CERTIFICATION TEST REPORT

Report Number : 11884357-E1V2

Applicant	:	Adaptrum 2740 Zanker Road Suite 100 San Jose, CA 95131
Model	:	ACRS2-B1000
FCC ID	:	A2UACRS2F-B1
EUT Description	:	Fixed TV Band Device
Test Standard(s)	:	FCC 47 CFR PART 15 SUBPART H

Date of Issue:
September 21, 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	08/18/17	Initial release	---
V2	09/20/17	- Update ant gain for sections: 6.2, 6.3, 10.1.1, 10.2.1, 10.3.1 - Added sections 6.2, 9, 11.2 and 11.4	C. Susa

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Adaptrum
2740 Zanker Road Suite 100
San Jose, CA 95131

EUT DESCRIPTION: Fixed TV Band Device

MODEL: ACRS2-B1000

SERIAL NUMBER: Proto 1

DATE TESTED: July 26th 2017 – September 15th 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.

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
Project Engineer
UL Verification Services Inc

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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.

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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:

Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)
36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m

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%.

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6. EQUIPMENT UNDER TEST

6.1. DESCRIPTION OF EUT

The EUT is a Fixed TV Band Device with a tuning range from 470 to 698MHz.

6.2. DATABASE PROVIDER

The database provider used during testing is Google TVWS Database.

6.3. MAXIMUM OUTPUT POWER

The transmitter has a maximum power as follows:

UHF BAND				
Frequency Range (MHz)	Conducted		EIRP	
	Output Power (dBm)	Output Power (mW)	Output Power (dBm)	Output Power (W)
470-698	25.71	372.39	37.71	5.90

6.4. DESCRIPTION OF AVAILABLE ANTENNAS

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

Type	Band	Gain
Log Periodic	UHF	11.0 dBi
Panel	UHF	12 dBi

6.5. SOFTWARE AND FIRMWARE

The software used during test was Adaptrum TVBD v3.6.0.60

The firmware installed in the EUT during testing was K.7.8.99

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6.6. WORST-CASE CONFIGURATION AND MODE

For below 1 GHz radiated emissions were performed with the EUT set to transmit at L/M/H channels at highest power and worst-case data rate as worst-case scenario.

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.

6.7. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List			
Description	**Manufacturer**	**Model**	**Serial Number**
Laptop	Lenovo	20319	CB37160795
POE	Laird	POE-HP-50i	138009847DRC00

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	Unshielded	2	
2	Ethernet	2	RJ45	Shielded	2.1	
3	antenna	1	N-Type	shielded	1.2	

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.

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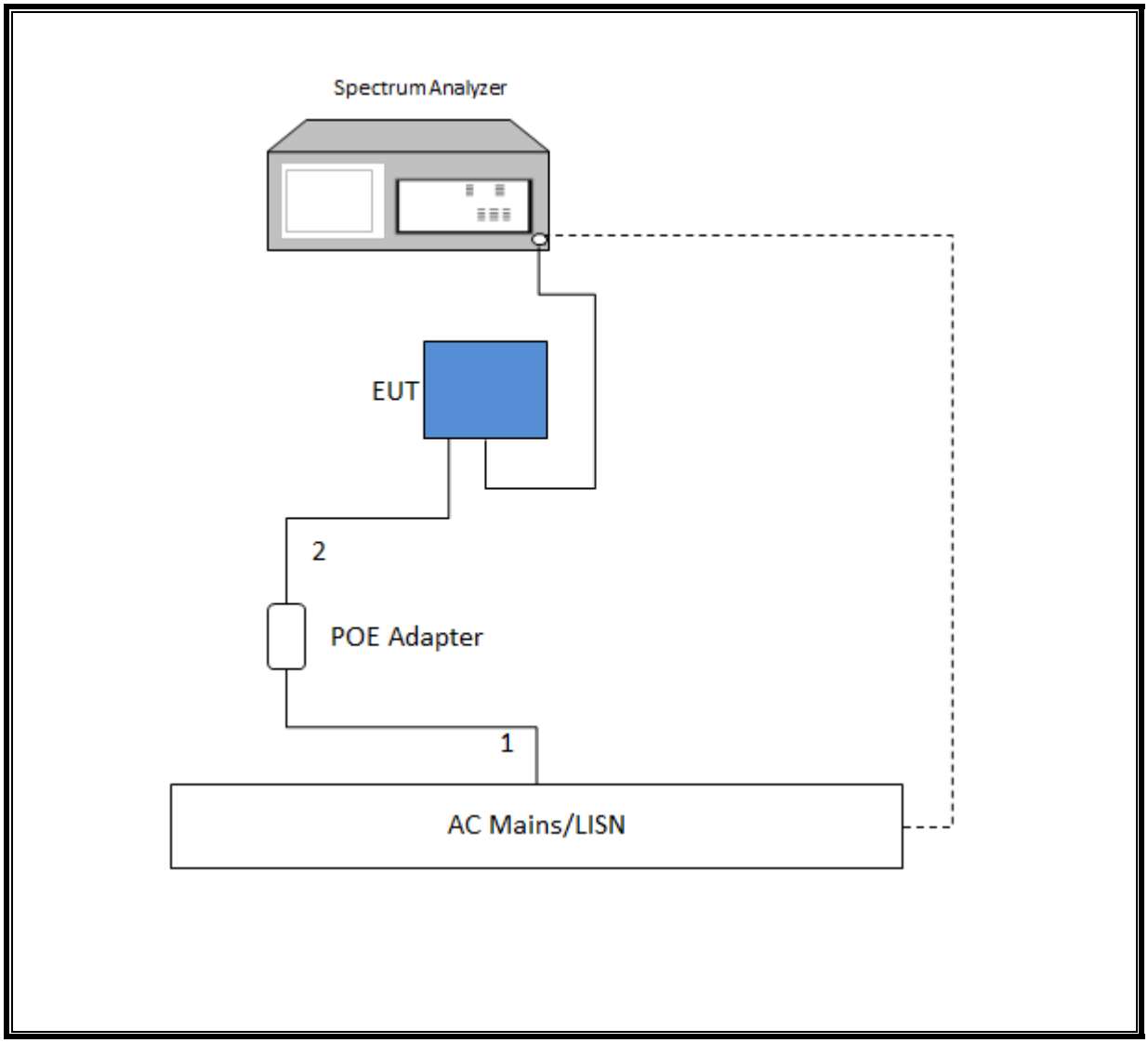
SETUP DIAGRAM FOR ANTENNA PORT AND AC LINE CONDUCTED TESTS



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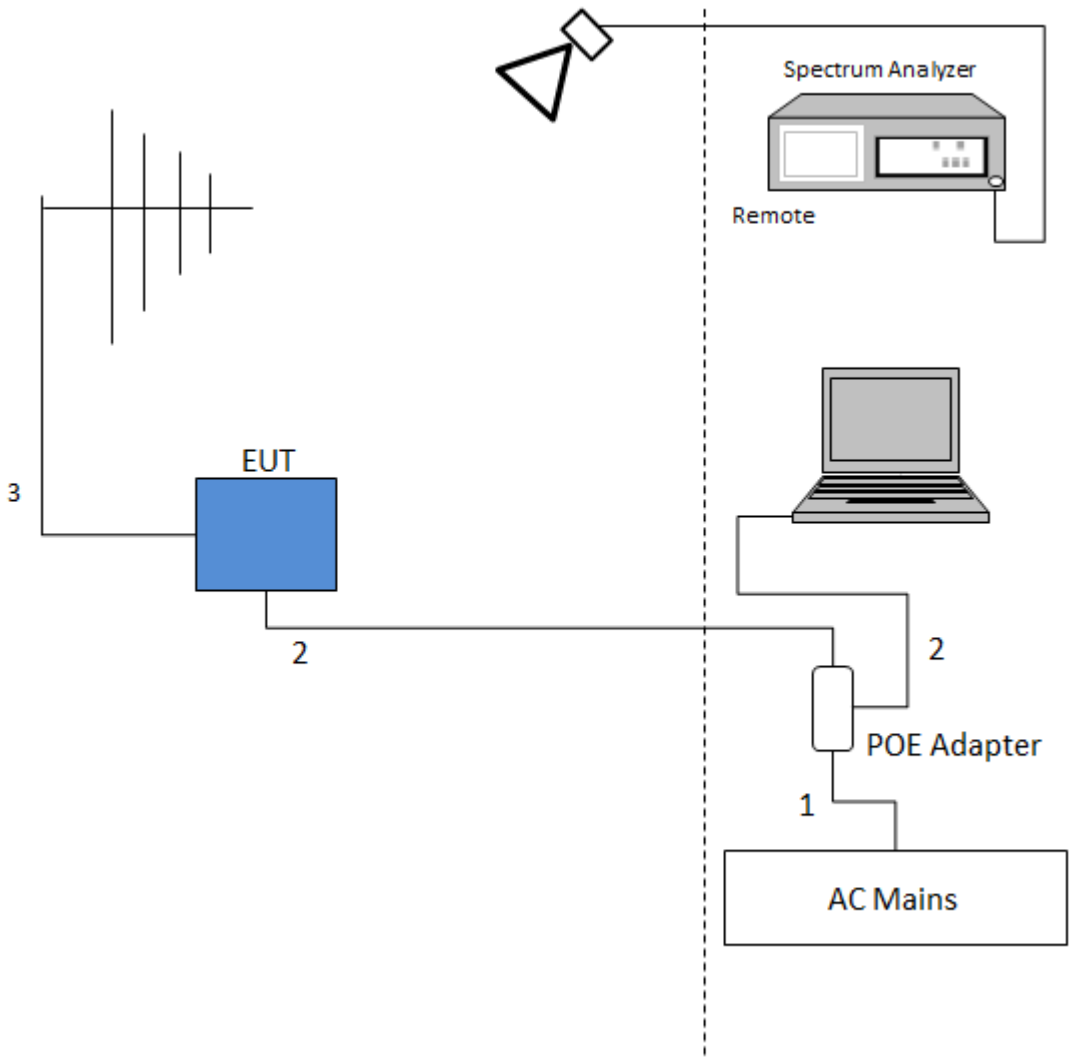
SETUP DIAGRAM FOR RADIATED TESTS



Note: EUT antennas used during testing were the Log periodic and the Panel antennas

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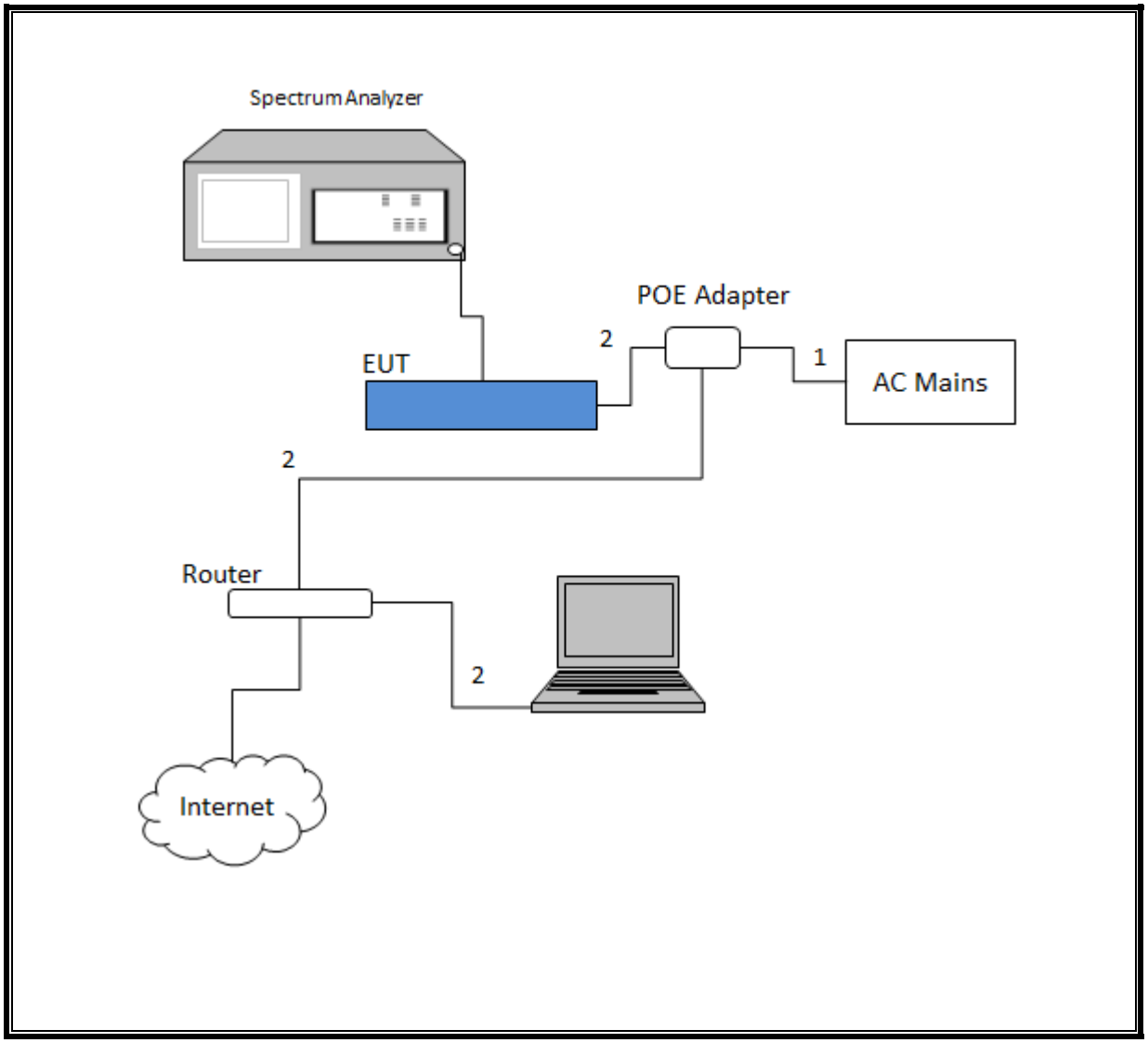
SETUP DIAGRAM FOR DATABASE TESTS



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7. TEST AND MEASUREMENT EQUIPMENT

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

TEST EQUIPMENT LIST					
Description	**Manufacturer**	**Model**	**Asset**	**Cal Date**	**Cal Due**
Spectrum Analyzer	Agilent	E4446A	T146	07/18/17	07/18/18
Spectrum Analyzer	Keysight	N9030A	T907	01/23/17	01/23/18
RF Preamplifier, 1 - 8GHz	Miteq	AMF-4D-01000800 -30-29P	T1156	02/15/17	02/15/18
RF Preamplifier, 10kHz - 1GHz	HP	8447D	T10	02/15/17	02/15/18
Antenna, Horn, 1-18GHz	ETS Lindgren	3117	T863	06/09/17	06/09/18
Antenna, Biconolog, 30MHz-1 GHz	Sunol Sciences	JB3	T899	06/15/17	06/15/18
Notch filter, 473MHz	EWT	EWT-14-0337	T242	04/27/17	04/27/18
Notch filter, 587MHz	EWT	EWT-14-0338	T239	04/27/17	04/27/18
Notch filter, 695MHz	EWT	EWT-14-0339	T238	04/27/17	04/27/18
Spectrum Analyzer	Keysight	N9030A	T1466	04/11/17	04/11/18
RF Preamplifier, 1 - 8GHz	Miteq	AMF-4D-01000800-30-29P	T1573	06/24/17	06/24/18
RF Preamplifier, 10kHz - 1GHz	Sonoma	310N	T300	11/10/16	11/10/17
Antenna, Horn, 1-18GHz	ETS Lindgren	3117	T862	06/09/17	06/09/18
Antenna, Biconolog, 30MHz-1 GHz	Sunol Sciences	JB1	T130	09/23/16	09/23/17
EMI Receiver	Rohde & Schwarz	ESR	T1436	01/06/17	01/06/18
LISN	Fischer Custom Communications	FCC-LISN-50/250-25-2	T24	03/01/17	03/01/18

TEST SOFTWARE LIST			
Description	**Manufacturer**	**Model**	**Version**
Radiated Software	UL	UL EMC	9.5, 12/01/16
Conducted Emissions Software	UL	UL EMC	9.5, 5/26/15

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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.

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9. TEST DATA REFERENCE FOR DATABASE TESTS

9.1. INTRODUCTION

According to the manufacturer, FCC ID: A2UACRS2F-B1 and FCC ID: A2UACRS10 database software is exactly identical. The FCC ID: A2UACRS10 database test data shall remain representative of FCC ID: A2UACRS2F-B1 so, FCC ID: A2UACRS2F-B1 leverages test data from FCC ID: A2UACRS10.

The applicant takes full responsibility that the test data as referenced in section 13 represents compliance for FCC ID: A2UACRS2F-B1.

9.2. DEVICES DIFFERENCES

Between FCC ID: A2UACRS2F-B1 and FCC ID: A2UACRS10 the database software is identical. No changes were made.

9.3. SPOT CHECK VERIFICATION RESULTS SUMMARY

Since there are no changes in the database software for this device, we need to only account for the additional tests due to an update to KDB 416721. These additional tests were also used to verify there were no changes in the database software. Below is a summary of the results

Test	Comments
Fixed WSD registration	Verified through interference protection requirement test (Section 13.9)
Fixed WSD channels of operation	Verified through interference protection requirement test (Section 13.9)
Fixed TVDB database update	Verified through fixed push notification test (Section 13.7)
48hr channel scheduling	Verified through fixed push notification test (Section 13.7)
WSD channel availability	Verified through interference protection requirement test (Section 13.9)
Security	Answers have not changed from FCC ID: A2UACRS10

9.4. REFERENCE DETAIL

Equipment Class	Reference FCC ID	Report Title/Section
WGF	A2UACRS10	13U14997-1A FCC Part 15 H Database Report

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10. ANTENNA PORT TEST RESULTS

10.1. 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

[1]The 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.

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RESULTS

10.1.1. UHF BAND

Tested By:	37699 CS
Test Date:	07/26/17

Antenna Gain (dBi)	12.00

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	25.71	25.71	37.71	28.00	-2.29
Mid	587	25.39	25.39	37.39	28.00	-2.61
High	695	25.45	25.45	37.45	28.00	-2.55

PSD Results

Channel	Frequency (MHz)	Measured Output PSD Chain 0 (dBm)	Measured Total PSD Power (dBm)	Conducted PSD Limit (dBm)	Margin (dBm)
Low	473	9.20	9.20	10.60	-1.40
Mid	587	8.86	8.86	10.60	-1.74
High	695	8.92	8.92	10.60	-1.68

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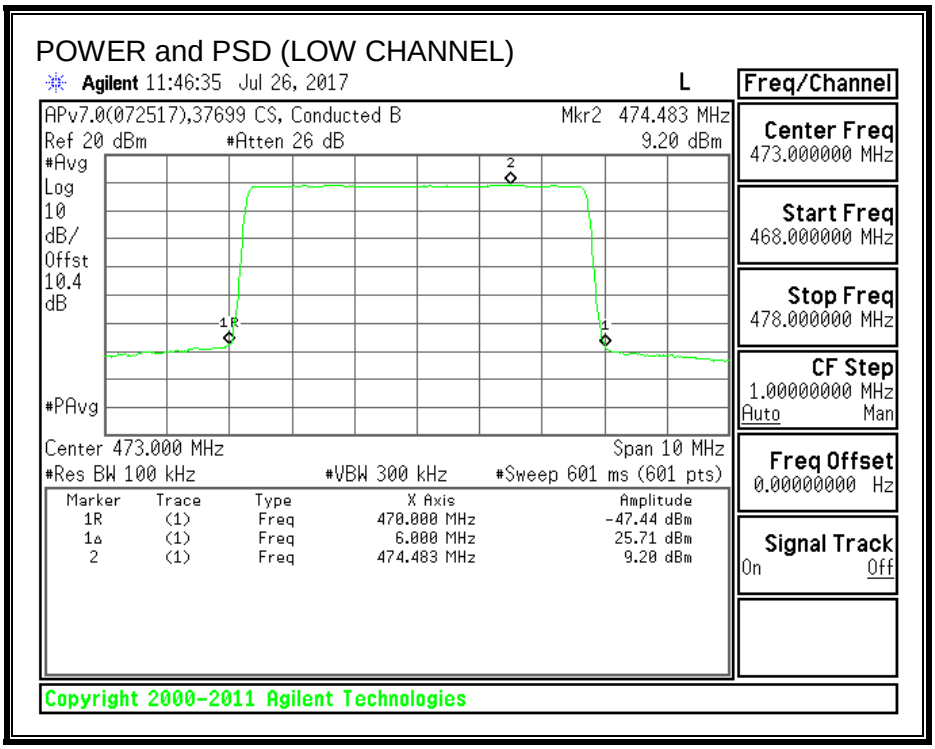
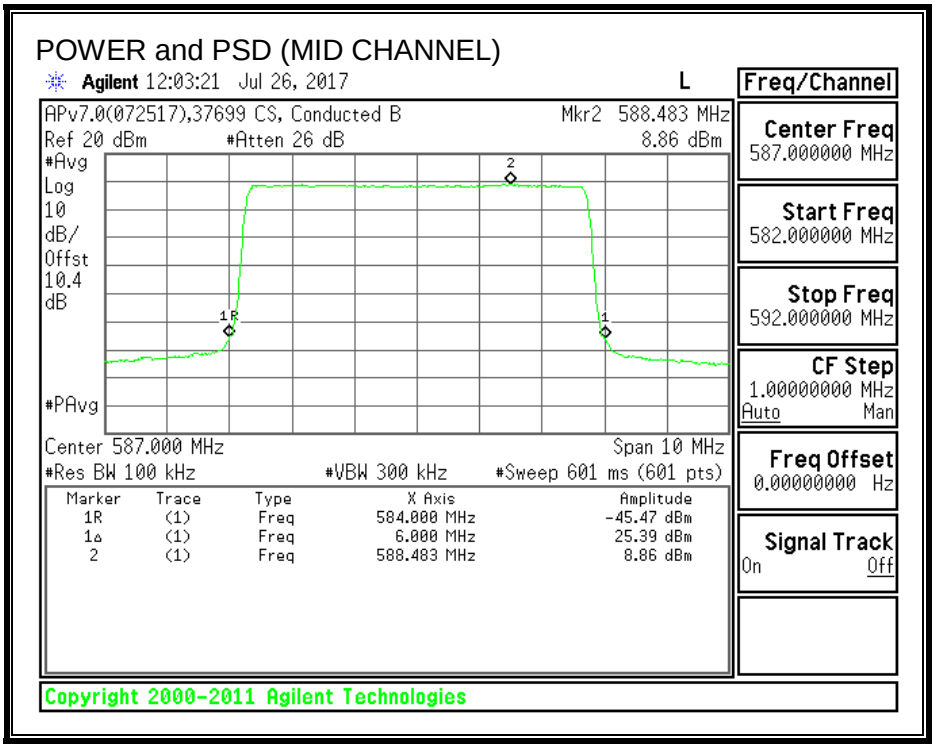
POWER and PSD (LOW CHANNEL)



POWER and PSD (MID CHANNEL)



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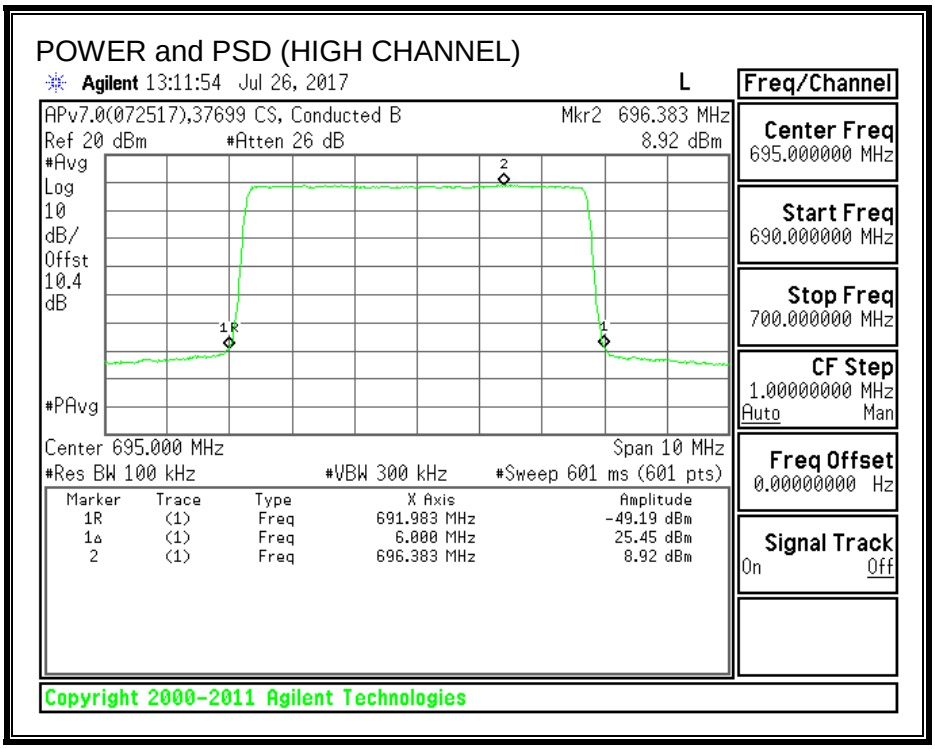
POWER and PSD (HIGH CHANNEL)



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10.2. 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

[1]The 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

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10.2.1. UHF BAND

Tested By:	37699 CS
Test Date:	07/26/17

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	-48.31	-48.31	-44.8	-3.51
Mid	587	-46.32	-46.32	-44.8	-1.52
High	695	-49.59	-49.59	-44.8	-4.79

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	-49.67	-49.67	-44.8	-4.87
Mid	587	-47.49	-47.49	-44.8	-2.69
High	695	-50.11	-50.11	-44.8	-5.31

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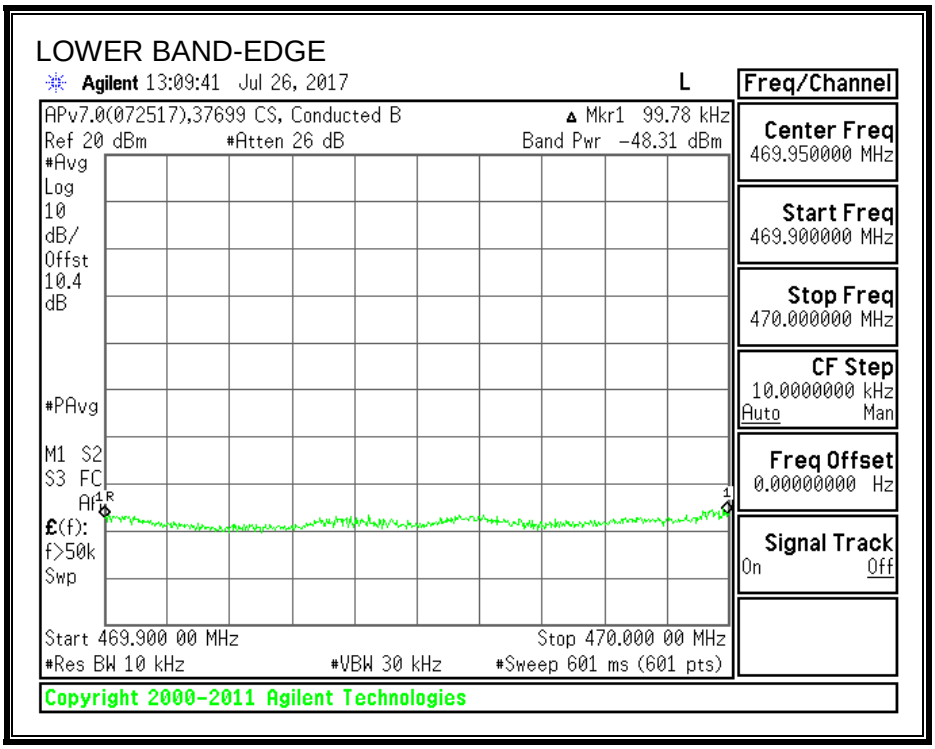
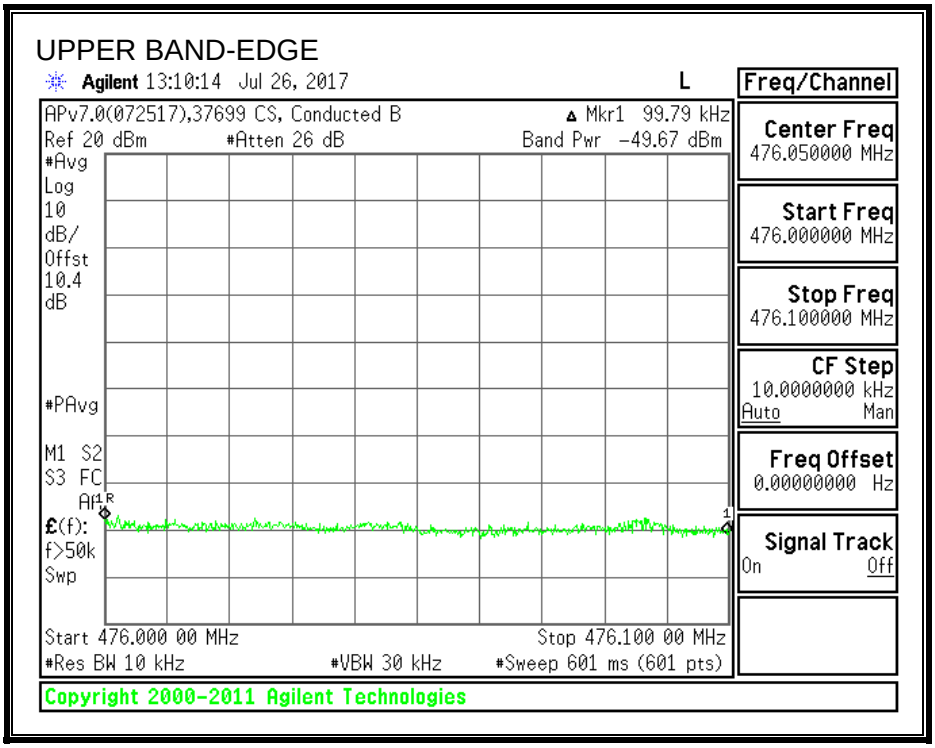
LOW CHANNEL





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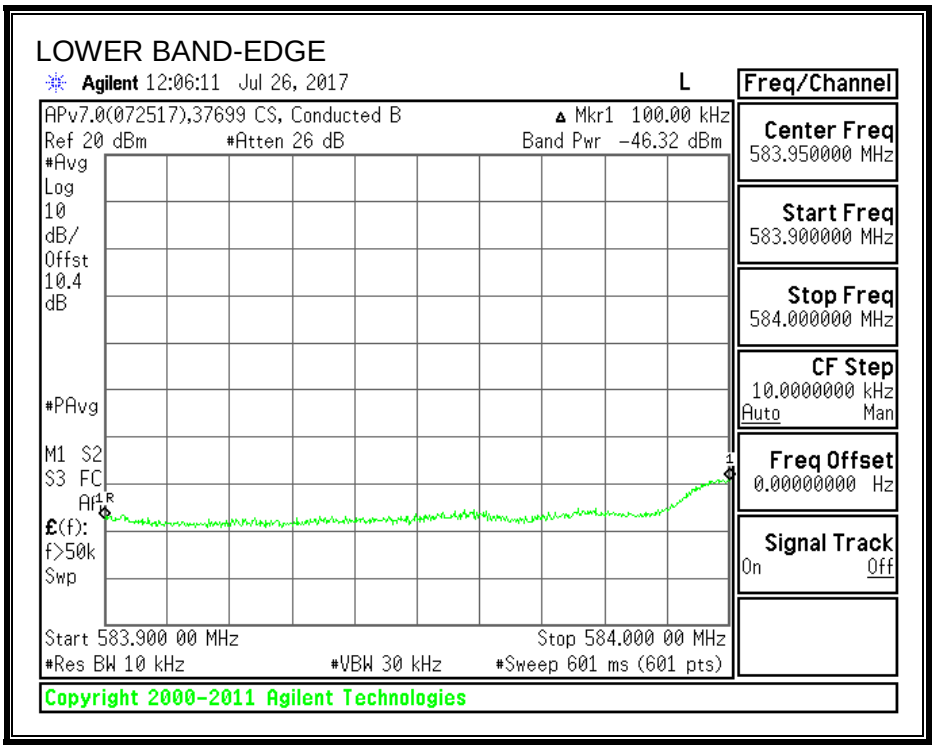
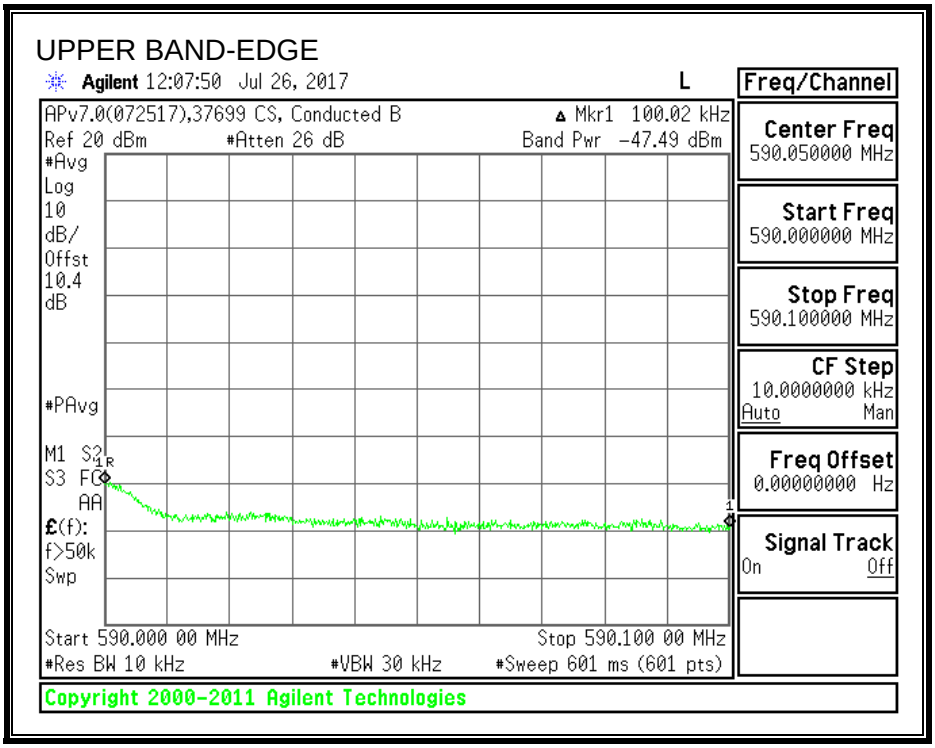
MID CHANNEL





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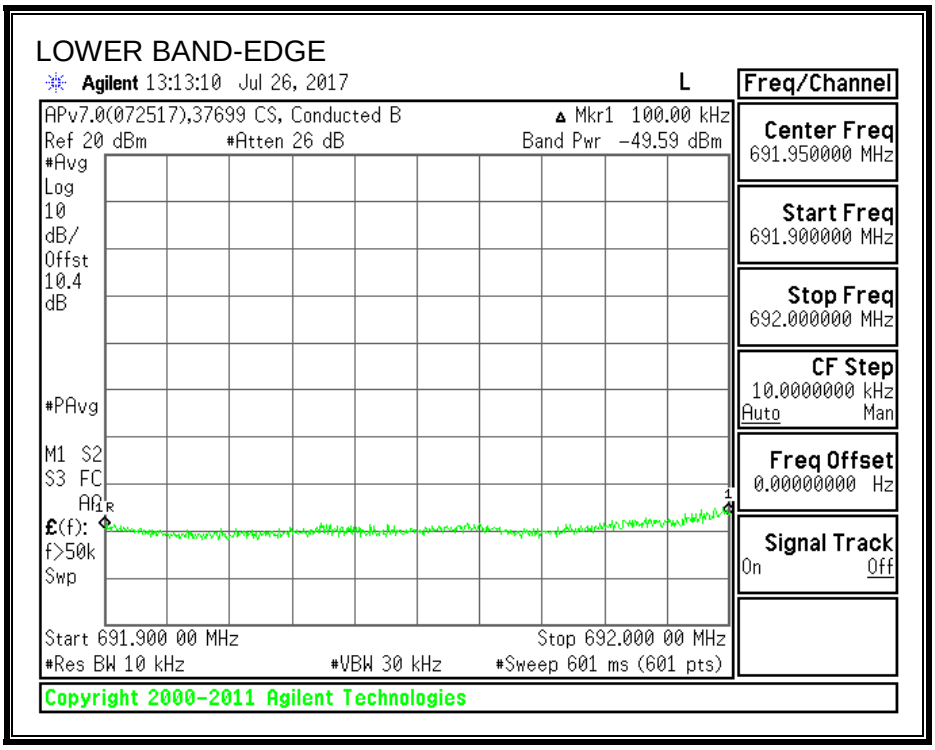
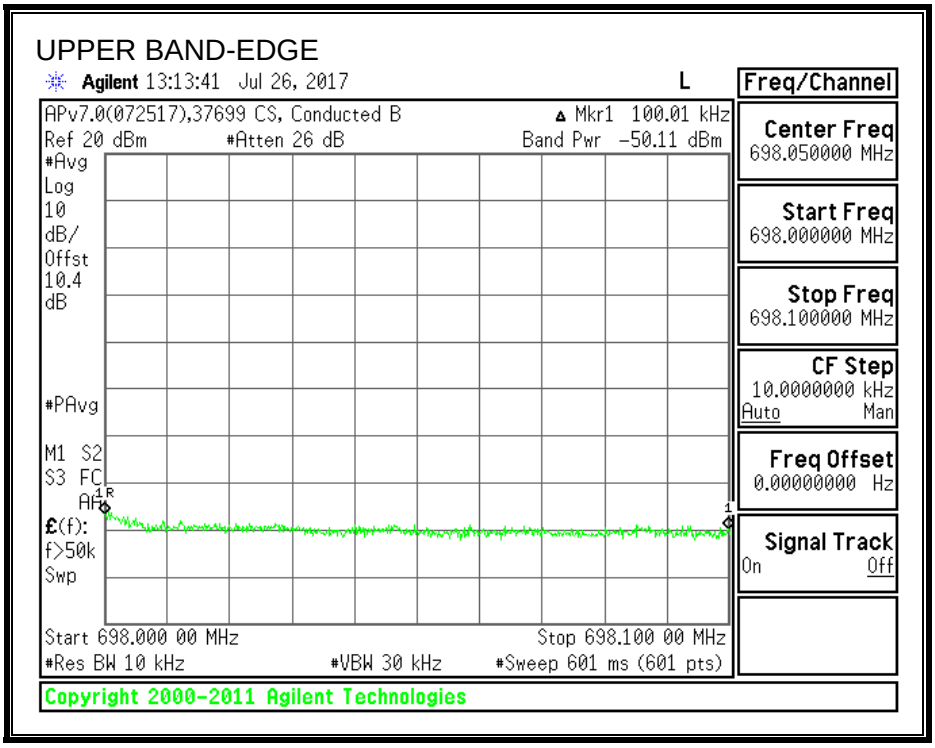
HIGH CHANNEL





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10.3. 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

[1]The 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

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10.3.1. UHF BAND

Tested By:	37699 CS
Test Date:	07/26/17

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	-48.53	-48.53	-44.8	-3.73
Mid	587	-49.27	-49.27	-44.8	-4.47
High	695	-51.00	-51.00	-44.8	-6.20

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	-49.41	-49.41	-44.8	-4.61
Mid	587	-49.92	-49.92	-44.8	-5.12
High	695	-51.22	-51.22	-44.8	-6.42

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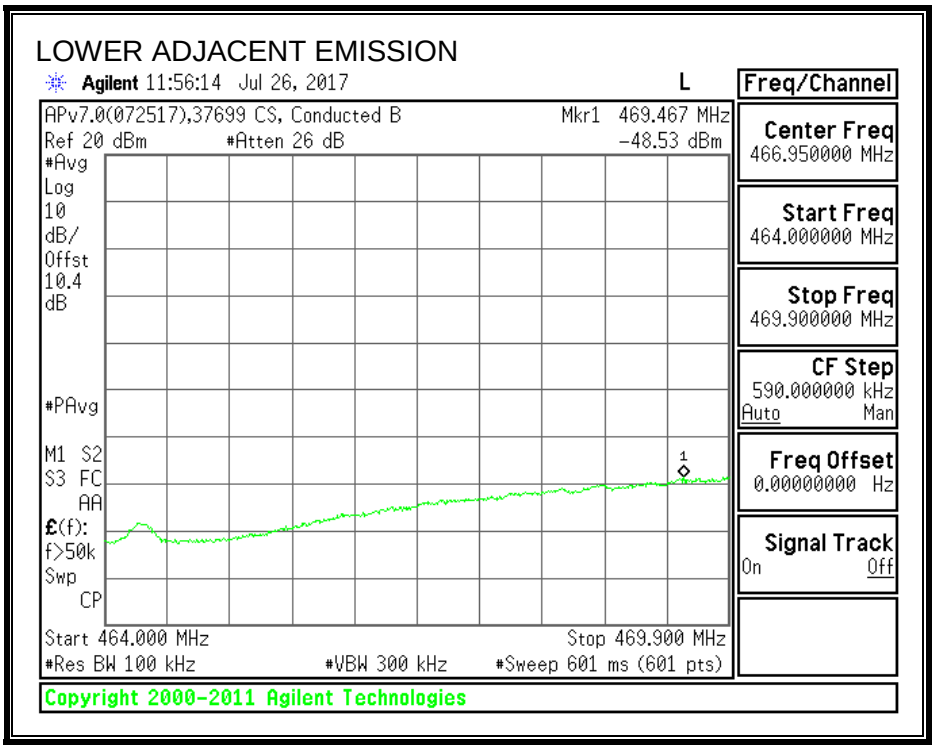
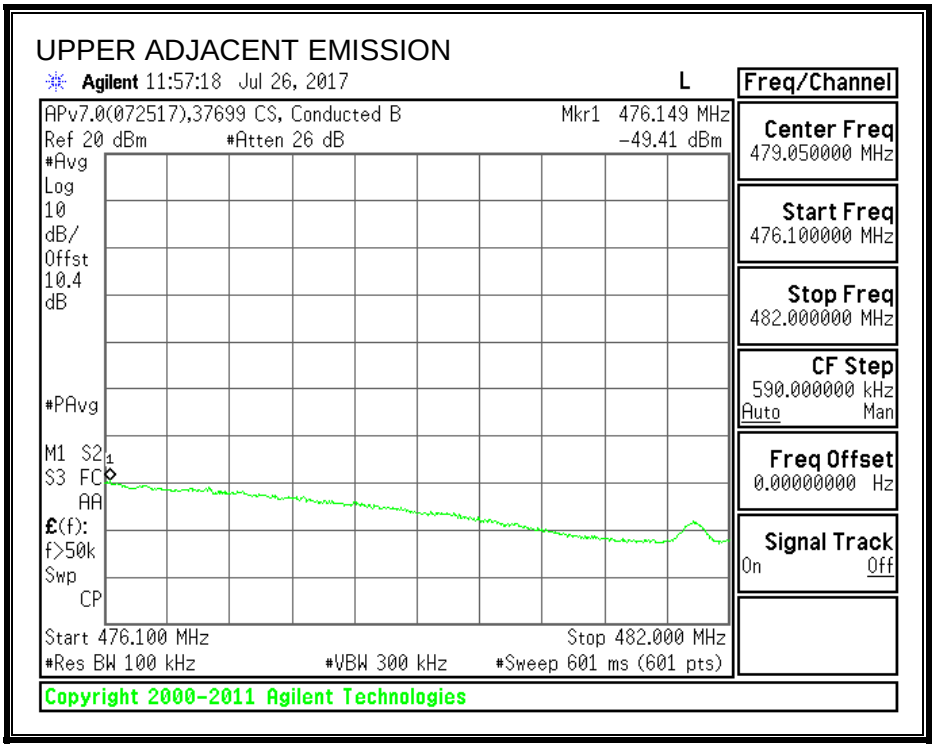
LOW CHANNEL





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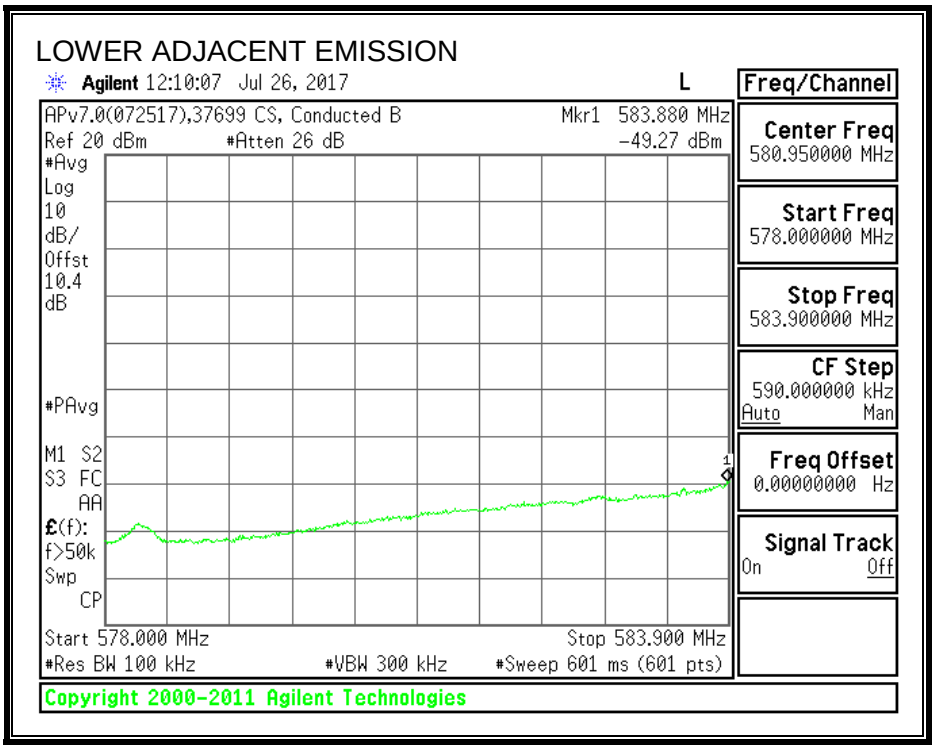
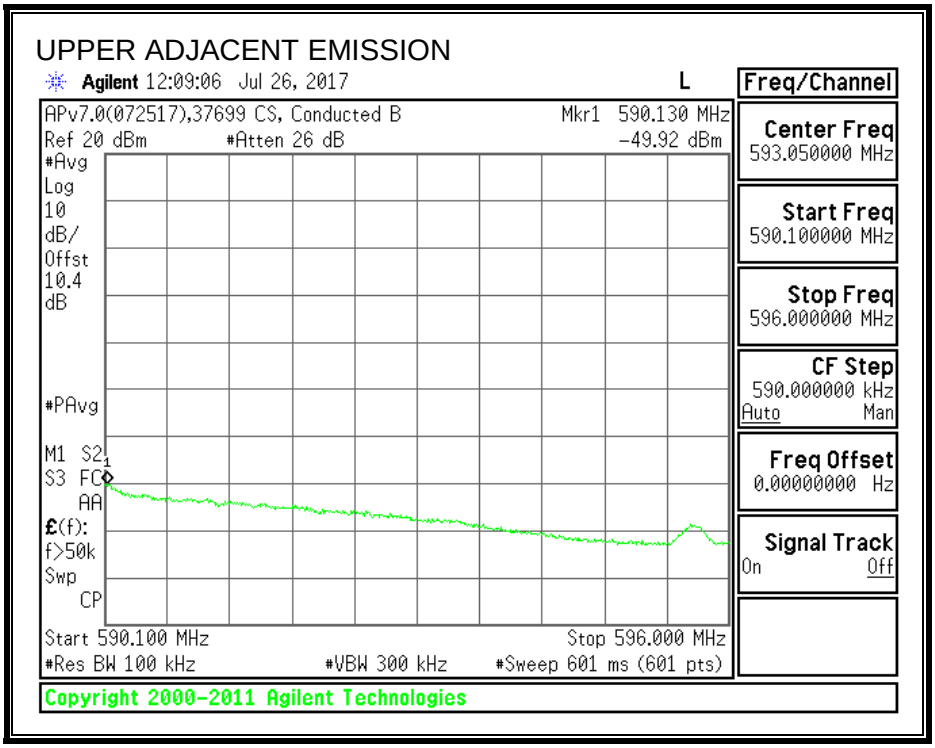
MID CHANNEL

LOWER ADJACENT EMISSION



UPPER ADJACENT EMISSION



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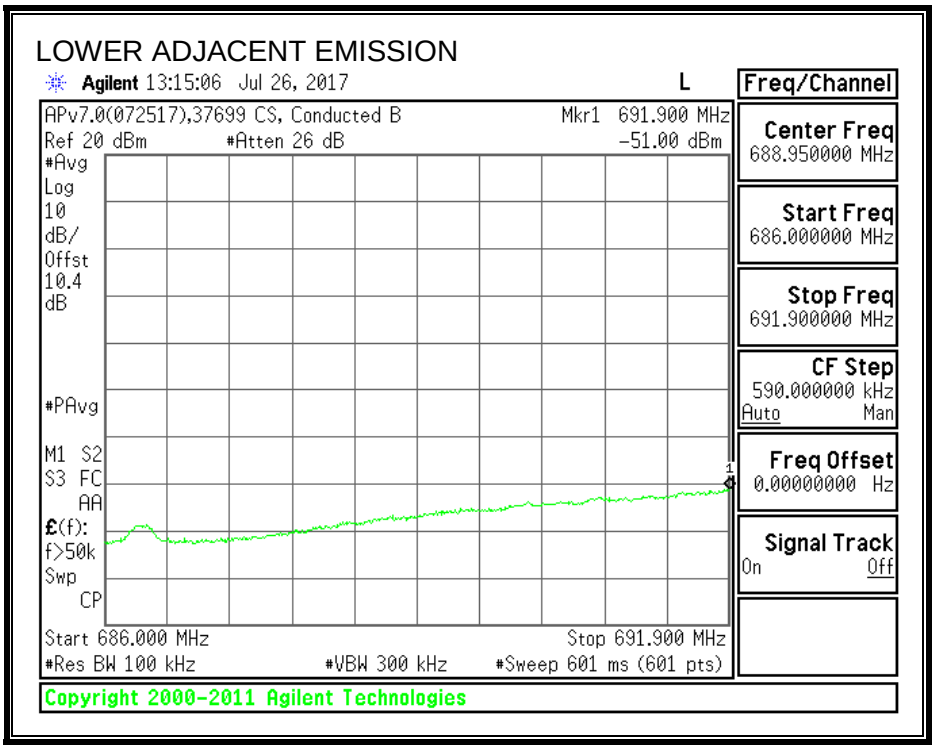
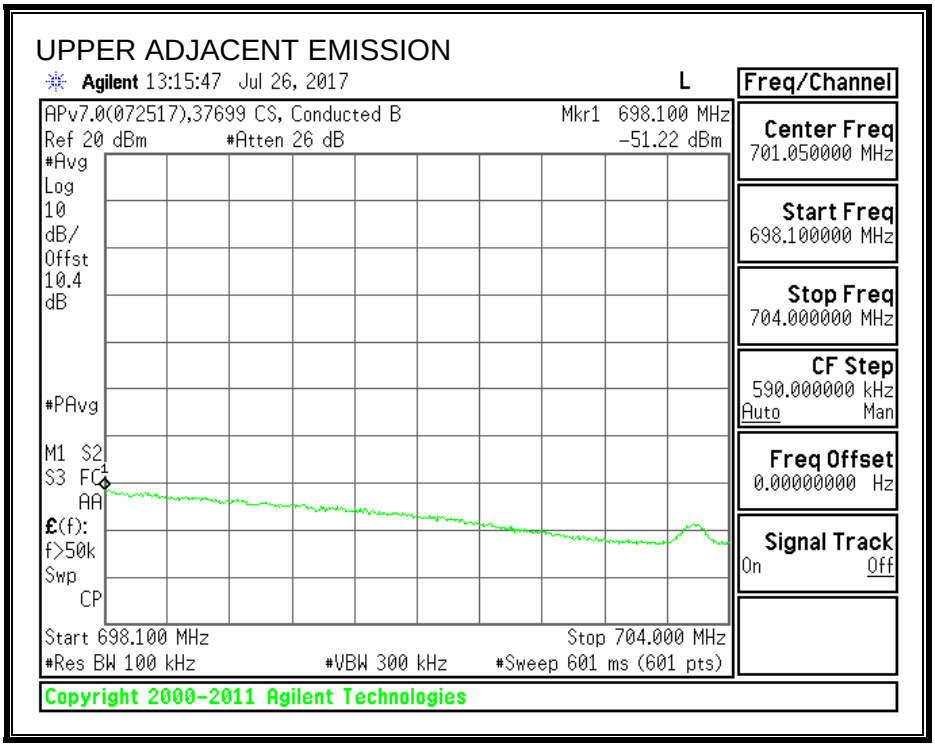
HIGH CHANNEL





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11. 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 3m	Measurement distance (m)
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.

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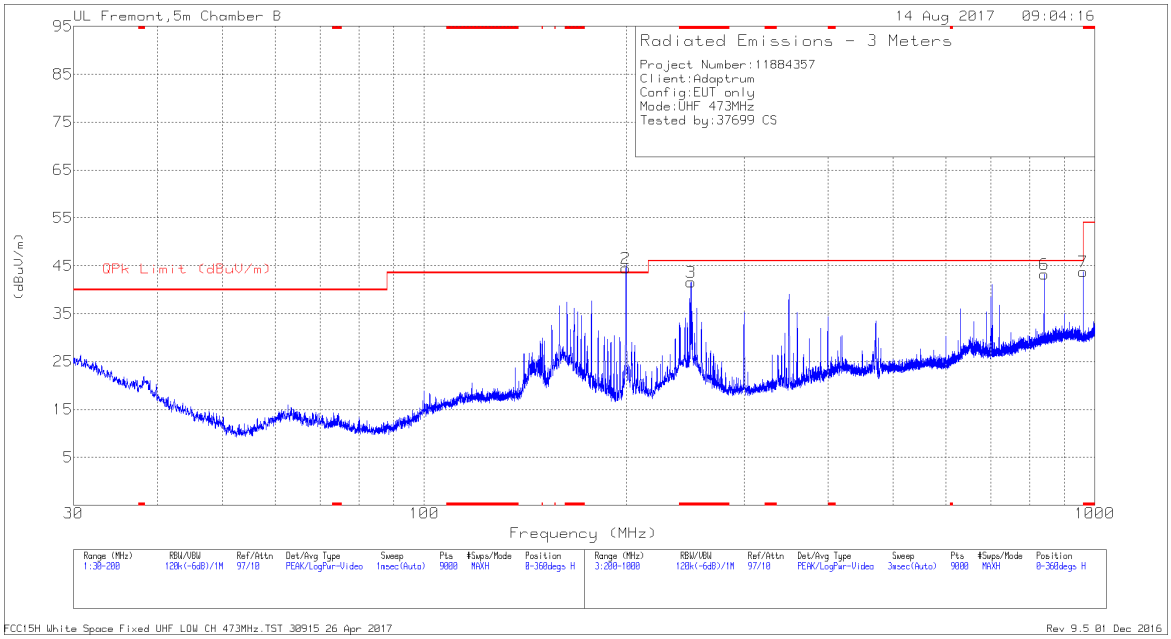
11.1. TRANSMITTER BELOW 1GHz WITH PANEL ANTENNA

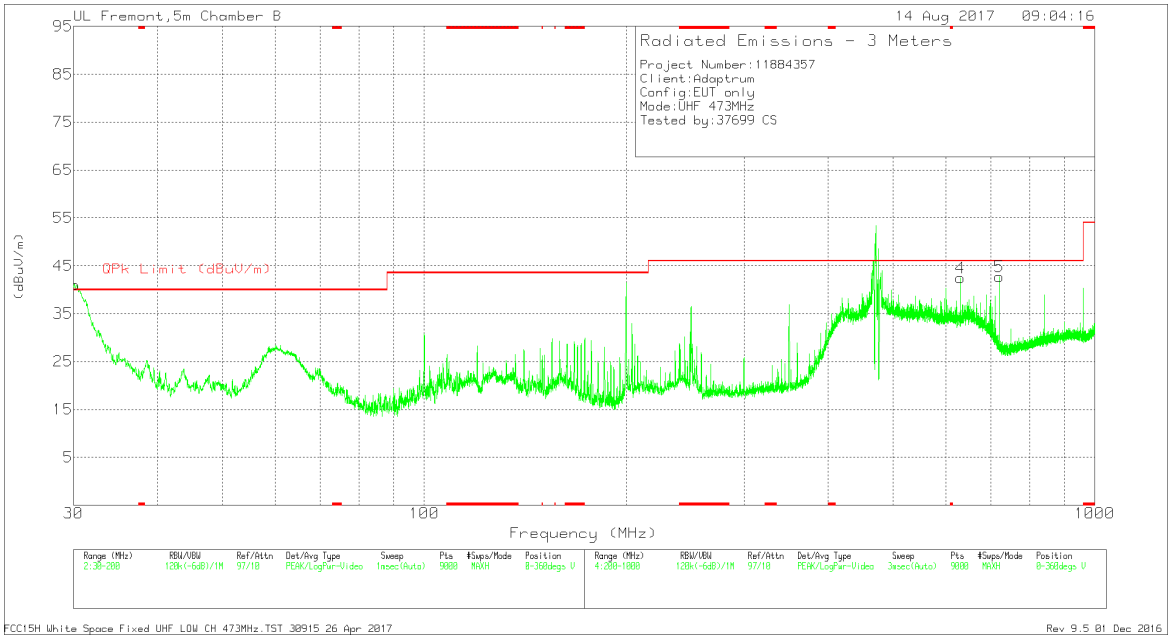
11.1.1. UHF BAND

BEYOND ADJACENT CHANNEL (LOW CHANNEL)

HORIZONTAL PLOT



VERTICAL PLOT



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LOW CHANNEL DATA

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T899 (dB/m)	Amp/Cbl (dB)	Fltr (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
3	* 250.003	51.01	Qp	15.4	-26.3	.1	40.21	46	-5.79	336	135	H
7	* 960.0053	37.49	Qp	26.7	-23.2	.1	41.09	54	-12.91	308	101	H
1	30.122	40.17	Qp	25.4	-28.8	.1	36.87	40	-3.13	250	104	V
2	199.9391	49.33	Qp	16.6	-26.8	.1	39.23	43.5	-4.27	65	148	H
4	630.004	42.23	Qp	23.5	-25.4	.1	40.43	46	-5.57	349	169	V
5	720.0044	39.64	Qp	24.3	-24.9	.1	39.14	46	-6.86	349	123	V
6	840.0084	42.21	Qp	25.8	-24	.1	44.11	46	-1.89	209	100	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Qp - Quasi-Peak detector

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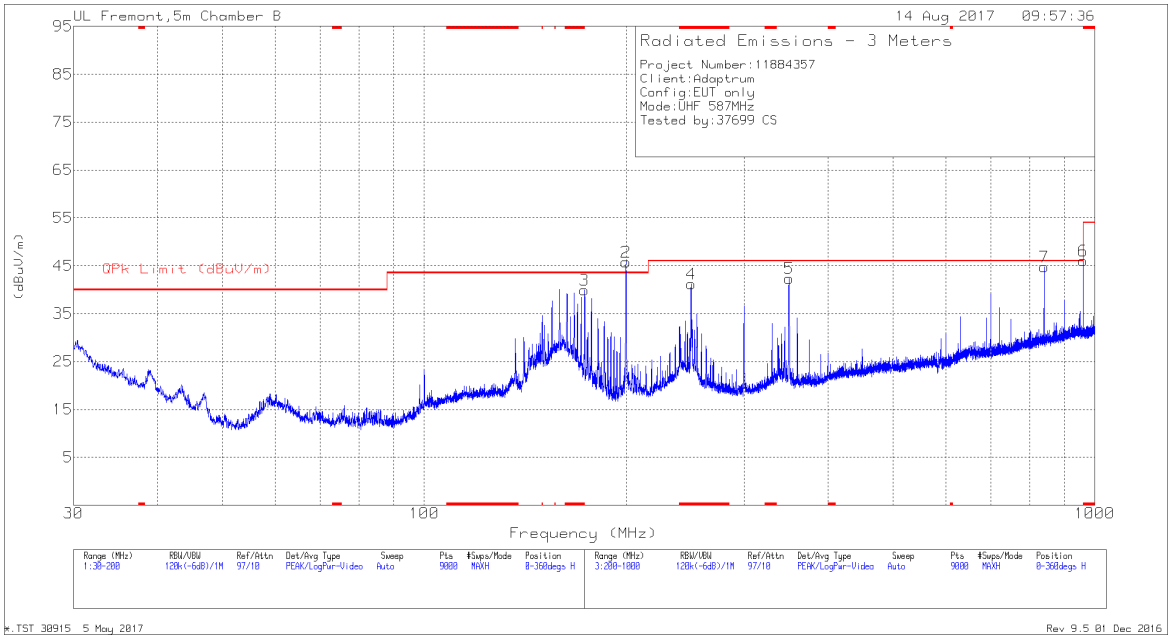
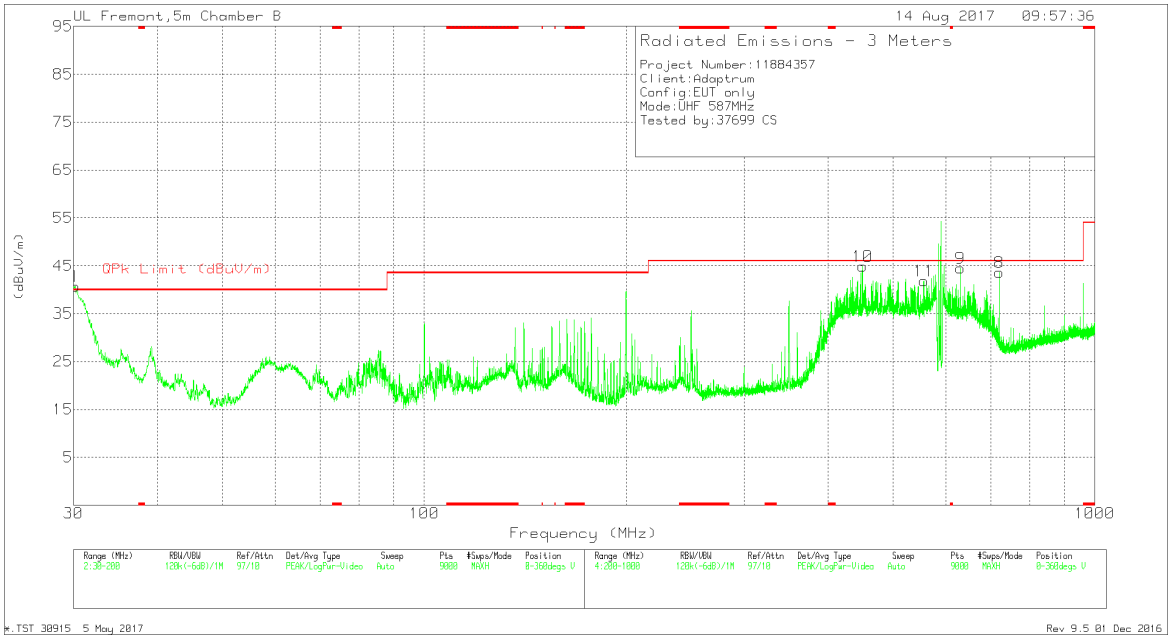
BEYOND ADJACENT CHANNEL (MID CHANNEL)

HORIZONTAL PLOT



VERTICAL PLOT



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MID CHANNEL DATA

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T899 (dB/m)	Amp/Cbl (dB)	Fltr (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
4	* 250.0064	50.49	Qp	15.4	-26.3	.2	39.79	46	-6.21	334	117	H
1	30.41	39.66	Qp	25.2	-28.8	.2	36.26	40	-3.74	238	109	V
3	173.3864	41.8	Qp	15.5	-27.1	.2	30.4	43.5	-13.1	89	173	H
2	199.9817	50.49	Qp	16.6	-26.8	.2	40.49	43.5	-3.01	75	145	H
5	349.8936	46.46	Qp	18.2	-25.8	.2	39.06	46	-6.94	101	101	H
10	450.2859	37.53	Qp	20.8	-26	.2	32.53	46	-13.47	2	108	V
11	555.6894	34.06	Qp	22.3	-25.8	.2	30.76	46	-15.24	328	151	V
9	630.0434	39.84	Qp	23.5	-25.4	.2	38.14	46	-7.86	351	100	V
8	719.9847	42.03	Qp	24.3	-24.9	.2	41.63	46	-4.37	357	132	V
7	839.9959	38.63	Qp	25.8	-24	.2	40.63	46	-5.37	211	176	H
6	959.9842	40.1	Qp	26.7	-23.2	.2	43.8	46	-2.2	308	102	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Qp - Quasi-Peak detector

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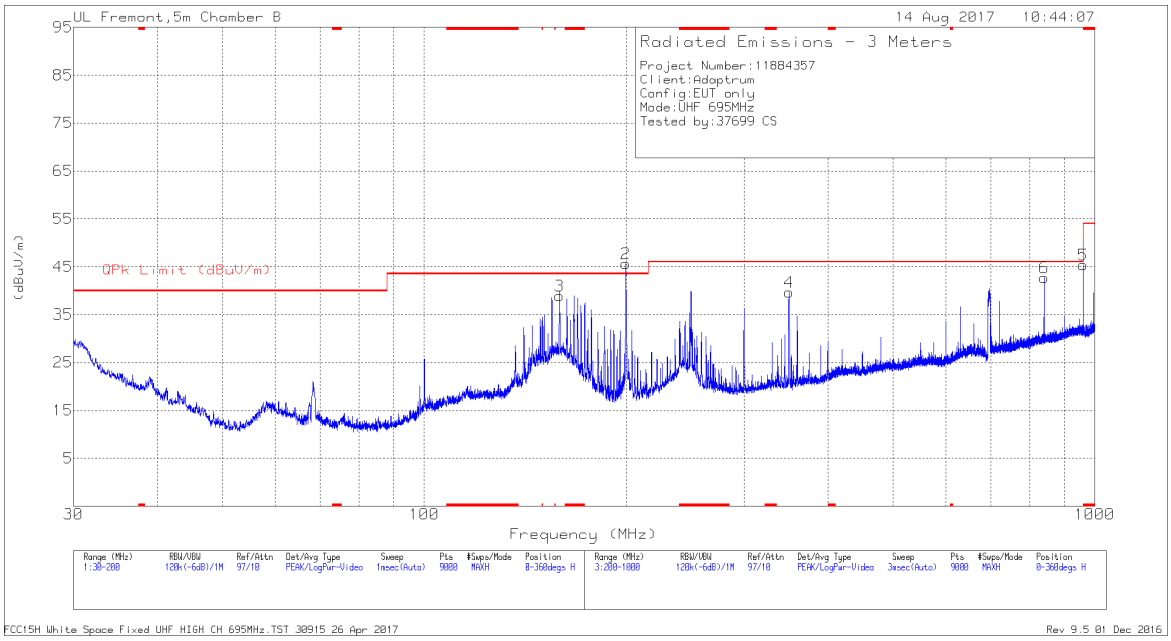
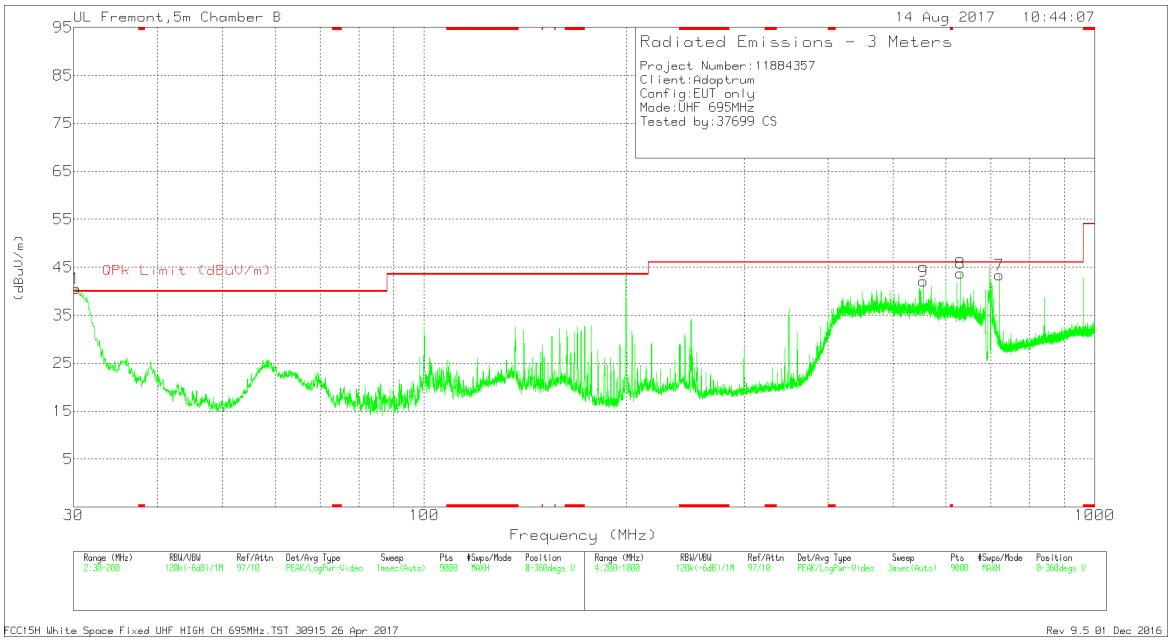
BEYOND ADJACENT CHANNEL (HIGH CHANNEL)

HORIZONTAL PLOT



VERTICAL PLOT



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HIGH CHANNEL DATA

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T899 (dB/m)	Amp/Cbl (dB)	Fltr (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	30.086	39.79	Qp	25.4	-28.8	0	36.39	40	-3.61	322	103	V
3	159.0845	44.9	Qp	15.9	-27.2	0	33.6	43.5	-9.9	91	164	H
2	199.9378	49.87	Qp	16.6	-26.8	0	39.67	43.5	-3.83	83	149	H
9	555.0414	37.09	Qp	22.3	-25.8	0	33.59	46	-12.41	351	106	V
8	629.9915	43.92	Qp	23.5	-25.4	0	42.02	46	-3.98	1	109	V
7	719.989	43.68	Qp	24.3	-24.9	0	43.08	46	-2.92	6	146	V
6	840.0098	38.95	Qp	25.8	-24	0	40.75	46	-5.25	204	101	H
5	959.9952	39.37	Qp	26.7	-23.2	0	42.87	46	-3.13	317	108	H
4	350.0615	47.28	Pk	18.2	-25.8	0	39.68	46	-6.32	0-360	100	H

Qp - Quasi-Peak detector
Pk - Peak detector

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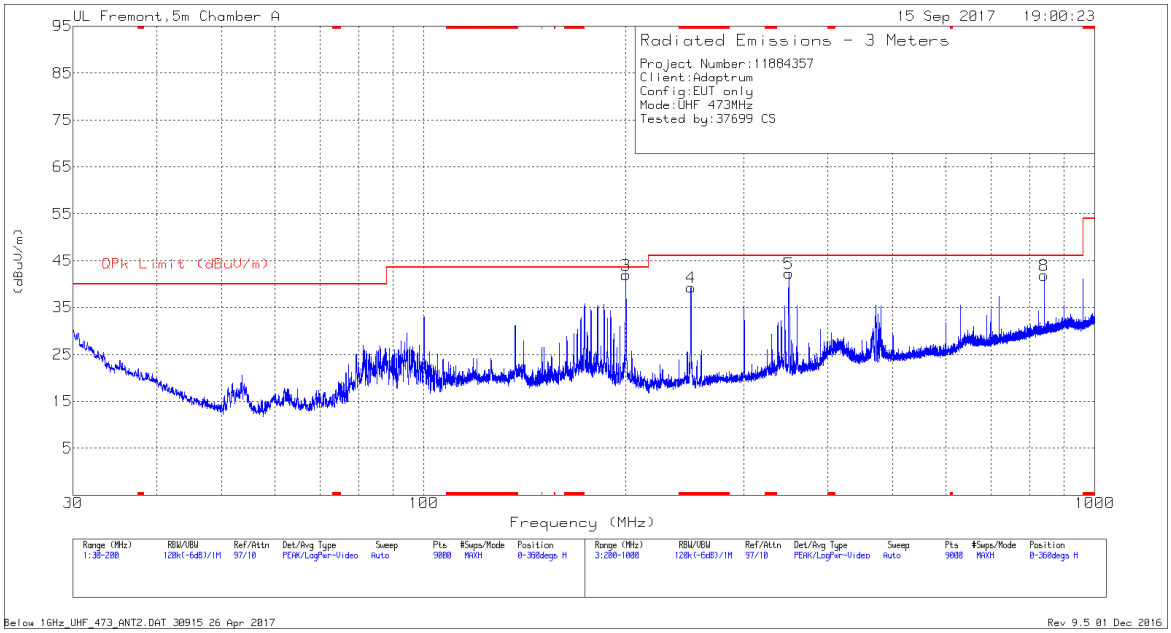
11.2. TRANSMITTER BELOW 1GHz WITH LOG PERIODIC ANTENNA

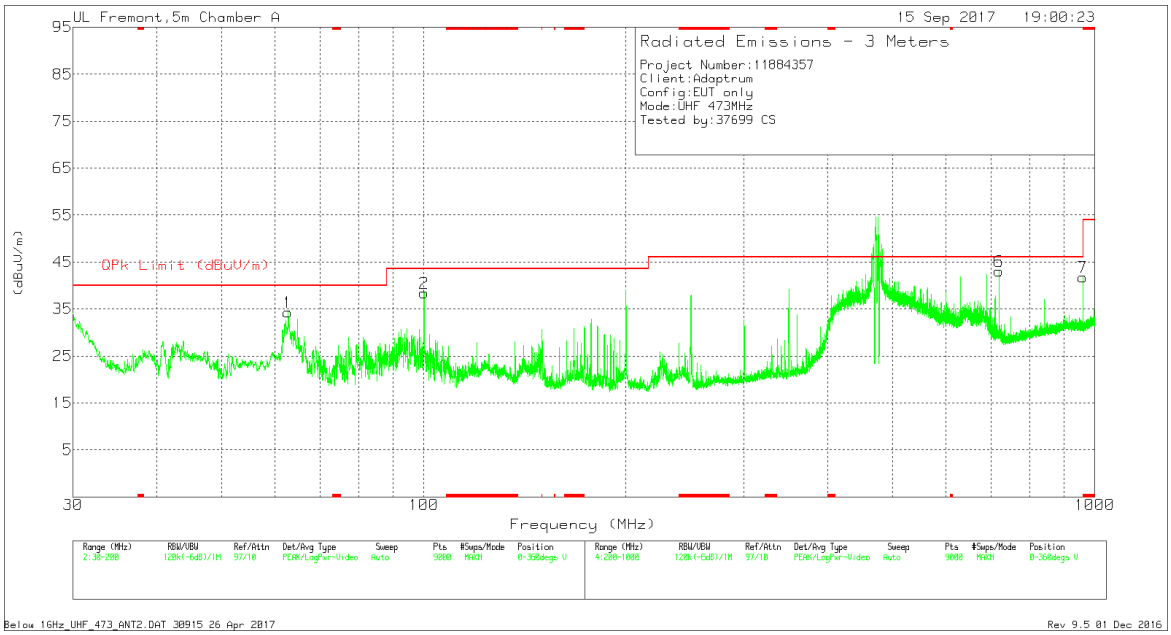
11.2.1. UHF BAND

BEYOND ADJACENT CHANNEL (LOW CHANNEL)

HORIZONTAL PLOT



VERTICAL PLOT



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LOW CHANNEL DATA

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T130 (dB/m)	Amp/Cbl (dB/m)	Fltr (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
4	* 249.9675	47.55	Qp	15.5	-24.8	.1	38.35	46	-7.65	193	118	H
7	* 960.0005	37.41	Qp	26.5	-22.7	.1	41.31	54	-12.69	310	116	V
1	62.7671	45.52	Qp	12.1	-26.8	.1	30.92	40	-9.08	18	134	V
2	99.994	38.44	Qp	14.2	-26.4	.1	26.34	43.5	-17.16	306	103	V
3	199.9822	47.23	Qp	16.7	-25.3	.1	38.73	43.5	-4.77	165	156	H
5	350.0139	48.01	Qp	18.3	-24.8	.1	41.61	46	-4.39	51	103	H
6	719.9885	41.56	Qp	24.5	-24.3	.1	41.86	46	-4.14	93	110	V
8	839.9844	37.38	Qp	25.7	-23.4	.1	39.78	46	-6.22	356	103	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Qp - Quasi-Peak detector

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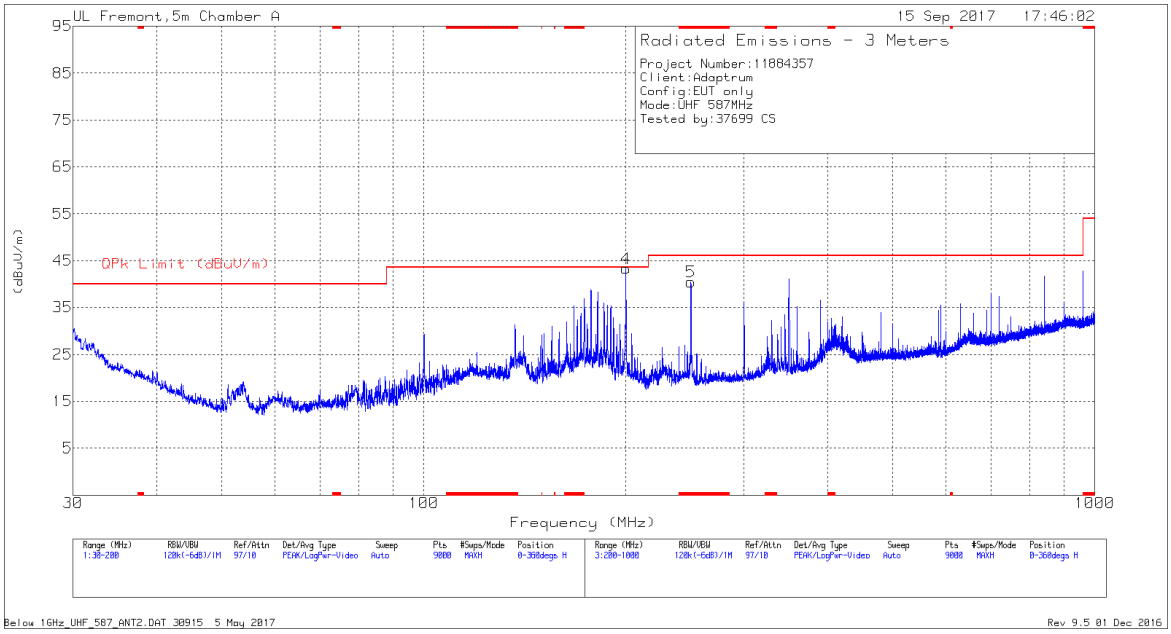
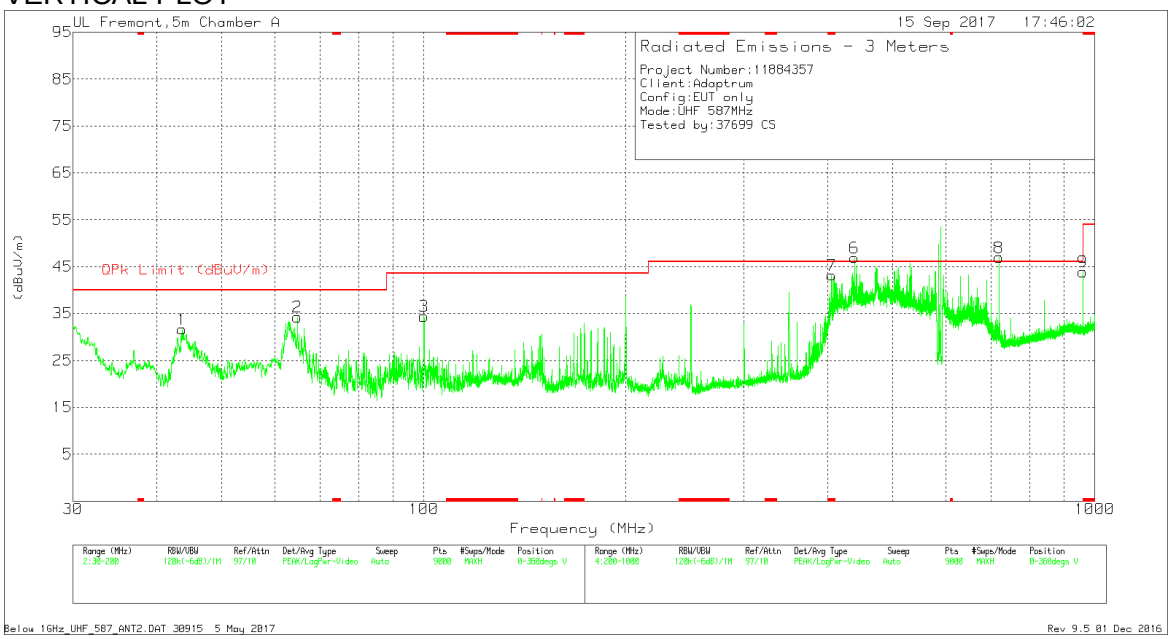
BEYOND ADJACENT CHANNEL (MID CHANNEL)

HORIZONTAL PLOT



VERTICAL PLOT



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MID CHANNEL DATA

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T130 (dB/m)	Amp/Cbl (dB/m)	Fltr (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
5	* 250.0116	48.08	Qp	15.5	-24.8	.2	38.98	46	-7.02	193	126	H
7	* 404.9839	36.64	Qp	19.8	-25.1	.2	31.54	46	-14.46	96	104	V
9	* 960.001	38.42	Qp	26.5	-22.7	.2	42.42	54	-11.58	309	124	V
1	43.7708	32.48	Qp	15.3	-27.1	.2	20.88	40	-19.12	237	152	V
2	64.7761	39.68	Qp	12.3	-26.8	.2	25.38	40	-14.62	69	119	V
3	100.0179	38.73	Qp	14.2	-26.4	.2	26.73	43.5	-16.77	284	113	V
4	200.0098	43.24	Qp	16.7	-25.3	.2	34.84	43.5	-8.66	211	153	H
6	438.5019	39.36	Qp	20.8	-25	.2	35.36	46	-10.64	79	115	V
8	720.0001	41.64	Qp	24.5	-24.3	.2	42.04	46	-3.96	92	164	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Qp - Quasi-Peak detector

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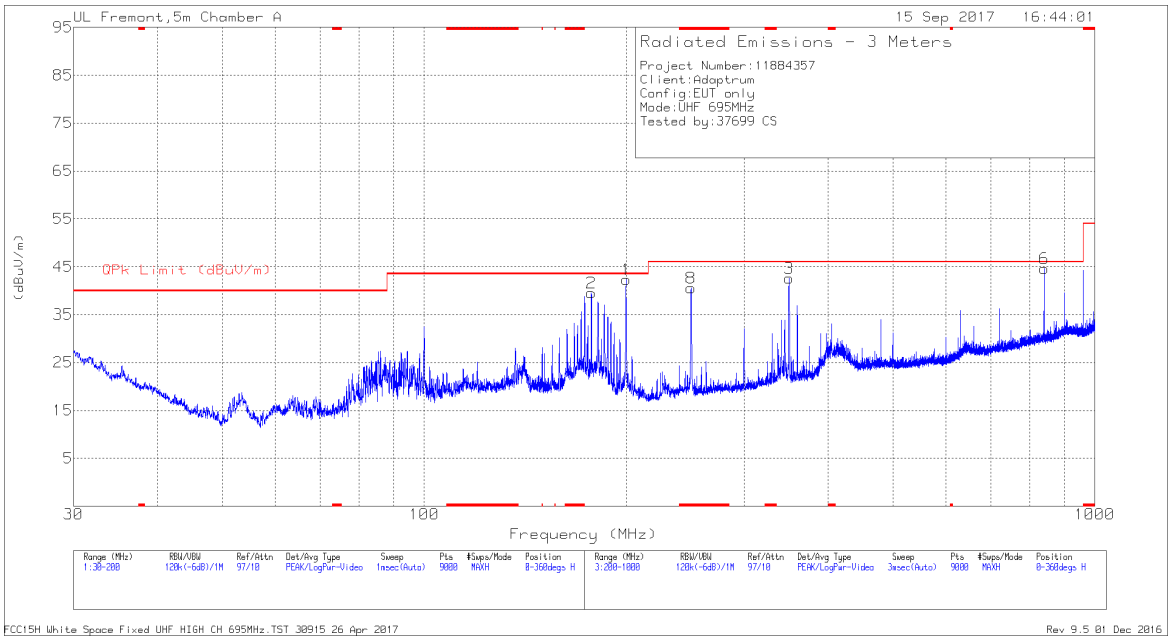
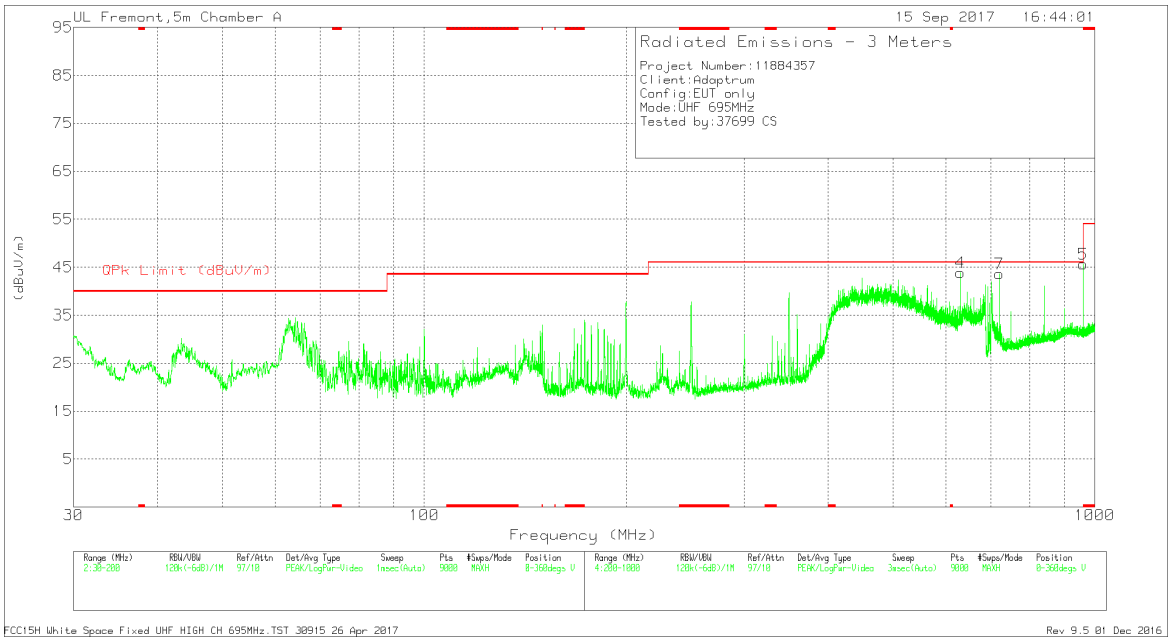
BEYOND ADJACENT CHANNEL (HIGH CHANNEL)

HORIZONTAL PLOT



VERTICAL PLOT



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HIGH CHANNEL DATA

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T130 (dB/m)	Amp/Cbl (dB/m)	Fltr (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
8	* 249.9991	48.83	Qp	15.5	-24.8	0	39.53	46	-6.47	191	133	H
2	177.5589	25.18	Qp	15.4	-25.5	0	15.08	43.5	-28.42	1	257	H
1	199.9849	41.16	Qp	16.7	-25.3	0	32.56	43.5	-10.94	169	164	H
3	349.9731	47.85	Qp	18.3	-24.8	0	41.35	46	-4.65	43	103	H
4	629.9853	34.69	Qp	23.6	-24.8	0	33.49	46	-12.51	100	104	V
7	720.0284	29.73	Qp	24.5	-24.3	0	29.93	46	-16.07	63	102	V
6	840.0093	34.68	Qp	25.7	-23.4	0	36.98	46	-9.02	347	105	H
5	959.9981	37.14	Qp	26.5	-22.7	0	40.94	46	-5.06	303	106	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Qp - Quasi-Peak detector

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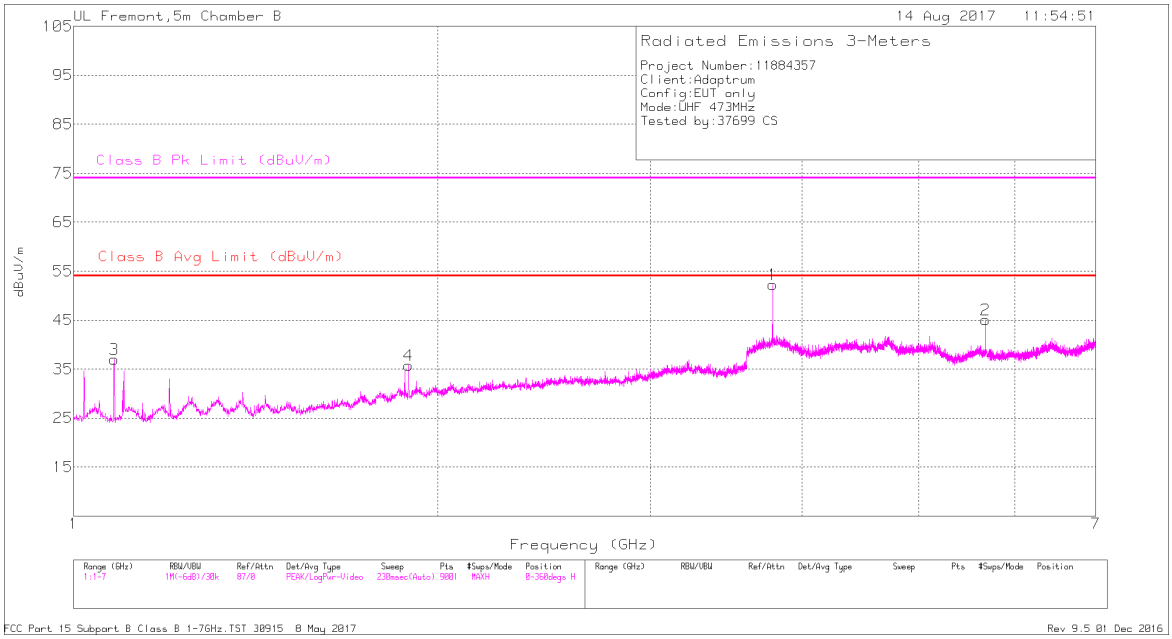
11.3. TRANSMITTER ABOVE 1GHz WITH PANEL ANTENNA

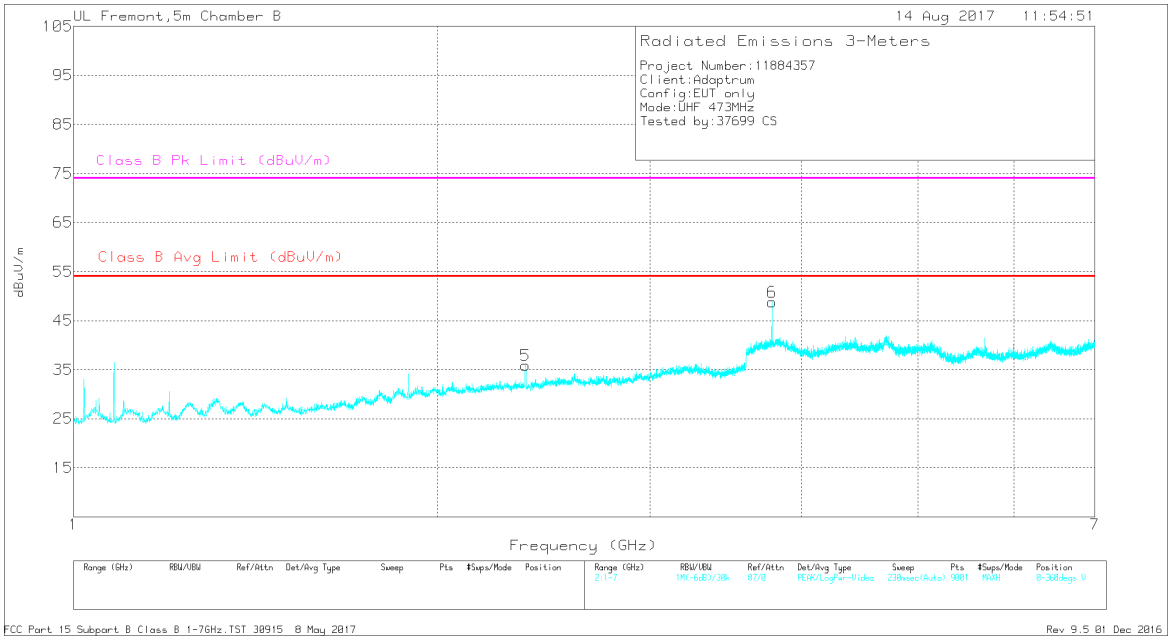
11.3.1. HARMONICS AND SPURIOUS EMISSIONS IN THE UHF BAND

LOW CHANNEL

HORIZONTAL PLOT



VERTICAL PLOT



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LOW CHANNEL DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T863 (dB/m)	Amp/Cbl/Fltr/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
3	1.08	37.82	Pk	27.4	-23	42.22	-	-	74	-31.78	259	244	H
	1.08	27.96	Av	27.4	-23	32.36	54	-21.64	-	-	259	244	H
4	1.892	31.3	Pk	30.9	-21.1	41.1	-	-	74	-32.9	251	110	H
	1.892	22.88	Av	30.9	-21.1	32.68	54	-21.32	-	-	251	110	H
5	2.365	34.95	Pk	31.9	-21.1	45.75	-	-	74	-28.25	217	252	V
	2.365	21.18	Av	31.9	-21.1	31.98	54	-22.02	-	-	217	252	V
1	3.784	38.91	Pk	33.5	-16.7	55.71	-	-	74	-18.29	240	105	H
	3.784	34.02	Av	33.5	-16.7	50.82	54	-3.18	-	-	240	105	H
6	3.784	38.01	Pk	33.5	-16.7	54.81	-	-	74	-19.19	25	287	V
	3.784	32.54	Av	33.5	-16.7	49.34	54	-4.66	-	-	25	287	V
2	5.676	33.75	Pk	35.2	-19	49.95	-	-	74	-24.05	242	161	H
	5.676	25.63	Av	35.2	-19	41.83	54	-12.17	-	-	242	161	H

Pk - Peak detector
Av - Average detection

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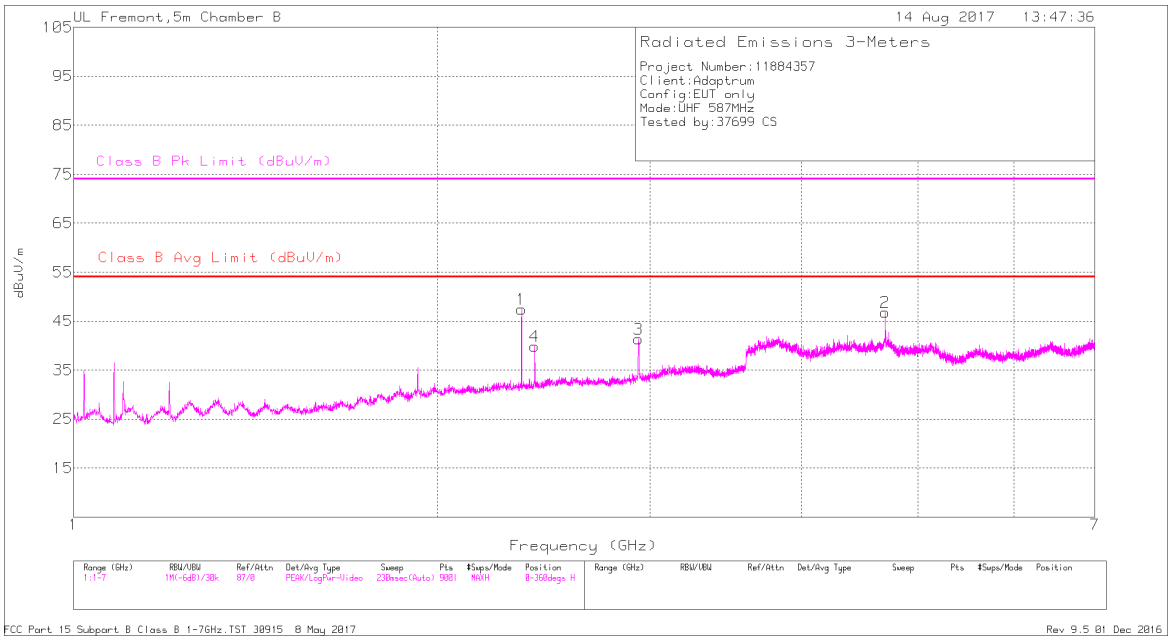
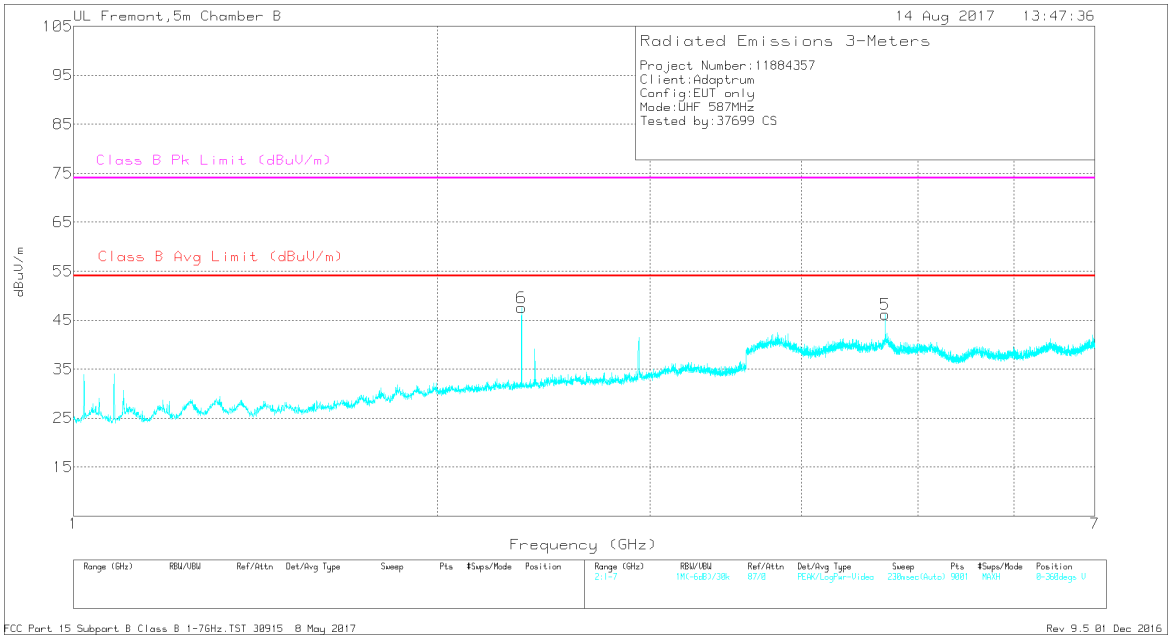
MID CHANNEL

HORIZONTAL PLOT



VERTICAL PLOT



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MID CHANNEL DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T863 (dB/m)	Amp/Cbl/Fltr/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	2.348	40.01	Pk	31.9	-21.1	50.81	-	-	74	-23.19	97	206	H
	2.348	37.05	Av	31.9	-21.1	47.85	54	-6.15	-	-	97	206	H
6	2.348	40.64	Pk	31.8	-21.1	51.34	-	-	74	-22.66	225	108	V
	2.348	37.75	Av	31.8	-21.1	48.45	54	-5.55	-	-	225	108	V
4	2.409	29.51	Pk	32.1	-21	40.61	-	-	74	-33.39	73	228	H
	2.409	14.74	Av	32.1	-21	25.84	54	-28.16	-	-	73	228	H
3	2.937	37.89	Pk	32.6	-19.4	51.09	-	-	74	-22.91	250	138	H
	2.937	21.44	Av	32.6	-19.4	34.64	54	-19.36	-	-	250	138	H
2	4.696	33.89	Pk	34.2	-16	52.09	-	-	74	-21.91	357	136	H
	4.696	24.29	Av	34.2	-16	42.49	54	-11.51	-	-	357	136	H
5	4.696	32.47	Pk	34.2	-16	50.67	-	-	74	-23.33	2	238	V
	4.696	20.46	Av	34.2	-16	38.66	54	-15.34	-	-	2	238	V

Pk - Peak detector
Av - Average detection

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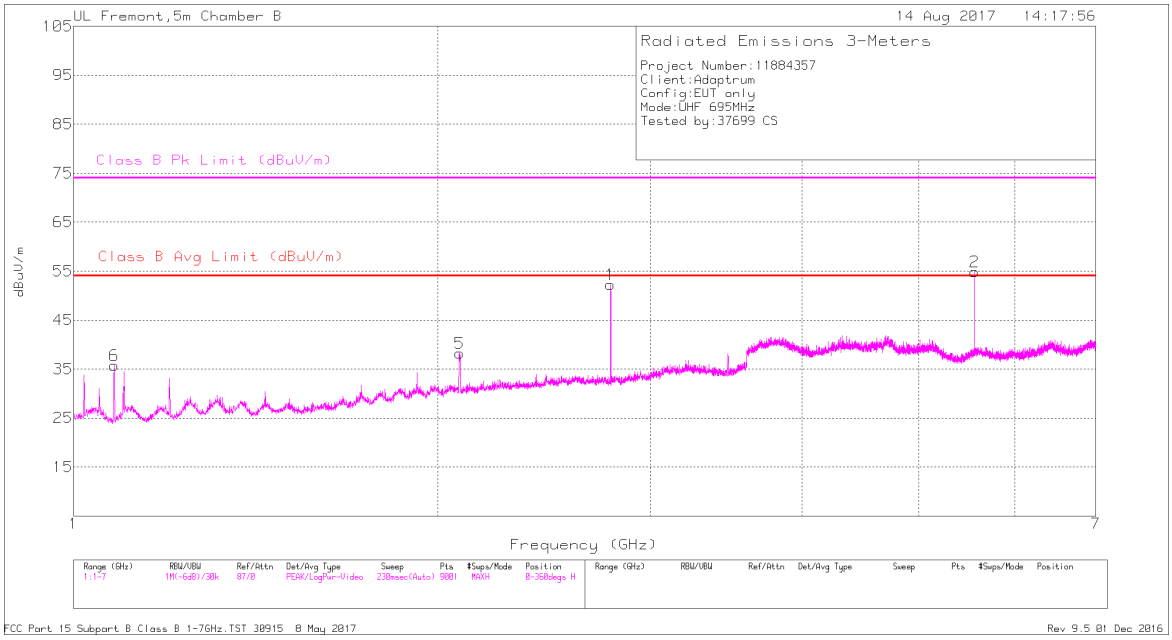
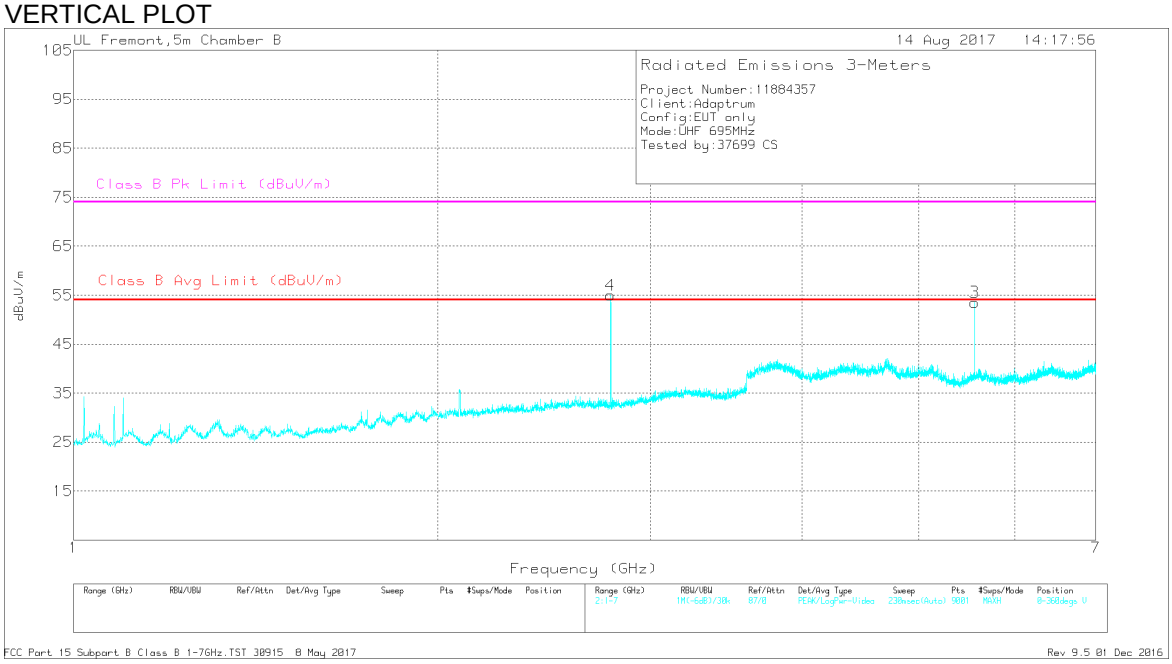
HIGH CHANNEL

HORIZONTAL PLOT



VERTICAL PLOT



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HIGH CHANNEL DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T863 (dB/m)	Amp/Cbl/Fltr/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	1.08	40.41	Pk	27.4	-23	44.81	-	-	74	-29.19	255	238	H
	1.08	31.24	Av	27.4	-23	35.64	54	-18.36	-	-	255	238	H
5	2.084	38.15	Pk	31.4	-21	48.55	-	-	74	-25.45	244	221	H
	2.084	21.93	Av	31.4	-21	32.33	54	-21.67	-	-	244	221	H
1	2.78	41.96	Pk	32.3	-20.5	53.76	-	-	74	-20.24	245	144	H
	2.78	39.83	Av	32.3	-20.5	51.63	54	-2.37	-	-	245	144	H
4	2.78	41.41	Pk	32.3	-20.5	53.21	-	-	74	-20.79	15	193	V
	2.78	40	Av	32.3	-20.5	51.8	54	-2.2	-	-	15	193	V
2	5.56	35.83	Pk	35.4	-19.3	51.93	-	-	74	-22.07	298	146	H
	5.56	32.7	Av	35.4	-19.3	48.8	54	-5.2	-	-	298	146	H
3	5.56	39.49	Pk	35.4	-19.3	55.59	-	-	74	-18.41	205	306	V
	5.56	35.55	Av	35.4	-19.3	51.65	54	-2.35	-	-	205	306	V

Pk - Peak detector
Av - Average detection

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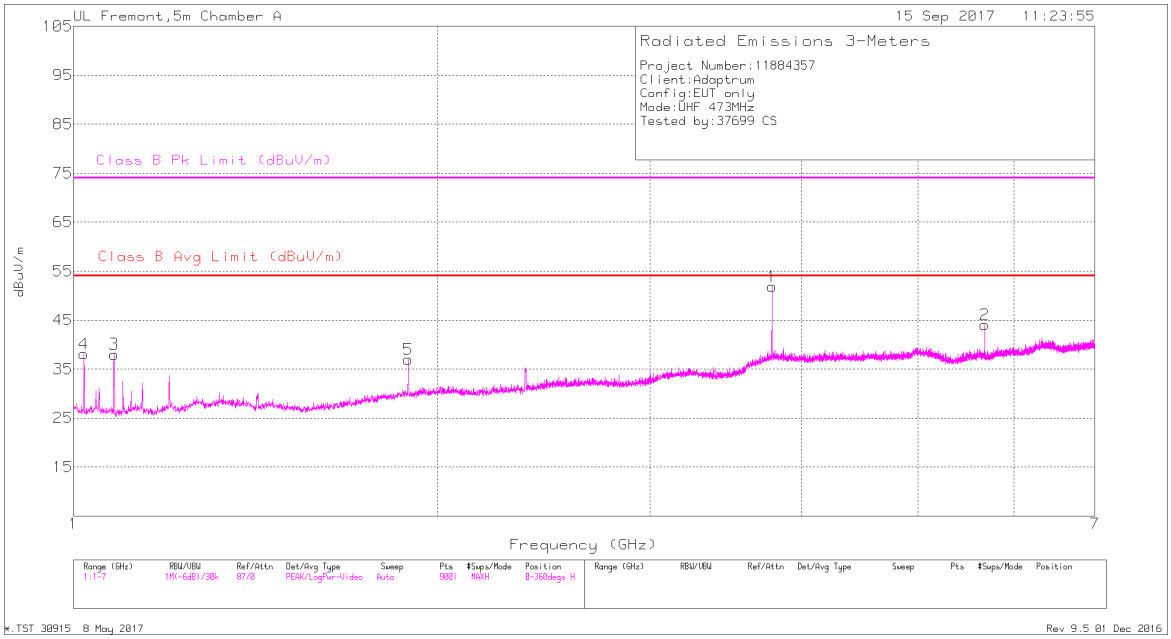
11.4. TRANSMITTER ABOVE 1GHz WITH LOG PERIODIC ANTENNA

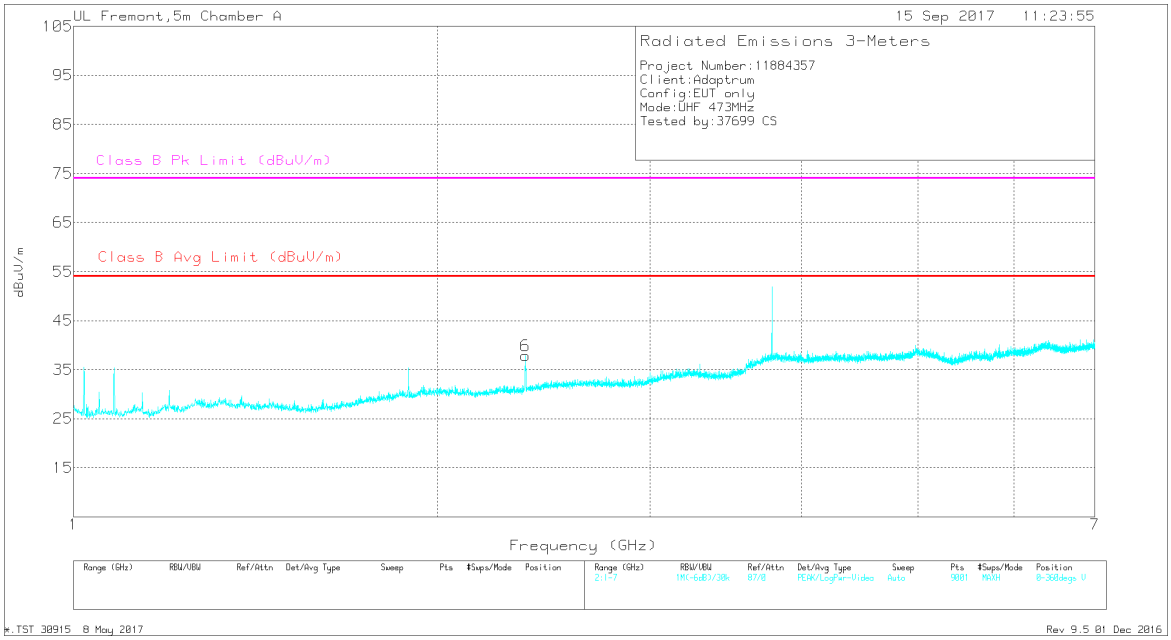
11.4.1. HARMONICS AND SPURIOUS EMISSIONS IN THE UHF BAND

LOW CHANNEL

HORIZONTAL PLOT



VERTICAL PLOT



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LOW CHANNEL DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T862 (dB/m)	Amp/Cbl/Fltr/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	1.02	40.59	Pk	27.6	-24.1	44.09	-	-	74	-29.91	335	143	H
	1.02	28.37	Av	27.6	-24.1	31.87	54	-22.13	-	-	335	143	H
3	1.08	40.38	Pk	27.5	-23.8	44.08	-	-	74	-29.92	343	107	H
	1.08	30.97	Av	27.5	-23.8	34.67	54	-19.33	-	-	343	107	H
5	1.892	35.05	Pk	31	-23.2	42.85	-	-	74	-31.15	251	208	H
	1.892	27.72	Av	31	-23.2	35.52	54	-18.48	-	-	251	208	H
6	2.365	37.37	Pk	31.6	-23.2	45.77	-	-	74	-28.23	285	101	V
	2.365	24.18	Av	31.6	-23.2	32.58	54	-21.42	-	-	285	101	V
1	3.784	40.18	Pk	33.2	-17.9	55.48	-	-	74	-18.52	30	103	H
	3.784	36.86	Av	33.2	-17.9	52.16	54	-1.84	-	-	30	103	H
2	5.676	37.94	Pk	35	-18.4	54.54	-	-	74	-19.46	34	106	H
	5.676	28.47	Av	35	-18.4	45.07	54	-8.93	-	-	34	106	H

Pk - Peak detector
Av - Average detection

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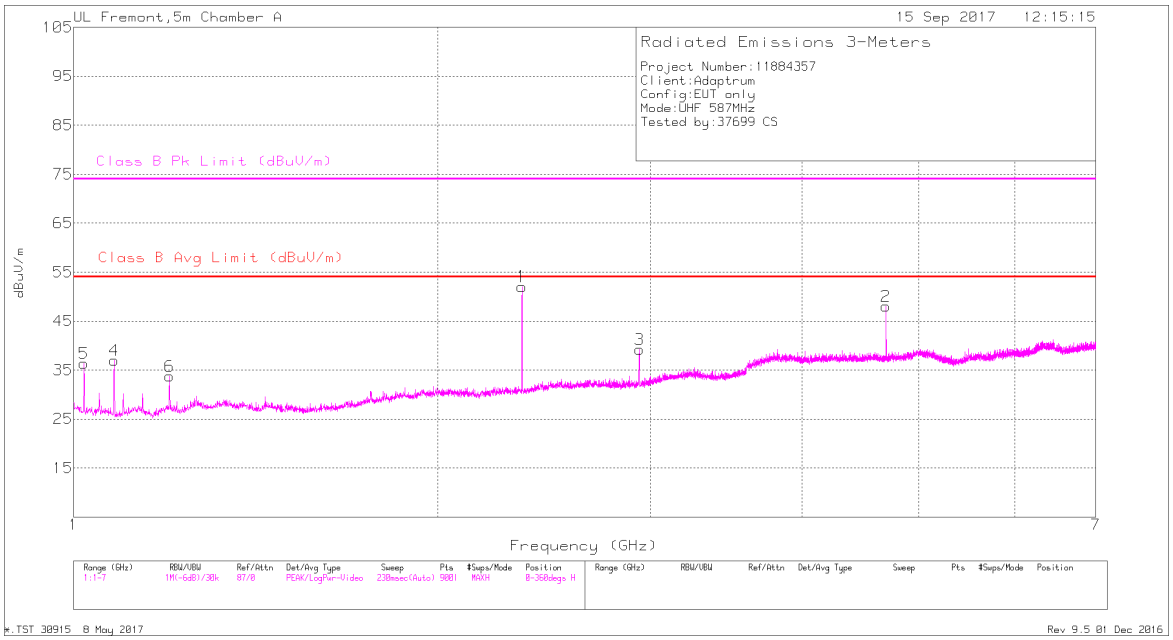
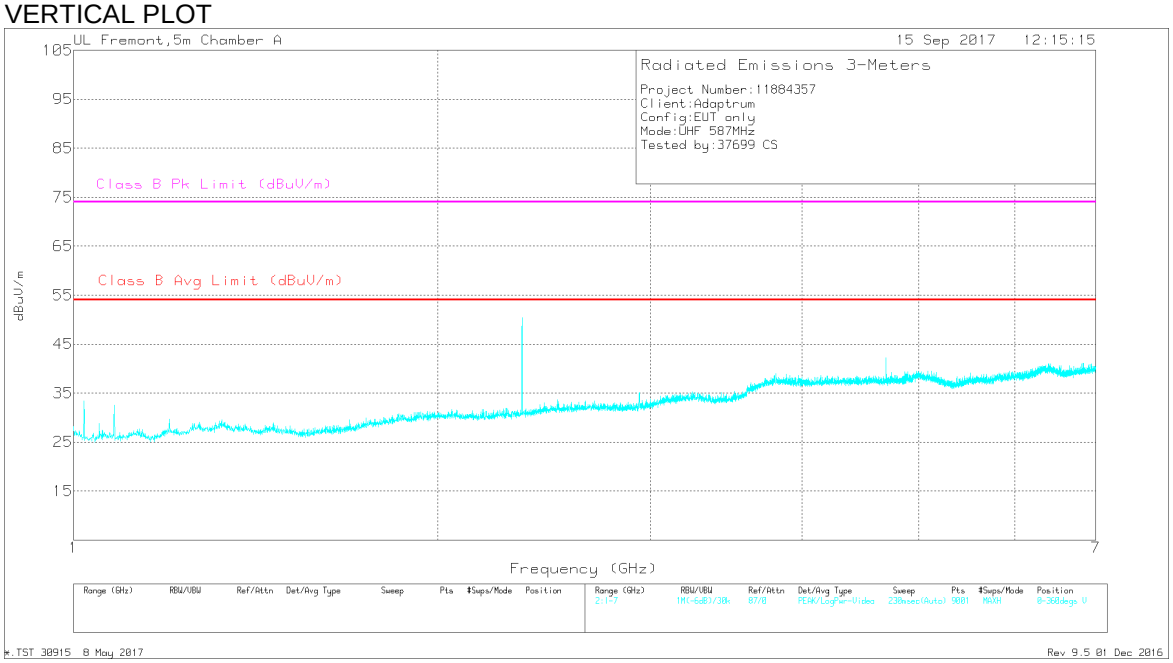
MID CHANNEL

HORIZONTAL PLOT



VERTICAL PLOT



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MID CHANNEL DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T862 (dB/m)	Amp/Cbl/Fltr/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
5	1.02	37.99	Pk	27.6	-24.1	41.49	-	-	74	-32.51	353	217	H
	1.02	25.27	Av	27.6	-24.1	28.77	54	-25.23	-	-	353	217	H
4	1.08	38.8	Pk	27.5	-23.8	42.5	-	-	74	-31.5	330	127	H
	1.08	29.01	Av	27.5	-23.8	32.71	54	-21.29	-	-	330	127	H
6	1.2	36.56	Pk	28.2	-23.6	41.16	-	-	74	-32.84	28	240	H
	1.2	27.43	Av	28.2	-23.6	32.03	54	-21.97	-	-	28	240	H
1	2.348	45.18	Pk	31.6	-23.2	53.58	-	-	74	-20.42	355	101	H
	2.348	43.45	Av	31.6	-23.2	51.85	54	-2.15	-	-	355	101	H
3	2.937	36.74	Pk	32.2	-21.7	47.24	-	-	74	-26.76	349	116	H
	2.937	21.51	Av	32.2	-21.7	32.01	54	-21.99	-	-	349	116	H
2	4.696	35.7	Pk	33.9	-17.2	52.4	-	-	74	-21.6	34	106	H
	4.696	30.55	Av	33.9	-17.2	47.25	54	-6.75	-	-	34	106	H

Pk - Peak detector
Av - Average detection

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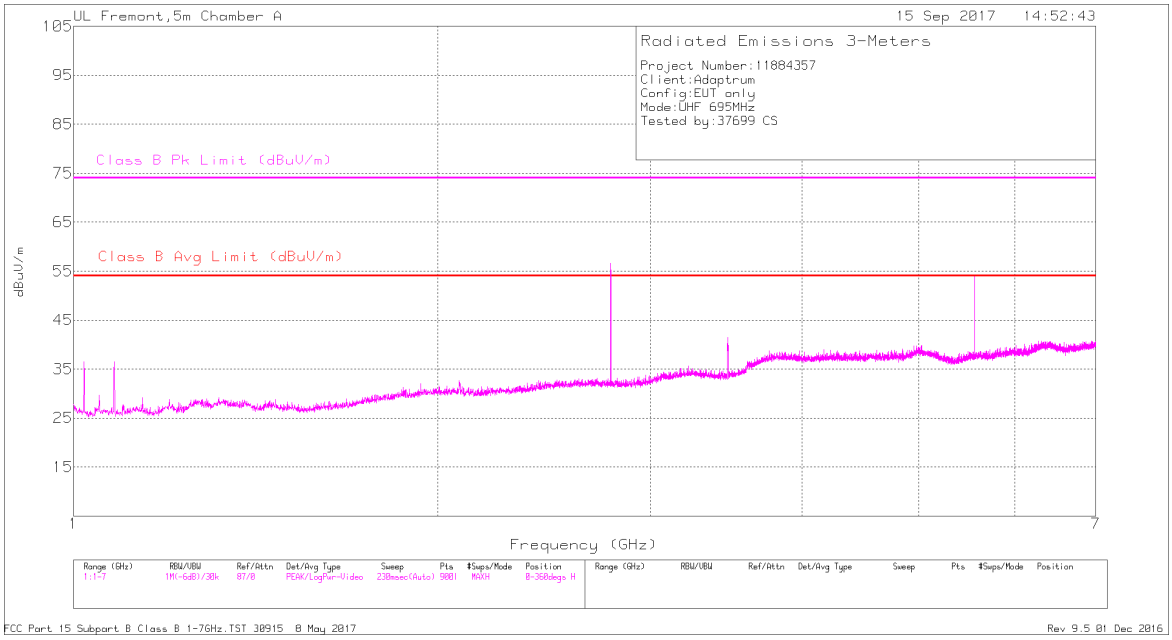
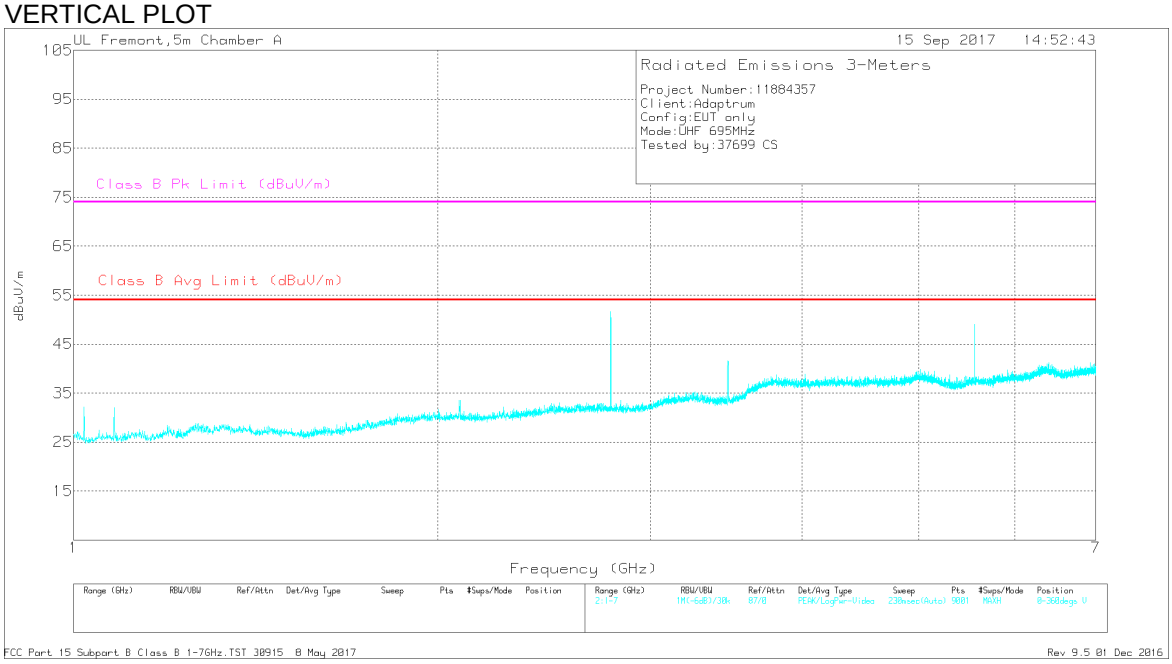
HIGH CHANNEL

HORIZONTAL PLOT



VERTICAL PLOT



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HIGH CHANNEL DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T862 (dB/m)	Amp/Cbl/Fltr/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	2.78	43.5	Pk	32.3	-22.2	53.6	-	-	74	-20.4	72	138	H
	2.78	43.01	Av	32.3	-22.2	53.11	54	-.89	-	-	72	138	H
2	2.78	45.23	Pk	32.3	-22.2	55.33	-	-	74	-18.67	106	243	V
	2.78	43.49	Av	32.3	-22.2	53.59	54	-.41	-	-	106	243	V
4	3.474	38.73	Pk	32.8	-19.5	52.03	-	-	74	-21.97	29	104	H
	3.474	22.95	Av	32.8	-19.5	36.25	54	-17.75	-	-	29	104	H
5	3.475	39.8	Pk	32.8	-19.5	53.1	-	-	74	-20.9	118	202	V
	3.475	23.37	Av	32.8	-19.5	36.67	54	-17.33	-	-	118	202	V
3	5.56	35.9	Pk	35	-18.6	52.3	-	-	74	-21.7	43	124	H
	5.56	35.12	Av	35	-18.6	51.52	54	-2.48	-	-	43	124	H
6	5.56	36.54	Pk	35	-18.6	52.94	-	-	74	-21.06	300	174	V
	5.56	31.58	Av	35	-18.6	47.98	54	-6.02	-	-	300	174	V

Pk - Peak detector
Av - Average detection

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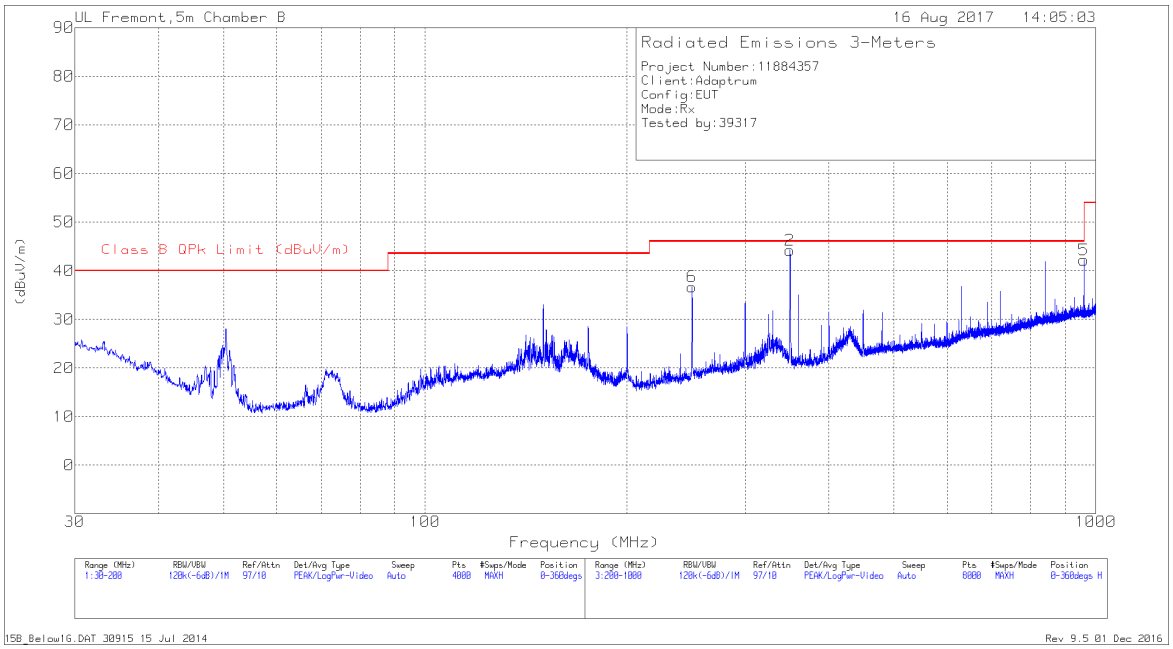
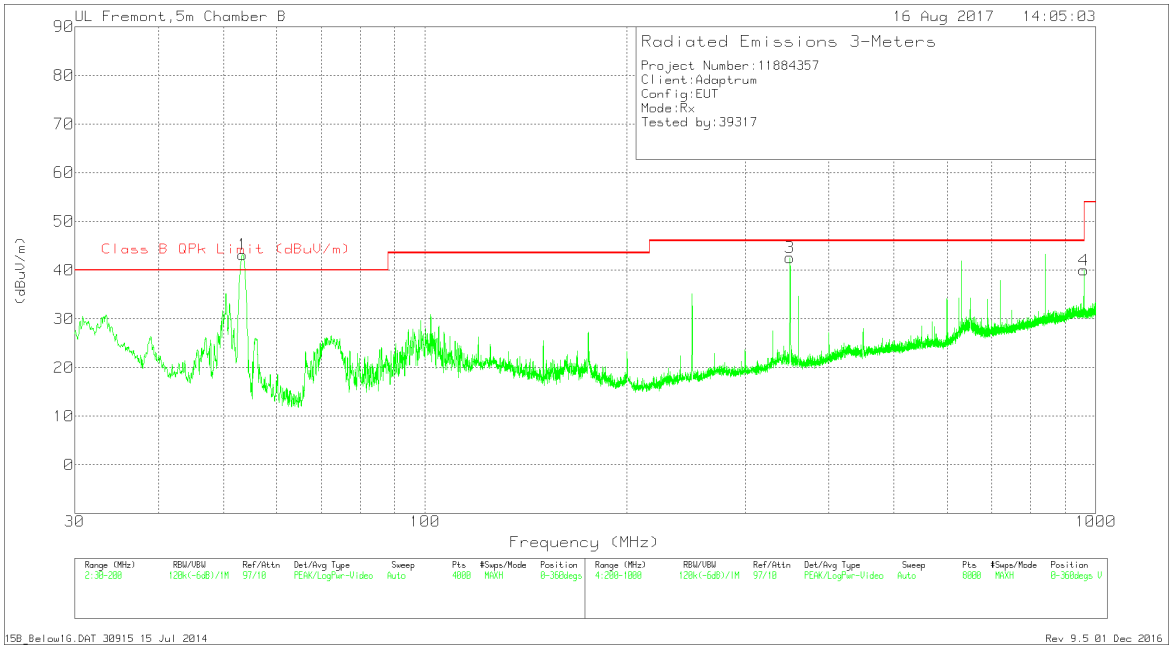
11.5. RECEIVER SPURIOUS EMISSIONS BELOW 1 GHz

11.5.1. UHF BAND

HORIZONTAL PLOT



VERTICAL PLOT



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DATA

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T899 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	Class B QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	53.5633	37.03	Qp	10.9	-28.4	19.53	40	-20.47	57	114	V
6	250.0065	51.08	Qp	15.4	-26.3	40.18	46.02	-5.84	50	200	H
2	349.9925	50.27	Qp	18.2	-25.8	42.67	46.02	-3.35	251	103	H
3	350.026	47.06	Qp	18.2	-25.8	39.46	46.02	-6.56	266	117	V
5	959.9976	35.89	Qp	26.7	-23.2	39.39	46.02	-6.63	63	104	H
4	960.0019	35.69	Qp	26.7	-23.2	39.19	53.97	-14.78	187	110	V

Qp - Quasi-Peak detector

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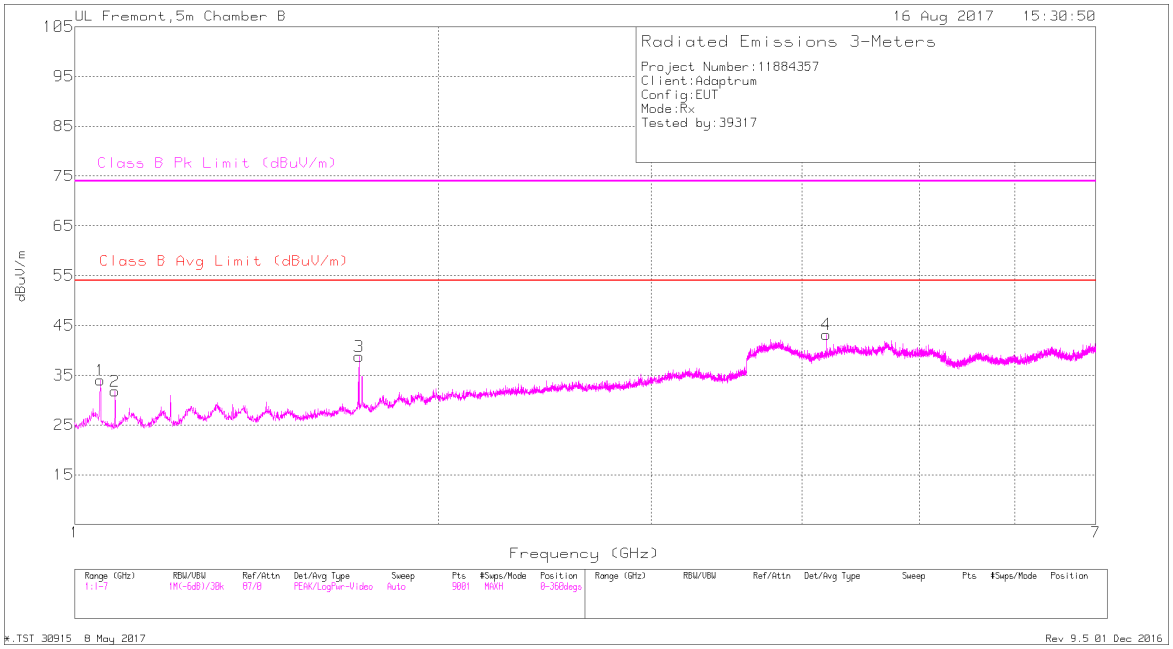
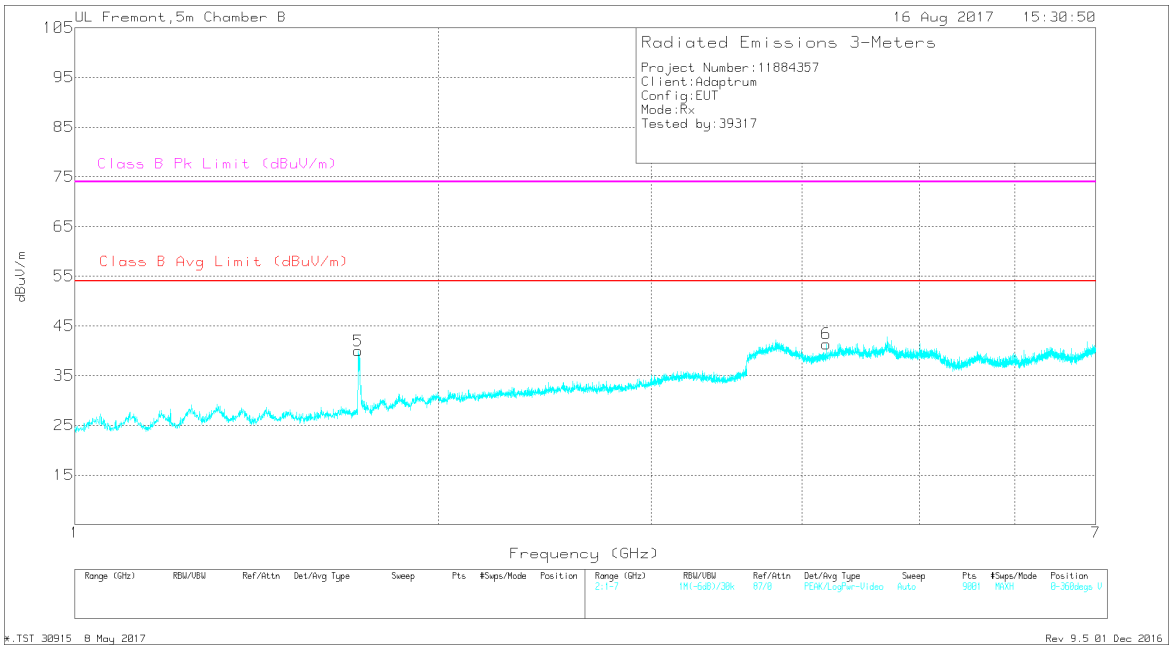
11.6. RECEIVER SPURIOUS EMISSIONS ABOVE 1 GHz

11.6.1. UHF BAND

HORIZONTAL PLOT



VERTICAL PLOT



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DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T863 (dB/m)	Amp/Cbl/Fltr/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	1.05	19	Av	27	-22.9	23.1	54	-30.9	-	-	210	308	H
	1.05	32.01	Pk	27	-22.9	36.11	-	-	74	-37.89	215	303	H
2	1.08	18.94	Av	27.4	-22.9	23.44	54	-30.56	-	-	275	342	H
	1.08	31.85	Pk	27.4	-22.9	36.35	-	-	74	-37.65	342	275	H
5	1.717	16.29	Av	29.3	-21.1	24.49	54	-29.51	-	-	347	144	V
	1.718	30.05	Pk	29.3	-21.1	38.25	-	-	74	-35.75	347	144	V
3	1.72	29.68	Pk	29.3	-20.9	38.08	-	-	74	-35.92	347	146	H
	1.722	16.48	Av	29.3	-21	24.78	54	-29.22	-	-	115	310	H
4	4.186	27.31	Pk	33.4	-15.8	44.91	-	-	74	-29.09	230	104	H
	4.187	17.48	Av	33.4	-15.8	35.08	54	-18.92	-	-	230	104	H
6	4.186	30.83	Pk	33.4	-15.8	48.43	-	-	74	-25.57	184	247	V
	4.187	17.36	Av	33.4	-15.8	34.96	54	-19.04	-	-	184	247	V

Pk - Peak detector
Av - Average detection

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12. 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.

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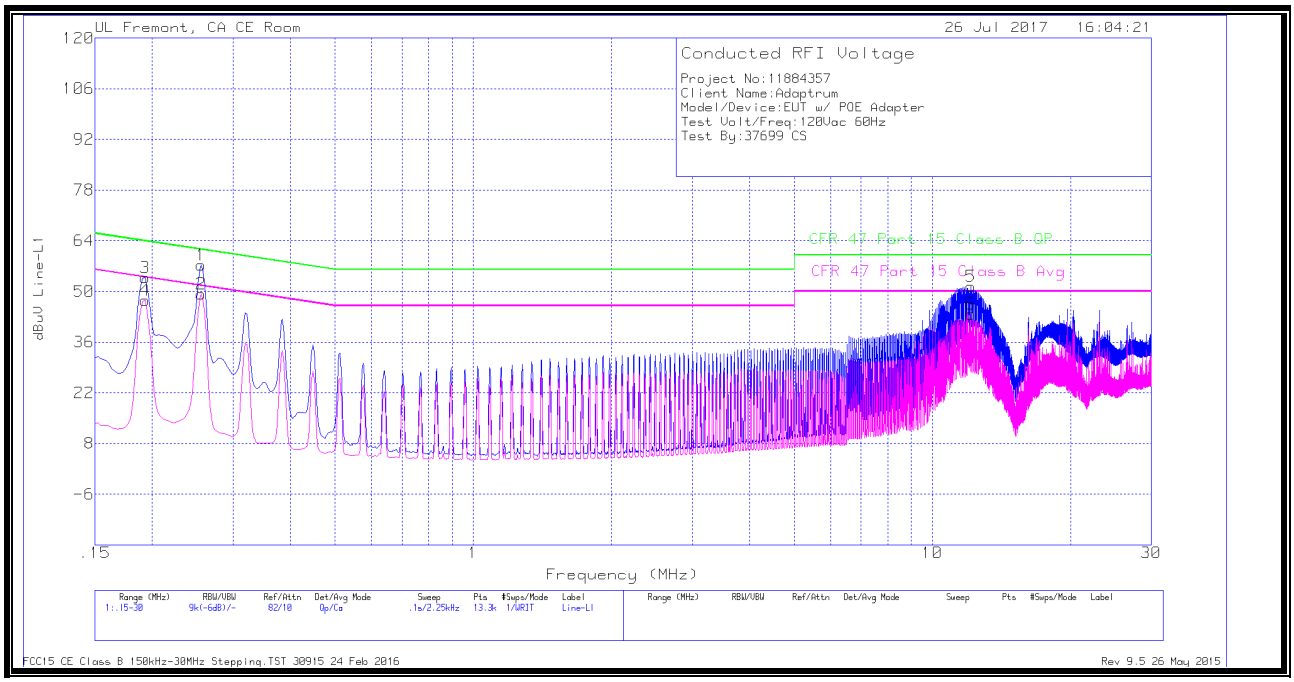
12.1. UHF BAND WORST CASE

12.1.1. 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	.25575	47.13	Qp	0	.1	10.1	57.33	61.57	-4.24	-	-
2	.25575	39.1	Ca	0	.1	10.1	49.3	-	-	51.57	-2.27
3	.19275	43.64	Qp	0	.1	10.1	53.84	63.92	-10.08	-	-
4	.19275	37.29	Ca	0	.1	10.1	47.49	-	-	53.92	-6.43
5	12.14475	40.84	Qp	.1	.2	10.2	51.34	60	-8.66	-	-
6	12.14475	33.24	Ca	.1	.2	10.2	43.74	-	-	50	-6.26

Qp - Quasi-Peak detector
Ca - CISPR average detection

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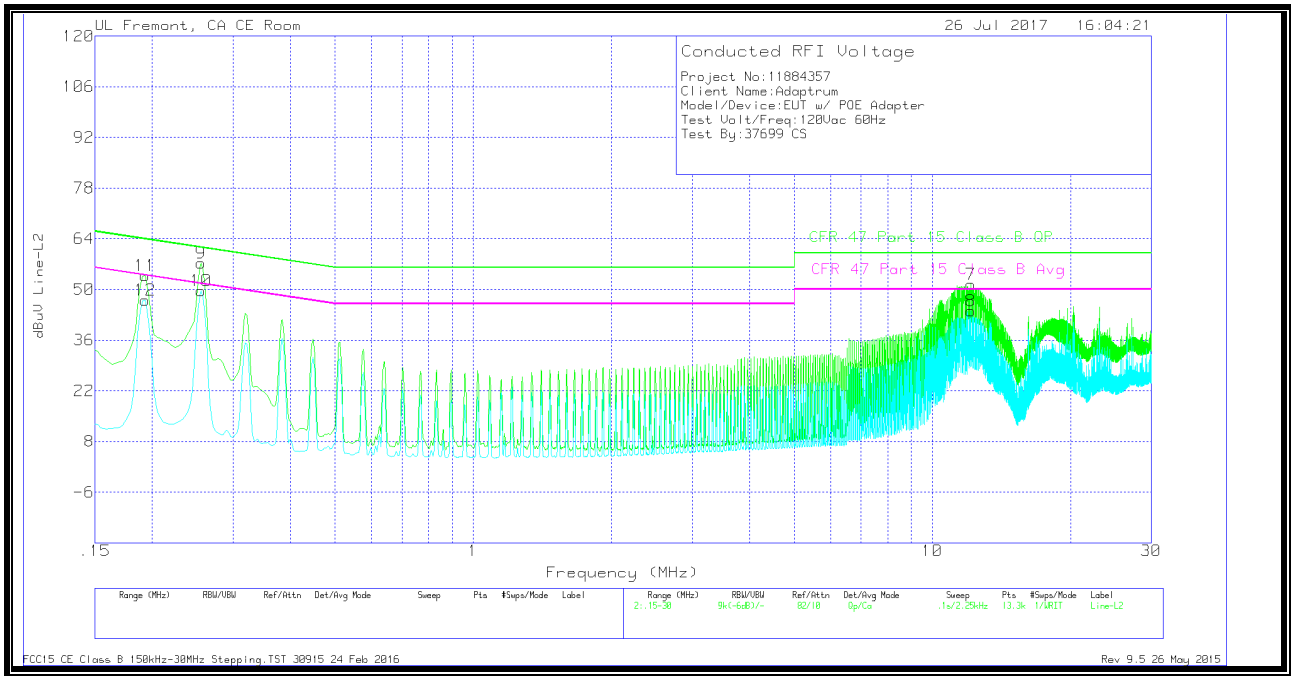
12.1.2. LINE 2 RESULTS



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	12.14025	40.96	Qp	0	.2	10.2	51.36	60	-8.64	-	-
8	12.14025	33.73	Ca	0	.2	10.2	44.13	-	-	50	-5.87
9	.25575	47.06	Qp	0	.1	10.1	57.26	61.57	-4.31	-	-
10	.25575	39.4	Ca	0	.1	10.1	49.6	-	-	51.57	-1.97
11	.19275	43.62	Qp	0	.1	10.1	53.82	63.92	-10.1	-	-
12	.19275	36.83	Ca	0	.1	10.1	47.03	-	-	53.92	-6.89

Qp - Quasi-Peak detector
Ca - CISPR average detection

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13. FIXED BASE STATION DATABASE CERTIFICATION TESTS

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.

13.1. 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

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13.1.1. 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**	**Comment**
☒	☐	Please refer to report 13U14997-1A Section 9.1.1

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13.1.2. FAILED REGISTRATION – Location Coordinates

TEST PROCEDURE

- Configure the EUT with restricted coordinates 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**	**Comment**
☒	☐	Please refer to report 13U14997-1A Section 9.1.2

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13.1.3. 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**	**Comment**
☒	☐	Please refer to report 13U14997-1A Section 9.1.4

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13.1.4. 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**	**Comment**
☒	☐	Please refer to report 13U14997-1A Section 9.1.5

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13.2. 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**	**Comment**
☒	☐	Please refer to report 13U14997-1A Section 9.2

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13.3. 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**	**Comment**
☒	☐	Please refer to report 13U14997-1A Section 9.3

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13.4. 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**	**Comment**
☒	☐	Please refer to report 13U14997-1A Section 9.4

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13.5. 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**	**Comment**
☒	☐	Please refer to report 13U14997-1A Section 9.5

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13.6. 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

Please refer to report 13U14997-1A Section 8.6

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13.7. 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	07/26/17

Push notification was simulated through a tool to send a database update to the EUT of a new channel list where the desired channel is no longer allowed for transmission.

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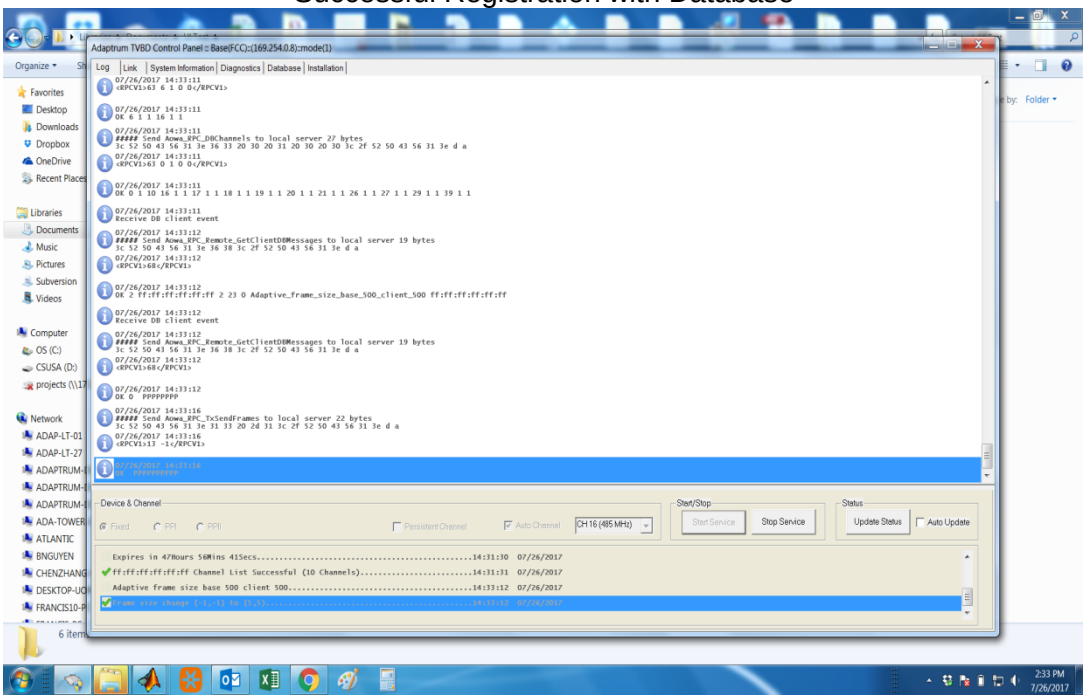
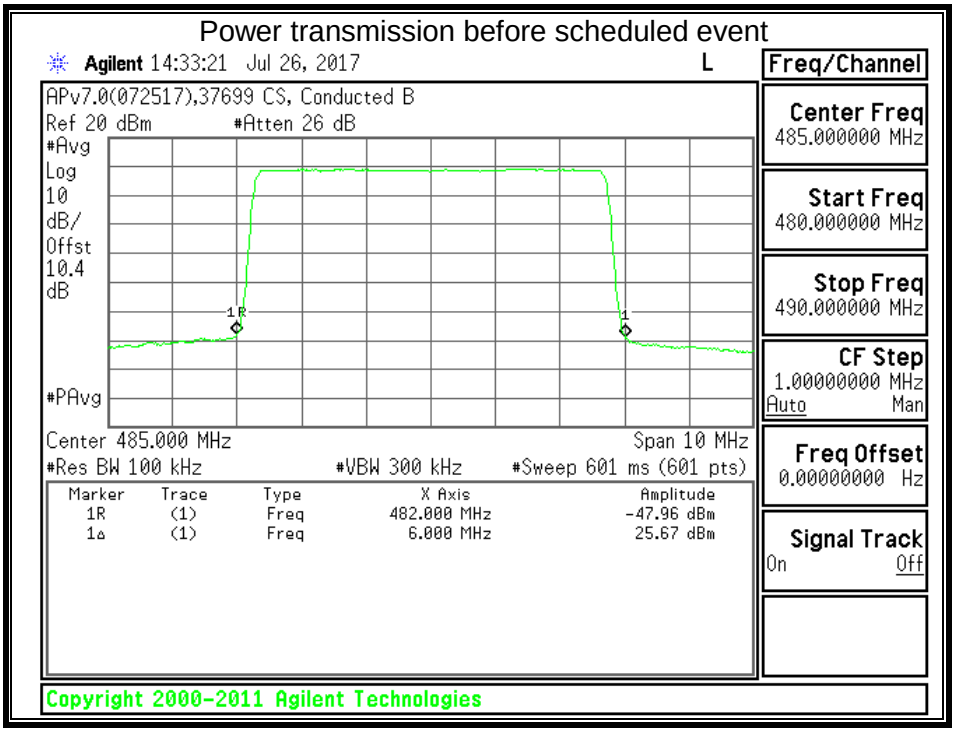
Successful Registration with Database



Power transmission before scheduled event



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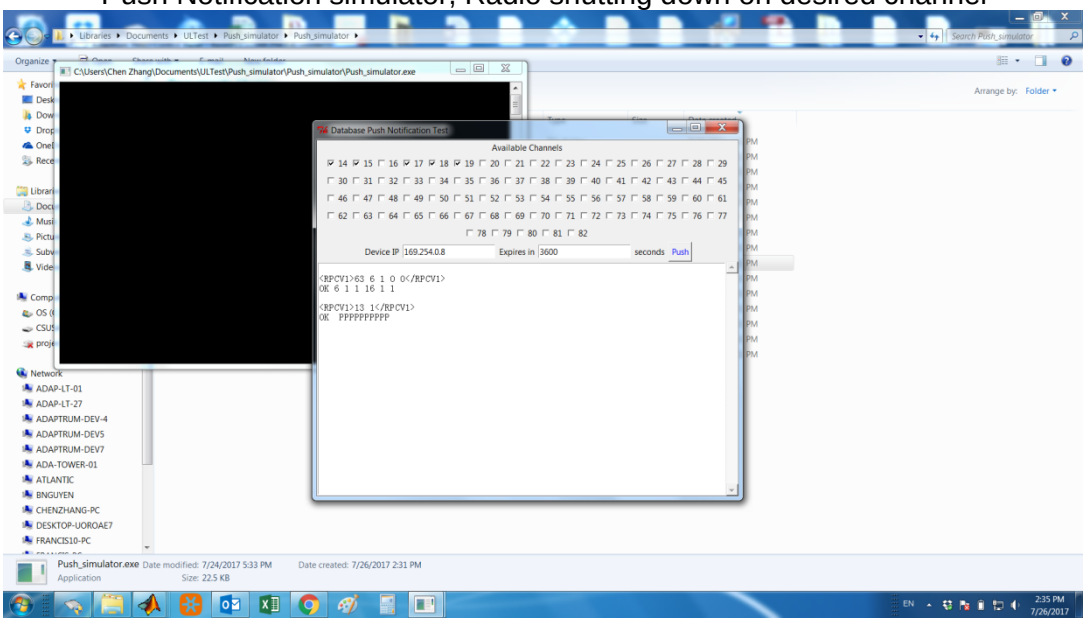
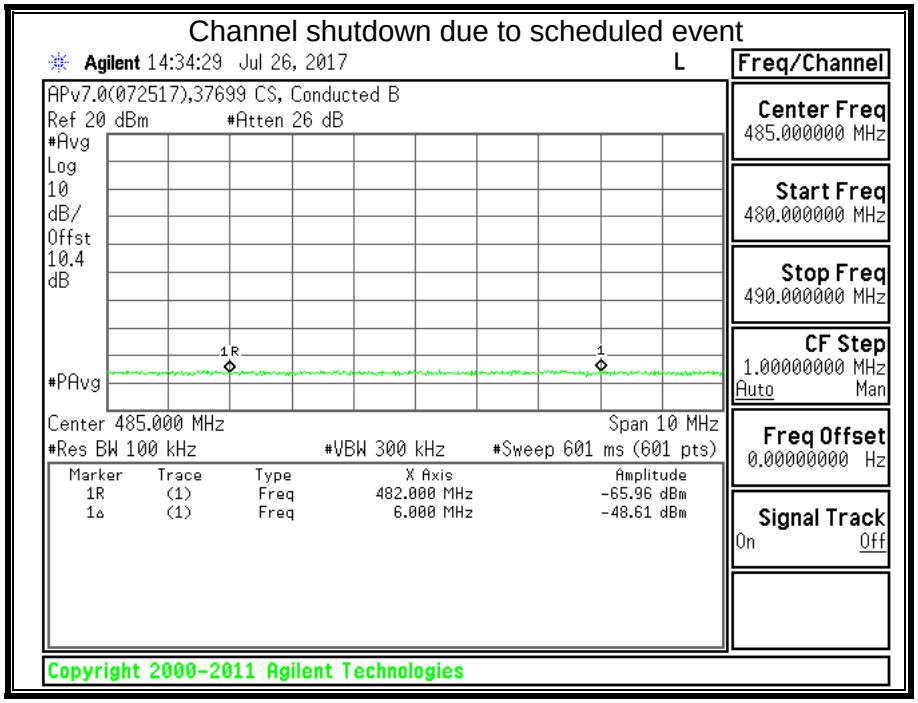
Push Notification simulator, Radio shutting down on desired channel



Channel shutdown due to scheduled event



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13.8. 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

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13.9. 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

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Scenario		Coordinate	Note
a	Digital television stations, and digital and analog Class A TV, low power TV, TV translator and TV booster stations	35.775, -106.24555 (UHF)	UHF No transmission allowed
b	TV translator, Low power TV(including Class A) and Multi-channel Video Programming Distributor (MVPD)	43.80102, -111.778 (UHF)	UHF coordinate cannot transmit Ch. 23
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	20.88, -156.678611	Cannot transmit on Ch. 17

Test Results			
Pass	Fail	Tested By	Test Date
☒	☐	37699 CS	07/26/17

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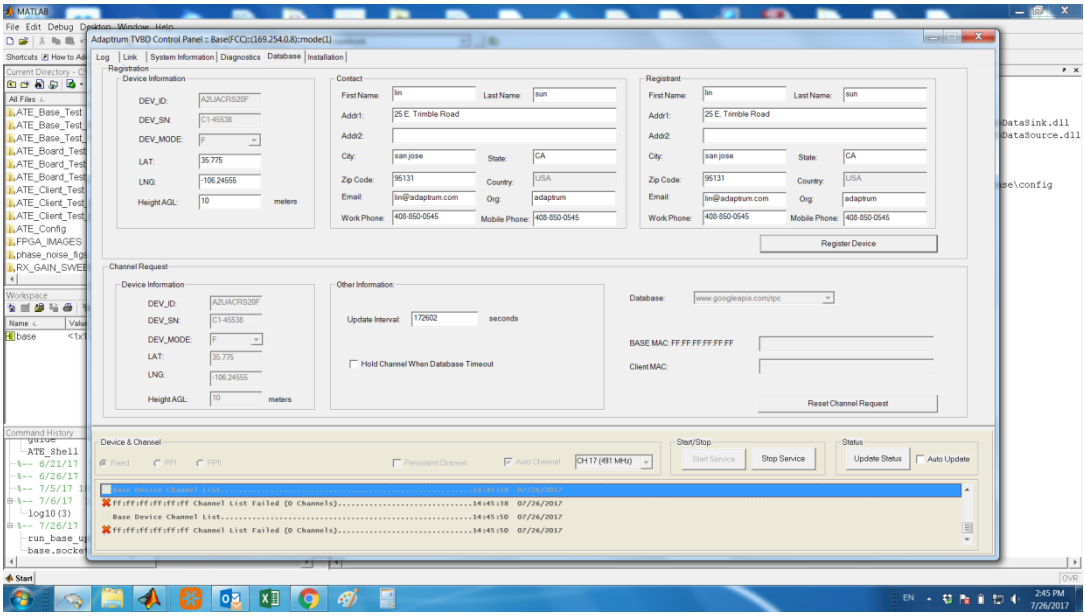
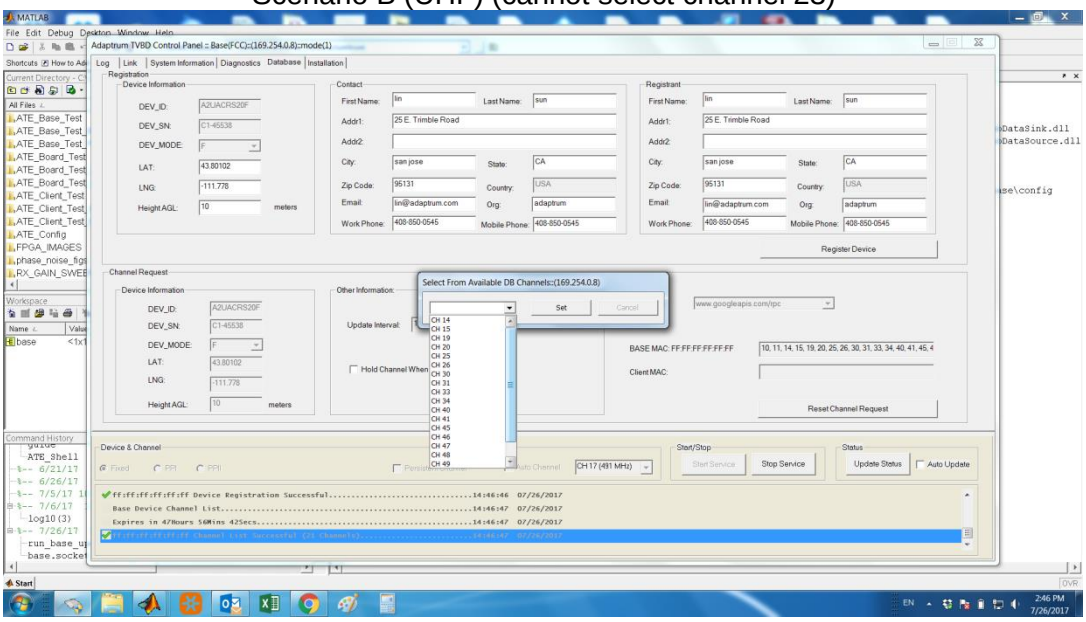
Scenario A UHF



Scenario B (UHF) (cannot select channel 23)



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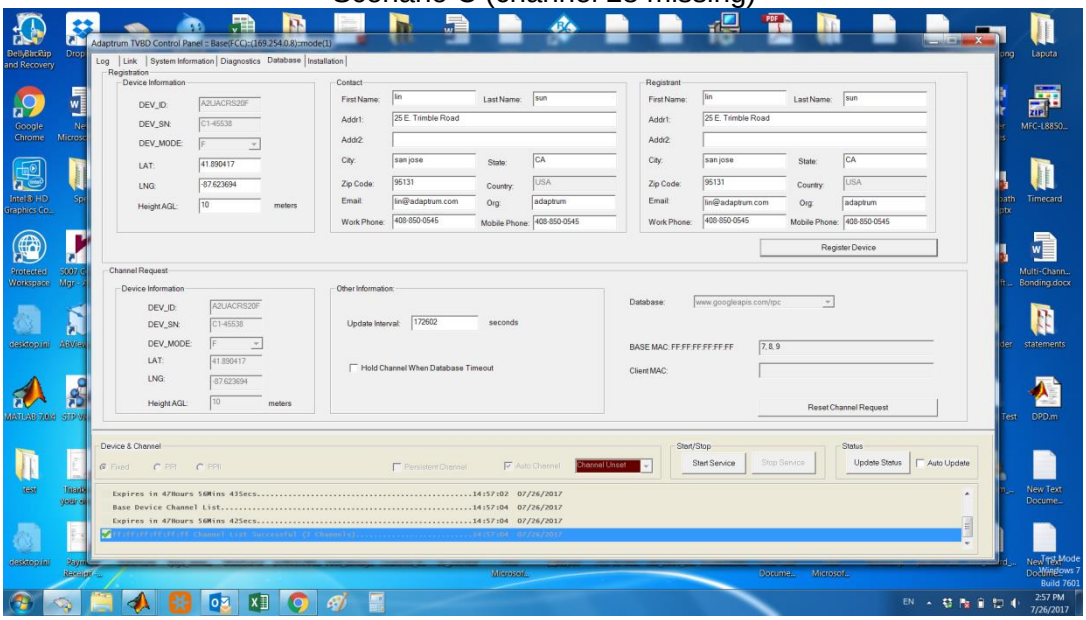
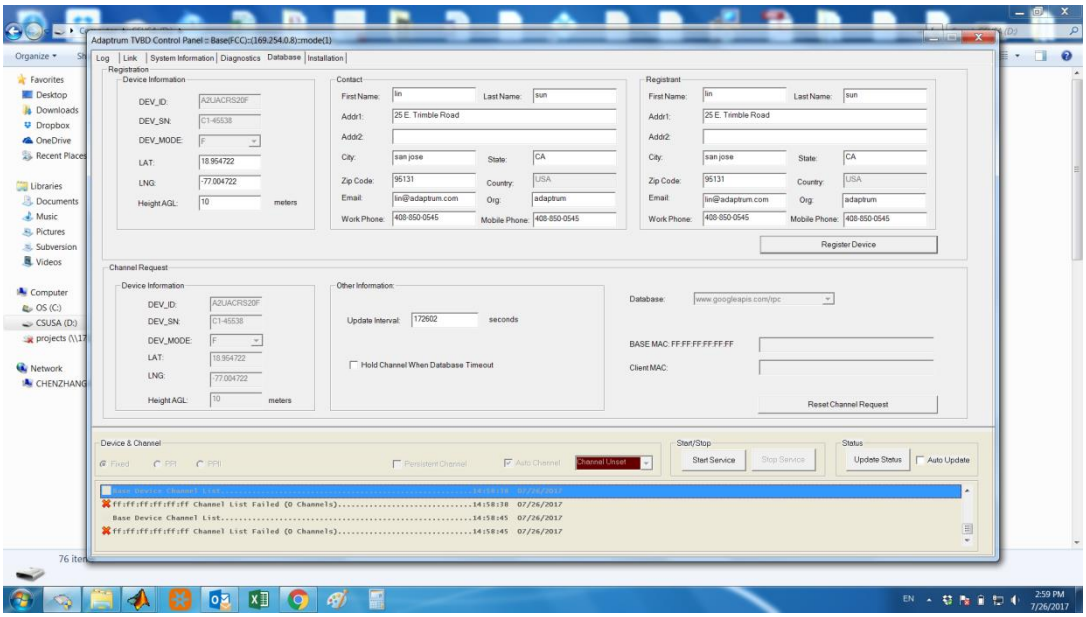
Scenario C (channel 28 missing)



Scenario D/E



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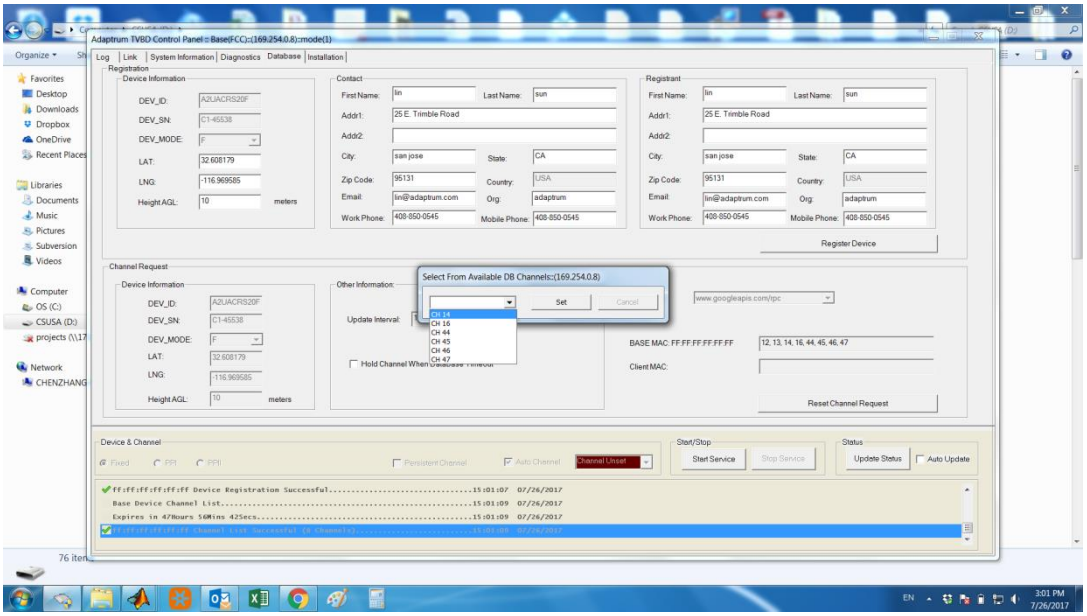
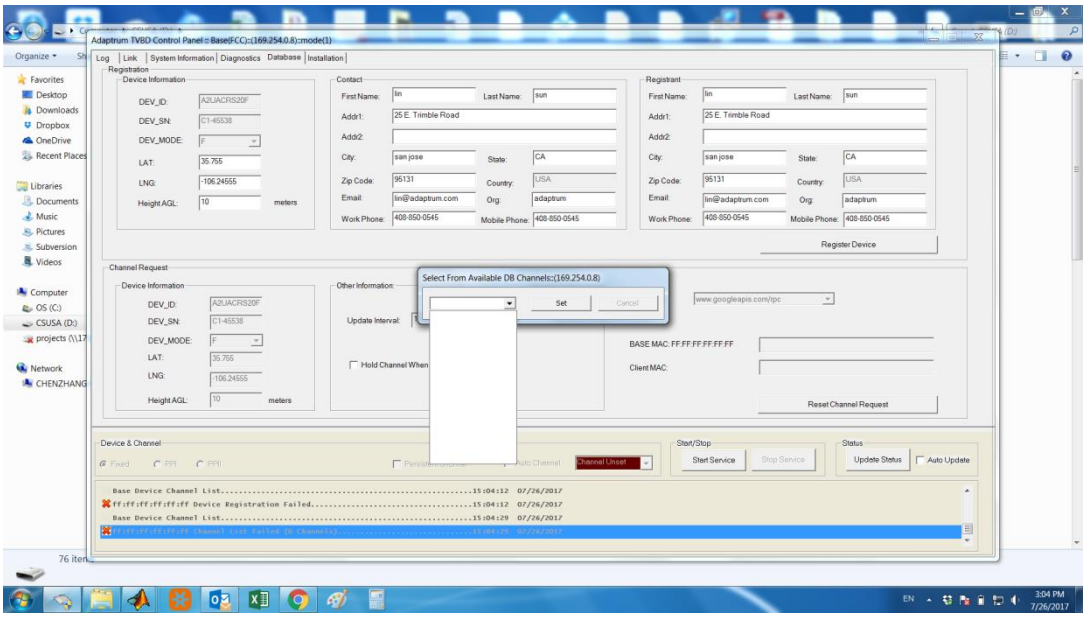
Scenario G



Scenario H



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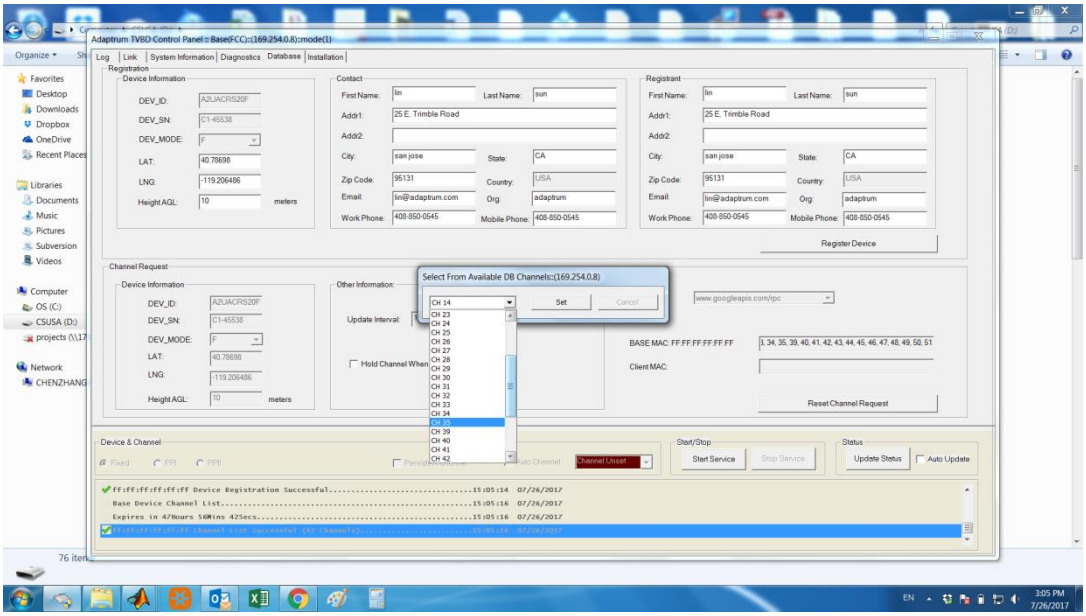
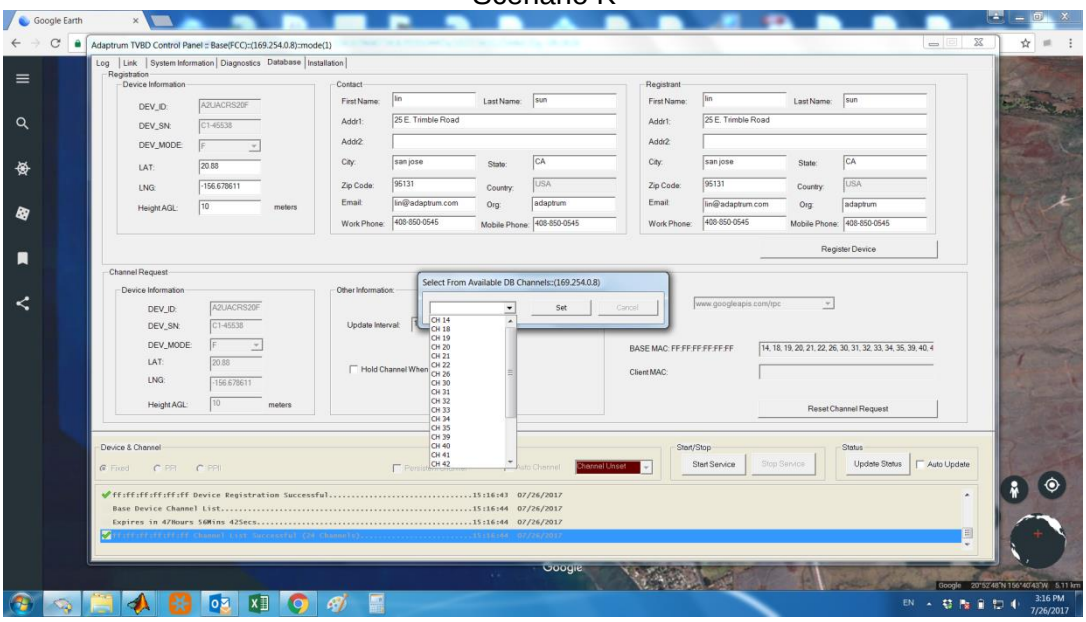
Scenario I



Scenario K



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13.10. Fixed Power level reduction

CLAUSES

- §15.711(c)(2)(ii)
- §15.715(e)

REQUIREMENT

Using system management software, make a channel availability request to the database. Using the spectrum analyzer, confirm that the WSD operates at no more than the maximum power level indicated by the database and that the power level cannot be set to a higher level than indicated by the database at that specific location. If the device cannot reduce power, it must cease operation.

TEST PROCEDURE

- Create a successful registration with the database
- Transmit at desired channel
- Confirm with spectrum analyzer that the EUT does not operate more than the max power level indicated by the database.
- Confirm power level cannot be set higher than the level indicated by the database

RESULTS

Test Results			
Pass	**Fail**	**Tested By**	**Test Date**
☒	☐	37699 CS	07/26/17

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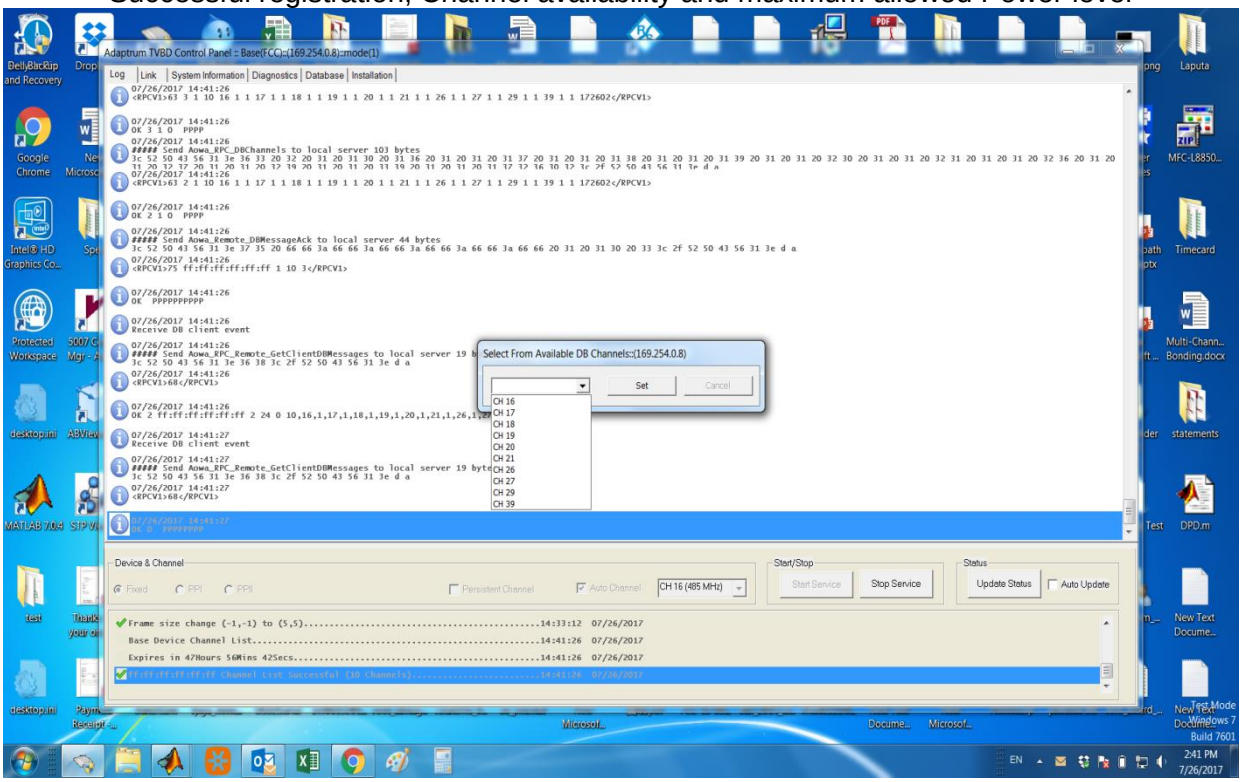
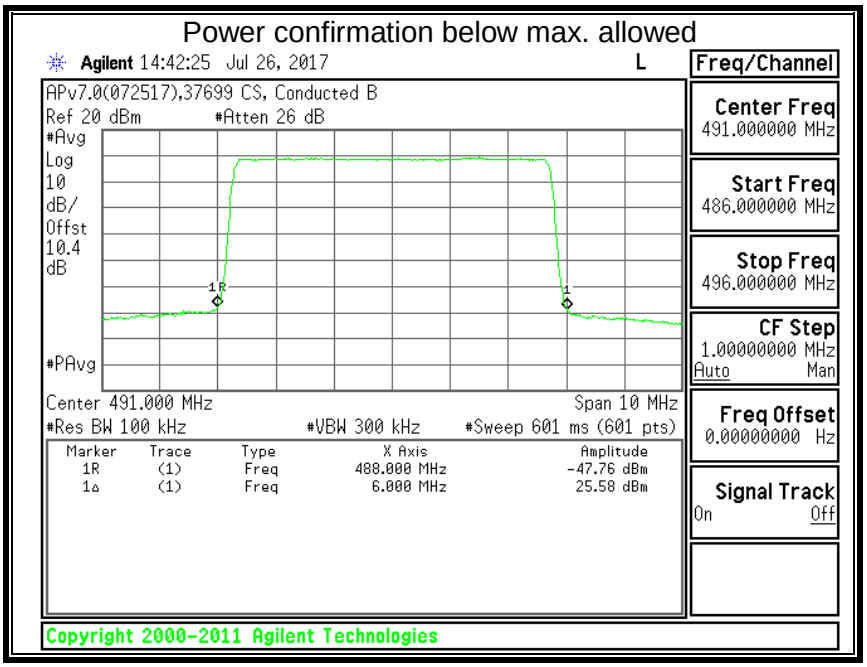
Successful registration, Channel availability and maximum allowed Power level



Power confirmation below max. allowed



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