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Wireless test report – 376028-2R1TRFWL

Applicant:
6harmonics Inc.

Product type:
Television Band Device (TVBD)

Model:
GWS-5002, GWS-5002E Series

Model number variants:
GWS-5002, GWS-5002E

FCC ID (BTS):
2AASTGWS-5002

IC Registration Number (BTS):
20750-GWS-5002

FCC ID (CPE):
2AASTGWS-5002E

IC Registration Number (CPE):
20750-GWS-5002E

Specifications:

- FCC 47 CFR Part 15 Subpart H, §15.713
  White Space devices; White space database.

Date of issue: November 7, 2019

Andrey Adelberg, Senior Wireless/EMC Specialist	
Test engineer(s)	Signature
Kevin Rose, Wireless/EMC Specialist	
Reviewed by	Signature

Nemko Canada Inc., a testing laboratory, is accredited by the Standards Council of Canada. The tests included in this report are within the scope of this accreditation

FCC 15 H Date: March 2016

Test location

Company name	Nemko Canada Inc.
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City	Ottawa
Province	Ontario
Postal code	K1V 1H2
Country	Canada
Telephone	+1 613 737 9680
Facsimile	+1 613 737 9691
Toll free	+1 800 563 6336
Website	www.nemko.com
Site number	FCC: CA2040; (3 m semi anechoic chamber)

Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.
This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contain in this report are within Nemko Canada's ISO/IEC 17025 accreditation.

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Section 1. Report summary

1.1 Applicant and manufacturer

Company name	6harmonics Inc.
Address	Suite 10 - 21 Concourse Gate
City	Ottawa
Province/State	ON
Postal/Zip code	K2E 7S4
Country	Canada

1.2 Test specifications

FCC 47 CFR Part 15, Subpart H	White Space Devices

1.3 Test methods

KDB 416721 D01 v03	White Space Test Procedures
Nominet manual V1.0	TVWS Radio Testing Manual FCC

1.4 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was performed against all relevant requirements of the test standard except as noted in section 1.5 below. Results obtained indicate that the product under test complies in full with the requirements tested. The test results relate only to the items tested.

See "Summary of test results" for full details.

1.5 Exclusions

None

1.6 Test report revision history

Revision #	Date of issue	Details of changes made to test report
TRF	July 15, 2019	Original report issued
R1TRF	November 7, 2019	Updated model name variant for CPE

Section 2. Summary of test results

2.1 FCC Part 15 Subpart H test results

Part	Test description	Verdict
§15.713(g)(3)	Fixed white space device registration	Pass
§15.713(g)(3)(iii)	Unsuccessful registration – restricted coordinates	Pass
§15.713(g)(3)(v)	Unsuccessful registration due to incomplete information – missing owner	Pass
§15.713(g)(3)(vi)	Unsuccessful registration due to incomplete information – contact name	Pass
§15.713(g)(3)(vii)	Unsuccessful registration due to incomplete information – contact address	Pass
§15.713(g)(3)(vii)	Unsuccessful registration due to incomplete information – contact state (province)	Pass
§15.713(g)(3)(vii)	Unsuccessful registration due to incomplete information – contact zip (postal) code	Pass
§15.713(g)(3)(vii)	Unsuccessful registration due to incomplete information – contact city	Pass
§15.713(g)(3)(vii)	Unsuccessful registration due to incomplete information – contact country	Pass
§15.713(g)(3)(viii)	Unsuccessful registration due to incomplete information – contact email	Pass
§15.713(g)(3)(ix)	Unsuccessful registration due to incomplete information – contact telephone	Pass
§15.713(e)(6)	Unsuccessful registration due to HAAT > 250 m	Pass
§15.713(e)(6)	Unsuccessful registration due to antenna height that exceeds 30 m	Pass
§15.713(g)(3)(i) and (ii)	Unsuccessful registration due to incomplete information – FCC ID and Serial number	Pass
§15.713(a)(1)	48-hour channel scheduling	Pass
§15.713(a)(3)	Relocation of fixed TVBD	Pass
§15.711(c)(2)(i)	Fixed & Mode II TVDB database update	Pass
§15.711(c)(2)(iii)	Low-power auxiliary device protection	Pass
§15.712	Interference protection requirements (Fixed and personal/portable)	Pass
§15.711(c)(2)(ii)	Fixed and Mode II Power level reduction	Pass
§15.711(j)	Security	Pass

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	June 24, 2019
Nemko sample ID number	1 and 2

3.2 EUT information

Product name	Television Band Device (TVBD)
Model	GWS-5000 Series
Model variants	GWS-5002 (BST), GWS-5002E (CPE)
Serial number	520000050 (BTS), 520000047 (CPE)

3.3 Technical information

Frequency band	470–698 MHz (channels 14–51)
Channel BW	6, 12, 18, 24 MHz
Type of modulation	OFDM (BPSK to 64QAM)
Power requirements	120 VAC 60 Hz or 48 V_{DC} via PoE

3.4 Product description and theory of operation

The GWS-5000 Series is the most advanced TV White Space solution available and is the 5th generation of TV White Space radio developed by 6Harmonics. Throughput with a 24 MHz and a single spatial stream can achieve 70 Mbps UDP and 50 Mbps TCP/IP. Based upon the globally accepted robust Wi-Fi protocol, the GWS-5000 Series radios can maintain NLOS data links in the most challenging of TVWS deployments when faced with in-band noise & interference, multipath fade, trees or other obstructions. The radios can operate in point-to-point or point-to-multipoint mode. With an internal GPS the radios automatically geolocate to ensure accurate compliance with channel availability from an approved database.

3.5 Database information

Nominet White Space Data Base and Data base sandbox were used for devices registration and testing.

Section 4. Engineering considerations

4.1 Modifications incorporated in the EUT

There were no modifications performed to the EUT during this assessment.

4.2 Technical judgment

None

4.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 5. Test conditions

5.1 Atmospheric conditions

Temperature	15–30 °C
Relative humidity	20–75 %
Air pressure	860–1060 mbar

When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.

5.2 Power supply range

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages ±5 %, for which the equipment was designed.

Section 6. Measurement uncertainty

6.1 Uncertainty of measurement

UKAS Lab 34 and TIA-603-B have been used as guidance for measurement uncertainty reasonable estimations with regards to previous experience and validation of data. Nemko Canada, Inc. follows these test methods in order to satisfy ISO/IEC 17025 requirements for estimation of uncertainty of measurement for wireless products.

Measurement uncertainty budgets for the tests are detailed below. Measurement uncertainty calculations assume a coverage factor of K = 2 with 95% certainty.

Table 6.1-1: *Measurement uncertainty*

Test name	Measurement uncertainty, dB
All antenna port measurements	0.55

Section 7. Test equipment

7.1 Test equipment list

Table 7.1-1: *Equipment list*

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
Spectrum analyzer	Rohde & Schwarz	FSP	FA001920	1 year	Sep.30/19

Section 8. Testing data

8.1 FCC 15.713(g)(3) Fixed white space device registration

8.1.1 Definitions and limits

Prior to operating for the first time or after changing location, a fixed white space device must register with the white space database by providing the information listed in paragraph (g)(3) of §15.713. Testing in accordance with KDB 416721 D01, III (2)(a)

8.1.2 Test summary

Test date	June 27, 2019

8.1.3 Observations, settings and special notes

EUT was configured with the with proper registration information. Successful registration with all required fields and as a Fixed device type was verified by showing on the GUI page.
There were no emissions detected, on any channels, until it has successfully registered

8.1.4 Test data

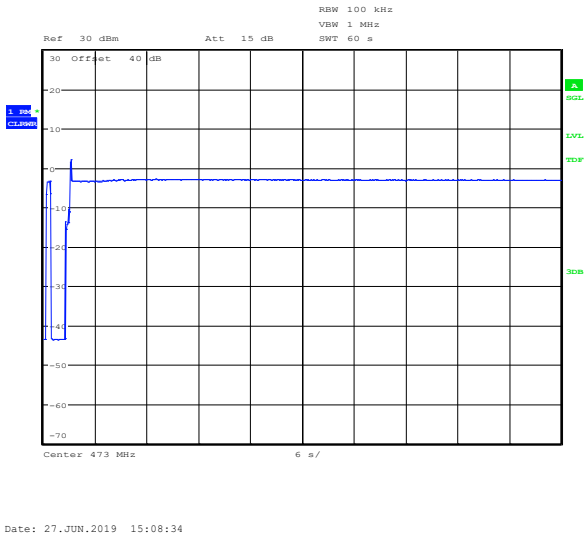

Figure 8.1-1: *Successful registration and transmission begins from Base station unit*

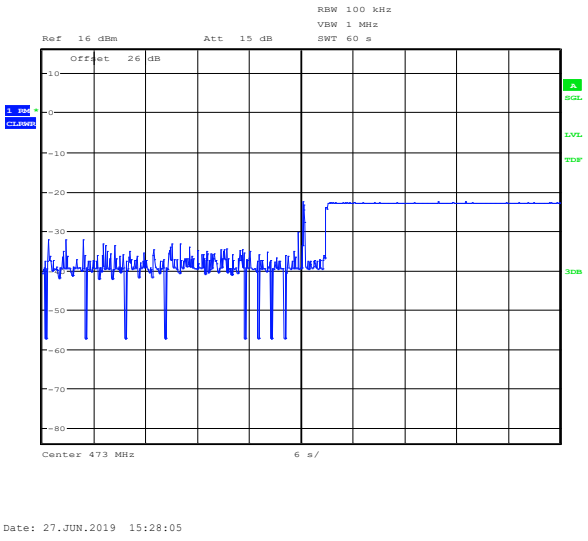

Figure 8.1-2: *Successful registration and transmission begins from CPE unit (lower level signal indicates advertising signal from base station)*

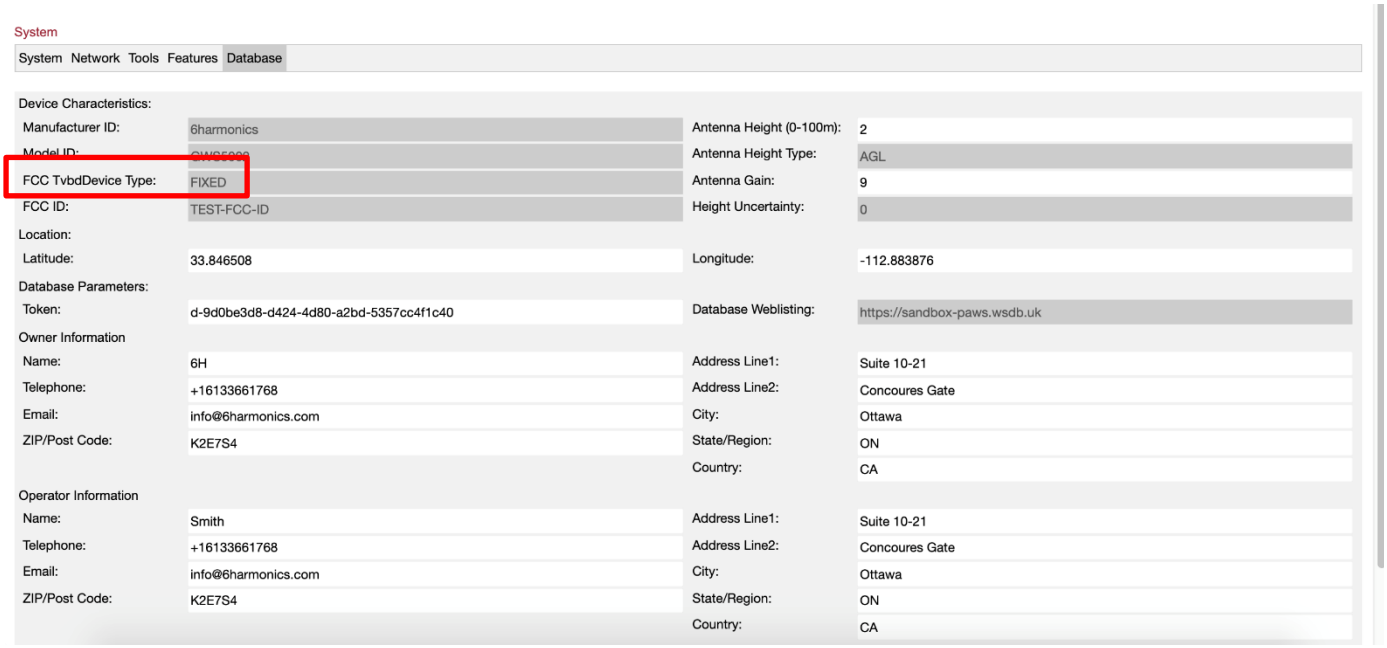

Figure 8.1-3: *Successful registration and identification as Fixed Device Type device*

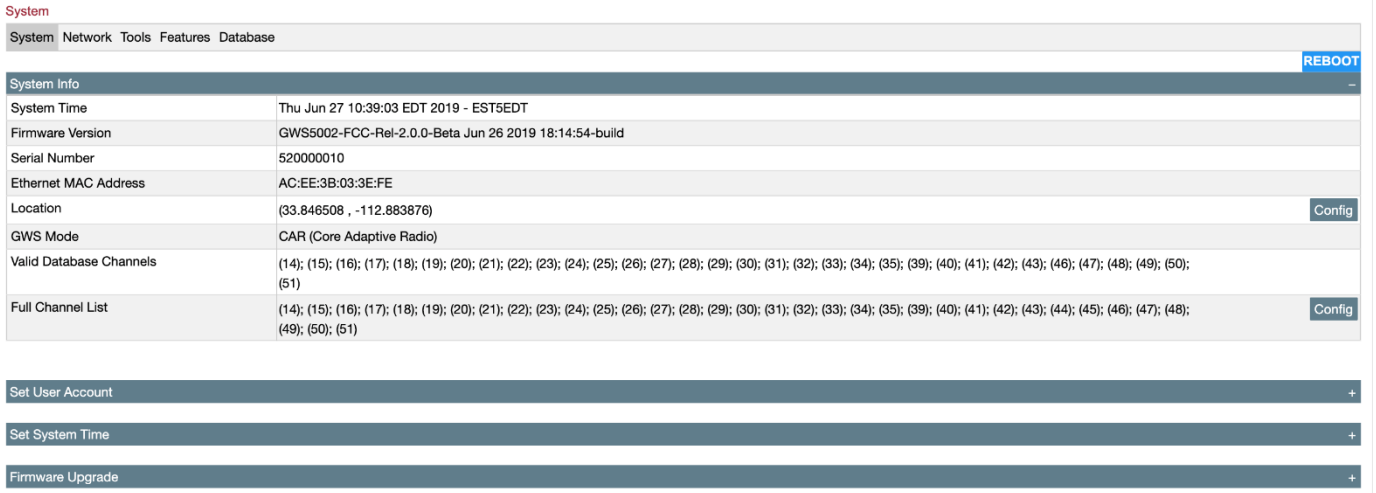

Figure 8.1-4: *Successful registration with received list of available channels*

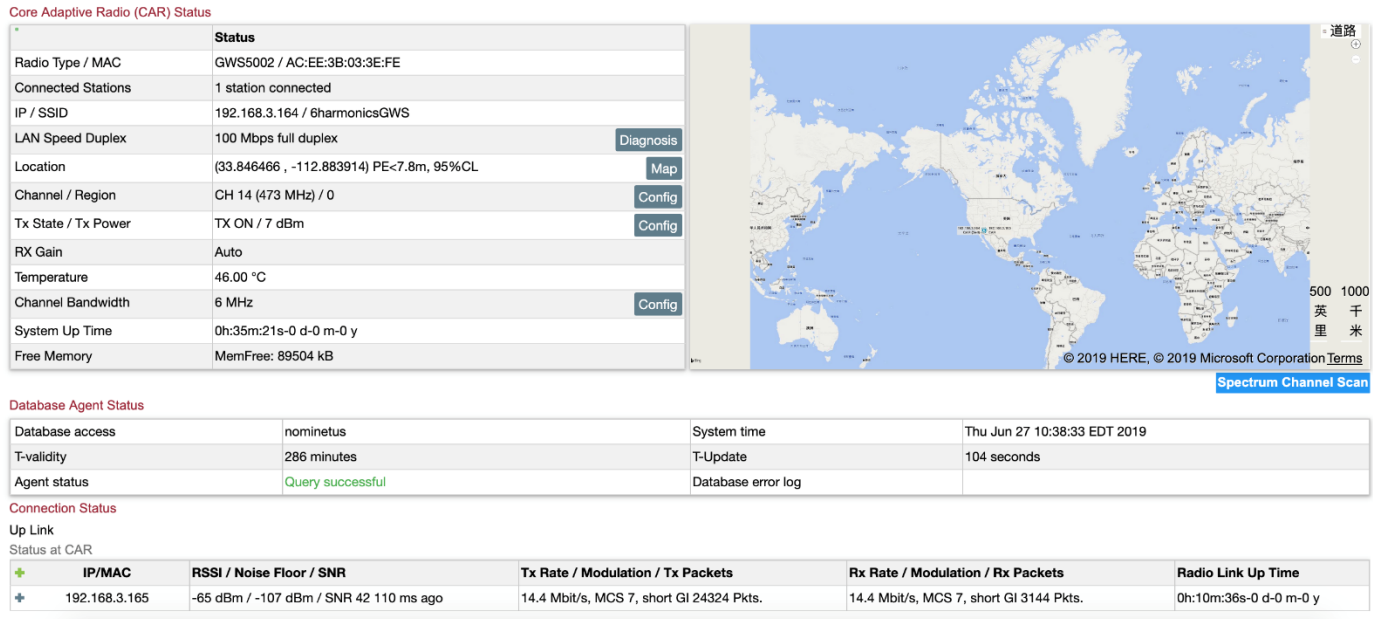

Figure 8.1-5: *Successful registration status*

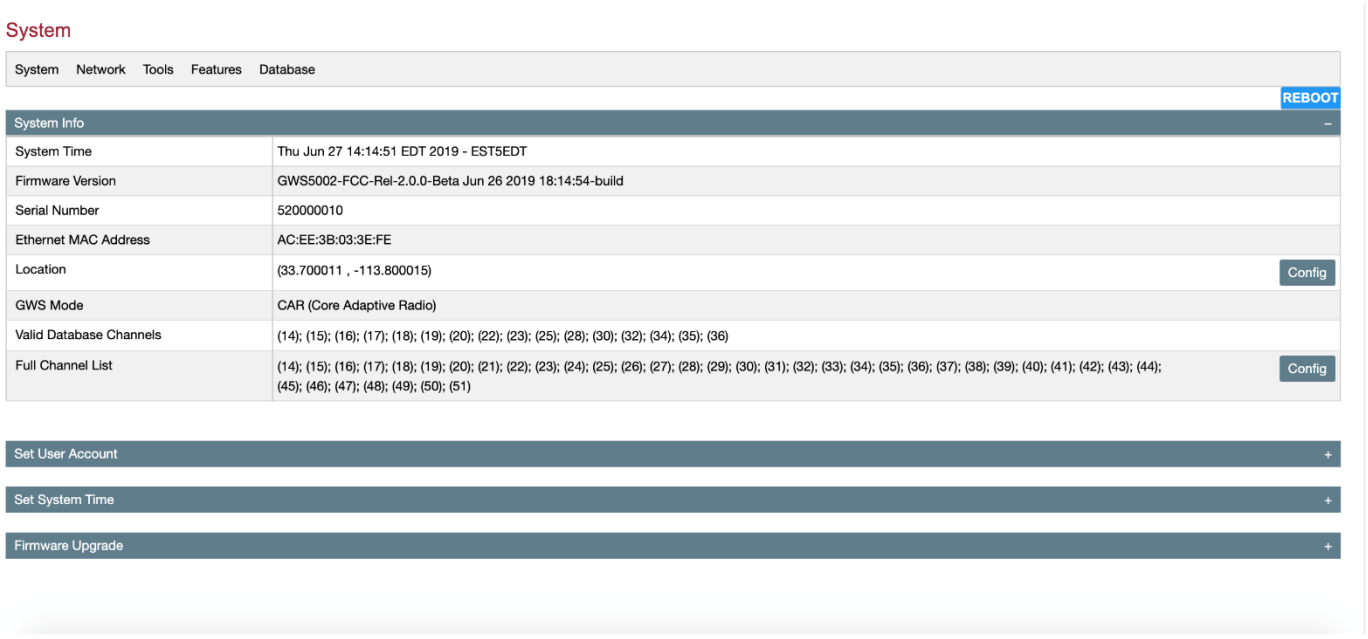

Figure 8.1-6: *Successful registration with received list of available 6-MHz channels*

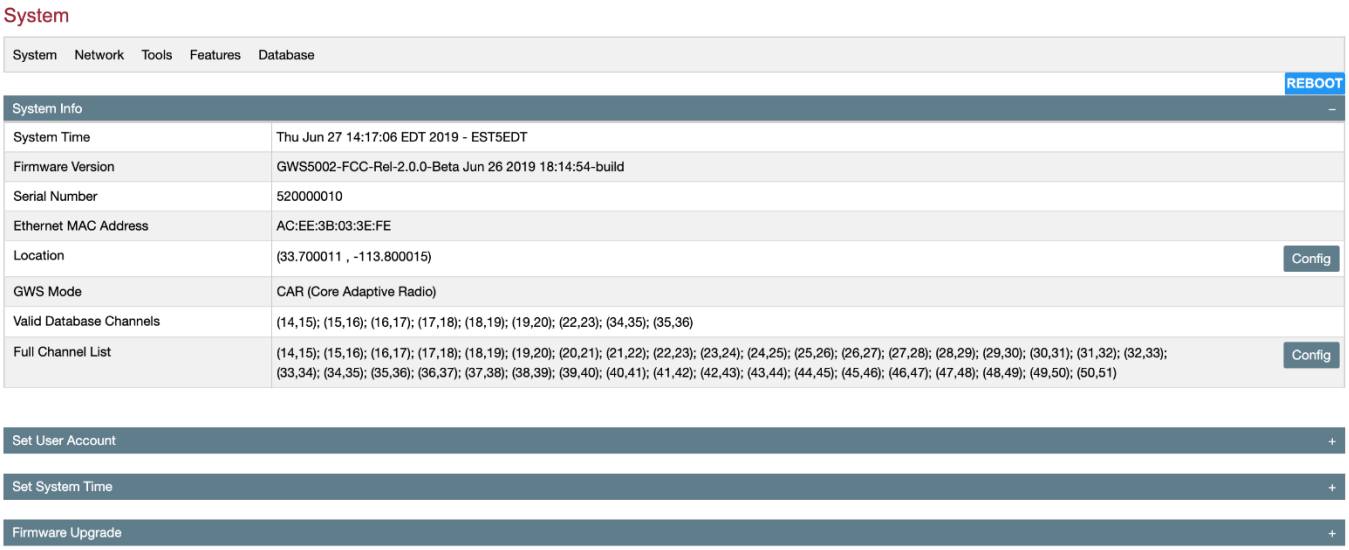

Figure 8.1-7: *Successful registration with received list of available 12-MHz channels*

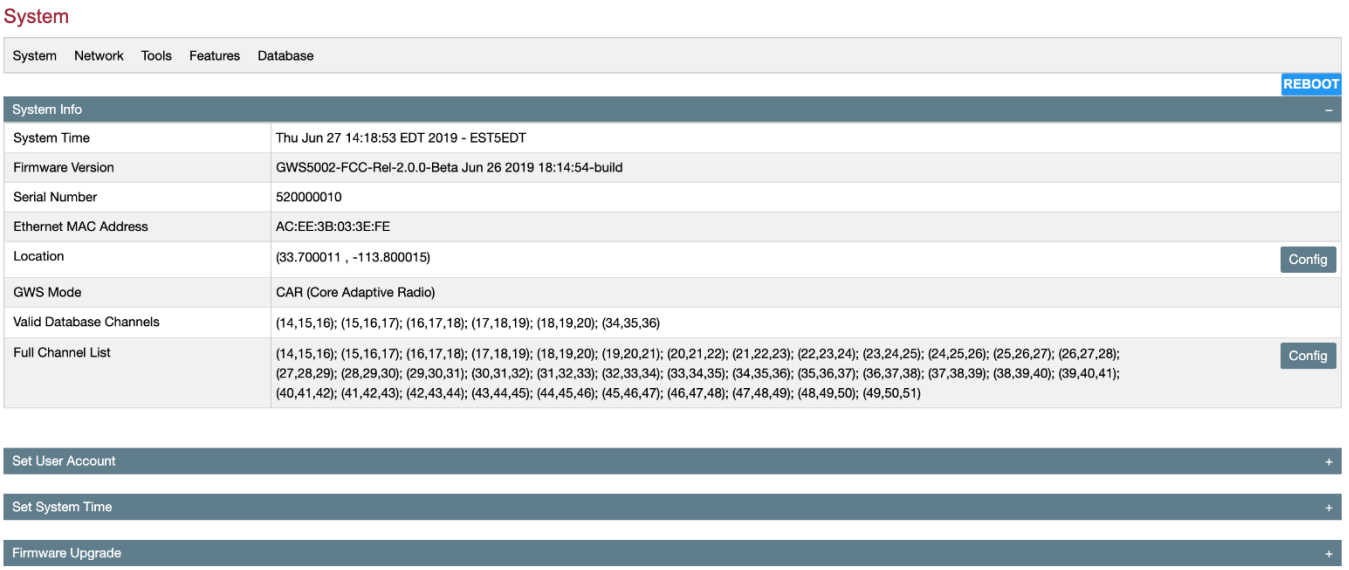

Figure 8.1-8: *Successful registration with received list of available 18-MHz channels*

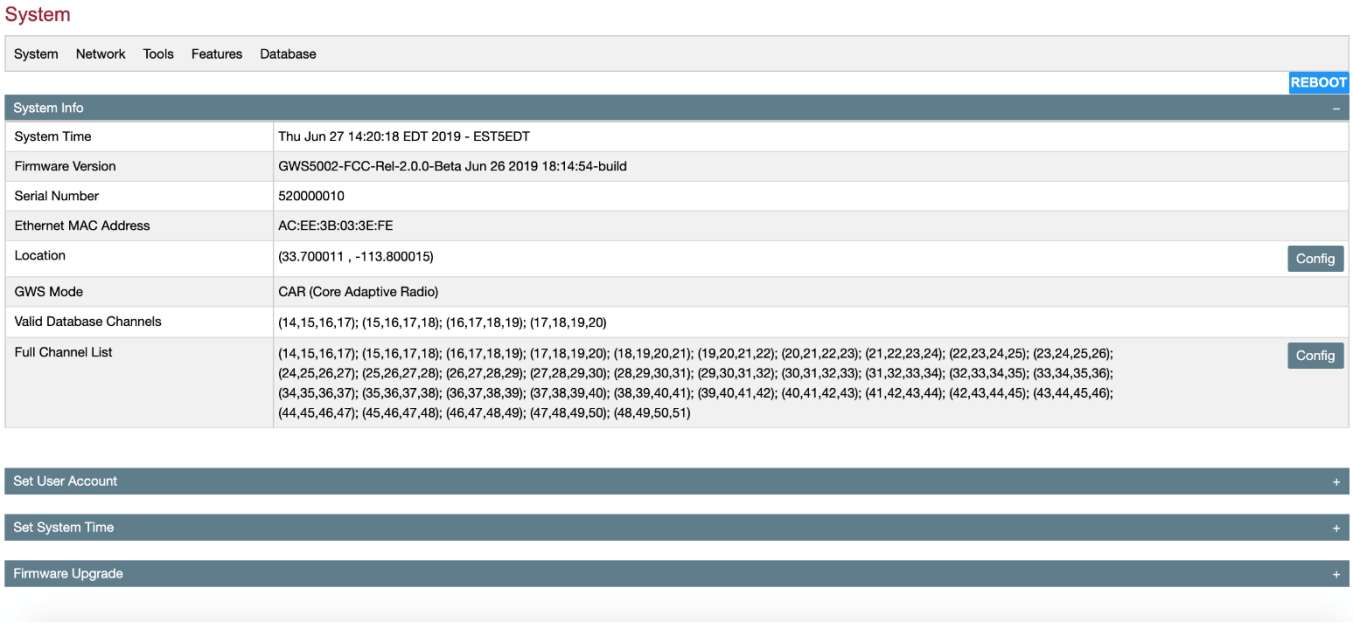

Figure 8.1-9: *Successful registration with received list of available 24-MHz channels*

8.2 FCC 15.713(a)(1), FCC 15.711(c)(2)(iii) 48-hour channel scheduling

8.2.1 Definitions and limits

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 an 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. Testing in accordance with KDB 416721 D01, III (2)(h)

8.2.2 Test summary

Test date	June 27, 2019

8.2.3 Observations, settings and special notes

EUT implements a refresh time of 800 seconds instead of 48-hour push notification wait. Information is sent to database more than 4 times an hour.

8.2.4 Test data

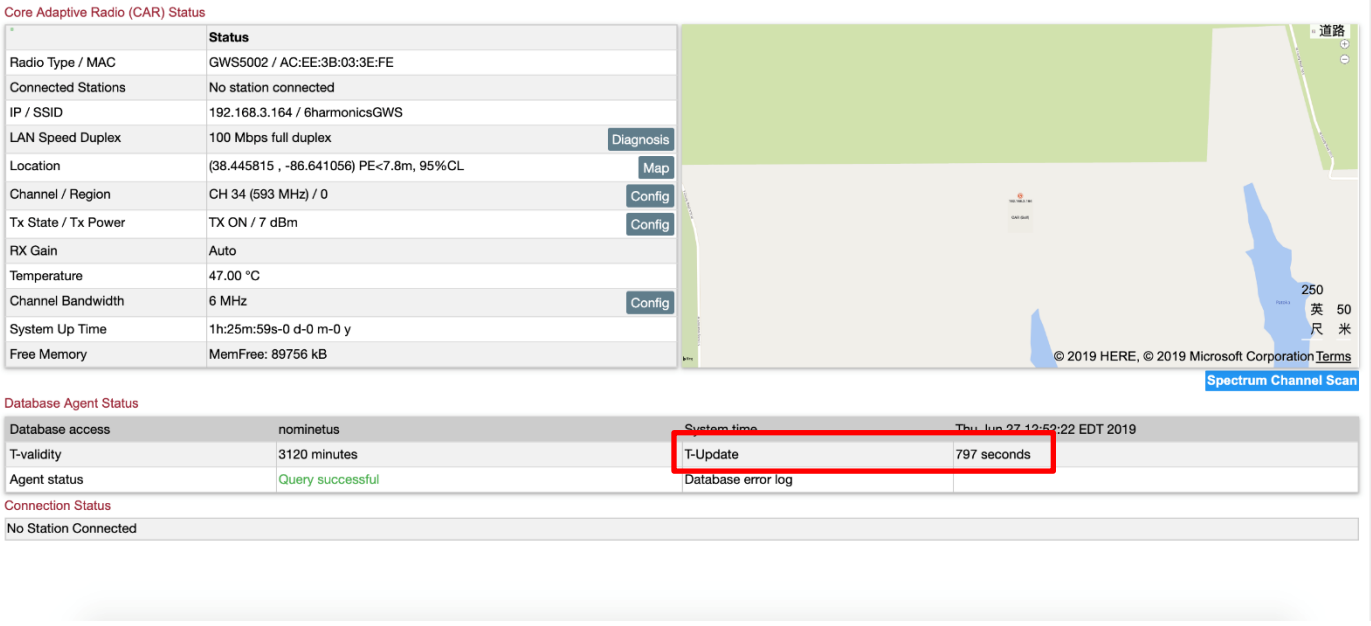

Figure 8.2-1: *Refresh time (T-Update) instead of 48-hour push notification wait*

8.3 FCC 15.713(g)(3)(iii) Unsuccessful registration – restricted coordinates

8.3.1 Definitions and limits

(3) The white space device registration database shall contain the following information for fixed white space devices:
(iii) Device's geographic coordinates (latitude and longitude (NAD 83));

8.3.2 Test summary

Test date	June 27, 2019

8.3.3 Observations, settings and special notes

The device was initially configured with a valid registration such that the device will begin to transmit on a given channel. Once the device was transmitting and the link was established, the registration data was modified to incorporate restricted coordinates. EUT was configured with restricted coordinated: outside US regulatory boundaries with latitude: 45.3° N and longitude: 75.7° W (within Canada). The registration process was re-initiated with the invalid coordinates. After database rejection, the EUT stopped the transmission.

8.3.4 Test data

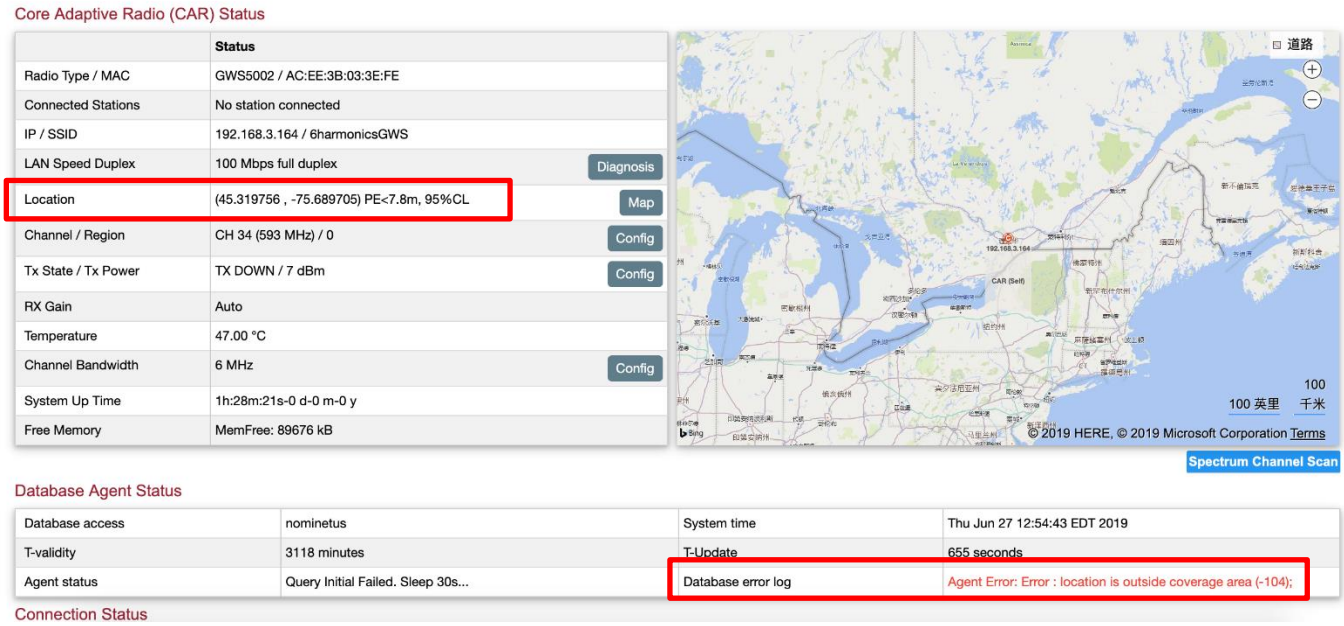

Figure 8.3-1: *Unsuccessful registration with restricted coordinates*

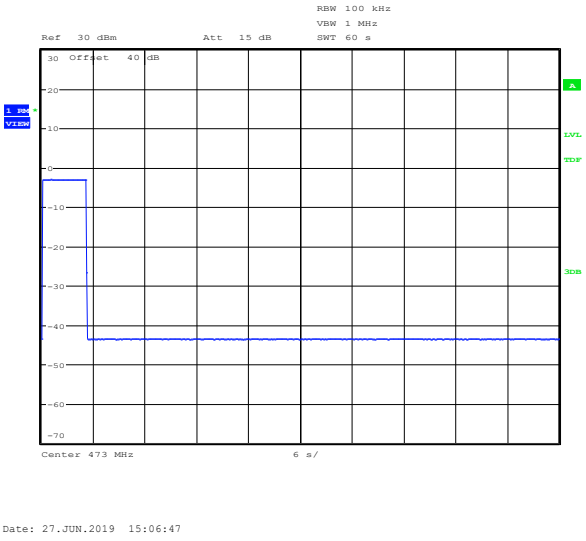

Figure 8.3-2: *Unsuccessful registration and transmission stops from Base station unit*

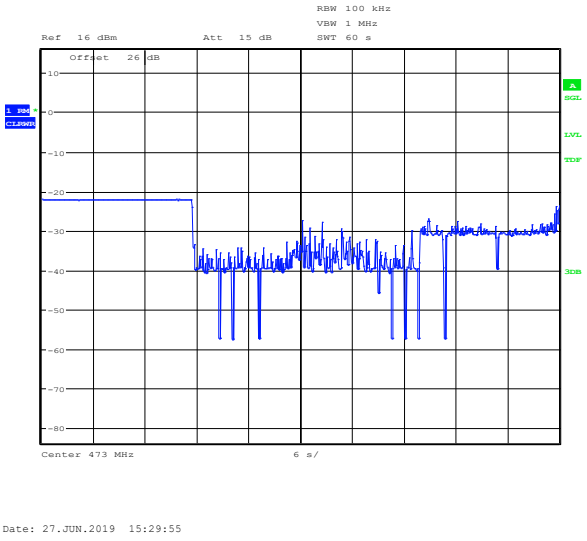

Figure 8.3-3: *Unsuccessful registration and transmission stops from CPE unit (lower level signal indicates advertising signal from base station)*

8.4 FCC 15.713(g)(3)(v) Unsuccessful registration due to incomplete information – missing owner

8.4.1 Definitions and limits

(3) The white space device registration database shall contain the following information for fixed white space devices:
(v) Name of the individual or business that owns the device

8.4.2 Test summary

Test date	June 27, 2019

8.4.3 Observations, settings and special notes

EUT was configured with incomplete information: owner name field was left intentionally blank (instead of *6H*). It was verified, that after detecting missing contact information, EUT did not send any form request to database.
To test this feature the device was initially configured with valid information and allowed to transmit on the channel. The registration information was then modified to render it invalid and a registration request was not re-initiated. Once the device detects an invalid registration field, the device flagged the error in the GUI.

8.4.4 Test data

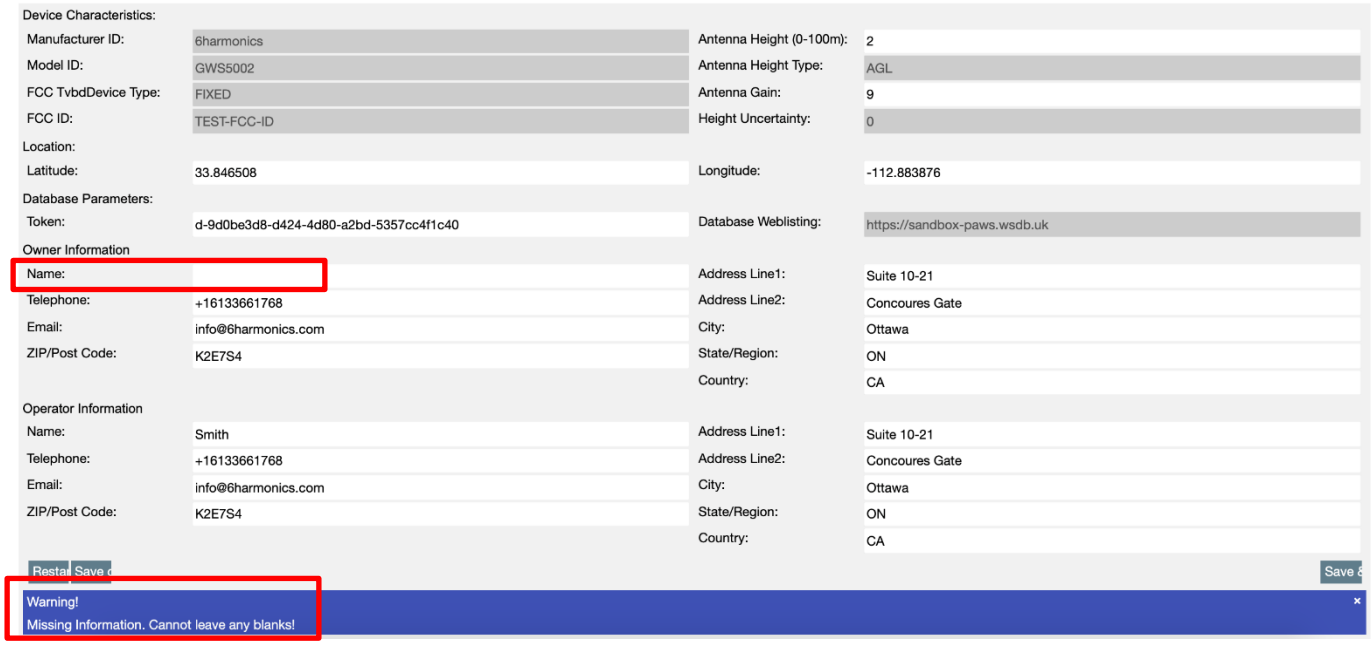

Figure 8.4-1: *Unsuccessful registration with missing owner name information*

8.5 FCC 15.713(g)(3)(vi) Unsuccessful registration due to incomplete information – contact name

8.5.1 Definitions and limits

(3) The white space device registration database shall contain the following information for fixed white space devices:
(vi) Name of a contact person responsible for the device's operation

8.5.2 Test summary

Test date	June 27, 2019

8.5.3 Observations, settings and special notes

EUT was configured with incomplete information: contact name field was left intentionally blank (instead of *Smith*). It was verified, that after detecting missing contact information, EUT did not send any form request to database.
To test this feature the device was initially configured with valid information and allowed to transmit on the channel. The registration information was then modified to render it invalid and a registration request was not re-initiated. Once the device detects an invalid registration field, the device flagged the error in the GUI.

8.5.4 Test data

Figure 8.5-1: *Unsuccessful registration with missing contact name*

8.6 FCC 15.713(g)(3)(vii) Unsuccessful registration due to incomplete information – contact address

8.6.1 Definitions and limits

(3) The white space device registration database shall contain the following information for fixed white space devices:
(vii) Address for the contact person

8.6.2 Test summary

Test date	October 16, 2018

8.6.3 Observations, settings and special notes

EUT was configured with incomplete information: owner/operator contact address field was left intentionally blank. It was verified, that after detecting missing contact information, EUT did not send any form request to database.
To test this feature the device was initially configured with valid information and allowed to transmit on the channel. The registration information was then modified to render it invalid and a registration request was not re-initiated. Once the device detects an invalid registration field, the device flagged the error in the GUI.

8.6.4 Test data

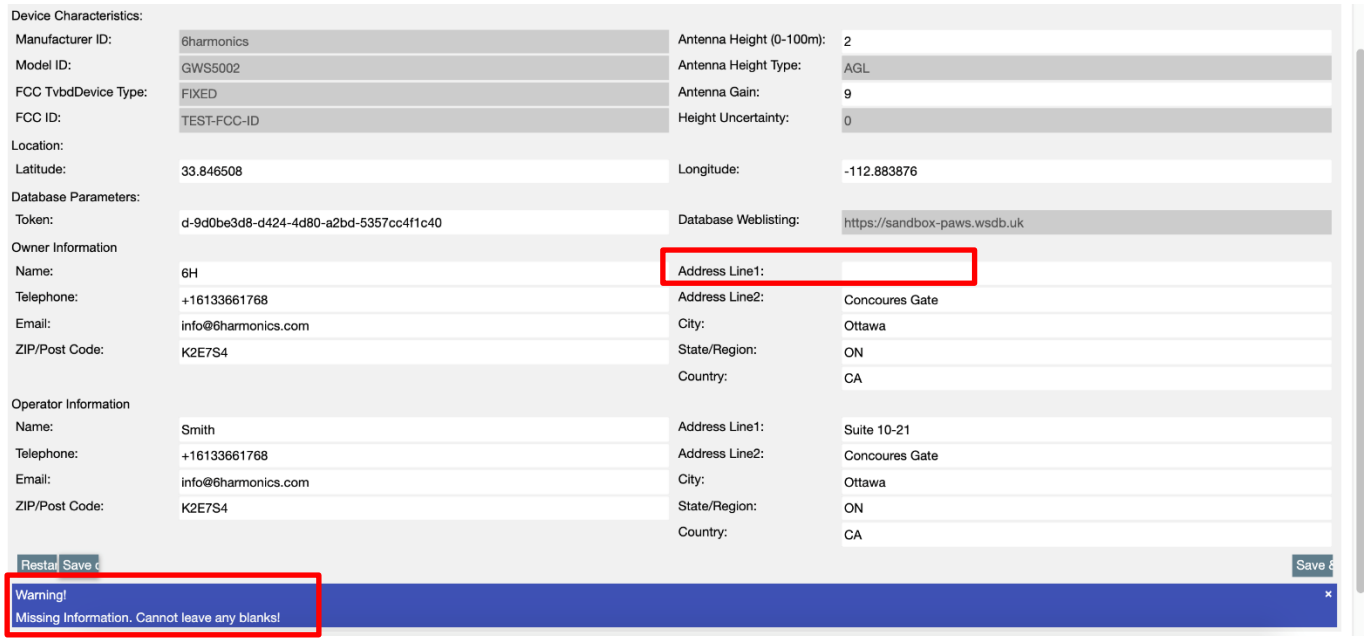

Figure 8.6-1: *Unsuccessful registration with missing owner contact address line 1*

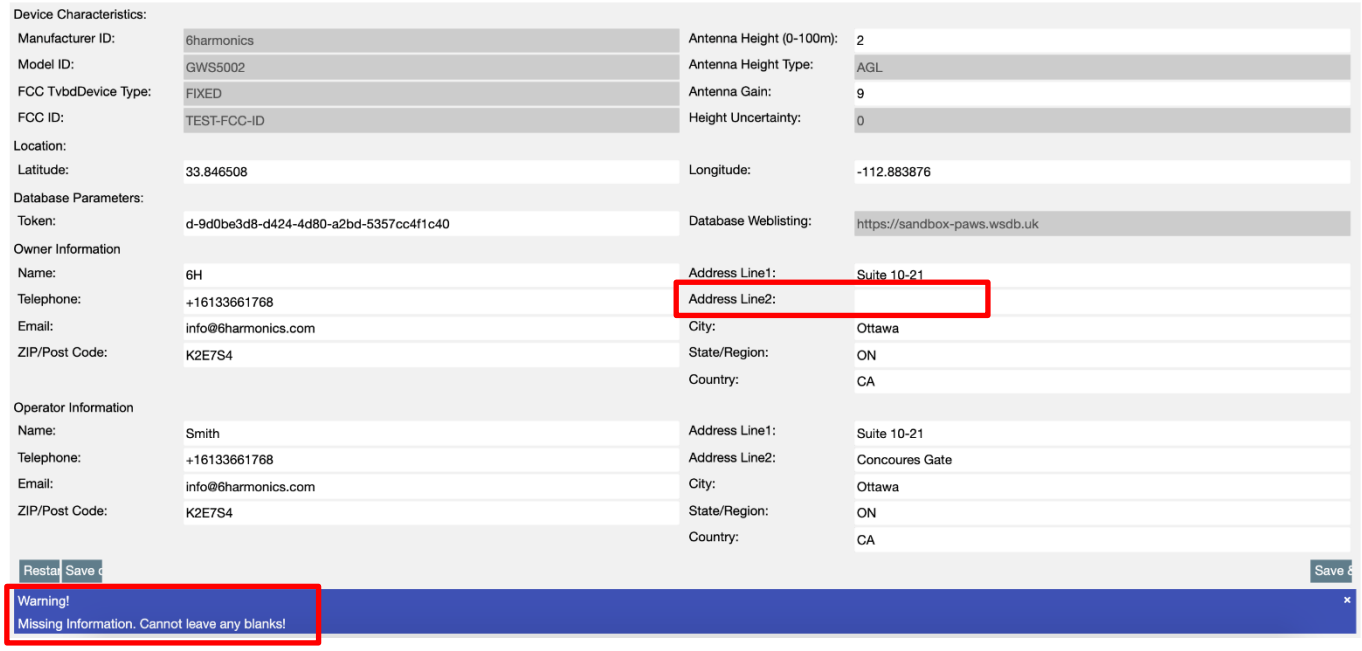

Figure 8.6-2: *Unsuccessful registration with missing owner contact address line 2*

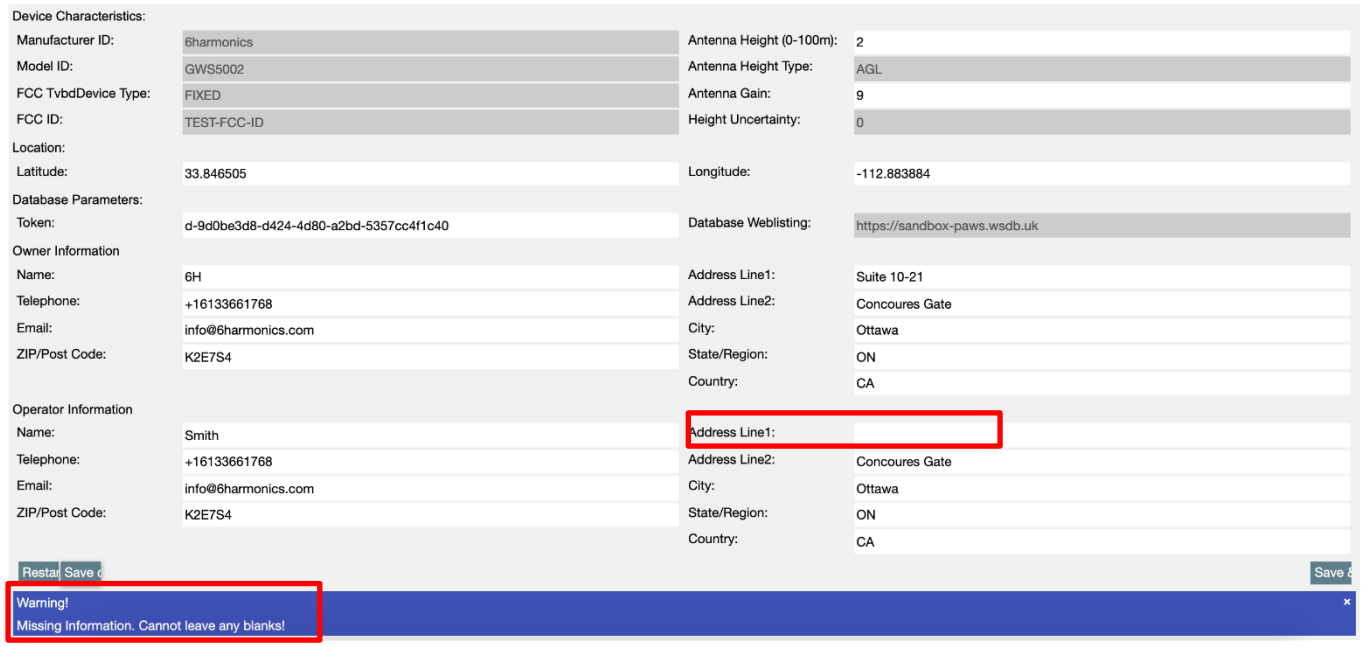

Figure 8.6-3: *Unsuccessful registration with missing operator contact address line 1*

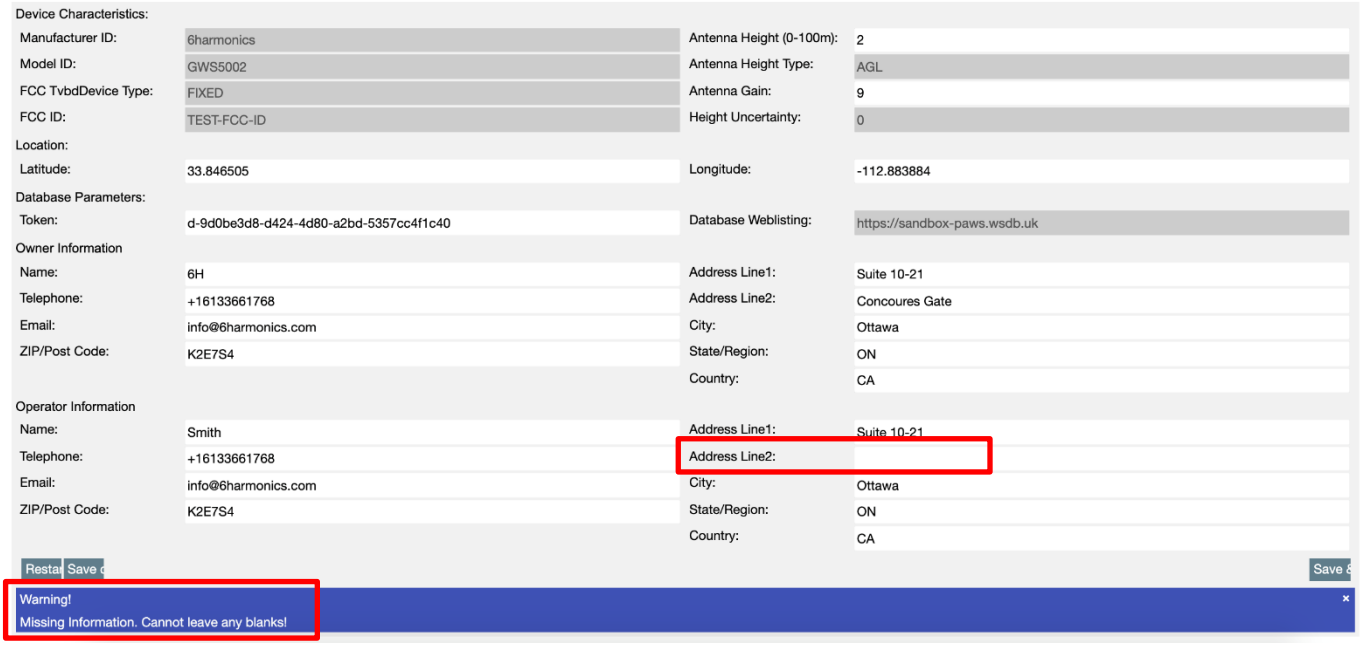

Figure 8.6-4: *Unsuccessful registration with missing operator contact address line 2*

8.7 FCC 15.713(g)(3)(vii) Unsuccessful registration due to incomplete information – contact state (region)

8.7.1 Definitions and limits

(3) The white space device registration database shall contain the following information for fixed white space devices:
(vii) Address for the contact person

8.7.2 Test summary

Test date	June 27, 2019

8.7.3 Observations, settings and special notes

EUT was configured with incomplete information: owner/operator contact state field was left intentionally blank (instead of *ON*). It was verified, that after detecting missing contact information, EUT did not send any form request to database.
To test this feature the device was initially configured with valid information and allowed to transmit on the channel. The registration information was then modified to render it invalid and a registration request was not re-initiated. Once the device detects an invalid registration field, the device flagged the error in the GUI.

8.7.4 Test data

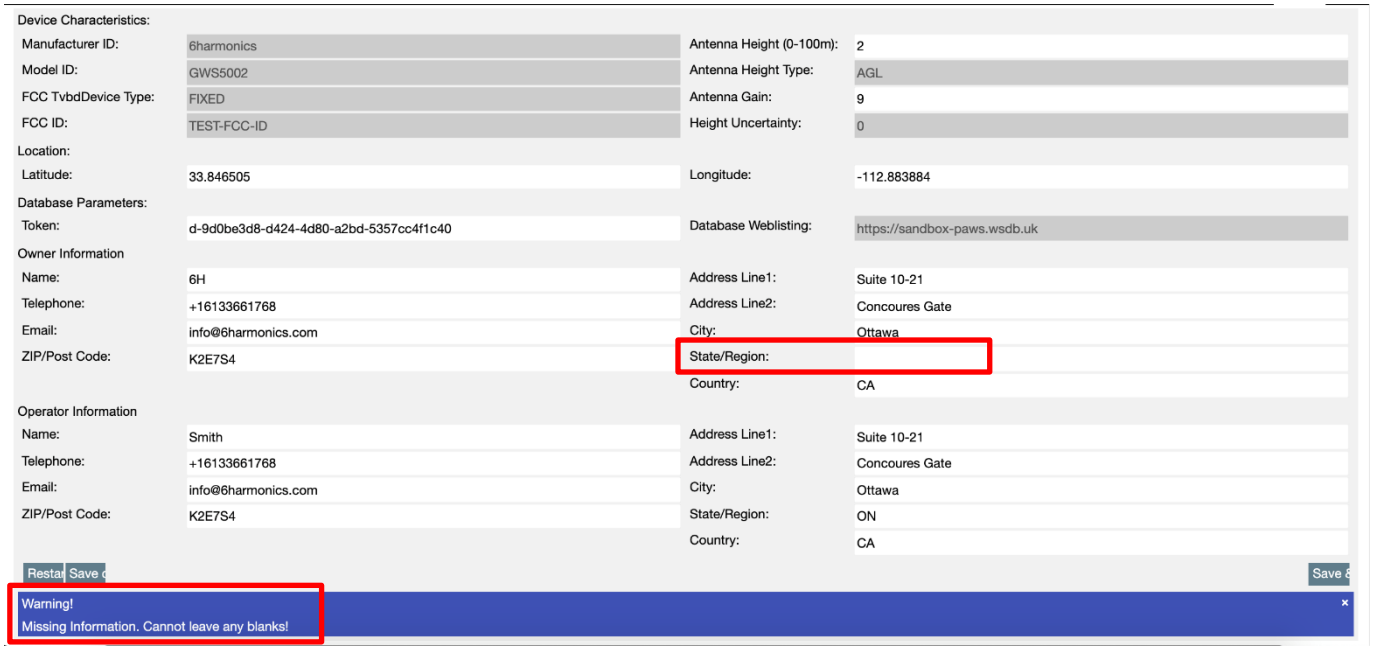

Figure 8.7-1: *Unsuccessful registration with missing owner contact state*

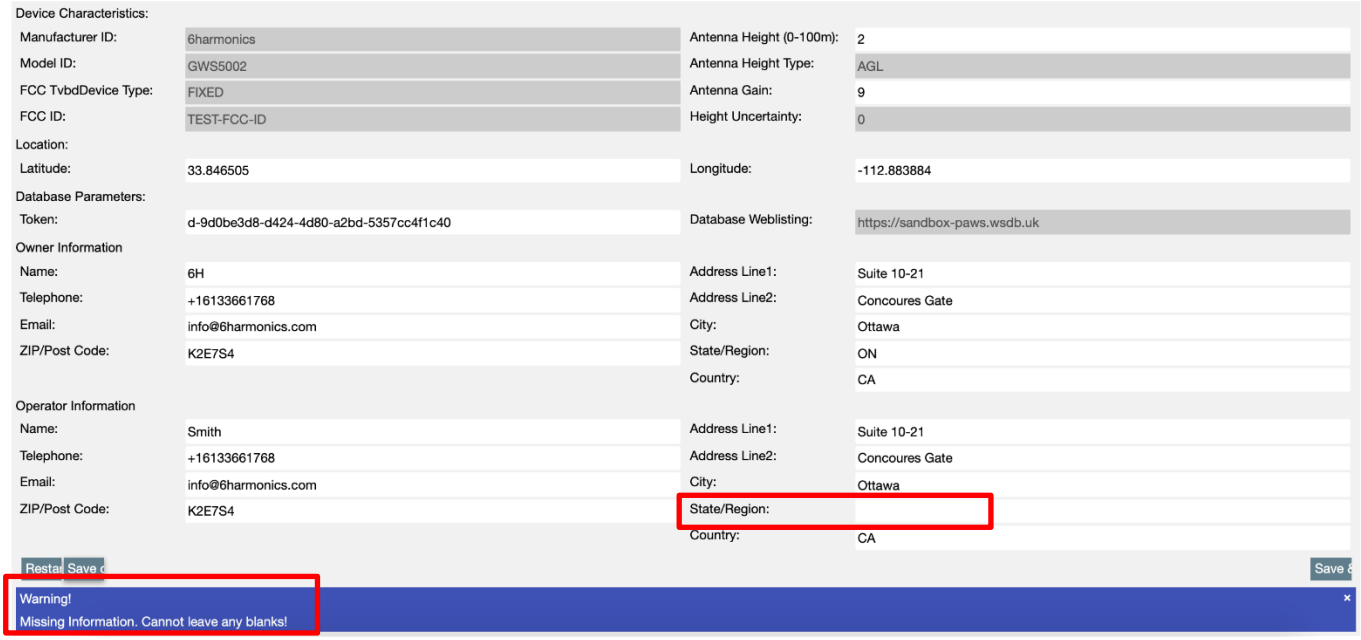

Figure 8.7-2: *Unsuccessful registration with missing operator contact state*

8.8 FCC 15.713(g)(3)(vii) Unsuccessful registration due to incomplete information – contact zip (postal) code

8.8.1 Definitions and limits

(3) The white space device registration database shall contain the following information for fixed white space devices:
(vii) Address for the contact person

8.8.2 Test summary

Test date	June 27, 2019

8.8.3 Observations, settings and special notes

EUT was configured with incomplete information: owner/operator contact zip (postal) code field was left intentionally blank (instead of *K2E7S4*). It was verified, that after detecting missing contact information, EUT did not send any form request to database, the EUT stopped the transmission.
To test this feature the device was initially configured with valid information and allowed to transmit on the channel. The registration information was then modified to render it invalid and a registration request was not re-initiated. Once the device detects an invalid registration field, the device flagged the error in the GUI.

8.8.4 Test data

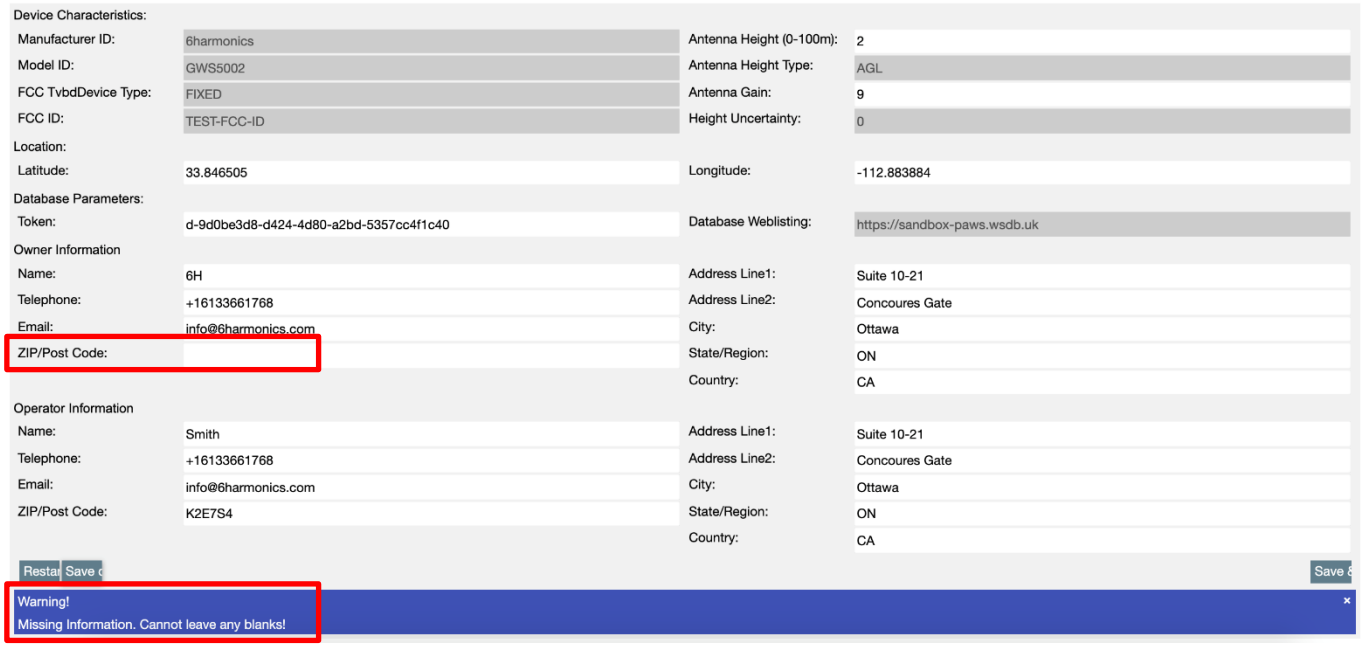

Figure 8.8-1: *Unsuccessful registration with missing owner contact zip (postal) code*

Figure 8.8-2: *Data log of unsuccessful registration with missing operator contact zip (postal) code*

8.9 FCC 15.713(g)(3)(vii) Unsuccessful registration due to incomplete information – contact city

8.9.1 Definitions and limits

(3) The white space device registration database shall contain the following information for fixed white space devices:
(vii) Address for the contact person

8.9.2 Test summary

Test date	June 27, 2019

8.9.3 Observations, settings and special notes

EUT was configured with incomplete information: owner/operator contact city field was left intentionally blank (instead of *Ottawa*). It was verified, that after detecting missing contact information, EUT did not send any form request to database.
To test this feature the device was initially configured with valid information and allowed to transmit on the channel. The registration information was then modified to render it invalid and a registration request was not re-initiated. Once the device detects an invalid registration field, the device flagged the error in the GUI.

8.9.4 Test data

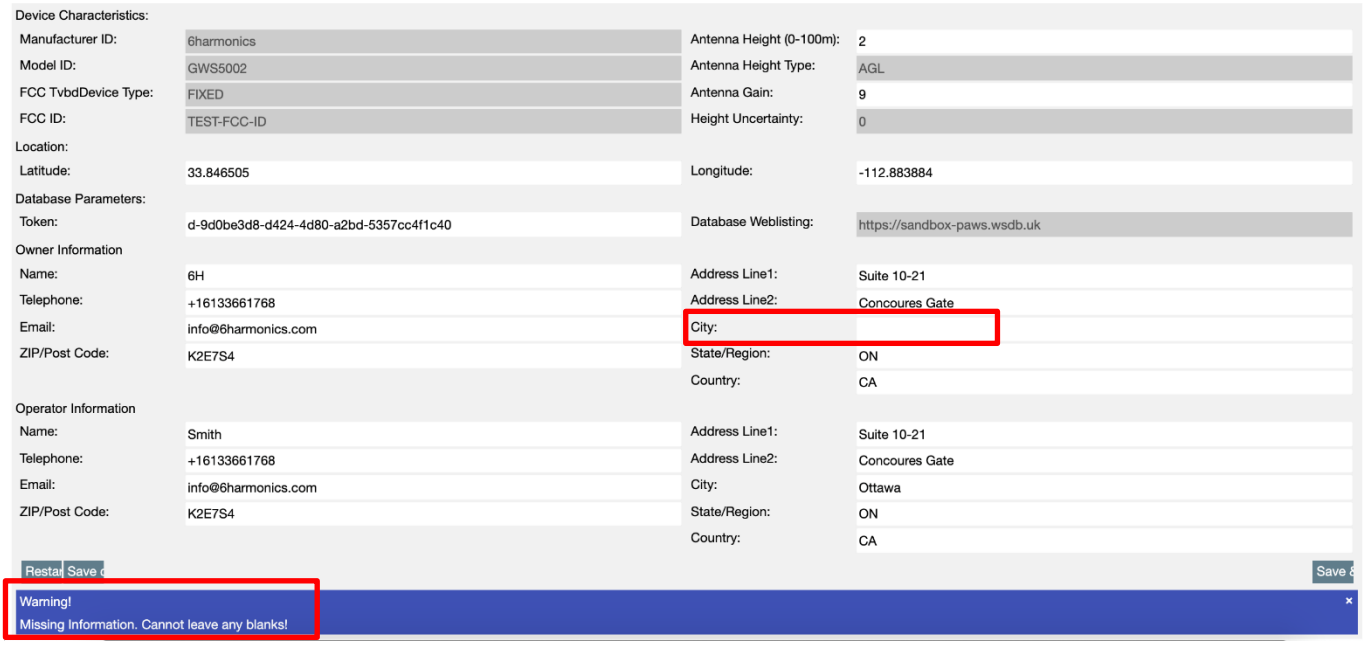

Figure 8.9-1: *Unsuccessful registration with missing owner contact city*

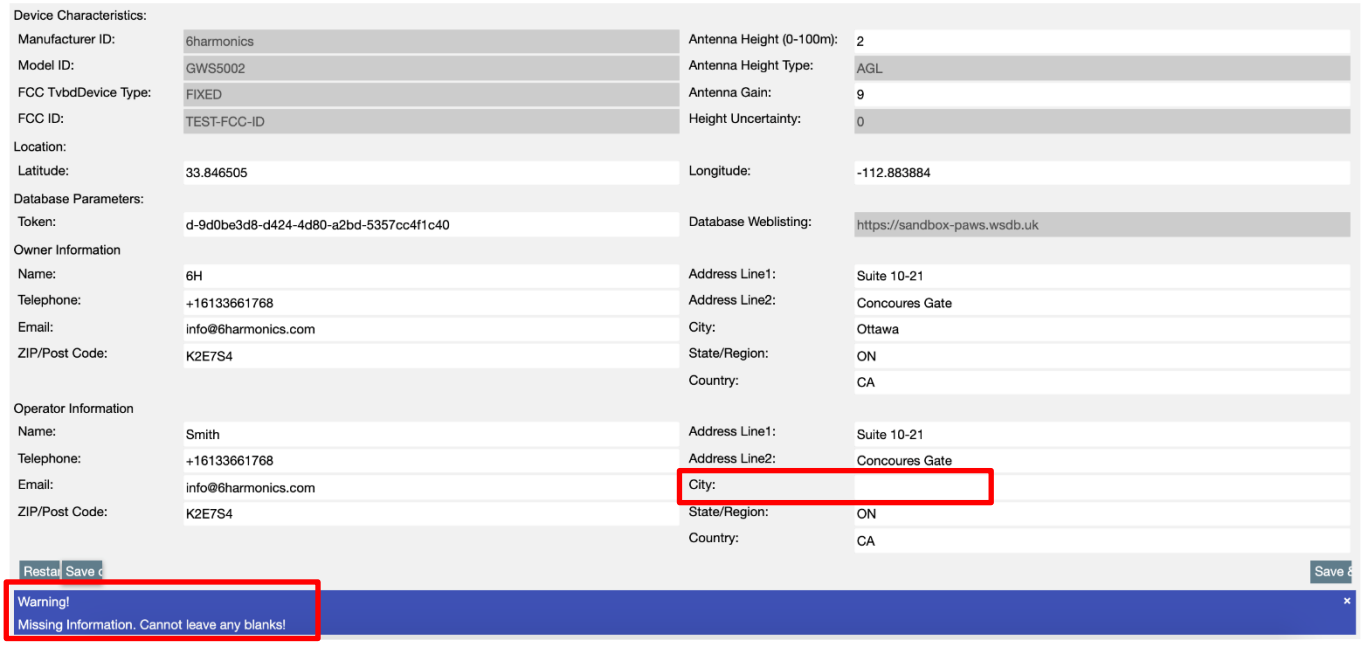

Figure 8.9-2: *Unsuccessful registration with missing operator contact city*

8.10 FCC 15.713(g)(3)(vii) Unsuccessful registration due to incomplete information – contact country

8.10.1 Definitions and limits

(3) The white space device registration database shall contain the following information for fixed white space devices:
(vii) Address for the contact person

8.10.2 Test summary

Test date	June 27, 2019

8.10.3 Observations, settings and special notes

EUT was configured with incomplete information: owner/operator contact country field was left intentionally blank (instead of *CA*). It was verified, that after detecting missing contact information, EUT did not send any form request to database.
To test this feature the device was initially configured with valid information and allowed to transmit on the channel. The registration information was then modified to render it invalid and a registration request was not re-initiated. Once the device detects an invalid registration field, the device flagged the error in the GUI.

8.10.4 Test data

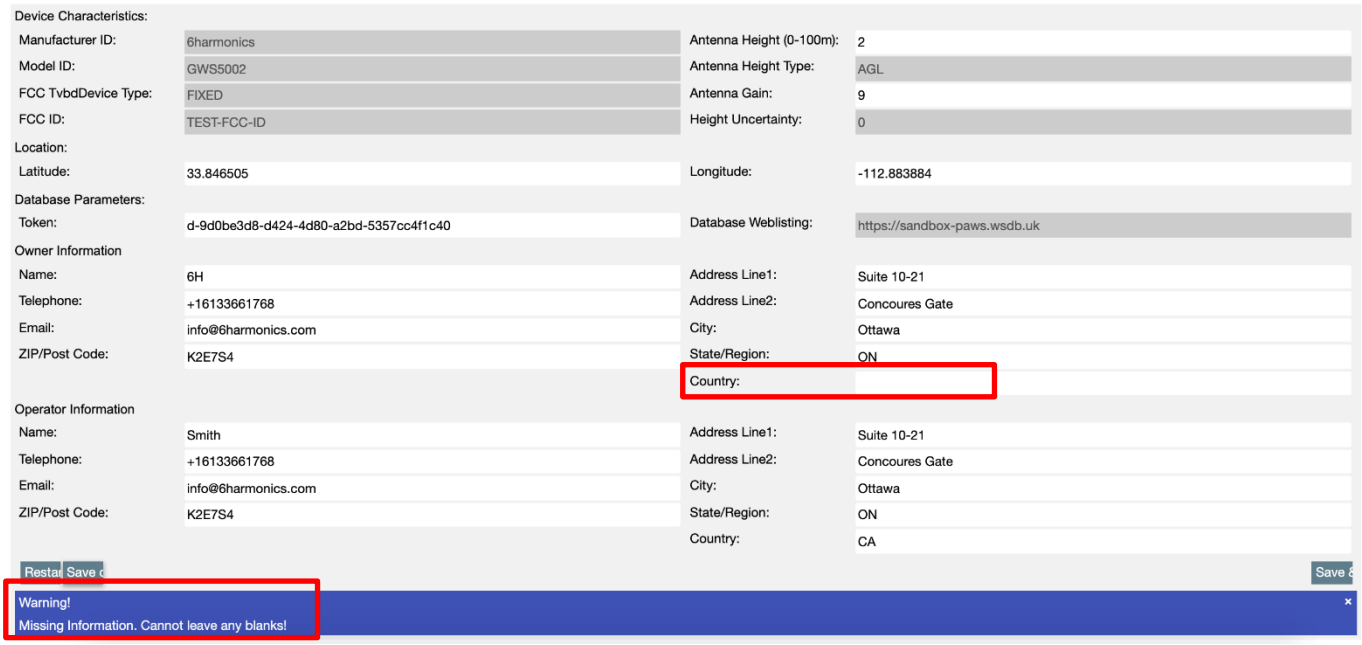

Figure 8.10-1: *Unsuccessful registration with missing owner contact country*

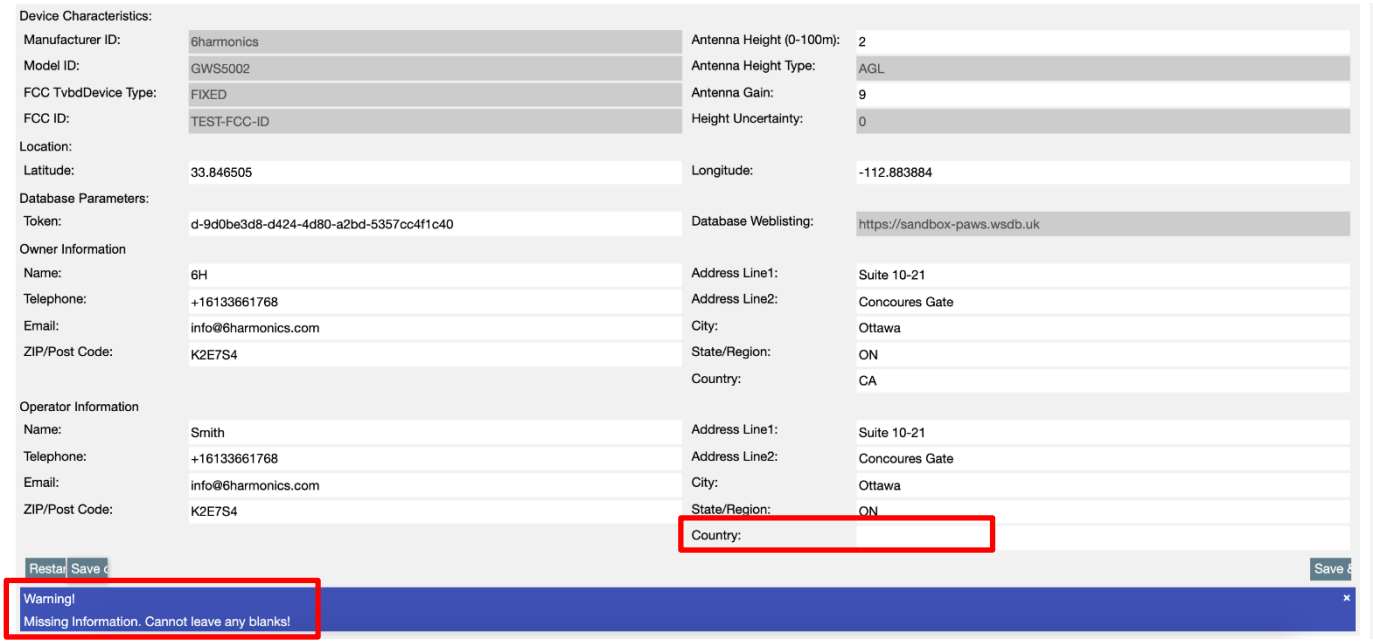

Figure 8.10-2: *Unsuccessful registration with missing operator contact country*

8.11 FCC 15.713(g)(3)(viii) Unsuccessful registration due to incomplete information – contact email

8.11.1 Definitions and limits

(3) The white space device registration database shall contain the following information for fixed white space devices:
(viii) Email address for the contact person

8.11.2 Test summary

Test date	June 27, 2019

8.11.3 Observations, settings and special notes

EUT was configured with incomplete information: owner/operator contact email field was left intentionally blank (instead of *info@6harmonics.com*). It was verified, that after detecting missing contact information, EUT did not send any form request to database.
To test this feature the device was initially configured with valid information and allowed to transmit on the channel. The registration information was then modified to render it invalid and a registration request was not re-initiated. Once the device detects an invalid registration field, the device flagged the error in the GUI.

8.11.4 Test data

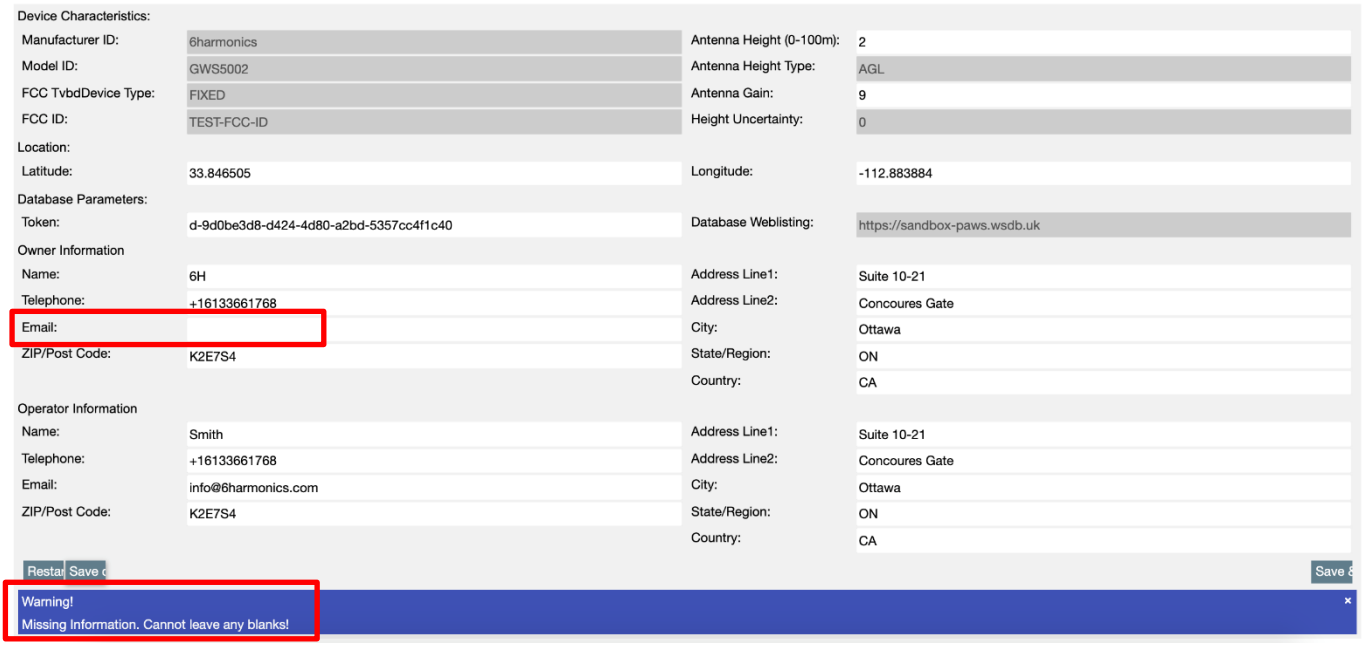

Figure 8.11-1: *Unsuccessful registration with missing owner contact email*

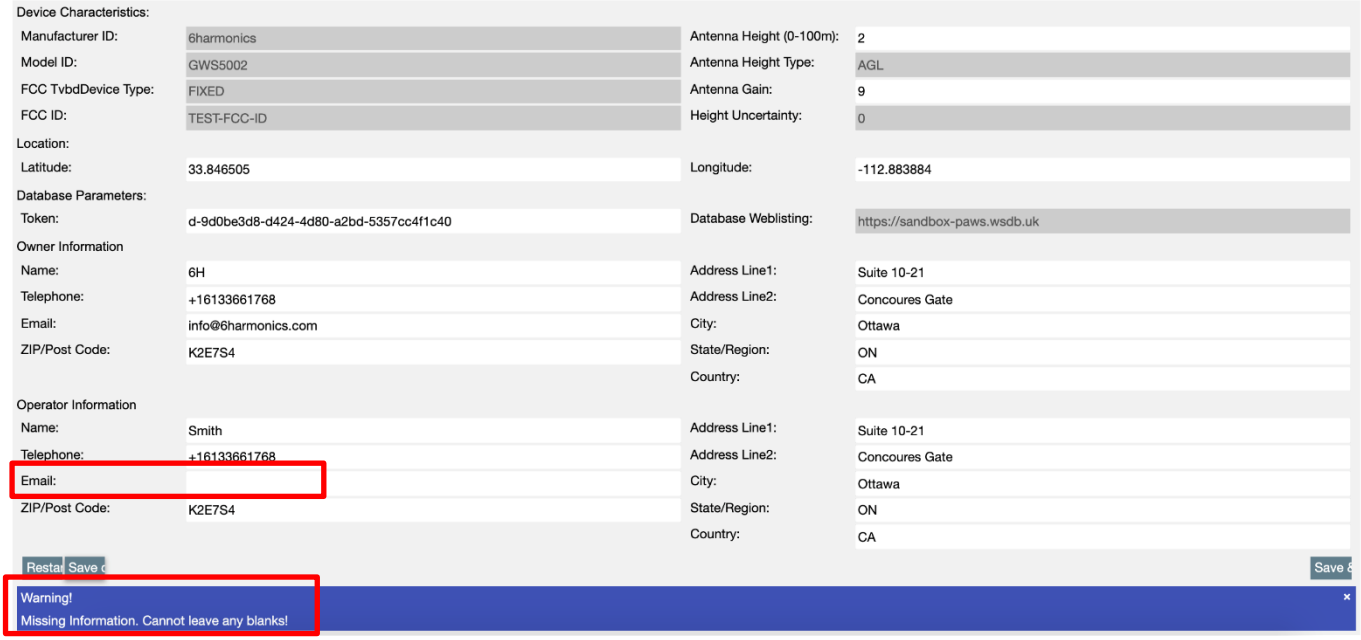

Figure 8.11-2: *Unsuccessful registration with missing operator contact email*

8.12 FCC 15.713(g)(3)(ix) Unsuccessful registration due to incomplete information – contact telephone

8.12.1 Definitions and limits

(3) The white space device registration database shall contain the following information for fixed white space devices:
(xi) Phone number for the contact person

8.12.2 Test summary

Test date	June 27, 2019

8.12.3 Observations, settings and special notes

EUT was configured with incomplete information: owner/operator contact telephone field was left intentionally blank (instead of *+16133661768*). It was verified, that after detecting missing contact information, EUT did not send any form request to database.
To test this feature the device was initially configured with valid information and allowed to transmit on the channel. The registration information was then modified to render it invalid and a registration request was not re-initiated. Once the device detects an invalid registration field, the device flagged the error in the GUI.

8.12.4 Test data

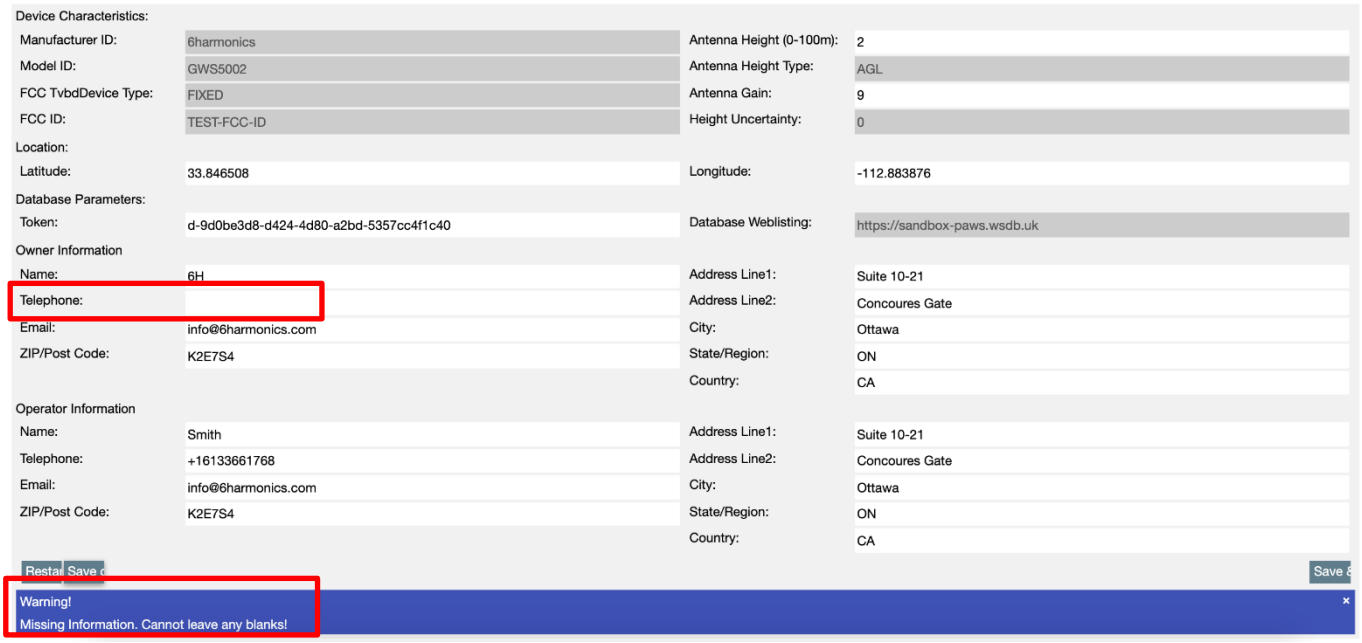

Figure 8.12-1: *Unsuccessful registration with missing owner contact telephone*

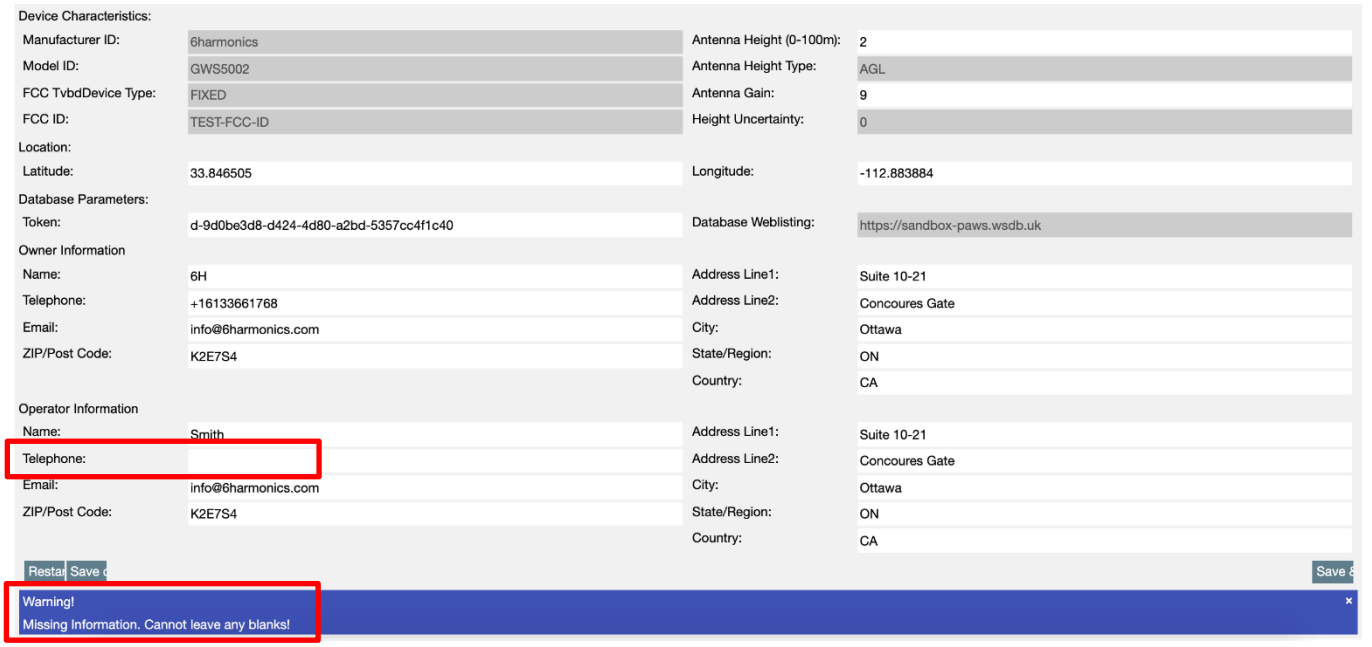

Figure 8.12-2: *Unsuccessful registration with missing operator contact telephone*

8.13 FCC 15.713(e)(6) Unsuccessful registration due to HAAT > 250 m

8.13.1 Definitions and limits

A fixed device with an antenna height above ground that exceeds 30 meters or an antenna height above average terrain (HAAT) that exceeds 250 meters shall not be provided a list of available channels.

8.13.2 Test summary

Test date	June 28, 2019

8.13.3 Observations, settings and special notes

EUT was configured with information that included a location with HAAT of more than 250 m (at latitude 37.9° N and longitude 114.6° W). It was verified, that after database rejection, the EUT didn't start the transmission.
To test this feature the device was configured with invalid information and requested to transmit on the channel. Once the database responded with an empty channel list as a result of the antenna height above ground, or excessive HAAT, the EUT didn't start to transmit. Subscriber unit was waiting for the information from Base station and didn't start transmission as well.

8.13.4 Test data

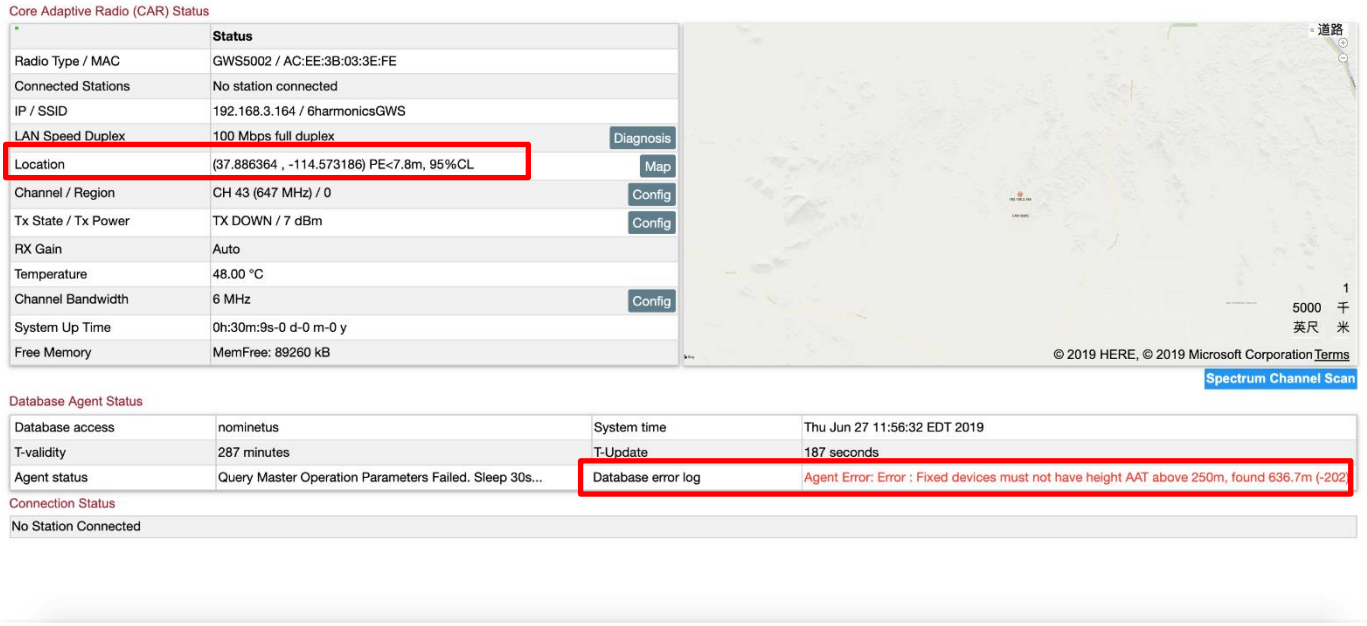

Figure 8.13-1: *Unsuccessful registration with restricted HAAT location*

8.14 FCC 15.713(e)(6) Unsuccessful registration due to antenna height that exceeds 30 m

8.14.1 Definitions and limits

A fixed device with an antenna height above ground that exceeds 30 meters or an antenna height above average terrain (HAAT) that exceeds 250 meters shall not be provided a list of available channels.

8.14.2 Test summary

Test date	October 17, 2018

8.14.3 Observations, settings and special notes

EUT was configured with information that included an antenna height that exceeded 30 m limit in congested areas and 100 m in less congested areas (the limit is set by the database). It was verified, that after database rejection, the EUT stopped the transmission.
To test this feature the device was initially configured with valid information and allowed to transmit on the channel. The registration information was then modified to render it invalid and a registration request was re-initiated. Once the database responded with an empty channel list as a result of the antenna height above ground, the EUT stopped to transmit. For the Base station device, during the initial power up and registration, if the database returns an empty channel list, it will not turn on the transmitter. For the Subscriber device, the EUT will perform a passive scan and will attempt to connect to a Base station device on a channel where it detects a beacon. If the database responds with an empty channel list, or the device is unable to connect to the database, it will cease to transmit on the channel.

8.14.4 Test data

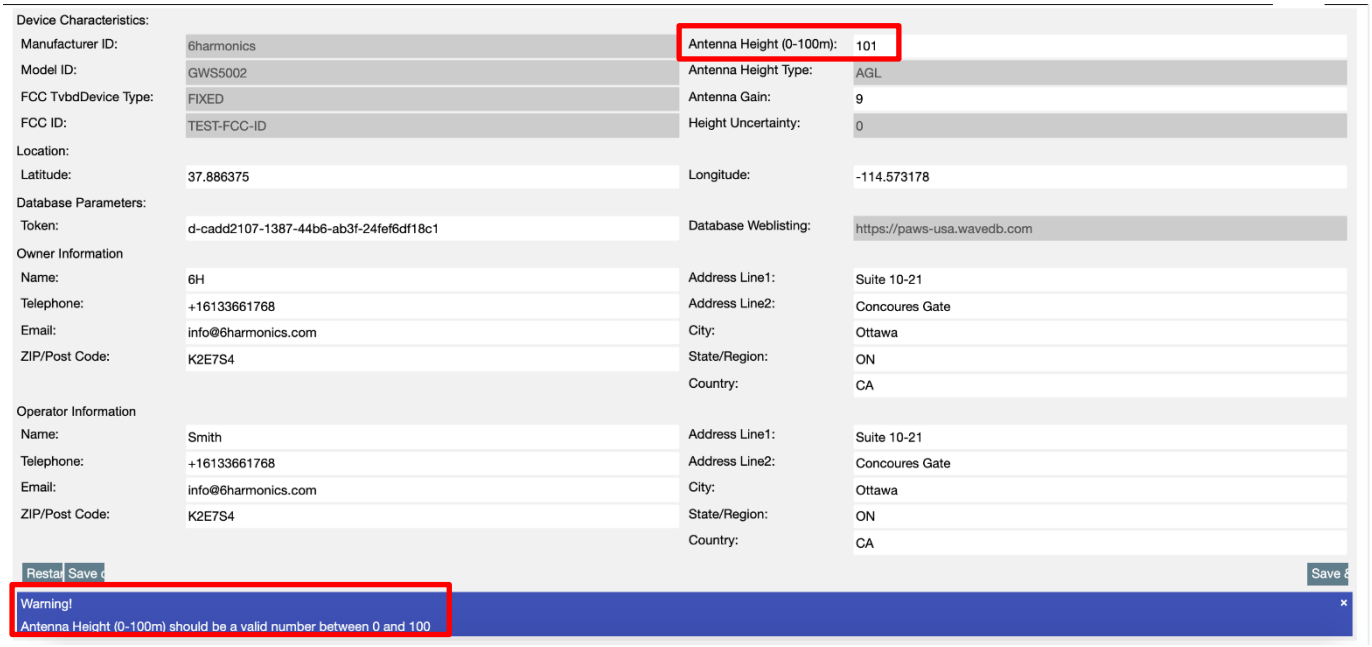

Figure 8.14-1: *Unsuccessful registration with restricted antenna height in the less congested area*

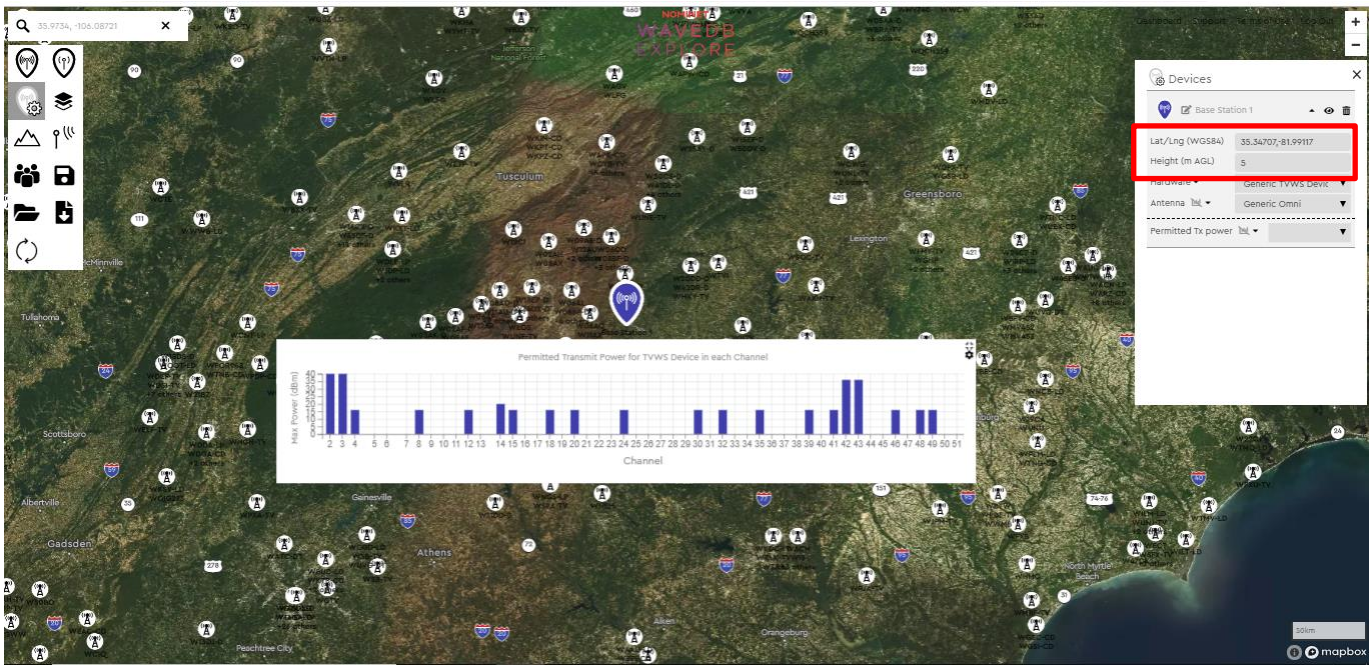

Figure 8.14-2: *Example of congested area location with available channels for antenna height of 5 m*

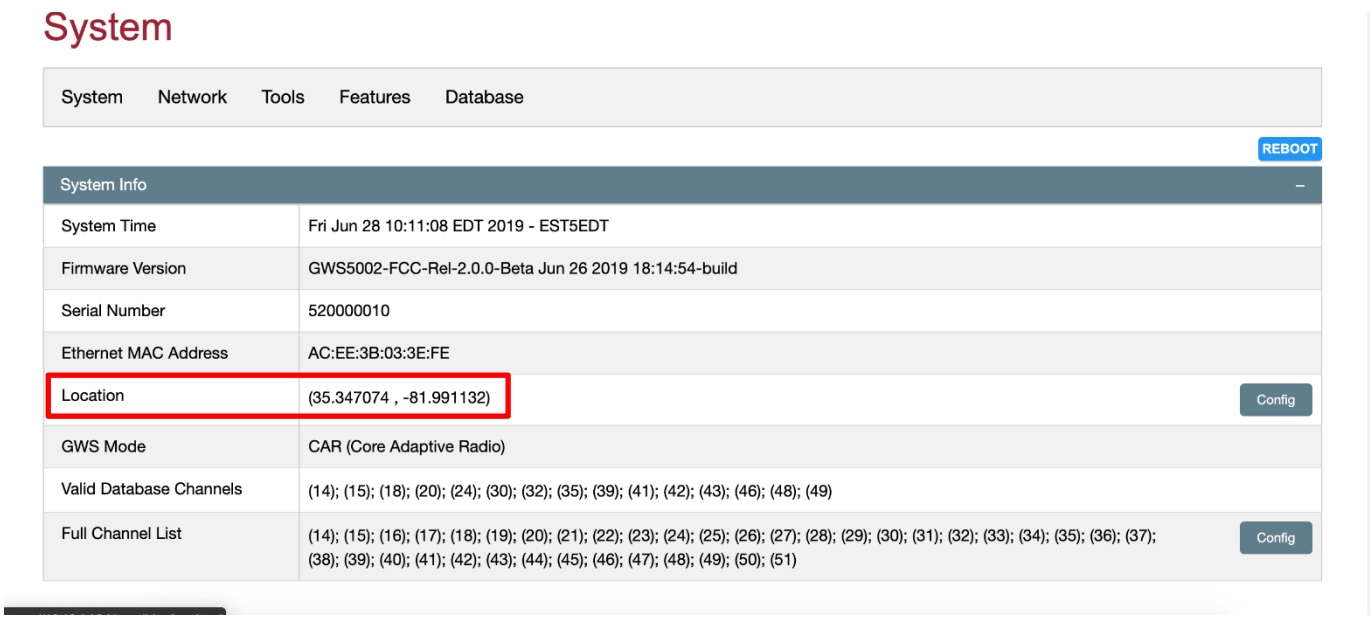

Figure 8.14-3: *System location settings*

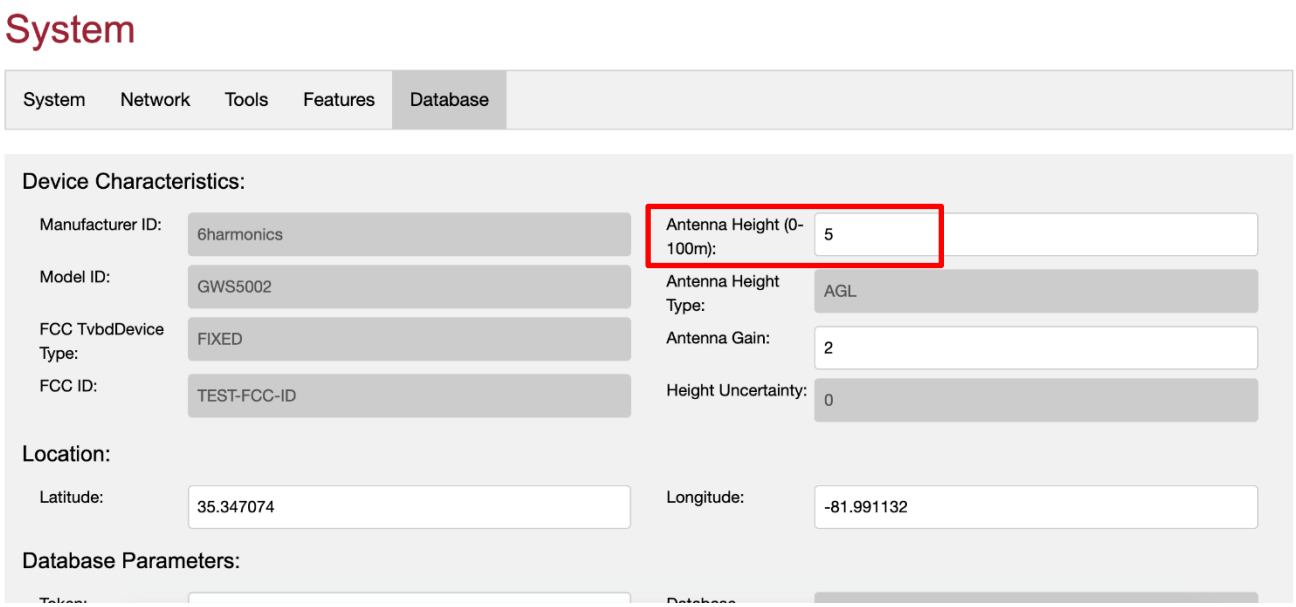

Figure 8.14-4: *Antenna height adjusted to the specific height.*

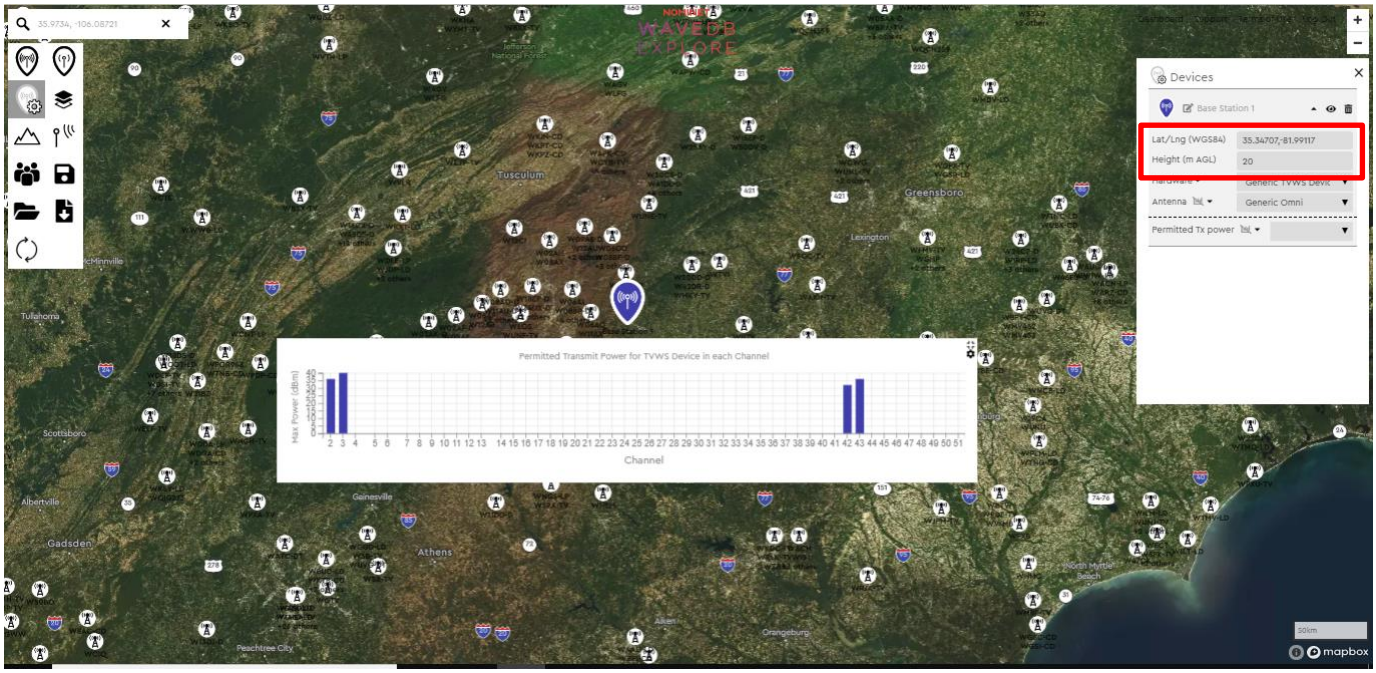

Figure 8.14-5: *Example of congested area location with available channels for antenna height of 20 m*

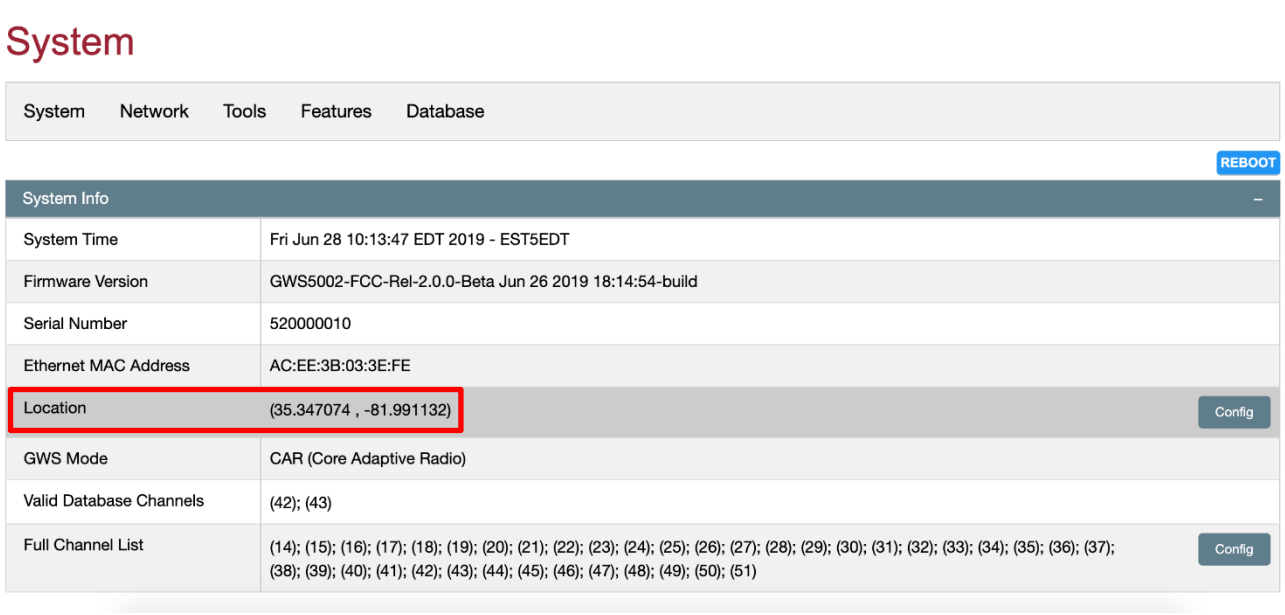

Figure 8.14-6: *System location settings*

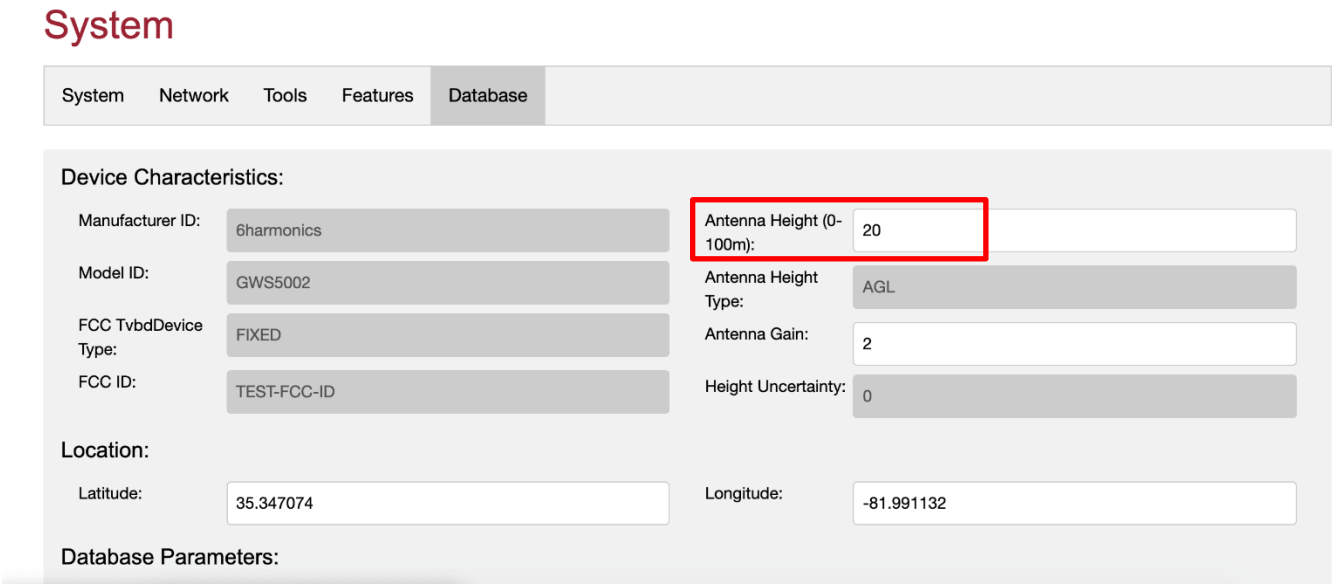

Figure 8.14-7: *Antenna height adjusted to the specific height.*