Project 17015-15

VER006
2.4 GHz Zigbee Module with PA

Wireless Certification Report

Prepared for:

Ketra, Inc.

By

Professional Testing (EMI), Inc.
1601 North A.W. Grimes Blvd., Suite B
Round Rock, Texas 78665

6 Aug 2015

Reviewed by

Larry Finn
Chief Technical Officer

Written by

Eric Lifsey
EMC Engineer

Revision History

Revision Number	Description	Date
00	Draft Release	29 Jul 2015
01	Revised.	31 Jul 2015
01	Final	31 Jul 2015
02	Final; revised RSS-Gen clause references.	6 Aug 2015

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Corrections:

The name of the witness where given as Steve Proffit is actually spelled Steve Proffitt.

Certificate of Compliance

Applicant	Device & Test Identification	
Ketra, Inc. (Mickey Malone)	FCC ID:	2AB3C4ZV
3815 S Capital of Texas Hwy, Suite 100	Industry Canada ID:	12066A-4ZV
Austin, TX 78704	Model(s):	VER006
Certificate Date: 6 Aug 2015	Laboratory Project ID:	17015-15

The device model(s) listed above were tested utilizing the following documents and found to be in compliance with the required criteria.

Requirement**	Reference	Detail
FCC 47 CFR Part 15 C	15.247	Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.
FCC 47 CFR Part 15 C	15.209	Radiated emission limits; general requirements.
FCC 47 CFR Part 15 C	15.207	Conducted emission limits.
FCC 47 CFR Part 15 C	15.205	Restricted Bands of Operation
KDB 558074 D01	DR01	DTS Measurement Guidance v03r02
KDB 412172	D01	Guidelines for Determining the ERP and EIRP of an RF Transmitting System
OET Bulletin 65*	Edition 97-01, and Supplement C, Ed. 01-01	Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields
RSS-247	Issue 1	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
RSS-Gen	Issue 4	General Requirements and Information for the Certification of Radio Apparatus
RSS-102	Issue 4	Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)

*MPE is reported separately from this document. **Corresponding RSS references are listed in the body of the report.

I, Eric Lifsey, for Professional Testing (EMI), Inc., being familiar with the above rules and test procedures have reviewed the test setup, measured data, and this report. I believe them to be true and accurate.

Eric Lifsey
EMC Engineer

This report has been reviewed and accepted by the Applicant. The undersigned is responsible for ensuring that this device will continue to comply with the requirements listed above.

_____

Representative of Applicant

1.0 Introduction

1.1 Scope

This report describes the extent to which the equipment under test (EUT) conformed to the intentional radiator requirements of the United States and Canada.

Professional Testing (EMI), Inc., (PTI) follows the guidelines of National Institute of Standards and Technology (NIST) for all uncertainty calculations, estimates, and expressions thereof for electromagnetic compatibility testing.

1.2 EUT Description

The EUT is an RF module intended for use in future end use products by the same manufacturer.

Table 1.2.1: Equipment Under Test

Manufacturer / Model	Serial #	Description
Ketra, Inc. VER006 Zigbee Module with PA P/N 830-000057-01	C2	2400-2483.5 MHz Zigbee transceiver module

The antenna is etched on the circuit board. The EUT is powered by a 3.3 V power source. This is not a hand-held device.

The EUT measures approximately 18 x 24 mm.

1.3 EUT Operation

The EUT was exercised in a manner consistent with normal operations. The EUT is held down in a fixture that makes electrical contact with the modules edge connectors to supply power and commands.

The EUT internal software operated the transmitter in a continuous modulated mode.

Commanding the EUT to operate was accomplished by software on a laptop application then passed through a development adapter, a Silabs model EM-ISA3-76E, as text commands. The Silabs EM-ISA3-76E received power only to configure operation of the EUT. Once the desired EUT operation was initiated, the Silabs programmer was disconnected from the EUT and the laptop was disconnected and removed from the test configuration.

1.4 Modifications to Equipment

No modifications were made to the EUT during the performance of the test program.

1.5 Test Site

Measurements were made at the PTI semi-anechoic facility designated Site 45 (FCC 459644, IC 3036B-1) in Austin, Texas. The site is registered with the FCC under Section 2.948 and Industry Canada per RSS-GEN, and is subsequently confirmed by laboratory accreditation (NVLAP). The test site is located

at 11400 Burnet Road, Austin, Texas 78758, while the main office is located at 1601 North A.W. Grimes Boulevard, Suite B, Round Rock, Texas, 78665.

1.6 Radiated Measurements

Radiated levels are determined as follows:

Raw Measured Level + Antenna Factor + Cable Losses – Amplifier Gain = Corrected Level

Conducted RF levels are determined as follows:

Raw Measured Level + Attenuator Factor + Cable Losses = Corrected Level

Conducted mains levels are determined as follows:

Raw Measured Level + LISN Factor + Cable/Filter/Limiter Losses = Corrected Level

Additionally, measurement distance extrapolation factors are applied and documented where used.

1.7 Applicable Documents and Clauses

Table 1.7.1: Applicable Documents

Document	Title
47 CFR	Part 15 – Radio Frequency Devices Subpart C -Intentional Radiators
RSS-247 Issue 1	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
RSS-Gen Issue 4	General Requirements and Information for the Certification of Radio Apparatus
ANSI C63.4 2009	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low Voltage Electrical and Electronic Equipment

Table 1.7.2: Applicable Clauses

Parameter	FCC Part 15 Rule Paragraphs	IC RSS References
Transmitter Characteristics	15.247(a)(2)	RSS-247 5.2 (DTS) & 5.4, RSS-Gen 6
Power Spectral Density	15.247(e)	RSS-247 5.2 (DTS)
Bandwidth	15.247(a)(2), 2.1049, KDB 558074 D01	RSS-247 5.2 (DTS), RSS-Gen 6.6
Spurious Emission	15.247, 15.209, 15.205	RSS-247 5.5, RSS-GEN 6.13, 7.1
Band Edge	15.247, 15.205	RSS-247 5.5, RSS-Gen 6.13
Antenna Requirement	15.203	RSS-Gen 8.3
Conducted Emissions, Mains	15.207	RSS-Gen 8.8

2.0 Fundamental Power

2.1 Test Procedure

Bandwidth is first determined to select correct entire bandwidth for power measurement and the fundamental power is then measured by direct connection to a spectrum analyzer.

2.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date
15.247(a)(2) // RSS-247 5.2	Fundamental Power Conducted Limit: 1 Watt	2014-05-20

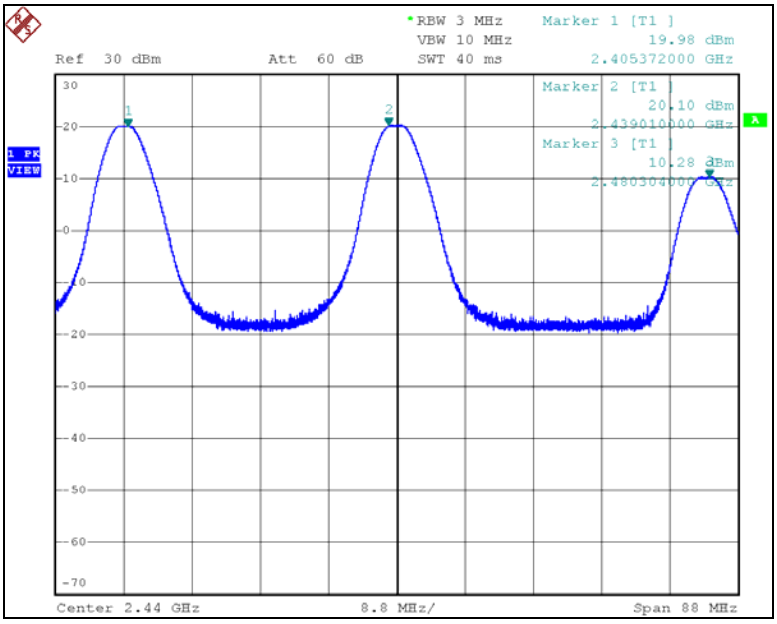
2.3 Test Results

The EUT bandwidth was found to be between 1 MHz and 3 MHz, the measurement resolution bandwidth was set to 3 MHz; video bandwidth was set to 3 MHz.

Table 2.3.1 Conducted Power		
Frequency MHz	Measured Peak Power dBm	Power in Linear Units mW
2405	19.98	99.54
2440	20.10	102.3
2480	10.28	10.67

Measured in 3 MHz RBW, 10 MHz VBW.

The EUT was found to be in compliance with the applicable criteria. Note that the highest frequency channel has power reduced to satisfy band-edge emissions. Plotted measurement appears below.



3.0 Power Spectral Density

3.1 Test Procedure

The EUT is directly connected to a spectrum analyzer and is then adjusted to record in max-hold mode for an extended time sufficient to capture all transmit products.

3.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date
15.247(e) // RSS-247 5.2	Power Spectral Density Conducted Limit: 8 dBm / 3 kHz	20 Jul 2015

3.3 Test Results

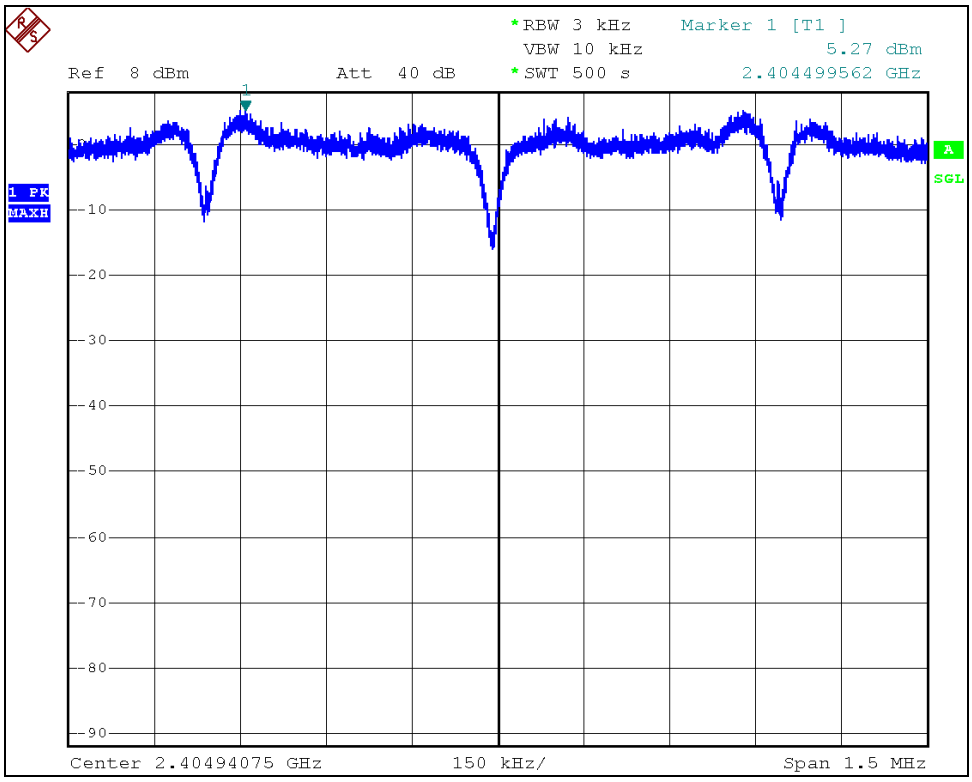
Sweep time 500 seconds.

Highest recorded measurement: 5.27 dBm

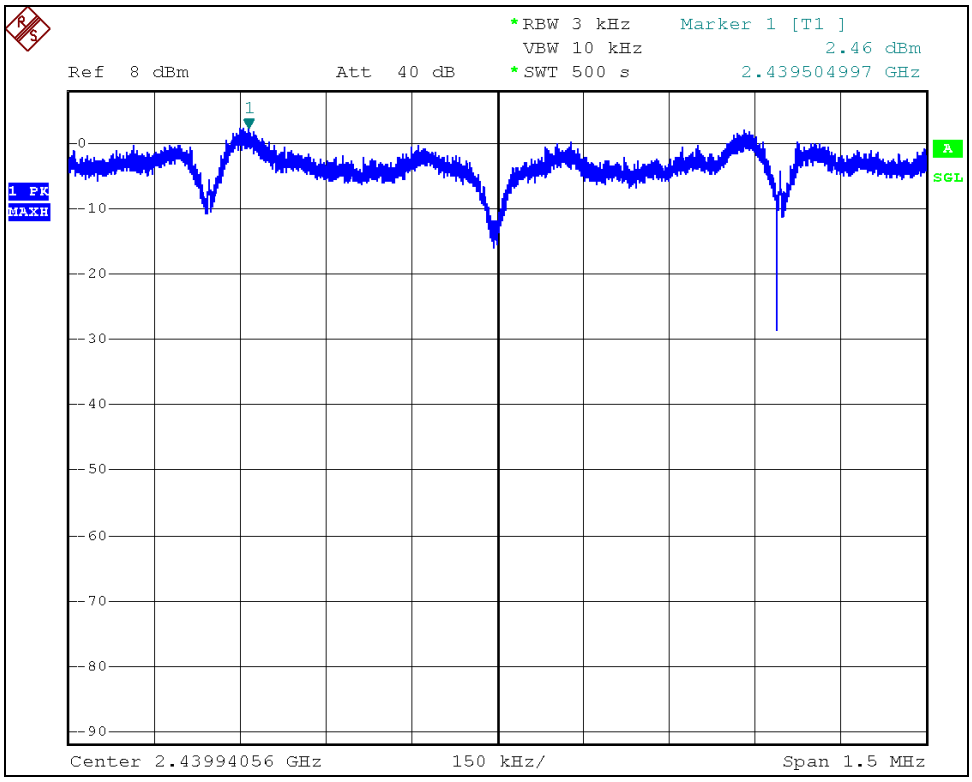
The EUT was found to be in compliance with the applicable criteria.

Plotted measurements appear below. The spectrum analyzer reference level is set to the PSD limit.

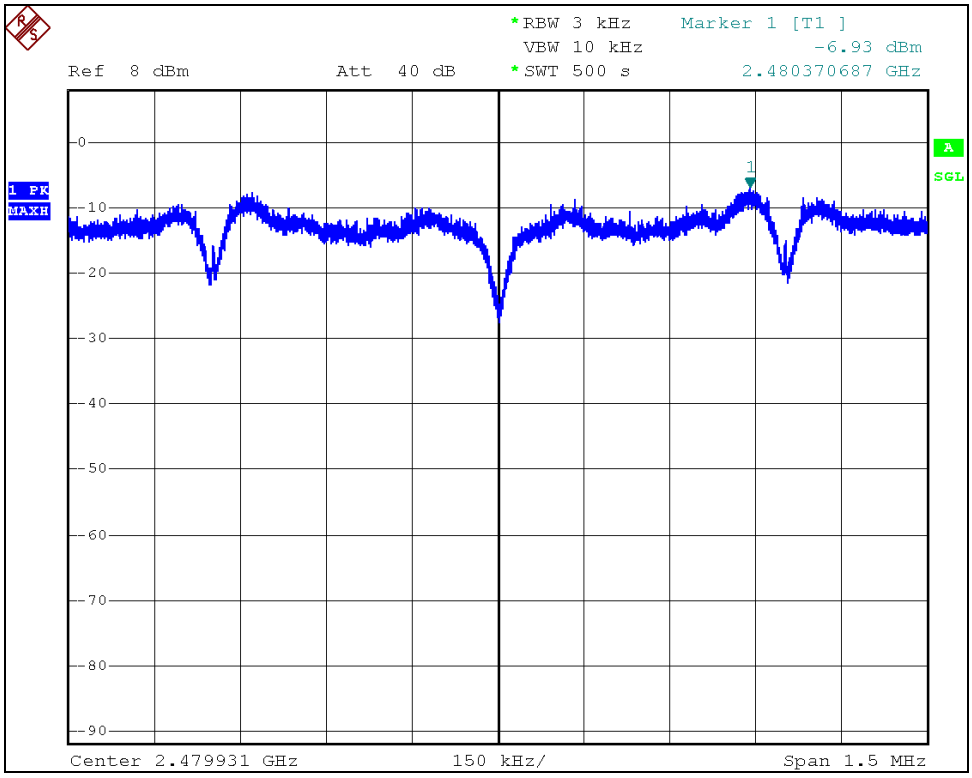
3.3.1 Low Channel PSD



3.3.2 Middle Channel PSD



3.3.3 High Channel PSD



4.0 Transmitter Duty Cycle

4.1 Test Procedure

EUT is placed into worse-case transmit operation to observe and record transmitter time domain performance.

4.2 Test Criteria

Section Reference	Parameter	Date(s)
15.247 // RSS-247, RSS-Gen 6.10	Transmit Duty Cycle	13 May 2015

Measurement is based on intervals not to exceed 100 msec. Maximum transmitter on time is divided by the lesser of 100 msec or the actual measured minimum transmitter interval time. The result is converted to dB and applied as needed to peak measurements of transmitter artifacts to determine average power. This is not a pass/fail measurement.

4.3 Test Results

Table 4.3.1 Duty Cycle Factor Result

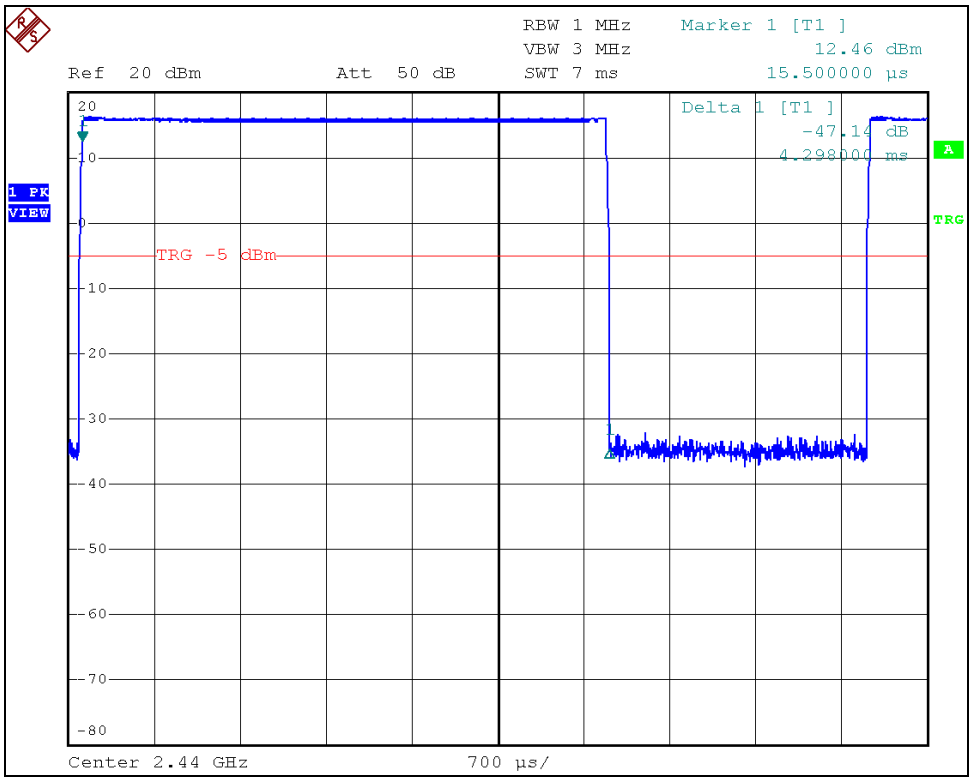
Measured On Time (msec)	Measured Time Interval (msec)	Duty Cycle Factor Calculation	Result (dB)	Duty Cycle Factor Allowed (dB)
4.298	6.412	= 20 * Log_{10} (4.298 msec / 6.412 msec)	-3.48	-3.48

The allowed duty cycle factor is applied to peak measured harmonic signals to find average levels.

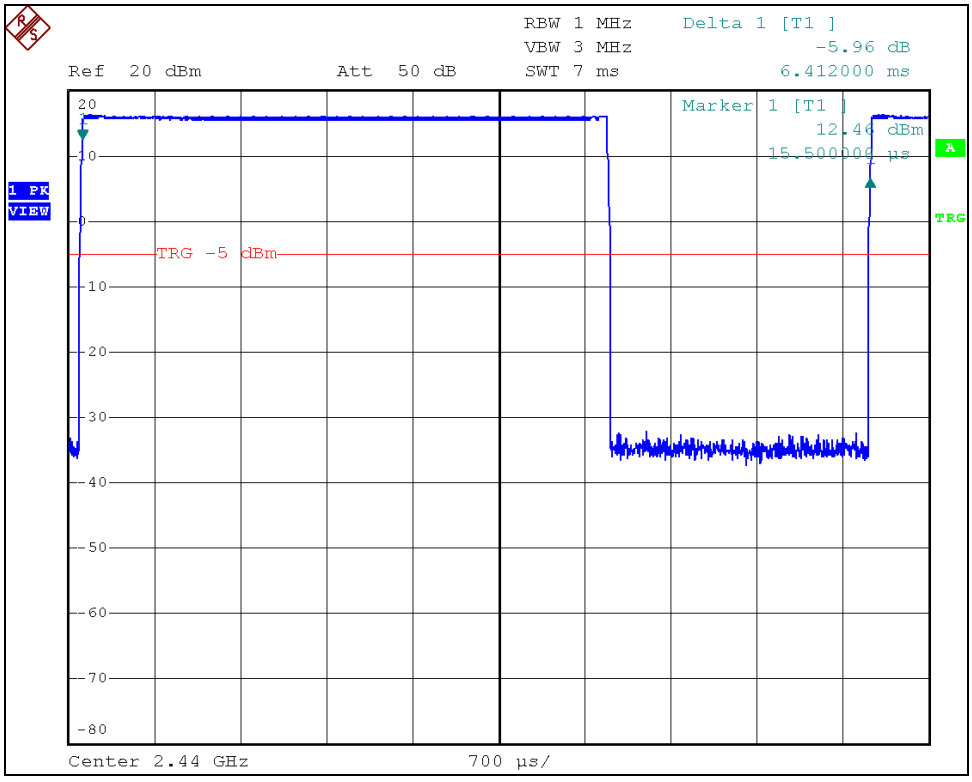
The source based factor for exposure is half of the above or: -1.74 dB

Plotted results appear on the following pages.

Plot 4.3.1 Transmit On Time



Plot 4.3.2 Transmit Period



5.0 Occupied Bandwidth

5.1 Test Procedure

The EUT is directly connected to a spectrum analyzer and bandwidth then is measured. A recording of the results is included.

5.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
14.247(a)(2), 2.1049 // RSS-Gen 5.2, RSS-Gen 6.6	Bandwidth, 6 dB, 20 dB	13 May 2015

5.3 Test Results

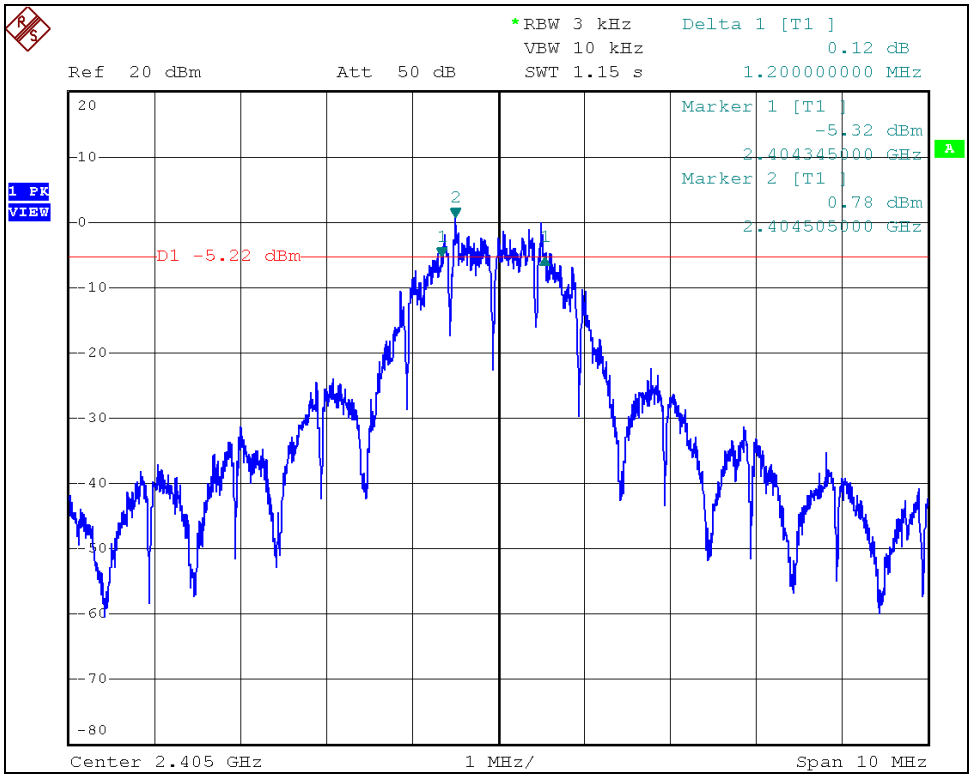
EUT was found to be in compliance with applicable requirements.

Table 5.3.1 Bandwidth 6 dB, Minimum 500 kHz			
Low Channel Measured BW (kHz)	Mid Channel Measured BW (kHz)	High Channel Measured BW (kHz)	**Minimum BW (kHz)**
1200	1360	1500	**1200**

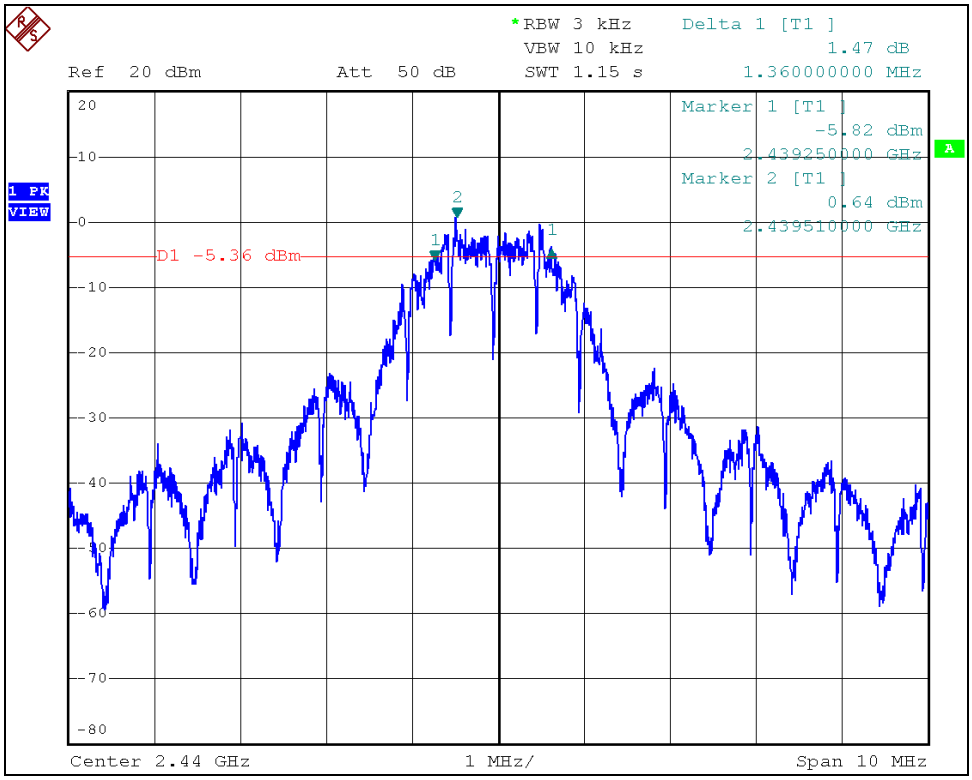
Table 5.3.2 Bandwidth 20 dB, Measure and Report			
Low Channel Measured BW (kHz)	Mid Channel Measured BW (kHz)	High Channel Measured BW (kHz)	**Reported Maximum BW (kHz)**
2540	2545	2500	**2545**

Plotted measurements appear on the following pages.

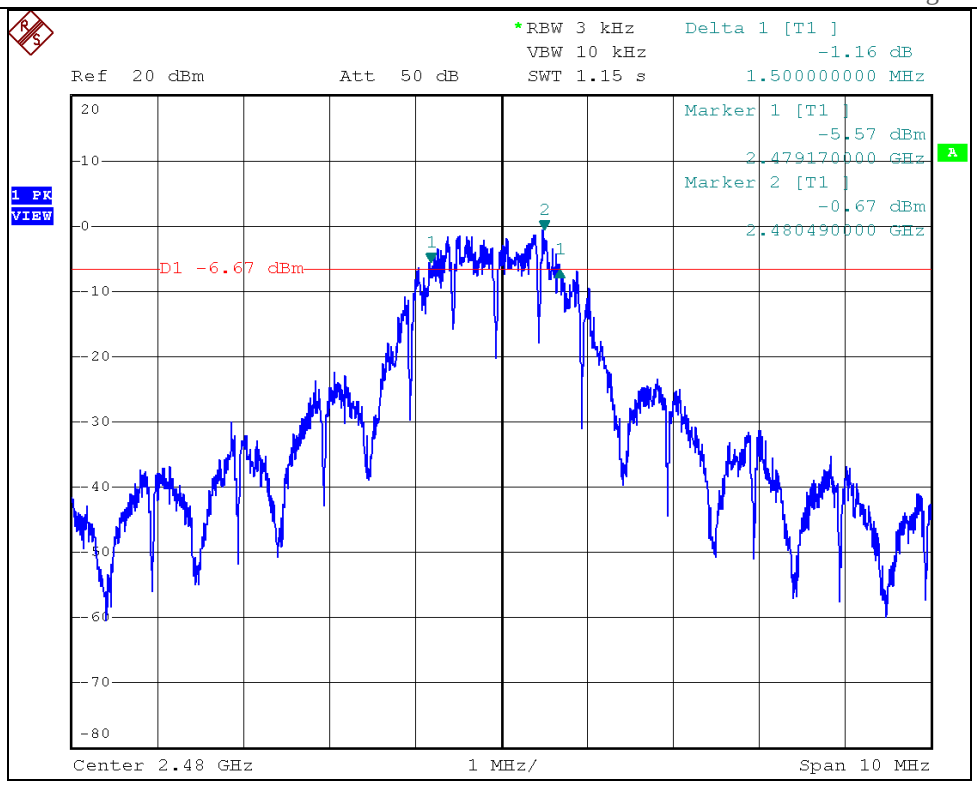
5.3.1 Bandwidth Plots, 6 dB



6 dB, Low Channel

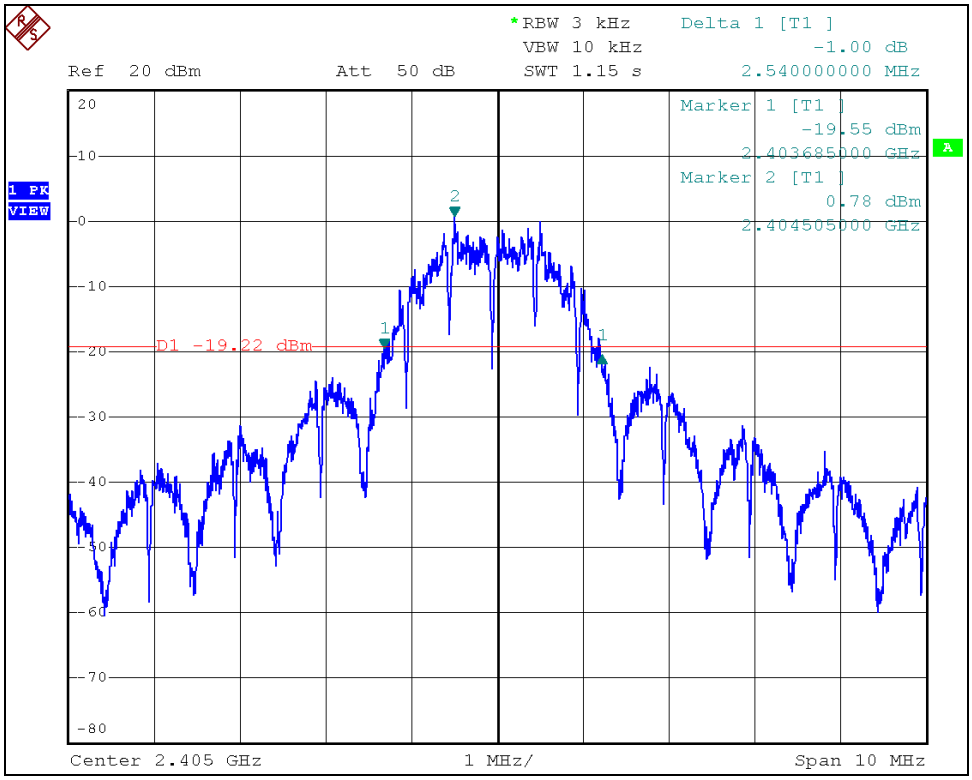


6 dB, Middle Channel

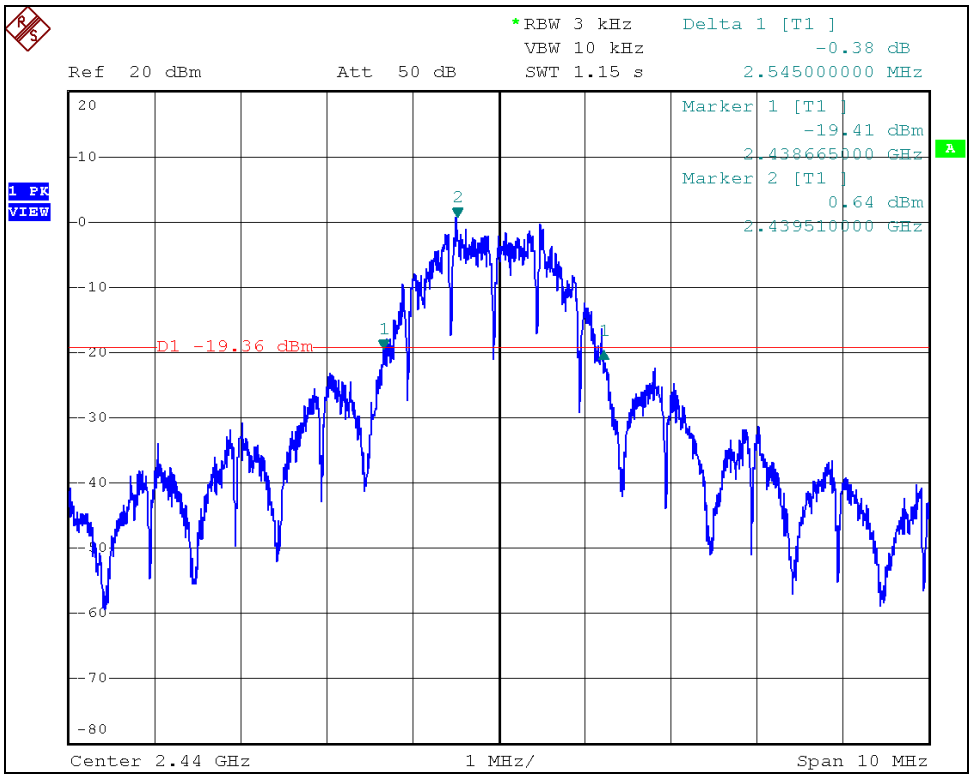


6 dB, High Channel

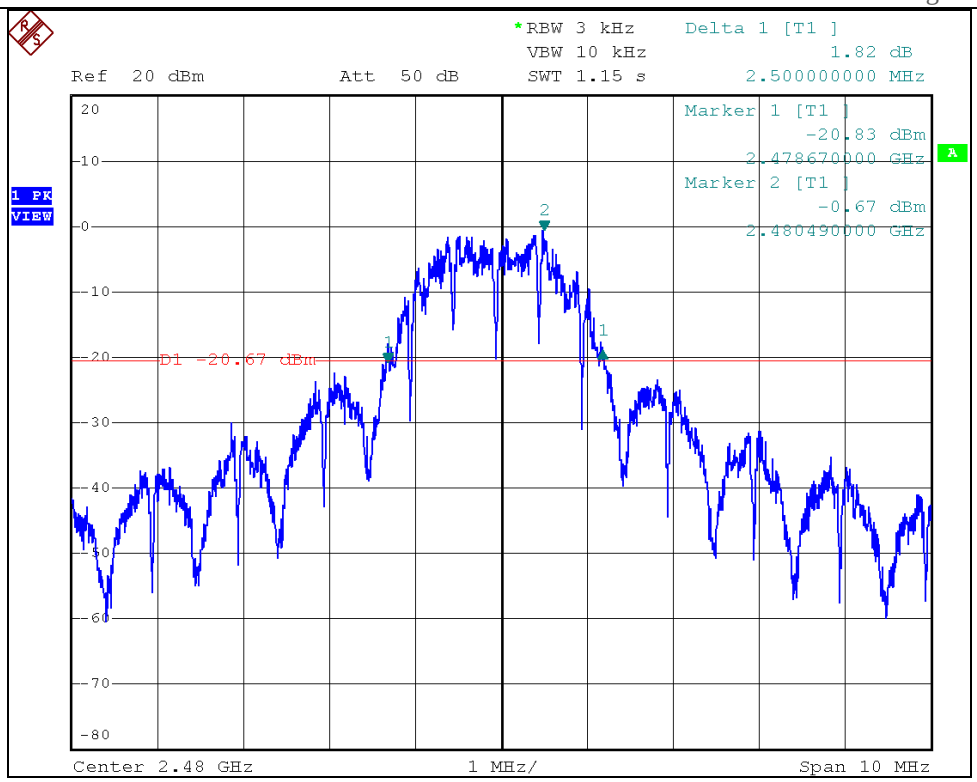
5.3.2 Bandwidth Plots, 20 dB



20 dB, Low Channel



20 dB, Middle Channel



20 dB, High Channel

6.0 Band Edge

6.1 Test Procedure

The EUT was placed on a non-conductive table 0.8 meters above the ground plane. The table was centered on a rotating turntable at a distance of 3 meters from the measurement antenna.

EUT is placed into normal transmit operation on the nearest band edge channel. The spectrum analyzer is centered on the band edge frequency with span sufficient to include the peak of the adjacent fundamental signal. Using peak detection, the analyzer measured emissions in max-hold mode. The measurement range includes two standard bandwidths from the respective band edge and some beyond to see the emission profile clearly. If required, the band-edge marker-delta method of C63.4 is utilized.

6.2 Test Criteria

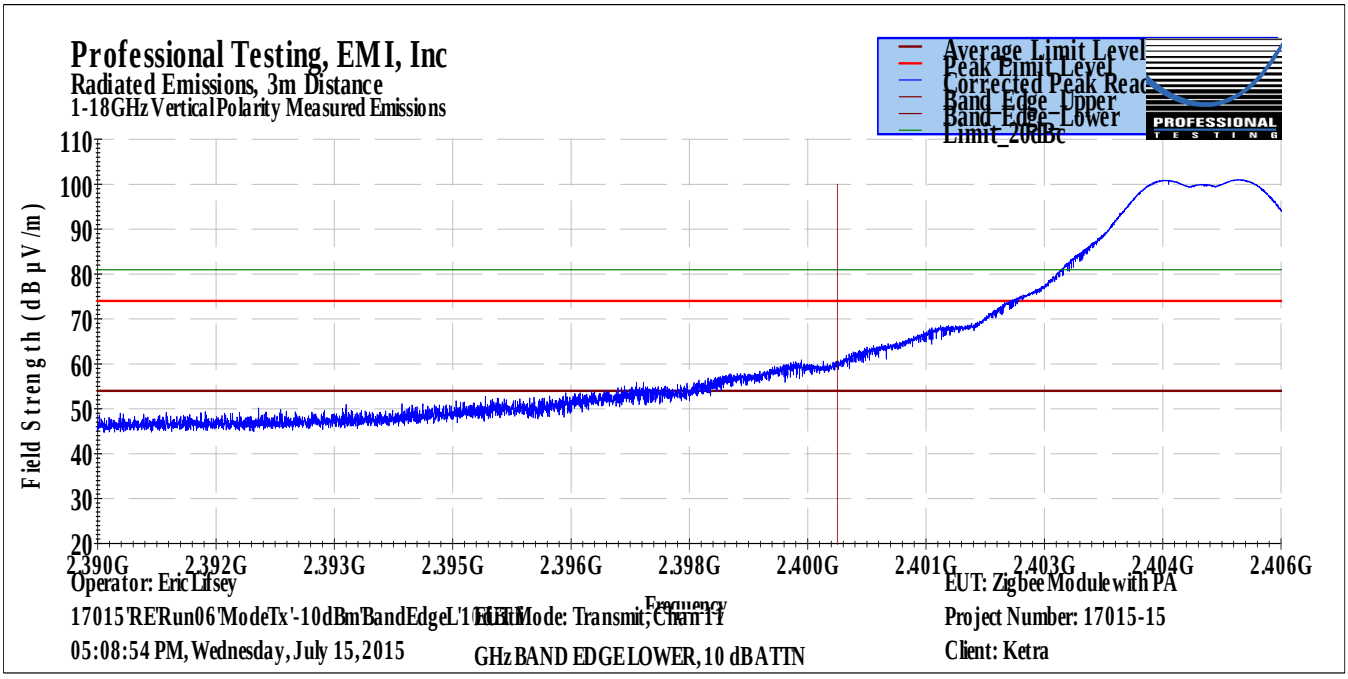
47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.205, 15.209 // RSS-247 5.5, RSS-Gen 6.13	Unwanted Emissions Adjacent to Authorized Band, Radiated	15 Jul 2015

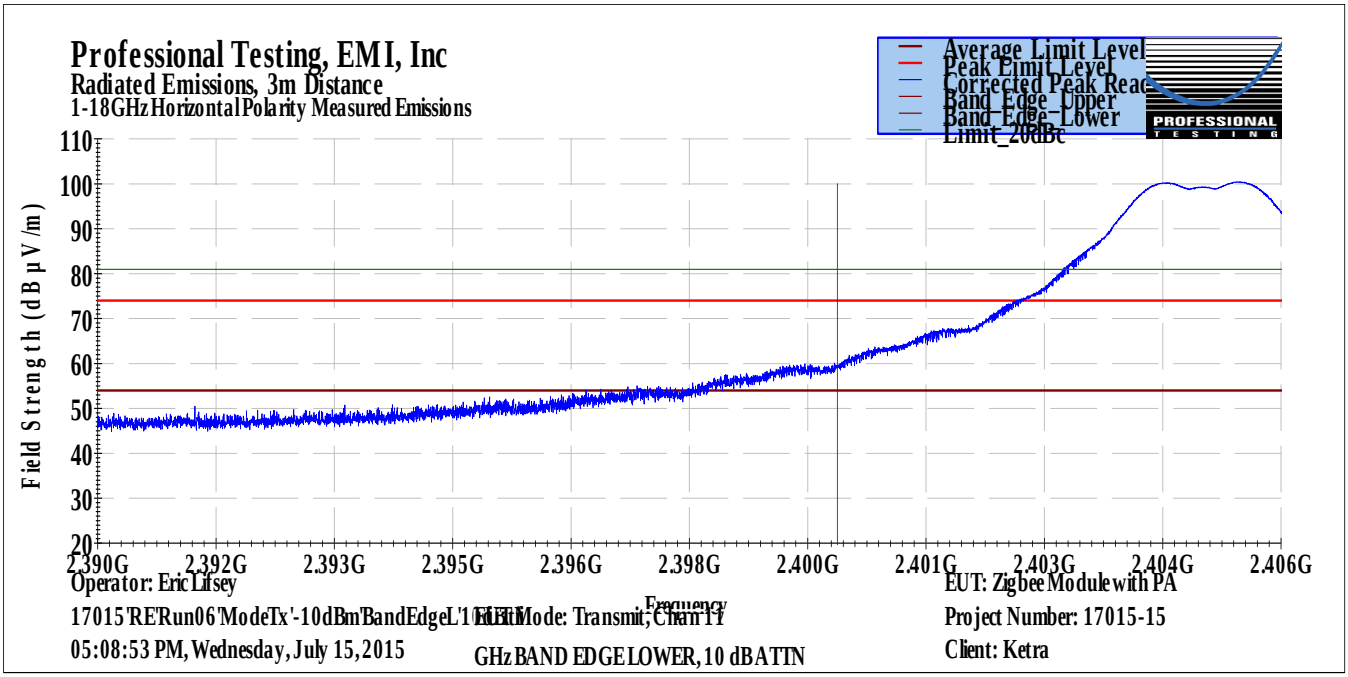
6.3 Test Results

Peak detection emissions at band edges were below the applicable general emission peak limits or the -20 dBc limit (shown in green).

With the duty cycle factor of -3.48 dB applied the EUT satisfied the criteria. Recorded data is presented below.

6.3.1 Low Channel Band Edge

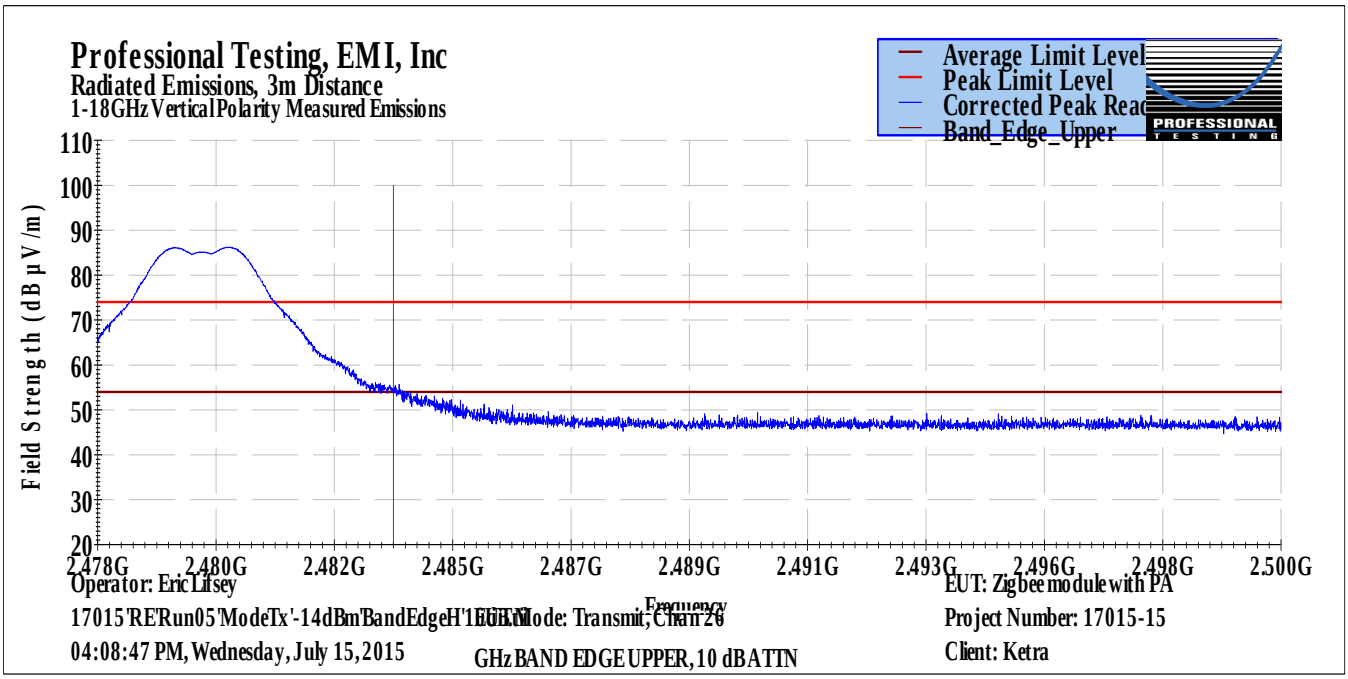


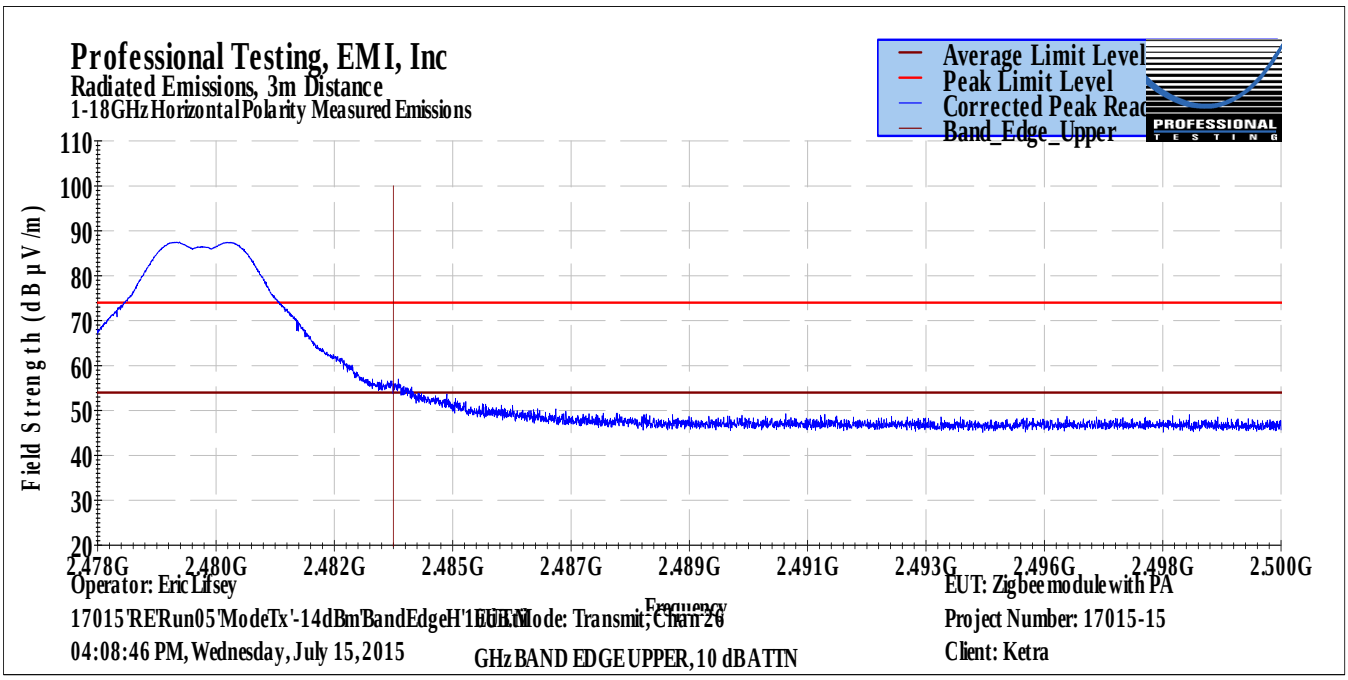


EUT Satisfies -20 dBc Criteria and 15.209 Criteria Below ~2.398 GHz

Peak detection levels shown.

6.3.2 High Channel Band Edge





EUT Satisfies -20 dBc Criteria and
15.209 Criteria Above 2.4835 GHz (When averaging factor is applied.)

Nearest/maximum peak recorded less averaging factor: 55.66 – 3.48 = 52.18 dBµV/m @ 3m

Peak detection levels shown.

7.0 Radiated Spurious Emissions, Receive Mode

7.1 Test Procedure

The EUT was placed on a non-conductive table 0.8 meters above the ground plane. The table was centered on a rotating turntable. The measurement antenna is scanned from 1 to 4 meters in height.

Spurious emissions below 1 GHz were measured with peak and quasi-peak detection with a resolution bandwidth of 120 kHz at a distance of 10 meters. Above 1 GHz the measurement distance was 3 meters with resolution bandwidth of 1 MHz and using peak and average detection. A diagram showing the test setup is given in the figure below.

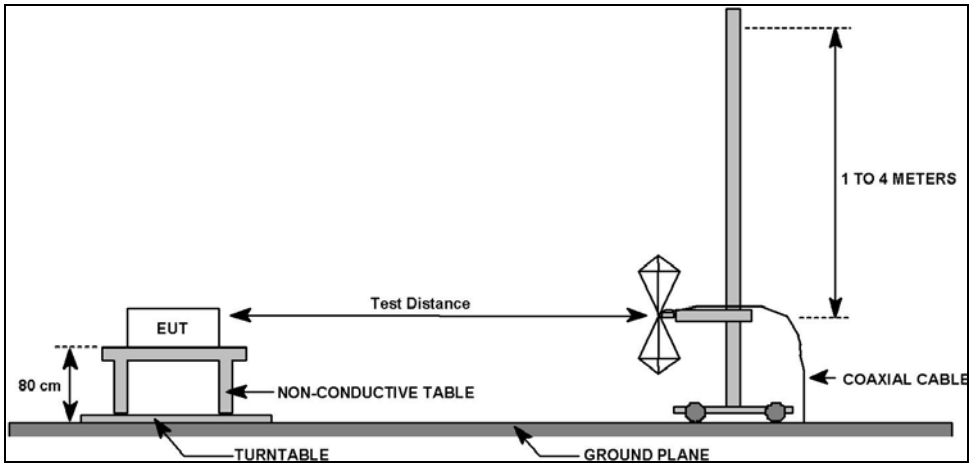


Figure 7.1.1: Field Strength of Spurious Emissions Test Setup

7.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.247, 15.209 // RSS-247 5.5, RSS-Gen 7.1	Field Strength of Radiated Spurious/Harmonic Emissions	15 Jul 2015

7.3 Test Results

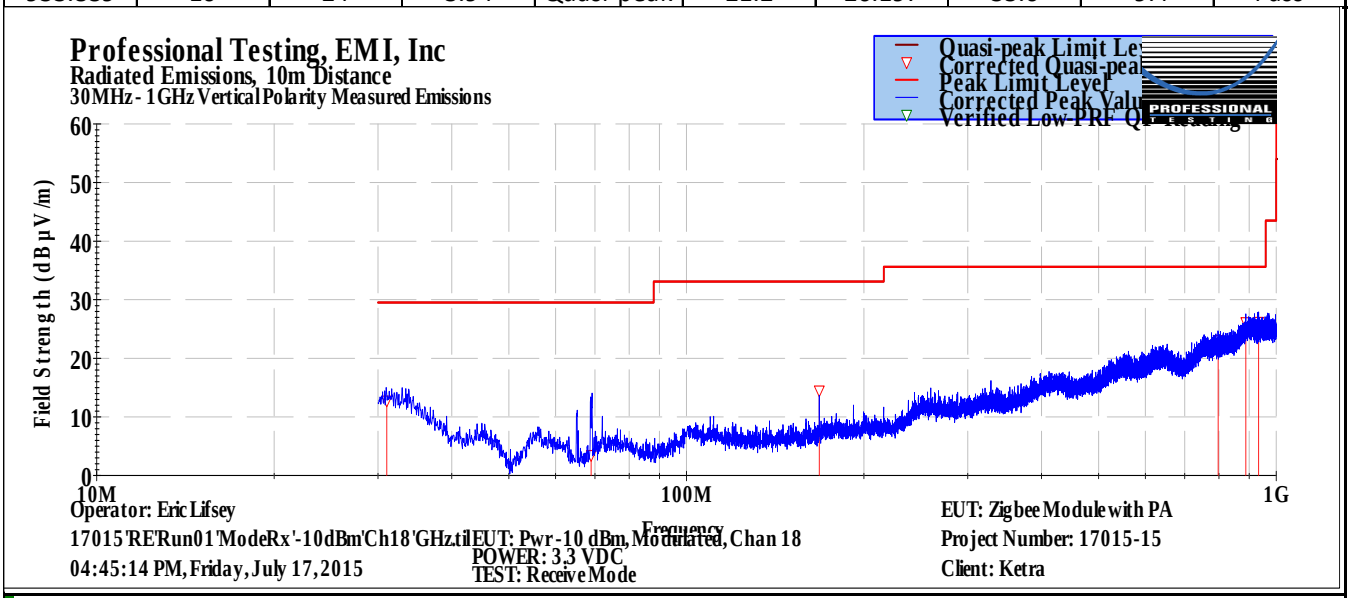
The EUT satisfied the criteria. Recorded data is presented below.

Table 7.3.1: Radiated Spurious Emissions, Receive Mode, Below 1 GHz, Vertical Polarity

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	7/15/2015	EUT Serial #:	Sample C2
Customer:	Ketra	EUT Part #:	0
Project Number:	17015	Test Technician:	Eric Lifsey
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	Zigbee Module with PA	Witness' Name:	Steve Proffit

Radiated Emissions Test Results Data Sheet			Page: 1 of 1
EUT Line Voltage:	3.3 VDC	EUT Power Frequency:	0 N/A
Antenna Orientation:	Vertical	Frequency Range:	30MHz to 1GHz
EUT Mode of Operation:		Receive Mode	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
31.0344	10	87	1.32	Quasi-peak	24.2	12.768	29.5	-16.7	Pass
68.9538	10	227	3.91	Quasi-peak	23.6	3.473	29.5	-26.0	Pass
167.995	10	290	1.38	Quasi-peak	30.1	14.482	33.1	-18.6	Pass
797.39	10	135	4.06	Quasi-peak	21.5	23.082	35.6	-12.5	Pass
888.584	10	354	1.72	Quasi-peak	21.4	26.161	35.6	-9.4	Pass
933.889	10	24	3.94	Quasi-peak	21.2	26.197	35.6	-9.4	Pass



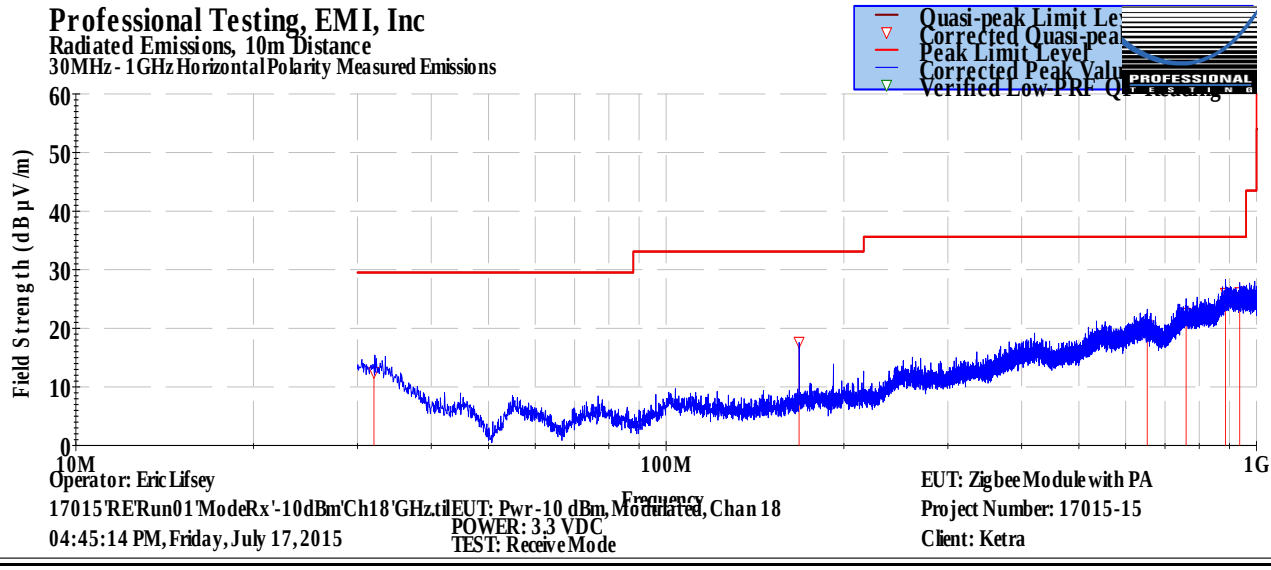
≤ 1GHz Vertical Antenna Polarity Measured Emissions

Table 7.3.2: Radiated Spurious Emissions, Receive Mode, Below 1 GHz, Horizontal Polarity

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	7/15/2015	EUT Serial #:	Sample C2
Customer:	Ketra	EUT Part #:	0
Project Number:	17015	Test Technician:	Eric Lifsey
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	Zigbee Module with PA	Witness' Name:	Steve Proffit

Radiated Emissions Test Results Data Sheet			Page: 1 of 1
EUT Line Voltage:	3.3 VDC	EUT Power Frequency:	0 N/A
Antenna Orientation:	Horizontal	Frequency Range:	30MHz to 1GHz
EUT Mode of Operation:		Receive Mode	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
31.9904	10	135	2.92	Quasi-peak	24	12.534	29.5	-17.0	Pass
167.999	10	102	3.64	Quasi-peak	33.3	17.682	33.1	-15.4	Pass
653.105	10	283	1.21	Quasi-peak	22	20.608	35.6	-15.0	Pass
759.662	10	155	1.27	Quasi-peak	21.7	22.63	35.6	-13.0	Pass
886.053	10	102	2.18	Quasi-peak	21.4	26.012	35.6	-9.6	Pass
936.456	10	322	1.09	Quasi-peak	21.1	26.133	35.6	-9.5	Pass

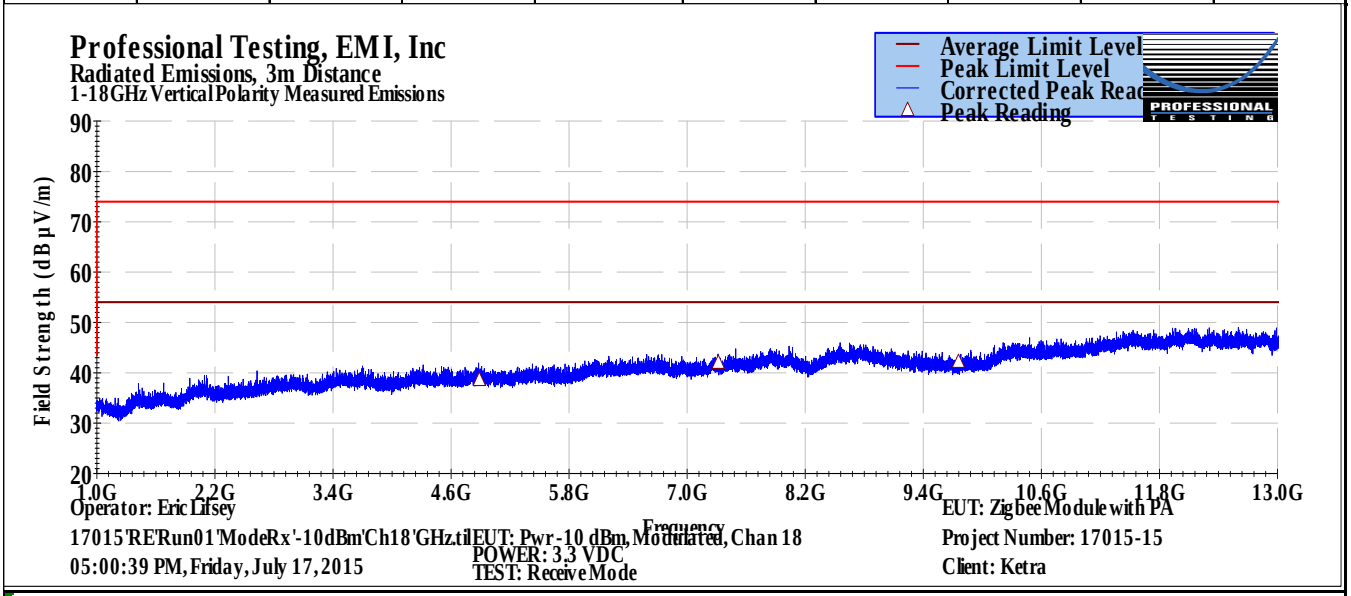


≤ 1GHz Horizontal Antenna Polarity Measured Emissions

Table 7.3.3: Radiated Spurious Emissions, Transmit Mode, Below 1 GHz, Middle Channel, Vertical Polarity

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	7/15/2015	EUT Serial #:	Sample C2
Customer:	Ketra	EUT Part #:	0
Project Number:	17015	Test Technician:	Eric Lifsey
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	Zigbee Module with PA	Witness' Name:	Steve Proffit

Radiated Emissions Test Results Data Sheet					Page: 1 of 1				
EUT Line Voltage:	3.3 VDC				EUT Power Frequency:	0 N/A			
Antenna Orientation:	Vertical				Frequency Range:	Above 1GHz			
EUT Mode of Operation:					Receive Mode				
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
4887.75	3	308	1	Peak	42.3	38.585	54.0	-15.4	Pass
7316.37	3	310	1	Peak	38.5	41.969	54.0	-12.0	Pass
9757.07	3	169	1	Peak	35.3	42.137	54.0	-11.9	Pass



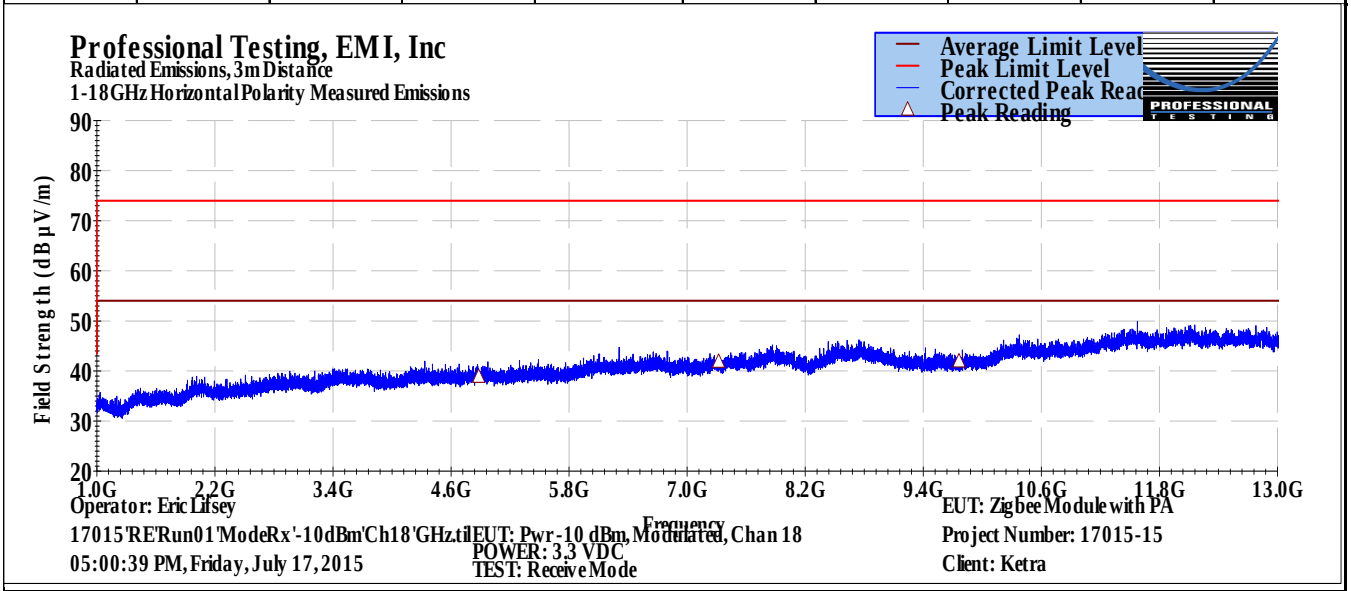
> 1GHz Vertical Antenna Polarity Measured Emissions

Table 7.3.4: Radiated Spurious Emissions, Transmit Mode, Below 1 GHz, Middle Channel, Horizontal Polarity

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	7/15/2015	EUT Serial #:	Sample C2
Customer:	Ketra	EUT Part #:	0
Project Number:	17015	Test Technician:	Eric Lifsey
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	Zigbee Module with PA	Witness' Name:	Steve Proffit

Radiated Emissions Test Results Data Sheet					Page:	1	of	1
EUT Line Voltage:	3.3	VDC	EUT Power Frequency:	0	N/A			
Antenna Orientation:	Horizontal		Frequency Range:	Above 1GHz				
EUT Mode of Operation:			Receive Mode					

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
4882	3	208	1	Peak	42.6	38.843	54.0	-15.2	Pass
7319.1	3	206	1	Peak	38.4	41.845	54.0	-12.2	Pass
9762.23	3	9	1	Peak	35	41.917	54.0	-12.1	Pass



> 1GHz Horizontal Antenna Polarity Measured Emissions

8.0 Radiated Spurious Emissions, Transmit Mode

8.1 Test Procedure

The EUT was placed on a non-conductive table 0.8 meters above the ground plane. The EUT was centered on a rotating turntable.

Spurious emissions below 1 GHz were measured with peak and quasi-peak detection with a resolution bandwidth of 120 kHz at a distance of 10 meters. Above 1 GHz the measurement distance was 3 meters with resolution bandwidth of 1 MHz and using peak and average detection. A diagram showing the test setup is given in the figure below.

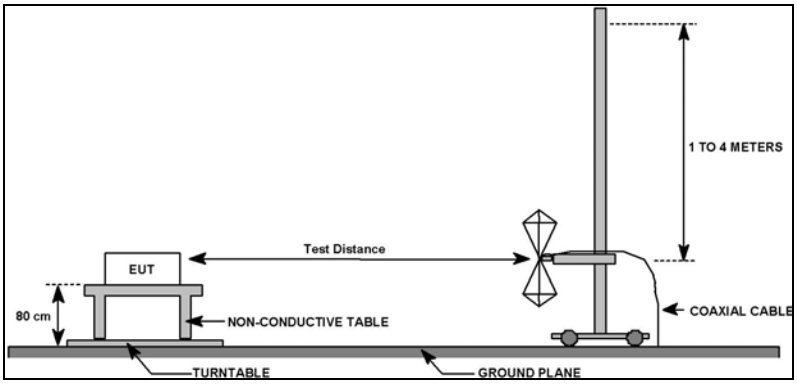


Figure 8.1.1: Field Strength of Spurious Emissions Test Setup

8.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.247, 15.209 // RSS-247 5.5, RSS-Gen 6.13	Field Strength of Radiated Spurious/Harmonic Emissions	15 Jul 2015

8.3 Test Results

In all cases detector mode is peak, RBW 1 MHz, VBW 3 MHz. All peak emissions can be seen as below the average limit. Also, the average duty cycle factor is -3.48 dB and affords even more margin than shown.

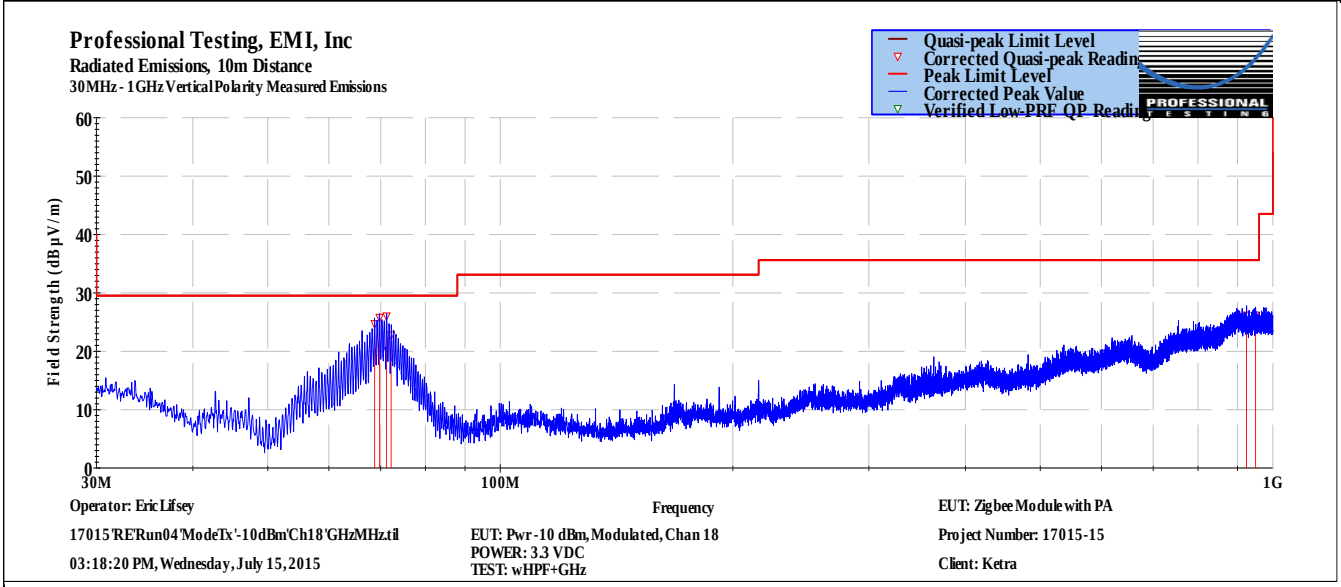
The EUT satisfied the criteria. Recorded data is presented below.

Table 8.3.1: Radiated Spurious Emissions, Transmit Mode, Below 1 GHz, Middle Channel, Vertical Polarity

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	7/15/2015	EUT Serial #:	Sample C2
Customer:	Ketra	EUT Part #:	0
Project Number:	17015	Test Technician:	Eric Lifsey
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	Zigbee Module with PA	Witness' Name:	Steve Proffit

Radiated Emissions Test Results Data Sheet			Page:	1	of	1
EUT Line Voltage:	3.3	VDC	EUT Power Frequency:	0	N/A	
Antenna Orientation:	Vertical		Frequency Range:	30MHz to 1GHz		
EUT Mode of Operation:			Transmit, Modulated			

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
68.7668	10	180	1.27	Quasi-peak	44.9	24.693	29.5	-4.8	Pass
69.7628	10	64	1.25	Quasi-peak	45.6	25.758	29.5	-3.7	Pass
71.2487	10	113	1.61	Quasi-peak	45.4	26.02	29.5	-3.5	Pass
72.2386	10	101	3.08	Quasi-peak	41.7	22.8	29.5	-6.7	Pass
924.677	10	140	1.52	Quasi-peak	21.2	26.142	35.6	-9.5	Pass
950.056	10	25	3.91	Quasi-peak	20.9	26.152	35.6	-9.4	Pass



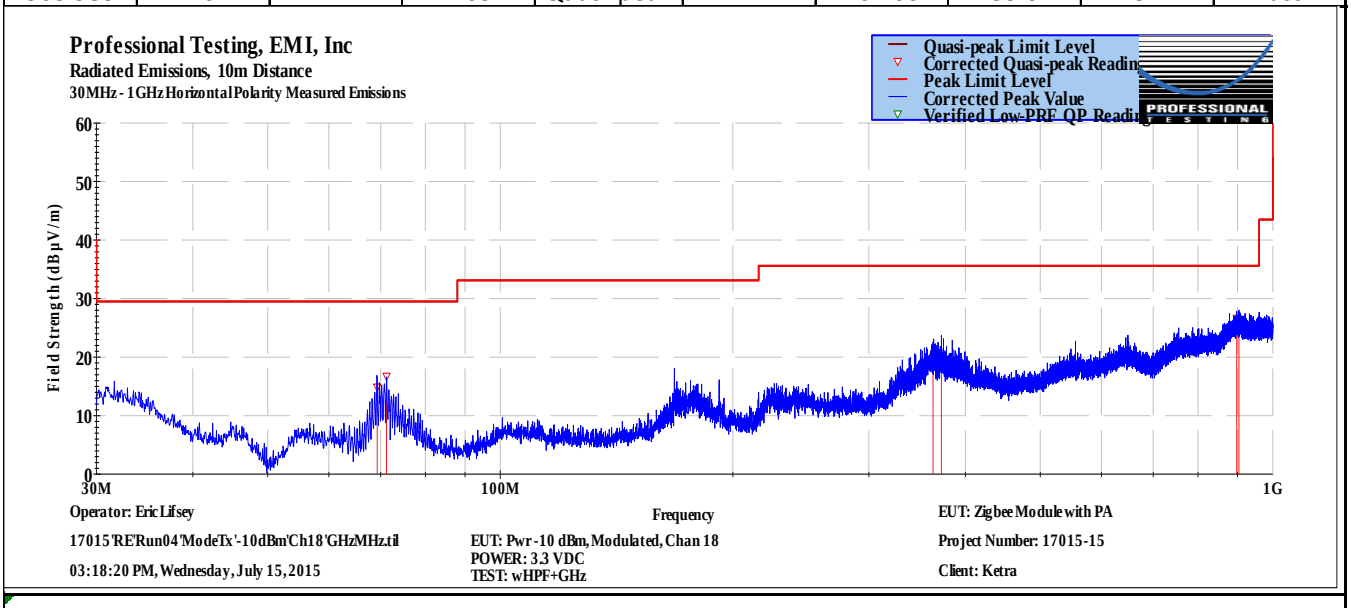
≤ 1GHz Vertical Antenna Polarity Measured Emissions

Table 8.3.2: Radiated Spurious Emissions, Transmit Mode, Below 1 GHz, Middle Channel, Horizontal Polarity

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	7/15/2015	EUT Serial #:	Sample C2
Customer:	Ketra	EUT Part #:	0
Project Number:	17015	Test Technician:	Eric Lifsey
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	Zigbee Module with PA	Witness' Name:	Steve Proffit

Radiated Emissions Test Results Data Sheet			Page: 1 of 1
EUT Line Voltage:	3.3 VDC	EUT Power Frequency:	0 N/A
Antenna Orientation:	Horizontal	Frequency Range:	30MHz to 1GHz
EUT Mode of Operation:		Transmit, Modulated	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
69.2844	10	197	2.91	Quasi-peak	34.9	14.859	29.5	-14.6	Pass
71.2397	10	229	3.03	Quasi-peak	36	16.703	29.5	-12.8	Pass
363.188	10	70	1.9	Quasi-peak	27.7	18.606	35.6	-17.0	Pass
372.391	10	236	1.75	Quasi-peak	28.3	19.629	35.6	-16.0	Pass
897.976	10	47	2.32	Quasi-peak	21.4	26.6	35.6	-9.0	Pass
903.983	10	11	2.05	Quasi-peak	21.2	26.466	35.6	-9.1	Pass

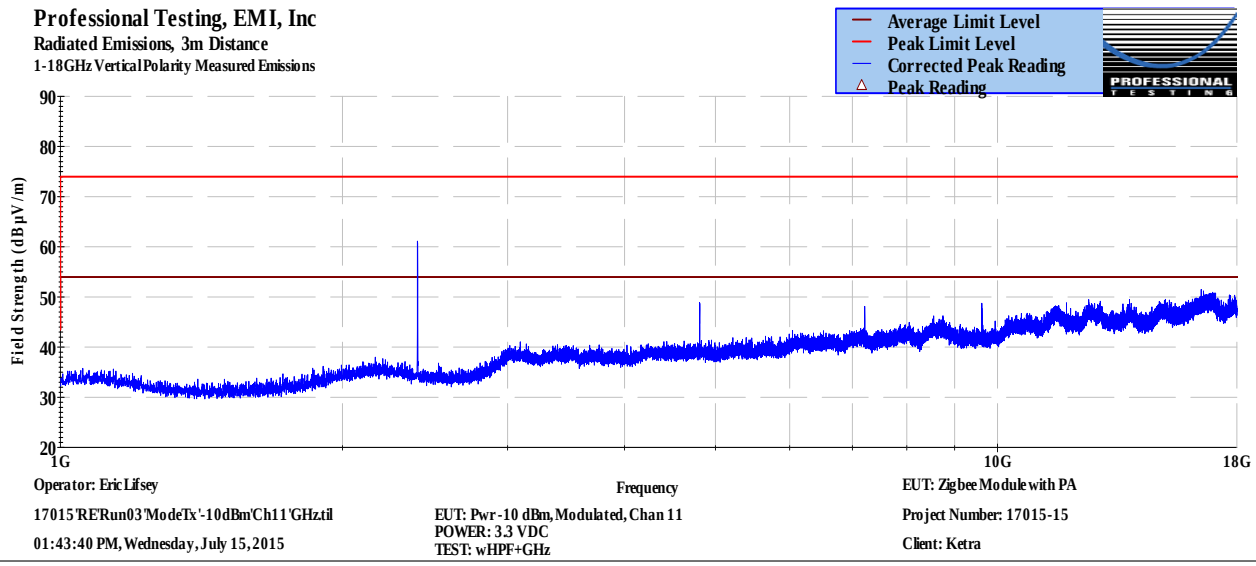


≤ 1GHz Horizontal Antenna Polarity Measured Emissions

Table 8.3.3: Radiated Spurious Emissions, Transmit Mode, 1 to 18 GHz, Low Channel, Vertical Polarity

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	7/15/2015	**EUT Serial #:**	Sample C2
Customer:	Ketra	**EUT Part #:**	0
Project Number:	17015	**Test Technician:**	Eric Lifsey
Purchase Order #:	0	**Supervisor:**	Lisa Arndt
Equip. Under Test:	Zigbee Module with PA	**Witness' Name:**	Steve Proffit

Radiated Emissions Test Results Data Sheet			Page: 1 of 1
EUT Line Voltage:	3.3 VDC	**EUT Power Frequency:**	0 N/A
Antenna Orientation:	Vertical	**Frequency Range:**	Above 1GHz
EUT Mode of Operation:		Transmit, Modulated	

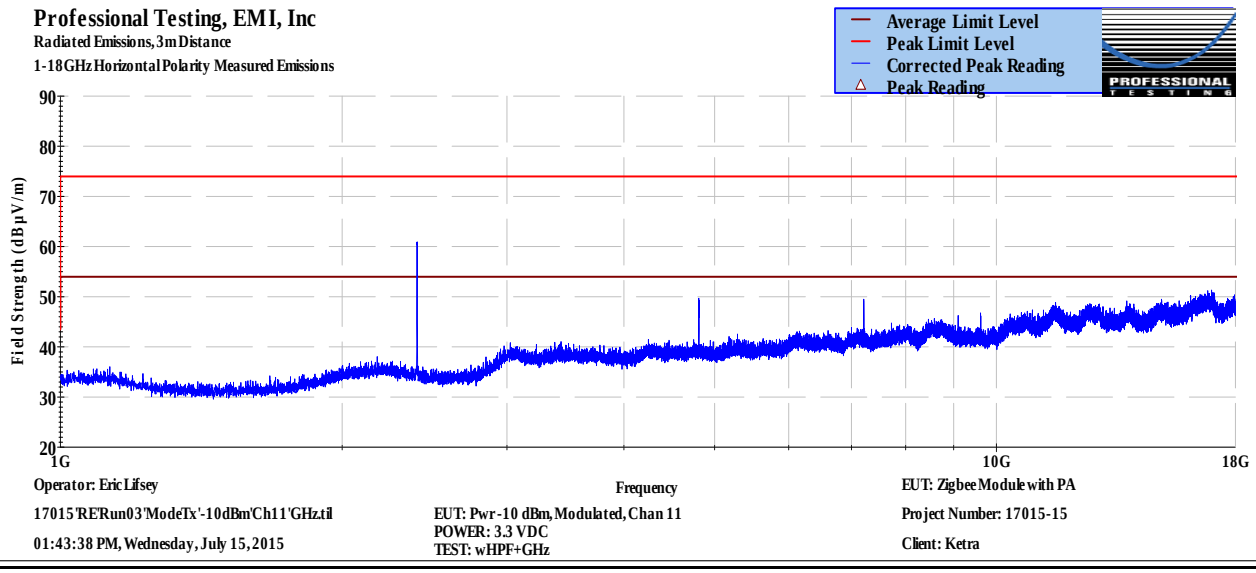


> 1GHz Vertical Antenna Polarity Measured Emissions

Table 8.3.4: Radiated Spurious Emissions, Transmit Mode, 1 to 18 GHz, Low Channel, Horizontal Polarity

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	7/15/2015	EUT Serial #:	Sample C2
Customer:	Ketra	EUT Part #:	0
Project Number:	17015	Test Technician:	Eric Lifsey
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	Zigbee Module with PA	Witness' Name:	Steve Proffit

Radiated Emissions Test Results Data Sheet			Page:	1	of	1
EUT Line Voltage:	3.3	VDC	EUT Power Frequency:	0	N/A	
Antenna Orientation:	Horizontal		Frequency Range:	Above 1GHz		
EUT Mode of Operation:			Transmit, Modulated			

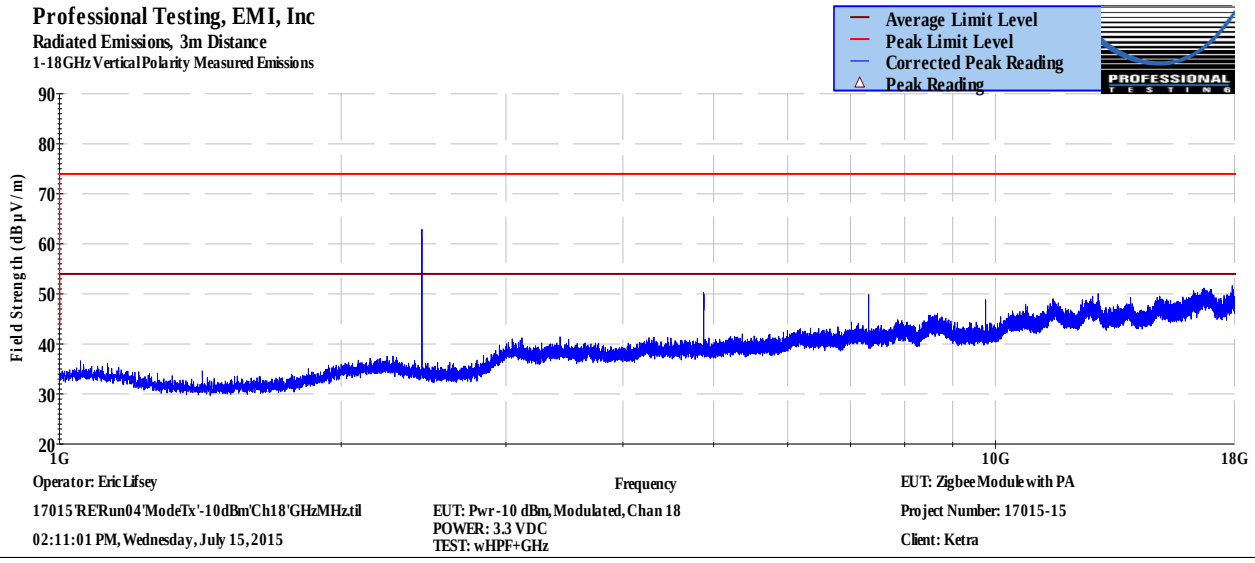


> 1GHz Horizontal Antenna Polarity Measured Emissions

Table 8.3.5: Radiated Spurious Emissions, Transmit Mode, 1 to 18 GHz, Middle Channel, Vertical Polarity

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	7/15/2015	EUT Serial #:	Sample C2
Customer:	Ketra	EUT Part #:	0
Project Number:	17015	Test Technician:	Eric Lifsey
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	Zigbee Module with PA	Witness' Name:	Steve Proffit

Radiated Emissions Test Results Data Sheet			Page:	1	of	1
EUT Line Voltage:	3.3	VDC	EUT Power Frequency:	0	N/A	
Antenna Orientation:	Vertical		Frequency Range:	Above 1GHz		
EUT Mode of Operation:			Transmit, Modulated			

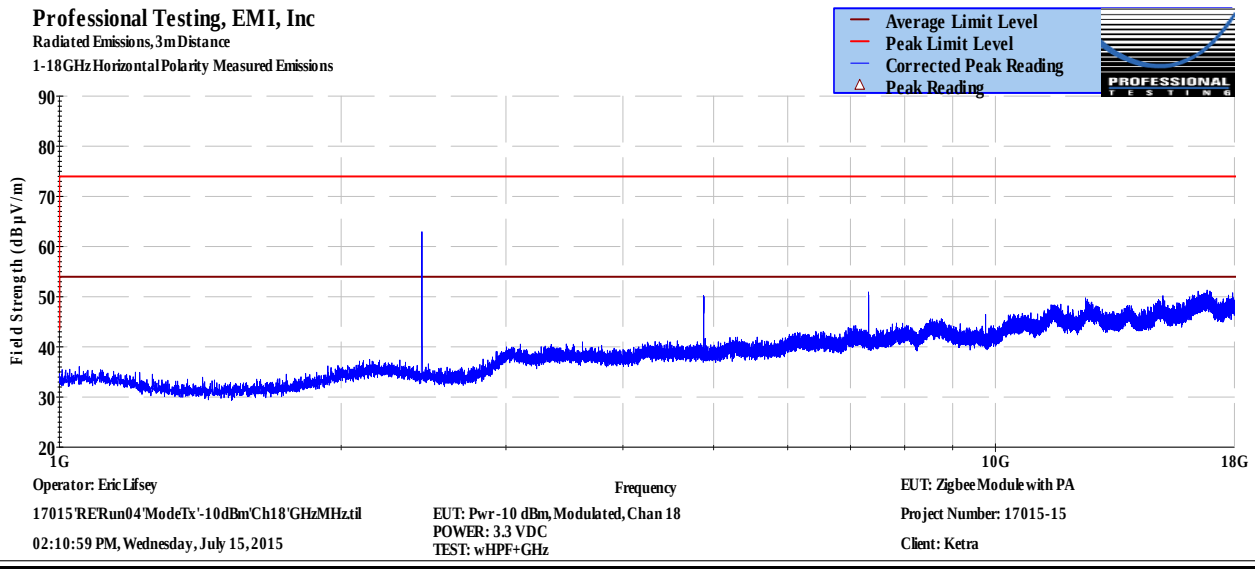


> 1GHz Vertical Antenna Polarity Measured Emissions

Table 8.3.6: Radiated Spurious Emissions, Transmit Mode, 1 to 18 GHz, Middle Channel, Horizontal Polarity

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	7/15/2015	EUT Serial #:	Sample C2
Customer:	Ketra	EUT Part #:	0
Project Number:	17015	Test Technician:	Eric Lifsey
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	Zigbee Module with PA	Witness' Name:	Steve Proffit

Radiated Emissions Test Results Data Sheet			Page:	1	of	1
EUT Line Voltage:	3.3 VDC	EUT Power Frequency:	0	N/A		
Antenna Orientation:	Horizontal	Frequency Range:	Above 1GHz			
EUT Mode of Operation:		Transmit, Modulated				

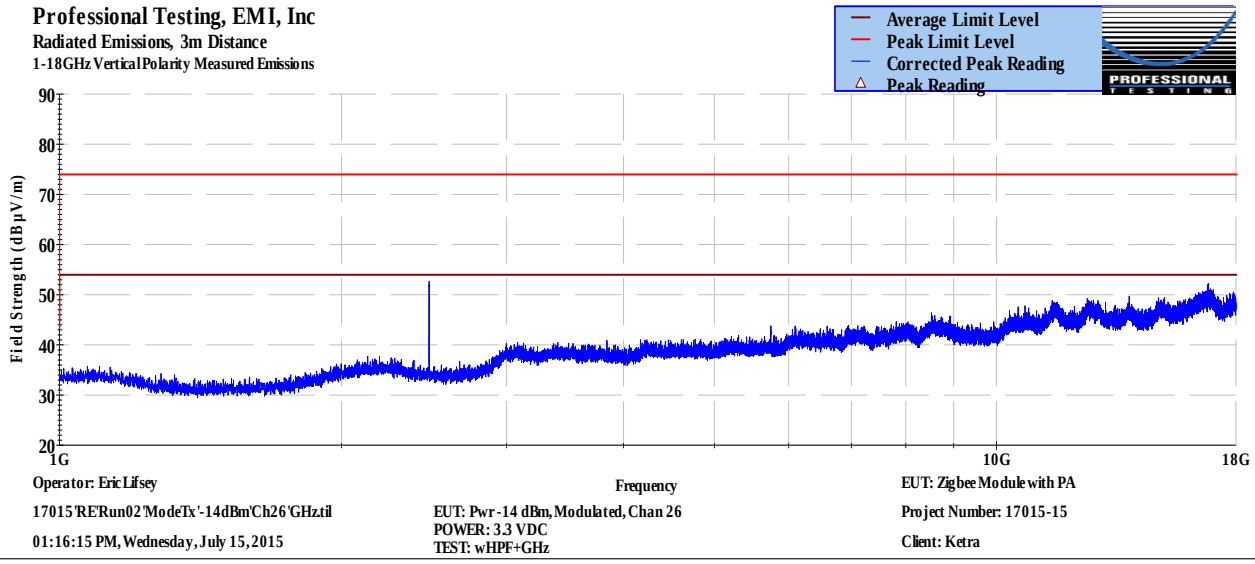


> 1GHz Horizontal Antenna Polarity Measured Emissions

Table 8.3.7: Radiated Spurious Emissions, Transmit Mode, 1 to 18 GHz, High Channel, Vertical Polarity

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	7/15/2015	EUT Serial #:	Sample C2
Customer:	Ketra	EUT Part #:	0
Project Number:	17015	Test Technician:	Eric Lifsey
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	Zigbee Module with PA	Witness' Name:	Steve Proffit

Radiated Emissions Test Results Data Sheet			Page:	1	of	1
EUT Line Voltage:	3.3	VDC	EUT Power Frequency:	0	N/A	
Antenna Orientation:	Vertical		Frequency Range:	Above 1GHz		
EUT Mode of Operation:			Transmit, Modulated			

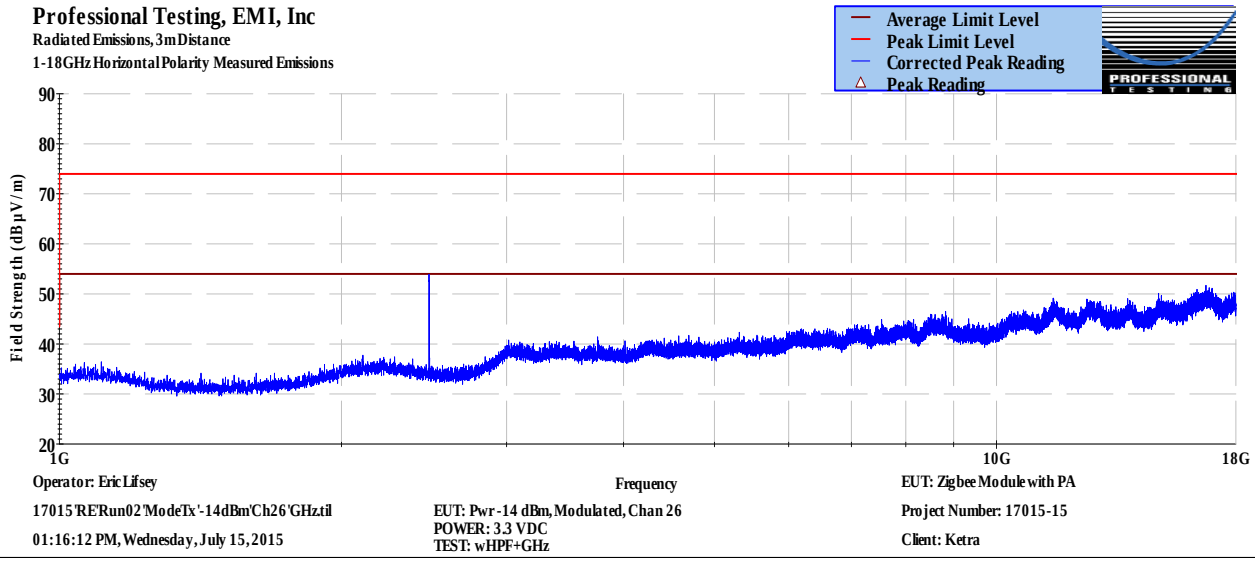


> 1GHz Vertical Antenna Polarity Measured Emissions

Table 8.3.8: Radiated Spurious Emissions, Transmit Mode, 1 to 18 GHz, High Channel, Horizontal Polarity

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	7/15/2015	EUT Serial #:	Sample C2
Customer:	Ketra	EUT Part #:	0
Project Number:	17015	Test Technician:	Eric Lifsey
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	Zigbee Module with PA	Witness' Name:	Steve Proffit

Radiated Emissions Test Results Data Sheet			Page:	1	of	1
EUT Line Voltage:	3.3	VDC	EUT Power Frequency:	0	N/A	
Antenna Orientation:	Horizontal		Frequency Range:	Above 1GHz		
EUT Mode of Operation:			Transmit, Modulated			



> 1GHz Horizontal Antenna Polarity Measured Emissions

Table 8.3.9: Radiated Spurious Emissions, Transmit Mode, 18 to 25 GHz, Low Channel, Vertical Polarity

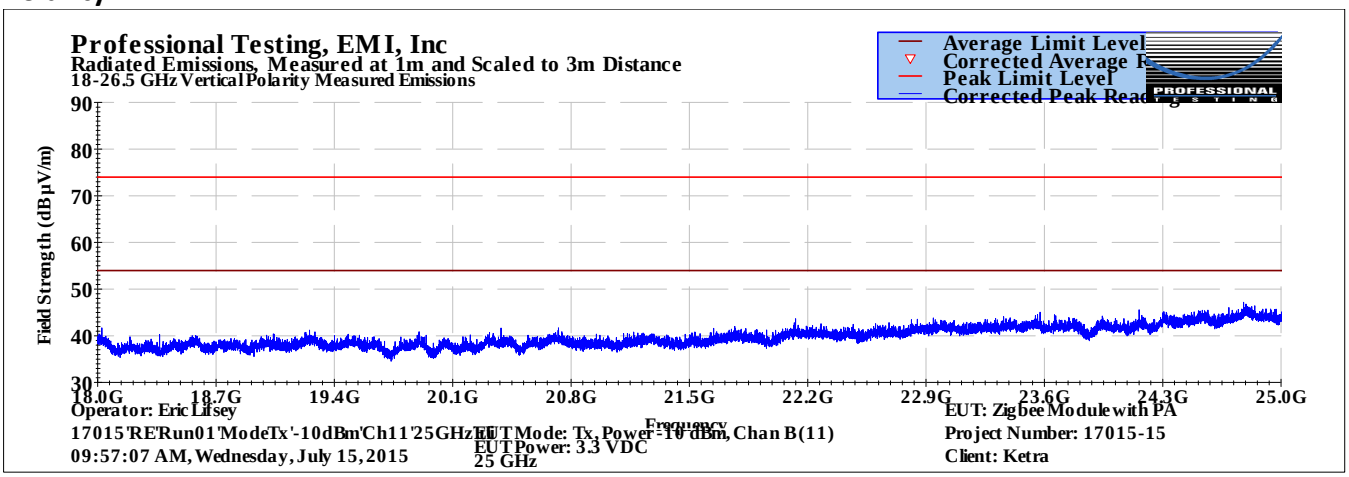


Table 8.3.10: Radiated Spurious Emissions, Transmit Mode, 18 to 25 GHz, Low Channel, Horizontal Polarity

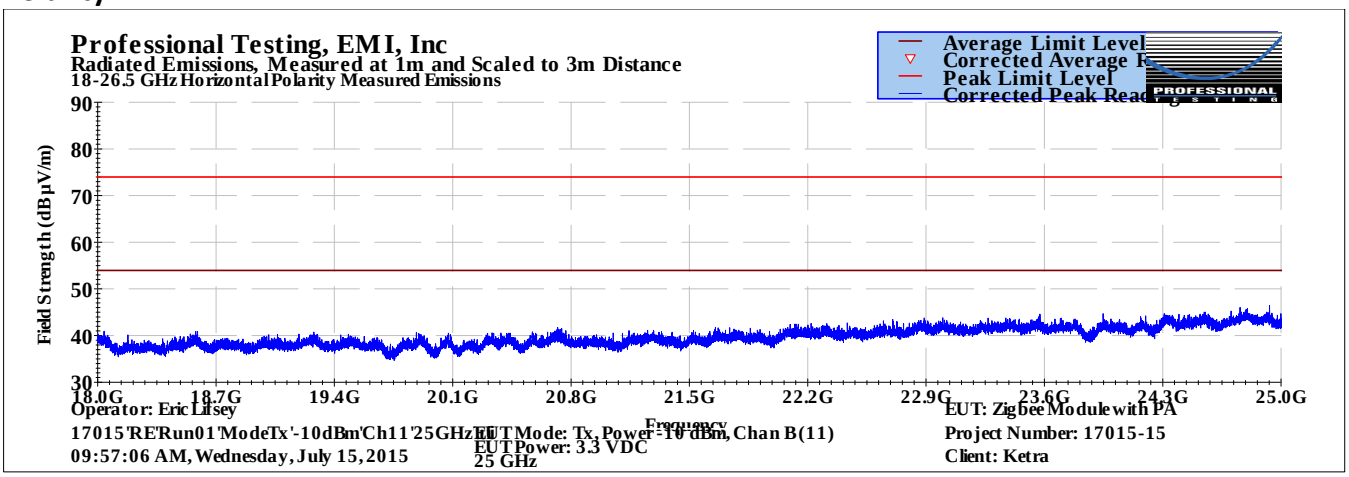


Table 8.3.11: Radiated Spurious Emissions, Transmit Mode, 18 to 25 GHz, Middle Channel, Vertical Polarity

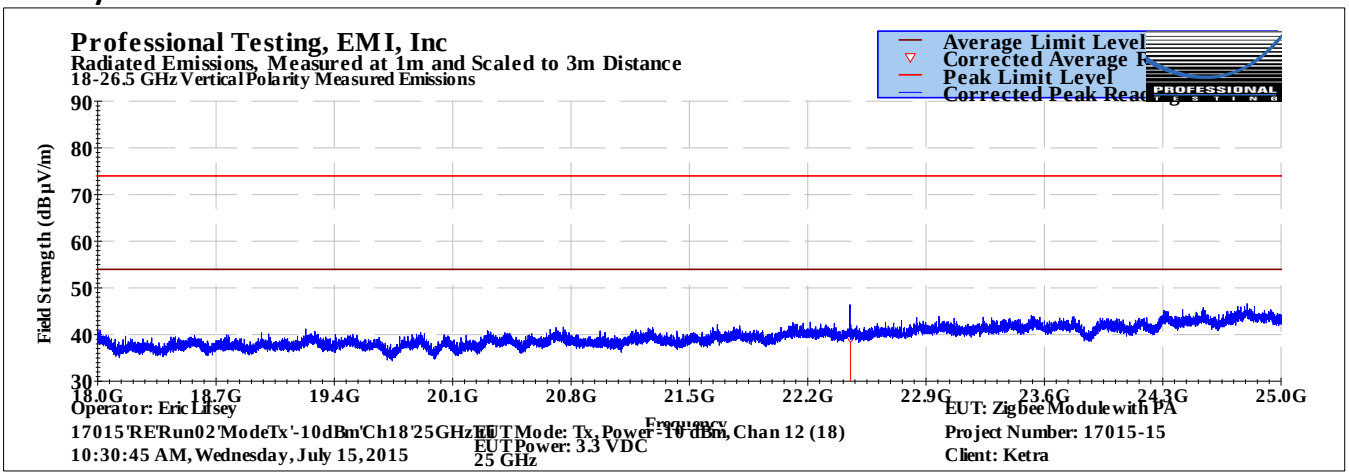


Table 8.3.12: Radiated Spurious Emissions, Transmit Mode, 18 to 25 GHz, Middle Channel, Horizontal Polarity

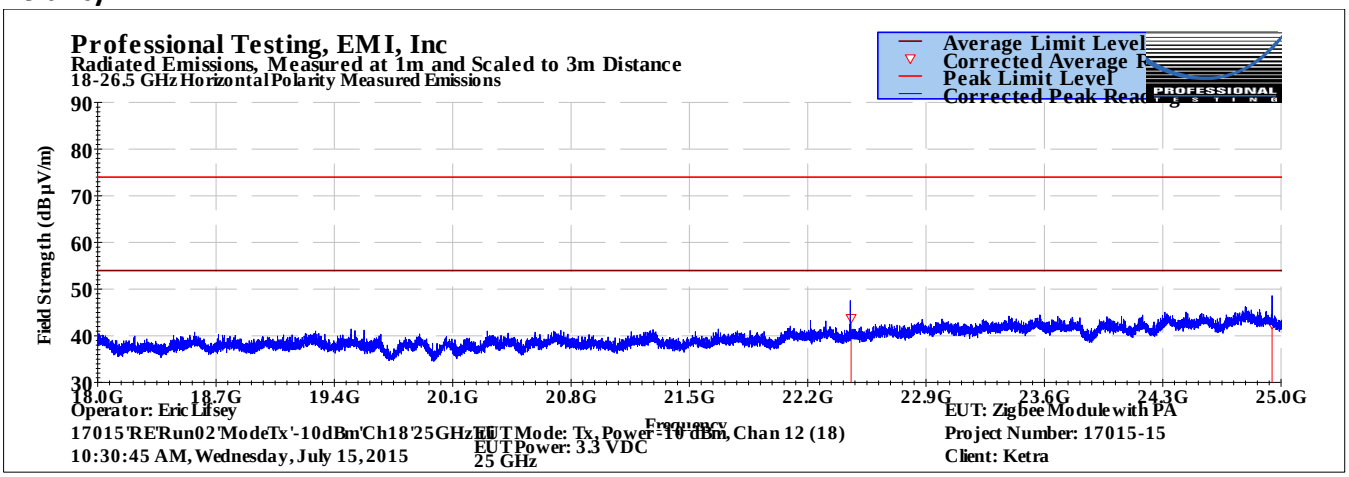


Table 8.3.13: Radiated Spurious Emissions, Transmit Mode, 18 to 25 GHz, High Channel, Vertical Polarity

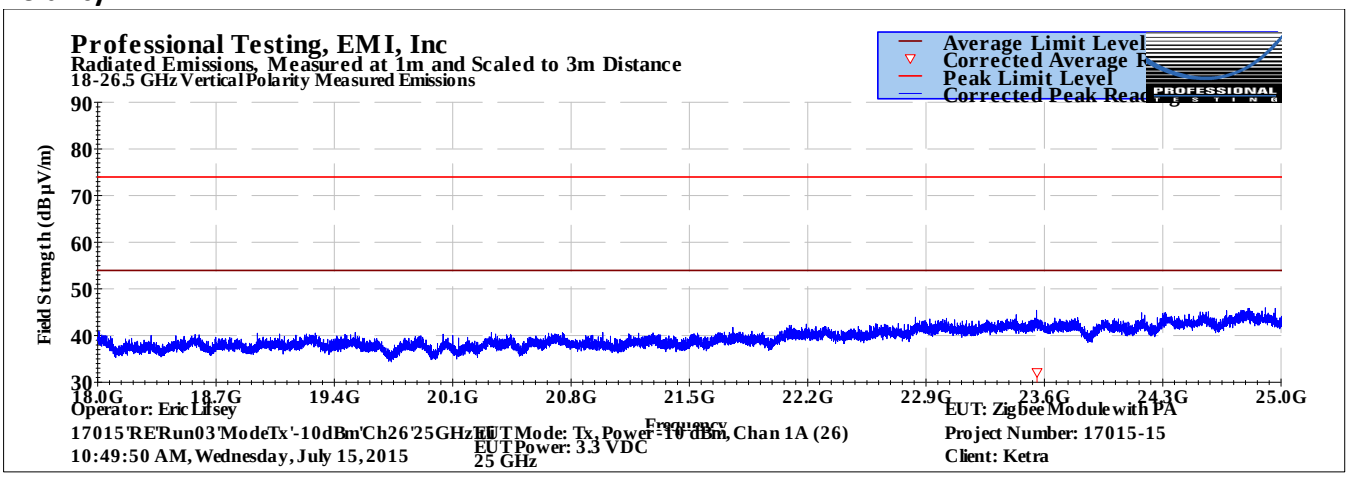
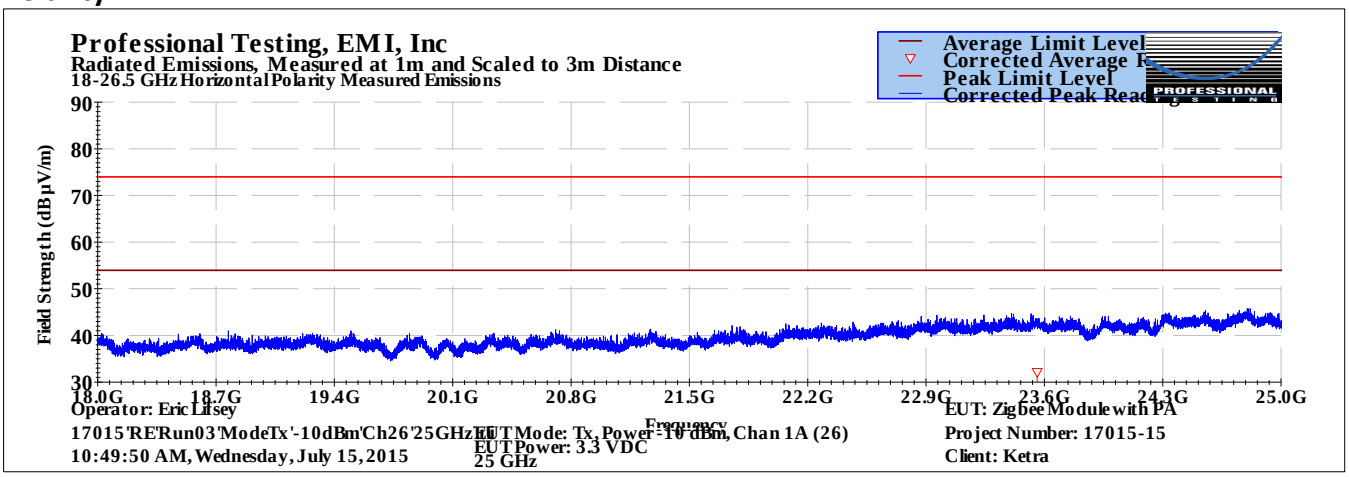


Table 8.3.14: Radiated Spurious Emissions, Transmit Mode, 18 to 25 GHz, High Channel, Horizontal Polarity



9.0 Conducted Emissions, Mains

9.1 Procedure

The EUT was placed on a non-conductive table 0.8 meters above the floor and 0.4 meters from the conductive vertical reference plane. The EUT is powered through a line impedance stabilization network (LISN) that provides a measurement tap and a termination approximating 50 Ohms in the measurement range of 150 kHz to 30 MHz. A spectrum analyzer is connected, in turn, to each mains line measurement tap and software is employed to measure the radio frequency noise generated by the EUT.

9.2 Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.207 // RSS-Gen 8.8	Mains conducted emissions	20 Jul 2015

9.3 Results

Measurements were taken for receive and transmit modes.

The EUT satisfied the criteria. Tabular and plotted measurements appear on the following pages.

9.3.1 Mains Conducted Emissions, Neutral Lead, Transmit Mode

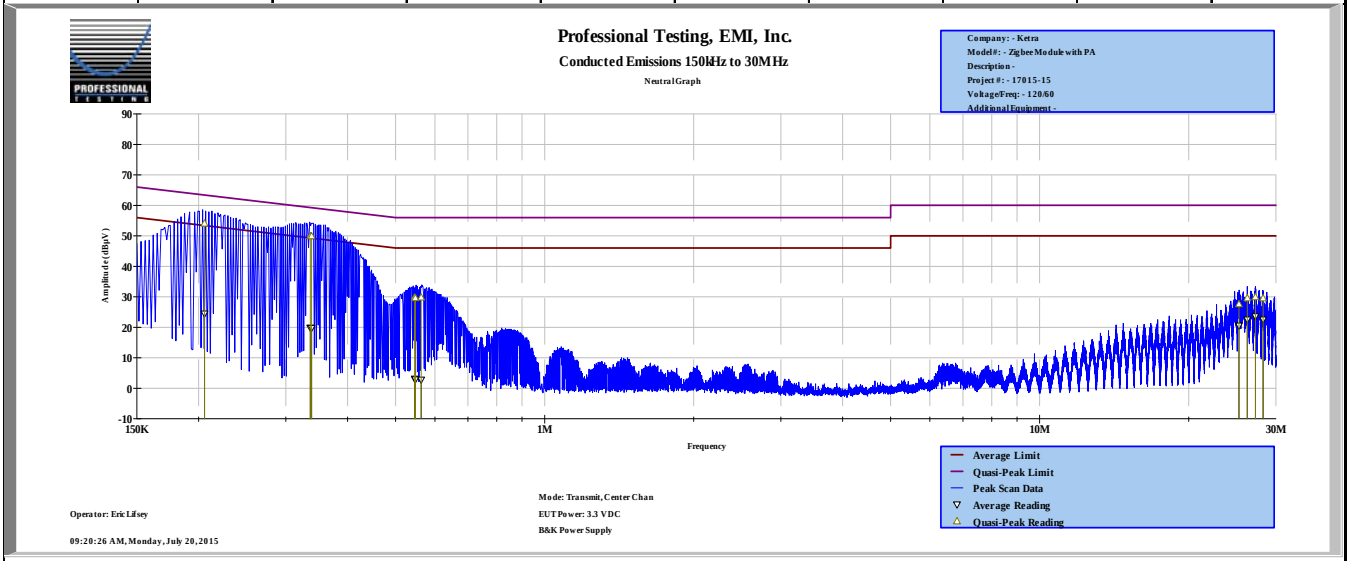
Professional Testing, EMI, Inc.

Test Method:	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 (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.207 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Conducted Emissions Limits		
Section:	15.207		
Test Date(s):	7/20/2015	**EUT Serial #:**	C02
Customer:	Ketra	**EUT Part #:**	NA (EUT module runs 3.3 VDC)
Project Number:	17015-15	**Test Technician:**	Eric Lifsey
Purchase Order #:	NA	**Supervisor:**	Lisa Arndt
Equip. Under Test:	Zigbee Module with PA	**Witness' Name:**	None

Conducted Emissions Test Results Data Sheet - Neutral Lead **Page: 1 of 2**

EUT Line Voltage:	120	VAC	EUT Line Frequency:	60	Hz

Frequency Measured (MHz)	Peak Detector Reading (dBµV)	Quasi-peak Detector Reading (dBµV)	Quasi-peak Detector Limit (dBµV)	Quasi-peak Detector Margin (dB)	Quasi-peak Detector Test Results	Average Detector Reading (dBµV)	Average Detector Limit (dBµV)	Average Detector Margin (dB)	Average Detector Test Results
0.20553	59	54.1	63.4	-9.3	PASS	24.5	53.4	-28.9	PASS
0.33603	54.7	49.9	59.3	-9.4	PASS	19.8	49.3	-29.5	PASS
0.33824	54.5	49.9	59.2	-9.4	PASS	19.8	49.2	-29.5	PASS
0.5462	35	29.8	56	-26.2	PASS	3.1	46	-42.9	PASS
0.5482	34.6	29.6	56	-26.4	PASS	2.9	46	-43.1	PASS
0.5629	35	29.8	56	-26.2	PASS	2.8	46	-43.2	PASS
25.2681	33.9	27.6	60	-32.4	PASS	20.5	50	-29.5	PASS
26.2718	35.1	29.6	60	-30.4	PASS	22.5	50	-27.5	PASS
27.2732	34.9	29.9	60	-30.1	PASS	23.5	50	-26.5	PASS
28.2718	34.4	29.5	60	-30.5	PASS	22.5	50	-27.5	PASS



Measured Conducted Emissions - Neutral Lead

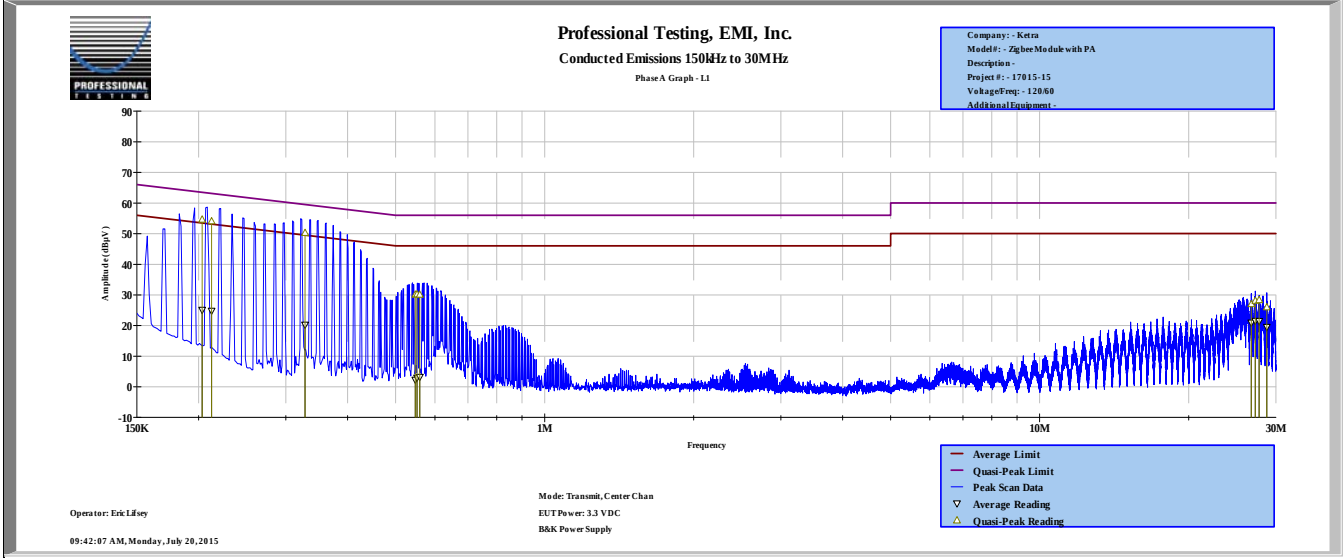
9.3.2 Mains Conducted Emissions, Phase Lead, Transmit Mode

Professional Testing, EMI, Inc.			
Test Method:	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 (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.207 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Conducted Emissions Limits		
Section:	15.207		
Test Date(s):	7/20/2015	**EUT Serial #:**	C02
Customer:	Ketra	**EUT Part #:**	NA (EUT module runs 3.3 VDC)
Project Number:	17015-15	**Test Technician:**	Eric Lifsey
Purchase Order #:	NA	**Supervisor:**	Lisa Arndt
Equip. Under Test:	Zigbee Module with PA	**Witness' Name:**	None

Conducted Emissions Test Results Data Sheet - Phase Lead (Line 1) Page: 2 of 2

EUT Line Voltage:	120	VAC	EUT Line Frequency:	60	Hz

Frequency Measured (MHz)	Peak Detector Reading (dBµV)	Quasi-peak Detector Reading (dBµV)	Quasi-peak Detector Limit (dBµV)	Quasi-peak Detector Margin (dB)	Quasi-peak Detector Test Results	Average Detector Reading (dBµV)	Average Detector Limit (dBµV)	Average Detector Margin (dB)	Average Detector Test Results
0.20326	59.4	54.6	63.5	-8.9	PASS	25.1	53.5	-28.4	PASS
0.21237	59.1	54.1	63.1	-9	PASS	24.8	53.1	-28.3	PASS
0.3281	55.1	50.3	59.5	-9.2	PASS	20.2	49.5	-29.3	PASS
0.5479	35.2	30.1	56	-25.9	PASS	2.2	46	-43.8	PASS
0.5522	35.4	30.2	56	-25.8	PASS	3	46	-43	PASS
0.5595	35.3	30.1	56	-25.9	PASS	3.2	46	-42.8	PASS
26.7739	32.7	27	60	-33	PASS	20.9	50	-29.1	PASS
27.269	33	28.1	60	-31.9	PASS	21.5	50	-28.5	PASS
27.7702	33.2	28.3	60	-31.7	PASS	21.4	50	-28.6	PASS
28.769	31.3	26	60	-34	PASS	19.4	50	-30.6	PASS



Measured Conducted Emissions - Phase Lead (Line 1)

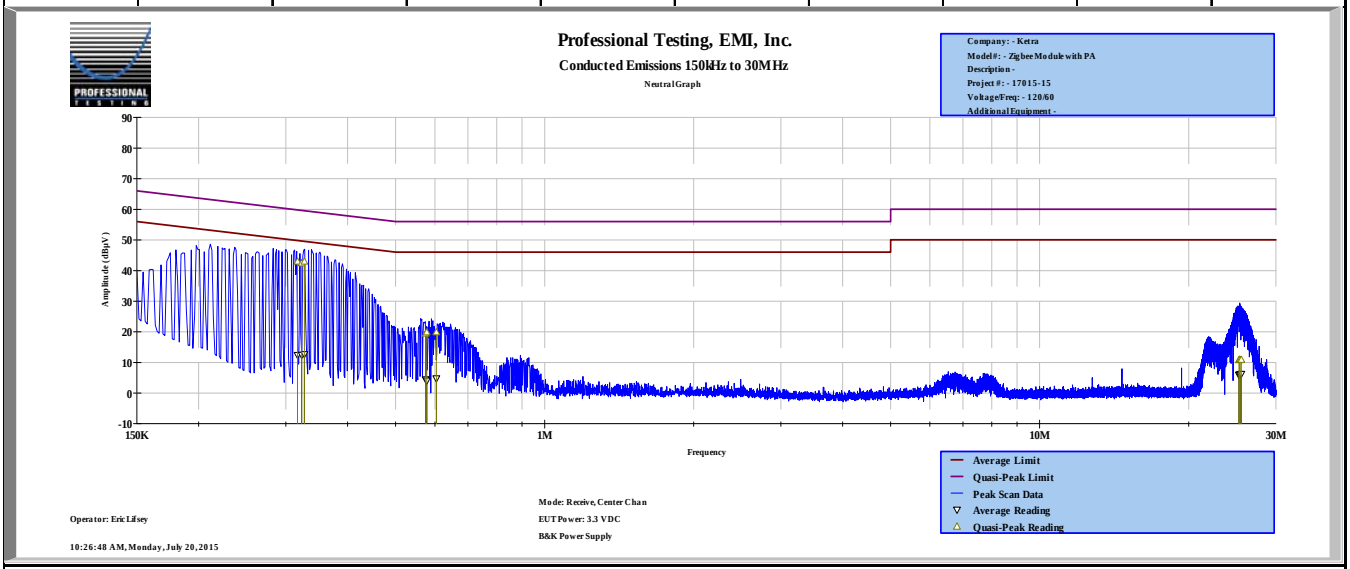
9.3.3 Mains Conducted Emissions, Neutral Lead, Receive Mode

Professional Testing, EMI, Inc.			
Test Method:	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 (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.207 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Conducted Emissions Limits		
Section:	15.207		
Test Date(s):	7/20/2015	EUT Serial #:	C02
Customer:	Ketra	EUT Part #:	NA (EUT module runs 3.3 VDC)
Project Number:	17015-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	Zigbee Module with PA	Witness' Name:	None

Conducted Emissions Test Results Data Sheet - Neutral Lead Page: 1 of 2

EUT Line Voltage:	120	VAC	EUT Line Frequency:	60	Hz

Frequency Measured (MHz)	Peak Detector Reading (dBµV)	Quasi-peak Detector Reading (dBµV)	Quasi-peak Detector Limit (dBµV)	Quasi-peak Detector Margin (dB)	Quasi-peak Detector Test Results	Average Detector Reading (dBµV)	Average Detector Limit (dBµV)	Average Detector Margin (dB)	Average Detector Test Results
0.31682	48.8	42.9	59.8	-16.9	PASS	12.4	49.8	-37.4	PASS
0.32302	49.4	42.4	59.6	-17.3	PASS	12.4	49.6	-37.2	PASS
0.32695	49.1	42.9	59.5	-16.6	PASS	12.6	49.5	-36.9	PASS
0.5751	28.3	19.4	56	-36.6	PASS	4.5	46	-41.5	PASS
0.5779	28	19.9	56	-36.1	PASS	4	46	-42	PASS
0.6042	28.4	19.9	56	-36.1	PASS	4.7	46	-41.3	PASS
25.2578	19.5	10.8	60	-49.2	PASS	5.9	50	-44.1	PASS
25.34	19.3	10.9	60	-49.1	PASS	6	50	-44	PASS
25.4154	20.1	10.8	60	-49.2	PASS	6.1	50	-43.9	PASS
25.5544	19.4	10.9	60	-49.1	PASS	6.2	50	-43.8	PASS



Measured Conducted Emissions - Neutral Lead

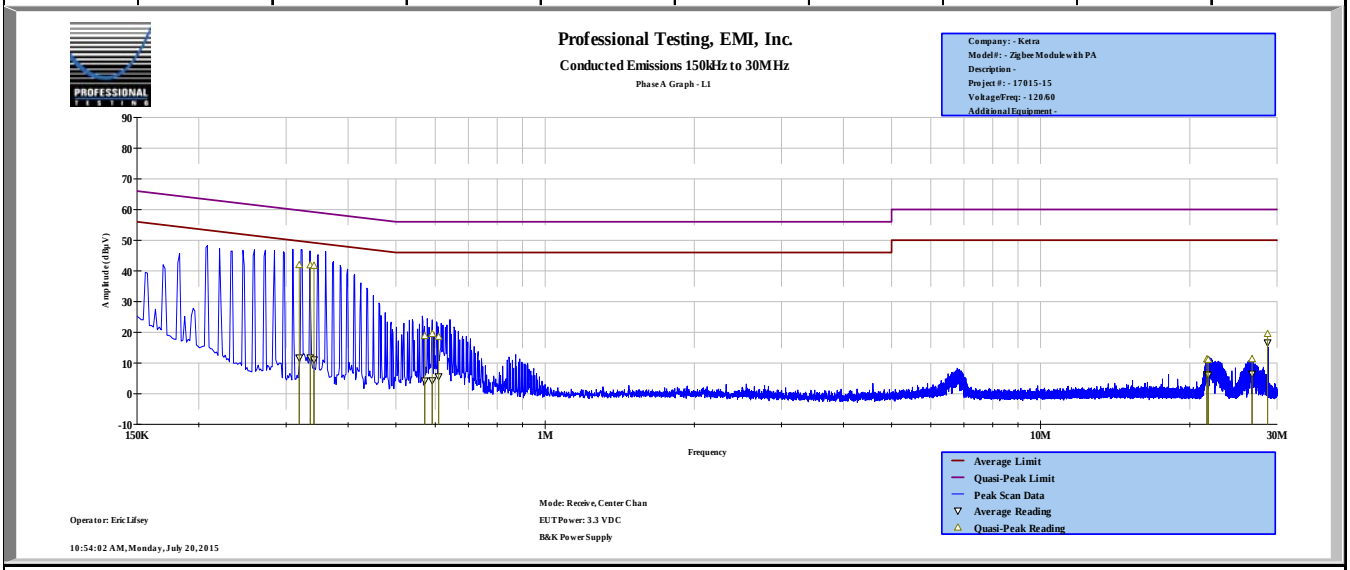
9.3.4 Mains Conducted Emissions, Phase Lead, Receive Mode

Professional Testing, EMI, Inc.			
Test Method:	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 (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.207 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Conducted Emissions Limits		
Section:	15.207		
Test Date(s):	7/20/2015	**EUT Serial #:**	C02
Customer:	Ketra	**EUT Part #:**	NA (EUT module runs 3.3 VDC)
Project Number:	17015-15	**Test Technician:**	Eric Lifsey
Purchase Order #:	NA	**Supervisor:**	Lisa Arndt
Equip. Under Test:	Zigbee Module with PA	**Witness' Name:**	None

Conducted Emissions Test Results Data Sheet - Phase Lead (Line 1) **Page: 2 of 2**

EUT Line Voltage:	120	VAC	EUT Line Frequency:	60	Hz

Frequency Measured (MHz)	Peak Detector Reading (dBµV)	Quasi-peak Detector Reading (dBµV)	Quasi-peak Detector Limit (dBµV)	Quasi-peak Detector Margin (dB)	Quasi-peak Detector Test Results	Average Detector Reading (dBµV)	Average Detector Limit (dBµV)	Average Detector Margin (dB)	Average Detector Test Results
0.31878	47.5	41.9	59.7	-17.9	PASS	11.7	49.7	-38	PASS
0.33572	48.2	41.8	59.3	-17.5	PASS	11.7	49.3	-37.6	PASS
0.34143	48	41.7	59.2	-17.5	PASS	11.1	49.2	-38	PASS
0.5715	27.3	18.8	56	-37.2	PASS	4.3	46	-41.7	PASS
0.5919	27.3	19.5	56	-36.5	PASS	4.3	46	-41.7	PASS
0.6095	26.5	18.5	56	-37.5	PASS	5.6	46	-40.4	PASS
21.6563	20	11.2	60	-48.8	PASS	6.3	50	-43.7	PASS
21.7915	20.2	11	60	-49	PASS	6.1	50	-43.9	PASS
26.713	21	11.3	60	-48.7	PASS	6.5	50	-43.5	PASS
28.7072	24.3	19.5	60	-40.5	PASS	16.7	50	-33.3	PASS



Measured Conducted Emissions - Phase Lead (Line 1)

Table 9.3.5 Equipment List

Professional Testing, EMI, Inc.			
Test Method:	**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 (incorporated by reference, see §15.38).**		
In accordance with:	**FCC Part 15.207 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Conducted Emissions Limits**		
Section:	**15.207**		
Test Date(s):	**7/20/2015**	**EUT Serial #:**	**C02**
Customer:	**Ketra**	**EUT Part #:**	**NA (EUT module runs 3.3 VDC)**
Project Number:	**17015-15**	**Test Technician:**	**Eric Lifsey**
Purchase Order #:	**NA**	**Supervisor:**	**Lisa Arndt**
Equip. Under Test:	**Zigbee Module with PA**	**Witness' Name:**	**None**

Conducted Emissions Test Equipment List	
Tile! Software Version:	**4.1.A.0, April 14, 2009, 11:01:00PM**
Test Profile:	**Profile#: CE_2014_R3.TIL, dated May 1, 2014**

Asset #	Manufacturer	Model	Equipment Nomenclature	Serial Number	Calibration Due Date
1842	HP	8568B	Spectrum Analyzer	2732A03633	10/1/2015
2113	HP	85662A	Spec Anal Dsply for A/N 1842	2403A07470	N/A
0990	HP	85685A	RF Preselector	3010A01119	9/30/2016
1281	HP	85650A	Quasi Peak Adapter	2043A00063	10/1/2015
1173	PTI	100k HPF	Filter, High Pass, 100kHz	none	1/15/2016
1087	PTI	PTI-ALF3	Attenuator Limiter Filter	none	4/28/2016
C107	Pomona	RG-223	Cable 9 ft BNC RG-223 (black)	none	8/11/2015
C108	HP	11170 C	Cable 5 ft BNC (Grey)	none	8/11/2015
C109	HP	none	Cable 19 inch BNC (grey)	none	8/11/2015
1185	EMCO	3825/2	LISN, 10kHz-100MHz	1235	11/11/2015
1132	AilTech	91550-1M	Probe, Current, 10kHz-100MHz	1856	2/16/2016
0936	FCC	FCC-TLISN-T2	TLISN-T2, 9kHz-30MHz, CISPR 22	20152	3/4/2016
0935	FCC	FCC-TLISN-T4	TLISN-T4, 9kHz-30MHz, CISPR 22	20153	3/5/2016
1683	Teseq	ISN T800	ISN-T8, Impedance Stabilization Network	27091	5/27/2016
0027	EMCO	3825/2	LISN, 10kHz-100MHz	9010-1708	11/5/2015
0586	HP	8447D	Preamp, 0.1-1300MHz, 26dB	1726A01364	2/18/2016

Table 9.3.6 Measurement Bandwidth

Conducted Emissions Spectrum Analyzer Bandwidth and Measurement Time				
Frequency Band Start (MHz)	**Frequency Band Stop (MHz)**	**6 dB Bandwidth (kHz)**	**Number of Ranges Used**	**Measurement Time per Range**
0.01	0.15	0.3	7	Five 1 second sweeps
0.15	30	9	20	Five 1 second sweeps

*Notes:
1. The settings above are specifically calculated for the HP856X series of spectrum analyzers, which have 1,000 data points per range.
2. The measurement receiver resolution bandwidth setting was 300 Hz for quasi-peak measurements from 10-150 kHz.
3. The measurement receiver resolution bandwidth setting was 9 kHz for quasi-peak measurements from 0.15-30 MHz.

10.0 Antenna Construction Requirements

The design was investigated for meeting the antenna construction requirements of the applicable rules.

10.1 Procedure

A direct examination of the antenna construction is performed and compared to rule criteria that prevent wireless device antennas from being modified by end users in ways that would void their authorization to use the device.

10.2 Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.203 // RSS-Gen 8.3	Antenna Construction	29 Jul 2015

10.3 Results

Table 9.3.1 Antenna Construction Details	
Antenna Manufacturer and Model	**Specifications**
Manufacturer: Ketra Model: N/A	Printed circuit loaded monopole.

- The antenna is internal only to the device.
- The antenna is an etched trace on the circuit board.
- There is no antenna connector on the finished product.

The antenna design above satisfies the requirements of the rules.

11.0 Equipment and Bandwidths

11.1 Equipment for Spurious Radiated Emissions 30 MHz to 25 GHz

Professional Testing, EMI, Inc.			
Test Method:	**ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference,**		
In accordance with:	**FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits**		
Section:	**15.209**		
Test Date(s):	**7/15/2015**	**EUT Serial #:**	**Sample C2**
Customer:	**Ketra**	**EUT Part #:**	**0**
Project Number:	**17015**	**Test Technician:**	**Eric Lifsey**
Purchase Order #:	**0**	**Supervisor:**	**Lisa Arndt**
Equip. Under Test:	**Zigbee Module with PA**	**Witness' Name:**	**Steve Proffit**

Radiated Emissions Test Equipment List	
Tile! Software Version:	**4.2.A, May 23, 2010, 08:38:52 AM**
Test Profile:	**Radiated Emissions_Profile Version October 12, 2011**

Asset #	Manufacturer	Model	Equipment Nomenclature	Serial Number	Calibration Due Date
1509A	Braden	N/A	TDK 10M Chamber, NSA < 1 GHz	DAC-012915-005	2/5/2016
1890	HP	8447F	Preamp/Amp, 9kHz-1300MHz, 28/25dB	3313A05298	2/6/2016
2081	Agilent	E4440A	Spectrum Analyzer, 3 Hz - 26.5 GHz	MY44303313	9/29/2015
1926	ETS-Lindgren	3142D	Antenna, Biconilog, 26 MHz - 6 GHz	135454	1/26/2016
C027	N/A	RG214	Cable Coax, N-N, 25m	none	10/22/2015
1327	EMCO	1050	Controller, Antenna Mast	none	N/A
0942	EMCO	11968D	Turntable, 4ft.	9510-1835	N/A
1969	HP	11713A	Attenuator/Switch Driver	3748A04113	N/A
1509B	Braden	N/A	TDK 10M Chamber, VSWR > 1 GHz	DAC-012915-005	3/13/2016
2004	Miteq	AFS44-00101800-2S-10P-44	Amplifier, 40dB, .1-18GHz	0	12/29/2015
C030	N/A	0	Cable Coax, N-N, 30m	none	10/10/2015
1325	EMCO	1050	Controller, Antenna Mast	9003-1461	N/A
1780	ETS-Lindgren	3117	Antenna, Double Ridged Guide Horn, 1 - 18 GHz	110313	2/26/2016
1542	A.H. Systems	SAS-572	Antenna, Horn 18-26.5GHz, 20dB gain	225	N/A
1973	Agilent	83017A	Amplifier, Microwave 0.5-26.5 GHz	MY39500497	2/4/2016

11.2 Equipment for Power, Power Spectral Density, Bandwidth, and Timings

Asset #	Manufacturer	Model #	Description	Calibration Due
ALN-077	Rohde & Schwarz	FSP-30	Spectrum Analyzer	2016-01-29

11.3 Measurement Bandwidths, Radiated

Radiated Emissions Spectrum Analyzer Bandwidth and Measurement Time - Peak Scan				
Frequency Band Start (MHz)	**Frequency Band Stop (MHz)**	**6 dB Bandwidth (kHz)**	**Number of Ranges Used**	**Measurement Time per Range**
0.009	0.15	0.3	2	Multiple Sweeps
0.15	30	9	6	Multiple Sweeps
30	1000	120	2	Multiple 800 mS Sweeps
1000	6000	1000	2	Multiple Sweeps
6000	18000	300	2	Multiple Sweeps

*Notes:
1. The settings above are specifically calculated for the E4440A series of spectrum analyzers, which have 8,000 data points per range.
2. The measurement receiver resolution bandwidth setting was 300 Hz for quasi-peak measurements from 9-150 kHz.
3. The measurement receiver resolution bandwidth setting was 9 kHz for quasi-peak measurements from 0.15-30 MHz.
4. The measurement receiver resolution bandwidth setting was 120 kHz for quasi-peak measurements from 30-1000 MHz.
5. The measurement receiver resolution bandwidth setting was 1 MHz for average measurements from 1-18 GHz.

Appendix: Policy, Rationale, and Evaluation of EMC Measurement Uncertainty

All uncertainty calculations, estimates and expressions thereof shall be in accordance with NIST policy. Since PTI operates in accordance with NIST (NVLAP) Handbook 150-11: 2007, all instrumentation having an effect on the accuracy or validity of tests shall be periodically calibrated or verified traceable to national standards by a competent calibration laboratory. The certificates of calibration or verification on this instrumentation shall include estimates of uncertainty as required by NIST Handbook 150-11.

1. Rationale and Summary of Expanded Uncertainty.

Each piece of instrumentation at PTI that is used in making measurements for determining conformance to a standard (or limit), shall be assessed to evaluate its contribution to the overall uncertainty of the measurement in which it is used. The assessment of each item will be based on either a type A evaluation or a type B evaluation. Most of the evaluations will be type B, since they will be based on the manufacturer's statements or specifications of the calibration tolerances, or uncertainty will be stated along with a brief rationale for the type of evaluation and the resulting stated uncertainties.

The individual uncertainties included in the combined standard uncertainty for a specific test result will depend on the configuration in which the item of instrumentation is used. The combination will always be based on the law of propagation of uncertainty. Any systematic effects will be accommodated by including their uncertainties, in the calculation of the combined standard uncertainty; except that if the direction and amount of the systematic effect cannot be determined and separated from its uncertainty, the whole effect will be treated as uncertainty and combined along with the other elements of the test setup.

Type A evaluations of standard uncertainty will usually be based on calculating the standard deviation of the mean of a series of independent observations, but may be based on a least-squares curve fit or the analysis of variance for unusual situations. Type B evaluations of standard uncertainty will usually be based on manufacturer's specifications, data provided in calibration reports, and experience. The type of probability distribution used (normal, rectangular, a priori, or u-shaped) will be stated for each Type B evaluation.

In the evaluation of the uncertainty of each type of measurement, the uncertainty caused by the operator will be estimated. One notable operator contribution to measurement uncertainty is the manipulation of cables to maximize the measured values of radiated emissions. The operator contribution to measurement uncertainty is evaluated by having several operators independently repeat the same test. This results in a Type A evaluation of operator-contributed measurement uncertainty.

A summary of the expanded uncertainties of PTI measurements is shown as Table 1. These are the worst-case uncertainties considering all operative influence factors.

Table 1: Summary of Measurement Uncertainties for Site 45

Type of Measurement	Frequency Range	Meas. Dist.	Expanded Uncertainty U, dB (k=2)
Mains Conducted Emissions	150 kHz to 30 MHz	N/A	2.9
Telecom Conducted Emissions	150 kHz to 30 MHz	N/A	2.8
Radiated Emissions	30 to 1,000 MHz	10 m	4.8
	1 to 18 GHz	3 m	5.7

End of Report

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