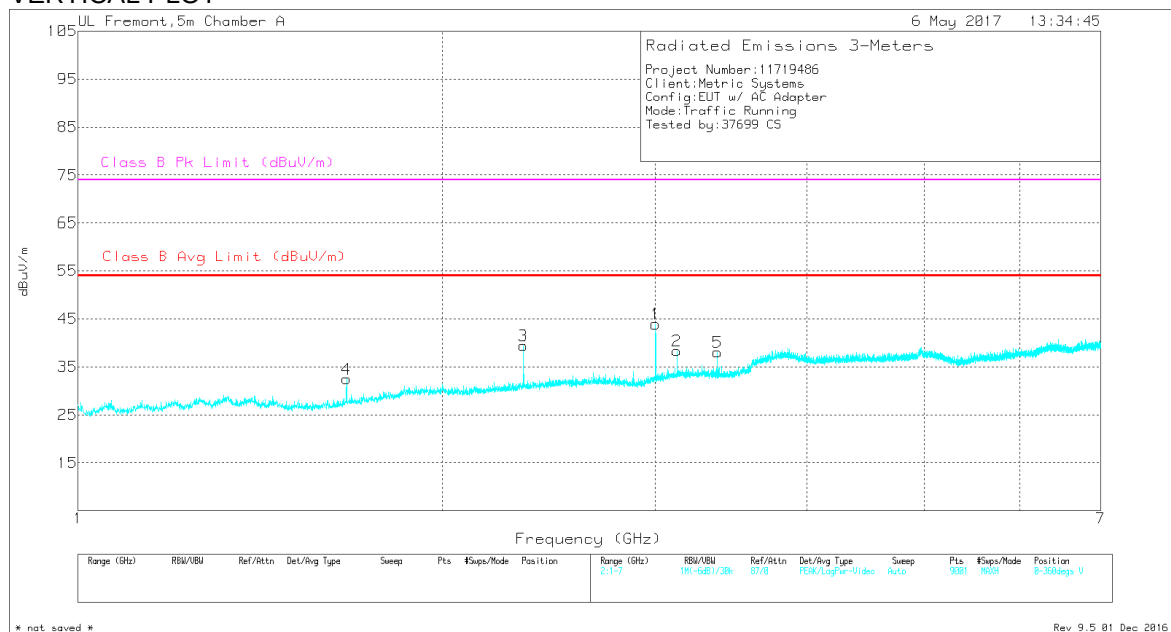
3 m RADIATED EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION)



3 m WORST CASE EMISSIONS – DATA FOR 30 TO 1000 MHz

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T408 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	Class B QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
5	31.67	21.86	Qp	24.1	-27.2	18.76	40	-21.24	81	209	H
1	36.7843	39.16	Qp	20.4	-27.2	32.36	40	-7.64	5	249	V
2	56.3822	49.54	Qp	11.1	-26.9	33.74	40	-6.26	124	163	V
3	100.0233	46.97	Qp	14.2	-26.3	34.87	43.52	-8.65	216	108	V
6	142.8446	41.73	Qp	16.9	-25.8	32.83	43.52	-10.69	5	272	H
4	157.4589	43.53	Qp	16.4	-25.6	34.33	43.52	-9.19	345	143	V
7	250.0108	50.45	Qp	15.4	-24.5	41.35	46.02	-4.67	240	105	H
8	300.0332	47.45	Qp	17.3	-24.2	40.55	46.02	-5.47	178	103	H
11	500.014	44.59	Qp	21.6	-24.6	41.59	46.02	-4.43	355	179	H
13	700.0295	37.95	Qp	24.1	-23.7	38.35	46.02	-7.67	307	130	V
9	750.0214	43.82	Qp	24.6	-23.3	45.12	46.02	-.9	260	184	H
12	800.0236	35.55	Qp	25.1	-22.9	37.75	46.02	-8.27	335	127	V
10	999.904	39.95	Pk	27.4	-21.4	45.95	53.97	-8.02	0-360	101	H

Qp - Quasi-Peak detector
Pk - Peak detector

3 m RADIATED EMISSIONS 1 TO 7 GHz (WORST-CASE CONFIGURATION)**HORIZONTAL PLOT****VERTICAL PLOT**

3 m WORST CASE EMISSIONS – DATA FOR 1 TO 7GHz

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T711 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	Corrected Reading dBuV/m	Class B Avg Limit (dBuV/m)	Av Margin (dB)	Class B Pk Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
4	1.667	33.87	Pk	28.9	-23.7	39.07	-	-	74	-34.93	20	201	V
	1.667	24.6	Av	28.9	-23.7	29.8	54	-24.2	-	-	20	201	V
3	2.333	35.33	Pk	32	-23.8	43.53	-	-	74	-30.47	123	184	V
	2.333	27.92	Av	32	-23.8	36.12	54	-17.88	-	-	123	184	V
1	3	36.72	Pk	32.7	-22.1	47.32	-	-	74	-26.68	86	209	V
	3	33.23	Av	32.7	-22.1	43.83	54	-10.17	-	-	86	209	V
2	3.125	30.7	Pk	33	-21.4	42.3	-	-	74	-31.7	98	339	V
	3.125	22.63	Av	33	-21.4	34.23	54	-19.77	-	-	98	339	V
5	3.375	31.53	Pk	32.8	-20.3	44.03	-	-	74	-29.97	98	210	V
	3.375	24.14	Av	32.8	-20.3	36.64	54	-17.36	-	-	98	210	V
6	3.79	28.32	Pk	33.1	-18.1	43.32	-	-	74	-30.68	120	158	H
	3.79	18.18	Av	33.1	-18.1	33.18	54	-20.82	-	-	120	158	H

Pk - Peak detector
Av - Average detection

6.3. AC MAINS LINE CONDUCTED EMISSIONS

LIMITS

FCC Part 15 Subpart B Class B

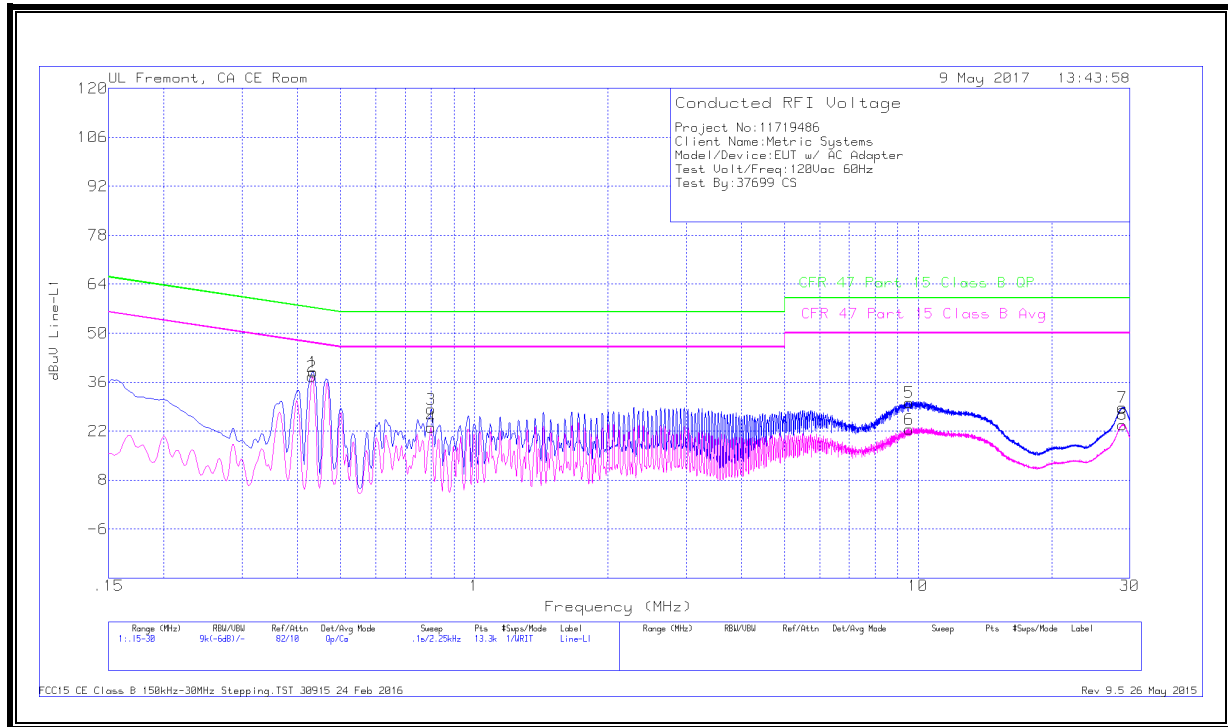
Frequency range (MHz)	Limits (dB μ V)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50
Notes: 1. The lower limit shall apply at the transition frequencies 2. The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.		

TEST PROCEDURE

ANSI C63.4

6.3.1. RESULTS VHF CONFIGURATION

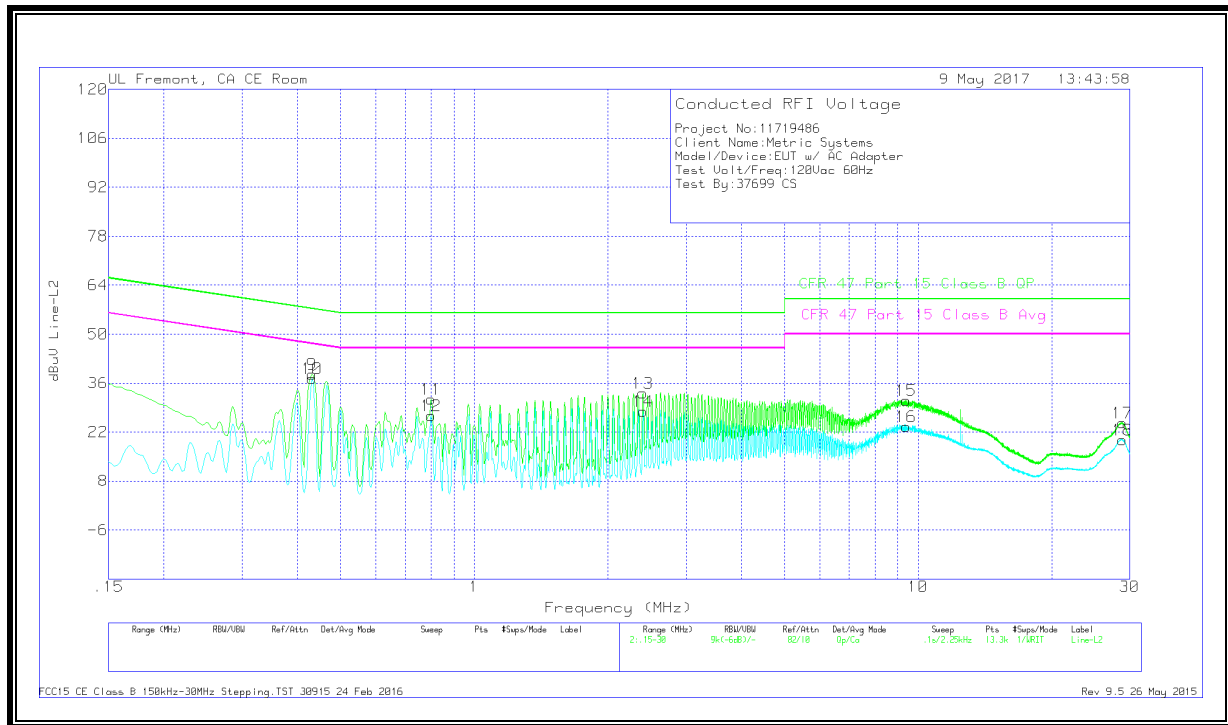
LINE 1 RESULTS – 120 V, 60 Hz



Range 1: Line-L1 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L1	LC Cables C1&C3	Limiter (dB)	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR) Margin (dB)
1	.4335	28.61	Qp	0	.1	10.1	38.81	57.19	-18.38	-	-
2	.43125	27.48	Ca	0	.1	10.1	37.68	-	-	47.23	-9.55
3	.80025	18.15	Qp	0	.1	10.1	28.35	56	-27.65	-	-
4	.80025	12.82	Ca	0	.1	10.1	23.02	-	-	46	-22.98
5	9.5595	19.77	Qp	0	.2	10.2	30.17	60	-29.83	-	-
6	9.56175	12.21	Ca	0	.2	10.2	22.61	-	-	50	-27.39
7	28.85888	17.87	Qp	.1	.3	10.5	28.77	60	-31.23	-	-
8	28.85888	12.94	Ca	.1	.3	10.5	23.84	-	-	50	-26.16

Qp - Quasi-Peak detector
Ca - CISPR average detection

LINE 2 RESULTS – 120 V, 60 Hz

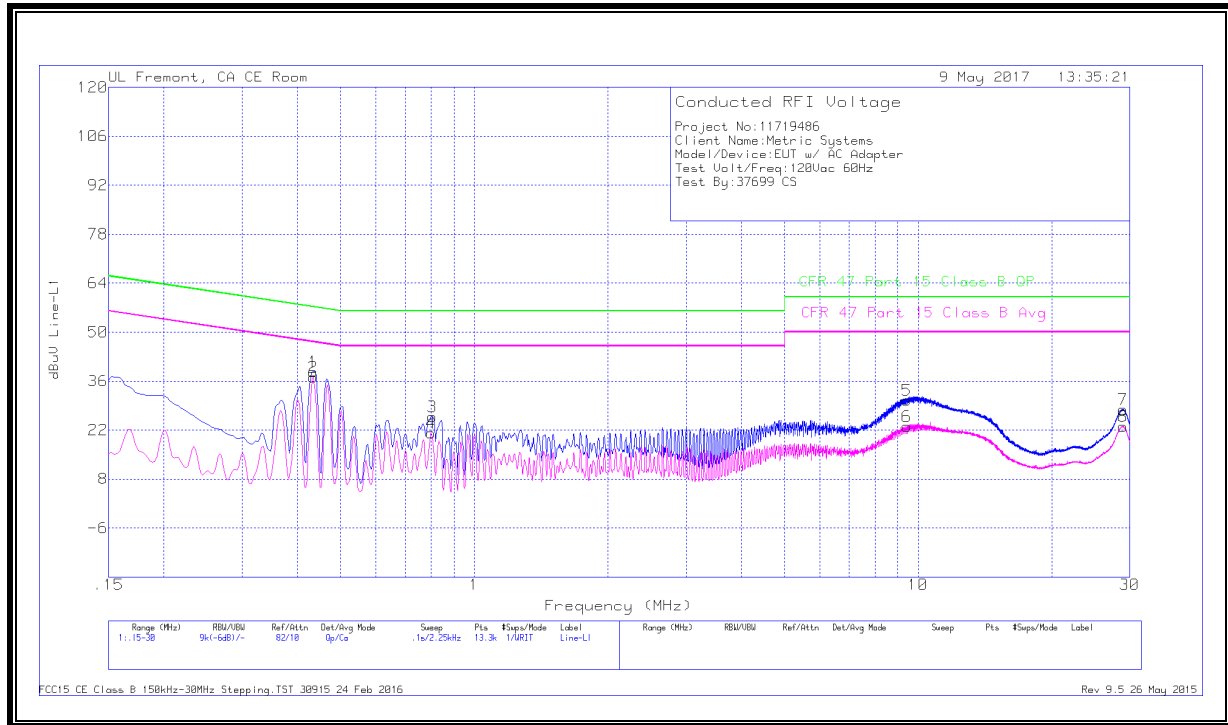


Range 2: Line-L2 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L2	LC Cables C2&C3	Limiter (dB)	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR) Margin (dB)
9	.43125	28.32	Qp	0	.1	10.1	38.52	57.23	-18.71	-	-
10	.43125	27.13	Ca	0	.1	10.1	37.33	-	-	47.23	-9.9
11	.80025	21.27	Qp	0	.1	10.1	31.47	56	-24.53	-	-
12	.80025	16.51	Ca	0	.1	10.1	26.71	-	-	46	-19.29
13	2.39775	22.98	Qp	0	.1	10.1	33.18	56	-22.82	-	-
14	2.40225	17.8	Ca	0	.1	10.1	28	-	-	46	-18
15	9.4065	20.61	Qp	0	.2	10.2	31.01	60	-28.99	-	-
16	9.402	13.11	Ca	0	.2	10.2	23.51	-	-	50	-26.49
17	28.8825	13.65	Qp	.1	.3	10.5	24.55	60	-35.45	-	-
18	28.8825	8.91	Ca	.1	.3	10.5	19.81	-	-	50	-30.19

Qp - Quasi-Peak detector
Ca - CISPR average detection

6.3.2. RESULTS UHF CONFIGURATION

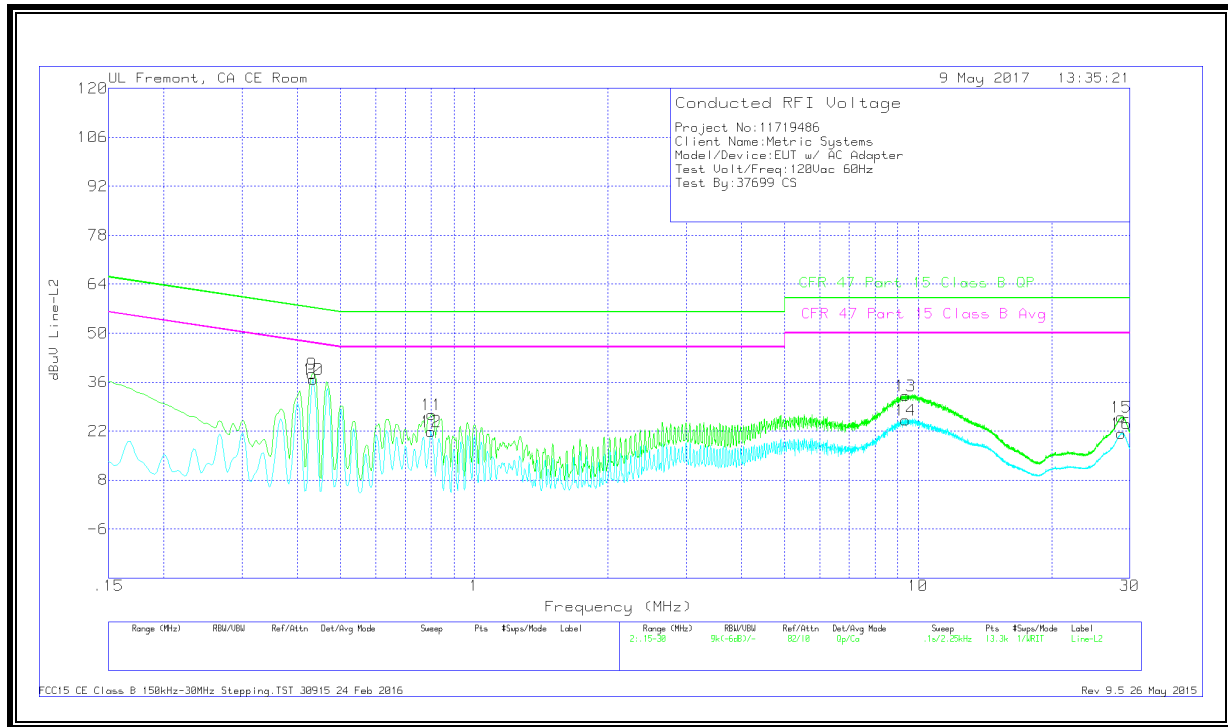
LINE 1 RESULTS – 120 V, 60 Hz



Range 1: Line-L1 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L1	LC Cables C1&C3	Limiter (dB)	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR)Margin (dB)
1	.4335	28.57	Qp	0	.1	10.1	38.77	57.19	-18.42	-	-
2	.4335	26.97	Ca	0	.1	10.1	37.17	-	-	47.19	-10.02
3	.80362	15.69	Qp	0	.1	10.1	25.89	56	-30.11	-	-
4	.80025	10.92	Ca	0	.1	10.1	21.12	-	-	46	-24.88
5	9.42	20.17	Qp	0	.2	10.2	30.57	60	-29.43	-	-
6	9.42225	12.68	Ca	0	.2	10.2	23.08	-	-	50	-26.92
7	28.9635	17.08	Qp	.1	.3	10.5	27.98	60	-32.02	-	-
8	28.9635	12.1	Ca	.1	.3	10.5	23	-	-	50	-27

Qp - Quasi-Peak detector
Ca - CISPR average detection

LINE 2 RESULTS – 120 V, 60 Hz



Range 2: Line-L2 .15 - 30MHz												
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L2	LC Cables C2&C3	Limiter (dB)	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR) Margin (dB)	
9	.43125	28.23	Qp	0	.1	10.1	38.43	57.23	-18.8	-	-	
10	.4335	26.62	Ca	0	.1	10.1	36.82	-	-	47.19	-10.37	
11	.8025	16.51	Qp	0	.1	10.1	26.71	56	-29.29	-	-	
12	.80025	11.72	Ca	0	.1	10.1	21.92	-	-	46	-24.08	
13	9.3705	21.72	Qp	0	.2	10.2	32.12	60	-27.88	-	-	
14	9.3705	14.72	Ca	0	.2	10.2	25.12	-	-	50	-24.88	
15	28.70025	15.11	Qp	.1	.3	10.5	26.01	60	-33.99	-	-	
16	28.70025	10.36	Ca	.1	.3	10.5	21.26	-	-	50	-28.74	

Qp - Quasi-Peak detector
Ca - CISPR average detection