FCC CFR47 PART 15 SUBPART H

DATABASE TEST REPORT

FOR

BROADBAND VHF/UHF NETWORKING RADIO SYSTEM

MODEL NUMBERS: RaptorX 50739, RaptorX-228

REPORT NUMBER: 14U18654-1

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ISSUE DATE: May 1, 2015

Prepared for
METRIC SYSTEMS CORP.
3055 ENTERPRISE COURT
VISTA, CA 92081

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: METRIC SYSTEMS CORP.
3055 ENTERPRISE COURT
VISTA, CA 92081

EUT DESCRIPTION: BROADBAND VHF/UHF NETWORKING RADIO SYSTEM

MODEL NUMBERS: RaptorX 50739, RaptorX-228

SERIAL NUMBER: BASE STATION: X001
REMOTE STATION: X002

DATE TESTED: SEPTEMBER 23 to 24, 2014

APPLICABLE STANDARDS	
SECTION	**TEST RESULTS**
DATABASE PORTIONS OF 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 any government.

Approved & Released For
UL Verification Services Inc. By:

FRACISCO DE ANDA
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UL Verification Services Inc.

Tested By:

JOE VANG
EMC ENGINEER
UL Verification Services Inc.

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2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 15 Subpart H and KDB 416271 D01 White Space Test Procedures v02.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, California, USA.

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at http://www.ccsemc.com.

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

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

4.3. MEASUREMENT UNCERTAINTY

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

PARAMETER	UNCERTAINTY
Conducted Disturbance, 0.15 to 30 MHz	3.52 dB
Radiated Disturbance, 30 to 1000 MHz	4.94 dB

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

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5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

EUT is an unlicensed fixed mode White Space broadband half-duplex Tx/Rx networking radio system operating in the authorized high VHF (174 MHz -216 MHz) and UHF (470 MHz-698 MHz) bands, with the exception of channels 36-38.

EUT Assemblies				
Description	**Manufacturer**	**Model**	**S/N**	**FCC ID**
Base Unit	Metric System Corp	Raptor X VHF/UHF Broadband Network Radio	X001	N/A
Base Power Unit	Metric System Corp	50900 X1	Power Supply 1	N/A
Remote Unit	Metric System Corp	Raptor X VHF/UHF Broadband Network Radio	X002	N/A
Remote Power Unit	Metric System Corp	50900 X2	Power Supply 2	N/A

5.2. DATABASE information

Telcordia's TV Bands White Space Database, IConectiv, provides a public interface that is available to entities authorized for protection under CFR Title 47 Part 15 Subpart H. The iConectiv registration system requires entities seeking protection to register for an account on the iConectiv site before they can create protected contours.

5.3. MAXIMUM OUTPUT POWER

The transmitter has a maximum conducted output power as follows;

28.7 dBm, 6 MHz bandwidth

5.4. DESCRIPTION OF AVAILABLE ANTENNAS

The radio can be configured with the following antenna types;

Type	Band	Gain
Directional	VHF	9 dBi
Directional	UHF	8 dBi

5.5. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was version 4.2.0.

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5.6. DETAILS OF TESTED SYSTEM

SUPPORT EQUIPMENT & PERIPHERALS

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	**Manufacturer**	**Model**	**S/N**	**FCC ID**
Power Splitter	Mini-Circuits 1	ZAPD-2-252-N+	N N324901317	N/A
Power Splitter	Mini-Circuits 2	ZAPD-2-252-N+	N N324901317	N/A
LAN Switch	Netgear	GS 108 v2	1DR1783702C21	DoC
AC Adaptor (Switch)	A Qualities	MD481212	5G66-E184870	N/A
Laptop	Apple	A1398	C02J704ADKQ4	DoC

I/O CABLES

I/O Cable List						
Cable No	**Port**	**# of identical ports**	**Connector Type**	**Cable Type**	**Cable Length (m)**	**Remarks**
1	Ethernet	1	RJ45	Un-shielded	1	Internet
2	Ethernet	1	RJ45	Un-shielded	1	Base to Switch
3	Ethernet	1	RJ45	Un-shielded	1	Laptop to Switch
4	Ethernet	1	RJ45	Un-shielded	1	Remote to Switch
5	DC	1	Barrel	Un-shielded	1	
6	AC	1	2-Prong	Un-shielded	1	

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TEST SETUP

As illustrated in the following setup diagram, the EUT is comprised of two independent fixed channel stations using a certified web-based White Space spectrum data base provider. Independently register each radio.

Base Unit Deployment: Deploy the base unit; reregister each radio and confirm channel availability. Modify if required. Place each radio in low duty cycle beacon mode.

Remote Unit Deployment: Upon start-up each unit will automatically link to its respectively assigned channel and establish a secure VPN to the base unit and to the internet. Re-register each radio.

Operation: each radio will independently manage its database reporting protocols according to Subpart H requirements.

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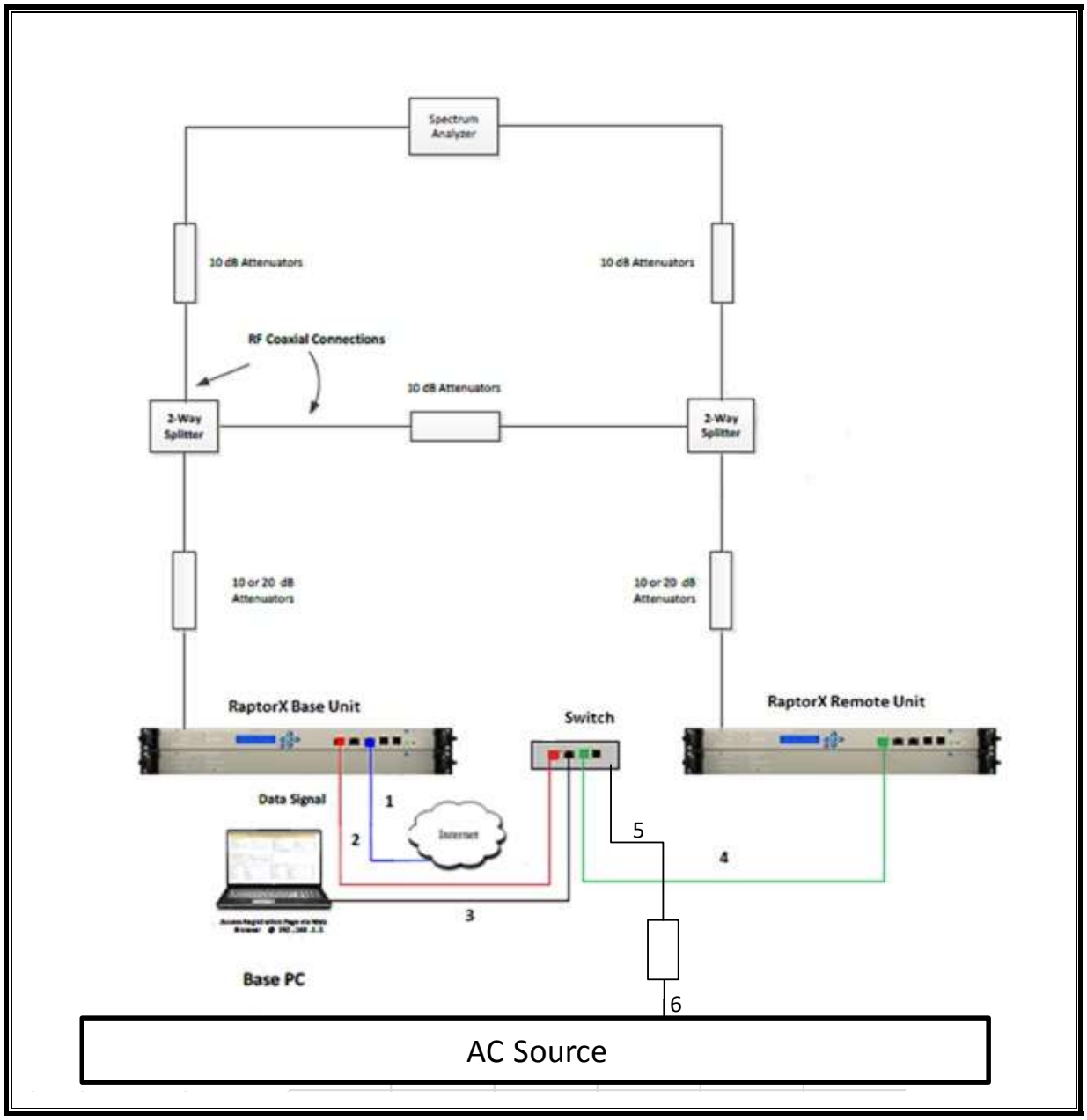
TEST SETUP DIAGRAM



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6. 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**	**Serial**	**Cal Due**
Spectrum Analyzer, PSA, 3Hz to 26.5GHz	Agilent	E4440A	MY46186329	5/9/2015

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7. DATABASE CERTIFICATION REQUIREMENTS

The following database related rules apply to TV White Space Systems under FCC CFR47 PART 15 SUBPART H for Fixed TVBD devices per KDB 416721 D01 White Space Test Procedures v02, Part 2:

§15.713(f)(3) Fixed TVBD Registration
§15.707(a) Fixed TVBD Relocated
§15.711(b)(3)(iii) Fixed & Mode II TVDB Database Update
§15.711(b)(3)(i)(ii), §15.713(a)(1) 48 Hour Channel Scheduling
§15.707, §15.711(b)(3)(i)(ii)(iv),(c), §15.712 TVBD Channel Availability
§15.715(f) Security

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8. BASE STATION DATABASE CERTIFICATION TEST RESULTS

8.1. §15.713(F)(3) FIXED TVBD REGISTRATION

REQUIREMENT

- The Fixed TVBD must be able to provide the required information to the TVWS database and obtain a successful registration:

- The database must indicate a failed device registration if any of the following data provided by the TVBD is invalid:
  i. FCC ID
  ii. Serial Number
  iii. Restricted Coordinates
  iv. HAAT> 250 m
  v. Antenna Height AGL > 30 m
  vi. Incomplete contact information

- For a fixed TVBD 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

1. Both the Base Station and Remote 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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8.1.1. 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 (Channel 16) from the returned channel list from the TVWS Database.

Test Results	
Pass	**Fail**
☒	☐

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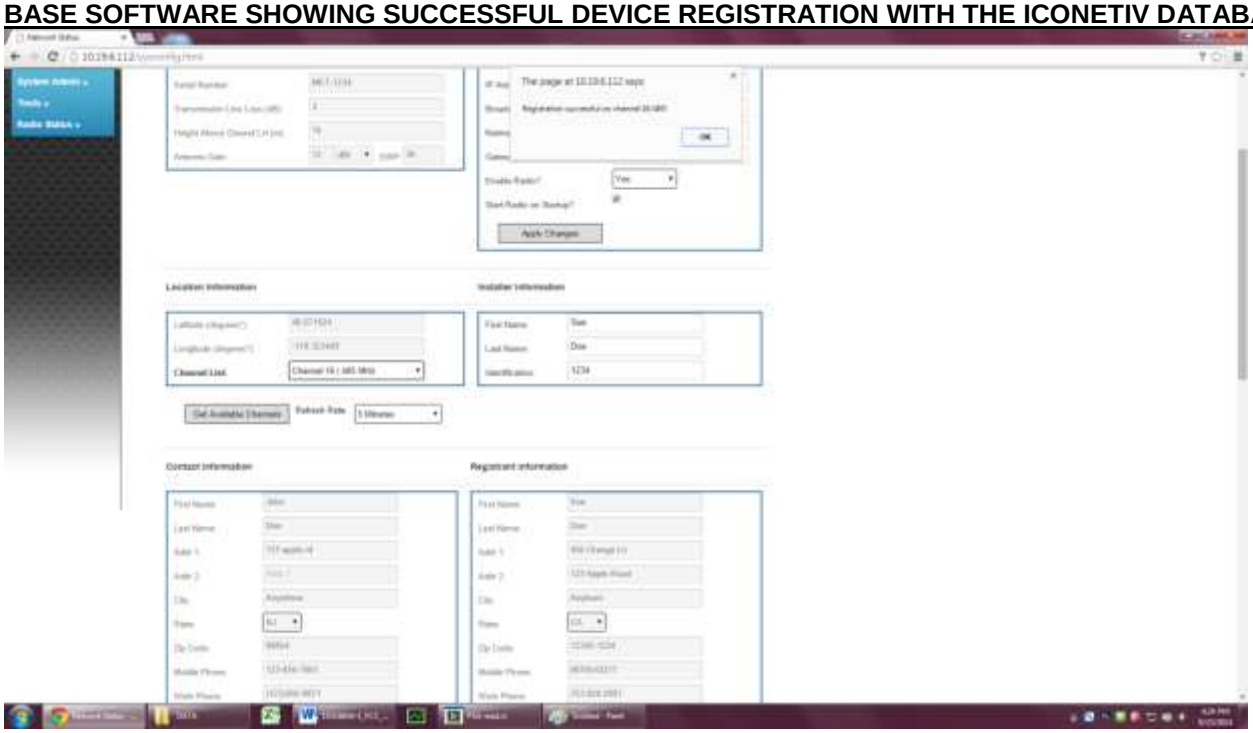
BASE SOFTWARE SHOWING SUCCESSFUL DEVICE REGISTRATION WITH THE ICONETIV DATABASE



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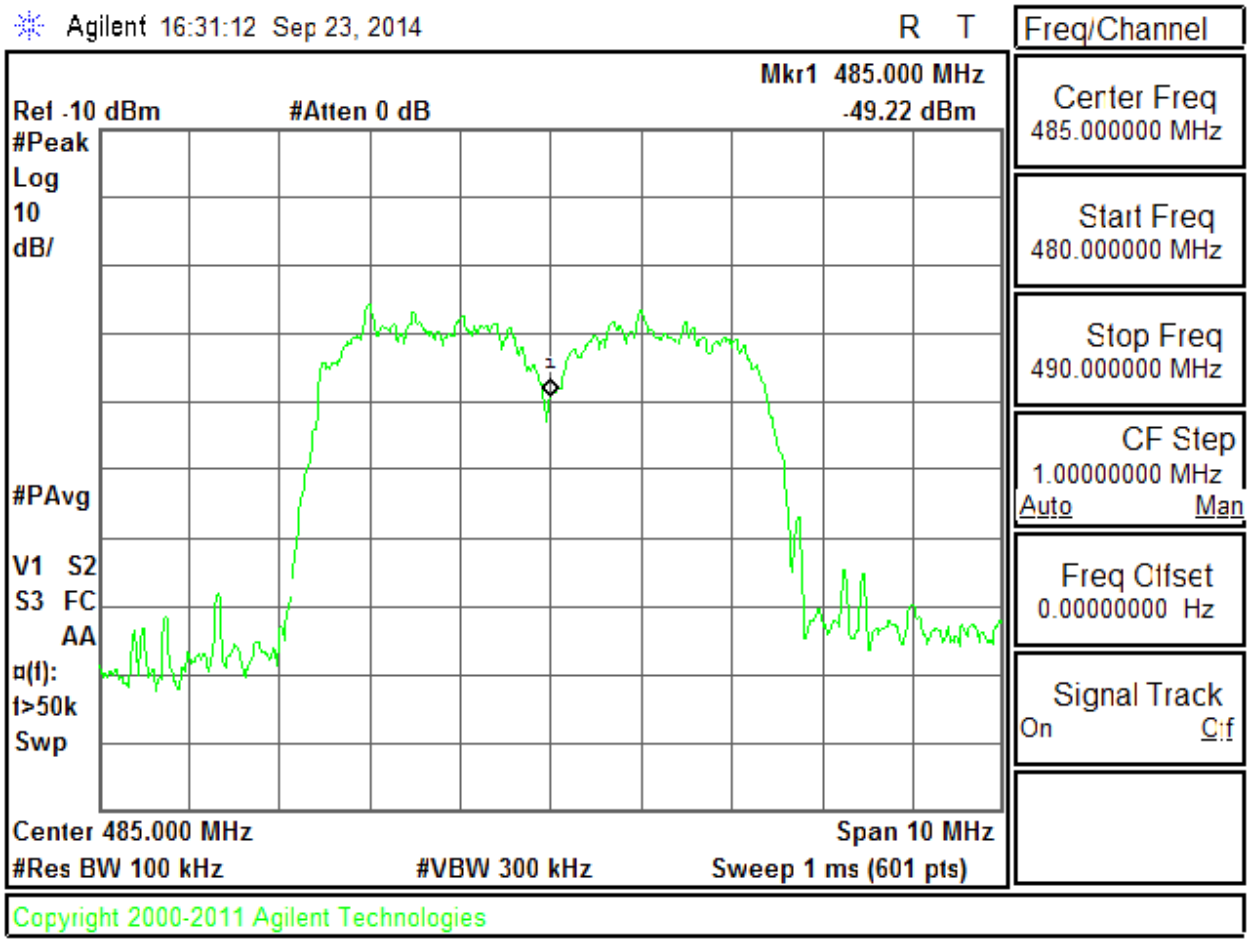
SPECTRUM ANALYZER SHOWING ACTIVE BASE SIGNAL ON THE SELECTED CHANNEL (CHANNEL 16)



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8.1.2. FAILED REGISTRATION – RESTRICTED COORDINATES

TEST PROCEDURE

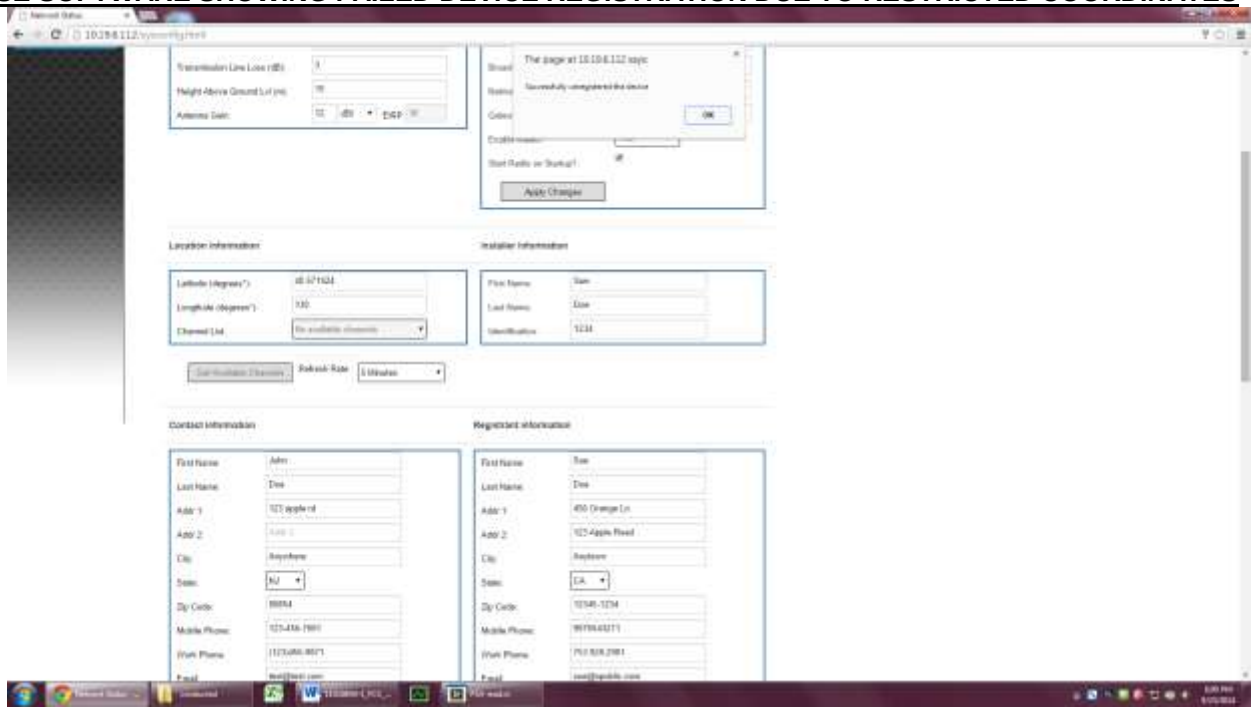
- Configure the EUT with restricted coordinates: (LAT= 40.571924, LNG= -130) which is a location outside US regulatory boundaries
- Observe the base EUT registration failure indicated by the database message

RESULT

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

Test Results	
Pass	Fail
☒	☐

BASE SOFTWARE SHOWING FAILED DEVICE REGISTRATION DUE TO RESTRICTED COORDINATES



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8.1.3. FAILED REGISTRATION – HAAT

TEST PROCEDURE

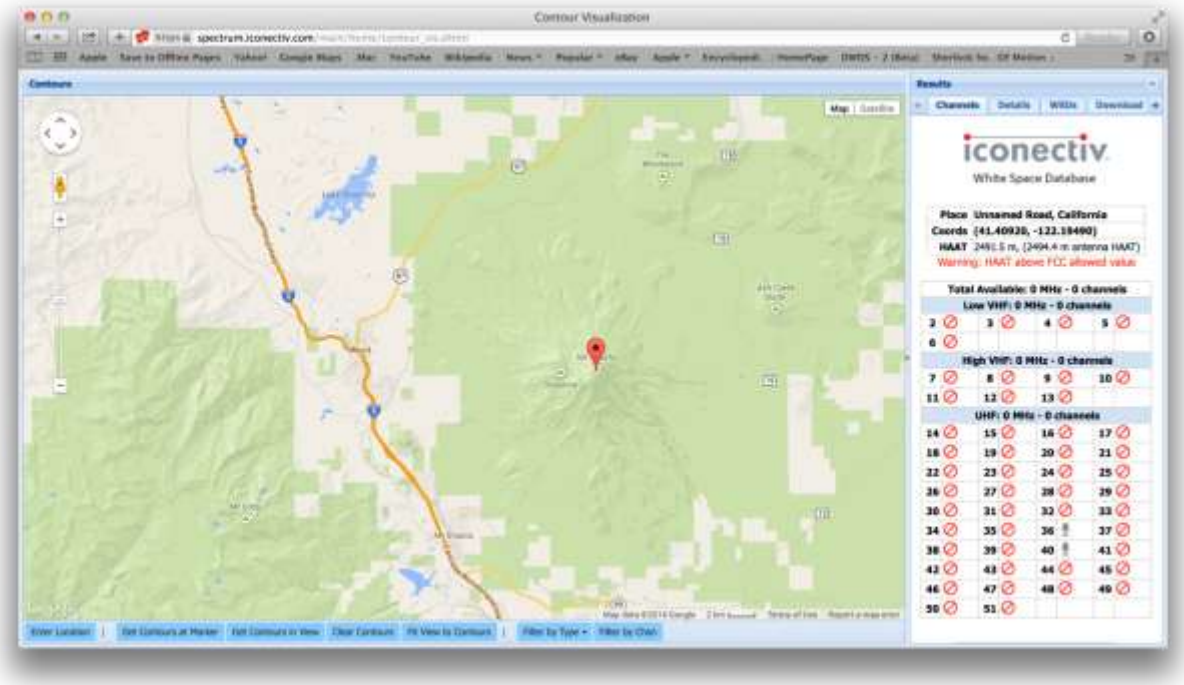
- Configure the EUT with Height Above Average Terrain(HAAT) > 250 m: the Mount Shasta coordinates (LAT=41.4092, LNG=-122.1949) were used.
- Observe the base registration failure indicated by the database message.

RESULTS

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

Test Results	
Pass	Fail
☒	☐

MOUNT SHASTA HAS NO TVWS CHANNELS DUE TO HAAT LIMIT AS INDICATED BY THE ICONECTIV TVWS DATABASE



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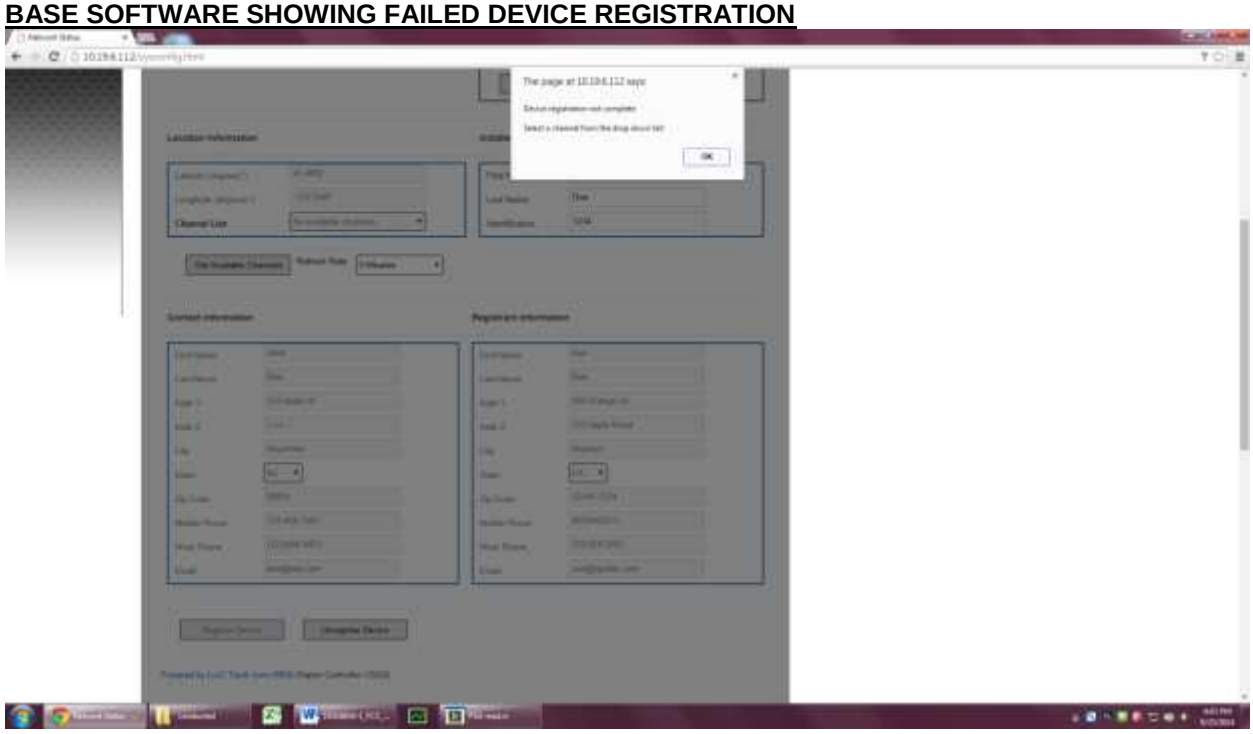
BASE SOFTWARE SHOWING FAILED DEVICE REGISTRATION



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8.1.4. FAILED REGISTRATION – ANTENNA HEIGHT AGL

TEST PROCEDURE

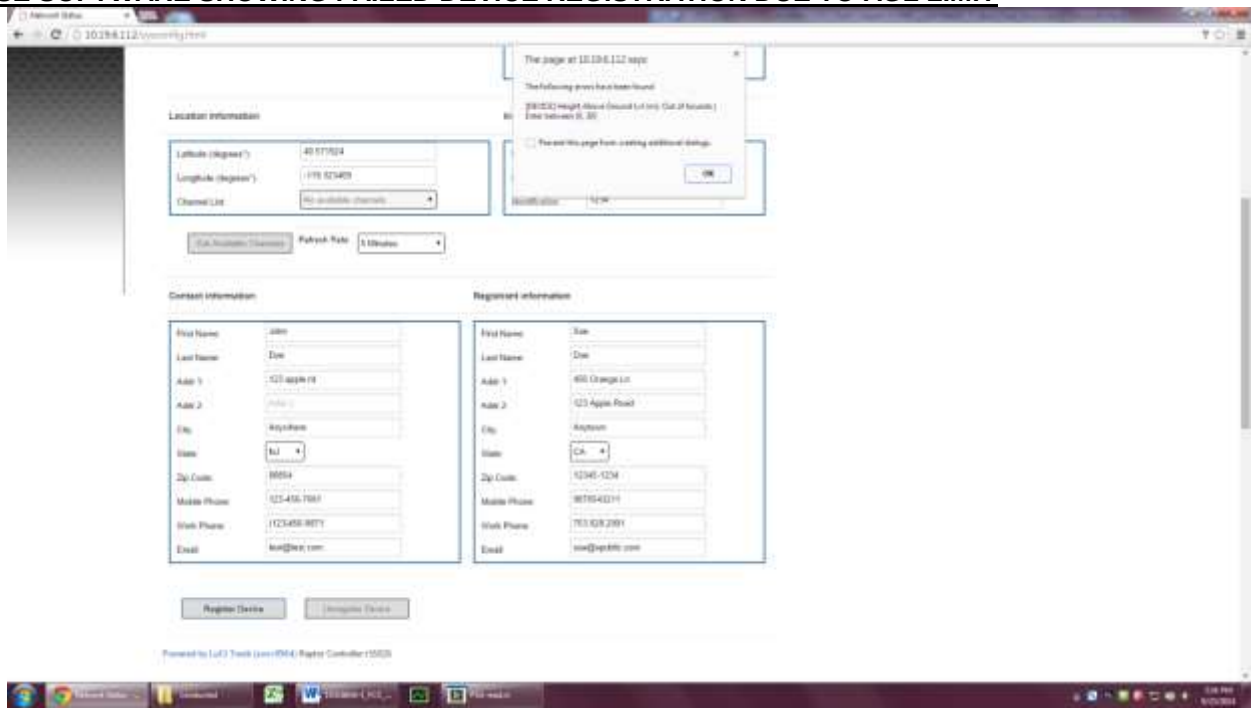
- Configure the EUT with antenna height Above Ground Level (AGL) > 30 meters.
- Observe the base registration failure indicated by the database message.

RESULTS

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

Test Results	
Pass	Fail
☒	☐

BASE SOFTWARE SHOWING FAILED DEVICE REGISTRATION DUE TO AGL LIMIT



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8.1.5. FAILED REGISTRATION – INCOMPLETE CONTACT INFORMATION

TEST PROCEDURE

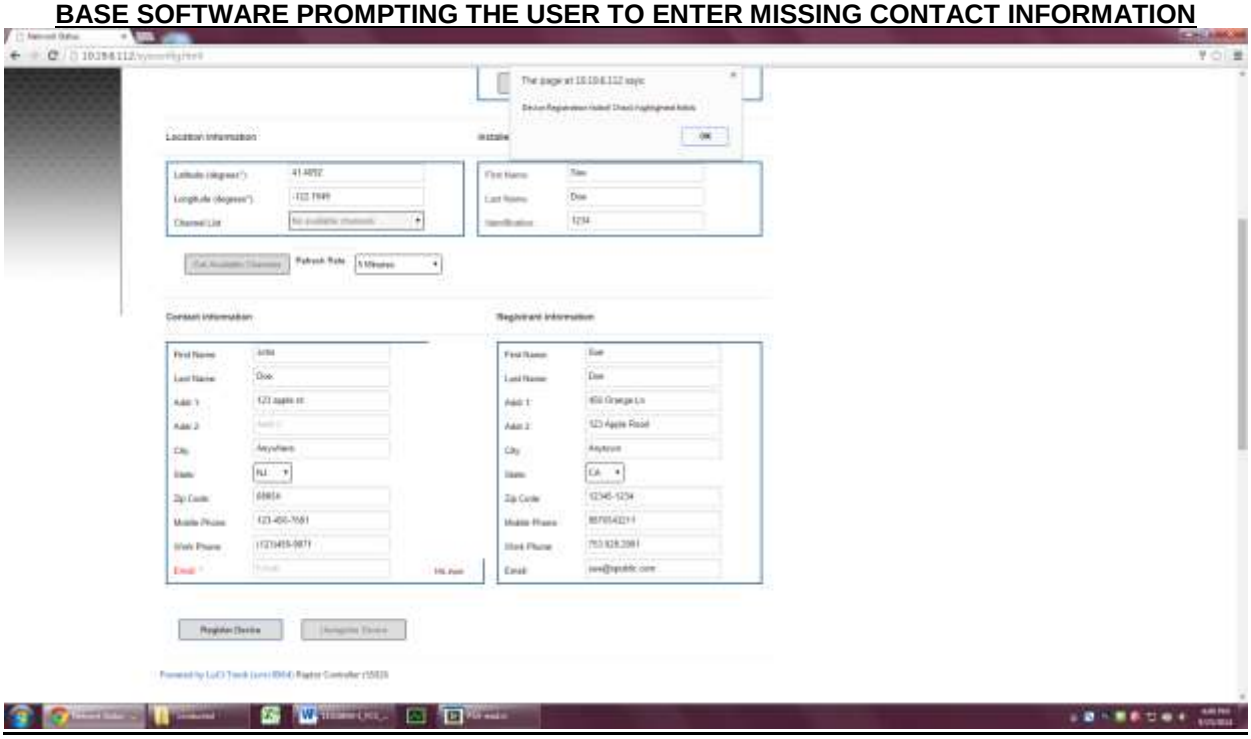
- Configure the base EUT with missing contact information, e.g. email.
- The device software cannot proceed with registration and prompts user to enter the missing information.

RESULTS

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

Test Results	
Pass	Fail
☒	☐

BASE SOFTWARE PROMPTING THE USER TO ENTER MISSING CONTACT INFORMATION



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8.2. §15.707(A) FIXED TVBD RELOCATED

REQUIREMENT

- Confirm that the database will not provide a channel list for Fixed TVBD at a location other than that registered.

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 – see RaptorX-225 Installation and User Manual.

Test Results	
Pass	**Fail**
☒	☐

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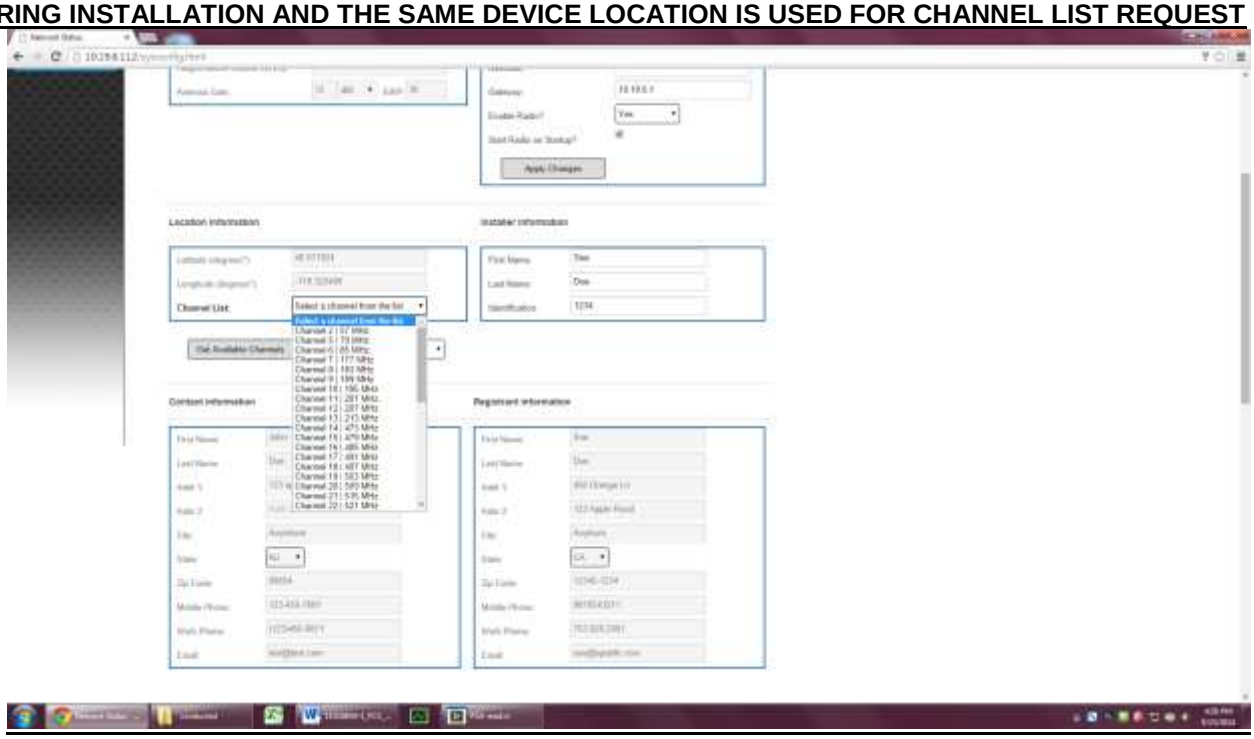
BASE SOFTWARE ONLY ALLOWS DEVICE REGISTRATION LOCATION INFORMATION TO BE ENTERED DURING INSTALLATION AND THE SAME DEVICE LOCATION IS USED FOR CHANNEL LIST REQUEST



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8.3. §15.711(B)(3)(III) FIXED & MODE II TVDB DATABASE UPDATE

REQUIREMENT

– §15.711(B)(3)(III) If a fixed or Mode II personal/portable TVBD fails to successfully contact the TV bands 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 TV bands database and re-verifies its list of available channels.

  Block access to the database from the TVBD. All other radio functions, including internet connectivity should be maintained. Confirm that the TVBD shuts down by 11:59 PM on the following day. All other radio functions, including internet connectivity should be maintained.

TEST PROCEDURE

- Set the base EUT to normal operation mode:
  - Enter proper registration information on the base with an IP 10.0.0.228.
  - 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 or remove connection to network 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 set to 5 minutes. After the database access was blocked, the next channel list requests failed and the EUTs stopped transmission immediately.

Test Results	
Pass	Fail
☒	☐

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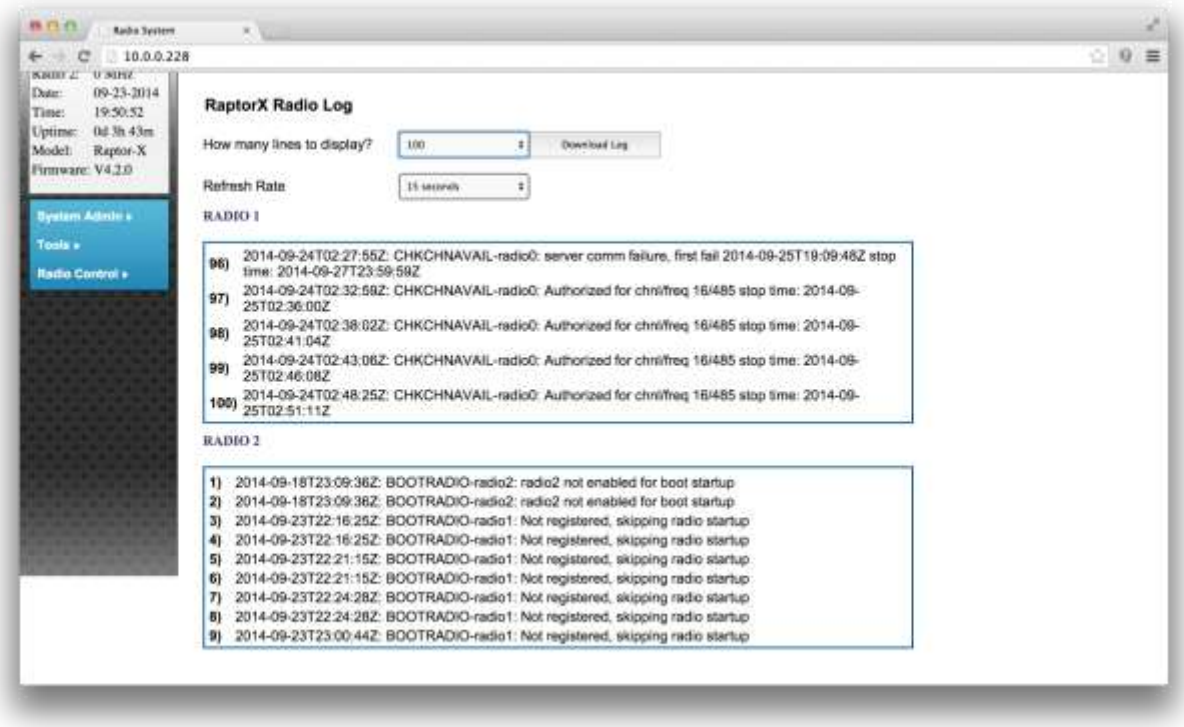
BASE SOFTWARE BEFORE DATABASE BLOCKING (BASE ON CHANNEL 16)



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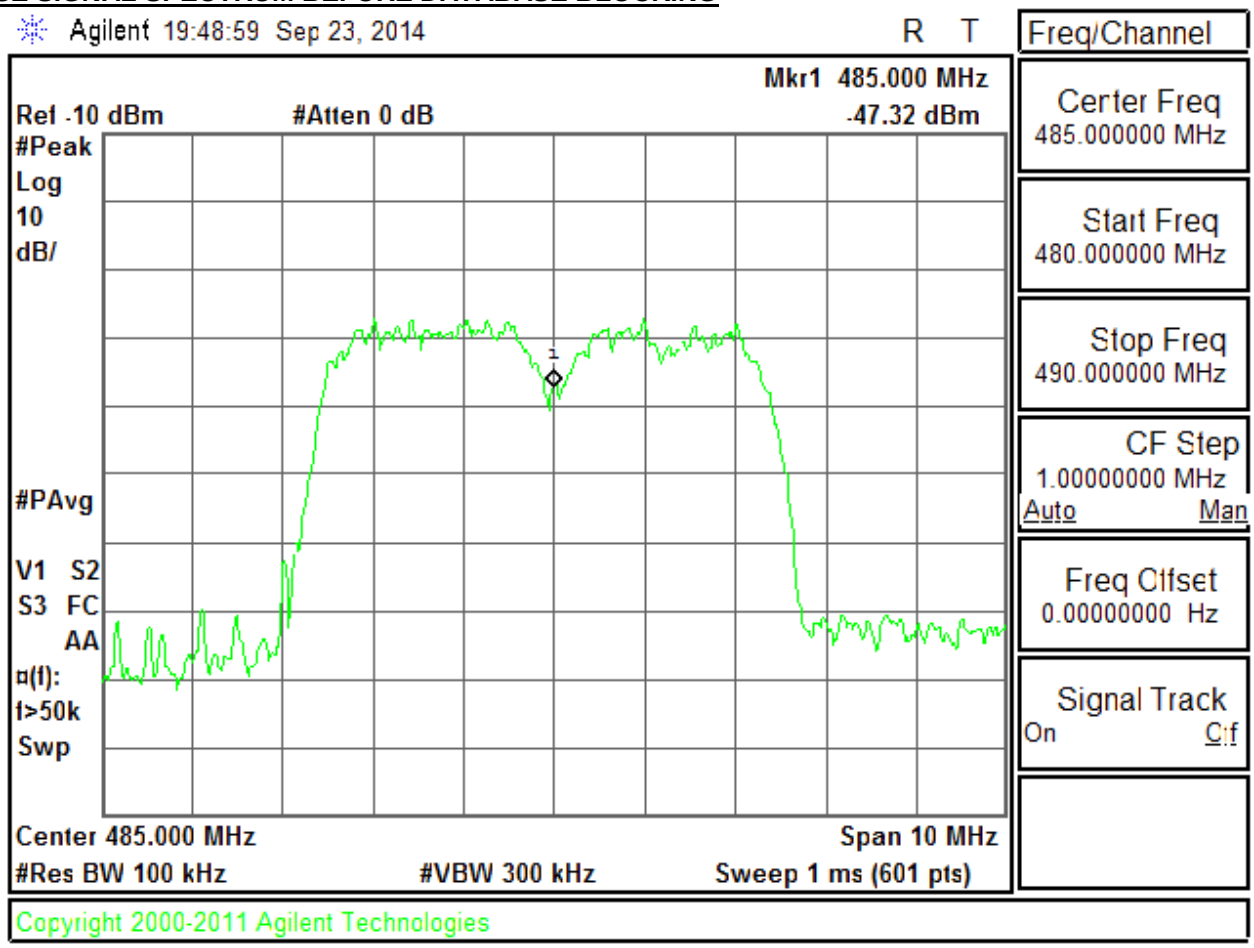
BASE SIGNAL SPECTRUM BEFORE DATABASE BLOCKING



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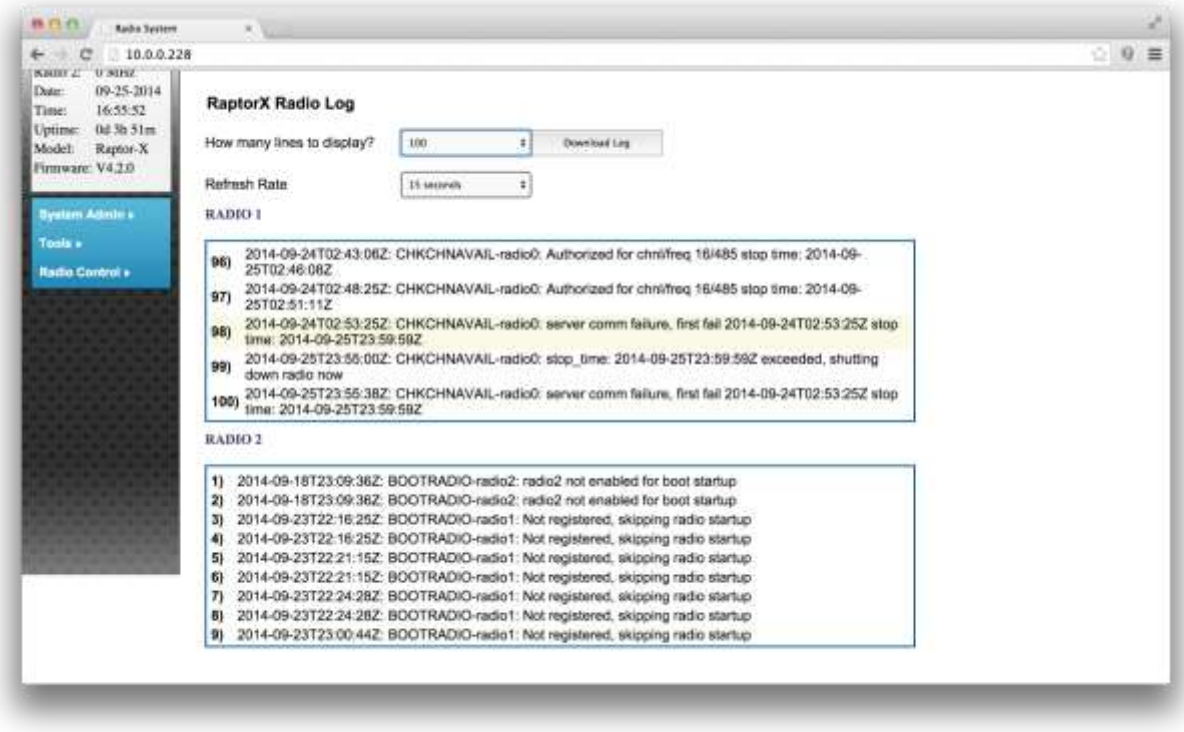
BASE SOFTWARE 5 MINUTES AFTER DATABASE BLOCKING (BASE STOPPED)



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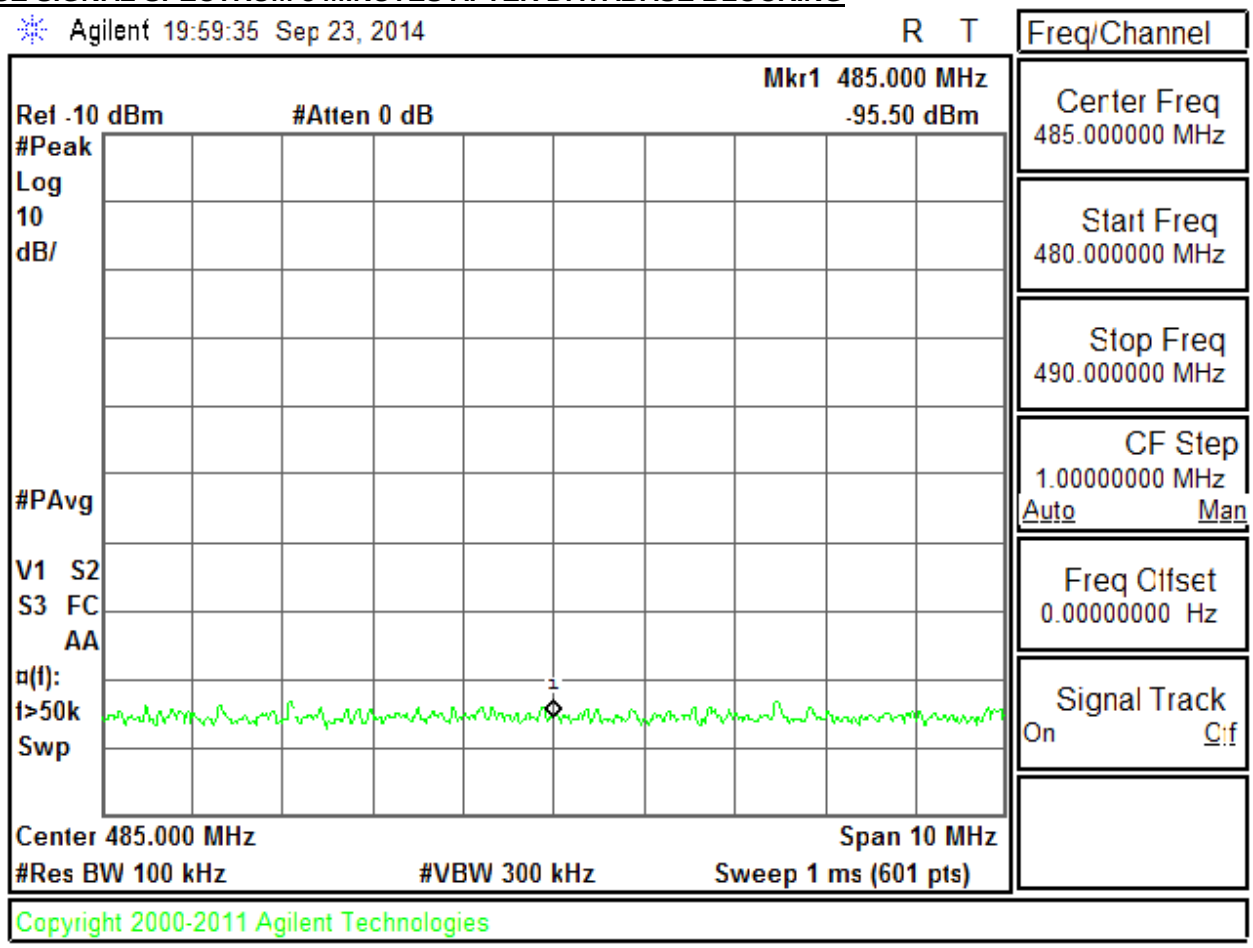
BASE SIGNAL SPECTRUM 5 MINUTES AFTER DATABASE BLOCKING



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8.4. §15.711(B)(3)(I)(II), §15.713(A)(1) 48 HOUR CHANNEL SCHEDULING

REQUIREMENT

- §15.711(B)(3)(I) Fixed devices must access a TV bands database over the Internet to determine the TV channels that are available at their geographic coordinates, taking into consideration the fixed device's antenna height, prior to their initial service transmission at a given location. Operation is permitted only on channels that are indicated in the database as being available for such TVBDs. Fixed TVBDs shall access the database at least once a day to verify that the operating channels continue to remain available. Operation on a channel must cease immediately if the database indicates that the channel is no longer available. Fixed TVBD must adjust their use of channels in accordance with channel availability schedule information provided by their database for the 48-hour period beginning at the time of 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 TVBD operating channel. Repeat the available channel request after the update interval 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

- Referring to the following testing timeline diagram. Low Power Auxiliary Devices are registered and scheduled for protection at both base and remote locations, i.e. from 8 PM to 8:30 PM on 9/23/2014 at base location and from 9 PM to 9:30 PM on 9/23/2014 at remote location.
- Allow the base and remote EUT to enter normal operations prior to testing, i.e. on Channel 16 before 8 PM 9/23/2014.
- Upon channel list request to the TVWS Database, the base EUT obtains the channel list expiration time (at 8 PM on 9/23/2014) reflecting the Low Power Auxiliary Device's registered protection period.
- The base EUT requests new channel list upon the channel list expiration time (8 PM on 9/23/2014) and the base EUT's current operating channel (Channel 16) is no longer in the returned channel list.
- The base EUT ceases transmission on Channel 16 immediately.
- The remote EUT ceases operation on Channel 16 right after the base EUT since the remote EUT won't transmit without receiving the base signal.
- The base EUT continues sending periodic channel list requests to the TVWS Database . The returned channel list expiration time (9:30 PM on 9/23/2014) reflecting the ending time of the registered protection period for the Low Power Auxiliary Device.
- The base EUT requests new channel list upon the channel list expiration time (9:30 PM on 9/23/2014) and Channel 16 becomes available again in the returned channel list from the TVWS Database . The base EUT will resume transmission on Channel 16.
- The remote EUT will detect the base EUT signal on Channel 16 and reconnect with the base EUT.

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RESULTS

The base EUT correctly ceased transmission on the protected channel over the protection period of the Low Power Auxiliary Device registered at the same location.

Test Results	
Pass	**Fail**
☒	☐

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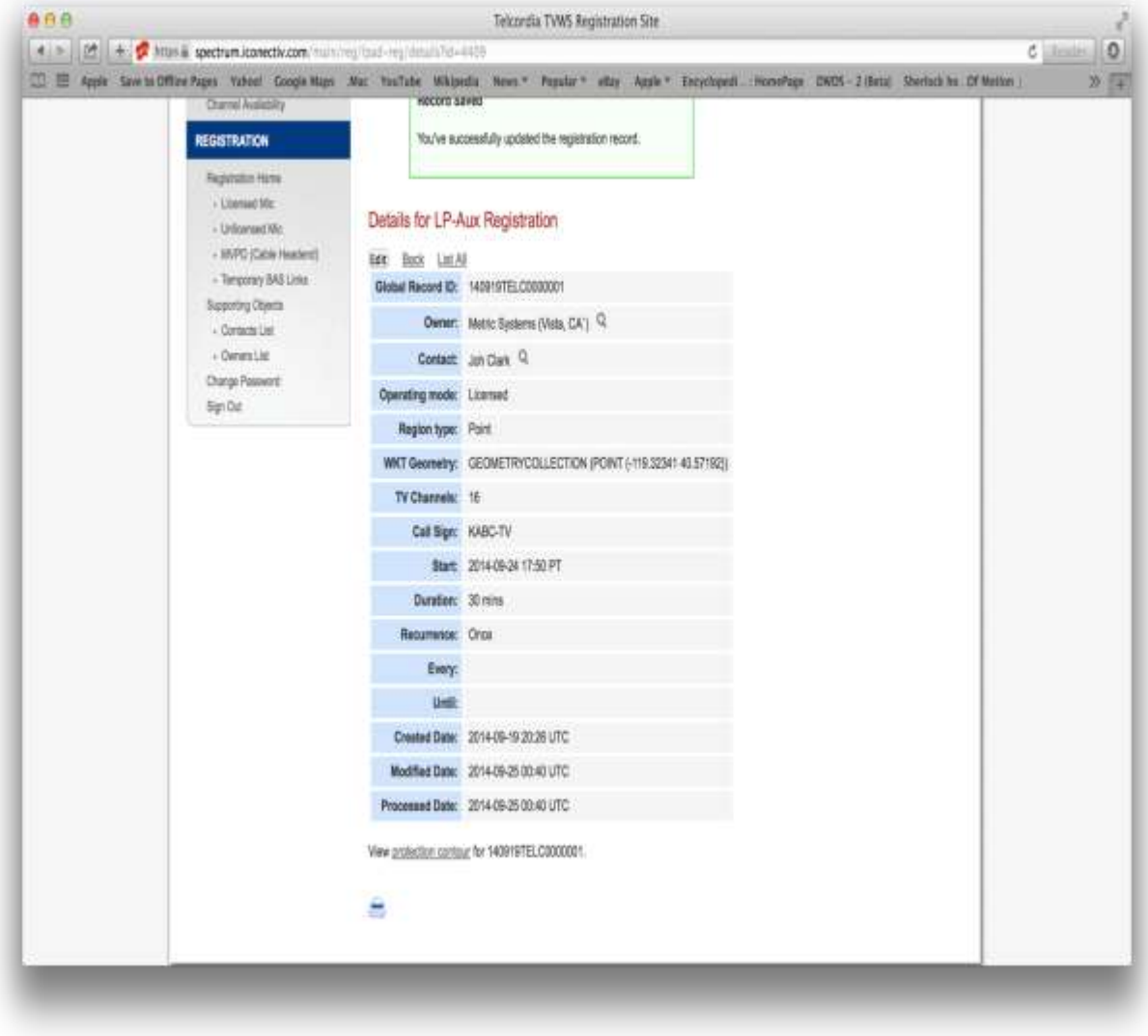
48 HOUR CHANNEL SCHEDULING LOW POWER AUXILIAR DEVICE REGISTRATION RECORD AT BASE LOCATION



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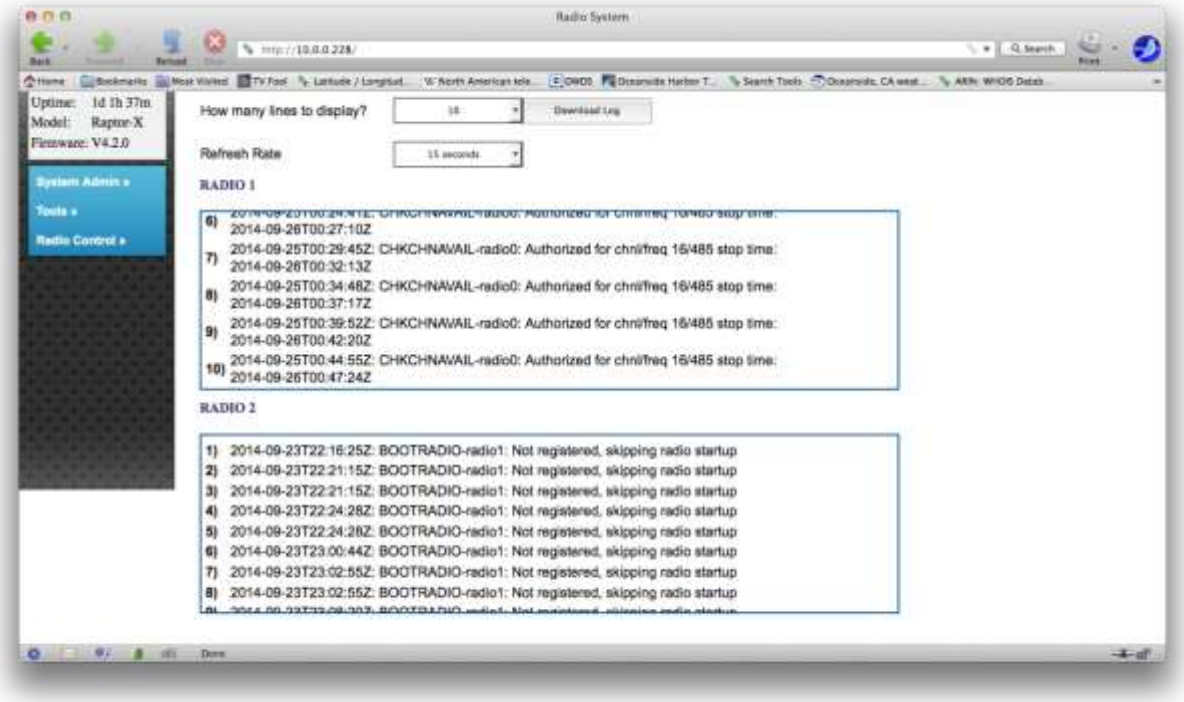
48 HOUR CHANNEL SCHEDULING BASE SOFTWARE BEFORE PROTECTION PERIOD.



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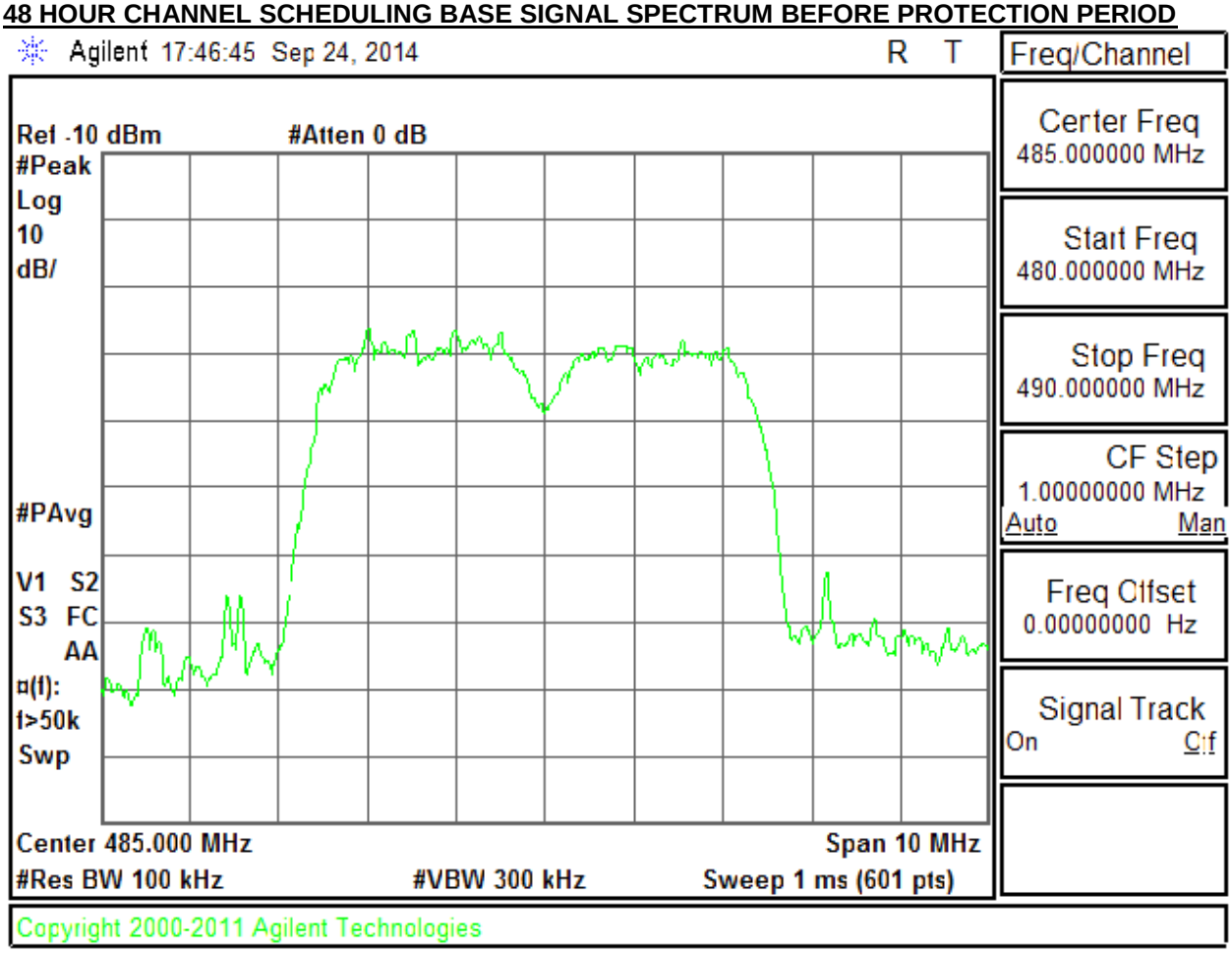
48 HOUR CHANNEL SCHEDULING BASE SIGNAL SPECTRUM BEFORE PROTECTION PERIOD



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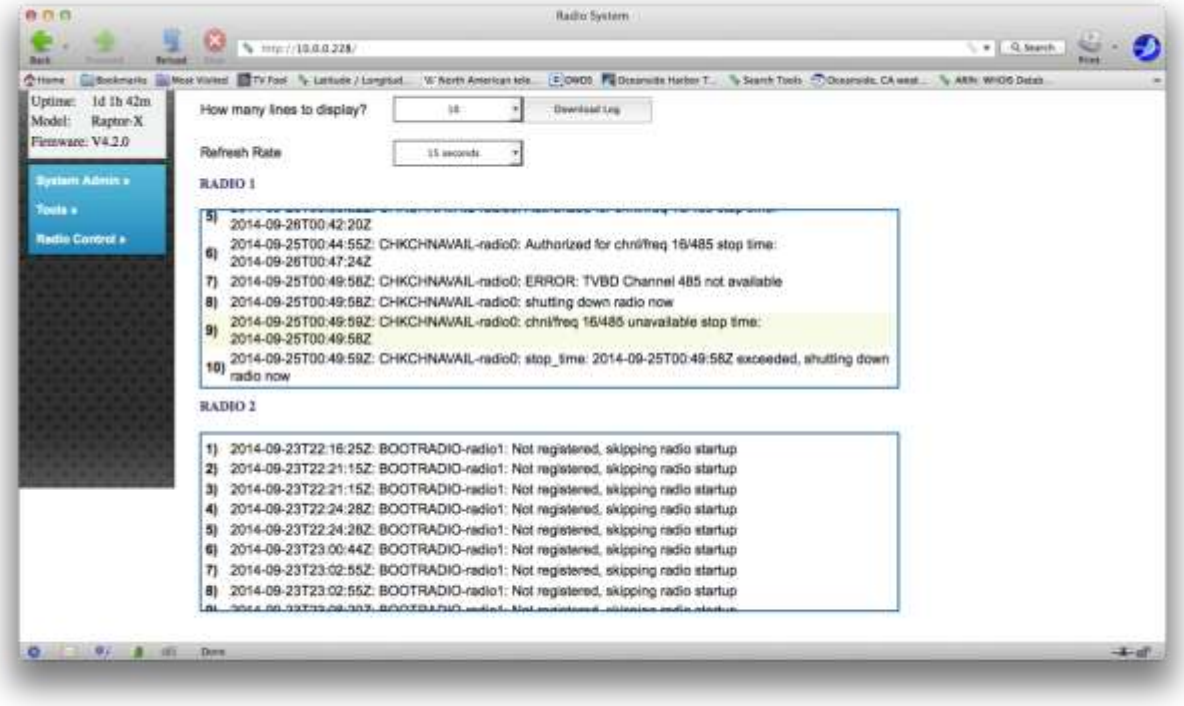
48 HOUR CHANNEL SCHEDULING BASE SOFTWARE DURING PROTECTION PERIOD (CHANNEL 16 UNAVAILABLE)



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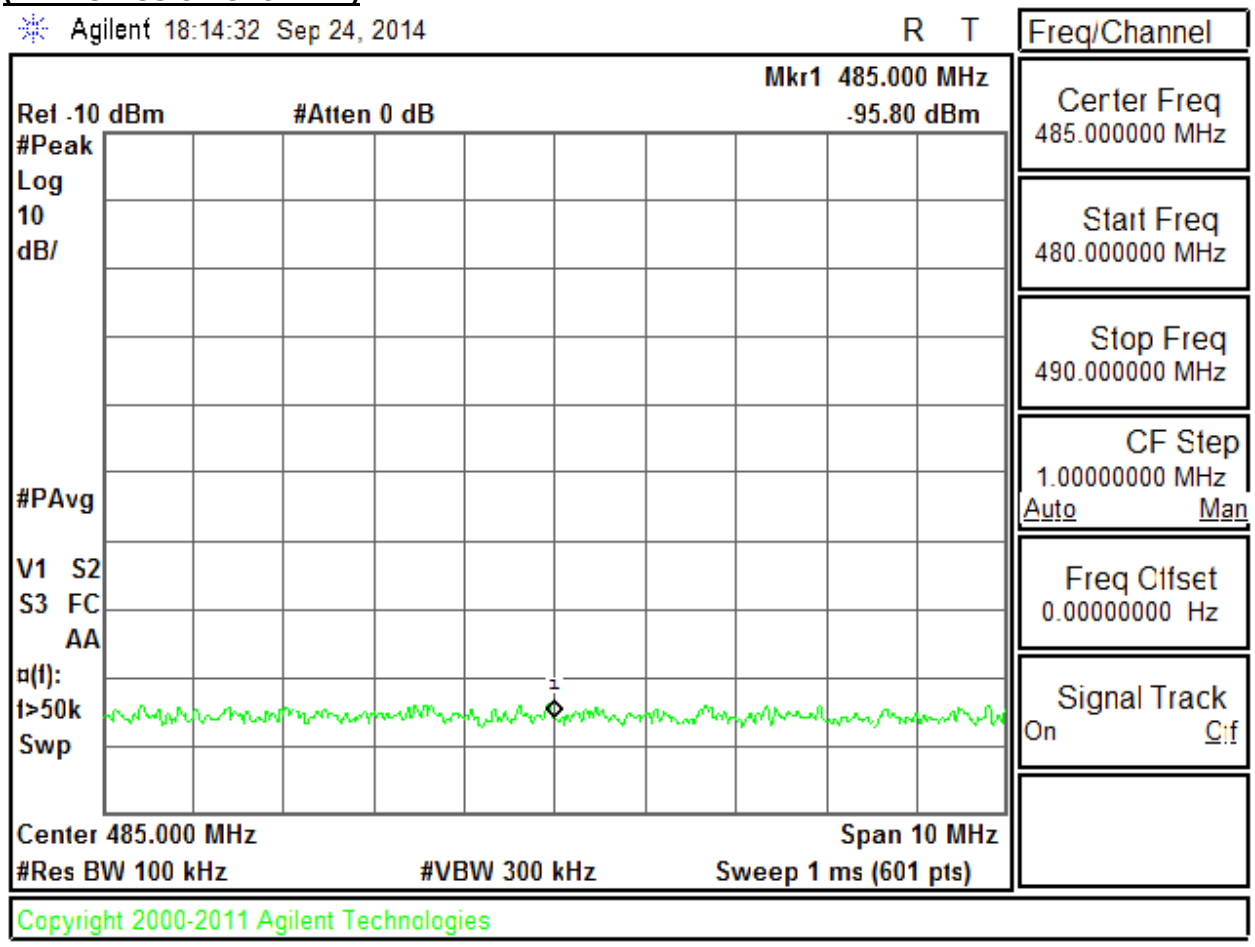
48 HOUR CHANNEL SCHEDULING BASE SIGNAL SPECTRUM DURING PROTECTION PERIOD (TRANSMISSION STOPPED)



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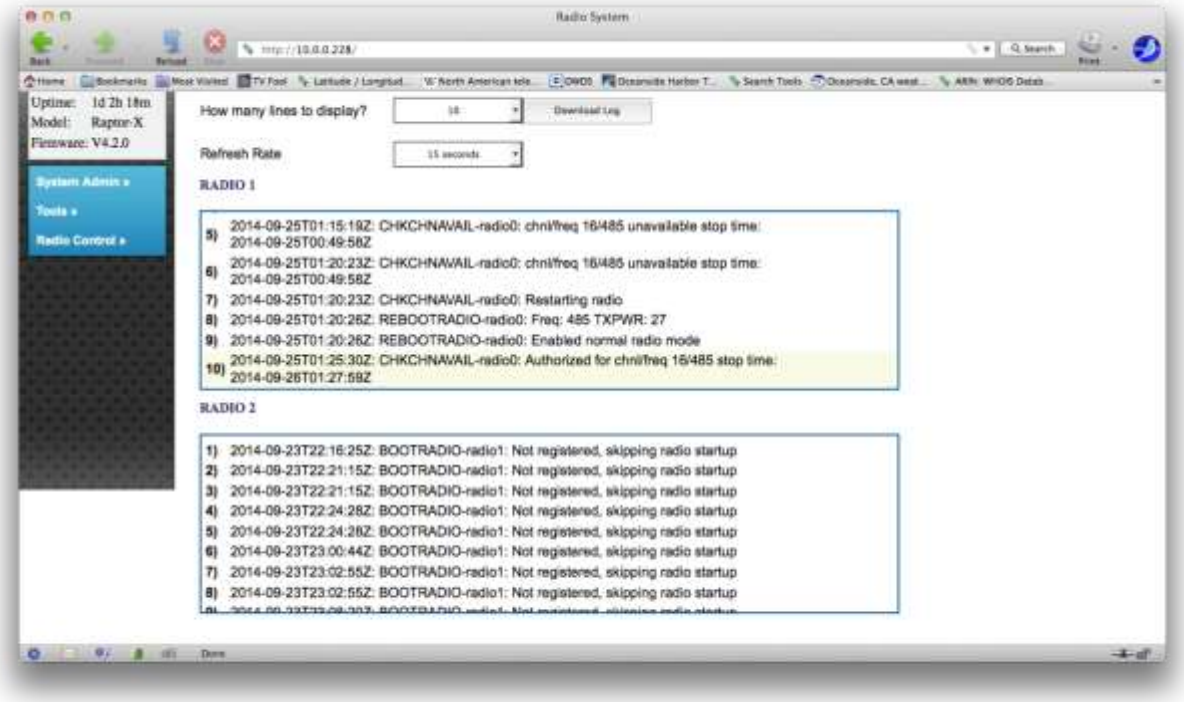
48 HOUR CHANNEL SCHEDULING BASE RESUMES ON CHANNEL 16 AFTER PROTECTION PERIOD



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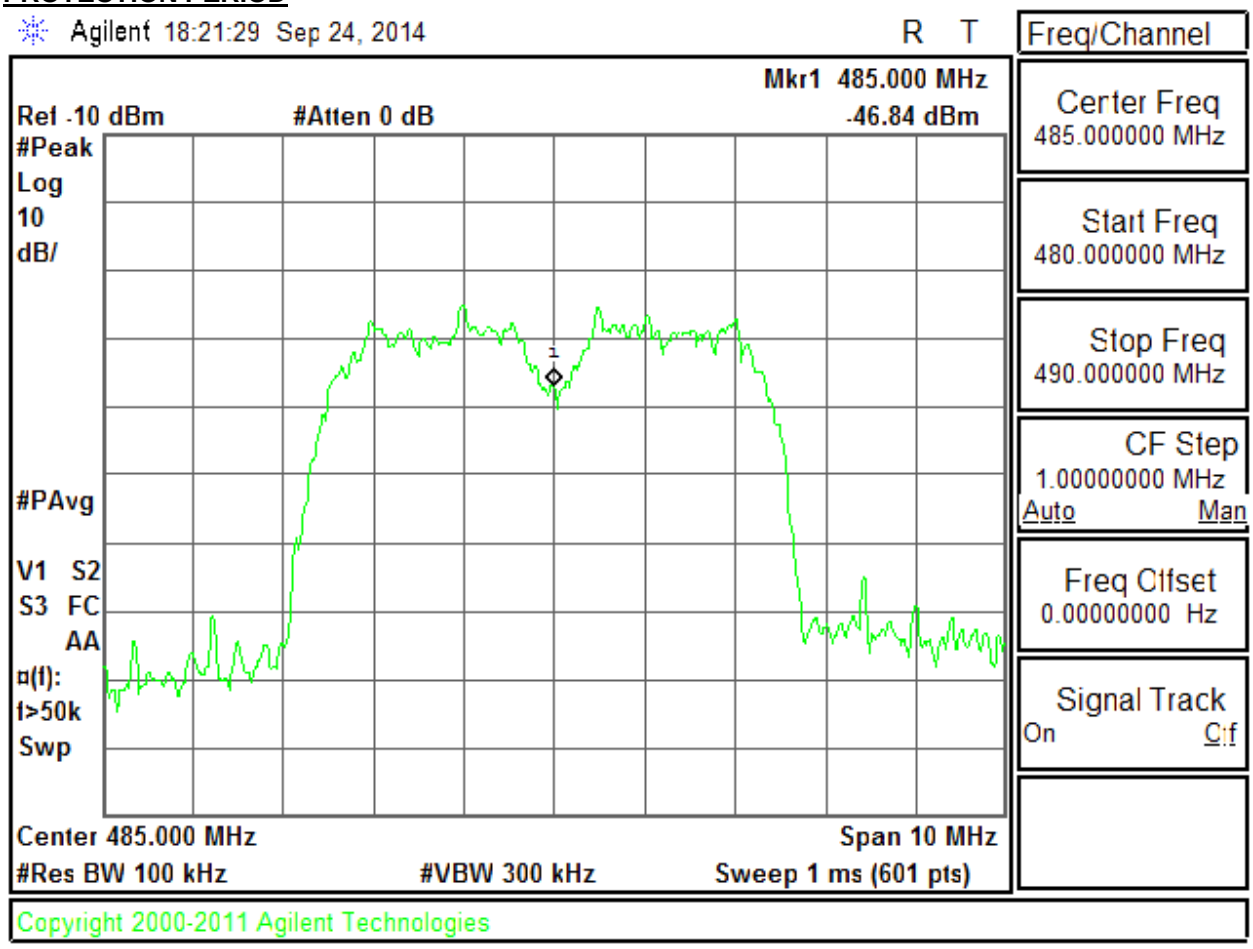
48 HOUR CHANNEL SCHEDULING BASE RESUMES TRANSMISSION ON CHANNEL 16 AFTER PROTECTION PERIOD



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8.5. §15.707, §15.711(B)(3)(I)(II)(IV),(C), §15.712 TVBD CHANNEL AVAILABILITY

REQUIREMENT

- Confirm that the channel list provided by the database conforms with those allowable to the class of TVBD under test. Confirm that the TVBD is operating on a channel from the list at 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.
- The base EUT software only allows the user to select a channel from the channel list returned from the database (see base software screen capture below) which are within the device operating frequency range 57 – 695 MHz.
- Test pre-condition: The device is configured to operate at a power level less than or equal to that which is authorized by the Grant.
- 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, i.e. Channel 16.

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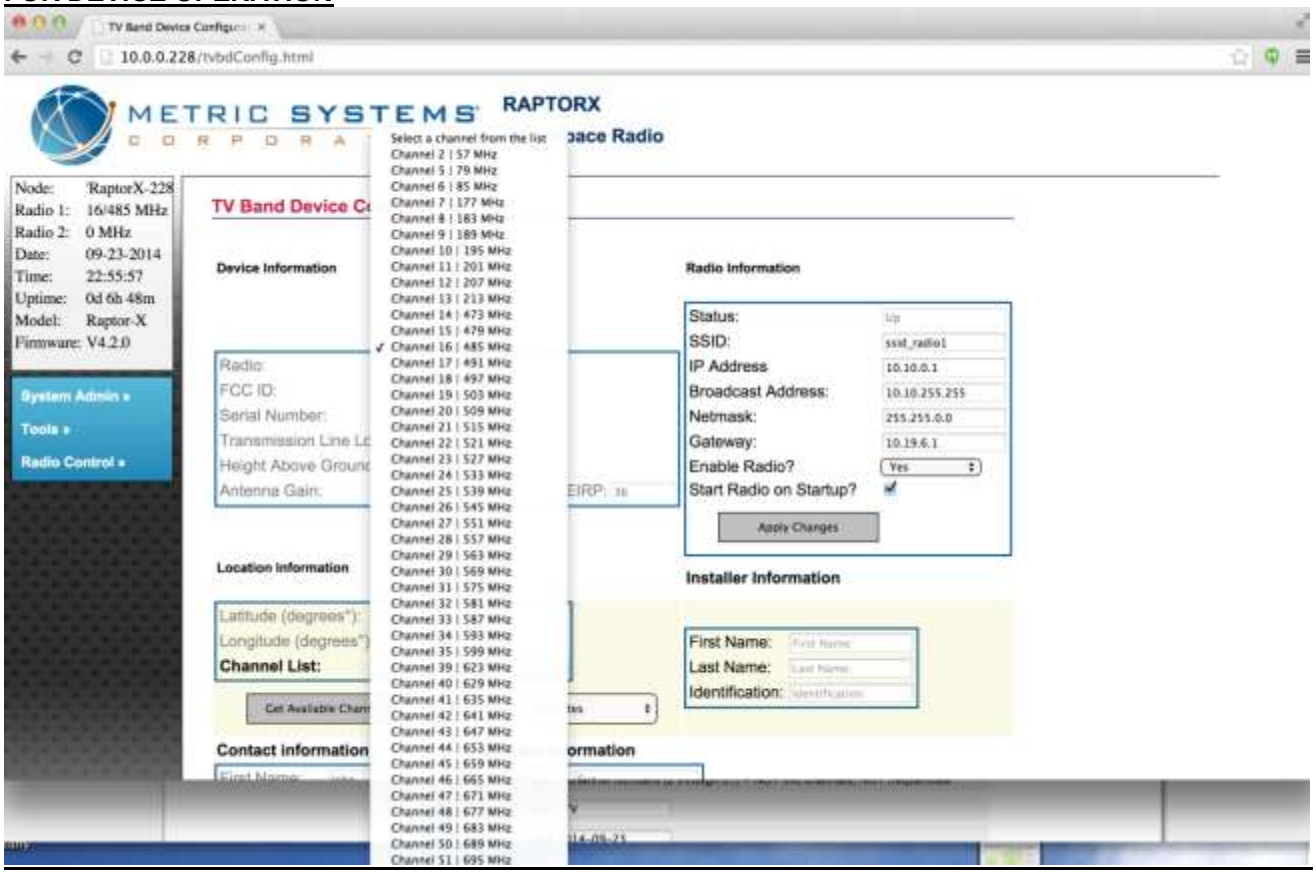
RESULTS

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**
☒	☐

BASE SOFTWARE ONLY ALLOWS A CHANNEL FROM AUTHORIZED CHANNEL LISTS TO BE SELECTED FOR DEVICE OPERATION



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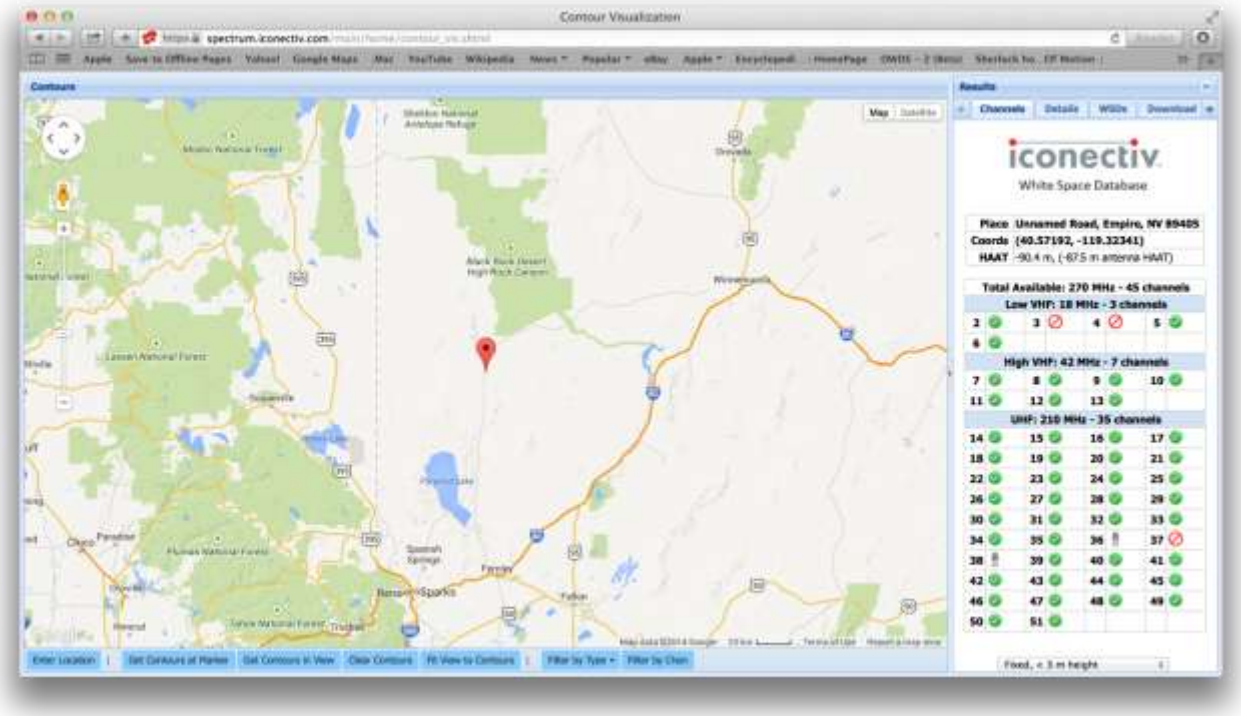
ICONECTIV WEB INTERFACE SHOWING AUTHORIZED CHANNELS AT THE DEVICE LOCATION.



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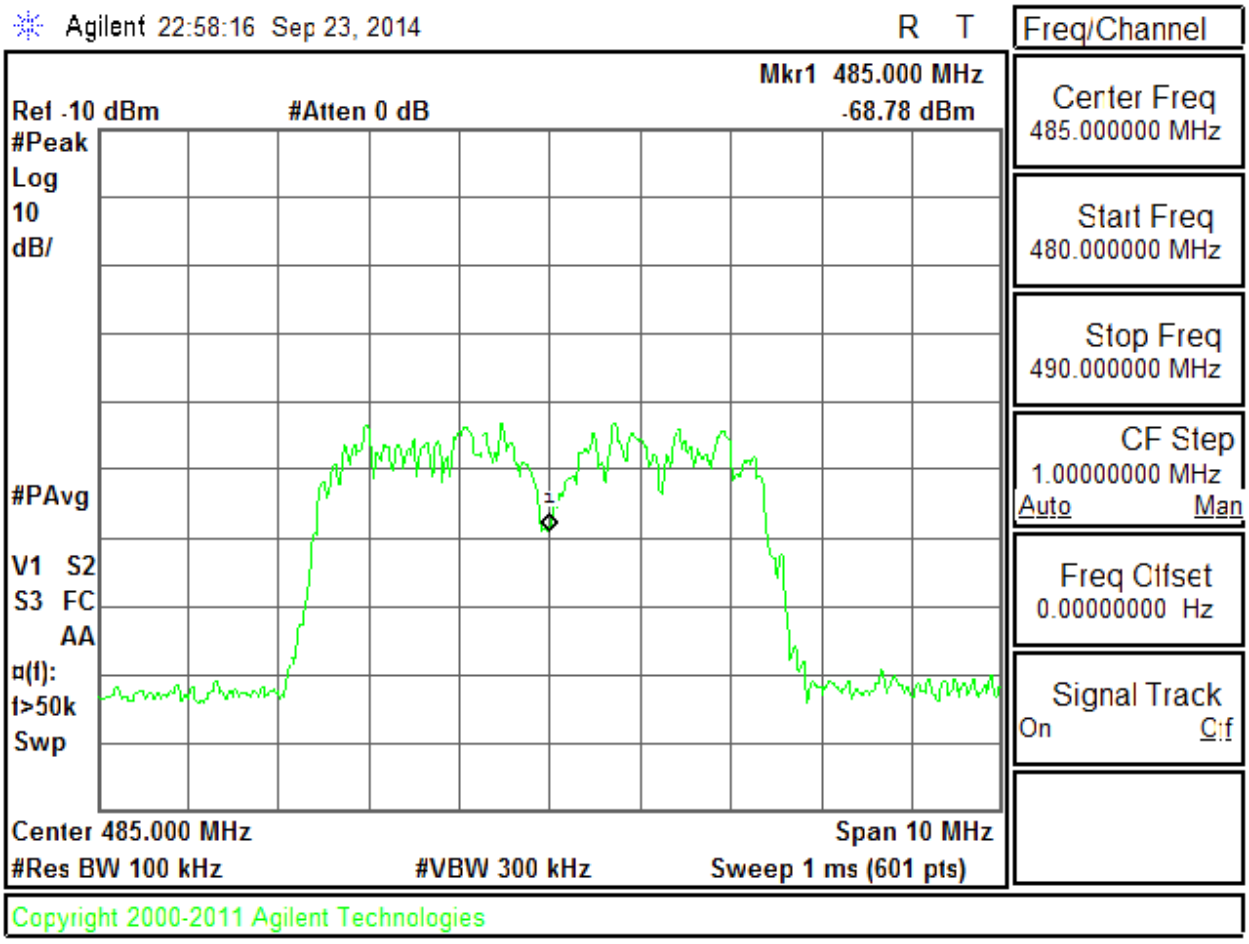
BASE SIGNAL SPECTRUM ON THE AUTHORIZED CHANNEL



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8.6. §15.715(F) SECURITY

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 TVBD?
  ii. How are communications initiated?
  iii. How does the TVBD 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 TVBD?
  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 TVBD?

The TVBD connects to the iConectiv database using HTTP over SSL/TLS. The protocol used over this transport layer is specified by the IETF Protocol to Access White Space (PAWS) Draft-12 specification.

ii. How are communications initiated?

The TVBD initiates communication with the iConectiv database by first 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 TVBD validate messages from the database?

The identity of the iConectiv database is validated through verification of the iConectiv SSL certificate through standard third-party certificate authority mechanisms, ensuring the communications are secure and authentic between the TVBD and the database.

At the application layer both the TVBD 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 TVBD 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 TVBD has never communicated with or authenticated the database, then it will not begin operation. If once operating, experiences a communication or authentication failure, then it will cease operation at 11:59 PM on the following day.

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

The database validates messages from the TVBD by checking the serial number and FCC ID received in the Device Descriptor data element 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 iConectiv 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 send between TVBD 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 TVBDs, e.g., Temporary BAS, MVPD, Licensed and Unlicensed Microphones.

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

IConectiv maintains two parallel registration sites. The first, production registration site, is available to entities seeking protection from operational TVBDs. The second, test and integration site is available to those device manufacturers looking to integrate with the iConectiv database and to FCC and test laboratories looking to test functionality of a TVBD operating in conjunction with the iConectiv 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://spectrum.iconectiv.com/main/reg/
2. Test and integration registration site: https://spectrum.iconectiv.com/dev/reg/

Testers should note that while a device is being tested for certification, it will be connecting to the iConectiv test and integration server. To test the TVBD for operation in conjunction with registered protected entities, the tester must register for protection on the test and integration server (#2) listed above.

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9. REMOTE STATION - DATABASE CERTIFICATION TESTS

9.1. §15.713(F)(3) FIXED TVBD REGISTRATION

REQUIREMENT

- The Fixed TVBD must be able to provide the required information to the TVWS database and obtain a successful registration.
- For a fixed TVBD 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

1. Both the Base Station and Remote 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.

2. The Remote Station is powered down and relocated to its permanent Fixed location.

3. The Remote Station upon power-up will monitor the channel, and when clear, Transmit its status requesting direct connection to internet. When connected, the Remote Station will execute the registration procedure. The Remote Station will use a channel on which the Base Station is authorized to operate.

4. If the registration process fails. The remote station will immediately shut-down the Remote Station Radio.

5. If the registration is successfully the Remote Station will periodically re-validate available channels by registering.

6. If, upon registering, a previously available channel is unavailable, and the Remote Station is operating on the unavailable channel, the Remote Station will immediately cease Remote Station radio operation.

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TEST PROCEDURE

- Pre-register the ‘remote’ Fixed device for operation using the ‘remote’ location, using a direct connection to the TVBD Database service, and select the channel that the ‘Base’ Fixed device is operating on.

- Remove the direct connection to Internet, and power cycle the ‘remote’ Fixed device

- Observe communication on the common channel between the ‘Base’ and ‘Remote’ stations.

- Confirm in the ‘Remote’ Fixed device’s radio log, that the TVBD Database service was contacted, and the channel of operation was authorized.

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RESULTS

The Remote Fixed device successfully contacted the TVWS Database and channel of operation was authorized.

Test Results	
Pass	**Fail**
☒	☐

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9.1.1. SUCCESSFUL REGISTRATION

TEST PROCEDURE

- Configure the Remote 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 Remote EUT automatically contacts the TVWS Database to perform device registration.
- Upon successful registration, the 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.

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 (Channel 16) from the returned channel list from the TVWS Database.

Test Results	
Pass	**Fail**
☒	☐

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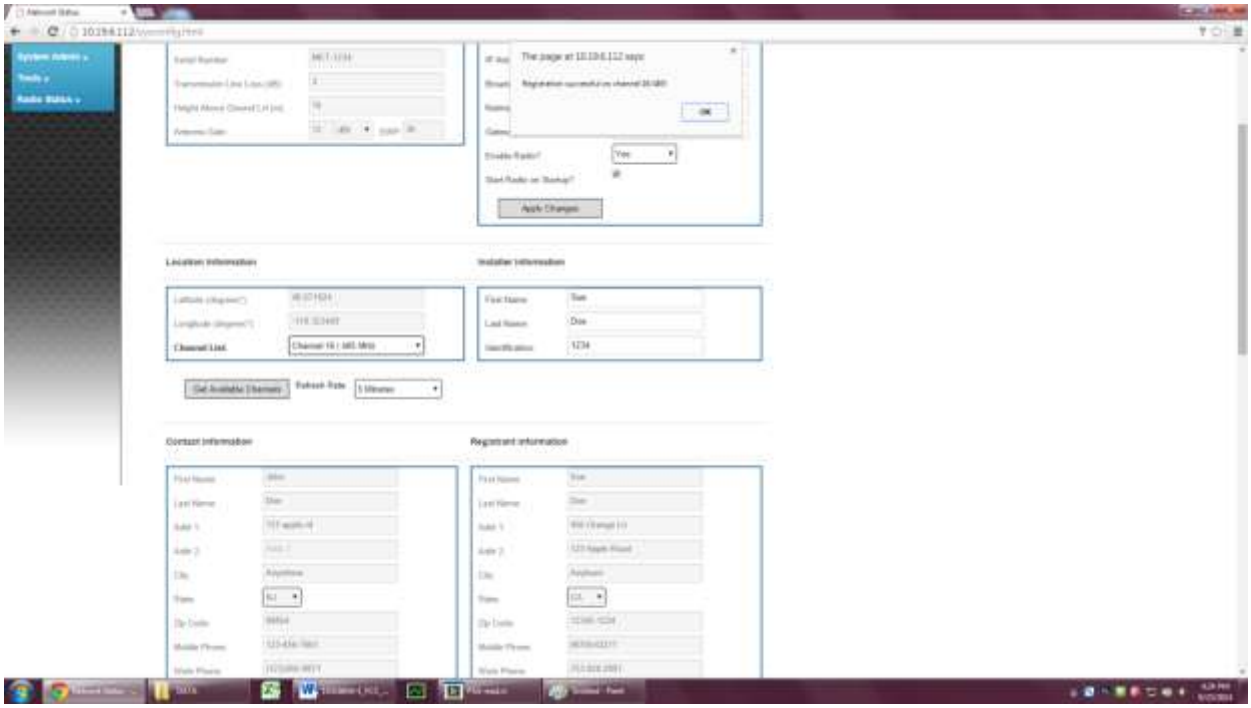
REMOTE SOFTWARE SHOWING SUCCESSFUL DEVICE REGISTRATION WITH THE TVWS DATABASE



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9.1.2. FAILED REGISTRATION – RESTRICTED COORDINATES

TEST PROCEDURE

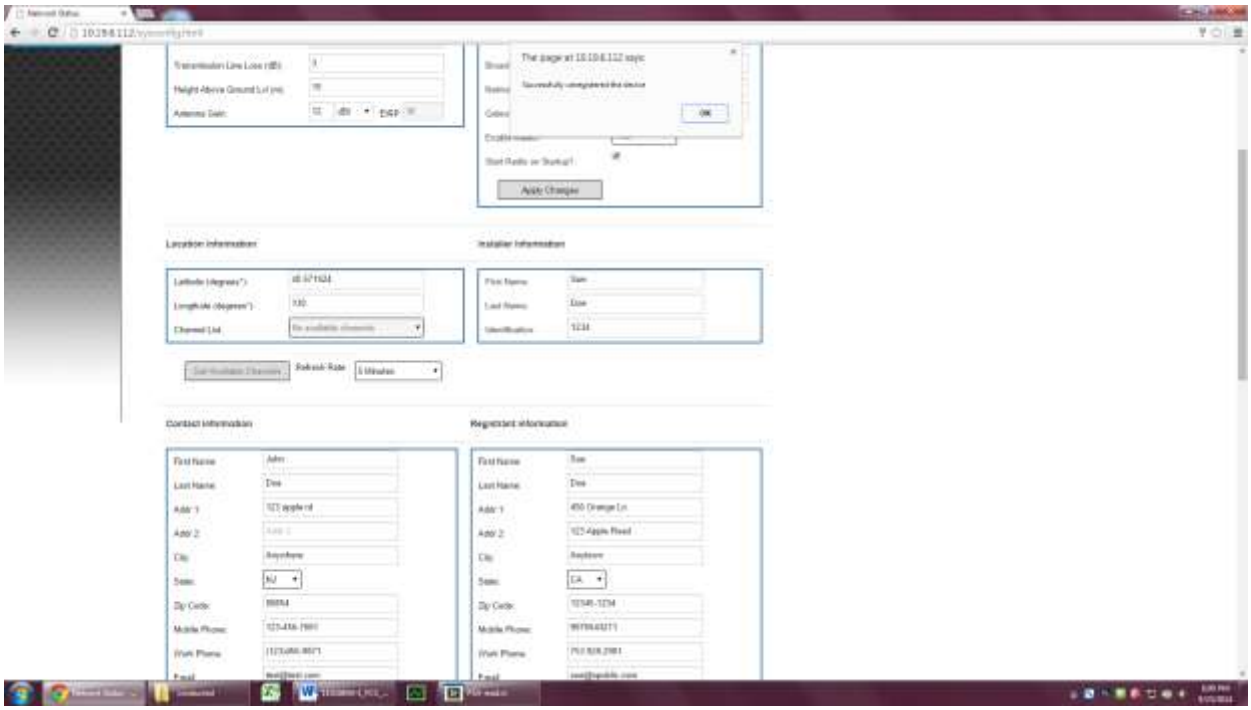
- Configure the EUT with restricted coordinates: (LAT= 40.571924, LNG= -130) which is a location outside US regulatory boundaries
- Observe the base EUT registration failure indicated by the database message

RESULT

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

Test Results	
Pass	Fail
☒	☐

REMOTE SOFTWARE SHOWING FAILED DEVICE REGISTRATION DUE TO RESTRICTED COORDINATES



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9.1.3. FAILED REGISTRATION – HAAT

TEST PROCEDURE

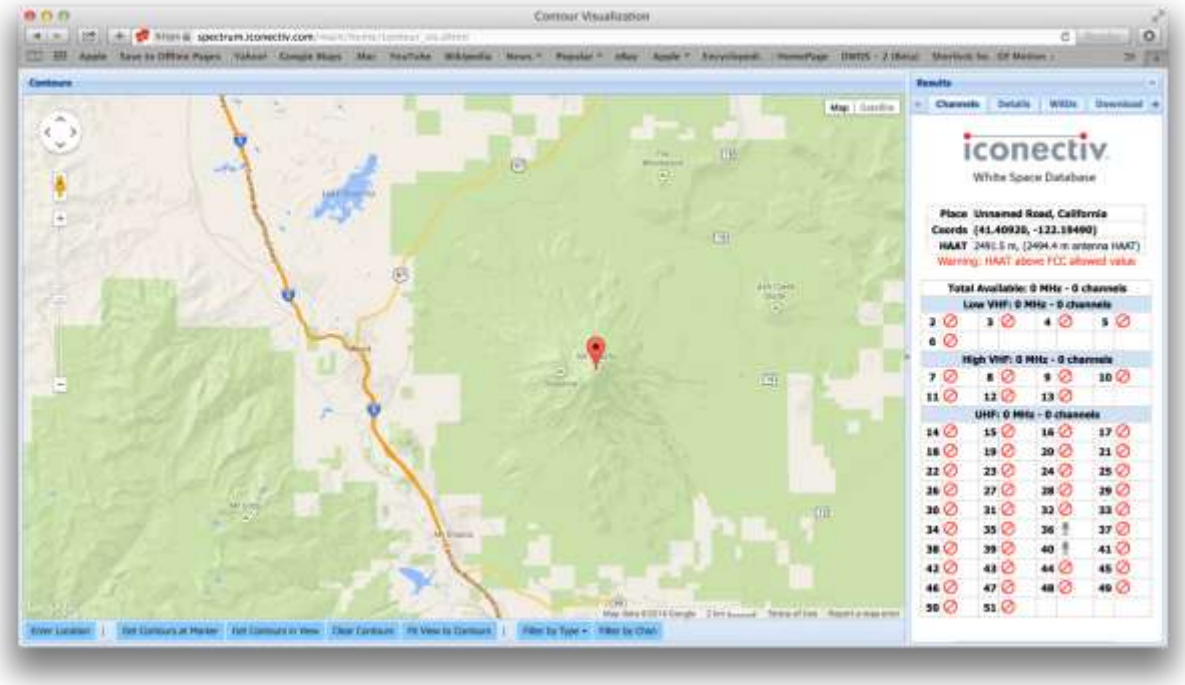
- Configure the EUT with Height Above Average Terrain(HAAT) > 250 m: the Mount Shasta coordinates (LAT=41.4092, LNG=-122.1949) were used.
- Observe the base registration failure indicated by the database message.

RESULTS

The Remote EUT failed to register when it is set to a location with HAAT above the limit.

Test Results	
Pass	Fail
☒	☐

MOUNT SHASTA HAS NO TVWS CHANNELS DUE TO HAAT LIMIT AS INDICATED BY THE TVWS DATABASE



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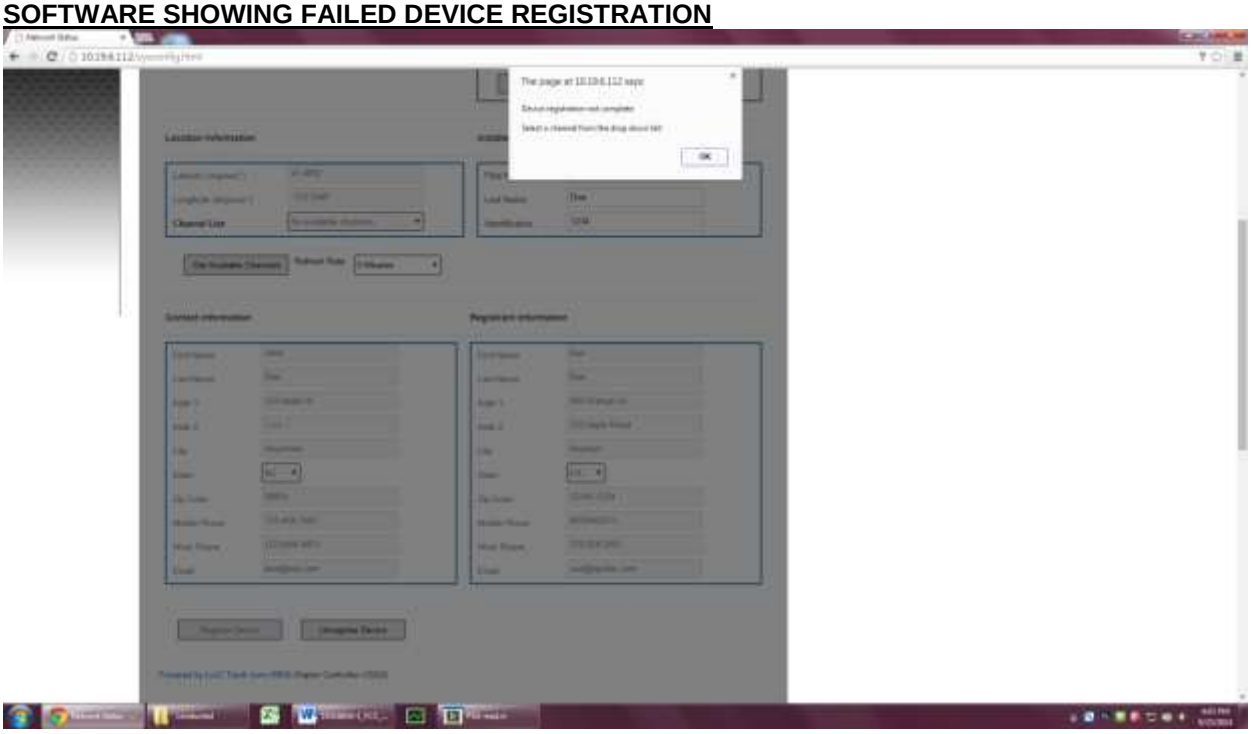
SOFTWARE SHOWING FAILED DEVICE REGISTRATION



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9.1.4. FAILED REGISTRATION – ANTENNA HEIGHT AGL

TEST PROCEDURE

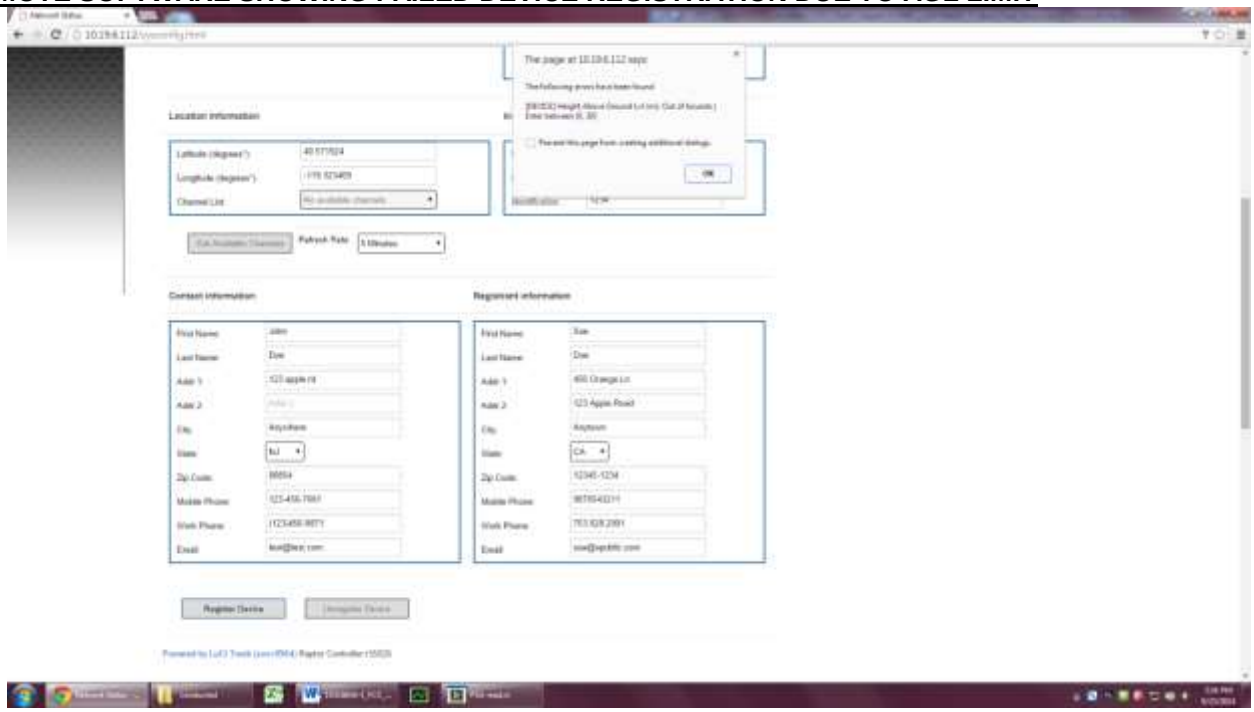
- Configure the EUT with antenna height Above Ground Level (AGL) > 30 meters.
- Observe the base registration failure indicated by the database message.

RESULTS

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

Test Results	
Pass	**Fail**
☒	☐

REMOTE SOFTWARE SHOWING FAILED DEVICE REGISTRATION DUE TO AGL LIMIT



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9.1.5. FAILED REGISTRATION – INCOMPLETE CONTACT INFORMATION

TEST PROCEDURE

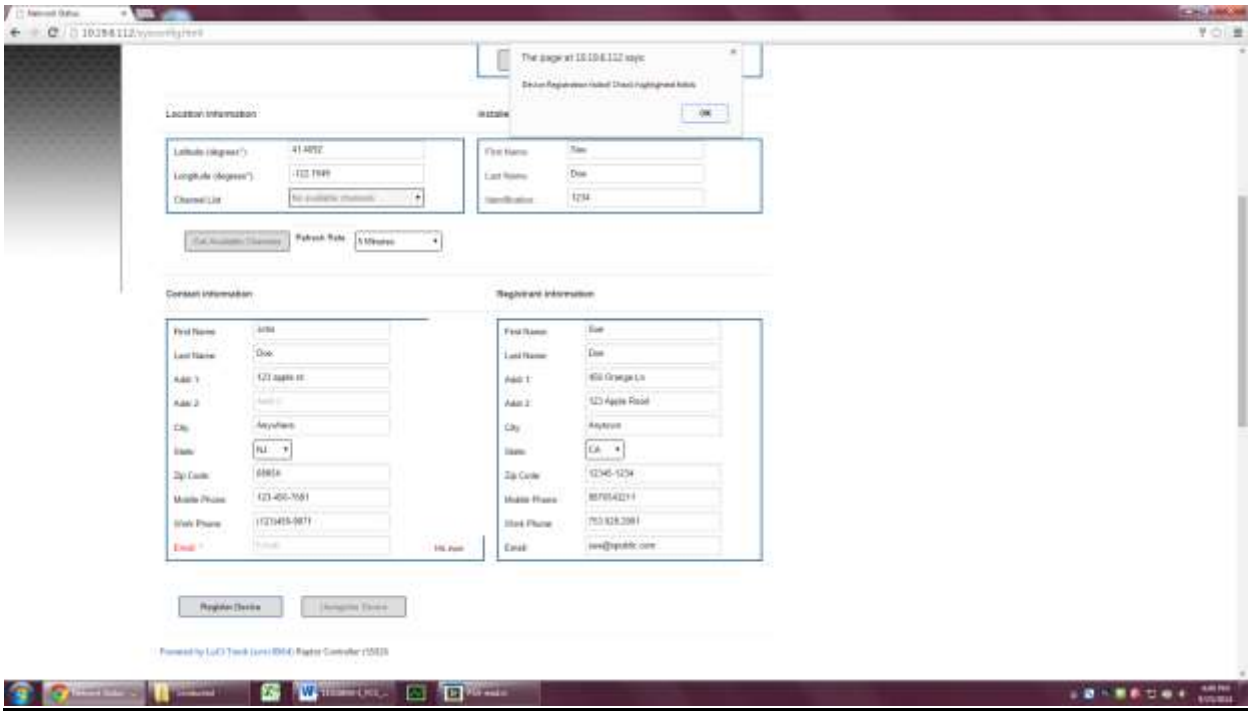
- Configure the EUT with missing contact information, e.g. email.
- The device software cannot proceed with registration and prompts user to enter the missing information.

RESULTS

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

Test Results	
Pass	Fail
☒	☐

SOFTWARE PROMPTING THE USER TO ENTER MISSING CONTACT INFORMATION



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9.2. §15.707(A) FIXED TVBD RELOCATED

REQUIREMENT

- Confirm that the database will not provide a channel list for Fixed TVBD at a location other than that registered.

TEST PROCEDURE

- The Remote 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 – see RaptorX-225 Installation and User Manual.

Test Results	
Pass	**Fail**
☒	☐

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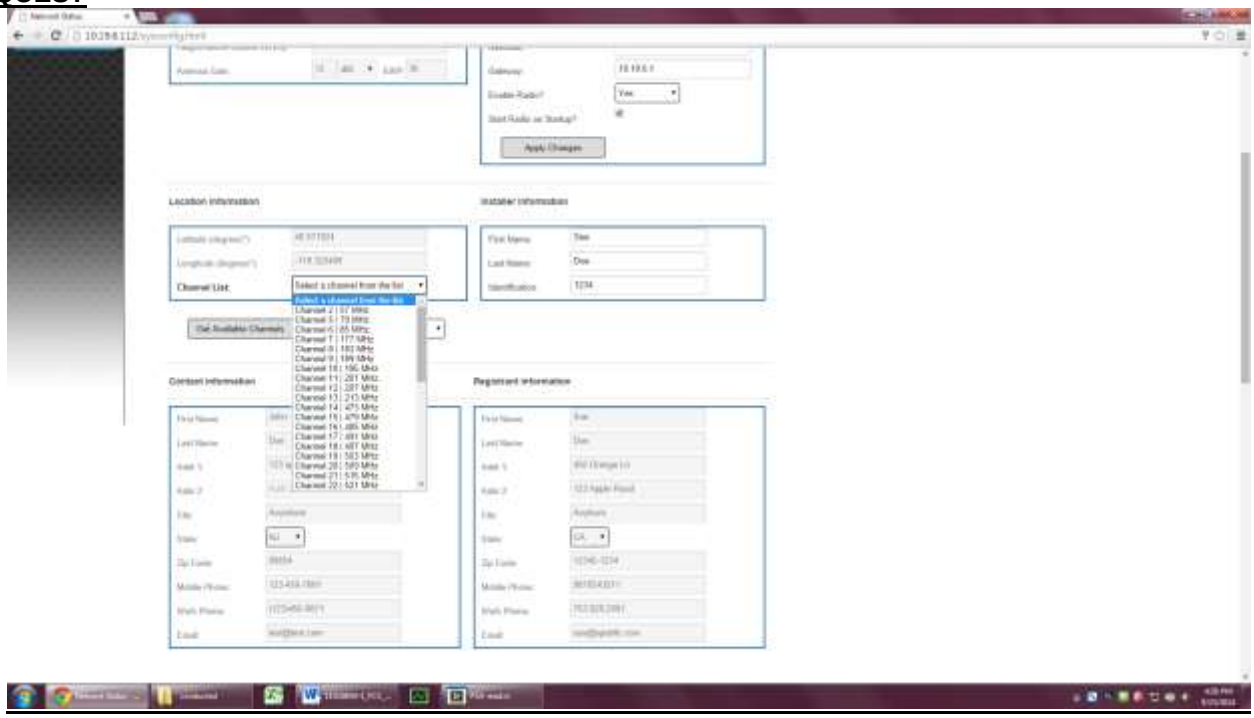
REMOTE SOFTWARE ONLY ALLOWS DEVICE REGISTRATION LOCATION INFORMATION TO BE ENTERED DURING INSTALLATION AND THE SAME DEVICE LOCATION IS USED FOR CHANNEL LIST REQUEST



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9.3. §15.711(B)(3)(I)(II), §15.713(A)(1) 48 HOUR CHANNEL SCHEDULING

REQUIREMENT

- After receiving an available channel list, register a low-power auxiliary device on the TVBD operating channel. Repeat the available channel request after the update interval 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.

- When a Low-Power Auxiliary device is registered on a channel in use by the Fixed device, the Fixed device is required to cease transmissions immediately.

TEST PROCEDURE

- A Low-Power Auxiliary device is registered and placed at the GPS location of the Remote Fixed device, with a scheduled time of operation.

- When the scheduled time for the Low-Power Auxiliary device to be in operation, observe that the Remote Fixed device ceases radio operation for the duration of the event period.

- Since the Remote Fixed device is 'Not Directly Connected to the Internet', manual intervention is required for the 'remote' Fixed device to restart radio operations.

- When the Remote Fixed device reconnects to the internet thru the base gateway, it starts normal operation after receiving the updated channel list that includes Channel 16 from the TVWS database.

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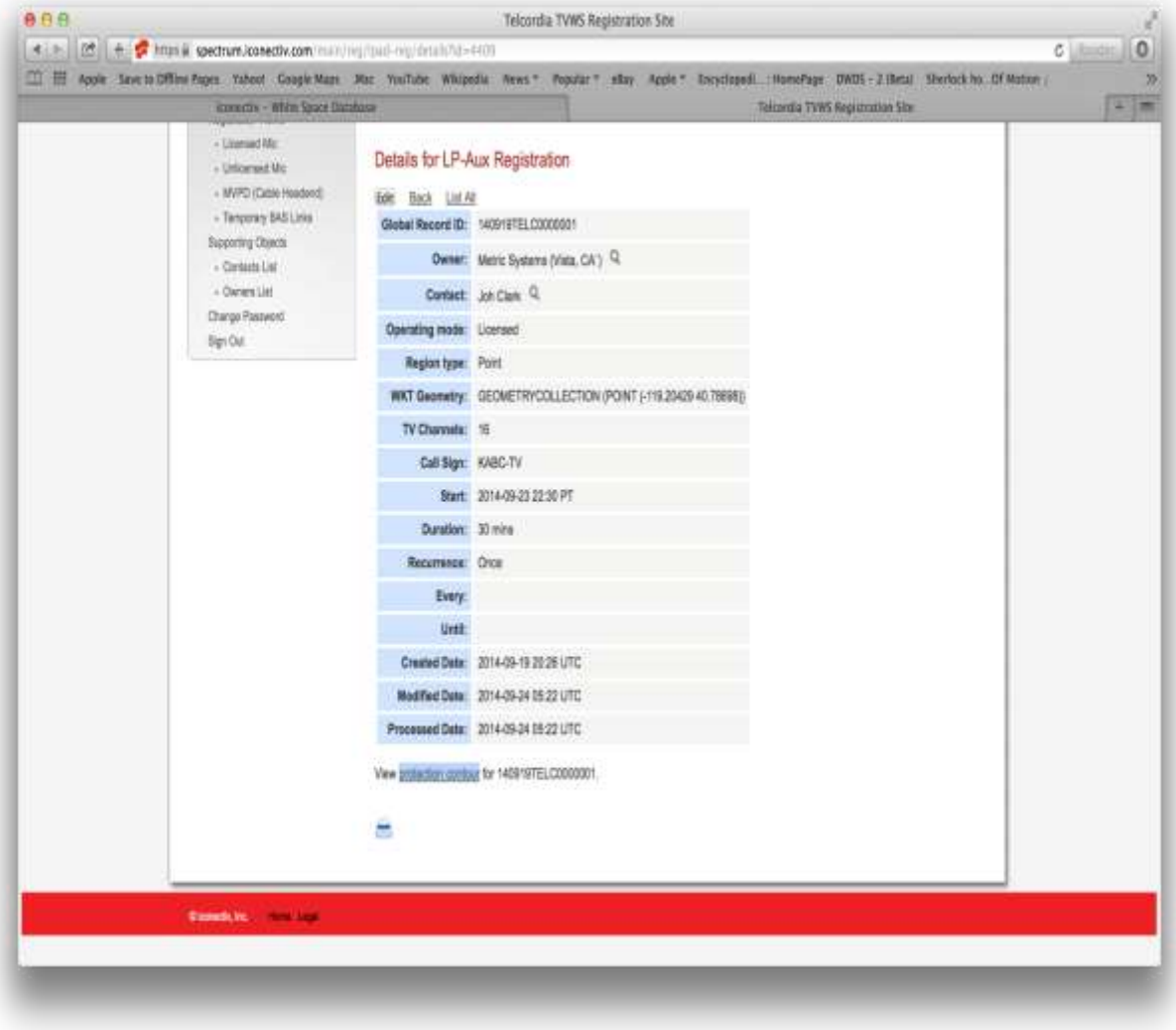
RESULTS

The Remote Fixed device EUT correctly ceased transmission on the protected channel over the protection period of the Low Power Auxiliary Device at the same location.

Test Results	
Pass	**Fail**
☒	☐

48 HOUR CHANNEL SCHEDULING LOW POWER AUXILIAR DEVICE REGISTRATION RECORD AT REMOTE FIXED DEVICE LOCATION



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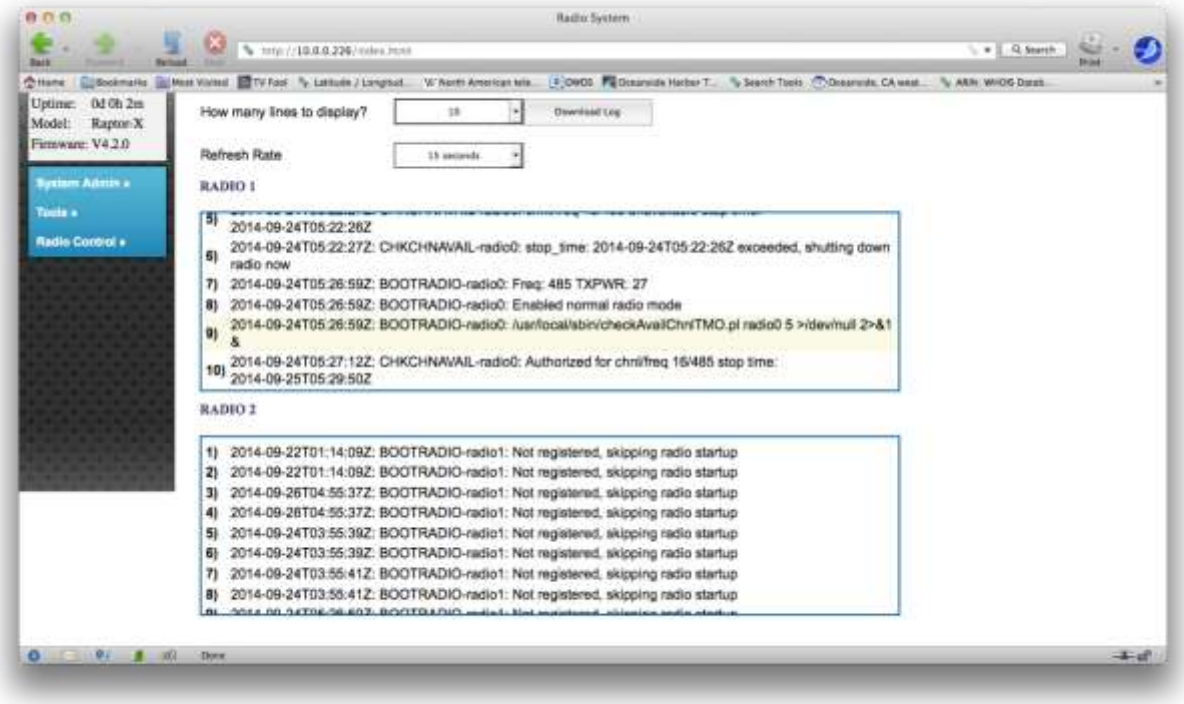
48 HOUR CHANNEL SCHEDULING BASE SOFTWARE BEFORE PROTECTION PERIOD FOR THE REMOTE FIXED DEVICE LOCATION



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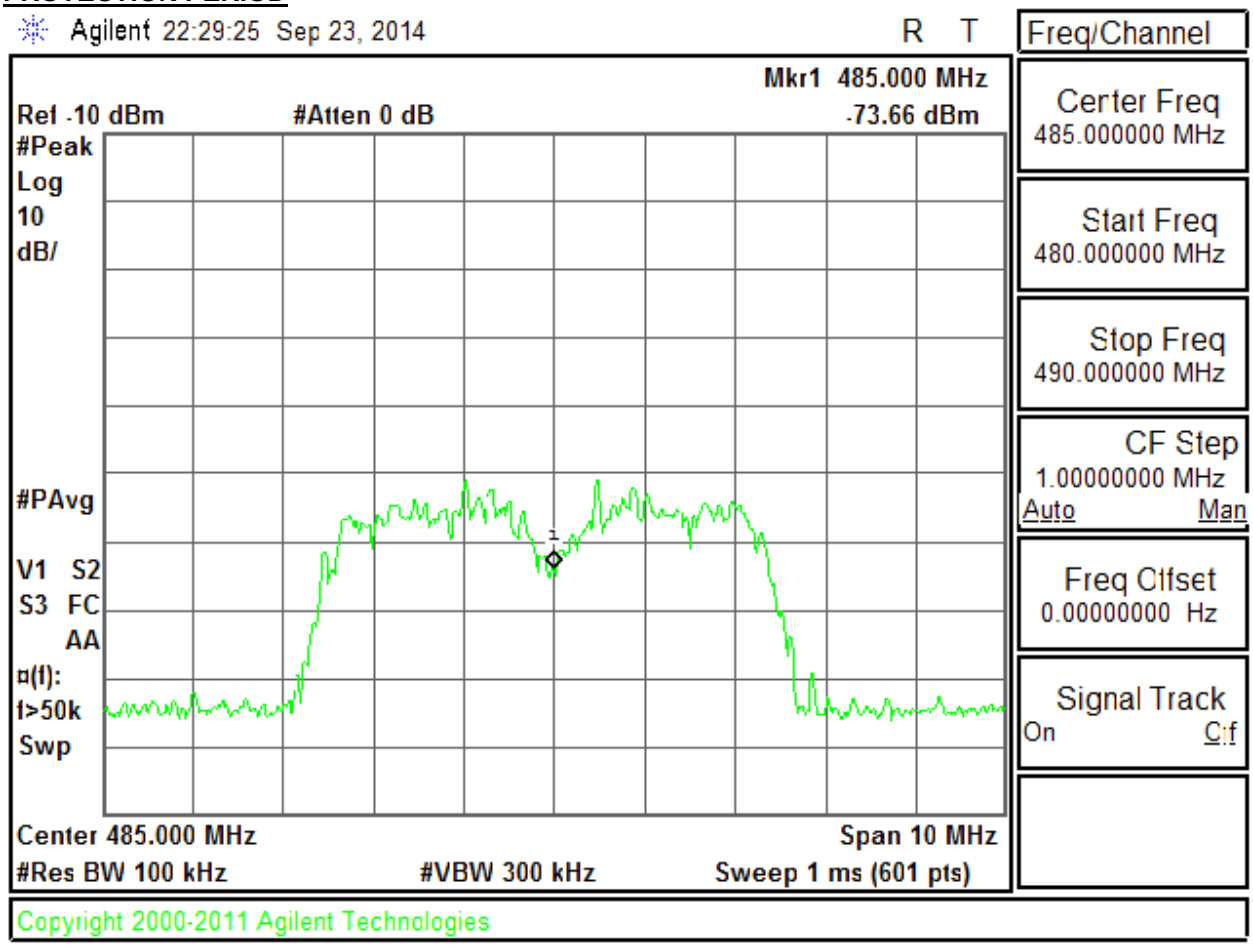
48 HOUR CHANNEL SCHEDULING ACTIVE REMOTE FIXED DEVICE SIGNAL SPECTRUM PRIOR TO PROTECTION PERIOD



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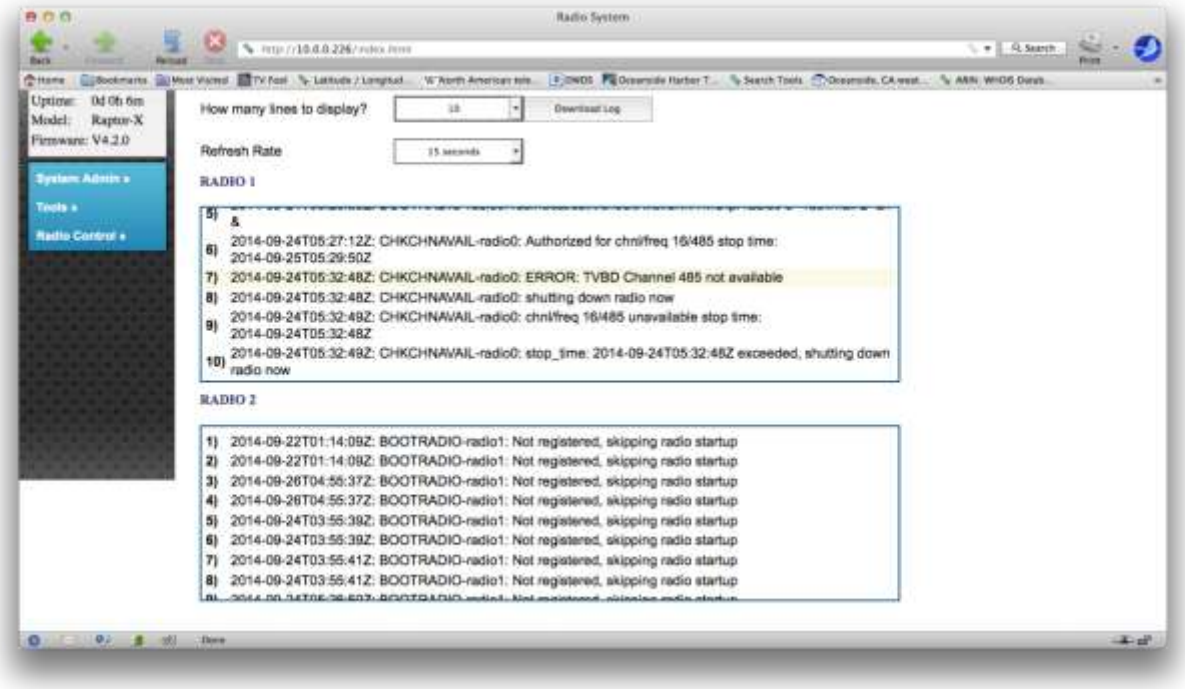
48 HOUR CHANNEL SCHEDULING BASE SOFTWARE DURING PROTECTION PERIOD FOR THE REMOTE FIXED DEVICE LOCATION (CHANNEL 16 NOT AVAILABLE AT THE CLIENT LOCATION)



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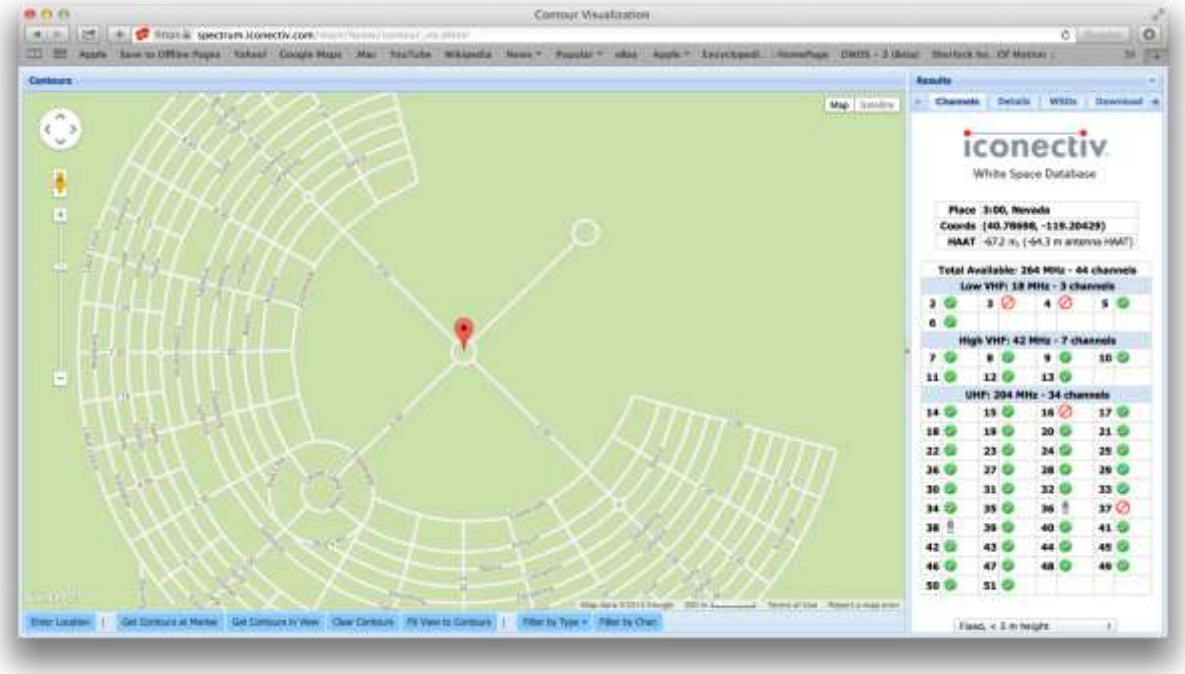
48 HOUR CHANNEL SCHEDULING CLIENT SOFTWARE DURING PROTECTION PERIOD (CHANNEL 16 NOT AVAILABLE AT THE REMOTE FIXED DEVICE LOCATION)



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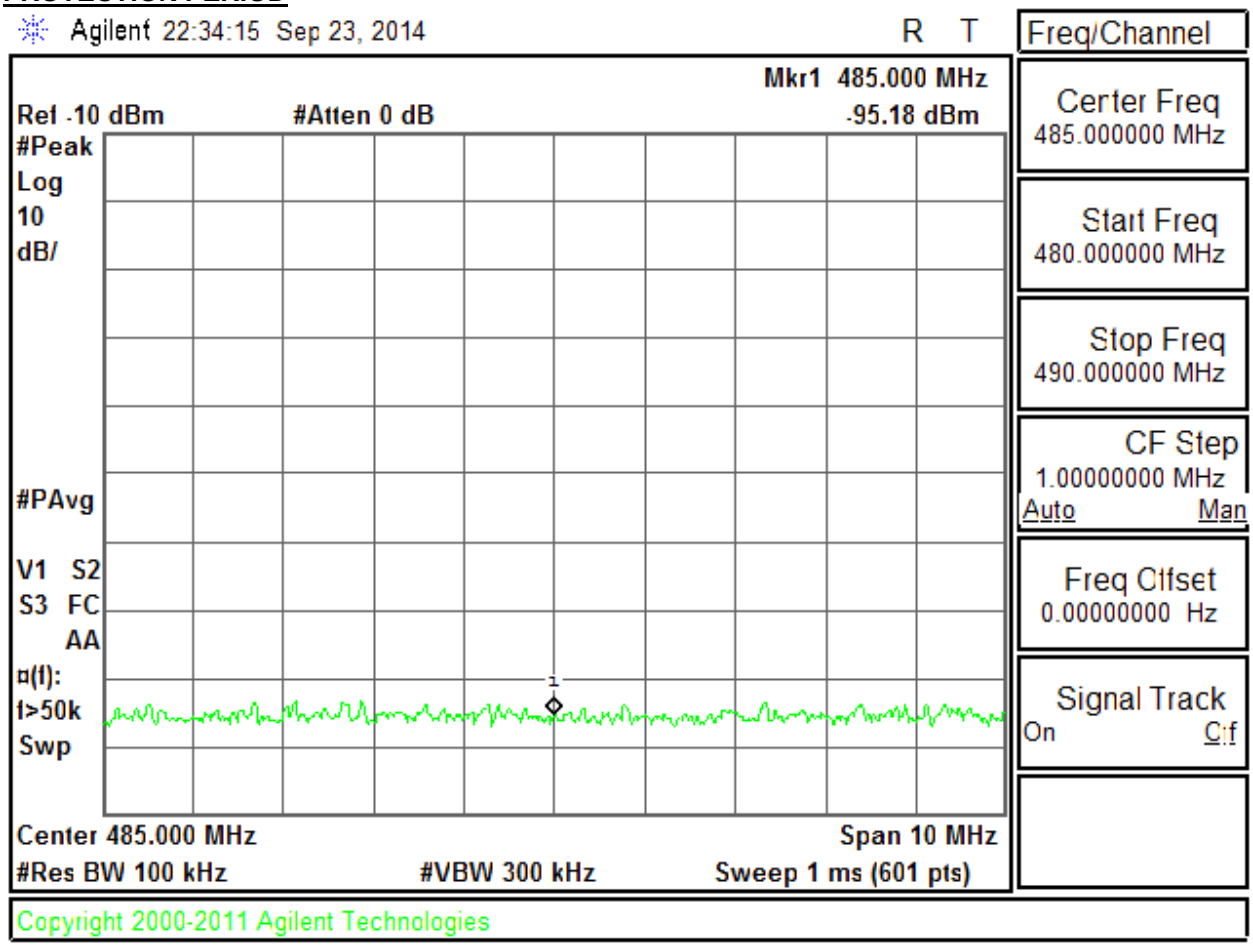
48 HOUR CHANNEL SCHEDULING REMOTE FIXED DEVICE SIGNAL NOT ACTIVE DURING THE PROTECTION PERIOD



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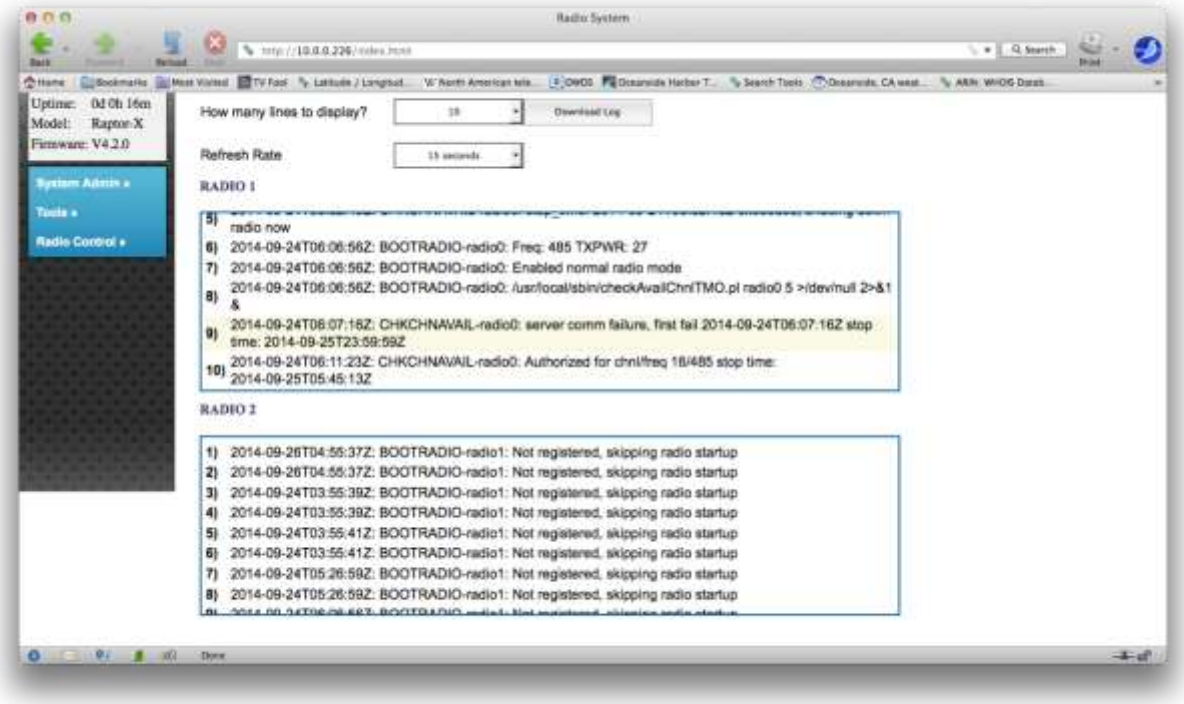
48 HOUR CHANNEL SCHEDULING BASE SOFTWARE AFTER PROTECTION PERIOD FOR THE REMOTE FIXED DEVICE LOCATION (CHANNEL 16 AVAILABLE AGAIN)



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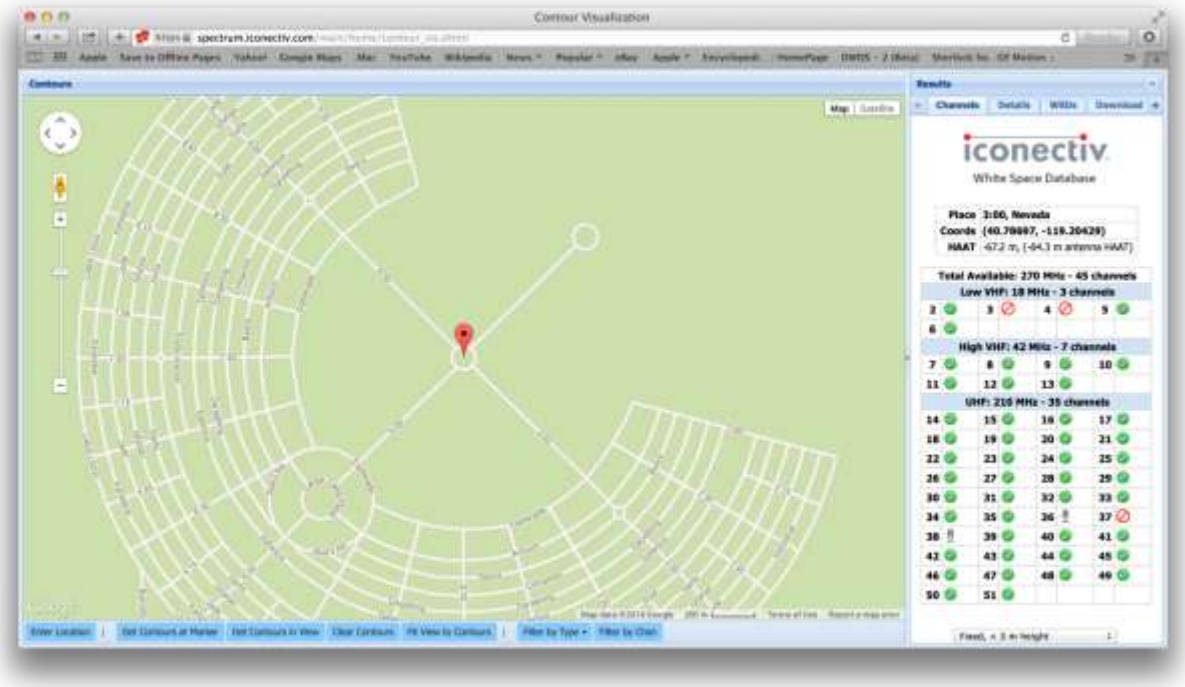
48 HOUR CHANNEL SCHEDULING CLIENT SOFTWARE AFTER PROTECTION PERIOD (REMOTE FIXED DEVICE RECONNECTS WITH BASE ON CHANNEL 16)



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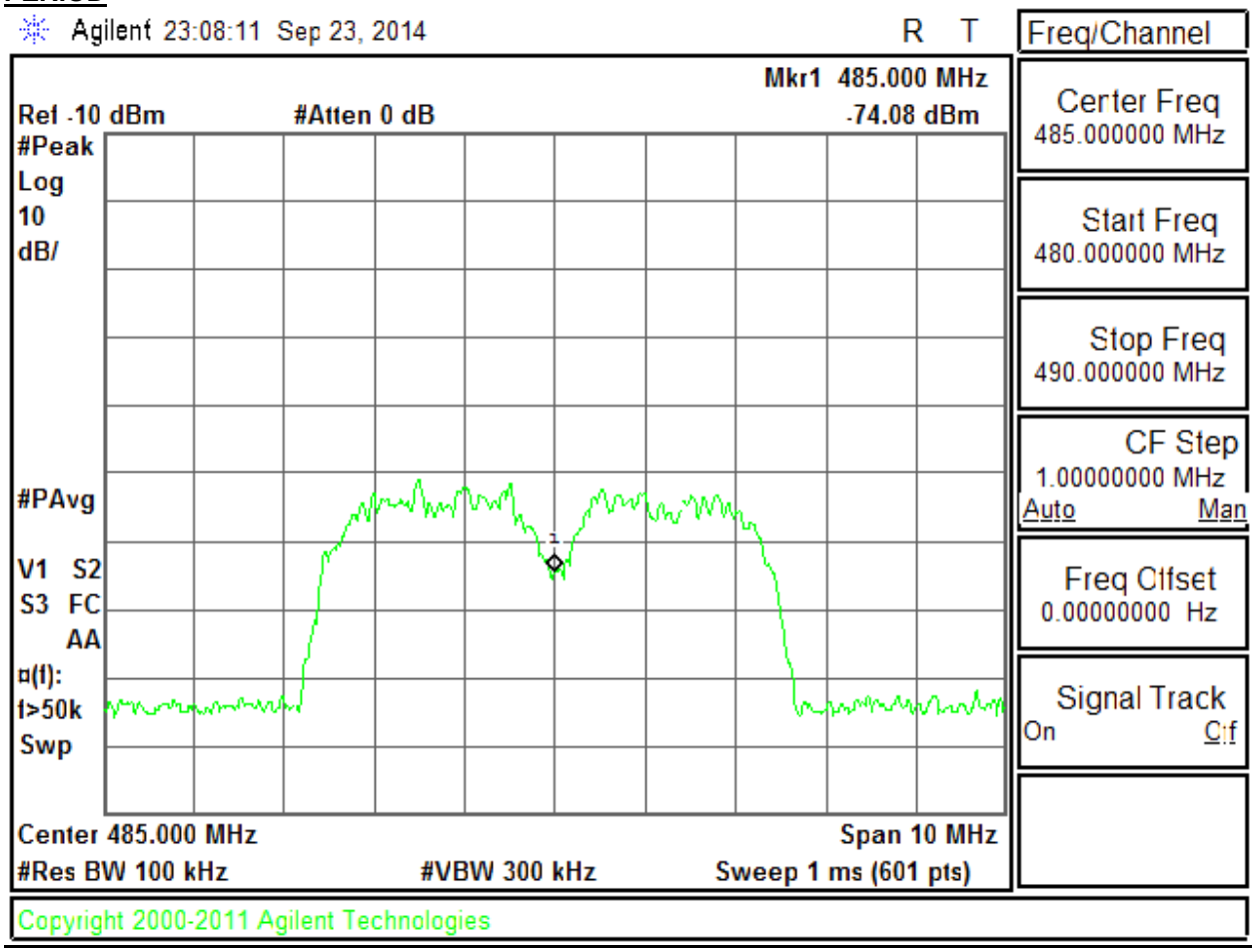
48 HOUR CHANNEL SCHEDULING REMOTE FIXED DEVICE SIGNAL RESUMED AFTER THE PROTECTION PERIOD



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9.4. §15.711(B)(3)(III) FIXED & MODE II TVDB DATABASE UPDATE

REQUIREMENT

– §15.711(B)(3)(III) If a fixed or Mode II personal/portable TVBD fails to successfully contact the TV bands 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 TV bands database and re-verifies its list of available channels.

Confirm that the Remote Fixed device shuts down by 11:59 PM on the following day.

TEST PROCEDURE

- Set the base to normal operation mode.
- Set the Remote Fixed device EUT to normal operation mode:
  - Enter proper registration information on the Remote Fixed device with an IP 10.0.0.226.
  - Choose a proper set of scan channels on the Remote Fixed device that includes the base operating channel(16).
  - The Remote Fixed device is registered through the base gateway.
  - The Remote Fixed device verifies its operating channel and enters normal operation.
- Register a Low-Power Auxiliary device at the location of the 'base' Fixed device; schedule an event of 30 minutes in duration.
- Observe that the 'base' Fixed device ceases operation during the event period.
- Observe in the 'radio log' that the 'remote' Fixed device has set a timer to cease operations on "Next Day, 11:59 pm'.
- After the event's 30 minute duration, observe that the 'base' Fixed device resumes operation on restored available channel.
- Observe in the 'radio log' that the 'remote' Fixed device has resumed receiving channel availability/authorization for use of the channel.

RESULTS

During normal operation, the base and Remote Fixed device(EUT) channel lists are updated periodically by sending channel list requests to the TVWS Database . After the database access was blocked, the next channel list requests failed and the EUTs stopped transmission immediately.

Test Results	
Pass	**Fail**
☒	☐

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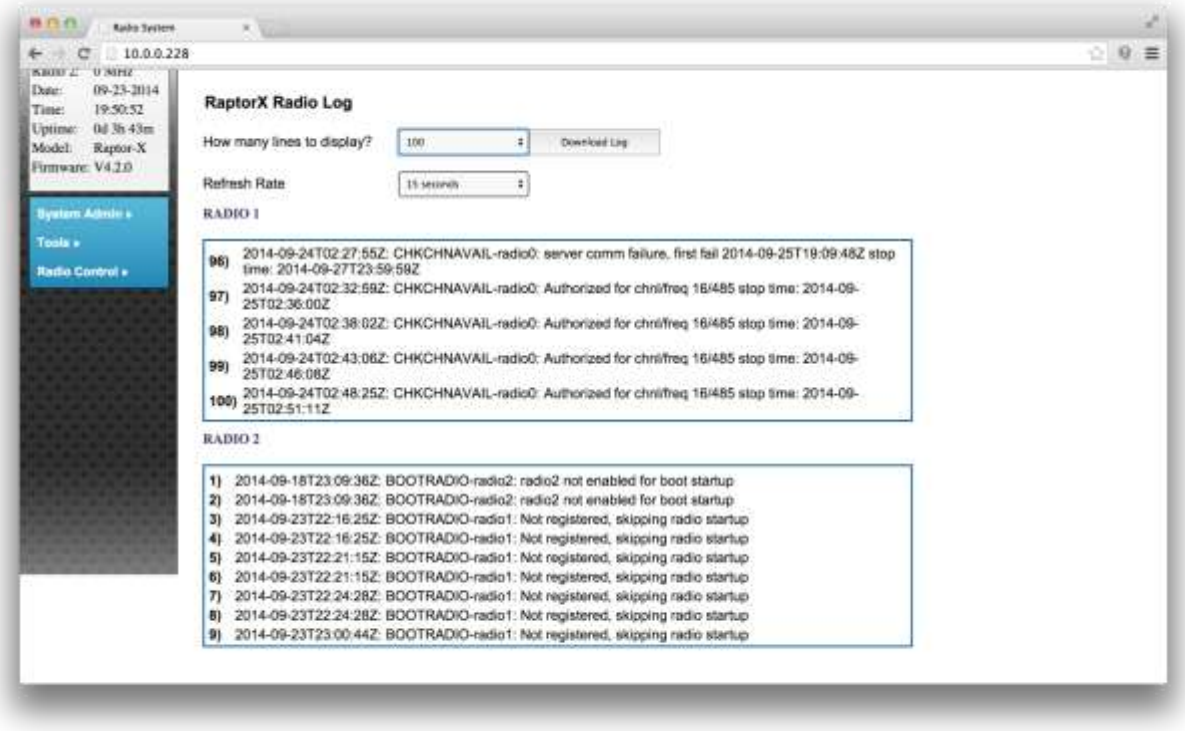
BASE SOFTWARE BEFORE DATABASE BLOCKING (REMOTE FIXED DEVICE /BASE ON CHANNEL 16)



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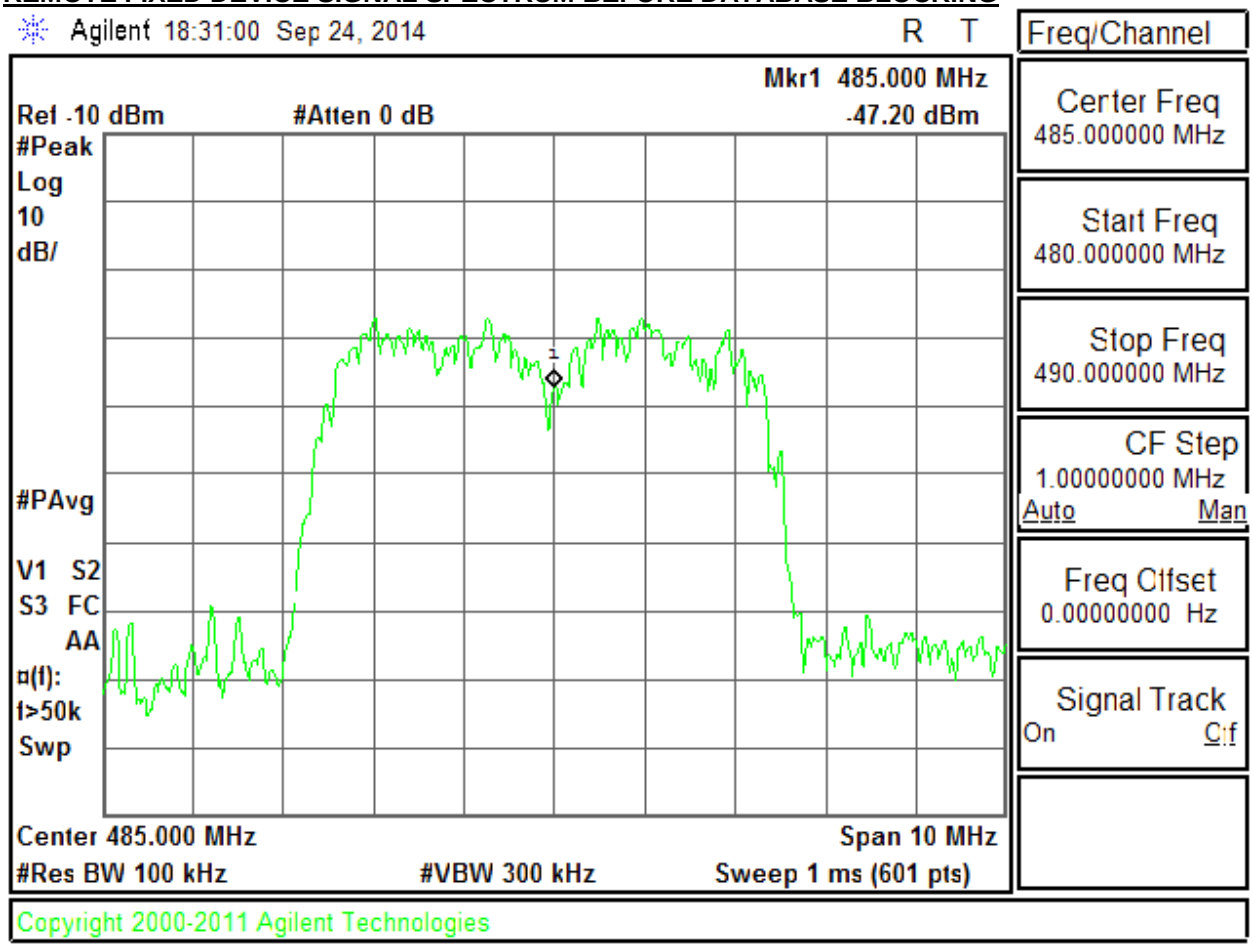
REMOTE FIXED DEVICE SIGNAL SPECTRUM BEFORE DATABASE BLOCKING



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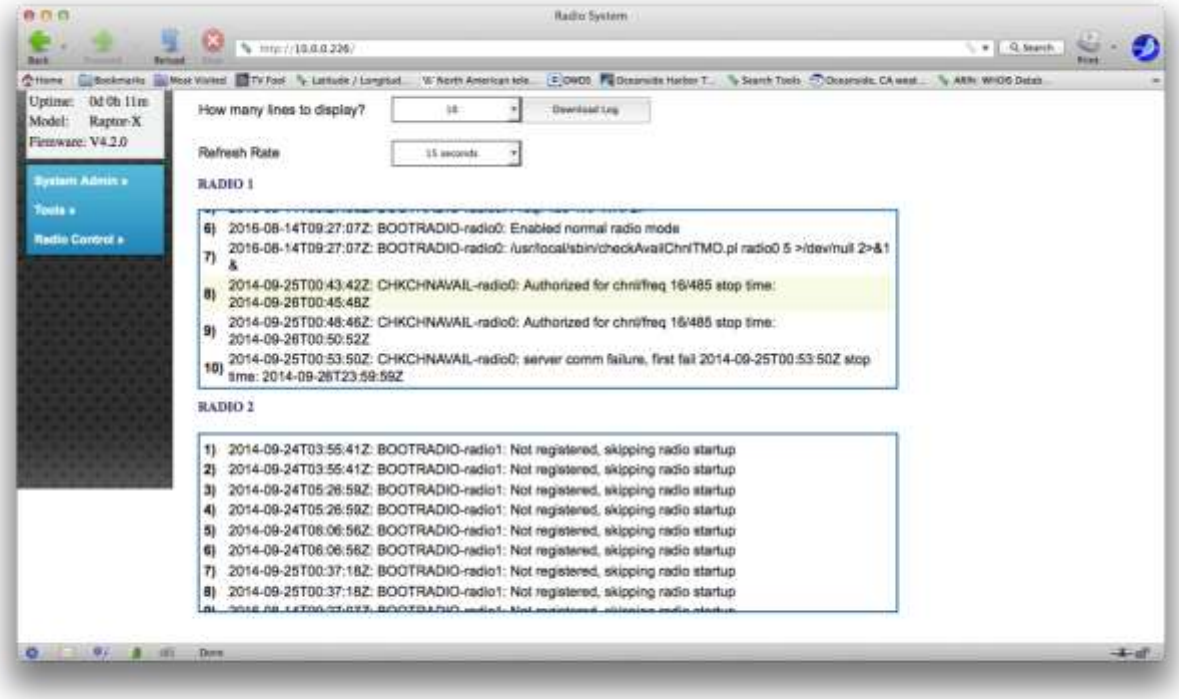
REMOTE FIXED DEVICE STOPPED AFTER DATABASE BLOCKING



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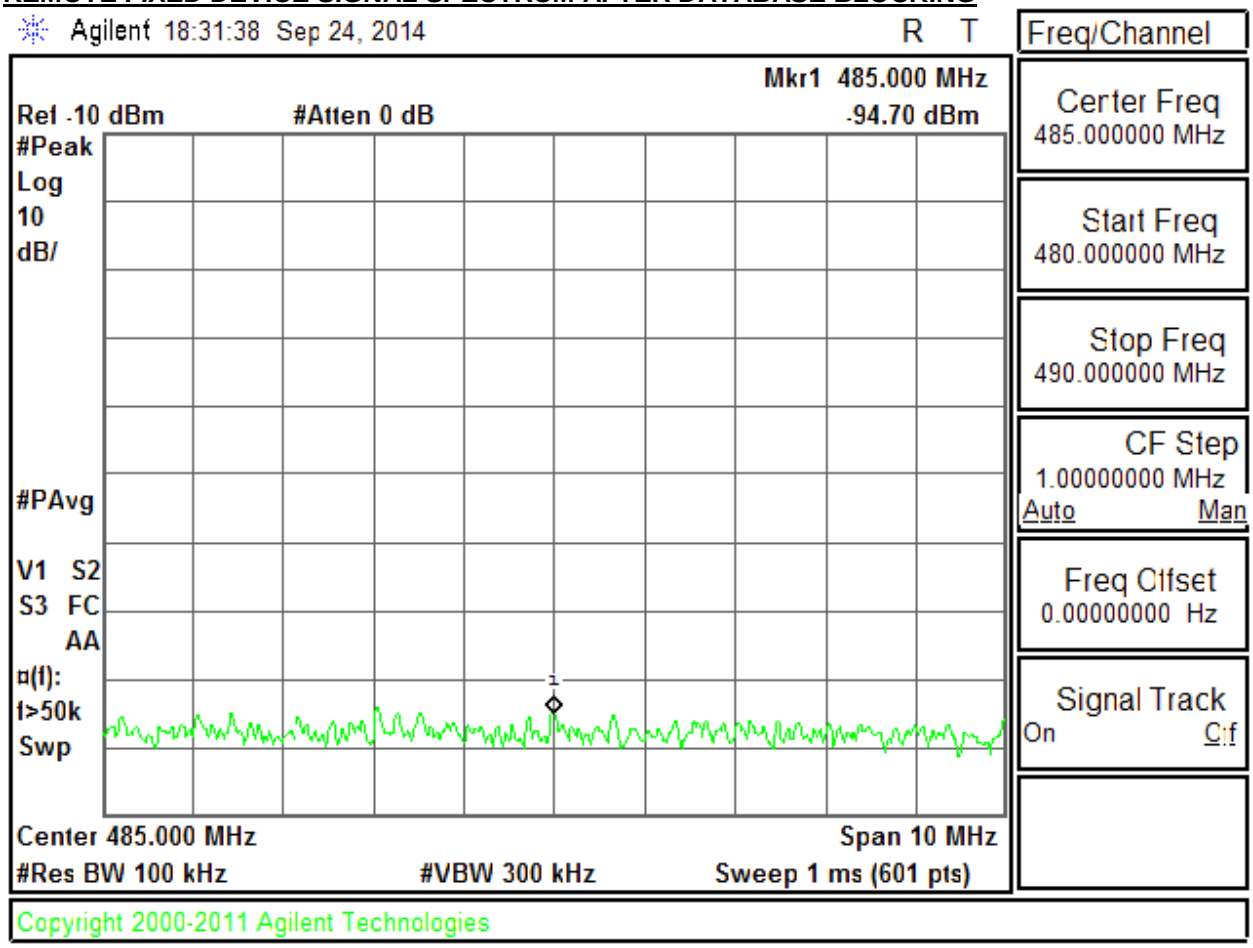
REMOTE FIXED DEVICE SIGNAL SPECTRUM AFTER DATABASE BLOCKING



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9.5. §15.707, §15.711(B)(3)(I)(II)(IV),(C), §15.712 TVBD CHANNEL AVAILABILITY

REQUIREMENT

– Confirm that the channel list provided by the database conforms with those allowable to the class of TVBD under test. Confirm that the TVBD is operating on a channel from the list at authorized power and cannot be made to operate on an unauthorized channel.

TEST PROCEDURE

- Set the base to normal operation (on Channel 19).
- Configure the Remote EUT with correct registration information.
- Configure the Remote EUT with proper scan channel set that includes the base operating channel. The Remote EUT will issue connection request to the base.
- Observe the Remote EUT performing device registration and channel list request. The operating channel is within the returned authorized channel list.
- The base grants connection request from the Remote EUT and the client starts normal operation on the channel (Channel 19).
- The Remote EUT can only operate on a channel if all of the following are true:
    - The channel is within the authorized channel list for the base
    - The channel is the current operating channel of the base
    - The channel is within the authorized channel list for the Remote EUT
    - The channel is within the Remote device operating frequency range, i.e. 470 – 698 MHz (Channels 14 – 51 excluding Channels 36 to 38) as approved by FCC for Fixed TVBD.
- Test pre-condition: The device is configured to operate at a power level less than or equal to that which is authorized by the Grant.
- Upon successful registration the database returns the allowable power according to the device type, Fixed 36 dBm eirp in this example.
- Verify the Remote EUT transmission on the spectrum analyzer.

RESULTS

The Remote EUT operates on a channel from the authorized channel list and at the authorized power level.

When the base EUT operating channel (Channel 19) was no longer in the channel list authorized for the Remote EUT, the Remote EUT ceased operation on the channel immediately. The testing verifies that the Remote EUT cannot operate on any channel other than those within the authorized channel list, returned from the TVWS Database, for the Remote EUT.

Test Results	
Pass	**Fail**
☒	☐

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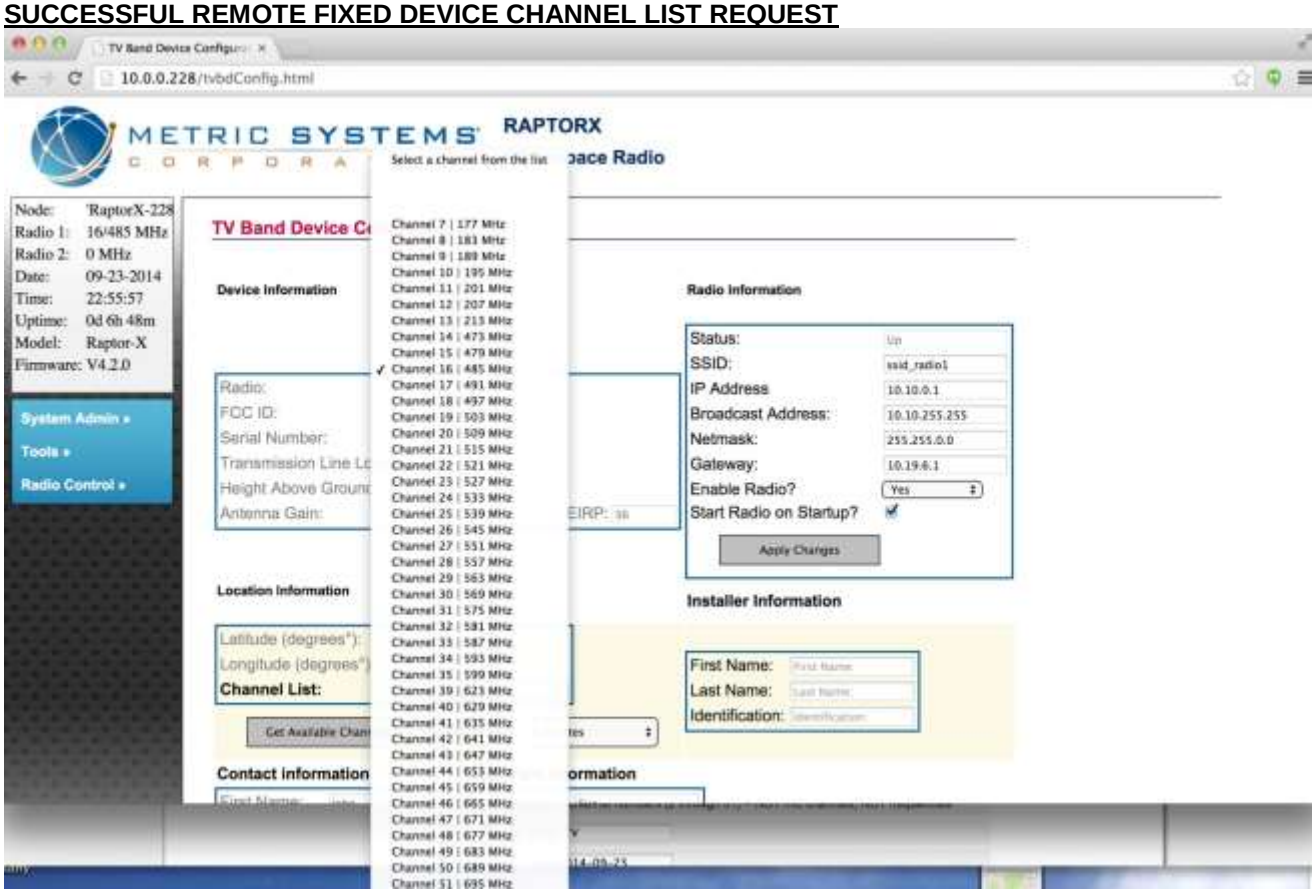
SUCCESSFUL REMOTE FIXED DEVICE CHANNEL LIST REQUEST



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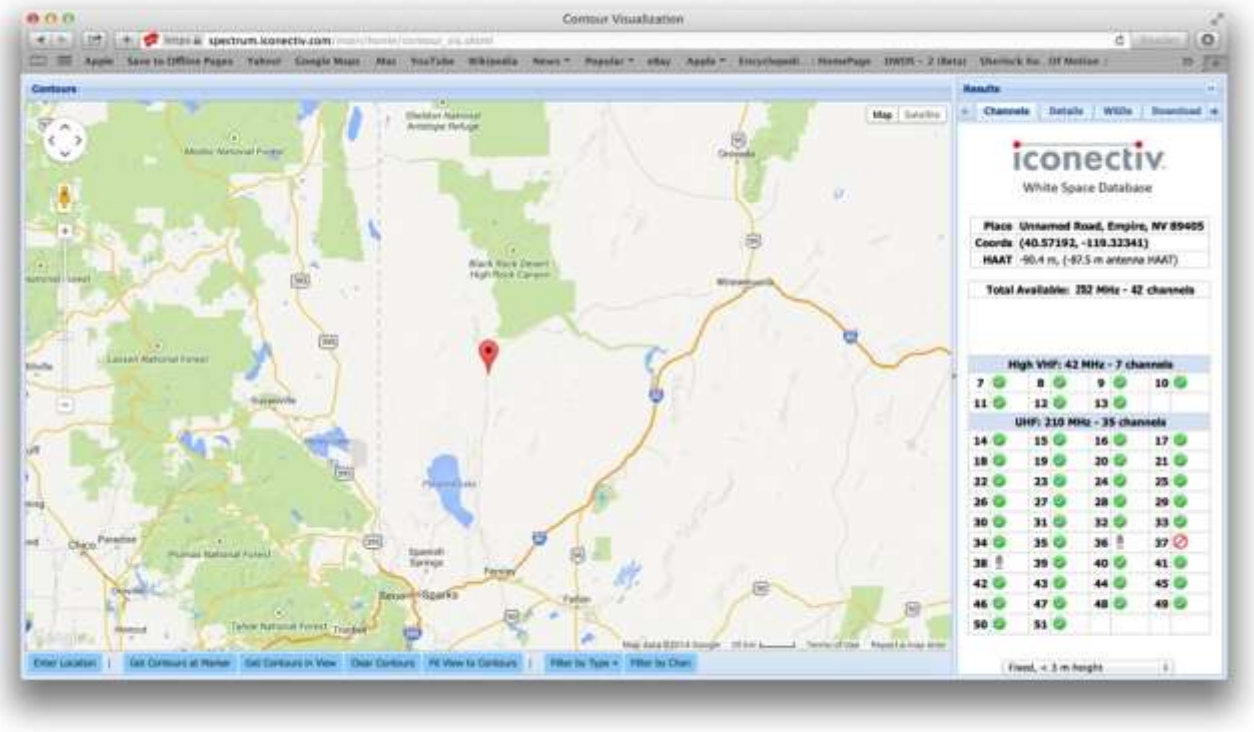
ICONECTIV WEB INTERFACE SHOWING AUTHORIZED CHANNELS AT THE REMOTE FIXED DEVICE LOCATION



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9.6. §15.715(F) SECURITY

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 TVBD?
  ii. How are communications initiated?
  iii. How does the TVBD 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 TVBD?
  vi. What encryption method is used?
  vii. How does the database ensure secure registration of protected devices?

ANSWERS

See answers in Section 8.6. Applicable to BASE and Remote stations.

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