



CERTIFICATION TEST REPORT

Report Number : 11719486-E1V2

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 H

Date of Issue:
September 12, 2017

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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
V1	07/11/17	Initial release	---
V2	9/12/17	Updated antenna gain in Section 6.3, 9.1, 9.2, and 9.3	C. Susa

TABLE OF CONTENTS

1. ATTESTATION OF TEST RESULTS	5
2. SCOPE.....	6
3. TEST METHODOLOGY	6
4. FACILITIES AND ACCREDITATION	6
5. CALIBRATION AND UNCERTAINTY	7
5.1. MEASURING INSTRUMENT CALIBRATION.....	7
5.2. SAMPLE CALCULATION.....	7
5.3. MEASUREMENT UNCERTAINTY	7
6. EQUIPMENT UNDER TEST.....	8
6.1. DESCRIPTION OF EUT	8
6.2. MAXIMUM OUTPUT POWER	8
6.3. DESCRIPTION OF AVAILABLE ANTENNAS.....	8
6.4. SOFTWARE AND FIRMWARE	8
6.5. WORST-CASE CONFIGURATION AND MODE.....	9
6.6. DESCRIPTION OF TEST SETUP	10
7. TEST AND MEASUREMENT EQUIPMENT.....	14
8. MEASUREMENT METHODS.....	15
9. ANTENNA PORT TEST RESULTS.....	16
9.1. OUTPUT POWER AND POWER SPECTRAL DENSITY.....	16
9.1.1. UHF BAND	17
9.1.2. VHF BAND	20
9.2. BAND-EDGE	23
9.2.1. UHF BAND.....	24
9.2.2. VHF BAND	28
9.3. ADJACENT CHANNEL EMISSIONS.....	32
9.3.1. UHF BAND	33
9.3.2. VHF BAND	37
10. RADIATED EMISSIONS.....	41
10.1. TRANSMITTER BELOW 1GHz.....	42
10.1.1. UHF BAND	42
10.1.2. VHF BAND.....	48
10.2. TRANSMITTER ABOVE 1GHz	54
10.2.1. HARMONICS AND SPURIOUS EMISSIONS IN THE UHF BAND	54
10.2.2. HARMONICS AND SPURIOUS EMISSIONS IN THE VHF BAND	60

10.3.	RECEIVER SPURIOUS EMISSIONS BELOW 1 GHz.....	66
10.3.1.	UHF BAND	66
10.3.2.	VHF BAND.....	68
10.4.	RECEIVER SPURIOUS EMISSIONS ABOVE 1 GHz	70
10.4.1.	UHF BAND	70
10.4.2.	VHF BAND.....	72
10.5.	WORST-CASE TRANSMITTER BELOW 30MHz.....	74
10.6.	WORST-CASE RECEIVER BELOW 30MHz.....	76
11.	AC MAINS LINE CONDUCTED EMISSIONS	78
11.1.	UHF MODE.....	79
11.1.1.	LINE 1 RESULTS	79
11.1.2.	LINE 2 RESULTS	80
11.2.	VHF MODE.....	81
11.2.1.	LINE 1 RESULTS	81
11.2.2.	LINE 2 RESULTS	82
12.	FIXED BASE STATION DATABASE CERTIFICATION TESTS.....	83
12.1.	Fixed WSD Registration.....	83
12.1.1.	SUCCESSFUL REGISTRATION	84
12.1.2.	FAILED REGISTRATION – Location Coordinates	87
12.1.3.	FAILED REGISTRATION – ANTENNA HEIGHT AGL.....	88
12.1.4.	FAILED REGISTRATION –CONTACT INFORMATION.....	89
12.2.	FIXED WSD CHANNELS OF OPERATION.....	90
12.3.	FIXED TVDB DATABASE UPDATE.....	92
12.4.	48 HOUR CHANNEL SCHEDULING	95
12.4.1.	RESULTS FOR BASE	96
12.4.2.	RESULTS FOR CLIENT	98
12.5.	WSD CHANNEL AVAILABILITY	100
12.6.	SECURITY.....	102
12.7.	Push notification to Fixed	104
12.7.1.	RESULTS FOR BASE	105
12.7.1.	RESULTS FOR CLIENT	107
12.8.	Location accuracy.....	109
12.9.	Interference protection requirement	110
12.10.	Fixed Power level reduction	117
13.	SETUP PHOTOS.....	119

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)

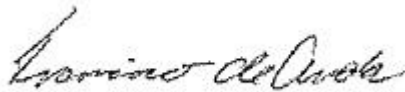
DATE TESTED: May 3rd, 2017 – May 10th 2017

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
FCC PART 15 SUBPART H	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, any agency of the Federal Government, or any agency of the U.S. government.

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2. SCOPE

This report documents the results of RF, emissions and database tests. This report will demonstrate compliance to the applicable rules in Part 15 Subpart H – White Space Devices.

3. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 15 Subpart H, KDB 416721 D01 v03, and ANSI C63.10-2013.

4. 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.

5. CALIBRATION AND UNCERTAINTY

5.1. 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.

5.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

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

5.3. MEASUREMENT UNCERTAINTY

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

Parameter	Uncertainty
Worst Case Conducted Disturbance, 9KHz to 0.15 MHz	3.84 dB
Worst Case Conducted Disturbance, 0.15 to 30 MHz	3.65 dB
Worst Case Radiated Disturbance, 9KHz to 30 MHz	3.15 dB
Worst Case Radiated Disturbance, 30 to 1000 MHz	5.36 dB
Worst Case Radiated Disturbance, 1000 to 18000 MHz	4.32 dB
Worst Case Radiated Disturbance, 18000 to 26000 MHz	4.45 dB
Worst Case Radiated Disturbance, 26000 to 40000 MHz	5.24 dB

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

6. EQUIPMENT UNDER TEST

6.1. 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.

6.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum conducted output power as follows;

BAND	Frequency Range (MHz)	Output Power (dBm)	Output Power (mW)
UHF	470 -698	5.93	3.92
VHF	174 -216	6.83	4.82

The transmitter has a maximum E.I.R.P as follows;

BAND	Frequency Range (MHz)	Output Power (dBm)	Output Power (mW)
UHF	470 -698	12.08	16.14
VHF	174 -216	12.48	17.70

6.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio can be configured with the following antenna types, and highest gain for each type:

Type	Band	Antenna Spec. Gain	Attenuation	*Total Gain
TV Panel Antenna	VHF	9.65dBi	4dB	5.65 dBi
Log-Periodic	UHF	10.15dBi	4dB	6.15 dBi

*Please note 4dB of attenuation is added to the antenna spec to lower the total gain of the antenna

6.4. SOFTWARE AND FIRMWARE

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

6.5. WORST-CASE CONFIGURATION AND MODE

For below 30MHz radiated emissions and power line conducted emissions were performed with the EUT set to transmit at the channel with the highest power and worst-case data rate as worst-case scenario.

Preliminary baseline tests were performed to determine worst case data rate. The worst case data rate was determined to be QPSK.

All final radiated testing was performed with the EUT in the X (Flatbed) orientation.

6.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List			
Description	Manufacturer	Model	Serial Number
EUT AC Adapter	Cincon Eletrconics	TRH100A280	100280-000607
Laptop #1	Apple	MacBook Pro	2012
Router	Netgear	P030WF120B	3113062131020003T9

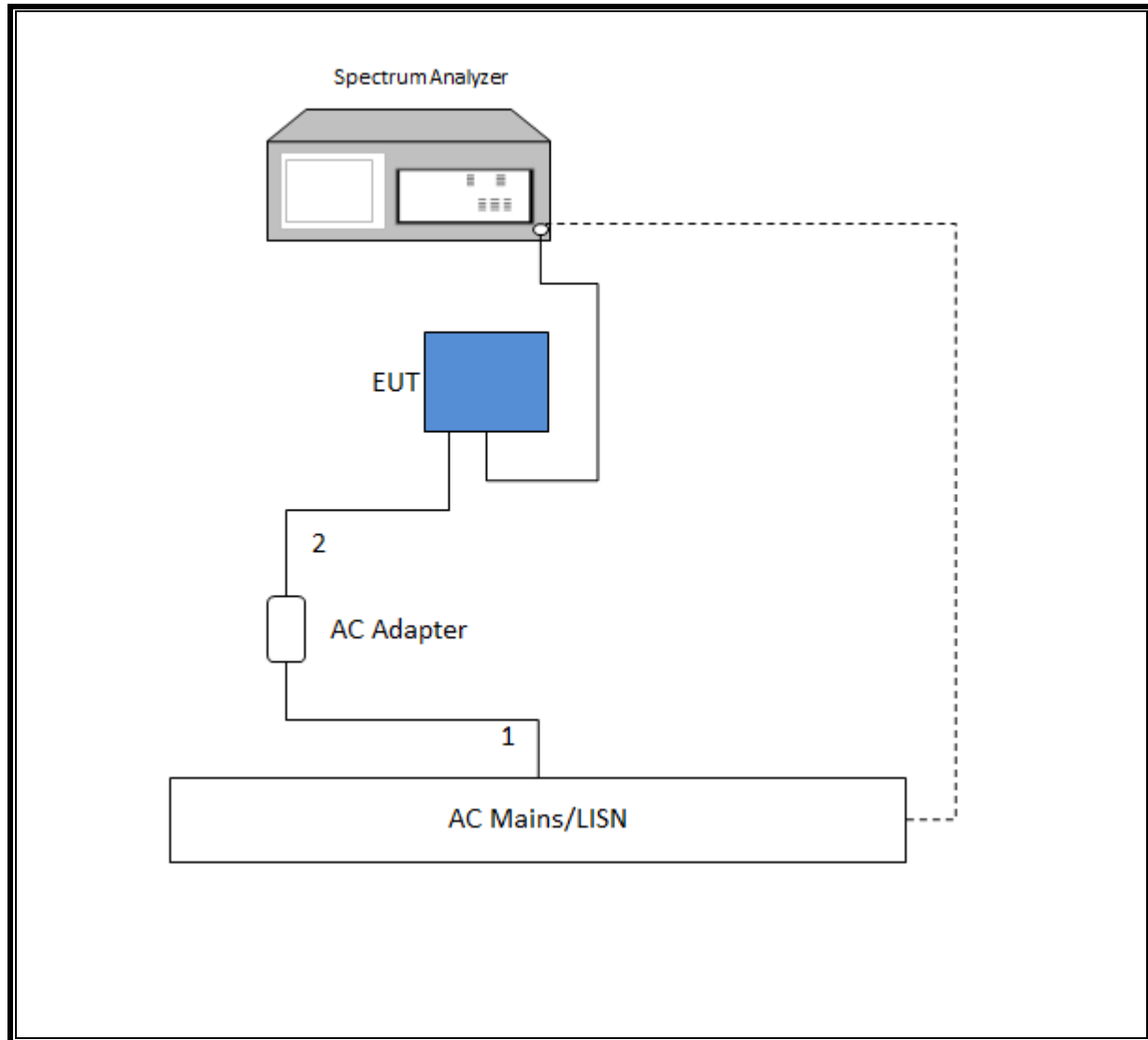
I/O CABLES

I/O CABLE LIST						
Cable No.	Port	No. 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	

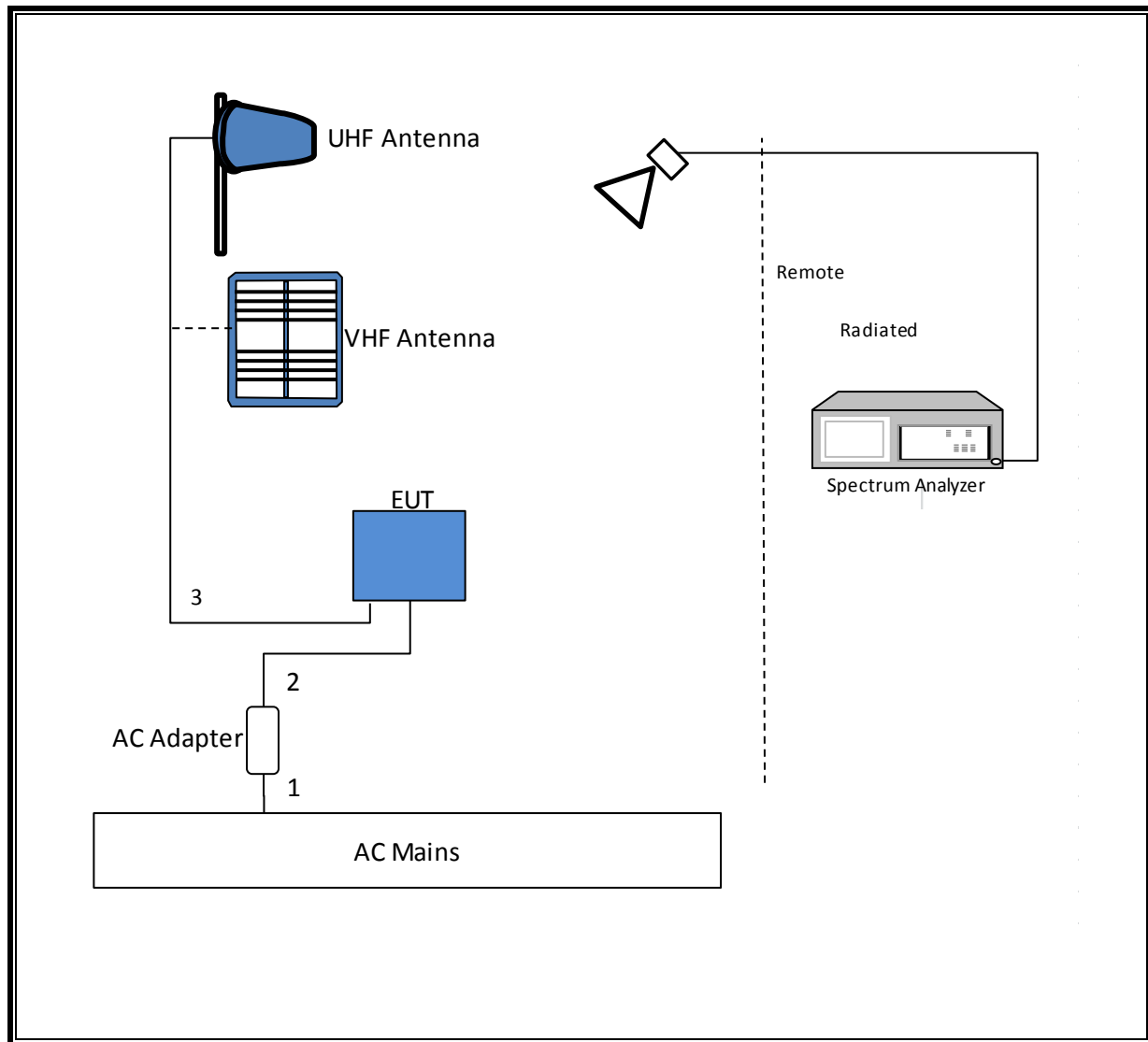
TEST SETUP

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

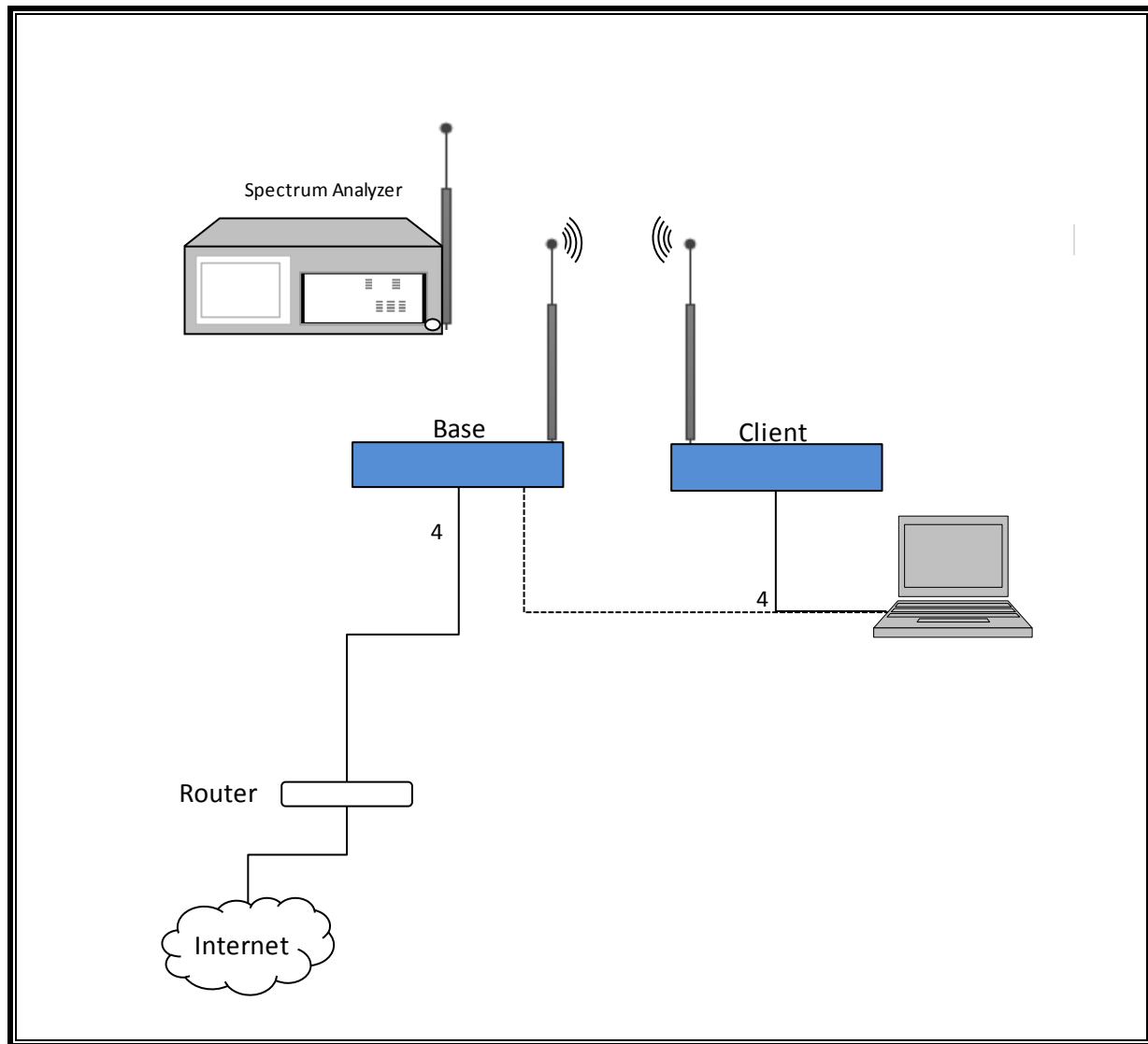
SETUP DIAGRAM FOR ANTENNA PORT AND AC LINE CONDUCTED TESTS



SETUP DIAGRAM FOR RADIATED TESTS



SETUP DIAGRAM FOR DATABASE TESTS



7. TEST AND MEASUREMENT EQUIPMENT

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

Description	TEST EQUIPMENT LIST				
	Manufacturer	Model	Asset	Cal Date	Cal Due
Antenna, Biconolog, 30MHz-1 GHz	Sunol Sciences	JB3	T477	06/22/16	06/22/17
Antenna, Horn, 1-18GHz	ETS Lindgren	3117	T346	03/28/17	03/28/18
RF Preamplifier, 10kHz - 1GHz	HP	8447D	T10	02/15/17	02/15/18
RF Preamplifier, 1 - 8GHz	Miteq	AMF-4D-01000800-30-29P	T1156	02/15/17	02/15/18
Spectrum Analyzer	Keysight	N9030A	T907	01/23/17	01/23/18
Antenna, Active Loop 9KHz to 30MHz	ETS-Lindgren	6502	T1683	02/17/17	02/17/18
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
Filter HPF, 250-1000MHz	EWT Products	EWT-57-0248	T1120	05/03/17	05/03/18
Filter, Notch, 473MHz	EWT Products	EWT-14-0337	T242	04/27/17	04/27/18
Filter, Notch, 587MHz	EWT Products	EWT-14-0338	T239	04/27/17	04/27/18
Filter, Notch, 695MHz	EWT Products	EWT-14-0339	T238	04/27/17	04/27/18
Filter, Notch, 177MHz	EWT Products	EWT-14-0500	T1117	04/27/17	04/27/18
Filter, Notch, 195MHz	EWT Products	EWT-14-0501	T1118	04/27/17	04/27/18
Filter, Notch, 213MHz	EWT Products	EWT-14-0502	T1119	04/27/17	04/27/18
Radiated Software	UL	UL EMC	Ver 9.5, December 01, 2016		

8. MEASUREMENT METHODS

Output Power & Power Spectral Density (Fixed WSD): KDB 416721 D01 v03 Section II, (2)(c)(i).

Band-Edge Measurement: KDB 416721 D01 v03 Section II (2)(d)(i)

Adjacent Channel Emissions: KDB 416721 D01 v03 Section II (2)(d)(ii)

Beyond Adjacent Channel Emissions: ANSI C63.10, Section 6.5 and 6.6.

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

9. ANTENNA PORT TEST RESULTS

9.1. OUTPUT POWER AND POWER SPECTRAL DENSITY

LIMITS

§15.709 (b)(1) Fixed White Space Device

For operation at EIRP levels of 36 dBm (4000 mW) or less, fixed white space devices may operate at EIRP levels between the values shown in the table provided that the conducted power and the conducted power spectral density (PSD) limits are linearly interpolated between the values shown and the adjacent channel emission limit of the higher value shown in the table is met. Operation at EIRP levels above 36 dBm (4000 mW) shall follow the requirements for 40 dBm (10,000 mW).

EIRP (6 MHz)	Conducted power limit ¹ (6 MHz)	Conducted PSD limit (100 kHz)	Conducted adjacent channel emission limit (100 kHz)
16 dBm (40 mW)	10 dBm (10 mW)	-7.4 dBm	-62.8 dBm
20 dBm (100 mW)	14 dBm (25 mW)	-3.4 dBm	-58.8 dBm
24 dBm (250 mW)	18 dBm (63 mW)	0.6 dBm	-54.8 dBm
28 dBm (625 mW)	22 dBm (158 mW)	4.6 dBm	-50.8 dBm
32 dBm (1600 mW)	26 dBm (400 mW)	8.6 dBm	-46.8 dBm
36 dBm (4000 mW)	30 dBm (1000 mW)	12.6 dBm	-42.8 dBm
40 dBm (10000 mW)	30 dBm (1000 mW)	12.6 dBm	-42.8 dBm

¹The conducted power spectral density from a fixed white space device shall not be greater than the values shown in the table when measured in any 100 kHz band during any time interval of continuous transmission, except that a 40 mW fixed white space device operating in a four megahertz channel within a seven megahertz guard band must comply with a conducted power spectral density limit of -5.4 dBm.

The conducted power, PSD and adjacent channel limits for fixed white space devices operating at up to 36 dBm (4000 milliwatts) EIRP shown in the table in paragraph (b)(1) of this section are based on a maximum transmitting antenna gain of 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The conducted power, PSD and adjacent channel limits for fixed white space devices operating at greater than 36 dBm (4000 milliwatts) EIRP shown in the table in paragraph (b)(1) of this section are based on a maximum transmitting antenna gain of 10 dBi. If transmitting antennas of directional gain greater than 10 dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 10 dBi.

DIRECTIONAL ANTENNA GAIN

There is only one transmitter output therefore the directional gain is equal to the antenna gain.

RESULTS

9.1.1. UHF BAND

Tested By:	5/3/17
Test Date:	37699 CS

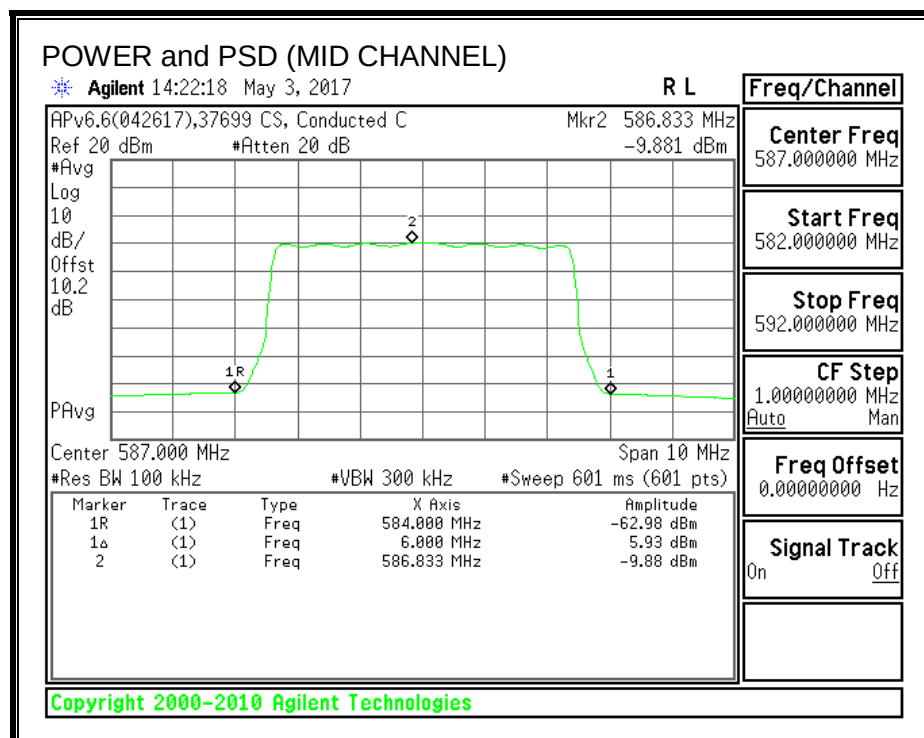
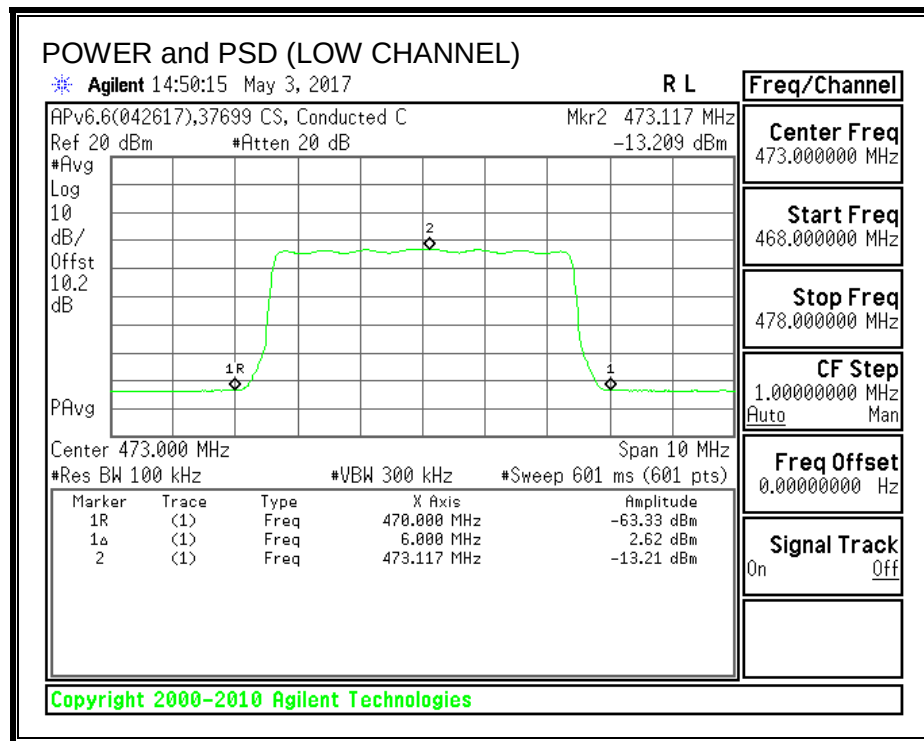
Antenna Gain (dBi)	6.15
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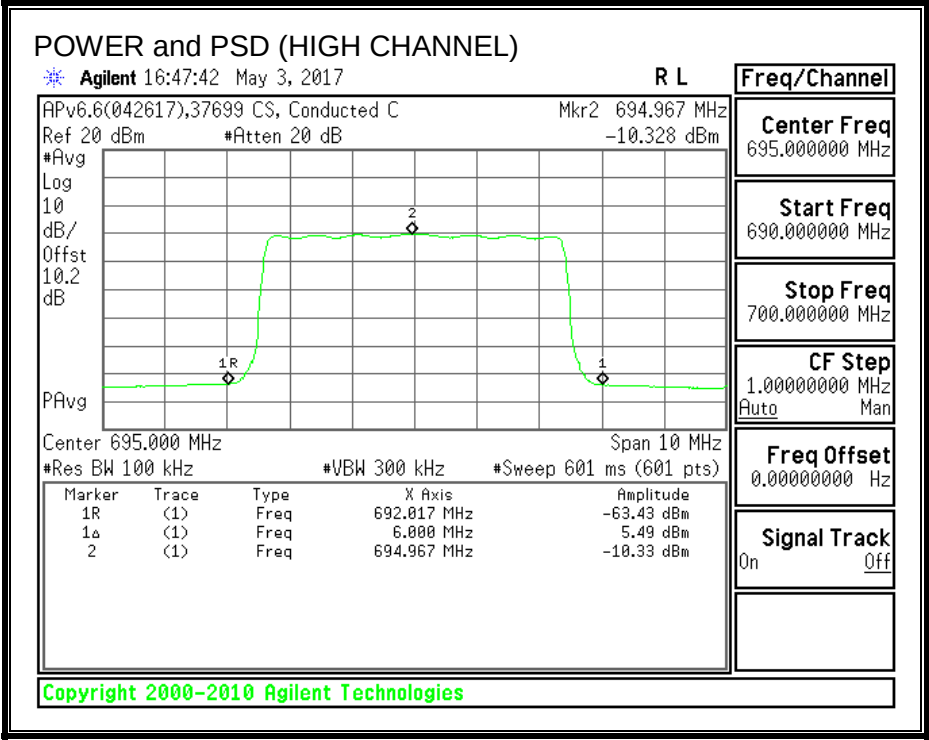
Output Power Results

Channel	Frequency (MHz)	Measured Output Power Chain 0 (dBm)	Measured Total Output Power (dBm)	Measured Total EIRP (dBm)	Conducted Power Limit (dBm)	Margin (dBm)
Low	473	2.62	2.62	8.77	9.85	-7.23
Mid	587	5.93	5.93	12.08	9.85	-3.92
High	695	5.49	5.49	11.64	9.85	-4.36

PSD Results

Channel	Frequency (MHz)	Measured Output PSD Chain 0 (dBm)	Measured Total PSD Power (dBm)	Conducted PSD Limit (dBm)	Margin (dBm)
Low	473	-13.21	-13.21	-7.55	-5.66
Mid	587	-9.88	-9.88	-7.55	-2.33
High	695	-10.33	-10.33	-7.55	-2.78





9.1.2. VHF BAND

Tested By:	37699 CS
Test Date:	5/4/17

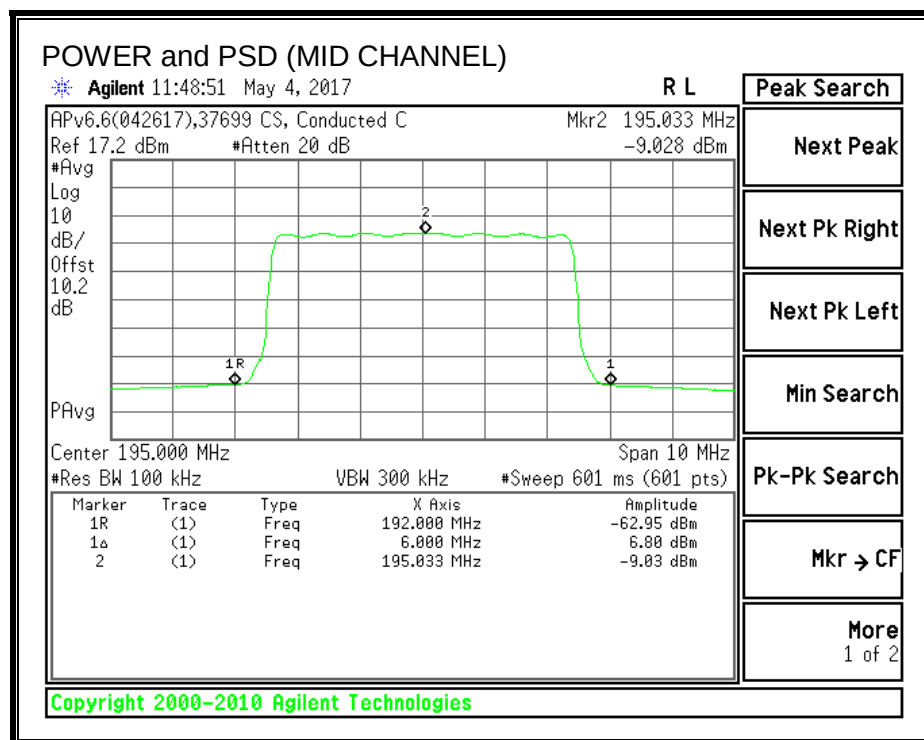
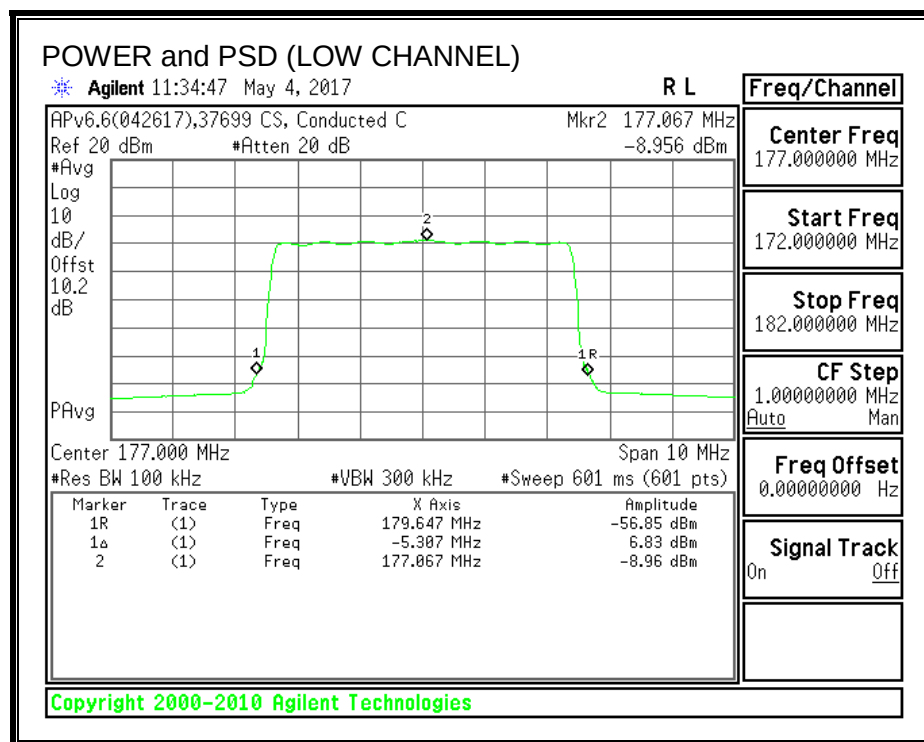
Antenna Gain (dBi)	5.65
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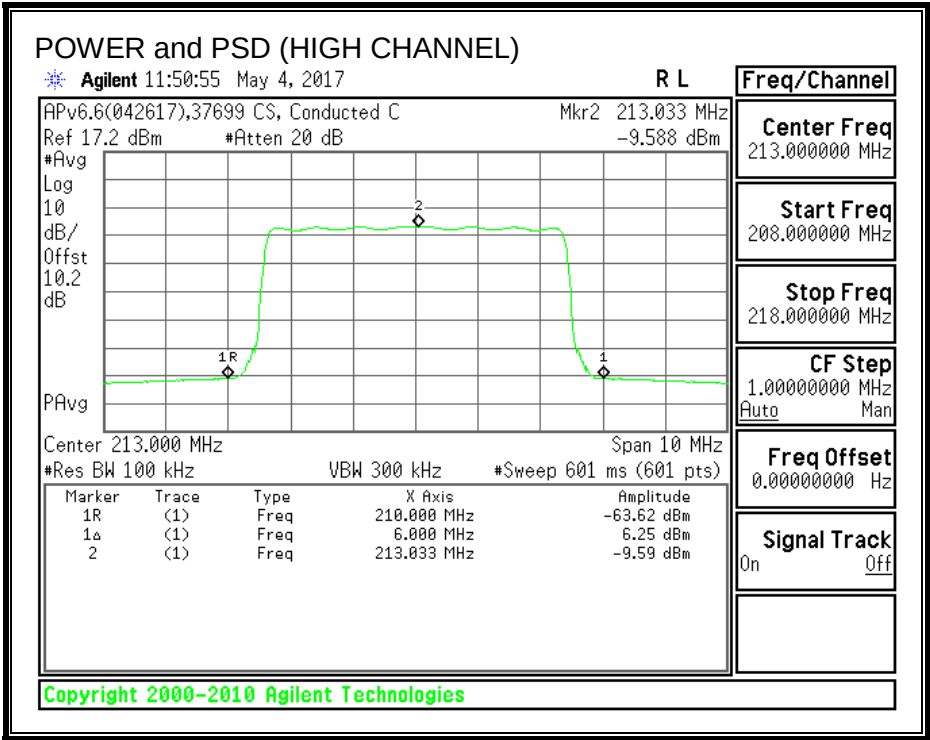
Output Power Results

Channel	Frequency (MHz)	Measured Output Power Chain 0 (dBm)	Measured Total Output Power (dBm)	Measured Total EIRP (dBm)	Conducted Power Limit (dBm)	Margin (dBm)
Low	177	6.83	6.83	12.48	10.00	-3.17
Mid	195	6.80	6.80	12.45	10.00	-3.20
High	213	6.25	6.25	11.90	10.00	-3.75

PSD Results

Channel	Frequency (MHz)	Measured Output PSD Chain 0 (dBm)	Measured Total PSD Power (dBm)	Conducted PSD Limit (dBm)	Margin (dBm)
Low	177	-8.96	-8.96	-7.40	-1.56
Mid	195	-9.03	-9.03	-7.40	-1.63
High	213	-9.59	-9.59	-7.40	-2.19





9.2. BAND-EDGE

LIMITS

§15.709 (b)(1) Fixed White Space Device

For operation at EIRP levels of 36 dBm (4000 mW) or less, fixed white space devices may operate at EIRP levels between the values shown in the table provided that the conducted power and the conducted power spectral density (PSD) limits are linearly interpolated between the values shown and the adjacent channel emission limit of the higher value shown in the table is met. Operation at EIRP levels above 36 dBm (4000 mW) shall follow the requirements for 40 dBm (10,000 mW).

EIRP (6 MHz)	Conducted power limit ¹ (6 MHz)	Conducted PSD limit (100 kHz)	Conducted adjacent channel emission limit (100 kHz)
16 dBm (40 mW)	10 dBm (10 mW)	-7.4 dBm	-62.8 dBm
20 dBm (100 mW)	14 dBm (25 mW)	-3.4 dBm	-58.8 dBm
24 dBm (250 mW)	18 dBm (63 mW)	0.6 dBm	-54.8 dBm
28 dBm (625 mW)	22 dBm (158 mW)	4.6 dBm	-50.8 dBm
32 dBm (1600 mW)	26 dBm (400 mW)	8.6 dBm	-46.8 dBm
36 dBm (4000 mW)	30 dBm (1000 mW)	12.6 dBm	-42.8 dBm
40 dBm (10000 mW)	30 dBm (1000 mW)	12.6 dBm	-42.8 dBm

¹The conducted power spectral density from a fixed white space device shall not be greater than the values shown in the table when measured in any 100 kHz band during any time interval of continuous transmission, except that a 40 mW fixed white space device operating in a four megahertz channel within a seven megahertz guard band must comply with a conducted power spectral density limit of -5.4 dBm.

The conducted power, PSD and adjacent channel limits for fixed white space devices operating at up to 36 dBm (4000 milliwatts) EIRP shown in the table in paragraph (b)(1) of this section are based on a maximum transmitting antenna gain of 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The conducted power, PSD and adjacent channel limits for fixed white space devices operating at greater than 36 dBm (4000 milliwatts) EIRP shown in the table in paragraph (b)(1) of this section are based on a maximum transmitting antenna gain of 10 dBi. If transmitting antennas of directional gain greater than 10 dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 10 dBi.

RESULTS

9.2.1. UHF BAND

Tested By:	37699 CS
Test Date:	5/3/17

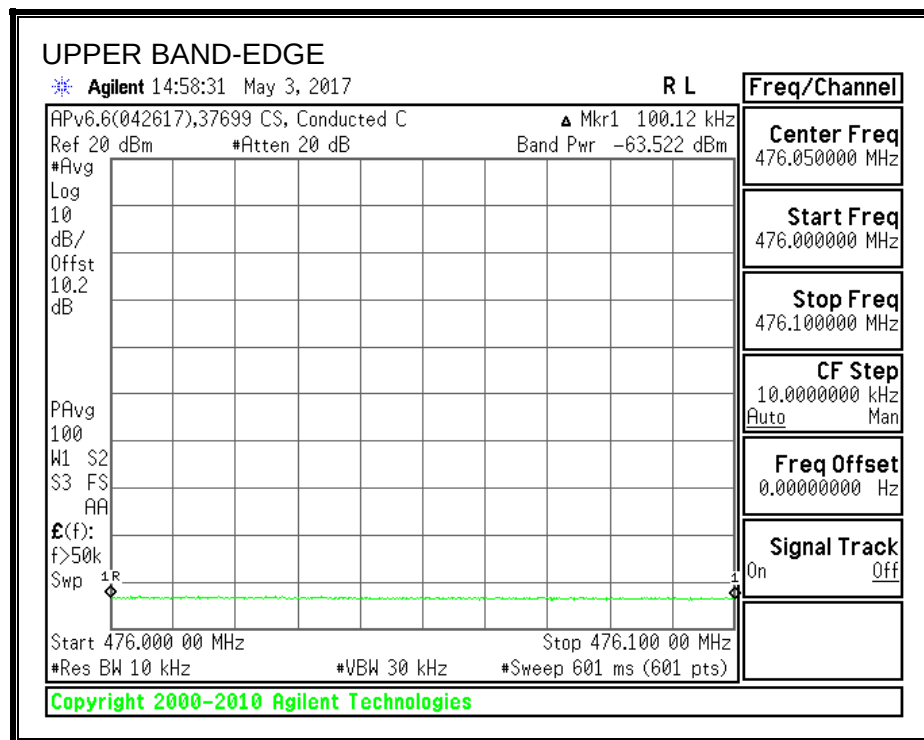
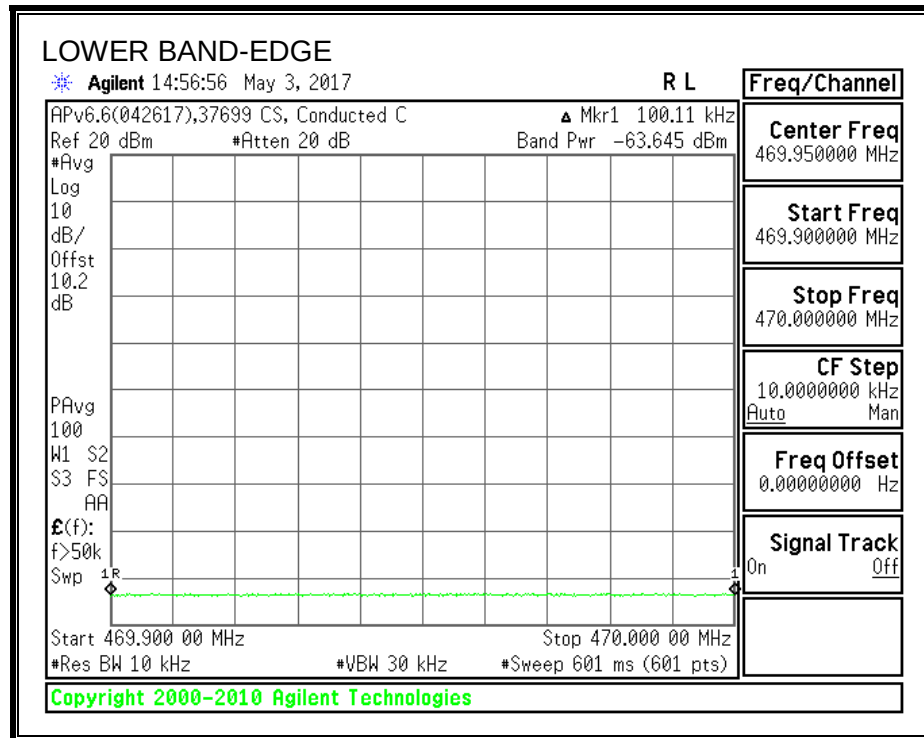
Lower Band-Edge Emissions

Channel	Frequency (MHz)	Measured Emission Chain 0 (dBm)	Measured Total Emission (dBm)	Emissions Limit (dBm)	Worst Case Margin (dBm)
Low	473	-63.65	-63.65	-62.95	-0.70
Mid	587	-63.36	-63.36	-62.95	-0.41
High	695	-63.83	-63.83	-62.95	-0.88

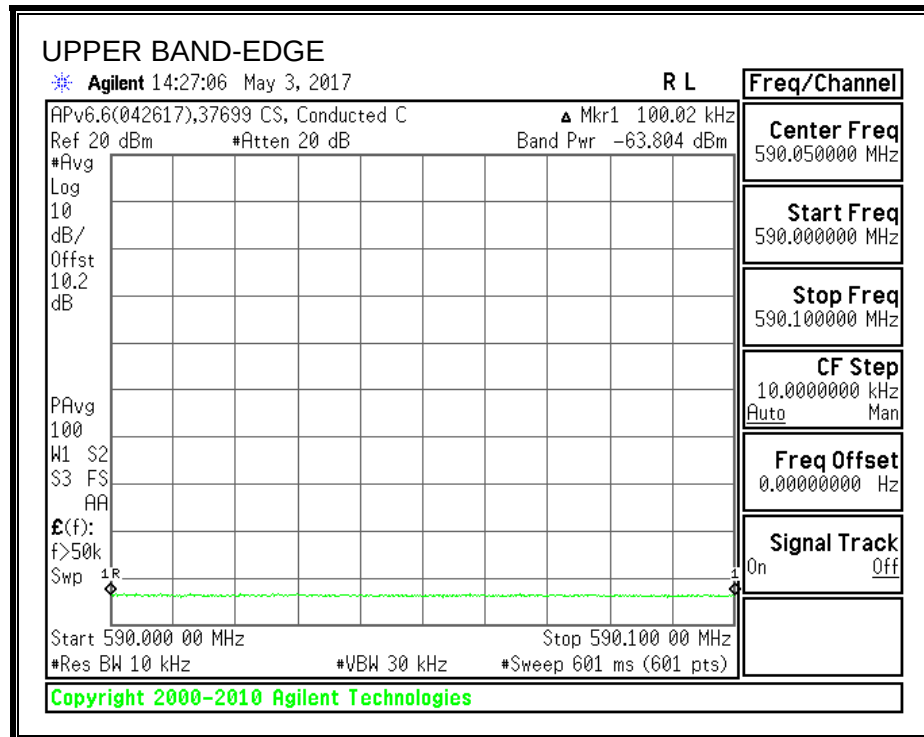
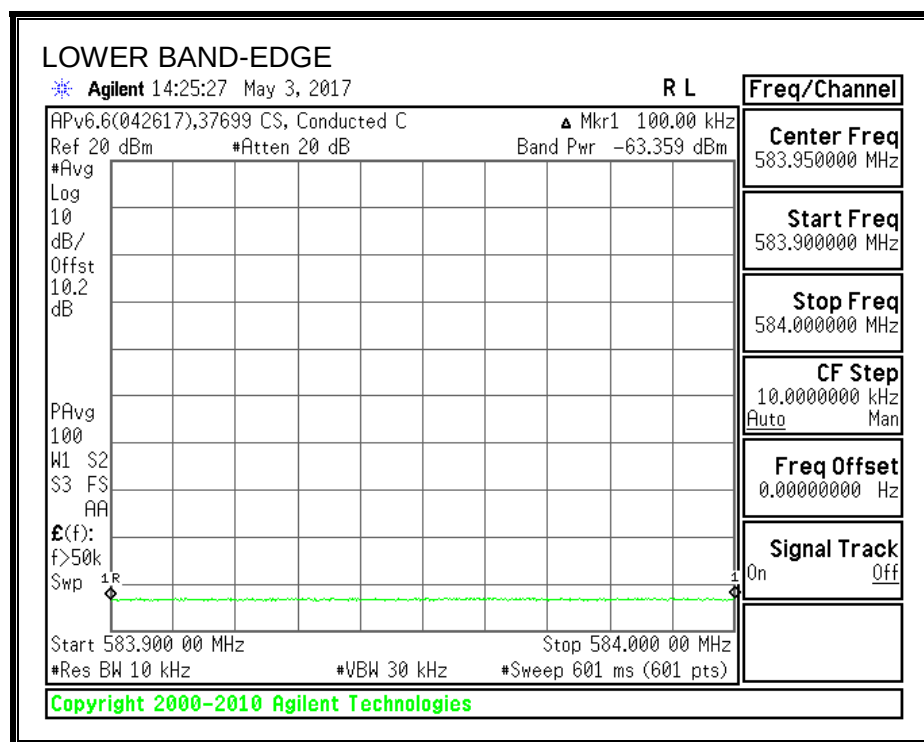
Upper Band-Edge Emissions

Channel	Frequency (MHz)	Measured Emission Chain 0 (dBm)	Measured Total Emission (dBm)	Emissions Limit (dBm)	Worst Case Margin (dBm)
Low	473	-63.52	-63.52	-62.95	-0.57
Mid	587	-63.80	-63.80	-62.95	-0.85
High	695	-64.11	-64.11	-62.95	-1.16

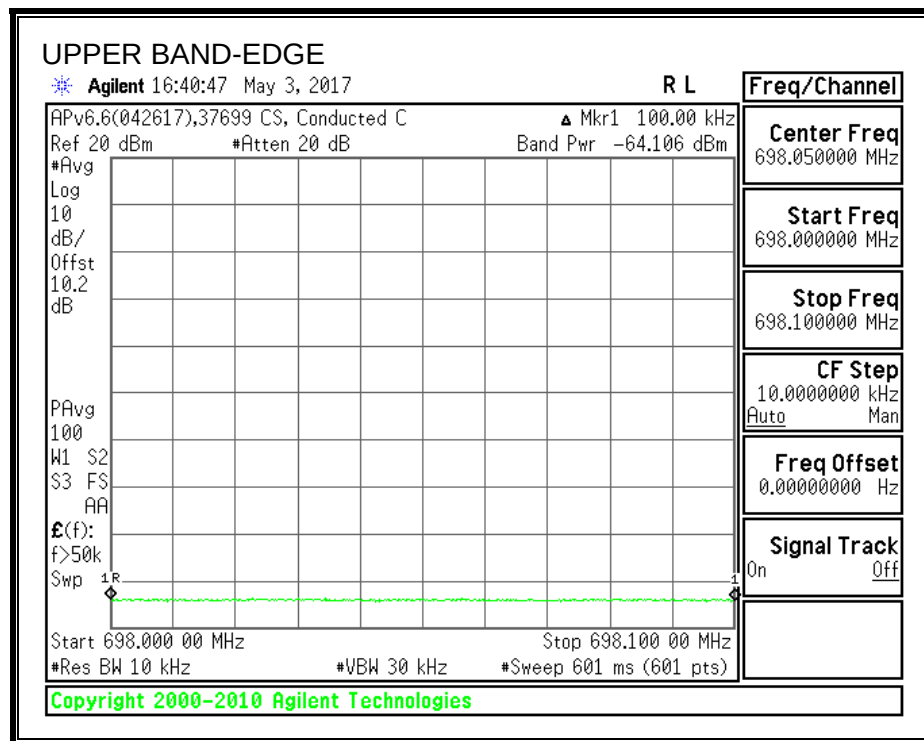
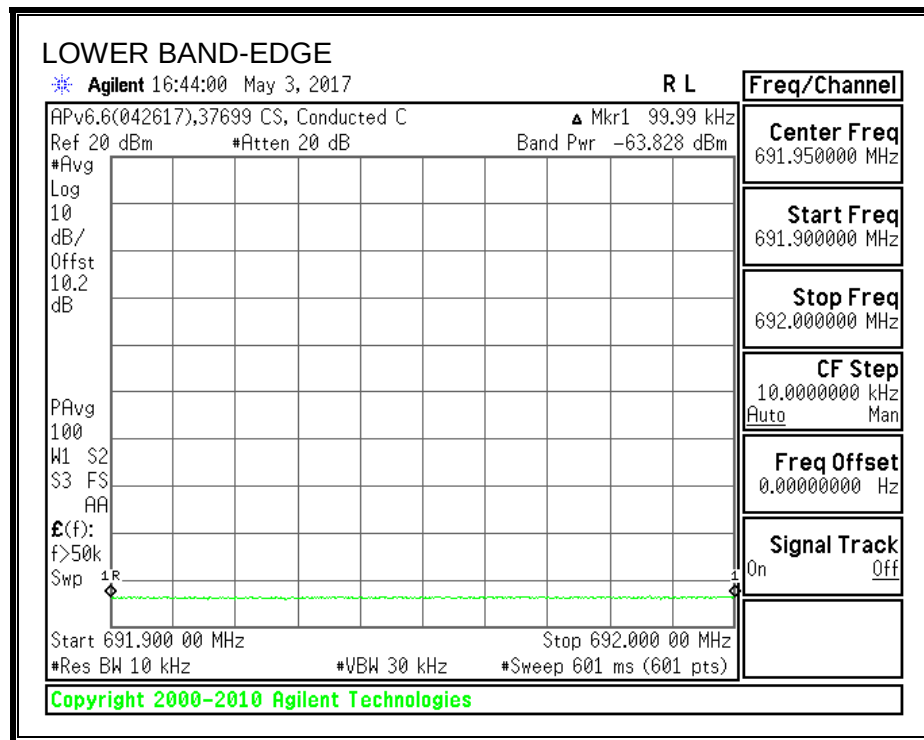
LOW CHANNEL



MID CHANNEL



HIGH CHANNEL



9.2.2. VHF BAND

Tested By:	37699 CS
Test Date:	5/4/17

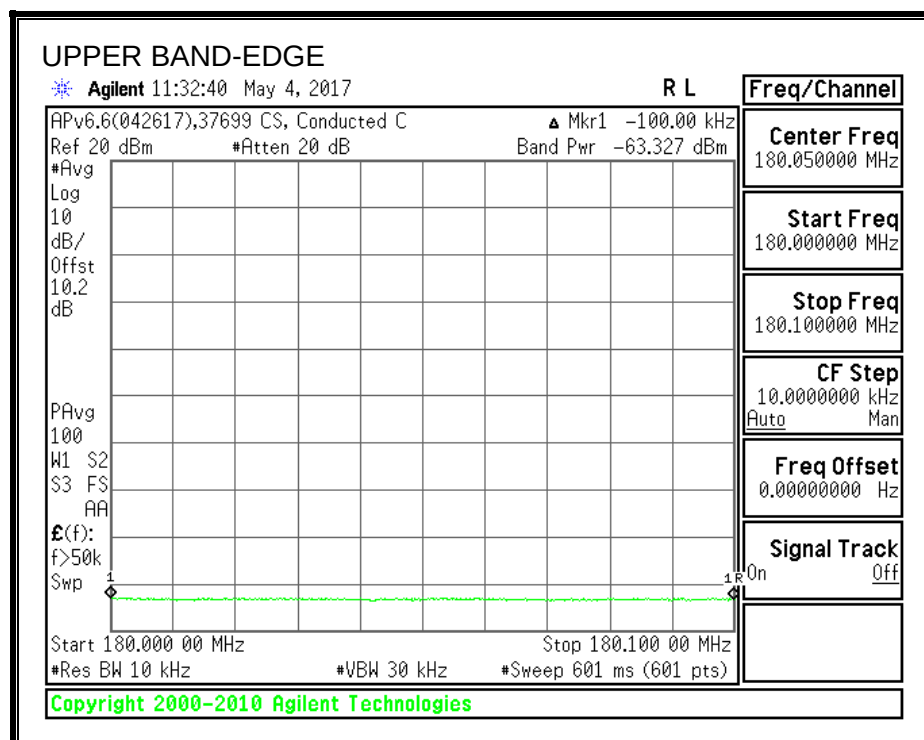
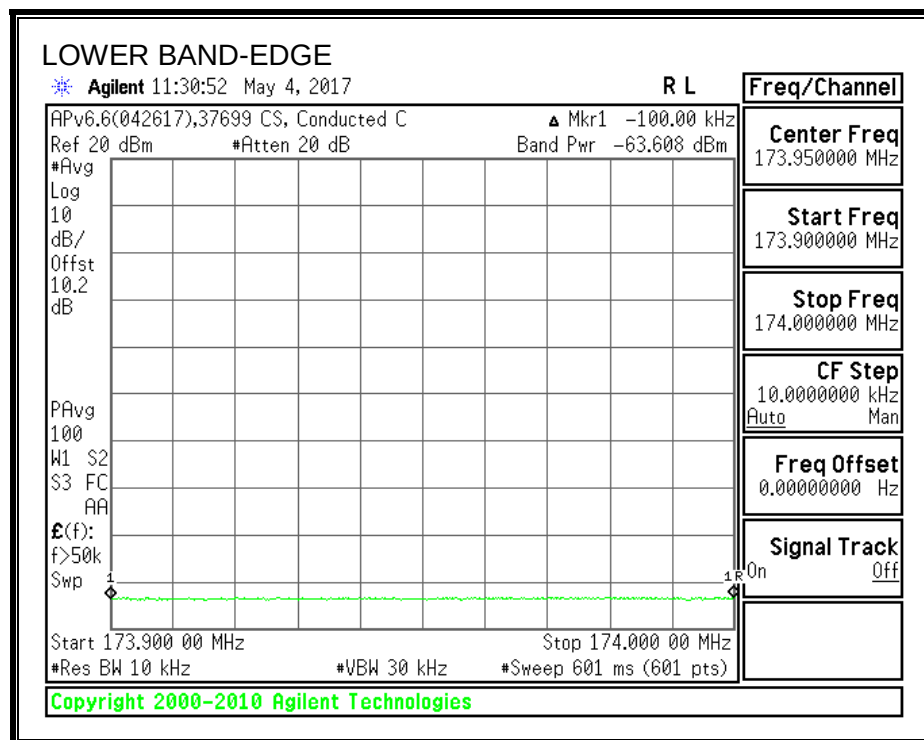
Lower Band-Edge Emissions

Channel	Frequency (MHz)	Measured Emission Chain 0 (dBm)	Measured Total Emission (dBm)	Emissions Limit (dBm)	Worst Case Margin (dBm)
Low	177	-63.61	-63.61	-62.8	-0.81
Mid	195	-63.32	-63.32	-62.8	-0.52
High	213	-64.02	-64.02	-62.8	-1.22

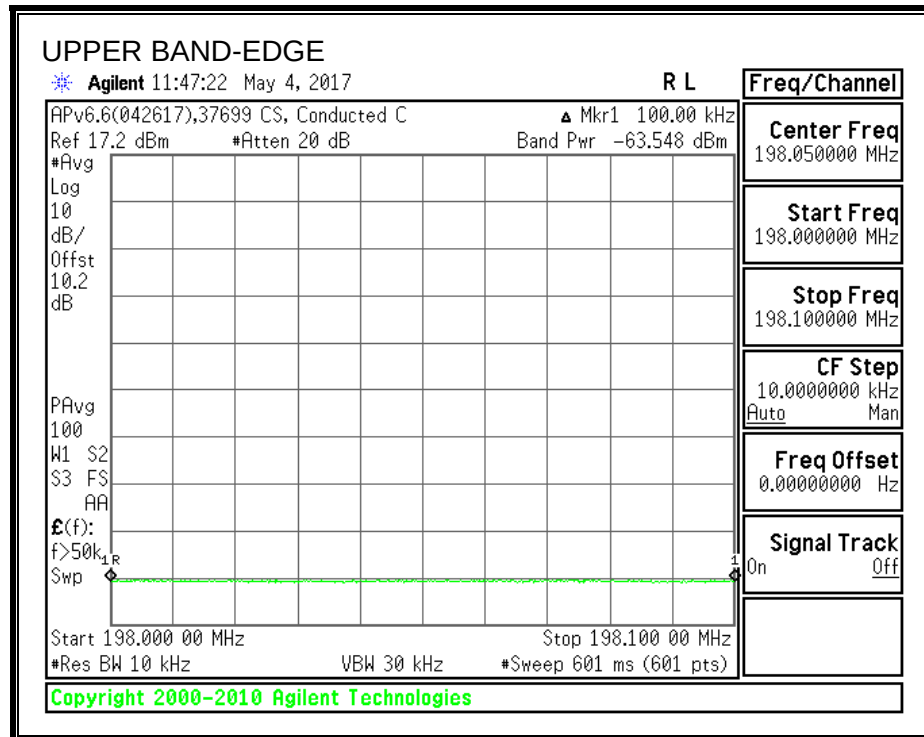
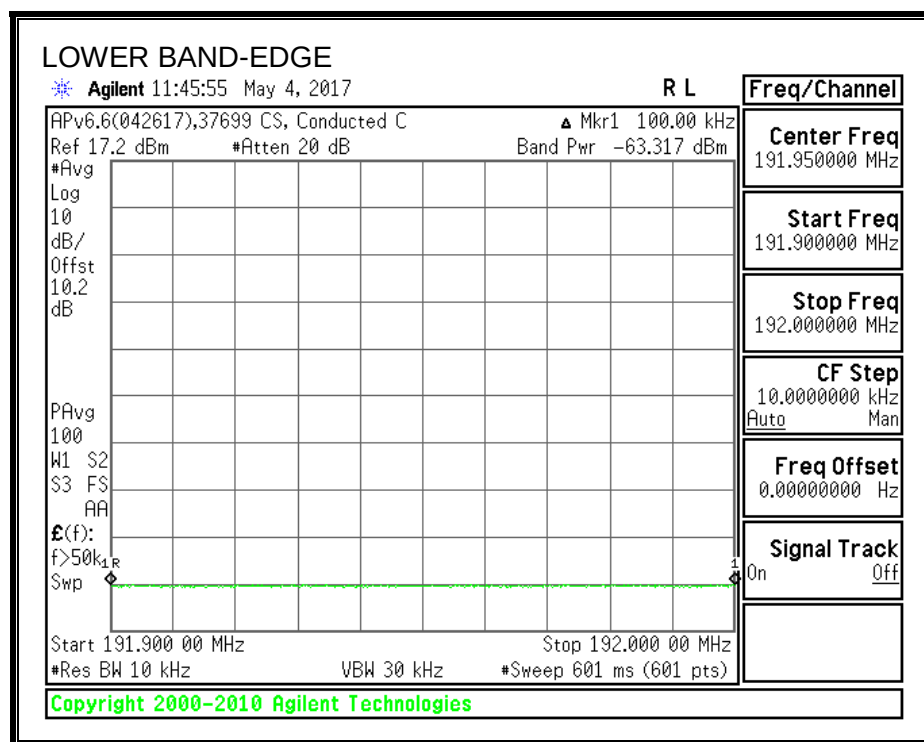
Upper Band-Edge Emissions

Channel	Frequency (MHz)	Measured Emission Chain 0 (dBm)	Measured Total Emission (dBm)	Emissions Limit (dBm)	Worst Case Margin (dBm)
Low	177	-63.33	-63.33	-62.8	-0.53
Mid	195	-63.55	-63.55	-62.8	-0.75
High	213	-63.99	-63.99	-62.8	-1.19

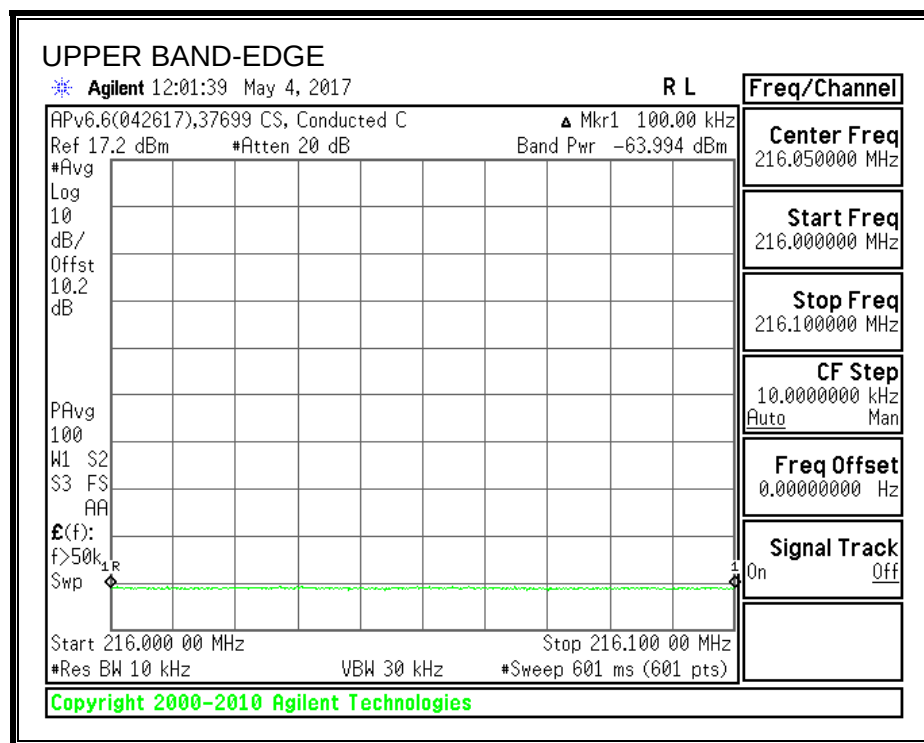
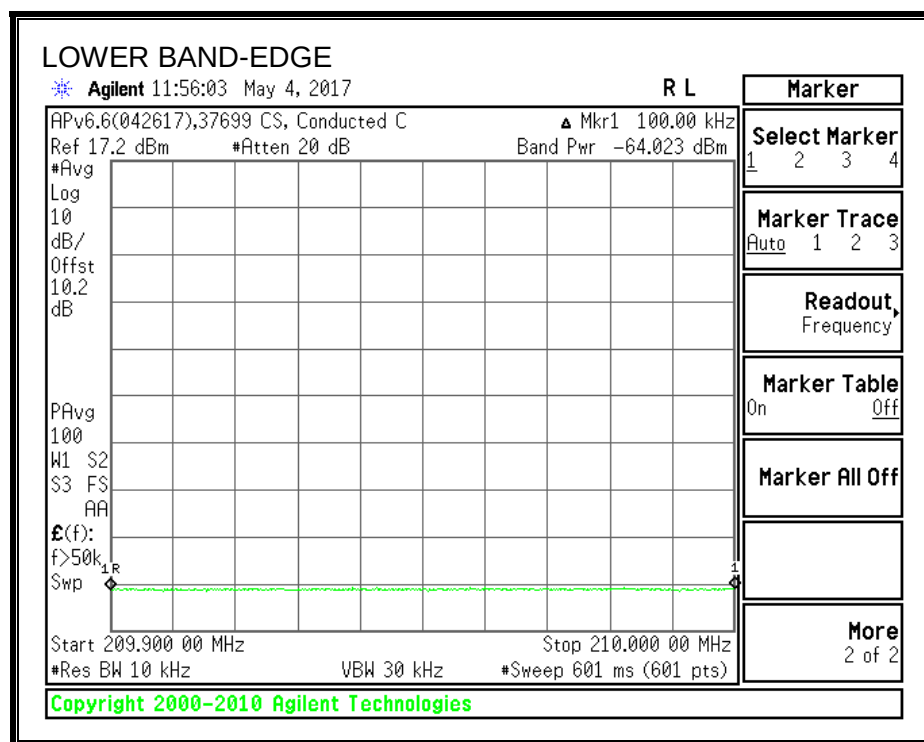
LOW CHANNEL



MID CHANNEL



HIGH CHANNEL



9.3. ADJACENT CHANNEL EMISSIONS

LIMITS

§15.709 (b)(1) Fixed White Space Device

For operation at EIRP levels of 36 dBm (4000 mW) or less, fixed white space devices may operate at EIRP levels between the values shown in the table provided that the conducted power and the conducted power spectral density (PSD) limits are linearly interpolated between the values shown and the adjacent channel emission limit of the higher value shown in the table is met. Operation at EIRP levels above 36 dBm (4000 mW) shall follow the requirements for 40 dBm (10,000 mW).

EIRP (6 MHz)	Conducted power limit ¹ (6 MHz)	Conducted PSD limit (100 kHz)	Conducted adjacent channel emission limit (100 kHz)
16 dBm (40 mW)	10 dBm (10 mW)	-7.4 dBm	-62.8 dBm
20 dBm (100 mW)	14 dBm (25 mW)	-3.4 dBm	-58.8 dBm
24 dBm (250 mW)	18 dBm (63 mW)	0.6 dBm	-54.8 dBm
28 dBm (625 mW)	22 dBm (158 mW)	4.6 dBm	-50.8 dBm
32 dBm (1600 mW)	26 dBm (400 mW)	8.6 dBm	-46.8 dBm
36 dBm (4000 mW)	30 dBm (1000 mW)	12.6 dBm	-42.8 dBm
40 dBm (10000 mW)	30 dBm (1000 mW)	12.6 dBm	-42.8 dBm

¹The conducted power spectral density from a fixed white space device shall not be greater than the values shown in the table when measured in any 100 kHz band during any time interval of continuous transmission, except that a 40 mW fixed white space device operating in a four megahertz channel within a seven megahertz guard band must comply with a conducted power spectral density limit of -5.4 dBm.

The conducted power, PSD and adjacent channel limits for fixed white space devices operating at up to 36 dBm (4000 milliwatts) EIRP shown in the table in paragraph (b)(1) of this section are based on a maximum transmitting antenna gain of 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The conducted power, PSD and adjacent channel limits for fixed white space devices operating at greater than 36 dBm (4000 milliwatts) EIRP shown in the table in paragraph (b)(1) of this section are based on a maximum transmitting antenna gain of 10 dBi. If transmitting antennas of directional gain greater than 10 dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 10 dBi.

RESULTS

9.3.1. UHF BAND

Tested By:	37699 CS
Test Date:	5/3/17

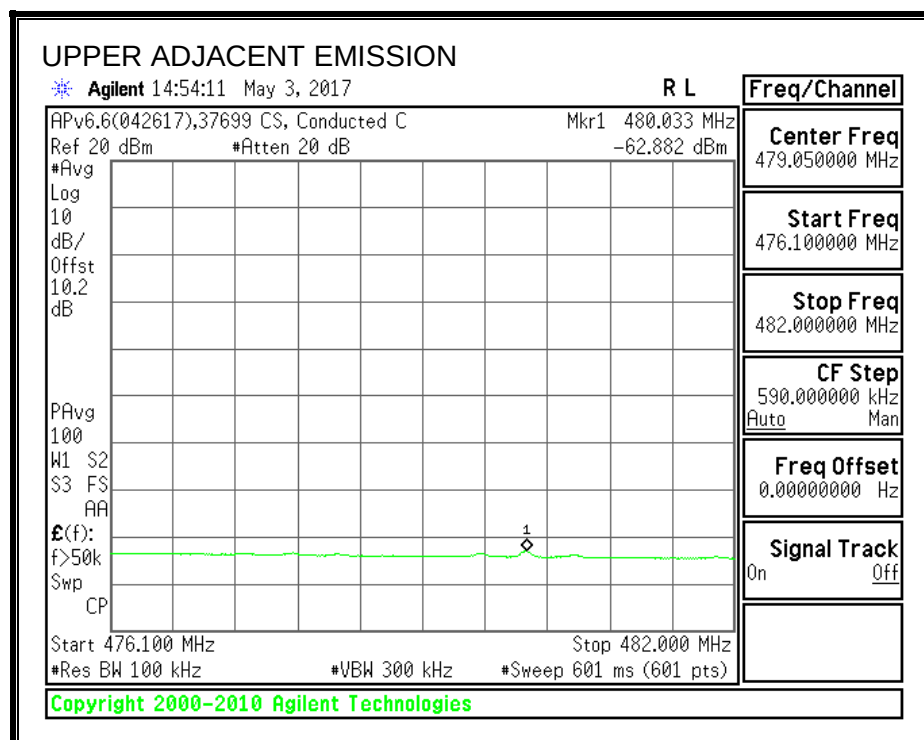
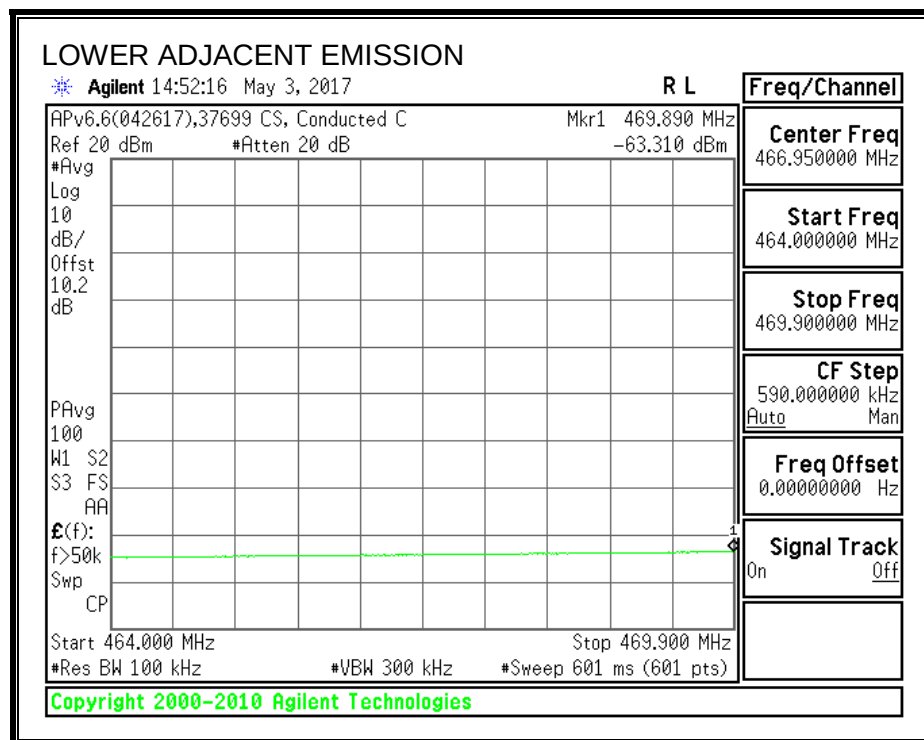
Lower Adjacent Channel Emissions

Channel	Frequency (MHz)	Measured Emission Chain 0 (dBm)	Measured Total Emission (dBm)	Emissions Limit (dBm)	Worst Case Margin (dBm)
Low	473	-63.31	-63.31	-62.95	-0.36
Mid	587	-63.05	-63.05	-62.95	-0.10
High	695	-63.55	-63.55	-62.95	-0.60

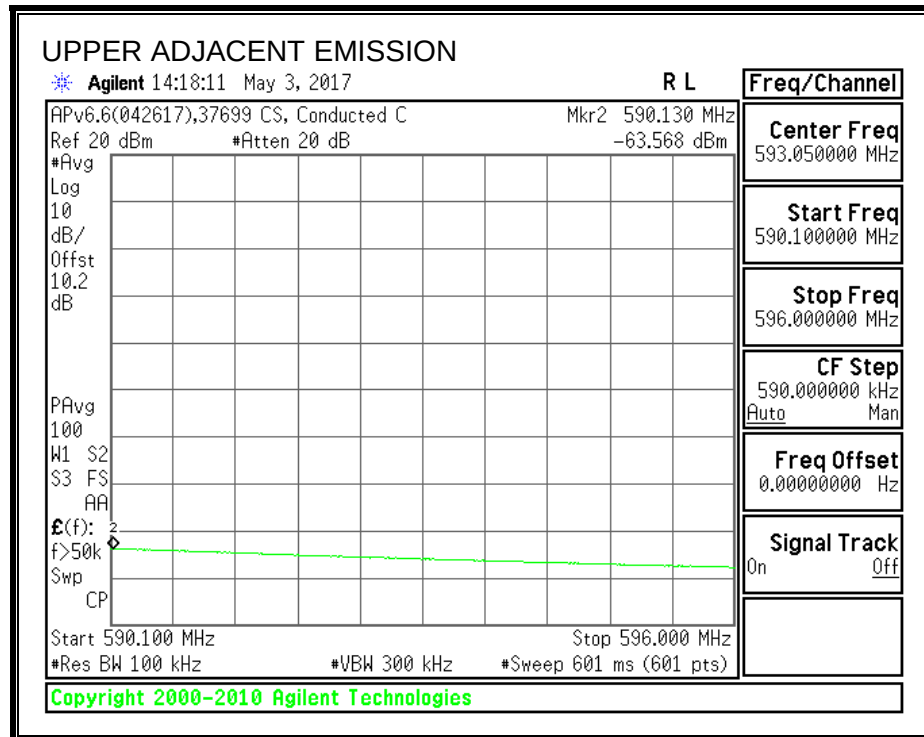
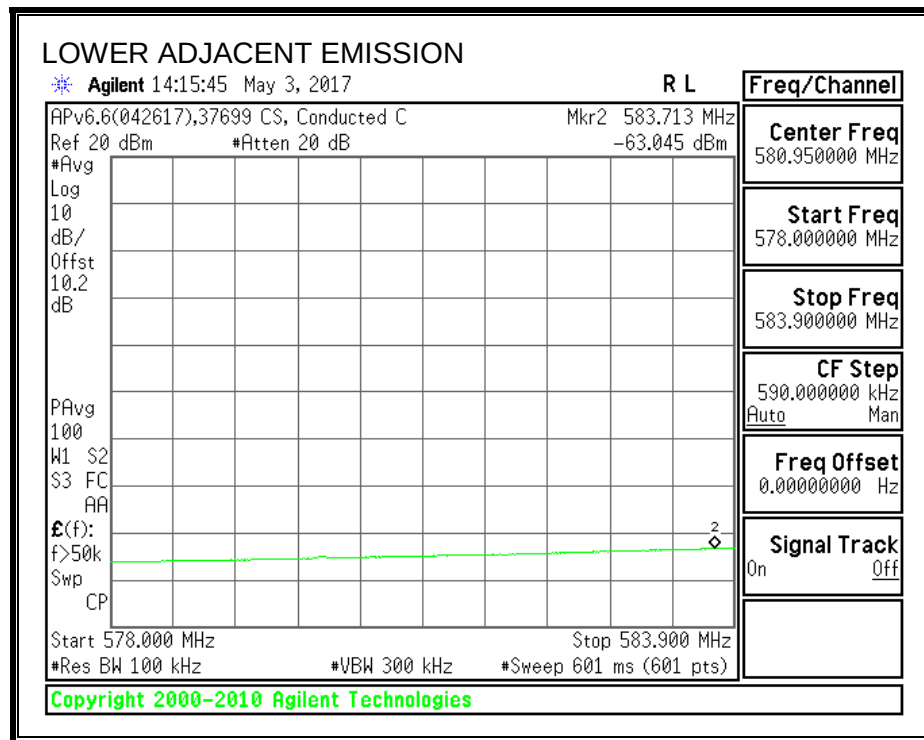
Upper Adjacent Channel Emissions

Channel	Frequency (MHz)	Measured Emission Chain 0 (dBm)	Measured Total Emission (dBm)	Emissions Limit (dBm)	Worst Case Margin (dBm)
Low	473	-62.88	-62.88	-62.95	0.07
Mid	587	-63.57	-63.57	-62.95	-0.62
High	695	-63.83	-63.83	-62.95	-0.88

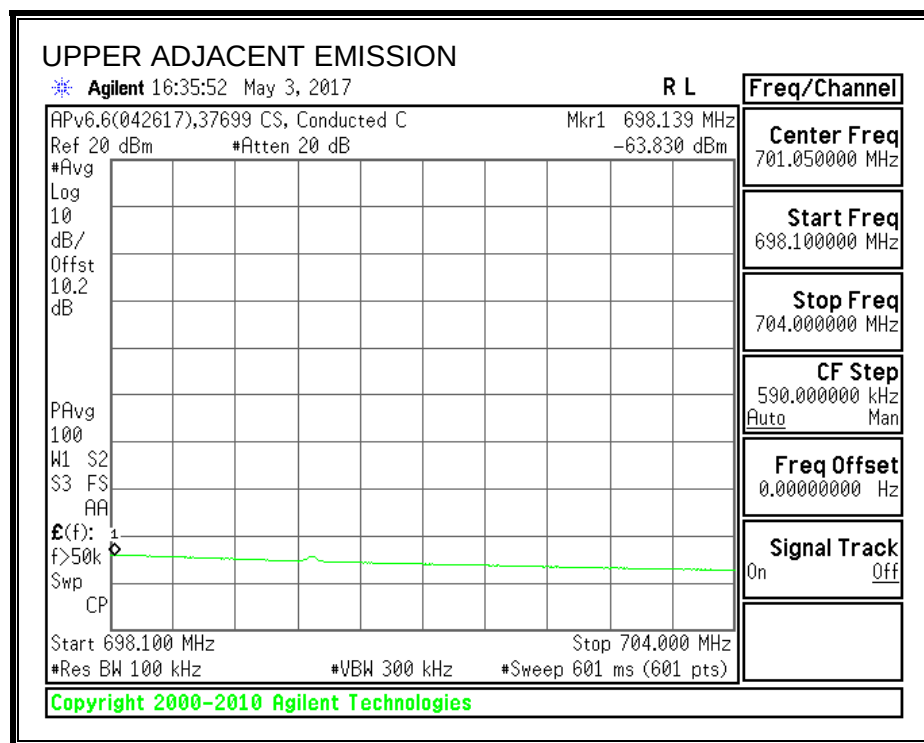
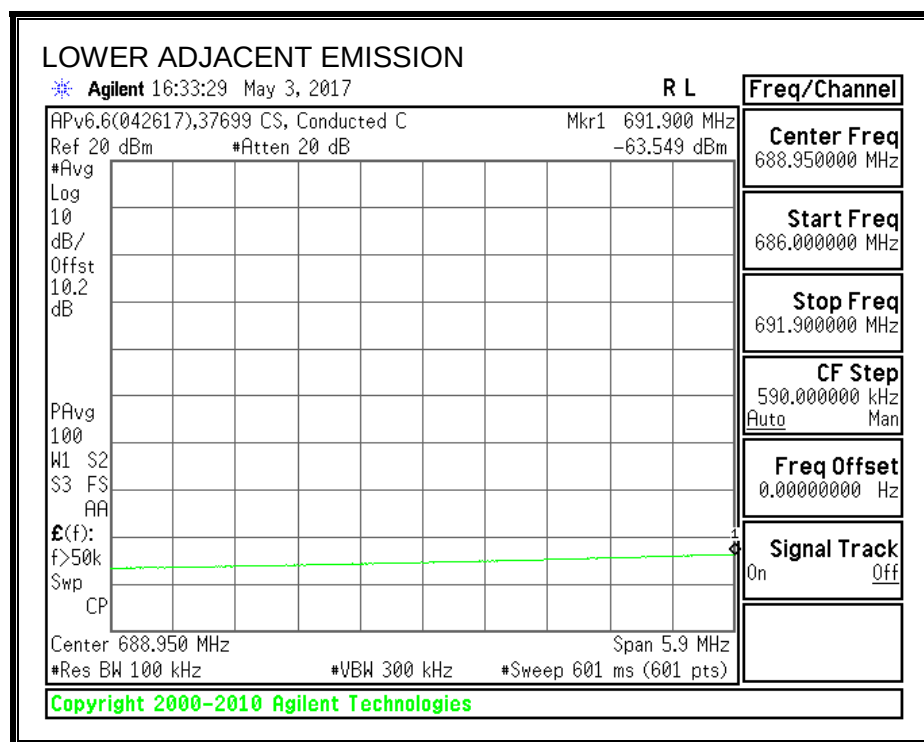
LOW CHANNEL



MID CHANNEL



HIGH CHANNEL



9.3.2. VHF BAND

Tested By:	37699 CS
Test Date:	5/9/17

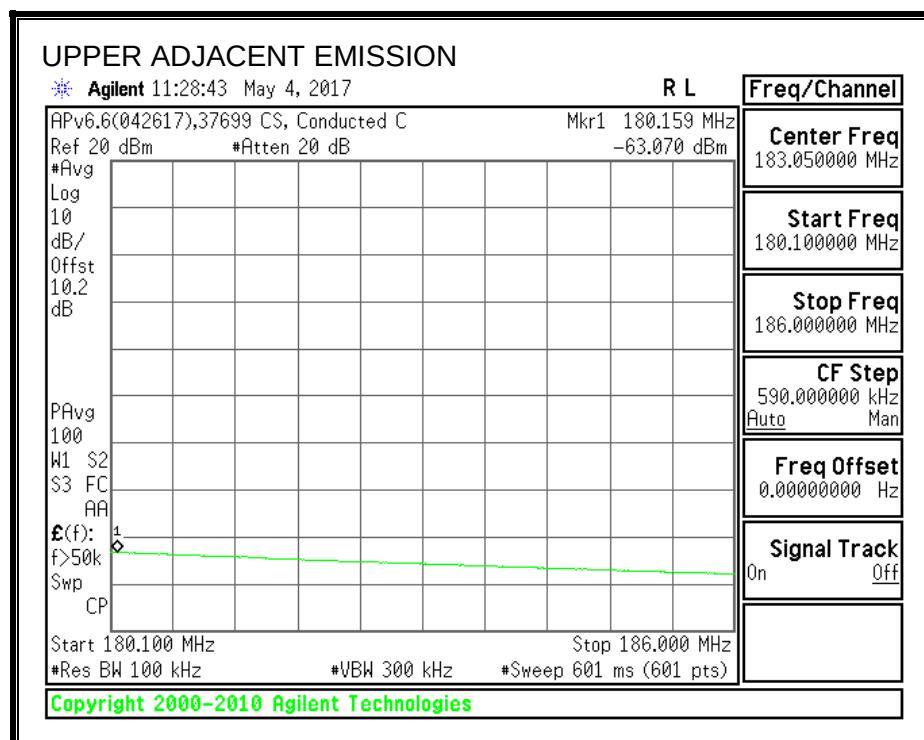
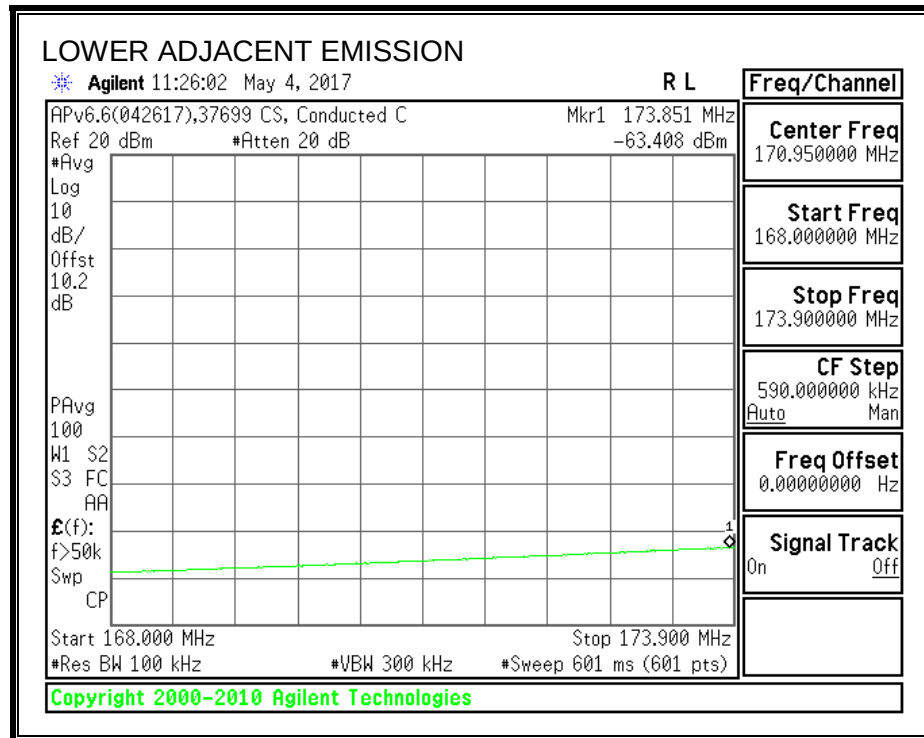
Lower Adjacent Channel Emissions

Channel	Frequency (MHz)	Measured Emission Chain 0 (dBm)	Measured Total Emission (dBm)	Emissions Limit (dBm)	Worst Case Margin (dBm)
Low	177	-63.41	-63.41	-62.8	-0.61
Mid	195	-63.11	-63.11	-62.8	-0.31
High	213	-63.67	-63.67	-62.8	-0.87

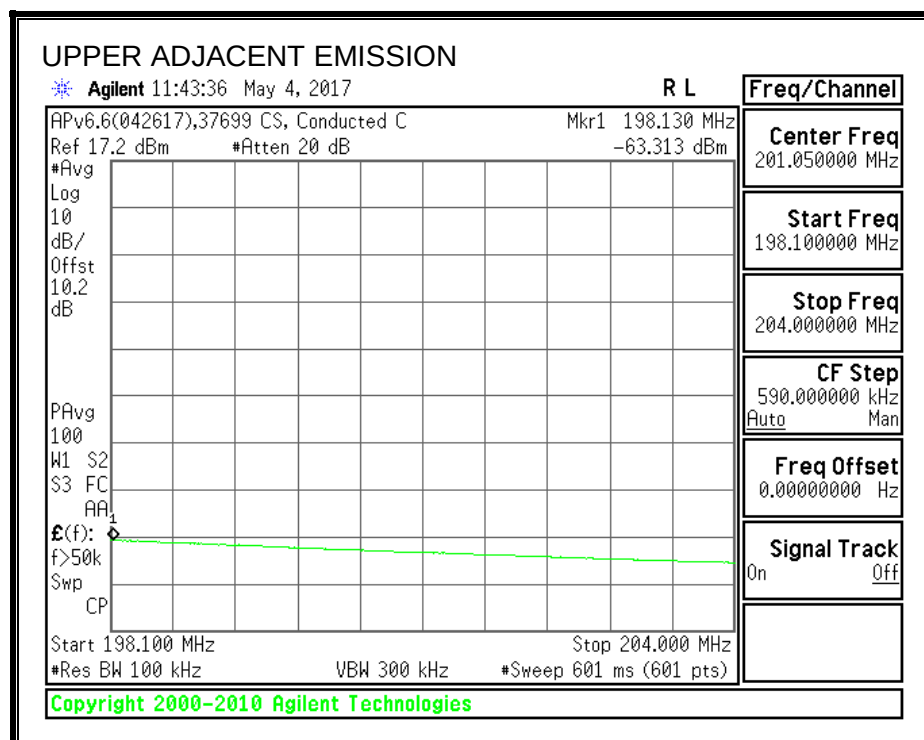
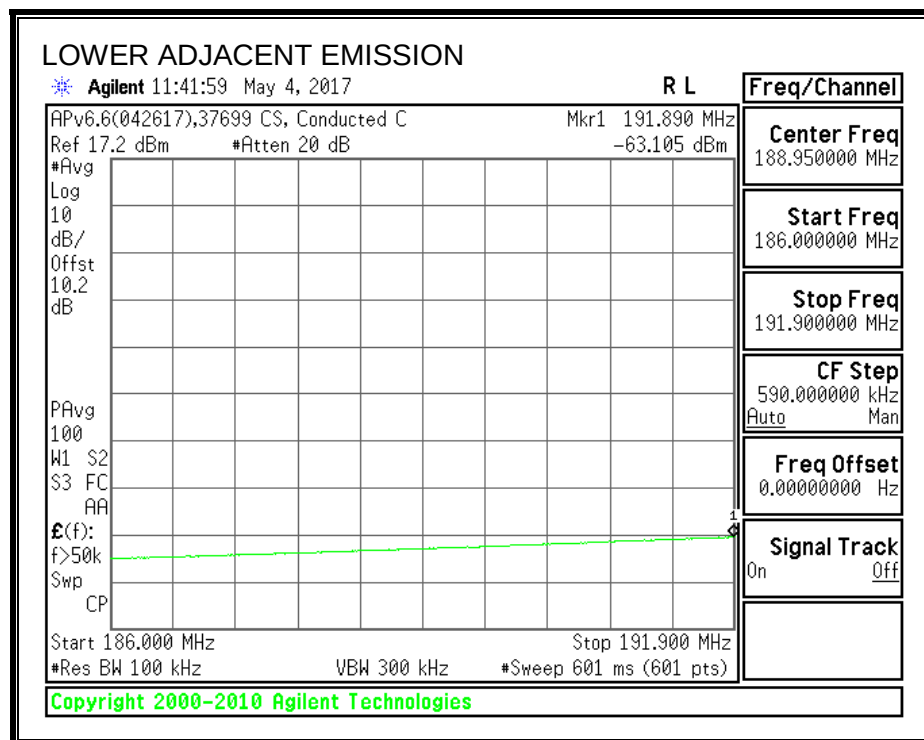
Upper Adjacent Channel Emissions

Channel	Frequency (MHz)	Measured Emission Chain 0 (dBm)	Measured Total Emission (dBm)	Emissions Limit (dBm)	Worst Case Margin (dBm)
Low	177	-63.07	-63.07	-62.8	-0.27
Mid	195	-63.31	-63.31	-62.8	-0.51
High	213	-63.74	-63.74	-62.8	-0.94

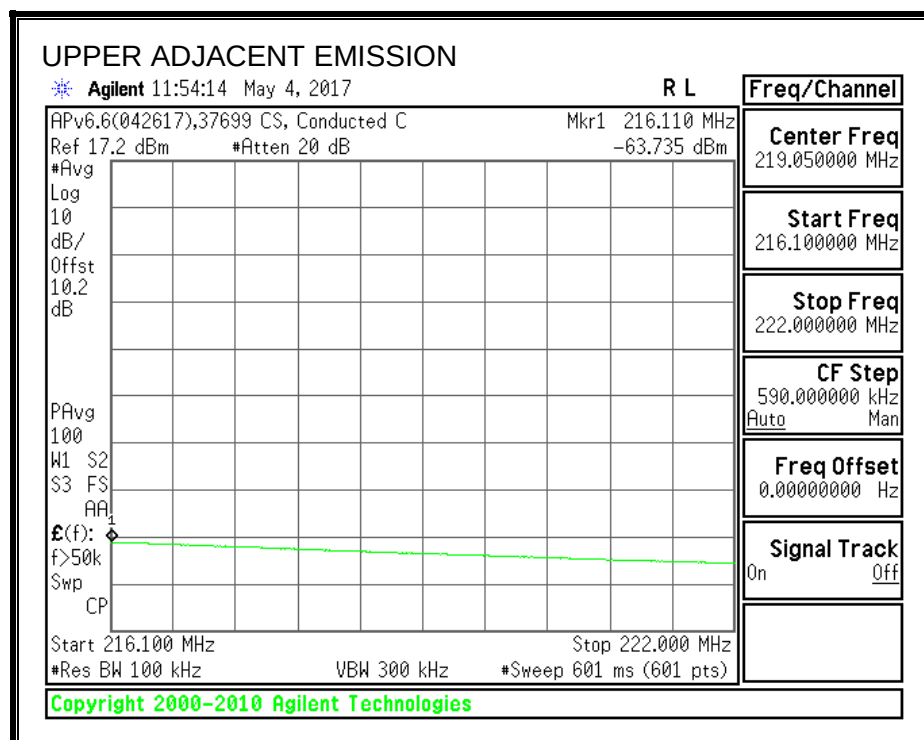
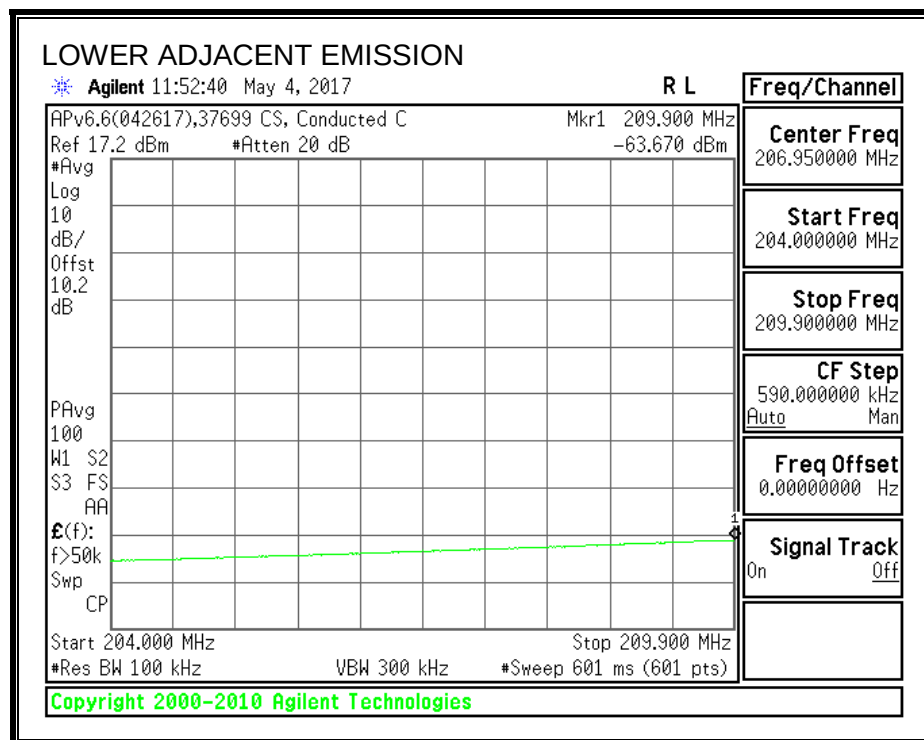
LOW CHANNEL



MID CHANNEL



HIGH CHANNEL



10. RADIATED EMISSIONS

BEYOND ADJACENT CHANNEL EMISSION LIMITS

FCC §15.709 (d) (2) At frequencies beyond the six megahertz channel immediately adjacent to each white space channel or group of contiguous white space channels in which the white space device is operating the white space device shall meet the requirements of §15.209.

The DUT must comply with radiated emission limits for a Class B digital device, except that authorization as a Class A device may be considered with appropriate justification for non-residential use.

§15.209 (a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

TEST PROCEDURE

ANSI C63.10-2013.

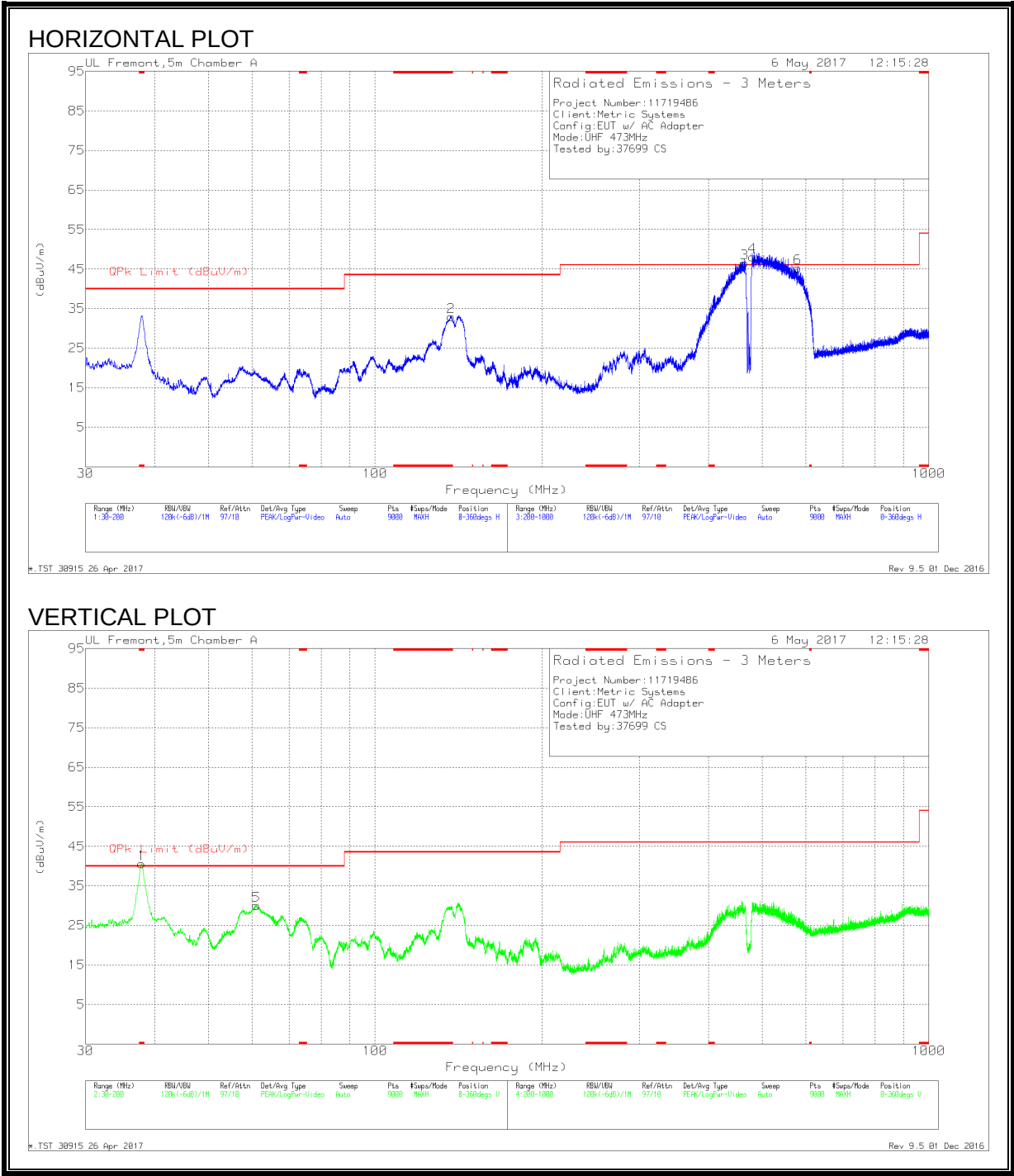
The EUT is set to transmit in a continuous mode.

High-Q Cavity Notch filters are used to reduce the amplitude of the intentional transmitter and prevent overload of the system preamplifier.

10.1. TRANSMITTER BELOW 1GHz

10.1.1. UHF BAND

BEYOND ADJACENT CHANNEL (LOW CHANNEL)



LOW CHANNEL DATA

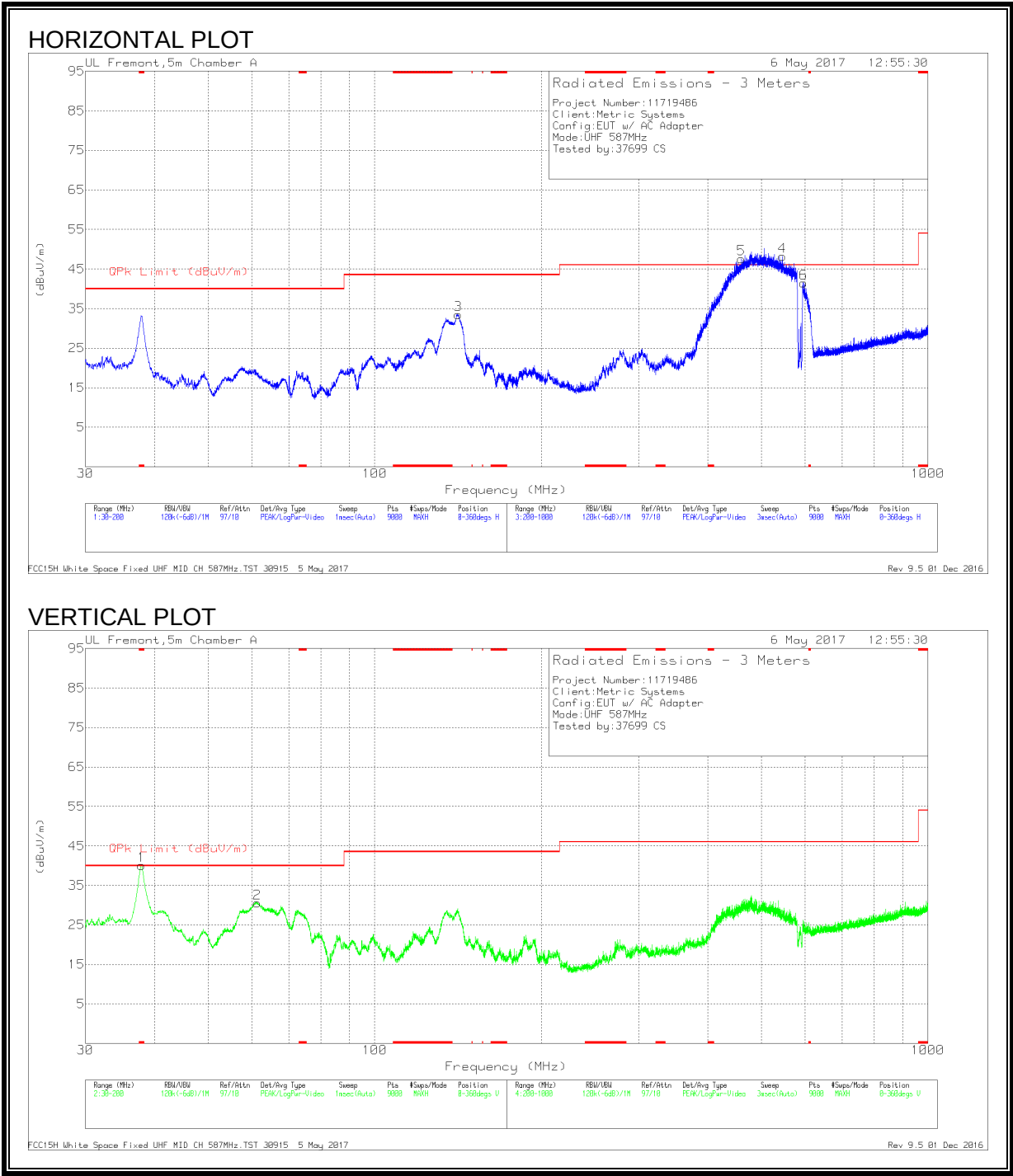
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T130 (dB/m)	Amp/Cbl (dB/m)	Filtr (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 37.9057	48.57	Qp	19.5	-31.2	.1	36.97	40	-3.03	285	108	V
3	464.8306	50.93	Qp	21.2	-28.8	.1	43.43	46	-2.57	65	124	H
4	479.3186	51.23	Qp	21.7	-28.8	.1	44.23	46	-1.77	61	112	H
6	578.0308	44.95	Qp	22.6	-28.6	.1	39.05	46	-6.95	93	162	H
2	* 137.3103	45.68	Pk	17.5	-30.3	.1	32.98	43.5	-10.52	0-360	200	H
5	61.019	48.83	Pk	11.9	-30.8	.1	30.03	40	-9.97	0-360	100	V

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

Qp - Quasi-Peak detector

Pk - Peak detector

BEYOND ADJACENT CHANNEL (MID CHANNEL)



MID CHANNEL DATA

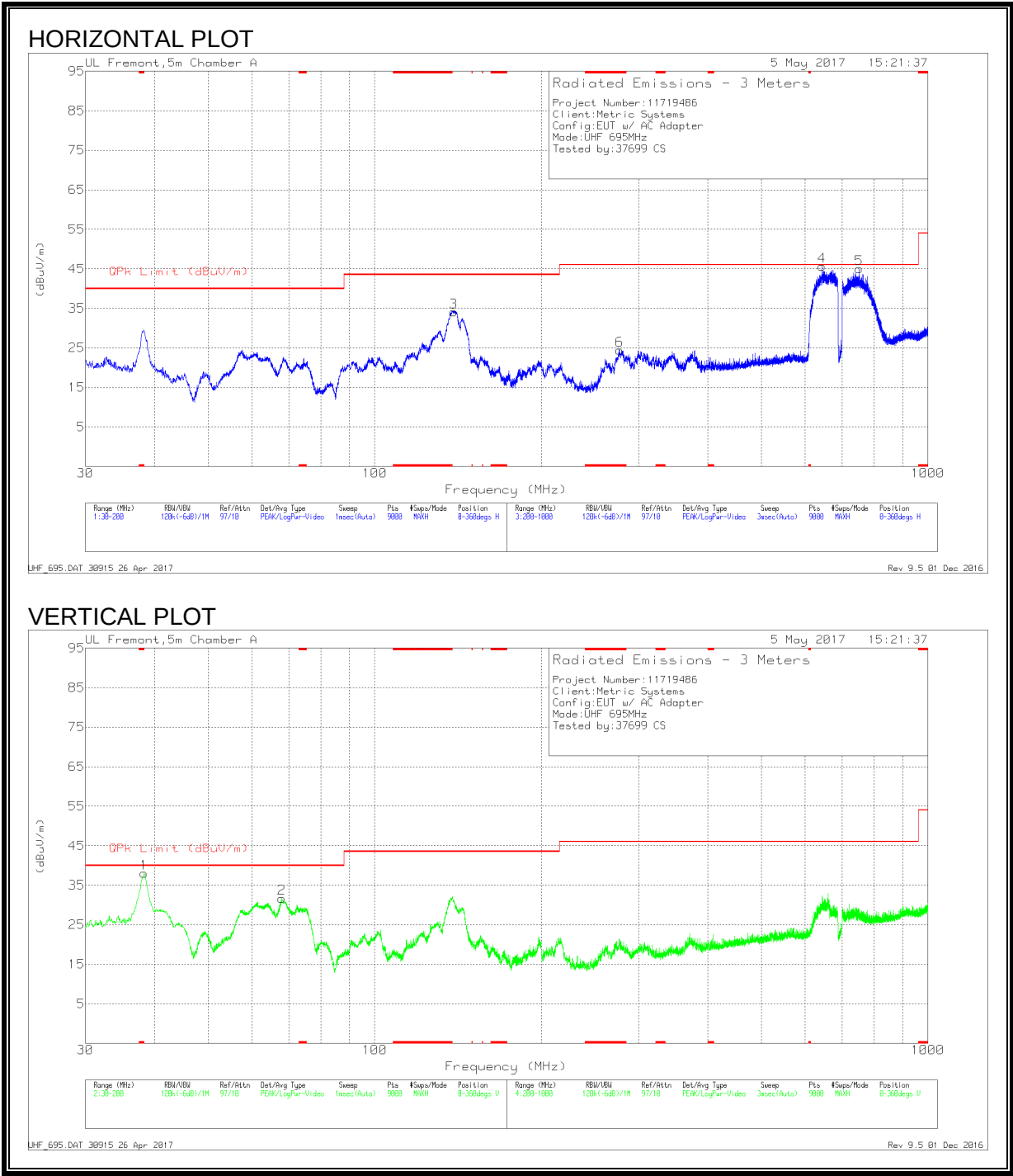
Marker	Frequency (MHz)	Meter Reading (dBUV)	Det	AF T130 (dB/m)	Amp/Cbl (dB/m)	Filtr (dB)	Corrected Reading (dBUV/m)	QPk Limit (dBUV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 37.8805	49.21	Qp	19.5	-31.2	.2	37.71	40	-2.29	352	101	V
5	458.828	51.49	Qp	21	-28.9	.2	43.79	46	-2.21	64	126	H
4	547.8144	47.41	Qp	22.2	-28.7	.2	41.11	46	-4.89	81	109	H
6	596.2706	41.22	Qp	22.4	-28.6	.2	35.22	46	-10.78	98	156	H
2	61.3402	49.4	Pk	11.9	-30.9	.2	30.6	40	-9.4	0-360	100	V
3	141.6836	46.45	Pk	17.1	-30.3	.2	33.45	43.5	-10.05	0-360	200	H

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

Qp - Quasi-Peak detector

Pk - Peak detector

BEYOND ADJACENT CHANNEL (HIGH CHANNEL)



HIGH CHANNEL DATA

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T130 (dB/m)	Amp/Cbl (dB/m)	Filtr (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 38.1191	45.93	Qp	19.3	-31.1	0	34.13	40	-5.87	25	104	V
4	643.1028	45.86	Qp	23.8	-28.4	0	41.26	46	-4.74	74	139	H
5	748.6954	42.77	Qp	24.7	-28.3	0	39.17	46	-6.83	68	158	H
3	139.02	47.1	Pk	17.3	-30.3	0	34.1	43.5	-9.4	0-360	200	H
6	* 277.2532	36.51	Pk	17.4	-29.5	0	24.41	46	-21.59	0-360	101	H
2	67.952	50.05	Pk	12.5	-30.8	0	31.75	40	-8.25	0-360	200	V

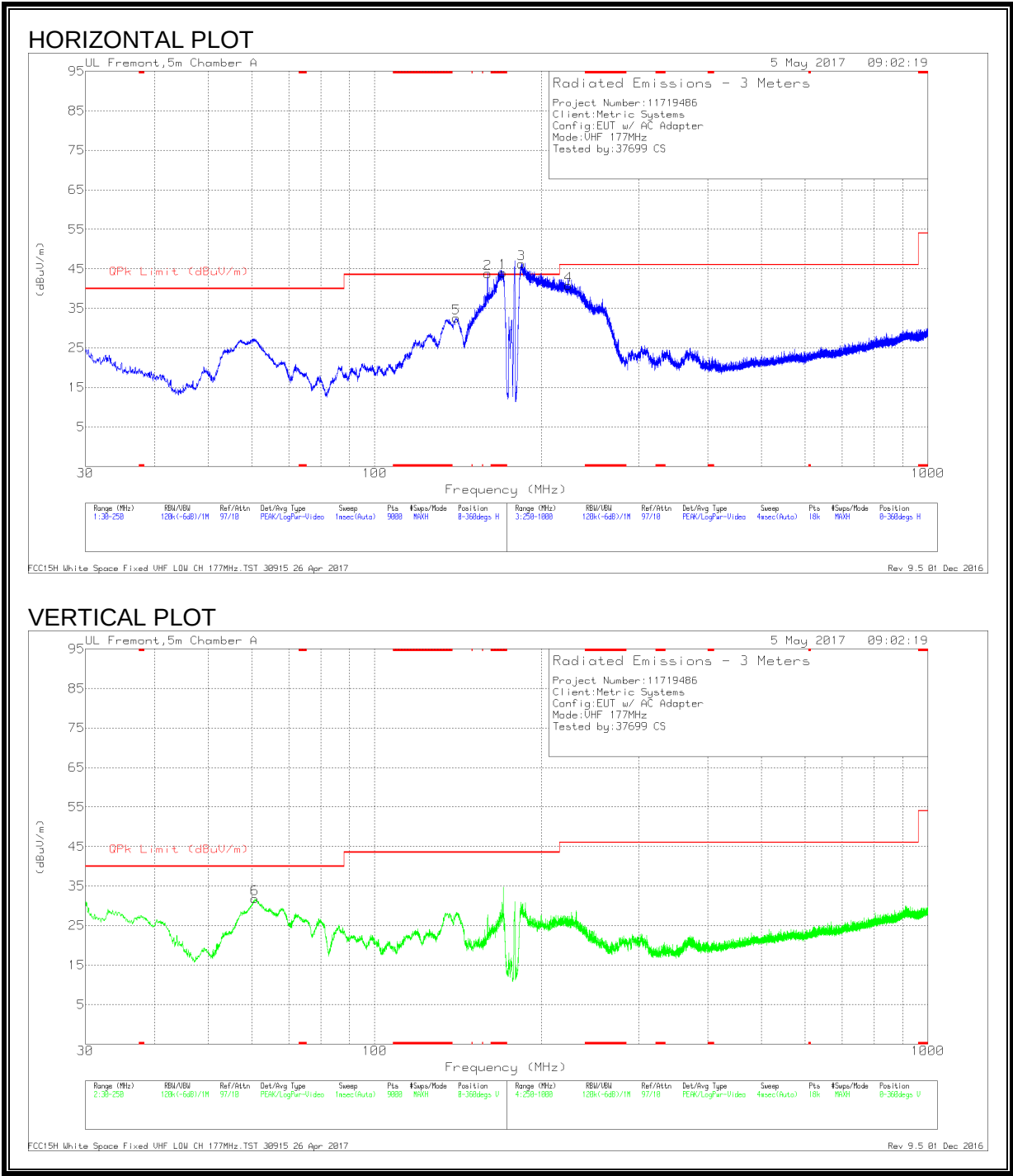
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Qp - Quasi-Peak detector

Pk - Peak detector

10.1.2. VHF BAND

BEYOND ADJACENT CHANNEL (LOW CHANNEL)



LOW CHANNEL DATA

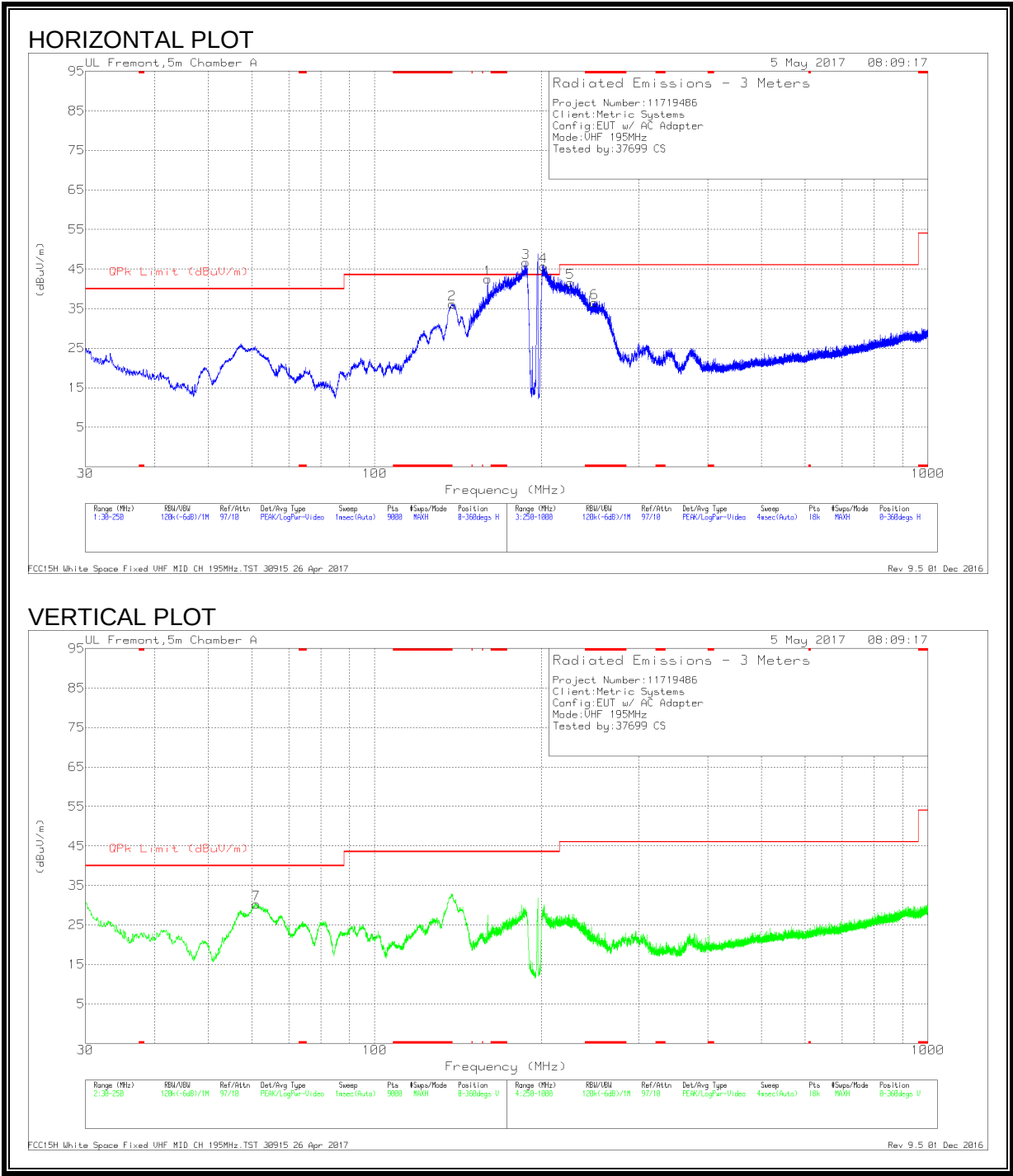
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T130 (dB/m)	Amp/Cbl (dB/m)	Filtr (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 169.5836	54.61	Qp	15.8	-30.1	.5	40.81	43.5	-2.69	63	123	H
2	159.9779	54.38	Qp	16.2	-30.2	.5	40.88	43.5	-2.62	63	139	H
3	184.6287	56.45	Qp	15.3	-30	.5	42.25	43.5	-1.25	81	111	H
4	223.933	51.61	Qp	14.8	-29.8	.5	37.11	46	-8.89	77	105	H
6	60.7299	50.28	Pk	11.8	-30.8	.5	31.78	40	-8.22	0-360	100	V
5	140.476	45.11	Pk	17.3	-30.3	.5	32.61	43.5	-10.89	0-360	101	H

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

Qp - Quasi-Peak detector

Pk - Peak detector

BEYOND ADJACENT CHANNEL (MID CHANNEL)



MID CHANNEL DATA

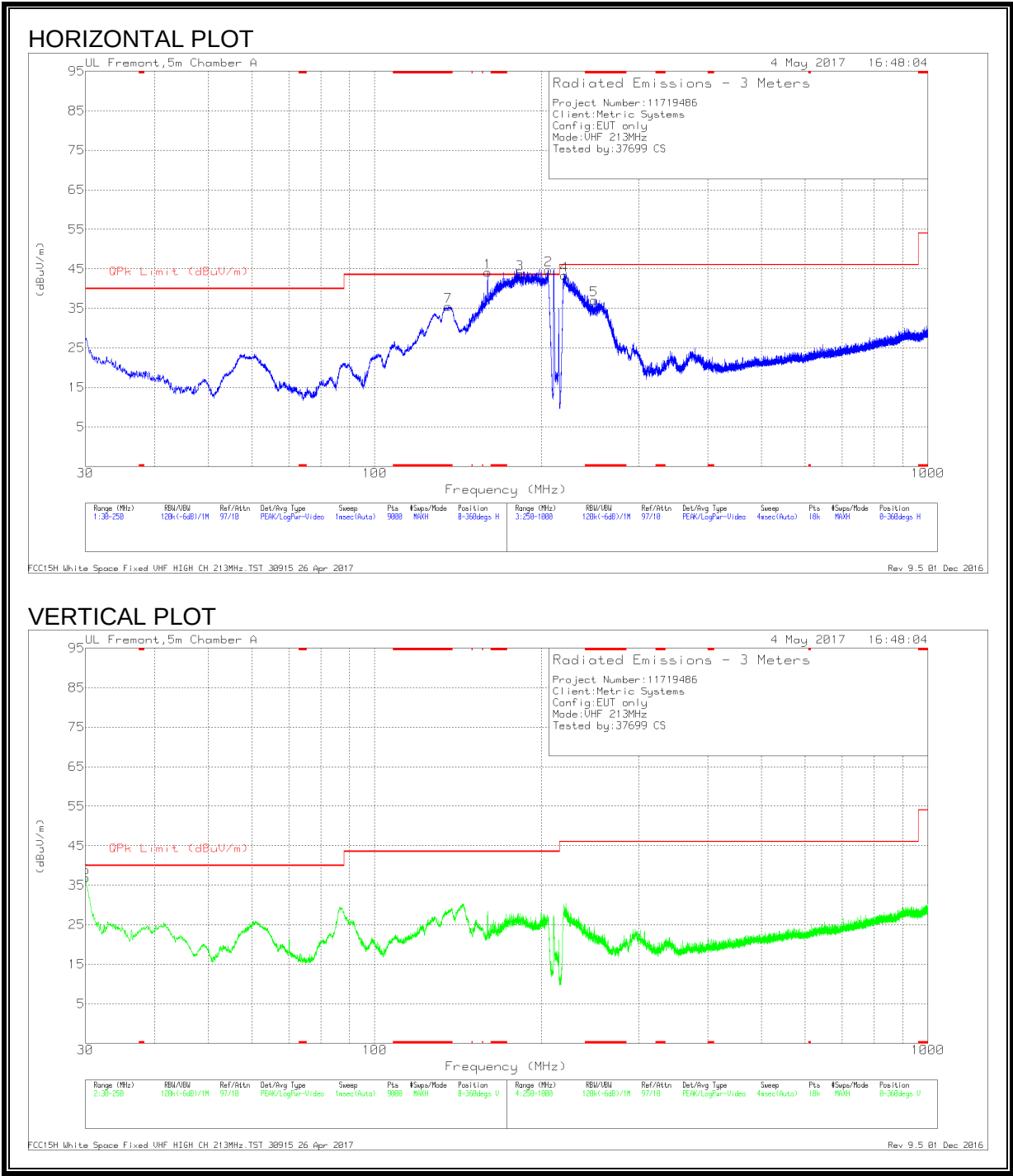
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T130 (dB/m)	Amp/Cbl (dB/m)	Filtr (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	160.0077	54.51	Qp	16.2	-30.2	.4	40.91	43.5	-2.59	76	132	H
3	187.5756	55.8	Qp	15.3	-30	.4	41.5	43.5	-2	85	108	H
4	202.1968	54.56	Qp	15.9	-29.9	.4	40.96	43.5	-2.54	49	107	H
5	225.8017	51.27	Qp	14.8	-29.8	.4	36.67	46	-9.33	72	232	H
6	* 249.6807	50.18	Pk	15.5	-29.6	.4	36.48	46	-9.52	0-360	200	H
7	61.0966	48.81	Pk	11.9	-30.8	.4	30.31	40	-9.69	0-360	100	V
2	138.1291	48.64	Pk	17.4	-30.3	.4	36.14	43.5	-7.36	0-360	200	H

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

Qp - Quasi-Peak detector

Pk - Peak detector

BEYOND ADJACENT CHANNEL (HIGH CHANNEL)



HIGH CHANNEL DATA

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T130 (dB/m)	Amp/Cbl (dB/m)	Filtr (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
6	30.022	38.47	Qp	24.5	-31.2	.4	32.17	40	-7.83	86	199	V
1	159.9813	55.36	Qp	16.2	-30.2	.4	41.76	43.5	-1.74	56	115	H
3	183.0949	54.24	Qp	15.3	-30.1	.4	39.84	43.5	-3.66	63	103	H
2	205.6759	54.51	Qp	14.8	-29.9	.4	39.81	43.5	-3.69	65	106	H
4	220.3481	53.7	Qp	14.7	-29.8	.4	39	46	-7	59	246	H
5	* 248.9962	50.89	Pk	15.5	-29.7	.4	37.09	46	-8.91	0-360	200	H
7	* 135.8311	47.88	Pk	17.5	-30.3	.4	35.48	43.5	-8.02	0-360	200	H

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

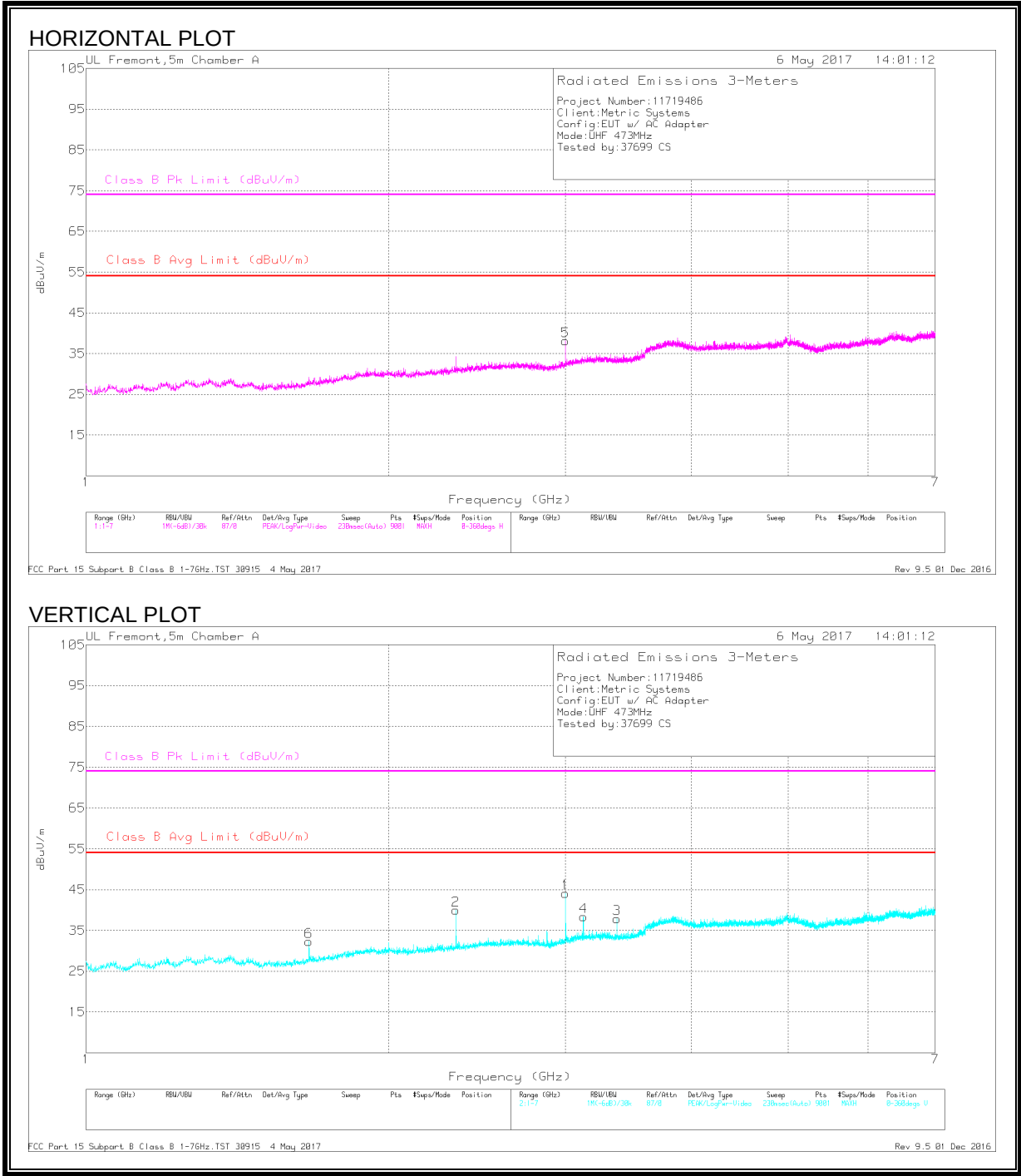
Qp - Quasi-Peak detector

Pk - Peak detector

10.2. TRANSMITTER ABOVE 1GHz

10.2.1. HARMONICS AND SPURIOUS EMISSIONS IN THE UHF BAND

LOW CHANNEL



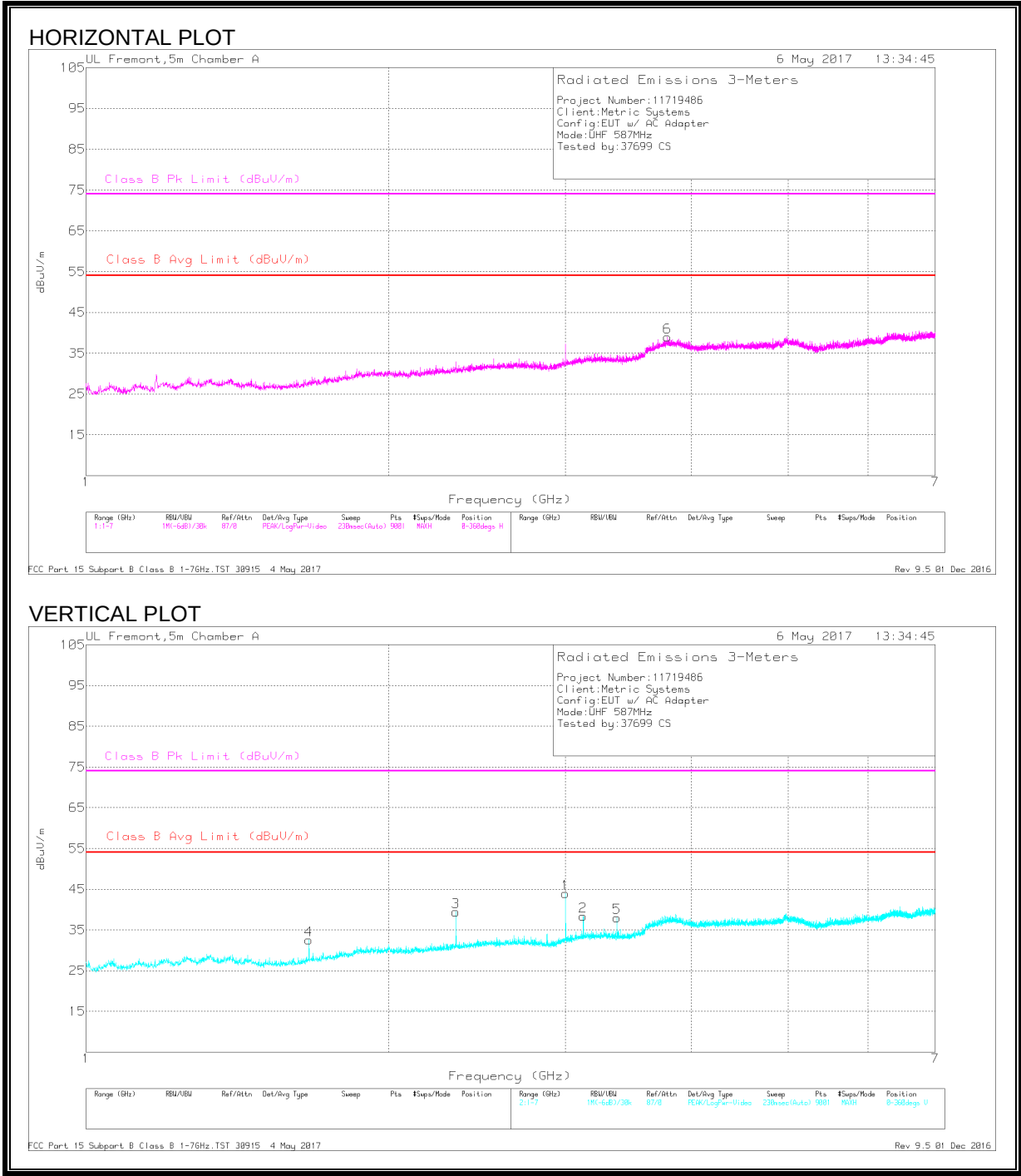
LOW CHANNEL DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T711 (dB/m)	Amp/Cbl/Fitr/P ad (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
6	1.667	33.45	Pk	28.9	-23.7	38.65	-	-	74	-35.35	54	244	V
	1.667	22.42	Av	28.9	-23.7	27.62	54	-26.38	-	-	54	244	V
2	2.333	36.3	Pk	32	-23.8	44.5	-	-	74	-29.5	129	123	V
	2.333	29.89	Av	32	-23.8	38.09	54	-15.91	-	-	129	123	V
5	3	33.94	Pk	32.7	-22.1	44.54	-	-	74	-29.46	187	101	H
	3	24.76	Av	32.7	-22.1	35.36	54	-18.64	-	-	187	101	H
1	3	37.99	Pk	32.7	-22.1	48.59	-	-	74	-25.41	86	207	V
	3	33.17	Av	32.7	-22.1	43.77	54	-10.23	-	-	86	207	V
4	3.125	33.7	Pk	33	-21.4	45.3	-	-	74	-28.7	129	152	V
	3.125	24.91	Av	33	-21.4	36.51	54	-17.49	-	-	129	152	V
3	3.375	33.06	Pk	32.8	-20.3	45.56	-	-	74	-28.44	100	115	V
	3.375	24.69	Av	32.8	-20.3	37.19	54	-16.81	-	-	100	115	V

Pk - Peak detector

Av - Average detection

MID CHANNEL



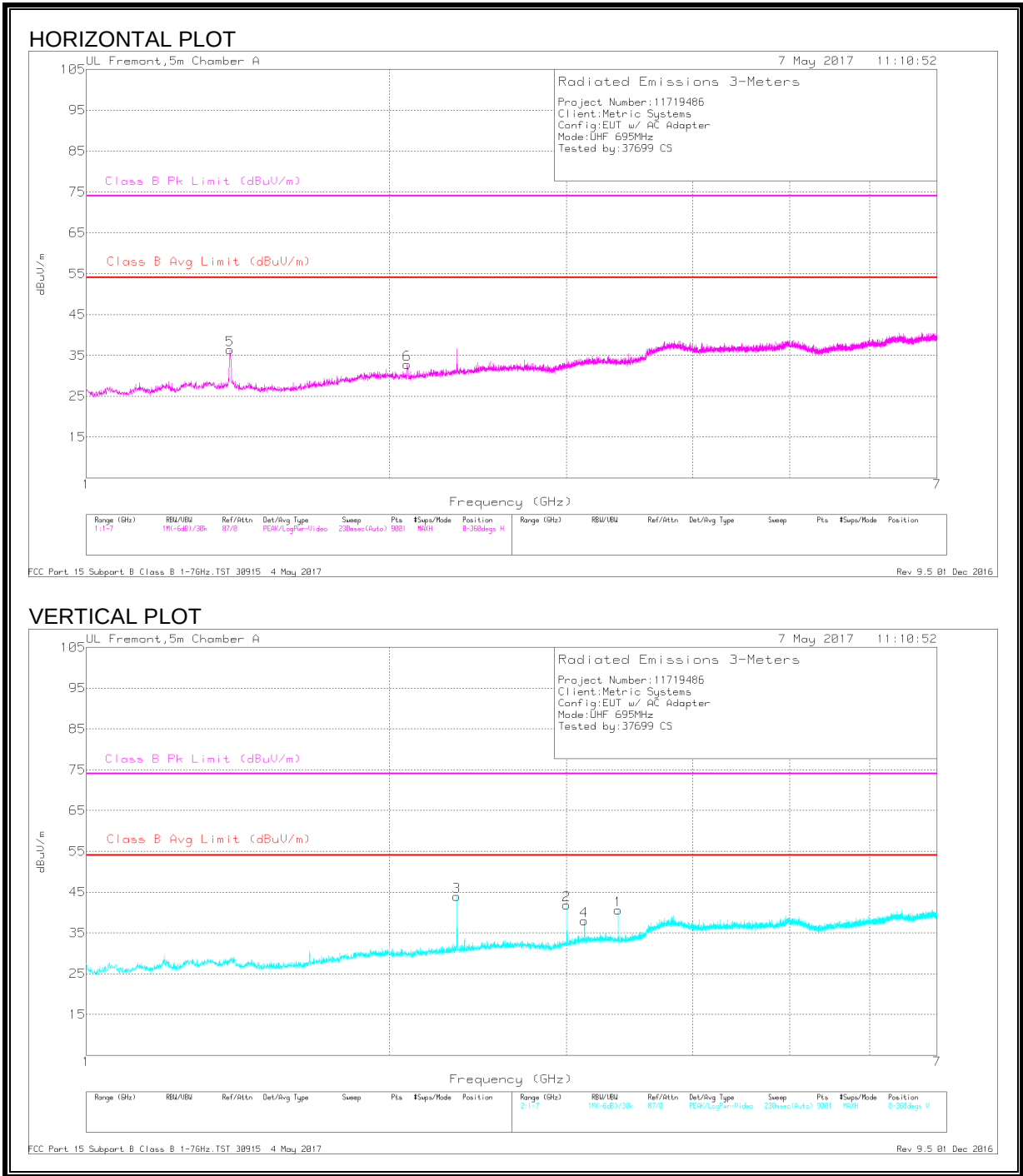
MID CHANNEL DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T711 (dB/m)	Amp/Cbl/Filtr/P ad (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

HIGH CHANNEL



HIGH CHANNEL DATA

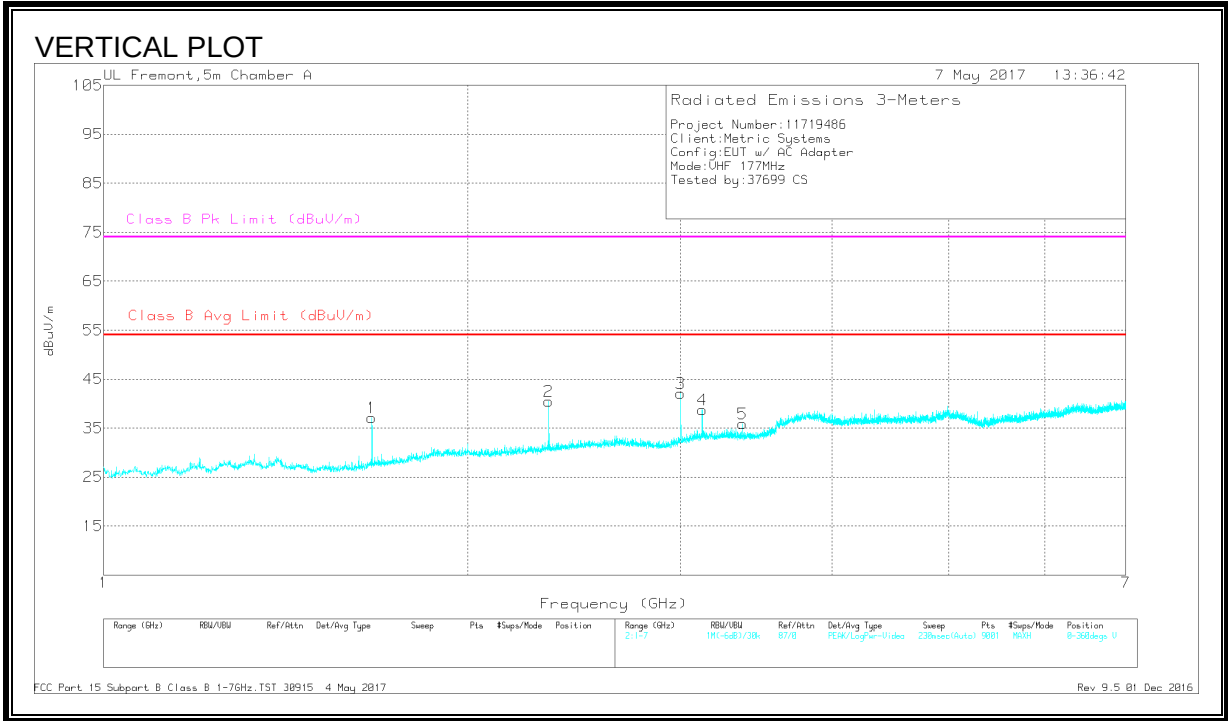
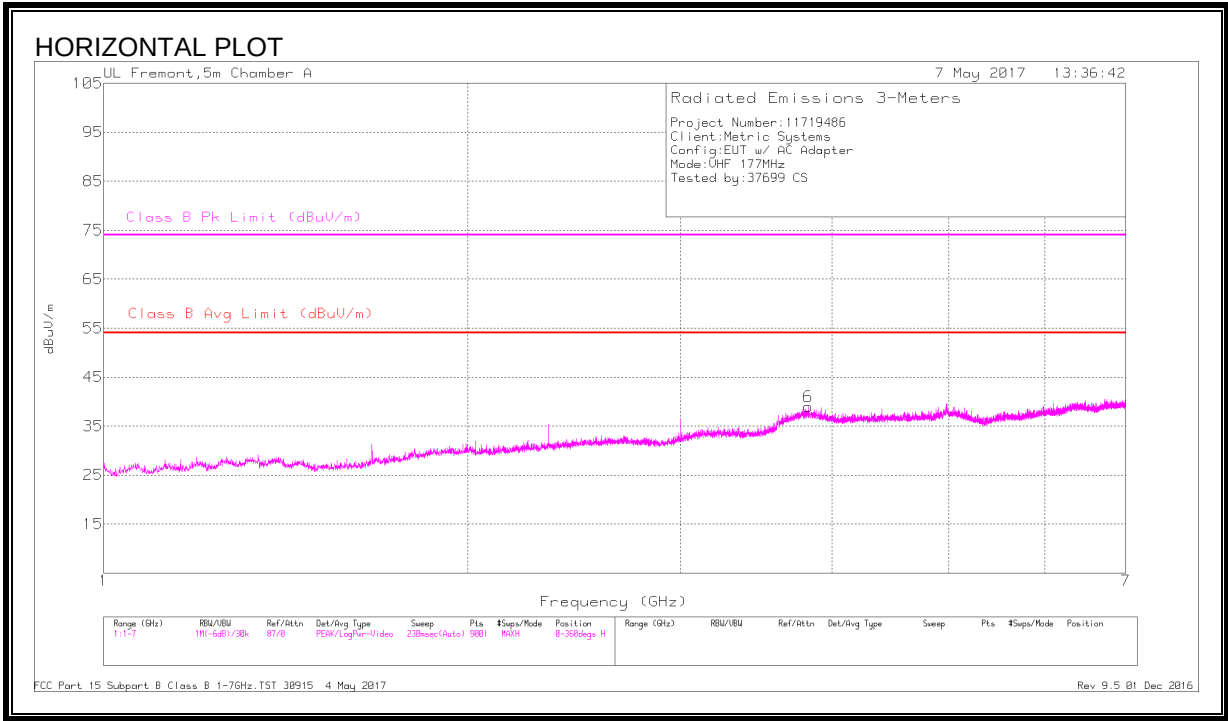
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T711 (dB/m)	Amp/Cbl/Fitr/P ad (dB)	Corrected Reading dBuV/m	Class B Avg Limit (dBuV/m)	Av Margin (dB)	Class B Pk Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
5	1.39	43.34	Pk	29.3	-23.7	48.94	-	-	74	-25.06	117	175	H
	1.39	26.84	Av	29.3	-23.7	32.44	54	-21.56	-	-	117	175	H
6	2.084	40.84	Pk	31.2	-23.8	48.24	-	-	74	-25.76	115	185	H
	2.084	21.75	Av	31.2	-23.8	29.15	54	-24.85	-	-	115	185	H
3	2.333	39.55	Pk	32	-23.8	47.75	-	-	74	-26.25	143	162	V
	2.333	35.31	Av	32	-23.8	43.51	54	-10.49	-	-	143	162	V
2	3	36.47	Pk	32.7	-22.1	47.07	-	-	74	-26.93	85	206	V
	3	29.83	Av	32.7	-22.1	40.43	54	-13.57	-	-	85	206	V
4	3.125	33.72	Pk	33	-21.4	45.32	-	-	74	-28.68	134	103	V
	3.125	25.09	Av	33	-21.4	36.69	54	-17.31	-	-	134	103	V
1	3.376	29.68	Pk	32.8	-20.3	42.18	-	-	74	-31.82	45	160	V
	3.376	16.47	Av	32.8	-20.3	28.97	54	-25.03	-	-	45	160	V

Pk - Peak detector

Av - Average detection

10.2.2. HARMONICS AND SPURIOUS EMISSIONS IN THE VHF BAND

LOW CHANNEL



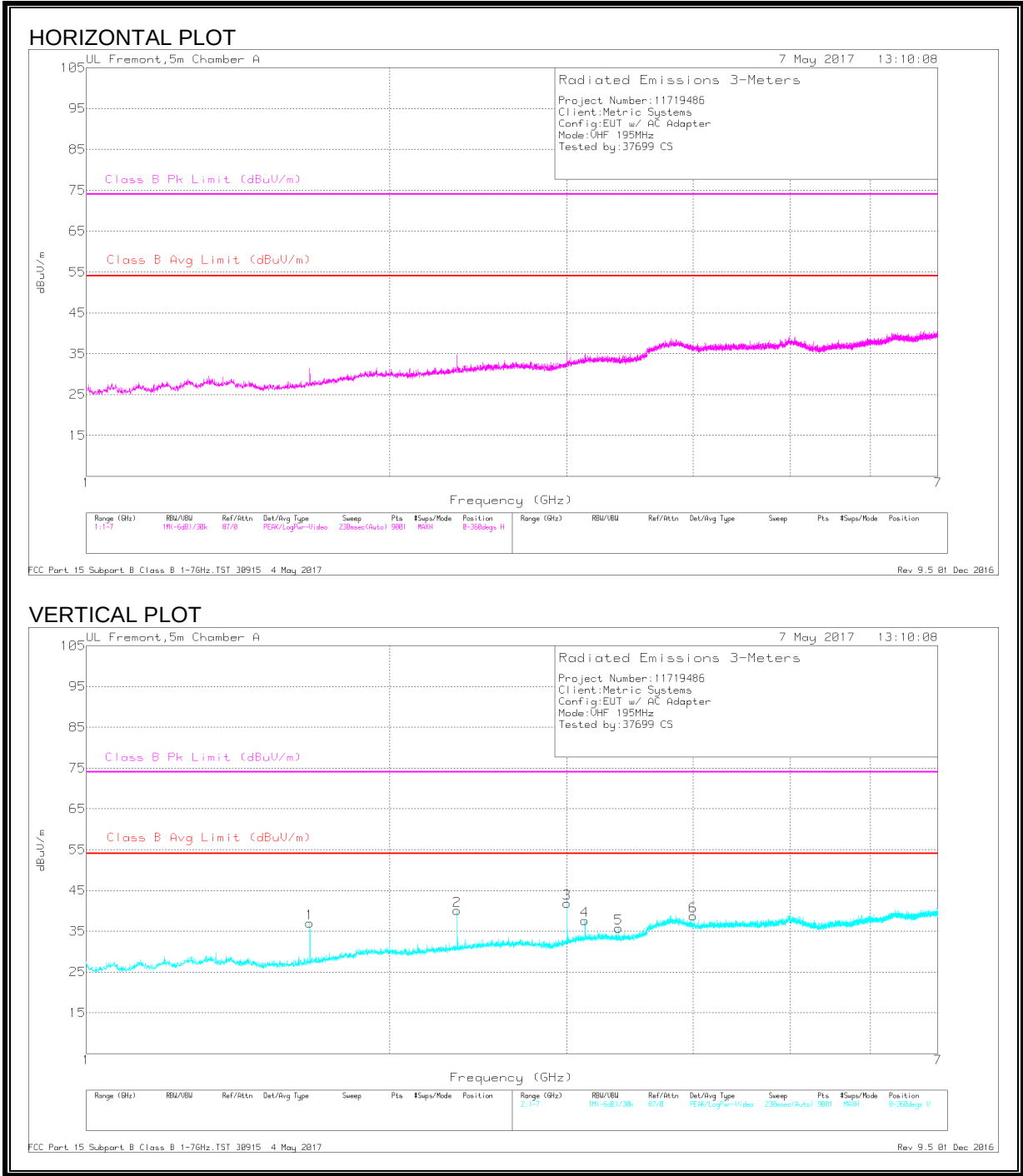
LOW CHANNEL DATA

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
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

MID CHANNEL



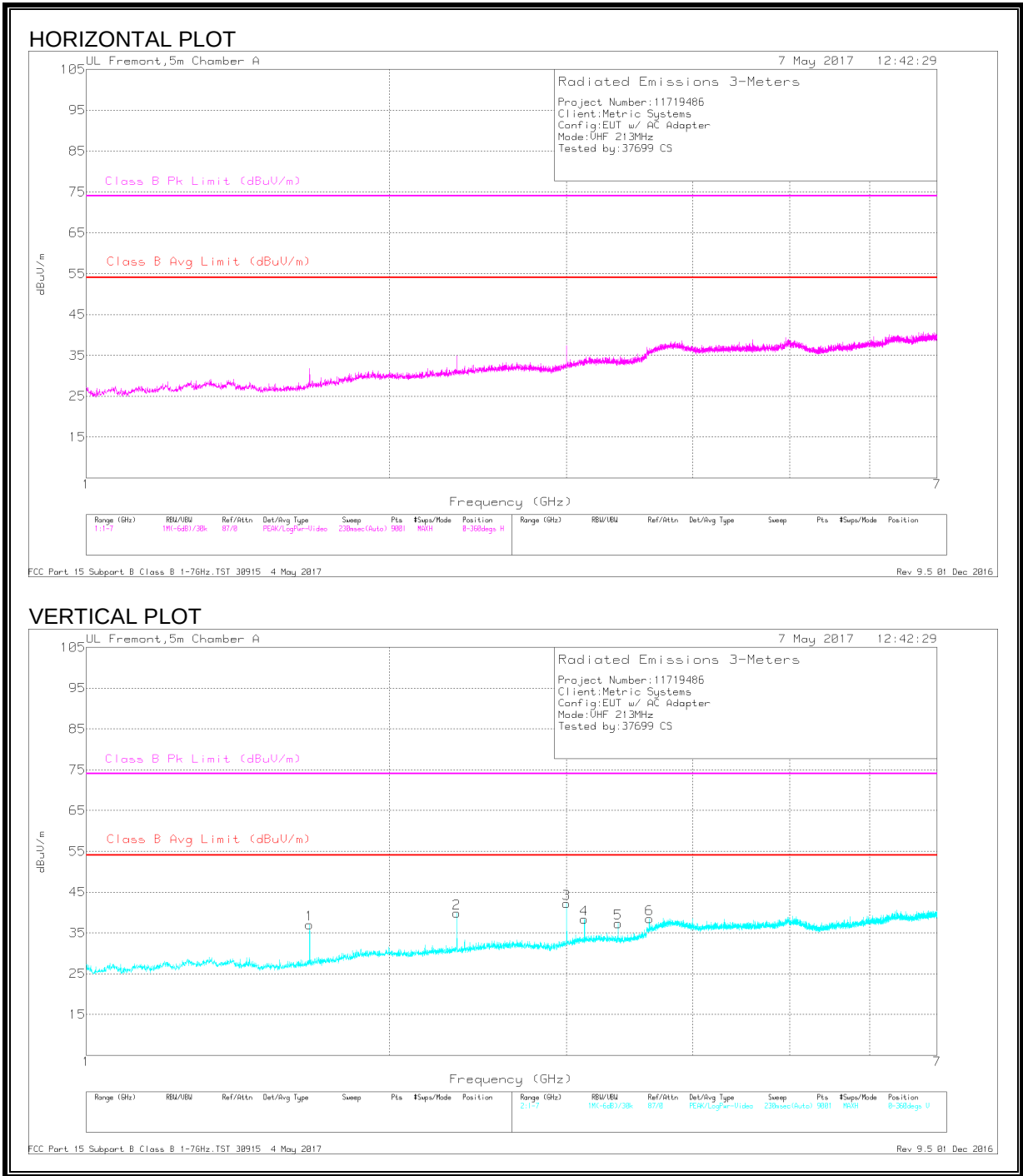
MID CHANNEL DATA

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
1	1.667	37.24	Pk	28.9	-23.7	42.44	-	-	74	-31.56	126	149	V
	1.667	32.14	Av	28.9	-23.7	37.34	54	-16.66	-	-	126	149	V
2	2.333	37.23	Pk	32	-23.8	45.43	-	-	74	-28.57	127	357	V
	2.333	31.97	Av	32	-23.8	40.17	54	-13.83	-	-	127	357	V
3	3	35.37	Pk	32.7	-22.1	45.97	-	-	74	-28.03	104	109	V
	3	30.4	Av	32.7	-22.1	41	54	-13	-	-	104	109	V
4	3.125	32.75	Pk	33	-21.4	44.35	-	-	74	-29.65	111	238	V
	3.125	26.12	Av	33	-21.4	37.72	54	-16.28	-	-	111	238	V
5	3.375	29.68	Pk	32.8	-20.3	42.18	-	-	74	-31.82	107	103	V
	3.375	21.14	Av	32.8	-20.3	33.64	54	-20.36	-	-	107	103	V
6	4	31.18	Pk	33.4	-17.7	46.88	-	-	74	-27.12	120	124	V
	4	18.83	Av	33.4	-17.7	34.53	54	-19.47	-	-	120	124	V

Pk - Peak detector

Av - Average detection

HIGH CHANNEL



HIGH CHANNEL DATA

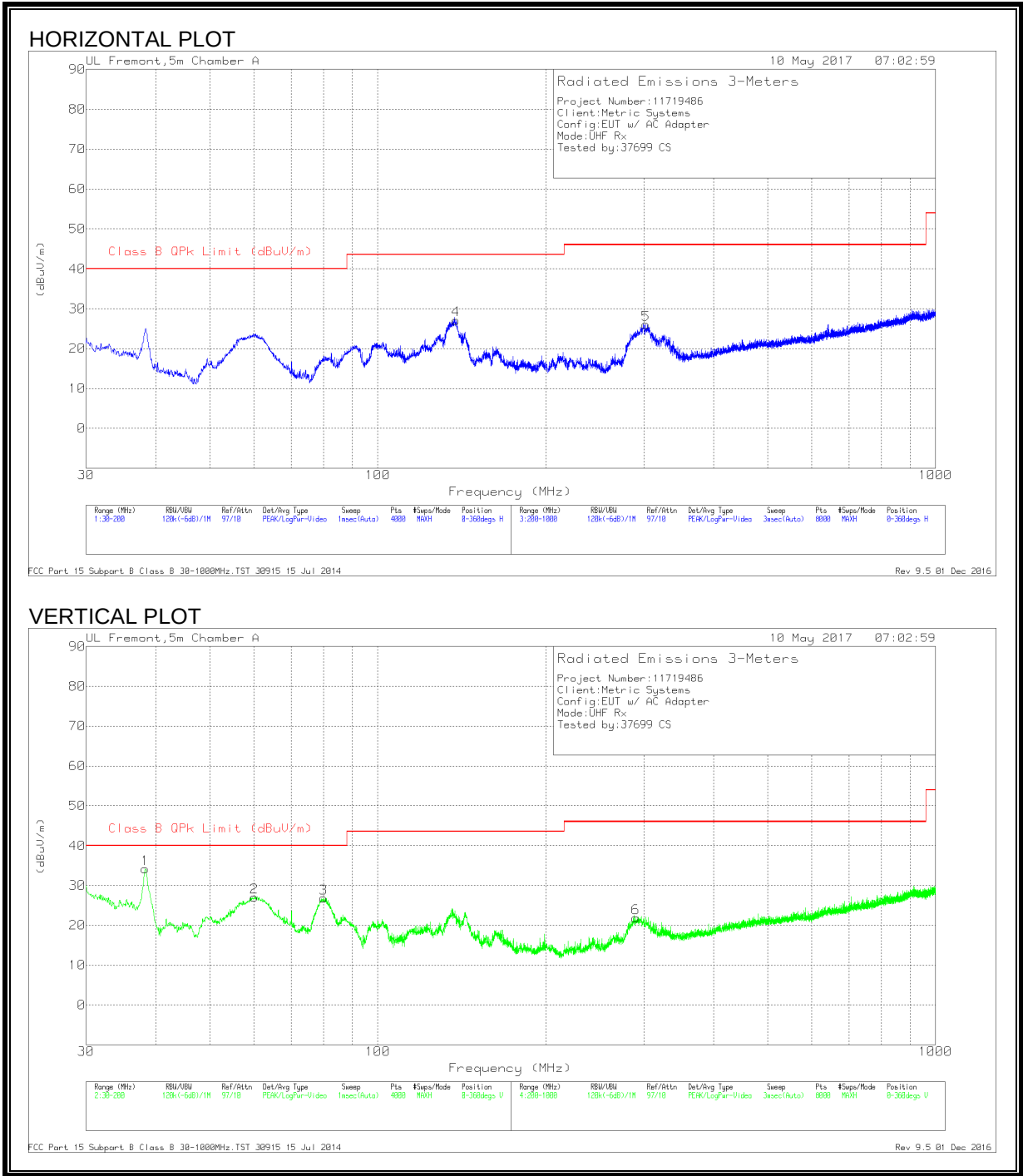
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T711 (dB/m)	Amp/Cbl/Fitr/P ad (dB)	Corrected Reading dBuV/m	Class B Avg Limit (dBuV/m)	Av Margin (dB)	Class B Pk Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	1.667	37.25	Pk	28.9	-23.7	42.45	-	-	74	-31.55	148	306	V
	1.667	32	Av	28.9	-23.7	37.2	54	-16.8	-	-	148	306	V
2	2.333	37.55	Pk	32	-23.8	45.75	-	-	74	-28.25	122	222	V
	2.333	32.1	Av	32	-23.8	40.3	54	-13.7	-	-	122	222	V
3	3	36.88	Pk	32.7	-22.1	47.48	-	-	74	-26.52	100	108	V
	3	31.38	Av	32.7	-22.1	41.98	54	-12.02	-	-	100	108	V
4	3.125	33.7	Pk	33	-21.4	45.3	-	-	74	-28.7	108	339	V
	3.125	24.52	Av	33	-21.4	36.12	54	-17.88	-	-	108	339	V
5	3.375	31.43	Pk	32.8	-20.3	43.93	-	-	74	-30.07	105	251	V
	3.375	20.96	Av	32.8	-20.3	33.46	54	-20.54	-	-	105	251	V
6	3.625	31.68	Pk	33.1	-18.9	45.88	-	-	74	-28.12	124	162	V
	3.625	20.19	Av	33.1	-18.9	34.39	54	-19.61	-	-	124	162	V

Pk - Peak detector

Av - Average detection

10.3. RECEIVER SPURIOUS EMISSIONS BELOW 1 GHz

10.3.1. UHF BAND



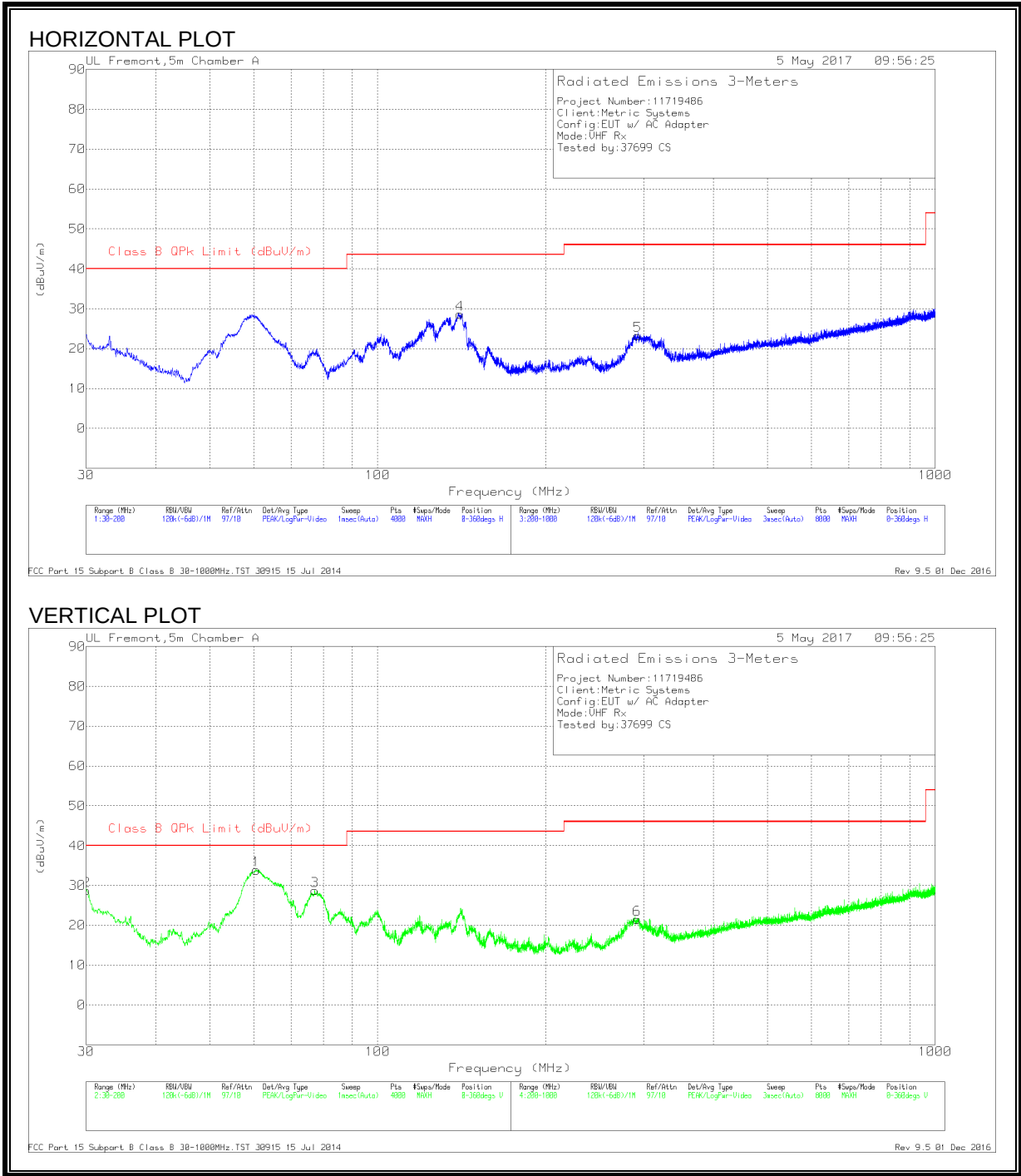
DATA

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
1	37.8326	38.22	Qp	19.5	-31.2	26.52	40	-13.48	58	103	V
2	60.0553	46.33	Pk	11.6	-30.9	27.03	40	-12.97	0-360	100	V
3	79.9504	45.73	Pk	11.8	-30.7	26.83	40	-13.17	0-360	100	V
4	138.148	40.04	Pk	17.4	-30.3	27.14	43.52	-16.38	0-360	200	H
6	290.0117	33.97	Pk	17.3	-29.4	21.87	46.02	-24.15	0-360	101	V
5	302.3133	37.97	Pk	17.5	-29.4	26.07	46.02	-19.95	0-360	101	H

Qp - Quasi-Peak detector

Pk - Peak detector

10.3.2. VHF BAND



DATA

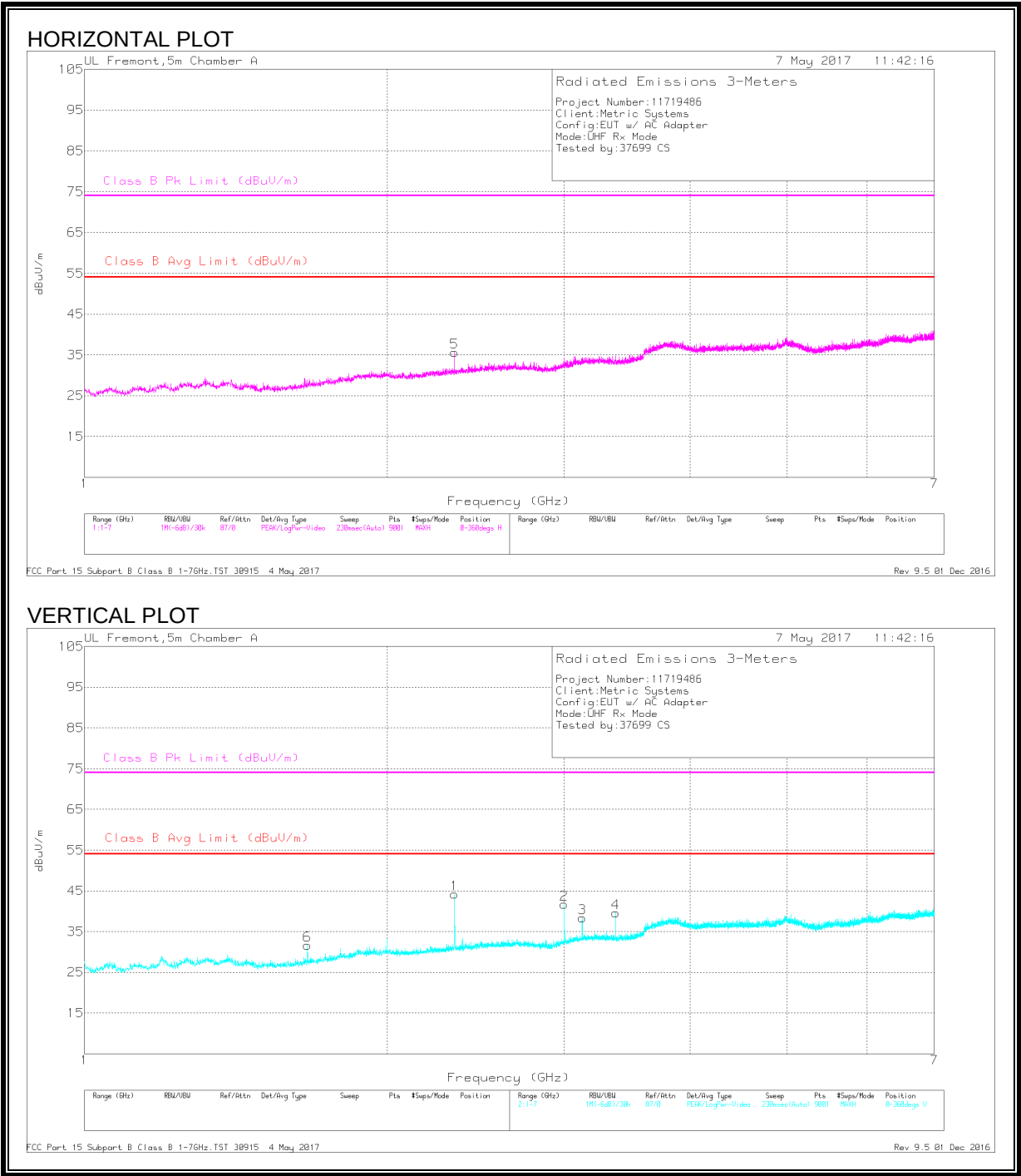
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T130 (dB/m)	Amp/Cbl (dB/m)	Corrected Reading (dBuV/m)	Class B QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	60.4079	50.76	Qp	11.7	-30.9	31.56	40	-8.44	312	101	V
3	77.1022	47.45	Pk	12.1	-30.8	28.75	40	-11.25	0-360	100	V
4	140.5286	41.69	Pk	17.2	-30.3	28.59	43.52	-14.93	0-360	200	H
6	291.7119	33.58	Pk	17.3	-29.4	21.48	46.02	-24.54	0-360	200	V
5	292.412	35.37	Pk	17.3	-29.4	23.27	46.02	-22.75	0-360	101	H
2	30.085	35.51	Pk	24.4	-31.2	28.71	40	-11.29	0-360	100	V

Qp - Quasi-Peak detector

Pk - Peak detector

10.4. RECEIVER SPURIOUS EMISSIONS ABOVE 1 GHz

10.4.1. UHF BAND

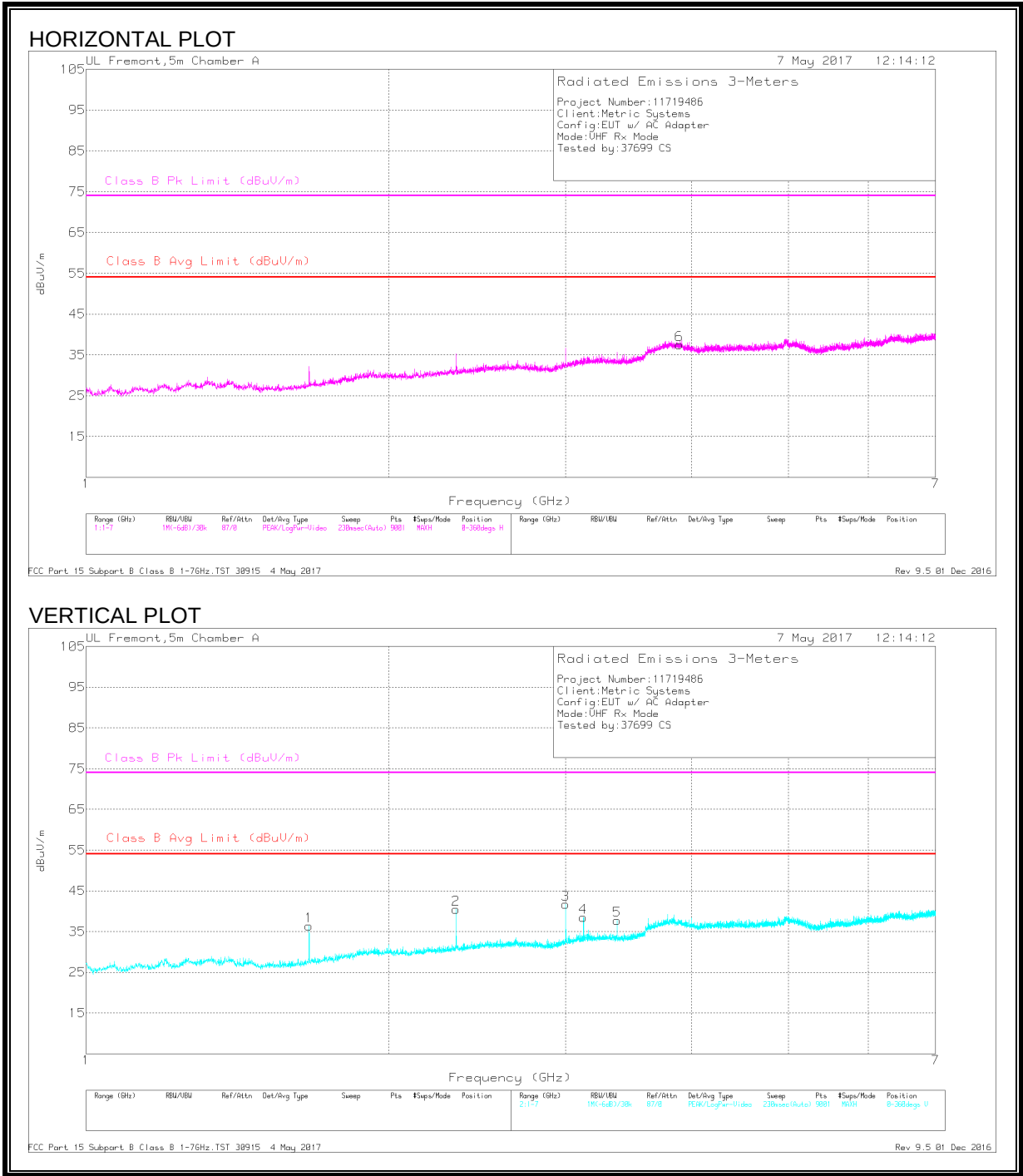


DATA

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
6	1.667	33.43	Pk	28.9	-23.7	38.63	-	-	74	-35.37	200	201	V
	1.667	23.58	Av	28.9	-23.7	28.78	54	-25.22	-	-	200	201	V
5	2.333	34.7	Pk	32	-23.8	42.9	-	-	74	-31.1	25	356	H
	2.333	26.08	Av	32	-23.8	34.28	54	-19.72	-	-	25	356	H
1	2.333	39.45	Pk	32	-23.8	47.65	-	-	74	-26.35	110	113	V
	2.333	35.56	Av	32	-23.8	43.76	54	-10.24	-	-	110	113	V
2	3	36.51	Pk	32.7	-22.1	47.11	-	-	74	-26.89	97	255	V
	3	30.11	Av	32.7	-22.1	40.71	54	-13.29	-	-	97	255	V
3	3.125	33.66	Pk	33	-21.4	45.26	-	-	74	-28.74	141	152	V
	3.125	25.33	Av	33	-21.4	36.93	54	-17.07	-	-	141	152	V
4	3.375	32.92	Pk	32.8	-20.3	45.42	-	-	74	-28.58	122	177	V
	3.375	25.31	Av	32.8	-20.3	37.81	54	-16.19	-	-	122	177	V

Pk - Peak detector
Av - Average detection

10.4.2. VHF BAND



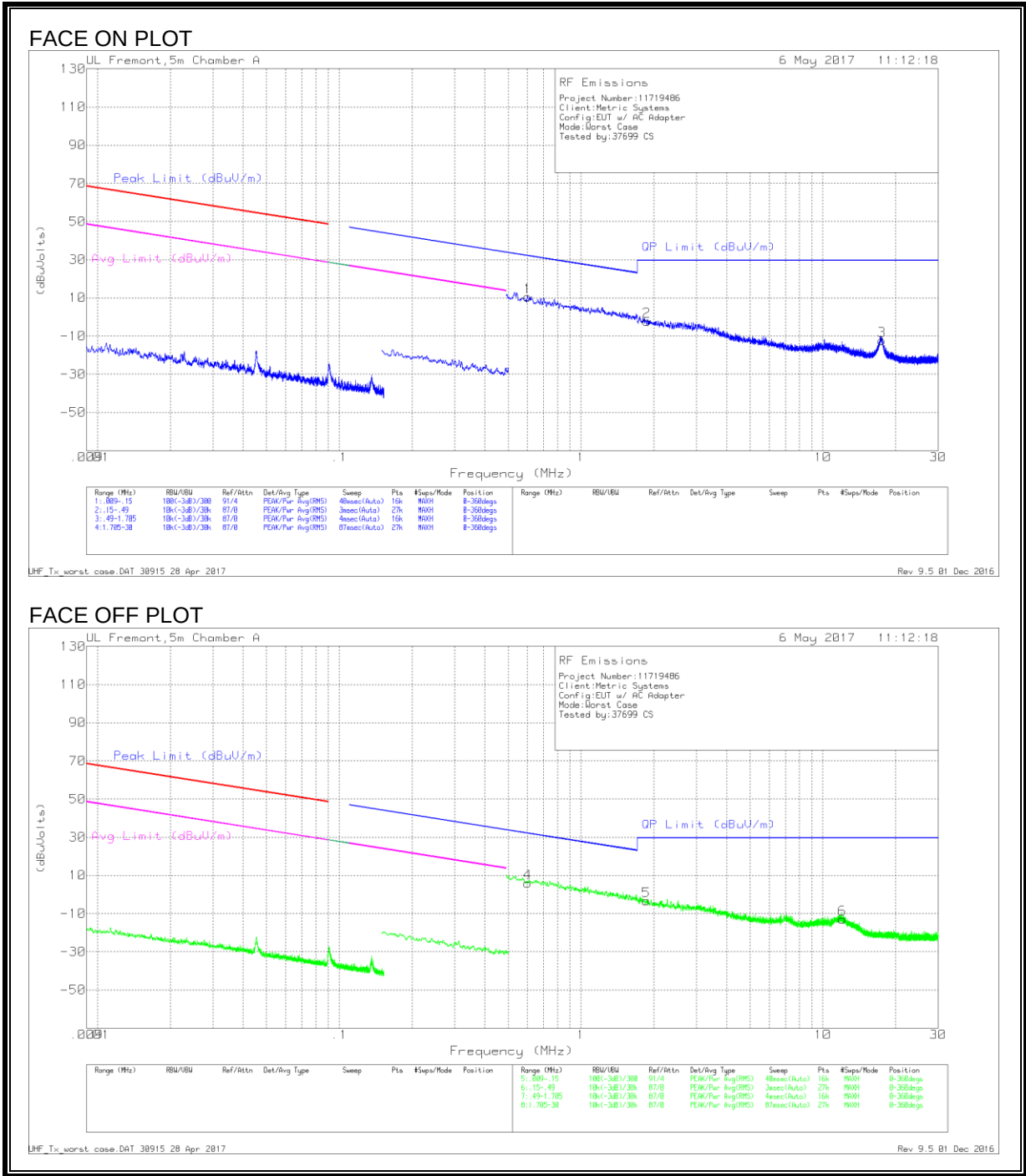
DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T711 (dB/m)	Amp/Cbl/Filtr/P ad (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	37	Pk	28.9	-23.7	42.2	-	-	74	-31.8	305	151	V
	1.667	30.91	Av	28.9	-23.7	36.11	54	-17.89	-	-	305	151	V
2	2.333	37.66	Pk	32	-23.8	45.86	-	-	74	-28.14	121	350	V
	2.333	32.58	Av	32	-23.8	40.78	54	-13.22	-	-	121	350	V
3	3	36.96	Pk	32.7	-22.1	47.56	-	-	74	-26.44	100	102	V
	3	30.95	Av	32.7	-22.1	41.55	54	-12.45	-	-	100	102	V
4	3.125	34.28	Pk	33	-21.4	45.88	-	-	74	-28.12	108	199	V
	3.125	26.14	Av	33	-21.4	37.74	54	-16.26	-	-	108	199	V
5	3.375	32.23	Pk	32.8	-20.3	44.73	-	-	74	-29.27	97	212	V
	3.375	23.04	Av	32.8	-20.3	35.54	54	-18.46	-	-	97	212	V
6	3.892	30.35	Pk	33.3	-17.8	45.85	-	-	74	-28.15	123	256	H
	3.892	17.72	Av	33.3	-17.8	33.22	54	-20.78	-	-	123	256	H

Pk - Peak detector

Av - Average detection

10.5. WORST-CASE TRANSMITTER BELOW 30MHz

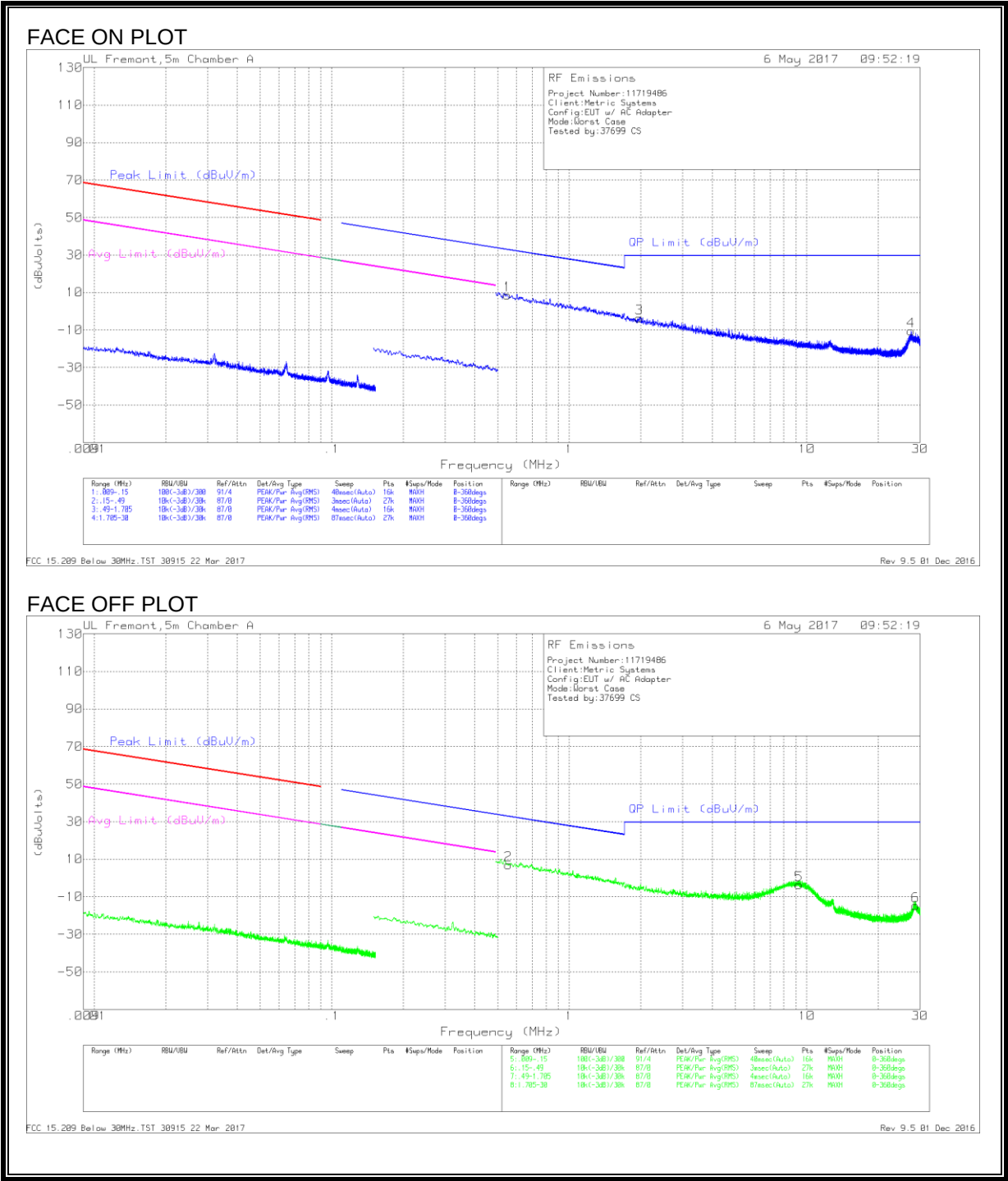


DATA

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (dB/m)	Cbl (dB)	Dist Corr 30m	Corrected Reading (dBuVolts)	QP Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
1	.60126	38.89	Pk	11.5	.1	-40	10.49	32.03	-21.54	0-360
4	.60199	34.36	Pk	11.5	.1	-40	5.96	32.02	-26.06	0-360
5	1.86325	24.79	Pk	11.6	.2	-40	-3.41	29.5	-32.91	0-360
2	1.8732	25.95	Pk	11.6	.2	-40	-2.25	29.5	-31.75	0-360
6	12.03723	16	Pk	10.6	.5	-40	-12.9	29.5	-42.4	0-360
3	17.54133	17.07	Pk	9.9	.6	-40	-12.43	29.5	-41.93	0-360

Pk - Peak detector

10.6. WORST-CASE RECEIVER BELOW 30MHz



DATA

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (dB/m)	Cbl (dB)	Dist Corr 30m	Corrected Reading (dBuVolts)	QP Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
1	.5486	37.04	Pk	11.6	.1	-40	8.74	32.82	-24.08	0-360
2	.55418	35.24	Pk	11.6	.1	-40	6.94	32.73	-25.79	0-360
3	1.96805	24.43	Pk	11.7	.2	-40	-3.67	29.5	-33.17	0-360
5	9.28309	25.11	Pk	10.9	.5	-40	-3.49	29.5	-32.99	0-360
4	27.43654	19.89	Pk	8.8	.8	-40	-10.51	29.5	-40.01	0-360
6	28.7151	15.95	Pk	8.6	.8	-40	-14.65	29.5	-44.15	0-360

Pk - Peak detector

11. AC MAINS LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

Frequency range (MHz)	Limits (dBμV)	
	Quasi-peak	Average
0.15 to 0.50	79	66
0.50 to 30	73	60
Note: The lower limit shall apply at the transition frequencies		

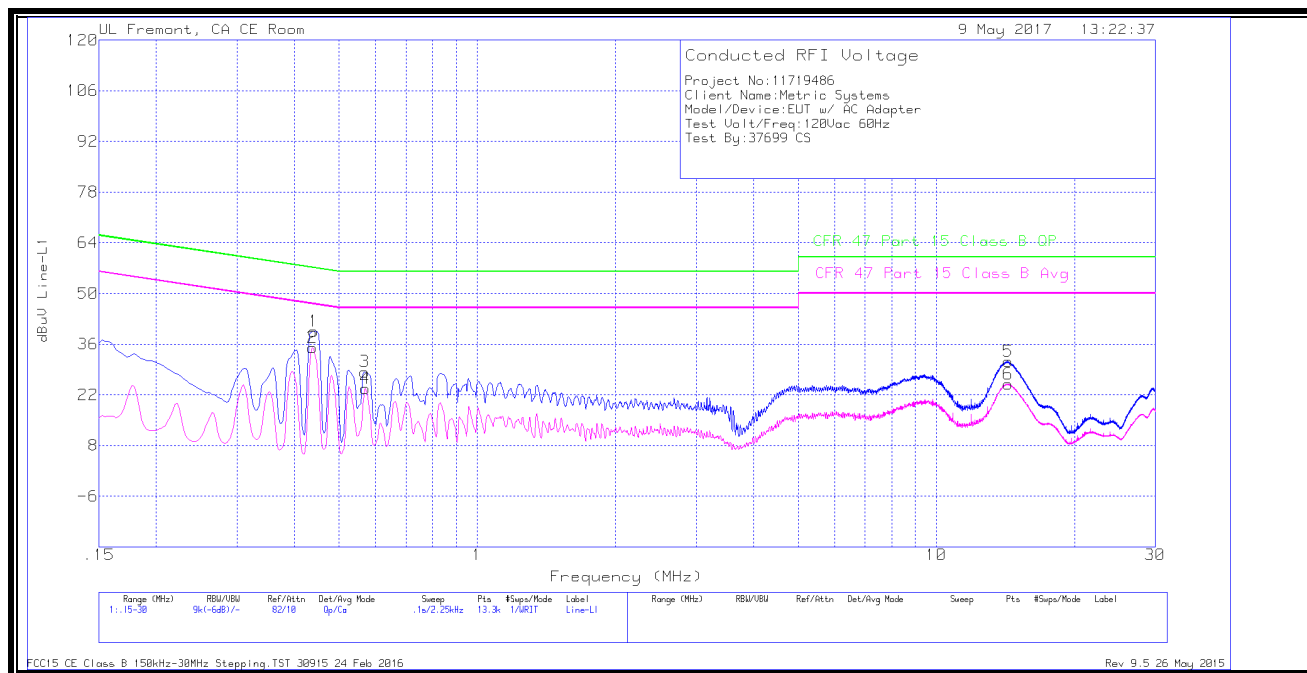
TEST PROCEDURE

ANSI C63.4-2009.

Line conducted data is recorded for both NEUTRAL and HOT lines.

11.1. UHF MODE

11.1.1. LINE 1 RESULTS



DATA

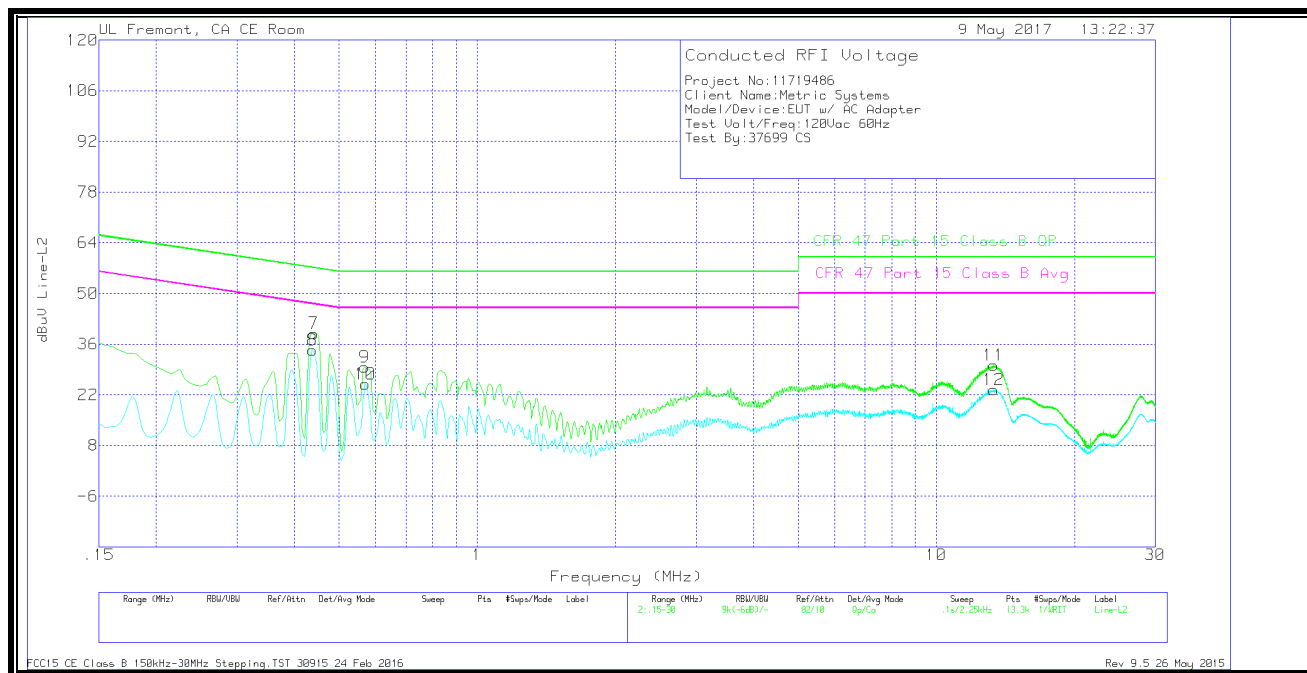
Range 1: Line-L1 .15 - 30MHz

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	.44025	29.44	Qp	0	.1	10.1	39.64	57.06	-17.42	-	-
2	.438	24.83	Ca	0	.1	10.1	35.03	-	-	47.1	-12.07
3	.5685	18.16	Qp	0	.1	10.1	28.36	56	-27.64	-	-
4	.57075	13.6	Ca	0	.1	10.1	23.8	-	-	46	-22.2
5	14.3385	20.9	Qp	0	.2	10.2	31.3	60	-28.7	-	-
6	14.352	14.61	Ca	0	.2	10.2	25.01	-	-	50	-24.99

Qp - Quasi-Peak detector

Ca - CISPR average detection

11.1.2. LINE 2 RESULTS



DATA

Range 2: Line-L2 .15 - 30MHz

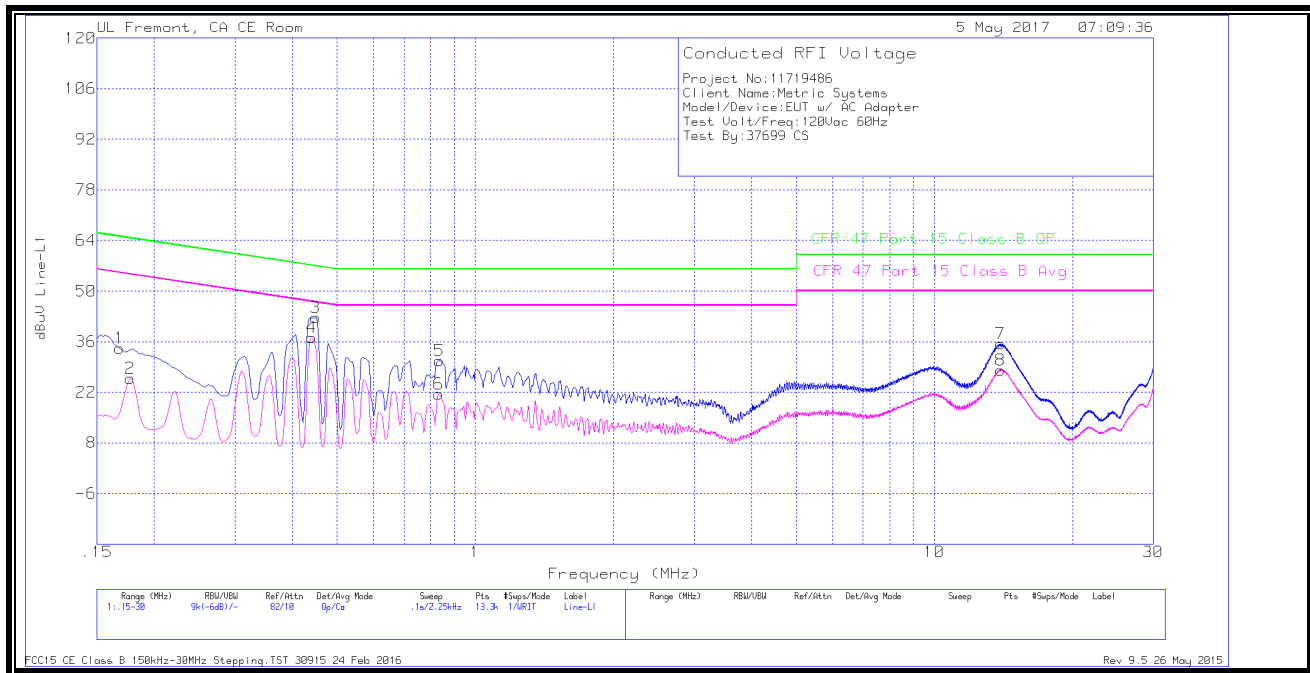
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L2	LC Cables C2&C3	Limiter (dB)	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR) Margin (dB)
7	.44025	28.76	Qp	0	.1	10.1	38.96	57.06	-18.1	-	-
8	.438	24.13	Ca	0	.1	10.1	34.33	-	-	47.1	-12.77
9	.5685	19.53	Qp	0	.1	10.1	29.73	56	-26.27	-	-
10	.57075	14.8	Ca	0	.1	10.1	25	-	-	46	-21
11	13.344	19.75	Qp	.1	.2	10.2	30.25	60	-29.75	-	-
12	13.34288	12.9	Ca	.1	.2	10.2	23.4	-	-	50	-26.6

Qp - Quasi-Peak detector

Ca - CISPR average detection

11.2. VHF MODE

11.2.1. LINE 1 RESULTS

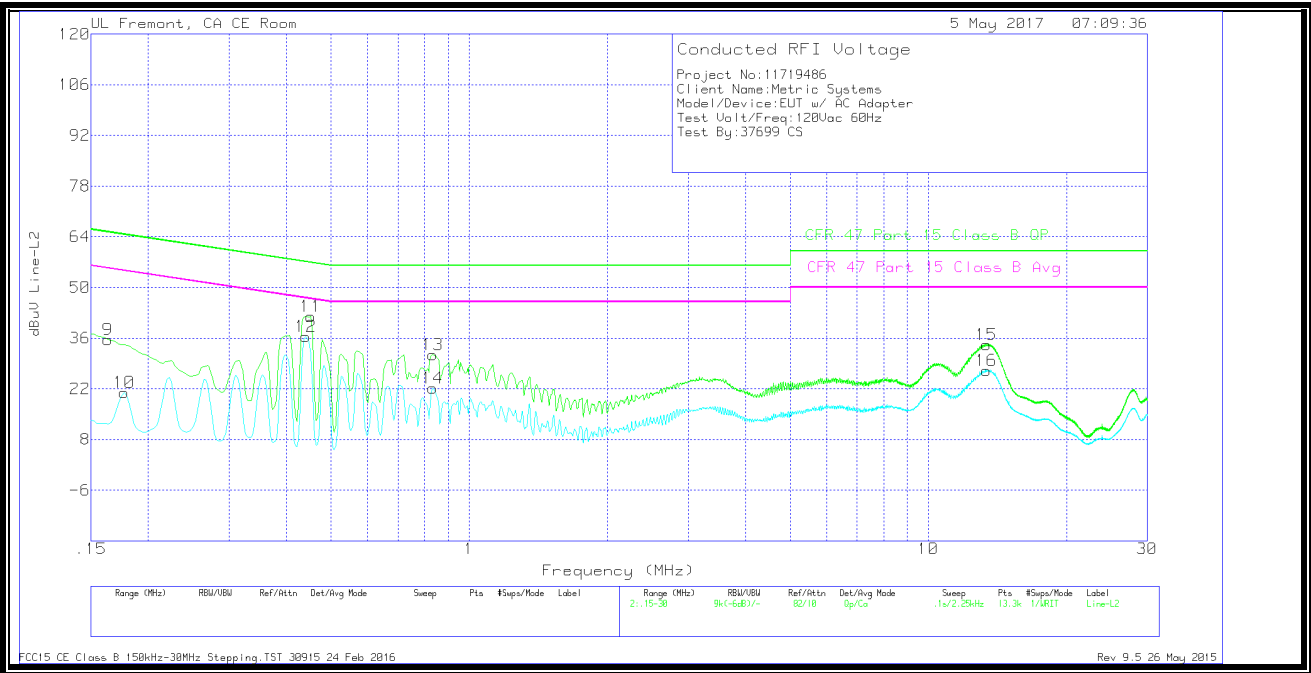


DATA

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	.168	24.01	Qp	0	0	10.1	34.11	65.06	-30.95	-	-
2	.177	15.63	Ca	0	.1	10.1	25.83	-	-	54.63	-28.8
3	.44925	32.43	Qp	0	.1	10.1	42.63	56.89	-14.26	-	-
4	.44025	26.91	Ca	0	.1	10.1	37.11	-	-	47.06	-9.95
5	.83625	20.56	Qp	0	.1	10.1	30.76	56	-25.24	-	-
6	.834	11.34	Ca	0	.1	10.1	21.54	-	-	46	-24.46
7	13.9335	24.92	Qp	.1	.2	10.2	35.42	60	-24.58	-	-
8	13.92788	17.61	Ca	.1	.2	10.2	28.11	-	-	50	-21.89

Qp - Quasi-Peak detector
Ca - CISPR average detection

11.2.2. LINE 2 RESULTS



DATA

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	.1635	25.41	Qp	0	.1	10.1	35.61	65.28	-29.67	-	-
10	.177	10.75	Ca	0	.1	10.1	20.95	-	-	54.63	-33.68
11	.4515	31.82	Qp	0	.1	10.1	42.02	56.85	-14.83	-	-
12	.44025	26.3	Ca	0	.1	10.1	36.5	-	-	47.06	-10.56
13	.83175	21.21	Qp	0	.1	10.1	31.41	56	-24.59	-	-
14	.834	12.03	Ca	0	.1	10.1	22.23	-	-	46	-23.77
15	13.39125	23.66	Qp	.1	.2	10.2	34.16	60	-25.84	-	-
16	13.39125	16.48	Ca	.1	.2	10.2	26.98	-	-	50	-23.02

Qp - Quasi-Peak detector
Ca - CISPR average detection

12. FIXED BASE STATION DATABASE CERTIFICATION TESTS

Test Procedure

Both base and client software and hardware are identical the only difference is the deployment location. The test requirements were done on the base except for a few scenarios where client was also tested.

12.1. Fixed WSD Registration

CLAUSES

- §15.713(g)(3)

REQUIREMENT

- The Fixed WSD must provide the required information to the database and obtain a successful registration.
- The management software must be able to collect the data listed below. Confirm that the EUT will not operate unless a successful registration notification is received from the database.
 - i. FCC ID
 - ii. Serial Number
 - iii. Location Coordinates
 - iv. Location uncertainty with 95% accuracy (covered by section 3.8 in this report)
 - v. Antenna Height AGL (must not be > 30 m)
 - vi. Contact information (Device owner and device contact)
- For a fixed WSD without a direct connection to the internet, confirm that registration through a registered fixed device takes place only on a channel available to that registered device.
- **PRE-REGISTRATION PROCESS**
- Both the Base and Client Station are registered using an authorized database via the Internet at the depot facility. Following registration a common available channel between each is site is selected as the initial transmitting channel for each site. This channel will be the initial “listening” channel for the Remote Station

12.1.1. SUCCESSFUL REGISTRATION

TEST PROCEDURE

- Configure the base EUT with correct registration information:
 - The FCC ID and serial number are permanently programmed to the device and cannot be modified.
 - Known acceptable geographic coordinates, antenna height AGL and contact information were entered into the EUT.
- The base EUT automatically contacts the TVWS Database to perform device registration.
- Upon successful registration, the base EUT automatically contacts the TVWS Database to retrieve device channel list.
- Selects a channel from the channel list returned from the TVWS Database and start normal radio operation on the selected channel.
- Verify base output signal on the selected channel on the spectrum analyzer.

RESULTS

The EUT successfully registered when correct registration information was submitted to the TVWS Database. The EUT transmission was observed on the spectrum analyzer on the selected TV channel from the returned channel list from the TVWS Database.

Test Results			
Pass	Fail	Tested By	Test Date
☒	☐	37699 CS	05/03/17

Successful Device Registration with Database

Raptor System

http://10.0.0.212/radioTVDBLogger.html

METRIC SYSTEMS CORPORATION RAPTOR-X Whitespace Radio

Node: RaptorXR-212
Date: 05-03-2017
Time: 14:55:05
Uptime: 0d 0h 33m
Model: RaptorXR
Firmware: V4.4.0 043017
FCC ID: 5077391P

System Admin »
Tools »
Radio Control »
Video Control »

Radio TVDB Log

RaptorXR Radio Log

How many lines to display? 10 Download Log

Refresh Rate 15 seconds

RADIO 1

- 2) 2017-05-03T21:47:52Z: REBOOTRADIO-radio: /usr/sbin/conting tapu up
- 3) 2017-05-03T21:48:16Z: CHKCHNAVAL-radio: Authorized for chnl/freq 16/485 stop time: 2017-05-04T21:48:16Z
- 4) 2017-05-03T21:48:23Z: CHKCHNAVAL-radio: Authorized for chnl/freq 16/485 stop time: 2017-05-04T21:48:23Z
- 5) 2017-05-03T21:50:30Z: CHKCHNAVAL-radio: Authorized for chnl/freq 16/485 stop time: 2017-05-04T21:50:30Z
- 6) 2017-05-03T21:52:20Z: CHKCHNAVAL-radio: Authorized for chnl/freq 16/485 stop time: 2017-05-04T21:52:20Z
- 7) 2017-05-03T21:52:47Z: CHKCHNAVAL-radio: Authorized for chnl/freq 16/485 stop time: 2017-05-04T21:52:47Z
- 8) 2017-05-03T21:52:54Z: CHKCHNAVAL-radio: Authorized for chnl/freq 16/485 stop time: 2017-05-04T21:52:54Z
- 9) 2017-05-03T21:53:19Z: CHKCHNAVAL-radio: Authorized for chnl/freq 16/485 stop time: 2017-05-04T21:53:19Z
- 10) 2017-05-03T21:53:25Z: CHKCHNAVAL-radio: Authorized for chnl/freq 16/485 stop time: 2017-05-04T21:53:25Z

Radio Status

Local Received Status:
Demod Lock: 0 TPS Lock: 0 Quality: 0 Sig Strength: 0 BER: 0.000e+00 Abort Count: 0

Remote Received Status:
Demod Lock: 0 TPS Lock: 0 Quality: 0 Sig Strength: 0 BER: 0.000e+00 Abort Count: 0

Channel selection from Database

TV Band Device Configuration

http://10.0.0.212/tvbandConfig.html

METRIC SYSTEMS CORPORATION RAPTORXR Whitespace Radio

Node: RaptorXR-212
Date: 05-03-2017
Time: 14:48:53
Uptime: 0d 0h 27m
Model: RaptorXR
Firmware: V4.4.0 043017
FCC ID: 5077391P

System Admin »
Tools »
Radio Control »
Video Control »

TV Band Device Configuration

Radio: 1
FCC ID: 2ABC-50739
Serial Number: 00001
Transmission Line Loss (dB): 3
Height Above Ground Lvl (m): 30
Antenna Gain: 12 dBi EIR 36

Status: Up
Enable Radio? Yes
Start Radio on Startup? ☒
Receive Frequency? Channel 44 (653 MHz)
Apply Changes

Location Information

Latitude (degrees): 33.144444
Longitude (degrees): -117.224444
Channel List: Channel 16 (485 MHz)
Get Available Channels Refresh Rate: 5 Minutes

Installer Information

First Name: First Name:
Last Name: Last Name:
Identification: Identification

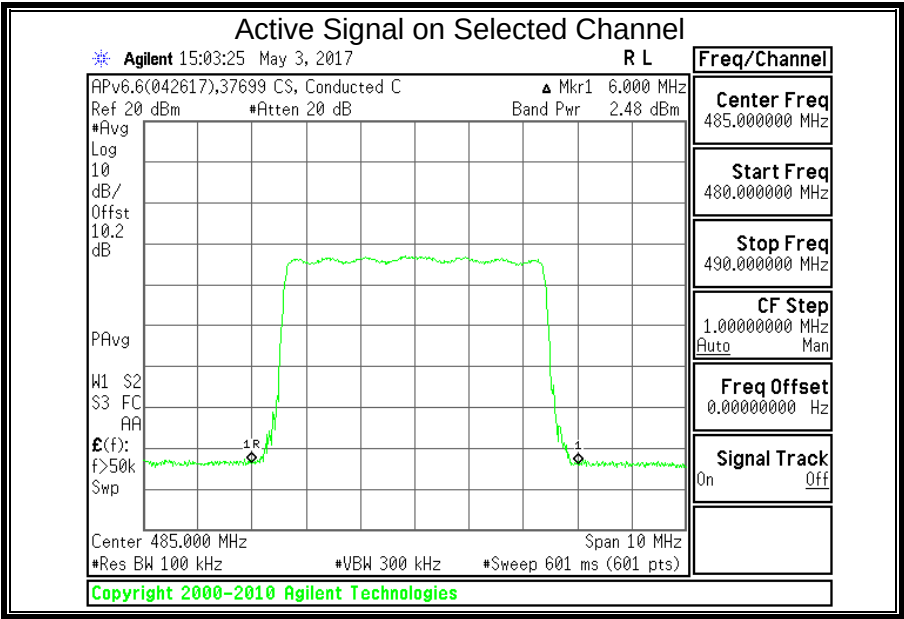
Contact information

First Name: John
Last Name: Doe
Addr 1: 123 apple rd
Addr 2: Addr 2:
City: Anywhere
State: NJ
Zip Code: 08854
Mobile Phone: 123-456-7891
Work Phone: (123)456-9871
Email: jclark@metricsystems.com
Country: undefined

Registrant information

First Name: General
Last Name: Inquiries
Addr 1: 3055 Enterprise Court
Addr 2: Addr 2:
City: Vista
State: CA
Zip Code: 92081
Mobile Phone: 760-560-0348
Work Phone: 760-560-0348
Email: jeclark@metricsystems.com
Country: undefined

Register Device Unregister Device



12.1.2. FAILED REGISTRATION – Location Coordinates

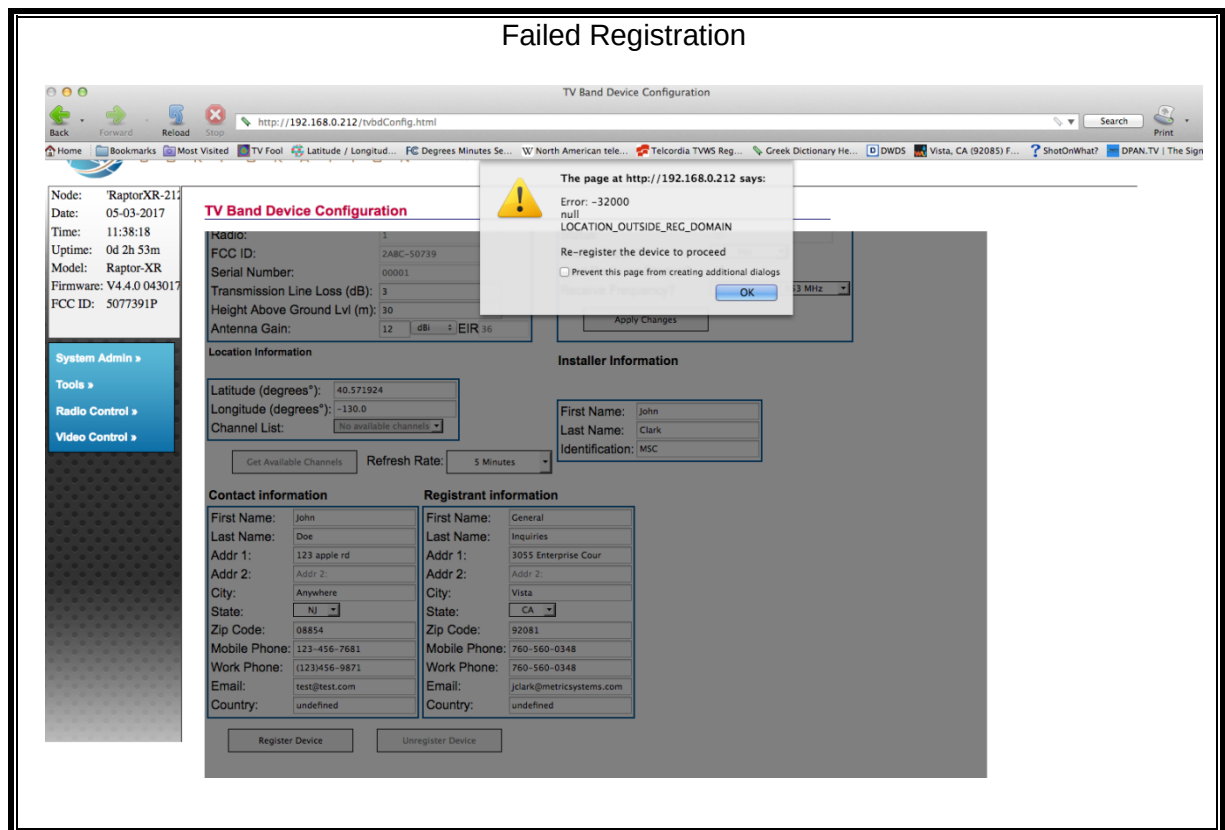
TEST PROCEDURE

- Configure the EUT with restricted coordinates: LAT=40° 34' 18.9264" (40.571924), LNG=-130° 0' 0" (-130) which is a location that is prohibited to transmit
- Observe the base EUT registration failure indicated by the database message

RESULT

The base EUT failed to register when restricted coordinates information were submitted to the TVWS Database.

Test Results			
Pass	Fail	Tested By	Test Date
☒	☐	37699 CS	05/03/17



12.1.3. FAILED REGISTRATION – ANTENNA HEIGHT AGL

TEST PROCEDURE

- Configure the EUT with antenna height Above Ground Level (AGL) > 30 meters.
- Observe the base registration failure indicated by the database message.

RESULTS

The base EUT failed to register when it is set to a location with antenna AGL above the limit.

Test Results			
Pass	Fail	Tested By	Test Date
☒	☐	37699 CS	05/03/17

Antenna AGL > 30m

The screenshot displays the 'TV Band Device Configuration' web page. A warning dialog box is present, stating: 'The page at http://192.168.0.212 says: Device Registration failed! Check highlighted fields.' The 'Height Above Ground Lvl (m)' field is highlighted in red and set to 40, with a message 'Out of bounds | Enter between [0, 30]'. Other fields include Node (RaptorXR-212), Date (05-03-2017), Time (11:44:07), Uptime (0d 2h 58m), Model (Raptor-XR), Firmware (V4.4.0 043017), FCC ID (5077391P), Latitude (33.144444), Longitude (-117.224444), and various contact and registrant details.

12.1.4. FAILED REGISTRATION –CONTACT INFORMATION

TEST PROCEDURE

- Configure the base EUT with missing contact information, e.g. email.
- The device software cannot proceed with registration and prompts user to enter the missing information.

RESULTS

Software didn't proceed with registration when contact information fields are missing.

Test Results			
Pass	Fail	Tested By	Test Date
☒	☐	37699 CS	05/03/17

Contact information missing field

The screenshot shows a web browser window titled "TV Band Device Configuration" at the URL "http://192.168.0.212/tvbdConfig.html". A yellow warning dialog box is displayed in the center, stating: "The page at http://192.168.0.212 says: Device Registration failed! Check highlighted fields". The background interface includes a sidebar with "System Admin", "Tools", "Radio Control", and "Video Control". The main content area is divided into several sections: "TV Band Device Configuration" (with fields for Radio, FCC ID, Serial Number, etc.), "Location Information" (with Latitude, Longitude, and Channel List), "Installer Information" (with First Name, Last Name, and Identification), "Contact information" (with First Name, Last Name, Address, City, State, Zip Code, Mobile Phone, Work Phone, Email, and Country), and "Registrant information" (with First Name, Last Name, Address, City, State, Zip Code, Mobile Phone, Work Phone, Email, and Country). The "Email" field in the "Contact information" section is highlighted in red, indicating it is a required field that is missing or invalid. At the bottom, there are buttons for "Register Device" and "Unregister Device".

12.2. FIXED WSD CHANNELS OF OPERATION

CLAUSES

- §15.711(c)(2)(ii)

REQUIREMENT

Confirm that the device only operates on channels provided by the database

TEST PROCEDURE

- The base EUT geographic coordinates are entered at registration time and stored in the device. The device channel list request uses the same coordinates established at registration time. No separate coordinates can be entered for channel list request.
- The device requires professional installation and device registration information including device location will be entered by the professional installer.
- Once the registration is complete, upon power cycling the device will use the stored registration location for channel list request.

RESULTS

The device only uses its registered location for channel list request. The device registered location will be established at installation time by a professional installer and cannot be altered after installation

Test Results			
Pass	Fail	Tested By	Test Date
☒	☐	37699 CS	05/03/17

Channel list after successful registration

The screenshot displays the 'TV Band Device Configuration' web interface. On the left, a sidebar contains links for 'System Admin', 'Tools', 'Radio Control', and 'Video Control'. The main content area is titled 'TV Band Device Configuration' and is divided into several sections:

- Device Information:** Fields for Radio (1), FCC ID (2ABC-50739), Serial Number (00001), Transmission Line Loss (dB) (3), Height Above Ground Lvl (m) (30), and Antenna Gain (12 dBi).
- Radio Information:** Fields for Status (Down), Enable Radio? (Yes), Start Radio on Startup? (checked), and Receive Frequency? (Channel 44 | 653 MHz).
- Location Information:** Fields for Latitude (degrees) (33.144444) and Longitude (degrees) (-117.224444).
- Channel List:** A dropdown menu showing 'Select a channel from the list' with a list of available channels: Channel 14 | 473 MHz, Channel 28 | 557 MHz, and Channel 45 | 659 MHz.
- Installer Information:** Fields for First Name (John), Last Name (Clark), and Identification (MSC).
- Contact information:** Fields for First Name (John), Last Name (Doe), Address 1 (123 apple rd), Address 2, City (Anywhere), State (NJ), Zip Code (08854), Mobile Phone (123-456-7681), Work Phone (123456-9871), and Email (jclark@metricsystems.com).
- Registrant information:** Fields for First Name (General), Last Name (Inquiries), Address 1 (3055 Enterprise Cour), Address 2, City (Vista), State (CA), Zip Code (92081), Mobile Phone (760-560-0348), Work Phone (760-560-0348), and Email (jeclark@metricsystems.com).

The 'Channel List' dropdown is currently open, showing the available channels. The 'Get Available Channel' button is also visible.

12.3. FIXED TVDB DATABASE UPDATE

CLAUSES

- §15.711(h)

REQUIREMENT

If a fixed or Mode II personal/portable TVBD fails to successfully contact the white space database during any given day, it may continue to operate until 11:59 p.m. of the following day at which time it must cease operations until it re-establishes contact with the white space database and re-verifies its list of available channels.

To simulate that the device fails to successfully contact the database, block access to the database from the WSD by removing connection to the database. All other radio functions, including internet connectivity should be maintained. Confirm that the WSD ceases operation by 11:59PM on the following day

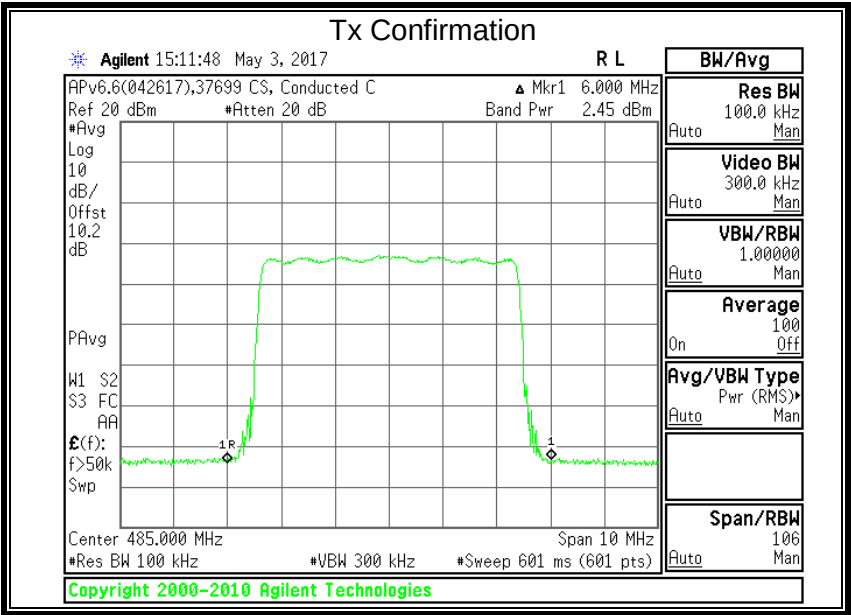
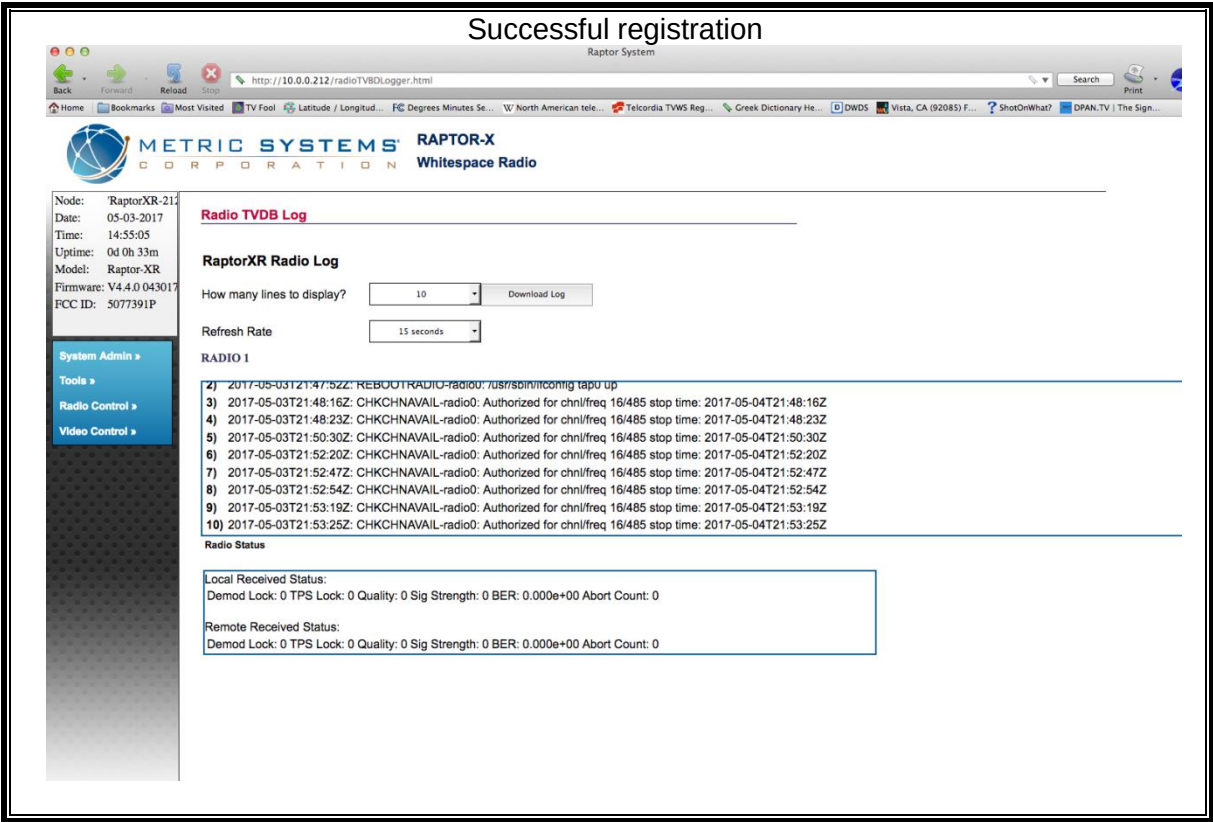
TEST PROCEDURE

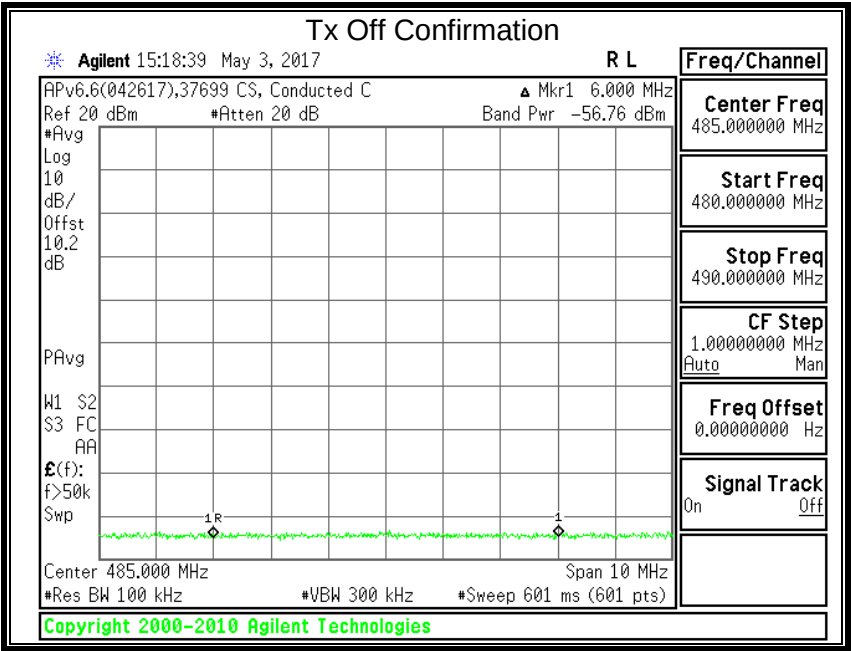
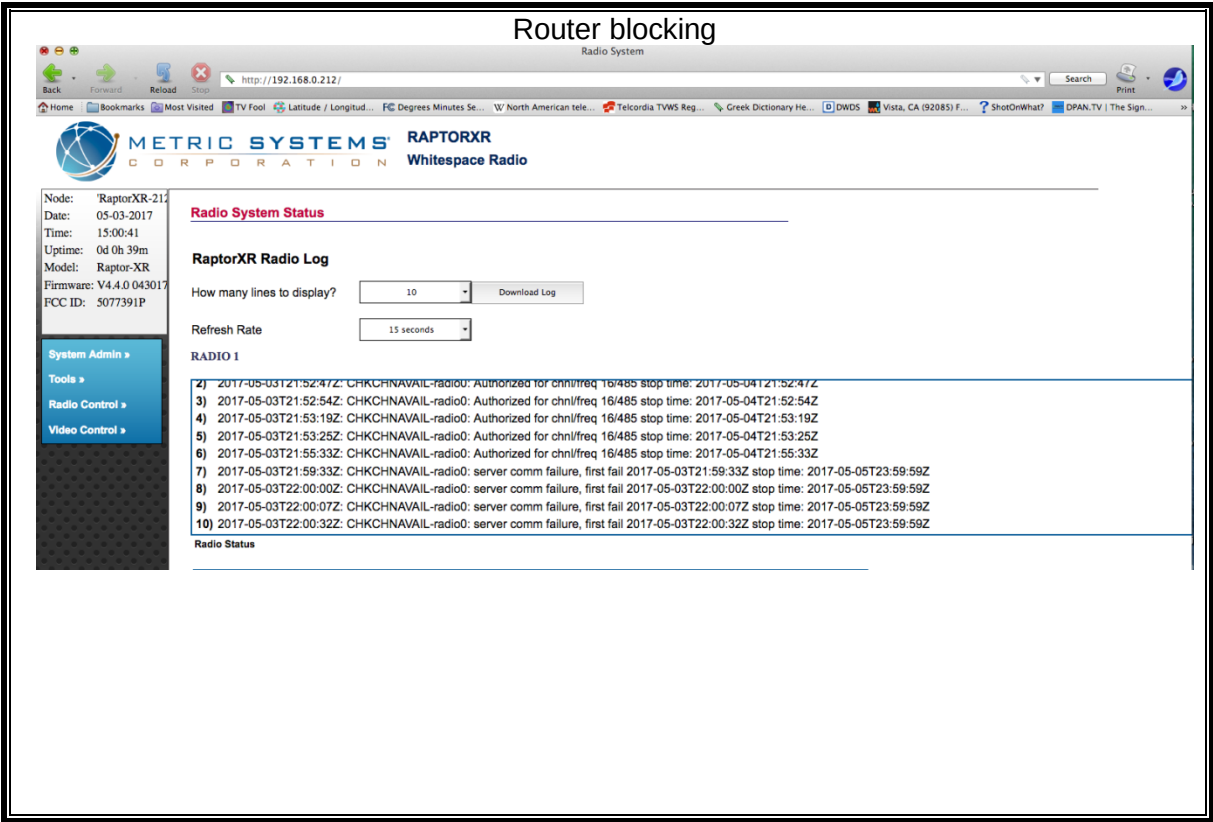
- Set the base EUT to normal operation mode:
 - Enter proper registration information on the base.
 - Base contacts the TVWS to perform registration.
 - Base contacts the TVWS to retrieve channel list.
 - Select an operating channel from returned channel list.
 - Enable base transmission.
- Observe the base EUT output signal on the spectrum analyzer.
- Use a programmable router to block the database URL.
- Observe that there is no output signal from the base after 11:59 PM on the following day.

RESULTS

During normal operation, the base and client channel lists are updated periodically by sending channel list requests to the TVWS Database. For test purposes this time period was shortened. After the database access was blocked, the next channel list requests failed and the EUTs stopped transmission immediately.

Test Results			
Pass	Fail	Tested By	Test Date
☒	☐	37699 CS	05/03/17





12.4. 48 HOUR CHANNEL SCHEDULING

CLAUSES

- FCC §15.711(c)(2)(iii)
- FCC §15.713(a)(1)

REQUIREMENT

Each fixed whitespace device shall access the database at least once a day to verify that the operating channels continue to remain available. Each fixed white space device must adjust its use of channels in accordance with channel availability schedule information provided by its database for the 48-hour period beginning at the time the device last accessed the database for a list of available channels.

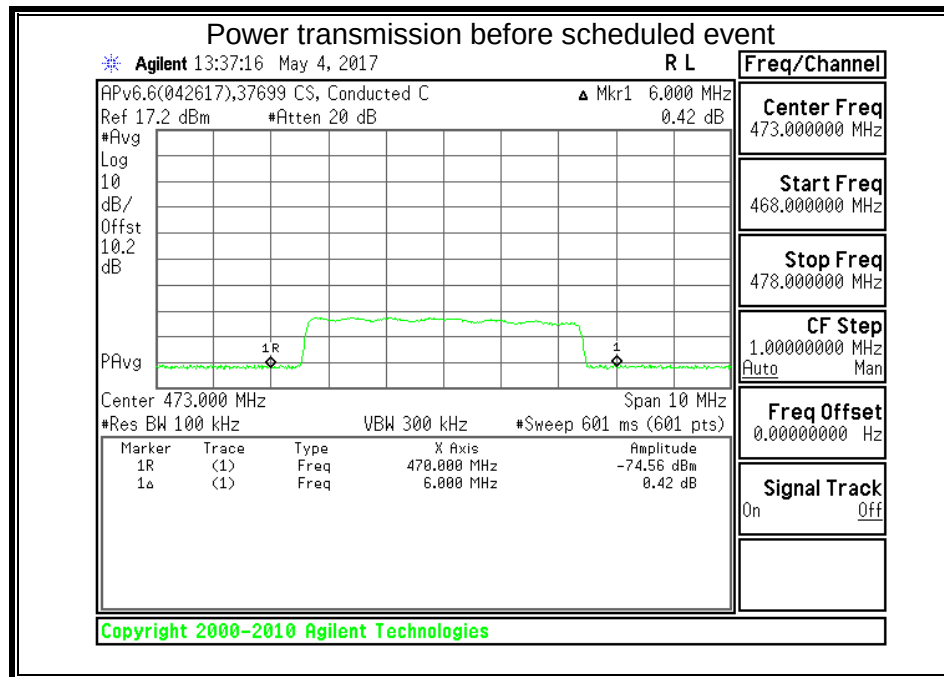
After receiving an available channel list, register a low-power auxiliary device on the WSD operating channel to operate on an available channel and in the upcoming time period when the device will be tested. Repeat the available channel request after the update interval and in the time period when the low-power auxiliary device is scheduled to operate, and confirm that the low-power device is accounted for in the schedule. Using the system management software, confirm that the device changes channels at the scheduled time.

TEST PROCEDURE

1. A lower power auxiliary devices are registered and scheduled for protection at both base and client locations
2. Allow the base and client EUT to enter normal operations prior to testing
3. Upon channel list request to the TVWS Database, the base EUT obtains the channel list expiration time reflecting the low power auxiliary device's registered protection period
4. The base EUT requests new channel list upon the channel list expiration time and the base EUT's current operation channel is no longer in the returned channel list
5. The base EUT ceases transmission on the protected channel immediately
6. Steps 3-5 were repeated for client EUT

Test Results			
Pass	Fail	Tested By	Test Date
☒	☐	37699 CS	05/04/17 – 05/05/17

12.4.1. RESULTS FOR BASE



Scheduled event, Radio shutting down

Radio System

http://10.0.0.213/

METRIC SYSTEMS CORPORATION **RAPTORXR**
Whitespace Radio

Node: RaptorXR-213
Date: 05-04-2017
Time: 14:32:14
Uptime: 0d 0h 14m
Model: RaptorXR
Firmware: V4.4.0 043017
FCC ID: 5077391P

Radio System Status

RaptorXR Radio Log

How many lines to display?

Refresh Rate

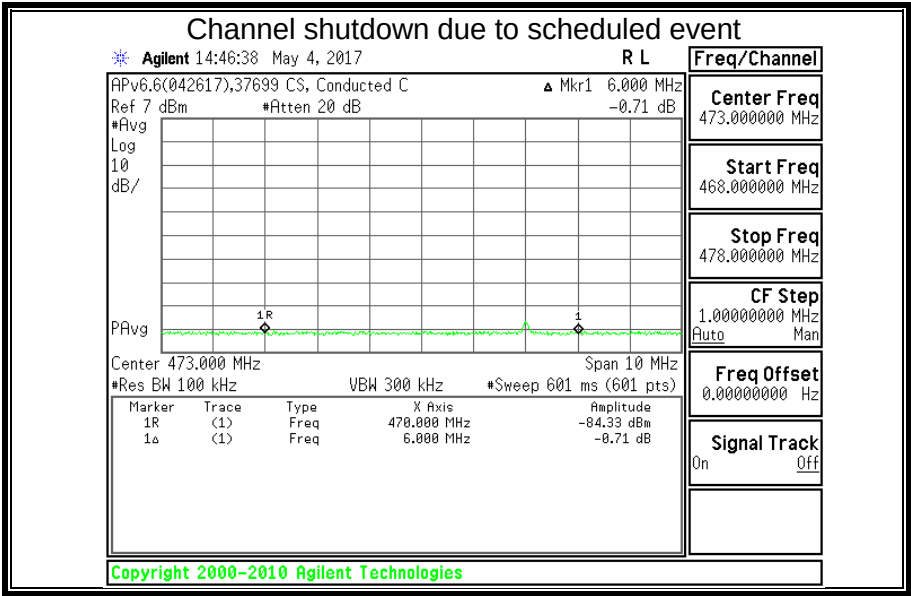
RADIO 1

- 1) 2017-05-04T21:18:08Z: BOOTRADIO-radio0: Enabled normal radio mode
- 2) 2017-05-04T21:18:08Z: BOOTRADIO-radio0: (/usr/local/sbin/checkAvailChnlTMO.pl radio0 5 >/dev/null 2>&1) &
- 3) 2017-05-04T21:18:11Z: CHKCHNAVAIL-radio0: Authorized for chnl/freq 14/473 stop time: 2017-05-05T21:18:11Z
- 4) 2017-05-04T21:23:13Z: CHKCHNAVAIL-radio0: Authorized for chnl/freq 14/473 stop time: 2017-05-05T21:23:13Z
- 5) 2017-05-04T21:28:16Z: CHKCHNAVAIL-radio0: ERROR: TVBD Channel 473 not available
- 6) 2017-05-04T21:28:16Z: CHKCHNAVAIL-radio0: shutting down radio now
- 7) 2017-05-04T21:28:18Z: CHKCHNAVAIL-radio0: chnl/freq 14/473 unavailable stop time: 2017-05-04T21:28:16Z

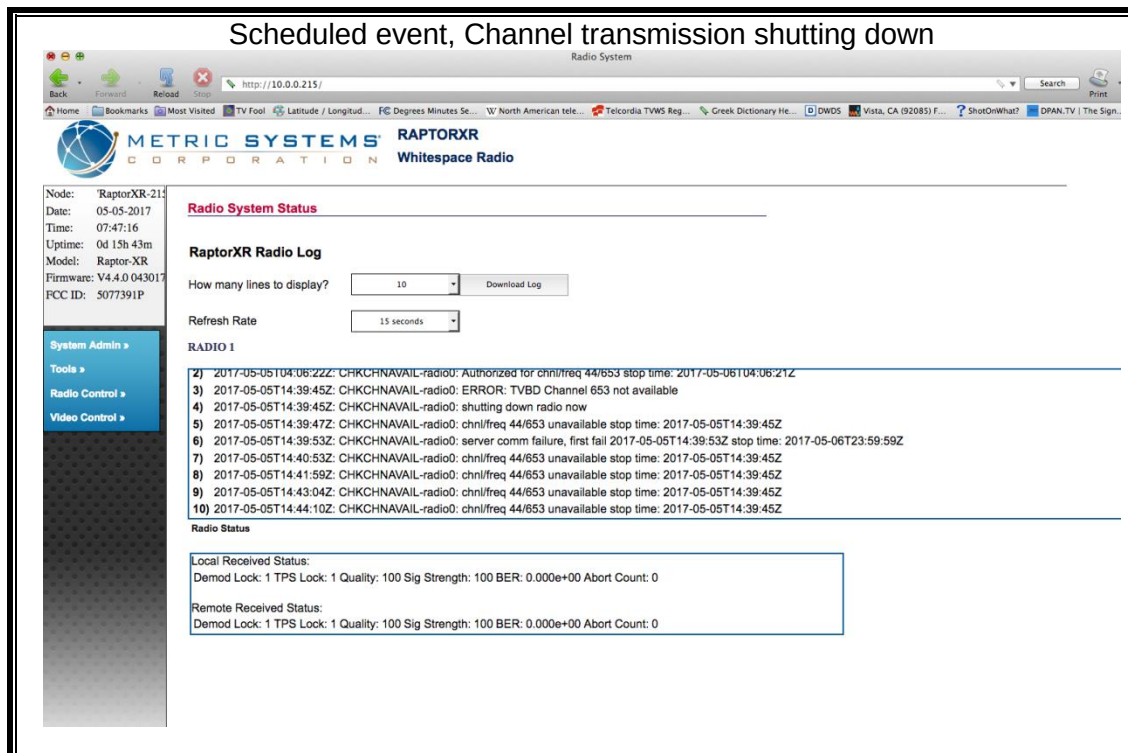
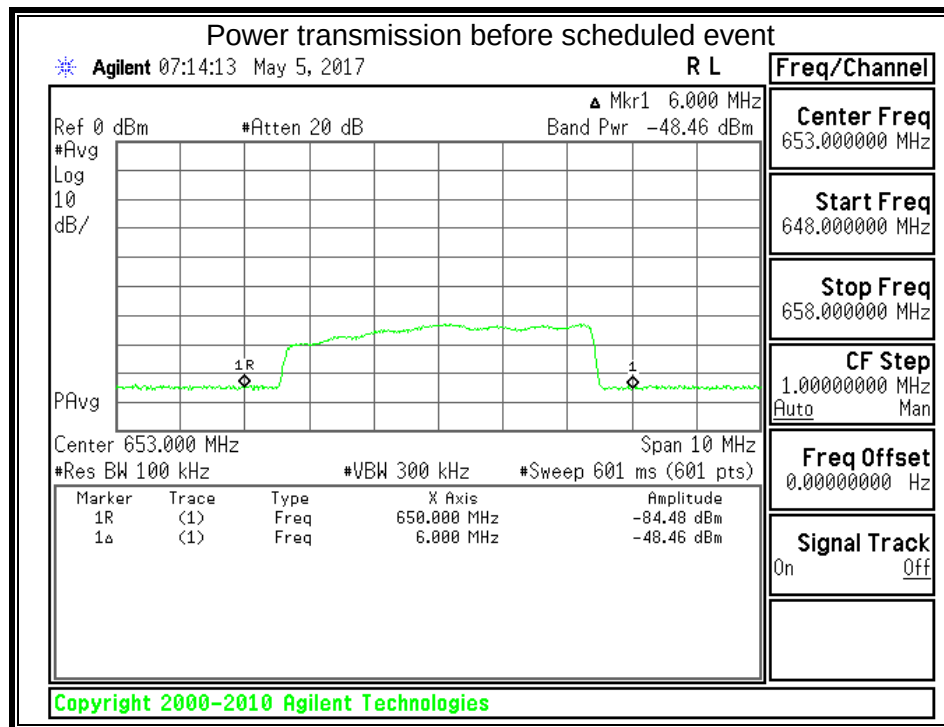
Radio Status

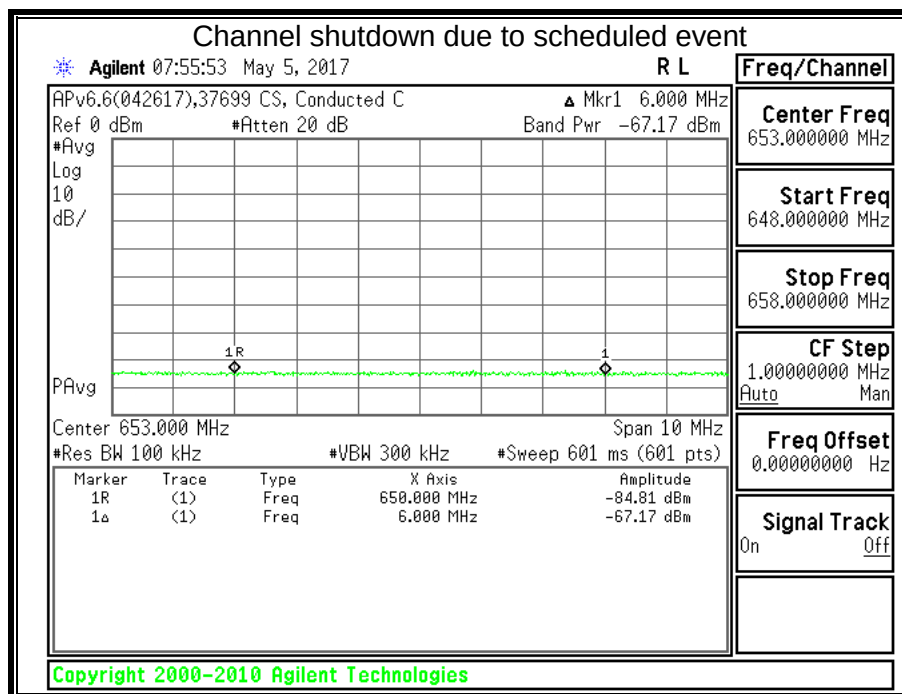
Local Received Status:
Demod Lock: 1 TPS Lock: 1 Quality: 100 Sig Strength: 100 BER: 0.000e+00 Abort Count: 0

Remote Received Status:
Demod Lock: 0 TPS Lock: 0 Quality: 0 Sig Strength: 90 BER: 0.000e+00 Abort Count: 0



12.4.2. RESULTS FOR CLIENT





12.5. WSD CHANNEL AVAILABILITY

CLAUSES

- FCC §15.707
- FCC §15.711(c)
- FCC §15.712

REQUIREMENT

Confirm that WSD properly identifies itself as fixed or personal/portable to the database by comparing the channel list provided by the database with those allowable to the class of WSD under test. Confirm that the WSD is operating on a channel or channels from the list at the authorized power and cannot be made to operate on an unauthorized channel.

TEST PROCEDURE

- Configure the base EUT with correct registration information.
- The base EUT automatically contacts the TVWS Database to perform device registration.
- Upon successful registration, base automatically contacts the TVWS Database to retrieve device channels.
- Confirm the base EUT software only allows the user to select a channel from the channel list returned from the database which are within the device operating frequency range
- Upon successful registration the database returns the allowable power according to the device type.
- Verify on the spectrum analyzer that the base EUT is operating on the selected channel

RESULTS

The EUT operates on a channel from the authorized channel list and at the authorized power level. The EUT cannot select and operate on any channel other than those within the authorized channel list returned from the TVWS Database, which are within the device operating frequency range.

Test Results			
Pass	Fail	Tested By	Test Date
☒	☐	37699 CS	05/03/17

Successful Device Registration with Database

TV Band Device Configuration



METRIC SYSTEMS CORPORATION
RAPTORXR
Whitespace Radio

Node: RaptorXR-21
Date: 05-03-2017
Time: 15:25:53
Uptime: 0d 0h 16m
Model: RaptorXR
Firmware: V4.4.0 043017
FCC ID: 5077391P

TV Band Device Configuration

Device Information

Radio: 1
FCC ID: 2ABCU-50739
Serial Number: 00001
Transmission Line Loss (dB): 3
Height Above Ground Lvl (m): 30
Antenna Gain: 12 dBi EIR 36

Location Information

Latitude (degrees): 33.144444
Longitude (degrees): -117.224444
Channel List:
Channel 14 | 473 MHz
Channel 28 | 557 MHz
Channel 45 | 659 MHz

Radio Information

Status: Up
Enable Radio? Yes
Start Radio on Startup? ☒
Receive Frequency? Channel 44 | 653 MHz

Installer Information

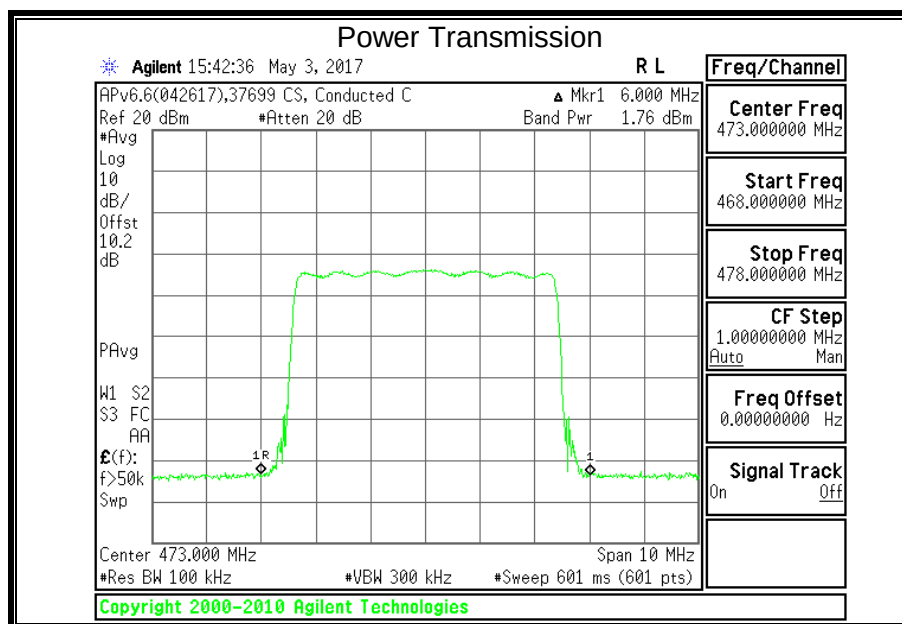
First Name: First Name:
Last Name: Last Name:
Identification: Identification:

Contact Information

First Name: John
Last Name: Doe
Addr 1: 123 apple rd
Addr 2:
City: Anywhere
State: NJ
Zip Code: 08854
Mobile Phone: 123-456-7891
Work Phone: (123)456-9871
Email: jdoe@metric.com
Country: undefined

Registrant Information

First Name: General
Last Name: Inquiries
Addr 1: 3055 Enterprise Cour
Addr 2:
City: Vista
State: CA
Zip Code: 92081
Mobile Phone: 760-560-0348
Work Phone: 760-560-0348
Email: jdoe@metric.com
Country: undefined



12.6. SECURITY

CLAUSES

- §15.715(f)
- §15.713(i)
- §15.711(j)

REQUIREMENT

The device operations procedures must include documentation with a detailed explanation of the following for each database the device is expected to work with:

- i. What communication protocol is used between the database and the WSD?
- ii. How are communications initiated?
- iii. How does the WSD validate messages from the database?
- iv. How does the device handle failure to communicate or authenticate the database?
- v. How does the database validate messages from a WSD?
- vi. What encryption method is used?
- vii. How does the database ensure secure registration of protected devices?

ANSWERS

- i. *What communication protocol is used between the database and the WSD?*

The Fixed WSD (WSD) connects to the Spectrum Bridge, Inc. (Spectrum Bridge) database using HTTP over SSL/TLS. The protocol, as certified by Spectrum Bridge at the FCC, used over this transport layer is similar to the IETF Protocol to Access White Space (PAWS) Draft-12 specification.

- ii. *How are communications initiated?*

The WSD initiates communication with the Spectrum Bridge database by initially sending an INIT_REQ message containing a Device Descriptor. The Device Descriptor element contains the device serial number, manufacturer ID, and model ID, which in the US is FCC ID.

- iii. *How does the WSD validate messages from the database?*

The identity of the Spectrum Bridge database is validated through verification of the Spectrum Bridge SSL certificate through standard third-party certificate authority mechanisms, ensuring communications are secure and authenticated between the WSD and the database.

At the application layer both the WSD and database only handle messages that conform to the PAWS protocol specification. One additional message validation feature included in PAWS is the ability for the WSD to correlate a response with a specific request by comparing the message's ID field with the ID field of the request that was sent.

iv. How does the device handle failure to communicate or authenticate the database?

If the WSD has never communicated with or authenticated the database, it will not begin operation. If the WSD experiences a communication or authentication failure, then it will cease operation at 11:59 PM on the following day.

v. How does the database validate messages from a WSD?

The database validates messages from the WSD by checking the serial number and FCC ID received in the Device Descriptor data element present in every message versus a table of valid client devices that is populated when the device is manufactured. The list of valid serial numbers is communicated from device manufacturer to Spectrum Bridge via "out-of-band means," such as email or telephone.

vi. What encryption method is used?

SSL/TLS standard encryption is used to encrypt packets sent between WSD and database.

vii. How does the database ensure secure registration of protected devices?

In this document, we interpret "protected devices" to mean entities authorized by the rules for protection from WSD transmissions, e.g., Temporary BAS, MVPD, Licensed and Unlicensed Microphones.

Spectrum Bridge provides a public interface that is available to entities authorized for protection under CFR Title 47 Part 15 Subpart H. The Spectrum Bridge registration system requires entities seeking protection to register for an account on the Spectrum Bridge site before they can create protected contours. Once a user creates an account, they can create new and view previously created registrations via the Spectrum Bridge registration site.

Spectrum Bridge maintains two parallel registration sites. The first, production registration site, is available to entities seeking protection from operational WSDs. The second, test and integration site is available to those device manufacturers looking to integrate with the Spectrum Bridge database and to FCC and test laboratories looking to test functionality of a WSD operating in conjunction with the Spectrum Bridge database. The test and integration site is provided so as to not corrupt data in the live production site with records used for testing only. The two registration sites can be accessed via these addresses:

1. Live production registration site:

<https://whitespaces.spectrumbridge.com/protectedentityregistration/lowpowerauxunlicensedregistration.aspx>

2. Test and integration registration site:

twws-demo.spectrumbridge.com

Testers should note that while a device is being tested for certification, it will be connecting to the Spectrum Bridge test and integration server.

To test the WSD for operation in conjunction with registered protected entities, the tester must register for protection on the test and integration server (#2) listed above.

12.7. Push notification to Fixed

CLAUSES

- §15.711(i)

REQUIREMENT

Confirm that the WSD device changes channels (or cease operation) when it receives 'push' notification from the database.

Using system management software, register the device at (specific coordinates) and wait for the database to send a push notification. Confirm that, once the notification is received, the device responds to the new channel availability list provided by the database, which would include ceasing operation on a channel no longer available, or ceases operation.

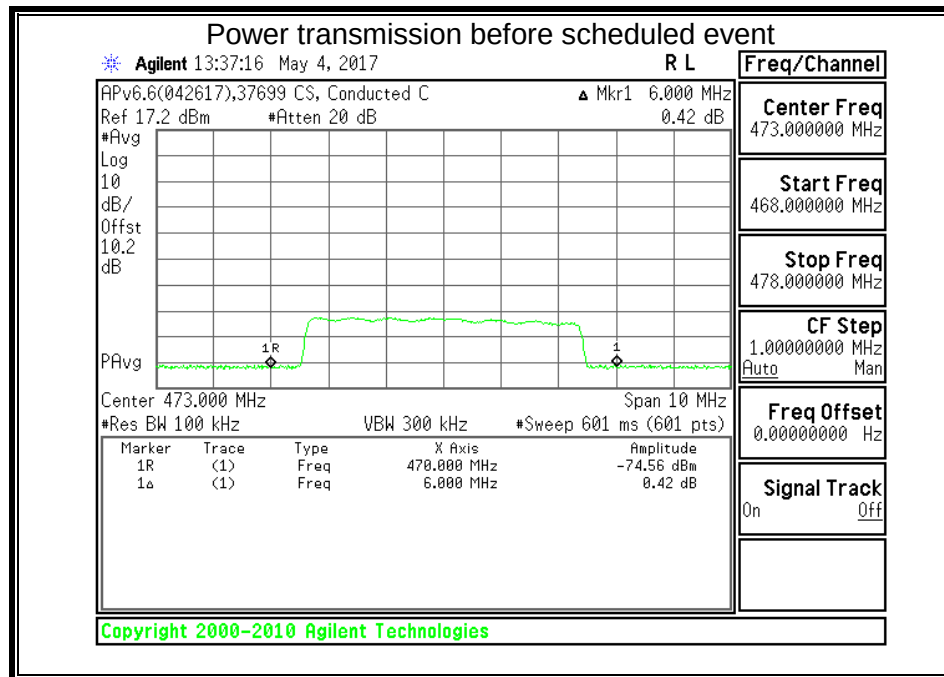
TEST PROCEDURE

- Obtain a successful registration to the database.
- Transmit on desired channel
- Wait for database to send a push notification to cease operation on desired channel
- Confirm that once the push notification is received, a new channel availability list is provided and the desired channel ceases operation.

Test Results			
Pass	Fail	Tested By	Test Date
☒	☐	37699 CS	05/04/17 – 05/05/17

Due to the push notification and 48hr channel scheduling only differing in time scheduled. The same event from the 48hr channel scheduling test was used to cover this requirement.

12.7.1. RESULTS FOR BASE



Scheduled event, Radio shutting down

Radio System

http://10.0.0.213/

METRIC SYSTEMS CORPORATION **RAPTORXR**
Whitespace Radio

Node: RaptorXR-213
Date: 05-04-2017
Time: 14:32:14
Uptime: 0d 0h 14m
Model: RaptorXR
Firmware: V4.4.0 043017
FCC ID: 5077391P

Radio System Status

RaptorXR Radio Log

How many lines to display? [Download Log](#)

Refresh Rate

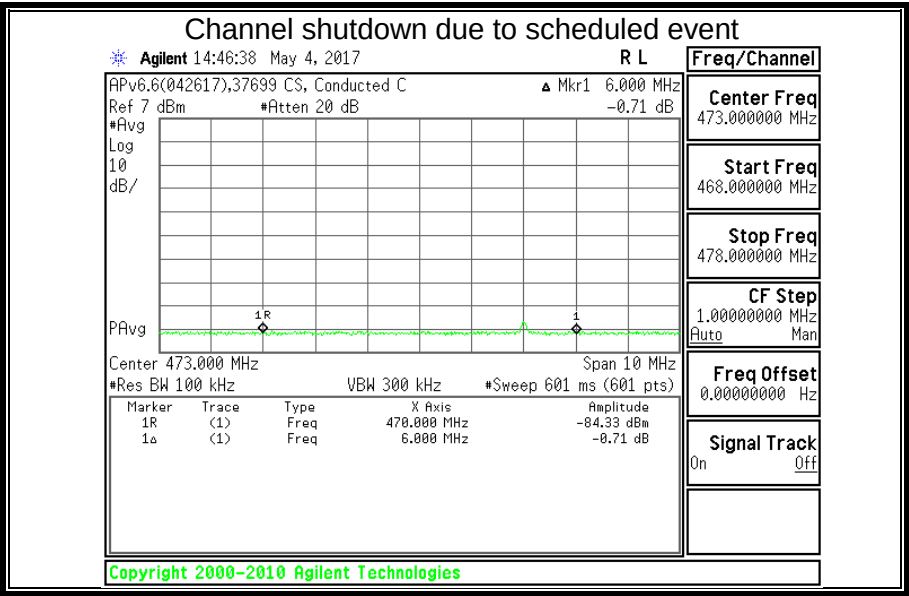
RADIO 1

- 2017-05-04T21:18:08Z: BOOTRADIO-radio0: Enabled normal radio mode
- 2017-05-04T21:18:08Z: BOOTRADIO-radio0: (/usr/local/sbin/checkAvailChnlTMO.pl radio0 5 >/dev/null 2>&1) &
- 2017-05-04T21:18:11Z: CHKCHNAvail-radio0: Authorized for chnl/freq 14/473 stop time: 2017-05-05T21:18:11Z
- 2017-05-04T21:23:13Z: CHKCHNAvail-radio0: Authorized for chnl/freq 14/473 stop time: 2017-05-05T21:23:13Z
- 2017-05-04T21:28:16Z: CHKCHNAvail-radio0: ERROR: TVBD Channel 473 not available
- 2017-05-04T21:28:16Z: CHKCHNAvail-radio0: shutting down radio now
- 2017-05-04T21:28:18Z: CHKCHNAvail-radio0: chnl/freq 14/473 unavailable stop time: 2017-05-04T21:28:16Z

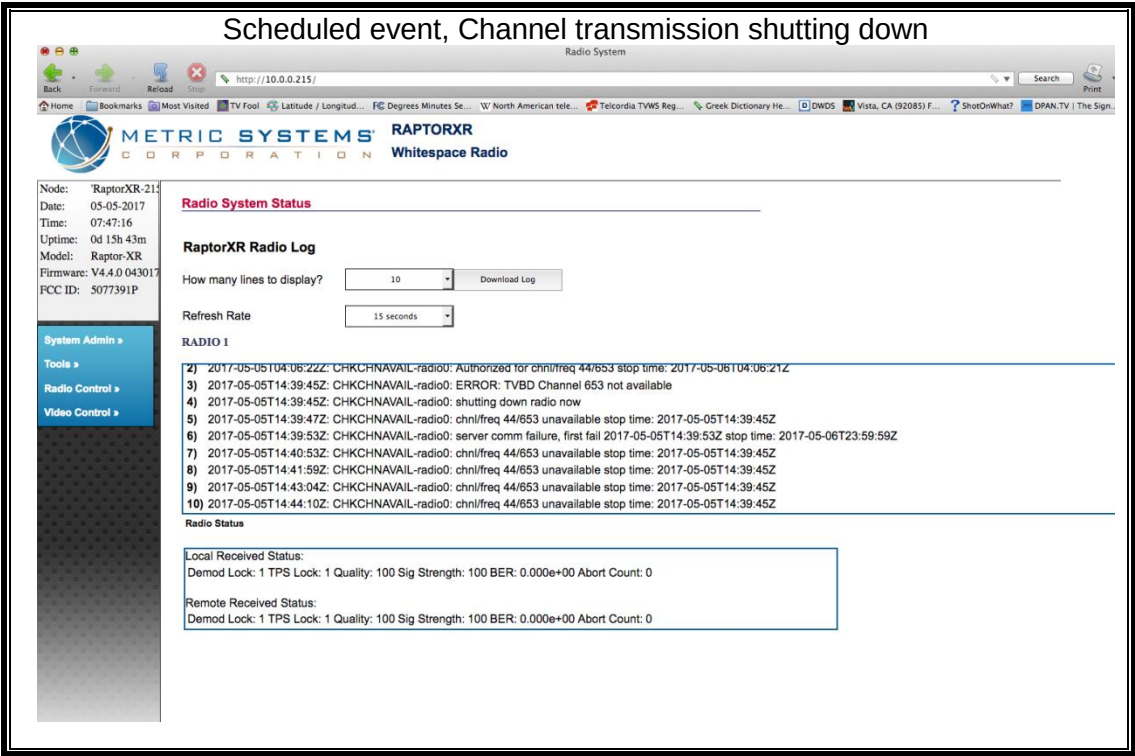
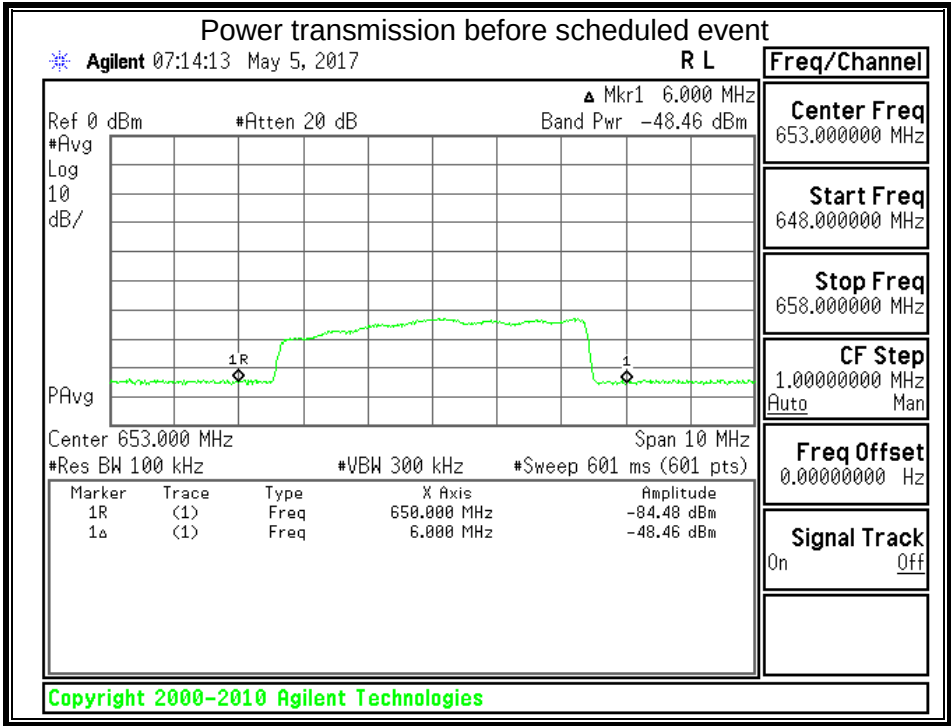
Radio Status

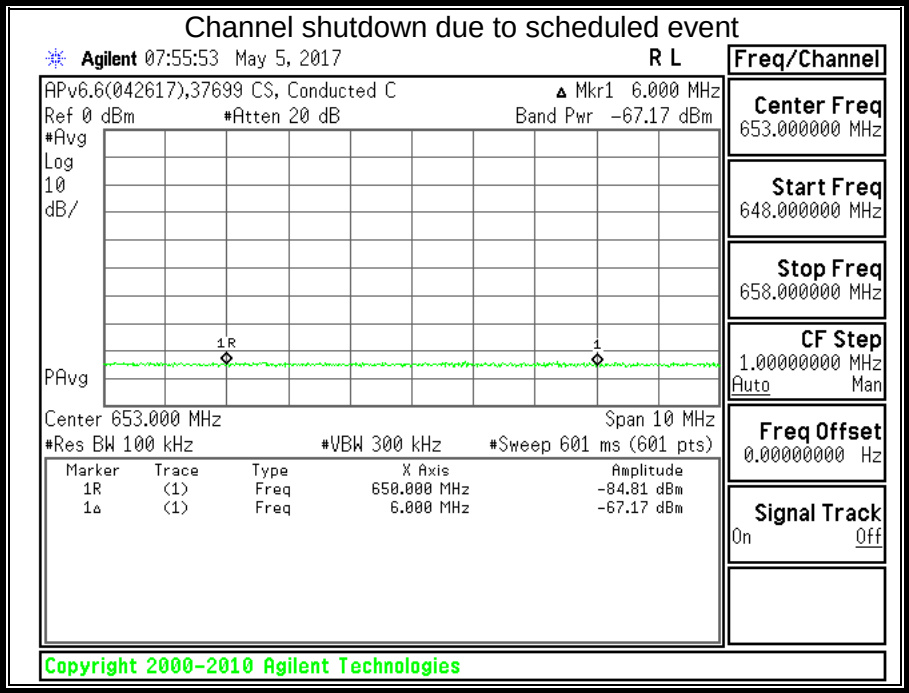
Local Received Status:
Demod Lock: 1 TPS Lock: 1 Quality: 100 Sig Strength: 100 BER: 0.000e+00 Abort Count: 0

Remote Received Status:
Demod Lock: 0 TPS Lock: 0 Quality: 0 Sig Strength: 90 BER: 0.000e+00 Abort Count: 0



12.7.1. RESULTS FOR CLIENT





12.8. Location accuracy

CLAUSES

- §15.711(b)

REQUIREMENT

For Fixed and Mode II devices, provide details regarding the technologies used by the device to determine its location and how, in case of other than GPS technology, the location uncertainty is calculated with a 95% confidence level

RESULTS

See theory of operations for details on Location accuracy

12.9. Interference protection requirement

CLAUSES

- §15.712

REQUIREMENT

Using system management software or database, provide different location (coordinates) so that compliance with operating channel and power level is shown under each of the scenarios outlines in §15.712. Include a sample scan showing the total channel power and adjacent channel emission settings for test coordinates.

TEST PROCEDURE

For the scenarios listed below confirm there is no allowance of transmission on specific channels according to that particular location

Scenarios

- a) Digital television stations, and digital and analog Class A TV, low power TV, TV translator and TV booster stations
- b) TV translator, Low power TV(including Class A) and Multi-channel Video Programming Distributor (MVPD)
- c) Fixed Broadcast Auxiliary Service (BAS) links
- d) PLMR/CMRS operations
- e) Offshore Radiotelephone Service
- f) Low power auxiliary services including wireless microphones
- g) Border areas near Canada and Mexico
- h) Radio astronomy services
- i) 600 Mhz service band
- j) Wireless Medical Telemetry Service
- k) 488-494 MHz band in Hawaii

RESULTS

Scenario		Coordinate	Note
a	Digital television stations, and digital and analog Class A TV, low power TV, TV translator and TV booster stations	38.73829, -108.887 (VHF) 35.775, -106.24555 (UHF)	UHF No transmission allowed VHF coordinate cannot transmit on Ch. 13
b	TV translator, Low power TV(including Class A) and Multi-channel Video Programming Distributor (MVPD)	43.80102, -111.778 (UHF) 35.66218, -117.604 (VHF)	UHF coordinate cannot transmit Ch. 23 VHF coordinate cannot transmit Ch. 11
c	Fixed Broadcast Auxiliary Service (BAS) links	41.890417, -87.623694	Cannot transmit on Ch. 28
d	PLMR/CMRS operations	18.954722, -77.004722	Cannot transmit on Ch. 17 and 18
e	Offshore Radio telephone Service	18.954722, -77.004722	Cannot transmit on Ch. 17 and 18
f	Low power auxiliary services including wireless microphones	N/A	48 hour channel scheduling requirement was based off this scenario
g	Border areas near Canada and Mexico	32.608179, -116.969585	Cannot transmit on Ch. 6 and 32
h	Radio astronomy services	35.775, -106.24555	No channels available
i	600 MHz service band	40.78698, -119.206486	Cannot transmit on Ch. 36, 37 and 38
j	Wireless Medical Telemetry Service	N/A	EUT does not support transmission in this frequency band
k	488-494 MHz band in Hawaii	19.7071, -155.0885	Cannot transmit on Ch. 17

Test Results			
Pass	Fail	Tested By	Test Date
☒	☐	37699 CS	05/04/17