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May 23, 2014

Steve Proffitt, Mickey Malone Ketra, Inc. 3815 S Capital of Texas Hwy Suite 100 Austin, TX 78704

Dear Steve, Mickey:

Thank you for allowing Professional Testing (EMI), Inc. an opportunity to perform testing for Ketra, Inc. Enclosed is the Wireless Certification Report for the VER003 2.4GHz Zigbee Module. This report can be used to demonstrate compliance with FCC and IC requirements for wireless devices in North America.

If you have any questions, please contact me.

Sincerely,

Jeffrey A. Lenk

President

Attachment

# Project 15714-15

# VER003 2.4GHz Zigbee Module

# **Wireless Certification Report**

Prepared for:

Ketra, Inc.

By

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

May 23, 2014

Reviewed by

Larry Finn
Product Development Engineer

Written by

Eric Lifsey Test Engineer

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# **Revision History**

Revision Number	Description	Date
00	Draft Release	April 17, 2014
01	Revised per comments Larry Finn	April 17, 2014

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NOTICE: (1) This Report must not be used to claim product endorsement, by NVLAP, NIST, the FCC or any other Agency. This report also does not warrant certification by NVLAP or NIST. (2) This report shall not be reproduced except in full, without the written approval of Professional Testing (EMI), Inc. (3) The significance of this report is dependent on the representative character of the test sample submitted for evaluation and the results apply only in reference to the sample tested. The manufacturer must continuously implement the changes shown herein to attain and maintain the required degree of compliance.

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#### **Certificate of Compliance**

Applicant: Ketra, Inc.

Applicant's Address: Ketra, Inc. (Mickey Malone)

3815 S Capital of Texas Hwy

Suite 100

Austin, TX 78704

**USA** 

FCC ID: 2AB3CJA7

Model: VER003 2.4GHz Zigbee Module, P/N 830-000005-xx

Project Number: 15714-15 Date: May 23, 2014

The **VER003 2.4GHz Zigbee Module** by **Ketra, Inc.** was tested utilizing the following documents and found to be in compliance with the required criteria.

Standard	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 limits.	
FCC 47 CFR Part 15 C	15.205	Restricted Bands of Operation	
KDB718828	DR01	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247	
KDB412172	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 Radiofreque Electromagnetic Fields	
RSS-210	Issue 8	Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment	
RSS-Gen	Issue 3	General Requirements and Information for the Certification of Radio Apparatus	
RSS-102	Issue 4	Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (Al Frequency Bands)	

<sup>\*</sup>MPE is reported separately from this document.

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

Jeffrey A. Lenk, President

This report has been reviewed and accepted by Ketra, Inc. The undersigned is responsible for ensuring that the VER003 2.4GHz Zigbee Module by Ketra, Inc. will continue to comply with the applicable rules.

Representative of Ketra, Inc.

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#### 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.

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. The procedures of ANSI C63.4: 2009 were used for making all radiated enclosure and mains emission measurements.

#### 1.2 EUT Description

The EUT is a small wireless transceiver module and is identified below:

Table 1.2.1: Equipment Under Test					
Manufacturer	cturer Model Serial # Description				
Ketra, Inc.	VER003 2.4GHz Zigbee Module P/N 830-000005-xx	None	Wireless modular radio.		

The antenna is etched on the circuit board. There is no antenna connector on the finished product. The EUT is powered by a 3 V power source.

The EUT measures approximately 18 x 24 mm. A photograph of the EUT is provided below.



Photograph 1.2.1: EUT

#### 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. The Silabs EM-ISA3-76E and the EUT received power from a wall-pluggable commercial USB power supply. Once the desired EUT operation was initiated, the laptop was disconnected and removed from the test configuration.

This is not a hand held device.

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#### 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.

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#### 2.0 Fundamental Power

#### 2.1 Test Procedure

EUT is placed on a non-conducting table and rotated to record the maximum emission. Bandwidth is first determined to select correct entire bandwidth for power measurement and the fundamental power is then measured.

#### 2.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date
15.247(a)(3) // RSS-210 Issue 8, A2.9	Fundamental Power Conducted Limit: 1 Watt Restated as Field Strength 125.2 dBμV/m @ 3 m	2014-03-25 2014-05-04

#### 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. Results are presented below:

# Fundamental Power Measured as Field Strength Conducted Limit 1 Watt (30 dBm)

Limit Restated as Field Strength 125.2 dBμV/m @ 3 m

Vertical Polarity			
Frequency GHz	Corrected Measured Peak Power at 3 m dBµV/m		
2.405	97.7		
2.440	93.2		
2.480	90.5		

Measured in 3 MHz RBW, 3 MHz VBW.

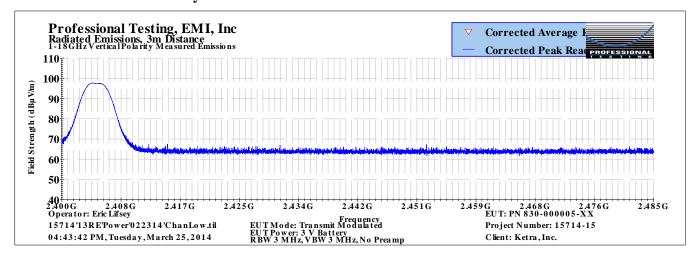
Horizontal Polarity			
Frequency GHz	Corrected Measured Peak Power at 3 m dBµV/m		
2.405	97.7		
2.440	95.9		
2.480	90.1		

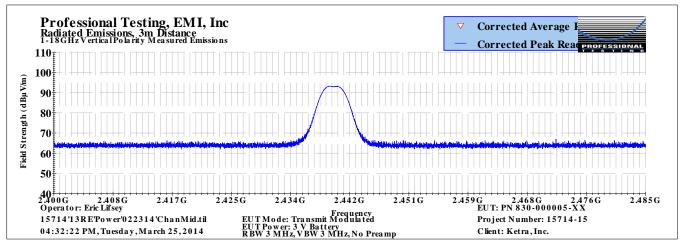
Measured in 3 MHz RBW, 3 MHz VBW.

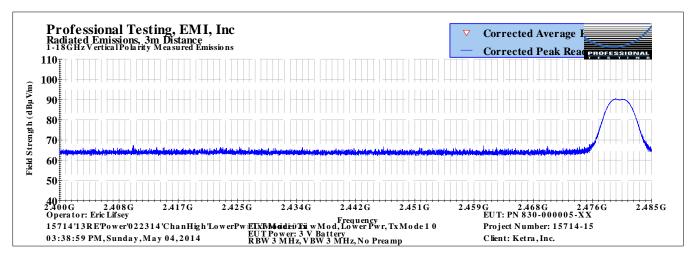
The EUT was found to be in compliance with the applicable criteria. Plotted measurement appears below. Highest emissions were in horizontal polarity. Note that the highest frequency channel has power reduced to satisfy band-edge emissions.

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#### 2.3.1 Vertical Polarity

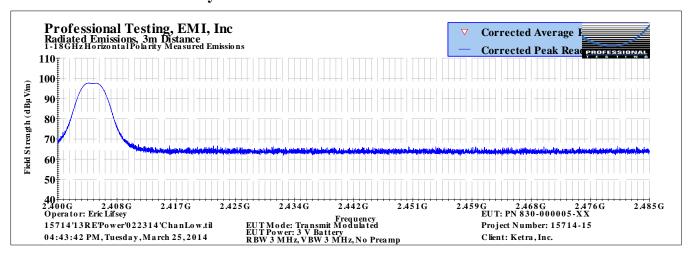


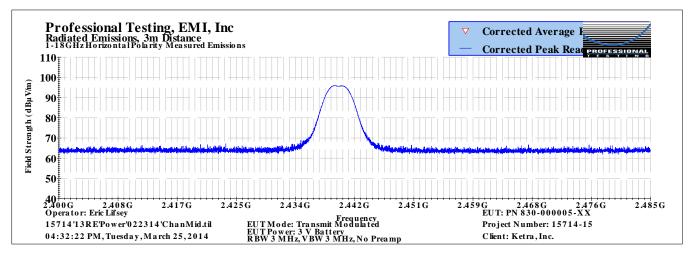


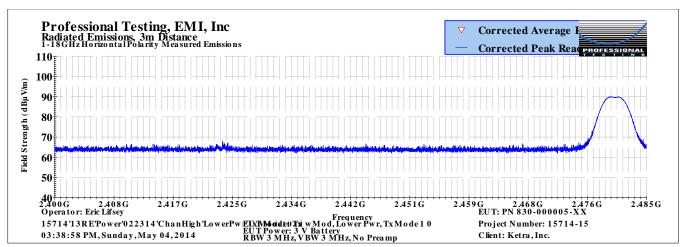


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#### 2.3.2 Horizontal Polarity







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# 3.0 Power Spectral Density

#### 3.1 Test Procedure

The EUT is placed on a non-conductive table and oriented for maximum signal. A spectrum analyzer is then adjusted to encompass the highest signals and allowed to record in max-hold mode for a time sufficient to capture all transmit products.

#### 3.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference Parameter		Date
15.247e // RSS-210 Issue 8, A2.9	Power Spectral Density Conducted Limit: 8 dBm / 3 kHz Restated as Field Strength 103.2 dBμV/m @ 3 m Restated as Field Strength 112.7 dBμV/m @ 1 m	2014-04-02

#### 3.3 Test Results

# Power Spectral Density Conducted Limit 8 dBm, Measured Radiated Polarity Per Highest Measured for Peak Power

Frequency GHz	Polarity	Raw Measured Field Strength dBµV	Antenna Factor dB	Cable Loss dB	Corrected* Measured Peak PSD at 1 m dBµV/m
2.405	Н	60.61	28.2	1.6	90.41
2.440	Н	58.97	28.2	1.6	88.77
2.480	Н	54.89	28.2	1.6	84.69

<sup>\*</sup>Factors were added to spectrum analyzer amplitude offset to obtain a direct corrected measurement.

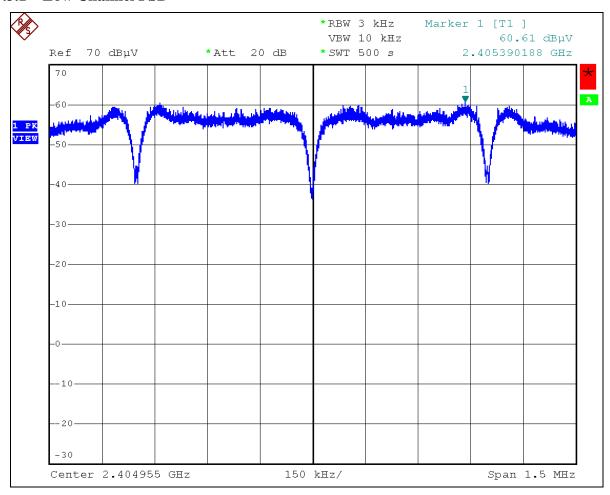
Sweep time 500 seconds.

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

Plotted measurements appear below.

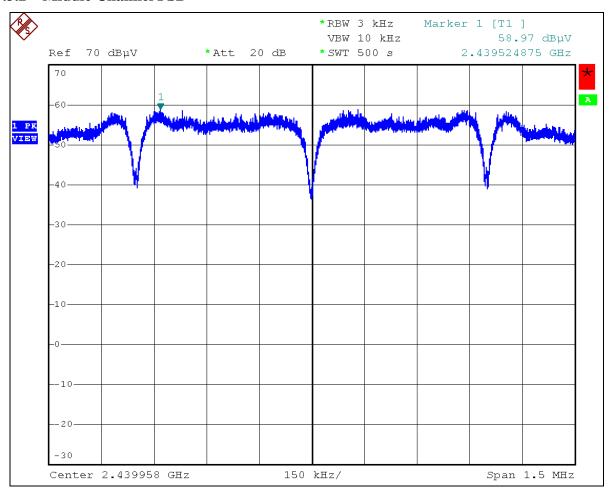
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#### 3.3.1 Low Channel PSD



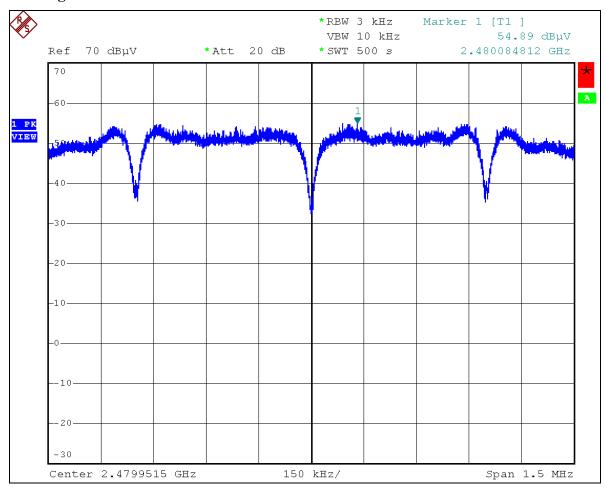
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# 3.3.2 Middle Channel PSD



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# 3.3.3 High Channel PSD



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# **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, RSS210 A2.9(a)	Transmit Duty Cycle	2014-05-02

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

<b>Table 4.3.1</b>	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)
4.373	6.459	= 20 * Log <sub>10</sub> (4.373 msec / 6.459 msec )	-2.87	-2.87

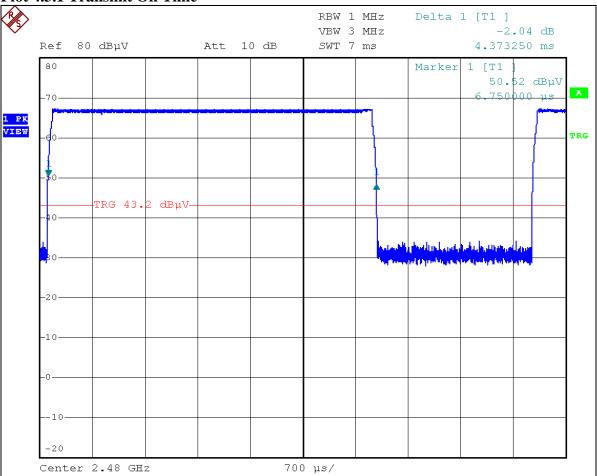
The allowed duty cycle factor is applied to peak measured fundamental and harmonic signals to find average levels.

The source based factor for exposure is half of the above or: -1.435 dB

Plotted results appear on the following pages.

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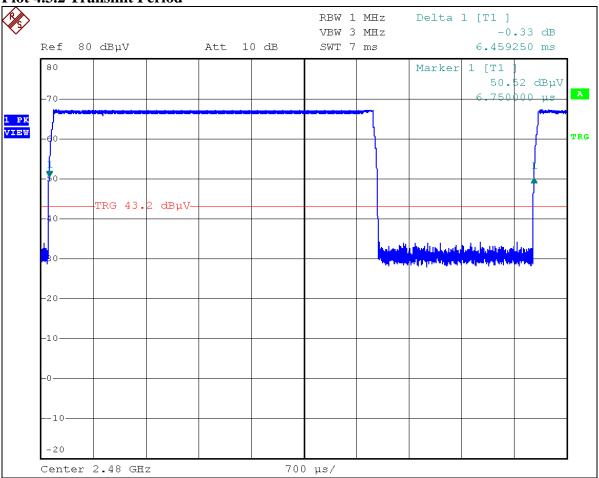
**Plot 4.3.1 Transmit On Time** 



Marker 1 delta = 4.373 ms of transmit on time.

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**Plot 4.3.2 Transmit Period** 



Marker 1 delta = 6.750 ms of transmit period.

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# 5.0 Occupied Bandwidth

#### **5.1** Test Procedure

The EUT is configured for best signal/power and the 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 Issue 3, 4.6	Bandwidth, 6 dB, 20 dB	2014-03-28	

#### 5.3 Test Results

EUT was found to be in compliance with applicable requirements.

# Bandwidth 6 dB Minimum 500 kHz

Low Channel Measured BW (kHz)	Mid Channel Measured BW (kHz)	High Channel Measured BW (kHz)	Minimum BW (kHz)
1495	1486	1529	1486

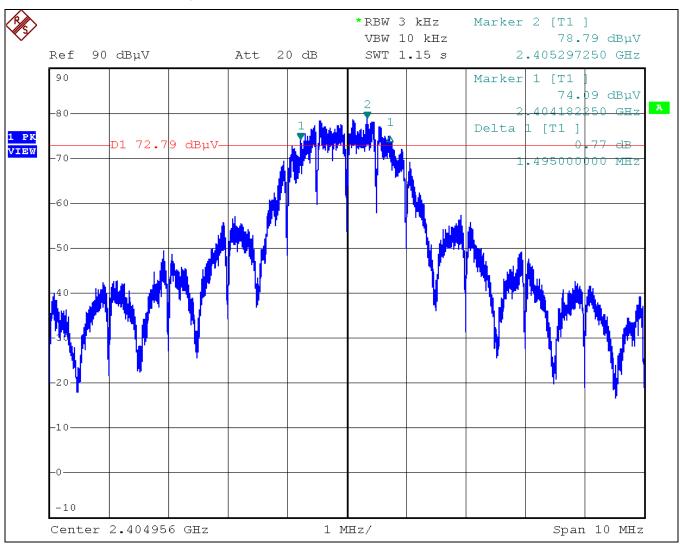
# Bandwidth 20 dB Measure and Report

Low Channel	Mid Channel	High Channel	Reported
Measured BW	Measured BW	Measured BW	Maximum BW
(kHz)	(kHz)	(kHz)	(kHz)
2600	2559	2617	2617

Plotted measurements appear on the following pages.

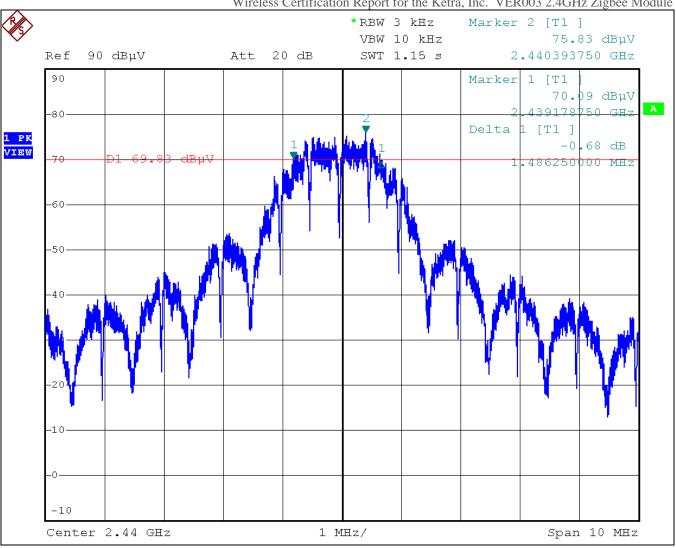
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# 5.3.1 Bandwidth Plots, 6 dB



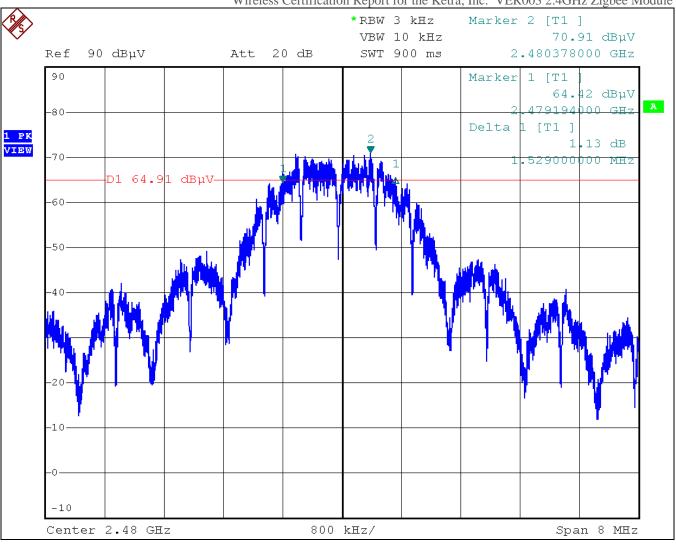
6 dB, Low Channel

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6 dB, Middle Channel

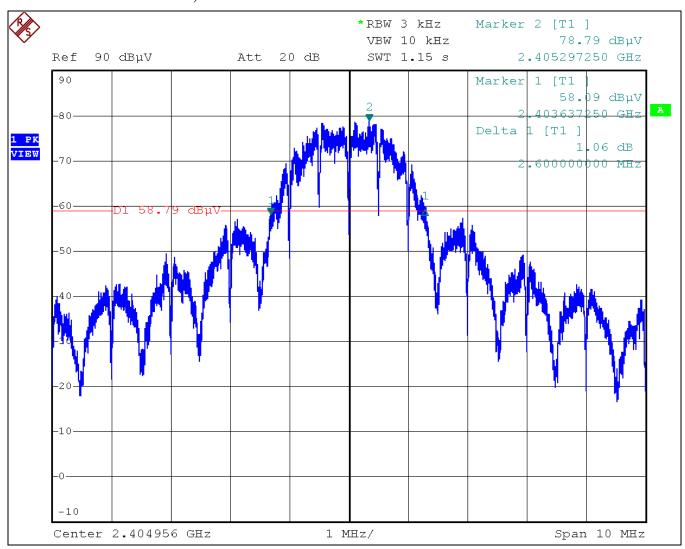
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6 dB, High Channel

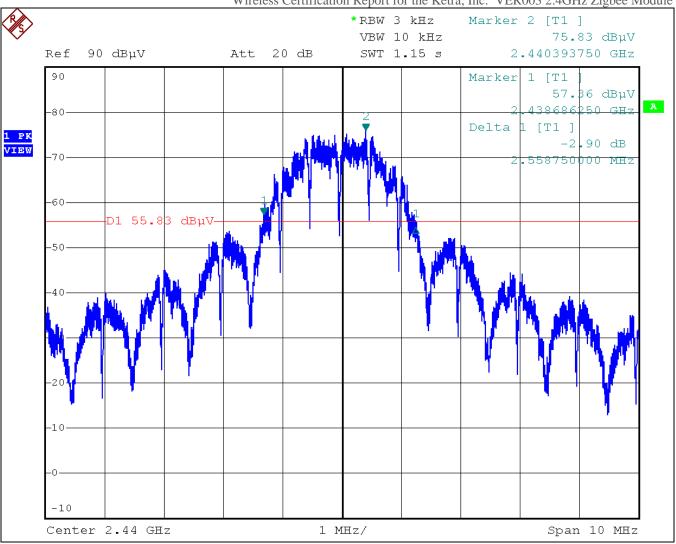
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# 5.3.2 Bandwidth Plots, 20 dB



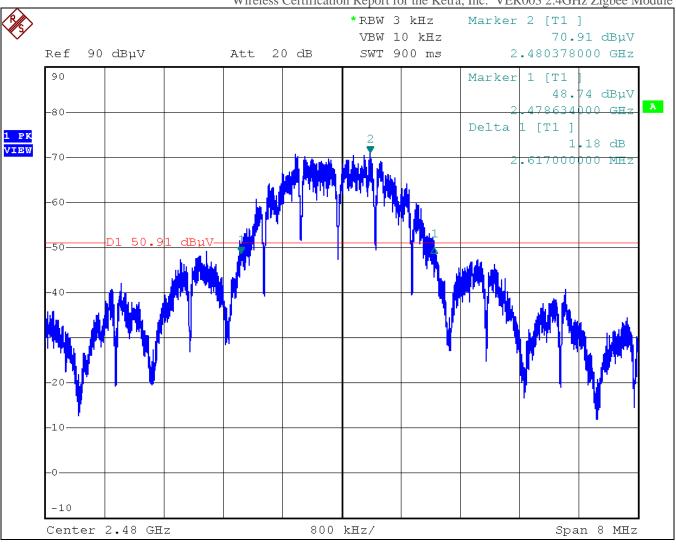
20 dB, Low Channel

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20 dB, Middle Channel

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20 dB, High Channel

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# 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 measures 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 //	Unwanted Emissions Adjacent to Authorized	2014-04-02
RSS-Gen Issue 3, 4.9	Band, Radiated	2014-04-02

#### **6.3** Test Results

Table 6.3.1 Hig	Table 6.3.1 Highest Band Edge Emissions										
Channel	Polarity	Frequency GHz	Peak Level dBμV/m	Duty Cycle Factor dB	Calculated Average dBµV/m						
High*	V	2.483545	56.55	-2.87	53.73						
High*	Н	2.483556	56.71	-2.87	53.84						
Low	V	2.399405	55.51	-2.87	52.64						
Low	Н	2.399587	56.56	-2.87	53.69						

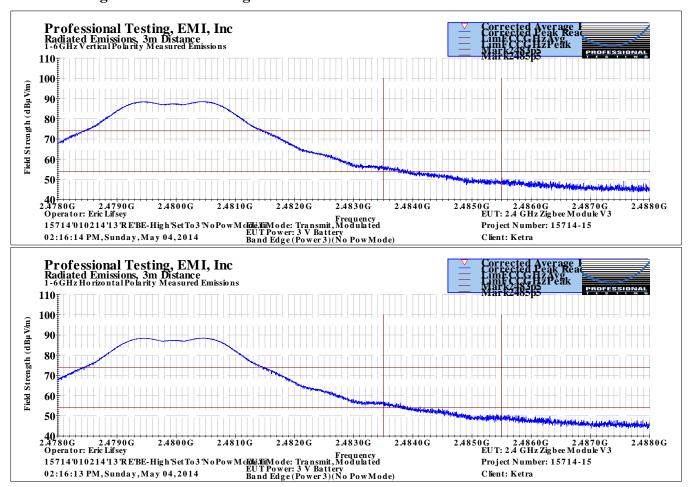
<sup>\*</sup>Restricted band region.

Peak detection emissions at band edges were below the general emission peak limits.

With the duty cycle factor of -2.87 dB applied the EUT satisfied the criteria. Recorded data is presented below.

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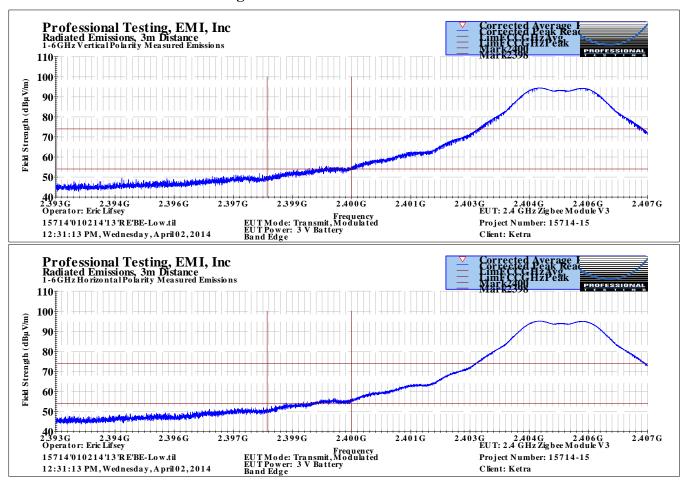
#### 6.3.1 High Channel Band Edge



Peak detection levels shown. Vertical markers represent band edge and 2 standard bandwidths beyond.

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### 6.3.2 Low Channel Band Edge



Peak detection levels shown. Vertical markers represent band edge and 2 standard bandwidths beyond.

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# 7.0 Radiated Spurious Emissions Below 1 GHz

Out of band spurious/harmonic emissions measurements were performed on the EUT to determine compliance to 47 CFR, Part 15.

#### 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 at a distance of 10 meters from the measurement antenna. 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. A diagram showing the test setup is given in the figure below.

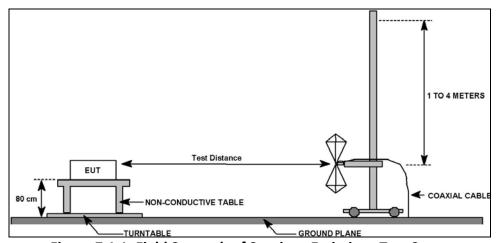


Figure 7.1.1: Field Strength of Spurious Emissions Test Setup

#### 7.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.247, 15.209 //	Field Strength of Radiated	2014-03-25
RSS-Gen Issue 3, 4.9, 4.10	Spurious/Harmonic Emissions	2014-05-25

#### 7.3 Test Results

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

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			Profes	sional Te	sting, EN	VII, Inc.				
Test Metho	d:			ds of Measurer e Range of 9 kH					•	
n accordar	ce with:	Emissions Li		Federal Regulat	ions Part 47, S	Subpart B - Ur	intention	al Radiato	ors, Radi	ated
Section:		15.109			I		Fa. 4.0			
Test Date(s	):	3/25/2014	•		EUT Serial		N/A			
ustomer:		Ketra, Inc. EUT Part #: None								
roject Nur		15714-15			Test Techni		Larry Fu		_	
urchase O		VED002.2	1CII- 7:-b	Na dula	Supervisor:		Rob Mc		<u> </u>	
quip. Und			4GHz Zigbee		Witness' N	ame:	Craig T	Phillips		
	l	Radiated En	nissions Test	t Results Data	ı			Page:	1	of 1
EUT Li	ne Voltage	:	3 VDC		EUT Pow	er Frequen	cy:	0	N/A	
Antenna	Orientation	on:	Vertic	al	Frequ	ency Range:	: 30MHz to 1GHz			1GHz
	EUT N	Mode of Op	eration:			R	eceive n	node		
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Le	_	argin dB)	Test Results
37.7001	10	104	1.29	Quasi-peak	29.7	14.448	39.1	-2	24.7	Pass
54.4205	10	32	1.73	Quasi-peak	33	12.246	39.1	-2	26.9	Pass
250.001	10	345	1.23	Quasi-peak	43.1	29.749	46.4	-:	16.7	Pass
325.001	10	232	1.22	Quasi-peak	41	28.174	46.4	-:	18.2	Pass
350.007	10	236	1.39	Quasi-peak	38.1	26.075	46.4	-2	20.3	Pass
500.017	10	206	3.78	Quasi-peak	31.1	23.216	46.4	-2	23.2	Pass
Radiate 30MHz	ional Testing, 1 Emissions, 10 1 GHz Vertical		red Emissions			<ul> <li>         ∇ Co         Pea     </li> </ul>	asi-peak L prected Quak Limit Le prected Pea	asi-peak Re vel	PROFES	SIONAL
(m/Angp) 440				·						
Held Strength (dBµ) 30	brah Majak		ALL MANAGEMENT				the latest			
-	r: Larry Fuller		100M	Frequence ode: Receive mode	uency		UT: Ver00	3 2.4GHz 7	-	1G odule

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Table 7.3.2	2: Radiate	d Spuriou	s Emission	s, Receive I	Mode, Belo	ow 1 GHz,	Horizonta	l Polarity	
			Profes	sional Te	sting, El	VII, Inc.			
Test Metho	d:			ds of Measurer e Range of 9 kH				•	
n accordan	ce with:	FCC Part 15. Emissions Li		Federal Regulat	ions Part 47, S	Subpart B - Ur	nintentional R	adiators, Rad	iated
Section:		15.109			T				
Test Date(s	):	3/25/2014			EUT Serial		N/A		
Customer:		Ketra, Inc.			EUT Part #:		None		
roject Nur		15714-15			Test Techn		Larry Fulle		
Purchase O		VED002.2	1CII- 7:abaa	Madula	Supervisor:		Rob McCo		
quip. Und			4GHz Zigbee		Witness' N	ame:	Craig T Phi	-	
			1	t Results Data				ige: 1	of 1
EUT Li	ne Voltage		3 VDC		EUT Pow	ver Frequen	су:	0 N/A	
Antenna	Orientatio	n:	Horizor	ntal	Frequ	ency Range:	•	30MHz to	1GHz
	EUT N	lode of Op	eration:			R	eceive mod	le	_
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
36.824	10	355	2.8	Quasi-peak	23.2	8.452	39.1	-30.6	Pass
149.994	10	266	3.95	Quasi-peak	42.1	22.42	43.5	-21.1	Pass
200.001	10	141	3.81	Quasi-peak	45.7	28.877	43.5	-14.6	Pass
250.016	10	306	3.74	Quasi-peak	35.4	22.018	46.4	-24.4	Pass
325.017	10	216	2.4	Quasi-peak	40	27.248	46.4	-19.2	Pass
500.006	10	261	1.59	Quasi-peak	38	30.073	46.4	-16.3	Pass
Radiated	ional Testing, 1 Emissions, 10 1 GHz Horizon	m Distance	isured Emissions	**************************************	<b>V</b>	<ul> <li></li></ul>	nasi-peak Limit rrected Quasi- ak Limit Level rrected Peak Va	oeak Re	SIONAL
2013 Ra	r: Larry Fuller d Emissions_C PM, Tuesday,		ETT Po	Frequence ode: Receive mode wer: 5 VDc	uency	Pi	UT: Ver003 2.croject Number:		1G dule
		≤ 10	Hz Horizont	tal Antenna P	olarity Mea	sured Emis	sions		

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

Polarity									
			Profes	sional Te	sting, EN	VII, Inc.			
Test Metho	d:			ds of Measuren e Range of 9 kH				~	
In accordar	ice with:	FCC Part 15 Emissions I		Federal Regulat	ions Part 47, S	Subpart B - Ur	nintentional R	adiators, Radi	ated
Section:		15.109							
Test Date(s	):	3/28/201	4		EUT Serial	#:	N/A		
Customer:		Ketra, Inc	•		EUT Part #:		None		
Project Nur		15714-15			Test Techni		Eric Lifsey		
Purchase O					Supervisor:		Rob McCol		
Equip. Und	er Test:	VER003 2	.4GHz Zigbee	Module	Witness' Na	ame:	Craig T Phi	llips	
	F	Radiated E	missions Test	Results Data	Sheet		Pa	ge: 1	of 1
EUT Li	ne Voltage:	i	120 VDC		EUT Pow	ver Frequen	cy: 6	0 N/A	
Antenna	Orientatio	n:	Vertic	al	Freque	ency Range:	ge: 30MHz to 1GHz		
	EUT N	lode of O	peration:			Tr	ansmit Mo	de	
Frequency	Test	EUT	Antenna		Recorded	Corrected			
Measured	Distance	Direction	Height	Detector	Amplitude	Level	Limit Level	Margin	Test Results
(MHz)	(Meters)	(Degrees)	_	Function	(dBμV)	(dBµV/m)	(dBµV/m)	(dB)	
38.8596	10	355	1.27	Quasi-peak	36.3	20.42	39.1	-18.7	Pass
52.7708	10	137	3.13	Quasi-peak	46.2	25.624	39.1	-13.5	Pass
250.019	10	357	1.23	Quasi-peak	40.3	26.862	46.4	-19.5	Pass
325.004	10	243	1.3	Quasi-peak	39.1	26.355	46.4	-20.0	Pass
350.005	10	253	1.45	Quasi-peak	37.2	25.087	46.4	-21.3	Pass
500.011	10	66	4.09	Quasi-peak	35.3	27.36	46.4	-19.0	Pass
Field Strength (dB uV/m) 200 400 400 400 400 400 400 400 400 400	or: Eric Lifs	ey 02'Transmi	y Measured En		0M	annel	Quasi-peak Li Corrected Qu Peak Limit Le Corrected Pea EUT: Ver003 Project Numb Client: Ketra,	2.4GHz Zigber: 15714-15	
11,00,7	- 12.1, 1 1100		•	I A	In with a B.C.				
		≤	1GHz Vertica	l Antenna Po	larity Meas	ured Emissi	ons		

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

Polarity											
			Profes	sional Te	sting, El	MI, Inc.					
Test Metho	d:			ds of Measurer e Range of 9 kH							
In accordar	ice with:	FCC Part 15.2 Emissions Lir		Federal Regulat	ions Part 47, S	Subpart B - Ur	nintention	al Radiato	rs, Radi	ated	
Section:		15.109									
Test Date(s	):	3/28/2014			EUT Serial		N/A				
Customer:		Ketra, Inc.			EUT Part #:		None				
Project Nur		15714-15			Test Techn		Eric Lifs				
Purchase O					Supervisor		_	Collough			
Equip. Und	er Test:	VER003 2.4	GHz Zigbee	Module	Witness' N	ame:	Craig T	Phillips			
				t Results Data				Page:	1	of	1
EUT Li	ne Voltage:		3 VDC		EUT Pov	ver Frequen	ісу:	0	N/A		
Antenna	Orientatio	n:	Horizor	ntal	Frequ	ency Range	e: 30MHz to 1GHz				
	EUT N	lode of Op	eration:			Ti	ransmit <b>N</b>	Mode			
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBμV)	Corrected Level (dBµV/m)	Limit Lev		irgin IB)	Test Re	sults
120.006	10	91	3.66	Quasi-peak	37.7	16.805	43.5	-2	6.7	Pas	S
149.993	10	111	3.96	Quasi-peak	42.6	22.878	43.5	-2	0.6	Pas	s
199.993	10	304	3.65	Quasi-peak	40.8	23.955	43.5	-1	9.5	Pas	S
325.002	10	57	3.06	Quasi-peak	39.7	26.919	46.4	-1	9.5	Pas	S
350.005	10	261	2.14	Quasi-peak	36.3	24.273	46.4	-2	2.1	Pas	S
500.002	10	61	1.79	Quasi-peak	41.2	33.229	46.4	-1	3.2	Pas	S
Field Strength (dBµV/m)  800 40  100 4	or: Eric Lifs	judaji judaji	Measured	10	0M		EUT: Ver	t Level Peak Valu	z Zigb	ssional de la constant de la constan	le
15714R 11:00:4	£ 020414 Run 4 AM, Friday	02"TransmitS y, March 28,	pur HPEUTI 2014 EUT I	Chdil Transmit Ower: 5 Vdc	pmanag, mid ch	nannel	Project Nu Client: Ke		/14-15		
		≤ 1G	Hz Horizont	tal Antenna P	olarity Mea	sured Emis	sions				

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# **8.0** Radiated Spurious Emissions Above 1 GHz

Out of band spurious/harmonic emissions measurements were performed on the EUT to determine compliance to 47 CFR, Part 15.

#### **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.

Emissions from 1 GHz to 12 GHz are measured with peak detection, a resolution bandwidth of 1 MHz, and at a distance of 3 meters. If peak measurements exceeded average limits, the peak limit is applicable and duty cycle factor is then applied for average level calculation. For 12 GHz to 18 GHz, the measurement distance is 1 meter. Above 18 GHz, the measurement distance is 0.5 meters. Emissions are investigated up to 25 GHz to include the 10<sup>th</sup> harmonic of the transmitter fundamental.

Non-harmonic spurious emissions must satisfy the average limit and the peak limit (20 dB above average). A diagram showing the test setup is given in the figure below.

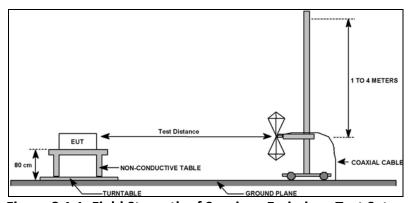


Figure 8.1.1: Field Strength of Spurious Emissions Test Setup

#### 8.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.247, 15.209 //	Field Strength of Radiated	2014-03-25
RSS-Gen Issue 3, 4.9, 4.10	Spurious/Harmonic Emissions	2014-03-28 2014-05-04

#### 8.3 Test Results

In all cases detector mode is peak, RBW 1 MHz, VBW 3 MHz. The applicable duty cycle factor for averaging is 0 dB. The EUT was receiving on the center channel or transmitting on the indicated channel. All peak emissions can be seen as below the average limit, meaning the average level would also be under the average limit.

A pre-scan of emissions from 12 GHz to 25 GHz found no measurable signals.

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Table 8.3.1: Radiated Spurious Emissions, Receive Mode, 1 to 12 GHz, Vertical Polarity

			Profess	sional Te	sting, EN	MI, Inc.				
est Metho	d:			ds of Measurei e Range of 9 kl				•		
n accordan	ce with:	FCC Part 15. Emissions Li		ederal Regula	tions Part 47, S	Subpart B - Ur	nintentional R	ladiators, Rad	iated	
Section:	-	15.109								
Test Date(s	):	3/25/2014			EUT Serial		N/A			
Customer:		Ketra, Inc.			EUT Part #:		None			
Project Nur		15714-15			Test Techni		Larry Fulle			
Purchase O		<u> </u>			Supervisor:		_	Rob McCollough		
quip. Und	er Test:	VER003 2.	4GHz Zigbee	Module	Witness' N	ame:	Craig T Ph	illips		
	F	Radiated Er	nissions Test	Results Dat	a Sheet		Pa	ige: 1	of 1	
EUT Li	ne Voltage:		3 VDC		EUT Pow	ver Frequen	cy: 0 N/A			
Antenna	Orientatio	n:	Vertic	al	Freque	ency Range	•	Above 1GHz		
	EUT N	lode of Op	eration:			R	eceive 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	
1403.17	3	79	1	Average	35.9	23.192	60.0	-36.8	Pass	
3503.7	3	38	1	Average	34.5	27.016	60.0	-32.9	Pass	
5739.01	3	128	1	Average	31.5	29.698	60.0	-30.3	Pass	
7579.13	3	231	1	Average	28.5	33.805	60.0	-26.2	Pass	
9314.66	3	85	1	Average	26.5	34.634	60.0	-25.3	Pass	
11572	3	39	1	Average	27.4	38.39	60.0	-21.6	Pass	
Radiated 1-12GHz 90 <del>**</del> 80 <del>**</del>	ional Testing, I Emissions, 3n I Horizontal Pol	n Distance	Emissions			<ul> <li>∇ Co</li> <li>Per</li> </ul>	erage Limit Le rrected Averag ik Limit Level rrected Peak Re	vel e Readi	SIONAL	
Field Strength (dBµV/m)  90  30	ulangia ang tank dan ka <sup>hi</sup> tin	land yet an arrange of the same	The Landson Hills		▼	The control of the co	Mary and the special section is		A CONTRACTOR OF THE PROPERTY O	
2013 Ra	r: Larry Fuller d Emissions_C		FIIT Do	Freq ode: Receive mod wer: 5 VDc	uency e	P	UT: Ver003 2. roject Number: lient: Ketra, In		12G odule	

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			Profess	sional Te	sting, El	VII, Inc.			
Test Metho	od:			ds of Measure e Range of 9 kl				_	
In accorda	nce with:	FCC Part 15.2 Emissions Lir		ederal Regula	tions Part 47, S	Subpart B - Ur	intentional R	tadiators, Rad	iated
Section:		15.109			_		_		
Test Date(s	s):	3/25/2014			EUT Serial	#:	N/A		
Customer:		Ketra, Inc.			EUT Part #:		None		
Project Nu		15714-15			Test Techn		Larry Fulle		
Purchase C		V			Supervisor		Rob McCo		
Equip. Und	ler Test:	est: VER003 2.4GHz Zigbee Module Witness' Name: Cra						illips	
	F	Radiated Em	nissions Test	Results Dat	a Sheet		Pa	ige: 1	of 1
EUT L	ine Voltage	:	3 VDC		EUT Pow	ver Frequen	cy:	0 N/A	
Antenn	a Orientatio	n:	Horizor	ntal	Frequ	ency Range:	Above 1GHz		
	EUT N	/lode of Op	eration:			R	eceive 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
1398.72	3	279	1	Average	36.9	24.263	60.0	-35.7	Pass
3518.96	3	221	1	Average	34.6	27.105	60.0	-32.9	Pass
5717.8	3	68	1	Average	31.4	29.533	60.0	-30.4	Pass
7595.96	3	352	1	Average	28.3	33.782	60.0	-26.2	Pass
9312.72	3	80	1	Average	26.5	34.649	60.0	-25.3	Pass
11570.2	3	338	1	Average	27.4	38.418	60.0	-21.5	Pass
Radiate	sional Testing, d Emissions, 31 z Horizontal Pol	n Distance	Emissions			▽ Co — Pea	erage Limit Le rrected Averag k Limit Level rrected Peak Re	e Readi	SIONAL 1 N 6
Field Strength (d BµV/m)			_					<del>                                     </del>	
_ I				المساورين المساورين	and the state of t	Providence for the latter to t	iliya kahua ya da ka a la ka ba ka		and the state of t
Field Stream 30	entrepta propinsi di dicida	the state of the second					The second secon		
30 20 1 G	r: Larry Fuller	de de la companya de	de la	To	uency	E	UT: Ver003 2.	10G 4GHz Zigbee Mo	12G odule

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Table 8.3.3: Radiated Spurious Emissions, Transmit Mode, 1 to 12 GHz, Low Channel, Vertical Polarity

Tabl	e 8.3.	3: Radiate	d Spuriou	s Emission	s, Transmit	Mode, 1 t	o 12 GHz,	Low (	Chann	el, Vertic	al Pol	arity
				Profess	sional Te	sting, El	MI, Inc.					
Test	Metho	d:			ds of Measurer e Range of 9 kH					•		ı
In ac	ccordar	nce with:	FCC Part 15 Emissions Li		Federal Regulat	tions Part 47,	Subpart B - Ur	nintenti	ional Rad	liators, Radi	iated	
Sect			15.109			I						
	Date(s	): 	3/28/2014			EUT Serial		N/A				
	omer: ect Nur	mhor:	Ketra, Inc. 15714-15			EUT Part #:		None Eric L				
		rder #:	13/14-13			Supervisor		_	vicCollo	ugh		
		er Test:	VFR003.2	4GHz Zigbee	Module	Witness' N		_	T Philli			
<u> Lqu</u>	p. Ona			Ť	Results Data	•	anic.	Cruig	Page		of	1
	EUT Li	ne Voltage:		3 VDC		<u> </u>	ver Frequen	icv:	0	N/A		
Α		Orientatio		Vertic	al		ency Range			Above 1	GHz	
		EUT N	lode of Op	eration:			Tı	ransmi	it Mode	9		
Mea	juency asured ИНz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBμV)	Corrected Level (dBµV/m)	Limit (dBµ	Level V/m)	Margin (dB)	Test R	esults
4	811	3	0	1	Peak	52.5	52.5	74	1.0	-21.5	Pa	SS
Field Strength (dBµV/m)	1-18GH 90 80 70 60 50 40 20 1000G 15714R	or: £1100Gfsc	3.200G 01'Transmit	4.300G Spur'HPEUE		00G 7.600	0G 8.7000 annel	EUT: V	Number	AGH299G 15714-15		MG
	U9:44:2	3 AM, Friday	, March 20,	2017					Ketra, I	IIC.		
			> :	.GHz Vertica	l Antenna Po	larity Meas	ured Emissi	ons				

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Table 8.3.4: Radiated Spurious Emissions, Transmit Mode, 1 to 12 GHz, Low Channel, Horizontal Polarity

Polarity								
		Profess	sional Te	sting, El	VII, Inc.			
Test Method:			ds of Measurer e Range of 9 kH					
In accordance with:	FCC Part 15.1 Emissions Lin		ederal Regulat	tions Part 47, S	Subpart B - Ur	nintentional R	adiators, Rad	iated
Section:	15.109			1				
Test Date(s):	3/28/2014			EUT Serial		N/A		
Customer:	Ketra, Inc.			EUT Part #:		None		
Project Number:	15714-15			Test Techn		Eric Lifsey	المنتجاة	
Purchase Order #: Equip. Under Test:	VED002 2 /	GHz Zigbee	Modulo	Supervisor: Witness' N		Rob McCol Craig T Phi		
					aille.			
		issions lest	Results Data	1			ge: 1	of 1
EUT Line Voltage		3 VDC			ver Frequen		0 N/A	
Antenna Orientation	on:	Horizon	ital	Frequ	ency Range	:	Above 1	GHz
EUT I	Mode of Ope	eration:			Tı	ransmit Mo	de	
Frequency Test Measured Distance (MHz) (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Result
4811 3	0	1	Peak	53.9	53.9	74.0	-20.1	Pass
Professional Te Radiated Emissions, 1-18GHz Horizonta 90 40 50 40 40 40 40 40 40 40 40 40 40 40 40 40	3.200G n01'TransmitS	4.300G	5.400G 6.5	00G 7.600 made, low ch	OG 8.7009 annel	Average Limi Corrected Average Limit Lo Corrected Per EUT: Verious Project Numb Client: Ketra,	2.4GH2991Gber: 15714-15	
<del></del>				Polarity Mea				

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Table 8.3.5: Radiated Spurious Emissions, Transmit Mode, 1 to 12 GHz, Middle Channel, Vertical Polarity

Professional Testing, EMI, Inc.  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).  FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits  Section: 15.109 Fest Date(s): 3/28/2014 EUT Serial #: N/A  Lustomer: Ketra, Inc. EUT Part #: None  Project Number: 15714-15 Test Technician: Eric Lifsey  Purchase Order #: Supervisor: Rob McCollough  Equip. Under Test: VER003 2.4GHz Zigbee Module Witness' Name: Craig T Phillips  Radiated Emissions Test Results Data Sheet Page: 1 of 1  EUT Line Voltage: 3 VDC EUT Power Frequency: 0 N/A  Antenna Orientation: Vertical Frequency Range: Above 1GHz  EUT Mode of Operation: Transmit Mode  Frequency Test EUT Antenna Detector Function (Meters) (Degrees) (Meters) (Meters) (Degrees) (Meters) (Purction) (Meters) (Degrees) (Meters) (Purction) (Meters) (Degrees) (Meters) (Purction) (Amplitude (Level (dBpu/m)) (dBpu/m) (dBpu/	Pola	rity												
Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).						Profess	ional Te	sting, EN	VII, Inc.					
Section: 15.109  Fest Date(s): 3/28/2014  Eut Serial #: N/A  Eut Serial #: N/A  Eut Serial #: None  Project Number: Ketra, Inc.  Eut Part #: None  Project Number: 15714-15  Radiated Emissions Test Results Data Sheet  Eut Under Test: Veroo3 2.4GHz Zigbee Module  Radiated Emissions Test Results Data Sheet  Eut Power Frequency: 0 N/A  Antenna Orientation: Vertical  Eut Mode of Operation:  Frequency Test  Measured (MHz)  Measured (MHz)  Project Soinal Testing, EMI, Inc  Radiated Emissions. 3m Distance  I-18GHz Vertical Polarity Measured Emissions  Project Antenna Distance  I-18GHz Vertical Polarity Measured Emissions  Eut Measured Limit Level  Corrected Arerage  Professional Testing, EMI, Inc  Radiated Emissions. 3m Distance  I-18GHz Vertical Polarity Measured Emissions  Project Number: 15714Fisey 3.200G 4.300G 5.400G 6.500G 7.600G 8.700 CUT: Verifical Polarity Measured Emissions  Project Number: 15714-15  Client: Ketra, Inc.	Test	Metho	d:									•	rical and	
Test Date(s): 3/28/2014 EUT Serial #: N/A  Customer: Ketra, Inc. EUT Part #: None  Project Number: 15714-15 Test Technician: Eric Lifsey  Purchase Order #: Supervisor: Rob McCollough  Page: 1 of 1  EUT Line Voltage: 3 VDC EUT Power Frequency: 0 N/A  Antenna Orientation: Vertical Frequency Range: Above 1GHz  EUT Mode of Operation: Transmit Mode  Frequency Test Distance (MHz) (Meters) (Degrees) (Meters) (Meters) (Meters) (Meters) (Abpt) (Meters) (Mete	In ac	cordan	ce with:				ederal Regulat	ions Part 47, S	Subpart B - Un	intentio	onal Radia	tors, Radi	ated	
Customer: Ketra, Inc.    EUT Part #: None	Secti	on:		15.109						_				
Porchase Order #:  Quip. Under Test: VER003 2.4GHz Zigbee Module Witness' Name: Craig T Phillips  Radiated Emissions Test Results Data Sheet Page: 1 of 1  EUT Line Voltage: 3 VDC EUT Power Frequency: 0 N/A  Antenna Orientation: Vertical Frequency Range: Above 1GHz  Frequency Test Distance Direction Height (MHz) (MHz) (Meters) (Degrees) (Meters) (Meters) (Meters) (Degrees) (Degrees) (Meters) (Degrees) (Degrees) (Meters) (Degrees) (Meters) (Degrees) (Degrees) (Meters) (Degrees)	Test	Date(s	):	3/28/20	14									
Purchase Order #: Equip. Under Test: VER003 2.4GHz Zigbee Module Witness' Name: Craig T Phillips  Radiated Emissions Test Results Data Sheet Page: 1 of 1  EUT Line Voltage: 3 VDC EUT Power Frequency: 0 N/A  Antenna Orientation: Vertical Frequency Range: Above 1GHz  EUT Mode of Operation: Transmit Mode  Frequency Test Distance (Meters) Direction (Height (Degrees) (Meters) (Meters) Peak 53.4 53.4 74.0 -20.6 Pass  Professional Testing, EMI, Inc Radiated Emissions 3 m Distance 1.18GHz Vertical Polarity Measured Emissions  Professional Testing, EMI, Inc Radiated Emissions 3 m Distance 1.18GHz Vertical Polarity Measured Emissions  Professional Testing, EMI, Inc Radiated Emissions 3 m Distance 1.18GHz Vertical Polarity Measured Emissions  Professional Testing, EMI, Inc Radiated Emissions 4 Delay Vertical Polarity Measured Emissions 4 Delay Vertical Polarity Measured Emissions 5 Delay Vertical Polarity Measured Emissions 6 Delay Vertical Polarity Measured Emissions 6 Delay Vertical Polarity Measured Emissions 7 Delay Vertical Polarity Measured Emissions 6 Delay Vertical Polarity Measured Emissions 7 Delay Vertical Polarity Measured Emissions 9 Delay Vertical Polarity Measured Emis				_					:					
Equip. Under Test: VER003 2.4GHz Zigbee Module Witness' Name: Craig T Phillips  Radiated Emissions Test Results Data Sheet Page: 1 of 1  EUT Line Voltage: 3 VDC EUT Power Frequency: 0 N/A  Antenna Orientation: Vertical Frequency Range: Above 1GHz  Frequency Test Distance Direction Height (Degrees) (Meters) (Degrees) (Meters) (Meters) (Degrees) (Meters) (Meters	_			15714-1	5					_				
Radiated Emissions Test Results Data Sheet  Page: 1 of 1  EUT Line Voltage: 3 VDC  EUT Power Frequency: 0 N/A  Antenna Orientation: Vertical Frequency Range: Above 1GHz  EUT Mode of Operation: Transmit Mode  Frequency Measured Distance Direction Height (MHz) (Meters) (Degrees) (Meters) (Meters) (Meters) (Meters) (Degrees) (Meters) (Me				K				•		_		_		
EUT Line Voltage: 3 VDC EUT Power Frequency: 0 N/A  Antenna Orientation: Vertical Frequency Range: Above 1GHz  EUT Mode of Operation: Transmit Mode  Frequency Test Distance Direction Height (Meters) (	Equi	p. Und	er Test:	VER003	2.40	GHz Zigbee	Module	Witness' Na	ame:	Craig	T Phillips	S		
Antenna Orientation: Vertical Frequency Range: Above 1GHz  EUT Mode of Operation: Transmit Mode  Frequency Test Distance Direction Direction (Meters) Distance (Meters) Distan			F	Radiated	Emi	issions Test	Results Data	a Sheet			Page:	1	of	1
Frequency   Test   Direction   Direction   Height   Height   (Meters)   Detector   Function   (Meters)   (M		EUT Li	ne Voltage		3	VDC		EUT Pow	er Frequen	cy:	0	N/A		
Frequency Test Measured Distance (MHz) Test (Degrees) Test (MHz) Detector Function (MHz) (Degrees) (Meters) Detector Function (Meters) Detector Function (Meters) Detector Function (Meters) (Meters) (Meters) Detector Function (Meters) (Meters) (Meters) (Meters) Detector Function (Meters) (Me	Α	ntenna	Orientatio	n:		Vertica	al	Frequ	ency Range:	1		Above 10	3Hz	
Measured (MHz) (Meters) (Direction (Meters) (Met			EUT N	lode of	Оре	ration:			Tr	ansmi	t Mode			
Professional Testing, EMI, Inc Radiated Emissions, 3m Distance 1-18GHz Vertical Polarity Measured Emissions    Average Limit Level   Corrected Average   Peak Limit Level   Corrected Peak Real Professional	Mea	sured	Distance	Direction		Height		Amplitude	Level	_		•	Test Resu	ults
1-18GHz Vertical Polarity Measured Emissions  80  70  40  20  1000Cator: EricoGifsey 3.200G 4.300G 5.400G 6.500G 7.600G 15714RE'020414'Run02'TransmitSpur'HPETSTi aChakil Transmitquande, mid channel 11:32:28 AM, Friday, March 28, 2014  EUT Power: 5 Vdc  1	48	379	3	0		1	Peak	53.4	53.4	74	.0	-20.6	Pass	
	Field	1-18GE 90 80 70 60 50 40 30 20 10 per at 15714R	or: £1100GfseE'020414'Rur	olarity Months and the second	easur	4.300G			DG 8.7009 namel	Correct	ed Averagmit Level ed Peak R	PROFES Real PROFES 10, 900 G	ee Wrodale	7
					> 16	GHz Vertical	Antenna Po	larity Meas	ured Emissi	ons	·			

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Table 8.3.6: Radiated Spurious Emissions, Transmit Mode, 1 to 12 GHz, Middle Channel, Horizontal Polarity

Polarity										
			Profess	ional Te	sting, EN	VII, Inc.				
Test Method:				ds of Measurer Range of 9 kH					•	rical and
In accordance	with:	CC Part 15.1 missions Lim		ederal Regulat	ions Part 47, S	Subpart B - Ur	intentio	onal Radiat	tors, Radi	ated
Section:		5.109			1		_			
Test Date(s):		3/28/2014			EUT Serial		N/A			
Customer:		Ketra, Inc.			EUT Part #:		None			
Project Number		15714-15			Test Techni		Eric Li	•	_	
Purchase Orde					Supervisor:		_	1cColloug		
Equip. Under 1	Test: V	/ER003 2.4	GHz Zigbee	Module	Witness' N	ame:	Craig	T Phillips	<u> </u>	
	Ra	diated Em	issions Test	Results Data	a Sheet			Page:	1	of 1
EUT Line	Voltage:	3	VDC		EUT Pow	er Frequen	cy:	0	N/A	
Antenna Oi	rientation	1:	Horizon	tal	Frequ	ency Range:		Α	Above 1	3Hz
	EUT Mo	ode of Ope	ration:			Tr	ansmi	Mode		
	Test istance Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit l (dΒμ\		/largin (dB)	Test Result
4879	3	0	1	Peak	52.7	52.7	74.	.0	-21.3	Pass
1-18GHz H 90 80 80 70 60 1000 G 1000 G 15714RE'02	Fricogises 20414' Runo'2	3.200G	4.300G		00G 7.600 made, mid ch	OG 8.7000 annel	EUT: Ve		10 990 G Hz Zigo 5714-15	sional ee N201116G
<del></del>		> 1GI	Hz Horizont	al Antenna P	olarity Mea	sured Emis	sions			

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Table 8.3.7: Radiated Spurious Emissions, Transmit Mode, 1 to 12 GHz, High Channel, Vertical Polarity

Polarity										
			Profess	sional Te	sting, El	VII, Inc.				
Test Metho	d:		–2003: "Metho quipment in the						•	
In accordan	ce with:	FCC Part 15 Limits	.209 - Code of I	ederal Regulat	tions Part 47, S	Subpart C - Int	tention	al Radiato	rs, Radiate	d Emissions
Section:		15.209					_			
Test Date(s	):	5/4/2014			EUT Serial		N/A			
Customer:		Ketra, Inc	•		EUT Part #:		None			
Project Nur		15714-15			Test Techn		Eric Li		•	
Purchase O			4011 711	00-11-	Supervisor			<b>AcCollou</b>	igh	
Equip. Und	er rest:	VERUU3 2	4GHz Zigbee	Module	Witness' N	ame:	None			
	F	Radiated E	missions Test	Results Data	a Sheet			Page:	1	of 1
EUT Li	ne Voltage:	:	3 VDC		EUT Pov	ver Frequen	су:	0	N/A	
Antenna	Orientatio	n:	Vertic	al	Frequ	ency Range	•		Above 10	<b>GHz</b>
	EUT N	lode of O	eration:		Transı	mit Mode, H	ligh Cl	nannel, F	Reduced	Power
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit (dBµ\		Margin (dB)	Test Results
4960.9	3	120	1	Peak	53.79	53.79	54	.0	-0.2	Pass
Field Strength (d B \( \text{Vm} \) \( \text{Mm} \) \( M	ssional Test d Emissions, z Vertical Polarit	3.2G	4.3G	5.4G 6	.5G 7.60	G 8.7G	Correct Peak Li Correct	9.8G	Rear PROFES	12.0G
02:55:0	0 PM, Sunday, N	May 04,2014	rHPF'Hig <b>EUT No</b> EUT Po EUT Lo	w er: 5 V d c w er Po w er, No Tx	Mode		Client: K			
		>	1GHz Vertica	l Antenna Po	olarity Meas	ured Emissi	ons			

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Table 8.3.8: Radiated Spurious Emissions, Transmit Mode, 1 to 12 GHz, High Channel, Horizontal Polarity

Polarity										
			Profess	sional Te	sting, EN	VII, Inc.				
Test Metho	d:		4–2003: "Method Equipment in the						•	rical and
In accordar	ice with:	FCC Part :	L5.209 - Code of F	ederal Regulat	ions Part 47, S	Subpart C - Int	entiona	al Radiato	rs, Radiate	d Emissions
Section:		15.209								
Test Date(s	):	5/4/201			EUT Serial	···	N/A			
Customer:		Ketra, Ir			EUT Part #:		None			
Project Nur		15714-1	5		Test Techni		Eric Li			
Purchase O			2.4011 71.1	Na l . l .	Supervisor:			/lcCollou	ıgh	
Equip. Und	er rest:	VERUU3	2.4GHz Zigbee	Module	Witness' N	ame:	None			
	F	Radiated	Emissions Test	Results Data	a Sheet			Page:	1	of 1
EUT Li	ne Voltage:		3 VDC		EUT Pow	ver Frequen	су:	0	N/A	
Antenna	Orientatio	n:	Horizon	tal	Freque	ency Range:			Above 10	GHz
	EUT N	lode of (	Operation:		Transr	mit Mode, H	ligh Ch	nannel, F	Reduced	Power
Frequency Measured (MHz)	Test Distance (Meters)	EUT Directio (Degree		Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit I		Margin (dB)	Test Results
4960.9	3	120	1	Peak	50.8	50.8	54	.0	-3.2	Pass
80 Reight (magazina) 80 Strength (magazina) 8	2.1 G r: Eric Lifsey E'020414 'Run0	3.2G 3 TransmitS	4.3G	5.4G 6.	5G 7.60	G 8.7G	Correct. Correct.  EUT: Ver	9.8G 003 2.4GH umber: 157	10.9G z Zig bee Mod	12.0G
02:54:5	6 PM,Sunday,	viay 04,201	4 EUT Lov	wer: 5 V dc wer Power, No Tx	Mode		Client: Ke	erra, Inc.		
		>	1GHz Horizont	al Antenna P	olarity Mea	sured Emis	sions			

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## 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 reference plane (wall). 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-210 Issue 8	Mains conducted emissions	2014-03-28

## 9.3 Results

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

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## **Table 9.3.1 Equipment List**

Table 9.3	.1 Equipment	LIST				
		Profes	sional Te	esting, EMI, Inc.		
Test Metho	d. ANSI	C63.4–2009: Metho	ods of Meas	urement of Radio-Noise	Emissions from Lov	v-Voltage
Test Metho	Electr			in the Range of 9 kHz to		
				egulations Part 47, Subpa	art C - Intentional F	Radiators,
In accordan		ucted Emissions Li	mits			
Section:	15.20			I		
Test Date(s	· · · · · · · · · · · · · · · · · · ·			EUT Serial #:	None	
Customer:	Ketra			EUT Part #: Test Technician:	830-000005-xx Bob Redoutey	
Project Nur Purchase O				Supervisor:	Rob McCollough	
Equip. Und		03 2.4GHz Zigbee N	Module	Witness' Name:	None	
Equip. Onc	er rest. VERO			•	None	
		Conduct	ed Emission	s Test Equipment List		
Ti	le! Software Version	on: 4.1.A.	0, April 14, 2	2009, 11:01:00PM		
	Test Profile:	Profil	e#: CE_2010	til, dated December 16,	2010	
Asset #	Manufacturer	Model	Equipr	ment Nomenclature	Serial Number	Calibration Due Date
1842	HP	8568B	Spe	ectrum Analyzer	2732A03633	5/17/2014
0045	НР	85662A	Spec Ar	nal Dsply for AN1842	2816A16413	N/A
0990	НР	85685A	F	RF Preselector	3010A01119	8/29/2014
1281	НР	85650A	Qua	asi Peak Adapter	2043A00063	6/5/2014
1173	PTI	100k HPF	Filter,	, High Pass, 100kHz	none	10/30/2014
1087	PTI	PTI-ALF3	Atten	uator Limiter Filter	none	5/6/2014
C107	Pomona	RG-223	Cable 9	ft BNC RG-223 (black)	none	7/10/2014
C108	Pomona	RG-223	Cable 5.5	ft BNC RG-223 (black)	none	7/10/2014
0939	EMCO	3825/2	LISN	N, 10kHz-100MHz	9603-2521	10/31/2014
C109	НР	none	Cable	19 inch BNC (grey)	none	7/10/2014
1185	EMCO	3825/2	LISN	N, 10kHz-100MHz	1235	10/31/2014

## **Table 9.3.2 Measurement Bandwidth**

. 4516 51612 11164541	cilicit Ballawiati										
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.

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<sup>3.</sup> The measurement receiver resolution bandwidth setting was 9 kHz for quasi-peak measurements from 0.15-30 MHz.

			Profes	sional Te	esting, EN	/II, Inc.			
Test Method	ı:				ent of Radio-No z (incorporated			age Electrical a	and Electronic
n accordanc	e with:	FCC Part 15.20 Limits	07 - Code of Fe	deral Regulation	ons Part 47, Su	bpart C - Inter	tional Radiato	rs, Conducted	Emissions
Section:		15.207							
Test Date(s)	:	3/28/2014			EUT Serial #	:	None		
Customer:		Ketra			EUT Part #:		830-000005	-хх	
Project Num	ber:	15714-15			Test Technic	cian:	<b>Bob Redout</b>	ey	
urchase Or	der #:	Not Listed			Supervisor:		Rob McColl	ough	
quip. Unde	r Test:	VER003 2.40	GHz Zigbee N	<i>N</i> odule	Witness' Na	me:	None		
	Conduct	ed Emissions	Test Result	s Data Sheet	- Neutral Le	ad	Pa	ge: 1	of 2
EU.	T Line Volta	ge:	120	VAC	EUT	Line Freque	ency:	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
0.41004	36.2	32.7	57.6	-25	PASS	22.2	47.6	-25.4	PASS
0.45204	37.9	32	56.8	-24.9	PASS	22.2	46.8	-24.6	PASS
0.45506	37.6	33.3	56.8	-23.5	PASS	23.5	46.8	-23.3	PASS
0.6563	33.1	29.9	56	-26.1	PASS	19.9	46	-26.1	PASS
0.6593	33.7	29.6	56	-26.4	PASS	18.9	46	-27.1	PASS
0.8217	34.4	28.9	56	-27.1	PASS	16.8	46	-29.2	PASS
8.9001	23.6	16.4	60	-43.6	PASS	9.2	50	-40.8	PASS
9.6529	24.3	17	60	-43	PASS	9.5	50	-40.5	PASS
9.7905 9.8362	24.1	17 17.5	60 60	-43 -42.5	PASS PASS	9.1	50 50	-40.9 -40.2	PASS PASS
PROFESSIONA F S Y I N	<b>E</b>	-	Pro Con	fessional Te	sting, EMI,	Inc.	l.	ra 003 2.4GHz Zigbee Mo 14-15 120VAC /60Hz	
80 - 70 - 60 - 60 - 60 - 60 - 60 - 60 - 6	MM	MANA CONTRACTOR OF THE PARTY OF			Andrew Start	March Literary and the			

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**Measured Conducted Emissions - Neutral Lead** 

			Profess	sional Te	esting, EN	ΛI, Inc.			
Test Method	d:				ent of Radio-No z (incorporated			age Electrical a	nd Electronic
n accordan	ce with:	FCC Part 15.20 Limits	07 - Code of Fe	deral Regulation	ons Part 47, Su	bpart C - Inter	tional Radiator	rs, Conducted	Emissions
Section:		15.207							
Test Date(s)	:	3/28/2014			<b>EUT Serial #</b>	•	None		
Customer:		Ketra			EUT Part #:		830-000005	-хх	
Project Num	ıber:	15714-15			Test Technic	cian:	<b>Bob Redout</b>	ey	
urchase Or	der #:	Not Listed			Supervisor:		Rob McColl	ough	
quip. Unde	r Test:	VER003 2.40	GHz Zigbee N	<b>Nodule</b>	Witness' Na	me:	None		
	Conducted	Emissions Te	st Results D	ata Sheet - P	hase Lead (L	ine 1)	Pa	ge: 2	of 2
EU	T Line Volta	ge:	120	VAC	EUT	Line Freque	ncy:	60	Hz
Frequency	Peak Detector	Quasi-peak Detector	Quasi-peak Detector	Quasi-peak Detector	Quasi-peak Detector	Average Detector	Average Detector	Average Detector	Average Detector
Measured	Reading	Reading	Limit	Margin	Test	Reading	Limit	Margin	Test
(MHz)	(dBµV)	(dBµV)	(dBμV)	(dB)	Results	(dBµV)	(dBµV)	(dB)	Results
0.45506	37.6	33.7	56.8	-23	PASS	24.2	46.8	-22.5	PASS
0.45687	37.6	34.4	56.7	-22.3	PASS	25.2	46.7	-21.5	PASS
0.45737	38	34.4	56.7	-22.3	PASS	25.4	46.7	-21.4	PASS
0.5418	35.5	29.8	56	-26.2	PASS	19.2	46	-26.8	PASS
0.5462	34.2	30.2	56	-25.8	PASS	20.4	46	-25.6	PASS
0.5508	34.5	30	56	-26	PASS	20.4	46	-25.6	PASS
9.6176	25.5	18.2	60	-41.8	PASS	10.1	50	-39.9	PASS
9.9885	26	19.3	60	-40.7	PASS	11.6	50	-38.4	PASS
10.4778	26.5	18.8	60	-41.2	PASS	11.2	50	-38.8	PASS
10.5034	25.8	19	60	-41	PASS	10.8	50	-39.2	PASS
PROFESSION 90 T					sting, EMI, ns 150kHz to 30M		Company: - Ket Model#: - VER( Description - Project #: - 157 Volta ge/Freq: - l Additional Equi	120VAC/60Hz	dule
80 - 70 - 60 - (Adg) 50 -									
(Arigp) apniliding (Arigp) and an ariginal and an ariginal and ariginal and ariginal	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~				A Company of the State of the S	The state of the s			
-10 <sup>±</sup> 150	K	<del></del>	1	M	Frequency	1 1	10M  Average Lin Quasi-Peak	nit Limit	30M

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Measured Conducted Emissions - Phase Lead (Line 1)

EUT Line Frequency Measured (MHz)  0.41514  0.45395  0.45557  0.7211  35	th: t: conducte e Voltage eak ector ading	Equipment in the FCC Part 15.20 Limits 15.207 3/28/2014 Ketra 15714-15 Not Listed VER003 2.40 ed Emissions ge:	the Range of 9 07 - Code of Fe GHz Zigbee N Test Result:	kHz to 40 GHz deral Regulation Module s Data Sheet	(incorporated	by reference, ppart C - Inter : : : : : : : : : : : : : : : : : : :	rom Low-Volta see §15.38). ntional Radiator None 830-00005 Bob Redout Rob McColle None	-xx ey ough	
ection: est Date(s): ustomer: roject Number: urchase Order #: quip. Under Test Co EUT Line Frequency Measured (MHz)  0.41514  0.45395  0.45557  0.7211  35	th: t: conducte e Voltage eak ector ading	Limits 15.207 3/28/2014 Ketra 15714-15 Not Listed VER003 2.40 ed Emissions ge: Quasi-peak	GHz Zigbee N Test Result: 120	Module s Data Sheet	EUT Serial #: EUT Part #: Test Technic Supervisor: Witness' Na	ian: me:	None 830-000005 Bob Redout Rob McColle None	-xx ey ough	
est Date(s): ustomer: roject Number: urchase Order #: quip. Under Test  Co  EUT Line requency Measured (MHz)  0.41514  0.45395  0.45557  0.7211  35	t: ponducte e Voltag eak ector	15.207 3/28/2014 Ketra 15714-15 Not Listed VER003 2.40 ed Emissions ge: Quasi-peak	Test Results	s Data Sheet	EUT Part #: Test Technic Supervisor: Witness' Na	ian: me:	830-000005 Bob Redout Rob McColle None	ey ough	of 2
ustomer: roject Number: urchase Order #: quip. Under Test  Co  EUT Line Frequency Measured (MHz)  0.41514  0.45395  0.7211  35	t: t: onducte e Voltag eak ector ading	Ketra 15714-15 Not Listed VER003 2.40 ed Emissions ge: Quasi-peak	Test Results	s Data Sheet	EUT Part #: Test Technic Supervisor: Witness' Na	ian: me:	830-000005 Bob Redout Rob McColle None	ey ough	of 2
roject Number: urchase Order #: quip. Under Test  Co  EUT Line Frequency Measured (MHz)  0.41514  0.45395  0.45395  0.7211  35	t: onducte voltage eak ector	15714-15 Not Listed VER003 2.40 ed Emissions ge: Quasi-peak	Test Results	s Data Sheet	Test Technic Supervisor: Witness' Na	me:	Rob McColle None	ey ough	of 2
rchase Order #3 quip. Under Test  Co  EUT Line Frequency Veasured (MHz)  0.41514  0.45395  0.45557  0.7211  35	t: conducte e Voltag eak ector ading	Not Listed VER003 2.40 ed Emissions ge: Quasi-peak	Test Results	s Data Sheet	Supervisor: Witness' Na	me:	Rob McColle None	ough	of 2
Co EUT Line Perequency Weasured (MHz) 0.41514 0.45395 0.45557 0.7211 35	t: onducte e Voltag eak ector ading	VER003 2.40 ed Emissions ge: Quasi-peak	Test Results	s Data Sheet	Witness' Na		None		of 2
Co EUT Line Frequency Measured (MHz)  0.41514  0.45395  0.45557  0.7211  35	onducte  Voltage eak ector ading	ed Emissions ge: Quasi-peak	Test Results	s Data Sheet				ge: 1	of 2
EUT Line Frequency Measured (MHz)  0.41514  0.45395  0.45557  0.7211  35	e Voltag eak ector ading	ge: Quasi-peak	120		- Neutral Lea	ad	Pa	ge: 1	of 2
Frequency Measured (MHz)  0.41514  0.45395  0.45557  0.7211  35	eak ector ading	Quasi-peak		VAC					
Grequency Measured (MHz)         Determine Rea (dB of the control of the contro	ector ading	•		VAC	EUT	Line Freque	ency:	60	Hz
0.45395     38       0.45557     39       0.7211     35	Βμν)	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
0.45557     39       0.7211     35	7.9	33.9	57.5	-23.7	PASS	24.1	47.5	-23.5	PASS
0.7211 35	8.8	35.6	56.8	-21.2	PASS	26.9	46.8	-19.9	PASS
	9.1	35.7	56.8	-21	PASS	27.1	46.8	-19.7	PASS
0.8191 3	5.2	30.9	56	-25.1	PASS	18.2	46	-27.8	PASS
0.0004	37	31.8	56	-24.2	PASS	19.2	46	-26.8	PASS
	6.5 25	32.3 17.8	56 60	-23.7 -42.2	PASS PASS	20.8	46 50	-25.2 -40	PASS PASS
	5.2	17.8	60	-42.2	PASS	9.9	50	-40.1	PASS
	5.6	17.6	60	-42.4	PASS	9.8	50	-40.2	PASS
	4.5	17.2	60	-42.8	PASS	9.5	50	-40.5	PASS
PROFESSIONAL 90 T			Prof Cond	fessional Ted ducted Emission Neutral	sting, EMI, l is 150kHz to 30M Graph	Inc. IHz	Company: - Ket Model#: - VER0 Description - Project #: - 1571 Voltage/Freq: - 1 Additional Equip	ra 103 2.4GHz Zigbee Mod 14-15 120VAC /60Hz 14-15	ule
80									
70									
€ 60									
я́р 50+									
A mplitude (dBh) 40 30 20 20	MM	MMM A A MM	<sup>PM</sup> WMPMPWPWWW			Marillandia di La	La contractiva de la contractiva del la contractiva del la contractiva de la contractiva de la contractiva del la contractiva de la contractiva del la contractiva		
10	ψ <sup>1</sup> 1		Y	far., , ,	1	The last of the la		Allegan Harry Hills Harry	are and the state of
0								The state of the s	all the little
-10 L		, , , , , , , ,	1	M	· · · · ·		10M	+	30M
2001			1		Frequency		Average Lim Quasi-Peak I	nit Limit	2011

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**Measured Conducted Emissions - Neutral Lead** 

			Profes	sional Te	esting, EN	∕II, Inc.			
Test Metho	d:				ent of Radio-No z (incorporated			age Electrical a	nd Electronic
In accordan	ce with:	FCC Part 15.20 Limits	07 - Code of Fe	deral Regulation	ons Part 47, Sul	bpart C - Inter	ntional Radiato	rs, Conducted	Emissions
Section:		15.207							
Test Date(s)	:	3/28/2014			EUT Serial #	:	None		
Customer:		Ketra		EUT Part #: 830-000005-xx					
Project Num	nber:	15714-15			Test Technic	cian:	<b>Bob Redout</b>	ey	
Purchase Or		Not Listed			Supervisor:		Rob McColl	ough	
Equip. Unde	er Test:	VER003 2.40	GHz Zigbee N	Module	Witness' Na	me:	None		
	Conducted	Emissions Te	st Results D	ata Sheet - P	hase Lead (L	ine 1)	Pa	ge: 1	of 2
EU	T Line Volta	ige:	120	VAC	EUT	Line Freque	ency:	60	Hz
Frequency Measured (MHz)	Peak Detector Reading	Quasi-peak Detector Reading	Quasi-peak Detector Limit	Quasi-peak Detector Margin	Quasi-peak Detector Test	Average Detector Reading	Average Detector Limit	Average Detector Margin	Average Detector Test
(IVITZ)	(dBμV)	(dBμV)	(dBµV)	(dB)	Results	(dBμV)	(dBμV)	(dB)	Results
0.41681	39	34.3	57.5	-23.2	PASS	24.6	47.5	-22.9	PASS
0.45344	39.6	35.7	56.8	-21.1	PASS	27.1	46.8	-19.7	PASS
0.45766	39.4	36.3	56.7	-20.4	PASS	27.8	46.7	-19	PASS
0.5602	34.7	30.7	56	-25.3	PASS	21.4	46	-24.6	PASS
0.8224	36.8	32.2	56	-23.8	PASS	19.2	46	-26.8	PASS
0.8289	37.6	32.4	56	-23.6	PASS	20.3	46	-25.7	PASS
9.0293	26.5	17.5	60	-42.5	PASS	10.2	50	-39.8	PASS
9.6806	26.8	19.8	60	-40.2	PASS	11.3	50	-38.7	PASS
9.8428	27.3	19.6	60	-40.4	PASS	12.1	50	-37.9	PASS
10.0237	26.6	19.8	60	-40.2	PASS	12.3	50	-37.7	PASS
Professional Testing, EMI, Inc. Conducted Emissions 150kHz to 30MHz Phase A Graph - L1  Phase A Graph - L1  Company: - Ketra Model#: - VER003 2.4GHz Zig bee Module Description - Project #: - 15714-15 VoltageFreq: - 120VAC/60Hz Additional Equipment -					lule				
80 - 70 -									
Amplitude (dBhV) Amplitude (dBhV) 30									
opn 40 -	Ma. 100M	WANTER TO SERVE	Marin		Mary Mary and April	4			

Measured Conducted Emissions - Phase Lead (Line 1)

Frequency

30M

10M Average Limit Quasi-Peak Limit Peak Scan Data Average Reading Quasi-Peak Reading

1M

Transmit Mode

-10 ⊥ 150K

Operator: Bob Redoutey
02:21:02 PM, Friday, March 28, 2014

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## **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-210 Issue 8, A2.9	Antenna Construction	2014-04-16			

#### 10.3 Results

Antenna Manufacturer and Model	Specifications	
Ketra	F . 1	
Printed circuit antenna on circuit board.	F-style	

- 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 meets the requirements of the rules.

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# 11.0 Equipment and Bandwidths

## 11.1 Equipment for Spurious Radiated Emissions 30 MHz to 12 GHz

		Profess	sional To	esting, EMI, Inc.			
Test Method:  ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage  Test Method:							
Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by referen FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators,							
In accordance		ted Emissions Limi		egulations Fait 47, Subpo	art B - Omntention	ai Nauiatois,	
Section:	15.10						
Test Date(s)				EUT Serial #:	N/A		
Customer:	Ketra			EUT Part #: None			
Project Num	ber: 15714	l-15	Test Technician:		Larry Fuller		
Purchase Or	der #:			Supervisor:	Rob McCollough		
Equip. Unde	r Test: VER0	03 2.4GHz Zigbee N	<b>Nodule</b>	Witness' Name:	Craig T Phillips		
		Radiate	d Emissions	Test Equipment List			
Tile	e! Software Version	on: 4.2.A,	May 23, 20	10, 08:38:52 AM			
	Test Profile:	Radia	ted Emissio	ns_Profile Version Octob	er 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	7/29/2014	
1890	НР	8447F	Preamp/Amp, 9kHz-1300MHz, 28/25dB		3313A05298	1/22/2015	
1937	Agilent	E4440A	Spectrum Analyzer, 3 Hz - 26.5 GHz		MY44303298	12/2/2014	
1926	ETS-Lindgren 3142D Antenna,		Antenna, B	siconilog, 26 MHz - 6 GHz	00135454	7/29/2014	
C027	N/A	RG214	Cable Coax, N-N, 25m		none	9/26/2014	
1327	EMCO	1050	Controller, Antenna Mast		none	N/A	
0942	EMCO	11968D	Turntable, 4ft.		9510-1835	N/A	
1969	НР	11713A	Attenuator/Switch Driver		3748A04113	N/A	
1509B	Braden	N/A	TDK 10M Chamber, VSWR > 1 GHz		DAC-012915-005	7/16/2014	
2004	Miteq	AFS44-00101800- 2S-10P-44	Amplifier, 40dB, .1-18GHz		0	11/19/2014	
C030	N/A	0	Cable Coax, N-N, 30m		none	9/26/2014	
Loaner-ETS	ETS-Lindgren	3117	Antenna, Double Ridged Guide Horn, 1 - 18 GHz		135203	1/14/2015	
1325	EMCO	1050	Contro	oller, Antenna Mast	9003-1461	N/A	

Same list also applies to spurious measurements on 3/28/2014.

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## 11.2 Equipment for Timings, Bandwidth, and Spurious from 12 to 25 GHz

Asset #	Manufacturer	Model #	Description	Calibration Due
0582	EMCO	3115	Ridge Guide Antenna	2014-04-14
1974	Agilent	83017A	Microwave Preamplifier (preamp 1)	2015-02-05
ALN-077	Rohde & Schwarz	FSP-30	Spectrum Analyzer	2015-01-29
C248	Pasternack	-	Cable, Low Loss	2014-04-12
1542	AH Systems	SAS-572	Horn Antenna, Standard Gain, 20 dB	Not Required

## 11.3 Measurement Bandwidths, Radiated

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 re						
	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators,					
In accordance with:	Radiated Emissions Limits					
Section:	15.109					
Test Date(s):	3/25/2014	EUT Serial #:	N/A			
Customer:	Ketra, Inc.	EUT Part #:	None			
Project Number:	15714-15	Test Technician:	Larry Fuller 3/25, Eric Lifsey 3/28			
Purchase Order #:		Supervisor:	Rob McCollough			
Equip. Under Test:	VER003 2.4GHz Zigbee Module	Witness' Name:	Craig T Phillips			

## 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  $1\,\mathrm{MHz}$  for average measurements from  $1\text{-}18\,\mathrm{GHz}$ .

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### 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.

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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
Radiated Emissions	1 to 18 GHz	3 m	5.7

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# **End of Report**

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