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test report

304460-2TRFWL

Date of issue: June 13, 2016

Applicant:

6harmonics Inc.

Product:

Television Band Device (TVBD)

Model:

GWS-4006-23

FCC ID:

2AASTGWS-4006-23

Specifications:

FCC 47 CFR Part 15 Subpart H

White Space Devices

Test location

Company name	Nemko Canada Inc.
Address	303 River Road
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: 176392; IC: 2040A-4 (3 m semi anechoic chamber)

Tested by	Andrey Adelberg, Senior Wireless/EMC Specialist
Reviewed by	Kevin Rose, Wireless/EMC Specialist
Date	June 13, 2016
Signature of reviewer	

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.

Copyright notification

Table of contents

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 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was completed against all relevant requirements of the test standard. 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.

1.4 Exclusions

None

1.5 Test report revision history

Revision #	Details of changes made to test report
TRF	Original report issued

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 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)(3)	Relocation of fixed TVBD	Pass
§15.711(c)(2)(i)	Database access	Pass
§15.711(c)(2)(iii)	Low-power auxiliary device protection	Pass
§15.711(j)	Security	Pass

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	February 29, 2016
Nemko sample ID number	None

3.2 EUT information

Product name	Television Band Device (TVBD)
Model	GWS-4006-23
Serial number	620000096 (master or slave)

3.3 Technical information

Frequency band	470–698 MHz
Channel BW	6 MHz
Type of modulation	BPSK, QPSK, 16-QAM, and 64-QAM
Power requirements	120 VAC 60 Hz or 48 V_{DC} via PoE

3.4 Product description and theory of operation

The 6Harmonics Inc. GWS radios are a new class of radios designed for the global white space radio market. The GWS-4006-23 is designed to provide up to 23 dBm of transmit power, offer a sensitivity of up to −100 dBm, and provide 16.5 Mbps of UDP throughput in a 6 MHz television channel. The product can be used for Point to Point or Point to Multi-point operation.

3.5 Test configuration

The work station laptop was connected to network router and established a network connection to the internet and the EUT. Two separate samples of GWS-4006-23 were used in the setup. One sample was configured as Master and the second sample was configured as Slave. Master device was connected to a network router with direct access to the internet. Slave device was connected to master device using RF cables, attenuators and RF splitter. Slave device doesn't have direct internet access. It was able to access the internet only during master-slave coax link. All EUT's were controlled and monitored by a work station using Terminal sessions.

3.6 Setup photo

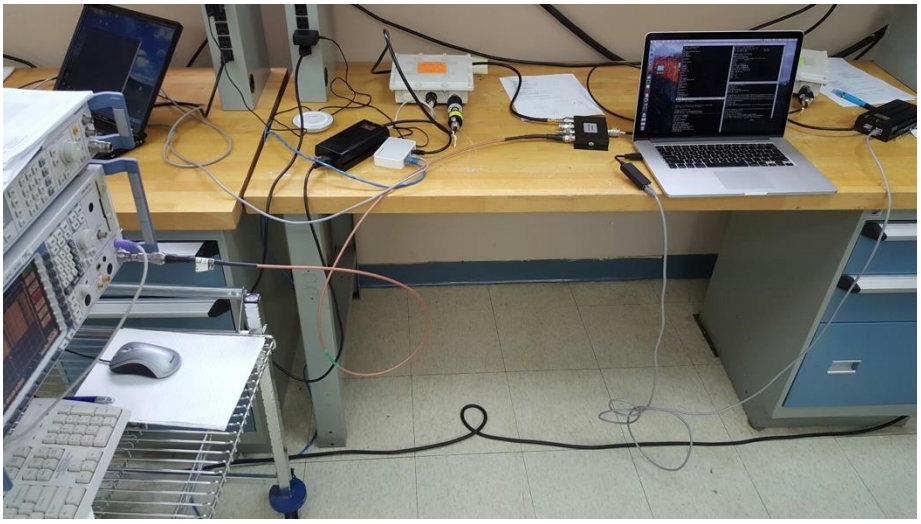

Figure3.6-1: *Setup photo*

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	860–1060mbar

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

Nemko Canada Inc. has calculated measurement uncertainty and is documented in EMC/MUC/001 “Uncertainty in EMC measurements.” Measurement uncertainty was calculated using the methods described in CISPR 16-4 Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC measurements; as well as described in UKAS LAB34: The expression of Uncertainty in EMC Testing. Measurement uncertainty calculations assume a coverage factor of K=2 with 95% certainty.

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	FSU	FA001877	1 year	Mar. 27/16

Note: NCR - no calibration required, VOU - verify on use

Section 8. Testing data

8.1 FCC 15.713(g) 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.

8.1.2 Test summary

Test date	February 29, 2016	Temperature	22 °C
Test engineer	Andrey Adelberg	Air pressure	1004 mbar
Verdict	Pass	Relative humidity	32 %

8.1.3 Observations, settings and special notes

EUT was configured with the with proper registration information. Successful registration was verified with spectrum analyzer and by accessing WSDB registration interface and showing on the EUT status information page.

8.1.4 Test data

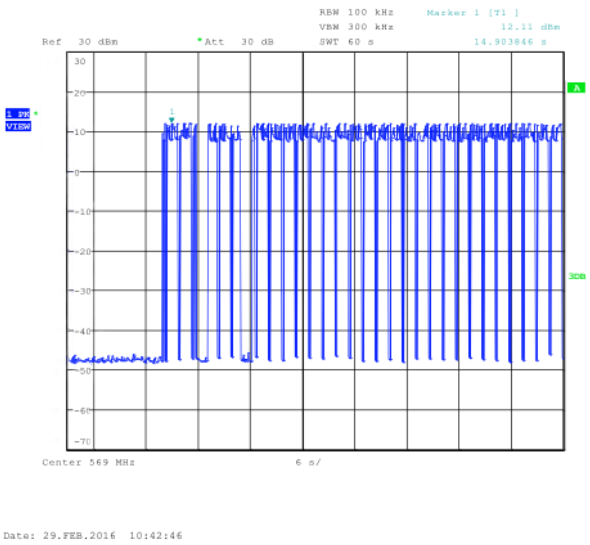

Figure 8.1-1: *Successful registration of master device. Spectrum plot shows that prior to the registration of the EUT there is no transmission and the transmission started right after the successful registration.*

Note: there were no emissions from the Master Device detected, on any channels, until it has successfully registered.

Figure8.1-2: *Data log of successful registration of master device*

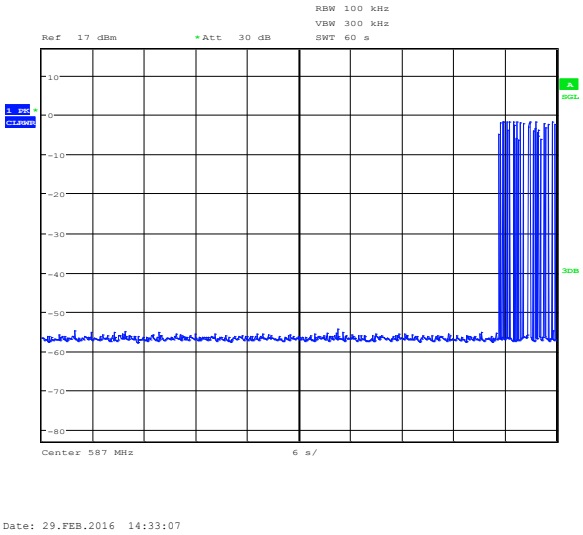

Figure 8.1-3: *Successful registration of slave device. Spectrum plot shows that prior to the registration of the EUT there is no transmission and the transmission started right after the successful registration.*

Note: Prior to registration, Slave Device did not transmit on any channels except for the channel where it saw a beacon from the Master Device. Only the Slave device is permitted to transmit prior to registration for the purposes of registering only on a channel where it sees a beacon from a Master Device. To achieve this, the SLAVE must perform a passive scan.

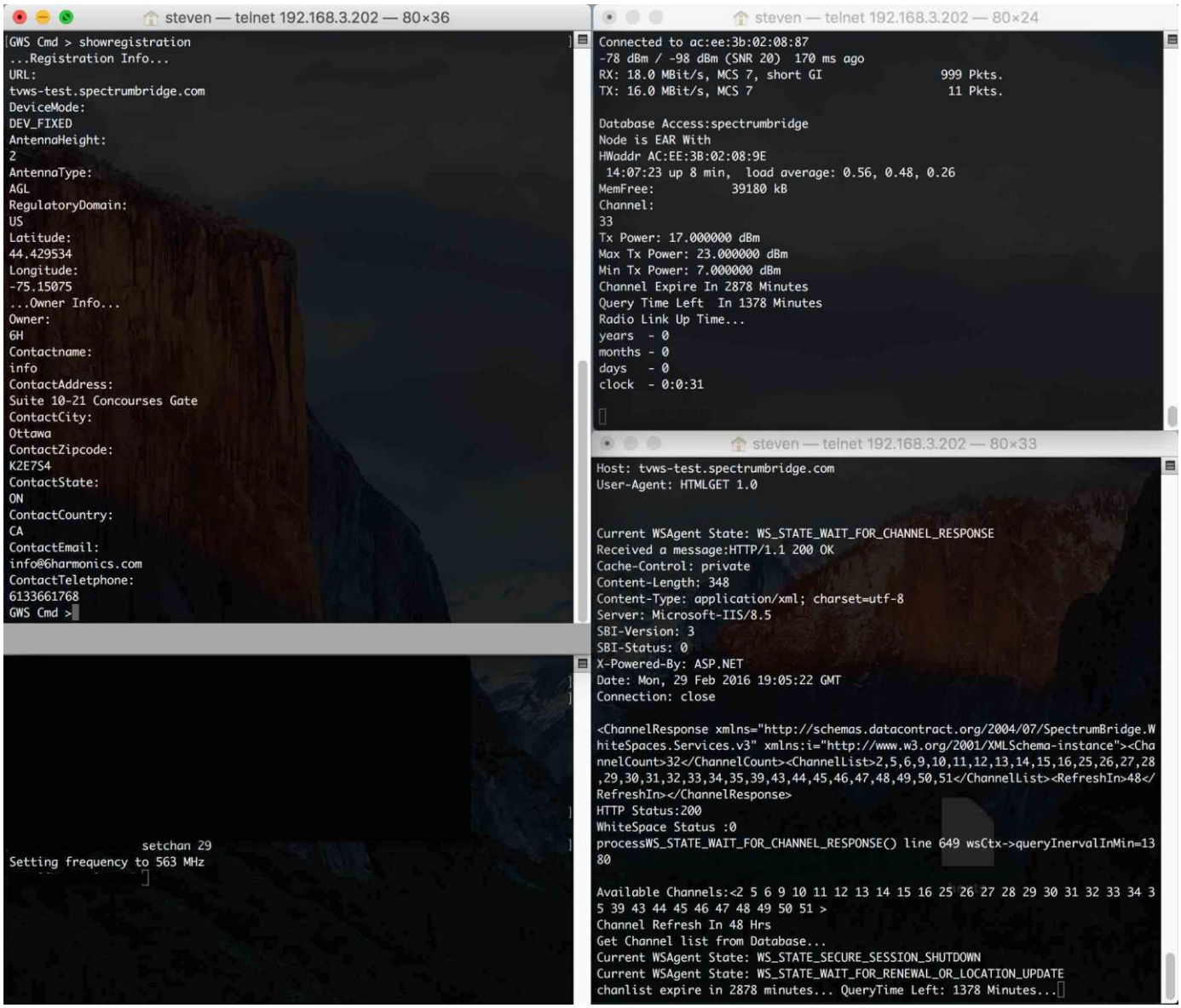

Figure8.1-4: *Data log of successful registration of slave device*

8.2 FCC15.713(g)(3)(iii)Unsuccessful registration – restricted coordinates

8.2.1 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));

8.2.2 Test summary

Test date	February 29, 2016	Temperature	22 °C
Test engineer	Andrey Adelberg	Air pressure	1004 mbar
Verdict	Pass	Relative humidity	32 %

8.2.3 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: 31.5 and longitude: −106.9. The registration process was re-initiated with the invalid coordinates. After database rejection, the EUT stopped the transmission as can be seen in figure 8.2-1. Conversly, if the device was initially configured with invalide coordinates, the device will not transmit since the registration will be rejected. The test was repeated for a Master Device Fig 8.2-1 and a Slave Device Fig 8.2-3.

8.2.4 Test data

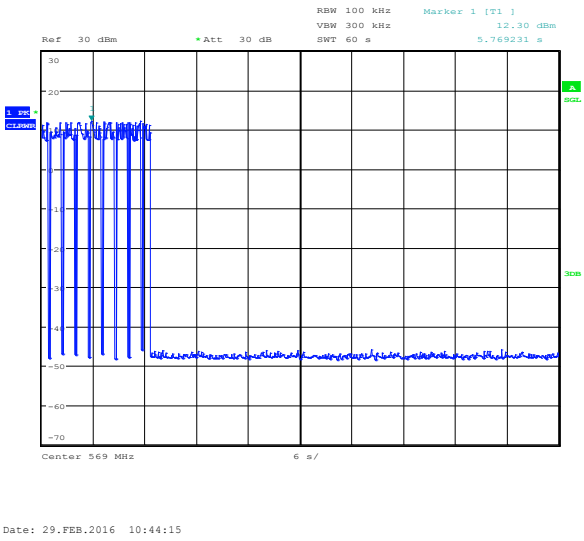

Figure8.2-1: *Unsuccessful registration with restricted coordinates of master device. Spectrum plot shows that prior to the unsuccessful registration the EUT was transmitting and the transmission stopped right after the EUT detected missing information in the registration form.*

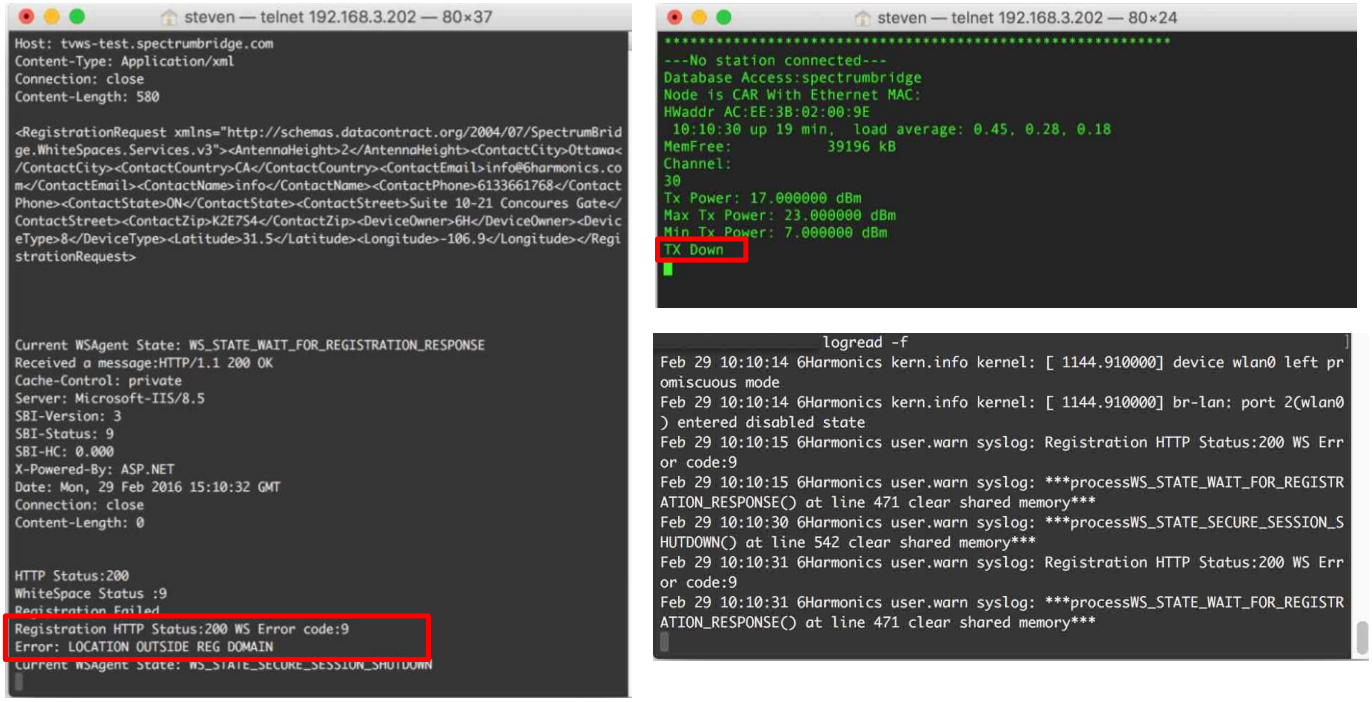

Figure8.2-2: *Data log of unsuccessful registration with restricted coordinates of master device*

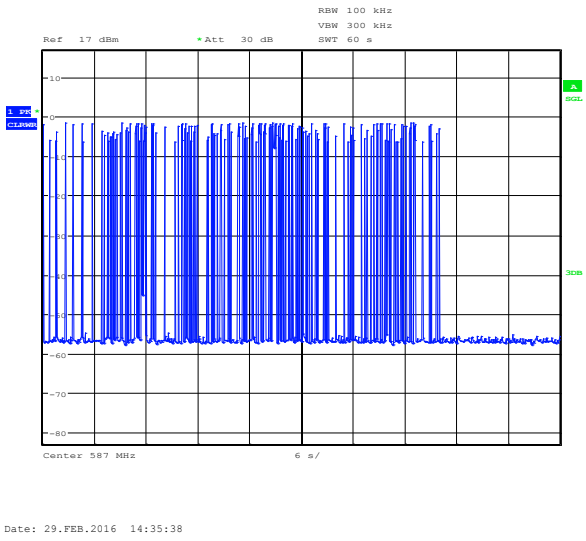

Figure8.2-3: *Unsuccessful registration with restricted coordinates of slave device. Spectrum plot shows that prior to the unsuccessful registration the EUT was transmitting and the transmission stopped right after the EUT detected missing information in the registration form.*

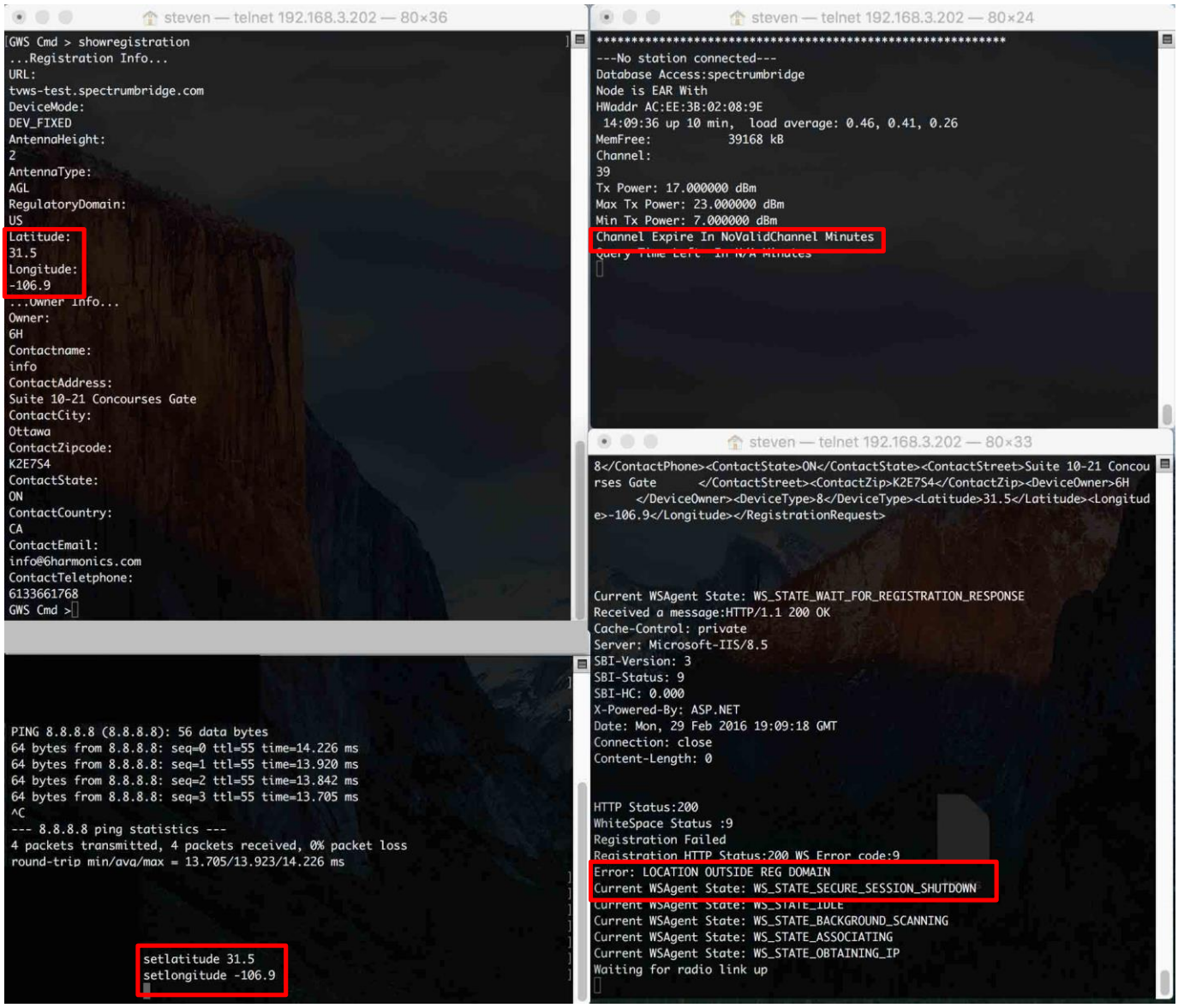

Figure8.2-4: *Data log of unsuccessful registration with restricted coordinates of slave device*

8.3 FCC15.713(g)(3)(v) Unsuccessful registration due to incomplete information – missing owner

8.3.1 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

8.3.2 Test summary

Test date	February 29, 2016	Temperature	22 °C
Test engineer	Andrey Adelberg	Air pressure	1004 mbar
Verdict	Pass	Relative humidity	32 %

8.3.3 Observations, settings and special notes

EUT was configured with incomplete information: owner 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, the EUT stopped the transmission.

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 such that the contact information was missing. The registration process was re-initiated with the missing contact information. The device Software detected the incomplete registration information and did not send a request to the database, but rather ceased to transmit as can be seen in Fig 8.3-1. Conversely, if the device was initially configured with invalid contact information, the device will not transmit or attempt to register. The test was repeated for a Master Device Fig 8.3-1 and a Slave Device Fig 8.3-3.

8.3.4 Test data

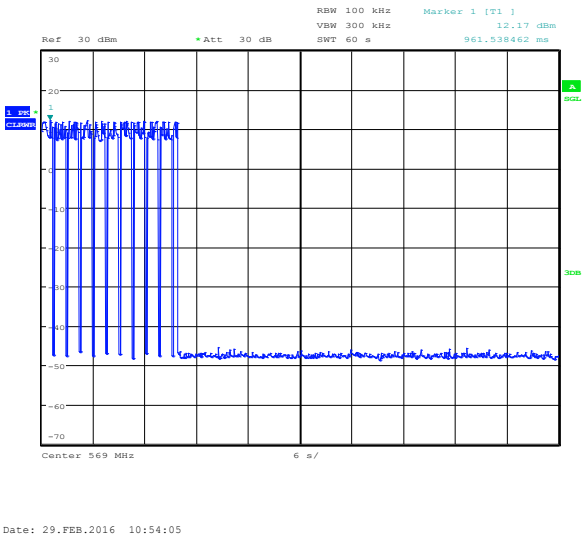

Figure8.3-1: *Unsuccessful registration with missing owner of master device. Spectrum plot shows that prior to the unsuccessful registration the EUT was transmitting and the transmission stopped right after the EUT detected missing information in the registration form.*

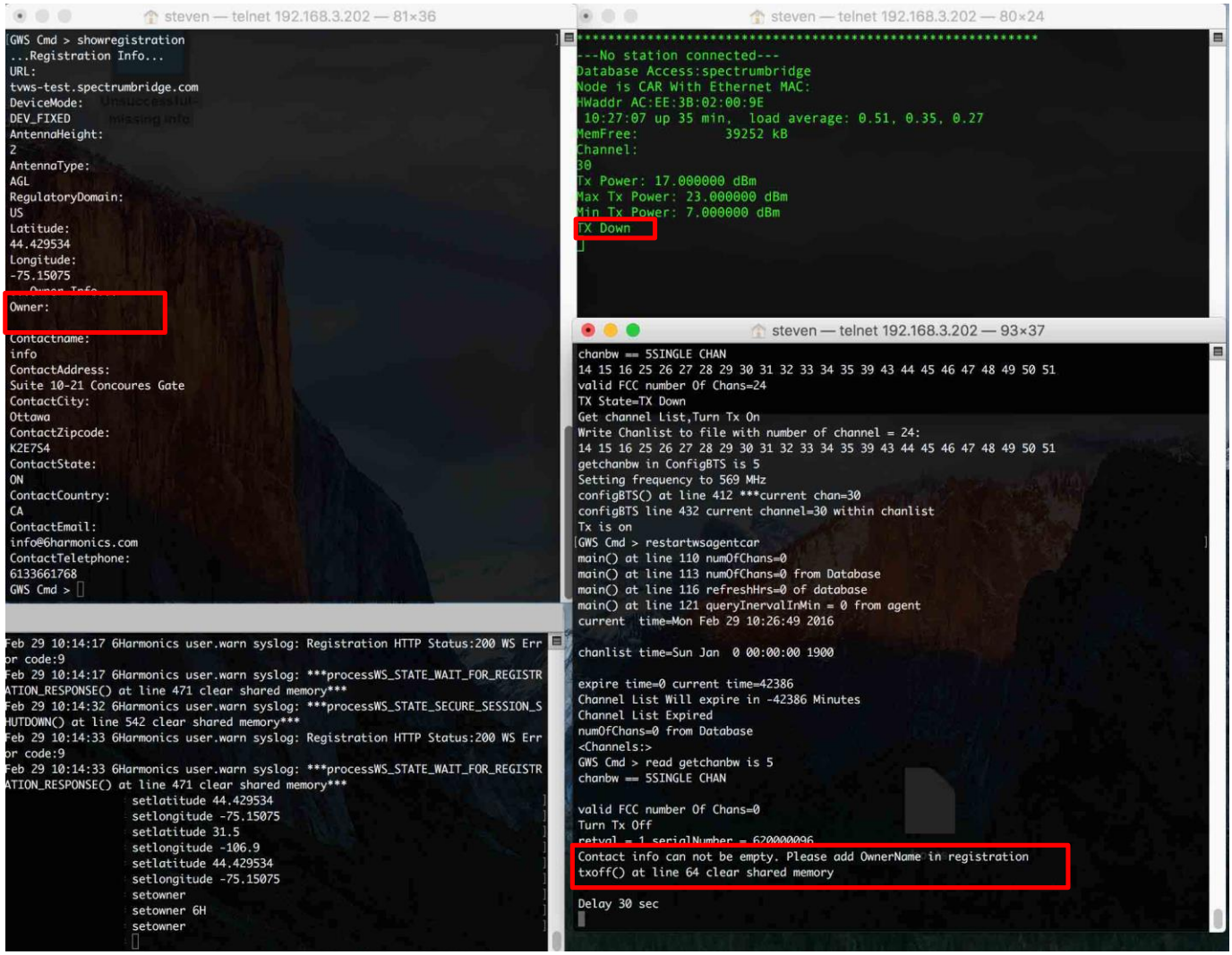

Figure8.3-2: *Data log of unsuccessful registration with missing owner information of master device*

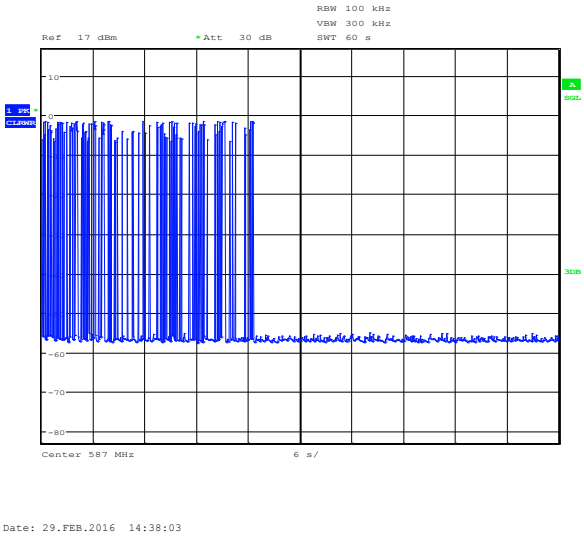

Figure8.3-3: *Unsuccessful registration with missing owner of slave device. Spectrum plot shows that prior to the unsuccessful registration the EUT had been configured with valid information and was transmitting. Subsequently when a registration request was initiated with invalid data the transmission stopped right after the EUT detected missing information in the registration form.*

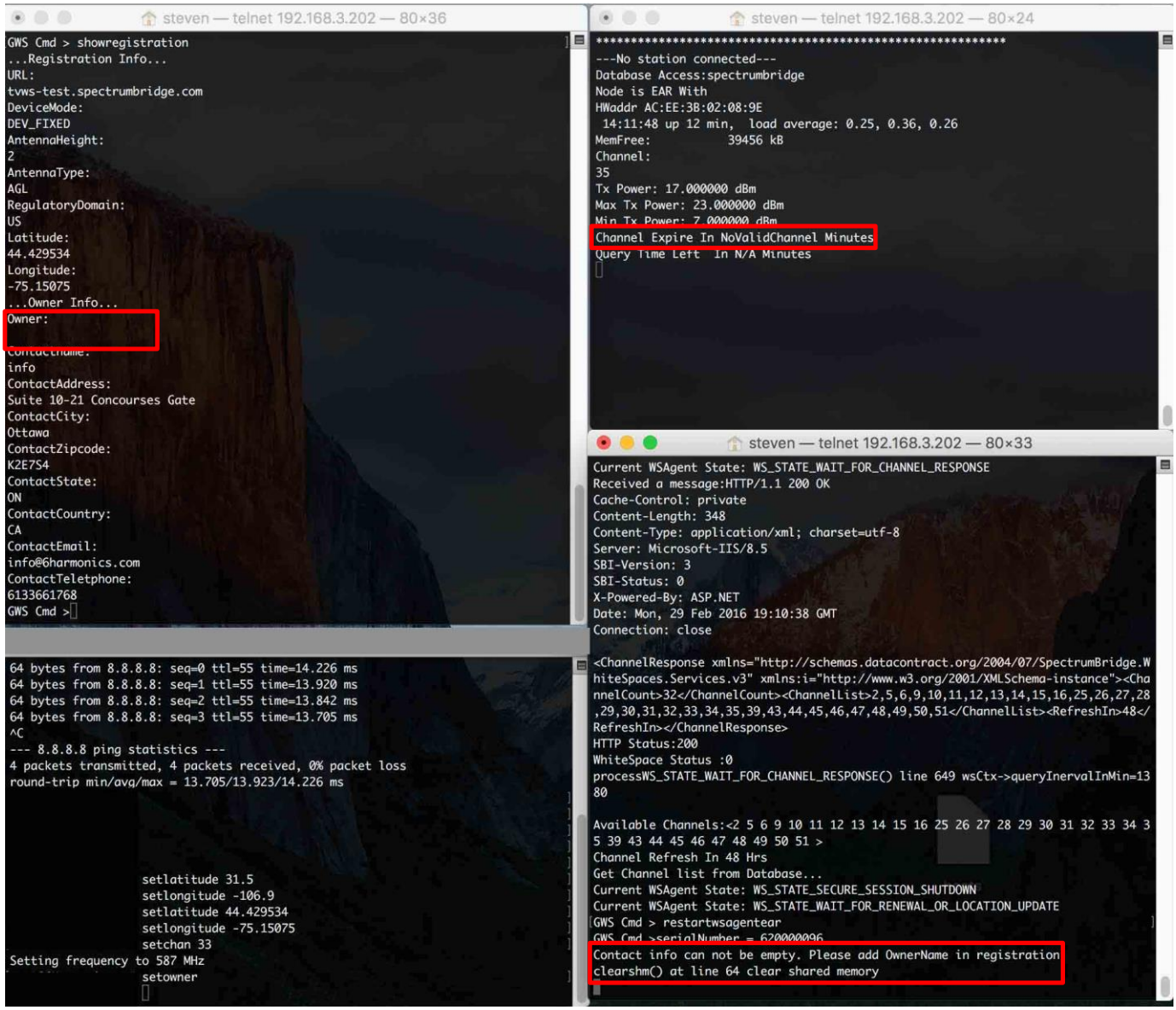

Figure8.3-4: *Data log of unsuccessful registration with missing owner information of slave device*

8.4 FCC15.713(g)(3)(vi) Unsuccessful registration due to incomplete information – contact name

8.4.1 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

8.4.2 Test summary

Test date	February 29, 2016	Temperature	22 °C
Test engineer	Andrey Adelberg	Air pressure	1004 mbar
Verdict	Pass	Relative humidity	32 %

8.4.3 Observations, settings and special notes

EUT was configured with incomplete information: contact name field was left intentionally blank (instead of *info*). 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 re-initiated. Once the device detects an invalid registration field, the device ceased to transmit and flagged the error in the GUI. The test was repeated when the device is configured as a Master as well as a Slave.

8.4.4 Test data

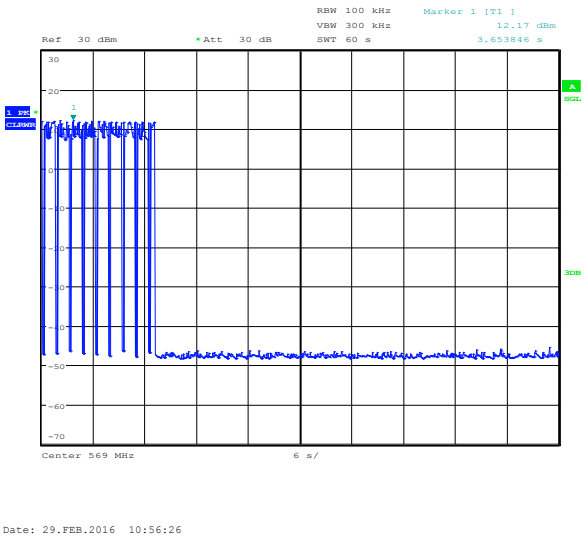

Figure8.4-1: *Unsuccessful registration with missing contact name of master device. Spectrum plot shows that prior to the unsuccessful registration the EUT had been configured with valid information and was transmitting. Subsequently when a registration request was initiated with invalid data the transmission stopped right after the EUT detected missing information in the registration form. If the EUT detects a missing contact name during initial power up, the device will not attempt to register with the database, will not transmit and will flag the error to the user.*

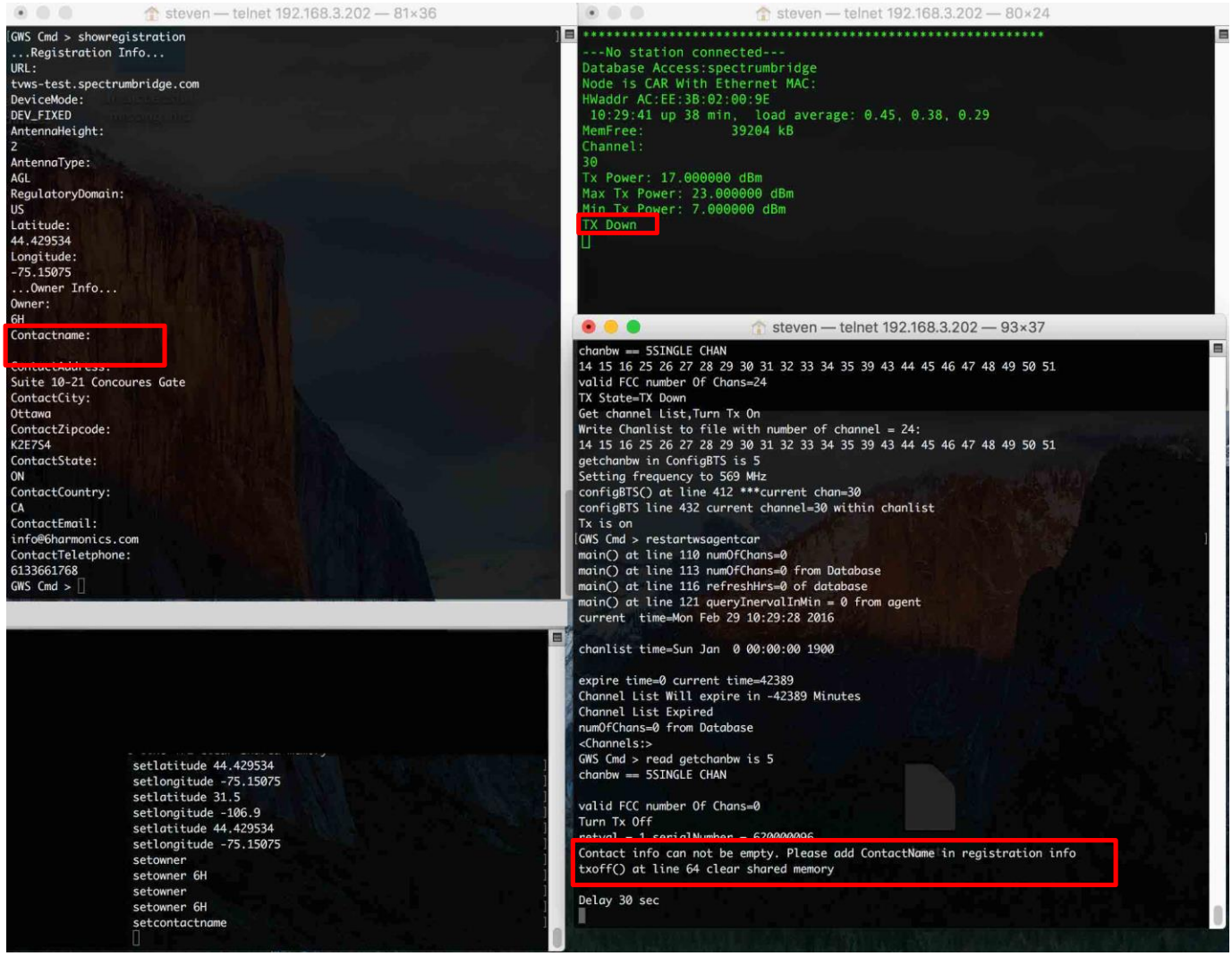

Figure8.4-2: *Data log of unsuccessful registration with missing contact name of master device*

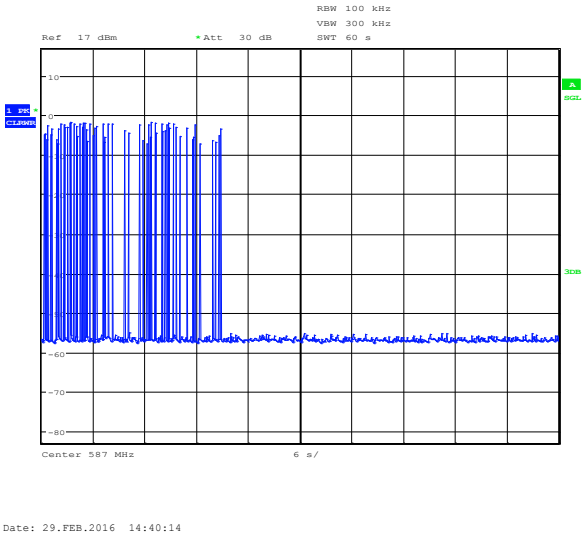

Figure8.4-3: *Unsuccessful registration with missing contact name of slave device. Spectrum plot shows that prior to the unsuccessful registration the EUT had been configured with valid information and was transmitting. Subsequently when a registration request was initiated with invalid data the transmission stopped right after the EUT detected missing information in the registration form. If the EUT detects a missing contact name during the initial power up, the device will not attempt to register with the database, will not transmit and will flag3 the error to the user.*

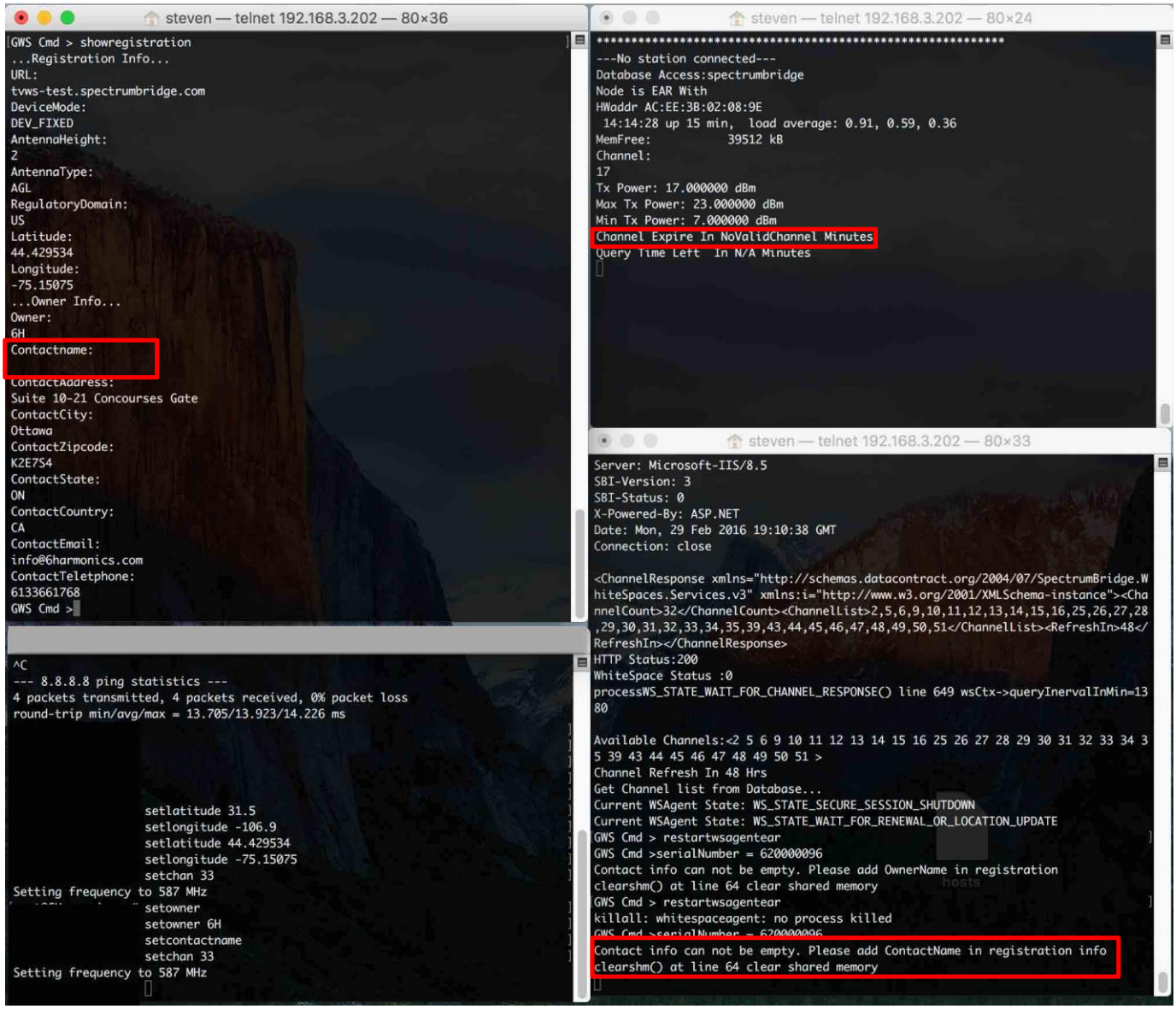

Figure8.4-4: *Data log of unsuccessful registration with missing contact name of slave device*

8.5 FCC15.713(g)(3)(vii) Unsuccessful registration due to incomplete information – contact address

8.5.1 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

8.5.2 Test summary

Test date	February 29, 2016	Temperature	22 °C
Test engineer	Andrey Adelberg	Air pressure	1004 mbar
Verdict	Pass	Relative humidity	32 %

8.5.3 Observations, settings and special notes

EUT was configured with incomplete information: contact address field was left intentionally blank (instead of *Suit 10-21 Concourse Gate*). 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 re-initiated. Once the device detects an invalid registration field, the device ceased to transmit and flagged the error in the GUI. The test was repeated when the device is configured as a Master as well as a Slave. If incomplete registration information is detected during the initial power up the device will not attempt to register and will flag the error to the user.

8.5.4 Test data

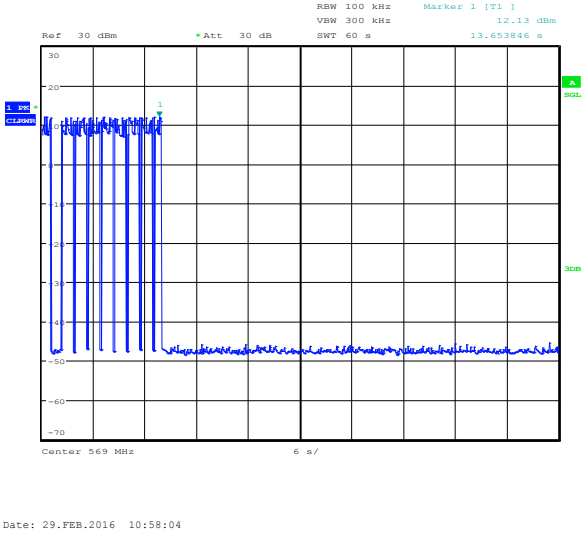

Figure8.5-1: *Unsuccessful registration with missing contact address of master device. Spectrum plot shows that prior to the unsuccessful registration the EUT had been configured with valid information and was transmitting. Subsequently when a registration request was initiated with invalid data the transmission stopped right after the EUT detected missing information in the registration form. If the EUT detects a missing contact name during the initial power up, the device will not attempt to register with the database, will not transmit and will flag the error to the user.*

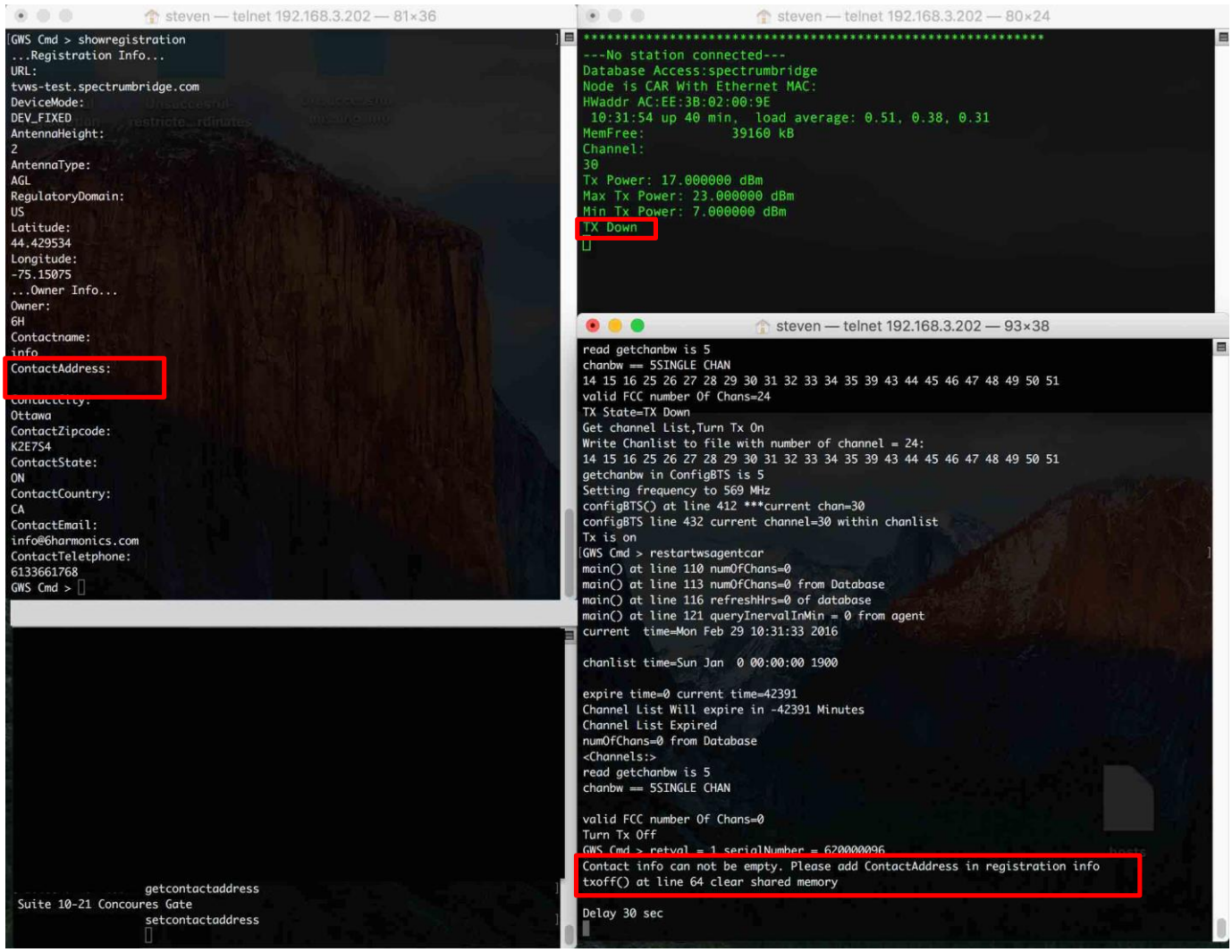

Figure8.5-2: *Data log of unsuccessful registration with missing contact address of master device*

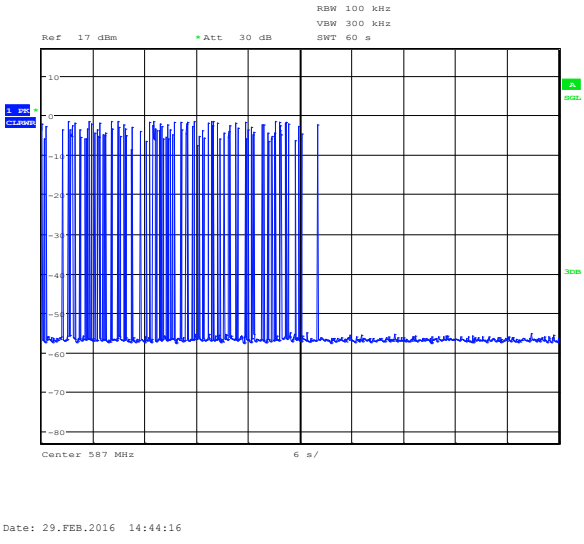

Figure8.5-3: *Unsuccessful registration with missing contact address of slave device. Spectrum plot shows that prior to the unsuccessful registration the EUT had been configured with valid information and was transmitting. Subsequently when a registration request was initiated with invalid data the transmission stopped right after the EUT detected missing information in the registration form. If the EUT detects a missing contact name during initial power up, the device will not attempt to register with the database, will not transmit and will flag the error to the user.*

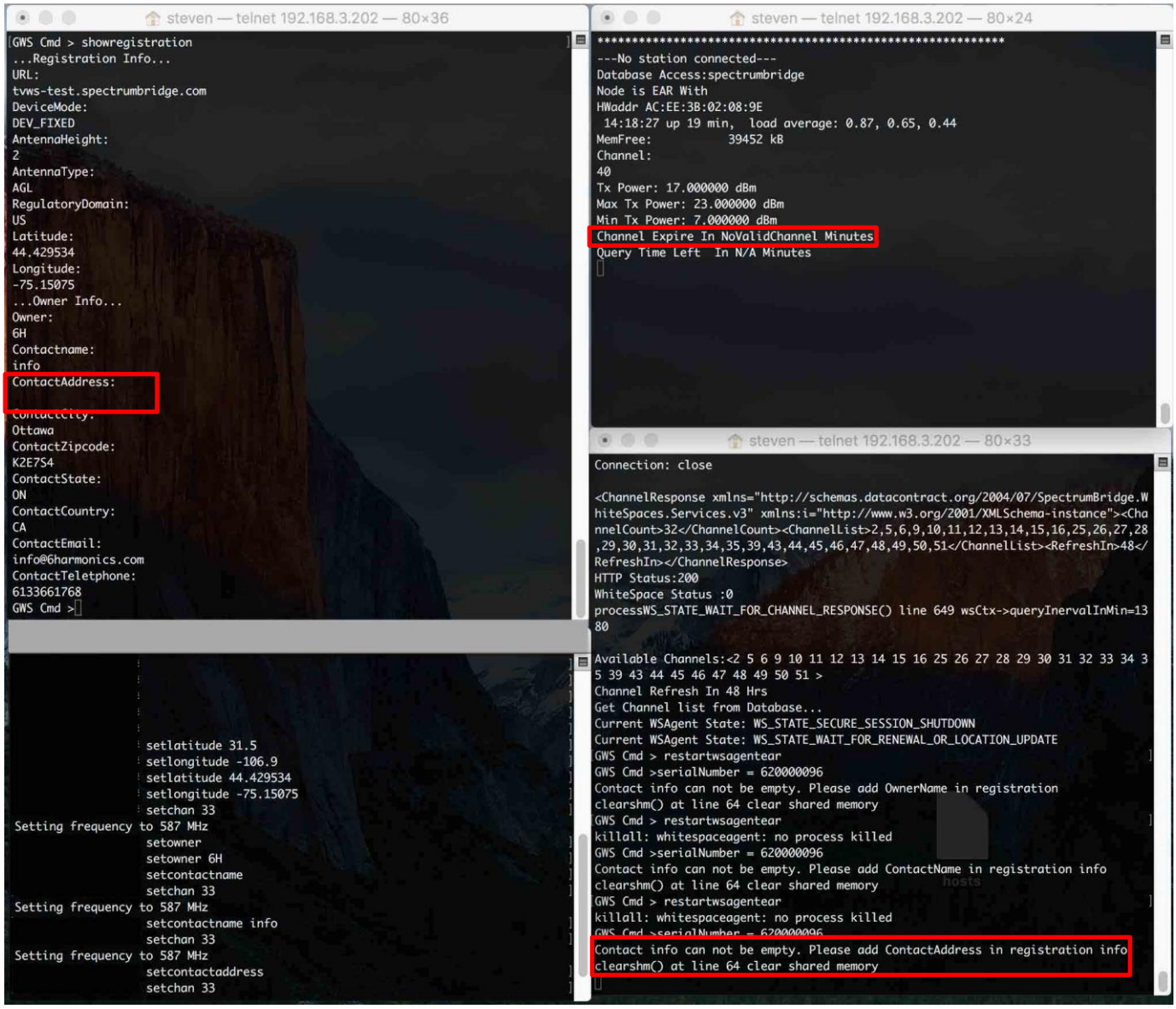

Figure8.5-4: *Data log of unsuccessful registration with missing contact address of slave device*

8.6 FCC15.713(g)(3)(vii) Unsuccessful registration due to incomplete information – contact state (province)

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	February 29, 2016	Temperature	22 °C
Test engineer	Andrey Adelberg	Air pressure	1004 mbar
Verdict	Pass	Relative humidity	32 %

8.6.3 Observations, settings and special notes

EUT was configured with incomplete information: 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, 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 device detects an invalid registration field, the device ceased to transmit and flagged the error in the GUI. The test was repeated when the device is configured as a Master as well as a Slave. If incomplete registration information is detected during the initial power up the device will not attempt to register and will flag the error to the user.

8.6.4 Test data

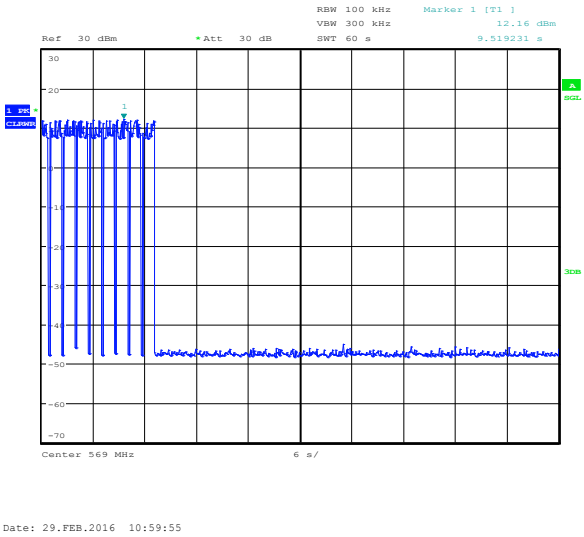

Figure8.6-1: *Unsuccessful registration with missing contact contact (state) of master device. Spectrum plot shows that prior to the unsuccessful registration the EUT had been configured with valid information and was transmitting. Subsequently when a registration request was initiated with invalid data the transmission stopped right after the EUT detected missing information in the registration form. If the EUT detects a missing contact name during initial power up, the device will not attempt to register with the database, will not transmit and will flag the error to the user.*

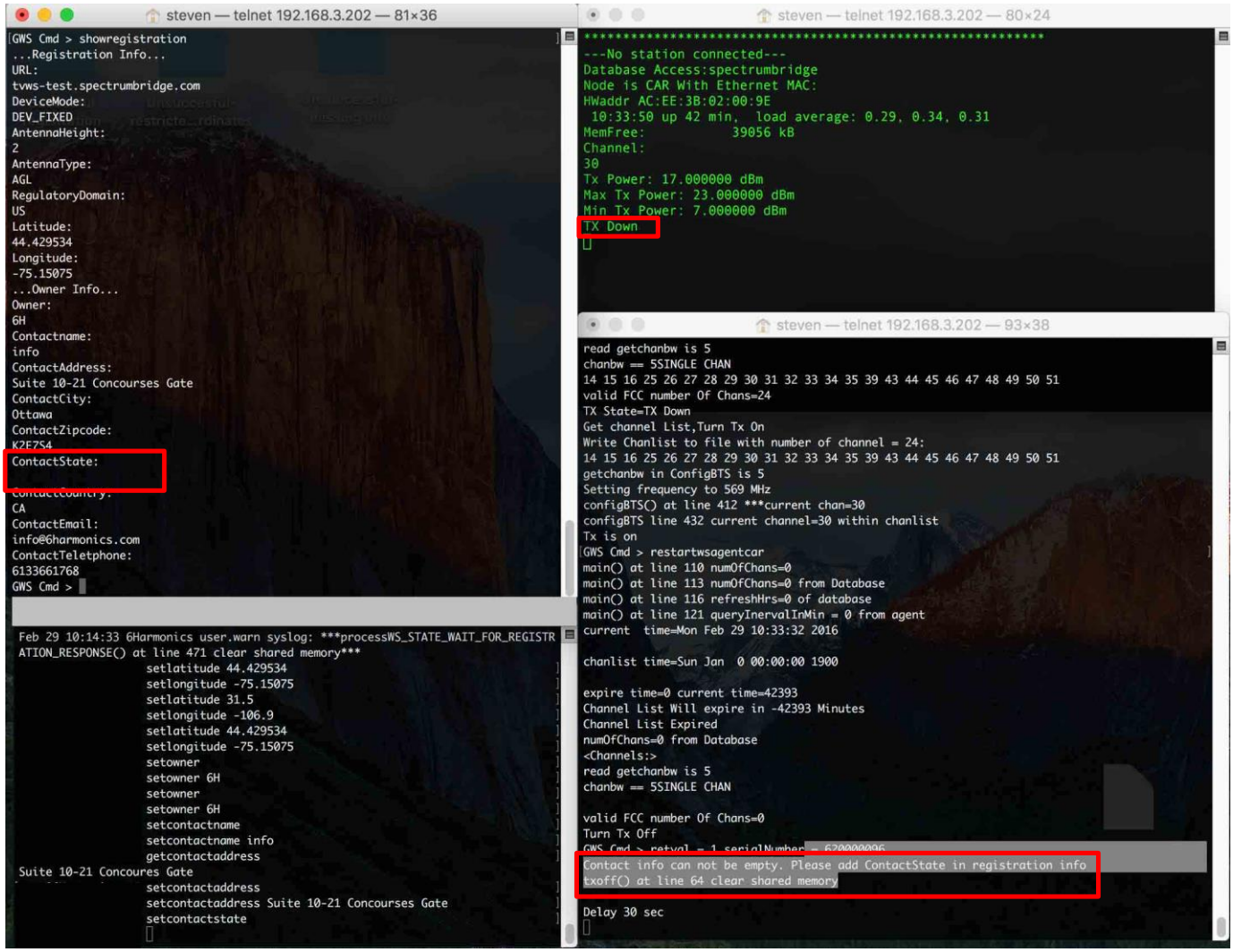

Figure8.6-2: *Data log of unsuccessful registration with missing contact state of master device*

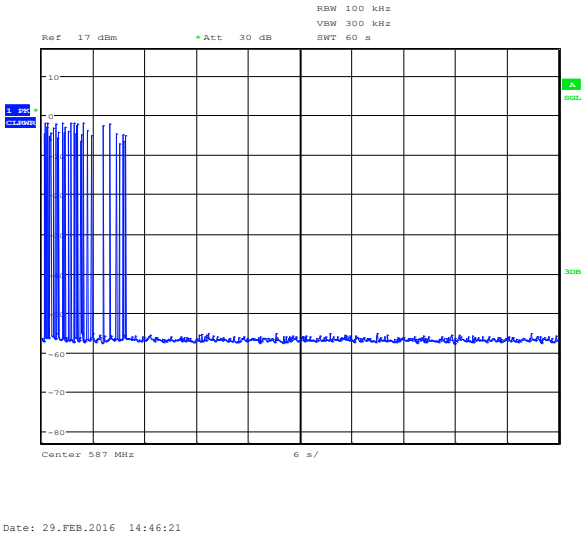

Figure8.6-3: *Unsuccessful registration with missing contact contact state (province) of slave device. Spectrum plot shows that prior to the unsuccessful registration the EUT had been configured with valid information and was transmitting. Subsequently when a registration request was initiated with invalid data the transmission stopped right after the EUT detected missing information in the registration form. If the EUT detects a missing contact name during initial power up, the device will not attempt to register with the database, will not transmit and will flag the error to the user.*

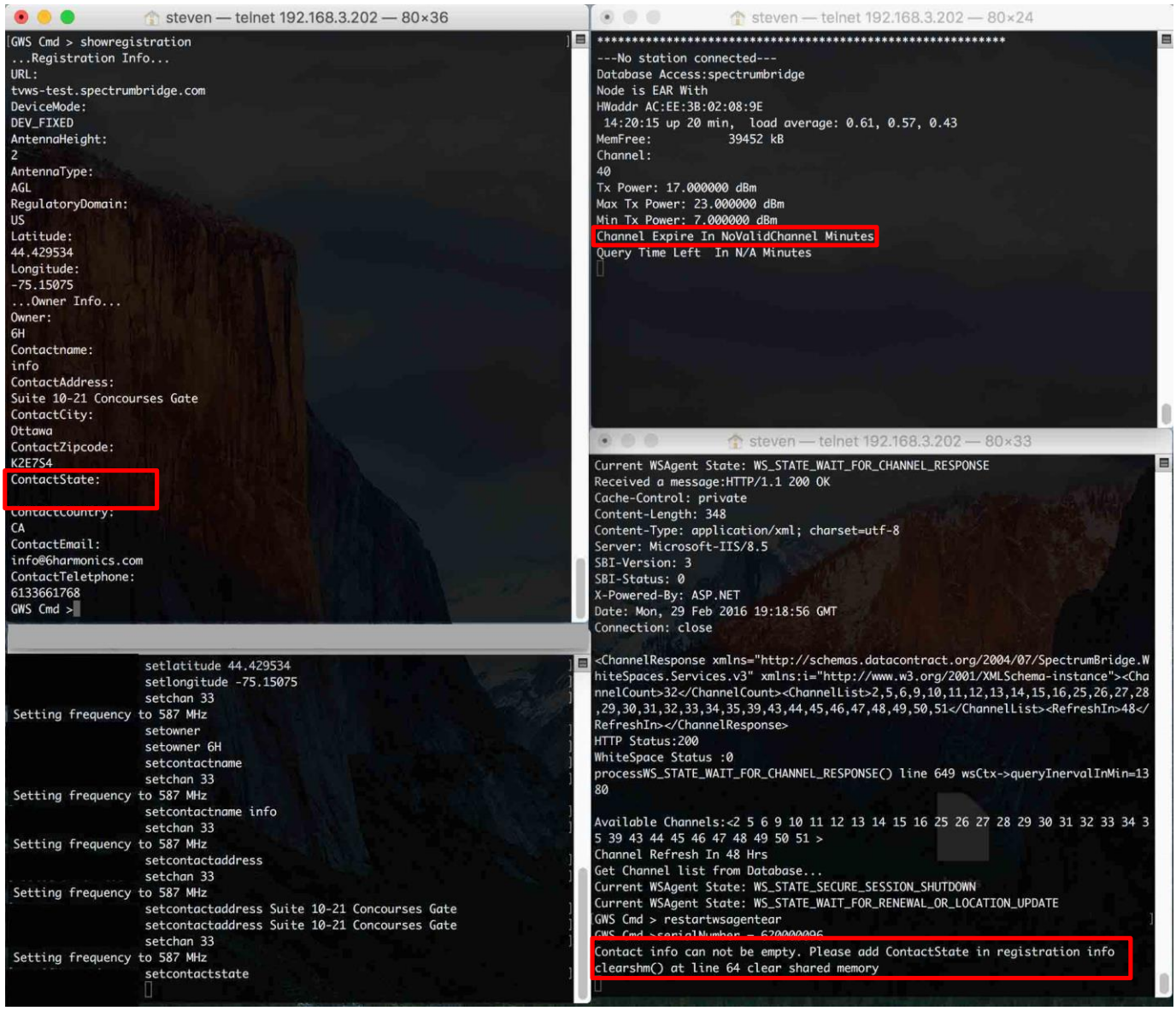

Figure8.6-4: *Data log of unsuccessful registration with missing contact state of slave device*

8.7 FCC15.713(g)(3)(vii) Unsuccessful registration due to incomplete information – contact zip code

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	February 29, 2016	Temperature	22 °C
Test engineer	Andrey Adelberg	Air pressure	1004 mbar
Verdict	Pass	Relative humidity	32 %

8.7.3 Observations, settings and special notes

EUT was configured with incomplete information: contact zip 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 re-initiated. Once the device detects an invalid registration field, the device ceased to transmit and flagged the error in the GUI. The test was repeated when the device is configured as a Master as well as a Slave. If incomplete registration information is detected during the initial power up the device will not attempt to register and will flag the error to the user.

8.7.4 Test data

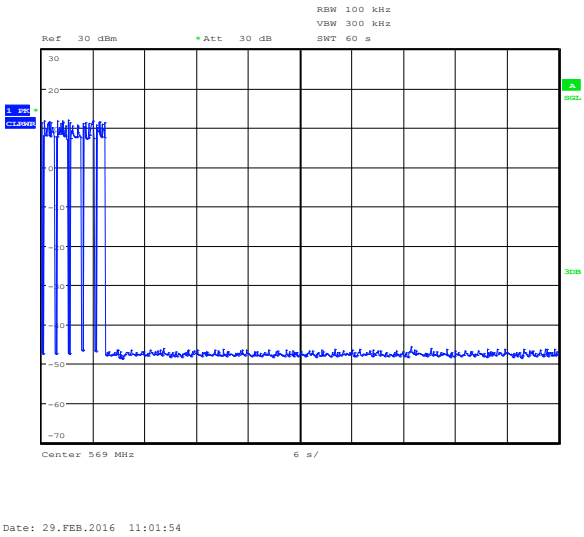

Figure8.7-1: *Unsuccessful registration with missing contact zip code of master device. Spectrum plot shows that prior to the unsuccessful registration the EUT had been configured with valid information and was transmitting. Subsequently when a registration request was initiated with invalid data the transmission stopped right after the EUT detected missing information in the registration form. If the EUT detects a missing contact zip code during initial power up, the device will not attempt to register with the database, will not transmit and will flag the error to the user.*

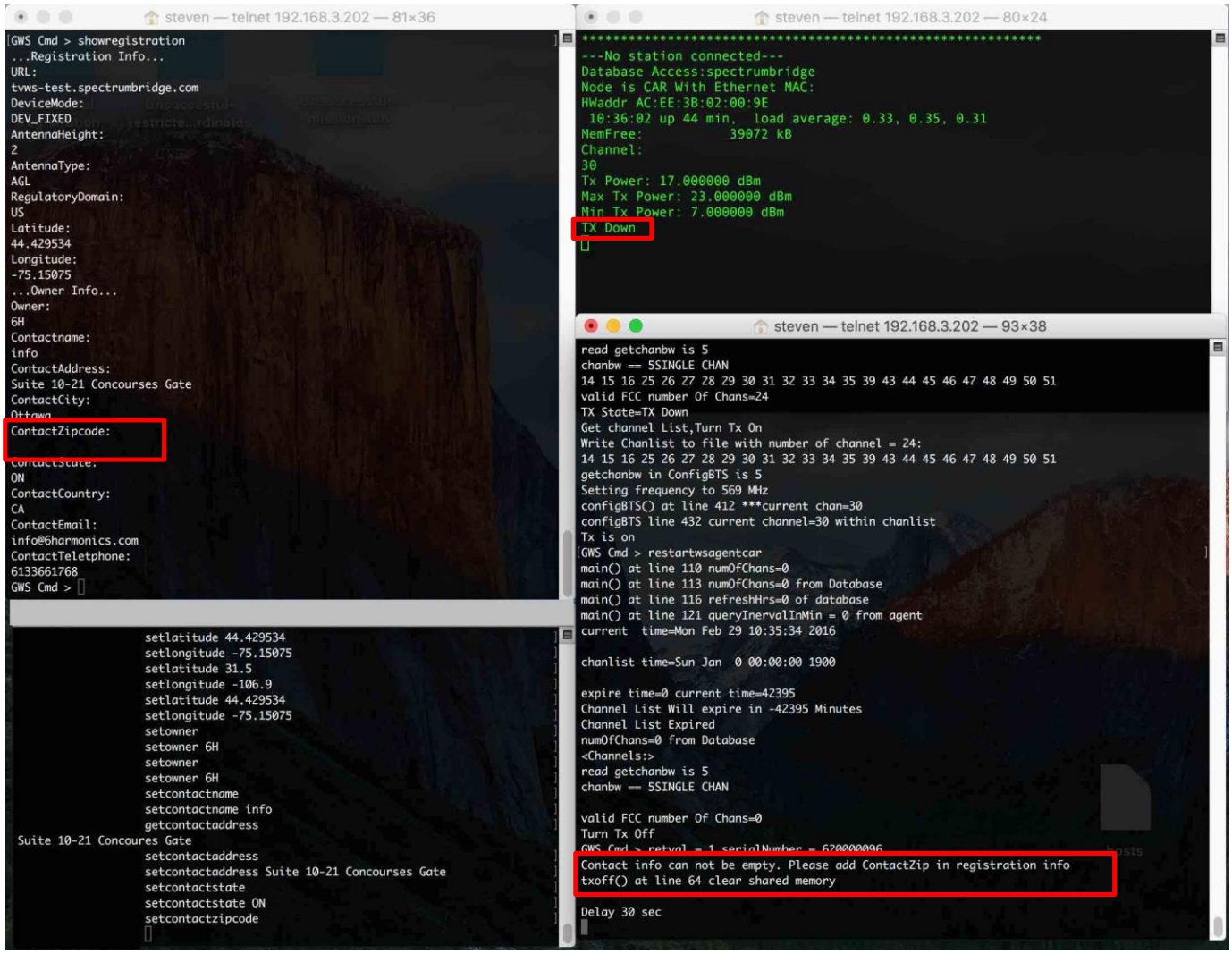

Figure8.7-2: *Data log of unsuccessful registration with missing contact zip code of master device*

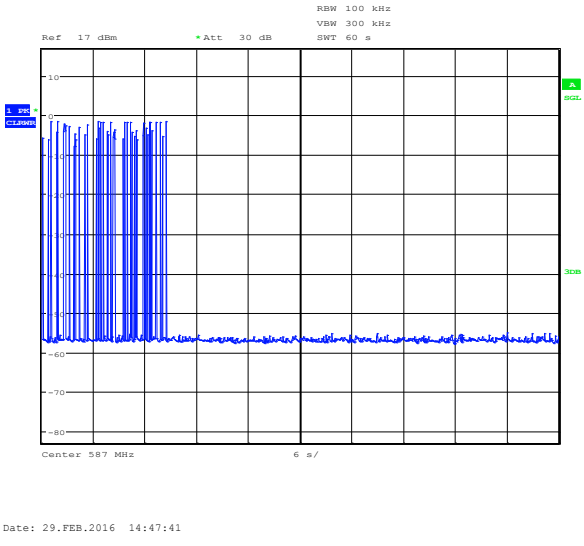

Figure8.7-3: *Unsuccessful registration with missing contact zip code of slave device. Spectrum plot shows that prior to the unsuccessful registration the EUT had been configured with valid information and was transmitting. Subsequently when a registration request was initiated with invalid data the transmission stopped right after the EUT detected missing information in the registration form. If the EUT detects a missing contact zip code during initial power up, the device will not attempt to register with the database, will not transmit and will flag the error to the user.*

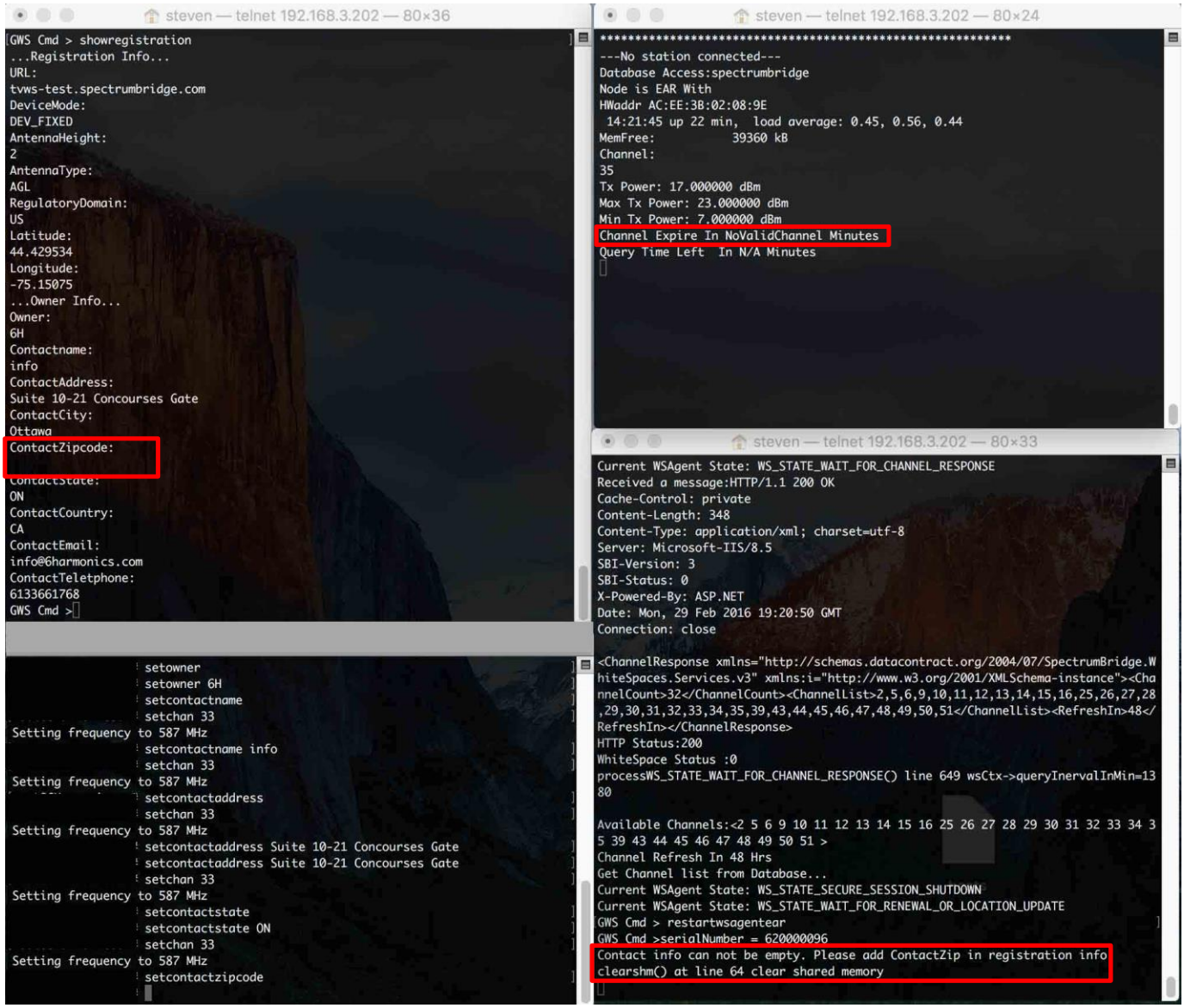

Figure8.7-4: *Data log of unsuccessful registration with missing contact zip code of slave device*