TEST REPORT CONCERNING THE COMPLIANCE OF A HEYREX COLLAR BIOSENSOR CAPSULE V7 ANIMAL BIOMETRICS MONITORING DEVICE (SPREAD SPECTRUM TRANSMITTER) BRAND HEYREX, MODEL C7 WITH 47 CFR PART 15 (10-1-14 Edition) AND RSS-GEN (ISSUE 4, NOVEMBER 2014) AND RSS-210 (ISSUE 8, DECEMBER 2010)

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FCC listed : 90828
Industry Canada : 2932G-2
R&TTE, LVD, EMC Notified Body : 1856

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MEASUREMENT/TECHNICAL REPORT

Brand: Heyrex
Model: C7

FCC ID: RGZ-C7
IC: 12380A-C7

This report concerns: Original grant/certification ~~Class 1 permissive change~~ ~~Verification~~

Equipment type: Spread Spectrum Transmitter (DSS)

Report prepared by:

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The data taken for this test and report herein was done in accordance with 47 CFR Part 15 (10-1-14 Edition), RSS-Gen (Issue 4, November 2014) and RSS-210 (Issue 8, December 2010) and the measurement procedures of FCC Public Notice DA 00-705. TÜV Rheinland Nederland B.V. at Leek, The Netherlands, certifies that the data is accurate and contains a true representation of the emission profile of the Equipment Under Test (EUT) on the date of the test as noted in the test report. I have reviewed the test report and find it to be an accurate description of the test(s) performed and the EUT so tested.

Date: March 04, 2015 Signature:

P. de Beer
Technical Manager TÜV Rheinland Nederland B.V.

Description of test item

Test item	:	Spread Spectrum Transmitter (DSS)
Manufacturer	:	Heyrex
Brand	:	Heyrex
Model	:	C7
Serial number	:	Unindentified test sample
Revision	:	--

Applicant information

Applicant's representative	:	Mr. M. Koop
Company	:	Teleconformity
Address	:	Constructieweg 1
Postal code	:	7451PS
City	:	Holten
Country	:	The Netherlands
Telephone number	:	+31 53 4785267
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Test(s) performed

Location	:	Leek
Test(s) started	:	August 07, 2014
Test(s) completed	:	March 03, 2015
Purpose of test(s)	:	Equipment Authorization (Original grant/certification)
Test specification(s)	:	FCC 47 CFR Part 15, Subpart C, Section 15.247 (10-1-14 Edition) and RSS-Gen (Issue 4, November 2014) and RSS-210 (Issue 8, December 2010) FCC Public Notice DA 00-705 march 30, 2000
Test engineer(s)	:	R. van der Meer 
Report written by	:	R. van der Meer 
Report date	:	March 04, 2015

Table of contents

1 General information.

1.1 Product description.

1.1.1 Introduction.

The brand Heyrex model C7, hereafter referred to as EUT, is a Spread Spectrum Transmitter (DSS) and is part of an animal activity and health monitoring system. The EUT is factory configured for the 2402-2462 MHz band.

Photographs of the EUT, front (left) and back (right)

The content of this report and measurement results have not been changed other than the way of presenting the data.

1.2 Related submittal(s) and/or Grant(s).

1.2.1 General.

This test report supports the original certification in equipment authorization files under FCC ID: RGZ-C7 and IC: 12380A-C7.

1.3 Tested system details.

Details and an overview of the system and all of its components, as it has been tested, may be found below.

EUT	:	Spread Spectrum Transmiiter (DSS)
Manufacturer	:	Heyrex
Brand	:	heyrex
Model	:	C7
Serial number	:	unindentified test sample
Voltage input rating	:	3 Vdc battery operated only
Voltage output rating	:	n.a.
Current input rating	:	--
Antenna	:	internal
Operation frequency	:	2402 – 2462 MHz
Modulation	:	GFSK (2Mbps)
Spreading technique	:	FHSS
Remarks	:	--

1.3.1 Description of input and output ports.

There are no in – and output ports on the EUT.

1.4 Test methodology.

The test methodology used is based on the requirements of 47 CFR Part 15 (10-1-14 Edition), sections 15.31, 15.209 and 15.247, RSS-Gen (Issue 4, November 2014) and RSS-210 (Issue 8, December 2010) . The test methods, which have been used, are based on FCC Public Notice DA 00-705.

Radiated emission tests were performed at a measurement distance of 3 meters.

The measurement receiver is switching automatically to the right bandwidth in accordance with CISPR 16. This is implemented in the receiver. The antenna factors are programmed in the measurement receiver. The receiver automatically calculates the appropriate correction factor for the utilized antenna and also the appropriate antenna factor for the cable loss. The total correction is automatically added to the measured value.

1.5 Test facility.

The Federal Communications Commission and Industry Canada has reviewed the technical characteristics of the test facilities at TÜV Rheinland Nederland B.V., located in Leek, 9351VT Eiberkamp 10, The Netherlands, and has found these test facilities to be in compliance with the requirements of 47 CFR Part 15, section 2.948.

The description of the test facilities has been filed at the Office of the Federal Communications Commission under registration number 90828. The facility has been added to the list of laboratories performing these test services for the public on a fee basis.

The description of the test facilities has been filed to Industry Canada under registration number 2932G-2. The facility has been added to the list of laboratories performing these test services for the public on a fee basis.

1.6 Test conditions.

Normal test conditions:

Temperature (*)	: +15°C to +35°C
Relative humidity(*)	: 20 % to 75 %
Supply voltage	: EUT is battery powered and new fully loaded batteries were used for testing
Air pressure	: 950 – 1050 hPa

*When it was impracticable to carry out the tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests are stated separately.

2 System test configuration.

2.1 Justification.

The system was configured for testing in a typical situation as a customer would normally use it. The EUT was provided with a switch that enabled selection of various test modes.

The justification and manipulation of cables and equipment in order to simulate a worst-case behavior of the test setup has been carried out as prescribed in FCC Public Notice DA 00-705.

The EUT was not provided with antenna port, therefor tests were performed in a radiated testsetup instead of conducted.

2.2 EUT mode of operation.

The EUT has been tested in continuous transmit mode and in receive mode. Testing was performed at the lowest operating frequency (2402 MHz), at the operating frequency in the middle of the specified frequency band (2432 MHz) and at the highest operating frequency (2462 MHz).

2.3 Special accessories.

No special accessories are used and/or needed to achieve compliance.

2.4 Test software.

No test software was required for testing.

2.5 Equipment modifications.

No modifications have been made to the equipment in order to achieve compliance.

2.6 Product Labeling

The product labeling information is available at Heyrex.

2.7 Schematics of the EUT.

The schematics are available at Heyrex.

2.8 Part list of the EUT.

The part list is available at Heyrex.

3 Peak output power

Results: Pass

Date of testing: 2014-09-25 and 2015-03-03

Requirements:

FCC 15.247(b)(3), RSS-210 A8.4(2)

For systems using frequency hopping using less than 75 channels in the 2400-2483.5MHz band, the maximum peak output power is 0.125W (+21dBm).

Test procedure:

FCC Public notice DA 00-705 March 30, 2000 Alternative Test Procedure.

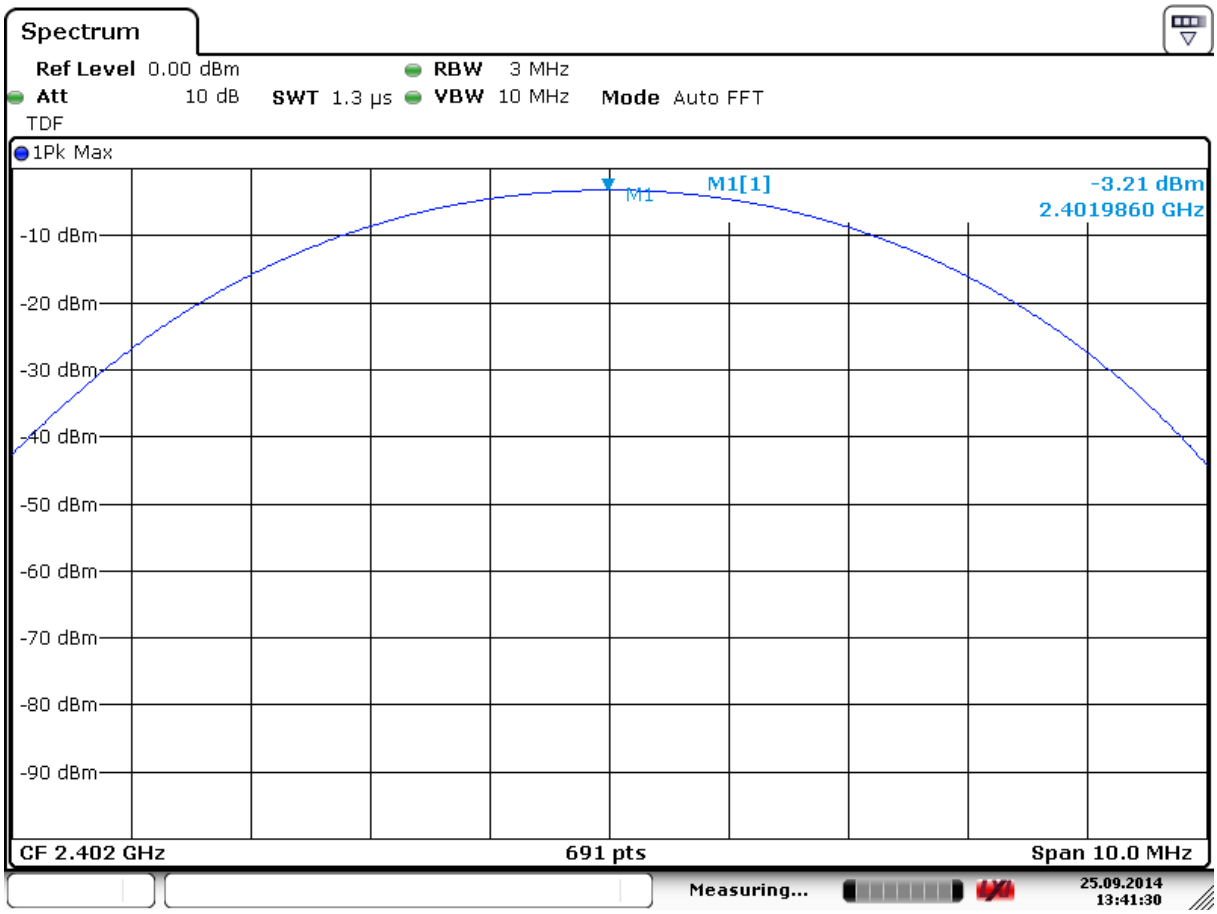
Because the EUT has no antenna port for conducted tests, the testresults are obtained by radiated power measurements using a spectrum analyzer with a Peak detector with a resolution bandwidth of 1 MHz. The conducted output power could not be tested because the EUT has no antenna port.

Frequency (MHz)	Measured Peak Output Power (dBm)	Limit (dBm)
2402	-3.21	21
2432	-3.42	21
2462	-2.94	21

Table 2 Peak output power

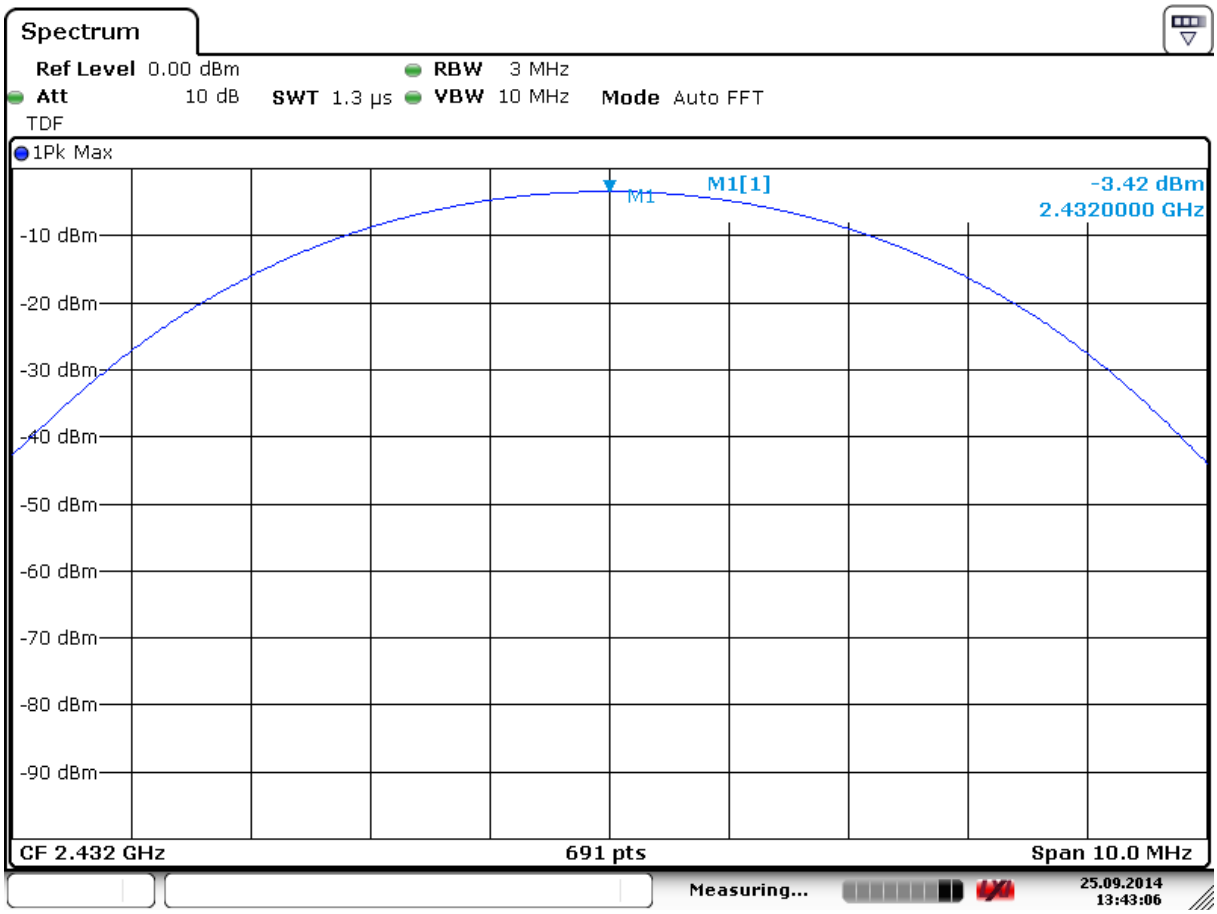
Notes:

1. Measured value includes correction factor for cable loss.
2. See plots on the next pages.



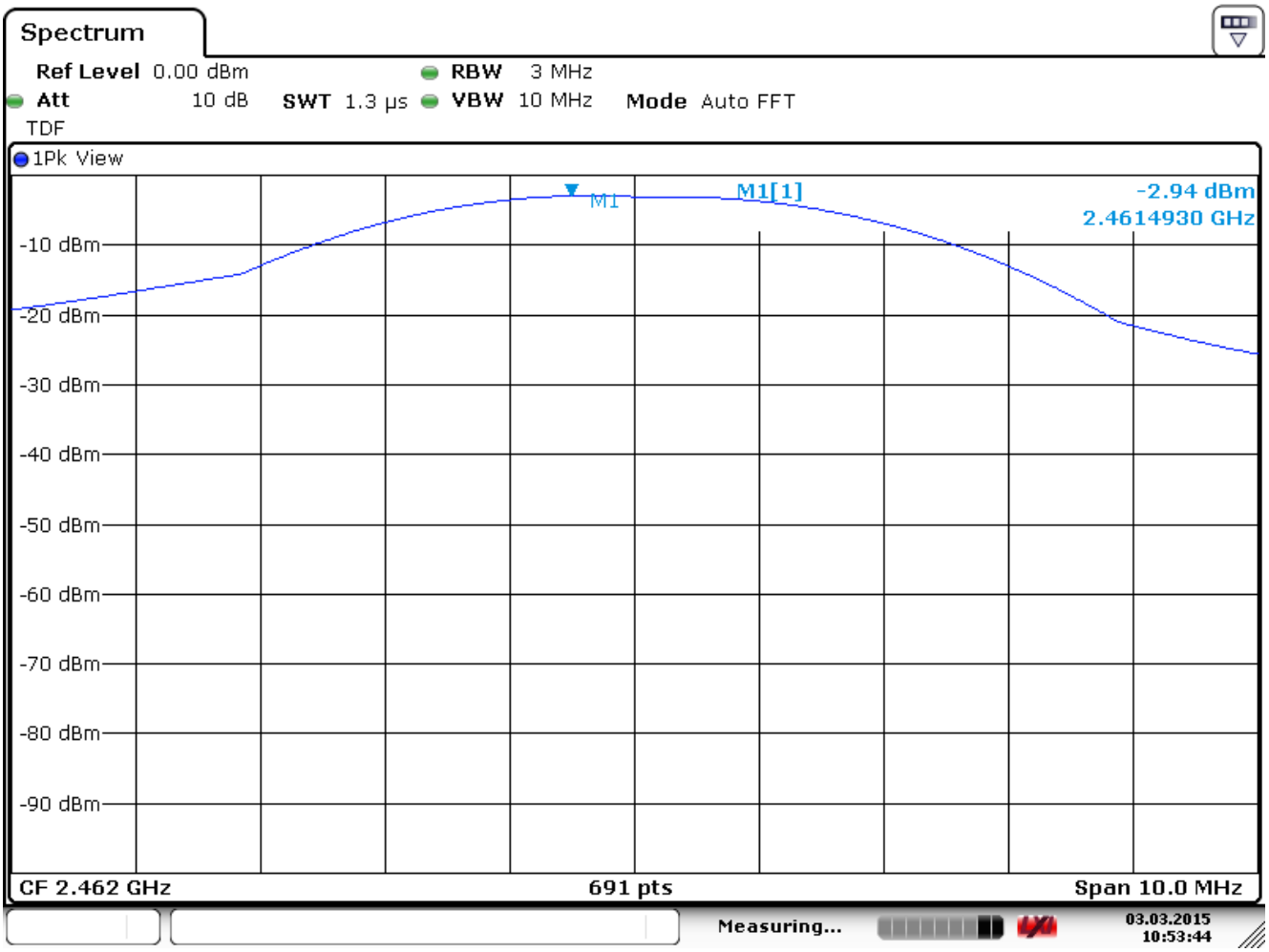
Date: 25.SEP.2014 13:41:30

Plot 1: Peak Output Power (2402 MHz)



Date: 25.SEP.2014 13:43:06

Plot 2: Peak Output Power (2432 MHz)



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Plot 3: Peak Output Power (2462 MHz)

4 Emission bandwidth

Results: Pass

Date of testing: 2014-09-25 and 03-03-2015

Requirements:

FCC 15.247(a)(2), RSS-210 A8.1

For systems using hopping technology in the 2400-2483.5MHz band, the 20dB bandwidth is not limited.

Test procedure:

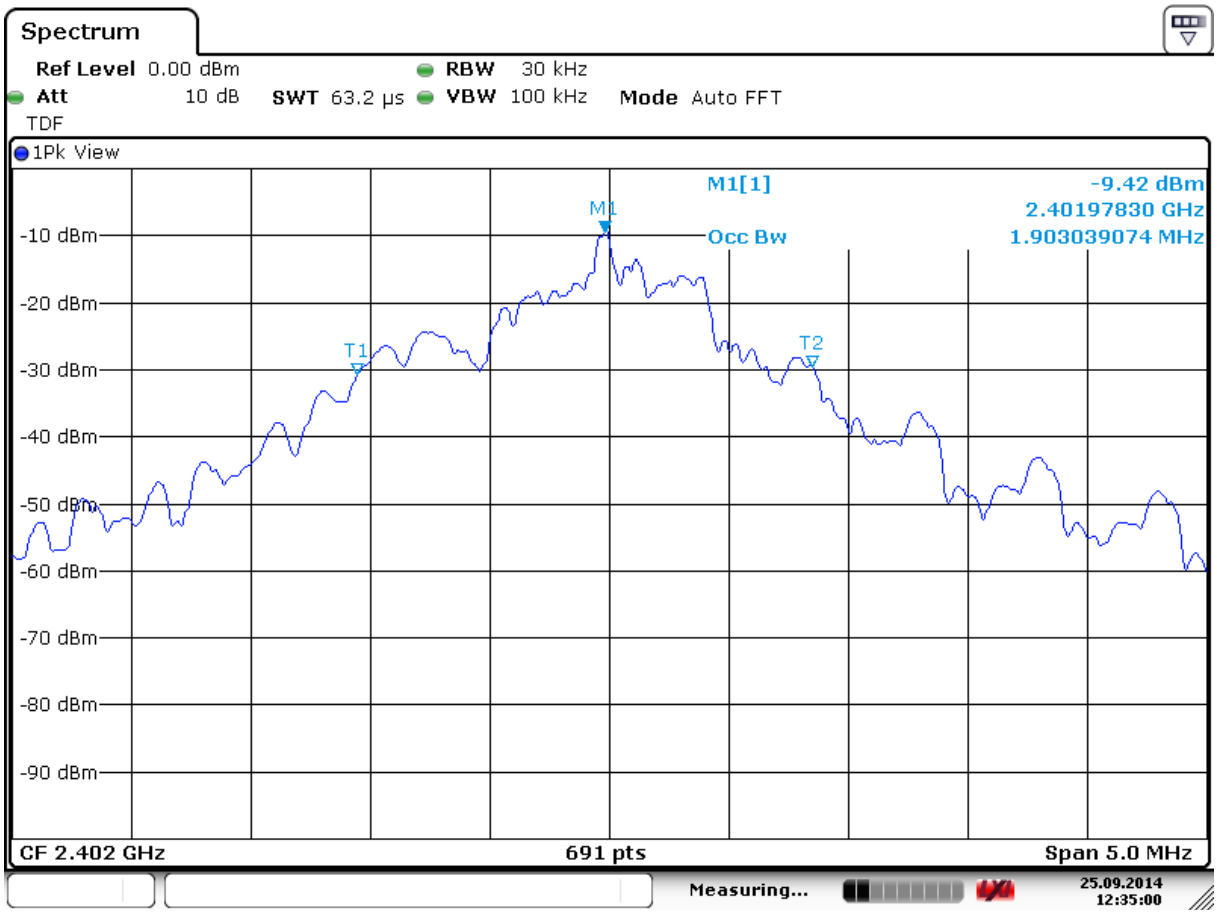
Public notice DA 00-705 March 30, 2000

The Occupied bandwidth was measured with the radiated test setup. The spectrum analyzer settings were as follows:

Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel
RBW ≥ 1% of the 20 dB bandwidth
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

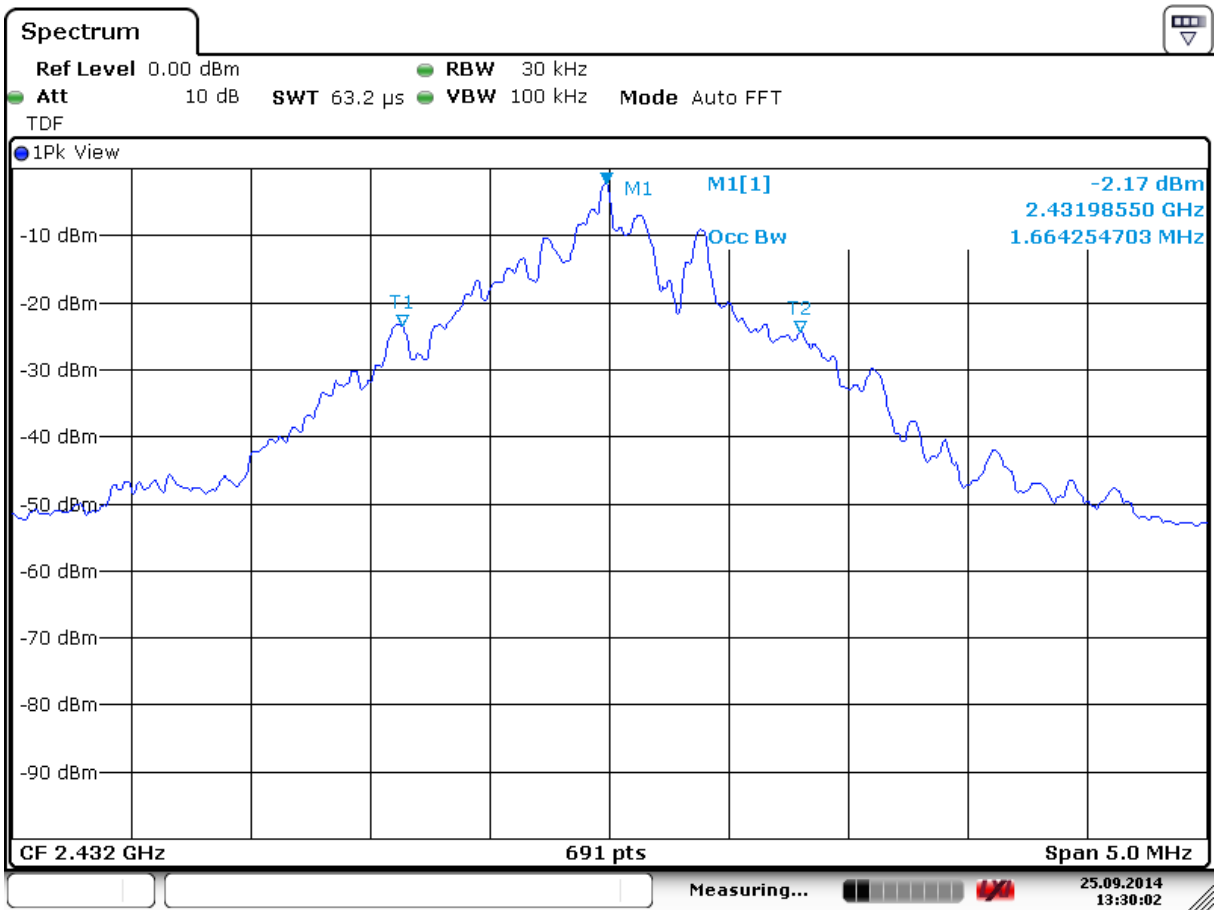
The marker-delta function was used to determine the -20 dB points.

See plots on the next pages.



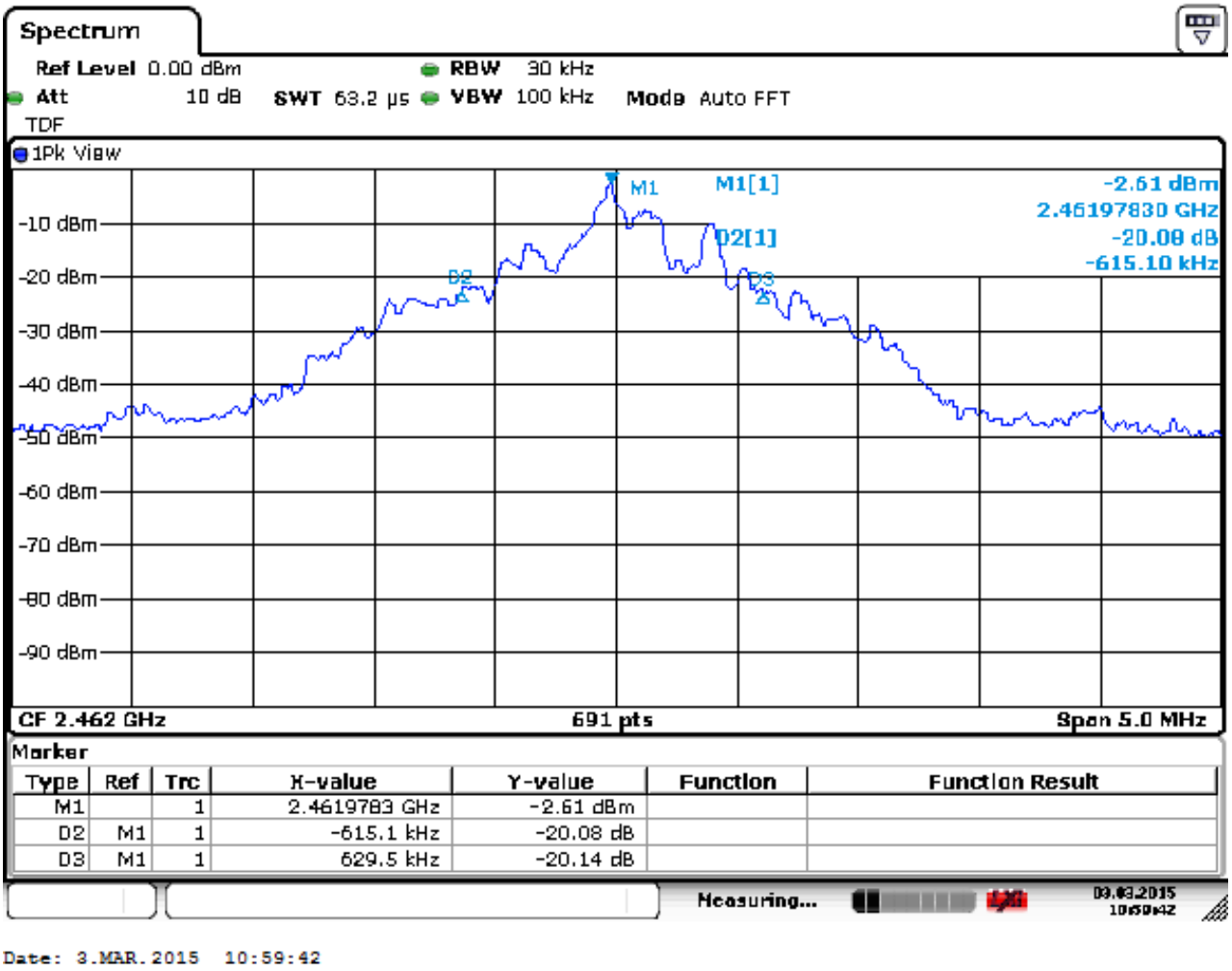
Date: 25.SEP.2014 12:35:00

Plot 4: Emission 20dB Bandwidth (=1.90 MHz) of the EUT transmitting at 2402 MHz



Date: 25.SEP.2014 13:30:02

Plot 5: Emission 20dB Bandwidth (=1.66 MHz) of the EUT transmitting at 2432 MHz



Plot 6: Emission 20dB Bandwidth (= 1.2446 MHz) of the EUT transmitting at 2462 MHz

5 Hopping frequencies, Average time of occupancy and Channel spacing.

RESULT: PASS

Date of testing: 2014-09-25

Requirements:

FCC 15.247(a)(1)(iii), RSS-210 A8.1(d)

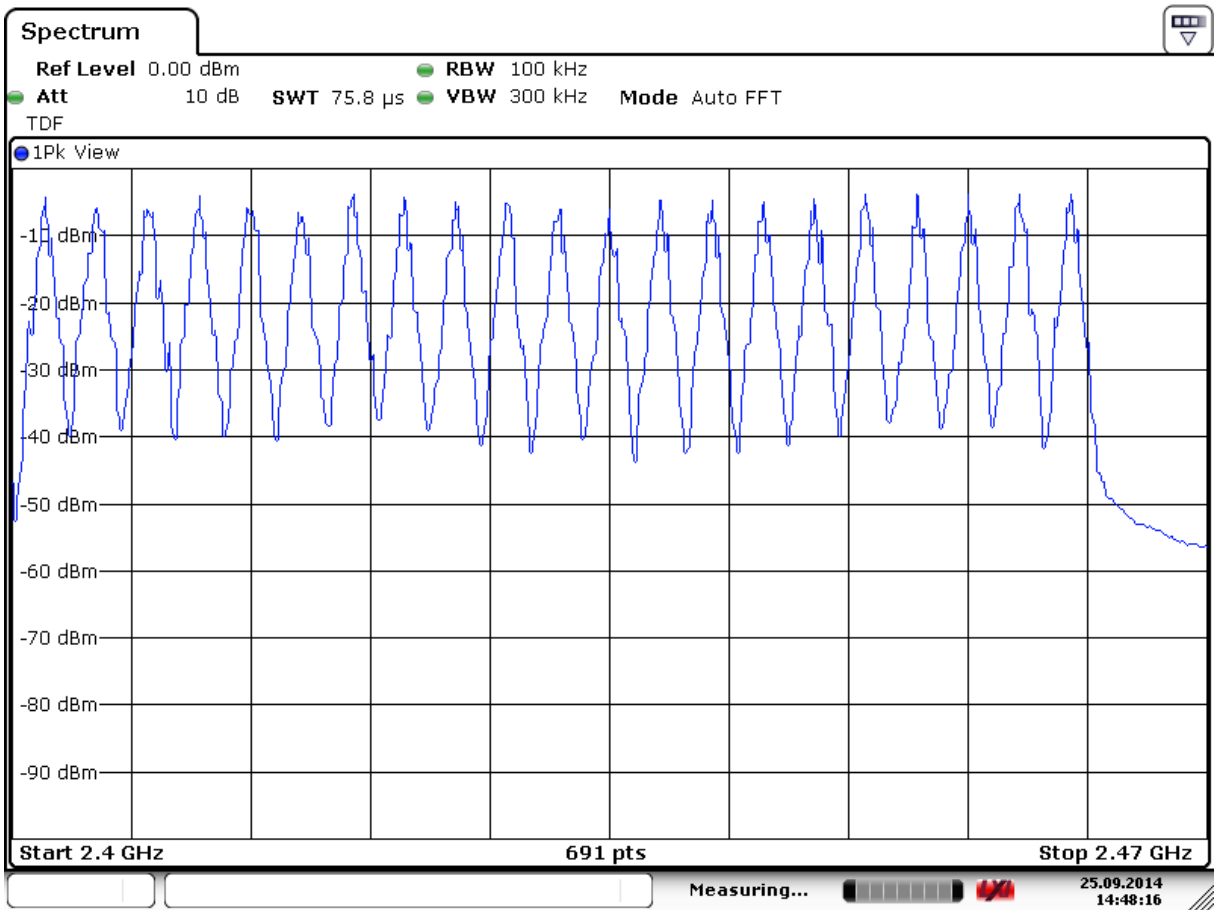
Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

Test procedure:

FCC Public notice DA 00-705 March 30, 2000.

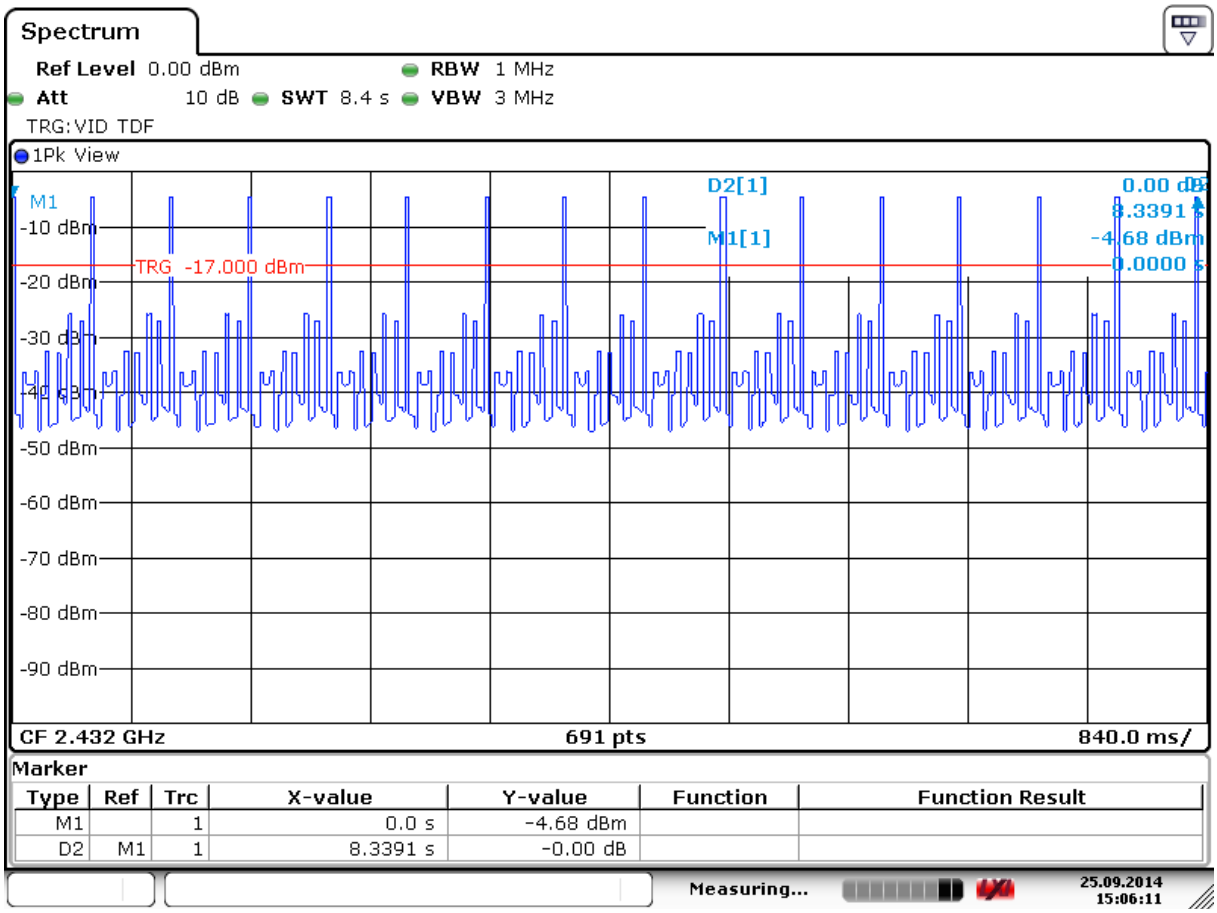
The EUT's hopping function was enabled.

Since the EUT was not provided with a antenna port for conducted tests, the tests were done with the radiated test setup (spectrum analyzer). See plots on the next pages.



Date: 25.SEP.2014 14:48:16

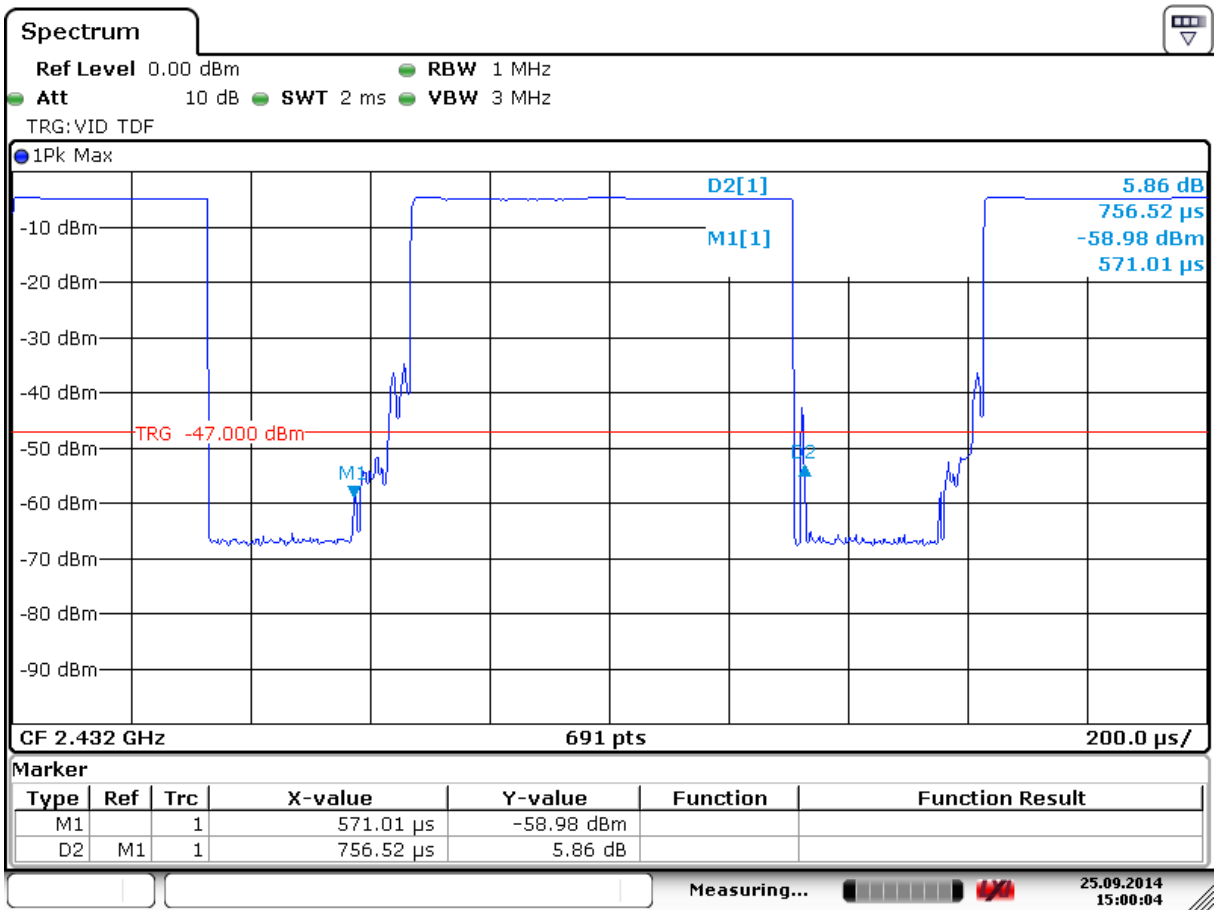
Plot 7: at least 15 (actual = 21) hopping frequencies, as measured on a spectrum analyzer



Date: 25.SEP.2014 15:06:11

Plot 8a: showing Average time of occupancy <0.4 s within a 8.4 sec period.

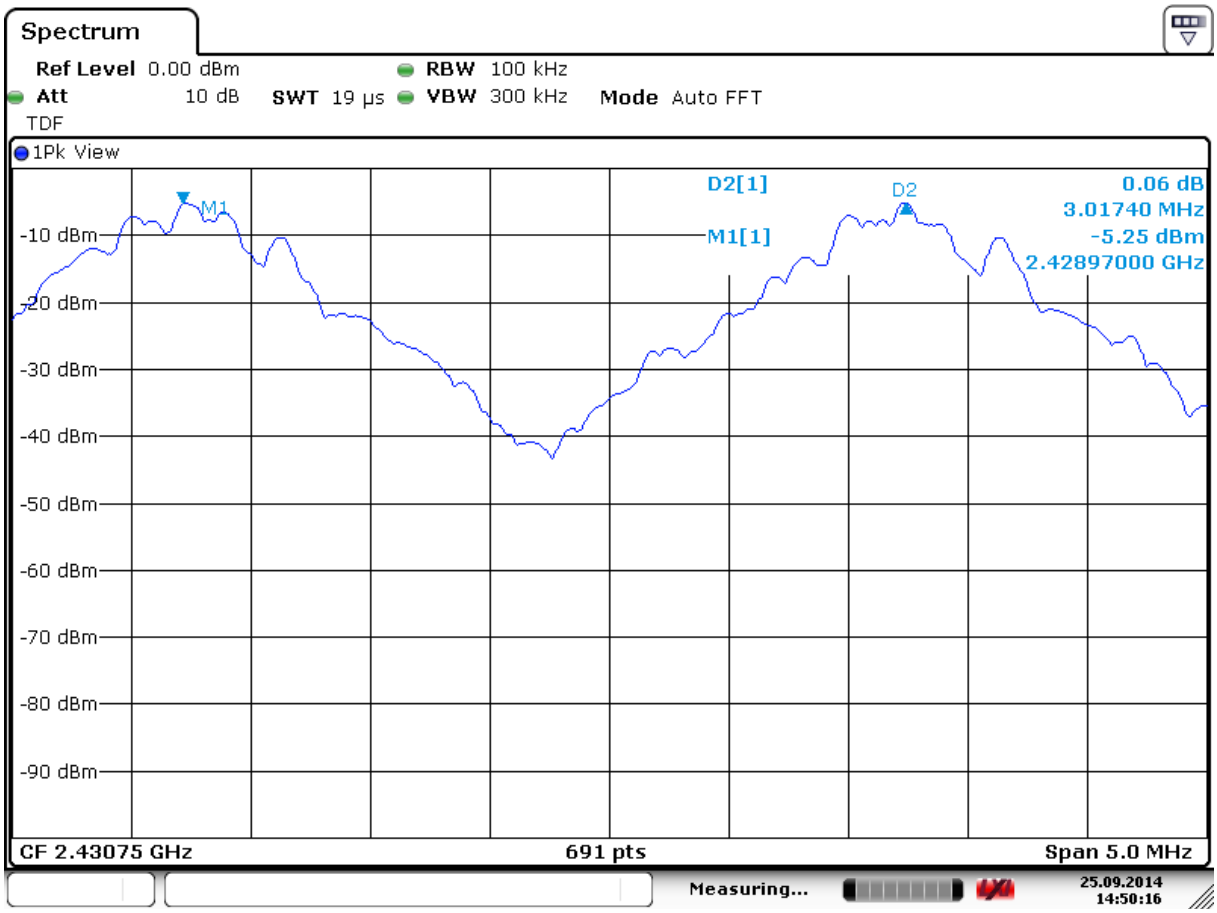
Average time of occupancy (Dwell time) as measure on a spectrum analyzer. Plot 8 shows a hoplenght of ms for 1 channel. The EUT has 21 channels for which each channel can transmit once per
1160 ms period (50 * 23.2 ms). During an observation of 20 seconds, the channel may there for transmit 17.24 times. The average time of occupancy would therefore be 17.24 * 23.2ms = 399.968 ms, which is below the 400 ms limit.



Date: 25.SEP.2014 15:00:03

Plot 8b: showing the RF on time of 756.52 µs for one emission

In a period of 8.4 seconds (0.4s * 21 channels) the transmitter was observed to transmit 16 times (see plot 8a).
16 emission * 0.7565ms results in an average time of occupancy of 12.104 ms, which is well within the limit of 0.4s.



Date: 25.SEP.2014 14:50:15

Plot 9: showing approximately 3 MHz spacing between channels as measured on a spectrum analyzer.

6 Band edge compliance

RESULT: Pass

Date of testing: 2014-09-25 and 03-03-2015

Requirements:

FCC 15.205, FCC 15.209, FCC 15.247(d) and RSS-210 A8.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

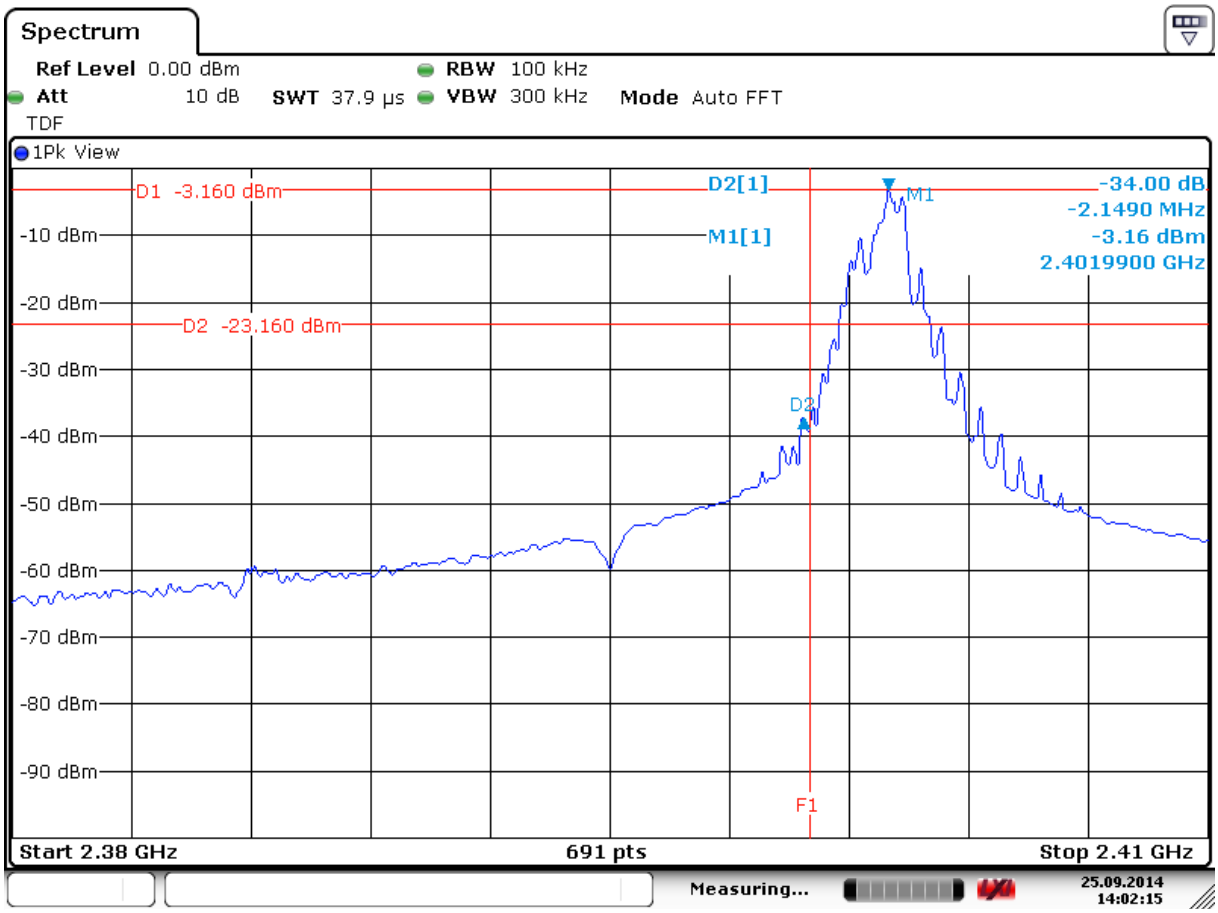
Test procedure:

FCC Public notice DA 00-705 March 30, 2000.

Since the EUT has no antenna port for conducted tests, the tests were performed by radiated measurement using a spectrum analyzer. Measurements were performed using a spectrum analyzer with a suitable span to encompass the peak of the fundamental and using the following settings:
RBW = 100kHz, VBW = 300kHz.

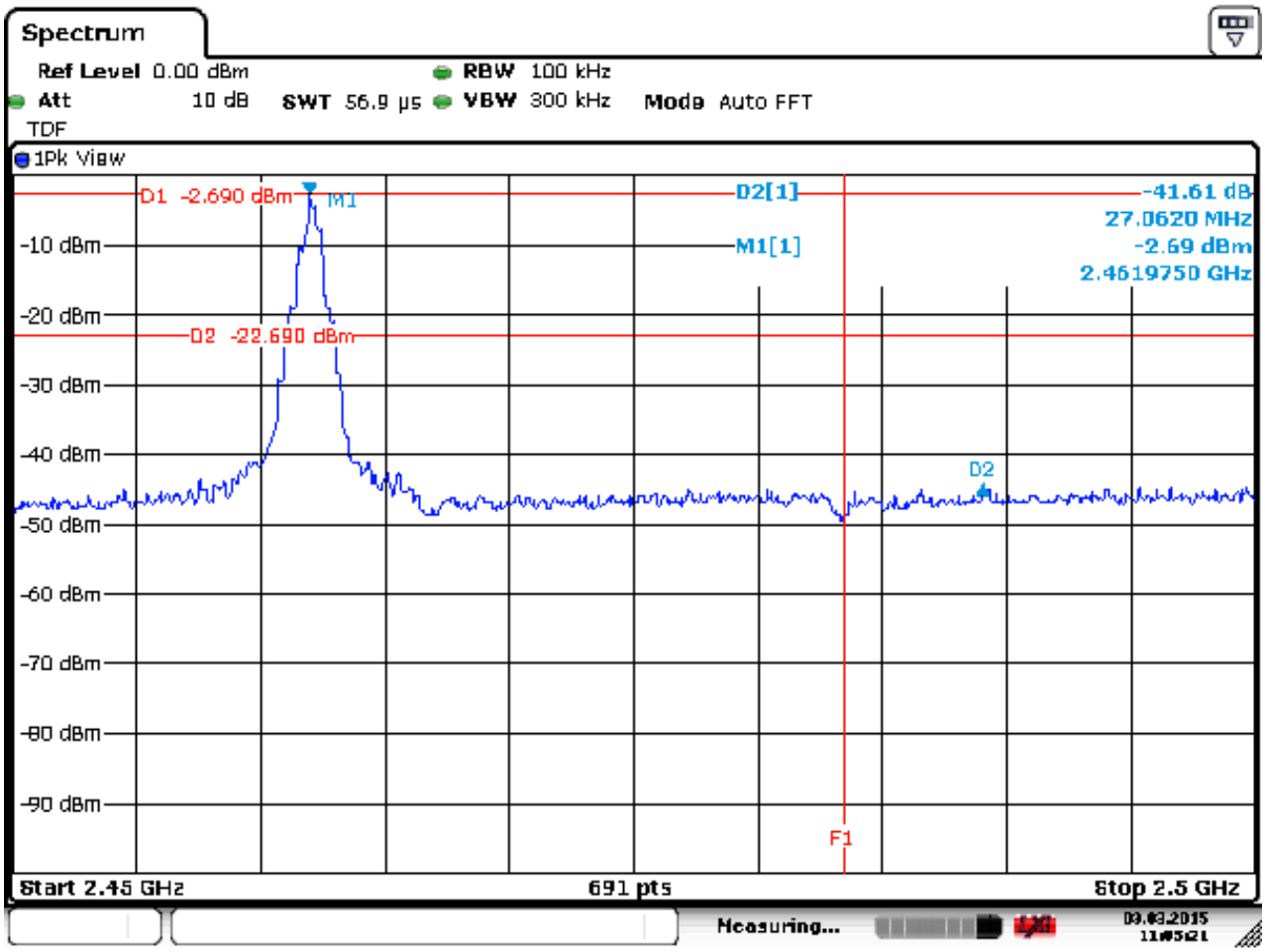
The highest emission amplitudes relative to the appropriate limit were measured and recorded in this report.

Results: All out of band spurious emissions are more than 20 dB below the fundamental.
See plots on the following pages.

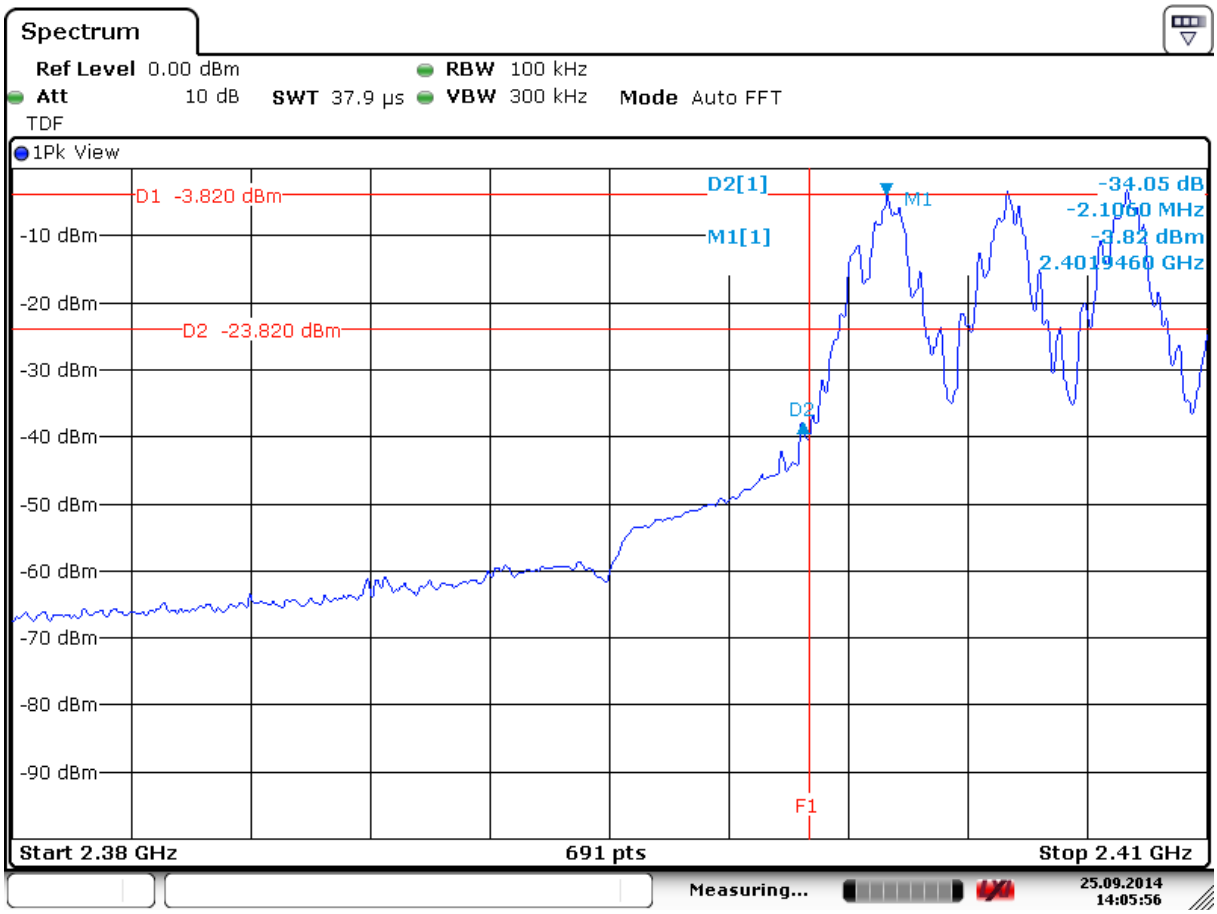


Date: 25.SEP.2014 14:02:14

Plot 10. showing more than 20 dB band edge attenuation, EUT continues modulated carrier at 2402 MHz F1 shows the band edge frequency of 2400 MHz.

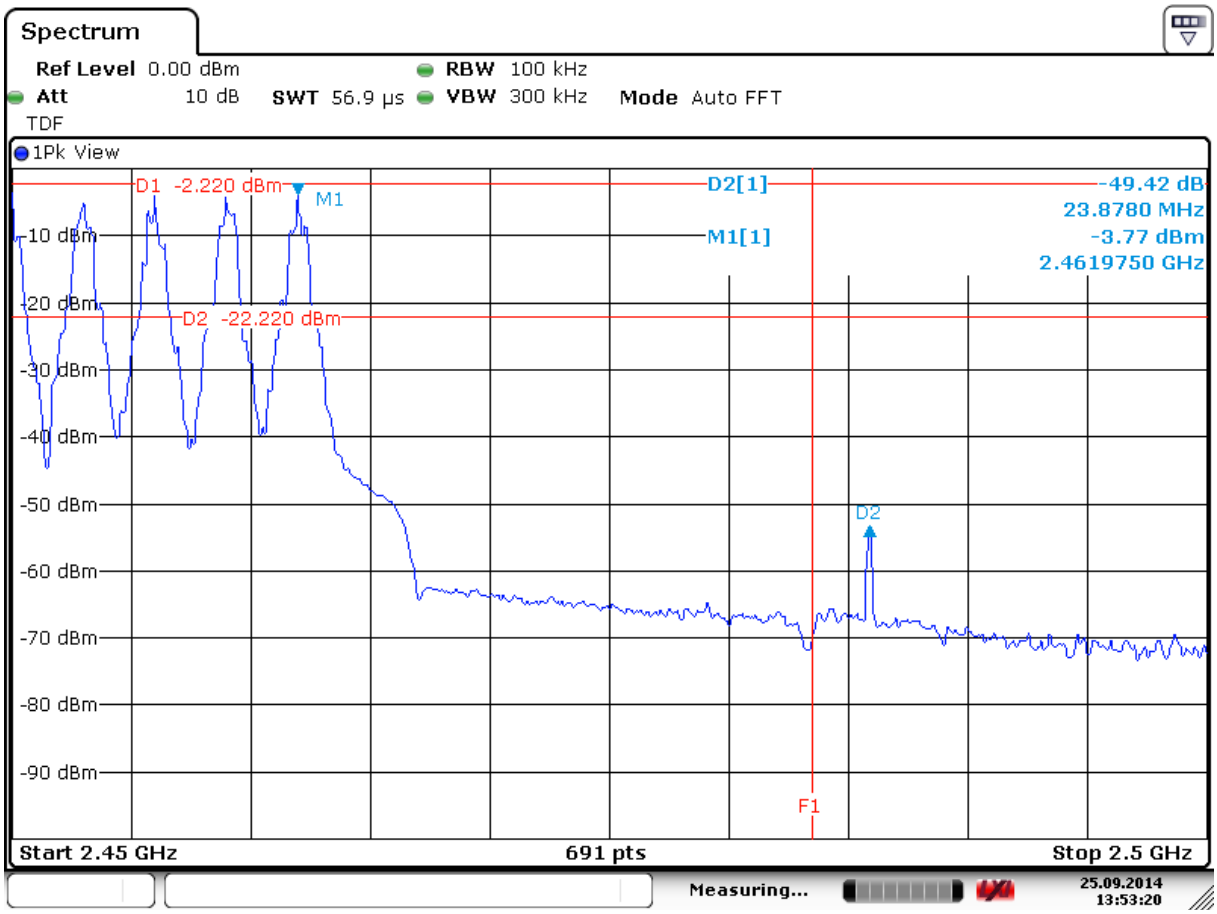


Plot 11. showing more than 20 dB band edge attenuation, EUT continues modulated carrier at 2462 MHz
F1 shows the band edge frequency of 2483.5 MHz.



Date: 25.SEP.2014 14:05:55

Plot 12. showing more than 20 dB band edge attenuation, EUT in Hopping mode
F1 shows the band edge frequency of 2400 MHz.



Date: 25.SEP.2014 13:53:20

Plot 13. showing more than 20 dB band edge attenuation, EUT in Hopping mode
F1 shows the band edge frequency of 2483.5 MHz.

7 Out of band Spurious Emissions of the Transmitter.

RESULT: PASS

Date of testing: 2014-09-25 and 03-03-2015

Requirements:

FCC 15.247(d) and RSS-210 A8.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

Test procedure:

Public Notice DA 00-705 March 30, 2000 Alternative test procedures.

Since the EUT has no antenna port for conducted tests, the tests were performed by radiated measurement using a spectrum analyzer.

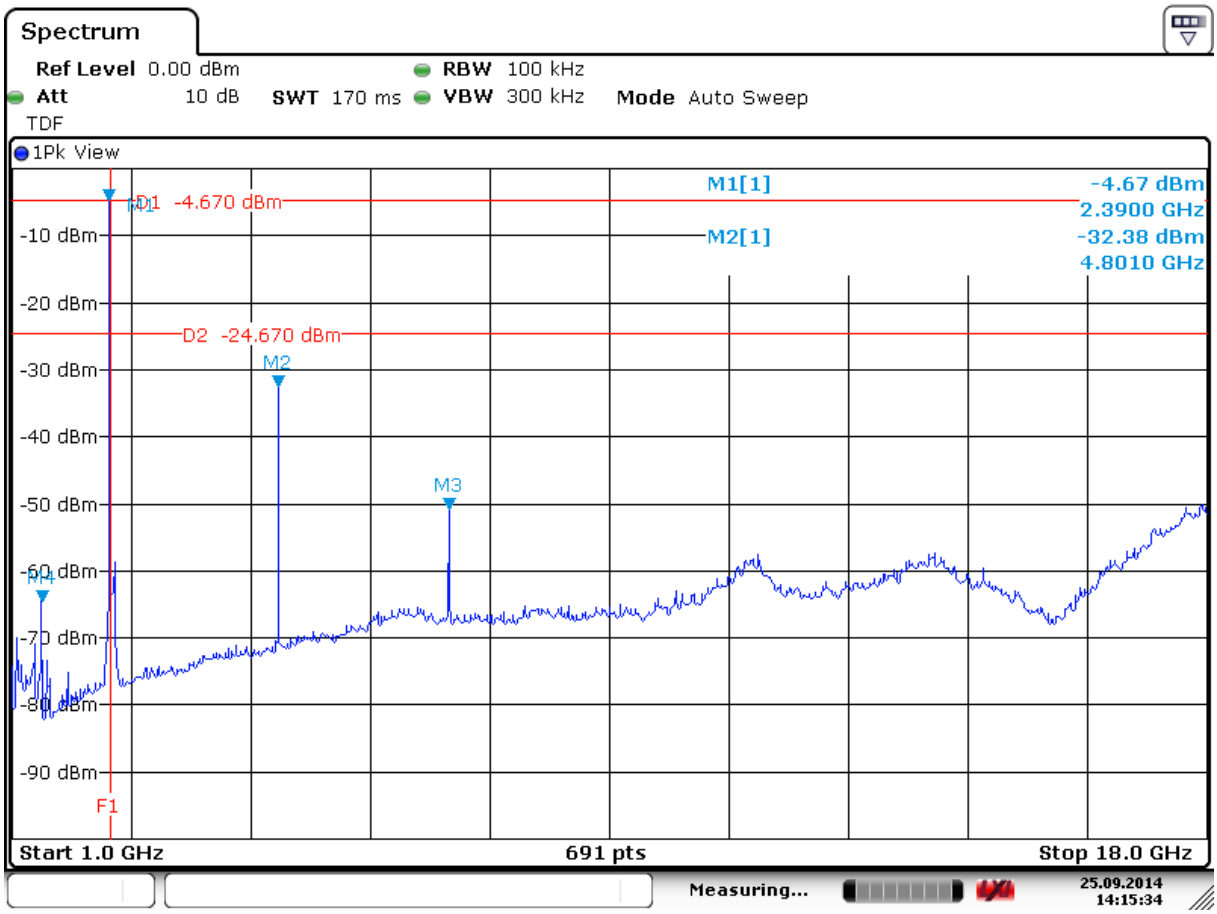
Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic.

RBW = 100 kHz
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

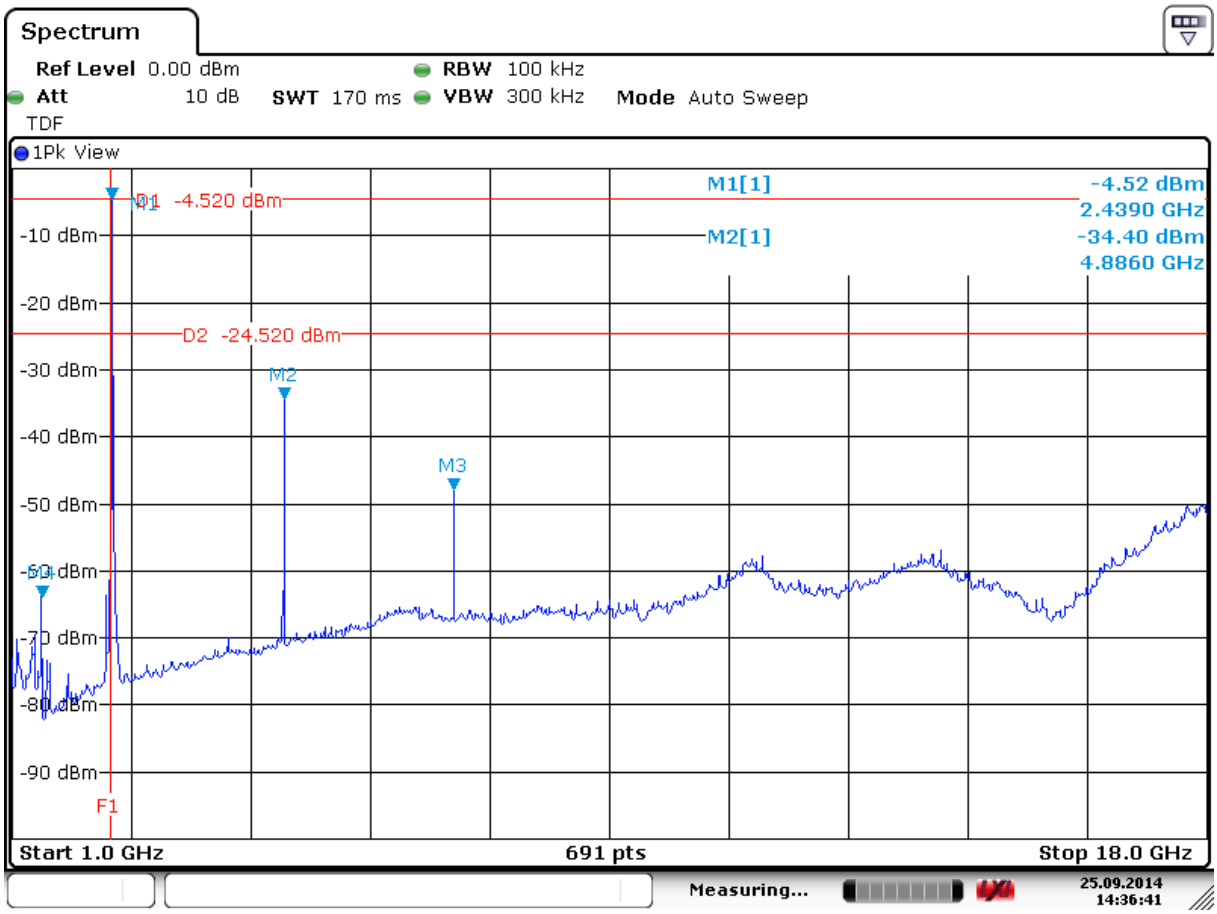
Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded. The level displayed must comply with the limit specified in this Section. See the plots on the next pages.

Tested up to 18 GHz, since above 12 GHz no emissions were found the range 18 – 25 GHz was not investigated.



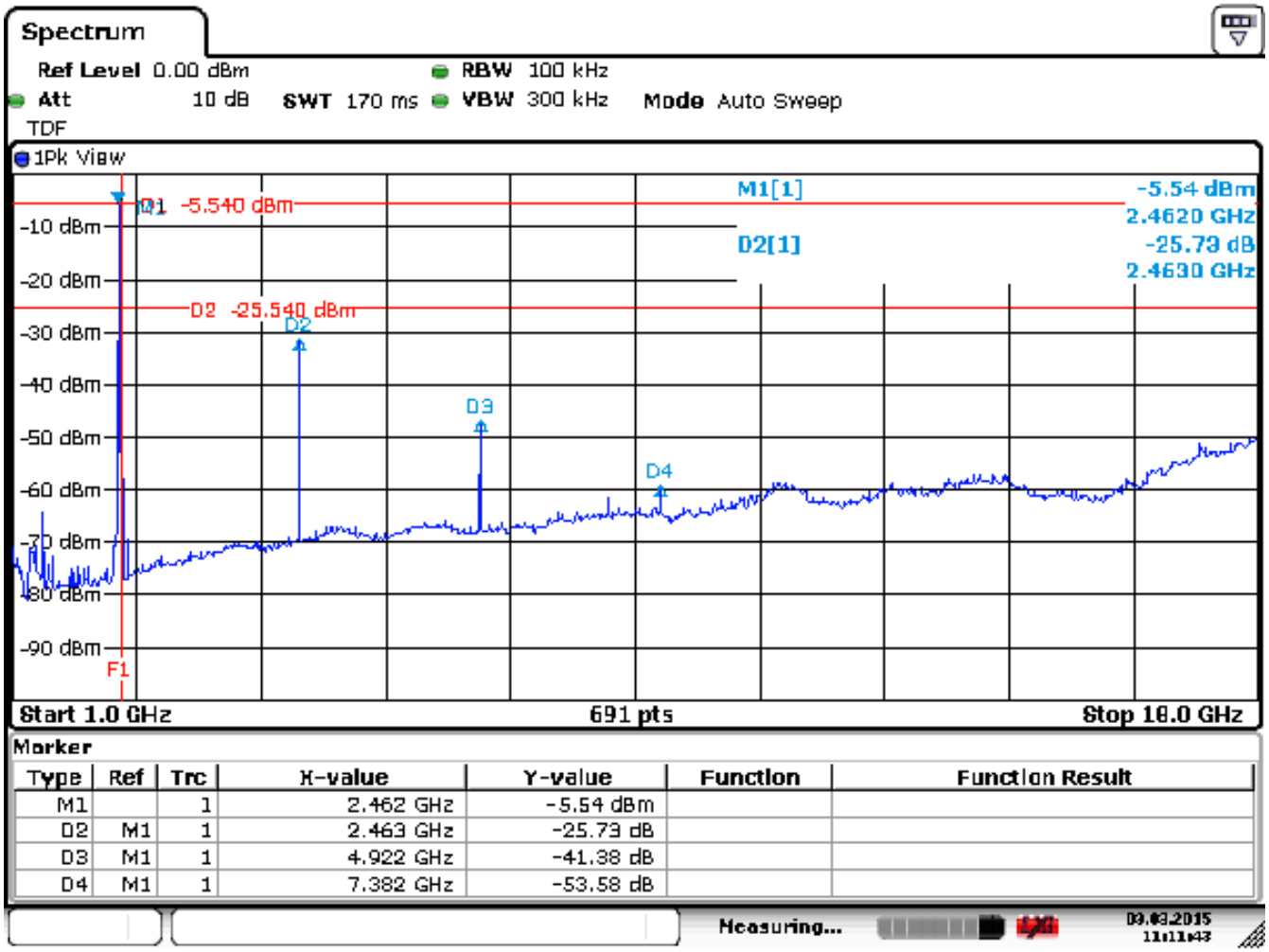
Date: 25.SEP.2014 14:15:34

Plot 14 of the radiated spurious emission, EUT frequency 2402 MHz Constant modulated carrier.



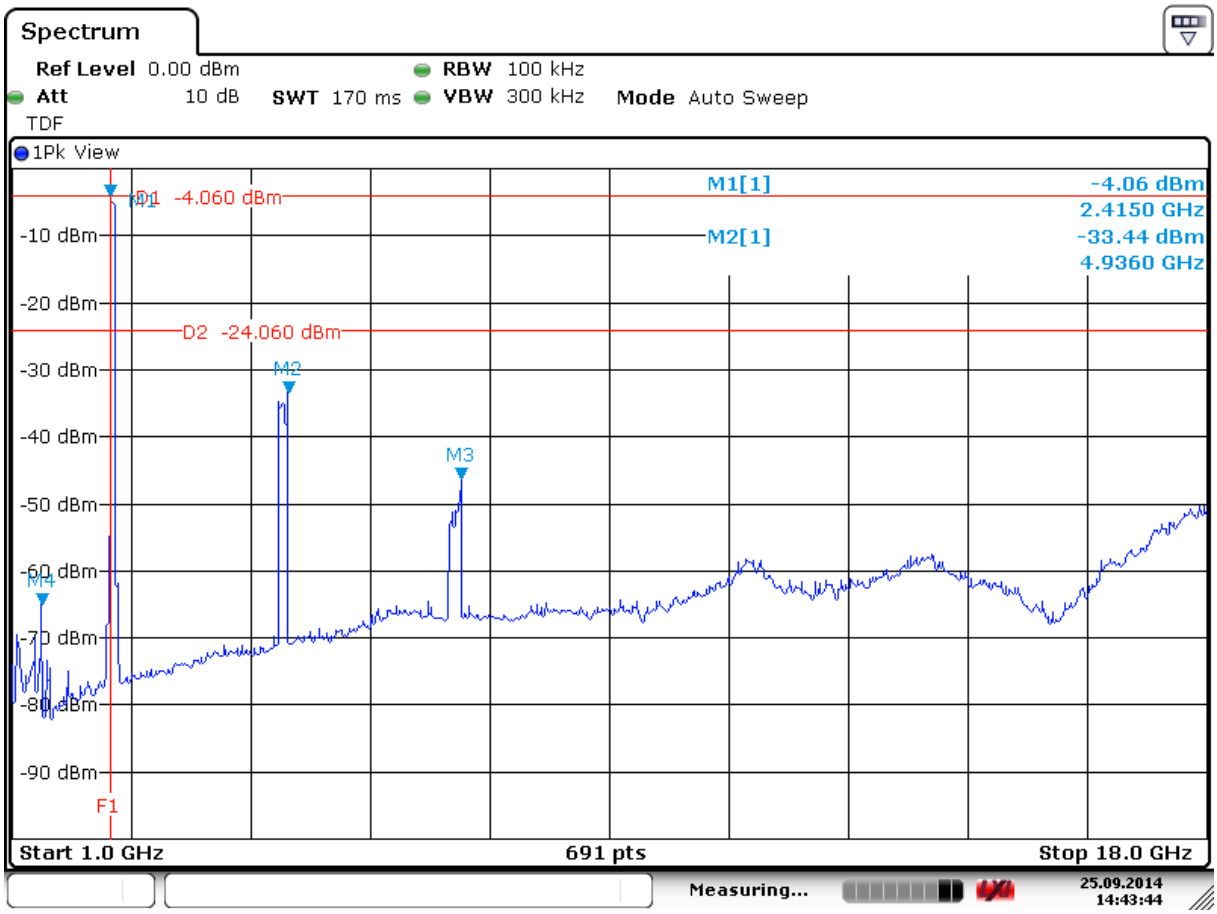
Date: 25.SEP.2014 14:36:40

Plot 15 of the radiated spurious emission, EUT frequency 2432 MHz Constant modulated carrier.



Date: 3.MAR.2015 11:11:42

Plot 16 of the radiated spurious emission, EUT frequency 2462 MHz Constant modulated carrier.



Date: 25.SEP.2014 14:43:44

Plot 17 of the radiated spurious emission, EUT in Hopping mode.

8 Radiated Spurious Emissions of the Transmitter in restricted bands.

RESULT: PASS

Date of testing: 2014-08-27 and 03-03-2015

Requirements:

Radiated emissions which fall in the restricted bands, as defined in FCC 15.205(a) must comply with the radiated emission limits specified in FCC 15.209(a) and RSS-Gen

Test procedure:

Public Notice DA 00-705 March 30, 2000 Alternative test procedures.

The EUT was tested against the limit specified in FCC 15.209(a) and RSS-Gen

This test is required for any spurious emission or modulation product that falls in a Restricted Band, as defined in Section 15.205. It must be performed with the highest gain of each type of antenna proposed for use with the EUT. Use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured
RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

The EUT was placed on a nonconductive turntable 0.8m above the ground plane. Before final measurements of radiated emissions were performed, the EUT was scanned to determine its emission spectrum profile. The physical arrangement of the test system, the associated cabling and the EUT orientation (X, Y, Z) were varied in order to ensure that maximum emission amplitudes were attained.

The spectrum was examined from 30MHz to the 10th harmonic of the highest fundamental transmitter frequency (10GHz). Final radiated emission measurements were made at 3m distance.

At each frequency where a spurious emission was found, the EUT was rotated 360° and the antenna was raised and lowered from 1 to 4m in order to determine the emission's maximum level. Measurements were taken using both horizontal and vertical antenna polarizations.

The highest emission amplitudes relative to the appropriate limit were recorded in this report. Field strength values of radiated emissions at frequencies not listed in the tables are more than 20 dB below the applicable limit. The final measurement takes into account the loss generated by all the involved cables and filters. The levels are expressed in dBm which are derived from dBm = E(dBµV/m) – 95.2dB.

Peak values were already within Av limits, therefor Av not tested.

Frequency [MHz]	Antenna Orientation	Detector	Level [dBm]	Limit Av / Pk [dBm]
1080	Vertical	Pk	-47.5	-21.2 / -41.2
1174	Vertical	Pk	-51.2	-21.2 / -41.2
1321	Vertical	Pk	-50.7	-21.2 / -41.2
2483.5-2500	Vertical	Pk	-60.0	-21.2 / -41.2
4804	Vertical	Pk	-55.8	-21.2 / -41.2
11467	Vertical	Pk	-46.8	-21.2 / -41.2

Table 1a Radiated spurious emissions in restricted bands of the EUT at 2402 MHz

Frequency [MHz]	Antenna Orientation	Detector	Level [dBm]	Limit Av / Pk [dBm]
1.070	Vertical	Pk	-56.7	-21.2 / -41.2
1.121	Vertical	Pk	-58.8	-21.2 / -41.2
1.321	Vertical	Pk	-65.3	-21.2 / -41.2
2483.5-2500	Vertical	Pk	-60.0	-21.2 / -41.2
4804	Vertical	Pk	-52.3	-21.2 / -41.2
11620	Vertical	Pk	-47.8	-21.2 / -41.2

Table 1b Radiated spurious emissions in restricted bands of the EUT at 2432 MHz

Frequency [MHz]	Antenna Orientation	Detector	Level [dBm]	Limit Av / Pk [dBm]
1280.03	Horizontal	Pk	-67.3	-21.2 / -41.2
1320.55	Horizontal	Pk	-65.0	-21.2 / -41.2
1440.70	Horizontal	Pk	-60.4	-21.2 / -41.2
1559.33	Horizontal	Pk	-66.0	-21.2 / -41.2
2483.5-2500	Vertical	Pk	<-60.0	-21.2 / -41.2
4921.00	Horizontal	Pk	-59.0	-21.2 / -41.2
7383.00	Horizontal	Pk	-53.5	-21.2 / -41.2
9844.00	Horizontal	Pk	-54.9	-21.2 / -41.2

Table 1c Radiated spurious emissions in restricted bands of the EUT at 2462 MHz

Freq. [MHz]	Antenna Orientation	Detector	Level [dBm]	Limit Av / Pk [dBm]
1080.0	Vertical	Pk	-59.3	-21.2 / -41.2
1441.2	Vertical	Pk	-58.7	-21.2 / -41.2
5051.0	Vertical	Pk	-57.5	-21.2 / -41.2
7383.0	Vertical	Pk	-49.8	-21.2 / -41.2
11481	Vertical	Pk	-47.7	-21.2 / -41.2
17729	Vertical	Pk	-43.2	-21.2 / -41.2

Table 1d Radiated spurious emissions of the EUT in normal mode (hopping)

The results of the radiated emission tests in the range 30 MHz – 25 GHz, carried out in accordance with 47 CFR Part 15 section 15.209 and 15.205 with the system operating in transmit mode are depicted in Table 1a through 1d.

Notes:

1. Field strength values of radiated emissions at frequencies in the range 30 MHz – 25 GHz not listed in the table above are more than 20 dB below the applicable limit.
2. Measurement uncertainty is ±5.0dB
3. The reported field strength values are the worst case values at the indicated frequency. The receiving antenna was varied in horizontal and vertical orientations and also in height (between 1m and 4m).
4. $*^{h}$ = harmonic of the fundamental frequency.

9 List of utilized test equipment.

Kind of Equipment	Manufacturer	Model Name	Inventory number	Calibration date (mm/yyyy)	Calibration due date (mm/yyyy)
For Antenna Port Conducted Tests					
Spectrum Analyzer	Rohde & Schwarz	FSV	99733	08-05/2014	08-05/2015
Temperature-Humiditymeter	Extech	SD500	99857	02/2014	02/2015
RF Cable	H&S	--	99738	04/2014	04/2015
For Radiated Emission					
Measurement Receiver	Rohde & Schwarz	ESCI	99699	03-26/2014	03-26/2015
RF Cable S-AR	Gigalink	APG0500	99858	02/2014	02/2016
Controller	Heinrich Deisel	4630-100	99107	N/A	N/A
Test fascility	Comtest	FCC listed: 90828 IC: 2932G-2	99580	07/2014	07/2017
Spectrum Analyzer	Rohde & Schwarz	FSP	99538	11/2014	11/2015
Controller	EMCS	DOC202	99608	N/A	N/A
Antenna mast	EMCS	AP-4702C	99609	N/A	N/A
Temperature-Humiditymeter	Extech	SD500	99855	02/2014	02/2016
Guidehorn 1-18 GHz	EMCO	3115	12484	04/2014	04/2015
Filter section	Reactel	--	99606	10/2013	10/2015
Biconilog Testantenna	Teseq	CBL 6111D	99877	06/2014	06/2015
Filter 2-3 GHz BP	BSC Filters	MH1630	13578	NA	NA

NA= Not Applicable

Conformance of the used measurement and test equipment with the requirements of ISO/IEC 17025:2005 has been confirmed before testing.