FCC/ Canada Certification Test Report

For the

TPW Innovations UPC

Couples Vibe Remote Control Key Fob

FCC ID: 2AFYM-0142015
IC: 20660-0142015

WLL JOB# **14123-01 Rev 2**
Revised July 27, 2016

Prepared for:
TPW Innovations UPC
64 Bakersfield Street
Toronto, ON, M3J 2W7 Canada

Prepared By:
Washington Laboratories, Ltd.
7560 Lindbergh Drive
Gaithersburg, Maryland 20879

Testing Certificate AT-1448

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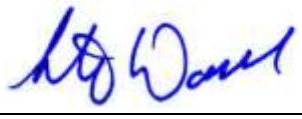

Steven Dovell
Compliance Engineer

Reviewed by:

Steven D. Koster
Vice President

Abstract

This report has been prepared on behalf of TPW Innovations UPC to support the attached Application for Equipment Authorization. The test report and application are submitted for an Intentional Radiator under Part 15.231 (10/2014) of the FCC Rules and Regulations and Industry Canada RSS210 issue 8 Annex 1. This Certification Test Report documents the test configuration and test results for a TPW Innovations UPC Couples Vibe Remote Control Key Fob.

Testing was performed on an Open Area Test Site (OATS) of Washington Laboratories, Ltd, 7560 Lindbergh Drive, Gaithersburg, MD 20879. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. The Industry Canada OATS numbers are 3035A-1 and 3035A-2 for Washington Laboratories, Ltd. Site 1 and Site 2, respectively. Washington Laboratories, Ltd. has been accepted by the FCC and approved by ACLASS under Certificate AT-1448 as an independent FCC test laboratory.

The TPW Innovations UPC Couples Vibe Remote Control Key Fob complies with the limits for an Intentional Radiator device under FCC Part 15.231 and RSS210 annex 1.

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1 Introduction

1.1 Compliance Statement

The TPW Innovations UPC Couples Vibe Remote Control Key Fob complies with the limits for an Intentional Radiator device under FCC Part 15.231 (10/2013) and IC RSS210 issue 8.

1.2 Test Scope

Tests for radiated were performed. All measurements were performed in accordance with FCC part 15.231, IC RSS 210, and ANSI C63.10:2013 (Site validated to ANSI C63.4: 2009). The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

1.3 Contract Information

Customer:	TPW Innovations UPC 64 Bakersfield Street Toronto, ON, M3J 2W7 Canada
Quotation Number:	68807
PO Number	Deposit

1.4 Test Dates

Testing was performed on the following date(s):	8/24/15 – 9/30/15

1.5 Test and Support Personnel

Washington Laboratories, LTD	Steven Dovell
Customer Representative(s)	Steven Page

1.6 Abbreviations

A	**A**mpere
ac	**a**lternating **c**urrent
AM	Amplitude Modulation
Amps	**Amp**ere**s**
b/s	**b**its per **s**econd
BW	**B**and**W**idth
CE	**C**onducted **E**mission
cm	**c**enti**m**eter
CW	**C**ontinuous **W**ave
dB	**d**eci**B**el
dc	**d**irect **c**urrent
EMI	**E**lectro**m**agnetic **I**nterference
EUT	**E**quipment **U**nder **T**est
FM	**F**requency **M**odulation
G	**g**iga - prefix for 10^9 multiplier
Hz	**H**ertz
IF	**I**ntermediate **F**requency
k	**k**ilo - prefix for 10^3 multiplier
LISN	**L**ine **I**mpedance **S**tabilization **N**etwork
M	**M**ega - prefix for 10^6 multiplier
m	**m**eter
µ	**m**icro - prefix for 10^{-6} multiplier
NB	**N**arrow**b**and
QP	**Q**uasi-**P**eak
RE	**R**adiated **E**missions
RF	**R**adio **F**requency
rms	**r**oot-**m**ean-**s**quare
SN	**S**erial **N**umber
S/A	**S**pectrum **A**nalyzer
V	**V**olt

2 Equipment Under Test

2.1 EUT Identification & Description

The TPW Innovations UPC Couples Vibe Remote Control key-fob is a remote controller for the bee2gether vibrator system. This component is used to change the vibration mode and amplitude of the vibrator. It uses radio signal (433.92MHz), OOK(OnOffKey) modulated to send commands to the vibrator. These commands consist of 16 bit of digital data at a baud rate of 3.3Kbps. Only 3 such commands can be sent, one for each corresponding button available on the remote.

Upon button actuation, the command is sent repeatedly at 100ms interval for a maximum of 10 times, regardless of the button hold time. Button needs to be released to initiate a new command.

Radio activity and commands being sent are signaled with and LED flash. The remote control operates on a 3V Li battery type CR2032.

Table 1: Device Summary

ITEM	DESCRIPTION
Manufacturer:	TPW Innovations UPC
FCC ID:	2AFYM-0142015
IC:	20660-0142015
Description:	Bee2gether Vibe – Couples Vibrating Ring
Model:	986908
FCC Rule Parts:	§15.231
IC Rule Parts:	RSS210 Annex 1
Emission Designator:	11k2D1D
Maximum Field Strength	2352uV/m Peak at 3m , 247.7uV/m average at 3m
Modulation:	OOK
Occupied Bandwidth:	5.44kHz (20dB), 11.16kHz (99%)
Keying:	Manual
Type of Information:	data
Number of Channels:	1 (433.92MHz)
Power Output Level	Fixed
Antenna Connector	integral
Antenna Type	trace
Interface Cables:	None
Power Source & Voltage:	3VDC Battery
Receiver	None

2.2 Test Configuration

The EUT is a standalone unit..

2.3 Testing Algorithm

The Couples Vibe Remote Control Key Fob was configured to transmit constantly at 433.92MHz for radiated measurements. A second identical unit had been programmed with the end user program; this unit was used for the timing measurements.

Worst case emission levels are provided in the test results data.

2.4 Test Location

All measurements herein were performed at Washington Laboratories, Ltd. test center in Gaithersburg, MD. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. Washington Laboratories, Ltd. has been accepted by the FCC and approved by ACLASS under Certificate AT-1448 as an independent FCC test laboratory.

2.5 Measurements

2.5.1 References

- ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation
- ANSI C63.4:2014 Methods of Measurement of Radio Noise from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz .
- ANSI C63.10:2013 Procedures for Compliance Testing of Unlicensed Wireless Devices

2.6 Measurement Uncertainty

All results reported herein relate only to the equipment tested. The basis for uncertainty calculation uses ANSI/NCSL Z540-2-1997 (R2012) with a type B evaluation of the standard uncertainty. Elements contributing to the standard uncertainty are combined using the method described in Equation 1 to arrive at the total standard uncertainty. The standard uncertainty is multiplied by the coverage factor to determine the expanded uncertainty which is generally accepted for use in commercial, industrial, and regulatory applications and when health and safety are concerned (see Equation 2). A coverage factor was selected to yield a 95% confidence in the uncertainty estimation.

Equation 1: Standard Uncertainty

$$u_c = \pm\sqrt{\frac{a^2}{div_a{}^2} + \frac{b^2}{div_b{}^2} + \frac{c^2}{div_c{}^2} + ...}$$

Where u_c = standard uncertainty

a, b, c,.. = individual uncertainty elements

$Div_{a, b, c}$ = the individual uncertainty element divisor based on the probability distribution

Divisor = 1.732 for rectangular distribution

Divisor = 2 for normal distribution

Divisor = 1.414 for trapezoid distribution

Equation 2: Expanded Uncertainty

$$U = ku_c$$

Where U = expanded uncertainty

k = coverage factor

$k \leq 2$ for 95% coverage (ANSI/NCSL Z540-2 Annex G)

u_c = standard uncertainty

The measurement uncertainty complies with the maximum allowed uncertainty from CISPR 16-4-2. Measurement uncertainty is not used to adjust the measurements to determine compliance. The expanded uncertainty values for the various scopes in the WLL accreditation are provided in Table 2 below.

Table 2: Expanded Uncertainty List

Scope	Standard(s)	Expanded Uncertainty
Conducted Emissions	CISPR11, CISPR22, CISPR14, FCC Part 15	±2.63 dB
Radiated Emissions	CISPR11, CISPR22, CISPR14, FCC Part 15	±4.55 dB

.

3 Test Equipment

Table 3 shows a list of the test equipment used for measurements along with the calibration information.

Table 3: Test Equipment List

Test Name: **Radiated Emissions**		Test Date: **09/14/2015**	
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
644	SUNOL SCIENCES CORPORATION - JB1 925-833-9936	BICONALOG ANTENNA	8/14/2017
425	ARA - DRG-118/A	ANTENNA DRG 1-18GHZ	10/30/2015
66	B&Z - BZ-01002650-401545-282525	PRE-AMPLIFIER RF. 1-26.5GHZ	10/23/2015
276	ELECTROMETRICS - BPA-1000	PRE-AMPLIFIER RF 50KHZ-1GHZ	10/26/2015
528	AGILENT - E4446A	3HZ - 44GHZ ANALYZER SPECTRUM	7/15/2016

4 Test Results

4.1 Duty Cycle Correction

Measurements may be adjusted where pulsed RF is utilized to find the average level associated with a quantity. This calculation is applied to limits for unlicensed devices.

- For Unlicensed Intentional Radiators under 47CFR Part 15, all duty cycle measurements are compared to a 100 millisecond period

The duty cycle correction factor is calculated by:

20 * LOG (on time/100 ms)

The measurement was performed in accordance with ANSI C63.10 section 7.5 "Procedure for determining the average value of pulsed emissions"

The following Figures show the plots of the modulated carrier. The spectrum analyzer was set to Zero Span and the video triggered to collect the pulse train of the modulation. Multiple sweeps were made to find the worst case 100ms. Calculations of the duty cycle correction factor were obtained from time data provided by the plots.

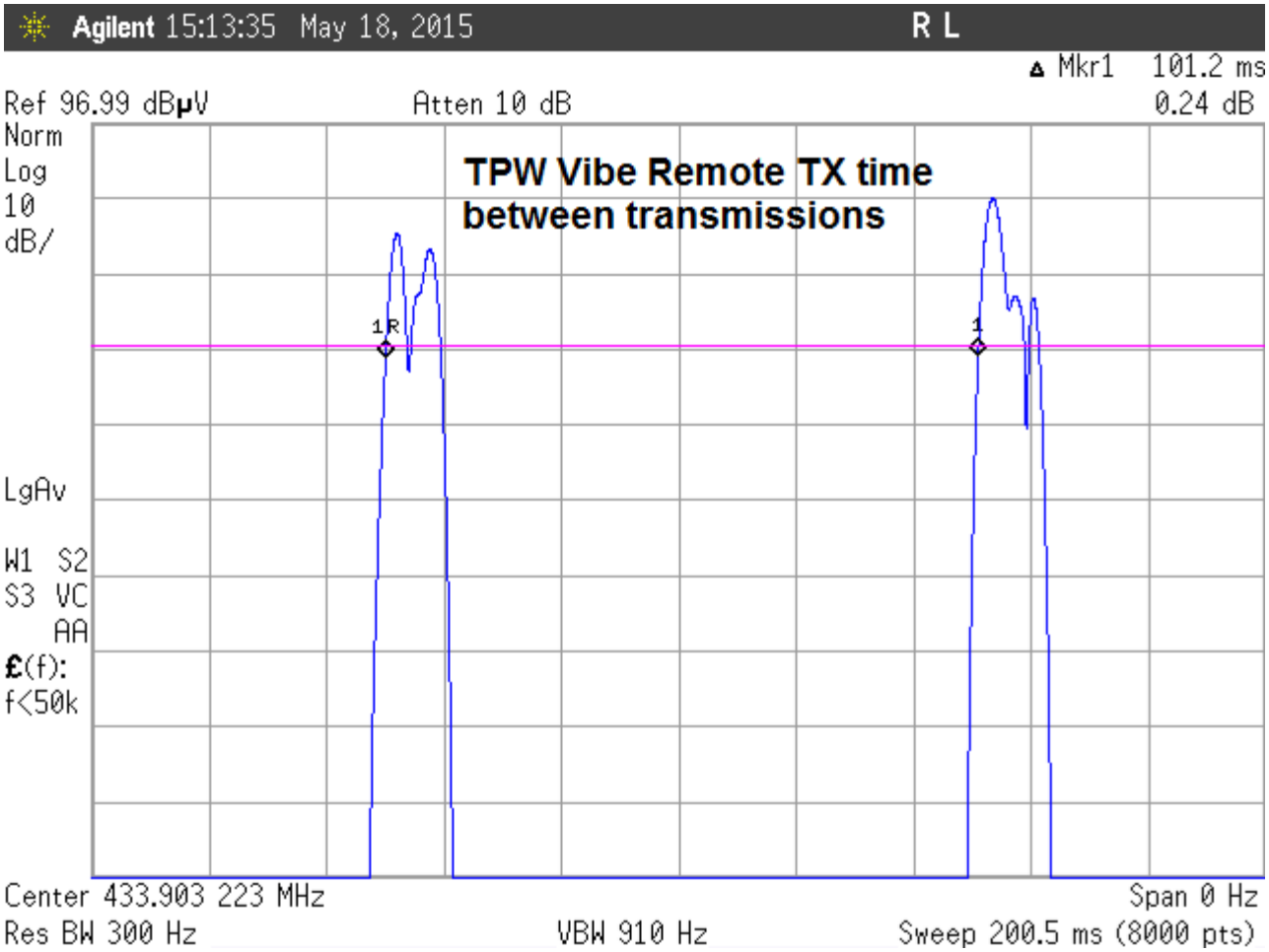

Figure 1: Duty Cycle Plot – Worst Case 100ms and Pulse Train

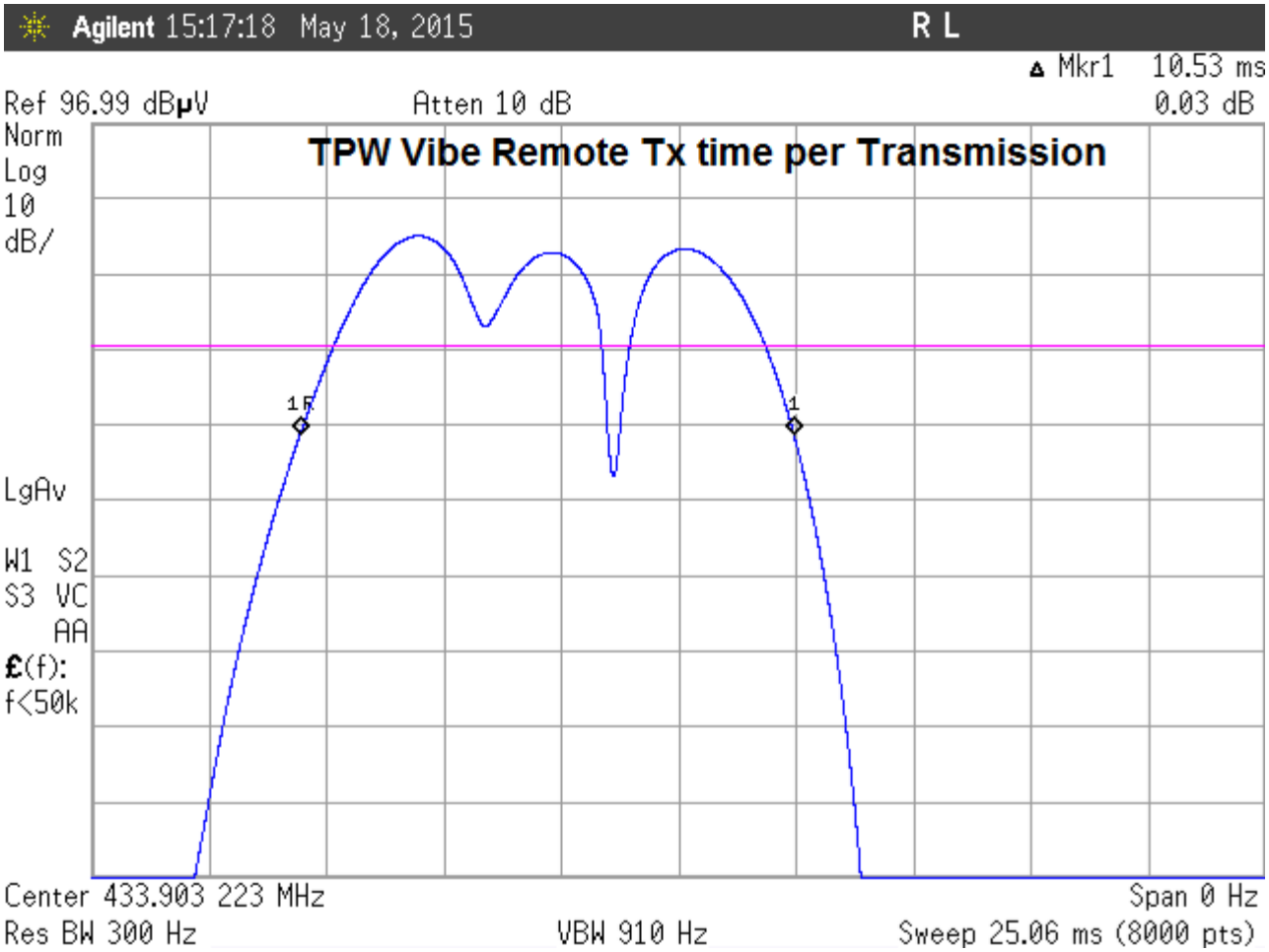

Figure 2: Duty Cycle Plot – Pulse Width

From the data in figures 2 and 3 the following calculations are made.

The worst case on time was comprised of one 10.53ms pulse within 100ms window

Duty cycle calculation:

20*LOG (10.53ms/100ms) = -19.55dB duty cycle correction

4.2 Transmit Turnoff Time (FCC Part §15.231(a) (2))

Per FCC part 15.231 Paragraph (a)(2) and RSS210 Annex1 '*A transmitter activated automatically shall cease transmission within 5 seconds after activation.'*

The below figure shows that the turnoff time after activation is less than 5 seconds (see marker delta on plot) complying with the requirements of part 15.231(a)(2). Time to turn-off was measured at 1.031 seconds.

The EUT was measured by a spectrum analyzer through a near field antenna. The sweep was activated at the start of the EUT transmit signal and the button held for 10 seconds.

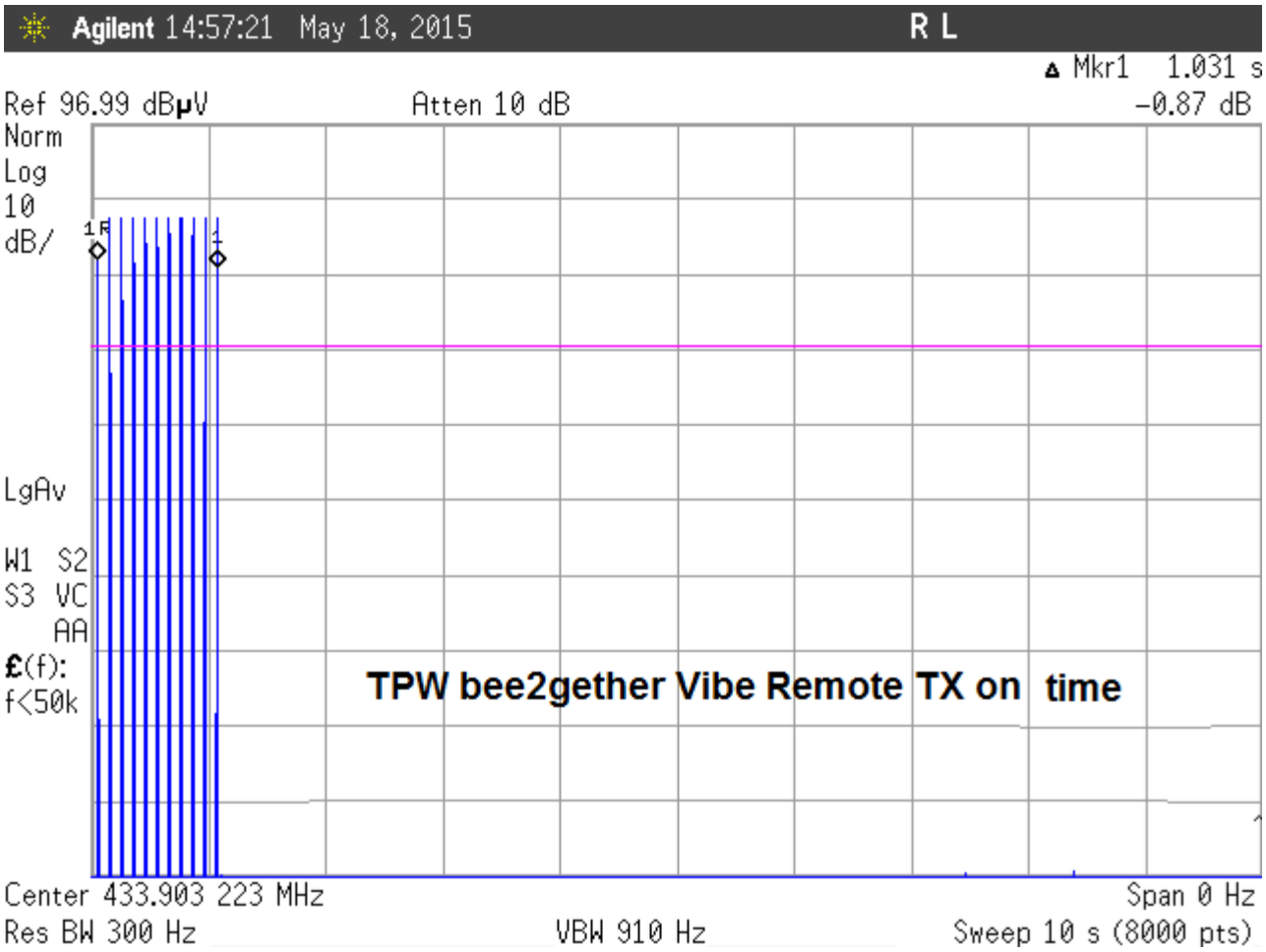

Figure 3: EUT Turnoff Time

4.3 Periodic Transmissions Compliance

Per FCC part 15.231 Paragraph (a)(3) and RSS210 Annex1 *'Periodic transmissions at regular predetermined intervals are not permitted. However, polling or supervision transmissions, including data, to determine system integrity of transmitters used in security or safety applications are allowed if the total duration of transmissions does not exceed more than two seconds per hour for each transmitter. There is no limit on the number of individual transmissions, provided the total transmission time does not exceed two seconds per hour'*

The EUT does not transmit periodic data. Transmission only occurs when a button is depressed.

4.4 Occupied Bandwidth: (FCC Part §2.1049)

Occupied bandwidth was performed by coupling the output of the EUT to the input of a spectrum analyzer via an nearfield probe.

The test was performed per ANSI C63.10 6.9.2 Occupied bandwidth—relative measurement procedure for the 20dB bandwidth and ANSI C63.10 6.9.3 Occupied bandwidth—power bandwidth (99%) measurement procedure (using power bandwidth function of the instrument).

According to FCC Part 15.231 & RSS210 Annex1 the Occupied bandwidth (20dB) shall be:
(c) The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

For a system operating at 433.9kHz, the maximum Occupied Bandwidth is 1.08475MHz.

At full modulation, the occupied bandwidth was measured at 5.44kHz for the 20dB BW and 11.16kHz for the 99% Bandwidth (as shown below):

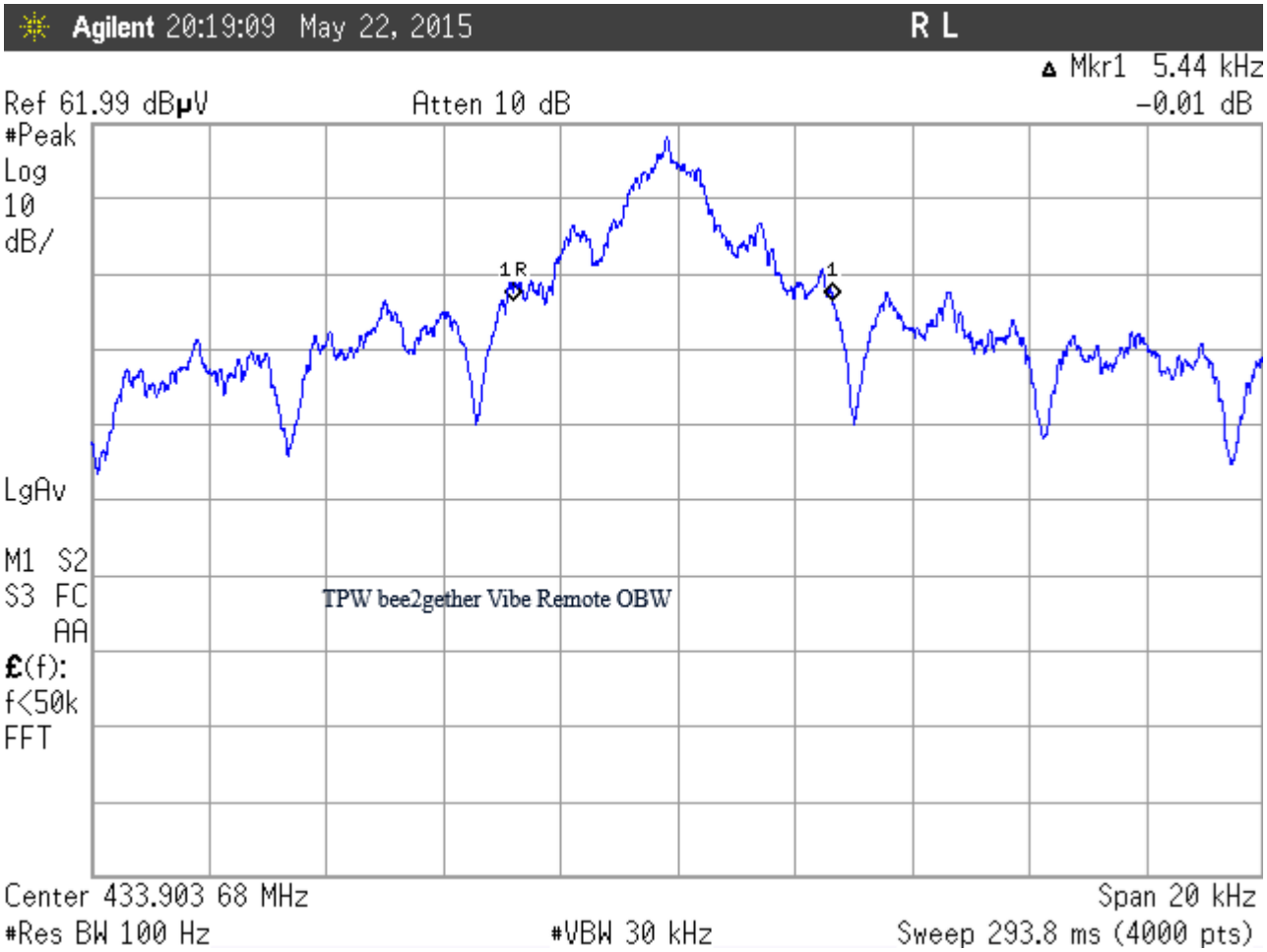

Figure 4: Occupied Bandwidth 20dB

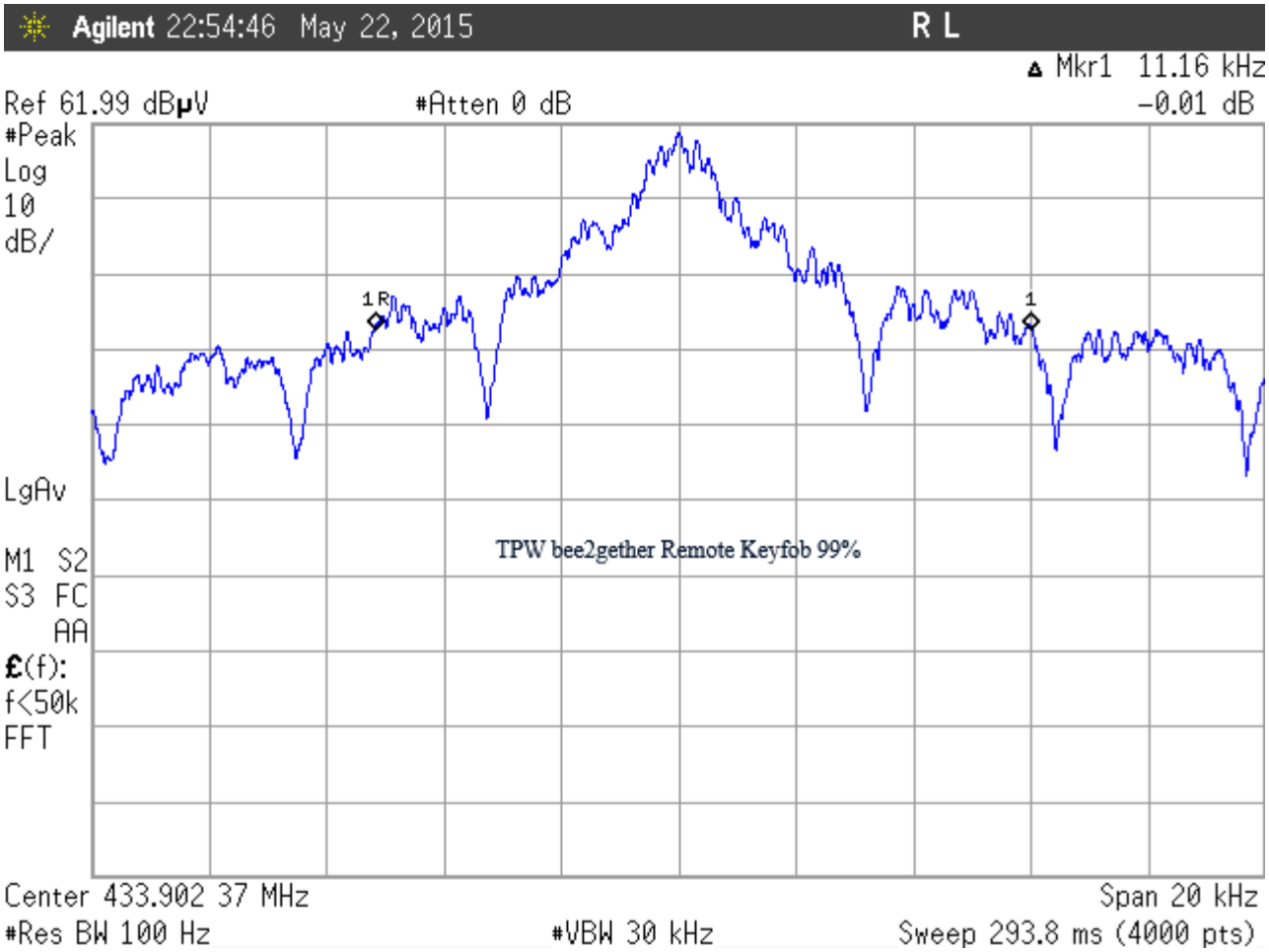

Figure 5: Occupied Bandwidth 99%

4.5 Radiated Emissions: (FCC Part §2.1053)

The EUT must comply with the radiated emission limits of 15.231(a). The limits are as shown in the following table.

Table 4: Radiated Emissions Limits

Fundamental Frequency (MHz)	Field Strength of Fundamental (µV/m)	Field Strength of Field strength of spurious emission (µV/m)
40.66-40.70	2250	225
70-130	1250	125
130-174	1250 to 3750	125 to 375
174-260	3750	375
260-470	3750 to 12500	375 to 1250
Above 470	12500	1250

The EUT transmits at a frequency of 433.92MHz.

The limit was calculated using the method described in C63.10:2013 section 7.6.2:

The effective limit at the frequency of interest is found by linearly interpolating using the familiar slope-intercept formula, y = mx + b, rewritten as in Equation:

$$\text{Limit}[uV/m] = \text{Lim}_{lower} + (\Delta F\ (\text{Lim}_{upper} - \text{Lim}_{lower})/(f_{upper} - f_{lower}))$$

Where:

Lim_{lower}	is the limit at the lower frequency of the intended band of operation
Lim_{upper}	is the limit at the upper frequency of the intended band of operation
f_{lower}	is the lower frequency of the intended band of operation
f_{upper}	is the upper frequency of the intended band of operation
ΔF	equals f_C - f_{lower}
f_C	is the center frequency of the emission signal

Limit = 3750 + (173.9M * ((12500-3750)/(470M-260M)) = 10995.8

Frequencies that fall in FCC part 15.205 restricted bands must be below part 15.209 limits within these bands.

In accordance with FCC part 15.35 when averaging is used the peak limit shall be 20 dB above the average limits.

4.5.1 Test Procedure

The measurement was performed in accordance with ANSI C63.10 section 6.5 "Radiated emissions from unlicensed wireless devices in the frequency range of 30 MHz to1000 MHz" and section 6.6 "Radiated emissions from unlicensed wireless devices above 1 GHz". Above 1 GHz RF absorber was placed between the EUT and Receive antenna in accordance with ANSI C63.10:2013. Above 1GHz, the EUT was placed on a closed cell foam block to achieve a 1.5m placement above the ground plane.

The EUT was placed on motorized turntable for radiated testing on a 3-meter open field test site. The emissions from the EUT were measured continuously at every azimuth by rotating the turntable. Receiving antennas were mounted on an antenna mast to determine the height of maximum emissions. The height of the antenna was varied between 1 and 4 meters.

In accordance with ANSI C63.10 section 7.5 averaging was performed by using a duty cycle correction subtracted from the peak reading. For this EUT a duty cycle correction of -19.55dB was calculated.

The EUT was tested in 3 orthogonals with the worst case reported (fundamental frequency is reported in all orthogonals).

Non harmonic spurious emissions peaks were tested against the average limits for compliance (no duty cycle correction was used).

The emissions were measured using the following resolution bandwidths:

Frequency Range	Resolution Bandwidth	Video Bandwidth
30MHz-1000 MHz	120kHz	>100 kHz
>1000 MHz	1 MHz	1MHz (Peak)

Emissions were measured to the 10th harmonic of the transmit frequency. Worst case emission levels are reported.

The following is a sample calculation used in the data tables for calculating the final field strength of spurious emissions and comparing these levels to the specified limits.

Sample Calculation:

Spectrum Analyzer Voltage (SA Level): V dBµV

Antenna Factor (Ant Corr): AFdB/m

Cable Loss Correction (Cable Corr): CCdB

Duty Cycle Correction (Average) DCCdB

Amplifier Gain: GdB

Electric Field (Corr Level): EdBµV/m = VdBµV + AFdB/m + CCdB + DCCdB - GdB

Table 5: Radiated Emission Test Data, 433.92MHz (Fundamental)

Orientation	Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)	Comments
X	433.90	V	265.00	3.00	71.56	-6.3	1823.5	109958.3	-35.6	Peak
	433.91	V	265.00	3.00	52.01	-6.3	192.1	10995.8	-35.2	Average
	1307.74	V	0.00	3.23	77.26	-21.5	611.6	5000.0	-18.2	Peak
	1307.74	V	0.00	3.23	57.71	-21.5	64.4	500.0	-17.8	Average
Y	433.91	V	270.00	3.00	73.77	-6.3	2352.0	109958.3	-33.4	Peak
	433.90	V	270.00	3.00	54.22	-6.3	247.7	10995.8	-32.9	Average
	1301.70	V	90.00	3.30	74.10	-21.5	425.2	5000.0	-21.4	Peak
	1301.70	V	90.00	3.30	54.55	-21.5	44.8	500.0	-21.0	Average
Z	433.91	V	180.00	2.50	57.13	-6.3	346.3	109958.3	-50.0	Peak
	433.91	V	180.00	2.50	37.58	-6.3	36.5	10995.8	-49.6	Average
	1307.74	V	260.00	3.27	73.43	-21.5	393.5	5000.0	-22.1	Peak
	1307.74	V	260.00	3.27	53.88	-21.5	41.4	500.0	-21.6	Average
	112.00	V	90.00	1.00	36.60	-12.0	17.0	150.0	-18.9	
	400.00	V	250.00	1.50	32.30	-7.5	17.4	150.0	-18.7	
	962.76	V	180.00	1.00	31.10	1.8	44.0	500.0	-21.1	
X	433.90	H	190.00	3.50	68.00	-6.3	1210.4	109958.3	-39.2	Peak
	433.91	H	190.00	3.50	48.45	-6.3	127.5	10995.8	-38.7	Average
	1307.74	H	180.00	3.31	68.66	-21.5	227.2	5000.0	-26.8	Peak
	1307.74	H	180.00	3.31	49.11	-21.5	23.9	500.0	-26.4	Average
Y	433.91	H	180.00	3.25	69.00	-6.3	1358.1	109958.3		Peak
	433.90	H	180.00	3.25	49.45	-6.3	143.0	10995.8	-37.7	Average
	1301.70	H	185.00	3.33	77.80	-21.5	651.0	5000.0	-17.7	Peak
	1301.70	H	185.00	3.33	58.25	-21.5	68.6	500.0	-17.3	Average
Z	433.91	H	0.00	2.75	73.05	-6.3	2164.9	109958.3	-34.1	Peak
	433.91	H	0.00	2.75	53.50	-6.3	228.0	10995.8	-33.7	Average
	1307.74	H	180.00	3.40	77.80	-21.5	650.9	5000.0	-17.7	Peak
	1307.74	H	180.00	3.40	58.25	-21.5	68.5	500.0	-17.3	Average
	112.00	H	45.00	4.00	37.50	-12.0	18.9	150.0	-18.0	
	400.00	H	300.00	4.00	31.20	-7.5	15.4	200.0	-22.3	
	962.76	H	0.00	2.50	36.10	1.8	78.2	500.0	-16.1	

4.6 Conducted Emissions (AC Power Line)

As this unit is only powered from in internal battery no Power mains testing is required.

4.7 Receiver Emissions

This EUT is only a transmitter.