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, <u>2400-2483.5 MHz</u> , 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 (A	

^{*}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.

Rep	oresentativ	ve of App	licant	

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		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:

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		
47 CFK	Subpart C -Intentional Radiators		
DCC 247 Issue 1	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-		
RSS-247 Issue 1	Exempt Local Area Network (LE-LAN) Devices		
RSS-Gen Issue 4	General Requirements and Information for the Certification of Radio Apparatus		
ANCI C62 4 2000	American National Standard for Methods of Measurement of Radio-Noise Emissions		
ANSI C63.4 2009	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) //	Fundamental Power	2014-05-20
RSS-247 5.2	Conducted Limit: 1 Watt	2014-05-20

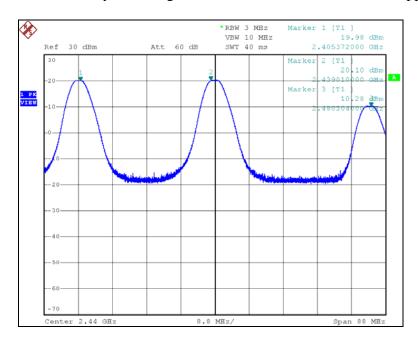
2.3 Test Results

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 Measured Peak Power Power in Linear Units			
MHz	dBm	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) //	Power Spectral Density	20 Jul 2015
RSS-247 5.2	Conducted Limit: 8 dBm / 3 kHz	20 Jul 2015

3.3 Test Results

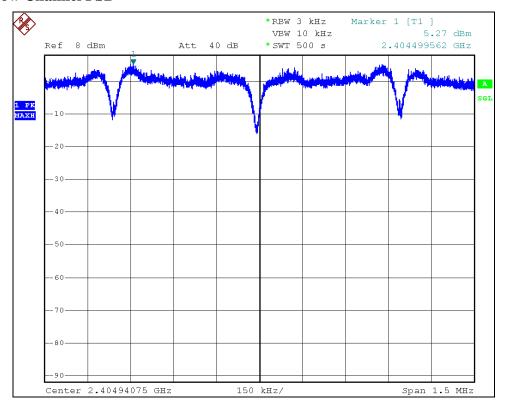
Sweep time 500 seconds.

Highest recorded measurement: 5.27 dBm

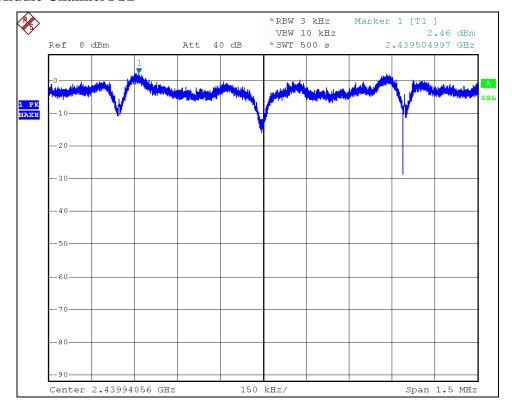
The EUT was found to be in compliance with the applicable criteria.

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

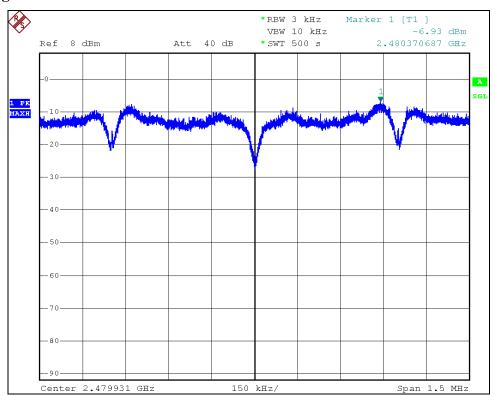
3.3.1 Low Channel PSD



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

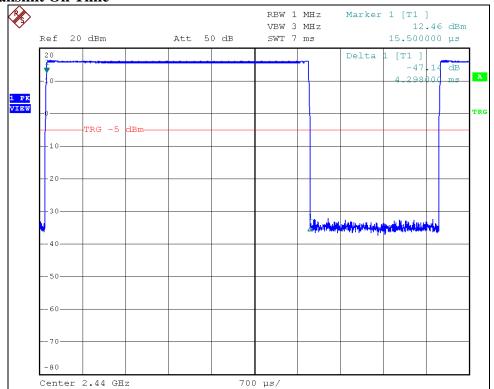
r	Table 4.3.1 Duty Cycle Factor Result								
	Measured On Time (msec)	Measured Time Interval (msec)	Duty Cycle Factor Calculation	Result (dB)	Duty Cycle Factor Allowed (dB)				
	4.298	6.412	= 20 * Log ₁₀ (4.298 msec / 6.412 msec)	-3.48	-3.48				

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

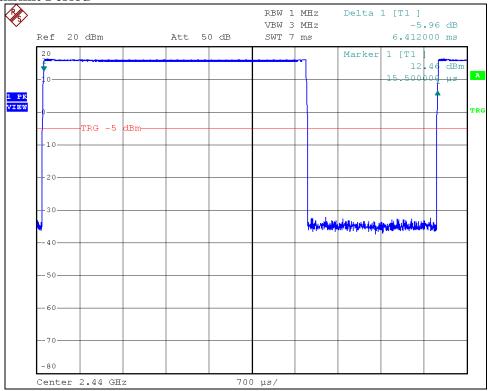
The source based factor for exposure is half of the above or: -1.74 dB

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

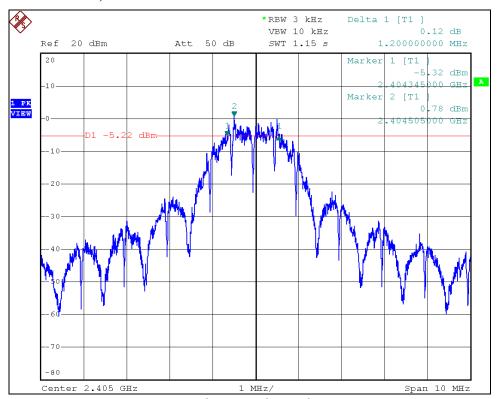
EUT was found to be in compliance with applicable requirements.

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

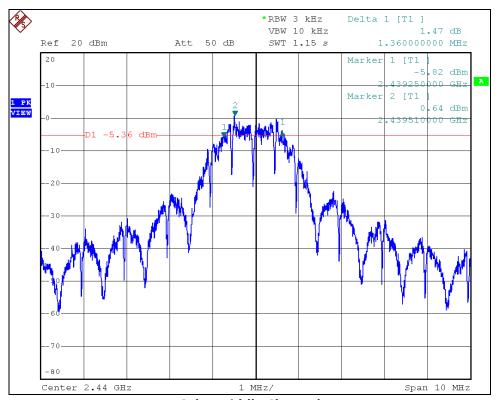
Table 5.3.2 Bandwidth 20 dB, Measure and Report									
Low Channel	Reported								
Measured BW	Measured BW	Measured BW	Maximum BW						
(kHz)	(kHz)	(kHz)	(kHz)						
2540	2545	2500	2545						

Plotted measurements appear on the following pages.

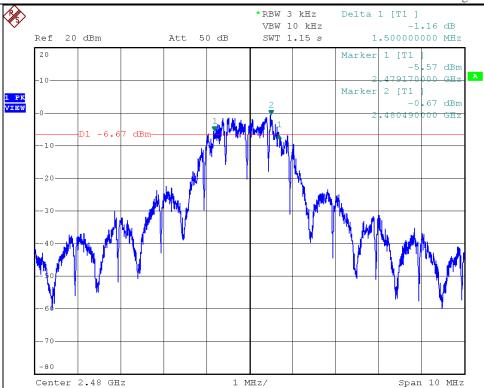
5.3.1 Bandwidth Plots, 6 dB



6 dB, Low Channel

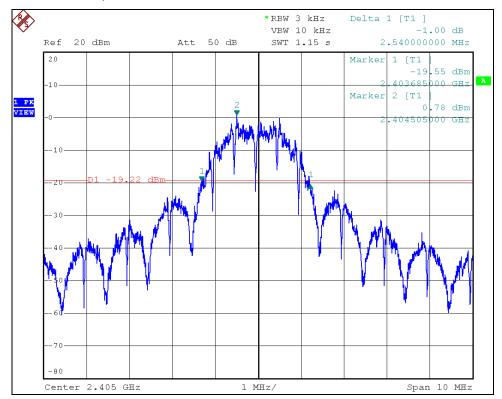


6 dB, Middle Channel

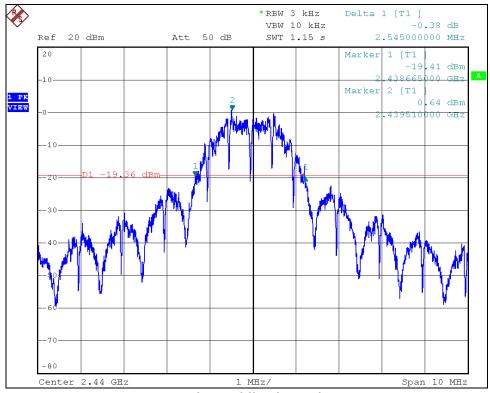


6 dB, High Channel

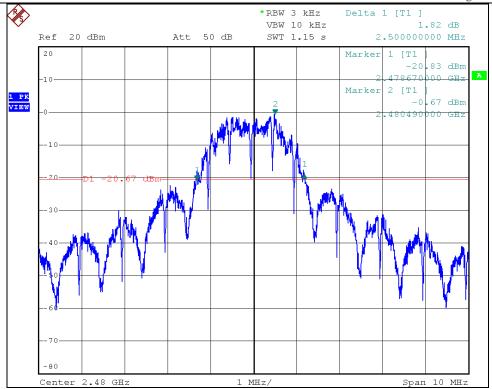
5.3.2 Bandwidth Plots, 20 dB



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

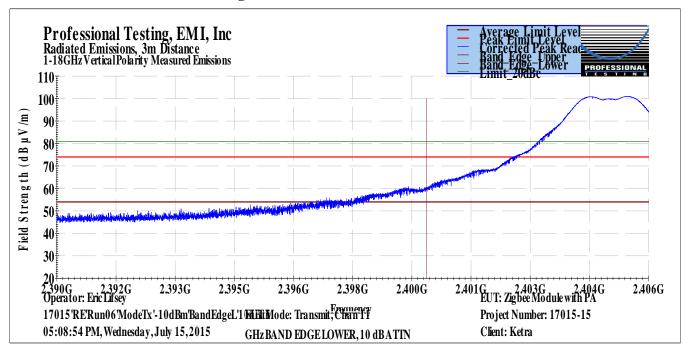
47 CFR (USA) // IC (Canada)								
Section Reference	Parameter	Date(s)						
15.205, 15.209 //	Unwanted Emissions Adjacent to Authorized	15 Jul 2015						
RSS-247 5.5, RSS-Gen 6.13	Band, Radiated	15 Jul 2015						

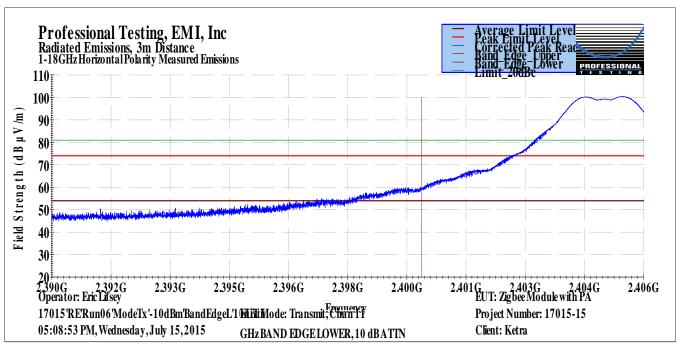
6.3 Test Results

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

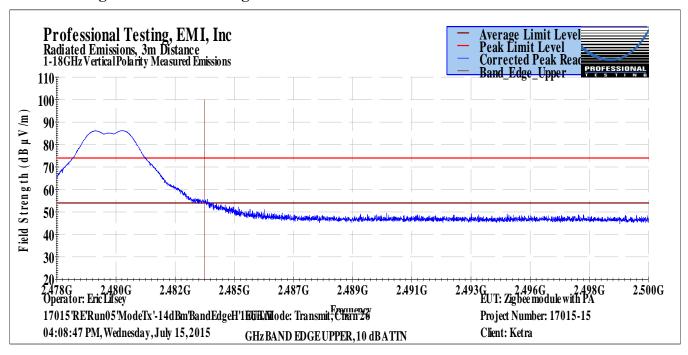


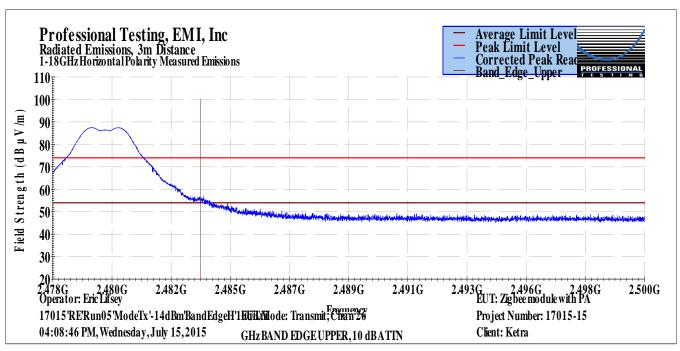


EUT Satisfies -20 dBc Criteria and 15.209 Criteria Below ~2.398 GHz

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: $55.66 - 3.48 = 52.18 \text{ dB}\mu\text{V/m}$ @ 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.

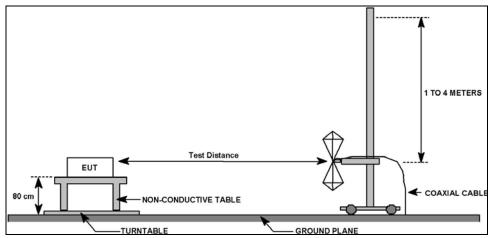


Figure 7.1.1: Field Strength of Spurious Emissions Test Setup

7.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.247, 15.209 //	Field Strength of Radiated	15 Jul 2015
RSS-247 5.5, RSS-Gen 7.1	Spurious/Harmonic Emissions	13 Jul 2013

7.3 Test Results

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

			Profes	sional Te	sting, El	VII, Inc.					
Test Metho	d:		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 accordan	ice with:	FCC Part 15. Limits	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 #:	art #: 0					
Project Nur	nber:	17015			Test Technician: Eric Lifsey						
Purchase O	rder #:	0			Supervisor: Lisa Arndt						
Equip. Und	er Test:	Zigbee Mo	dule with P	4	Witness' Name: Steve Proffit						
	F	Radiated Er	nissions Test	Results Data	a Sheet			Page:	1	of	1
EUT Li	ne Voltage:	: 3	3.3 VDC		EUT Pow	ver Frequen	су:	0	N/A		
Antenna	Orientatio	n:	Vertic	al	Frequ	ency Range		30	MHz to	1GHz	
	EUT N	/lode of Op	eration:			R	eceive N	/lode			
Frequency Measured	Test Distance	EUT Direction	Antenna Height	Detector	Recorded Amplitude	Corrected Level	Limit Le		/largin	Test R	esults

	EUIN	lode of Ope	eration:		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	

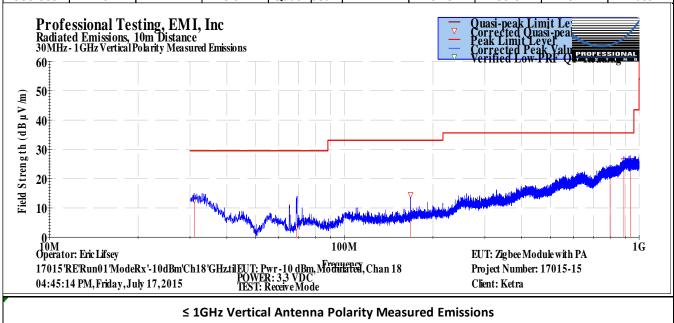


Table 7.3.	2: Radiate	d Spurioւ	s Emission	s, Receive N	Mode, Belo	ow 1 GHz,	Horizonta	l Polarity			
			Profess	sional Te	sting, EN	VII, Inc.					
Test Method: ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).									rical and		
In accordan	nce with:	FCC Part 15 Limits	209 - Code of	Federal Regulat	tions Part 47, S	Subpart C - Int	entional Radi	ators, Radiate	ed Emissions		
Section:		15.209									
Test Date(s	;):	7/15/201	;		EUT Serial #	# :	Sample C2				
Customer:		Ketra			EUT Part #:		0				
							Eric Lifsey				
Purchase O		0			Supervisor:		Lisa Arndt				
Equip. Und	er Test:	Zigbee Mo	dule with P	A	Witness' Na	ame:	Steve Proff	it			
	F	Radiated E	nissions Test	t Results Data	a Sheet		Pa	ge: 1	of 1		
EUT Li	ine Voltage:		3.3 VDC		EUT Power Frequency: 0 N/A						
Antenna				·	Frequency Range: 30MHz to 1GHz						
	a Orientatio	n:	Horizor	ntal	Freque	ency Range:		30MHz to	1GHz		
		on: Mode of Op		ntal	Freque		eceive Mod		1GHz		
Frequency Measured (MHz)				Detector Function	Recorded Amplitude (dBµV)						
Measured	EUT N Test Distance	Aode of Op EUT Direction	Antenna Height	Detector	Recorded Amplitude (dBµV)	R Corrected Level	eceive Mod	e Margin			
Measured (MHz)	Test Distance (Meters)	Aode of Op EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	R Corrected Level (dBμV/m)	eceive Mod Limit Level (dBμV/m)	e Margin (dB)	Test Result:		
Measured (MHz) 31.9904	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function Quasi-peak	Recorded Amplitude (dBµV)	R Corrected Level (dBμV/m) 12.534	eceive Mod Limit Level (dBμV/m) 29.5	e Margin (dB)	Test Results		
Measured (MHz) 31.9904 167.999	Test Distance (Meters) 10 10	EUT Direction (Degrees) 135 102	Antenna Height (Meters) 2.92 3.64	Detector Function Quasi-peak Quasi-peak	Recorded Amplitude (dBµV)	Corrected Level (dBμV/m) 12.534 17.682	Limit Level (dBµV/m) 29.5 33.1	e Margin (dB) -17.0 -15.4	Test Results Pass Pass		
Measured (MHz) 31.9904 167.999 653.105	Test Distance (Meters) 10 10 10	EUT Direction (Degrees) 135 102 283	Antenna Height (Meters) 2.92 3.64 1.21	Detector Function Quasi-peak Quasi-peak Quasi-peak	Recorded Amplitude (dBμV) 24 33.3 22 21.7 21.4	R Corrected Level (dBμV/m) 12.534 17.682 20.608	Limit Level (dBµV/m) 29.5 33.1 35.6	e Margin (dB) -17.0 -15.4 -15.0	Pass Pass Pass Pass		

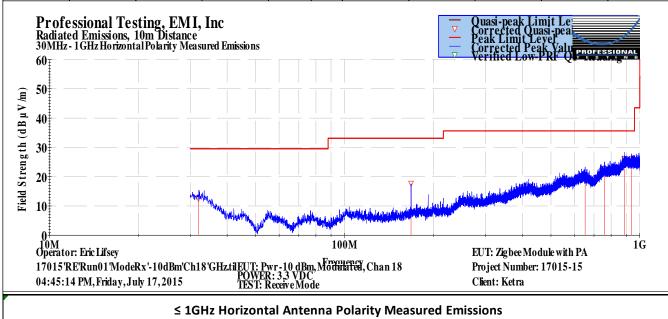


Table 7.3.3: Radiated Spurious Emissions, Transmit Mode, Below 1 GHz, Middle Channel, Vertical Polarity

Polarity												
				Profes	sional Te	sting, EN	VII, Inc.					
Test Metho	od:				ds of Measure e Range of 9 kl					•		
In accordar	ice with:	FCC Pa	rt 15.2	09 - Code of	Federal Regula	tions Part 47, S	Subpart C - Int	tentional	Radiat	ors, Radiate	ed Emissi	ons
Section:		15.209)									
Test Date(s):	7/15/	2015			EUT Serial	# :	Sample	C2			
Customer:		Ketra				EUT Part #:		0				
Project Number: 17015						Test Techni	ician:	Eric Lifs	sey			
Purchase Order #: 0						Supervisor:		Lisa Arı				
Equip. Und	er Test:	Zigbe	e Mod	dule with P	A	Witness' Na	ame:	Steve P	roffit			
	F	Radiate	ed Em	issions Tes	t Results Dat	a Sheet			Page	e: 1	of	1
EUT Li	ne Voltage	:	3.	.3 VDC		EUT Pow	er Frequen	cy:	0	N/A		
Antenna	Orientatio	n:		Vertic	al	Freque	ency Range:			Above 1	GHz	
	EUT N	/lode c	of Ope	eration:			R	Receive I	Mode			
Frequency Measured (MHz)	Test Distance (Meters)	EU Direc (Degi	tion	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBμV)	Corrected Level (dBµV/m)	Limit Le		Margin (dB)	Test Re	sult
4887.75	3	30)8	1	Peak	42.3	38.585	54.0)	-15.4	Pas	— s
7316.37	3	31	.0	1	Peak	38.5	41.969	54.0)	-12.0	Pas	s
9757.07	3	16	69	1	Peak	35.3	42.137	54.0)	-11.9	Pas	S
Field Strength (dB µV/m) Solution 1-18GH Solution 1-18G	essional Tested Emissions, iz Vertical Polarit	sting, 3m Dist ty Measu	EM I, ance red Emis	Inc sions				Average I Peak Lim Corrected Peak Read	it Lev I Peak	el Reac	SSIONAL	
20 1.0G Operato 17015 F	2,2G r: Eric Lifsey RE'Run01'Mode		Bm'Ch1	4.6G 8'GHztilEUT: P	wr-10 dBm, Mod	.0G 8.20]]	Project Nur	mber: 17	11.8G le with PA 7015-15	13.00	Ĵ
17015'F		Rx'-10d	Bm'Ch18	8'GHz.tilEUT: P POWE TEST: 1		mency mated, Chan 18]	Project Nur Client: Ketr	mber: 17		13.00	_

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

Polarity										
		P	rofes	sional Te	sting, El	MI, Inc.				
Test Method:				ods of Measure ne Range of 9 kl					•	
n accordance with:	FCC Part	t 15.209	- Code of	Federal Regula	tions Part 47,	Subpart C - Int	tentional	Radiat	ors, Radiate	ed Emission
Section:	15.209									
Test Date(s):	7/15/2	2015			EUT Serial	#:	Sample	e C2		
Customer:	Ketra 17015				EUT Part #:		O			
Project Number:		Test Techn	ician:	Eric Lif						
Purchase Order #:		Supervisor		Lisa Ar						
Equip. Under Test:	Zigbee	<u>Modul</u>	e with P	Α	Witness' N	ame:	Steve I	Proffit		
	Radiate	d Emiss	ions Tes	t Results Dat	a Sheet			Page	: 1	of 1
EUT Line Voltag	e:	3.3	VDC		EUT Pov	ver Frequen	су:	0	N/A	
Antenna Orientat	ion:		Horizo	ntal	Frequ	ency Range	:		Above 1	GHz
EUT	Mode of	f Operat	tion:			R	Receive	Mode		
Frequency Test Measured Distance (MHz) (Meters)	EU1 Direct (Degre	tion	intenna Height Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit L		Margin (dB)	Test Resu
4882 3	208	8	1	Peak	42.6	38.843	54.0	0	-15.2	Pass
7319.1 3	206	6	1	Peak	38.4	41.845	54.0	0	-12.2	Pass
9762.23 3	9		1	Peak	35	41.917	54.0	0	-12.1	Pass
Professional T Radiated Emissions, 3r 1-18GHz Horizontal P 90 80 80 70 80 40 40 1.0G Operator: Eric Lifsey 17015 RERun01 Mo	olarity Meas	sured Emiss	4.6G		.0G 8.20 High red, Chan 18	G 94G	Average Peak Lin Correcte Peak Rea	o.6G ee Modul	Rea PROFES	13.0G

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.

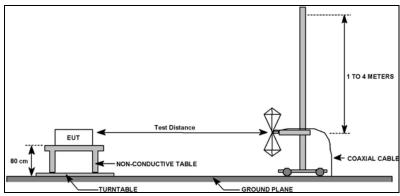


Figure 8.1.1: Field Strength of Spurious Emissions Test Setup

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

Polarity									
			Profes	sional Te	sting, EN	VII, Inc.			
Test Metho	d:		I–2003: "Metho Equipment in th					•	
In accordan	ce with:	FCC Part 19	5.209 - Code of	Federal Regulat	ions Part 47, S	Subpart C - Int	entional Rad	iators, Radiat	ed Emissions
Section:		15.209							
Test Date(s):	7/15/201	.5		EUT Serial		Sample C2		
Customer:		Ketra			EUT Part #:		0		
Project Nur		17015			Test Techni		Eric Lifsey		
Purchase O		0		_	Supervisor:		Lisa Arndt	· .	
Equip. Und	er Test:	Zigbee IV	odule with P	A	Witness' N	ame:	Steve Prof	rit	
	F	Radiated E	missions Test	Results Data	Sheet		Pa	ige: 1	of 1
EUT Li	EUT Line Voltage: 3. Antenna Orientation:				EUT Pow	ower Frequency: 0 N/A			
Antenna	Orientatio	n:	Vertic	al	Frequ	ency Range:		30MHz to	1GHz
	EUT N	lode of O	peration:			Tran	smit, Modu	lated	
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees		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
Radiated	ional Testing, Emissions, 10m Di GHz Vertical Polarity	stance	is			— Qu	asi-peak Limit Le rrected Quasi-pea ak Limit Level rrected Peak Valu rified Low-PRF Q	vel k Readin le P Readin	SSIONAL
Field Strength (dB µV/m) Programmer 100 Programmer									- Marie III
10	Managar Middelling Mill			Mention of the second		Management Management	And the state of t		
	Eric Lifsey Run04'ModeTx'-10d 'M, Wednesday, July	15,2015	POWER: TEST: wH	-10 dBm, Modulated, Ch 3.3 VDC IPF+GHz	uency nan 18	P	UT: Zig bee Module w roject Number: 1701 Lient: Ketra		1G

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

Polarity									
			Profess	sional Te	sting, EN	∕II, Inc.			
Test Metho	d:			ds of Measurer e Range of 9 kH				_	
In accordar	ice with:	FCC Part 15.2 Limits	109 - Code of I	Federal Regulat	ions Part 47, S	Subpart C - Int	entional Radi	iators, Radiat	ed Emissions
Section:		15.209			1				
Test Date(s	<u>):</u>	7/15/2015			EUT Serial		Sample C2		
Customer:		Ketra			EUT Part #:		0		
Project Nur		17015			Test Techni		Eric Lifsey		
Purchase O		0			Supervisor:		Lisa Arndt	-	
Equip. Und	er Test:	Zigbee Mo	dule with P	A	Witness' N	ame:	Steve Prof	fit	
	F	Radiated Em	issions Test	Results Data	a Sheet		Pa	ge: 1	of 1
EUT Li	ne Voltage	: 3	.3 VDC		EUT Pow	er Frequen	cy:	0 N/A	
Antenna	Orientatio	n:	Horizor	ntal	Frequ	ency Range:		30MHz to	1GHz
	EUT N	lode of Ope	eration:			Trans	smit, Modu	lated	
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
Radiated	sional Testing, Emissions, 10m Di GHz Horizontal Polar	,	s			— Qu Cor — Per — Cor Ver	asi-peak Limit Le rrected Quasi-pea ak Limit Level rrected Peak Valu rified Low-PRF Q	vel k Readin e P Readir	SIONAL
Field Strength (dB µV/m) 70 70 70 70 70 70 70 70 70 7									
10	hypocology hodge the hodge	water the plant of	100M	A plate bill a grad about the plate by	The second secon	AND			1G
		Bm'Ch18'GHzMHztil		-10 dBm, Modulated, Cl 3.3 VDC	uency nan 18	P	UT: Zigbee Module w roject Number: 1701 Lient: Ketra		-

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

	P	rofessional Te	esting, EMI, Inc	.				
'est Method:			ement of Radio-Noise Emi Hz to 40 GHz" (incorporat			•	rical and	t
n accordance with: FCC Limit		- Code of Federal Regula	ations Part 47, Subpart C -	Intention	al Radiators,	Radiate	d Emis	ion
ection: 15.2	09							
est Date(s): 7/1	5/2015		EUT Serial #:	Samp	ole C2			
Customer: Keti	ra		EUT Part #:	0				
roject Number: 170	15		Test Technician:	Eric L	ifsey			
urchase Order #: 0			Supervisor:	Lisa A	Arndt			
quip. Under Test: Zigb	ee Modul	e with PA	Witness' Name:	Steve	Proffit			
Radia	ited Emissi	ions Test Results Da	ta Sheet		Page:	1	of	1
EUT Line Voltage:	3.3	VDC	EUT Power Frequ	ency:	0	N/A		
Antenna Orientation:		Vertical	Frequency Ran	ge:	Al	ove 10	GHz	
EUT Mode	of Operat	tion:	Tr	ansmit,	Modulated			
Professional Testing, EMI, Radiated Emissions, 3m Distance 1-18GHz Vertical Polarity Measured Emi 90 T				Average Lin Peak Limit Corrected F Peak Readin	Level Peak Reading	PROFES:	SIONAL 7 I N 6	
80 =								
(ii) 70								
a 60 — — — — —								
Elel d Streng th (d B µV) (m / V) (m				The state of the s				
30	And the second s	the state of the s						
2016								

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

Polarity										
		P	rofessional	Testing, E	MI, Inc.					
Test Method:			3: "Methods of Meas ment in the Range of					_	ical and	d
In accordance with:	FCC Part	t 15.209	- Code of Federal Reg	ulations Part 47	, Subpart C - Int	tentiona	l Radiators,	. Radiate	d Emiss	sion
Section:	15.209									
Test Date(s):	7/15/2	2015		EUT Seria	l #:	Sampl	e C2			
Customer:	Ketra			EUT Part	#:	0				
Project Number:	17015			Test Tech	nician:	Eric Li	fsey			
Purchase Order #:	0	0			r:	Lisa A	rndt			
Equip. Under Test:	Zigbee Module with PA			Witness'	Name:	Steve	Proffit			
	Radiate	d Emissi	ions Test Results [Data Sheet			Page:	1	of	1
EUT Line Voltag	EUT Line Voltage: 3.			EUT Po	wer Frequen	ency: 0 N/A				
Antenna Orientat	ion:		Horizontal	Freq	:	Al	bove 10	SHz		
EUT	Mode of	Operat	ion:		Tran	smit, N	/lodulated	i		
Professional Testin Radiated Emissions, 3m Dista 1-18GHz Horizontal Polarity 90 80	nœ				— Pes — Con	erage Limi ak Limit Lo rrected Pe ak Reading	evel ak Reading	PROFESS T E S T	SIONAL IN 6	
Field Strength (dB µV/m) 20 40 40 40 40							- Control of the Cont			
	15 1:00	and all the same	the second state of the se		mp-up-i					
30										
20 [±] 1G Operator: Eric Lifsey 17015 'RE'Run03'ModeTx'-1 01:43:38 PM, Wednesday, Ji		ztil	EUT: Pwr-10 dBm, Modula POWER: 3.3 VDC TEST: wHPF+6Hz	Frequency ed, Chan 11	P	EUT: Zigbee M	LOG fodule with PA er: 17015-15		180	G.

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

Polarity											
		Pr	ofessional T	esting, EMI, In	c.						
Test Method:				ement of Radio-Noise En kHz to 40 GHz" (incorpor			•	rical and	t		
In accordance with:	FCC Part Limits	: 15.209 -	Code of Federal Regul	ations Part 47, Subpart C	- Intention	al Radiators,	Radiate	d Emiss	sion		
Section:	15.209										
Test Date(s):	7/15/2	015		EUT Serial #:	Samp	ole C2					
Customer:	Ketra			EUT Part #:	O						
Project Number:	17015			Test Technician:	Eric L	ifsey					
Purchase Order #:	O			Supervisor:		Arndt					
Equip. Under Test:	Zigbee	Module	with PA	Witness' Name:	Steve	Proffit					
	Radiated	d Emissic	ons Test Results Da	ta Sheet		Page:	1	of	1		
EUT Line Voltage: 3.3			VDC	EUT Power Freq	uency:	0	N/A				
Antenna Orientation:			Vertical	Frequency Ra	nge:	Above 1GHz					
EUT	Mode of	Operati	on:	7	ransmit.	Modulated	l				
Professional Testin Radiated Emissions, 3m 1-18GHz Vertical Polarity Mo	Distance				- Average Lin - Peak Limit - Corrected P - Peak Readin	Level Peak Reading	PROFES	SIONAL N 6			
Fied Strength (dB µV/m) 609 609 609 609 609 609 609 609 609 609					- - 1 	_	Total Manager				
30 30	<u>ig kerindika pirikan pinggalan di</u>		the little of the latest the late								
20 1G											
~1G Operator: Eric Lifsey		:MHz.til	F. EUT: Pwr-10 dBm,Modulated,	requency Chan 18	EUT: Zigbee Project Nun	10G Module with PA		180	;		

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

Polarity										
		Р	rofessional	Testing, E	EMI, Inc.					
Test Method:			3: "Methods of Meas nent in the Range of					_	rical and	d
In accordance with:	FCC Part Limits	15.209	- Code of Federal Reg	gulations Part 47	7, Subpart C - In	tentiona	l Radiators,	. Radiate	d Emis	sion
Section:	15.209									
Test Date(s):	7/15/2	015		EUT Seria	nl #:	Samp	le C2			
Customer:	Ketra			EUT Part	#:	0				
Project Number:	17015			Test Tech	nician:	Eric Li	fsey			
Purchase Order #:	0				or:	Lisa A	rndt			
Equip. Under Test:	Zigbee Module with PA			Witness'	Name:	Steve	Proffit			
	Radiated	l Emissi	ons Test Results [Data Sheet			Page:	1	of	1
EUT Line Voltag	EUT Line Voltage: 3.3			EUT Po	ower Frequer	ncy: 0 N/A				
Antenna Orientat	ion:		Horizontal	Fred	uency Range	:	Al	bove 10	3Hz	
EUT	Mode of	Operat	ion:		Tran	nsmit, N	/lodulated	ı		
Professional Testin Radiated Emissions, 3 m Dista 1-18 GHz Horizontal Polarity 90 80	nce	ns			— Pe — Co	verage Limi eak Limit L orrected Pe eak Reading	evel ak Reading	PROFESS T E S T	SIONAL IN 6	
Field Streng th (dB µV m) 20 40 40							***************************************			
30	<u>Unique et estimation</u>									
20 [±] 1G Operator: Eric Lifsey	.0dBm'Ch18'GHz	MHztil	EUT: Pwr-10 dBm, Modula	Frequency ted, Chan 18		EUT: Zigbee N	10G Module with PA per: 17015-15		180	G

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

Polarity										
		Pr	ofessional T	Testing, EN	∕II, Inc.					
Test Method:			: "Methods of Measu ent in the Range of 9					•	rical and	d
n accordance wit	:h: FCC Par Limits	t 15.209 -	Code of Federal Regu	ılations Part 47, S	Subpart C - Int	tentiona	l Radiators,	Radiate	d Emis	sior
Section:	15.209									
Test Date(s):	7/15/2	2015		EUT Serial #	‡ :	Sample	e C2			
Customer:	Ketra			EUT Part #:		o				
Project Number:	17015			Test Techni	cian:	Eric Lif	sey			
Purchase Order #	: 0			Supervisor:		Lisa Ar				
Equip. Under Tes	t: Zigbee	Module	with PA	Witness' Na	ame:	Steve	Proffit			
	Radiate	d Emissio	ons Test Results D	ata Sheet			Page:	1	of	:
EUT Line Voltage: 3.3			VDC	EUT Pow	er Frequen	ісу:	0	N/A		
Antenna Orientation: Ver			Vertical	Freque	ency Range:	:	Al	oove 10	GHz	
E	UT Mode o	f Operati	on:		Tran	smit. N	lodulated	l		
Professional Te Radiated Emissions, 1-18GHz Vertical Polar 90	3m Distance				— Pea — Con	erage Limi ak Limit Lo rrected Pea ak Reading	evel ak Reading	PROFESS	SIONAL IN 6	
80										
‡										
70 — — — —		_			+					
g 60 — —		_								
Field Strength (dB µV/m) 40 40 40 40 40 40 40 40 40 40 40 40 40			1						L.	
ert 20					- Line	ر العظام	July Wales	A contract of		
40 1 − − − − − − − − − − − − − − − − −			a desirate de la compansa de la comp	Charles of the State of the Sta	Alternative and the second	The same of the sa				
30	home April Divinity in the Home April 2006 (1996)		The second secon							
										
20±				Frequency	F		0G Iodule with PA		180	Ġ
20 [±] 1G Operator: Eric Lifsey										

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

		Pr	ofessional '	Testing, I	EMI, Inc.					
Test Method:			"Methods of Meas ent in the Range of						rical and	ŀ
n accordance with:	FCC Part 1 Limits	5.209 - (Code of Federal Reg	ulations Part 4	7, Subpart C - Int	tentiona	al Radiators,	Radiate	d Emiss	sion
Section:	15.209									
Гest Date(s):	7/15/201	15		EUT Seria	al #:	Samp	le C2			
Customer:	Ketra			EUT Part	#:	0				
Project Number:	17015			Test Tech	nnician:	Eric Li	fsey			
Purchase Order #:	0	O			or:	Lisa A	rndt			
Equip. Under Test:	Zigbee N	1odule	with PA	Witness'	Name:	Steve	Proffit			
	Radiated E	Emissio	ns Test Results [Data Sheet			Page:	1	of	1
EUT Line Voltage: 3.3			VDC	EUT Po	ower Frequen	су:	0 N/A			
Antenna Orientat	ion:	I	Horizontal	Fred	quency Range:		Al	ove 10	3Hz	
EUT	Mode of O	peratio	on:		Tran	smit. N	/lodulated			
Professional Testing Radiated Emissions, 3m Distant 1-18GHz Horizontal Polarity	ice				— Pea — Con	erage Lim ak Limit L rrected Pe ak Reading	evel eak Reading	PROFESS	SIONAL I N 6	
Fiedd Strength (dB µV/m) 90 90 90 90 90 90 90 90 90 9										
30	Military department of the second									
20 [±] 1G Operator: Eric Lifsey	4dBm'Ch26'GHztil	1	EUT: Pwr-14 dBm, Modula	Frequency ted, Chan 26		UT: Zigbee N	10G Module with PA per: 17015-15		180	3

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

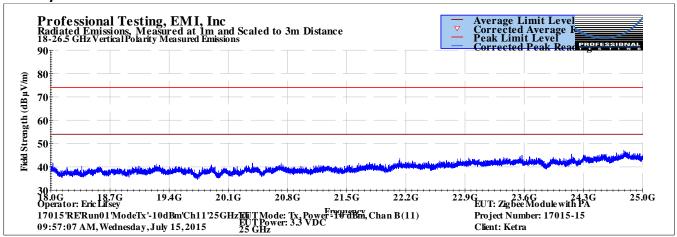


Table 8.3.10: Radiated Spurious Emissions, Transmit Mode, 18 to 25 GHz, Low Channel, Horizontal Polarity

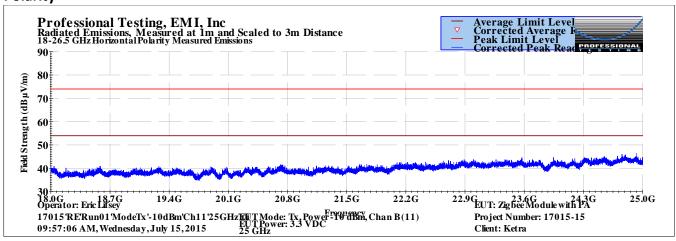


Table 8.3.11: Radiated Spurious Emissions, Transmit Mode, 18 to 25 GHz, Middle Channel, Vertical Polarity

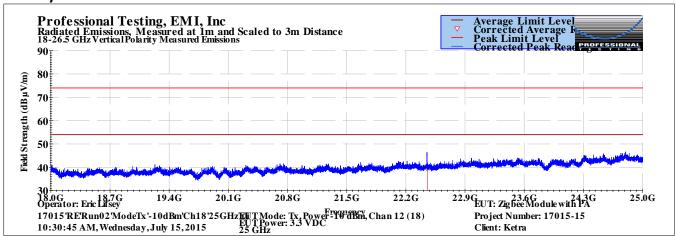


Table 8.3.12: Radiated Spurious Emissions, Transmit Mode, 18 to 25 GHz, Middle Channel, Horizontal Polarity

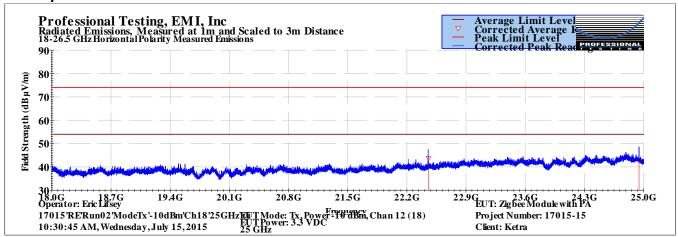


Table 8.3.13: Radiated Spurious Emissions, Transmit Mode, 18 to 25 GHz, High Channel, Vertical Polarity

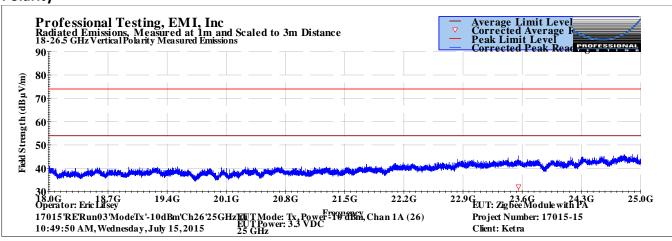
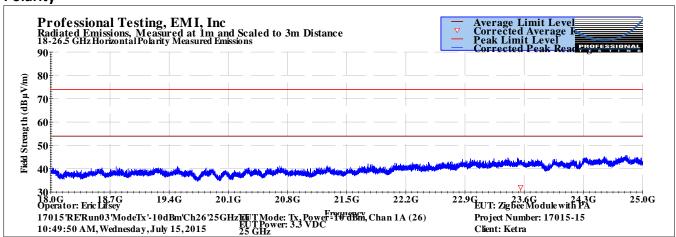


Table 8.3.14: Radiated Spurious Emissions, Transmit Mode, 18 to 25 GHz, High Channel, Horizontal Polarity



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

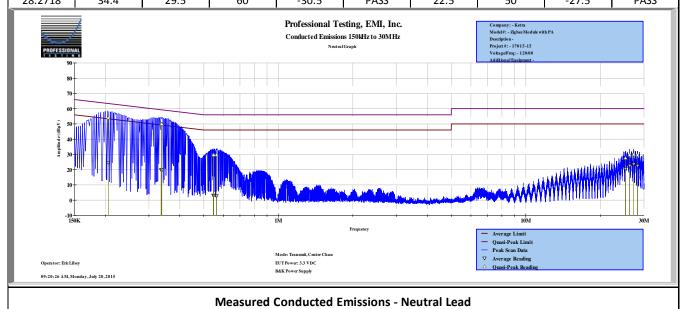
Measurements were taken for receive and transmit modes.

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						

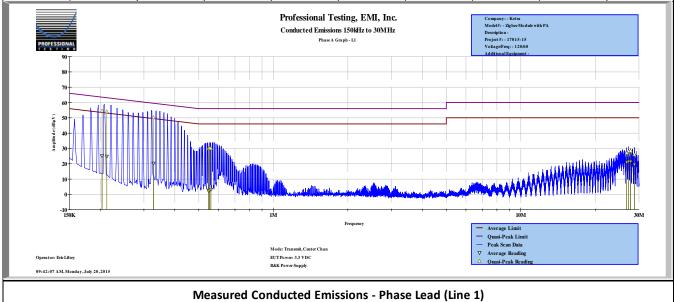
Conducted Emissions Test Results Data Sheet - Neutral Lead Page:									
EU	T Line Volta	ge:	120	VAC	EUT	Line Freque	ncy:	60	Hz
Frequency Measured (MHz)	Peak Detector Reading (dBµV)	Quasi-peak Detector Reading (dBµV)	Quasi-peak Detector Limit (dBµV)	Quasi-peak Detector Margin (dB)	Quasi-peak Detector 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



9.3.2 Mains Conducted Emissions. Phase Lead. Transmit Mode

Professional Testing, EMI, Inc.									
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						

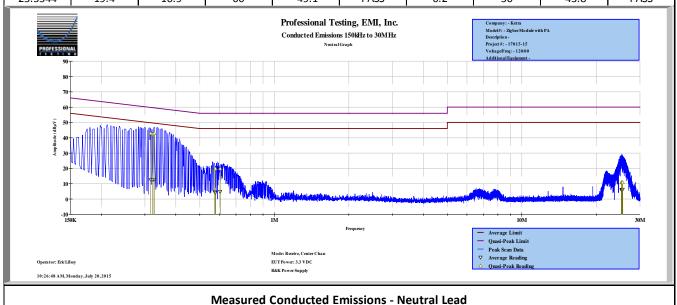
	Conducted Emissions Test Results Data Sheet - Phase Lead (Line 1) Page: 2 of 2									
EU	T Line Volta	ge:	120	VAC	EUT	Line Freque	ncy:	60	Hz	
Frequency Measured (MHz)	Peak Detector Reading (dBµV)	Quasi-peak Detector Reading (dBµV)	Quasi-peak Detector Limit (dBµV)	Quasi-peak Detector Margin (dB)	Quasi-peak 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	



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										
EU	T Line Volta	ige:	120	VAC	EUT	Line Freque	ncy:	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		



9.3.4 Mains Conducted Emissions. Phase Lead. Receive Mode

Professional Testing, EMI, Inc.									
Test Method:	Method: ANSI C63.4–2009: Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electron 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										
EU	T Line Volta	ge:	120	VAC	EUT	Line Freque	ncy:	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		

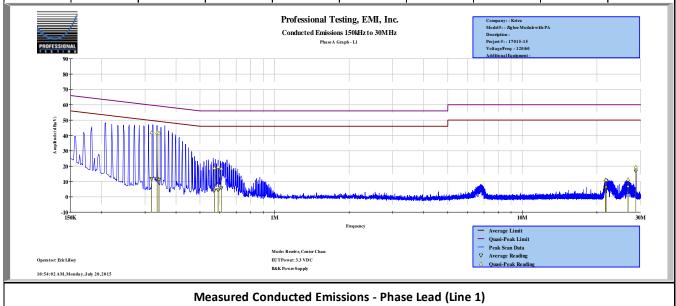


Table 9.3.5 Equipment List

Table Stole Equip.								
Professional Testing, EMI, Inc.								
	ANSI C63.4–2009: Methods of	Measurement of Radio-No	ise Emissions from Low-Voltage					
Test Method:	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
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Test Profile: Profile#: CE_2014_R3.TIL, dated May 1, 2014								
Asset #	Manufacturer	Model	Equipment Nomenclature	Serial Number	Calibration Due Date			
1842	НР	8568B	Spectrum Analyzer	2732A03633	10/1/2015			
2113	НР	85662A	Spec Anal Dsply for A/N 1842	2403A07470	N/A			
0990	НР	85685A	RF Preselector	3010A01119	9/30/2016			
1281	НР	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	НР	11170 C	Cable 5 ft BNC (Grey)	none	8/11/2015			
C109	НР	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	НР	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)	, , , , ,		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

		Profes	sional 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, FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators,							
In accordance with: Radiated Emissions Limits							
Section:	15.20		1				
Test Date(s)	<u> </u>	2015	EUT Serial #:	Sample C2			
Customer: Project Nun	Ketra nber: 17015		EUT Part #: Test Technician:	0 Eric Lifsey			
Purchase O		•	Supervisor:	Lisa Arndt			
Equip. Und	er Test: Zigbe	e Module with PA	Witness' Name:	Steve Proffit			
		Radiate	d Emissions Test Equipment List				
Til	le! Software Version		May 23, 2010, 08:38:52 AM				
	Test Profile:	Radia	ted Emissions_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	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	9 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		N/A		
1973	Agilent	83017A	Amplifier, Microwave 0.5-26.5 GHz MY39500497 2/4/201				

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
Radiated Ellissions	1 to 18 GHz	3 m	5.7

End	of	Re	port

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