

Test report

282852-1TRFWL

Date of issue: May 4, 2015

Applicant:

VuZiTech LLC

Product:

Remote

Model:

VuZiTech 3D Secure

FCC ID:

2AEOB-3DSKEYFOB


Specification:

◆ **FCC 47 CFR Part 15 Subpart C, §15.247**

Operation in the 902–928 MHz, 2400–2483.5 MHz, 5725–5850 MHz

Test location

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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
Review date	May 4, 2015
Reviewer signature	

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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Table of contents

Table of contents	3
Section 1. Report summary	4
1.1 Applicant and manufacturer	4
1.2 Test specifications	4
1.3 Test methods.....	4
1.4 Statement of compliance	4
1.5 Exclusions	4
1.6 Test report revision history	4
Section 2. Summary of test results.....	5
2.1 FCC Part 15 Subpart C, general requirements test results.....	5
2.2 FCC Part 15 Subpart C, intentional radiators test results.....	5
Section 3. Equipment under test (EUT) details	6
3.1 Sample information.....	6
3.2 EUT information	6
3.3 Technical information	6
3.4 Product description and theory of operation	6
3.5 EUT exercise details.....	6
Section 4. Engineering considerations.....	7
4.1 Modifications incorporated in the EUT.....	7
4.2 Technical judgment	7
4.3 Deviations from laboratory tests procedures	7
Section 5. Test conditions.....	8
5.1 Atmospheric conditions	8
5.2 Power supply range.....	8
Section 6. Measurement uncertainty	9
6.1 Uncertainty of measurement	9
Section 7. Test equipment	10
7.1 Test equipment list.....	10
Section 8. Testing data	11
8.1 FCC 15.247(a)(2) Minimum 6 dB bandwidth for systems using digital modulation techniques	11
8.2 FCC 15.247(b) Transmitter output power and e.i.r.p. requirements	12
8.3 FCC 15.247(d) Spurious (out-of-band) emissions	14
8.4 FCC 15.247(e) Power spectral density for digitally modulated devices	17
Section 9. Block diagrams of test set-ups	18
9.1 Radiated emissions set-up.....	18

Section 1. Report summary

1.1 Applicant and manufacturer

Company name	VuZiTech LLC
Address	5452 Oberlin Dr.
City	San Diego
Province/State	CA
Postal/Zip code	92121
Country	United States

1.2 Test specifications

FCC 47 CFR Part 15, Subpart C, Clause 15.247	Operation in the 902–928 MHz, 2400–2483.5 MHz, 5725–5850 MHz
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1.3 Test methods

558074 D01 DTS Meas Guidance v03r02 (June 5, 2014)	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247
ANSI C64.10 v2009	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

1.4 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.

1.5 Exclusions

None

1.6 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 C, general requirements test results

Part	Test description	Verdict
§15.207(a)	Conducted limits	Not applicable
§15.31(e)	Variation of power source	Pass ¹
§15.203	Antenna requirement	Pass ²

Notes: ¹ The EUT was tested with full battery

² The Antenna is located within the enclosure of EUT and not user accessible.

2.2 FCC Part 15 Subpart C, intentional radiators test results

Part	Test description	Verdict
§15.247(a)(1)(i)	Frequency hopping systems operating in the 902–928 MHz band	Not applicable
§15.247(a)(1)(ii)	Frequency hopping systems operating in the 5725–5850 MHz band	Not applicable
§15.247(a)(1)(iii)	Frequency hopping systems operating in the 2400–2483.5 MHz band	Not applicable
§15.247(a)(2)	Minimum 6 dB bandwidth for systems using digital modulation techniques	Pass
§15.247(b)(1)	Maximum peak output power of frequency hopping systems operating in the 2400–2483.5 MHz band and 5725–5850 MHz band	Not applicable
§15.247(b)(2)	Maximum peak output power of Frequency hopping systems operating in the 902–928 MHz band	Not applicable
§15.247(b)(3)	Maximum peak output power of systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands	Pass
§15.247(c)(1)	Fixed point-to-point operation with directional antenna gains greater than 6 dBi	Not applicable
§15.247(c)(2)	Transmitters operating in the 2400–2483.5 MHz band that emit multiple directional beams	Not applicable
§15.247(d)	Spurious emissions	Pass
§15.247(e)	Power spectral density for digitally modulated devices	Pass
§15.247(f)	Time of occupancy for hybrid systems	Not applicable

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	April 20, 2015
Nemko sample ID number	

3.2 EUT information

Product name	Remote
Model	VuZiTech 3D Secure
Serial number	N/A

3.3 Technical information

Frequency band	2400–2483.5 MHz
Frequency Min (MHz)	2403
Frequency Max (MHz)	2403
RF power Max (W)	N/A
Field strength, Units @ distance	85.98 dBμV/m @ 3 m
Measured BW (kHz) (6 dB)	503.2
Calculated BW (kHz), as per TRC-43	N/A
Type of modulation	GFSK
Emission classification (F1D, G1D, D1D)	F1D
Transmitter spurious, Units @ distance	58.12 dBμV/m @ 3 m at 2483.5 MHz
Power requirements	3 V battery
Antenna information	Internal antenna The EUT uses a unique antenna coupling/ non-detachable antenna to the intentional radiator.

3.4 Product description and theory of operation

EUT is a remote control for Scooter/Bike system, operated in 2.4 GHz ISM band.

3.5 EUT exercise details

EUT was energized and it was preprogrammed to transmit every 600 ms.

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 $\pm 5\%$, for which the equipment was designed.



Section 6. Measurement uncertainty

6.1 Uncertainty of measurement

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

Test name	Measurement uncertainty, dB
All antenna port measurements	0.55
Conducted spurious emissions	1.13
Radiated spurious emissions	3.78
AC power line conducted emissions	3.55

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.
3 m EMI test chamber	TDK	SAC-3	FA002047	1 year	Feb. 25/16
Flush mount turntable	Sunol	FM2022	FA002082	—	NCR
Controller	Sunol	SC104V	FA002060	—	NCR
Antenna mast	Sunol	TLT2	FA002061	—	NCR
Bilog antenna (20–3000 MHz)	Sunol	JB3	FA002108	1 year	Apr. 12/16
Horn antenna (1–18 GHz)	EMCO	3115	FA000825	1 year	Apr. 01/16
Horn antenna (18–26.5 GHz)	Electro-metrics	SH-50/60-1	FA000479	—	VOU
Pre-amplifier (1–18 GHz)	JCA	JCA118-503	FA002091	1 year	June 23/15
Pre-amplifier (18–26 GHz)	Narda	BBS-1826N612	FA001550	—	VOU

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

Section 8. Testing data

8.1 FCC 15.247(a)(2) Minimum 6 dB bandwidth for systems using digital modulation techniques

8.1.1 Definitions and limits

- (a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:
- (2) Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

8.1.2 Test summary

Test date	April 29, 2015	Temperature	22 °C
Test engineer	Andrey Adelberg	Air pressure	1010 mbar
Verdict	Pass	Relative humidity	33 %

8.1.3 Observations, settings and special notes

Spectrum analyser settings:

Resolution bandwidth	100 kHz
Video bandwidth	$\geq 3 \times \text{RBW}$
Frequency span	2 MHz
Detector mode	Peak – Max Hold

8.1.4 Test data



Figure 8.1-1: 6 dB bandwidth (503.2 kHz)

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8.2 FCC 15.247(b) Transmitter output power and e.i.r.p. requirements

8.2.1 Definitions and limits

- (b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:
- (3) For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 W (30 dBm). As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.
 - (4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.
 - (i) Systems operating in the 2400–2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

Fixed, point-to-point operation, as used in paragraphs (b)(3)(i) and (b)(3)(ii) of this section, excludes the use of point-to-multipoint systems, omnidirectional applications, and multiple co-located intentional radiators transmitting the same information. The operator of the spread spectrum intentional radiator or, if the equipment is professionally installed, the installer is responsible for ensuring that the system is used exclusively for fixed, point-to-point operations. The instruction manual furnished with the intentional radiator shall contain language in the installation instructions informing the operator and the installer of this responsibility.

- (c) Operation with directional antenna gains greater than 6 dBi.
- (2) In addition to the provisions in paragraphs (b)(1), (b)(3), (b)(4) and (c)(1)(i) of this section, transmitters operating in the 2400–2483.5 MHz band that emit multiple directional beams, simultaneously or sequentially, for the purpose of directing signals to individual receivers or to groups of receivers provided the emissions comply with the following:
 - (i) Different information must be transmitted to each receiver.
 - (ii) If the transmitter employs an antenna system that emits multiple directional beams but does not do emit multiple directional beams simultaneously, the total output power conducted to the array or arrays that comprise the device, i.e., the sum of the power supplied to all antennas, antenna elements, staves, etc. and summed across all carriers or frequency channels, shall not exceed the limit specified in paragraph (b)(1) or (b)(3) of this section, as applicable. However, the total conducted output power shall be reduced by 1 dB below the specified limits for each 3 dB that the directional gain of the antenna/antenna array exceeds 6 dBi. The directional antenna gain shall be computed as follows:
 - (A) The directional gain shall be calculated as the sum of 10 log (number of array elements or staves) plus the directional gain of the element or staff having the highest gain.

8.2.2 Test summary

Test date	April 29, 2015	Temperature	22 °C
Test engineer	Andrey Adelberg	Air pressure	1010 mbar
Verdict	Pass	Relative humidity	33 %

8.2.3 Observations, settings and special notes

Spectrum analyser settings:

Resolution bandwidth	2 MHz
Video bandwidth	$\geq 3 \times \text{RBW}$
Detector mode	Peak – Max Hold

8.2.4 Test data

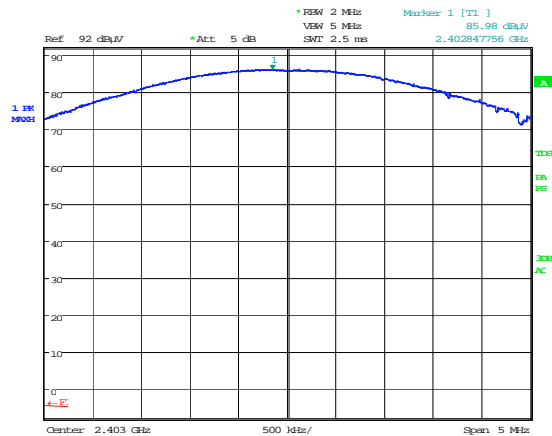


Figure 8.2-1: Peak output power

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Table 8.2-1: Peak output power measurement results

Frequency, MHz	Field Strength @ 3 m, dBµV/m	FS to EIRP conversion factor, dB	EIRP, dBm	EIRP limit, dBm	Margin, dB
2403	85.98	-95.23	-9.25	36.00	45.25

Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.

Output power limit is 30 dBm. EIRP calculation results were lower than Output power limit

8.3 FCC 15.247(d) Spurious (out-of-band) emissions

8.3.1 Definitions and limits

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. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

Table 8.3-1: FCC §15.209 – Radiated emission limits

Frequency, MHz	Field strength of emissions		Measurement distance, m
	µV/m	dBµV/m	
0.009–0.490	2400/F	$67.6 - 20 \times \log_{10}(F)$	300
0.490–1.705	24000/F	$87.6 - 20 \times \log_{10}(F)$	30
1.705–30.0	30	29.5	30
30–88	100	40.0	3
88–216	150	43.5	3
216–960	200	46.0	3
above 960	500	54.0	3

Notes: In the emission table above, the tighter limit applies at the band edges.

For frequencies above 1 GHz the limit on peak RF emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test

Table 8.3-2: Restricted frequency bands

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
0.495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2690–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	Above 38.6
13.36–13.41			

8.3.2 Test summary

Test date	April 21, 2015	Temperature	22 °C
Test engineer	Andrey Adelberg	Air pressure	1002 mbar
Verdict	Pass	Relative humidity	32 %

8.3.3 Observations, settings and special notes

The spectrum was searched from 30 MHz to the 10th harmonic.
Radiated measurements were performed at a distance of 3 m

Spectrum analyser settings for radiated measurements within restricted bands below 1 GHz:

Resolution bandwidth:	100 kHz
Video bandwidth:	300 kHz
Detector mode:	Peak
Trace mode:	Max Hold

Spectrum analyser settings for peak radiated measurements within restricted bands above 1 GHz:

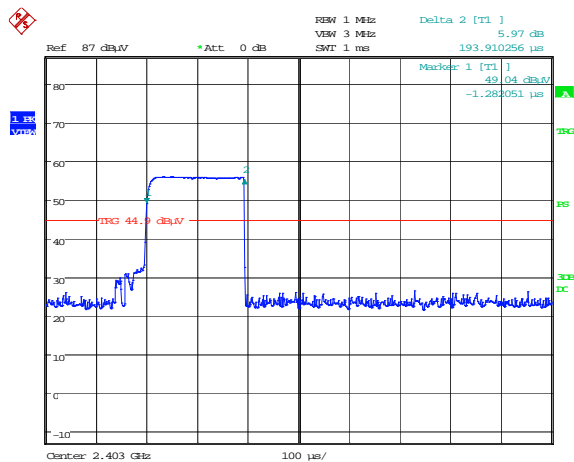
Resolution bandwidth:	1 MHz
Video bandwidth:	3 MHz
Detector mode:	Peak
Trace mode:	Max Hold

8.3.4 Test data

Table 8.3-3: Radiated field strength measurement results

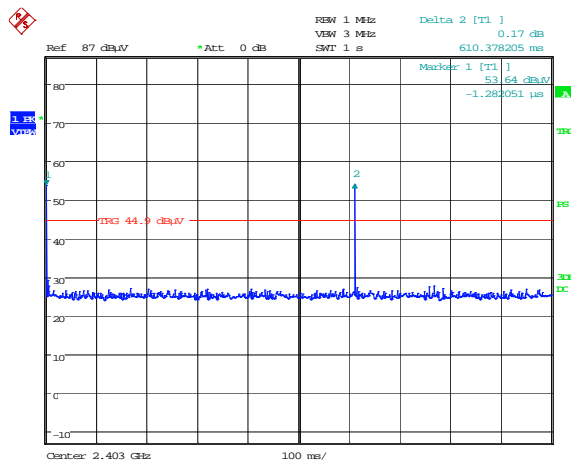
Frequency, MHz	Peak Field strength, dBμV/m		Margin, dB	Average correction factor, dB	Average Field strength, dBμV/m		Margin, dB
	Measured	Limit			Calculated	Limit	
2390.0	57.74	74.00	19.26	-54.24	3.50	54.00	51.50
2483.5	58.12	74.00	15.88	-54.24	3.88	54.00	50.12

Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.



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Figure 8.3-1: Pulse width (194 μs)



Date: 21.APR.2015 13:35:41

Figure 8.3-2: Pulse repetition (610 ms)

Average correction factor was calculated as follows:

$$A_{CF} = 20 \times \log_{10} (0.194 / 100) = -54.24 \text{ dB}$$

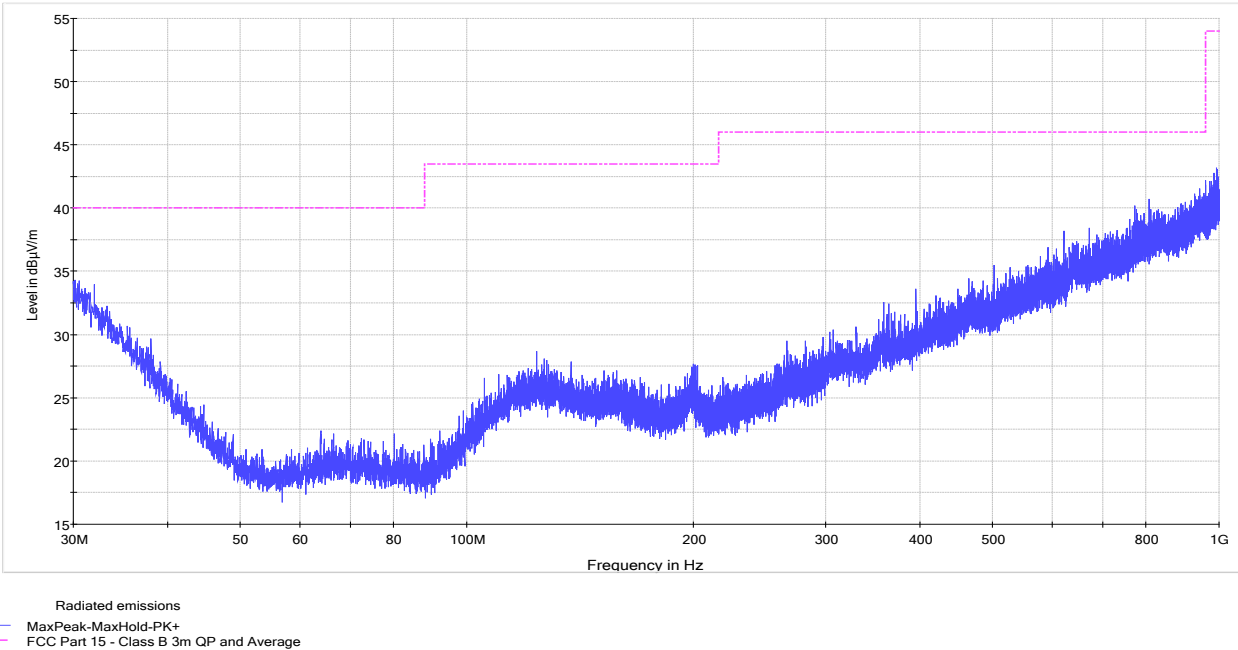


Figure 8.3-3: Radiated spurious emissions below 1 GHz

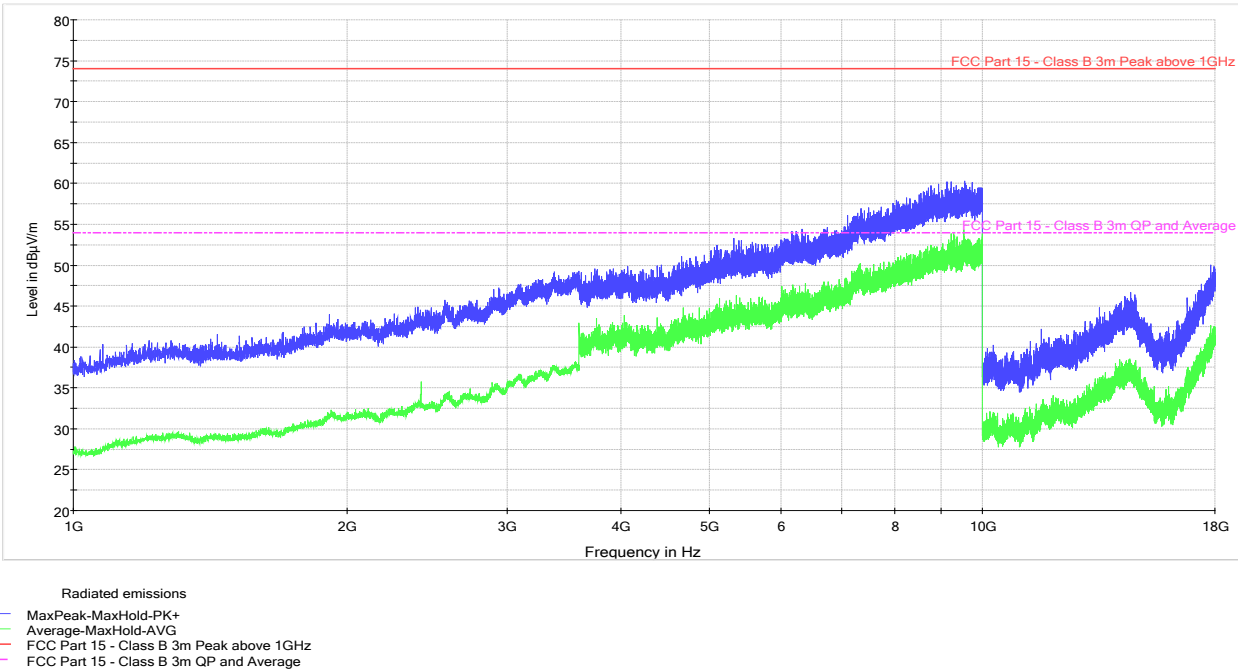


Figure 8.3-4: Radiated spurious emissions above 1 GHz

8.4 FCC 15.247(e) Power spectral density for digitally modulated devices

8.4.1 Definitions and limits

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

8.4.2 Test summary

Test date	April 29, 2015	Temperature	22 °C
Test engineer	Andrey Adelberg	Air pressure	1010 mbar
Verdict	Pass	Relative humidity	33 %

8.4.3 Observations, settings and special notes

Spectrum analyser settings:

Resolution bandwidth:	100 kHz
Video bandwidth:	300 kHz
Detector mode:	Peak – Max Hold

8.4.4 Test data

Table 8.4-1: PSD measurements results

Frequency, MHz	Field Strength @ 3 m, dBμV/m	FS to EIRP conversion factor, dB	EIRP PSD, dBm/100 kHz	PSD limit, dBm/3 kHz	Margin, dB
2403	85.41	95.23	-9.82	8.00	17.82

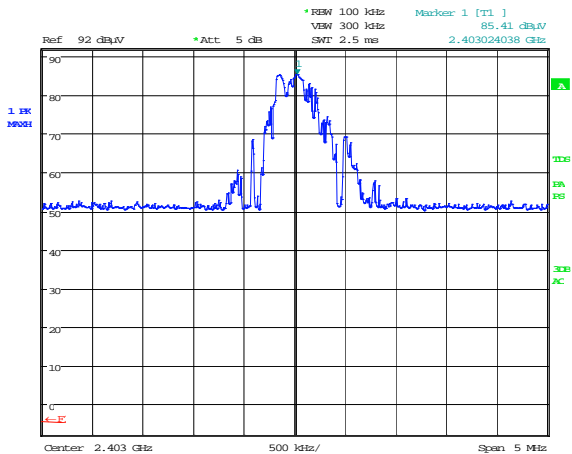


Figure 8.4-1: PSD measurement

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Section 9. Block diagrams of test set-ups

9.1 Radiated emissions set-up

