

# Global EMC Inc. Labs

## EMC & RF Test Report

As per

RSS 210 Issue 8:2010

&

FCC Part 15 Subpart C:2014

Unlicensed Intentional Radiators

on the

Zen



Min Xie  
Project Engineer  
11 Gordon Collins Dr,  
Gormley, ON, L0H 1G0 Canada  
Ph: (905) 883-8189

Testing produced for

ZEN

Zen Within Inc

See Appendix A for full customer & EUT details.



Industry  
Canada

LAB REGISTRATION  
#6844A-3



Testing Laboratory  
Certificate  
#2555.01



FCC  
REGISTRATION  
#377448



R-4023, G-506  
T-1246, C-4498

Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



## Table of Contents

Table of Contents .....	2
Report Scope .....	3
Summary .....	4
Test Results Summary .....	5
Justifications, Descriptions, or Deviations.....	6
Applicable Standards, Specifications and Methods.....	7
Sample calculation(s).....	8
Document Revision Status .....	8
Definitions and Acronyms .....	9
Testing Facility .....	10
Calibrations and Accreditations .....	10
Testing Environmental Conditions and Dates .....	11
Detailed Test Results Section .....	12
6 dB Bandwidth of Digitally Modulated Systems – 15.247 .....	13
Maximum Peak Envelope Conducted Power – DM .....	20
Purpose.....	20
Antenna Spurious Conducted Emissions (-20 dBc Requirement) – 15.247 .....	25
Radiated Emissions – 15.247 .....	32
Power Spectral Density – 15.247 DM .....	68
Maximum Permissible Exposure – 15.247 .....	74
Power Line Conducted Emissions .....	75
Appendix A – EUT Summary.....	82
Appendix B – EUT and Test Setup Photographs.....	85

Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



## Report Scope

This report addresses the EMC verification testing and test results of Zen Within Inc's Zen, herein referred to as EUT (Equipment Under Test) performed at Global EMC Labs.

The EUT was tested for compliance against the following standards:

RSS 210 Issue 8:2010  
 FCC Part 15 Subpart C 15.247:2014

Test procedures, results, justifications, and engineering considerations, if any, follow later in this report.

The results contained in this report relate only to the item(s) tested.

This report does not imply product endorsement by A2LA or any other accreditation agency, any government, or Global EMC Inc.

Opinions/interpretations expressed in this report, if any, are outside the scope of Global EMC Inc accreditation. Any opinions expressed do not necessarily reflect the opinions of Global EMC Inc, unless otherwise stated.

Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



## Summary

The results contained in this report relate only to the item(s) tested.

EUT FCC Certification #, FCC ID:	2ADJL-ZEN01
EUT Industry Canada Certification #, IC:	12476A-ZEN01
EUT Passed all tests performed.	Yes (see test results summary)
Tests conducted by	Min Xie

Client	<b>Zen Within Inc</b>	
Product	<b>Zen</b>	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

## **Test Results Summary**

Standard/Method	Description	Class/Limit	Result
FCC 15.203	Antenna Requirement	Unique	Pass See Justification
FCC 15.205 RSS 210 (Table 1)	Restricted Bands for intentional operation	QuasiPeak Average	Pass
FCC 15.207	Power line conducted emissions	QuasiPeak Average	Pass
FCC 15.209 RSS-210 (Table 2)	Spurious Radiated emissions	QuasiPeak Average	Pass
FCC 15.247(a)2 RSS-210 A8.2(a)	6 dB Bandwidth	> 500 kHz	Pass
FCC 15.247(b)2 RSS-210 A8.4(4)	Max output power	< 1 Watt	Pass
FCC 15.247(b)(4) RSS-210 A8.4(5)	Antenna Gain	< 6 dBi	Pass See Justifications
FCC 15.247(d) RSS-210 A8.5	Antenna conducted spurious	< 20 dBc	Pass
FCC 15.247(e) RSS-210 A8.2(b)	Spectral Density	< 8 dBm (3 kHz BW)	Pass
FCC 15.247(i) IC Safety code 6	Maximum Permissible Exposure	> 20 cm separation.	Pass See justification and calculations
<b>Overall Result</b>			<b>PASS</b>

All tests were performed by Min Xie.

If the product as tested or otherwise complies with the specification, the EUT is deemed to comply with the requirement and is deemed a 'PASS' grade. If not 'FAIL' grade will be issued. Note that 'PASS' / 'FAIL' grade is independent of any measurement uncertainties.

Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



### ***Justifications, Descriptions, or Deviations***

The following justifications for tests not performed or deviations from the above listed specifications apply:

For the Antenna requirement specified in FCC 15.203 (RSS 210 section 5.5), the unit uses a ceramic chip antenna (0 dBi gain - Johanson 2450AT42A100E) which is less than 6 dBi gain.

For the Restricted Bands of operation, the EUT is designed to only operate between 2400 – 2483.5 MHz band.

For maximum permissible exposure, this device operates at less than 1 Watt at 2400 – 2483.5 MHz and is designed to operate greater than 20 cm from any personnel during normal operation. No testing is required, however worst case calculated exposure compliance follows later in this report.

The EUT is not a hybrid system and FCC 15.247 (f) does not apply to it. However the 15.247 (d) requirement of power density were met and are detailed later in this test report.

For the scope of this test report the EUT was mounted in three orthogonal axes to maximize radiated emissions. Worst case results are presented.

Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



## ***Applicable Standards, Specifications and Methods***

- ANSI C63.4:2009 - Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
- ANSI C63.10:2009 - American national standard for testing unlicensed wireless devices
- CFR 47 FCC 15 - Code of Federal Regulations – Radio Frequency Devices
- FCC KDB 558074 - FCC KDB 558074 Digital Transmission Systems, measurements and procedures
- ICES-003:2012 - Digital Apparatus - Spectrum Management and Telecommunications Policy Interference-Causing Equipment Standard
- RSS-GEN General Requirements and Information for the Certification of Radio Apparatus
- RSS 210:2010 - Issue 8: Spectrum Management and Telecommunications Policy. Radio Standards Specification Low Power License-Exempt Radiocommunication Devices
- CISPR 22:2008 - Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement
- ISO 17025:2005 - General Requirements for the competence of testing and calibration laboratories

Client	<b>Zen Within Inc</b>	
Product	<b>Zen</b>	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

### ***Sample calculation(s)***

Margin = limit – (received signal + antenna factor + cable loss – pre-amp gain)

Margin = 50.5dBuV/m – (50dBuV + 10dB + 2.5dB – 20dB)

Margin = 8.5 dB

### ***Document Revision Status***

Revision 1 - November 14, 2014

Initial release

Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



## Definitions and Acronyms

The following definitions and acronyms are applicable in this report.  
See also ANSI C63.14.

**AE** – Auxillary Equipment.

**BW** – Bandwidth. Unless otherwise stated, this is refers to the 6 dB bandwidth.

**EMC** – Electro-Magnetic Compatibility

**EMI** – Electro-Magnetic Immunity

**EUT** – Equipment Under Test

**ITE** – Information Technology Equipment with a primary function(s) of entry, storage, display, retrieval, transmission, processing, switching, or control, of data.

**LISN** – Line impedance stabilization network

**NCR** – No Calibration Required

**RF** – Radio Frequency

**DTS Bandwidth** – 6 dB bandwidth of the a DTS transmitter.

Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



## **Testing Facility**

Testing for EMC on the EUT was carried out at Global EMC labs in Toronto, Ontario, Canada. The testing lab consists of a 3m semi-anechoic chamber calibrated to be able to allow measurements on an EUT with a maximum width or length of up to 2m and height up to 3m. The chamber is equipped with a turn table that is capable of testing devices up to 3300lb in weight. This facility is capable of testing products that are rated for 120 Vac and 240Vac single phase, or 208 Vac 3 phase input. DC capability is also available. The chamber is equipped with an antenna mast that controls polarization and height from the control room adjoining the shielded chamber. Radiated emissions measurements are performed using a Bilog, and Horn antenna where applicable. Conducted emissions, unless otherwise stated, are performed using a LISN.

### ***Calibrations and Accreditations***

The 3m semi-anechoic chamber is registered with Federal Communications Commission (FCC, 377448), Industry Canada (IC, 6844A-3) and VCCI (R-4023, G-506, T-1246, and C-4498). This semi-anechoic chamber complies with the requirements of EN55016-2-3:2006, section 7.5 and the site attenuation requirements of EN55016-1-4. This chamber was additionally calibrated for Normalized Site Attenuation (NSA) using test procedures outlined in ANSI C63.4 “Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz”. The chamber is lined with ferrite tiles and absorption cones to minimize any undesired reflections. The NSA data is kept on file at Global EMC. For radiated susceptibility testing, a 16 point field calibration has been performed on the chamber. The field uniformity data is kept on file at Global EMC. Global EMC Inc is accredited to ISO 17025 by A2LA with Testing Certificate #2555.01. The laboratories current scope of accreditation listing can be found as listed on the A2LA website. All measuring equipment is calibrated on an annual or bi-annual basis as listed for each respective test.

Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



## ***Testing Environmental Conditions and Dates***

Following were the environmental conditions in the facility during time of testing –

Date	Test	Init.	Temperature (°C)	Humidity (%)	Pressure (kPa)
2014/10/21 - 25	Radio Requirements	MX	18-21°C	39 - 50%	96 -102kPa
2014/11/3	Power line Conducted Emission	MX	18-21°C	39 - 50%	96 -102kPa

Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



## **Detailed Test Results Section**

Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



## ***6 dB Bandwidth of Digitally Modulated Systems – 15.247***

### **Purpose**

The purpose of this test is to ensure that the bandwidth occupied exceeds a stated minimum. This helps ensure the utilization of the frequency allocation is sufficiently wide. This also helps prevent corruption of data by ensuring adequate data separation to distinguish the reception of the intended information.

### **Limits and Methods**

The Limit is as specified in FCC Part 15 and RSS 210.

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. This should be measured with a 100 kHz RBW and a 300 kHz VBW.

The method is given in Section 8.1 of FCC KDB 558074: June 9, 2014.

### **Results**

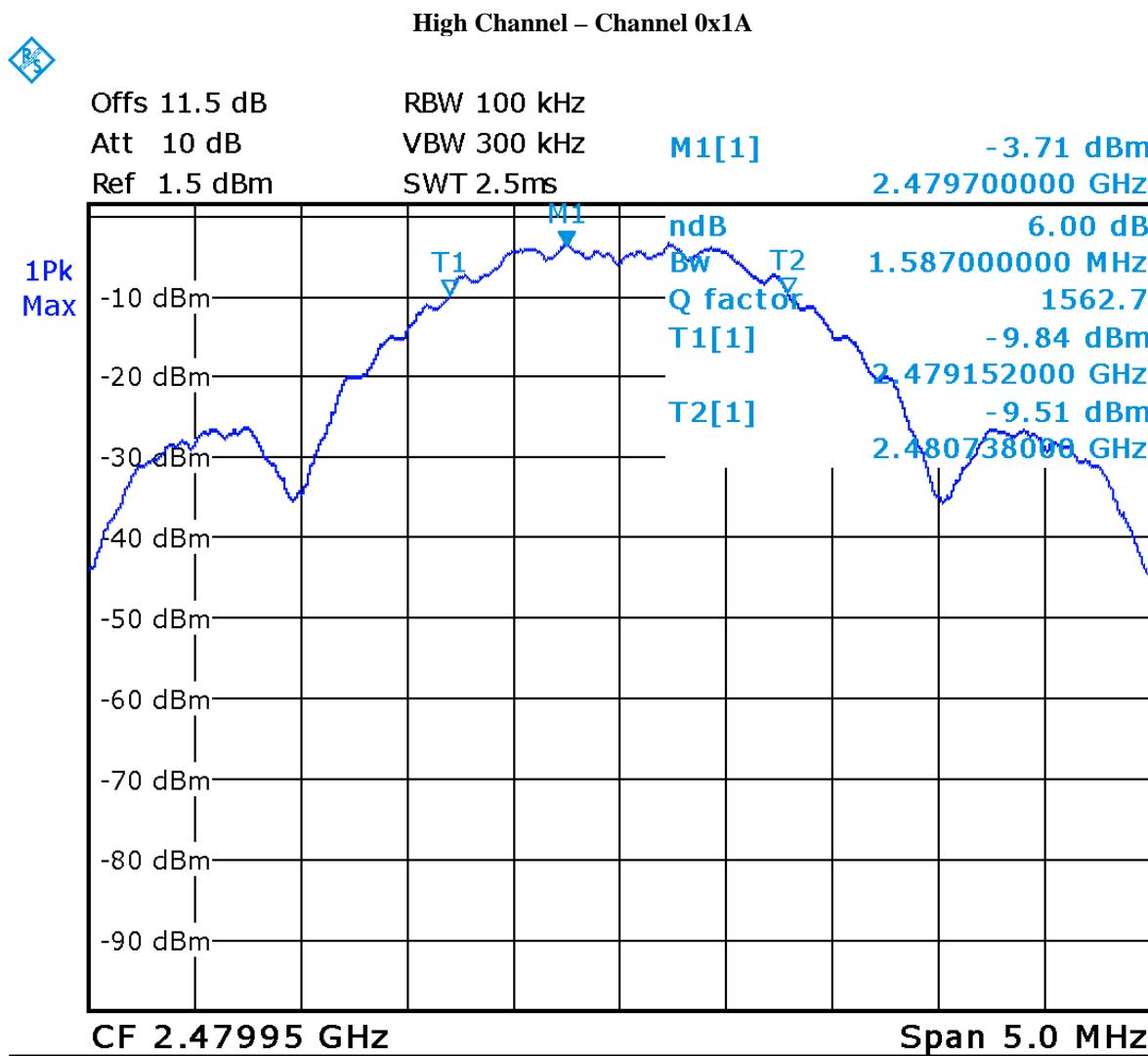
The EUT meet the 6 dB bandwidth requirement. The minimum measured 6 dB BW was 1.59 MHz and the 20 dB BW was 2.67 MHz

Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



## Graph(s)

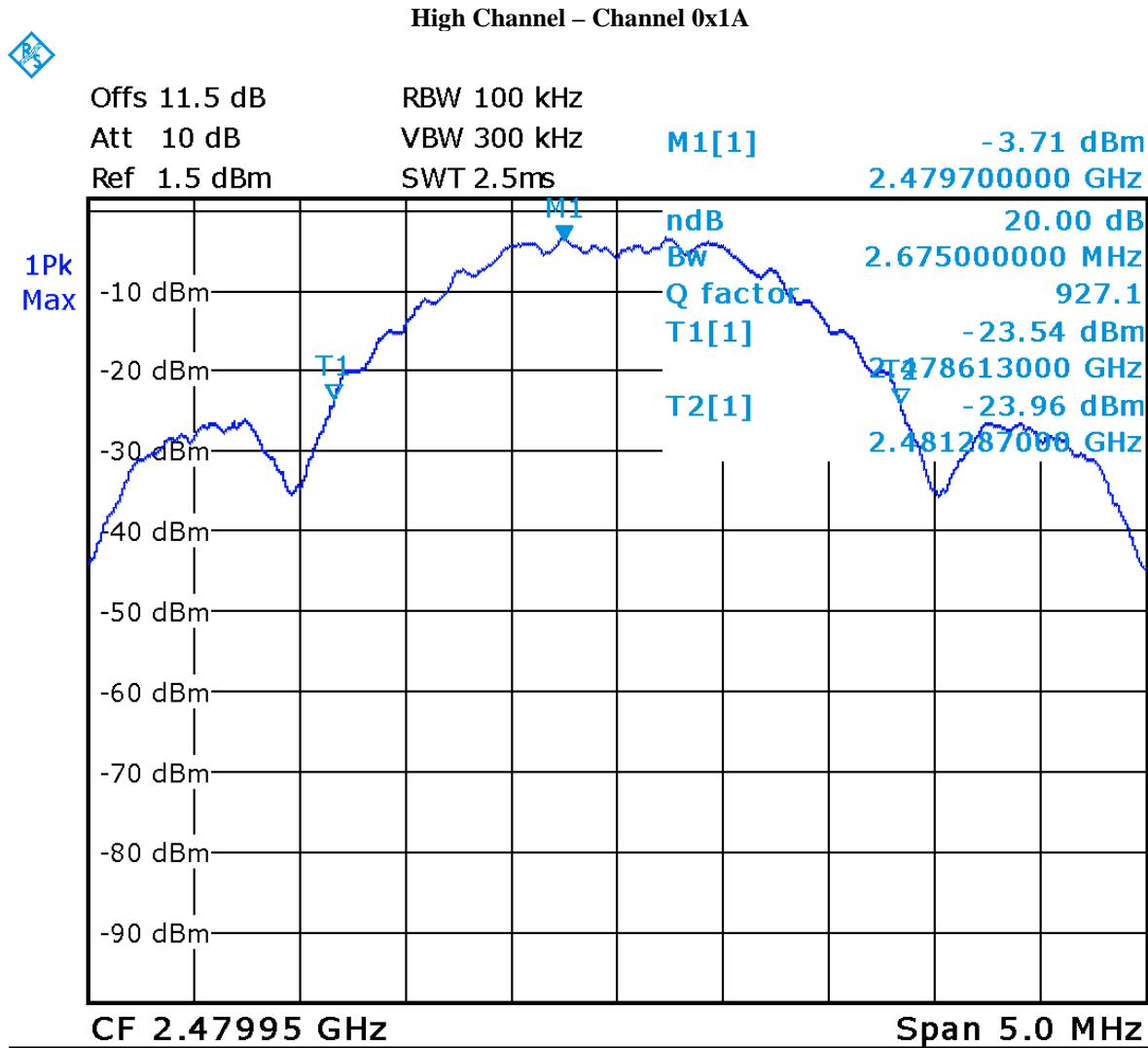
The graphs showed below shows the DTS Bandwidth during the operation of the device. This is measured by a max hold on the spectrum analyzer and the highest resolution bandwidth that is sufficiently low to exhibit the 6 dB bandwidth of a channel during operation of the EUT. This measurement is a peak measurement. Max hold is performed for a duration of not less than 1 minute.



Date: 26.OCT.2014 20:05:39

6 dB BW = 1.59 MHz

Client	Zen Within Inc
Product	Zen
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014

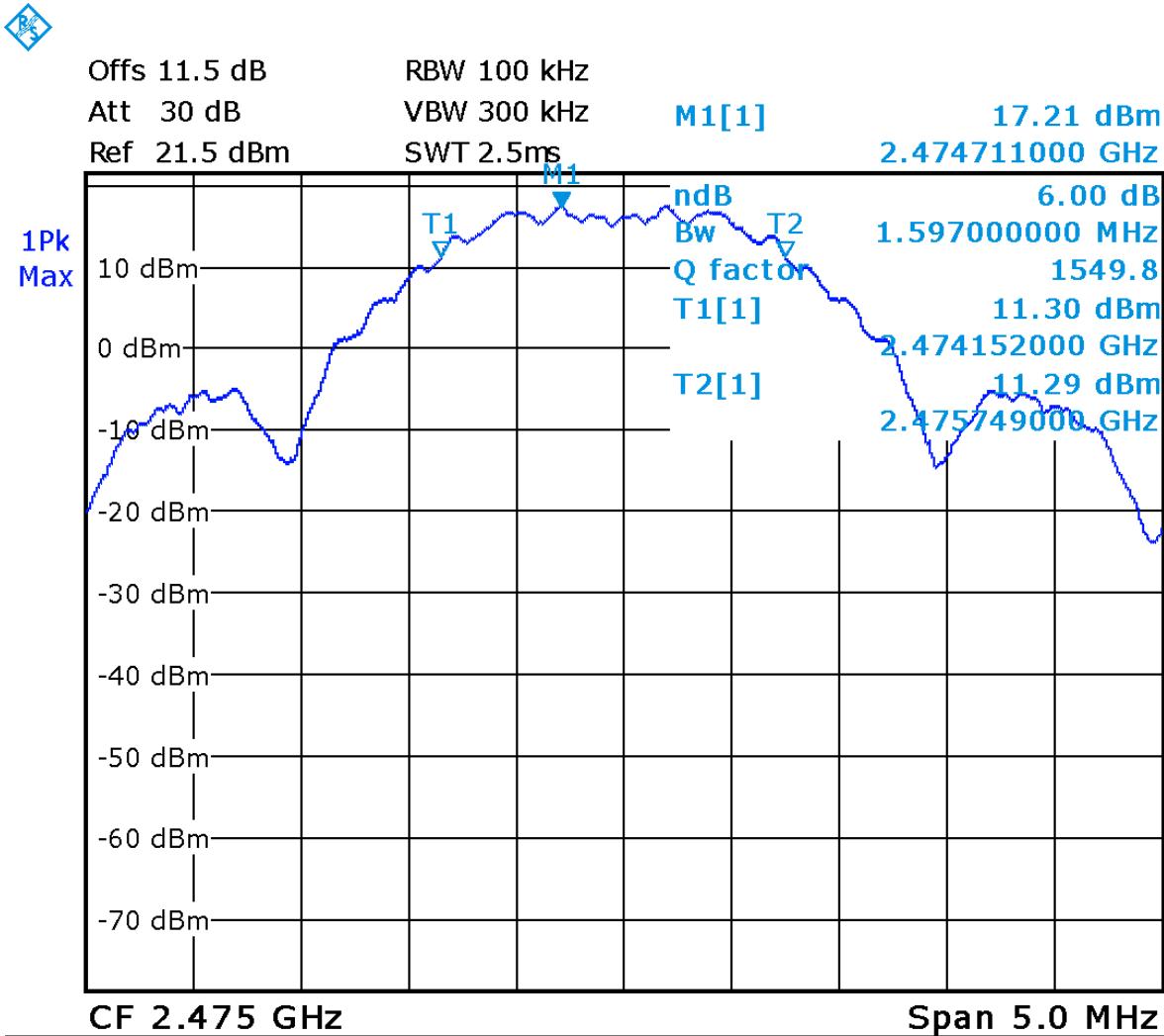


Date: 26.OCT.2014 20:06:26

20 dB BW = 2.68 MHz

Channel 0x19

Client	Zen Within Inc
Product	Zen
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014

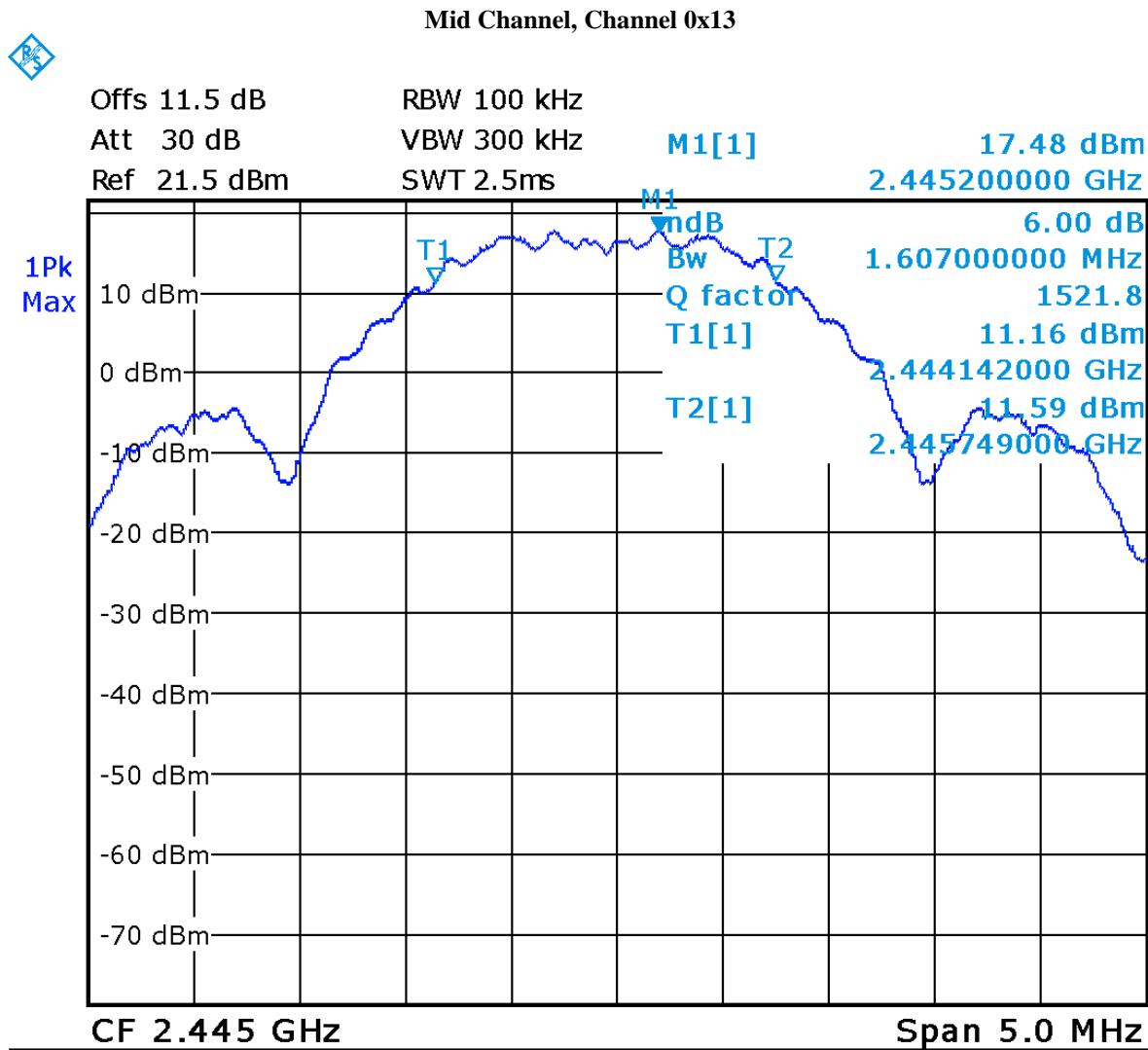


Date: 26.OCT.2014 20:09:08

$$6 \text{ dB BW} = 1.60 \text{ MHz}$$

$$20 \text{ dB BW} = 2.68 \text{ MHz}$$

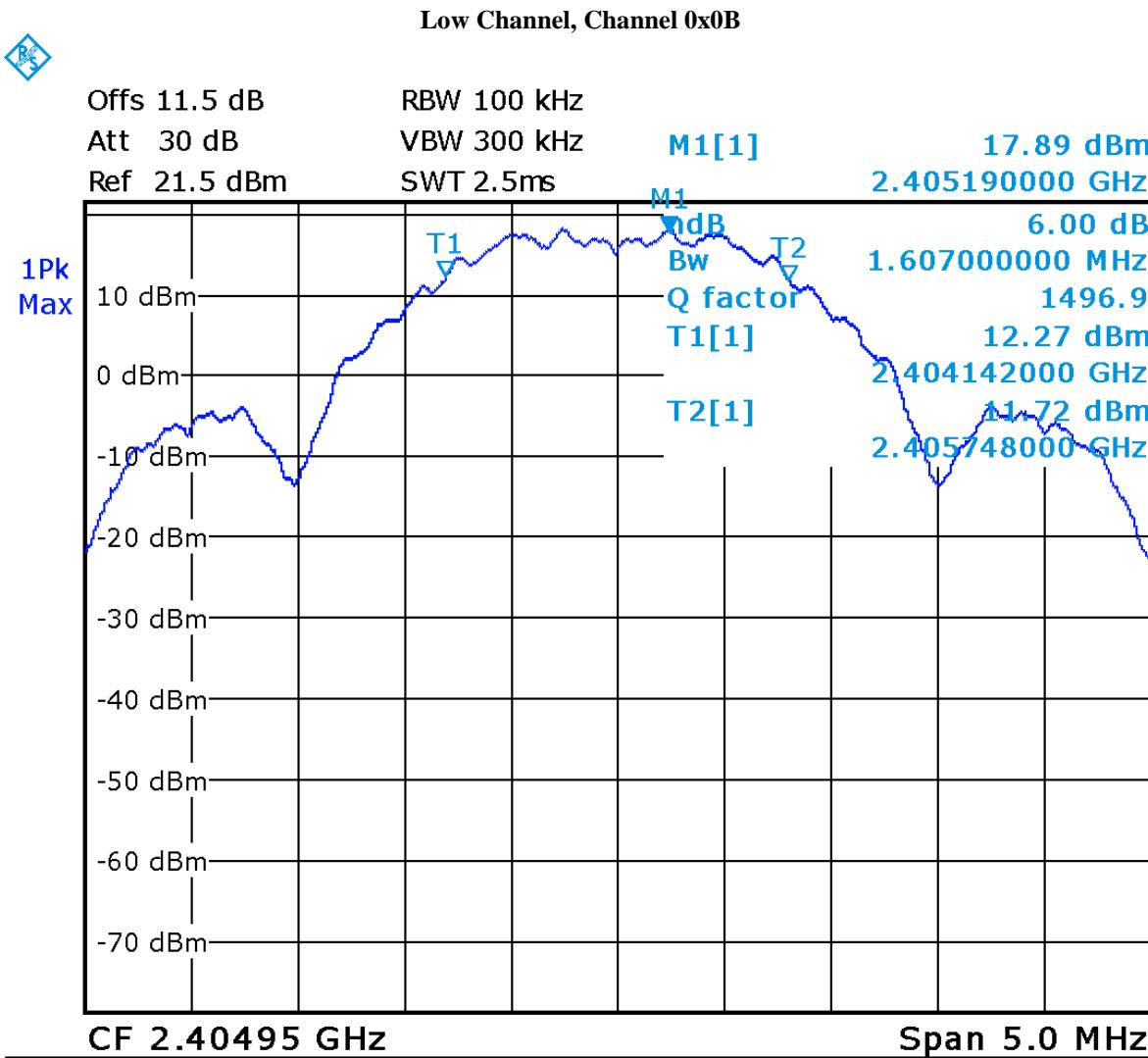
Client	Zen Within Inc
Product	Zen
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



Date: 26.OCT.2014 20:10:48

6 dB BW = 1.61 MHz  
 20 dB BW = 2.68 MHz

Client	Zen Within Inc
Product	Zen
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



Date: 26.OCT.2014 20:20:07

$$6 \text{ dB BW} = 1.61 \text{ MHz}$$

$$20 \text{ dB BW} = 2.68 \text{ MHz}$$

Note: See 'Appendix B – EUT & Test Setup Photographs' for photos showing the test set-up.

Client	<b>Zen Within Inc</b>	
Product	<b>Zen</b>	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

## Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	ESL6	Rohde & Schwarz	Nov 15, 2013	Nov 15, 2015	GEMC 160
Attenuator 10 dB	8493B	Agilent	NCR	NCR	GEMC133
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 29

This report module is based on GEMC template "FCC – Power Line Conducted Emissions Class B\_Rev1"

Client	<b>Zen Within Inc</b>	
Product	<b>Zen</b>	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

## ***Maximum Peak Envelope Conducted Power – DM***

### **Purpose**

The purpose of this test is to ensure that the maximum power conducted to the radiating element does not exceed the limits specified. This ensures that if the end-user replaces the antenna, that the maximum power does not exceed an amount which may create an excessive power level.

### **Limits and Methods**

The limits are defined in FCC Part 15.247(b) and RSS 210.

For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands, the peak limit is 1 watt.

The method is given in Section 9.1.2 of FCC KDB 558074: June 9, 2014.

### **Results**

The EUT passed. The power of the EUT was set to transmit at maximum power. Four Channels were measured. The following tables show the peak powers measured

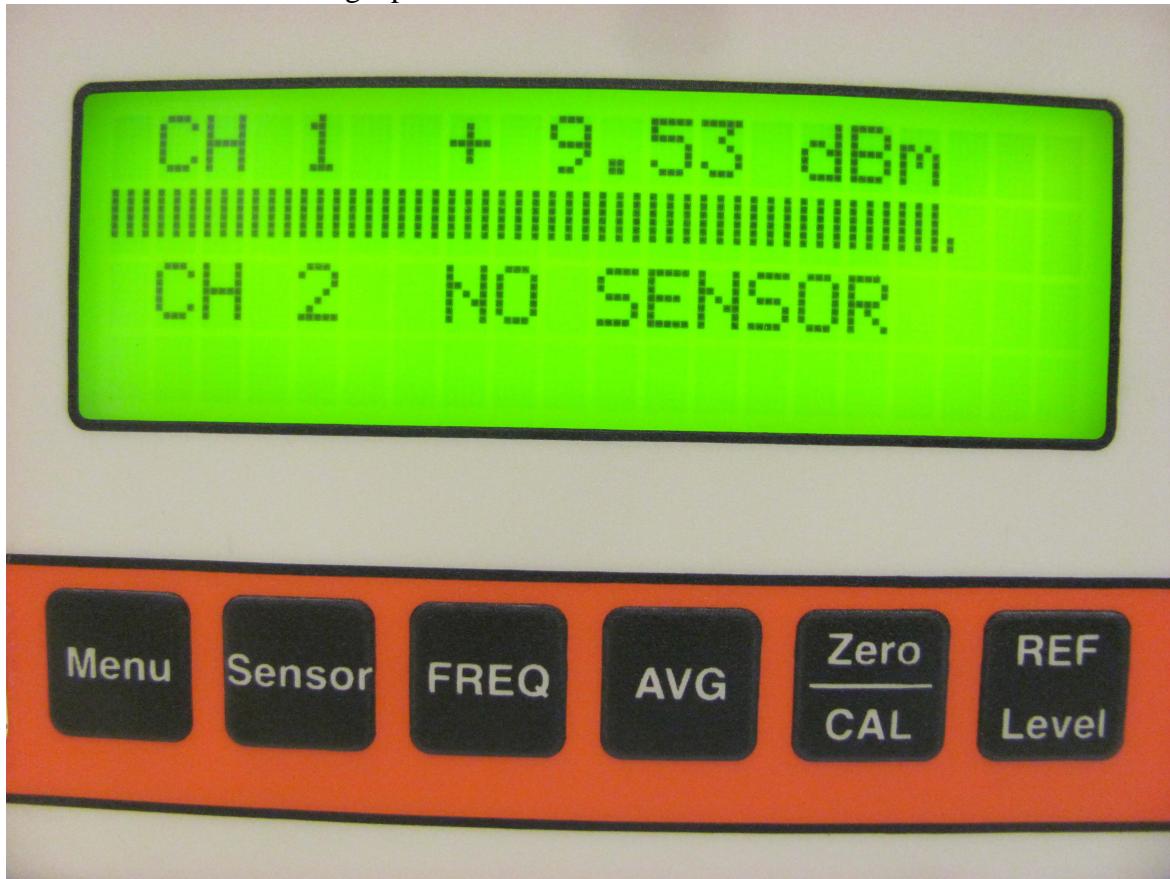
Channel	Frequency (MHz)	Power (dBm) (raw)	Attenuator (dB)	Power (dBm)	Power (mW)
Lo Channel 0x0B	2405	9.53	10	19.53	89.74
Mid Channel 0x13	2445	9.41	10	19.41	87.30
Hi Channel 0x19	2475	9.22	10	19.22	83.56
Hi Channel 0x1A	2480	-12.52	10	-2.52	0.56

Client	<b>Zen Within Inc</b>	
Product	<b>Zen</b>	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

## Readings

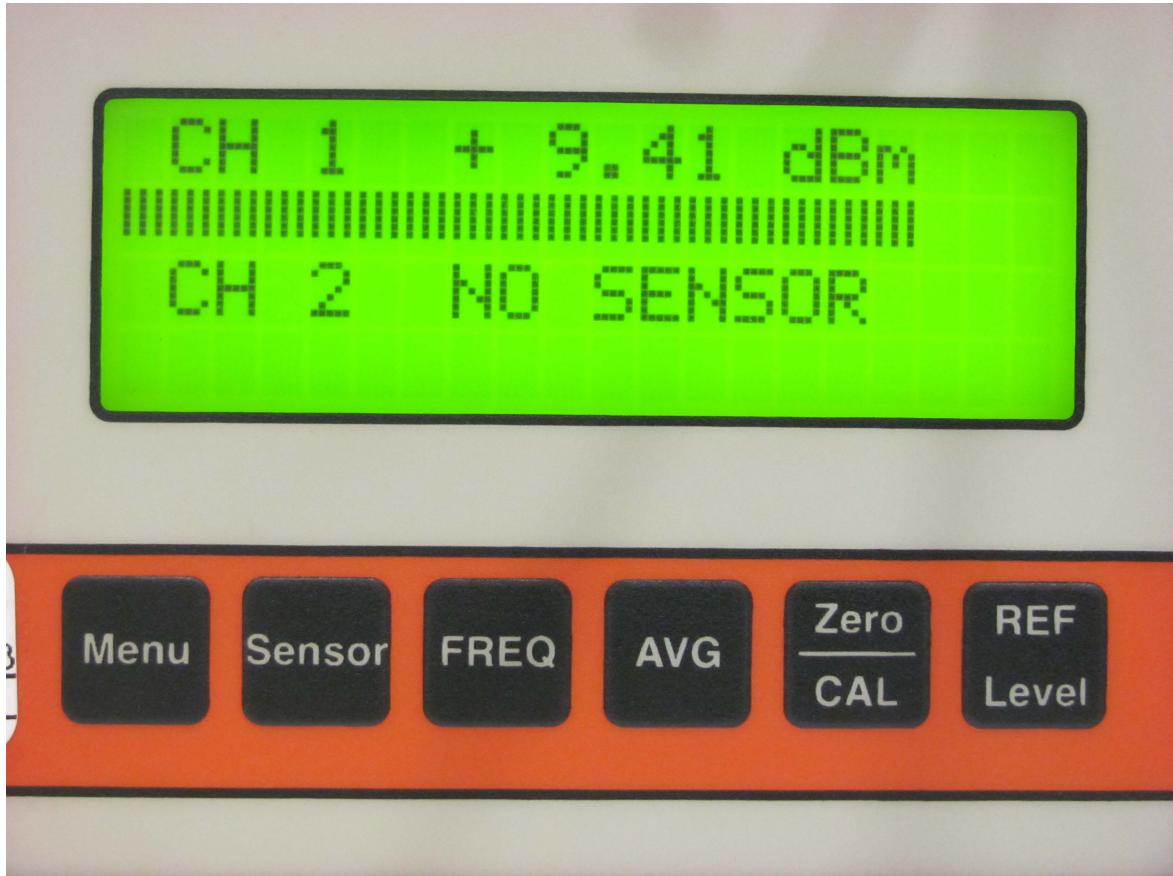
The photos shown below shows the peak power output of the device during the antenna conducted measurement during transmit operation of the EUT.

Tests were conducted using a power meter.



**Figure 1: Power meter reading, channel 0x0B- photo**

Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



**Figure 2: Power meter reading, channel 0x13– photo**

Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



**Figure 3: Power meter reading, channel 0x19– photo**

Client	Zen Within Inc
Product	Zen
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



Figure 4:Power meter reading, channel 0x1A - photo

Note: See ‘Appendix B – EUT & Test Setup Photographs’ for photos showing the test set-up.

## Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Power Head	PH 2000	AR	Feb 7, 2013	Feb 7, 2015	GEMC 15
Power meter	PM 2002	AR	Feb 7, 2013	Feb 7, 2015	GEMC 16
Attenuator 10 dB	8493B	Agilent	NCR	NCR	133
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 29

This report module is based on GEMC template “FCC – Power Line Conducted Emissions Class B\_Rev1”

Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



## ***Antenna Spurious Conducted Emissions (-20 dBc Requirement) – 15.247***

### **Purpose**

The purpose of this test is to ensure that the maximum power conducted to the radiating element at frequencies outside of the authorized spectrum does not exceed the limits specified. This ensures that the only the intended signal is delivered to the radiating element.

### **Limits and Methods**

The limits are defined in 15.247(d). In any 100 kHz band, the peak spurious harmonics emissions must be at least 20 dB below the fundamental. Spurious Conducted emissions are to be evaluated up to the 10<sup>th</sup> harmonic. This -20 dBc requirement also applies at the ‘band edge’ or 2.4 GHz and 2.4835 GHz.

The method is given in Section 11 of FCC KDB 558074: June 9, 2014.

### **Results**

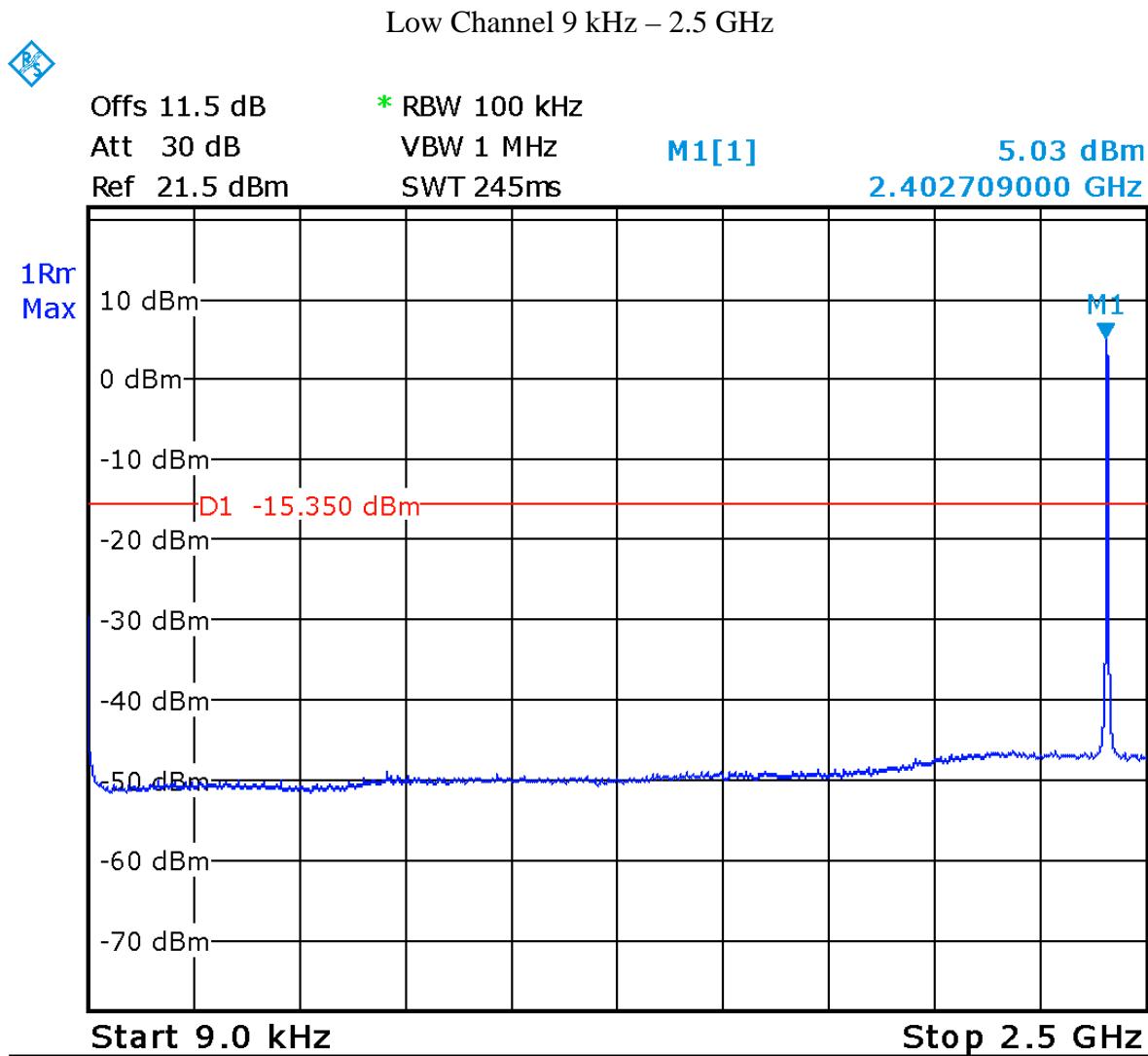
The EUT passed the limits. B, G and N protocols are measured; low, middle and high channels were measured for each Protocol. The worst case was presented as a graph for the spectrum. The -20 dBc requirement is shown for the lower band edge at 2.4 GHz in the low band. The -20 dBc requirement is also shown for the higher band edge at 2.4835 GHz in the high band.

Client	Zen Within Inc
Product	Zen
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



## Graph(s)

The graphs shown below shows the peak power output of the device during the antenna conducted measurement during transmit operation of the EUT.

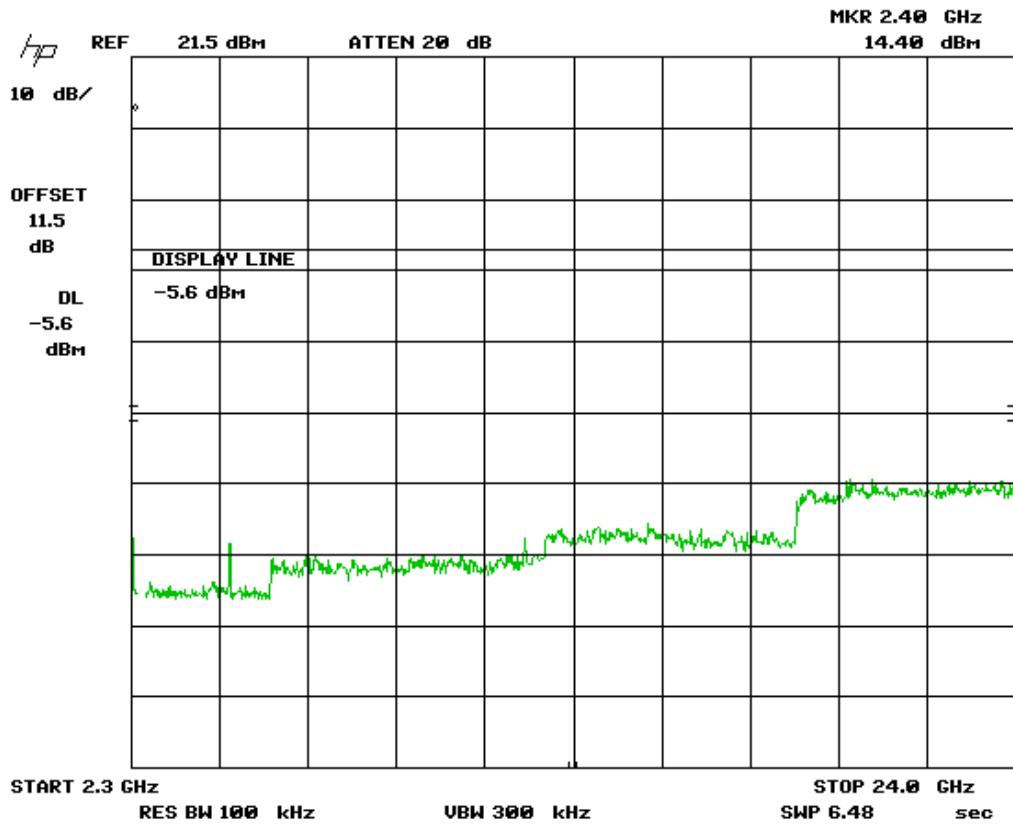


Date: 26.OCT.2014 21:01:26

Client	Zen Within Inc
Product	Zen
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



### Low Channel 2.4 GHz – 24 GHz



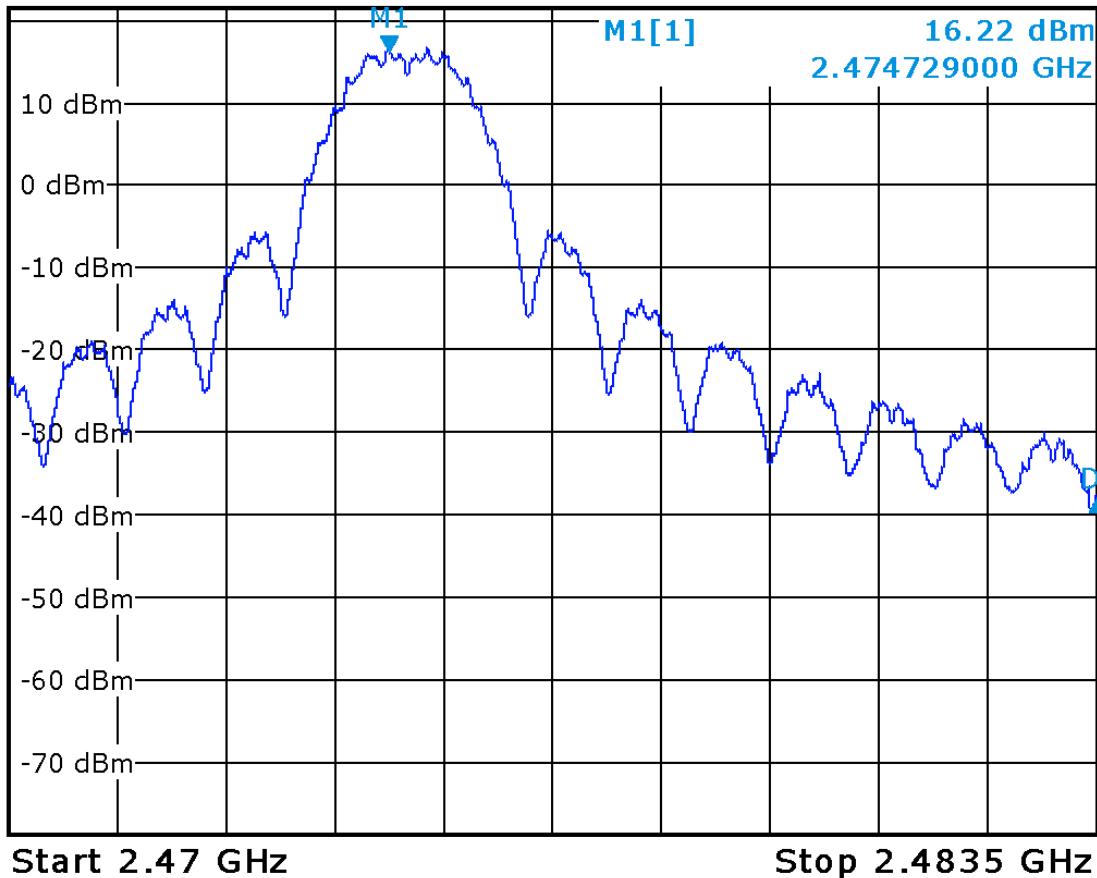
Client	Zen Within Inc
Product	Zen
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



### Channel 0x19 – 2483.5 Band Edge



Offs 11.5 dB      \* RBW 100 kHz  
 Att 30 dB      VBW 1 MHz      D2[1]      -54.11 dB  
 Ref 21.5 dBm      SWT 2.5ms      M1      8.770000000 MHz  
 1Rm Max

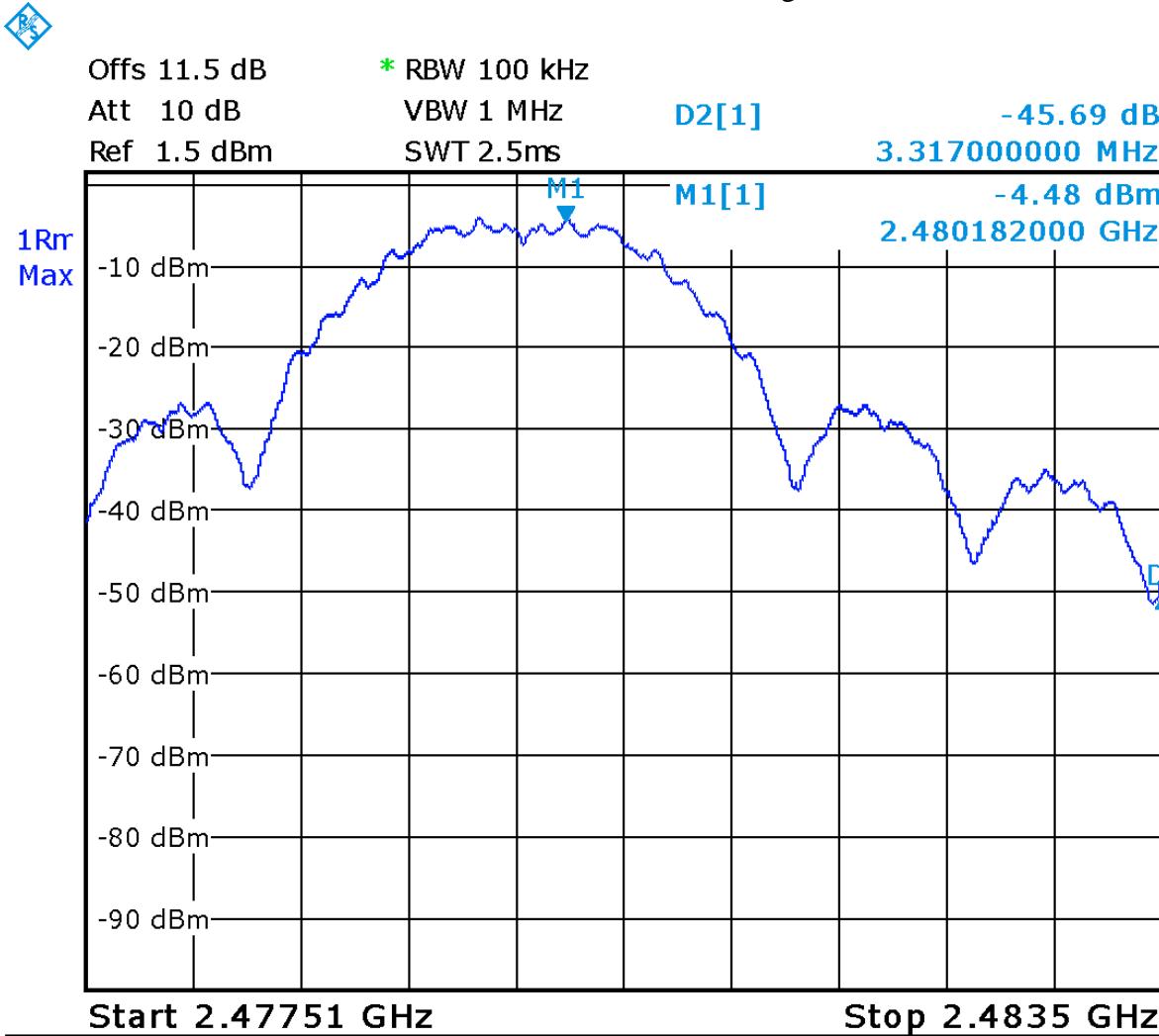


Date: 26.OCT.2014 20:57:37

Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



### Channel 0x1A – 2483.5 Band Edge

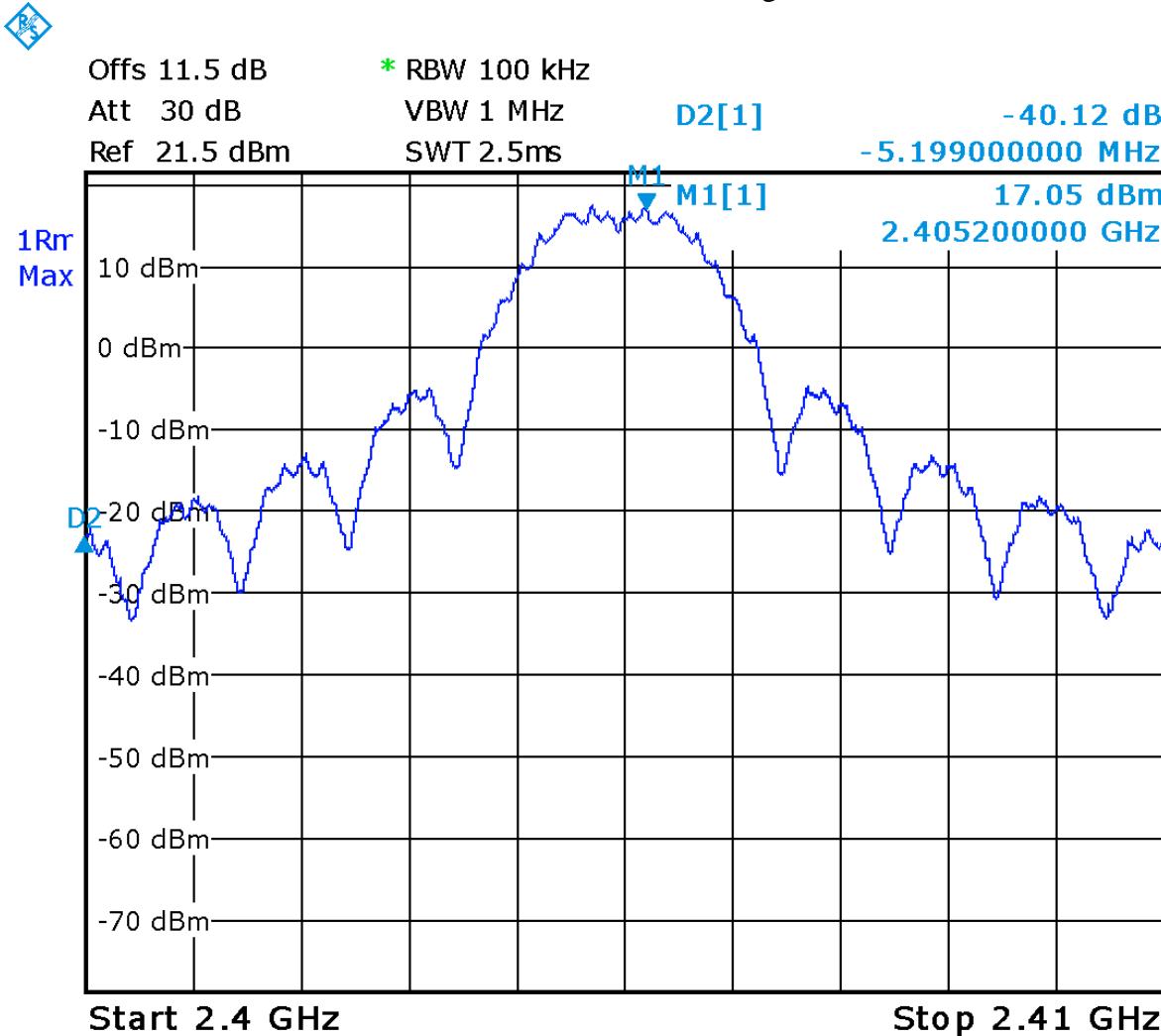


Date: 26.OCT.2014 20:45:15

Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



### Low Channel – 2400 Band edge



Date: 26.OCT.2014 21:00:23

Note: See ‘Appendix B – EUT & Test Setup Photographs’ for photos showing the test set-up.

Client	<b>Zen Within Inc</b>	
Product	<b>Zen</b>	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

## Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	8566B	HP	Oct 2, 2013	Oct 2, 2015	GEMC 190
Quasi Peak Adapter	85650A	HP	Oct 1, 2013	Oct 1, 2015	GEMC 191
Spectrum Analyzer	ESL6	Rohde & Schwarz	Nov 15, 2013	Nov 15, 2015	GEMC 160
Attenuator 10 dB	8493B	Agilent	NCR	NCR	GEMC133
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 29

This report module is based on GEMC template "FCC – Power Line Conducted Emissions Class B\_Rev1"

Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



## ***Radiated Emissions – 15.247***

### **Purpose**

The purpose of this test is to ensure that the RF energy unintentionally emitted from the EUT does not exceed the limits listed below as defined in the applicable test standard, as measured from a receiving antenna. This helps protect broadcast radio services such as television, FM radio, pagers, cellular telephones, emergency services, and so on, from unwanted interference.

### **Limit and Method**

The method is given in Section 12.1 of FCC KDB 558074: June 9, 2014.

The limits are as defined in FCC Part 15, Section 15.209:

The limits, as defined in 15.247(d) for unintentional radiated emissions apply for those emissions that fall in the restricted bands, as defined in Section 15.205(a). These emissions must comply with the radiated emission limits specified in Section 15.209(a).

All unintentional emissions must also meet the ‘Spurious Conducted Emissions’ requirements of -20 dBc or greater. See also ‘Spurious Conducted Emissions’ for further details.

0.009 MHz – 0.490 MHz, 2400/F(kHz) uV/m at 300 m<sup>1</sup>

0.490 MHz – 1.705 MHz, 24000/F(kHz) uV/m at 30 m<sup>1</sup>

1.705 MHz – 30 MHz, 30 uV/m at 30 m<sup>1</sup>

30 MHz – 88 MHz, 100 uV/m (40.0 dB<sub>u</sub>V/m<sup>1</sup>) at 3 m

88 MHz – 216 MHz, 150 uV/m (43.5 dB<sub>u</sub>V/m<sup>1</sup>) at 3 m

216 MHz – 960 MHz, 200 uV/m (46.0 dB<sub>u</sub>V/m<sup>1</sup>) at 3 m

Above 960 MHz, 500 uV/m (54.0 dB<sub>u</sub>V/m<sup>1</sup>) at 3 m

Above 1000 MHz, 500 uV/m (54 dB<sub>u</sub>V/m<sup>2</sup>) at 3m

Above 1000 MHz, 500 uV/m (74 dB<sub>u</sub>V/m<sup>3</sup>) at 3m

<sup>1</sup>Limit is with Quasi Peak detector with bandwidths as defined in CISPR-16-1-1

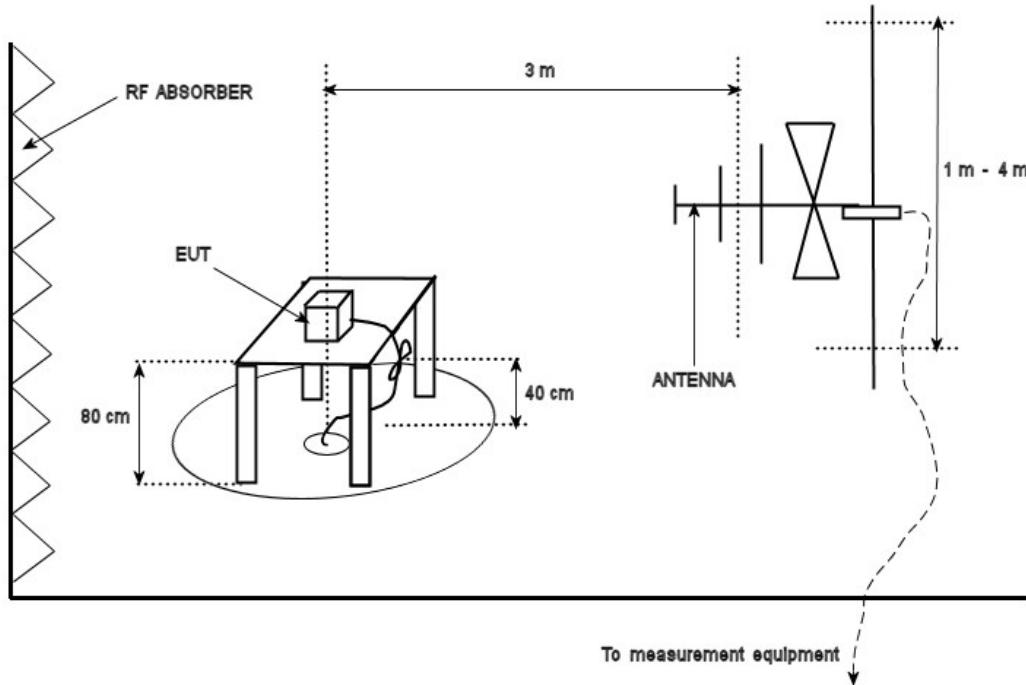
<sup>2</sup>Limit is with 1 MHz measurement bandwidth and using an Average detector

<sup>3</sup>Limit is with 1 MHz measurement bandwidth and using a Peak detector

Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



### Typical Radiated Emissions Setup



### Measurement Uncertainty

The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is +/-4.4 dB with a 'k=2' coverage factor and a 95% confidence level.

### Preliminary Graphs

The graphs shown below are maximized peak measurement graphs, measured with a resolution bandwidth greater than the final required detector and over a full 0-360° rotation. This peaking process is done as a worst case measurement. This process enables the detection of frequencies of concern for final measurement.

For final measurements with the appropriate detector, please refer to the final measurement tables where applicable.

In accordance with FCC Part 15, Subpart A, Section 15.33, the device was scanned to the 10<sup>th</sup> harmonic (a minimum of a 24.835 GHz).

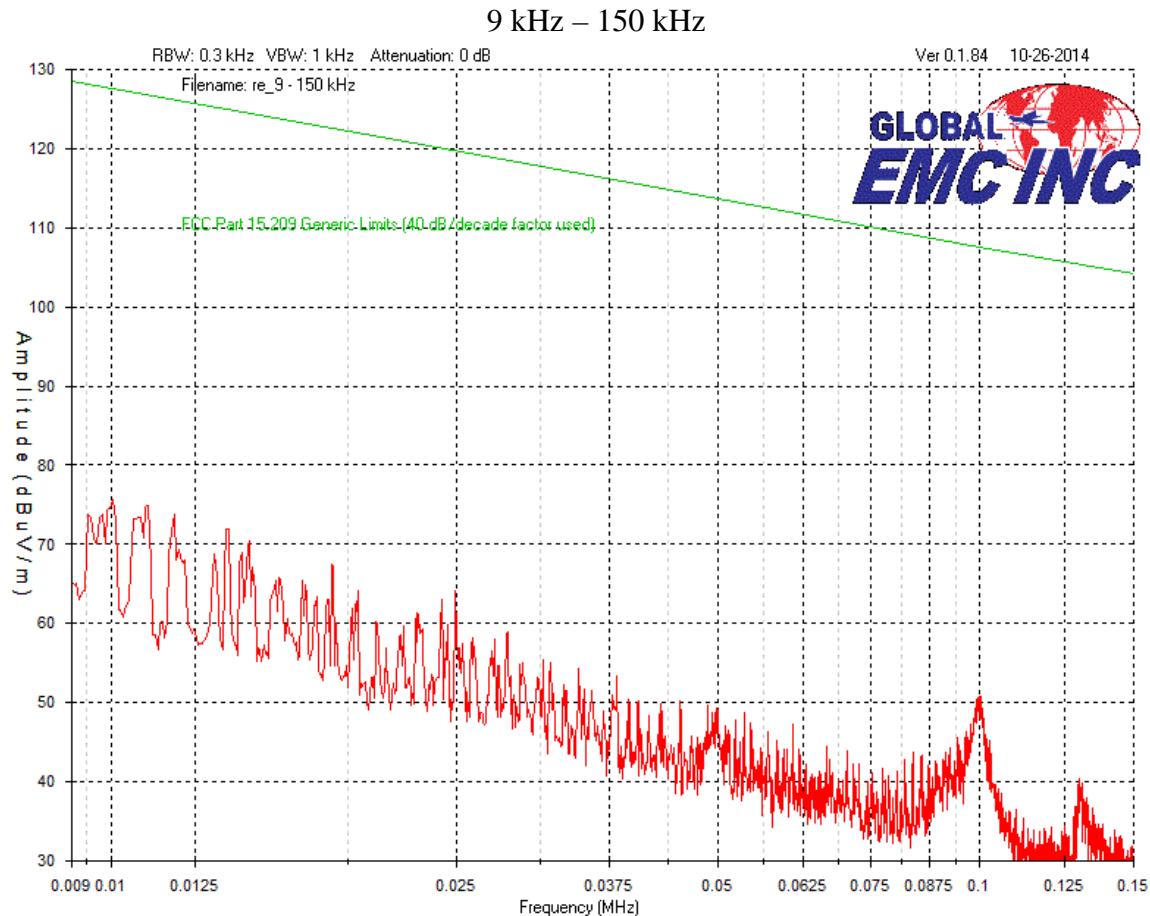
Devices scanned may be scanned at alternate test distances, and in accordance with FCC Part 15, Subpart A, Section 15.31, an extrapolation factor of 20 dB/decade was used above

Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014

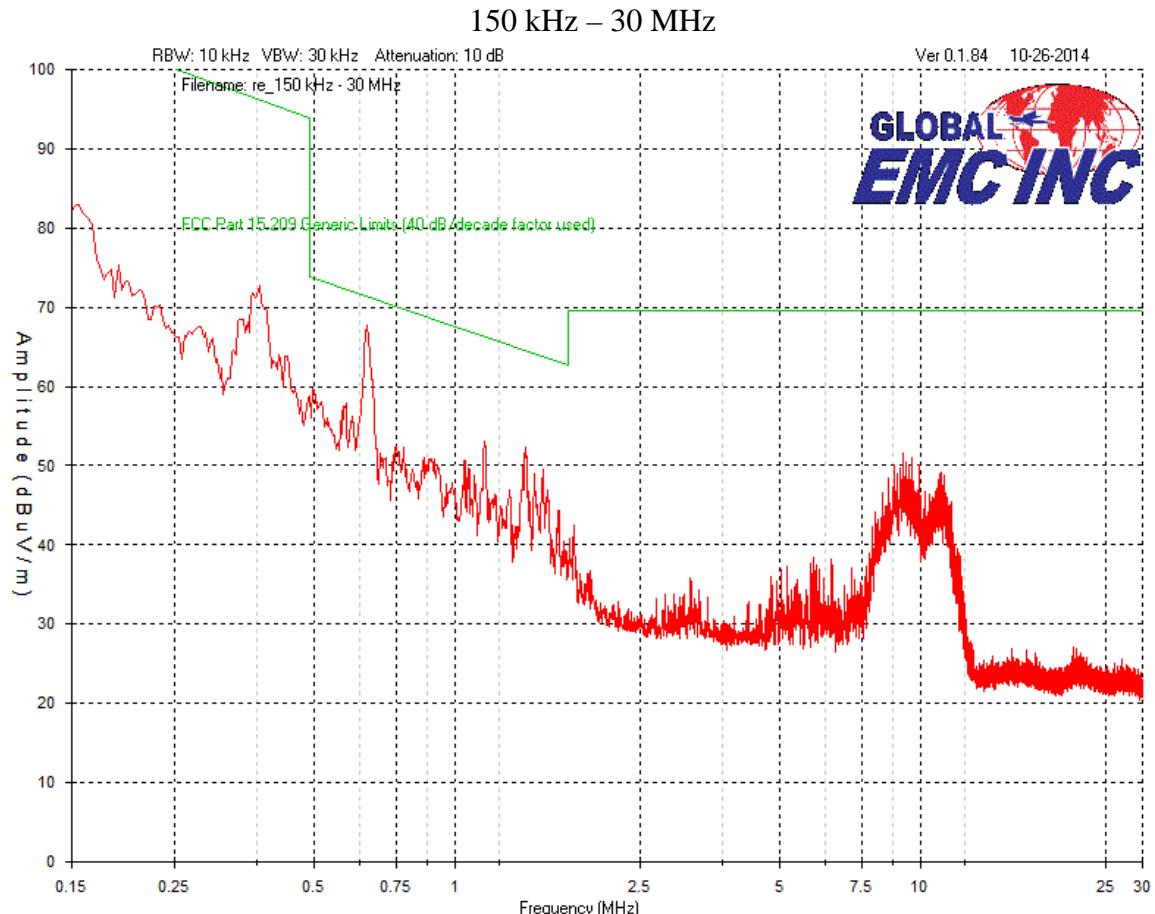


30 MHz and 40 dB/decade below 30 MHz. For example for 1 meter measurements, an extrapolation factor 9.5 dB from 20 Log (1m / 3m) is applied.

Band edge measure graphs were shown for illustrations purpose. See final measurement section for all measurements.



Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014

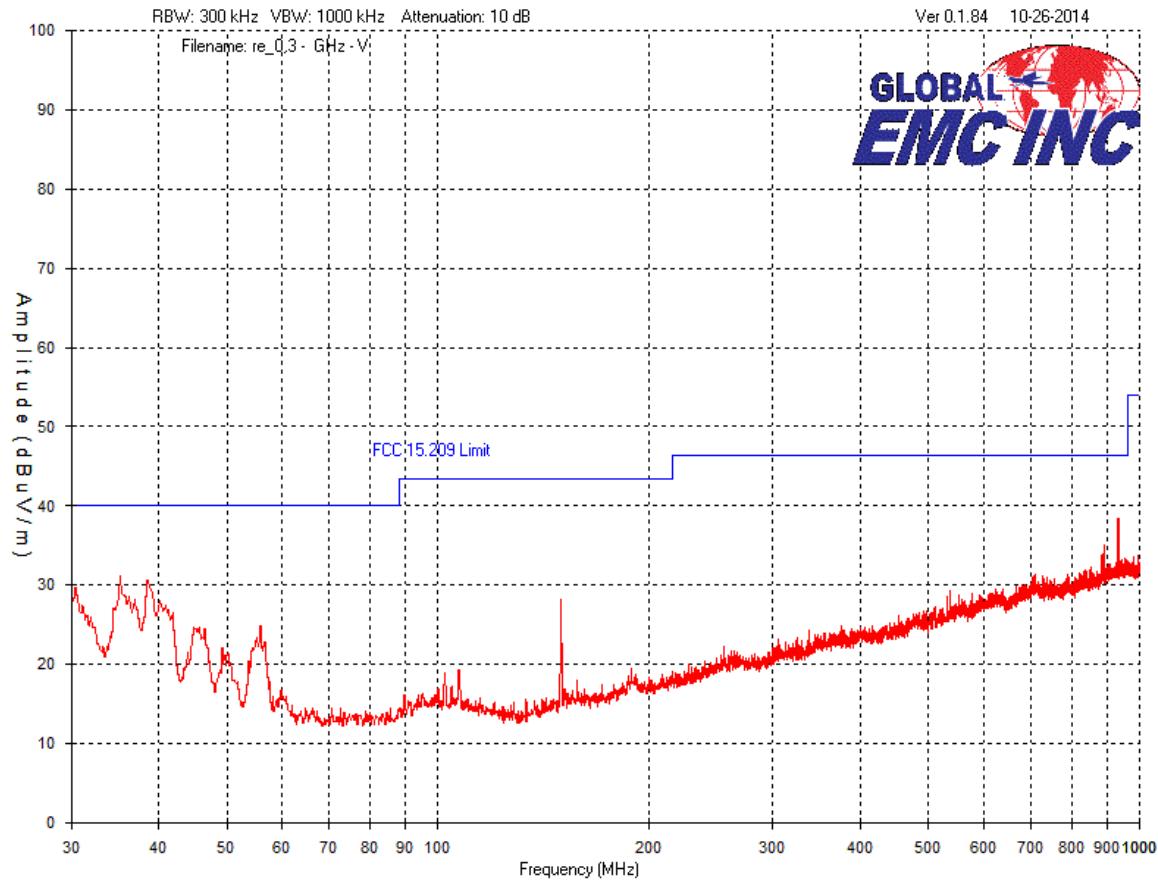


Note: See Final Measurements and Results for measurements and explanations.

Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



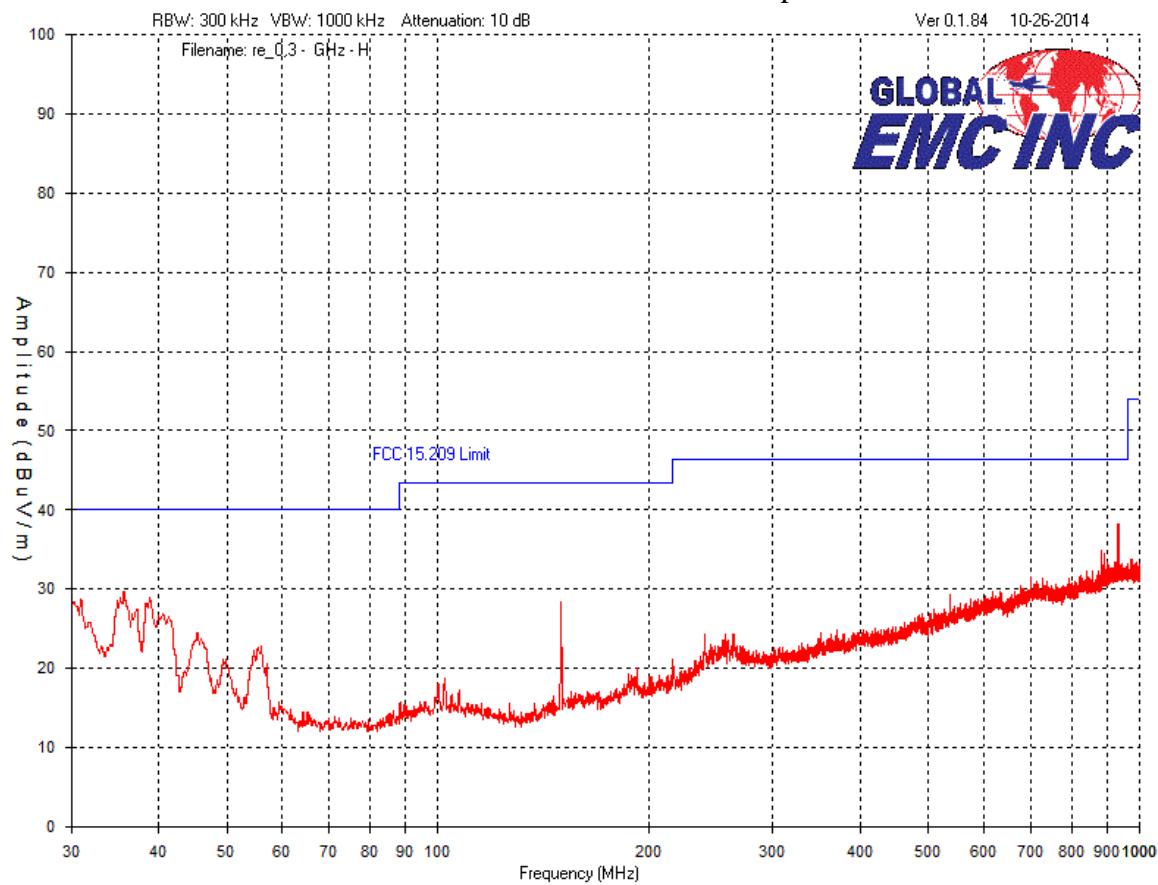
**Low Channel - 30 MHz – 1 GHz  
Vertical – Peak Emission Graph**



Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



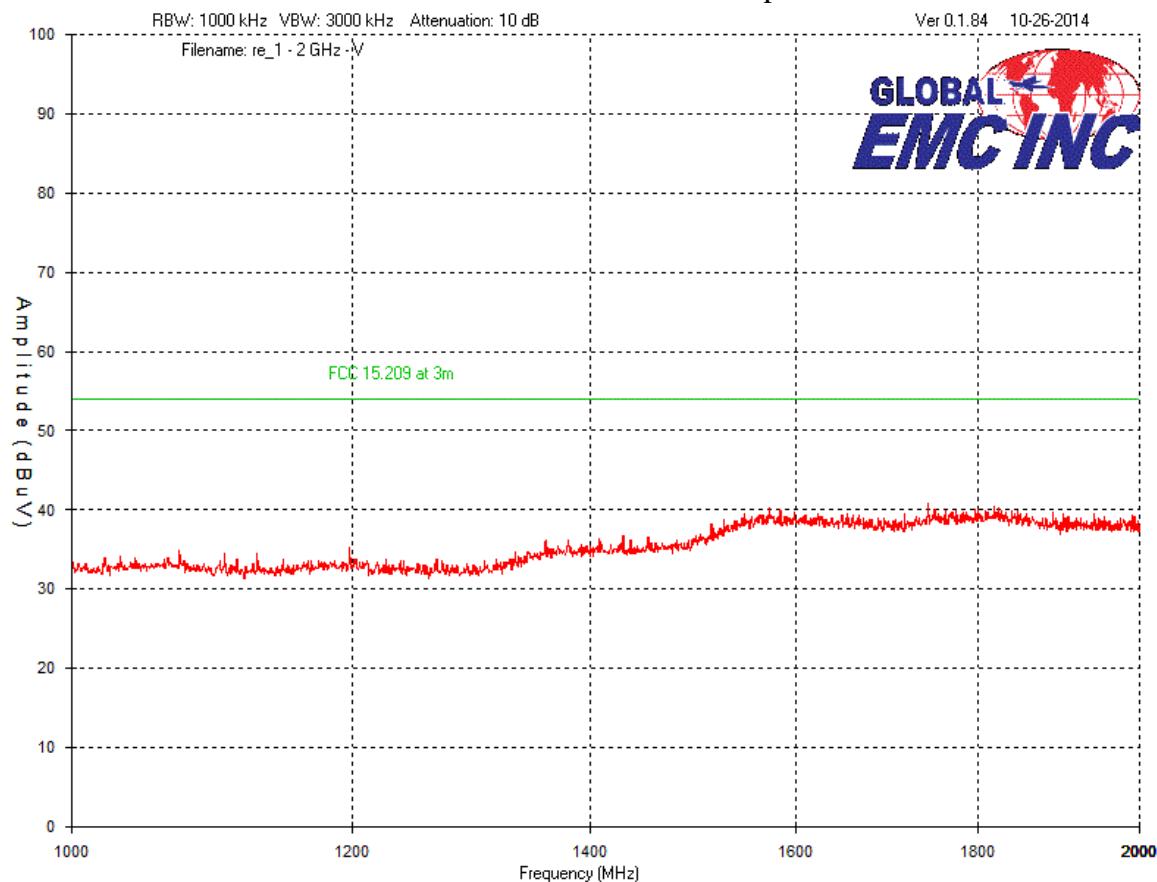
**Low Channel – 30 MHz – 1 GHz  
Horizontal - Peak Emission Graph**



Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



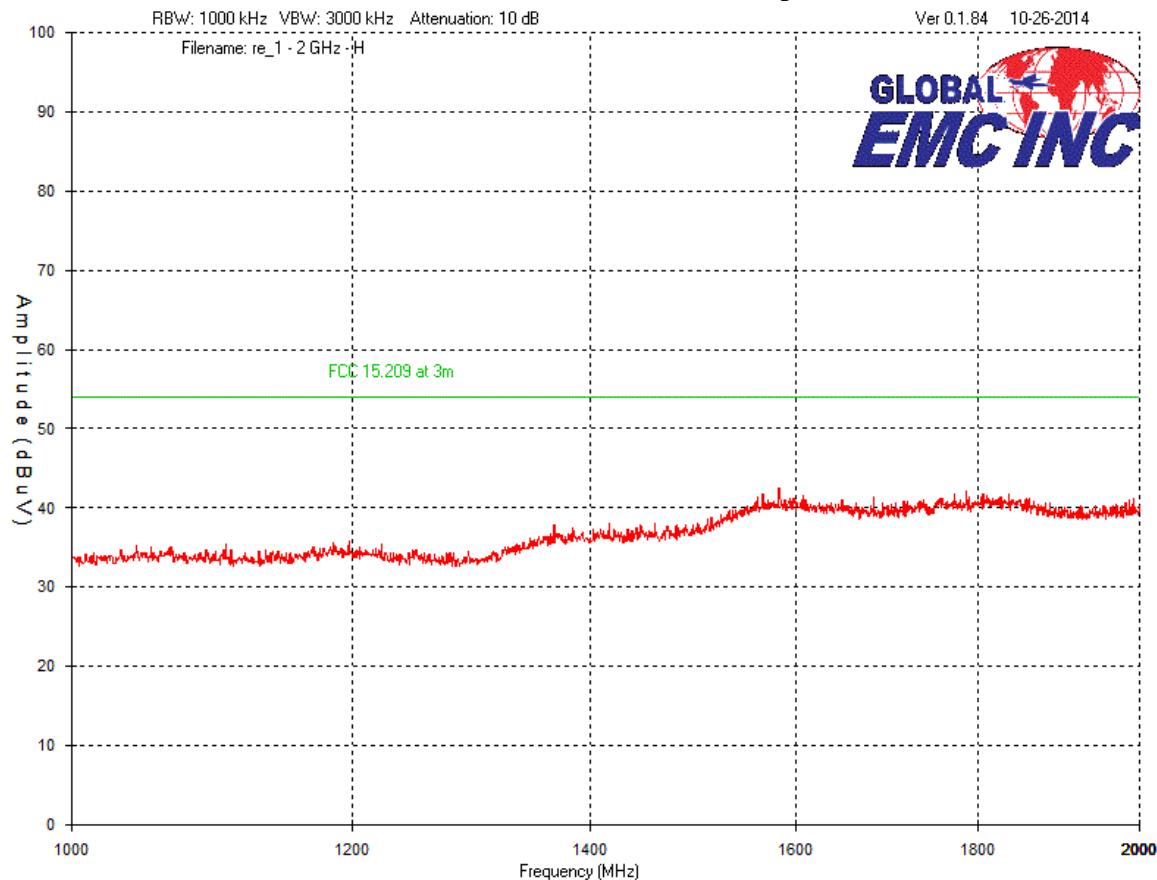
**Low Channel – 1 GHz – 2 GHz  
Vertical - Peak Emission Graph**



Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



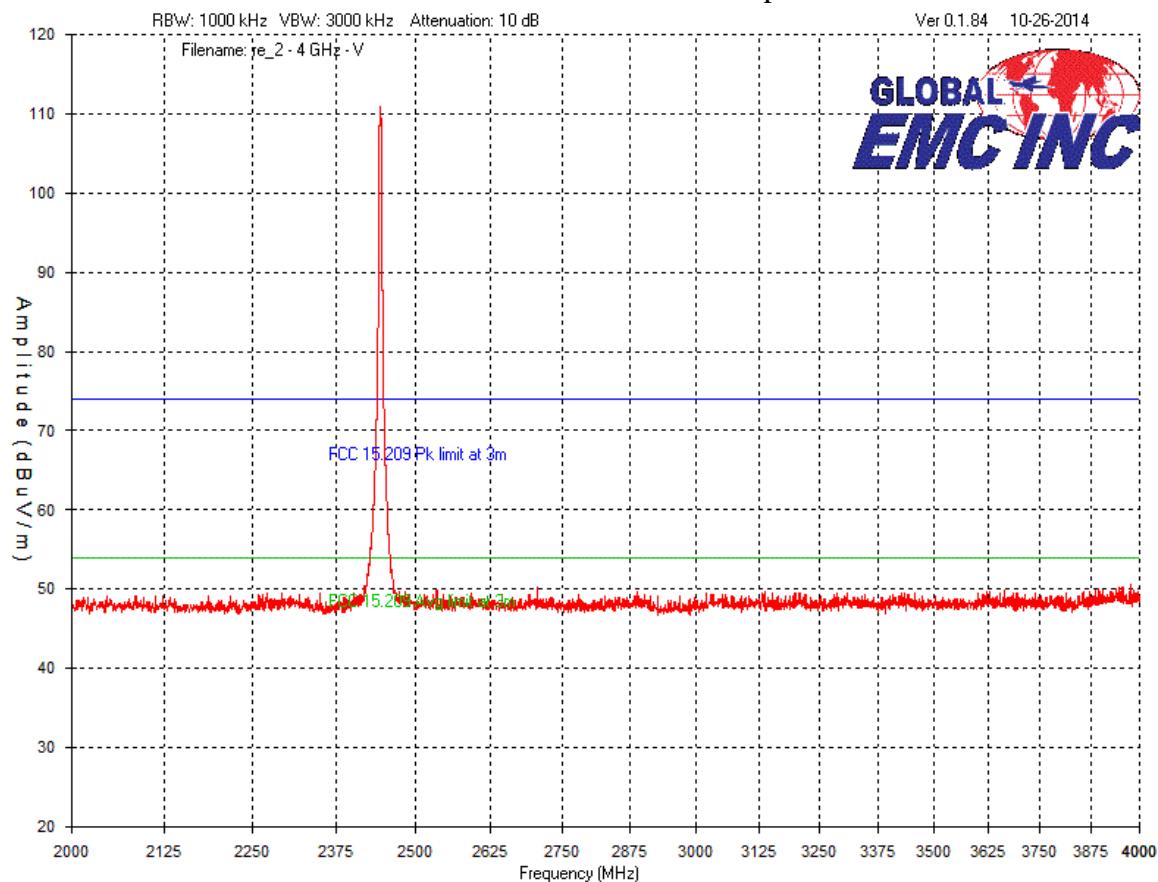
**Low Channel – 1 GHz – 2 GHz  
Horizontal - Peak Emission Graph**



Client	Zen Within Inc
Product	Zen
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



### Low Channel – 2 GHz – 4 GHz Vertical - Peak Emission Graph

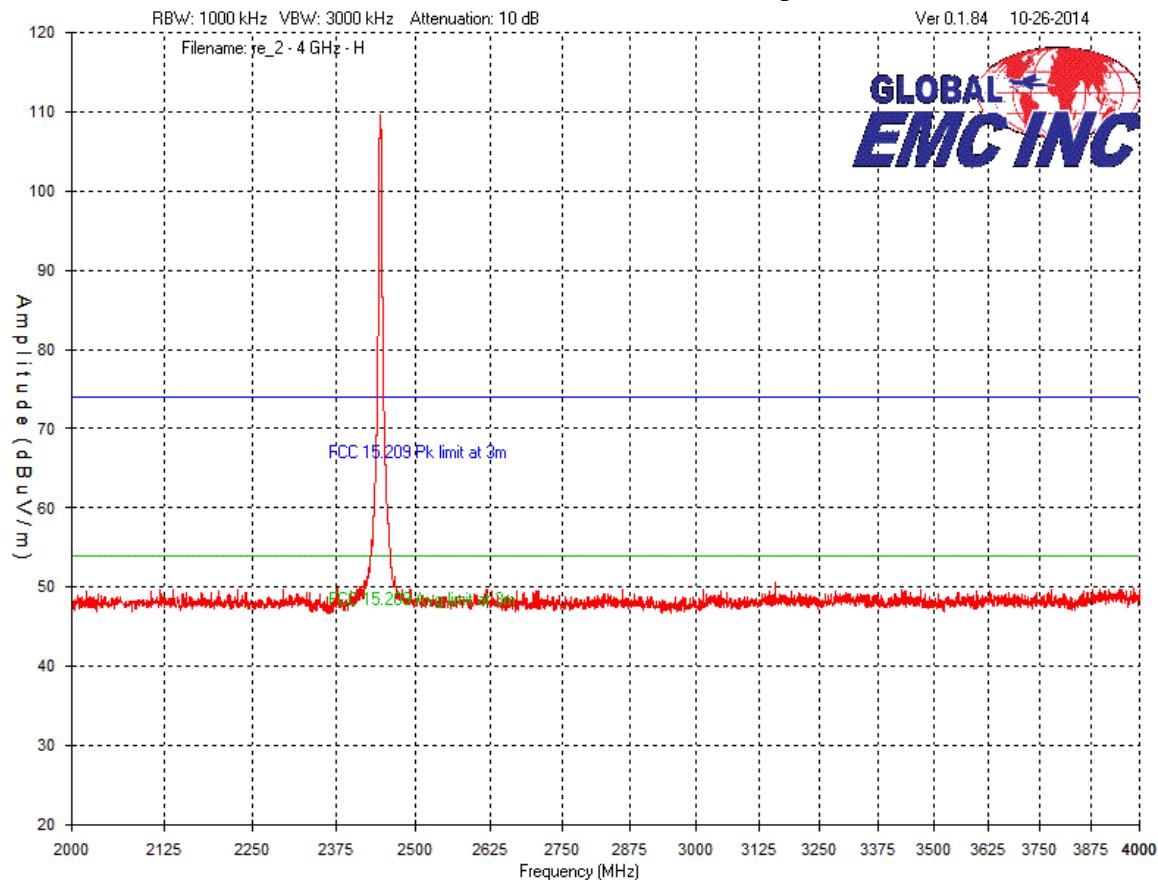


Note: See Final Measurements and Results section for measurements.

Client	Zen Within Inc
Product	Zen
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



### Low Channel – 2 GHz – 10 GHz Horizontal - Peak Emission Graph

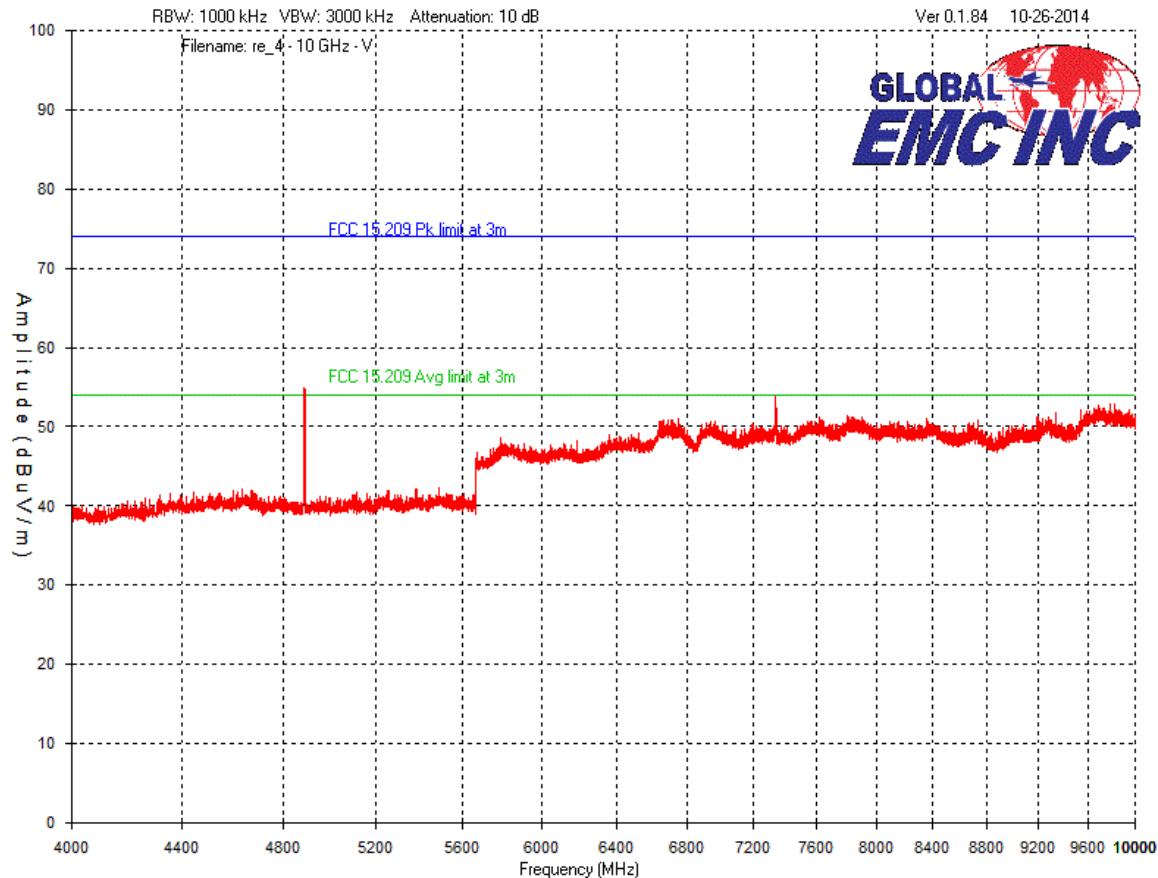


Note: See Final Measurements and Results section for measurements.

Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



### Low Channel – 4 GHz – 10 GHz Vertical - Peak Emission Graph

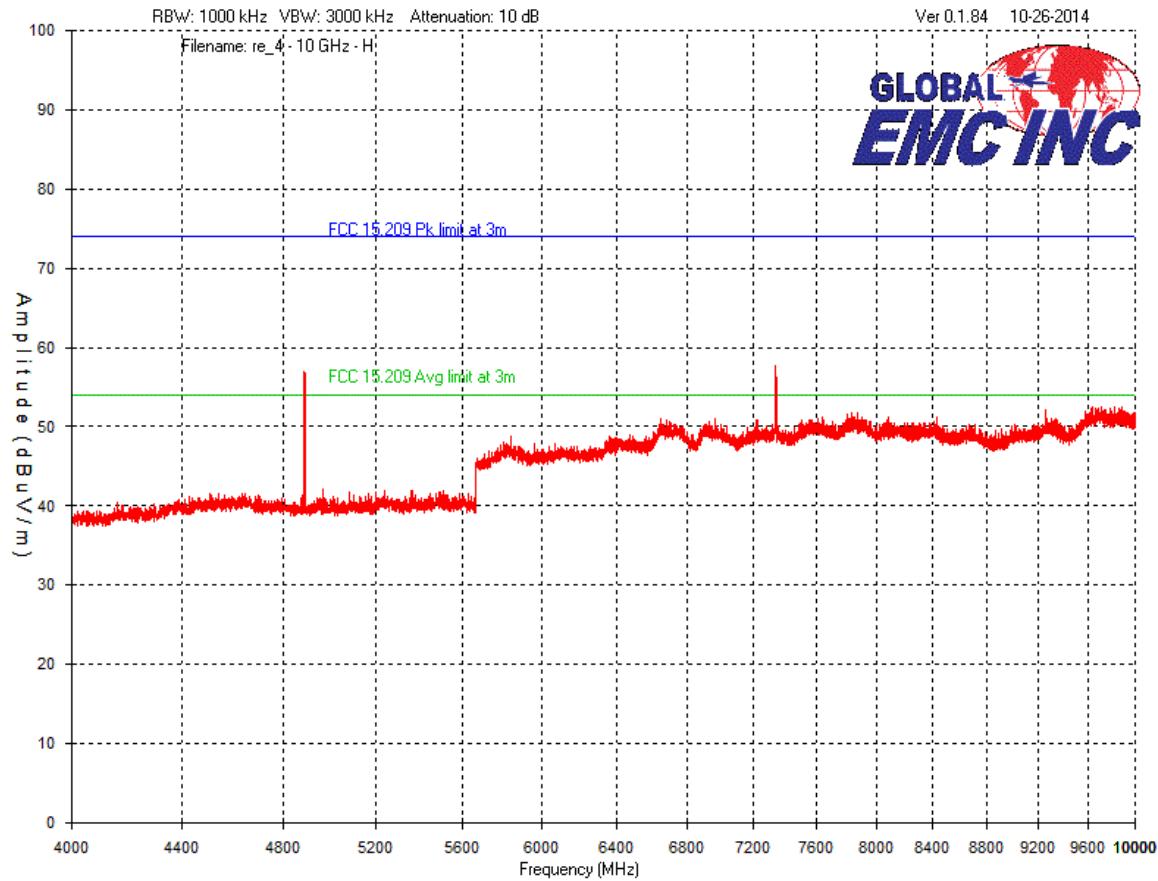


Note: See Final Measurements and Results section for details.

Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



### Low Channel – 4GHz – 10 GHz Horizontal - Peak Emission Graph

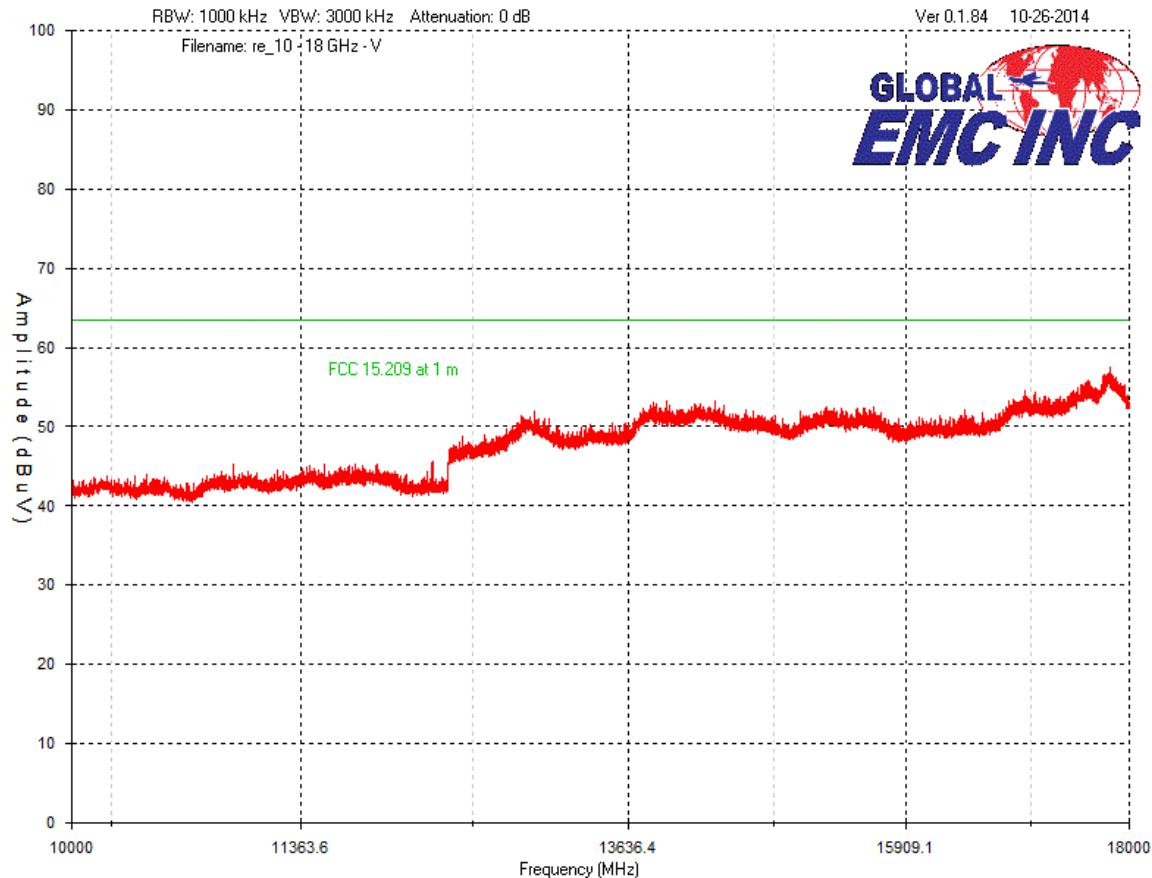


Note: See Final Measurements and Results section for details.

Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



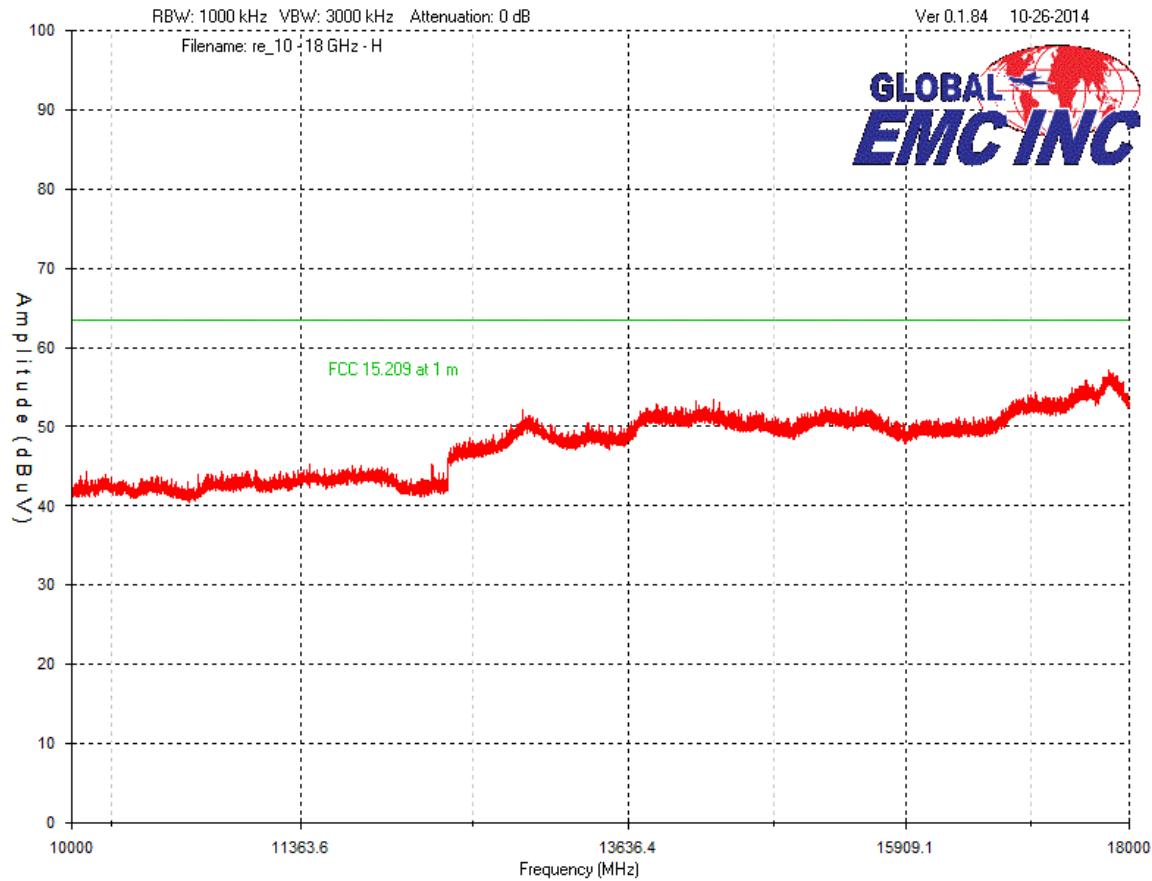
### Low Channel – 10 GHz – 18 GHz Vertical - Peak Emission Graph



Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



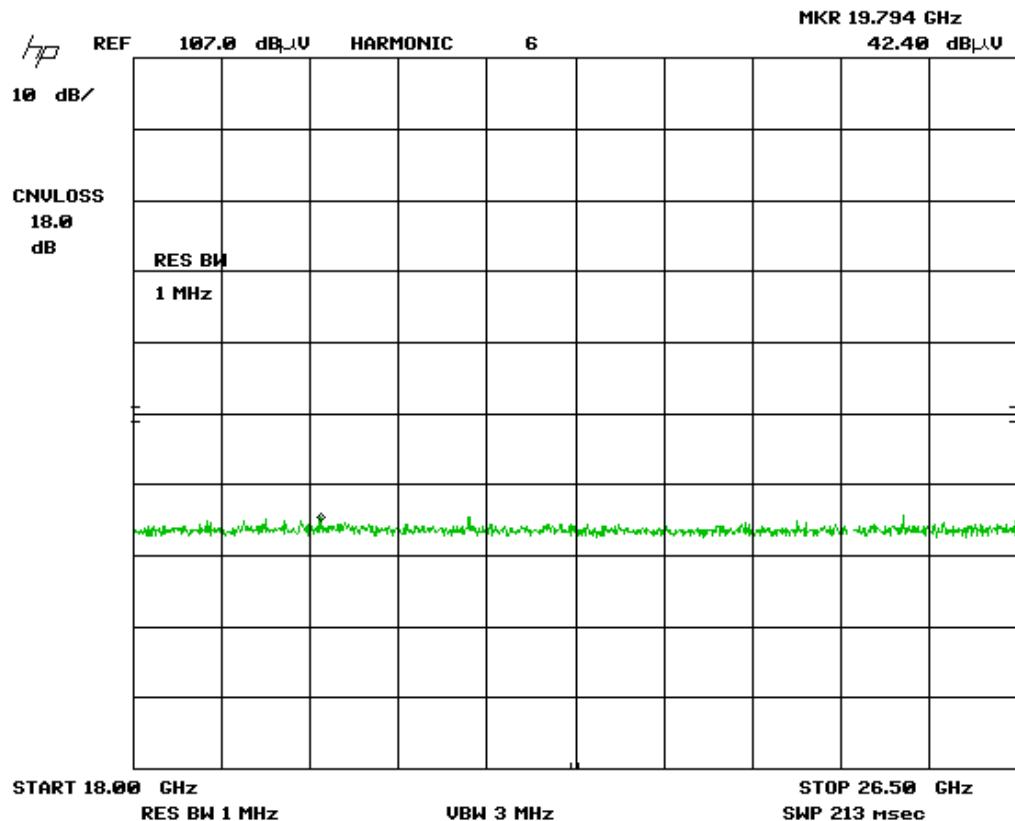
### Low Channel – 10 GHz – 18 GHz Horizontal - Peak Emission Graph



Client	Zen Within Inc
Product	Zen
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



Low Channel – 18 GHz – 26 GHz  
Horizontal - Peak Emission Graph

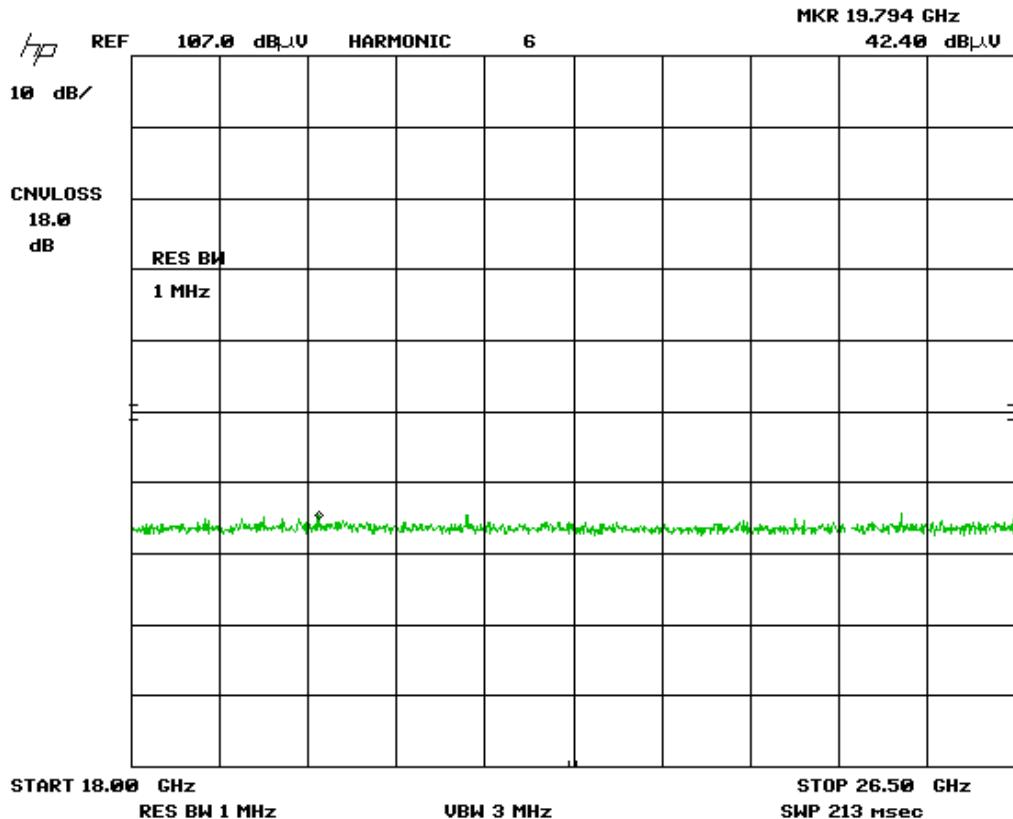


Plot was taken at 1 meter distances. All emission shown were noise floor of measurement instrument. No emissions were found in this frequency range.

Client	Zen Within Inc
Product	Zen
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



Low Channel – 18 GHz – 26 GHz  
Vertical - Peak Emission Graph

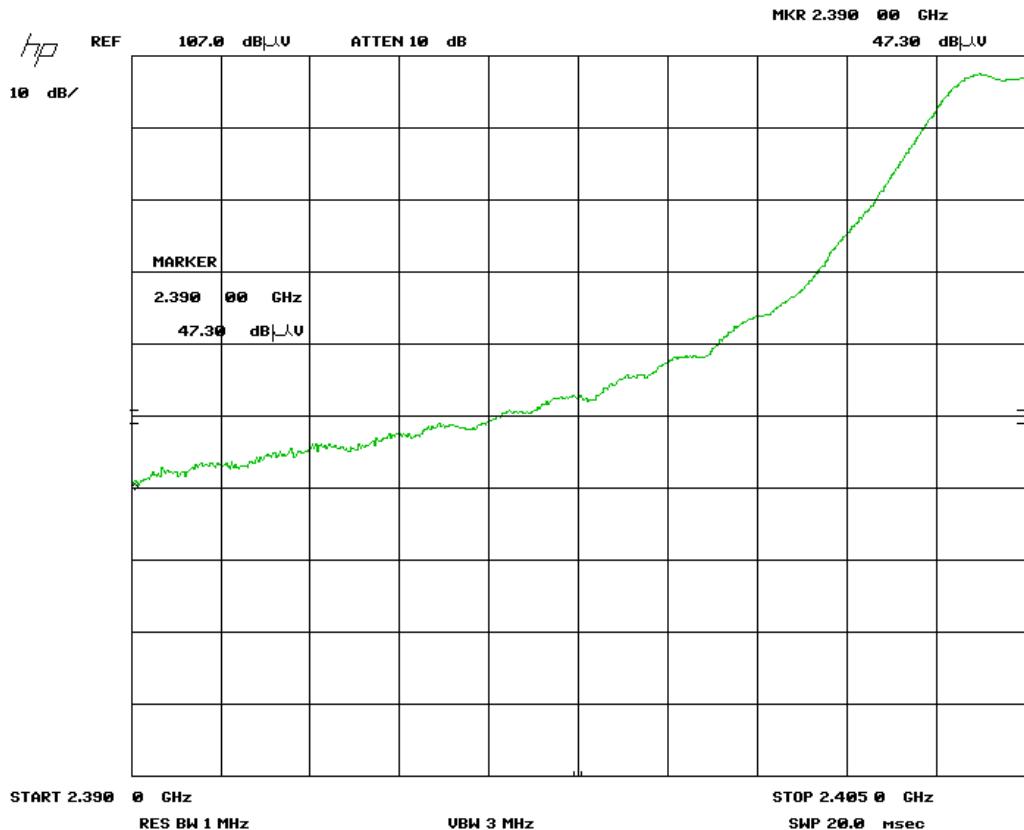


Plot was taken at 1 meter distances. All emission shown were noise floor of measurement instrument. No emissions were found in this frequency range.

Client	Zen Within Inc
Product	Zen
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



Band Edge – Low Channel  
Vertical - Peak Emission

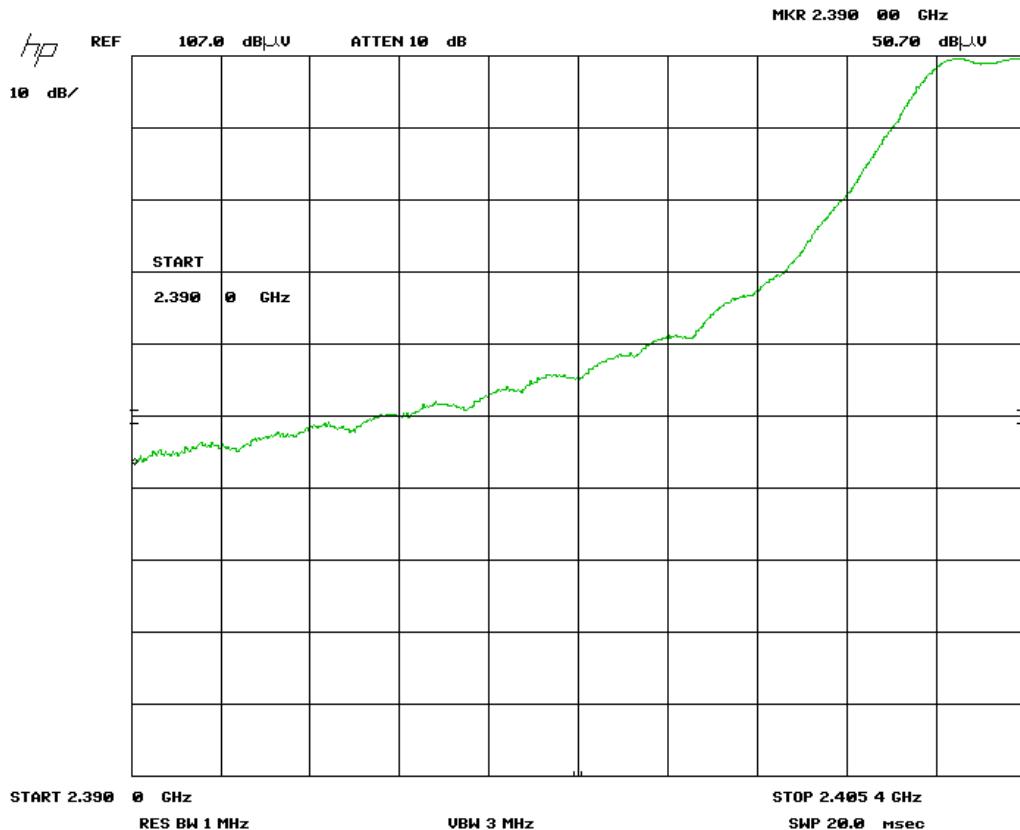


Note: Bandedge plots were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section for corrected values.

Client	Zen Within Inc
Product	Zen
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



Band Edge – Low Channel  
Horizontal - Peak Emission

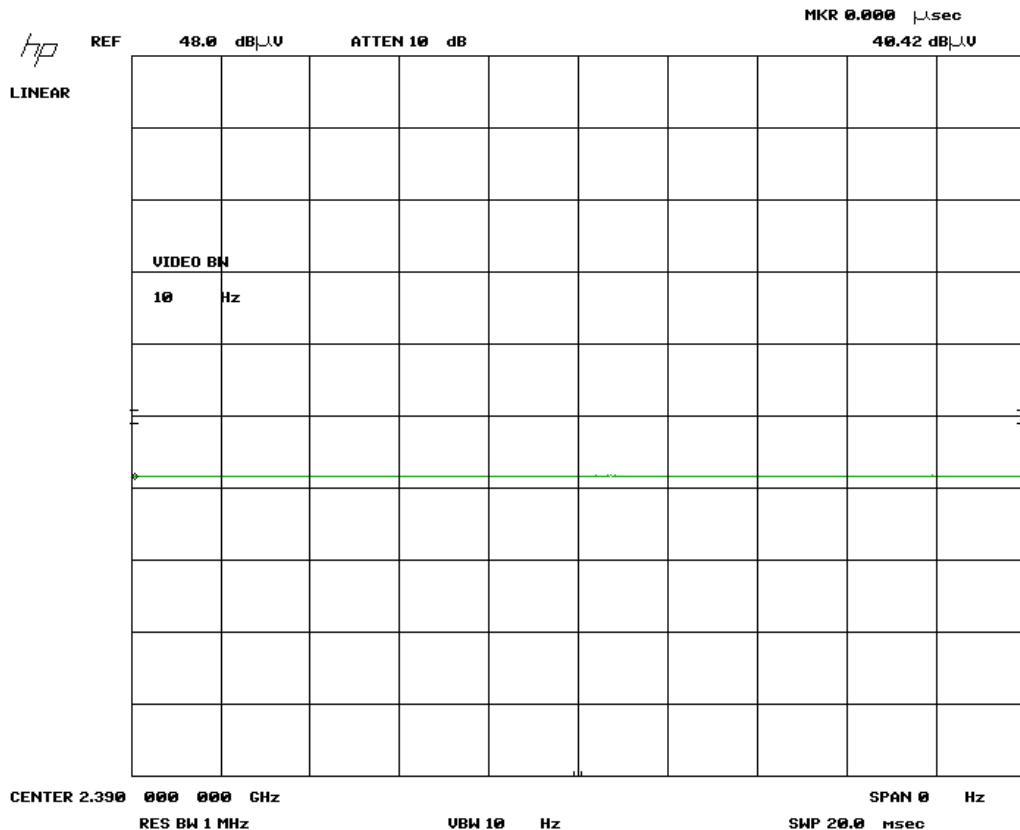


Note: Bandedge plots were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section for corrected values.

Client	Zen Within Inc
Product	Zen
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



Band Edge – Low Channel  
Vertical – Average Emission

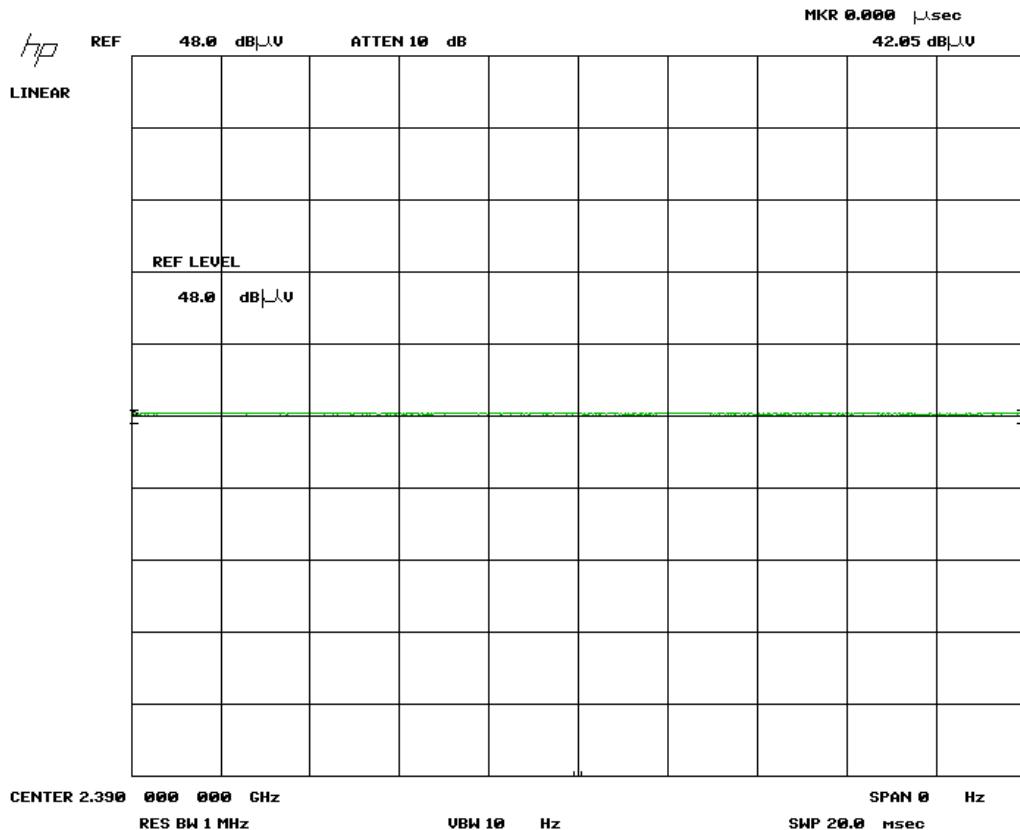


Note: Bandedge plots were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section for corrected values.

Client	Zen Within Inc
Product	Zen
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



Band Edge – Low Channel  
Horizontal - Average Emission

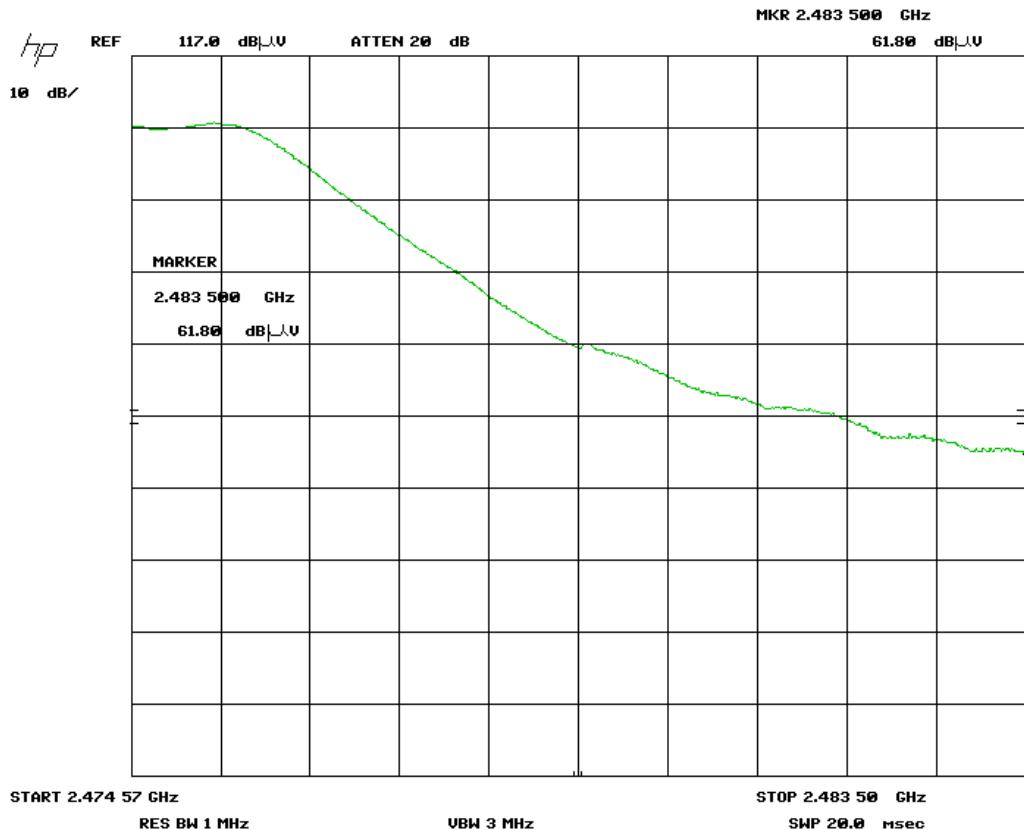


Note: Bandedge plots were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section for corrected values.

Client	Zen Within Inc
Product	Zen
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



Band Edge – Channel 0x19  
Vertical - Peak Emission

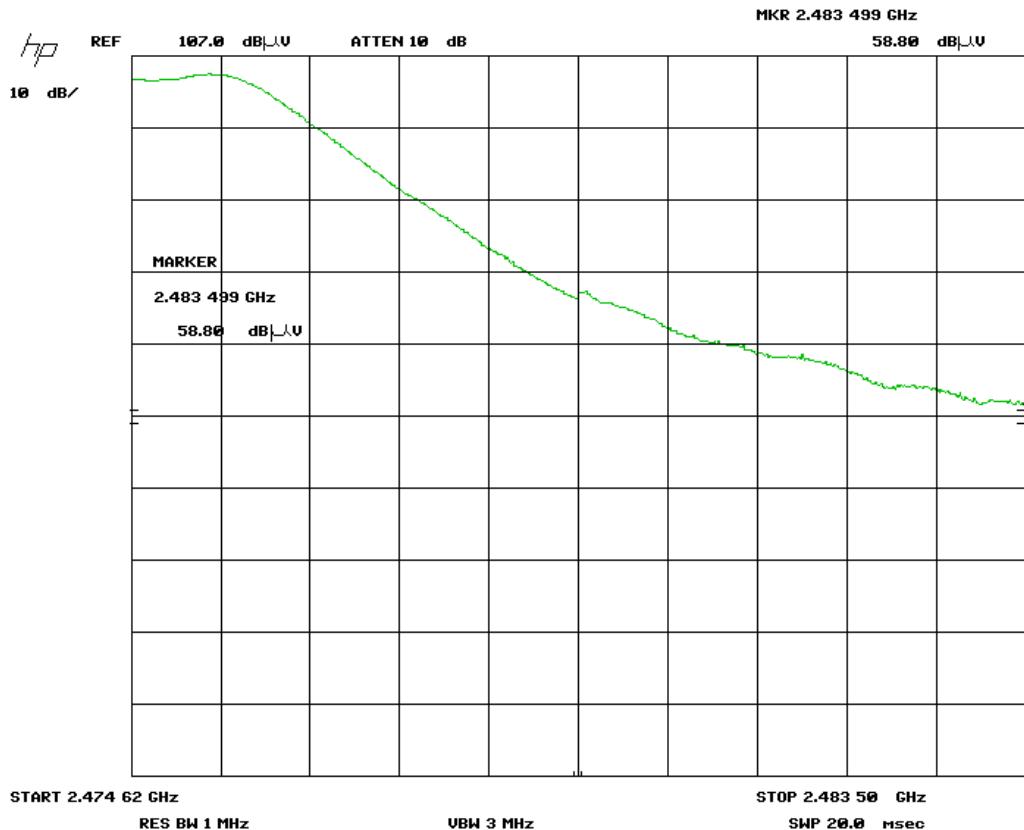


Note: Bandedge plots were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section for corrected values.

Client	Zen Within Inc
Product	Zen
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



Band Edge – Channel 0x25  
Horizontal - Peak Emission

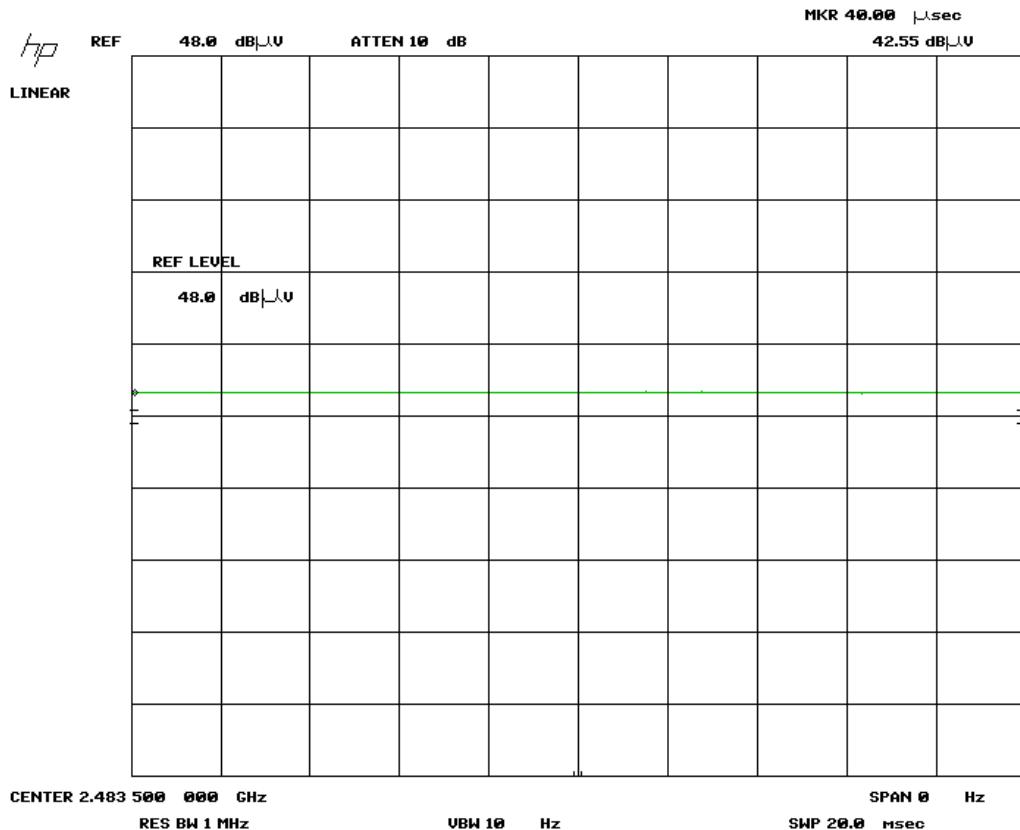


Note: Bandedge plots were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section for corrected values.

Client	Zen Within Inc
Product	Zen
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



Band Edge – Channel 0x25  
Vertical - Average Emission

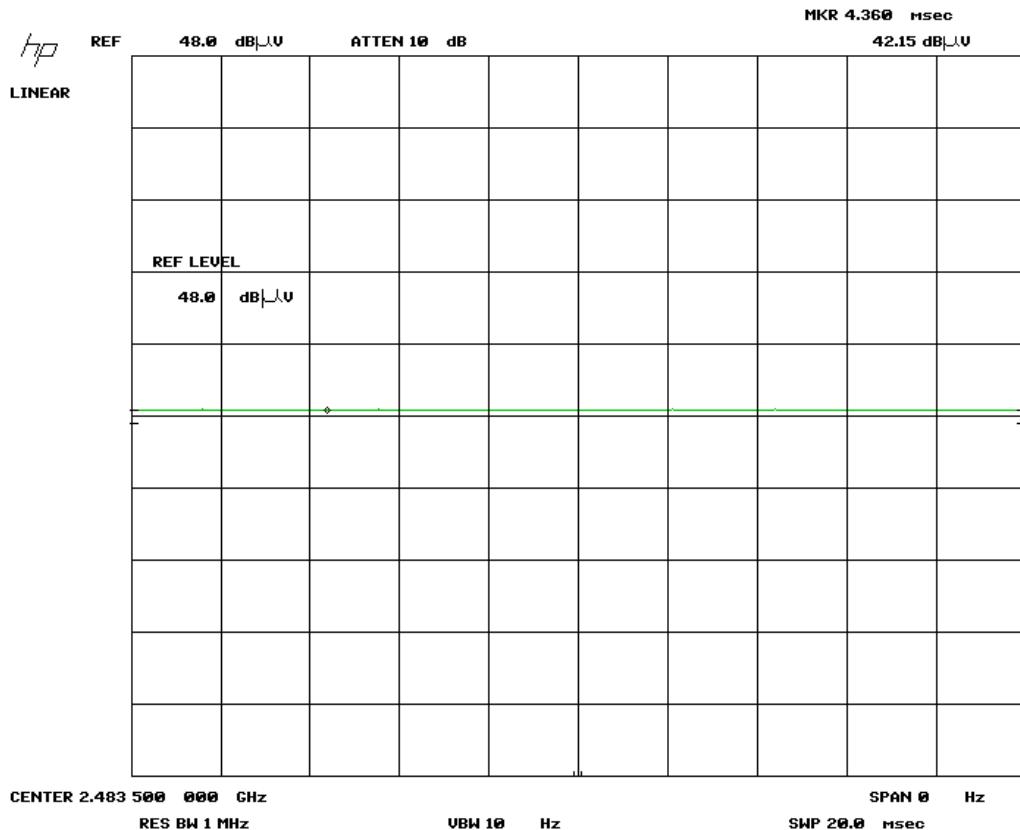


Note: Bandedge plots were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section for corrected values.

Client	Zen Within Inc
Product	Zen
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



Band Edge – Channel 0x25  
Horizontal - Average Emission

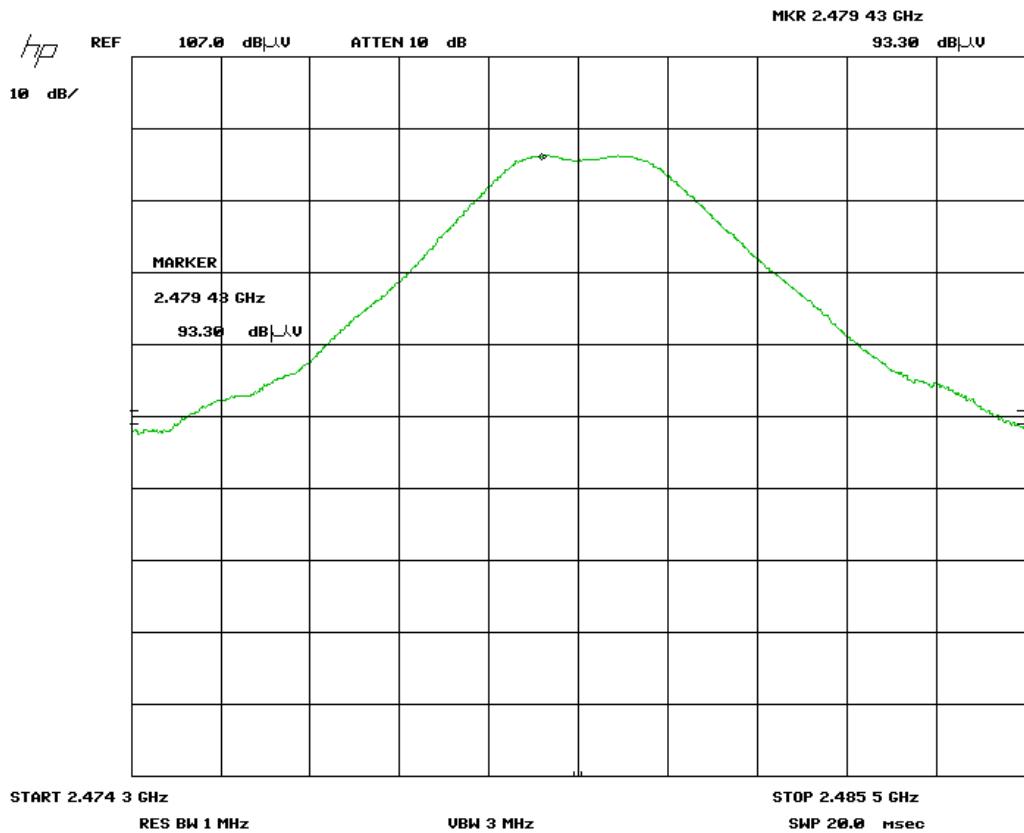


Note: Bandedge plots were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section for corrected values.

Client	Zen Within Inc
Product	Zen
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



Hi Channel 0x1A  
Vertical - Fundamental Peak Emission

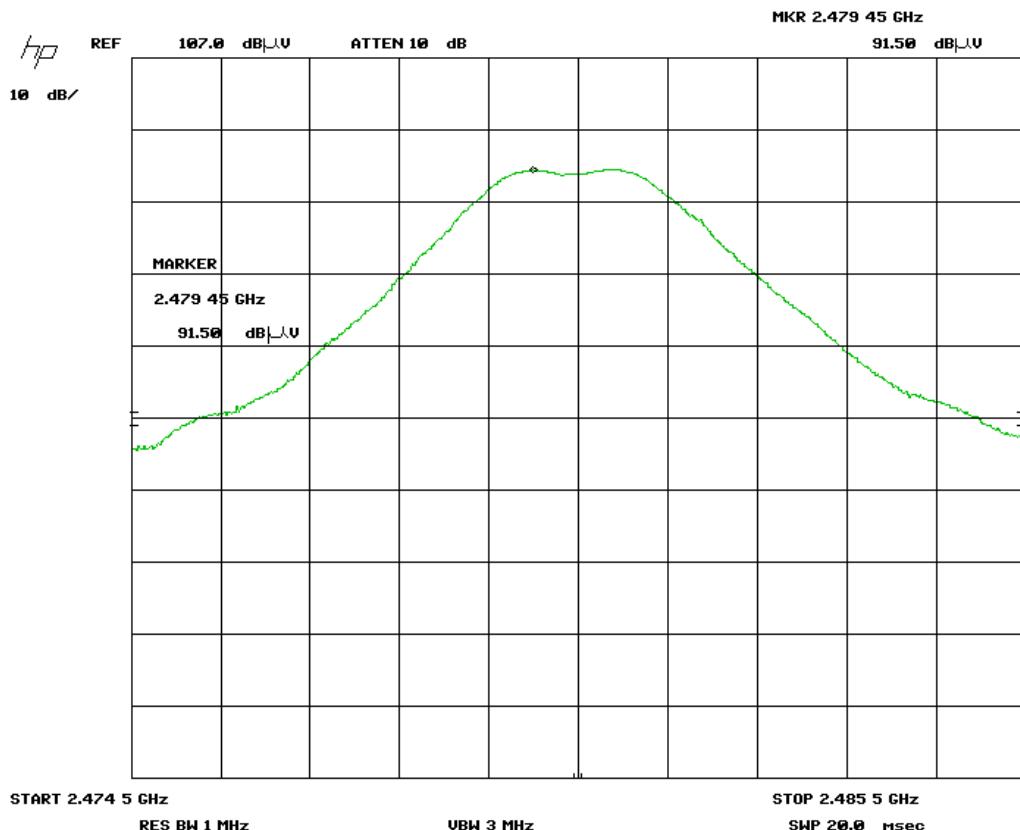


Note: Fundamental peak emission plots were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section for corrected values.

Client	Zen Within Inc
Product	Zen
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



Hi Channel 0x1A  
Horizontal – Fundamental Peak Emission

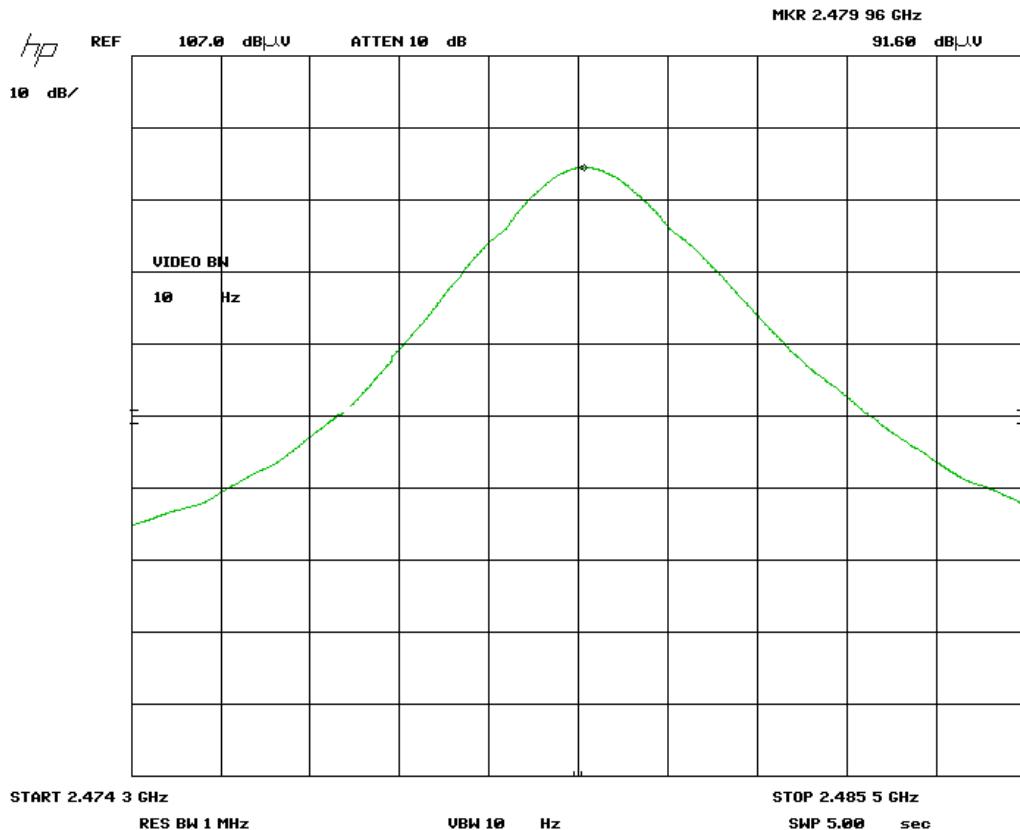


Note: Fundamental peak emission plots were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section for corrected values.

Client	Zen Within Inc
Product	Zen
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



Hi Channel 0x1A  
Vertical - Fundamental Average Emission

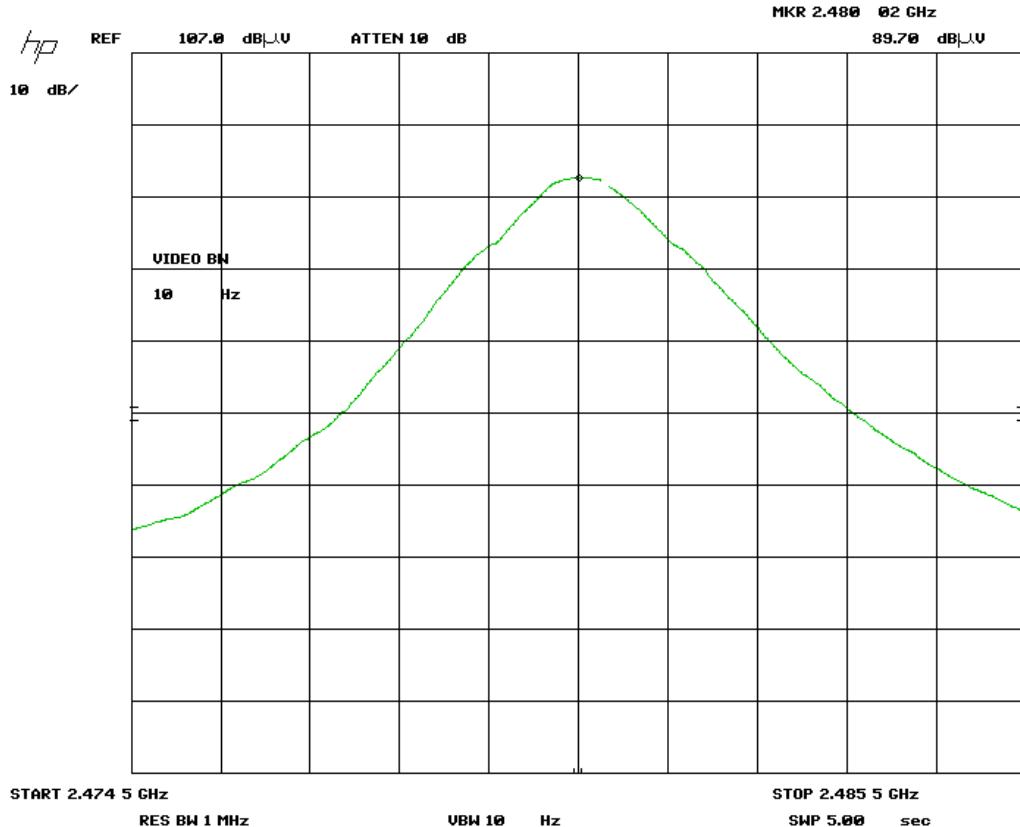


Note: Fundamental average emission plots were taken with 3 m measurements distance.  
The marker shows the raw value; see Final Measurements and Results section for corrected values.

Client	Zen Within Inc
Product	Zen
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



Hi Channel 0x1A  
Horizontal – Fundamental Average Emission

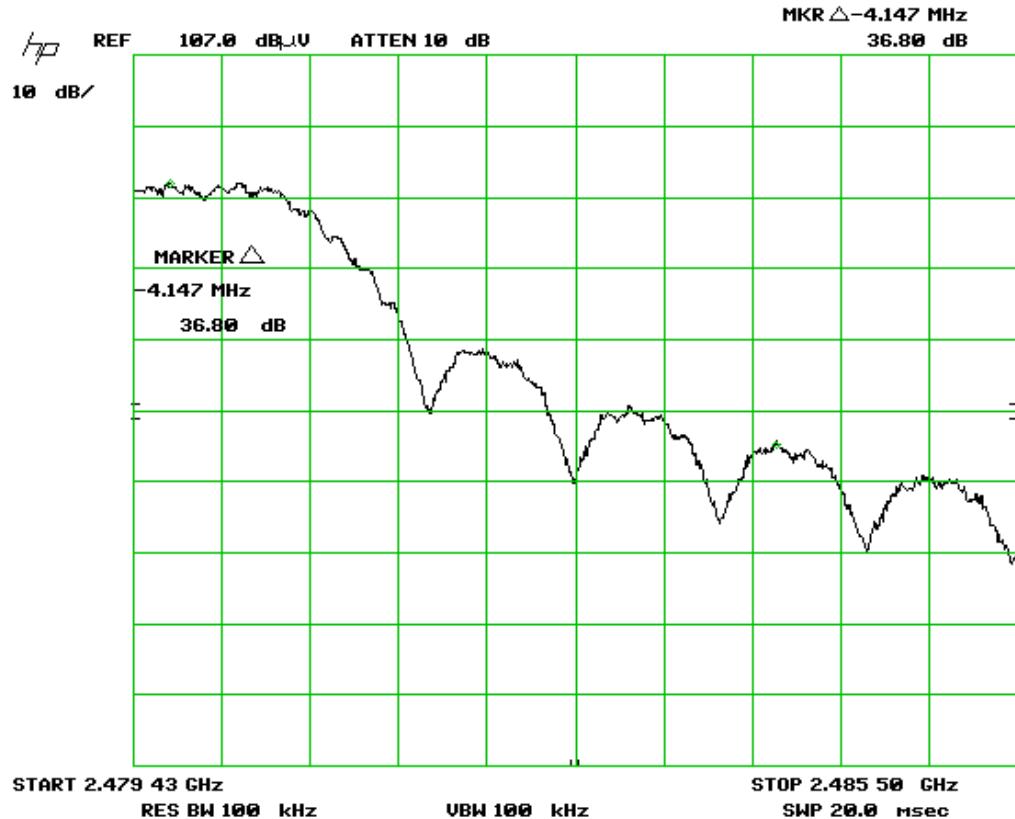


Note: Fundamental average emission were taken with 3 m measurements distance. The marker shows the raw value; see Final Measurements and Results section for corrected values.

Client	Zen Within Inc
Product	Zen
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



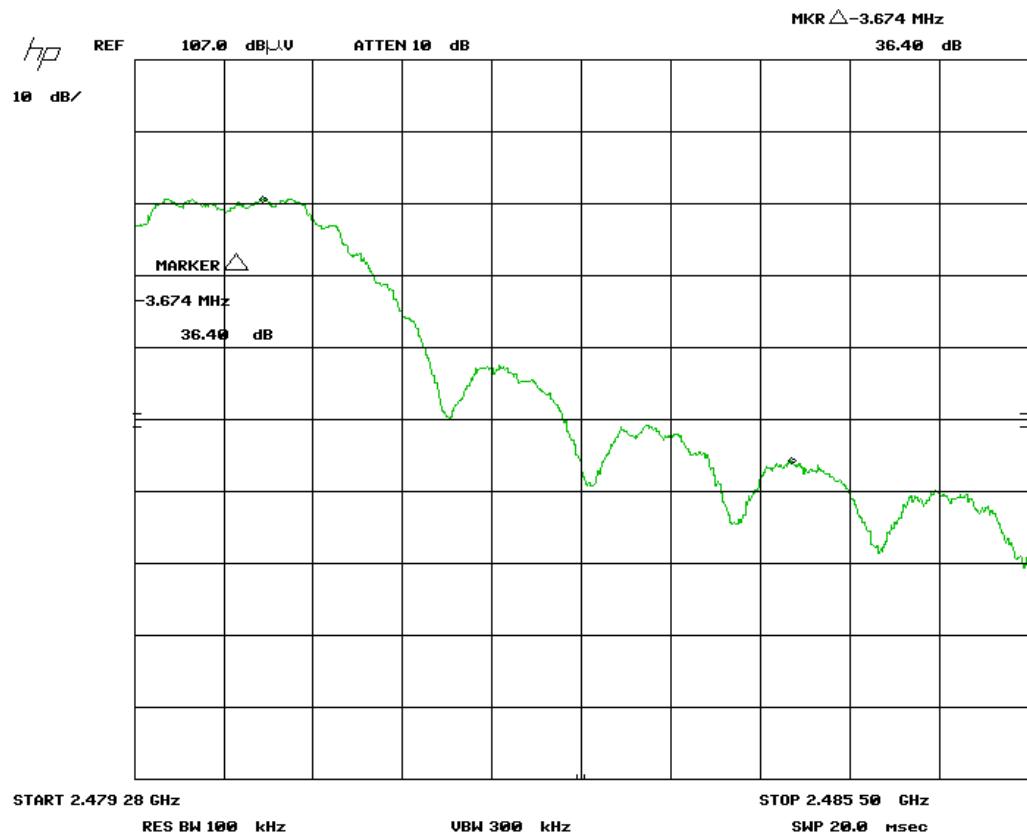
Band Edge – Hi channel 0x1A  
 Vertical – Marker-Delta measurement



Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



Band Edge – Hi channel 0x1A  
 Horizontal – Marker-Delta measurement



Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



## Final Measurements and Results

The EUT passed the limits. Low, middle and high bands were measured.

In accordance with 15.247(d), only frequencies exceeding the 15.209 limit that occur within the bands listed in 15.205, need to be verified with a final detector.

For frequency shown on the peak graphs and not listed in 15.205, measurements were taken for reference.

Loop Antenna							
Frequency (MHz)	Detector	Raw (dBuV)	Factors	Level (dBuV)	Limit (dB)	Margin (dB)	Pass/Fail
0.6475	QP	43.1	20.4	63.5	71.4	7.9	Pass

Client	Zen Within Inc	
Product	Zen	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

Test Frequency (MHz)	Detection mode	Antenna polarity (Horz/Vert)	Raw signal dB(µV)	Antenna factor dB	Cable loss dB + Presel	Attenuator dB	Pre-Amp Gain dB	Received signal dB(µV/m)	Emission limit dB(µV/m)	Margin dB(µV)	Result
Low Channel (0xB) - Z axis (Flat)											
2404	Peak	Horz	98.1	30.8	4.1	10.0	35.8	107.2			PASS
2404	Avg	Horz	95.9	30.8	4.1	10.0	35.8	105.0			PASS
2404	Peak	Vert	107.0	30.8	4.1	10.0	35.8	116.1			PASS
2404	Avg	Vert	104.8	30.8	4.1	10.0	35.8	113.9			PASS
2390	Peak	Horz	43.8	30.8	4.1	10.0	35.8	52.9	74.0	21.1	PASS
2390	Avg	Horz	33.4	30.8	4.1	10.0	35.8	42.5	54.0	11.5	PASS
2390	Peak	Vert	53.4	30.8	4.1	10.0	35.8	62.5	74.0	11.5	PASS
2390	Avg	Vert	42.7	30.8	4.1	10.0	35.8	51.8	54.0	2.2	PASS
Low Channel (0xB) - X axis (Horizontal)											
2404	Peak	Horz	106.6	30.8	4.1	10.0	35.8	115.7			PASS
2404	Avg	Horz	104.7	30.8	4.1	10.0	35.8	113.8			PASS
2404	Peak	Vert	104.5	30.8	4.1	10.0	35.8	113.6			PASS
2404	Avg	Vert	102.3	30.8	4.1	10.0	35.8	111.4			PASS
2390	Peak	Horz	49.9	30.8	4.1	10.0	35.8	59.0	74.0	15.0	PASS
2390	Avg	Horz	42.1	30.8	4.1	10.0	35.8	51.2	54.0	2.8	PASS
2390	Peak	Vert	47.3	30.8	4.1	10.0	35.8	56.4	74.0	17.6	PASS
2390	Avg	Vert	39.2	30.8	4.1	10.0	35.8	48.3	54.0	5.7	PASS
Low Channel (0xB) - Y axis (Vertical)											
2404	Peak	Horz	105.6	30.8	4.1	10.0	35.8	114.7			PASS
2404	Avg	Horz	103.5	30.8	4.1	10.0	35.8	112.6			PASS
2404	Peak	Vert	106.2	30.8	4.1	10.0	35.8	115.3			PASS
2404	Avg	Vert	103.7	30.8	4.1	10.0	35.8	112.8			PASS
2390	Peak	Horz	50.3	30.8	4.1	10.0	35.8	59.4	74.0	14.6	PASS
2390	Avg	Horz	42.1	30.8	4.1	10.0	35.8	51.2	54.0	2.8	PASS
2390	Peak	Vert	48.4	30.8	4.1	10.0	35.8	57.5	74.0	16.5	PASS
2390	Avg	Vert	40.4	30.8	4.1	10.0	35.8	49.5	54.0	4.5	PASS
4808	Peak	Horz	56.5	33.5	5.9	0.0	35.2	60.7	74.0	13.3	PASS
4808	Avg	Horz	37.8	33.5	5.9	0.0	35.2	42.0	54.0	12.0	PASS
4808	Peak	Vert	61.9	33.5	5.9	0.0	35.2	66.1	74.0	7.9	PASS
4808	Avg	Vert	43.2	33.5	5.9	0.0	35.2	47.4	54.0	6.6	PASS
7212	Peak	Horz	53.8	38.6	7.4	0.0	35.6	64.2	74.0	9.8	PASS
7212	Avg	Horz	35.1	38.6	7.4	0.0	35.6	45.5	54.0	8.5	PASS
7212	Peak	Vert	52.2	38.6	7.4	0.0	35.6	62.6	74.0	11.4	PASS
7212	Avg	Vert	33.5	38.6	7.4	0.0	35.6	43.9	54.0	10.1	PASS
9616	Peak	Horz	47.9	40.1	9.5	0.0	36.1	61.4	74.0	12.6	PASS
9616	Avg	Horz	29.2	40.1	9.5	0.0	36.1	42.7	54.0	11.3	PASS
9616	Peak	Vert	48.1	40.1	9.5	0.0	36.1	61.6	74.0	12.4	PASS
9616	Avg	Vert	29.4	40.1	9.5	0.0	36.1	42.9	54.0	11.1	PASS
12020	Peak	Horz	47.7	39.3	9.5	0.0	35.1	61.4	74.0	12.6	PASS
12020	Avg	Horz	29.0	39.3	9.5	0.0	35.1	42.7	54.0	11.3	PASS
12020	Peak	Vert	47.1	39.3	9.5	0.0	35.1	60.8	74.0	13.2	PASS
12020	Avg	Vert	28.4	39.3	9.5	0.0	35.1	42.1	54.0	11.9	PASS

Note: Average emissions at harmonic of the fundamental was obtained by applying duty cycle correction factor of 18.7 dB (a maximum duty cycle of 11.56% was declared by the client).

Client	Zen Within Inc
Product	Zen
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



Test Frequency (MHz)	Detection mode	Antenna polarity (Horz/Vert)	Raw signal dB(µV)	Antenna factor dB	Cable loss dB + Presel ecor			Pre-Amp Gain dB	Received signal dB(µV/m)	Emission limit dB(µV/m)	Margin dB(µV)	Result
					Attenuator dB	Pre-Amp Gain dB	Received signal dB(µV/m)					
Mid Channel (0x13) - Z axis (Flat)												
2445	Peak	Horz	99.5	30.8	4.1	10.0	35.8	108.6				PASS
2445	Avg	Horz	97.3	30.8	4.1	10.0	35.8	106.4				PASS
2445	Peak	Vert	103.4	30.8	4.1	10.0	35.8	112.5				PASS
2445	Avg	Vert	101.1	30.8	4.1	10.0	35.8	110.2				PASS
Mid Channel (0x13) - X axis (Horizontal)												
2445	Peak	Horz	105.2	30.8	4.1	10.0	35.8	114.3				PASS
2445	Avg	Horz	103.2	30.8	4.1	10.0	35.8	112.3				PASS
2445	Peak	Vert	106.6	30.8	4.1	10.0	35.8	115.7				PASS
2445	Avg	Vert	104.6	30.8	4.1	10.0	35.8	113.7				PASS
Mid Channel (0x13) - Y axis (Vertical)												
2445	Peak	Horz	105.8	30.8	4.1	10.0	35.8	114.9				PASS
2445	Avg	Horz	103.8	30.8	4.1	10.0	35.8	112.9				PASS
2445	Peak	Vert	103.2	30.8	4.1	10.0	35.8	112.3				PASS
2445	Avg	Vert	101.0	30.8	4.1	10.0	35.8	110.1				PASS
4890	Peak	Horz	60.3	33.5	5.9	0.0	35.2	64.5	74.0	9.5		PASS
4890	Avg	Horz	41.6	33.5	5.9	0.0	35.2	45.8	54.0	8.2		PASS
4890	Peak	Vert	62.0	33.5	5.9	0.0	35.2	66.2	74.0	7.8		PASS
4890	Avg	Vert	43.3	33.5	5.9	0.0	35.2	47.5	54.0	6.5		PASS
7335	Peak	Vert	54.1	38.6	7.4	0.0	35.6	64.5	74.0	9.5		PASS
7335	Avg	Vert	35.4	38.6	7.4	0.0	35.6	45.8	54.0	8.2		PASS
7335	Peak	Horz	52.3	38.6	7.4	0.0	35.6	62.7	74.0	11.3		PASS
7335	Avg	Horz	33.6	38.6	7.4	0.0	35.6	44.0	54.0	10.0		PASS
9780	Peak	Horz	47.4	40.1	9.5	0.0	36.1	60.9	74.0	13.1		PASS
9780	Avg	Horz	28.7	40.1	9.5	0.0	36.1	42.2	54.0	11.8		PASS
9780	Peak	Vert	48.6	40.1	9.5	0.0	36.1	62.1	74.0	11.9		PASS
9780	Avg	Vert	29.9	40.1	9.5	0.0	36.1	43.4	54.0	10.6		PASS
12225	Peak	Horz	47.5	40.1	9.5	0.0	35.4	61.7	74.0	12.3		PASS
12225	Avg	Horz	28.8	40.1	9.5	0.0	35.4	43.0	54.0	11.0		PASS
12225	Peak	Vert	47.3	40.1	9.5	0.0	35.4	61.5	74.0	12.5		PASS
12225	Avg	Vert	28.6	40.1	9.5	0.0	35.4	42.8	54.0	11.2		PASS

Note: Average emissions at harmonic of the fundamental was obtained by applying duty cycle correction factor of 18.7 dB (a maximum duty cycle of 11.56% was declared by the client).

Client	Zen Within Inc
Product	Zen
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



Test Frequency (MHz)	Detection mode	Antenna polarity (Horz/Vert)	Raw signal dB(µV)	Antenna factor dB	Cable loss dB + Presel			Atten uator dB	Pre-Amp Gain dB	Received signal dB(µV/m)	Emission limit dB(µV/m)	Margin dB(µV)	Result
					cor	ecor	cor						
High Channel (0x19) - Z axis (Flat)													
2475	Peak	Horz	97.3	30.8	4.1	10.0	35.8	106.4					PASS
2475	Avg	Horz	95.2	30.8	4.1	10.0	35.8	104.3					PASS
2475	Peak	Vert	104.6	30.8	4.1	10.0	35.8	113.7					PASS
2475	Avg	Vert	102.3	30.8	4.1	10.0	35.8	111.4					PASS
2483.5	Peak	Horz	52.7	30.8	4.1	10.0	35.8	61.8	74.0	12.2			PASS
2483.5	Avg	Horz	40.6	30.8	4.1	10.0	35.8	49.7	54.0	4.3			PASS
2483.5	Peak	Vert	58.8	30.8	4.1	10.0	35.8	67.9	74.0	6.1			PASS
2483.5	Avg	Vert	42.1	30.8	4.1	10.0	35.8	51.2	54.0	2.8			PASS
High Channel (0x19) - X axis (Horizontal)													
2475	Peak	Horz	104.6	30.8	4.1	10.0	35.8	113.7					PASS
2475	Avg	Horz	102.1	30.8	4.1	10.0	35.8	111.2					PASS
2475	Peak	Vert	107.5	30.8	4.1	10.0	35.8	116.6					PASS
2475	Avg	Vert	105.5	30.8	4.1	10.0	35.8	114.6					PASS
2483.5	Peak	Horz	58.8	30.8	4.1	10.0	35.8	67.9	74.0	6.1			PASS
2483.5	Avg	Horz	42.1	30.8	4.1	10.0	35.8	51.2	54.0	2.8			PASS
2483.5	Peak	Vert	61.7	30.8	4.1	10.0	35.8	70.8	74.0	3.2			PASS
2483.5	Avg	Vert	42.6	30.8	4.1	10.0	35.8	51.7	54.0	2.3			PASS
4950	Peak	Horz	65.9	33.5	5.9	0.0	35.2	70.1	74.0	3.9			PASS
4950	Avg	Horz	47.2	33.5	5.9	0.0	35.2	51.4	54.0	2.6			PASS
4950	Peak	Vert	61.0	33.5	5.9	0.0	35.2	65.2	74.0	8.8			PASS
4950	Avg	Vert	42.3	33.5	5.9	0.0	35.2	46.5	54.0	7.5			PASS
7425	Peak	Vert	55.0	38.6	7.4	0.0	35.6	65.4	74.0	8.6			PASS
7425	Avg	Vert	36.3	38.6	7.4	0.0	35.6	46.7	54.0	7.3			PASS
7425	Peak	Horz	56.6	38.6	7.4	0.0	35.6	67.0	74.0	7.0			PASS
7425	Avg	Horz	37.9	38.6	7.4	0.0	35.6	48.3	54.0	5.7			PASS
9900	Peak	Horz	47.0	40.1	9.5	0.0	36.1	60.5	74.0	13.5			PASS
9900	Avg	Horz	28.3	40.1	9.5	0.0	36.1	41.8	54.0	12.2			PASS
9900	Peak	Vert	47.1	40.1	9.5	0.0	36.1	60.6	74.0	13.4			PASS
9900	Avg	Vert	28.4	40.1	9.5	0.0	36.1	41.9	54.0	12.1			PASS
12375	Peak	Horz	47.6	39.3	9.5	0.0	35.1	61.3	74.0	12.7			PASS
12375	Avg	Horz	28.9	39.3	9.5	0.0	35.1	42.6	54.0	11.4			PASS
12375	Peak	Vert	47.7	39.3	9.5	0.0	35.1	61.4	74.0	12.6			PASS
12375	Avg	Vert	29.0	39.3	9.5	0.0	35.1	42.7	54.0	11.3			PASS
High Channel (0x19) - Y axis (Vertical)													
2475	Peak	Horz	104.3	30.8	4.1	10.0	35.8	113.4					PASS
2475	Avg	Horz	102.1	30.8	4.1	10.0	35.8	111.2					PASS
2475	Peak	Vert	105.6	30.8	4.1	10.0	35.8	114.7					PASS
2475	Avg	Vert	103.7	30.8	4.1	10.0	35.8	112.8					PASS
2483.5	Peak	Horz	57.4	30.8	4.1	10.0	35.8	66.5	74.0	7.5			PASS
2483.5	Avg	Horz	41.9	30.8	4.1	10.0	35.8	51.0	54.0	3.0			PASS
2483.5	Peak	Vert	58.2	30.8	4.1	10.0	35.8	67.3	74.0	6.7			PASS
2483.5	Avg	Vert	42.4	30.8	4.1	10.0	35.8	51.5	54.0	2.5			PASS

Note: Average emissions at harmonic of the fundamental was obtained by applying duty cycle correction factor of 18.7 dB (a maximum duty cycle of 11.56% was declared by the client).

Client	Zen Within Inc	
Product	Zen	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

Test Frequency (MHz)	Detection mode	Antenna polarity (Horz/Vert)	Raw signal dB(µV)	Antenna factor dB	Cable loss dB + Presel	Attenuator dB	Pre-Amp Gain dB	Received signal dB(µV/m)	Emission limit dB(µV/m)	Margin dB(µV)	Result
High Channel (0x1A) - Z axis (Flat)											
2480	Peak	Horz	87.0	30.8	4.1	0.0	35.8	86.1			PASS
2480	Avg	Horz	85.2	30.8	4.1	0.0	35.8	84.3			PASS
2480	Peak	Vert	89.3	30.8	4.1	0.0	35.8	88.4			PASS
2480	Avg	Vert	87.4	30.8	4.1	0.0	35.8	86.5			PASS
2483.5	Peak	Horz	59.0	30.8	4.1	0.0	35.8	58.1	74.0	15.9	PASS
2483.5	Avg	Horz	50.5	30.8	4.1	0.0	35.8	49.6	54.0	4.4	PASS
2483.5	Peak	Vert	62.0	30.8	4.1	0.0	35.8	61.1	74.0	12.9	PASS
2483.5	Avg	Vert	53.1	30.8	4.1	0.0	35.8	52.2	54.0	1.8	PASS
High Channel (0x1A) - X axis (Horizontal)											
2480	Peak	Horz	92.9	30.8	4.1	0.0	35.8	92.0			PASS
2480	Avg	Horz	91.1	30.8	4.1	0.0	35.8	90.2			PASS
2480	Peak	Vert	91.9	30.8	4.1	0.0	35.8	91.0			PASS
2480	Avg	Vert	90.1	30.8	4.1	0.0	35.8	89.2			PASS
2483.84	Peak	Horz	56.4	30.8	4.1	0.0	35.8	55.5	74.0	18.5	PASS
2483.84	Avg	Horz	54.6	30.8	4.1	0.0	35.8	53.7	54.0	0.3	PASS
2483.84	Peak	Vert	55.9	30.8	4.1	0.0	35.8	55.0	74.0	19.0	PASS
2483.84	Avg	Vert	54.1	30.8	4.1	0.0	35.8	53.2	54.0	0.8	PASS
2485.5	Peak	Vert	54.4	30.8	4.1	0.0	35.8	53.5	74.0	20.5	PASS
2485.5	Avg	Vert	43.4	30.8	4.1	0.0	35.8	42.5	54.0	11.5	PASS
2485.5	Peak	Horz	55.3	30.8	4.1	0.0	35.8	54.4	74.0	19.6	PASS
2485.5	Avg	Horz	44.3	30.8	4.1	0.0	35.8	43.4	54.0	10.6	PASS
High Channel (0x1A) - Y axis (Vertical)											
2480	Peak	Horz	91.5	30.8	4.1	0.0	35.8	90.6			PASS
2480	Avg	Horz	89.7	30.8	4.1	0.0	35.8	88.8			PASS
2480	Peak	Vert	93.3	30.8	4.1	0.0	35.8	92.4			PASS
2480	Avg	Vert	91.6	30.8	4.1	0.0	35.8	90.7			PASS
2483.84	Peak	Horz	55.1	30.8	4.1	0.0	35.8	54.2	74.0	19.8	PASS
2483.84	Avg	Horz	53.3	30.8	4.1	0.0	35.8	52.4	54.0	1.6	PASS
2483.84	Peak	Vert	56.5	30.8	4.1	0.0	35.8	55.6	74.0	18.4	PASS
2483.84	Avg	Vert	54.8	30.8	4.1	0.0	35.8	53.9	54.0	0.1	PASS
2485.5	Peak	Horz	54.3	30.8	4.1	0.0	35.8	53.4	74.0	20.6	PASS
2485.5	Avg	Horz	43.0	30.8	4.1	0.0	35.8	42.1	54.0	11.9	PASS
2485.5	Peak	Vert	55.4	30.8	4.1	0.0	35.8	54.5	74.0	19.5	PASS
2485.5	Avg	Vert	44.5	30.8	4.1	0.0	35.8	43.6	54.0	10.4	PASS
4960	Peak	Horz	42.5	33.5	5.9	0.0	35.2	46.7	74.0	27.3	PASS
4960	Avg	Horz	23.8	33.5	5.9	0.0	35.2	28.0	54.0	26.0	PASS
4960	Peak	Vert	43.1	33.5	5.9	0.0	35.2	47.3	74.0	26.7	PASS
4960	Avg	Vert	24.4	33.5	5.9	0.0	35.2	28.6	54.0	25.4	PASS
7440	Peak	Vert	45.5	38.6	7.4	0.0	35.6	55.9	74.0	18.1	PASS
7440	Avg	Vert	26.8	38.6	7.4	0.0	35.6	37.2	54.0	16.8	PASS
7440	Peak	Horz	45.0	38.6	7.4	0.0	35.6	55.4	74.0	18.6	PASS
7440	Avg	Horz	26.3	38.6	7.4	0.0	35.6	36.7	54.0	17.3	PASS

Client	<b>Zen Within Inc</b>	
Product	<b>Zen</b>	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

## Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	8566B	HP	Oct 2, 2013	Oct 2, 2015	GEMC 190
Quasi Peak Adapter	85650A	HP	Oct 1, 2013	Oct 1, 2015	GEMC 191
Loop Antenna	EM 6871	Electro-Metrics	Feb 5, 2013	Feb 5, 2015	GEMC 70
Loop Antenna	EM 6872	Electro-Metrics	Feb 5, 2013	Feb 5, 2015	GEMC 71
BiLog Antenna	3142-C	ETS	Feb 4, 2013	Feb 4, 2015	GEMC 137
Attenuator 10 dB	8493B	Agilent	NCR	NCR	GEMC 133
4GHZ-12GHz High Pass filter	11SH10-4000/T12000-0/0	K & L Microwave	NCR	NCR	GEMC 119
Chase Preamp 9kHz - 2 GHz	CPA9231A	Chase	Sept 9, 2014	Sept 9, 2016	GEMC 6403
Q-Par 1.5-18 GHz Horn	6878/24	Q-par	Sept 10, 2014	Sept 10, 2016	GEMC 6365
Horn Antenna 18 GHz - 26.5 GHz	SAS-572	A.H. Systems	Sept 9, 2014	Sept 9, 2016	GEMC 6371
18.0-26.5 GHz Harmonic Mixer	11970K	HP	Jan 28, 2014	Jan 28, 2016	GEMC 158
1-26G pre-amp	HP 8449B	HP	Sept 9, 2014	Sept 9, 2016	GEMC 6351
RF Cable 7m	LMR-400-7M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 28
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 29
RF Cable 0.5M	LMR-400-0.5M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 31

This report module is based on GEMC template "FCC - 15.209 - Radiated Emissions\_Rev1.doc"

Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



## **Power Spectral Density – 15.247 DM**

### **Purpose**

The purpose of this test is to ensure that the maximum power spectral density to the radiating element does not exceed the limits specified. This ensures that the modulation is significantly wide enough, or low enough in power that it will allow for co-operation of other wireless devices operating within this frequency allocation.

### **Limits and Methods**

The limits are defined in 15.247(e).

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.

The method is given in Section 10.2 of FCC KDB 558074: June 9, 2014.

### **Results**

The EUT passed. Low, medium, and high band was tested. The worst case value is 1.96 dBm as measured with a 3 kHz resolution bandwidth.

Channel 0xB	1.96 dBm/3 kHz
Channel 0x13	0.54 dBm/3 kHz
Channel 0x19	-0.46 dBm/3 kHz
Channel 0x1A	-21.62 dBm/3 kHz

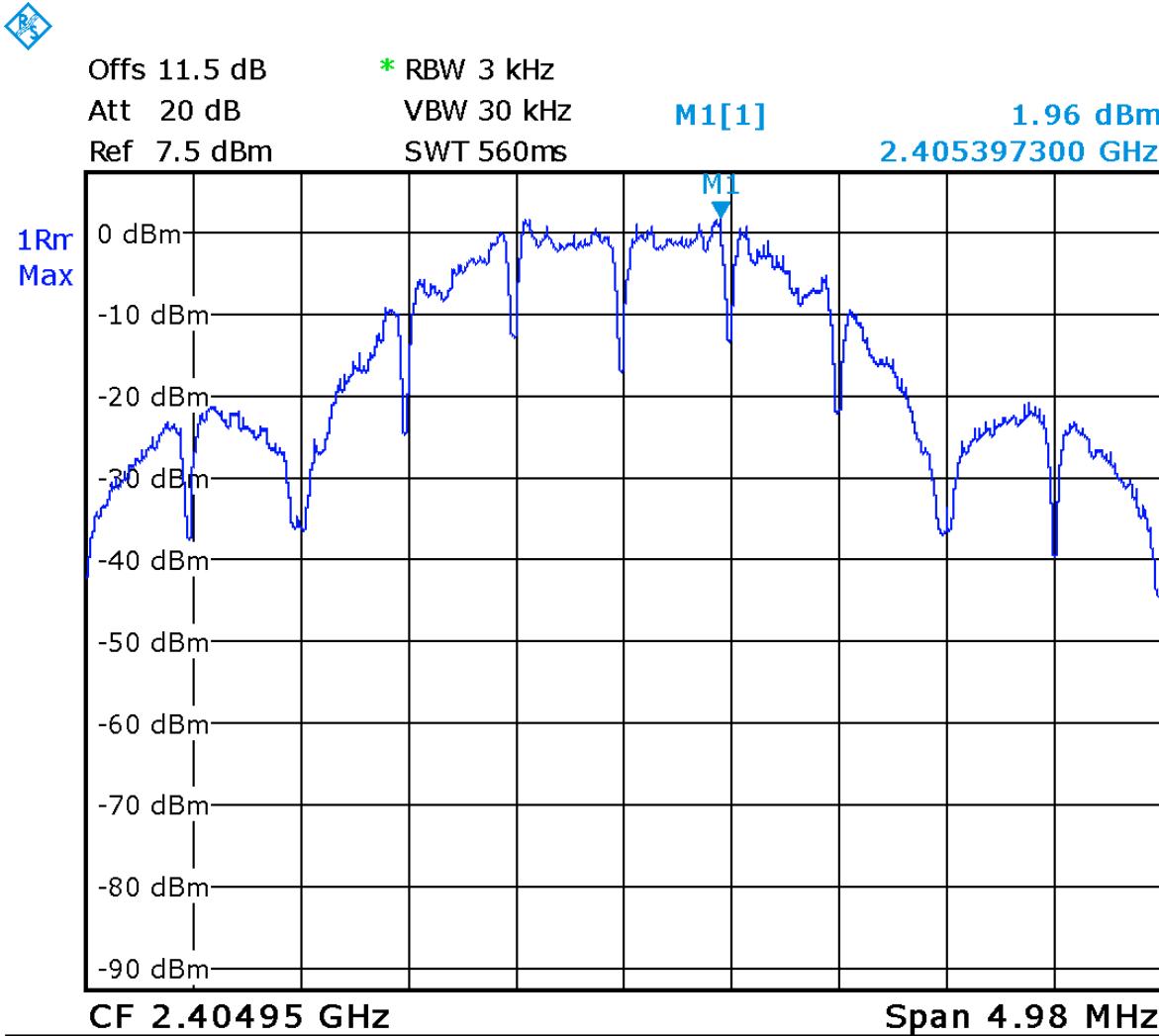
### **Graph(s)**

The graphs shown below show the power spectral density of the device during the conducted measurement operation of the EUT. Low, middle, and high channel was investigated in each mode, with the worst case being presented.

Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



### Channel 0xB

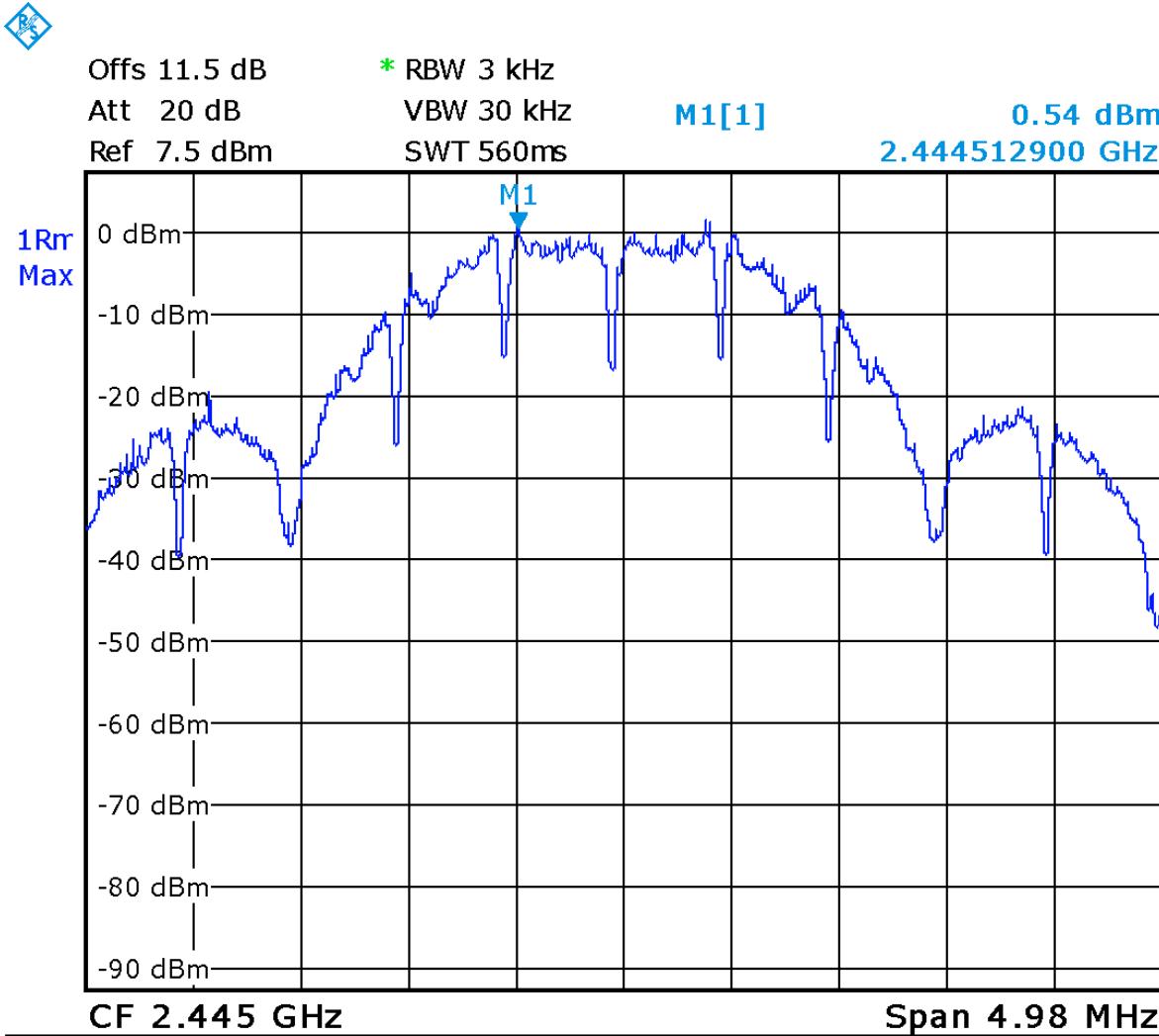


Date: 26.OCT.2014 20:29:22

Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



### Channel 0x13

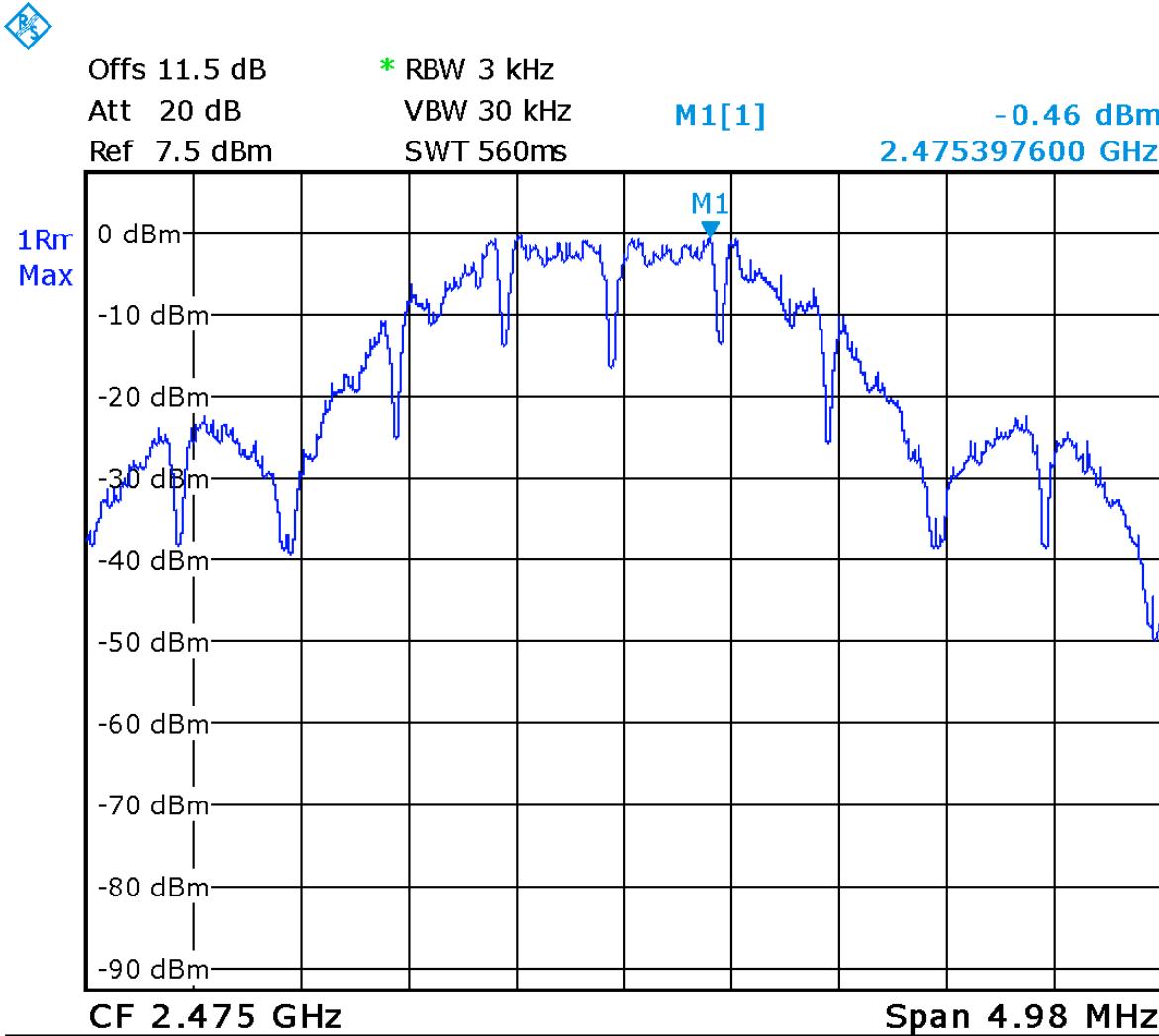


Date: 26.OCT.2014 20:30:31

Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



### Channel 0x19

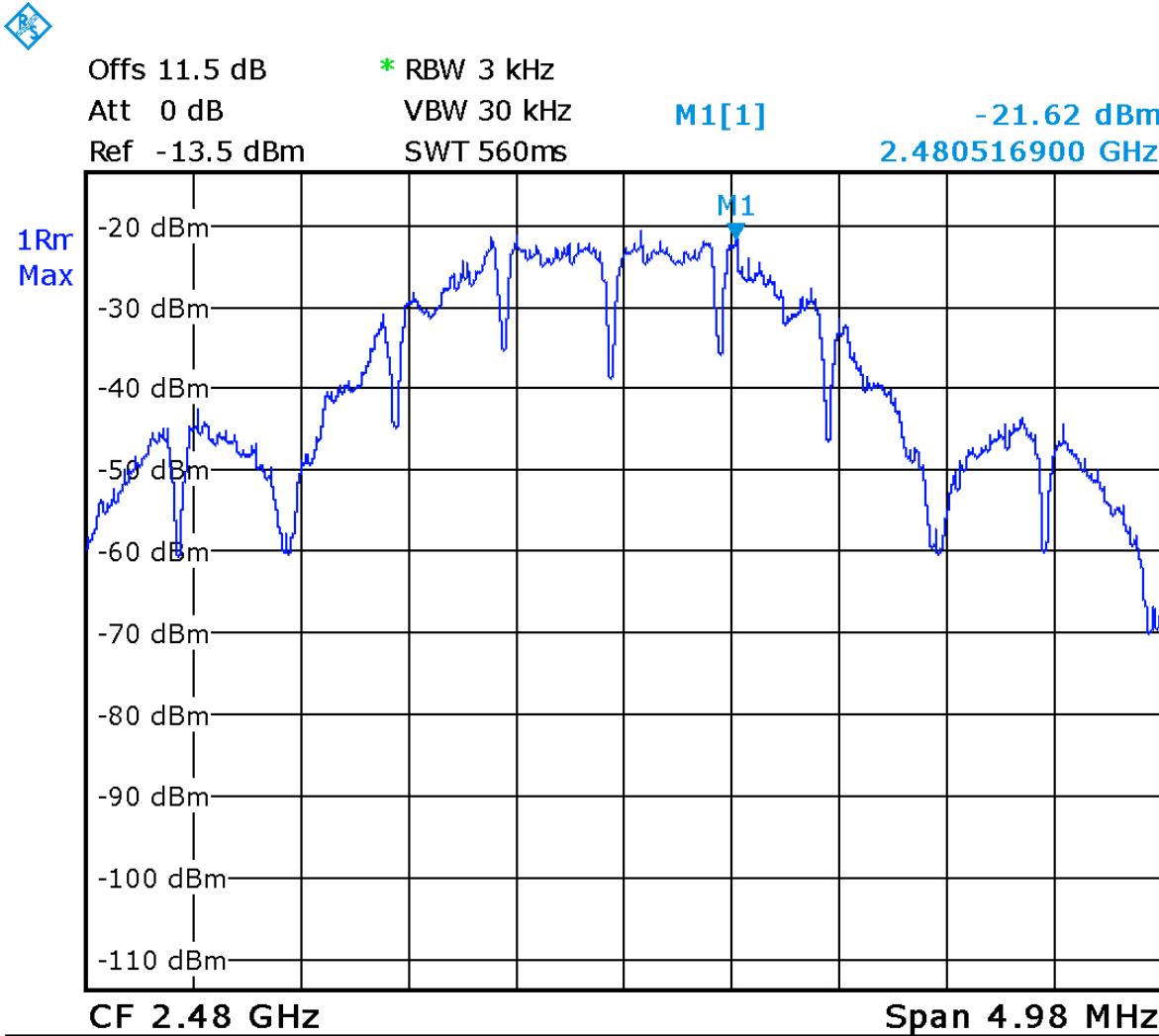


Date: 26.OCT.2014 20:35:00

Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



### Channel 0x1A



Date: 26.OCT.2014 20:36:30

Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



Note: See ‘Appendix B – EUT & Test Setup Photographs’ for photos showing the test set-up.

## Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	ESL6	Rohde & Schwarz	Nov 15, 2013	Nov 15, 2015	GEMC 160
Attenuator 10 dB	8493B	Agilent	NCR	NCR	GEMC133
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 29

This report module is based on GEMC template “FCC – Power Line Conducted Emissions Class B\_Rev1”

Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



## **Maximum Permissible Exposure – 15.247**

### **Purpose**

The purpose of this test is to ensure that the RF energy intentionally transmitted, in terms of power density emitted from the EUT at a stated operating distance does not exceed the limits listed below as defined in the applicable test standard, as calculated based upon readings obtained during testing. This helps protect human exposure to excessive RF fields.

### **Limit(s) and Method**

The limits, as defined in FCC 15.247(i) and FCC 1.1310 Table 1 (B) limits for general public exposure was applied. The limit for the frequency range of 1.5 GHz to 100 GHz was applied to the 15.247 device. This is a limit of 1.0 mW/cm<sup>2</sup>. The distance used for calculations was 20 cm, as this is the minimum distance an operator will be from the EUT during normal operation, as stated by the manufacturer.

### **Results**

The EUT passed the requirements. The worst case calculated power density was 0.020 mW/cm<sup>2</sup>, this is significantly under the 1.0 mW/cm<sup>2</sup> requirement.

### **Calculations**

Method 1 (conducted power)

Internal antenna

$$P_d = (P_t * G) / (4 * \pi * R^2)$$

Where Pt = 19.53 dBm or 89.74 mW as per Peak power conducted output

Where G = 0.5 dBi, or numerically 1.12

Where R = 20 cm

$$P_d = (89.74 \text{ mW} * 1.12) / (4 * \pi * 20\text{cm}^2)$$

$$P_d = 100.51 \text{ mW} / 5026 \text{ cm}^2$$

$$P_d = 0.020 \text{ mW/cm}^2$$

Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



## ***Power Line Conducted Emissions***

### **Purpose**

The purpose of this test is to ensure that the RF energy unintentionally emitted from the EUT's power line does not exceed the limits listed below as defined in the applicable test standard, as measured from a LISN. This helps protect lower frequency radio services such as AM radio, shortwave radio, amateur radio operators, maritime radio, CB radio, and so on, from unwanted interference.

### **Limits & Method**

The limits are as defined in 47 CFR FCC Part 15 Section 15.207

Method is as defined in ANSI C64.10:2009

Average Limits		QuasiPeak Limits	
150 kHz – 500 kHz	56 to 46 dBuV	150 kHz – 500 kHz	66 to 56 dBuV
500 kHz – 5 MHz	46 dBuV	500 kHz – 5 MHz	56 dBuV
5 MHz – 30 MHz	50 dBuV	500 kHz – 30 MHz	60 dBuV

The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.

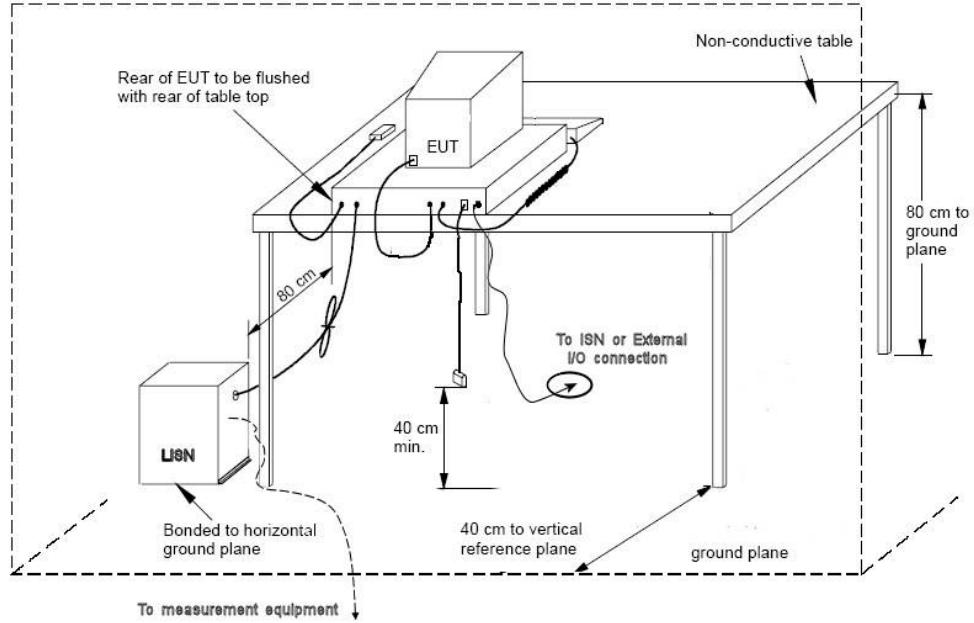
Note: If the Peak or Quasi Peak detector measurements do not exceed the Average limits, then the EUT is deemed to have passed the requirements.

Both limits are applicable, and each is specified as being measured with a 9 kHz measurement bandwidth.

Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



### Typical Setup Diagram



### Measurement Uncertainty

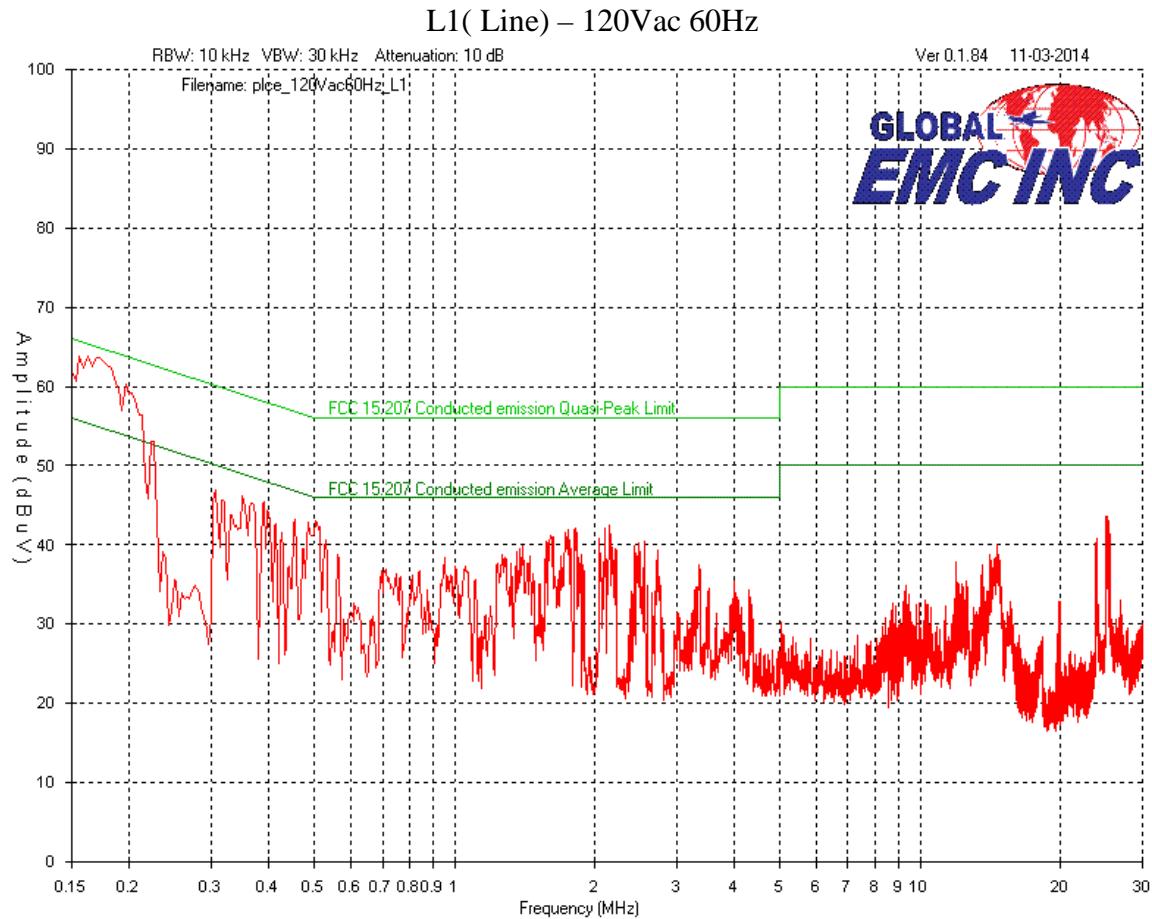
The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is +/-3.6 dB with a 'k=2' coverage factor and a 95% confidence level.

### Preliminary Graphs

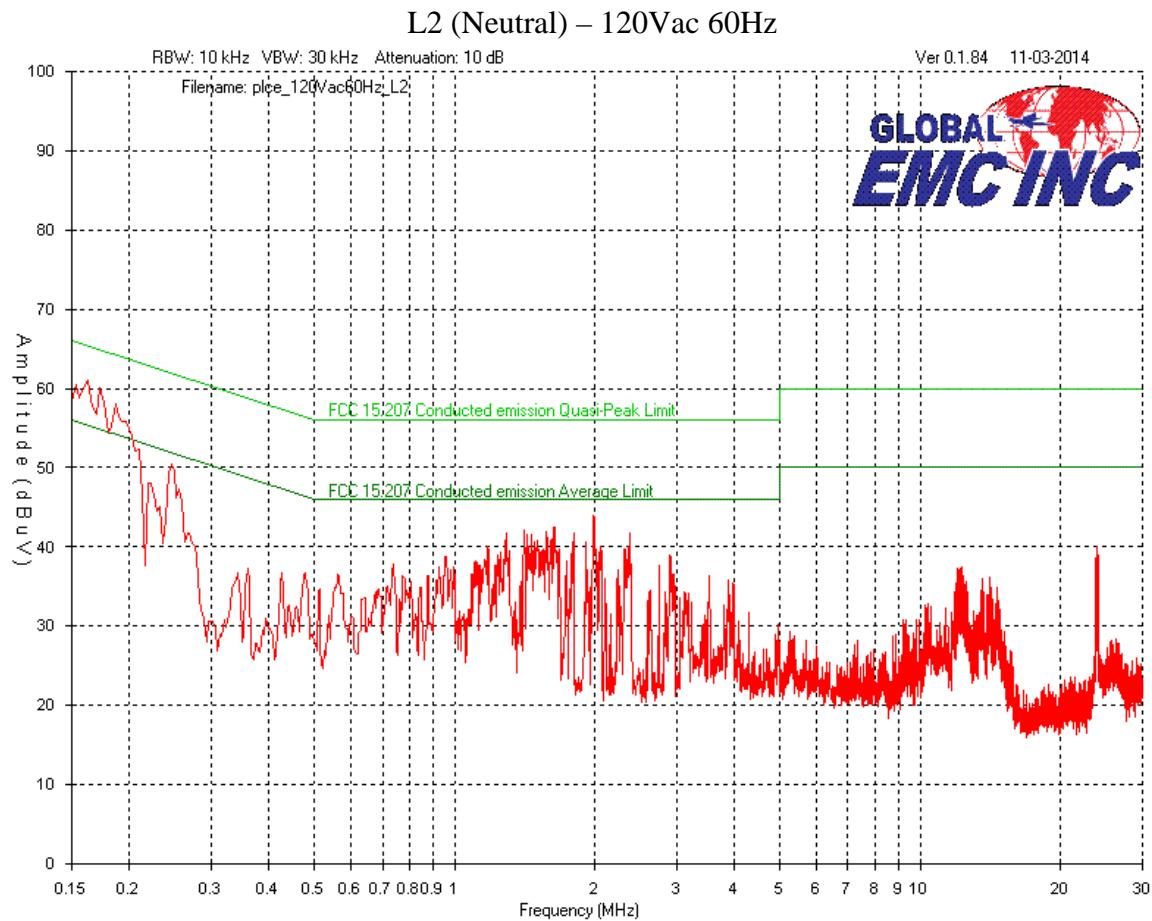
Note the graphs shown below are for graphical illustration only. For final measurements with the appropriate detector where applicable, please refer to the table. The graph shown below is a peak measurement graph, measured with a resolution bandwidth greater than or equal to the final required detector. These graphs are performed as a worst case measurement to enable the detection of frequencies of concern and for considerable time savings.

Power line conducted emissions were performed with the transmitter transmitting at 100% duty cycle.

Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014

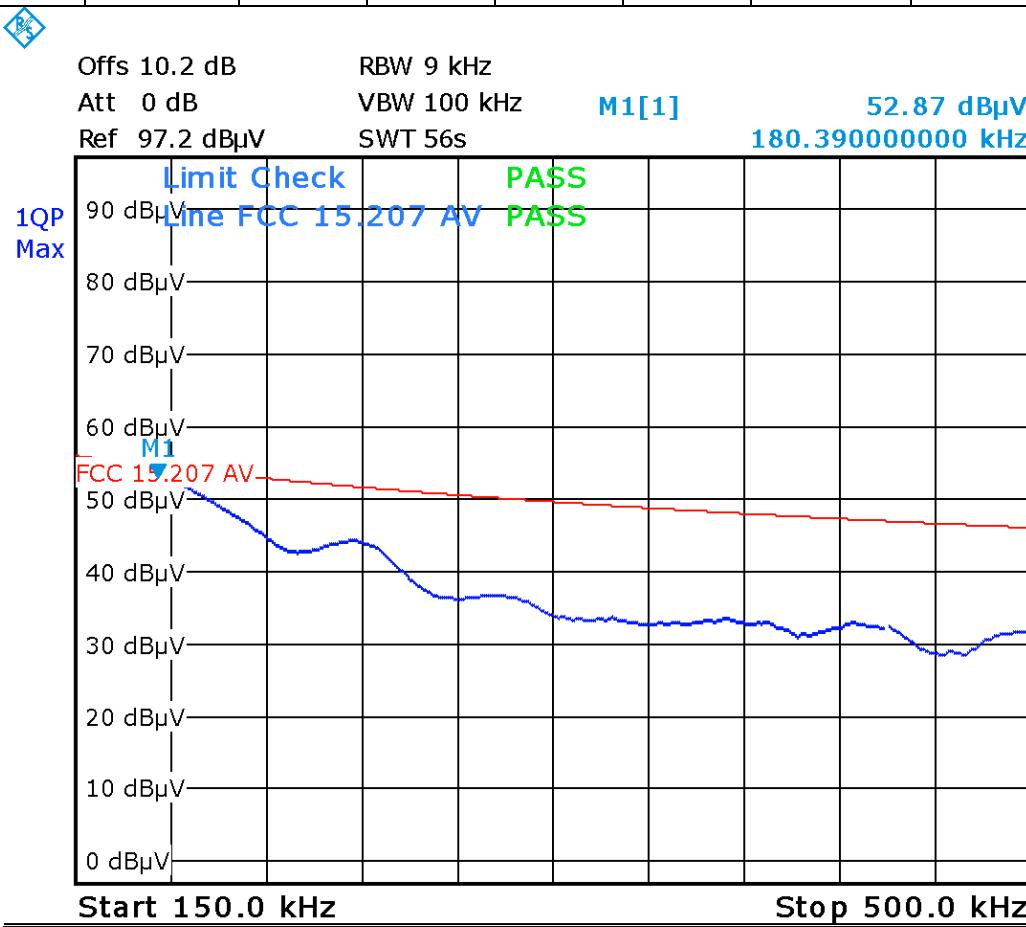


Client	Zen Within Inc
Product	Zen
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



## Final Measurements

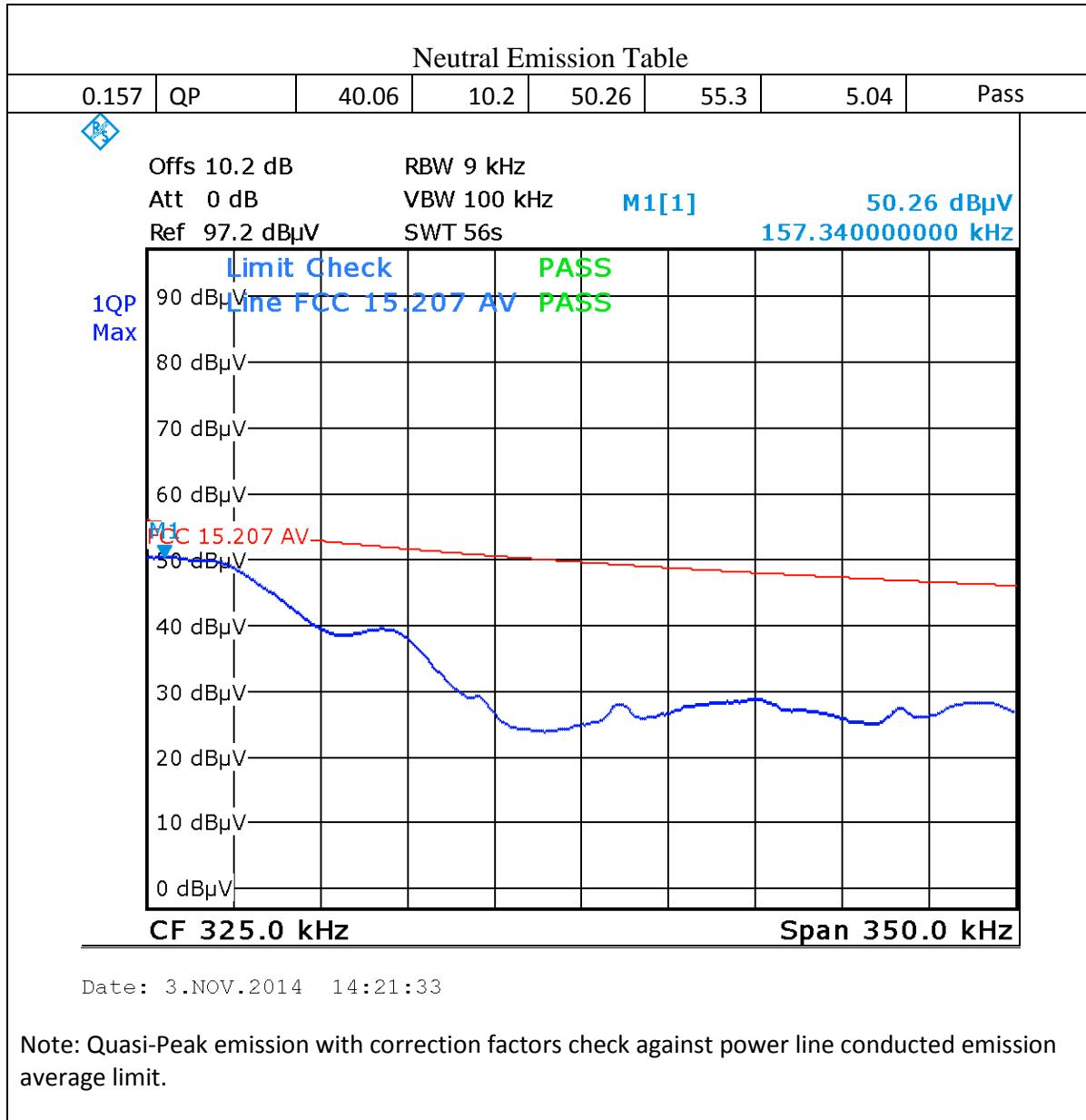
Product Category	Class B						
Product	Zen						
Supply	120 VAC 60 Hz						
Line Emission Table							
Frequency (MHz)	Detector	Raw (dBuV)	Factors	Level (dBuV)	Limit (dB)	Margin (dB)	Pass/Fail
0.1633	AVG	16.83	10.2	27.03	55.3	28.27	Pass
0.1633	QP	42.5	10.2	52.7	55.3	2.6	Pass



Date: 3.NOV.2014 13:41:40

Note: Quasi-Peak emission with correction factors check against power line conducted emission average limit.

Client	Zen Within Inc
Product	Zen
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



Date: 3.NOV.2014 14:21:33

Note: Quasi-Peak emission with correction factors check against power line conducted emission average limit.

Notes:

1. Power line conducted emissions was performed on the 120 Vac to 24 Vac step-down transformer.
2. See 'Appendix B – EUT & Test Setup Photographs' for photos showing the test set-up for the highest line conducted emission

Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



## Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	ESL 6	Rohde & Schwarz	Nov 15, 2013	Nov 15, 2015	GEMC 160
LISN	FCC-LISN-50/250-16-2-01	FCC	Feb 06, 2013	Feb 06, 2015	GEMC 65
RF Cable 7m	LMR-400-7M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 28

This report module is based on GEMC template "FCC – Power Line Conducted Emissions Class B\_Rev1"

Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



## **Appendix A – EUT Summary**

Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



For further details for filing purposes, refer to filing package.

## General EUT Description

<b>Client</b>	
<b>Organization</b>	Zen Within Inc 243 College St. Suite 500 Toronto, Ontario M5T 1R5
<b>Contact</b>	Mark Borins
<b>EUT Details</b>	
<b>EUT Name (for report title)</b>	Zen
<b>FCC ID</b>	2ADJL-ZEN01
<b>Industry Canada #</b>	12476A-ZEN01
<b>Equipment category</b>	HVAC Controller
<b>EUT is powered using</b>	4 x AA Batteries or 24 VAC provided via Class 2 Certified Power Supply
<b>Input voltage range(s) (V)</b>	24 Vac or 6VDC from batteries
<b>Frequency range(s) (Hz)</b>	60 Hz
<b>Rated input current (A)</b>	2 A
<b>Number of power supplies in EUT</b>	1
<b>Transmits RF energy? (describe)</b>	Yes
<b>Basic EUT functionality description</b>	Thermostat

Note the EUT is considered to have been received the date of the commencement of the first test, unless otherwise stated. For a close-up picture of the EUT, see 'Appendix B – EUT & Test Setup Photographs'.

Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



## EUT Configuration

Please see Appendix B for a picture of the unit running in normal conditions.

- Wireless were configured to transmit at continuously at 100% duty cycle

## Operational Setup

These devices are required to be attached to the EUT for its normal operation.

- A debug board was connected to the EUT.

Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



## **Appendix B – EUT and Test Setup Photographs**

Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



**Figure 5: Radiated emission setup – photo 1**

Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



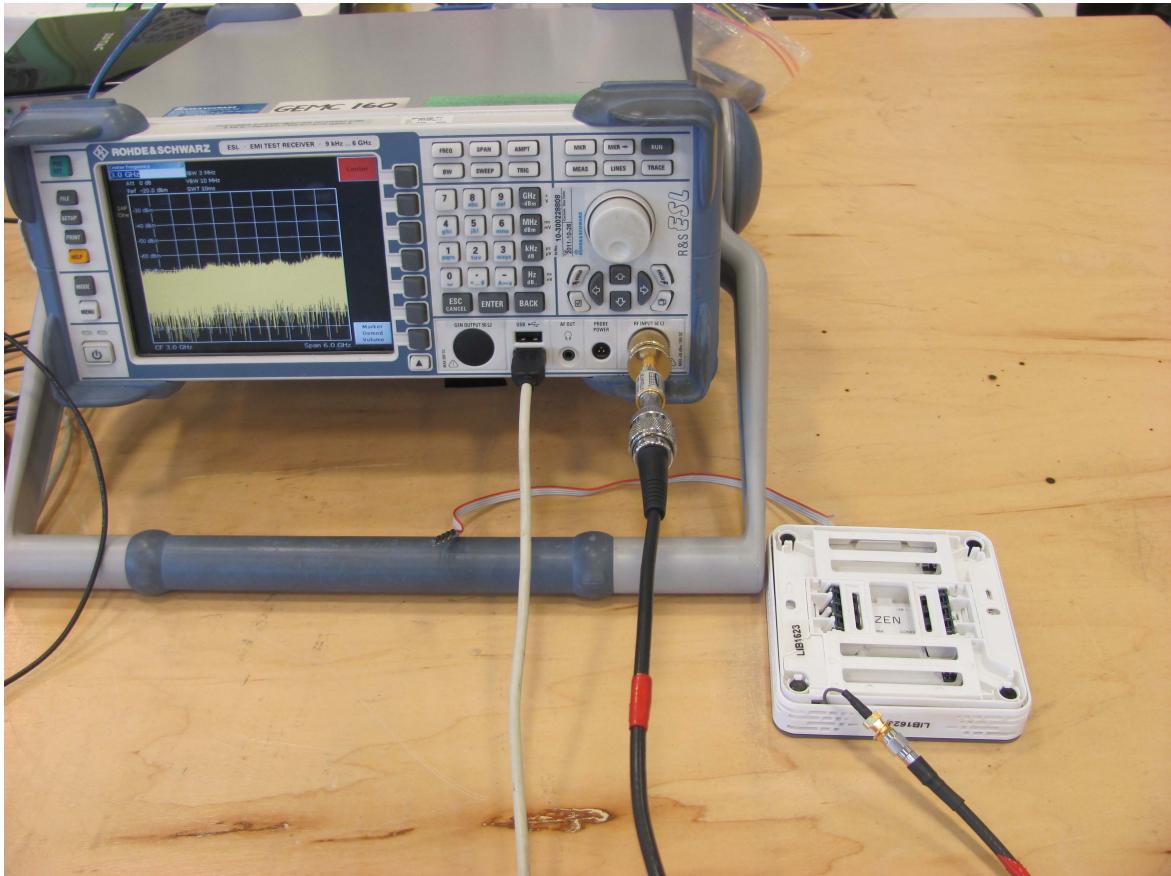
**Figure 6: Radiated emission setup – photo 2**

Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



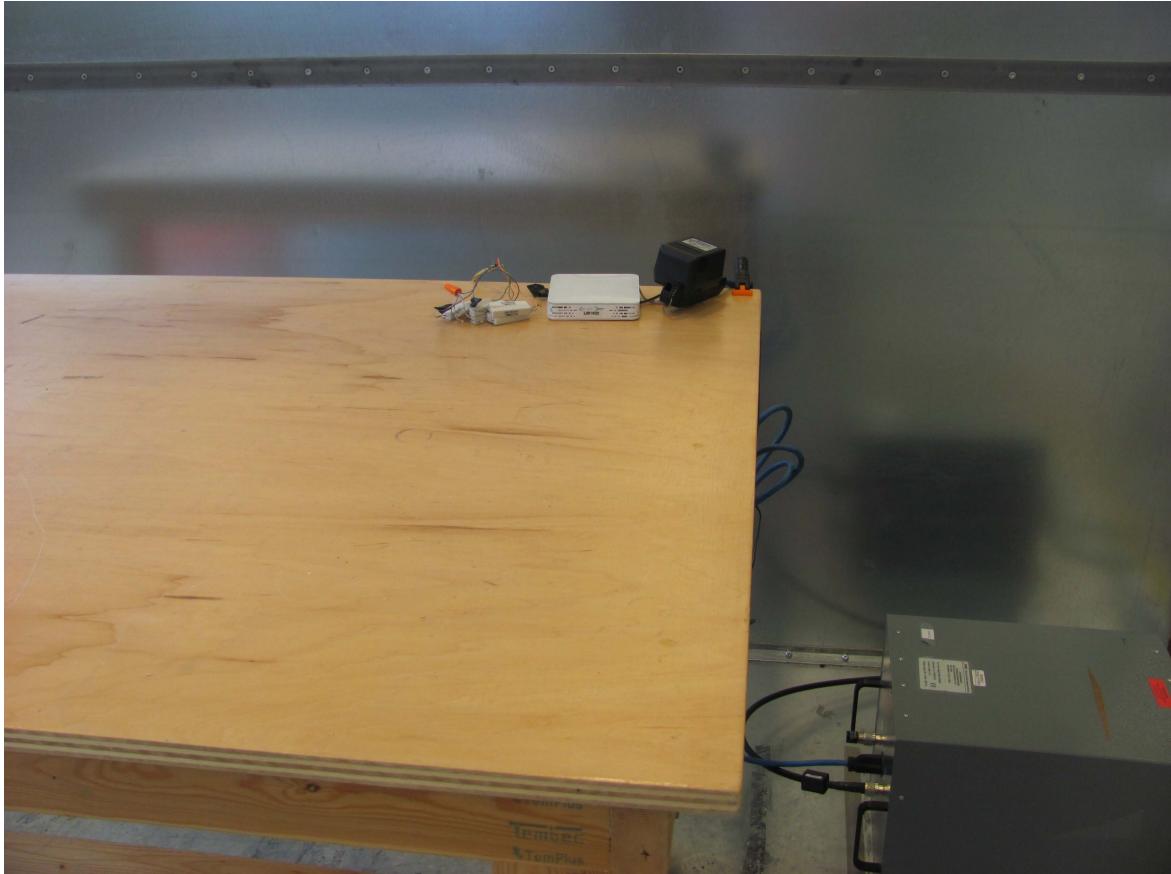
**Figure 7: Radiated emission setup – photo 3**

Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



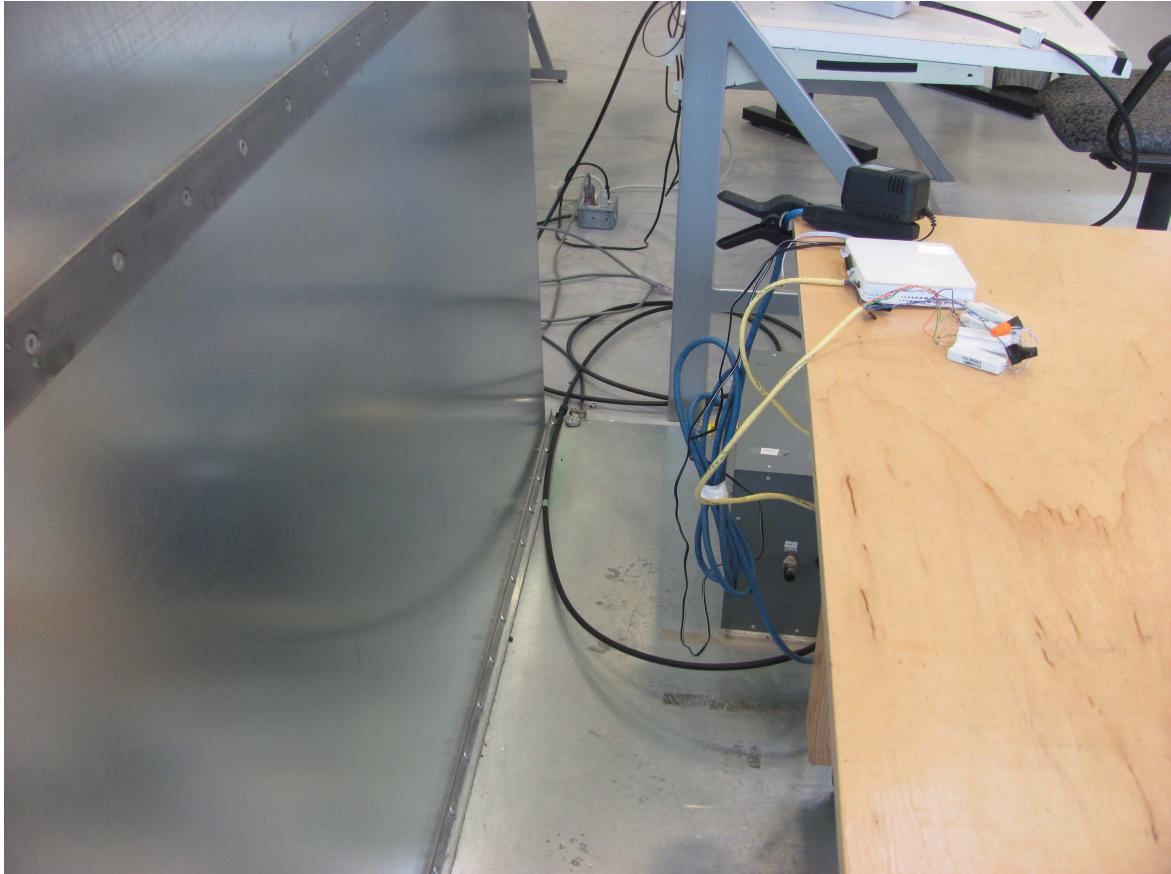
**Figure 8: Antenna port conducted emission setup – photo**

Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



**Figure 9: Power line conducted emission setup – photo 1**

Client	<b>Zen Within Inc</b>
Product	<b>Zen</b>
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014



**Figure 10: Power line conducted emission setup – photo 2**