Testing Tomorrow's Technology

Class 2 Permissive Change Test Report

For

Part 2, Subpart J, Paragraph 2.907 Equipment Authorization of Certification for an Intentional Radiator per Part 15, Subpart C, paragraphs 15.207, 15.209 and Part 15, Subpart F, paragraph 15.509

And

Innovation, Science, and Economic Development Canada Certification Per Industry Canada, RSS-GEN Issue 5, April 2018 General Requirements for Compliance of Radio Apparatus And Industry Canada RSS-220 Issue 1+ Amd 1, July 2018 Devices Using Ultra-Wideband (UWB) Technology

For the

Headsight, Inc.

Terrahawk
Model: HT5200

FCC ID: 2AEP2-THAWK1
IC: 20168-THAWK1

UST Project: 19-0056
Report Issue Date: April 5, 2019

Total Pages in This Report: 30

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I certify that I am authorized to sign for the Test Agency and that all of the statements in this report and in the Exhibits attached hereto are true and correct to the best of my knowledge and belief:

US TECH (Agent Responsible For Test):

By: Alan Ghasiani

Name: 

Title: Compliance Engineer – President

Date: April 5, 2019

NVLAP LAB CODE 200162-0

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MEASUREMENT TECHNICAL REPORT

COMPANY NAME: Headsight, Inc.

MODEL: HT5200

FCC ID: 2AEP2-THAWK1

IC: 20168-THAWK1

DATE: April 5, 2019

This report concerns (check one): Original grant
Class 2 change X

Equipment type: UWB Transmitter, GPR device

Deferred grant requested per 47 CFR 0.457(d)(1)(ii)? yes_____ No X

If yes, defer until: N/A
date

agrees to notify the Commission by N/A
date

of the intended date of announcement of the product so that the grant can be issued on that date.

Report prepared by:

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1 General Information

1.1 Purpose of this Report

This report is prepared to show that the modifications made to the EUT do not impact the performance of the EUT in such as way that it would warrant full retesting and submittal of new test data according to the FCC Rules and Regulations Part 15, Section 509, 521, 525 and based on the FCC Waiver docket DA 17-207, released March 1, 2017.

The modification consists of the following:

1. Replaced amp chip with new amp, PN E101224. The new part is pin for pin compatible, performs the same basic function and changes no radio parameter.
2. The following changes were made to the digital circuits of the device:
    - Moved small components our from between pins of panel mount Deutsch connector
    - Increased pad size and trace width near Deutsch connector pins
    - Changed switches to jumpers
    - Updated EEProm chip – old component was going obsolete (U18)
    - Updated IMU chip – old component was going obsolete (U20)

The changes made do not affect the electrical characteristics of the device. The previously reported modulation and frequency determining circuitry remain the same. No radio parameters changed.

1.2 Characterization of Test Sample

The sample used for testing was received by US Tech on February 25, 2019 in good operating condition.

1.3 Product Description

The Equipment under Test (EUT) is the Headsight, Inc. Terrahawk, Model Number HT5200. The EUT is a DC powered, non-contact radar height sensor used exclusively on mobile agricultural equipment to determine the distance between the ground and mounting position. The EUT is normally mounted between 1 inch and 12 feet above the ground and during operation is always positioned to emit towards the ground. The EUT includes one user access port to connect a USB cable to the device for data acquisition purposes.

Frequency of operation: 1.510 Ghz to 6.425 Ghz

Center Frequency: 3.9675 Ghz
Maximum Radiated Emission Frequency: 5.209 Ghz
Number of channels: 1 ch
Antenna Type: Flat Earth Planar Modified Bowtie Antenna
Antenna Gain: 4 to 6.0 dBi
Firmware version: Onyx3.29a

Note: For testing the EUT was tested in a dual configuration, where two EUT were separated by 1.5 m from each other. The EUT was also tested at two different heights, 1.0 m and 3.7 m.

1.4 Configuration of Tested System

The Test Sample was tested per *ANSI C63.10:2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices (2013)* and per FCC Part 15 Subpart F.

A list of EUT and Peripherals is found in Table 1 below. A block diagram of the tested system is shown in Figure 1. Test configuration photographs are provided in separate Appendices.

1.5 Test Facility

Testing was performed at US Tech's measurement facility at 3505 Francis Circle, Alpharetta, GA30004. This site has been fully described and registered with the FCC, with designation number 186022.

1.6 Related Submittals

No related submittals were made by US Tech.

Table 1. EUT and Peripherals

PERIPHERAL MANUFACTURER.	MODEL NUMBER	SERIAL NUMBER	FCC/IC ID	CABLES P/D
Headsight, Inc.	HT5200	Engineering Sample	FCC ID: 2AEP2-THAWK1 IC: 20168-THAWK1	1 m U P
Antenna See antenna details	--	--	--	--
Laptop computer	Dell	Various	Various	1.5 m U P

U= Unshielded
S= Shielded
P= Power
D= Data

2 Tests and Measurements

2.1 Test Equipment

The table below lists test equipment used to evaluate this product. Model numbers, serial numbers and their calibration status are indicated.

Table 2.Test Instruments

TEST INSTRUMENT	MODEL NUMBER	MANUFACTURER	SERIAL NUMBER	CALIBRATION DUE DATE
SPECTRUM ANALYZER	E4407B	AGILENT	US41442935	8/17/2020 2 yr.
SPECTRUM ANALYZER	8593E	HEWLETT PACKARD	3205A00124	10/25/2019 2 yr.
HORN ANTENNA	SAS-571	A.H. Systems	605	10/18/2019 2 yr
LOG PERIODIC ANTENNA	3146	EMCO	9110-3236	5/1/2019 2 yr.
BICONICAL ANTENNA	3110B	EMCO	9306-1708	5/2/2019 2 yr
LOOP ANTENNA	6502	ETS Lindgren	9810-3246	1/22/2020 2 yr
PRE-AMPLIFER	8447D	HEWLETT-PACKARD	1937A02980	11/8/2019
PRE-AMPLIFER	8447E	HEWLETT-PACKARD	1937A01828	5/7/2019 extended
PRE-AMPLIFER	8449B	HEWLETT-PACKARD	3008A00480	6/4/2019
PRE-AMPLIFER	UST	U.S. Tech	RA106	3/12/2020
HORN ANTENNA	3115	EMCO	9107-3723	11/28/2020 2 yr.

Note: The calibration interval of the above test instruments are 12 months unless stated otherwise and all calibrations are traceable to NIST/USA.

2.2 Modifications to EUT Hardware

No physical modifications were made by US Tech in order to bring the EUT into compliance with FCC Part 15, Subpart F Intentional Radiator Limits for the transmitter portion of the EUT.

2.3 Frequency Range of Radiated Measurements (Part 15.33, 15.521(h))

2.3.1 Intentional Radiator

The spectrum shall be investigated for the intentional radiator from the lowest RF signal generated in the EUT, without going below 9 kHz to the 5^{th} harmonic of the peak level of fundamental frequency generated or 40 GHz, whichever is the lowest.

The highest frequency used to determine the frequency range over which measurements are made shall be based on the center frequency (fc). If the center frequency is less than 10 GHz there is no requirement to measure beyond 40 GHz.

2.4 Measurement Detector Function and Bandwidth (CFR 15.35, RSS-220 Section 7)

The radiated and conducted emissions limits shown herein are based on the following:

FCC Part 15.207, 15.209, 15.509 and RSS-220 Section 6.2.1

2.4.1 Detector Function and Associated Bandwidth

On frequencies below 1000 MHz, the limits herein are based upon measurement equipment employing a CISPR Quasi-peak detector function and related measurement bandwidths (i.e. 9 kHz from 150 kHz to 30 MHz and 120 kHz from 30 MHz to 1000 MHz). Alternatively, measurements may be made with equipment employing a peak detector function as long as the same bandwidths specified for the Quasi-peak device are used.

2.4.2 Corresponding Peak and Average Requirements

Above 1000 MHz, radiated limits are based on measuring instrumentation employing an average detector function. When average radiated emissions are specified there is also a corresponding Peak requirement, as measured using a peak detector, of 20 dB greater than the average limit. For all measurements above 1000 MHz the Resolution Bandwidth shall be at least 1 MHz.

2.5 EUT Antenna Requirements (CFR 15.203, RSS-Gen 6.8)

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. Only the antenna(s) listed in Table 4 will be used with this module.

Table 3. Allowed Antenna(s)

REPORT REFERENCE	MANUFACTURER	TYPE OF ANTENNA	MODEL	GAIN dB_i	TYPE OF CONNECTOR
Antenna	Flat Earth, Inc	Bowtie	BT6100	4.0 to 6.0dBi	Internally connected

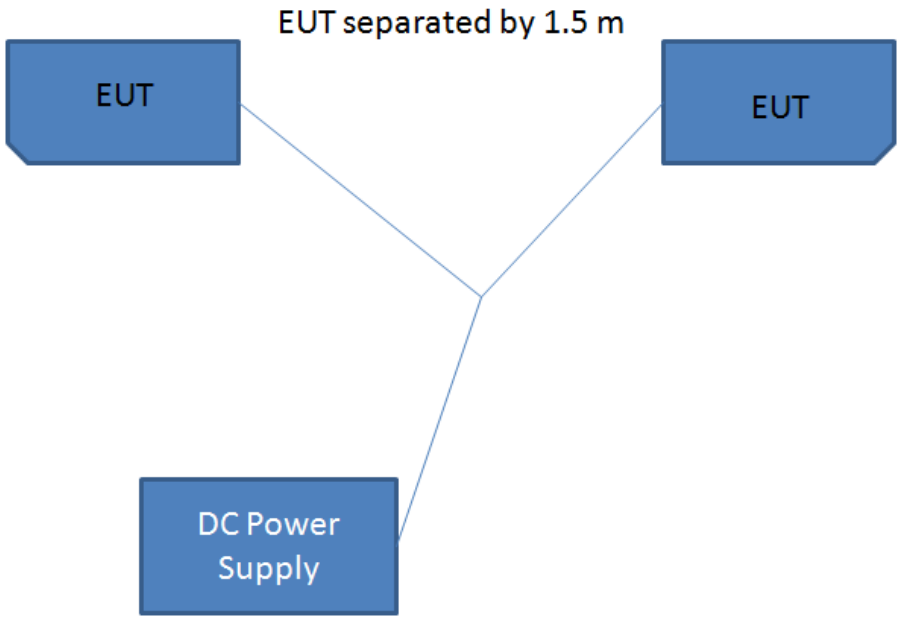


Figure 1. Block Diagram of Test Configuration

Note: EUT was tested in a dual configuration.

2.6 Restricted Bands of Operation (Part 15.205, RSS-Gen 8.10)

Only spurious emissions can fall in the frequency bands of CFR 15.205. The field strength of these spurious cannot exceed the limits of 15.209. Radiated harmonics and other Spurious are examined for this requirement see paragraph 2.1

2.7 Intentional Radiator, Power Line Conducted Emissions (CFR 15.207, RSS-Gen 8.8)

The EUT is battery powered. The EUT is indirectly connected the AC mains for testing purposes only. During normal operation the EUT is battery powered and will not be operated while directly or indirectly connected to the AC mains. This test was not applicable.

2.8 Intentional Radiator, Radiated Emissions (CFR 15.509 (f), 15.521 (g), RSS-220 Section 6.2.1, RSS-Gen 8.9)

UWB devices where the highest radiated emission, $\mathbf{f_M}$ (The frequency at which the highest radiated emission occurs), is above 960 MHz have a limit on the peak level of the emission within a 50 MHz bandwidth of 0 dBm EIRP. A different RBW was used, therefore the peak emissions limit was adjusted per CFR 15.521 (g).The limit was also converted to peak field strength at 3 meters.

The antenna was positioned as it would be in normal operation and the fundamental emission was maximized to ensure the maximum reading and measured with the receiving antenna in both horizontal and vertical position. Below is the measured peak radiated emission at 3 meters.

RBW used: 1 MHz

Peak EIRP Limit	=	20 log (RBW/50)dBm EIRP
	=	20 log(1/50) dBm EIRP
	=	-33.97dBm EIRP
Peak Field Strength Limit	=	-33.97dBm EIRP +95.2
	=	61.22dBuV/m

The EUT was tested at both 1.0 meter and 3.7 meter heights. The worst case emission was recorded at a height of 1.0 meter. That data is presented following.

Table 4. Intentional Radiated Emissions (CFR 15.509 (f), RSS-220 Sect 6.2.1)

Frequency (MHz)	Distance / Polarization	Raw Test Data (dBuV)	Correction Factors (dB/m)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detection
5051.00	3.0m./VERT	35.57	9.19	44.76	61.2	16.5	**PK**
5109.00	3.0m./HORZ	37.89	4.95	42.84	61.2	18.4	**PK**

Note: Worst Case fundamental reading recorded at 1.0 meter configuration.

Sample Calculation at 5051 MHz:

Raw Test Data	35.57	dBuV
+ Correction Factors	9.19	dBm
Results	44.76	dBuV/m

Test Date: March 12-14, 2019

Tested By
Signature: Afzal Fazal Name: Afzal Fazal

2.8.1 Pulse Repetition Frequency and Duty Cycle

The device employs pulse modulation and has a repetition rate of 41.66 Hz. The pulse signal has been verified below.

Pulse Rate: 37.0 Hz
Period= 27 mSec
Frequency= 1/seconds= 1/0.027 secs = 37.0 Hz

Duty Cycle correction factor: -15.1 dB
20 log ($TX_{on}/TX_{on}+TX_{off}$) = 20 log (4.75ms/27ms) = -15.1 dB

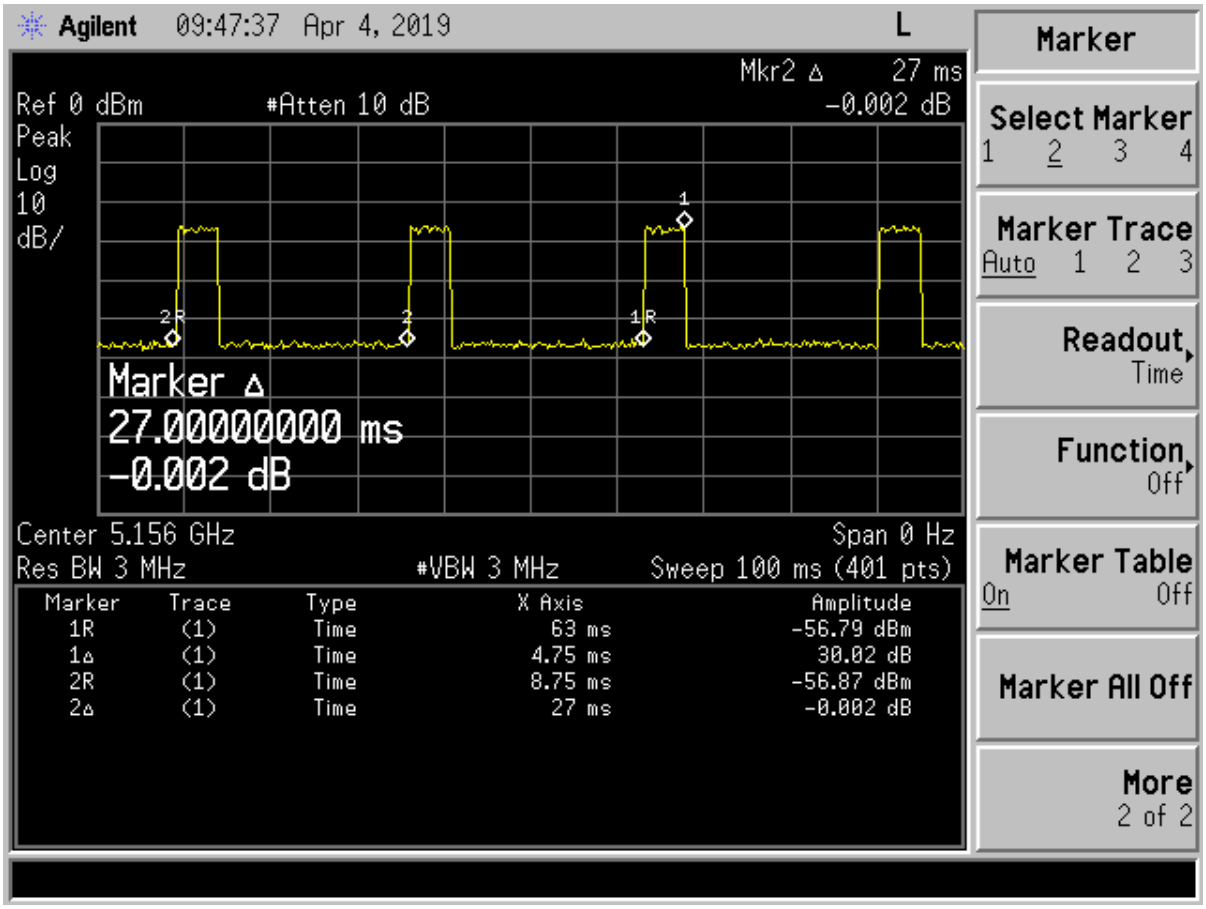


Figure 2. Pulse Repetition Frequency

2.9 UWB Bandwidth (CFR 15.509 (a), 15.521(e), RSS-220 Section 6.2.1(a))

The bandwidth of an imaging system under 15.509 must by below 10.6 GHz. The bandwidth is defined as the frequency band bounded by the points that are 10 db below the highest radiated emissions, as based on the complete transmission system including the antenna. The upper boundary is designated f_H and the lower boundary is designated f_L. The frequency at which the highest radiated emission occurs is designated f_M. If multiple bandwidths occur, then the maximum bandwidth is used.

The bandwidth was determined from a radiated measurement using the designated antenna with which EUT will operate in the final product. The receiving antenna's height was repeatedly varied from 1 m to 4 m and the polarity was adjusted several times. The turn table on which the EUT was placed was also rotated several times. This ensured that the true bandwidth of the EUT was measured. Below is the measured UWB bandwidth with the receiving antenna horizontal and vertical. Both polarities met the 10.6 GHz limit.

Emissions are contained within 1.510 GHz to 6.425 GHz which is below 10.6 GHz.

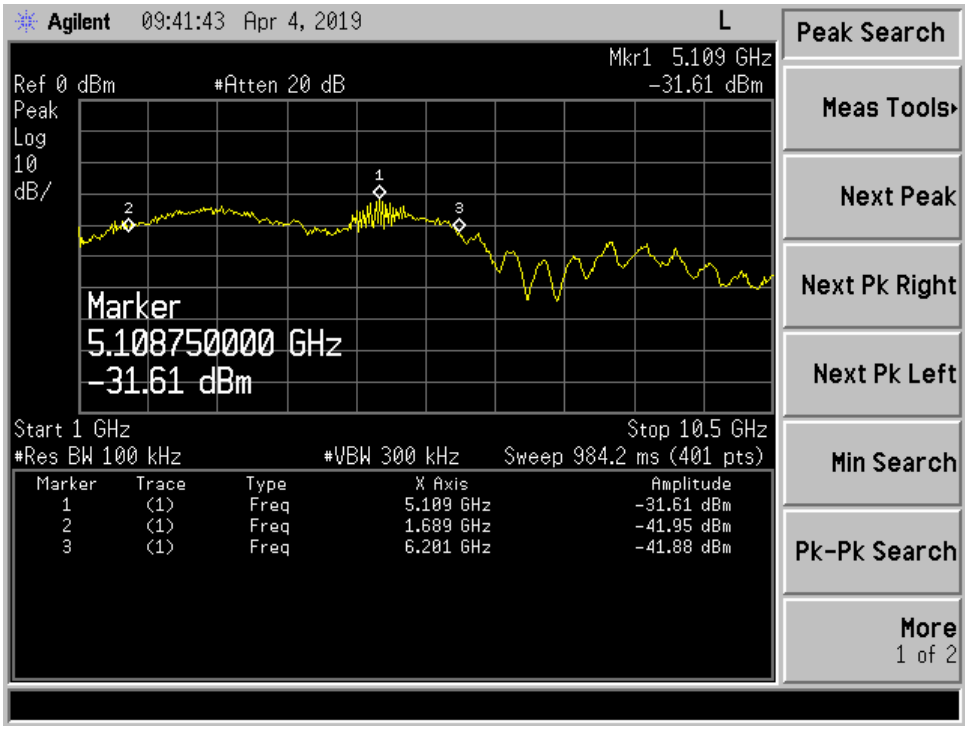


Figure 3. UWB f_L, f_M, f_H Measurement Plot

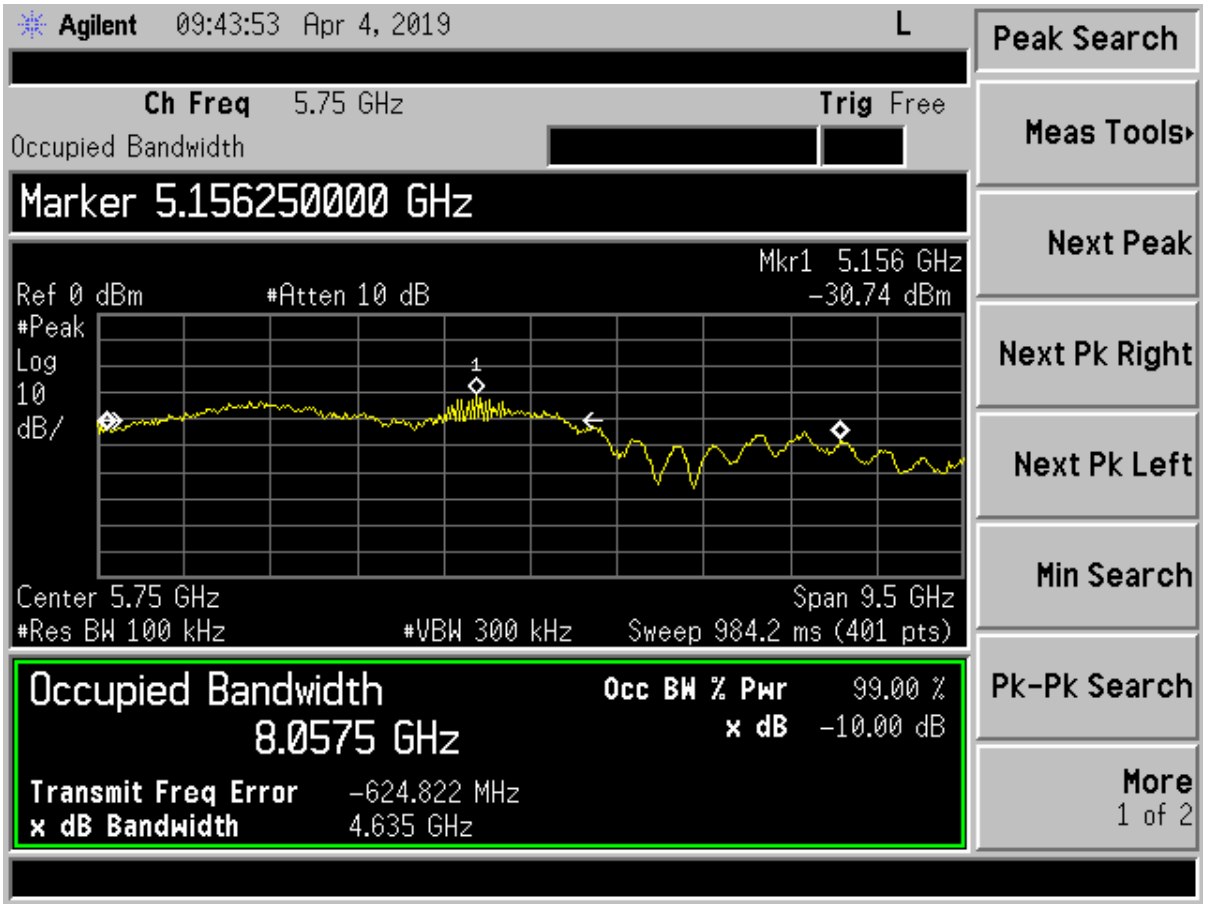


Figure 4. UWB 99% and -10 dB Bandwidth

The EUT has a fractional bandwidth of > 0.20 when calculated using the formula referenced in 15.503(c): $2(F_H-F_L)/(F_H+F_L)$= 2(6.20-1.69 GHz)/(6.20+1.69 GHz) = 1.14, > 0.20.

2.10 UWB Purpose, Part 90 License, and Coordination (CFR 15.509 (b))

The EUT, operating under CFR 15.509, is limited to GPR and wall imaging systems operating under the FCC Waiver agreement, DA 17-207, Waiver conditions. The details of the waiver conditions are include as a separate exhibit.

Based on the waiver, operation of this device shall be limited to parties eligible for licensing under the provisions of Part 90 of the Commission's rules (e.g. persons regularly involved in activities such as the operation of farms, ranches, or similar land areas, for the quantity production of crops or plants; including soil plowing, soil conditioning, seeding, fertilizing, or harvesting for agricultural activities. No operation in city gardens or on trees is permitted.

2.11 Remote Switch (CFR 15.509 (c), RSS-220 Section 6.2.1(b))

A GPR that is designed to operate while being hand-held or a wall-imaging system must contain a manually operated switch or a remote switch that causes the transmitter to cease operation within 10 seconds of being released.

Since the EUT is not hand-held, and is not a wall-imaging system, it is exempt from this requirement.

2.12 Unintentional Radiator, Power line Emissions (CFR 15.207, 15.521 (j), RSS-Gen 8.8)

This EUT will not have access to the AC Main power line; therefore this requirement is not applicable.

2.13 Radiated Emissions at or Below 960 MHz (CFR 15.509 (d), 15.209, RSS-Gen 8.9)

The radiated emissions at or below 960 MHz from the transmitter shall not exceed the emissions levels in CFR 15.209. Furthermore the emissions due to the digital circuitry of the EUT must also comply with the limits for 15.109.

EUT was tested in dual configuration at two different heights. The test results are presented below.

The worst-case radiated emission for the EUT in the range of below 960 MHz was 3.4 dB below the limit at 750.00 MHz at a test height of 1.0m. All other radiated emissions were at least 6.0 dB below the limits. This data can be found in the tables below.

Table 5. Radiated Emissions Test Data Below 960 MHz @ 1.0 m

30 MHz to 960 MHz							
Test: Radiated Emissions				**Client:** Headsight, Inc.			
Project: 19-0056				**Model:** HT5200			
Frequency (MHz)	**Test Data (dBuv)**	**AF+CA-AMP (dB/m)**	**Results (dBuV/m)**	**Limits (dBuV/m)**	**Antenna Distance/ Polarization**	**Margin (dB)**	**Detector PK or QP**
0.615	64.59	1.22	65.81	71.8	3m./LOOP	6.0	**PK**
134.98	59.04	-25.30	33.74	43.5	3m./HORZ	9.8	**PK**
134.98	50.90	-25.30	25.60	43.5	3m./VERT	17.9	**PK**
232.00	54.53	-24.98	29.55	46.4	3m./HORZ	16.8	**PK**
452.00	50.96	-19.23	31.73	46.4	3m./HORZ	14.7	**PK**
452.00	46.73	-19.03	27.70	46.4	3m./VERT	18.7	**PK**
750.00	55.87	-12.83	43.04	46.4	3m./VERT	3.4	**QP**
All other emission found are 20 dB or greater from the applicable limit. All emissions from the lowest operating clock frequency to 30 MHz were at greater than 20 dB from the applicable limits.							

Sample Calculation at 134.98 MHz:

Magnitude of Measured Frequency	59.04	dBuV
+Antenna Factor + Cable Loss+ Amplifier Gain	-25.30	dB/m
Corrected Result	33.74	dBuV/m

Test Date: March 5-14, 2019

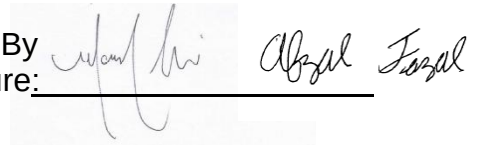
Tested By
Signature:  Name: Mark Afroozi; Afzal Fazal

Table 6. Radiated Emissions Test Data Below 960 MHz @ 3.7 m

30 MHz to 960 MHz							
Test: Radiated Emissions				**Client:** Headsight, Inc.			
Project: 19-0056				**Model:** HT5200			
Frequency (MHz)	**Test Data (dBuv)**	**AF+CA-AMP (dB/m)**	**Results (dBuV/m)**	**Limits (dBuV/m)**	**Antenna Distance/ Polarization**	**Margin (dB)**	**Detector PK or QP**
0.615	52.92	11.72	64.64	71.8	3m./LOOP	7.2	**PK**
20.52	43.17	10.76	53.93	69.5	3m./LOOP	15.6	**PK**
35.08	43.69	-14.00	29.69	40.0	3m./HORZ	10.3	**PK**
61.47	48.70	-17.75	30.95	40.0	3m./VERT	9.0	**PK**
150.16	48.85	-13.59	35.26	43.5	3m./HORZ	8.2	**PK**
150.16	46.12	-12.99	33.13	43.5	3m./VERT	10.4	**QP**
184.88	49.75	-12.29	37.46	43.5	3m./HORZ	6.0	**PK**
194.96	47.06	-11.42	35.64	43.5	3m./HORZ	7.9	**PK**
205.16	49.77	-14.25	35.52	43.5	3m./VERT	8.0	**PK**
209.88	50.00	-13.87	36.13	43.5	3m./HORZ	7.4	**PK**
209.88	51.91	-14.47	37.44	43.5	3m./VERT	6.1	**QP**
214.24	50.47	-13.97	36.50	43.5	3m./HORZ	7.0	**PK**
230.88	53.26	-13.38	39.88	46.0	3m./VERT	6.1	**QP**
251.34	45.35	-12.74	32.61	46.0	3m./HORZ	13.4	**QP**
251.34	47.94	-12.54	35.40	46.0	3m./VERT	10.6	**QP**
269.94	43.00	-11.87	31.13	46.0	3m./VERT	14.9	**QP**
749.82	38.72	-1.93	36.79	46.0	3m./HORZ	9.2	**QP**
All other emission found are 20 dB or greater from the applicable limit. All emissions from the lowest operating clock frequency to 30 MHz were at greater than 20 dB from the applicable limits.							

Sample Calculation at 35.08 MHz:

Magnitude of Measured Frequency	43.69	dBuV
+Antenna Factor + Cable Loss+ Amplifier Gain	-14.00	dB/m
Corrected Result	29.69	dBuV/m

Test Date: March 14, 2019

Tested By
Signature: Afzal Fazal Name: Afzal Fazal

2.14 Radiated Emissions above 960 MHz (CFR 15.509 (d), 15.521(d,g,h), RSS-220 Section 6.2.1(d))

The radiated emissions above 960 MHz from the transmitter shall comply with the AVG limits in Table 5 when measured using a resolution bandwidth of 1 MHz. The following are the worst case emissions with the receiving antenna in both horizontal and vertical polarities. The emissions were maximized using a Peak Detector, and the final measurement was taken using an Average Detector.

Table 7. Radiated Emissions above 960 MHz, CFR 15.509 (d), 15.521(g), RSS-220 Section 6.2.1(d)

Frequency Range (MHz)	EIRP Limit (dBm)	Field Strength Limit at 3 meters (dBuV/m)
960 -1610	-65.3	30.0
1610 – 1990	-53.3	42.0
1990 – 3100	-51.3	44.0
3100 - 10600	-41.3	54.0
Above 10600	-51.3	44.0

EUT was tested in single configuration and with dual configuration. The test results show that there are negligible differences between having a single configuration or dual configuration. The test results for dual configuration have been selected and presented here as a representative case.

The worst-case radiated emission for the EUT in the range above 960 MHz was 1.0 dB below the limit at 1106.30 MHz at a test height of 1.0 m. All other radiated emissions were at least 2.8 dB below the CFR 15.509 limits. This data can be found in the table below.

Table 8. Radiated Emissions from Transmitter Above 960 MHz @ 1.0 m

Above 960 MHz							
Test: Radiated Emissions				**Client:** Headsight, Inc.			
Project: 19-0056				**Model:** HT5200			
Frequency (MHz)	**Test Data (dBuv)**	**AF+CA-AMP (dB/m)**	**Results (dBuV/m)**	**AVG Limits (dBuV/m)**	**Antenna Distance/ Polarization**	**Margin (dB)**	**Detector AVG**
1106.30	19.56	9.45	29.01	30.0	3.0m./HORZ	1.0	**AVG**
1726.85	35.17	-4.40	30.77	42.0	3.0m./VERT	11.2	**AVG**
1950.10	37.42	-2.63	34.79	42.0	3.0m./VERT	7.2	**AVG**
2123.20	38.13	-1.49	36.64	44.0	3.0m./VERT	7.4	**AVG**
2436.77	34.86	-0.46	34.40	44.0	3.0m./VERT	9.6	**AVG**
2462.20	33.24	-0.46	32.78	44.0	3.0m./VERT	11.2	**AVG**
2477.60	21.36	17.04	38.40	44.0	3.0m./HORZ	5.6	**AVG**
3150.75	31.94	2.98	34.92	54.0	3.0m./VERT	19.1	**AVG**
14226.00	14.82	26.36	41.18	44.0	3.0m./VERT	2.8	**AVG**
14596.00	17.38	17.86	35.24	44.0	3.0m./HORZ	8.8	**AVG**
All other emission found are 20 dB or greater from the applicable limit.							

Sample Calculation at 1106.30 MHz:

Magnitude of Measured Frequency	19.56	dBuV
+ Antenna Factor + Cable Loss + Amplifier Gain	9.45	dB/m
Corrected Result	24.86	dBuV/m

Test Date: March 12-13, 2019

Tested By
Signature: Afzal Fazal Name: Afzal Fazal

Table 9. Radiated Emissions from Transmitter Above 960 MHz @ 3.7 m

Above 960 MHz							
Test: Radiated Emissions				**Client:** Headsight, Inc.			
Project: 19-0056				**Model:** HT5200			
Frequency (MHz)	**Test Data (dBuv)**	**AF+CA-AMP (dB/m)**	**Results (dBuV/m)**	**AVG Limits (dBuV/m)**	**Antenna Distance/ Polarization**	**Margin (dB)**	**Detector AVG**
1787.65	33.78	-14.61	19.17	42.0	3.0m./VERT	22.8	**AVG**
1995.55	36.22	-12.99	23.23	44.0	3.0m./HORZ	20.8	**AVG**
2131.53	33.79	-11.99	21.80	44.0	3.0m./VERT	22.2	**AVG**
2261.95	34.29	-11.89	22.40	44.0	3.0m./HORZ	21.6	**AVG**

Sample Calculation at 1787.65 MHz:

Magnitude of Measured Frequency	33.78	dBuV
+Antenna Factor + Cable Loss+ Amplifier Gain	-14.61	dB/m
Corrected Result	19.17	dBuV/m

Test Date: March 14, 2019

Tested By
Signature: Afzal Fazal Name: Afzal Fazal

2.15 Radiated Emissions in the GPS band (CFR 15.509 (e), 15.521(g), RSS-220 Section 6.2.1(e))

In addition to the radiated emissions limits from CFR 15.509 (d), the transmitter shall not exceed the following average limits, in Table 8 when measured using a resolution bandwidth of no less than 1 kHz.

Note: measurement taken with a resolution bandwidth of greater than 1 kHz was corrected using the following equation: recorded measurement (dBuV) + 10 log (RBW_{ref}/RBW_{meas})

Table 10. Radiated Emissions in the GPS band (CFR 15.509 (e), 15.221(g), RSS-220 Section 6.2.1(e))

Frequency Range (MHz)	EIRP Limit (dBm)	Field Strength Limit at 3 meters (dBuV/m)
1164-1240	-75.3	19.9
1559-1610	-75.3	19.9

The EUT was configured according to ANSI C63.10, Clause 10. During the testing the EUT was rated 360 degrees and the receive antenna was elevated between 1m and 4m to measure and record the maximum emissions being generated by the EUT. The receive antenna was oriented in both the horizontal and vertical polarity. The worst case data is recorded and presented in the tables below.

In each of these bands, the emissions from the transmitter were maximized using a larger bandwidth and the peak detector, then the resolution bandwidth was decreased and the final measurement was taken using the average detector. The spectrum analyzer settings were set to the following parameters:

Frequency start and stop: 1164 MHz to 1240 MHz and 1559 MHz to 1610 MHz. The resolution bandwidth was set to 1 kHz or 3 kHz, when the measurements were performed at 3 kHz a correction factor was used to correct the data collected at 3 kHz back to 1 kHz using the equation noted in the paragraph above. The video bandwidth was set to greater than or equal to the resolution bandwidth. The detector used was Peak or Average. The worse case emissions are seen below.

EUT was tested in single configuration and in dual configuration. The test results show that there are negligible differences between having a single configuration or dual configuration. The test results for dual configuration have been selected and presented here as a representative case.

The worst-case radiated emission for the EUT in the GPS band was 12.9 dB below the limit at 1238.50 MHz at a test height of 1.0 m. All other radiated emissions were at least 13.3 dB below the CFR 15.509 limits. This data can be found in the tables below.

Table 11. Radiated Emissions Test Data in The GPS Bands @ 1.0 m

1164 – 1240 MHz and 1559- 1610 MHz								
Test: Radiated Emissions					**Client:** Headsight, Inc.			
Project: 19-0056					**Model:** HT5200			
Frequency (MHz)	**Test Data (dBuv)**	**Additional Factor**	**AF+CA-AMP (dB/m)**	**Results (dBuV/m)**	**AVG Limits (dBuV/m)**	**Antenna Distance/ Polarization**	**Margin (dB)**	**Detector AVG**
1224.68	12.43	--	-8.81	3.62	19.9	3.0m./HORZ	16.3	**AVG**
1238.50	13.31	--	-6.30	7.01	19.9	3.0m./VERT	12.9	**AVG**
1600.00	11.41	--	-4.82	6.59	19.9	3.0m./VERT	13.3	**AVG**
1606.00	8.15	--	-7.50	0.65	19.9	3.0m./HORZ	19.3	**AVG**

Note: measurements collected with a RBW of 3 kHz therefore a correction factor was applied in the additional factor column.
Note: A duty cycle correction factor of -13.6 dB was included in the AF+CA-AMP column to correct from PK to AVG detection.

Sample Calculation at 1224.68 MHz:

Magnitude of Measured Frequency	12.43	dBuV
+Additional Factor	-0.00	dB
+Antenna Factor + Cable Loss+ Amplifier Gain	-8.81	dB/m
Corrected Result	3.62	dBuV/m

Test Date: March 12-13, 2019

Tested By
Signature: Afzal Fazal Name: Afzal Fazal

Table 12. Radiated Emissions Test Data In The GPS Bands @ 3.7 m

1164 – 1240 MHz and 1559- 1610 MHz								
Test: Radiated Emissions					**Client:** Headsight, Inc.			
Project: 19-0056					**Model:** HT5200			
Frequency (MHz)	**Test Data (dBuv)**	**Additional Factor**	**AF+CA-AMP (dB/m)**	**Results (dBuV/m)**	**AVG Limits (dBuV/m)**	**Antenna Distance/ Polarization**	**Margin (dB)**	**Detector AVG**
1171.73	4.86	--	-17.10	-12.24	19.9	3.0m./VERT	32.1	**AVG**
1214.56	5.51	--	-16.87	-11.36	19.9	3.0m./VERT	31.3	**AVG**
1235.69	4.19	--	-16.83	-12.64	19.9	3.0m./HORZ	32.5	**AVG**
1573.04	4.54	--	-15.39	-10.85	19.9	3.0m./VERT	30.8	**AVG**
1586.69	4.01	--	-15.64	-11.63	19.9	3.0m./HORZ	31.5	**AVG**

Note: measurements collected with a RBW of 3 kHz therefore a correction factor was applied in the additional factor column.
Note: A duty cycle correction factor of -13.6 dB was included in the AF+CA-AMP column to correct from PK to AVG detection.

Sample Calculation at 1171.73 MHz:

Magnitude of Measured Frequency	4.86	dBuV
+Additional Factor	-0.00	dB
+Antenna Factor + Cable Loss+ Amplifier Gain	-17.10	dB/m
Corrected Result	-12.24	dBuV/m

Test Date: March 14, 2019

Tested By
Signature: Afzal Fazal Name: Afzal Fazal

2.16 Measurement Uncertainty

The measurement uncertainties given were calculated using the method detailed in CISPR 16-4. A coverage factor of k=2 was used to give a level of confidence of approximately 95%.

2.16.1 Conducted Emissions Measurement Uncertainty

Measurement Uncertainty (within a 95% confidence level) for this test is ± 2.85 dB.

This test is not applicable.

2.16.2 Radiated Emissions Measurement Uncertainty

For a measurement distance of 3 m the measurement uncertainty (with a 95% confidence level) for this test using a Biconical Antenna (30 MHz to 200 MHz) is ± 5.40 dB. This value includes all elements of measurement.

The measurement uncertainty (with a 95% confidence level) for this test using a Log Periodic Antenna (200 MHz to 1000 MHz) is ± 5.19 dB.

The measurement uncertainty (with a 95% confidence level) for this test using a Horn Antenna is ± 5.20 dB.

The data listed in this test report does not have sufficient margin to negate the effects of uncertainty. Therefore, the EUT conditionally meets this requirement.