

Test Report Prepared By:

Electronics Test Centre
27 East Lake Hill
Airdrie, Alberta
Canada
T4A 2K3

sales@etc-mpbtech.com

<http://www.etc-mpb.com>

Telephone: 1-403-912-0037

ETC Report #: z05e15a312-1 Release 2

Date: 2017-04-27

**EMC testing of the Zone4 Systems Inc GoChip
in accordance with FCC Part 15.247, ANSI C63.4: 2014 and ANSI C63.10: 2013
FCC ID: 2AF42GO1**

Test Personnel: **D. Raynes, I. Akram**

Prepared for: **Zone4 Systems Inc**

205 – 820 Main Street
Canmore, Alberta
Canada
T1W 2B7

Telephone: 1-888-444-0199



David Raynes

draynes@etc-mpbtech.com

QA Deputy

Electronics Test Centre (Airdrie)

Authorized Signatory

REVISION RECORD

ISSUE	DATE	AUTHOR	REVISIONS
DRAFT 1	2017-04-05	D. Raynes	Initial draft submitted for review.
Release 1	2017-04-24	D. Raynes	Released for distribution.
Release 2	2017-04-27	D. Raynes	Updated the Radiated Emissions data

TABLE OF CONTENTS

1.0	INTRODUCTION	5
1.1	Scope	5
1.2	Applicant	5
1.3	Test Sample Description	5
1.4	General Test Conditions and Assumptions	5
1.5	Scope of Testing	6
1.5.1	Test Methodology	6
1.5.2	Variations in Test Methodology	6
1.5.3	Test Sample Verification, Configuration & Modifications	6
2.0	TEST CONCLUSION	7
2.1	AC Power Line Conducted Emissions: Transmit Mode	8
2.2	Peak Output Power	9
2.2.1	Test Guidance: ANSI C63.10-2013, Clause 11.9.1.1	9
2.2.2	Deviations From The Standard:	9
2.2.3	Test Equipment	9
2.2.4	Test Sample Verification, Configuration & Modifications	9
2.2.5	Peak Output Power Data	10
2.3	Power Spectral Density	12
2.3.1	Test Guidance: ANSI C63.10-2013, Clause 11.10.2	12
2.3.2	Deviations From The Standard:	12
2.3.3	Test Equipment	12
2.3.4	Test Sample Verification, Configuration & Modifications	12
2.3.5	Peak PSD Data	13
2.4	Channel Occupied Bandwidth	15
2.4.1	Test Guidance: ANSI C63.10-2013, Clause 11.8.2	15
2.4.2	Deviations From The Standard:	15
2.4.3	Test Equipment	16
2.4.4	Test Sample Verification, Configuration & Modifications	16
2.4.5	Channel Occupied Bandwidth Data:	16
2.5	Band Edge Attenuation	20
2.5.1	Test Guidance: ANSI C63.10-2013 Clause 11.13.2	20
2.5.2	Deviations From The Standard:	20
2.5.3	Test Equipment	20
2.5.4	Test Sample Verification, Configuration & Modifications	21
2.5.5	Band Edge Data	21
2.6	Conducted Spurious Emissions	24
2.6.1	Test Guidance: ANSI C63.10-2013, Clause 6.7	24
2.6.2	Deviations From The Standard:	24
2.6.3	Test Equipment	24
2.6.4	Test Sample Verification, Configuration & Modifications	25
2.6.5	Conducted Emissions Data:	25
2.7	EUT Positioning Assessment	27
2.7.1	Test Guidance: ANSI C63.4-2014, Clause 6.3.2.1	27
2.7.2	Deviations From The Standard:	27
2.7.3	Uncertainty of Measurement:	28
2.7.4	Test Equipment	28
2.7.5	Test Sample Verification, Configuration & Modifications	28
2.7.6	Peak Radiated Emissions Data:	29

2.8	Transmitter Radiated Spurious Emissions.....	30
2.8.1	Test Guidance: ANSI C63.10-2013, Clause 11.11 & 11.12.....	31
2.8.2	Deviations From The Standard:.....	31
2.8.3	Uncertainty of Measurement:.....	31
2.8.4	Test Equipment.....	32
2.8.5	Test Sample Verification, Configuration & Modifications	32
2.8.6	Radiated Emissions Data:.....	33
2.9	Receiver Radiated Spurious Emissions.....	51
2.9.1	Test Guidance: ANSI C63.10-2013, Clause 11.11 & 11.12.....	51
2.9.2	Deviations From The Standard:.....	51
2.9.3	Uncertainty of Measurement:.....	52
2.9.4	Test Equipment.....	52
2.9.5	Test Sample Verification, Configuration & Modifications	52
2.9.6	Radiated Emissions Data:.....	53
2.10	Antenna Requirements	58
2.2.1	Test Methodology.....	58
2.2.2	Deviations From The Standard:.....	58
2.2.3	Assessment	58
2.11	RF Exposure	59
3.1	Location.....	60
3.2	Grounding Plan	60
3.3	Power Supply	60
3.4	Emissions Profile	60
	End of Document	61

1.0 INTRODUCTION

1.1 Scope

The purpose of this report is to present the results of compliance testing performed in accordance with FCC Part 15.247 as specified by Zone4 Systems Inc. All test procedures, limits, criteria, and results described in this report apply only to the Zone4 Systems Inc GoChip test sample, referred to herein as the EUT (Equipment Under Test).

This report does not imply product endorsement by the Electronics Test Centre, SCC, NAVLP, A2LA, nor any Canadian Government agency.

1.2 Applicant

This test report has been prepared for Zone4 Systems Inc, located in Canmore, Alberta, Canada.

1.3 Test Sample Description

As provided to ETC (Airdrie) by Zone4 Systems Inc:

Product Name:	GoChip
Model #	GO1
Serial #	n/a
Power:	Internal battery

The device is a wireless (Bluetooth Low Energy) device. It incorporates an integral antenna, with characteristics as specified in Texas Instruments Application Report SWRU120C - April 2007 - Revised February 2017.

The device has an internal non-rechargeable battery.

1.4 General Test Conditions and Assumptions

The EUT was set up and exercised using the configurations, modes of operation and arrangements defined in this report only. All inputs and outputs to and from other equipment associated with the EUT were adequately simulated.

Where relevant, the EUT was only tested using the monitoring methods and test criteria defined in this report.

The environmental conditions are recorded during each test, and are reported in the relevant sections of this document.

1.5 Scope of Testing

Tests were performed in accordance with FCC Part 15.247, ANSI C63.4-2014, and ANSI C63.10-2013 as referenced in FCC KDB 558074 v03r05.

1.5.1 Test Methodology

Test methods are documented in the part of Section 2 of this report associated with each particular Test Case.

1.5.2 Variations in Test Methodology

Any variance in methodology or deviation from the reference Standard is documented in the part of Section 2 of this report associated with each particular Test Case.

1.5.3 Test Sample Verification, Configuration & Modifications

EUT setup, configuration, protocols for operation and monitoring of EUT functions, and any modifications performed in order to meet the requirements, are detailed in each Test Case of Section 2 of this report.

2.0 TEST CONCLUSION

STATEMENT OF COMPLIANCE

The customer equipment referred to in this report was found to comply with the requirements, as summarized below.

The EUT was subjected to the following tests. Compliance status is reported as **Compliant** or **Non-compliant**. **N/A** indicates the test was Not Applicable to the EUT.

Note: Maintenance of compliance is the responsibility of the Manufacturer. Any modifications to the product should be assessed to determine their potential impact on the compliance status of the EUT with respect to the standards detailed in this test report.

The following table summarizes the tests performed in terms of the specification, class or performance criterion applied, and the EUT modification state.

Test Case	Test Type	Specification	Test Sample	Modifications	Config.	Result
2.1	AC Conducted Emissions (Tx)	15.207	GoChip	none	see § 2.1	N/A
2.2	Occupied Bandwidth	15.247(a)	GoChip	none	see § 2.2	Compliant
2.3	Peak Output	15.247(d)	GoChip	none	see § 2.3	Compliant
2.4	PSD	15.247(e)	GoChip	none	see § 2.4	Compliant
2.5	Band Edge	15.247(d)	GoChip	none	see § 2.5	Compliant
2.6	Conducted Spurious	15.247(d)	GoChip	none	see § 2.6	Compliant
2.7	EUT Position	ANSI C63.4	GoChip	none	see § 2.7	see § 2.7
2.8	Transmitter Radiated Spurious	15.205, 15.209 15.247(d)	GoChip	none	see § 2.8	Compliant
2.9	Receive Radiated Spurious	15.205, 15.109	GoChip	none	see § 2.9	Compliant
2.10	Antenna Requirements	15.203	GoChip	none	see § 2.10	Compliant
2.11	RF Exposure	15.247(i)	GoChip	none	see § 2.11	Compliant

Refer to the test data for applicable test conditions.

2.1 AC Power Line Conducted Emissions: Transmit Mode

Test Lab: Electronics Test Centre, Airdrie	EUT: GoChip
Test Personnel: N/A	Standard: FCC Part 15.207
Date:	Basic Standard: ANSI C63.4: 2014
EUT status: Not Applicable	
Comments: The device is only powered by an internal, non-rechargeable battery. There is no connection to the AC mains.	

2.2 Peak Output Power

Test Lab: Electronics Test Centre, Airdrie	EUT: GoChip
Test Personnel: D. Raynes	Standard: FCC PART 15.247
Date: 2017-01-03 (19.0° C, 12.2% RH)	Basic Standard: ANSI C63.10: 2013
EUT status: Compliant	

Specification: FCC Part 15.247(b)(3)

For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt.

2.2.1 Test Guidance: ANSI C63.10-2013, Clause 11.9.1.1

This measurement is performed at low, mid and high frequencies, with modulation.

The RF output of EUT with an antenna connector is fed to the input of the spectrum analyzer through appropriate attenuation.

The EUT antenna is integral to the device. The SMA connector provided by the customer is for testing purposes only.

The spectrum analyzer is set for a frequency span $\geq (3 \times \text{RBW})$ centered on a channel. The RBW is set $\geq (6\text{dB BW})$ and VBW is set $\geq (3 \times \text{RBW})$. The Peak detector is used, with the trace set to Max Hold. After the trace has stabilized, the peak amplitude is found with the marker Peak Search function.

2.2.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

2.2.3 Test Equipment

Testing was performed with the following equipment:

Equipment	Manufacturer	Model #	Asset #	Calibration Date	Calibration Due
EMI receiver	Agilent	N9038A	6130	2016-06-23	2017-06-23

2.2.4 Test Sample Verification, Configuration & Modifications

The EUT was set to a Low, Mid and High channels with test-specific software. The output was modulated as in normal operation. The EUT was modified to permit direct connection of the RF output to the spectrum analyzer.

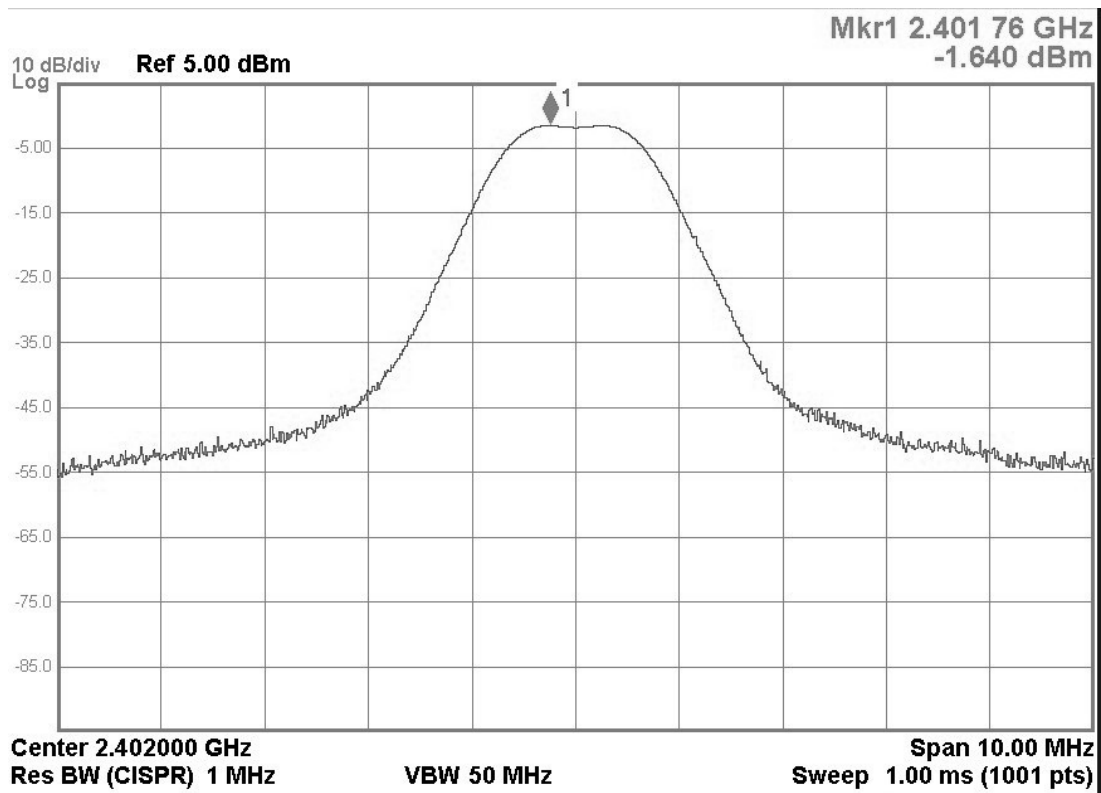
Test setup diagram for Peak Power testing:



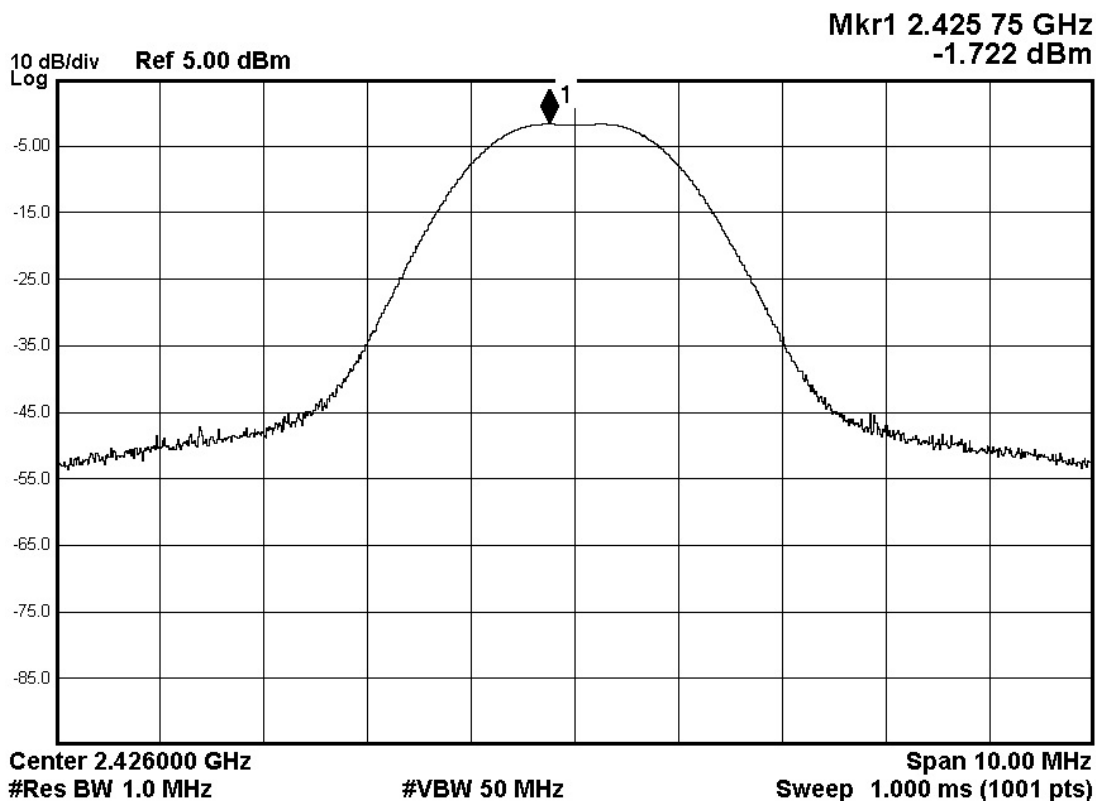
2.2.5 Peak Output Power Data

Carrier Frequency (MHz)	Peak RF Output (dBm)	Peak RF Output (Watts)	Limit (Watts)	Margin (Watts) (Pk O/P – Limit)
2402	-1.640	0.0007	1.000	-0.9993
2426	-1.722	0.0007	1.000	-0.9993
2480	-2.127	0.0006	1.000	-0.9994

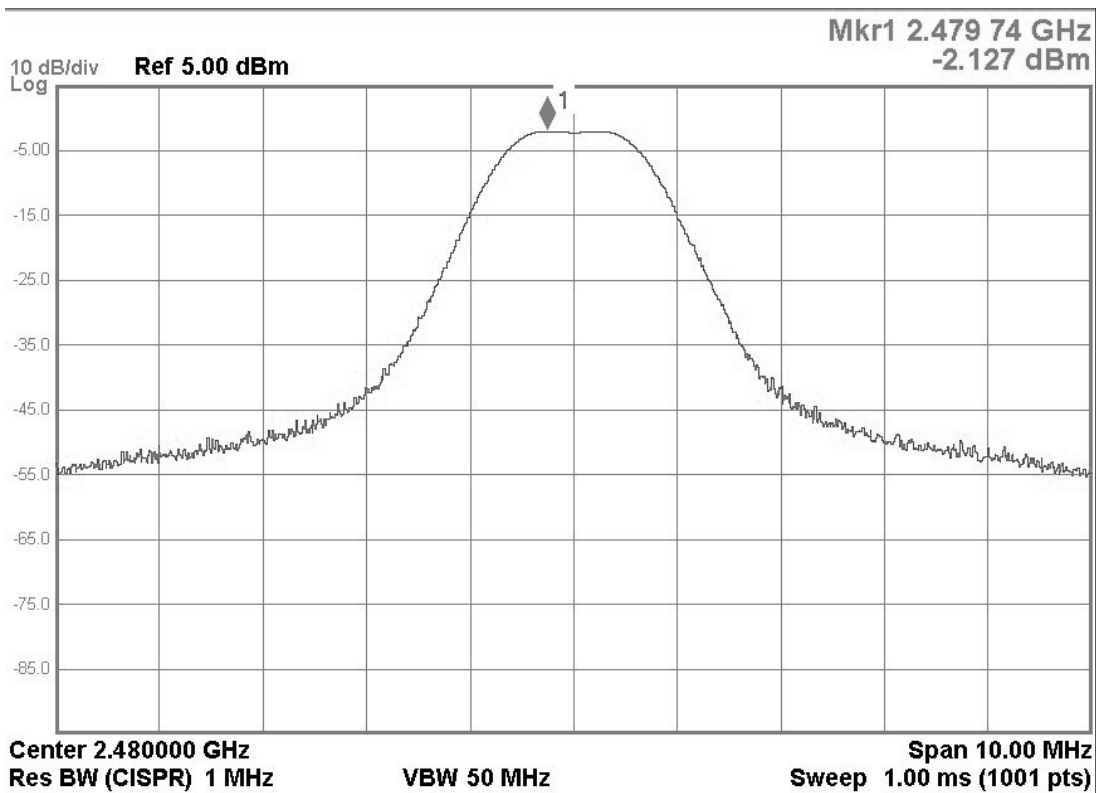
Screen capture from the spectrum analyzer: 2402 MHz



Screen capture from the spectrum analyzer: 2426 MHz



Screen capture from the spectrum analyzer: 2480 MHz



2.3 Power Spectral Density

Test Lab: Electronics Test Centre, Airdrie	EUT: GoChip
Test Personnel: D. Raynes	Standard: FCC PART 15.247
Date: 2017-01-03 (19.0° C, 12.2% RH)	Basic Standard: ANSI C63.10: 2013
EUT status: Compliant	

Specification: FCC Part 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.

2.3.1 Test Guidance: ANSI C63.10-2013, Clause 11.10.2

This measurement is performed at low, mid and high frequencies, in continuous transmission, with modulation.

The RF output of EUT with an antenna connector is fed to the input of the spectrum analyzer through appropriate attenuation.

The spectrum analyzer is set for a frequency span of (1.5*(6dB BW)) centered on a channel. The RBW is set to 3 kHz and VBW is set $\geq$ (3*RBW). The Peak detector is used, with the trace set to Max Hold. The marker is placed on the highest peak of the resulting trace.

2.3.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

2.3.3 Test Equipment

Testing was performed with the following equipment:

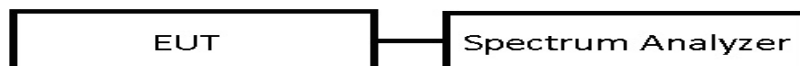
Equipment	Manufacturer	Model #	Asset #	Calibration Date	Calibration Due
EMI receiver	Agilent	N9038A	6130	2016-06-23	2017-06-23

2.3.4 Test Sample Verification, Configuration & Modifications

The EUT was modified to permit direct connection of the RF output to the spectrum analyzer.

The EUT was set to a selected channel with test-specific software. The output was modulated as in normal operation.

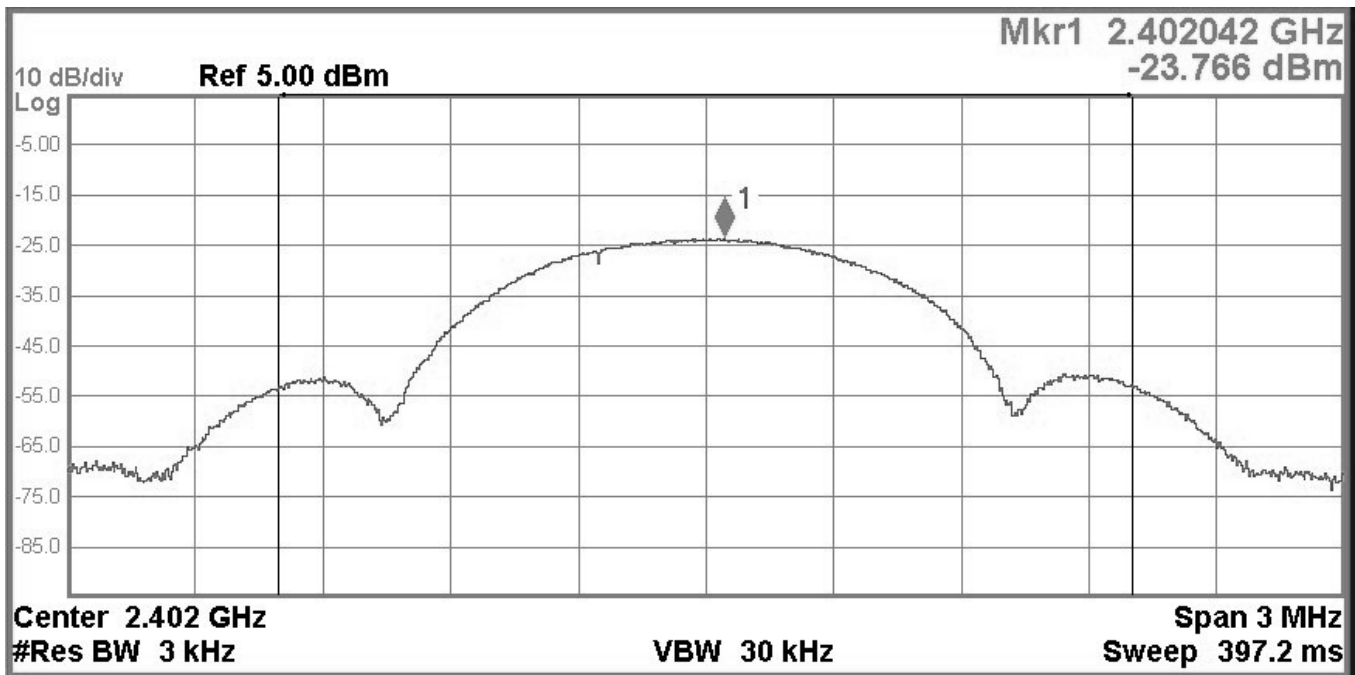
Test setup diagram for Power Spectral Density testing:



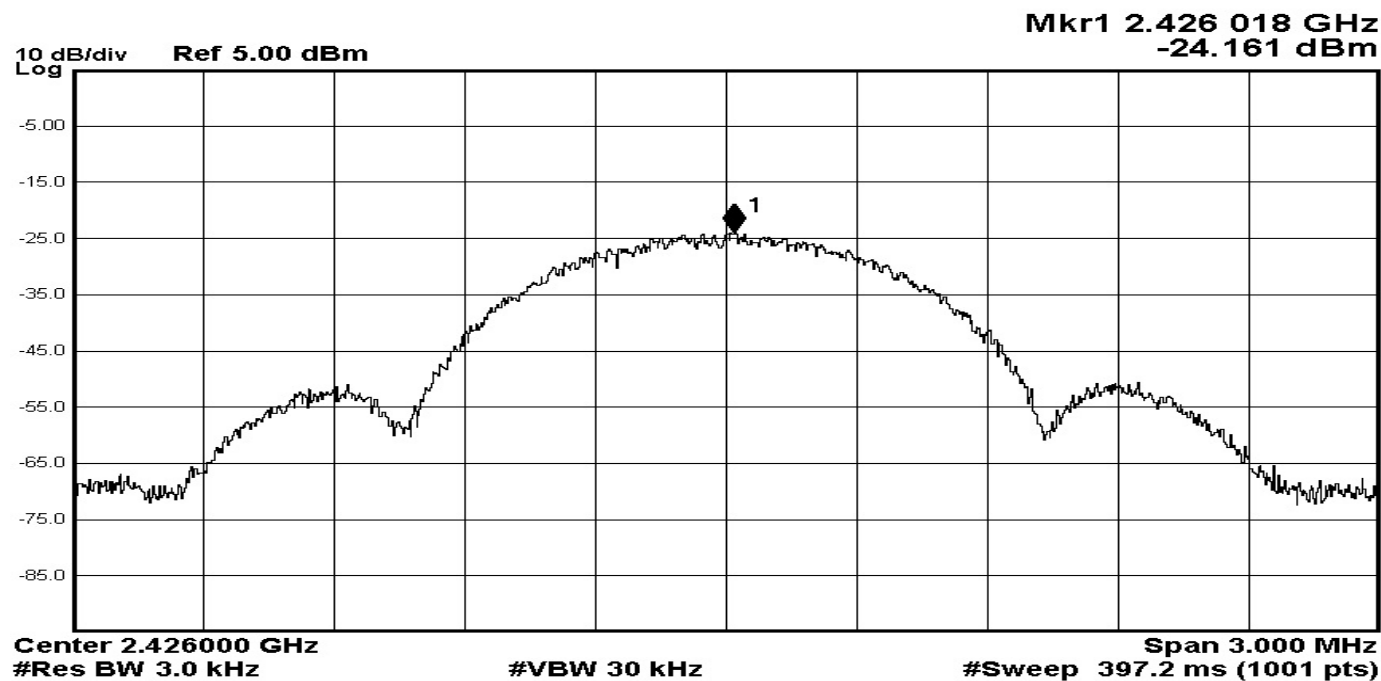
2.3.5 Peak PSD Data

Frequency (MHz)	Peak PSD (dBm)	Limit (dBm)	Margin (dB) (PSD – Limit)
2402	-23.77	8	-31.77
2426	-24.16	8	-32.15
2480	-24.20	8	-32.20

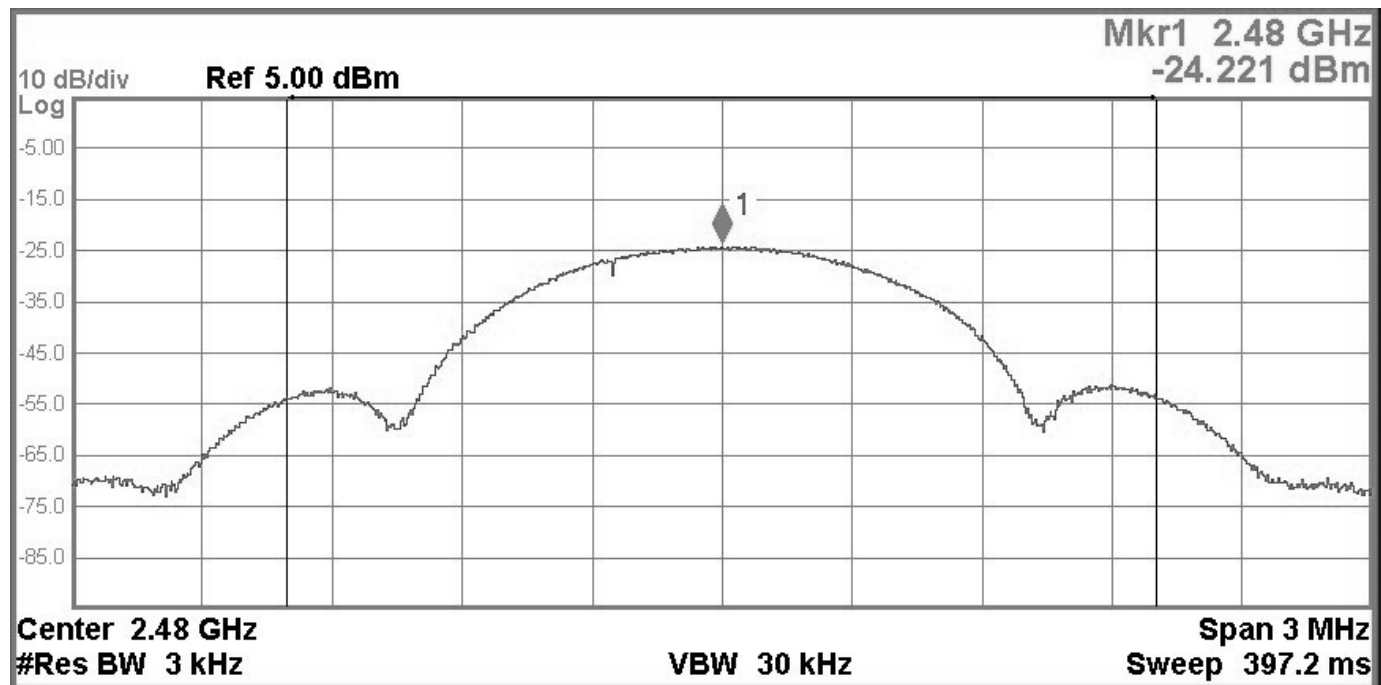
Screen Capture from the spectrum analyzer: 2402 MHz:



Screen Capture from the spectrum analyzer: 2426 MHz



Screen Capture from the spectrum analyzer: 2480 MHz:



2.4 Channel Occupied Bandwidth

Test Lab: Electronics Test Centre, Airdrie	EUT: GoChip
Test Personnel: D. Raynes	Standard: FCC PART 15.247
Date: 2017-01-03 (19.0° C, 12.2% RH)	Basic Standard: ANSI C63.10: 2013
EUT status: Compliant	

Specification: FCC Part 15.247(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.

2.4.1 Test Guidance: ANSI C63.10-2013, Clause 11.8.2

This measurement is performed at low, mid and high frequencies, with modulation.

The RF output of EUT with an antenna connector is fed to the input of the spectrum analyzer through appropriate attenuation. If the EUT antenna is integral to the device, an antenna is placed to capture the transmitted signals.

The spectrum analyzer is set for a frequency span $\geq (2 * \text{OBW})$, $\leq (5 * \text{OBW})$, selected to clearly display the channel. The RBW is set to 100 kHz. The VBW is set to $\geq (3 * \text{RBW})$. The Peak detector is used, with the trace set to Max Hold.

The automated 99% BW function of the spectrum analyzer is engaged, and the 6 dB OBW and/or 20 dB OBW is measured with the x dB function.

2.4.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

2.4.3 Test Equipment

Testing was performed with the following equipment:

Equipment	Manufacturer	Model #	Asset #	Calibration Date	Calibration Due
EMI receiver	Agilent	N9038A	6130	2016-06-23	2017-06-23

2.4.4 Test Sample Verification, Configuration & Modifications

The EUT was set to transmit continuously on a selected channel with test-specific software. The output was modulated as in normal operation. The EUT met the requirements without modification.

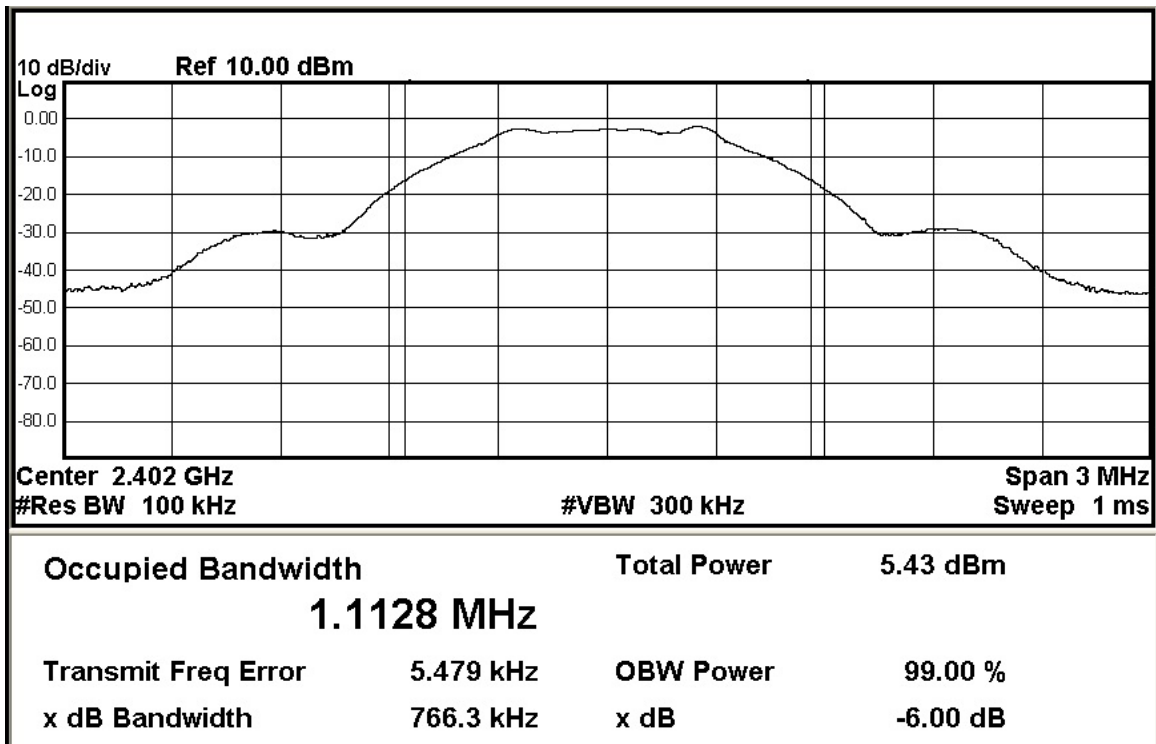
Test setup diagrams for Occupied Bandwidth testing:



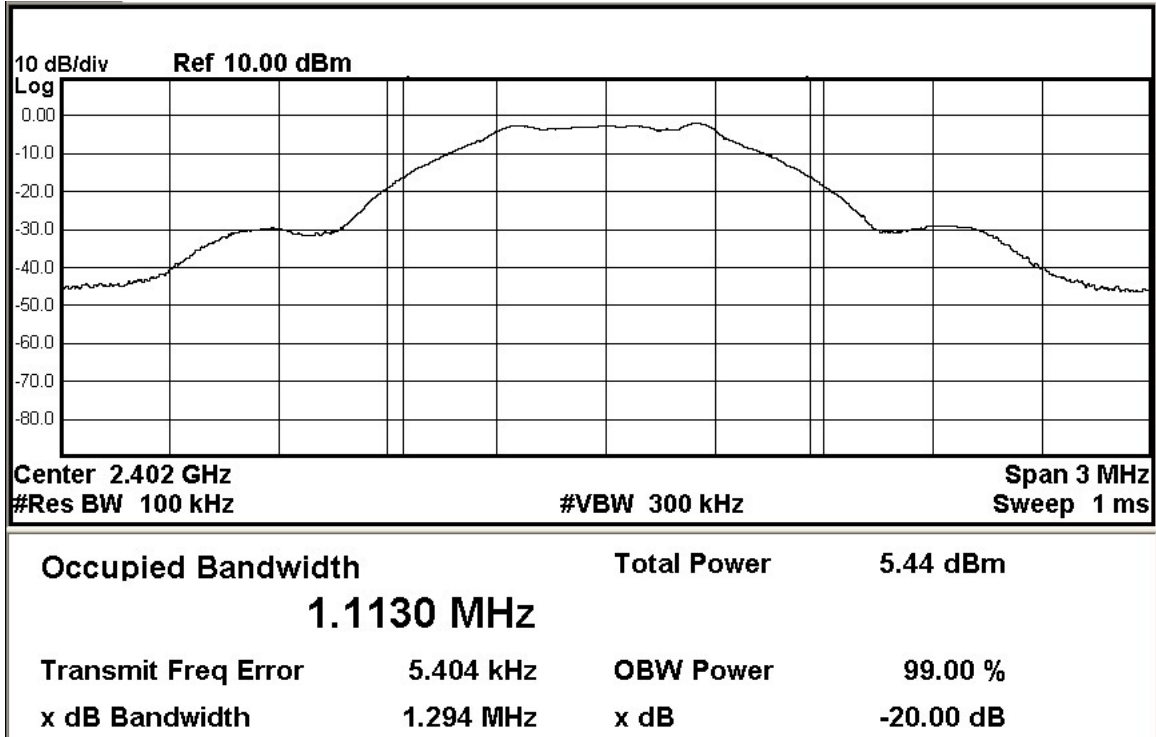
2.4.5 Channel Occupied Bandwidth Data:

Freq. [MHz]	-6 dB OBW (kHz)	-20 dB OBW (MHz)	99% OBW (MHz)	-6 dB OBW Limit	Margin (kHz)
2402	766.3	1.294	1.113	≥ 500 KHz	266.3
2426	743.1	1.284	1.100	≥ 500 KHz	243.1
2480	752.2	1.291	1.104	≥ 500 KHz	252.2

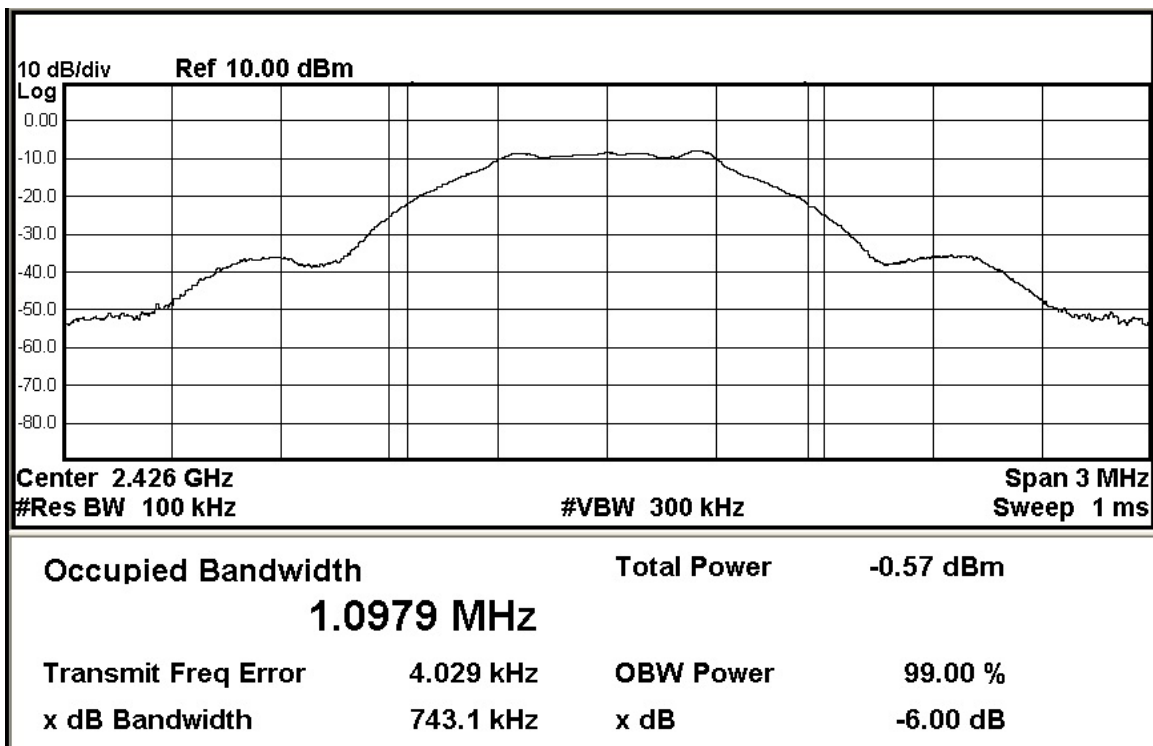
Screen Capture from the spectrum analyzer: 6 dB OBW, 2402 MHz:



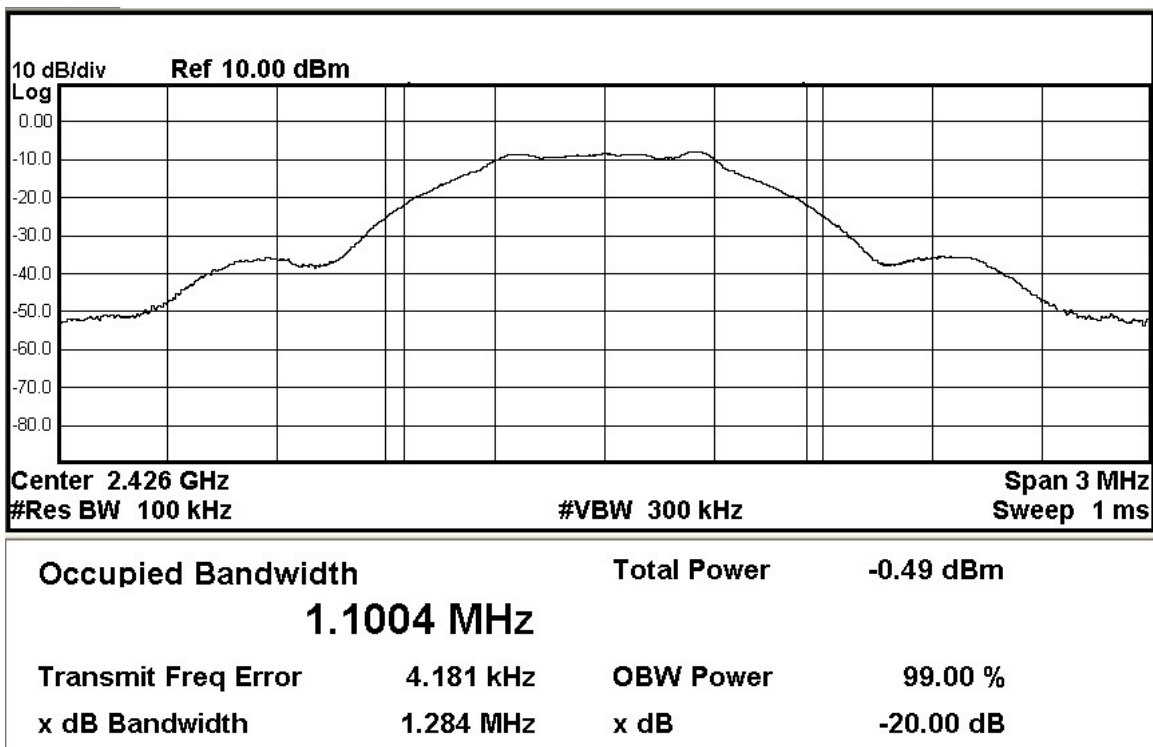
Screen Capture from the spectrum analyzer: 20 dB OBW, 2402 MHz:



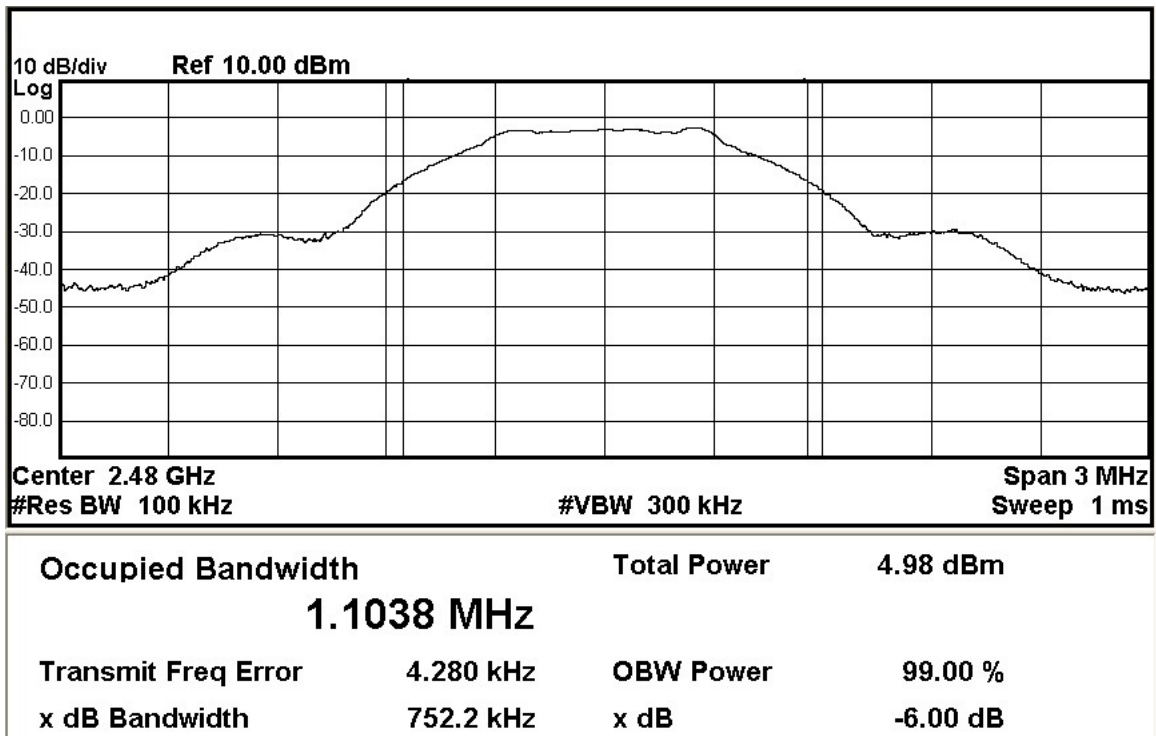
Screen Capture from the spectrum analyzer: 6 dB OBW, 2426 MHz:



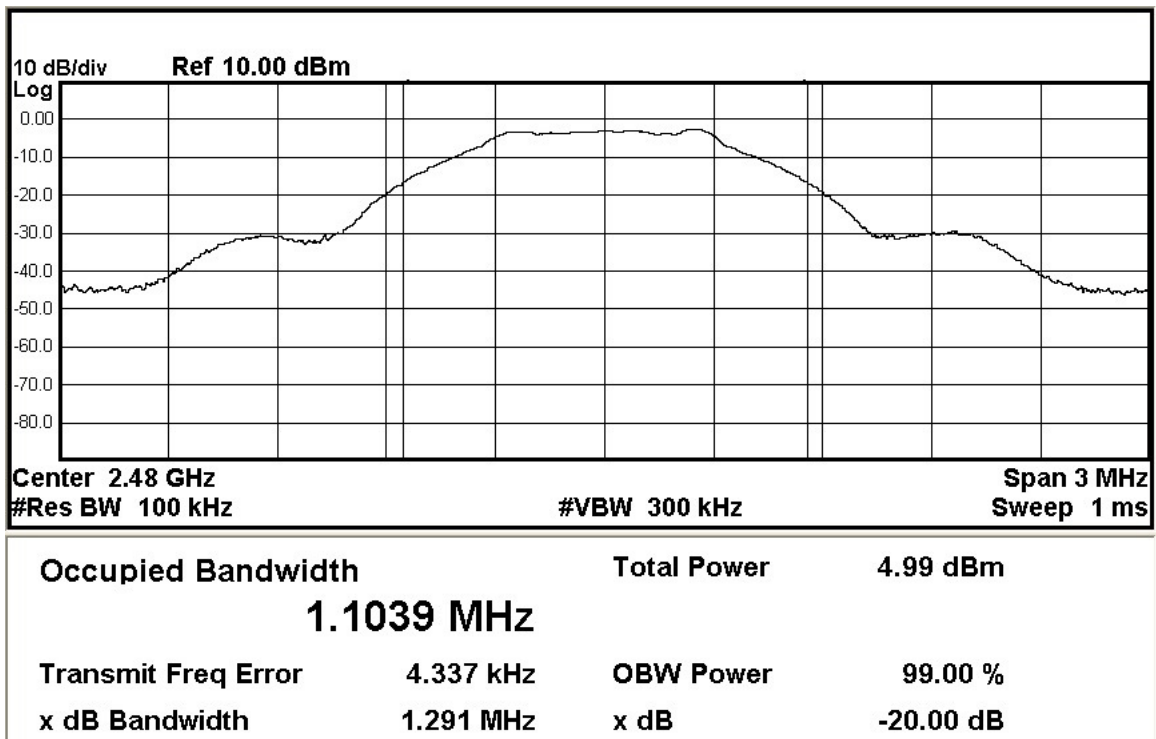
Screen Capture from the spectrum analyzer: 20 dB OBW, 2426 MHz:



Screen Capture from the spectrum analyzer: 6 dB OBW, 2480 MHz:



Screen Capture from the spectrum analyzer: 20 dB OBW, 2480 MHz:



2.5 Band Edge Attenuation

Test Lab: Electronics Test Centre, Airdrie	EUT: GoChip
Test Personnel: D. Raynes	Standard: FCC PART 15.247
Date: 2017-01-03 (19.0° C, 12.2% RH)	Basic Standard: ANSI C63.10: 2013
EUT status: Compliant	

Specification: FCC Part 15.247(d)

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)).

2.5.1 Test Guidance: ANSI C63.10-2013 Clause 11.13.2

This measurement is performed at the low and high frequencies, with modulation.

The RF output of EUT with an antenna connector is fed to the input of the spectrum analyzer through appropriate attenuation. If the EUT antenna is integral to the device, the radiated output is measured.

The spectrum analyzer is set for a frequency span to show the band edge and the nearest channel. The RBW is set to ≥ 100 kHz. The VBW is set to $\geq (\text{RBW} * 3)$. The Peak detector is used, with the trace set to Max Hold.

The attenuation is measured with the Marker Delta function.

2.5.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

2.5.3 Test Equipment

Testing was performed with the following equipment:

Equipment	Manufacturer	Model #	Asset #	Calibration Date	Calibration Due
EMI receiver	Agilent	N9038A	6130	2016-06-23	2017-06-23

2.5.4 Test Sample Verification, Configuration & Modifications

The EUT was operating normally, in communication with an iPod. The EUT met the requirements without modification.

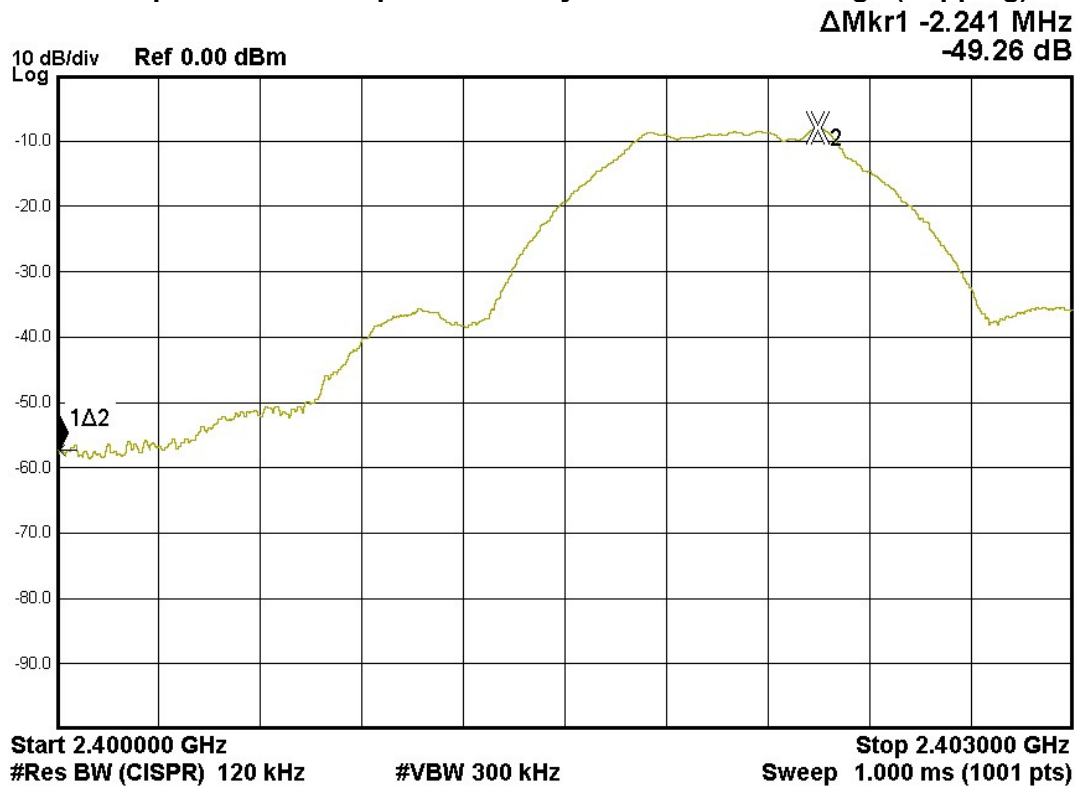
Test setup diagrams for Band Edge Attenuation testing:



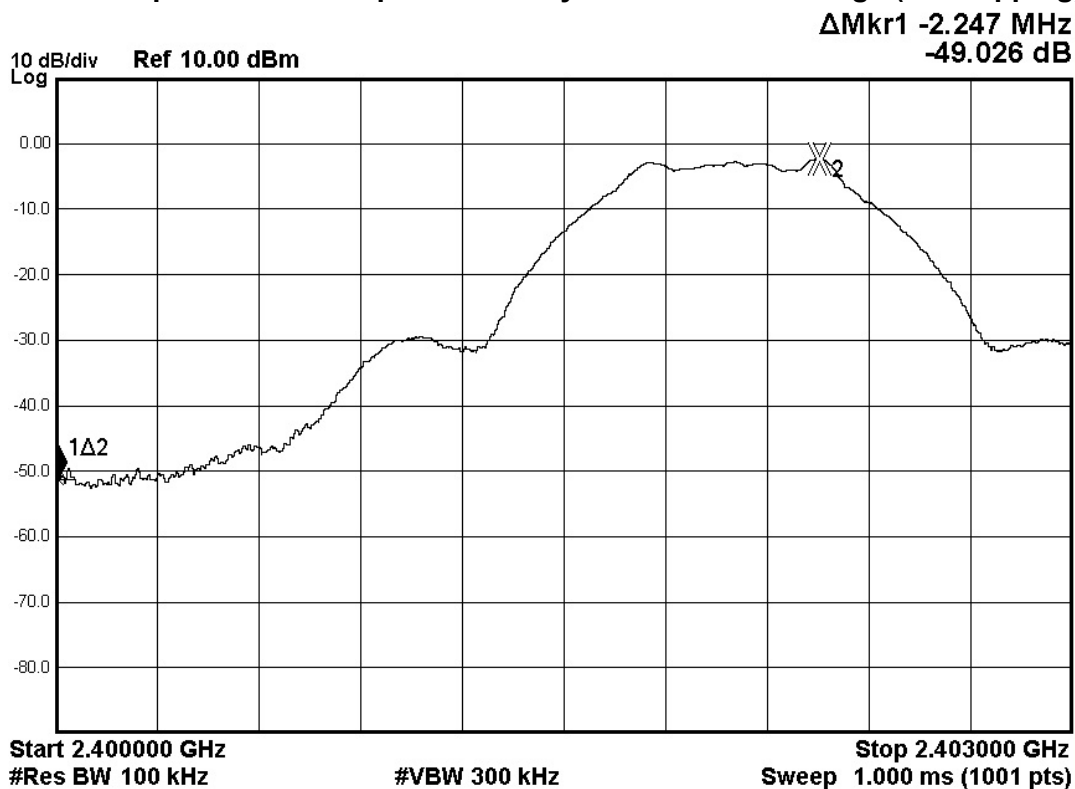
2.5.5 Band Edge Data

Channel	Edge	Attenuation at Band Edge (dBc)	Limit (dBc]	Margin
2402 MHz	Lower Band	-49.026	≥ -20	-29.026
2480 MHz	Upper Band	-56.250	≥ -20	-36.250

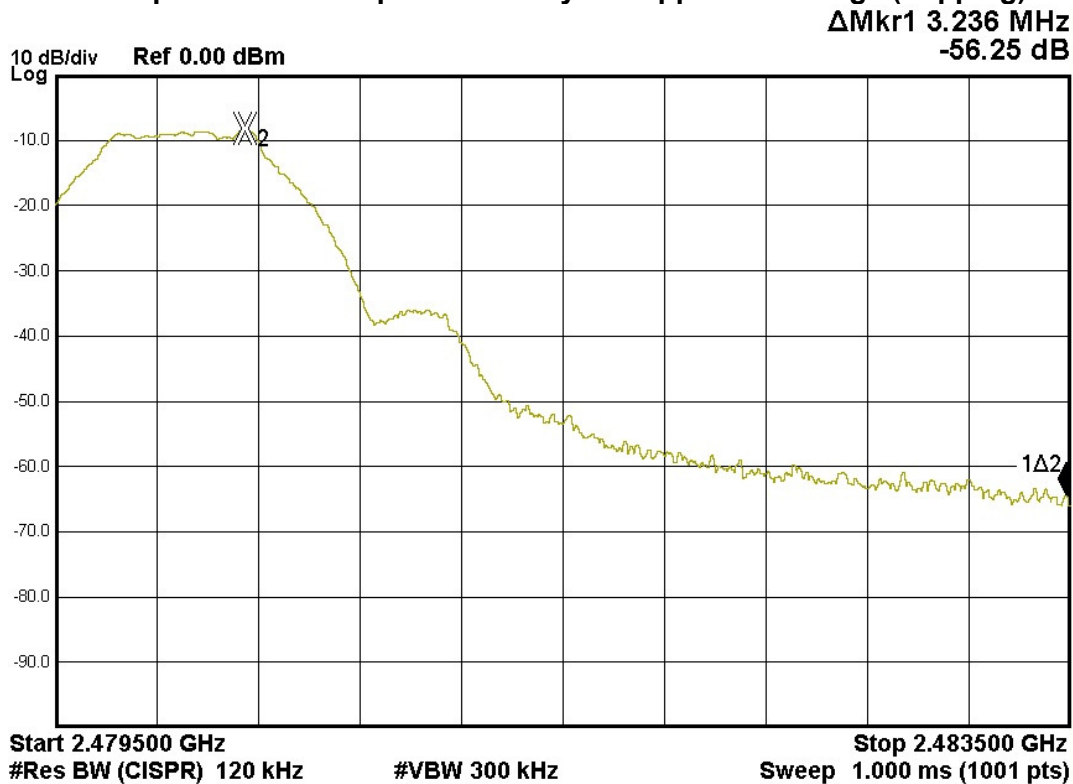
Screen Capture from the spectrum analyzer: Lower Band Edge (hopping)



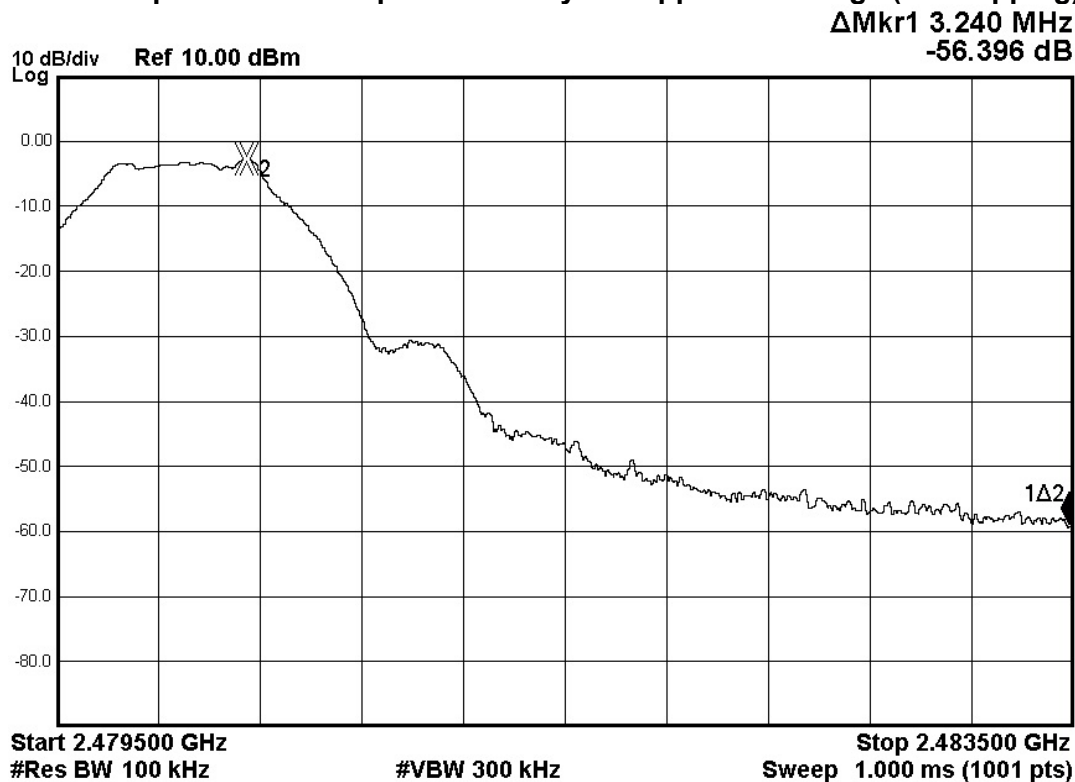
Screen Capture from the spectrum analyzer: Lower Band Edge (not hopping)



Screen Capture from the spectrum analyzer: Upper Band Edge (hopping)



Screen Capture from the spectrum analyzer: Upper Band Edge (not hopping)



2.6 Conducted Spurious Emissions

Test Lab: Electronics Test Centre, Airdrie	EUT: GoChip
Test Personnel: I. Akram	Standard: FCC PART 15.247
Date: 2017-01-03 (19.0° C, 12.2% RH)	Basic Standard: ANSI C63.4-2013
EUT status: Compliant	

Specification: FCC Part 15.247(d)

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.

2.6.1 Test Guidance: ANSI C63.10-2013, Clause 6.7

This measurement is performed at the low, mid and high frequencies, with modulation.

The RF output of EUT with an antenna connector is fed to the input of the spectrum analyzer through appropriate attenuation and/or band-block filter.

The spectrum analyzer is stepped through the spectrum. The RBW is set to ≥ 100 kHz. The VBW is set to ≥ 300 kHz. The Peak detector is used, with the trace set to Max Hold.

2.6.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

2.6.3 Test Equipment

Testing was performed with the following equipment:

Equipment	Manufacturer	Model #	Asset #	Calibration Date	Calibration Due
EMI receiver	Agilent	N9038A	6130	2016-06-23	2017-06-23

2.6.4 Test Sample Verification, Configuration & Modifications

The EUT was set to a selected channel with test-specific software. The output was modulated as in normal operation. The EUT met the requirements without modification.

Test setup diagram for Conducted Spurious Emissions testing:

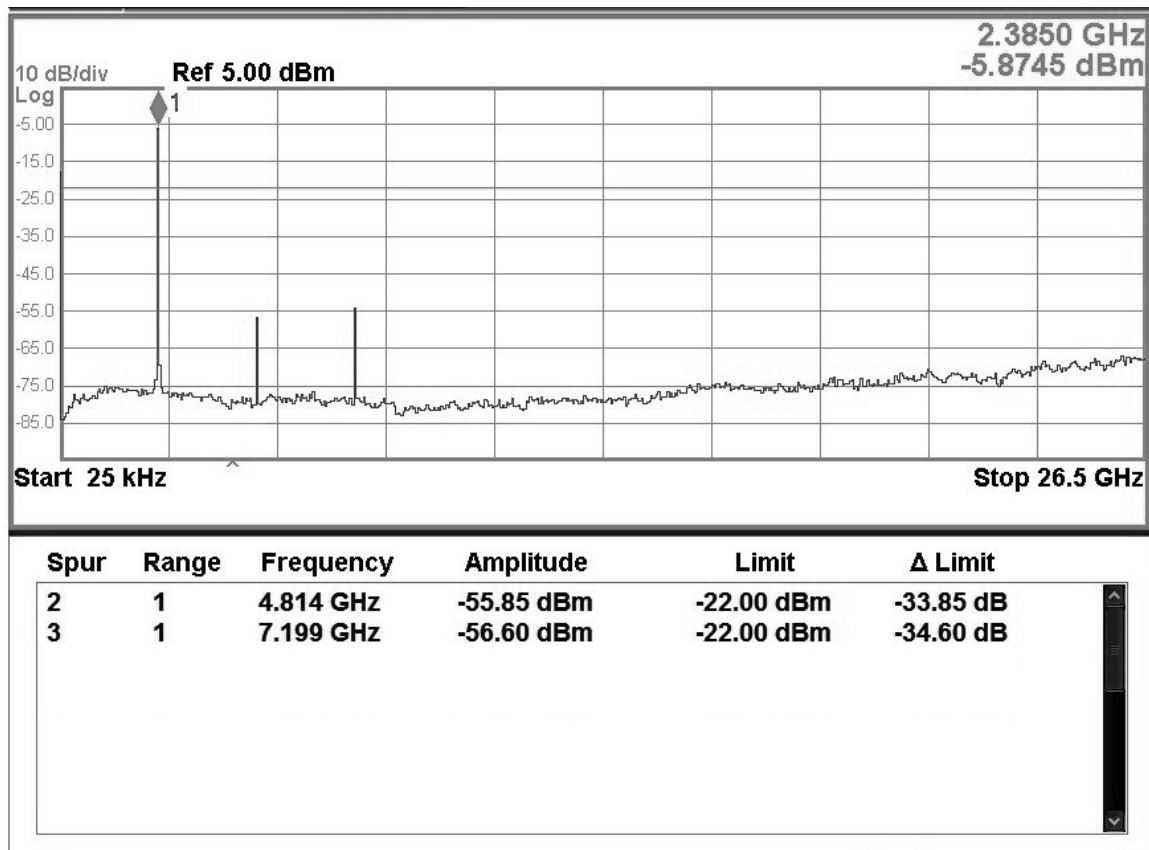


2.6.5 Conducted Emissions Data:

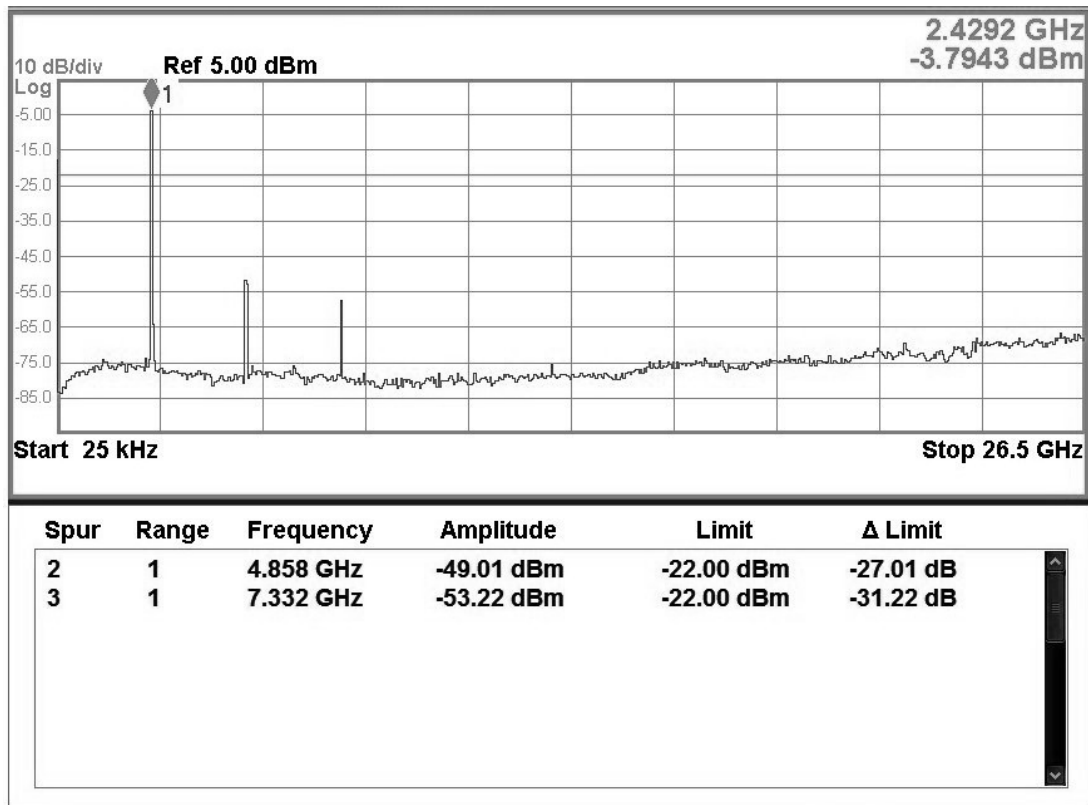
$\Delta = \text{Measured Value} - \text{Limit}$

Negative values for Delta indicate compliance.

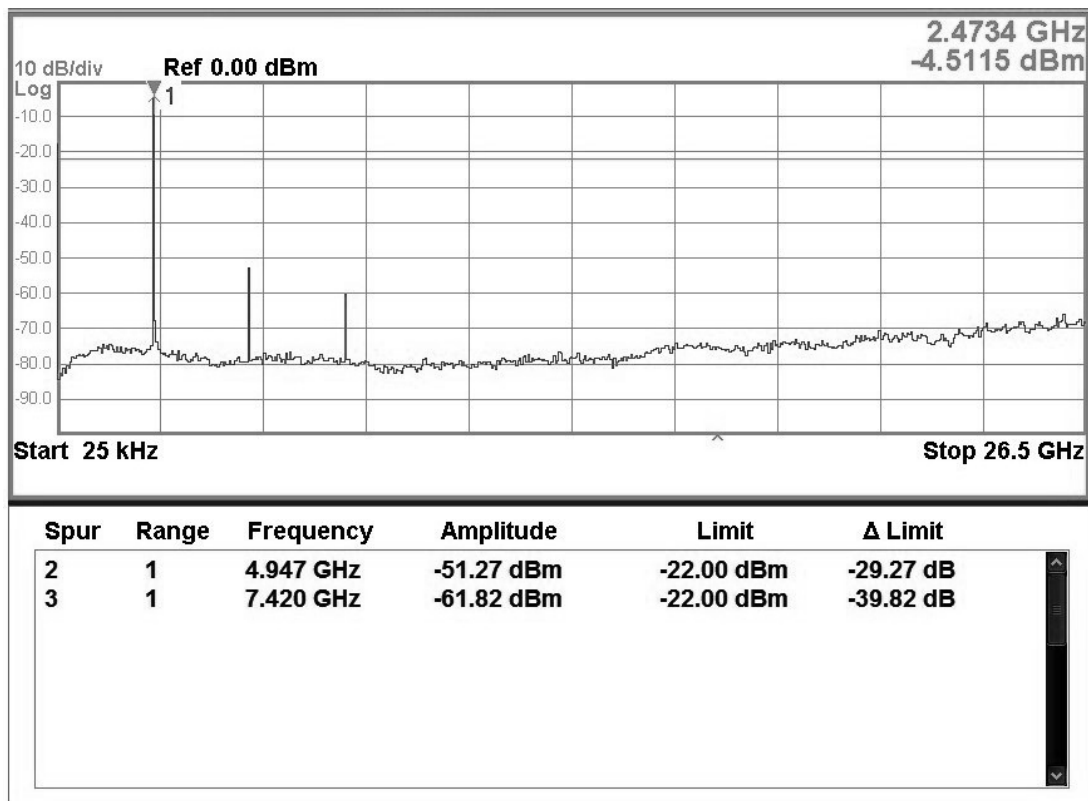
Screen Capture from the spectrum analyzer: Low Channel 2402 MHz



Screen Capture from the spectrum analyzer: Low Channel 2426 MHz



Screen Capture from the spectrum analyzer: Low Channel 2480 MHz



2.7 EUT Positioning Assessment

Test Lab: Electronics Test Centre, Airdrie	EUT: GoChip
Test Personnel: D. Raynes	Standard: FCC PART 15.247
Date: 2017-04-26 (21.1° C, 27.6% RH)	Basic Standard: ANSI C63.4-2014
EUT status: Z-axis selected	

Specification: ANSI C63.4-2014, Clause 6.3.2.1

Portable, small, lightweight, or modular devices that may be handheld, worn on the body, or placed on a table during operation shall be positioned on a nonconducting platform, the top of which is 80 cm above the reference ground plane. The preferred area occupied by the EUT arrangement is 1 m by 1.5 m, but it may be larger or smaller to accommodate various sized EUTs (see Figure 6, Figure 7, and Figure 9). For testing purposes, ceiling- and wall-mounted devices also shall be positioned on a tabletop (see also 6.3.4 and 6.3.5). In making any tests involving handheld, body-worn, or ceiling-mounted equipment, it is essential to recognize that the measured levels may be dependent on the orientation (attitude) of the three orthogonal axes of the EUT. Thus, exploratory tests as specified in 8.3.1 shall be carried out for various axes orientations to determine the attitude having maximum or near-maximum emission level.

2.7.1 Test Guidance: ANSI C63.4-2014, Clause 6.3.2.1

The EUT is set to a selected channel with test-specific software. The output is modulated as in normal operation.

Assessment measurements are performed with a DRG Horn antenna or a Standard Gain horn, and a resolution bandwidth of 1 MHz. The EUT is placed 80 cm above the ground plane, and the area between the EUT and the antenna mast is covered with RF absorbent material.

The EUT is rotated in azimuth over 360 degrees to find the direction of maximum emission. Antenna height is varied from 1 – 4 meters at this azimuth to obtain the maximum emission. Then the maximum level is measured with the Peak detector and recorded.

This process is repeated for all three orthogonal axes of the EUT, in both polarizations.

2.7.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

2.7.3 Uncertainty of Measurement:

The factors contributing to uncertainty of measurement are identified and calculated in accordance with UKAS (United Kingdom Accreditation Service) document “Lab 34, The Expression of Uncertainty in EMC Testing, Aug 2002.” as based on the “ISO Guide to the Expression of Uncertainty in Measurement, 1995.”

This uncertainty estimate represents an expanded uncertainty expressed at approximately 95% confidence using a coverage factor of $k = 2$.

Test Method	Frequency	Uncertainty
Radiated Emissions Level	1 GHz – 26.5 GHz	± 5.31 dB

2.7.4 Test Equipment

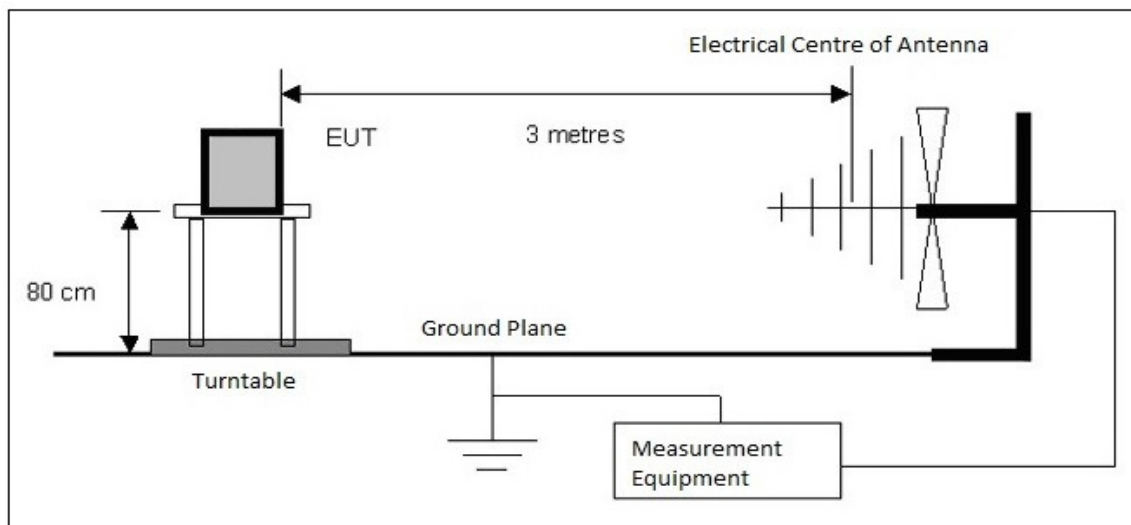
Testing was performed with the following equipment:

Equipment	Manufacturer	Model #	Asset #	Calibration Date	Calibration Due
Temperature/RH	Extech	42270	5892	2017-04-06	2018-04-06
EMC Software	UL	Ver. 9.5	ETC-SW-EMC 2.1	Monitored	
EMI receiver	Agilent	N9038A	6130	2016-06-23	2017-06-23
DRG Horn	EMCO	3115	19357	2016-08-24	2018-08-24
Low Noise Amplifier (1 – 18 GHz)	MITEQ	JS43-01001800- 21-5P	4354	Monitored	

2.7.5 Test Sample Verification, Configuration & Modifications

The EUT was set to a selected channel with test-specific software. The output was modulated as in normal operation. The EUT was not modified.

Test setup diagram for EUT Positioning Assessment:



2.7.6 Peak Radiated Emissions Data:

The emissions data are presented in tabular form, showing turntable azimuth, antenna height and polarization, and the uncorrected spectrum analyzer reading.

					
X		Y		Z	
EUT Position	Frequency [MHz]	SA Reading [dBuV]	Azimuth [deg]	Antenna Height [cm]	Polarization
X	2402	49.59	74	108	Horizontal
X	2402	51.80	169	127	Vertical
X	2426	46.99	224	124	Horizontal
X	2426	53.39	106	124	Vertical
X	2480	44.86	338	199	Horizontal
X	2480	53.93	175	141	Vertical
Y	2402	54.14	182	159	Horizontal
Y	2402	48.49	98	127	Vertical
Y	2426	55.94	172	139	Horizontal
Y	2426	46.74	99	165	Vertical
Y	2480	54.73	188	169	Horizontal
Y	2480	44.58	351	108	Vertical
Z	2402	56.12	338	125	Horizontal
Z	2402	45.01	251	126	Vertical
Z	2426	56.52	338	107	Horizontal
Z	2426	46.79	259	109	Vertical
Z	2480	55.56	26	105	Horizontal
Z	2480	45.22	255	108	Vertical

2.8 Transmitter Radiated Spurious Emissions

Test Lab: Electronics Test Centre, Airdrie	EUT: GoChip
Test Personnel: D. Raynes	Standard: FCC PART 15.247
Date: 2017-04-26 (21.1° C, 27.6% RH) 2017-04-27 (20.0° C, 28.1% RH)	Basic Standard: ANSI C63.10: 2013
EUT status: Compliant	

Specification: FCC PART 15.247(d)

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)).

Restricted Bands of Operation:

MHz	MHz	MHz	MHz	MHz	GHz	GHz
0.0900000 – 0.1100000	8.2910000 - 8.2940000	16.804250 - 16.804750	162.01250 - 167.17000 	1660.0000 – 1710.0000	3.6000000 – 4.4000000	14.470000 – 14.500000
0.4950000 - 0.5050000 	8.3620000 - 8.3660000	25.500000 - 25.670000	167.72000 - 173.20000 	1718.8000 – 1722.2000	4.5000000 – 5.1500000	15.350000 – 16.200000
2.1735000 - 2.1905000	8.3762500 - 8.3867500	37.500000 - 38.250000	240.00000 – 285.00000	2200.0000 – 2300.0000	5.3500000 – 5.4600000	17.700000 – 21.400000
4.1250000 - 4.1280000	8.4142500 - 8.4147500	73.000000 - 74.600000	322.00000 - 335.40000	2310.0000 – 2390.0000	7.2500000 – 7.7500000	22.010000 – 23.120000
4.1772500 - 4.1777500	12.290000 - 12.293000	74.800000 - 75.200000	399.90000 – 410.00000	2483.5000 – 2500.0000 	8.0250000 – 8.5000000	23.600000 – 24.000000
4.2072500 - 4.2077500	12.519750 - 12.520250	108.00000 - 121.94000 	608.00000 – 614.00000	2655.0000 – 2900.0000	9.0000000 – 9.2000000	31.200000 – 31.800000
5.6770000 - 5.6830000	12.576750 - 12.577250	123.00000 - 138.00000 	960.00000 – 1240.0000 	3260.0000 – 3267.0000	9.3000000 – 9.5000000	36.430000 – 36.500000
6.2150000 - 6.2180000	13.360000 - 13.410000	149.90000 - 150.05000 	1300.0000 – 1427.0000 	3332.0000 – 3339.0000	10.600000 – 12.700000	Above 38.600000
6.2677500 - 6.2682500	16.420000 - 16.423000	156.52475 - 156.52525	1435.0000 – 1626.5000	3345.8000 – 3358.0000	13.250000 – 13.400000	
6.3117500 - 6.3122500	16.694750 - 16.695250	156.70000 - 156.90000	1645.5000 – 1646.5000	3500.0000 – 3600.0000 		

 US only

 Canada 108 – 138 MHz

 Canada 960 – 1427 MHz

 Canada only

2.8.1 Test Guidance: ANSI C63.10-2013, Clause 11.11 & 11.12

From 9kHz to 150 kHz (resolution bandwidth of 200 Hz) and from 150 kHz to 30 MHz (resolution bandwidth 9 kHz) measurements are performed with a loop antenna (as per KDB 460108).

From 30 MHz to 1000 MHz, measurements are performed with a broadband biconilog antenna and a resolution bandwidth of 120 kHz.

Above 1000 MHz, measurements are performed with a DRG Horn antenna or a Standard Gain horn, and a resolution bandwidth of 1 MHz. The EUT is raised to 150 cm above the ground plane, and the area between the EUT and the antenna mast is covered with RF absorbent material.

The scan is performed at discreet increments of turntable azimuth and antenna height, which are selected in accordance with the applicable standard in order to assure capture of frequencies of interest. Optimization is performed based on the scan data.

Frequencies having peak emissions within 10dB of the limits are optimized. The EUT is rotated in azimuth over 360 degrees and the direction of maximum emission is noted.

Antenna height is varied from 1 – 4 meters at this azimuth to obtain the maximum emission. Then the maximum level is measured with the appropriate detector and recorded. Up to 1 GHz, measurements are performed with a Quasi-Peak detector. Above 1 GHz, measurements are recorded with Peak and/or Average detectors, as applicable.

Note: The EUT was assessed for worst-case orientation. All radiated testing was performed with this orientation, as shown in the test setup photos.

2.8.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

2.8.3 Uncertainty of Measurement:

The factors contributing to uncertainty of measurement are identified and calculated in accordance with UKAS (United Kingdom Accreditation Service) document “Lab 34, The Expression of Uncertainty in EMC Testing, Aug 2002.” as based on the “ISO Guide to the Expression of Uncertainty in Measurement, 1995.”

This uncertainty estimate represents an expended uncertainty expressed at approximately 95% confidence using a coverage factor of $k = 2$.

Test Method	Frequency	Uncertainty
Radiated Emissions Level	30 MHz – 1 GHz	±4.6 dB
Radiated Emissions Level	1 GHz – 26.5 GHz	±5.31 dB

2.8.4 Test Equipment

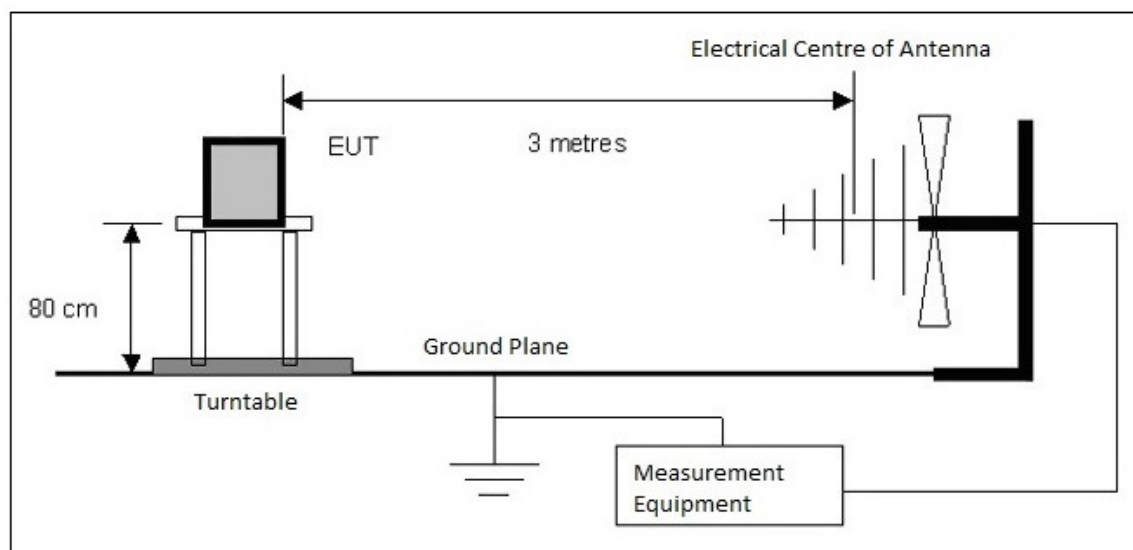
Testing was performed with the following equipment:

Equipment	Manufacturer	Model #	Asset #	Calibration Date	Calibration Due
Temperature/RH	Extech	42270	5892	2017-04-06	2018-04-06
EMC Software	UL	Ver. 9.5	ETC-SW-EMC 2.1	Monitored	
EMI receiver	Agilent	N9038A	6130	2016-06-23	2017-06-23
Loop Antenna	EMCO	6502	10868	2017-03-29	2019-03-29
Biconilog Antenna	ARA	LPB-2520/A	4318	2016-05-18	2018-05-18
DRG Horn	EMCO	3115	19357	2016-08-24	2018-08-24
Standard Gain Horn 18 – 26.5 GHz	QuinStar	QWH-KPRS-00	6163	2016-08-22	2018-08-22
Low Noise Amplifier (1 – 18 GHz)	MITEQ	JS43-01001800- 21-5P	4354	Monitored	
Low Noise Amplifier (18 – 26.5GHz)	MITEQ			Monitored	

2.8.5 Test Sample Verification, Configuration & Modifications

The EUT was set to Low, Mid and High channels with test-specific software. The output was modulated as in normal operation. The EUT met the requirements without modification.

Test setup diagram for Radiated Spurious Emissions testing:



2.8.6 Radiated Emissions Data:

The emissions data are presented in tabular form, showing turntable azimuth, antenna height and polarization, the uncorrected spectrum analyzer reading, the correction factors applied, the net result, the value of the limit at the frequency investigated, and the Delta between the result and the limit.

Raw Reading (dB μ V) + Antenna Factor (dB/m) + Cable Loss (dB) = Corrected Field Strength (dB μ V/m)

Delta = Field Strength - Limit

Notes:

- When a preamp is used, the resulting gain is compensated, producing a negative value for the Cable Loss.
- Measurements reported are the result of adjusting the turntable azimuth and antenna height to obtain the maximum EUT emission. This may produce a different reading than the plot trace. The plot is a Peak Hold function obtained at discreet increments of height and azimuth, while the reported measurement is obtained with the appropriate Peak, Quasi Peak or Average detector after the height and azimuth have been adjusted for maximum emission.
- In Transmit mode, the EUT was assessed up to 26.5 GHz. To prevent LNA saturation, a band-reject filter was used to block frequencies between 2.4 GHz and 2.5 GHz. Above 12 GHz, in Transmit mode, preliminary scanning of the EUT was performed at a distance of 50 cm with the RBW set at 300 kHz. There were no emissions.
- Pursuant to Part 15.31(o), emissions that are more than 20 dB below the applicable limit are not reported.

Negative values for Delta indicate compliance.

Transmit Mode, Low Channel 2402 MHz:

Freq. Marker	Freq. (GHz)	Raw reading (dBµv)	Det	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Field Strength (dBµv/m)	FCC 15.209 Limit (dBµv/m)	Delta (dB)	Azimuth (Deg)	Height (cm)	Polarization
1	4.8046*	40.03	Av	32.8	-31.6	41.23	53.98	-12.75	68	225	Horizontal
1	4.8045*	48.19	PK	32.8	-31.6	49.39	73.98	-24.59	60	217	Horizontal

*** Restricted Band**

PK - Peak detector

Av – Linear average detection

Transmit Mode, Mid Channel 2426 MHz:

Freq. Marker	Freq. (GHz)	Raw reading (dBµv)	Det	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Field Strength (dBµv/m)	FCC 15.209 Limit (dBµv/m)	Delta (dB)	Azimuth (Deg)	Height (cm)	Polarization
1	4.8525*	41.93	Av	32.9	-31.5	43.33	53.98	-10.65	101	118	Horizontal
1	4.8515*	46.52	PK	32.9	-31.5	47.92	73.98	-26.06	103	171	Horizontal

*** Restricted Band**

PK - Peak detector

Av – Linear average detection

Transmit Mode, High Channel 2480 MHz:

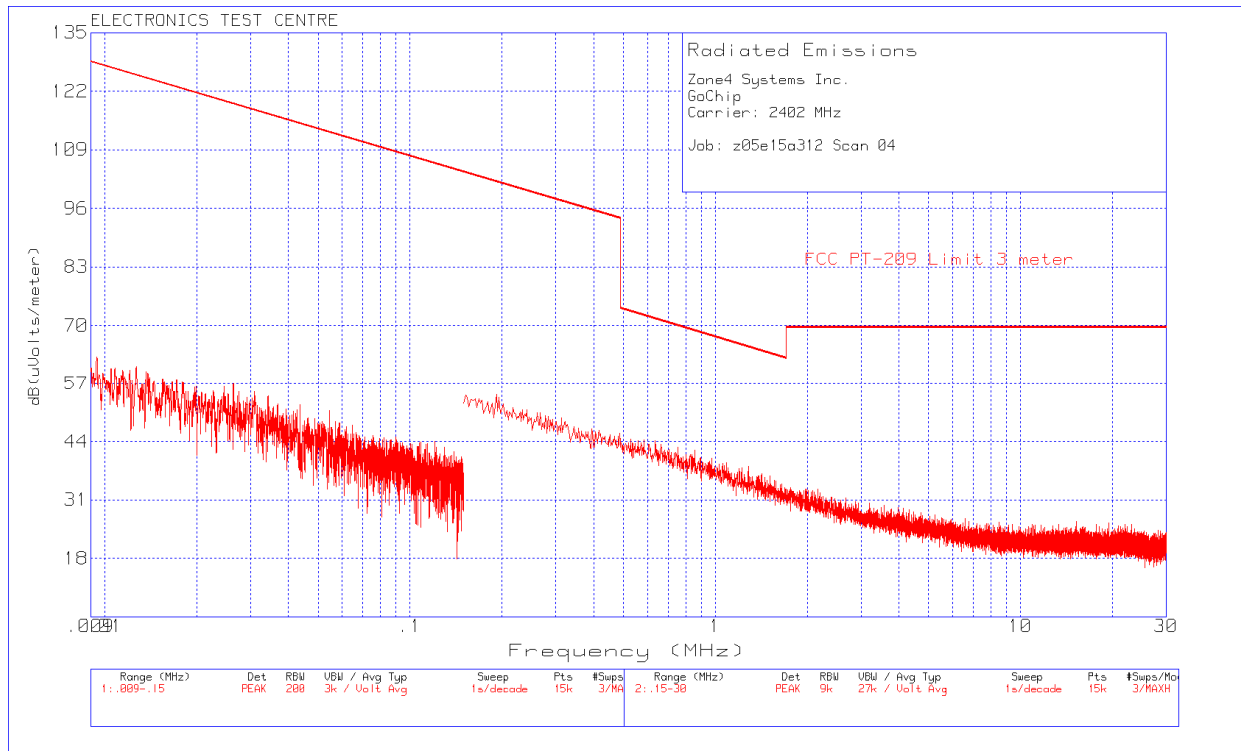
Freq. Marker	Freq. (GHz)	Raw reading (dBµv)	Det	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Field Strength (dBµv/m)	FCC 15.209 Limit (dBµv/m)	Delta (dB)	Azimuth (Deg)	Height (cm)	Polarization
1	4.9596*	39.92	Av	33.2	-31.5	41.62	53.98	-12.36	177	127	Horizontal
1	4.9595*	45.38	PK	33.2	-31.5	47.08	73.98	-26.90	196	134	Horizontal

*** Restricted Band**

PK - Peak detector

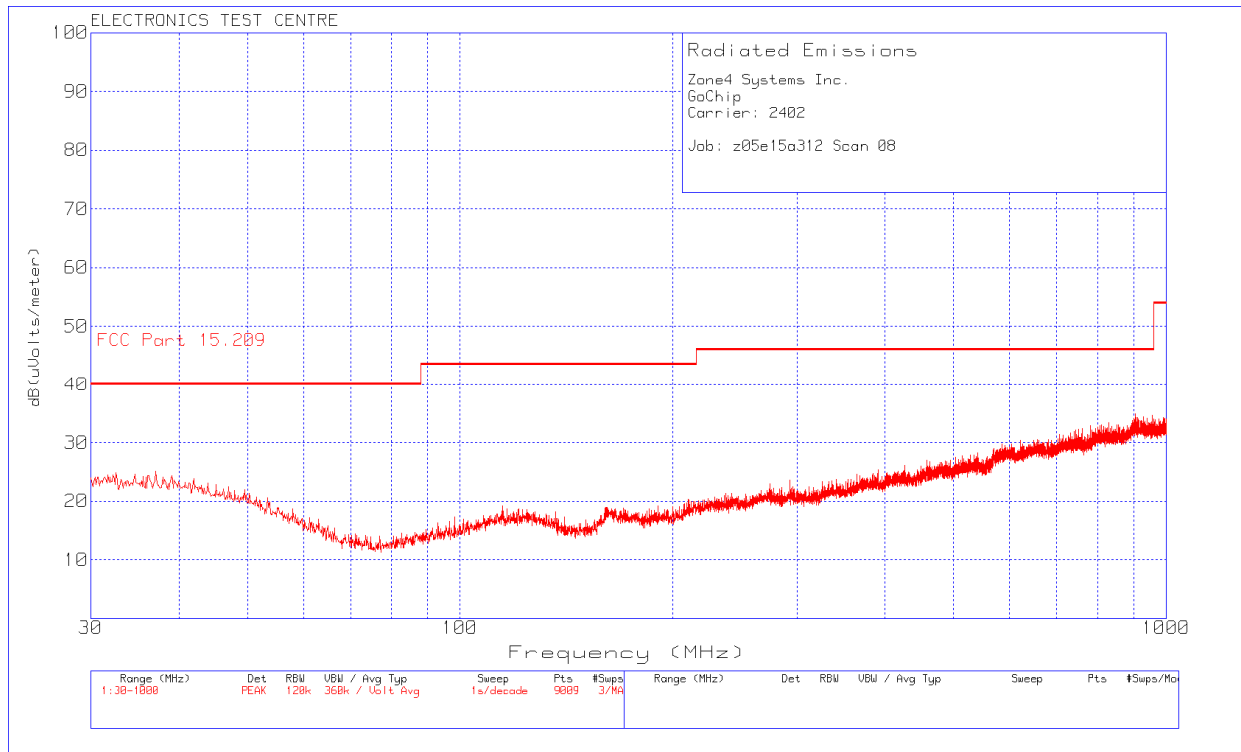
Av – Linear average detection

Plot of Radiated Emissions: Low Channel 2402 MHz

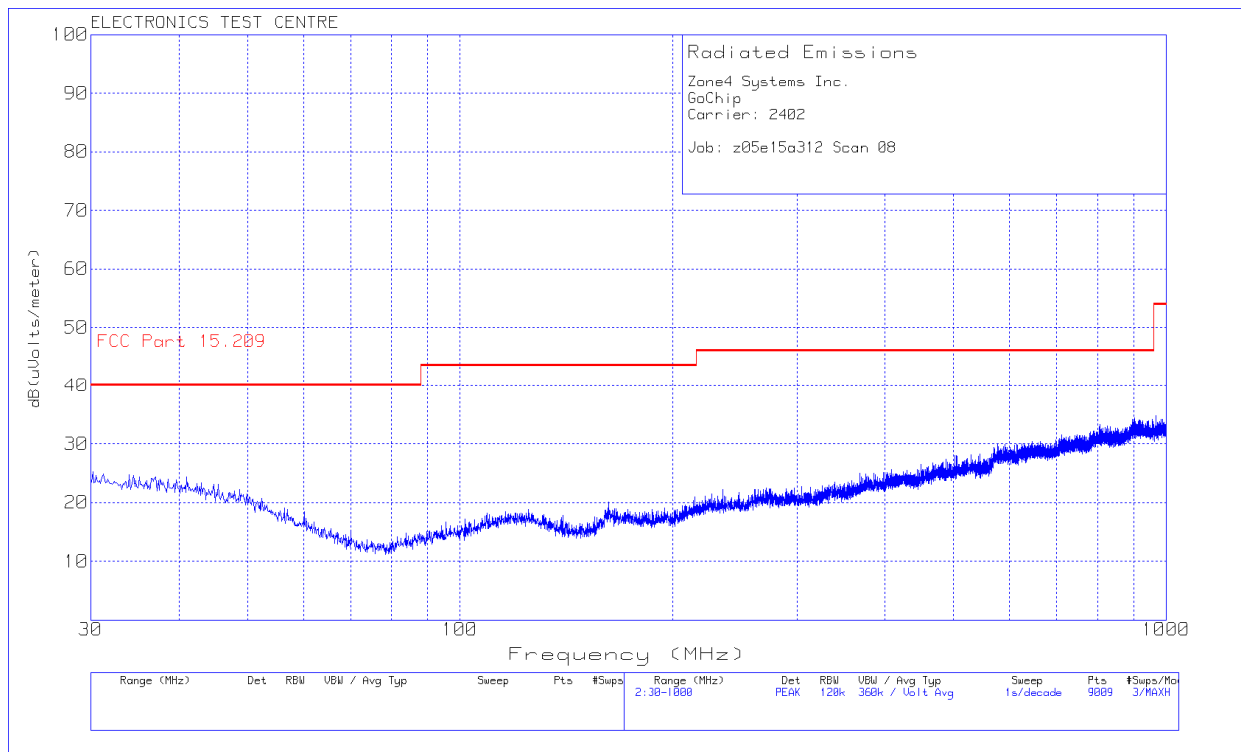


Low Channel 2402 MHz

Plot of Radiated Emissions: Horizontal polarization

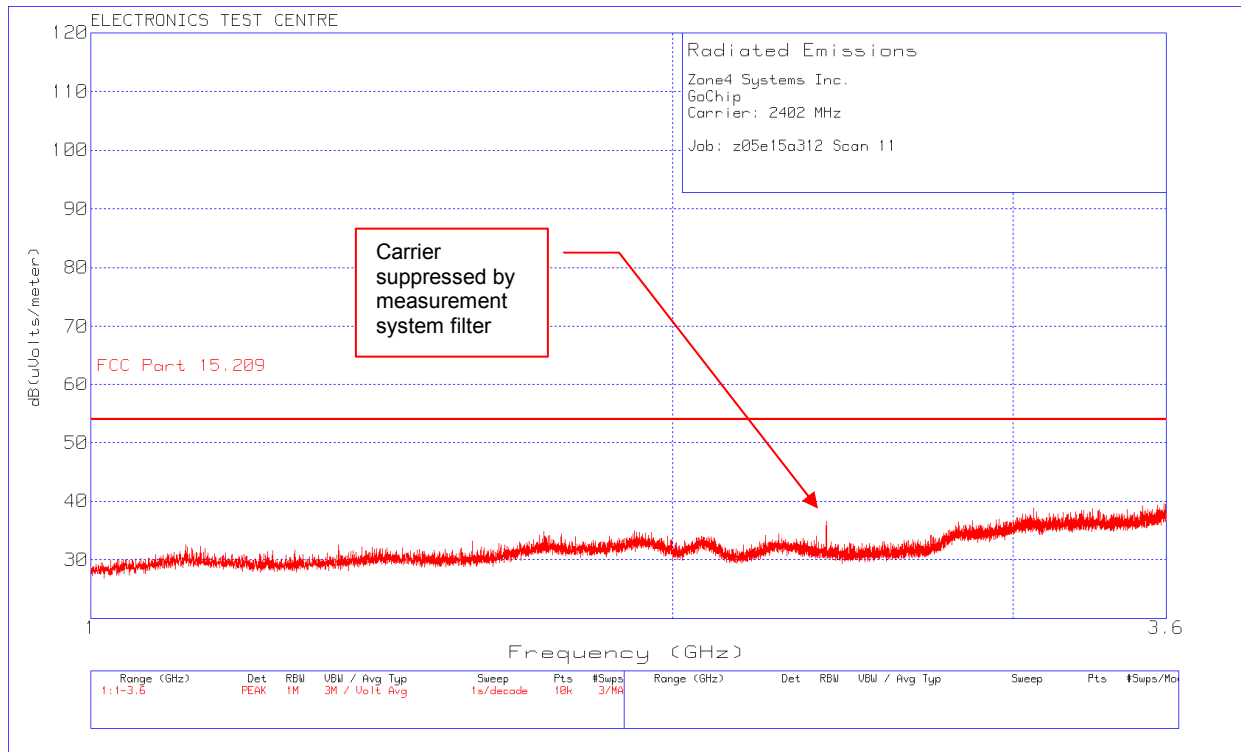


Plot of Radiated Emissions: Vertical polarization

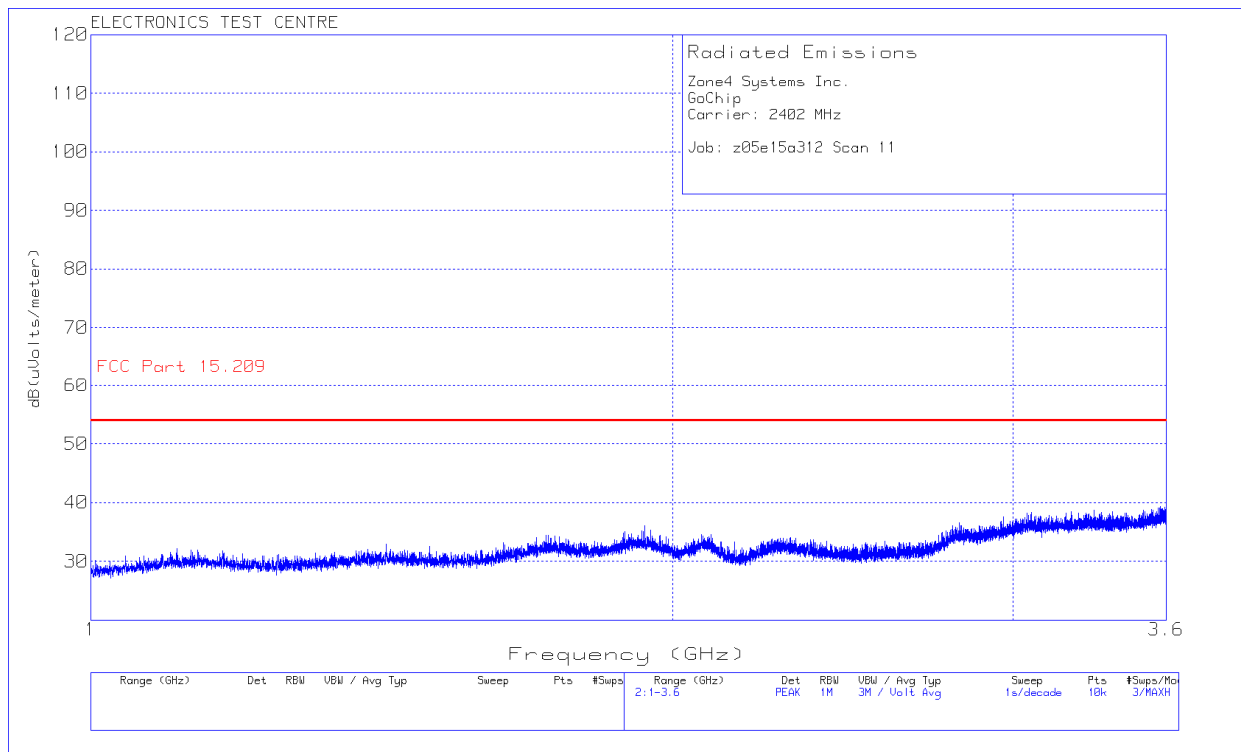


Low Channel 2402 MHz

Plot of Radiated Emissions: Horizontal polarization

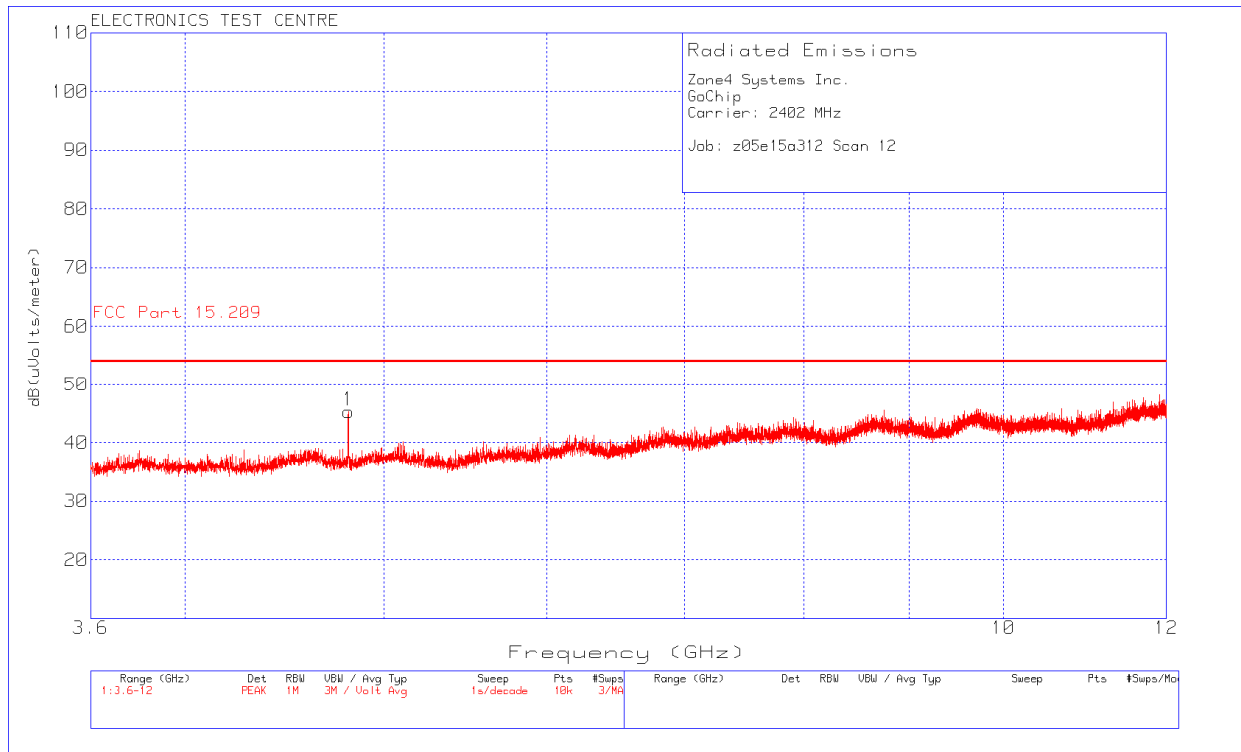


Plot of Radiated Emissions: Vertical polarization

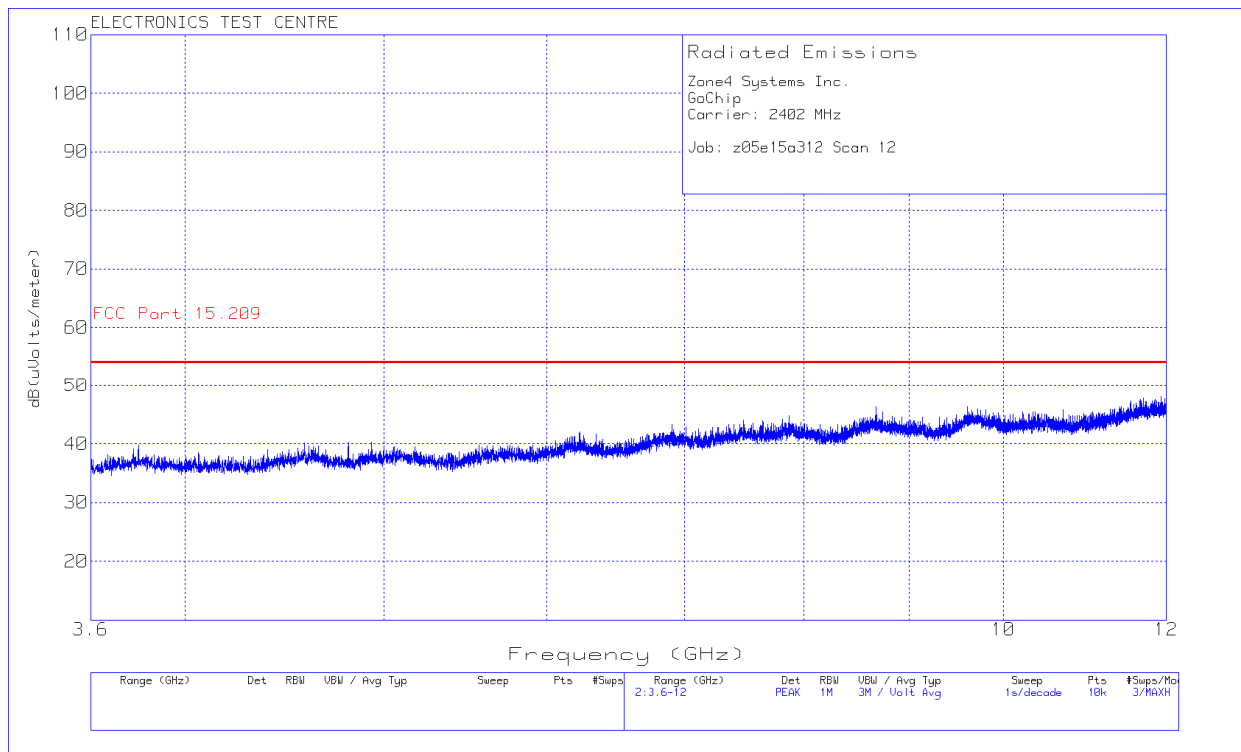


Low Channel 2402 MHz

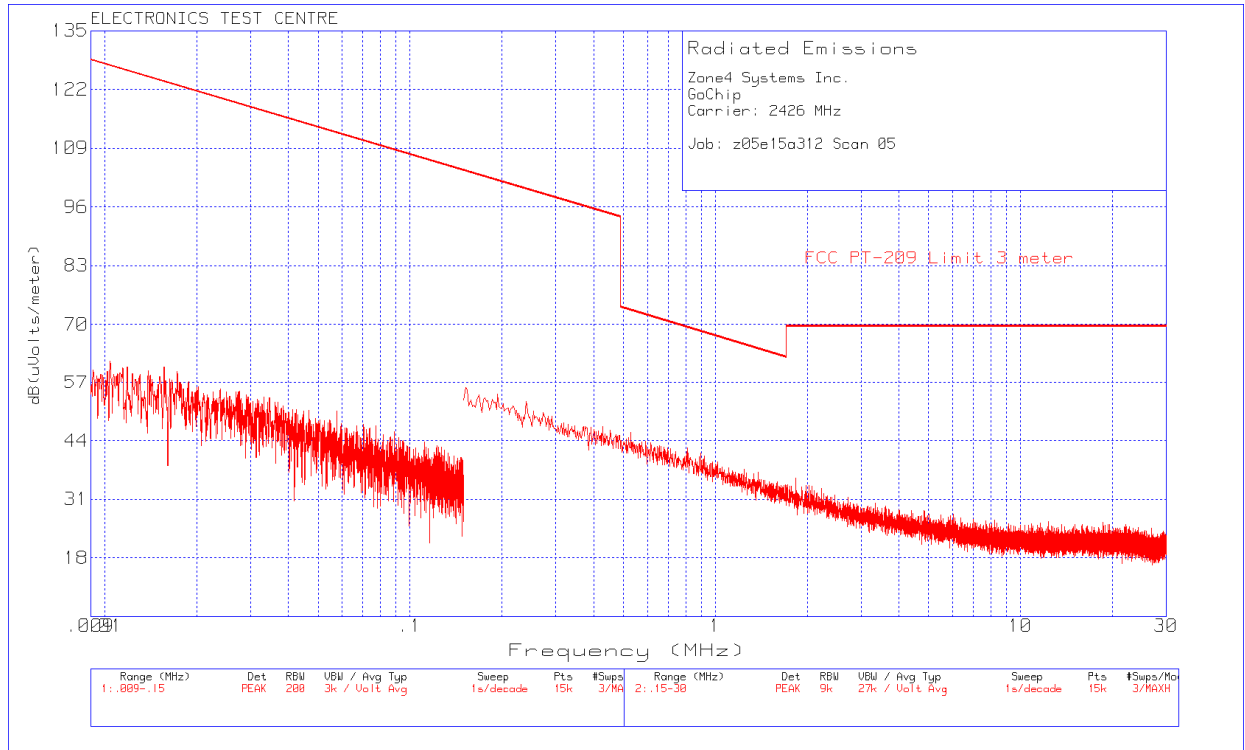
Plot of Radiated Emissions: Horizontal polarization



Plot of Radiated Emissions: Vertical polarization

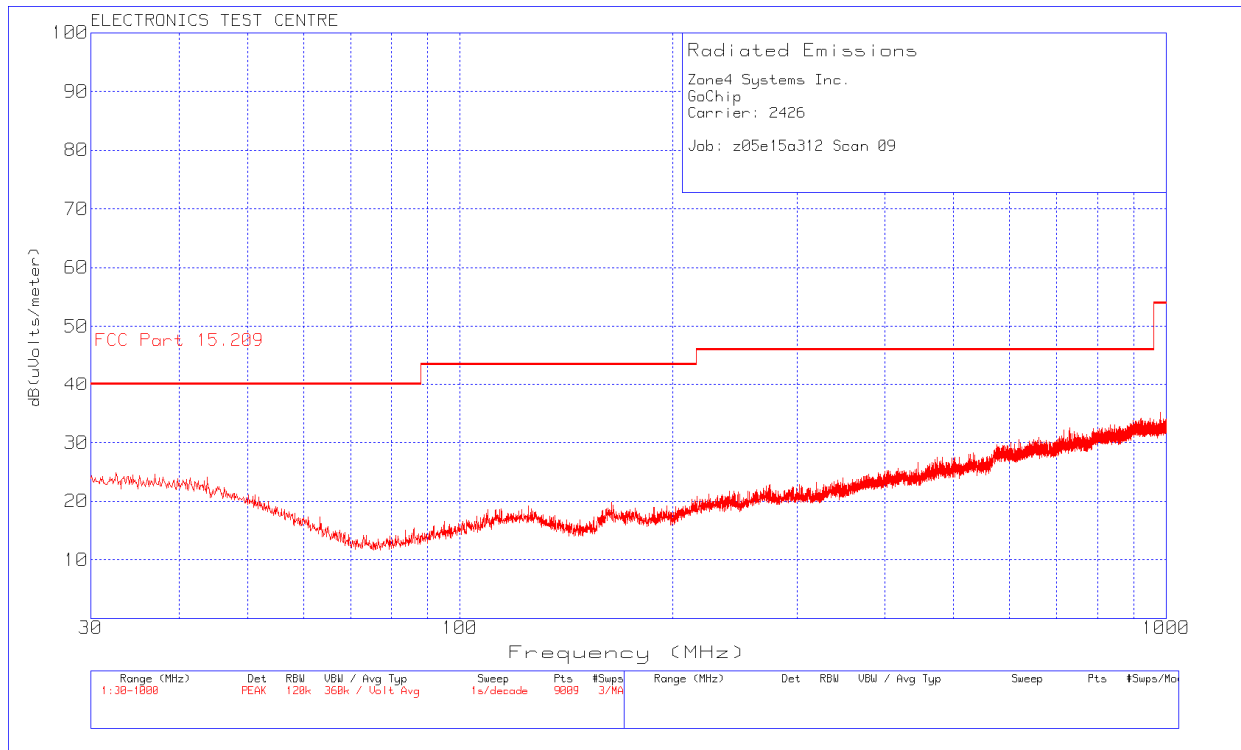


Plot of Radiated Emissions: Mid Channel 2426 MHz

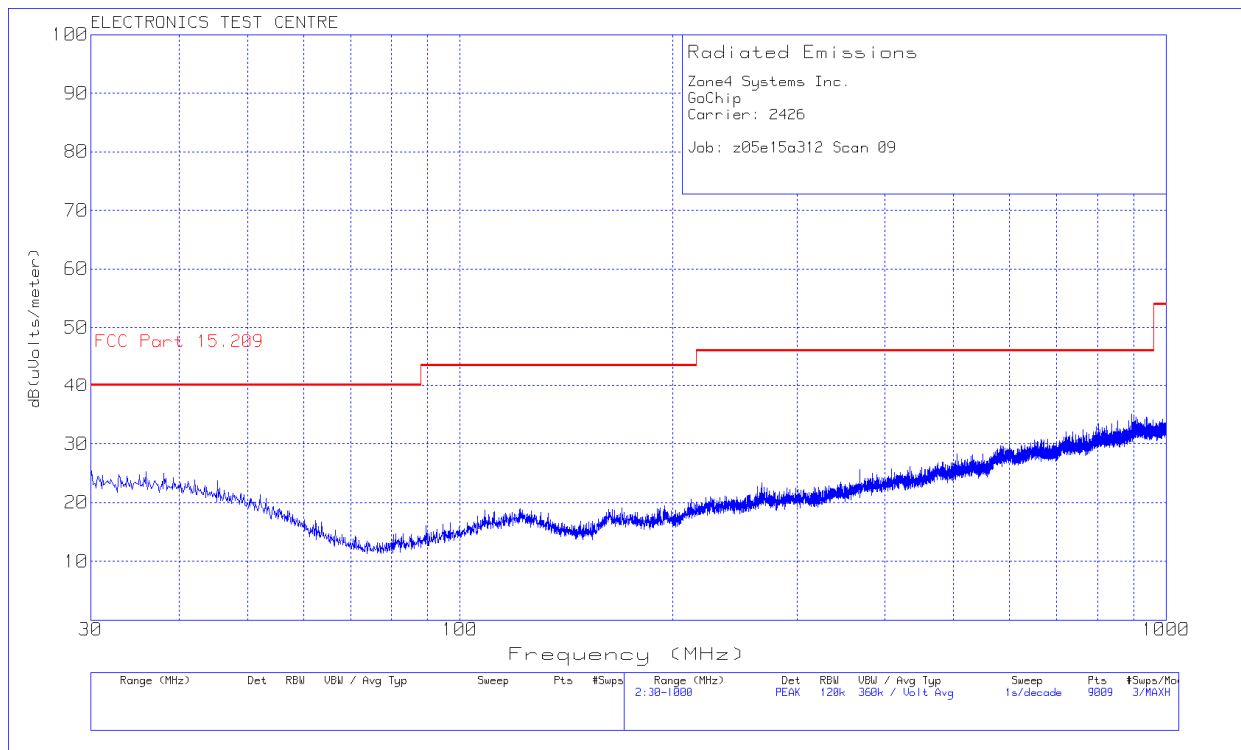


Mid Channel 2426 MHz

Plot of Radiated Emissions: Horizontal polarization

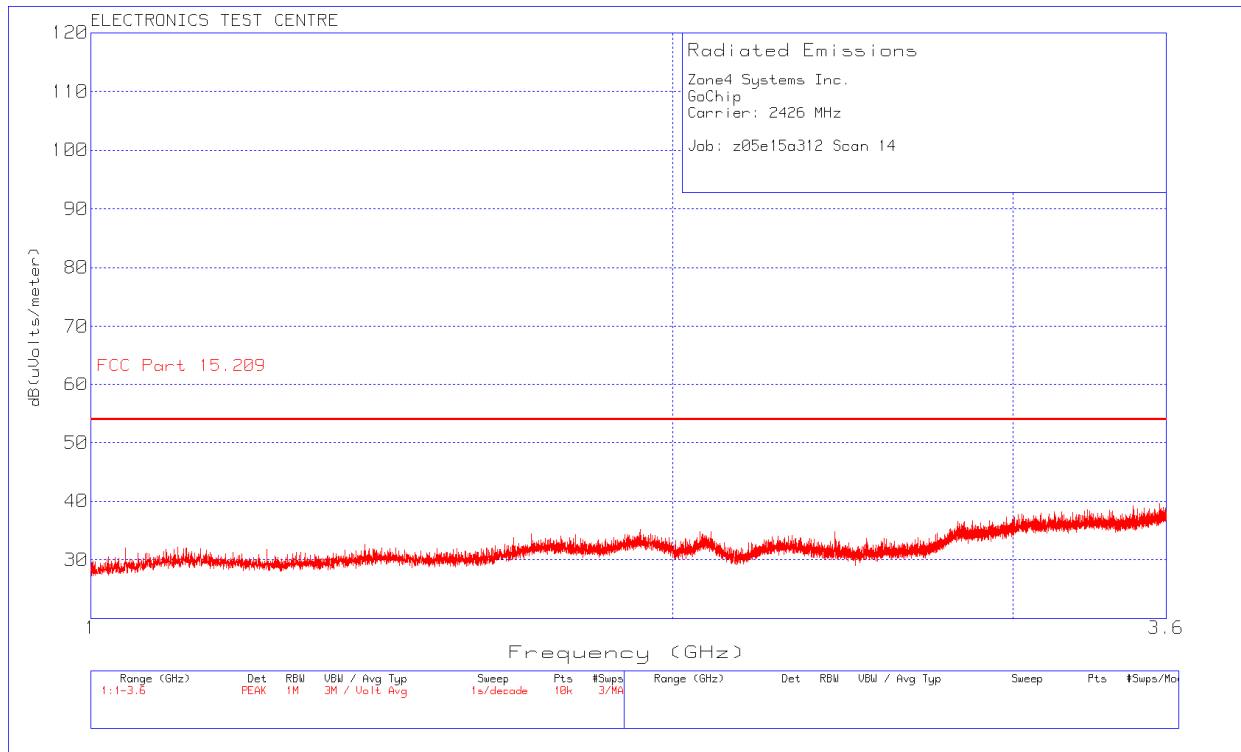


Plot of Radiated Emissions: Vertical polarization

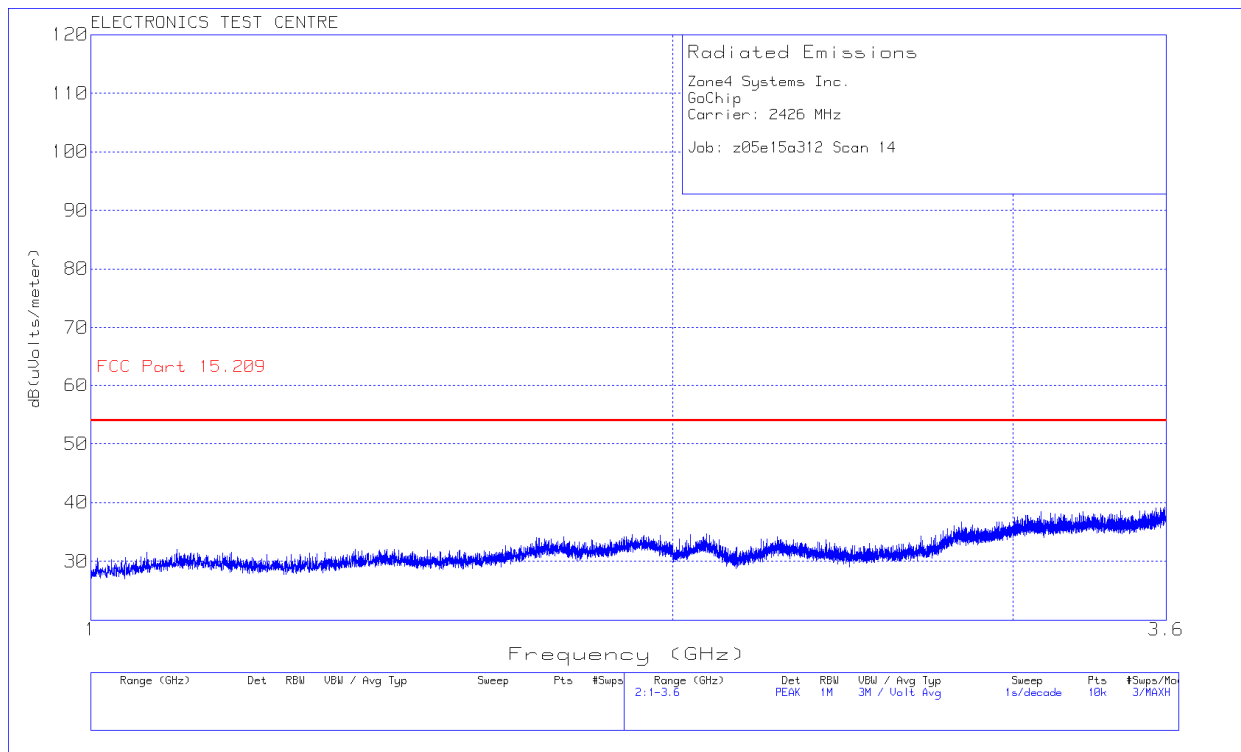


Mid Channel 2426 MHz

Plot of Radiated Emissions: Horizontal polarization

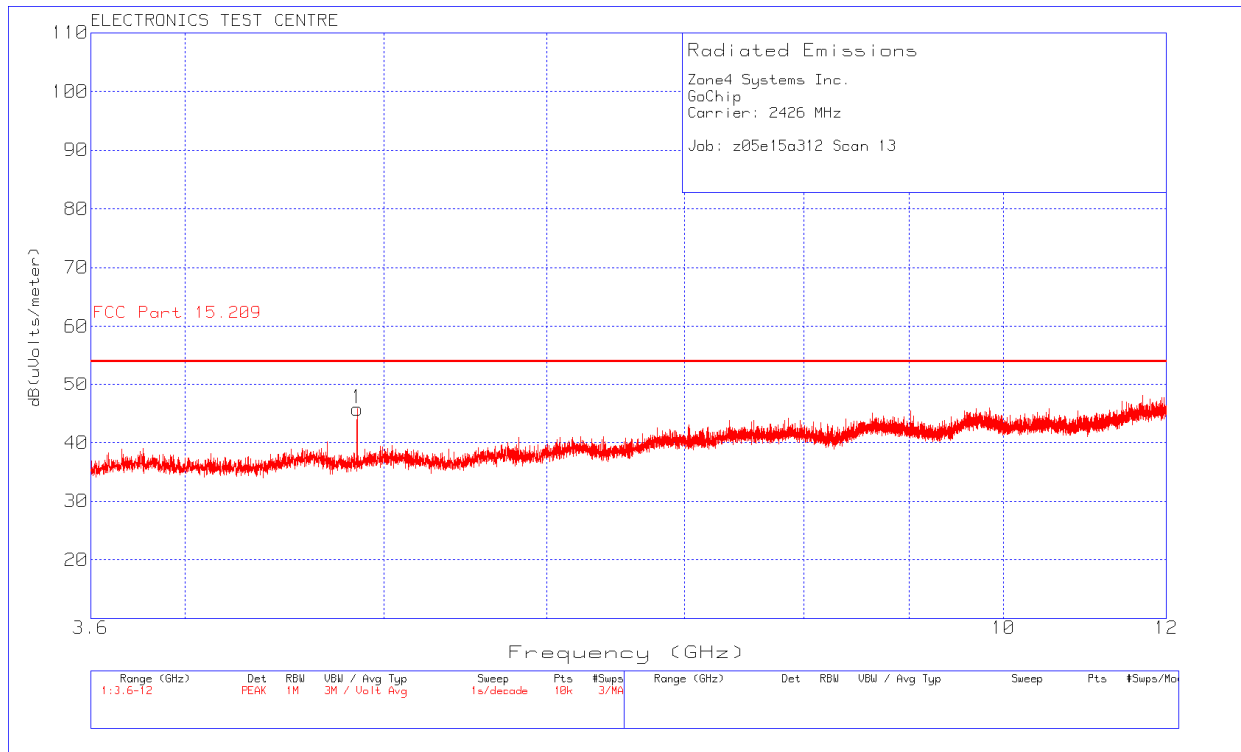


Plot of Radiated Emissions: Vertical polarization

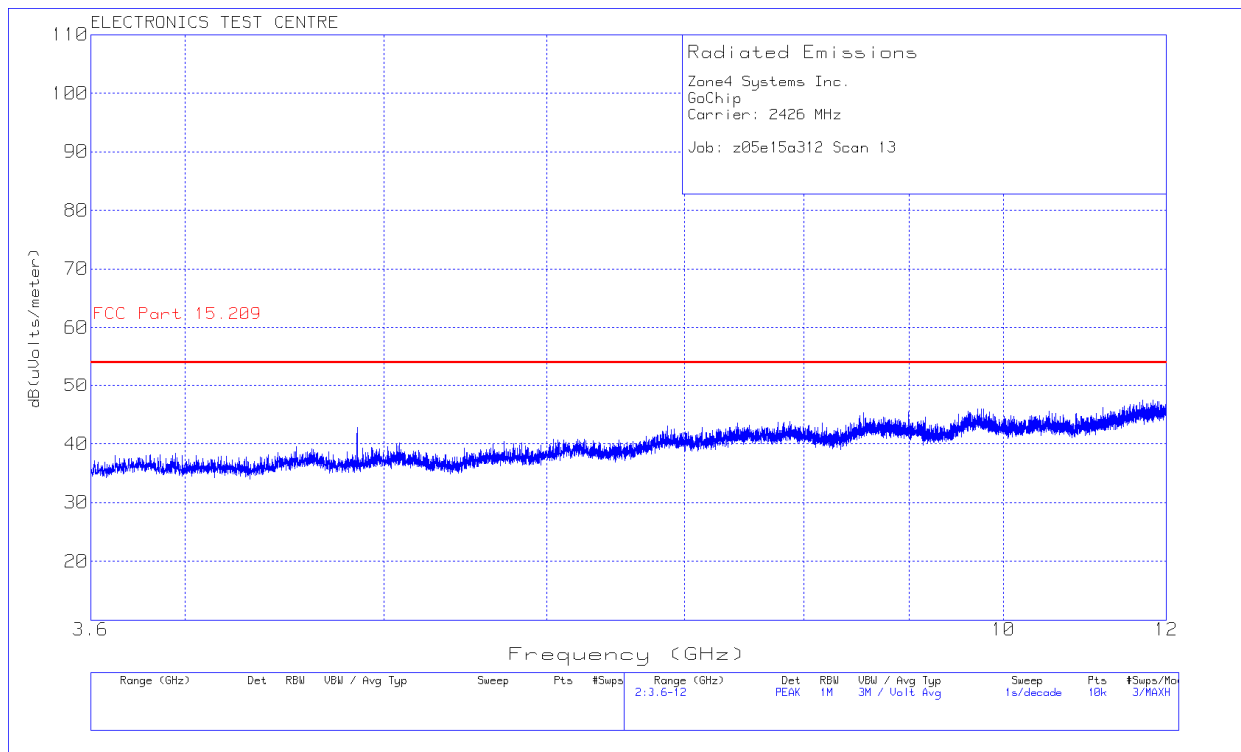


Mid Channel 2426 MHz

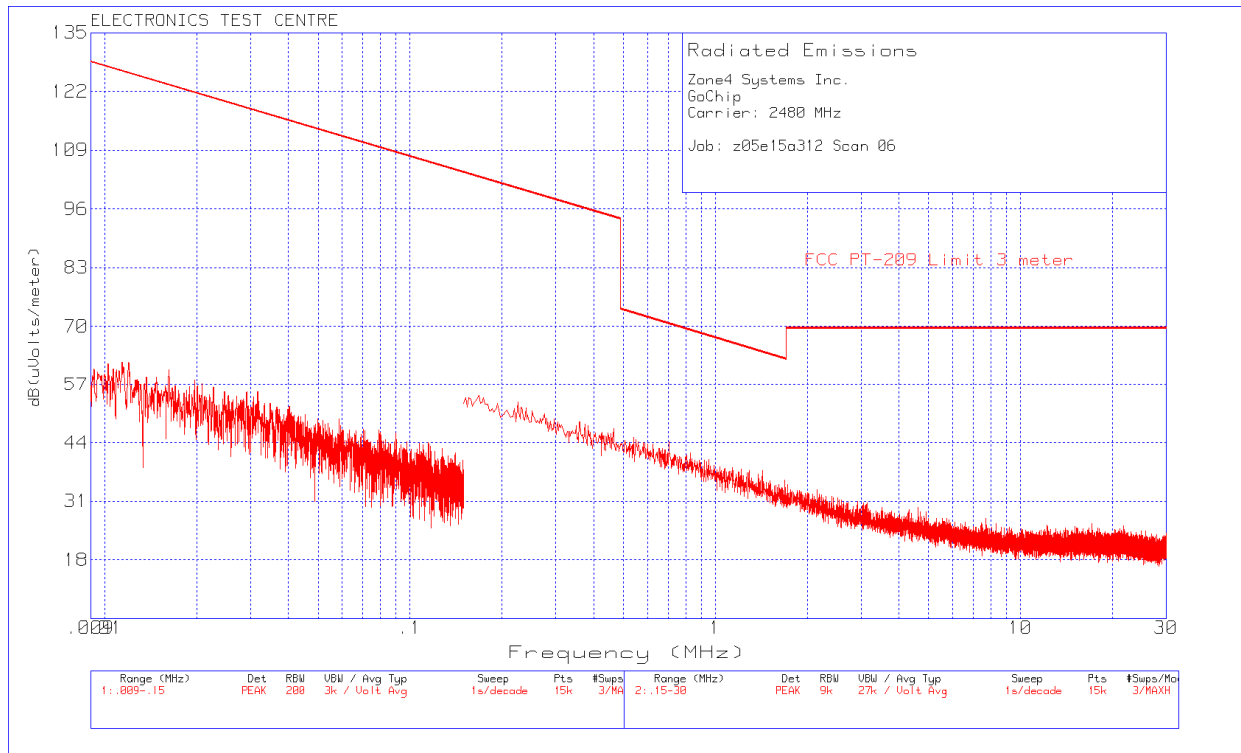
Plot of Radiated Emissions: Horizontal polarization



Plot of Radiated Emissions: Vertical polarization

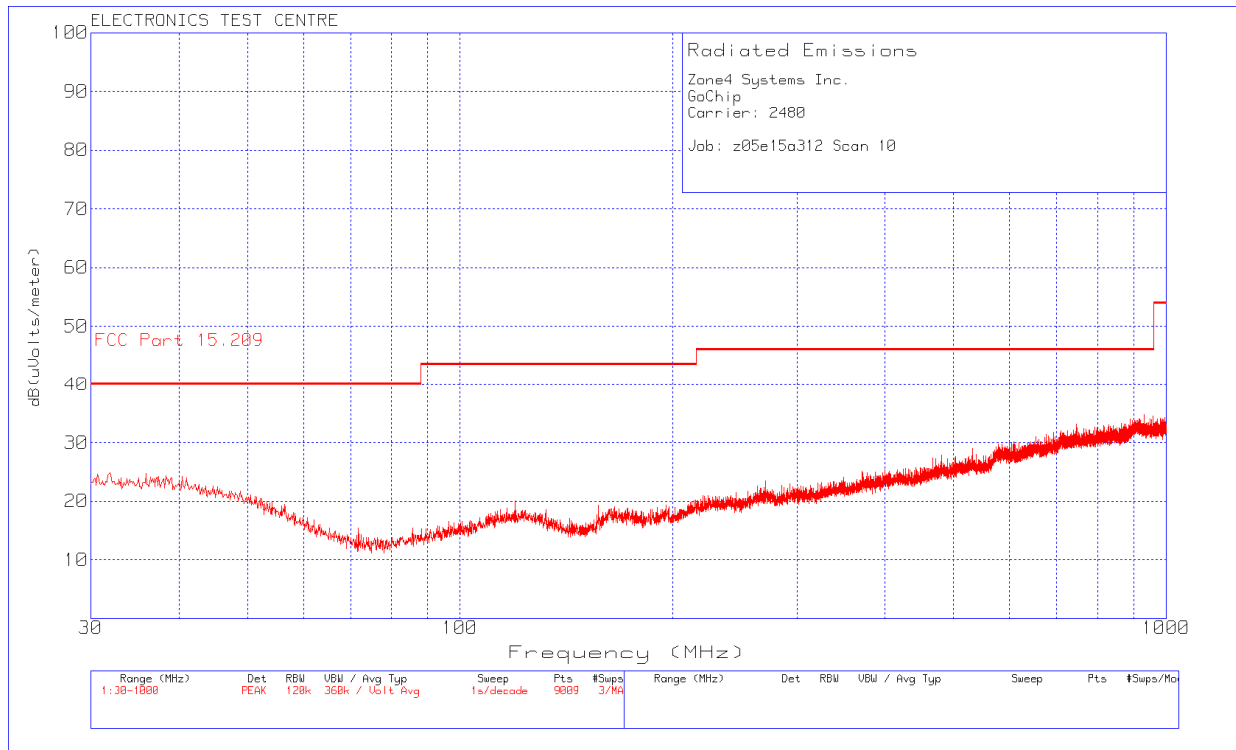


Plot of Radiated Emissions: High Channel 2480 MHz

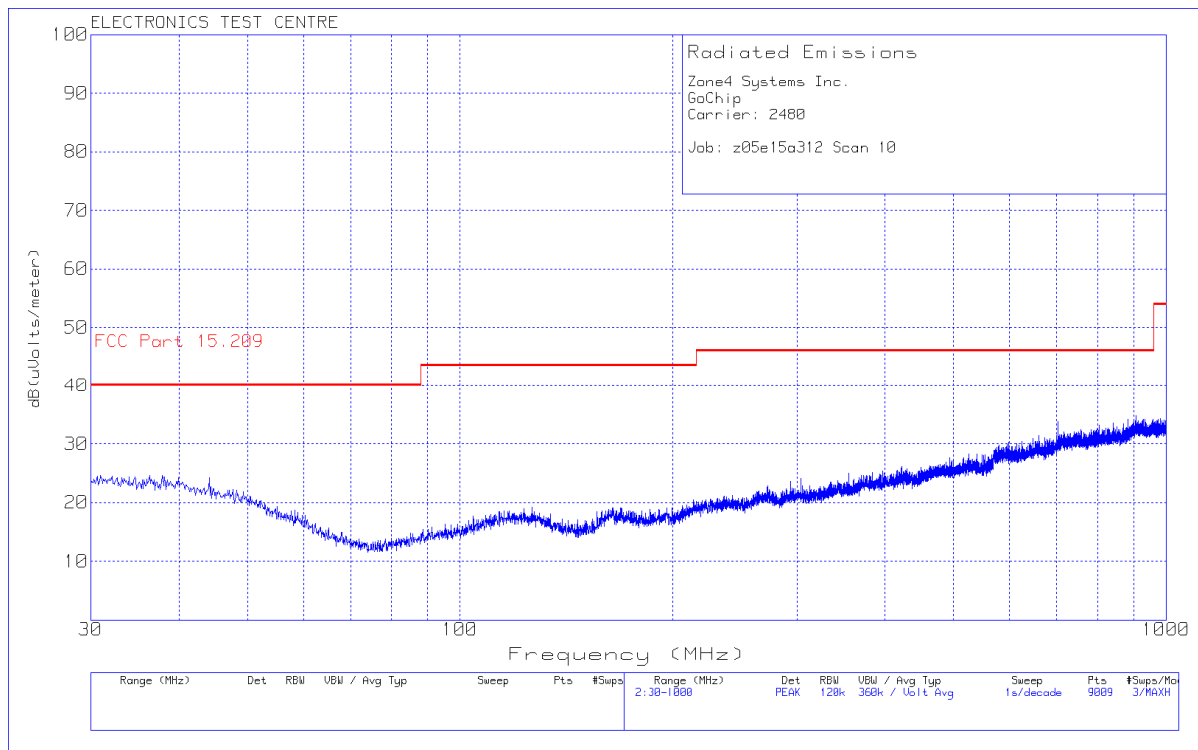


High Channel 2480 MHz

Plot of Radiated Emissions: Horizontal polarization

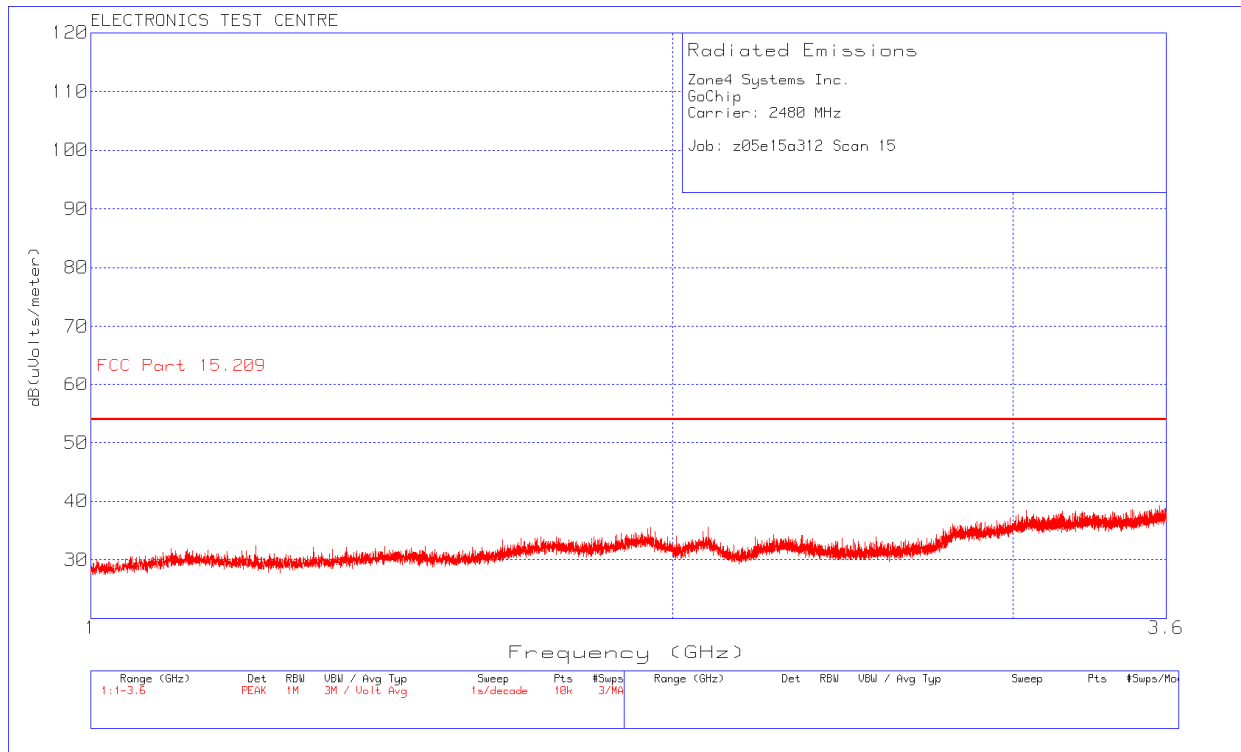


Plot of Radiated Emissions: Vertical polarization

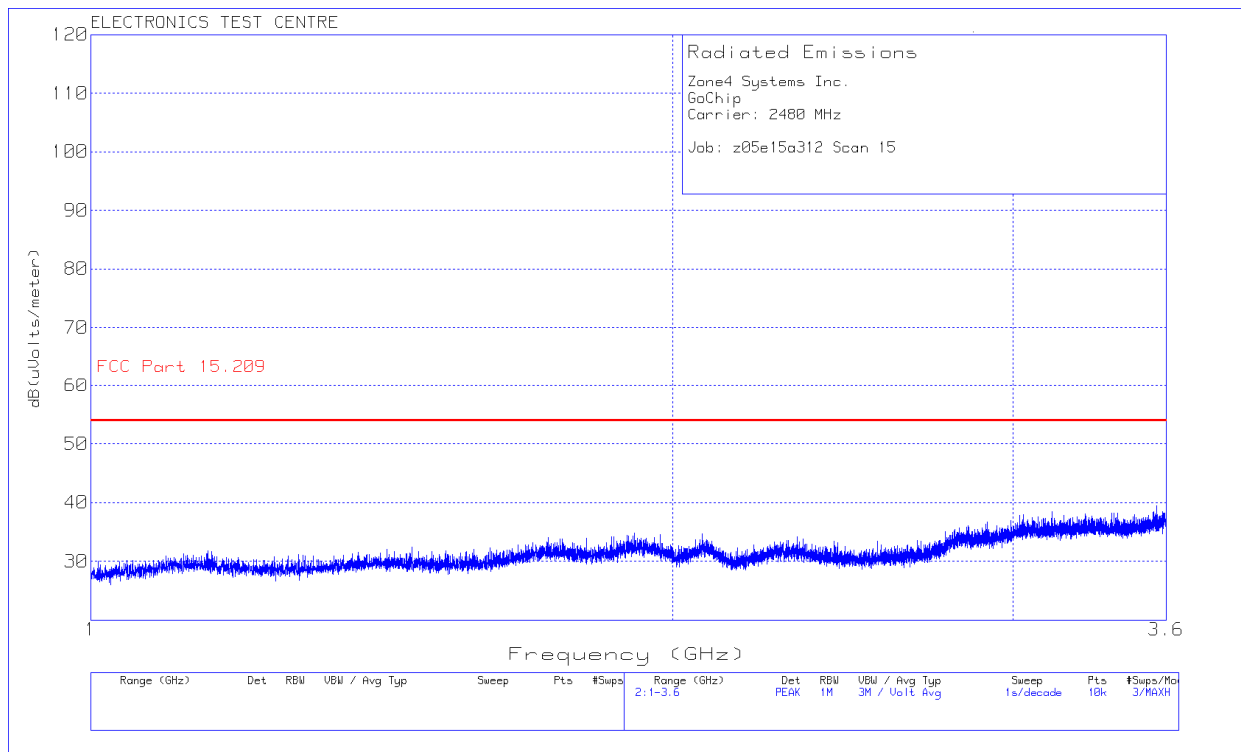


High Channel 2480 MHz

Plot of Radiated Emissions: Horizontal polarization

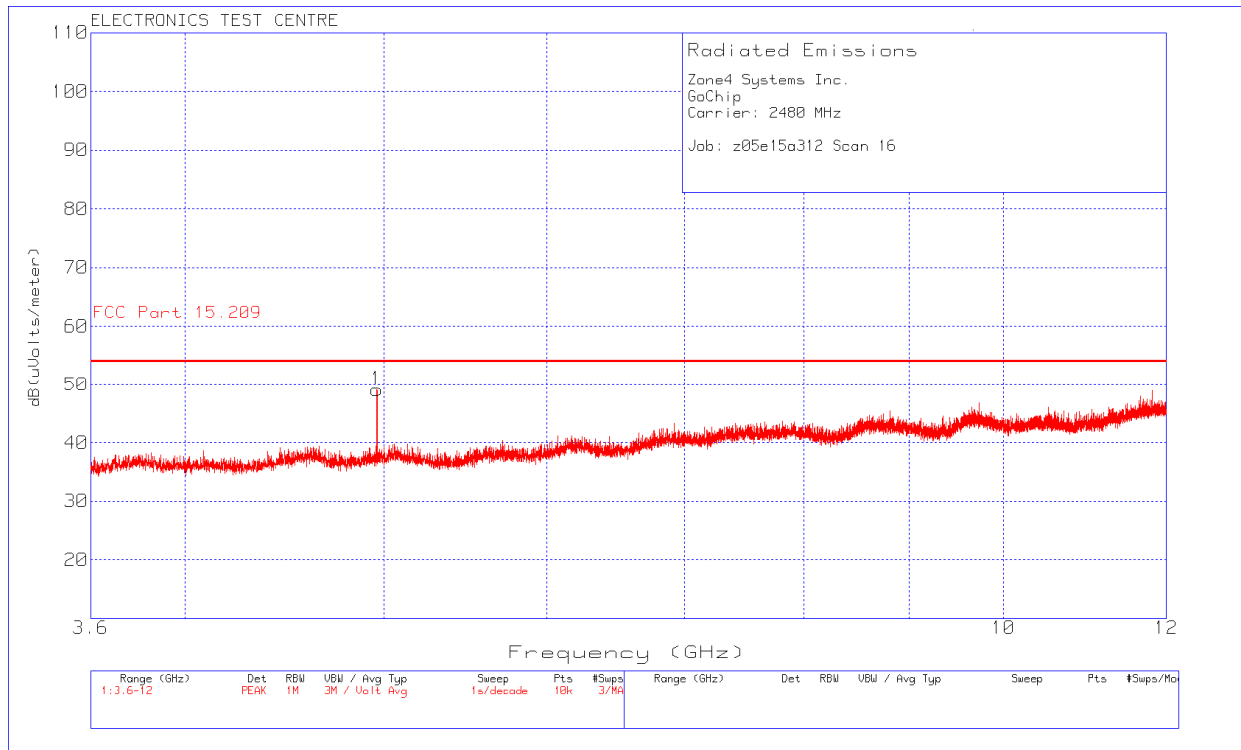


Plot of Radiated Emissions: Vertical polarization

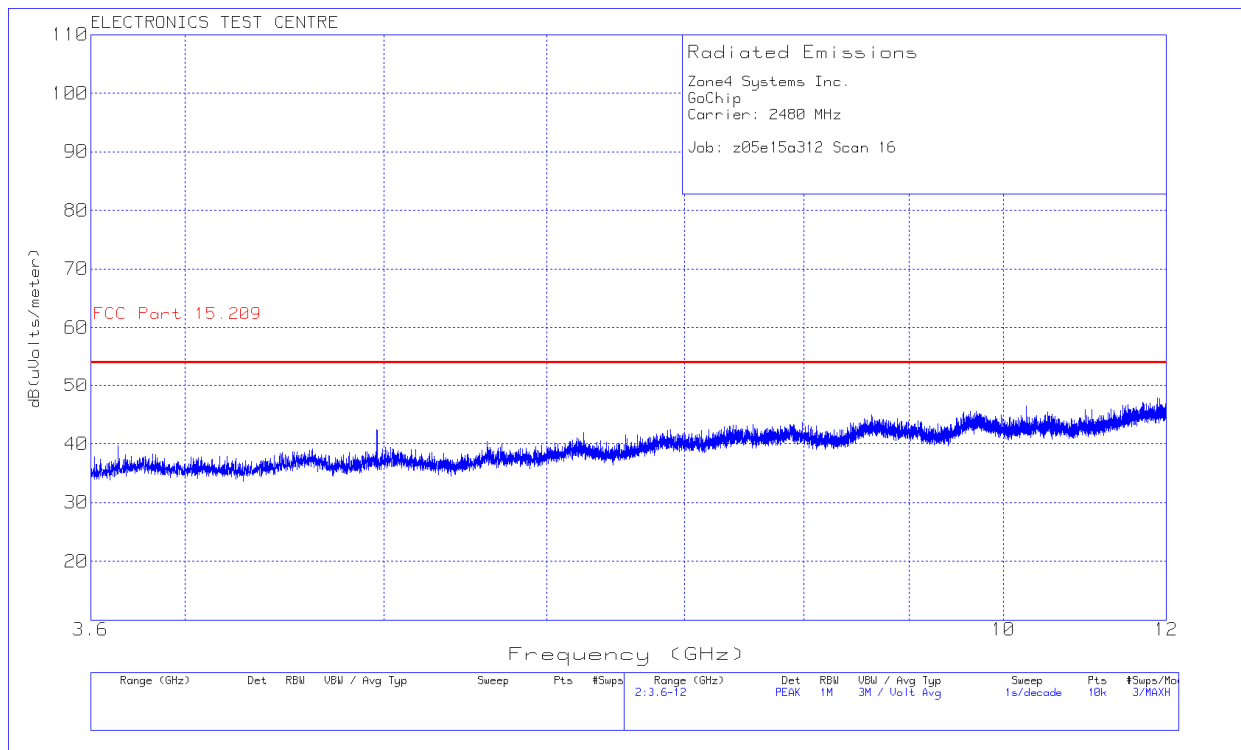


High Channel 2480 MHz

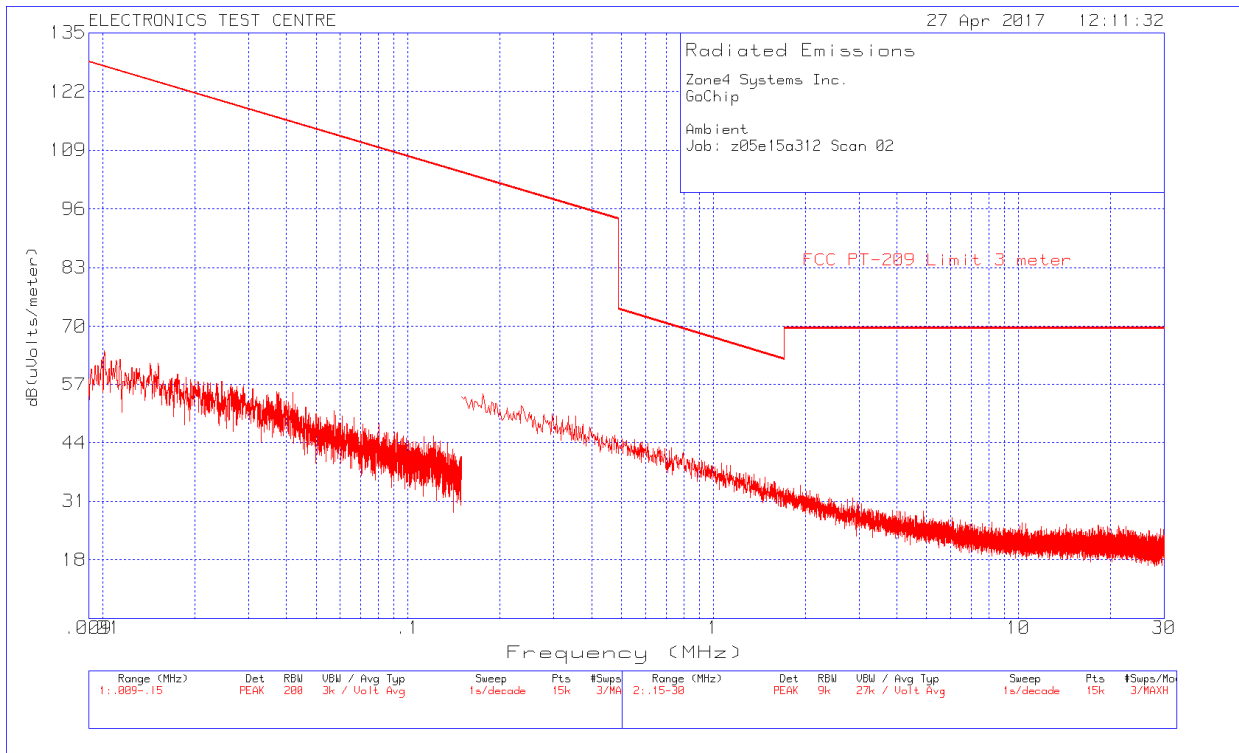
Plot of Radiated Emissions: Horizontal polarization



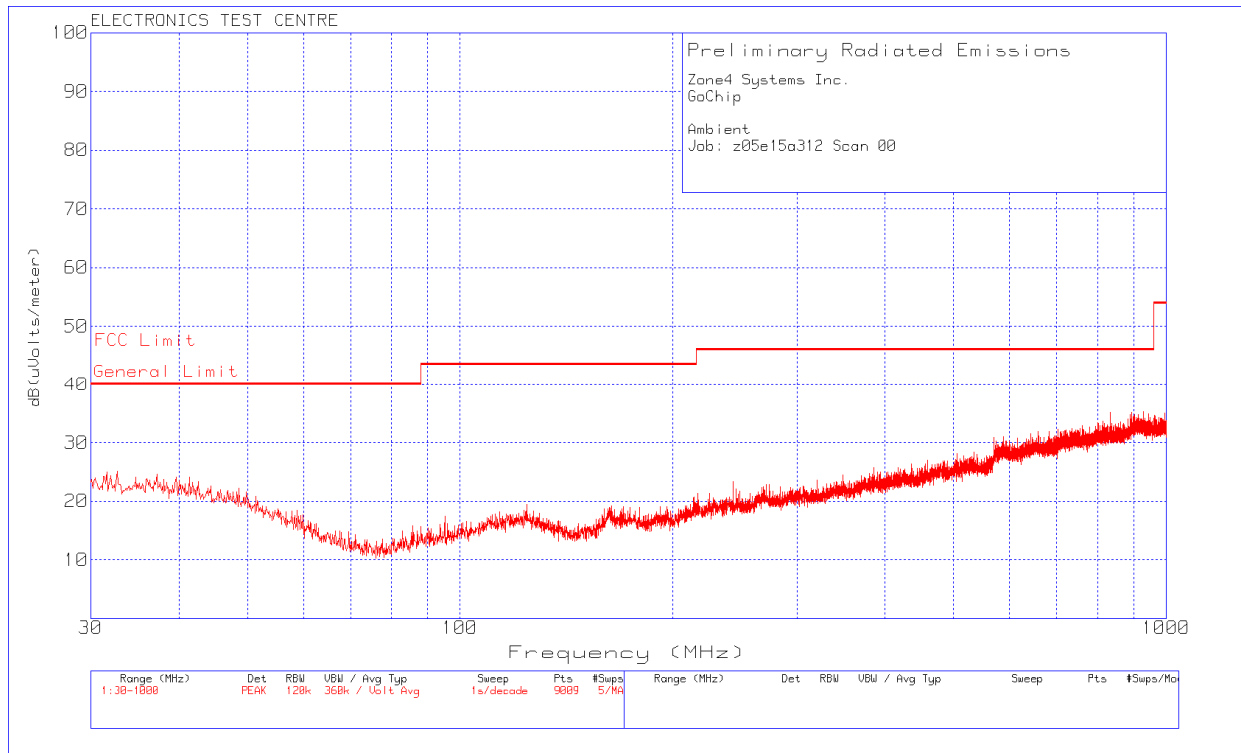
Plot of Radiated Emissions: Vertical polarization



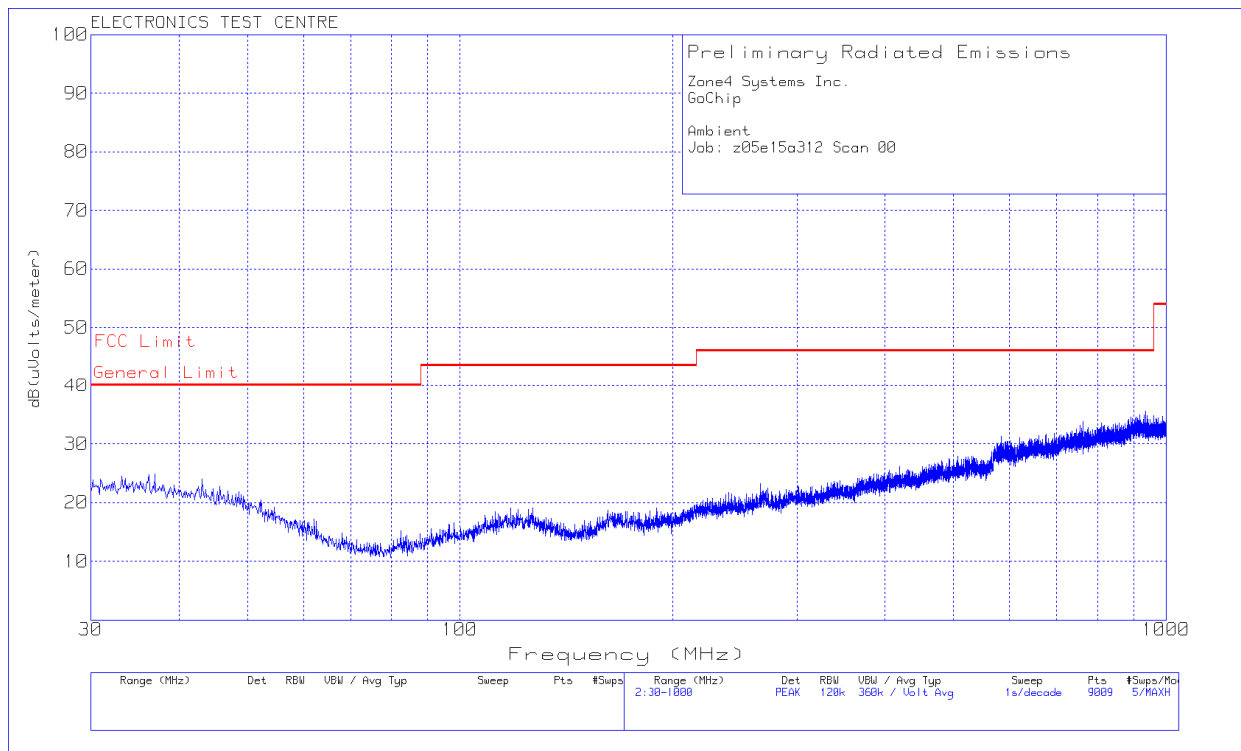
Plot of Test Chamber Ambient: (measurement noise floor):



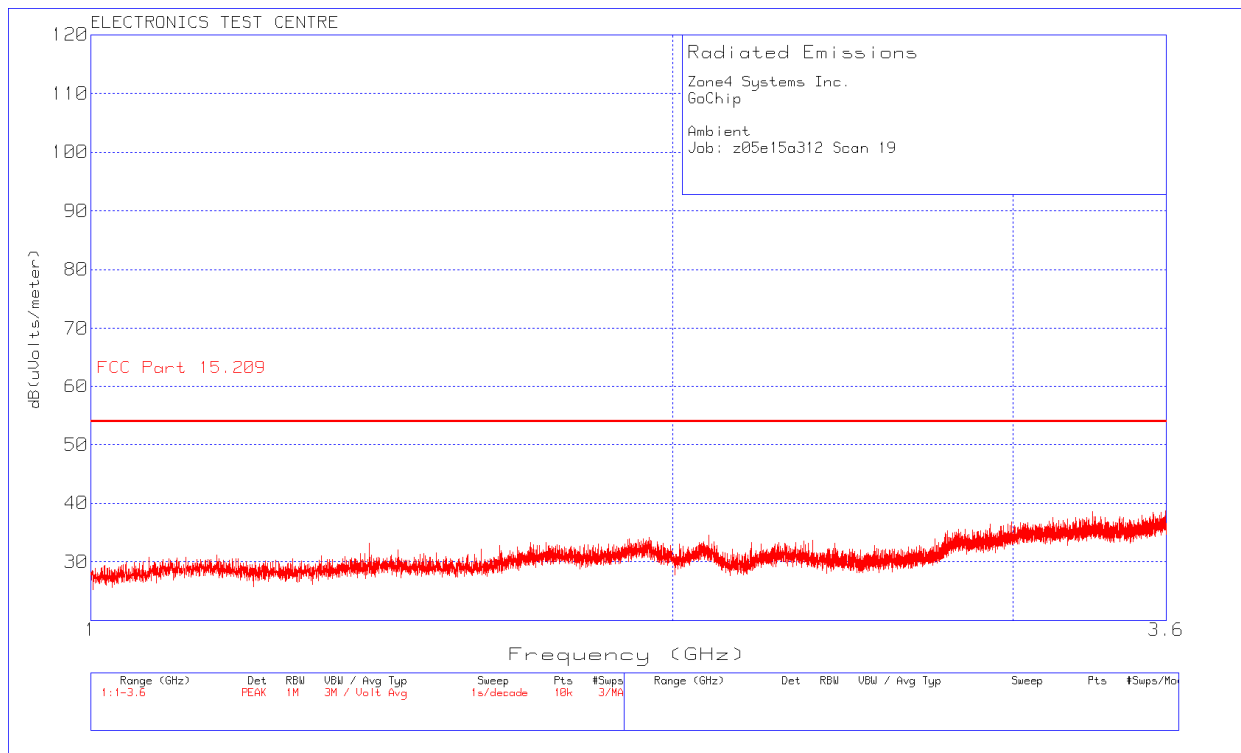
Plot of Test Chamber Ambient: (measurement noise floor):



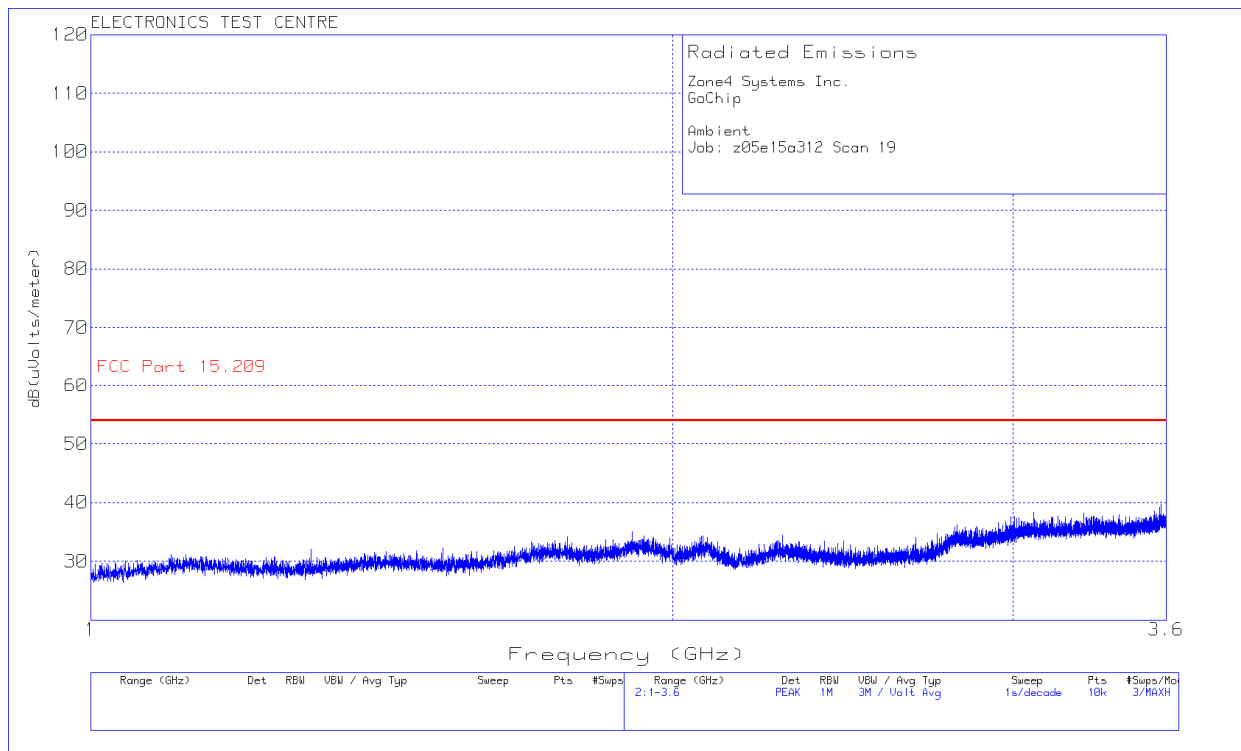
Plot of Test Chamber Ambient: (measurement noise floor):



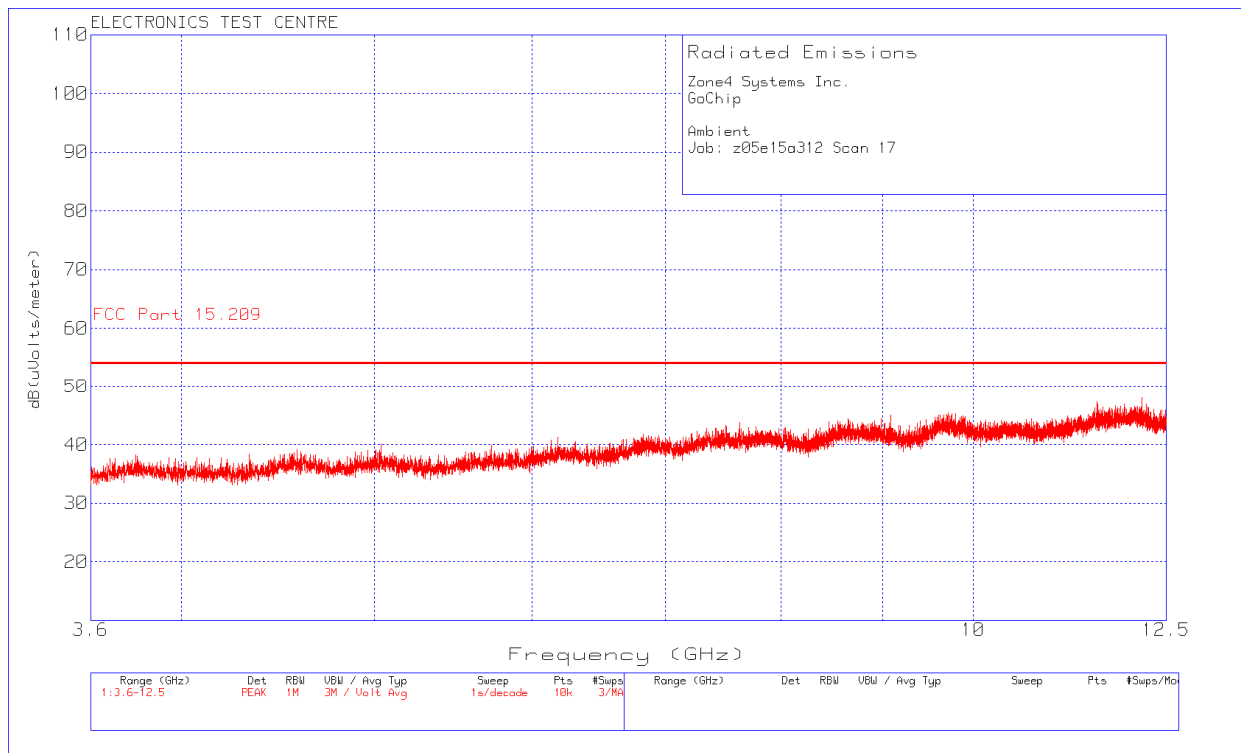
Plot of Test Chamber Ambient: (measurement noise floor):



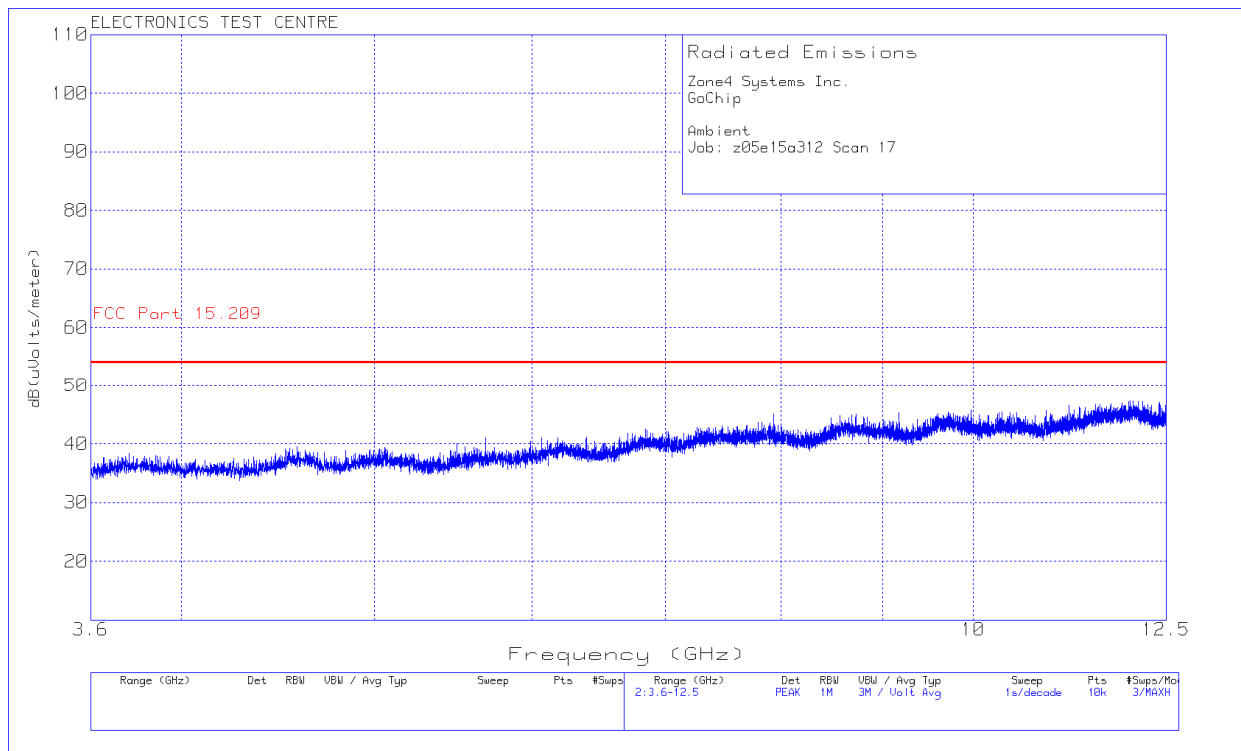
Plot of Test Chamber Ambient: (measurement noise floor):



Plot of Test Chamber Ambient: (measurement noise floor):



Plot of Test Chamber Ambient: (measurement noise floor):



2.9 Receiver Radiated Spurious Emissions

Test Lab: Electronics Test Centre, Airdrie	EUT: GoChip
Test Personnel: I. Akram	Standard: FCC PART 15.247
Date: 2017-01-05 (19.6° C, 14.9% RH)	Basic Standard: ANSI C63.10: 2013
EUT status: Compliant	

Specification: FCC PART 15.109

The EUT was in receiving mode and measurement performed on middle channel only.

Frequency	FCC Class B Limit (3 m)	FCC Class B Limit (3 m)
30 – 88 MHz	100 μ V/m (QP)	40 dB μ V/m (QP)
88 – 216 MHz	150 μ V/m (QP)	43.52 dB μ V/m (QP)
216 – 960 MHz	200 μ V/m (QP)	46.02 dB μ V/m (QP)
960 – 1000 MHz	500 μ V/m (QP)	53.98 dB μ V/m (QP)
Above 1000 MHz	500 μ V/m (Avg.)	53.98 dB μ V/m (Avg.)
Criteria: The radiated emissions produced by a device, measured at a distance of 3 meters, shall not exceed the limits as specified. EUT emissions were scanned up to 12.5 GHz. No reportable emissions were observed.		

2.9.1 Test Guidance: ANSI C63.10-2013, Clause 11.11 & 11.12

From 30 MHz to 1000 MHz, measurements are performed with a broadband biconilog antenna and a resolution bandwidth of 120 kHz.

Above 1000 MHz, measurements are performed with a DRG Horn antenna or a Standard Gain horn, and a resolution bandwidth of 1 MHz. The EUT is raised to 150 cm above the ground plane, and the area between the EUT and the antenna mast is covered with RF absorbent material.

The scan is performed at discreet increments of turntable azimuth and antenna height, which are selected in accordance with the applicable standard in order to assure capture of frequencies of interest. Optimization is performed based on the scan data.

Frequencies having peak emissions within 10dB of the limits are optimized. The EUT is rotated in azimuth over 360 degrees and the direction of maximum emission is noted.

Antenna height is varied from 1 – 4 meters at this azimuth to obtain the maximum emission. Then the maximum level is measured with the appropriate detector and recorded. Up to 1 GHz, measurements are performed with a Quasi-Peak detector. Above 1 GHz, measurements are recorded with Peak and/or Average detectors, as applicable.

Note: The EUT was assessed for worst-case orientation. All radiated testing was performed with this orientation, as shown in the test setup photos.

2.9.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

2.9.3 Uncertainty of Measurement:

The factors contributing to uncertainty of measurement are identified and calculated in accordance with UKAS (United Kingdom Accreditation Service) document "Lab 34, The Expression of Uncertainty in EMC Testing, Aug 2002." as based on the "ISO Guide to the Expression of Uncertainty in Measurement, 1995."

This uncertainty estimate represents an expanded uncertainty expressed at approximately 95% confidence using a coverage factor of $k = 2$.

Test Method	Frequency	Uncertainty
Radiated Emissions Level	30 MHz – 1 GHz	± 4.6 dB
Radiated Emissions Level	1 GHz – 26.5 GHz	± 5.31 dB

2.9.4 Test Equipment

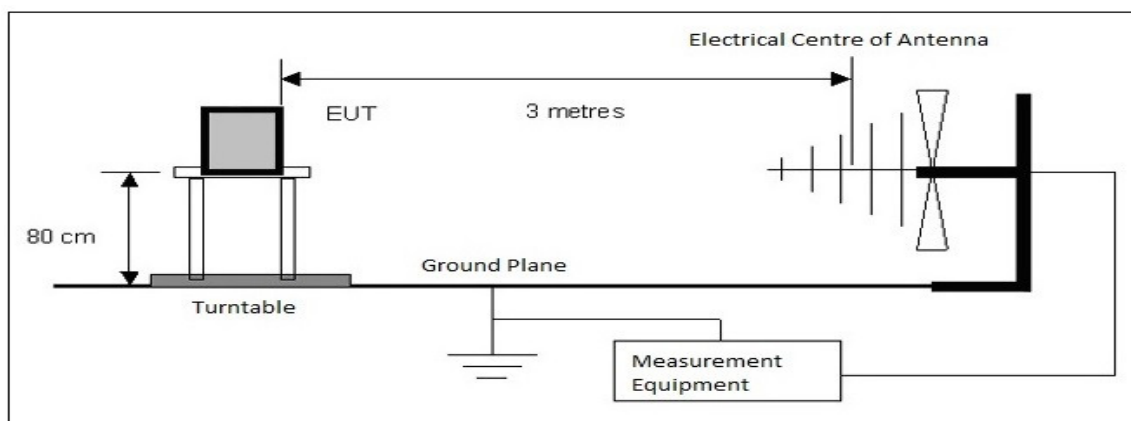
Testing was performed with the following equipment:

Equipment	Manufacturer	Model #	Asset #	Calibration Date	Calibration Due
Temperature/RH	Extech	42270	5892	2017-04-06	2018-04-06
EMC Software	UL	Ver. 9.5	ETC-SW-EMC 2.1	Monitored	
EMI receiver	Agilent	N9038A	6130	2016-06-23	2017-06-23
Loop Antenna	EMCO	6502	10868	2017-03-29	2019-03-29
Biconilog Antenna	ARA	LPB-2520/A	4318	2016-05-18	2018-05-18
DRG Horn	EMCO	3115	19357	2016-08-24	2018-08-24
Low Noise Amplifier (1 – 18 GHz)	MITEQ	JS43-01001800- 21-5P	4354	Monitored	

2.9.5 Test Sample Verification, Configuration & Modifications

The EUT was set to disable the transmitter. All other functions continued as in normal operation. The EUT met the requirements without modification.

Test setup diagram for Radiated Spurious Emissions testing:



2.9.6 Radiated Emissions Data:

The emissions data are presented in tabular form, showing turntable azimuth, antenna height and polarization, the uncorrected spectrum analyzer reading, the correction factors applied, the net result, the value of the limit at the frequency investigated, and the Delta between the result and the limit.

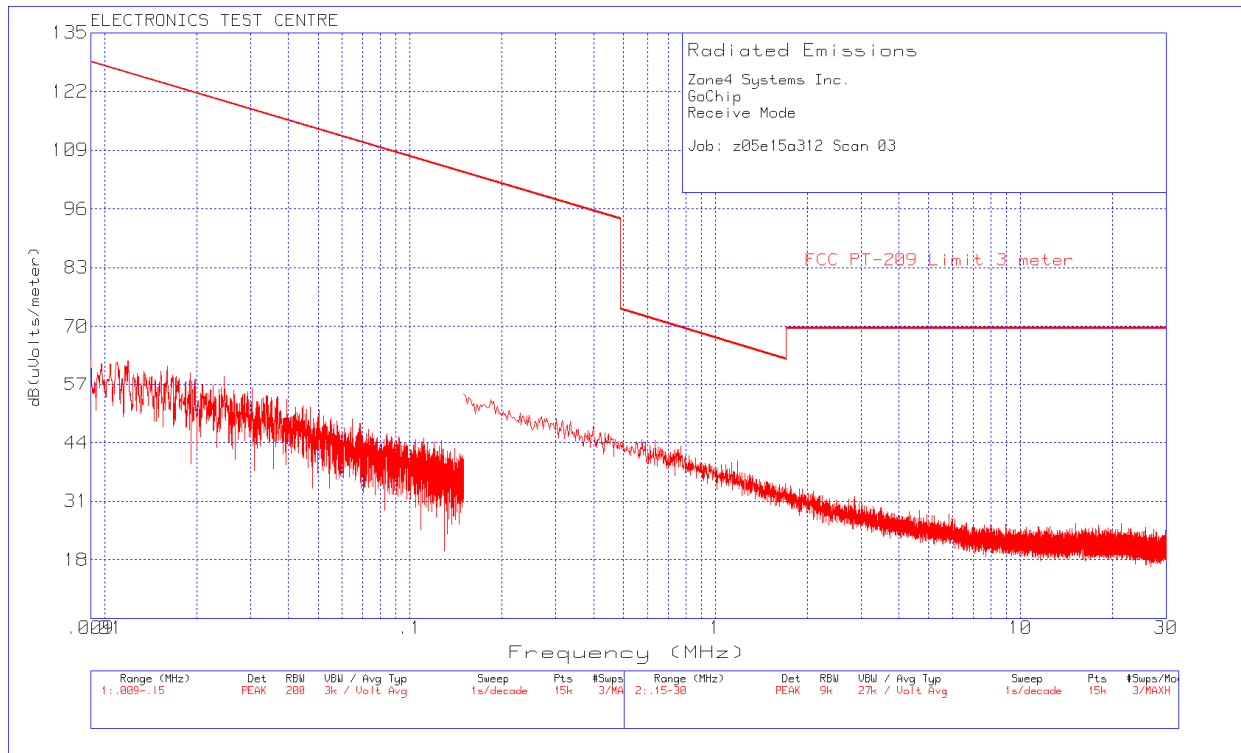
Meter Reading in dB μ V + Antenna Factor in dB/m + Gain/Loss Factor in dB = Corrected Field Strength in dB μ V/m.

Delta = Field Strength - Limit

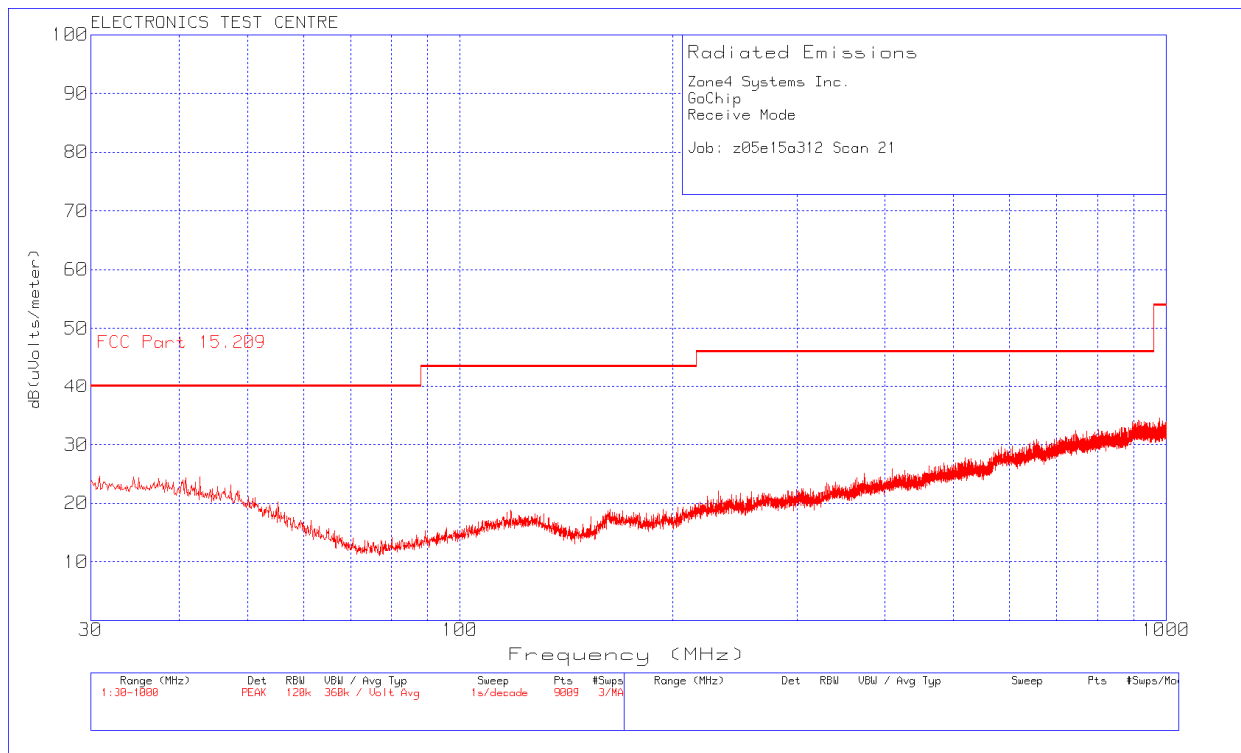
Notes:

- When a preamp is used, the resulting gain is compensated, producing a negative value for the Cable Loss.
- Measurements reported are the result of adjusting the turntable azimuth and antenna height to obtain the maximum EUT emission. This may produce a different reading than the plot trace. The plot is a Peak Hold function obtained at discreet increments of height and azimuth, while the reported measurement is obtained with the appropriate Quasi Peak or Average detector after the height and azimuth have been adjusted for maximum emission.
- The EUT was assessed up to 12.5 GHz. There were no emissions.
- Pursuant to Part 15.31(o), emissions that are more than 20 dB below the applicable limit are not reported.

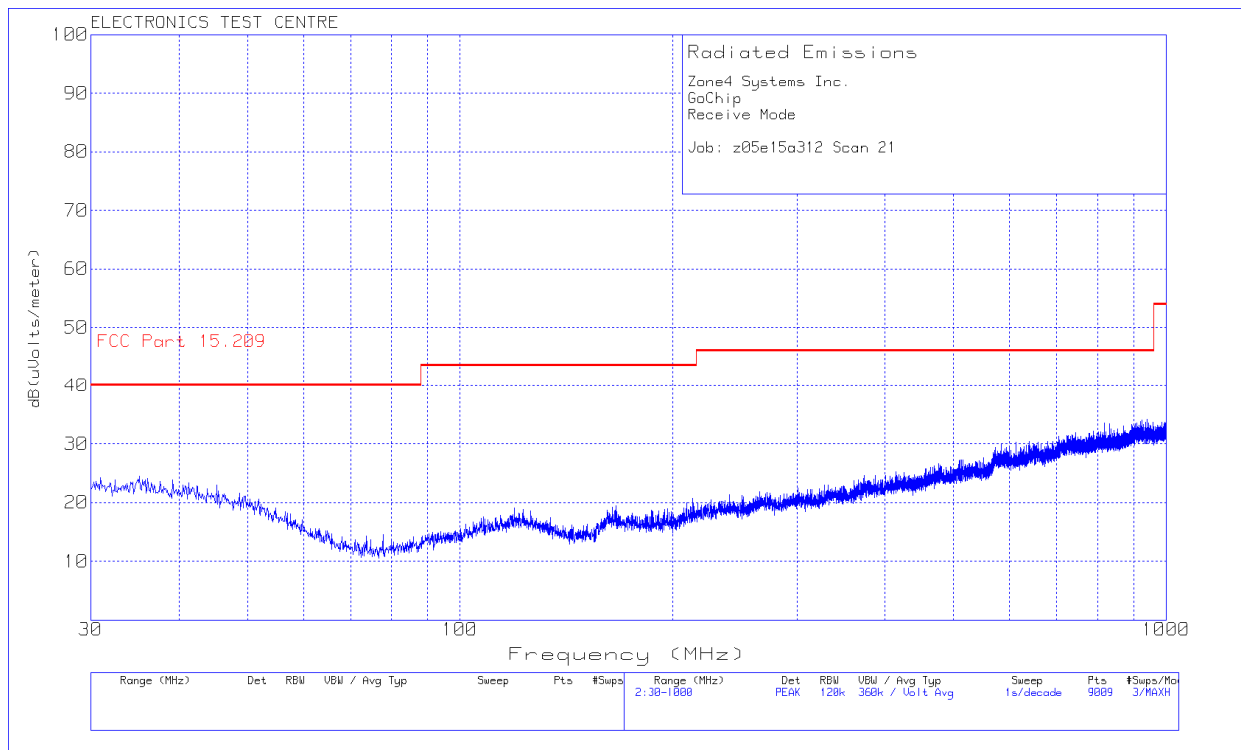
Plot of Radiated Emissions:



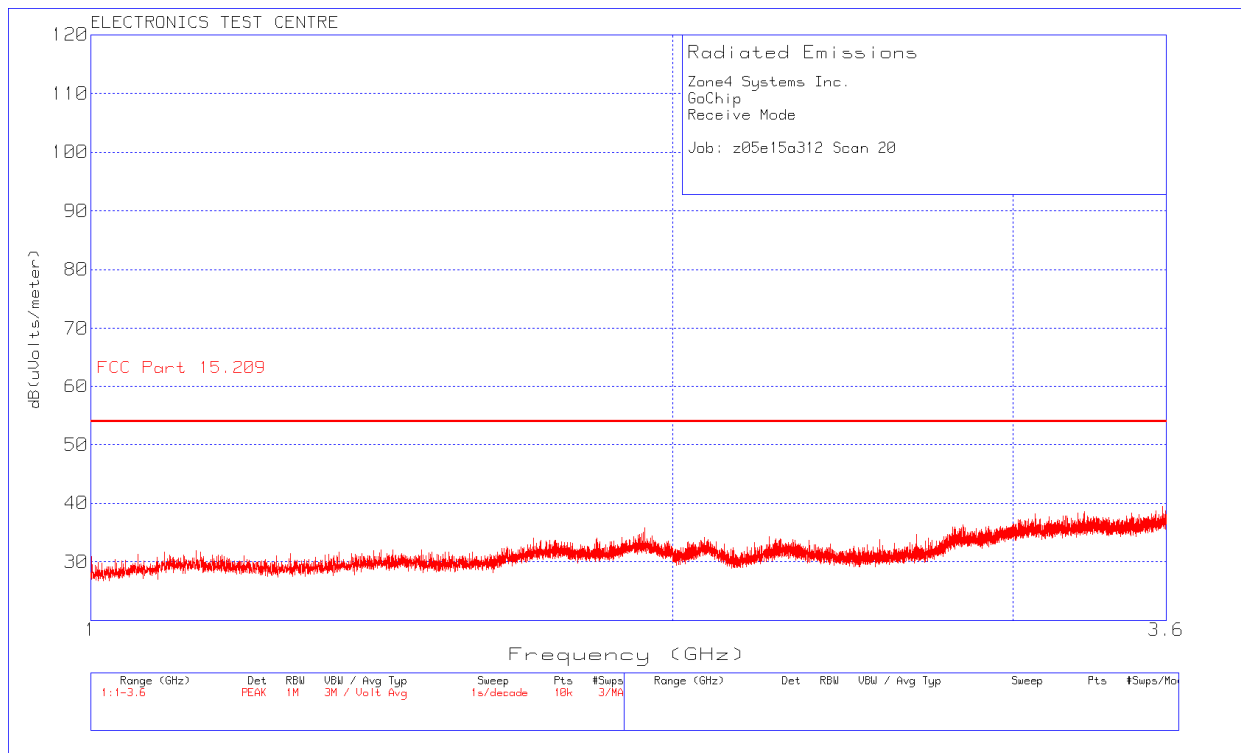
Plot of Radiated Emissions: Horizontal polarization



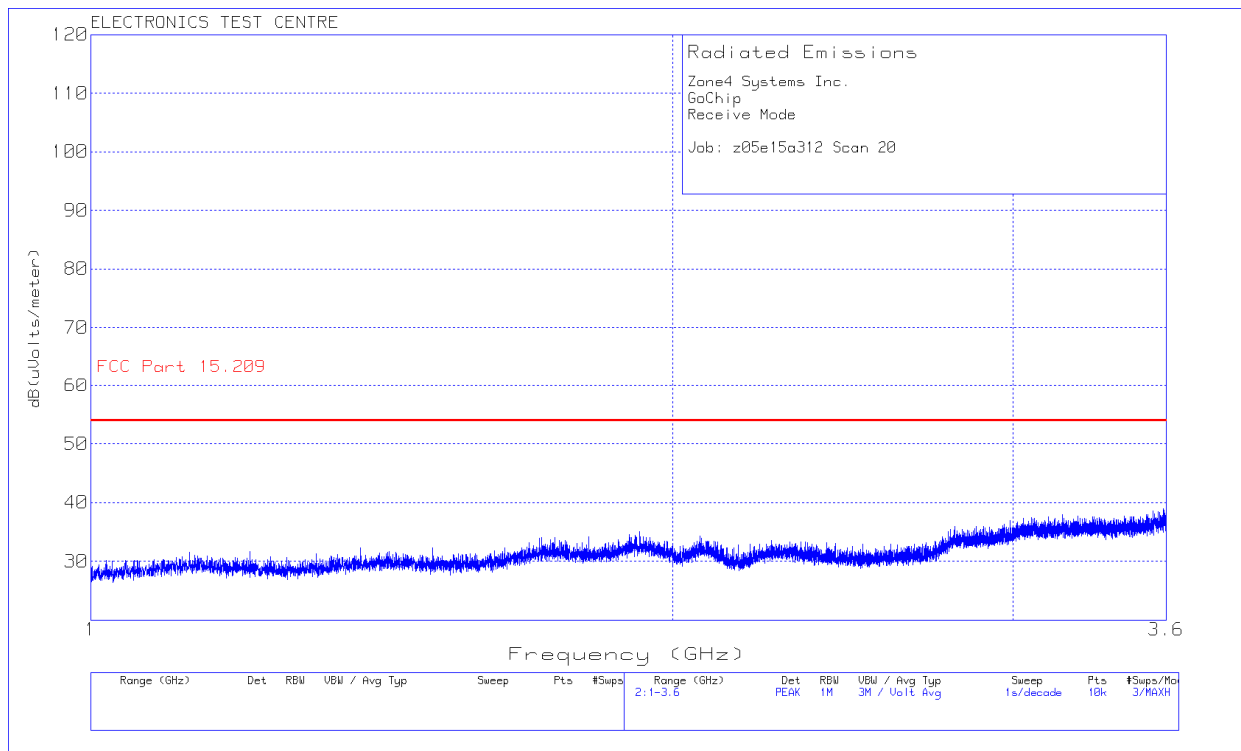
Plot of Radiated Emissions: Vertical polarization



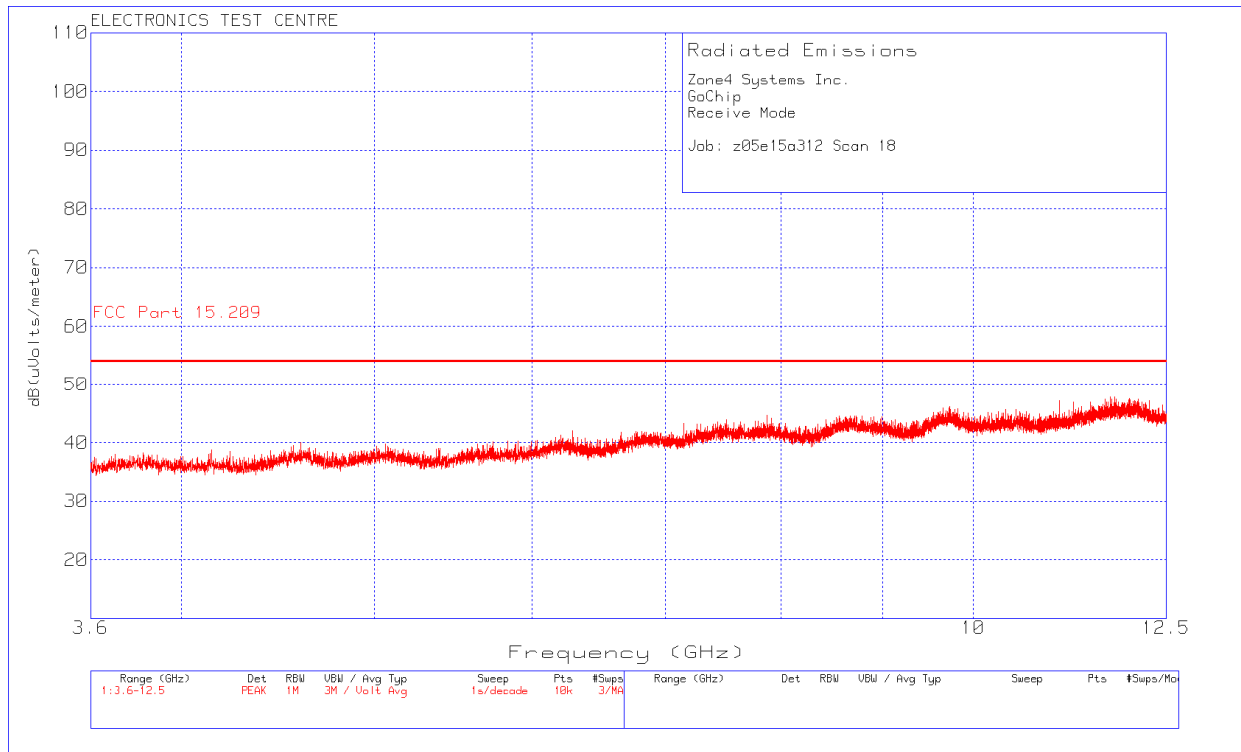
Plot of Radiated Emissions: Horizontal polarization



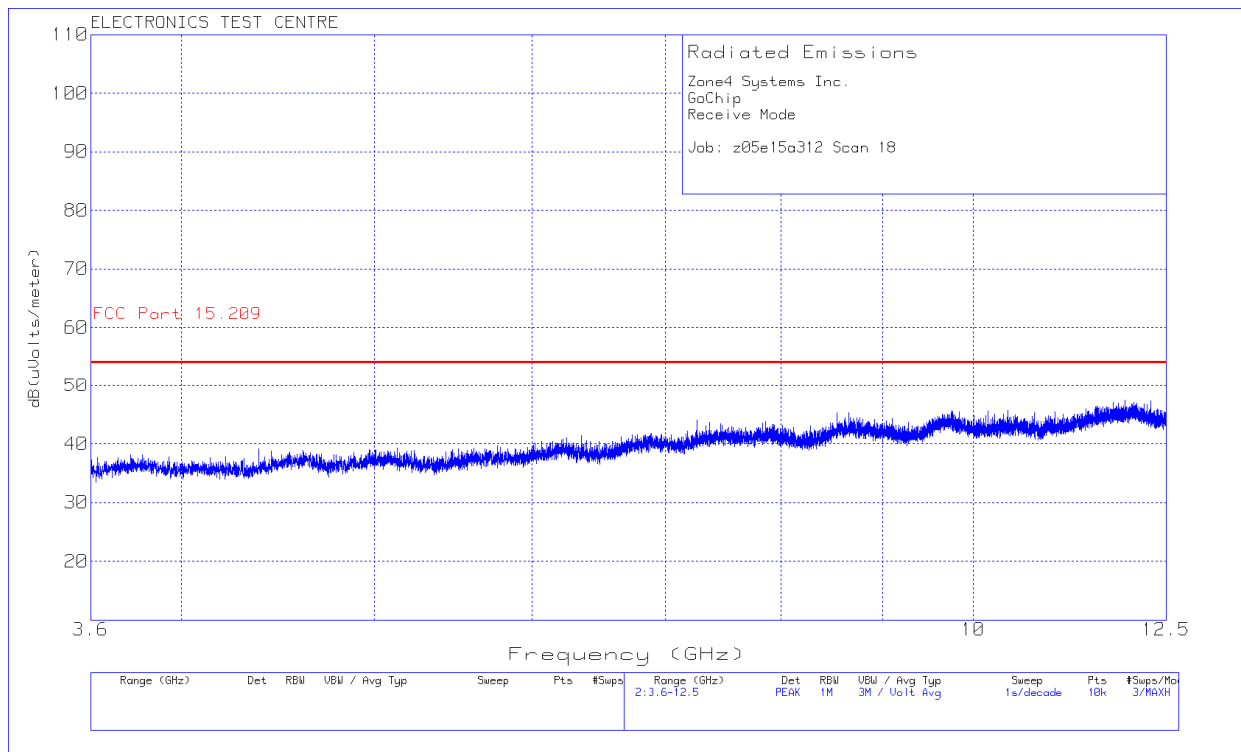
Plot of Radiated Emissions: Vertical polarization



Plot of Radiated Emissions: Horizontal polarization



Plot of Radiated Emissions: Vertical polarization



2.10 Antenna Requirements

Test Lab: Electronics Test Centre, Airdrie

EUT: GoChip

Test Personnel: D. Raynes

Standard: FCC Part 15.203

Date: 2017-01-03 (19.0° C, 12.2% RH)

EUT status: Compliant

Specification: FCC Part 15.203

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

2.2.1 Test Methodology

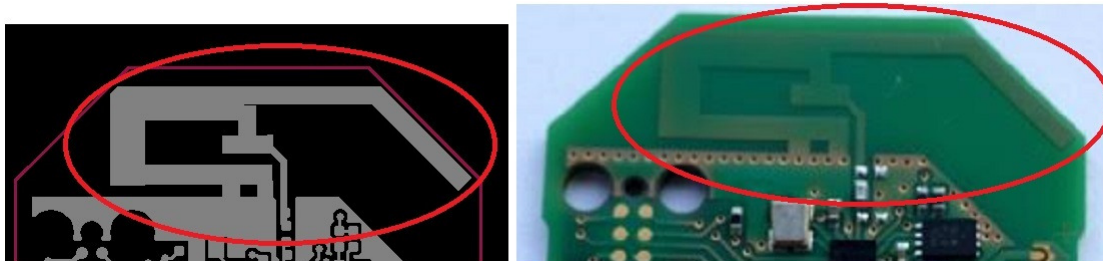
The EUT is visually inspected to assess compliance.

2.2.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

2.2.3 Assessment

The antenna is integral to the printed circuit board of the device, which is then urethane potted into the case, preventing any replacement or substitution by the end user.



2.11 RF Exposure

Test Lab: Electronics Test Centre, Airdrie	EUT: GoChip
Test Personnel:	Standard: FCC PART 15.247
Date:	

EUT status: Compliant

Compliant: See the Environmental Assessment provided in a separate Exhibit.

3.0 TEST FACILITY

3.1 Location

The GoChip was tested for emissions at the Electronics Test Centre laboratory located in Airdrie, Alberta, Canada. The Radio Frequency Anechoic Chamber (RFAC), identified as Chamber 1, has a usable working space measuring 10.6 m long x 7.3 m wide x 6.5 m high.

Measurements taken at this site are accepted by Industry Canada as evidence of conformity per registration file # 2046A. This site is also listed with the FCC under Registration Number CA2046.

The floor, walls and ceiling consist of annealed steel panels. The walls and ceiling are covered with ferrite tile, augmented by RF absorbant foam material on the end wall nearest the turntable, and on the adjacent walls and the ceiling. The chamber floor supports a 15 cm high internal floor, constructed of annealed steel panels, that forms the ground plane, and is bonded to the chamber walls.

The 3-m diameter turntable is flush-mounted with the floor. A sub-floor cable-way is provided to route cables between the turntable pit and EUT support equipment located in the Control Room. Cables reach the EUT through an opening in the centre of the turntable.

Test instrumentation and EUT support equipment is located in the Control Room, consisting of two shielded vestibules joined together at the side of the main room. Cables are routed through bulkhead panels between the rooms and the test chamber as required. Power feeds are routed into the main room and vestibules through line filters providing at least 100 dB of attenuation between 10 kHz and 10 GHz.

Either floor mounted or table-top equipment can be tested at this facility.

3.2 Grounding Plan

The GoChip was placed at the centre of the test chamber turntable on top of a polystyrene foam table. The EUT was not grounded, in accordance with Zone4 Systems Inc specifications.

3.3 Power Supply

All EUT power was supplied by an internal non-rechargeable battery.

3.4 Emissions Profile

Ambient emission profiles were generated throughout the tests and are included in the test data.

End of Document