



BEC INCORPORATED

CLASS 2 PERMISSIVE CHANGE TEST REPORT

**TEST STANDARDS:
FCC Part 15 Subpart C
DTS Intentional Radiator**

**Peacock Technology
Model I-QUBE**

FCC ID: WWP-I-QUBE

REPORT BEC-2300-01

TEST DATES: 02/09/2024 – 02/21/2024

**CUSTOMER:
Peacock Technology Limited
Unit 13 Alpha Centre
Stirling University Innovation Park
STIRLING FK9 4NF
Scotland, UK**

PREPARED BY:

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Notice to Customer

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The BEC Decision Rule: Measurement Uncertainty is not applied to any testing measurements or test results provided to the customer by BEC Incorporated at this time.

Revision History

Revision #	Description of Changes	Date of Changes	Date Released
0	Test Report Initial Release	N/A	02/23/2024
1	Changed the Tables for Radiated Emissions in Sections 4.2.3 and 4.2.4 of this report to clarify that the measurements are adjusted for correction factors	04/16/2024	04/16/2024
2	Removed the FCC Part 15.35(b) Peak limit for the results in the 30 to 1000 MHz Spurious Emissions tables.	05/06/2024	05/06/2024



1.0 Administrative Information

1.1 General Project Information

Project Number	BEC-2290
Manufacturer	Peacock Technology
Model Number	I-QUBE
EUT Description	Cow Wireless Sensor
Sample Type	Unmodified Sample (Radiated Emissions Test Samples)
Sample Numbers	2290-03
Serial Numbers	90040065
Sample Type	Modified with SMA connector on transmitter output port (Antenna Conducted Test Sample)
Sample Number	2290-02
Serial Number	No Serial Number on the Antenna Conducted Sample
FCC ID	WWP-I-QUBE
Frequency of Operation	902 MHz – 928 MHz
RF Module Manufacturer	Texas Instruments
RF Module Model	CC1310 MCU
Modulation	WB-DSSS
FCC Classification	Digital Transmission System (DTS)
Date Samples Received	06/05/2023
EUT Firmware Version	CC1310 F/W: 3.012
Sample Types and Condition Received	Production Units Suitable for Test
Applicable FCC Rules	FCC Rules Part 15.247: Operation within the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz Direct Sequence System



1.2 Preface

This report documents product testing conducted to verify compliance of the specified EUT with applicable standards and requirements as identified herein. EUT, test instrument configurations, test procedures, and recorded data are generally described in this report. The reader is referred to the applicable test standards for detailed procedures. The following table summarizes the test results obtained during this evaluation.

1.3 Laboratory and Customer Information

Test Laboratory Location	BEC Incorporated 970 East High Street Pottstown, PA 19464
BEC Test Personnel	JR Fanella / Steve Fanella
BEC Laboratory Number FCC Registration	US1118
BEC Laboratory Number ISED Registration	7342A-1
Test Performed For	Peacock Technology Limited Unit 13 Alpha Centre Stirling University Innovation Park STIRLING FK9 4NF Scotland, UK
Customer Technical Contacts	Gavin Saxby
Customer Reference Number	PO # 8045



1.4 Measurement Uncertainty

Measurement	Measurement Distance	Frequency Range	Measurement Limit	Expanded Uncertainty
Radiated Disturbance	3 Meter	30 MHz – 1 GHz	Class B	4.65
Conducted Disturbance AC Mains	N/A	150 kHz – 30 MHz	Class A or B	2.69

No adjustments to measured data presented in this report are required because all values of uncertainty are less than the CISPR 16-4-2:2018 recommendations. These uncertainties have a coverage factor of $k = 2$, which yields approximately a 95% level of confidence for the near-normal distribution typical of most measurement results.

FCC Registered Test Site Number: US1118
ISED Registered Test Site Number: 7342A-1

Test Measurement	ETSI TR 100 028 and CISPR 16-4-2 Limits	BEC Value
Radio Frequency	± 0.5 ppm	± 0.027 ppm
RF Power, Conducted	± 1.5 dB	± 1.45 dB
Conducted Spurious Emission of Transmitter, Valid up to 6 GHz	± 3 dB	± 0.9 dB
Radiated Emission of Transmitter, Valid up to 6 GHz	± 5.2 dB	± 4.87 dB
Radiated Emission of Receiver, Valid up to 6 GHz	± 5.2 dB	± 4.87 dB
Radiated Emission of Transmitter, Valid up to 18 GHz	± 5.5 dB	± 4.90 dB
Radiated Emission of Receiver, Valid up to 18 GHz	± 5.5 dB	± 4.90 dB
Occupied Bandwidth	± 5 %	± 2 %
Temperature	± 2.5 ° C	± 0.5 ° C
Humidity	± 10 %	± 2.5 %

These uncertainties have a coverage factor of $k = 1.96$ or $k = 2$, (which provide confidence levels of respectively 95 % and 95.45 % in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian)). Principles for the calculation of measurement uncertainty are contained in ETSI TR 100 028 [i.3], in particular in annex D of ETSI TR 100 028-2 [i.3].



1.5 Test Result Summary Table

The Peacock Model I-QUBE wireless sensor was tested and found to be compliant to the sections of the FCC Part 15 Subpart C and ISSED standards listed below:

Report Section	FCC Part 15, Subpart C		Test Description	Result
4.1	15.247(d)		Antenna Conducted Spurious Emissions Frequency Bands 30 MHz to 10 GHz	PASS
4.2.3	15.205, 15.209 15.35(b)		Radiated Spurious Emissions Frequency Bands 30 MHz to 1000 MHz Radiated Emission	PASS
4.2.4	15.205, 15.209 15.35(b)		Radiated Spurious Emissions Frequency Bands 1 GHz to 10 GHz Radiated Emission	PASS
4.3	15.247(b)(3)		Maximum Peak Power Output Antenna Conducted and EIRP	PASS
4.4	15.247(a)(2)		6 dB Occupied Bandwidth	PASS
4.5	15.247(e)		Antenna Port, Power Spectral Density	PASS

1.6 Condition of Received Sample

An evaluation of the EUT was conducted in order to verify test subject identity and condition and to ensure suitability for testing. No evidence of physical damage was noted. The test item condition was deemed acceptable for the performance of the requested test services.

1.7 Climatic Environment

The following were the general environmental conditions inside the laboratory during testing:

Temperature: 22°C ± 5° C

Humidity: 50% ± 20%

Barometric Pressure: 1010 – 1050 mb ± 20%

1.8 Test Equipment

All test equipment is checked to manufacturer's specifications and, when applicable, have current N.I.S.T. traceable, ISO 9002 conforming certificates of calibration. Test equipment used for the tests described herein is listed in Appendix A.



2.0 Equipment Under Test

Unless otherwise noted in the individual test results sections, testing was performed on the EUT as follows.

2.1 EUT Description

The Peacock Model I-QUBE is a wireless sensor intended to be fitted to the rear leg of cows. The sensors contain an accelerometer to monitor the animal's movements and routines.

2.2 Product Category

FCC Part 15, Subpart C (Section 15.247)

2.3 Product Classification

Intentional Radiator Testing Requirements, DTS Operation within the band of 902 - 928 MHz.

2.4 Test Configuration

The Peacock Model I-QUBE was configured to transmit at maximum output power with WB-DSSS modulation or in CW mode. The I-QUBE had the ability to be programmed to transmit individual channels from Channel 0 through Channel 37. The Radiated Samples were considered to be factory samples without any modification to the transmit antenna. The Antenna Conducted sample had a SMA connection installed where the antenna would typically be located.

2.5 Test Configuration Rationale

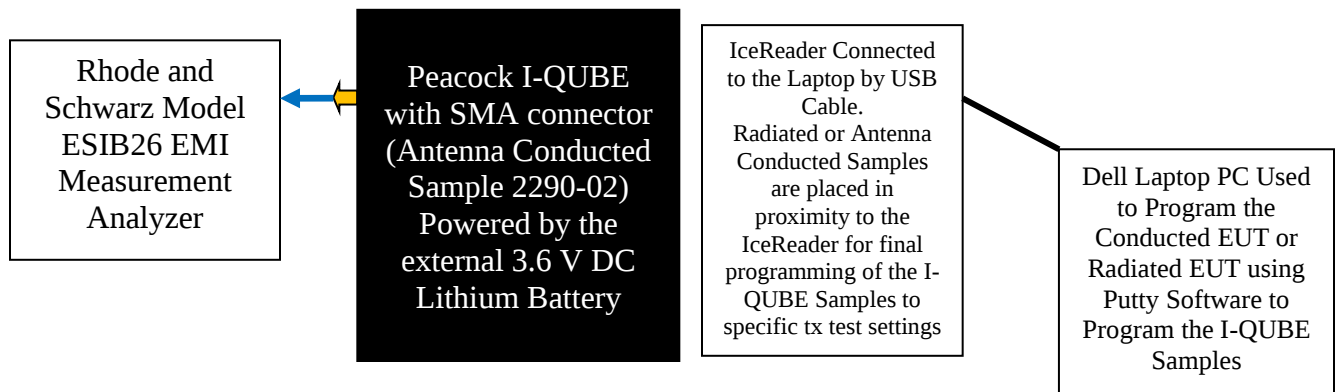
The programming configurations allow the test technicians to place the EUT in a typical transmission mode representative of normal operation or other modes required by the test standards for this frequency range of operation.



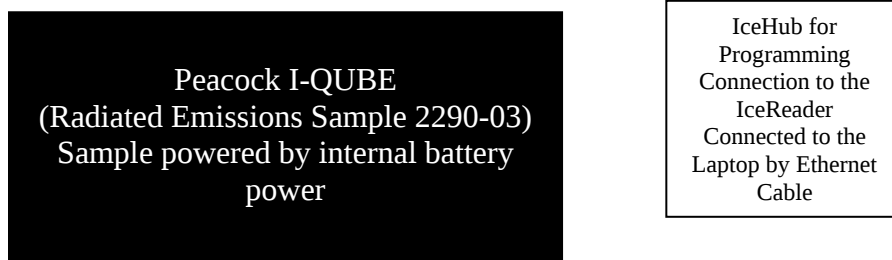
2.6 Test Configuration Diagrams

Block diagrams of the EUT configuration showing interconnection cables are illustrated below. The drawing shows the physical hardware layout used for the tests along with I/O cables and AC power distribution.

Antenna Conducted Test Configuration (modified with SMA connector in place of antenna)



Radiated Emission Test Configuration (Unmodified EUT)





2.7 EUT Information, Interconnection Cabling and Support Equipment

EUT Hardware

Description	Manufacturer	Model	Serial Numbers	Sample Number
Cow Wireless Sensor (Unmodified Emissions Samples)	Peacock Technology	I-QUBE	90040065	2290-03
Cow Wireless Sensor (Modified with SMA Antenna Conducted Sample)			No Serial Number	2290-02

Interconnection Cable List (Conducted Test Setup)

Manufacturer	Model	Type	Shielding	Length	Description
Huber + Suhner	S 04272B	Antenna Conducted RF Measurement Cable	Braid, 86% and Foil, 100%	0.7 Meter	Measurement Cable from the Antenna SMA Connector of the EUT to the input of the Rohde and Schwarz ESIB26 Receiver. BEC Asset # BEC-962

Support Equipment

Description	Manufacturer	Model	Serial Number
Lap Top Computer	Dell	Vostro	B5RR042
I-QUBE Programming HUB	IceRobotics Ltd./Peacock Technologies	IceHub	No Serial Number
I-QUBE Reader with Firmware Version v3.004	IceRobotics Ltd./Peacock Technologies	IceReader	2021083109
3.6 V DC Lithium Battery	Saft	LS 14500	No Serial Number



2.8 Test Signals and Test Modulation

For the required testing, the EUT was configured to transmit at Low Frequency 903.244 MHz (Channel 0), Middle Frequency 914.44 MHz (Channel 18) and High Frequency 926.258 MHz (Channel 37). The EUT operates with a 622 kHz bandwidth with a maximum output power with WB-DSSS modulation setting for all tests requiring a typical transmission.

IceQube Channels		622Khz channel width
Channel	Frequency (Hz)	
0	903244000	
1	903866000	
2	904488000	
3	905110000	
4	905732000	
5	906354000	
6	906976000	
7	907598000	
8	908220000	
9	908842000	
10	909464000	
11	910086000	
12	910708000	
13	911330000	
14	911952000	
15	912574000	
16	913196000	
17	913818000	
18	914440000	
19	915062000	
20	915684000	
21	916306000	
22	916928000	
23	917550000	
24	918172000	
25	918794000	
26	919416000	
27	920038000	
28	920660000	
29	921282000	
30	921904000	
31	922526000	
32	923148000	
33	923770000	
34	924392000	
35	925014000	
36	925636000	
37	926258000	

;

2.9 Antenna Gain

The antenna gain was documented as 2.33 dBi or 1.71 dBd.

2.10 Grounding

There was no ground connection used; the EUT is battery powered and self-contained.

2.11 EUT Modifications

The Peacock I-QUBE Antenna Conducted Test Sample 2290-02 was modified with a SMA connector installed replacing the normal antenna. The Peacock I-QUBE Radiated Emissions Test Sample 2290-03 was an unmodified sample.



3.0 Applicable Requirements, Methods, and Procedures

3.1 Applicable Requirements

The results of the measurement of the radio disturbance characteristics of the EUT described herein may be applied and where appropriate, provide a presumption of compliance to one or more of the following requirements or to other requirements at the discretion of the customer, regulatory agencies, or other entities.

3.1.1 FCC Requirements

Code of Federal Regulations: Title 47 – Telecommunication
Chapter I - Federal Communications Commission
Sub-chapter A – General
Part 15 – Radio Frequency Devices
Subpart C - Intentional Radiators
15.247 Operation within the bands 902-928 MHz,
2400-2483.5 MHz, and 5725-5850 MHz.

3.1.2 Basic Test Methods and Test Procedures

KDB Document 558074 D01 15.247 Meas Guidance v05r02, Guidance for Performing Compliance Measurements on Digital Transmission Systems, Frequency Hopping Spread Spectrum System, and Hybrid System Devices Operating under Section 15.247 of the FCC Rules.

ANSI C63.10-2020, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

3.1.3 Deviations or Exclusions from the Requirements

No deviations or exclusions were made.



4.0 Test Results

4.1 Antenna Conducted Spurious Emissions in the Frequency Range of 30 MHz to 10 GHz Emissions FCC Section 15.247(d)

4.1.1 Antenna Conducted Spurious Emissions in the Frequency Range of 30 MHz to 10 GHz Emissions Test Procedure

A measurement of the emissions in non-restricted frequency bands was made at the Low Frequency 903.244 MHz (Channel 0), Middle Frequency 914.44 MHz (Channel 18) and High Frequency 926.258 MHz (Channel 37). The EUT was set to transmit a signal at maximum output power setting of + 12 dBm in a Continuous High Duty Cycle Stream Mode with WB-DSSS modulation.

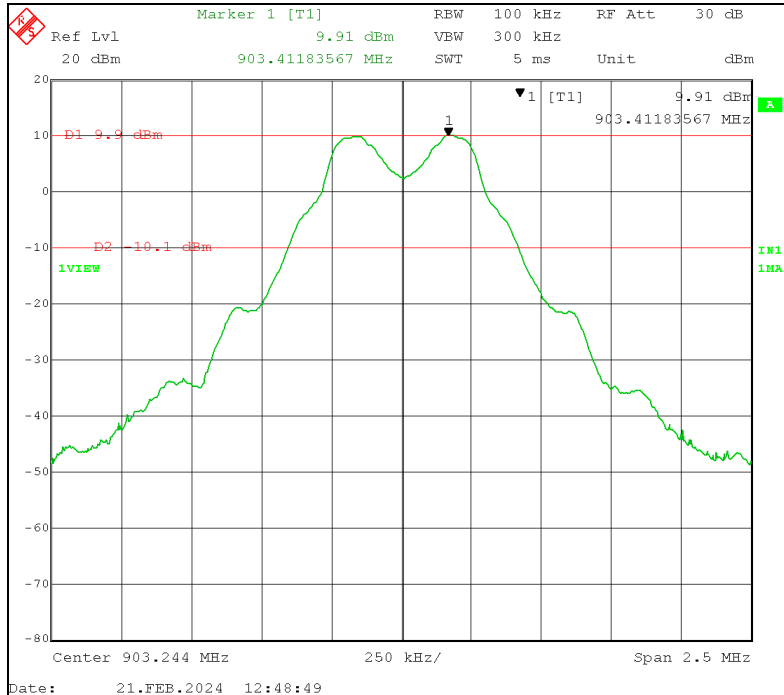
The procedure for the test is ANSI C63.10, Section 11.11. The frequency spectrum from 30 MHz to 10 GHz was divided into five bands: 30 MHz - 100 MHz, 100 MHz - 500 MHz, 500 MHz - 1 GHz, 1 GHz - 5 GHz and 5 GHz - 10 GHz. Each of the three fundamental test frequencies was measured for the reference value to determine the -20 dBc value.

Spectrum Analyzer Settings

RBW	100	kHz
VBW	300	kHz
Span	Varies	MHz
Sweep (Auto)	Varies	ms



4.1.2 Antenna Conducted Spurious Emissions Reference Level Measurement Channel 0 at 903.244 MHz (02/21/2024)

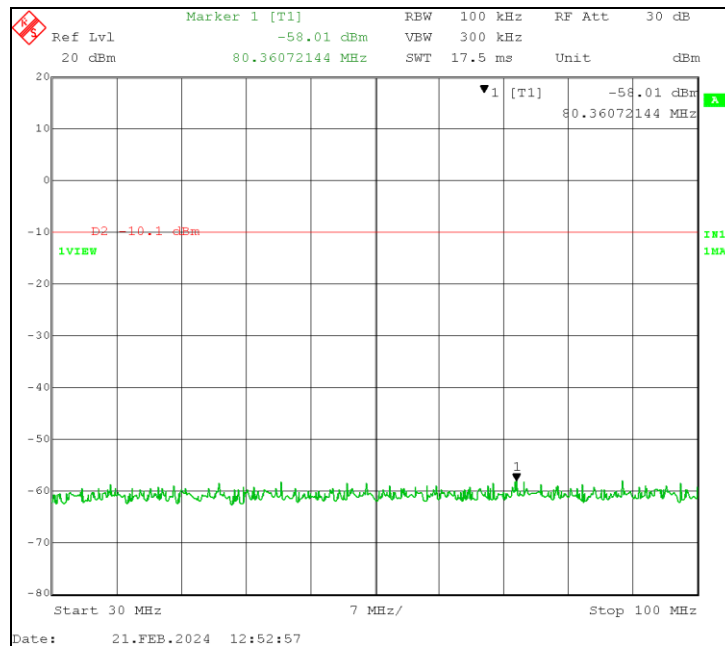


The peak level of 9.91 dBm is the maximum peak output reference level of the Peacock Technology Model I-QUBE Sample 2290-02 when transmitting at the Low Channel 0 at 903.244 MHz. The conducted spurious emissions from the antenna port must be 20 dB down from this peak. The resultant limit is therefore -10.1 dBm and is displayed on the plots from the Low Transmit Frequency Spurious Emissions from 30 MHz to 10 GHz.

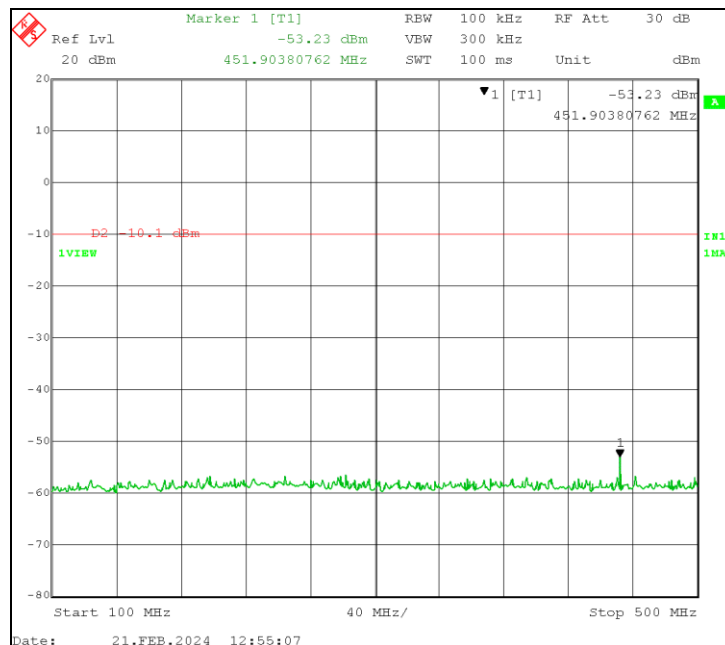


4.1.3 Antenna Conducted Spurious Emissions Channel 0 @ 903.244 MHz Test Results (02/21/2024)

30 MHz – 100 MHz

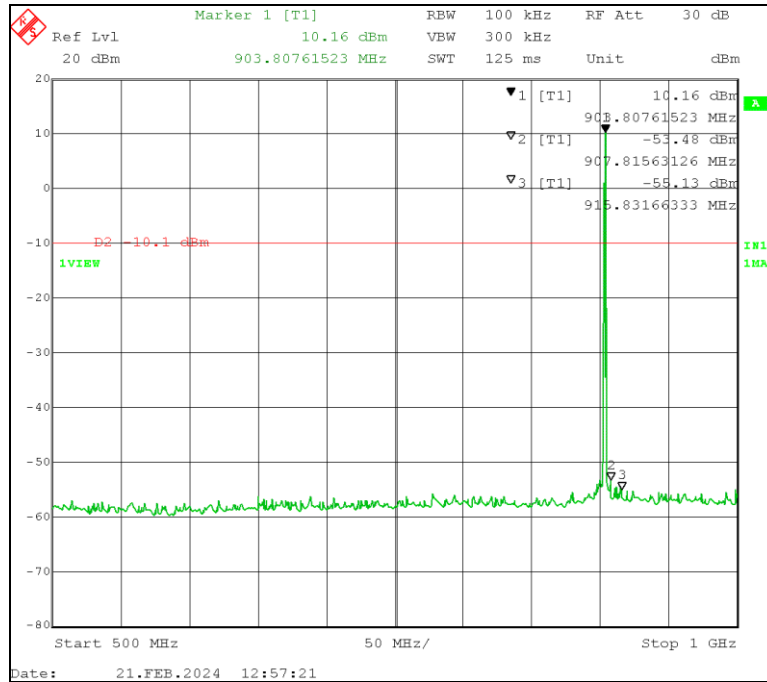


100 MHz – 500 MHz

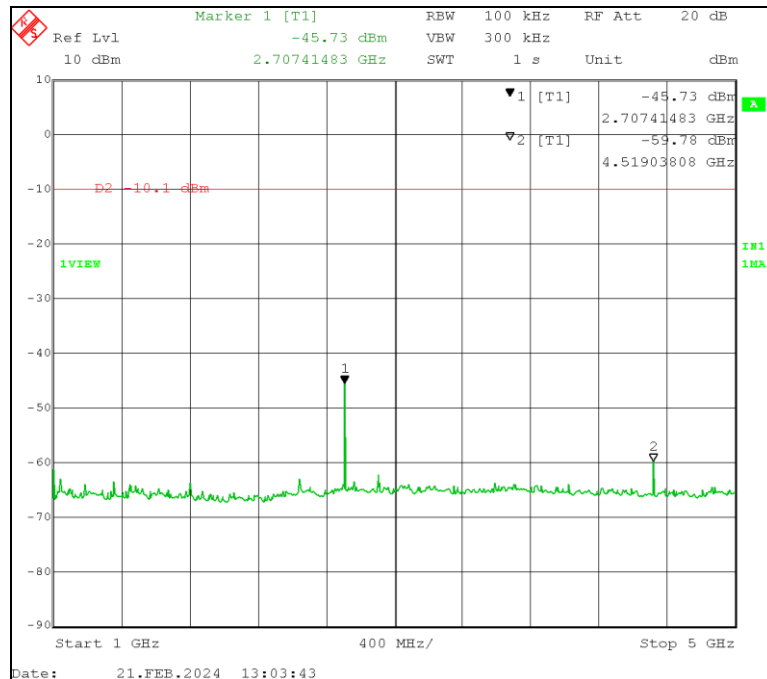




500 MHz – 1000 MHz

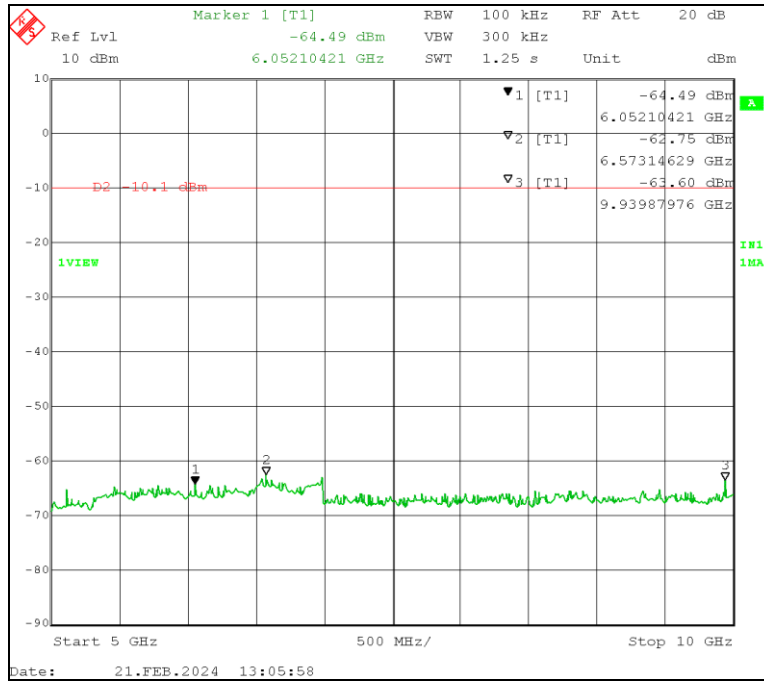


1 GHz – 5 GHz





5 GHz – 10 GHz

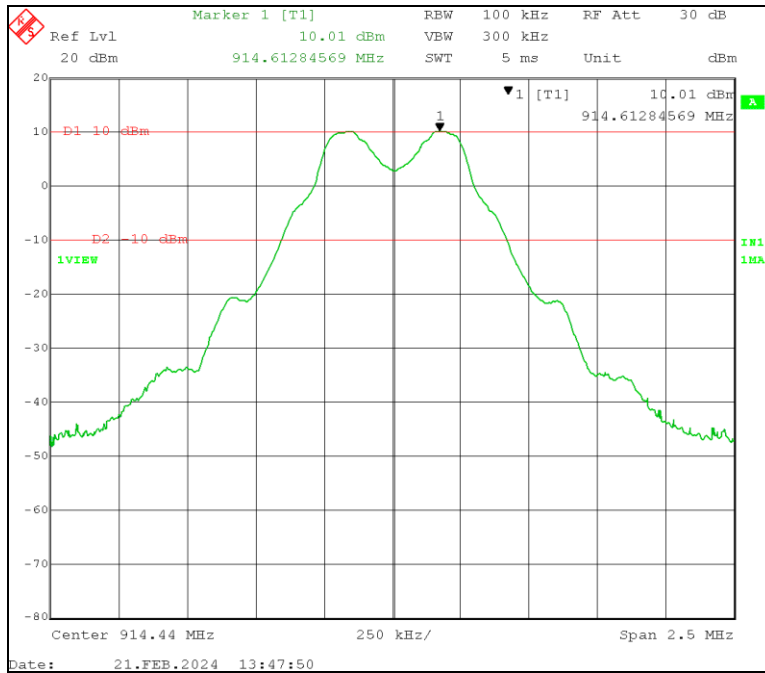


Test Results of Highest Emissions: Channel 0 (Frequency 903.244 MHz)

Channel	Tx Channel Frequency	Level	Limit	Margin	Result
#	GHz	dBc	dBc	dB	
0	0.4519	-53.23	-20.00	-33.23	Pass
0	2.70741	-45.73	-20.00	-25.73	Pass
0	4.51904	-59.78	-20.00	-39.78	Pass



4.1.4 Antenna Conducted Spurious Emissions Channel 18 @ 914.44 MHz Test Results (02/21/2024)

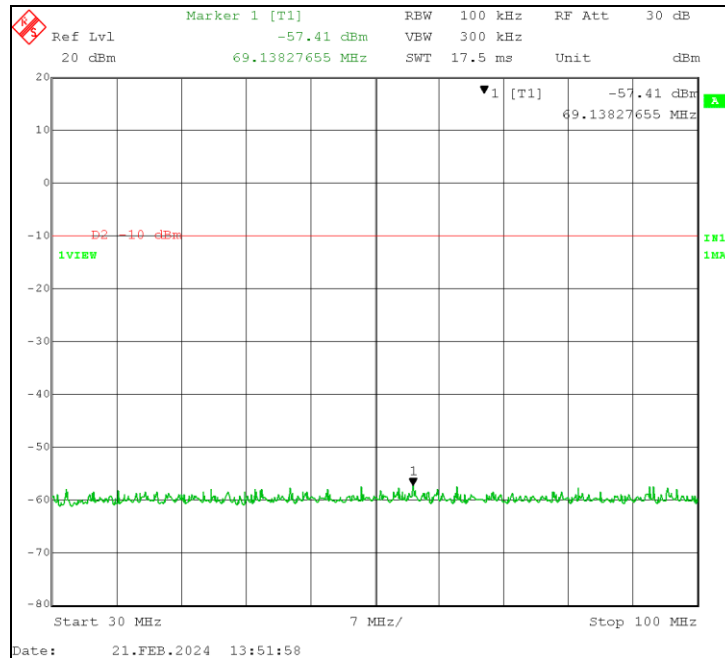


The peak level of 10.01 dBm is the maximum peak output reference level of the Peacock Technology Model I-QUBE Sample 2290-02 when transmitting at the Middle Channel 18 at 914.44 MHz. The conducted spurious emissions from the antenna port must be 20 dB down from this peak. The resultant limit is therefore -10.0 dBm and is displayed on the plots from the Middle Transmit Frequency Spurious Emissions from 30 MHz to 10 GHz.

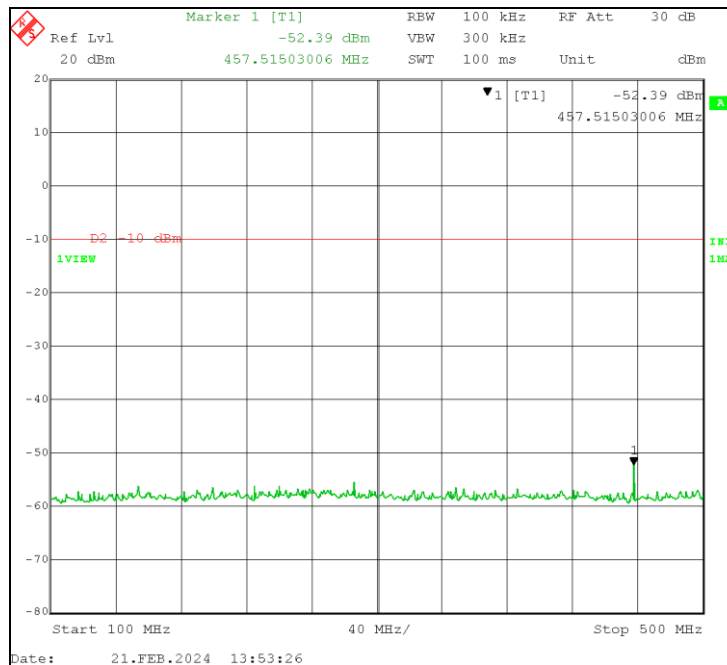


4.1.5 Antenna Conducted Spurious Emissions Channel 18 @ 914.44 MHz Test Results (02/21/2024)

30 MHz – 100 MHz

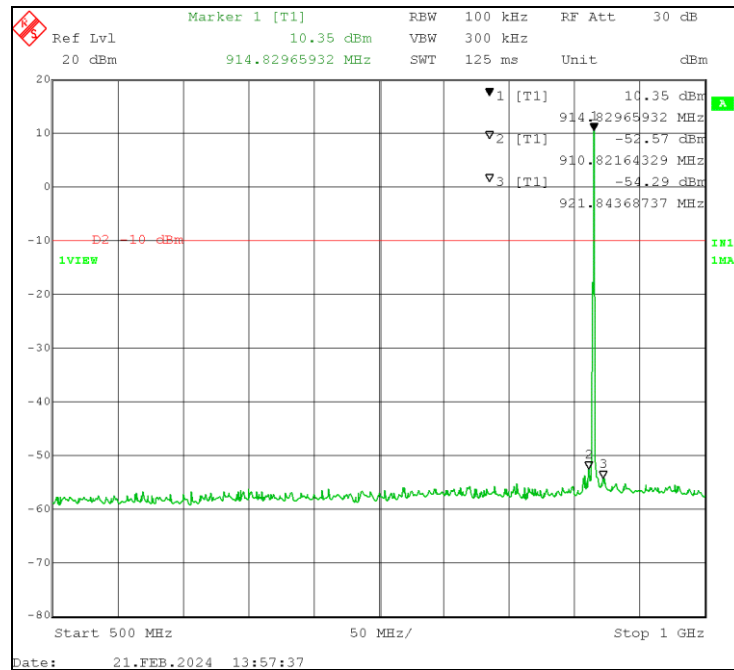


100 MHz – 500 MHz

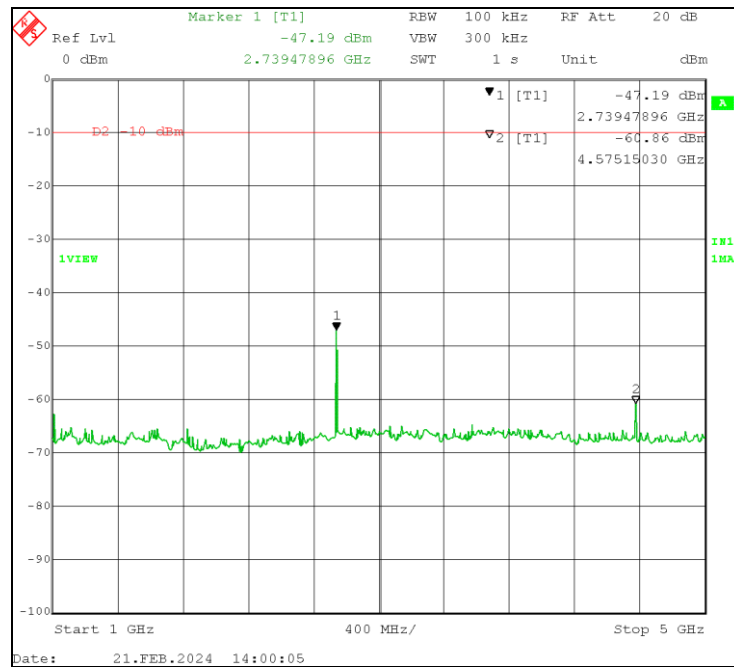




500 MHz – 1000 MHz

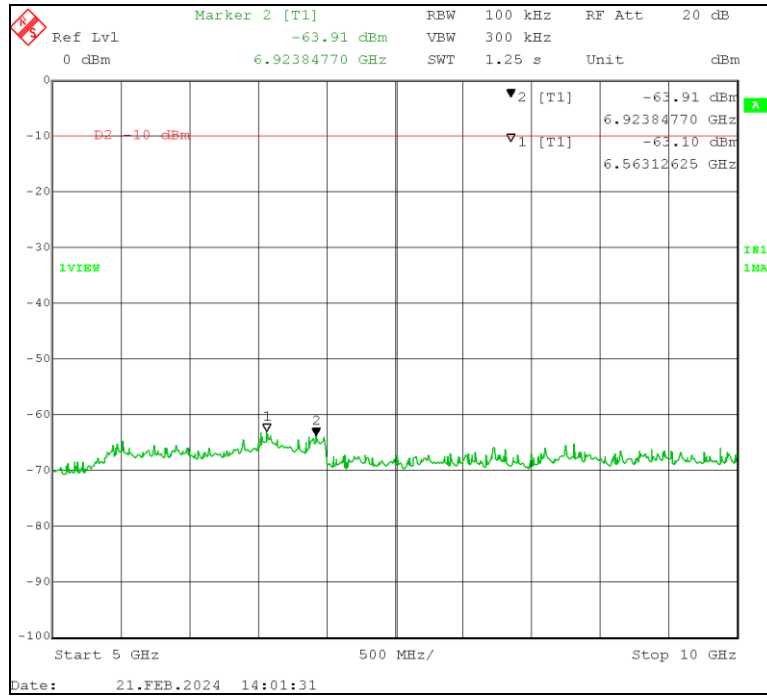


1 GHz – 5 GHz





5 GHz – 10 GHz



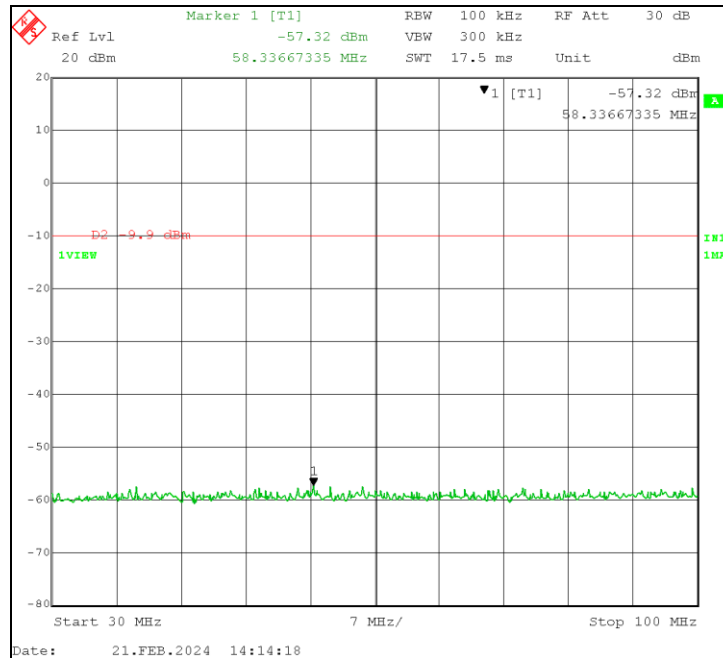
Test Results Table Highest Emissions: Channel 18 (914.44 MHz)

Channel	Tx Channel Frequency	Level	Limit	Margin	Result
#	GHz	dBc	dBc	dB	
18	0.45751	-52.39	-20.00	-32.39	Pass
18	2.73948	-47.19	-20.00	-27.19	Pass
18	4.57515	-60.86	-20.00	-40.86	Pass

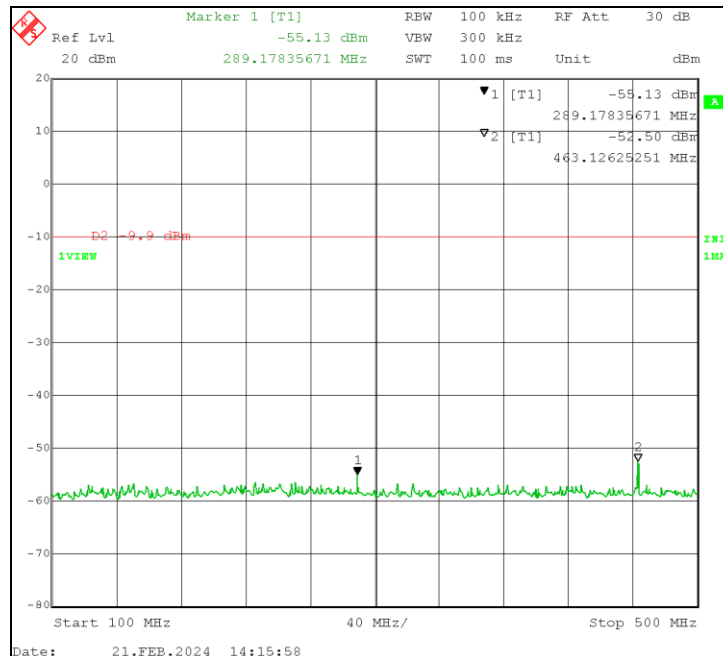


4.1.7 Antenna Conducted Spurious Emissions Channel 37 @ 926.258 MHz Test Results (02/21/2024)

30 MHz – 100 MHz

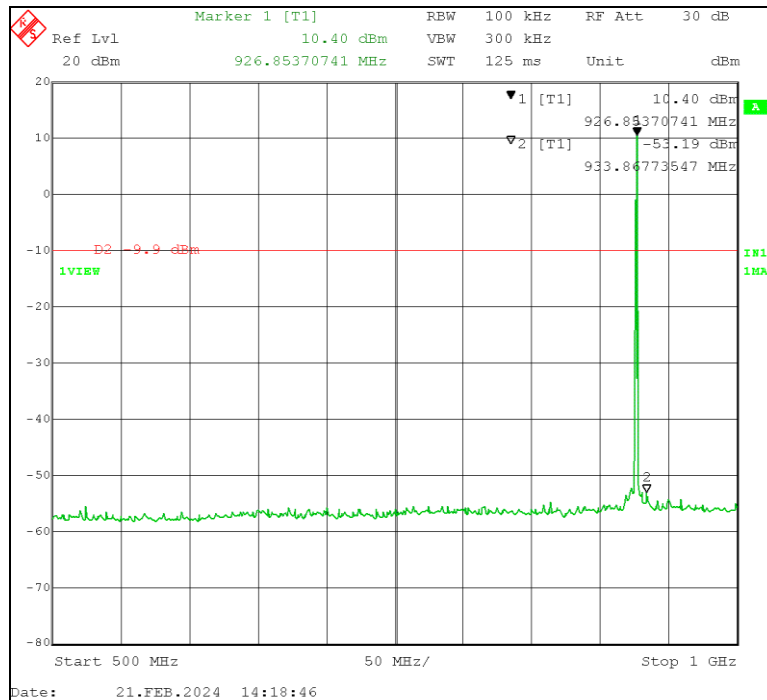


100 MHz – 500 MHz

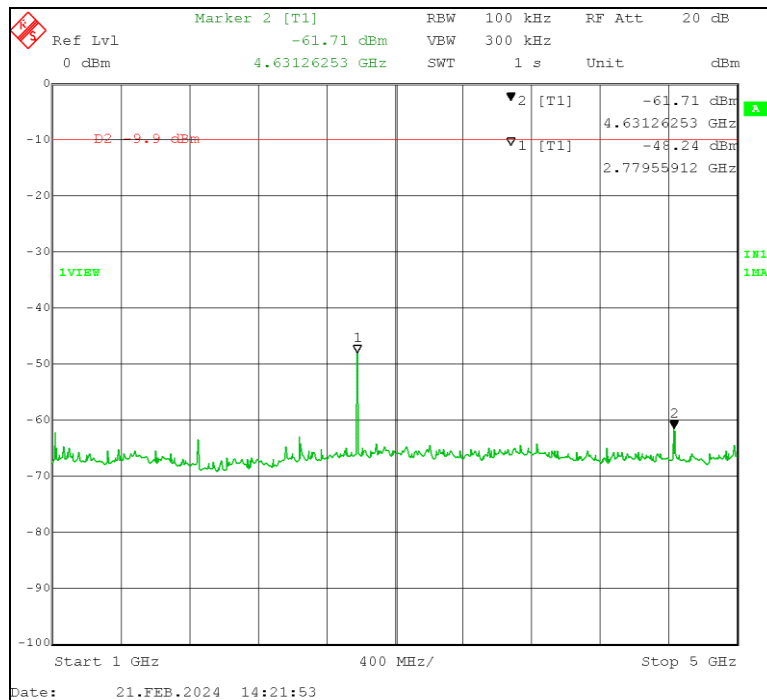




500 MHz – 1000 MHz

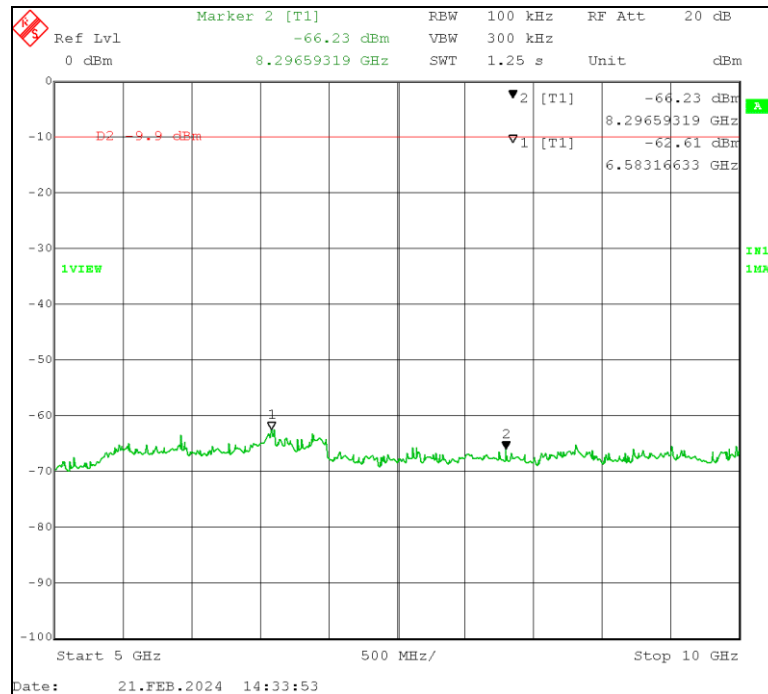


1 GHz – 5 GHz





5 GHz – 10 GHz



Test Results of Highest Emissions: Channel 37 (Frequency 926.258 MHz)

Channel	Tx Channel Frequency	Level	Limit	Margin	Result
#	GHz	dBc	dBc	dB	
37	0.4631	-52.50	-20.00	-32.50	Pass
37	2.77956	-48.24	-20.00	-28.24	Pass
37	4.63126	-61.71	-20.00	-41.71	Pass

Test Results: The Antenna Conducted Spurious Emissions of the Peacock Technology Model I-QUBE Sample 2290-02 at Low, Middle and High Frequencies, are below the carrier 20 dBc limit and therefore compliant with the limits specified in FCC Section 15.247(d).



4.2 Radiated Spurious Emissions in Non-restricted and Restricted Frequency Bands, 30 MHz – 1000 MHz and 1 GHz – 10 GHz. 47 CFR 15.205 & 47 CFR 15.209

The emissions from the Peacock I-QUBE IceCube Wireless Sensor, which fall in the restricted bands of operation and unrestricted bands of operation, detailed in this section, comply with the limits of 15.209. The Peacock I-QUBE IceCube Wireless Sensor was tested at three frequencies: Low Frequency 903.244 MHz (Channel 0), Middle Frequency 914.44 MHz (Channel 18) and High Frequency 926.258 MHz (Channel 37). The EUT was set to transmit a signal at maximum output power setting of + 12 dBm in a Continuous High Duty Cycle Stream Mode with WB-DSSS modulation.

Measurement of the signals was performed with the EUT on a turntable and a variable height antenna mast at 3 meters distance. The signals residing in restricted bands of operation are indicated in the tables below.

4.2.1 Non-Restricted and Restricted Bands Test Facility

OATS

The Open Area Test Site (OATS) is an all-weather facility with a wooden enclosure that contains a ground level 4-foot diameter turntable capable of rotating equipment 360 degrees. The enclosure is free of reflective metallic objects and extraneous electromagnetic signals. This non-metallic enclosure and the 3 meter and 10 meter test range existing outside the enclosure rest upon a protective insulating material, which in turn covers a flat, metal, continuous ground plane.

Instrumentation for remote control of the antenna mast, turntable, and other equipment are controlled by personnel indoors. The EUT and support peripherals required for EUT operation were placed on a table 80 cm high for tabletop equipment or directly on the turntable surface for floor standing equipment. The test site complies with the requirements of ANSI C63.4 and ANSI C63.10.

SR#1

The Semi-Anechoic Shielded Room (SR#1) is a ferrite and absorber lined chamber which houses a 5-foot diameter turntable capable of rotating equipment 360 degrees and antenna mast for Horizontal and Vertical polarity measurements. The enclosure is free of reflective metallic objects and extraneous electromagnetic signals. This 3 meter shielded enclosure has a raised computer floor with metal tile bottoms providing a continuous ground plane.

Instrumentation for remote control of the antenna mast, turntable, and other equipment are controlled by personnel outside the chamber. The EUT and support peripherals required for EUT operation were placed on a table 150 cm high for tabletop equipment or directly on the turntable surface for floor standing equipment.

The chamber complies with the requirements of ANSI C63.4 and ANSI C63.10.



4.2.2 Non-restricted and Restricted Bands Radiated Emissions Test Procedure

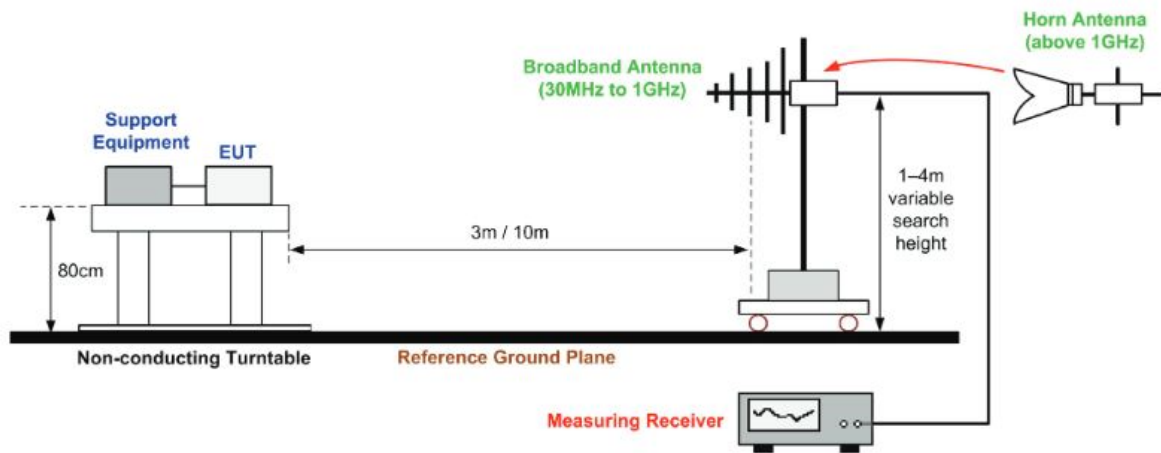
Radiated Emissions 30 MHz – 10 GHz

The EMI receiver was set to measure peak and average detectors for frequencies from 30 MHz to 1000 MHz and 1 GHz to 10 GHz. For all measurements the appropriate CISPR bandwidths were employed.

Significant emissions found during the preliminary scans were maximized by rotating the turntable and varying the antenna height. Both horizontal and vertical antenna polarities were also investigated for suspect emissions. The signals are maximized and measured using the in house generated RADE or off the shelf TILE software. The support equipment and test item(s) were powered off in turn to determine the source of the emissions where appropriate.

Field strengths were calculated as follows:

Field Strength (dB μ V/m) = Meter Reading (dB μ V) + Antenna Factor (dB/m) + Cable Loss (dB) – Amplifier Gain (dB)



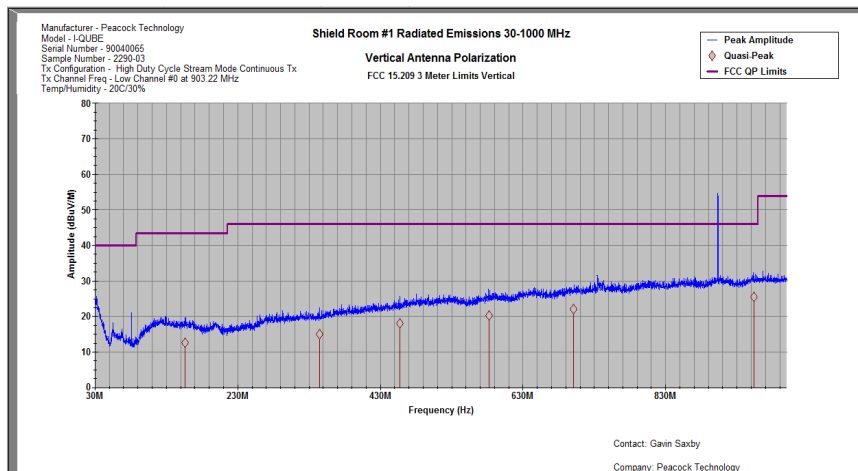
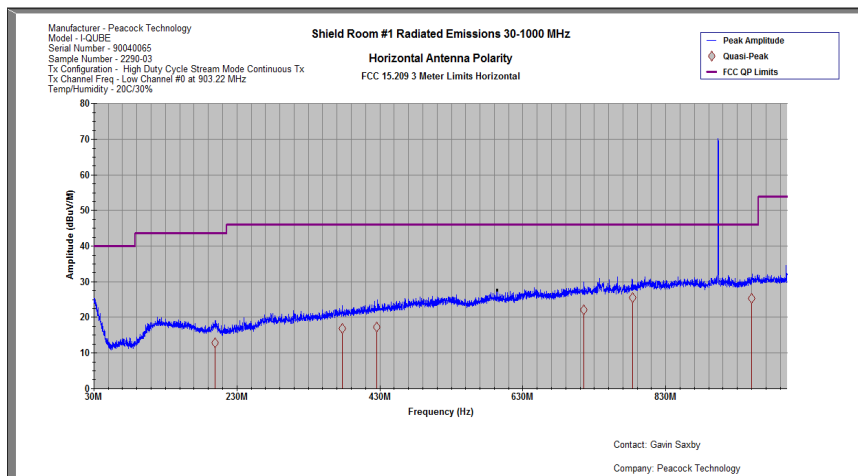
The EUT was configured to transmit a signal at its maximum output power setting of + 12 dBm in the Continuous High Duty Cycle Stream Mode with WB-DSSS modulation. The position of the EUT in the X position, placed flat on the horizontal surface of the 150-cm table, was determined to be the axis that produced the highest emissions. All radiated emissions tests were carried out with the EUT positioned in the X-axis. The following tables are the highest emissions recorded and summarized. Restricted band signals are marked with an asterisk. Other spurious emissions are shown to demonstrate compliance of the EUT to 15.209 limits.



4.2.3 Radiated Spurious Emissions in Non-restricted and Restricted Bands of Operation 30 – 1000 MHz Test Results (02/20/2024 and 02/21/2024)

Low Channel 0 (903.244 MHz)

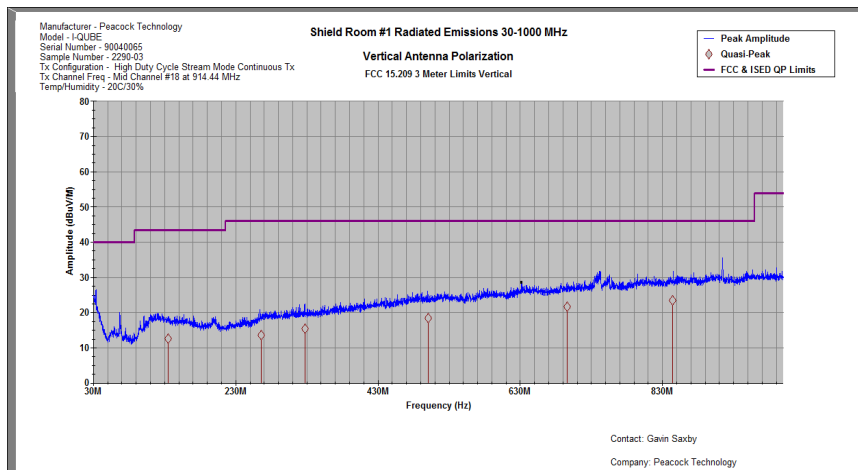
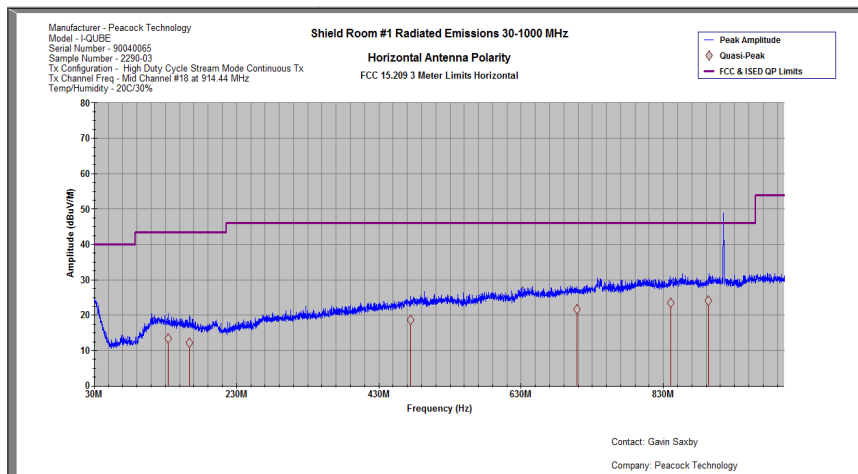
Low Tx Channel									
Frequency MHz	Peak Corrected dBuV/m	Quasi-Peak Corrected dBuV/m	Antenna Polarity H or V	Turntable Angle degrees	Antenna Height cm	Correction Factor dB	FCC Part 15.209 Limit dBuV/m	FCC Part 15.209 Margin dB	Result
156.266	15.42	12.69	V	124	157	-7.17	43.52	-28.10	Pass
199.913	13.85	12.78	H	185	183	-6.90	43.52	-29.67	Pass
344.555	17.10	15.09	V	250	105	-4.55	46.02	-28.92	Pass
377.456	16.82	16.75	H	234	136	-4.09	46.02	-29.20	Pass
425.485	19.04	17.34	H	260	110	-3.12	46.02	-26.98	Pass
457.794	19.32	17.96	V	214	188	-2.44	46.02	-26.70	Pass
582.468	21.54	20.29	V	036	213	-0.62	46.02	-24.48	Pass
700.810	24.73	22.05	V	191	109	1.13	46.02	-21.29	Pass
715.647	23.66	22.04	H	001	251	1.41	46.02	-22.36	Pass
783.110	26.03	25.41	H	065	109	2.37	46.02	-19.99	Pass
949.719	26.82	25.26	H	201	250	4.67	46.02	-19.20	Pass
953.387	25.03	25.43	V	210	120	4.67	46.02	-20.99	Pass
* Restricted Band Signal									





Middle Channel 18 (914.44 MHz)

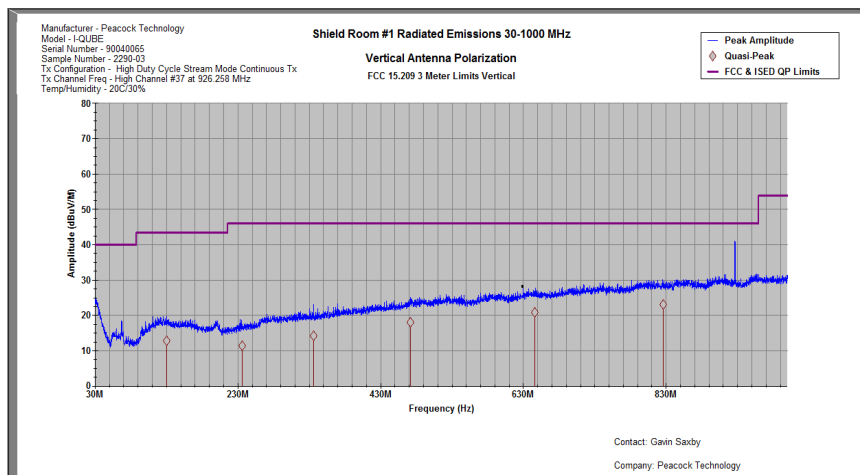
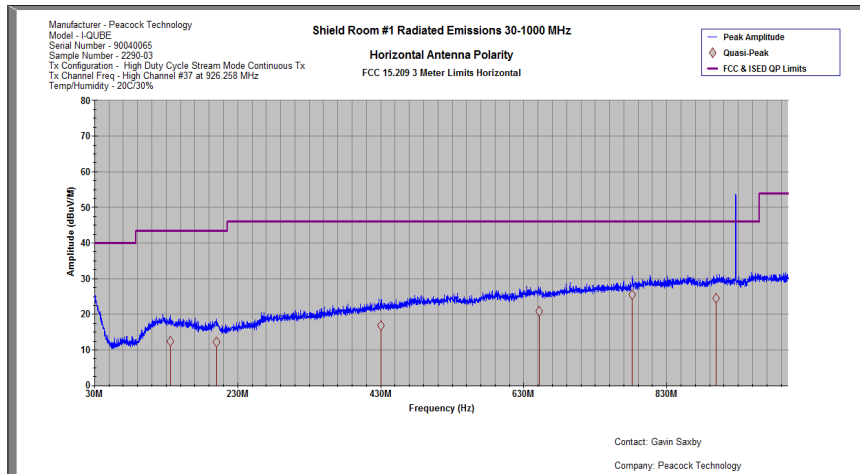
Middle Tx Channel									
Frequency	Peak Corrected	Quasi-Peak	Antenna	Turntable	Antenna	Correction	FCC Part	FCC Part	Result
MHz	dBuV/m	Corrected	Polarity	Angle	Height	Factor	15.209 Limit	15.209 Margin	
			H or V	degrees	cm	dB	dBuV/m	dB	
133.883*	15.61	13.30	H	095	252	-6.77	43.52	-27.91	Pass
135.17*	16.63	12.67	V	125	136	-6.79	43.52	-26.89	Pass
163.449*	14.02	12.23	H	256	105	-7.31	43.52	-29.50	Pass
265.967*	15.82	13.51	V	185	182	-5.76	46.02	-30.20	Pass
327.265*	17.88	15.47	V	204	224	-4.77	46.02	-28.14	Pass
474.461	21.86	18.54	H	143	220	-2.06	46.02	-24.16	Pass
500.173	19.01	18.51	V	295	209	-1.81	46.02	-27.01	Pass
696.051	21.07	21.57	V	175	189	1.05	46.02	-24.95	Pass
708.102	23.47	21.70	H	140	101	1.28	46.02	-22.55	Pass
840.273	22.88	23.40	H	356	158	3.29	46.02	-23.14	Pass
843.937	25.20	23.54	V	264	224	3.46	46.02	-20.82	Pass
893.232	25.25	24.03	H	081	161	3.93	46.02	-20.77	Pass
* Restricted Band Signal									





High Channel 37 (926.25 MHz)

High Tx Channel									
Frequency	Peak Corrected	Quasi-Peak	Antenna	Turntable	Antenna	Correction	FCC Part	FCC Part	Result
MHz	dBuV/m	dBuV/m	Polarity	Angle	Height	Factor	15.209 Limit	15.209 Margin	
			H or V	degrees	cm	dB	dBuV/m	dB	
129.699*	13.78	12.73	V	078	179	-6.53	43.52	-29.74	Pass
136.34*	15.53	12.34	H	276	102	-6.89	43.52	-27.99	Pass
200.772	12.65	12.24	H	206	205	-6.96	43.52	-30.87	Pass
236.180	11.36	11.34	V	258	136	-7.54	46.02	-34.66	Pass
336.109	13.98	14.19	V	356	250	-4.71	46.02	-32.04	Pass
430.806	17.16	16.88	H	234	230	-2.93	46.02	-28.86	Pass
471.482	19.19	18.14	V	036	104	-2.15	46.02	-26.83	Pass
646.156	23.36	20.78	V	122	145	0.41	46.02	-22.66	Pass
651.382	21.29	20.82	H	343	146	0.53	46.02	-24.73	Pass
781.697	27.49	25.58	H	086	104	2.34	46.02	-18.53	Pass
825.533	25.11	23.01	V	169	109	3.17	46.02	-20.91	Pass
898.652	26.70	24.41	H	127	162	3.99	46.02	-19.32	Pass
* Restricted Band Signal									



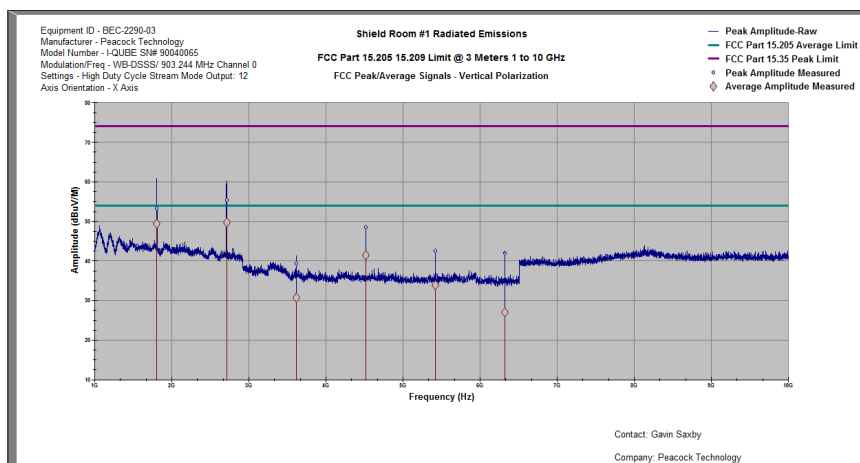
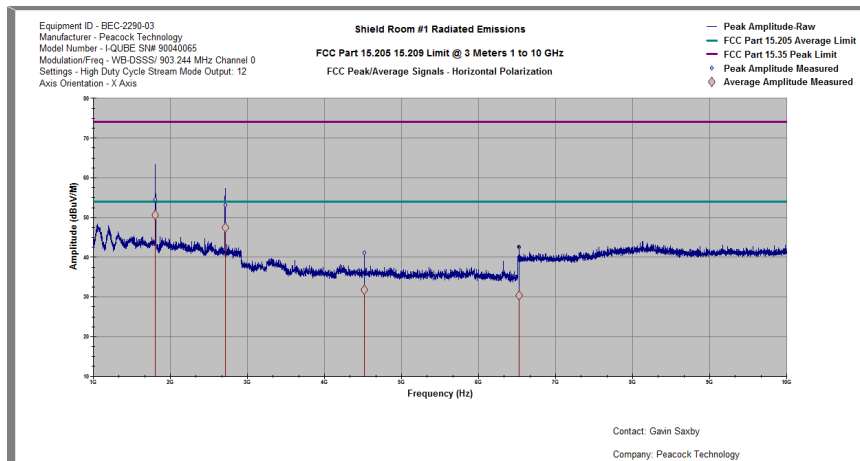
Test Results: The Peacock I-QUBE IceCube Wireless Sensor comply with the requirements of 47 CFR Part 15.205 for restricted bands of operation with a margin of 18.53 dB.



4.2.4 Radiated Spurious Emissions in Non-restricted and Restricted Bands of Operation 1 – 10 GHz Test Results (01/15/2024 and 01/16/2024)

Low Channel 0 (903.244 MHz)

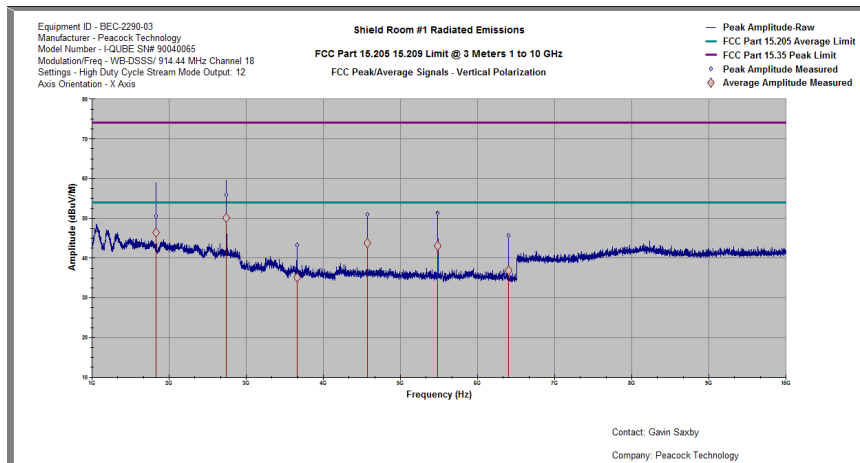
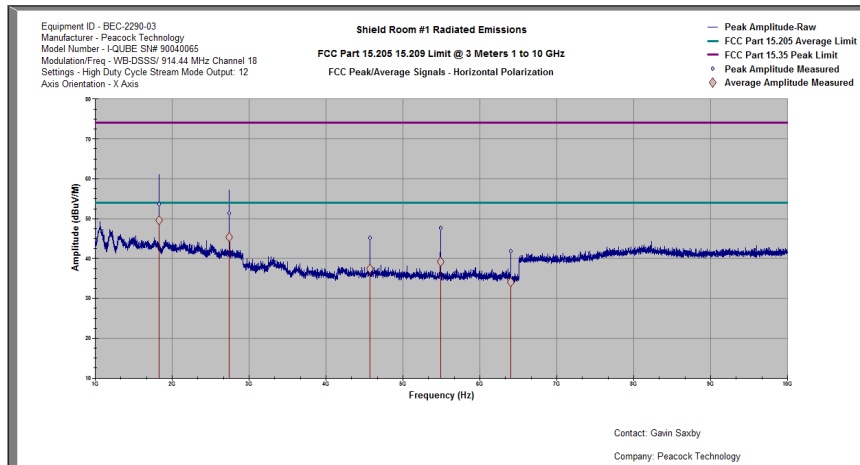
EUT PROGRAMMING DETAILS: High Duty Cycle Stream Mode in a Continuous Transmission Tx Mode at Low Channel #0 at 903.244 MHz, Power Set to +12, X-Axis											
Frequency	Peak Corrected	Average Corrected	Antenna	Turntable Angle	Antenna	Correction	15.35(b) Peak	Peak Margin	15.209 Average Limit	Average	Result
GHz	dBuV/m	dBuV/m	H or V	degrees	cm	dB	dBuV/m	dB	dBuV/m	dB	
1.8069	54.57	50.60	H	179	108	-8.01	73.98	-19.41	53.98	-3.38	Pass
* 2.7103	53.05	47.51	H	1	115	-4.52	73.98	-20.93	53.98	-6.47	Pass
* 4.51521	41.03	31.74	H	243	140	0.66	73.98	-32.95	53.98	-22.24	Pass
6.5248	42.55	30.46	H	51	158	2.81	73.98	-31.43	53.98	-23.52	Pass
1.8061	53.30	49.34	V	305	119	-8.02	73.98	-20.68	53.98	-4.64	Pass
* 2.7103	55.46	49.73	V	238	155	-4.52	73.98	-18.52	53.98	-4.25	Pass
* 3.61386	39.28	30.78	V	298	102	-1.20	73.98	-34.70	53.98	-23.20	Pass
* 4.5173	53.76	45.56	V	267	137	0.66	73.98	-20.22	53.98	-8.42	Pass
* 5.42047	42.60	33.83	V	213	104	3.29	73.98	-31.38	53.98	-20.15	Pass
6.3244	41.98	26.99	V	98	104	3.08	73.98	-32.00	53.98	-26.99	Pass
* Restricted Band Signal											





Middle Channel 18 (914.44 MHz)

EUT PROGRAMMING DETAILS: High Duty Cycle Stream Mode in a Continuous Transmission Tx Mode at Middle Channel #18 at 914.44 MHz. Power Set to +12, X-Axis											
Frequency	Peak Corrected	Average Corrected	Antenna	Turntable Angle	Antenna	Correction	15.35(b) Peak	Peak Margin	15.209 Average Limit	Average	Result
GHz	dBuV/m	dBuV/m	H or V	degrees	cm	dB	dBuV/m	dB	dBuV/m	dB	
1.8292	53.69	49.63	H	187	135	-7.81	73.98	-20.29	53.98	-4.35	Pass
* 2.74283	51.41	45.42	H	332	102	-4.48	73.98	-22.57	53.98	-8.56	Pass
* 4.57314	45.24	37.48	H	222	205	0.80	73.98	-28.74	53.98	-16.50	Pass
5.4878	47.61	39.23	H	212	206	3.28	73.98	-26.37	53.98	-14.75	Pass
6.3997	41.74	34.02	H	216	210	2.90	73.98	-32.24	53.98	-19.96	Pass
1.8286	50.56	46.34	V	311	103	-7.81	73.98	-23.42	53.98	-7.64	Pass
* 2.74394	55.90	50.14	V	231	171	-4.47	73.98	-18.08	53.98	-3.84	Pass
* 3.65704	43.17	35.12	V	130	119	-0.91	73.98	-30.81	53.98	-18.86	Pass
* 4.57131	54.09	46.09	V	241	129	0.79	73.98	-19.89	53.98	-7.89	Pass
5.4854	56.08	47.48	V	212	107	3.28	73.98	-17.90	53.98	-6.50	Pass
6.4024	45.61	36.88	V	91	101	2.89	73.98	-28.37	53.98	-17.10	Pass
* Restricted Band Signal											



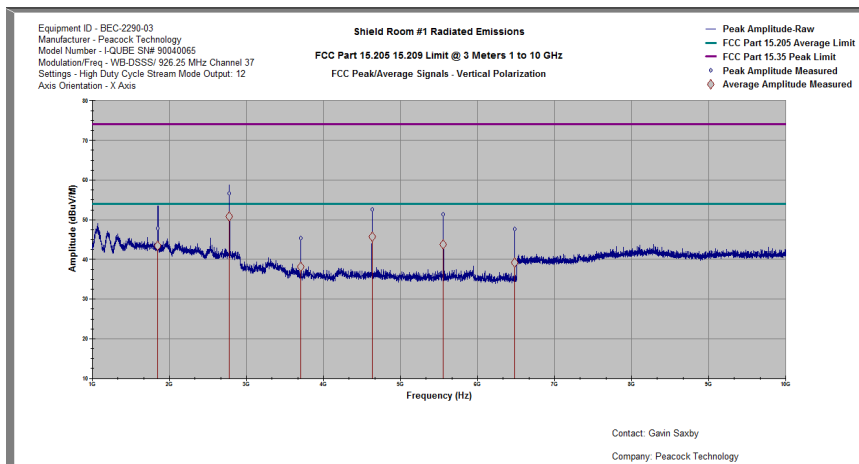
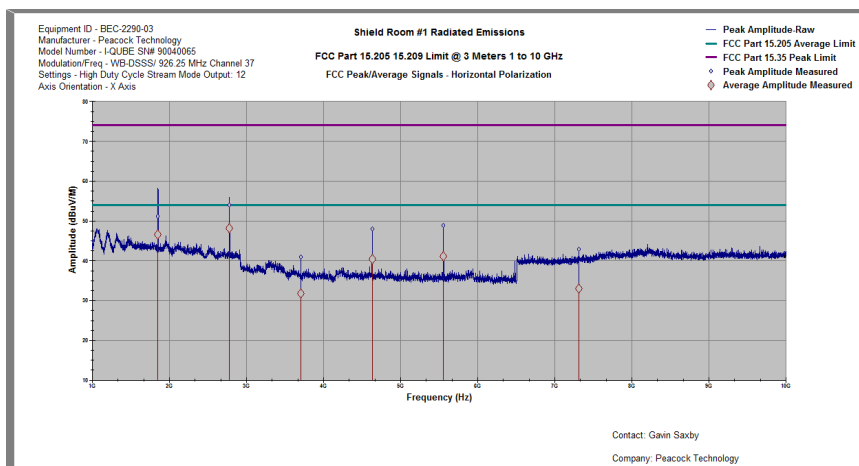


High Channel 37 (926.25 MHz)

EUT PROGRAMMING DETAILS: High Duty Cycle Stream Mode in a Continuous Transmission Tx Mode at High Channel #37 at 926.25 MHz, Power Set to +12, X-Axis

Frequency	Peak Corrected	Average Corrected	Antenna	Turntable Angle	Antenna	Correction	15.35(b) Peak	Peak Margin	15.209 Average Limit	Average	Result
GHz	dBuV/m	dBuV/m	Polarity	degrees	Height	Factor	Limit	dB	dBuV/m	Margin	
1.8522	51.09	46.61	H	186	140	-7.72	73.98	-22.89	53.98	-7.37	Pass
* 2.77818	54.05	48.16	H	276	205	-4.45	73.98	-19.93	53.98	-5.82	Pass
* 3.70424	40.94	31.75	H	74	211	-0.44	73.98	-33.04	53.98	-22.23	Pass
* 4.63229	48.00	40.41	H	213	213	1.06	73.98	-25.98	53.98	-13.57	Pass
5.5563	48.81	41.15	H	219	209	3.29	73.98	-25.17	53.98	-12.83	Pass
* 7.31036	42.83	32.95	H	281	149	4.62	73.98	-31.15	53.98	-21.03	Pass
1.8529	47.89	43.39	V	312	103	-7.71	73.98	-26.09	53.98	-10.59	Pass
* 2.77827	56.58	50.89	V	248	160	-4.45	73.98	-17.40	53.98	-3.09	Pass
* 3.70578	45.33	38.17	V	155	102	-0.42	73.98	-28.65	53.98	-15.81	Pass
* 4.63042	56.26	48.56	V	119	125	1.06	73.98	-17.72	53.98	-5.42	Pass
5.5587	56.89	48.69	V	214	215	3.29	73.98	-17.09	53.98	-5.29	Pass
6.4826	47.67	39.22	V	259	210	2.78	73.98	-26.31	53.98	-14.76	Pass

* Restricted Band Signal



Test Results: The Peacock I-QUBE IceCube Wireless Sensor comply with the requirements of 47 CFR Part 15.205 for restricted bands of operation with a margin of 3.09 dB.



4.3 Maximum Peak Output Power FCC Part 15.247(b)(3)

4.3.1 Maximum Peak Output Power Test Procedure

A conducted power measurement of the output frequency was measured according to ANSI C63.10, Section 11.9.1.1. Spectrum Analyzer Resolution Bandwidth and Frequency Span were based upon the Operating Bandwidth (OBW) measured in the previous section. The Peacock I-QUBE IceCube Wireless Sensor was tested at three frequencies: Low Frequency 903.244 MHz (Channel 0), Middle Frequency 914.44 MHz (Channel 18) and High Frequency 926.258 MHz (Channel 37). The EUT was set to transmit a signal at maximum output power setting of + 12 dBm in a Continuous High Duty Cycle Stream Mode with WB-DSSS modulation and in a Constant Wave Mode.

Spectrum Analyzer Settings:

Measurement Analyzer Settings	
Span	10 MHz
RBW	1 MHz
VBW	3 MHz
Sweep Time	5 ms

4.3.2 Maximum Peak Output Power Test Results (02/14/2024)

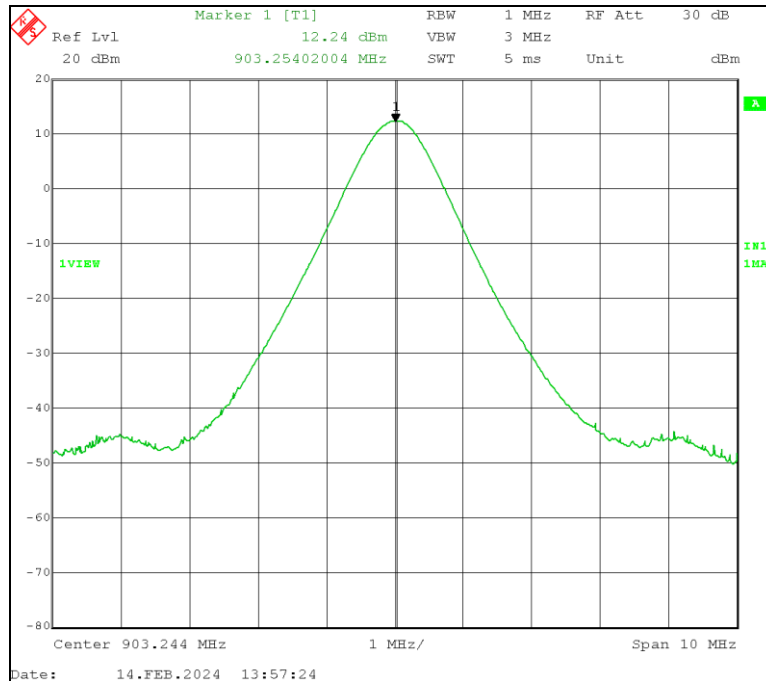
Tx Channel Frequency	Modulation Tested	Peak Output Power (dBm)	BEC-962 Cable Correction Factors	Corrected Peak Output Power (dBm)	Peak Output Power (Watts)	Limit (Watts)	Margin (Watts)
903.244 (Channel 0)	High Duty Cycle Stream Mode	12.24	0.209	12.449	0.01758	1	-0.98242
903.244 (Channel 0)	CW Mode	12.24	0.209	12.449	0.01758	1	-0.98242
914.44 (Channel 18)	High Duty Cycle Stream Mode	12.41	0.211	12.621	0.01829	1	-0.98171
914.44 (Channel 18)	CW Mode	12.36	0.211	12.571	0.01808	1	-0.98192
926.258 (Channel 37)	High Duty Cycle Stream Mode	12.43	0.212	12.642	0.01837	1	-0.98163
926.258 (Channel 37)	CW Mode	12.43	0.212	12.642	0.01837	1	-0.98163



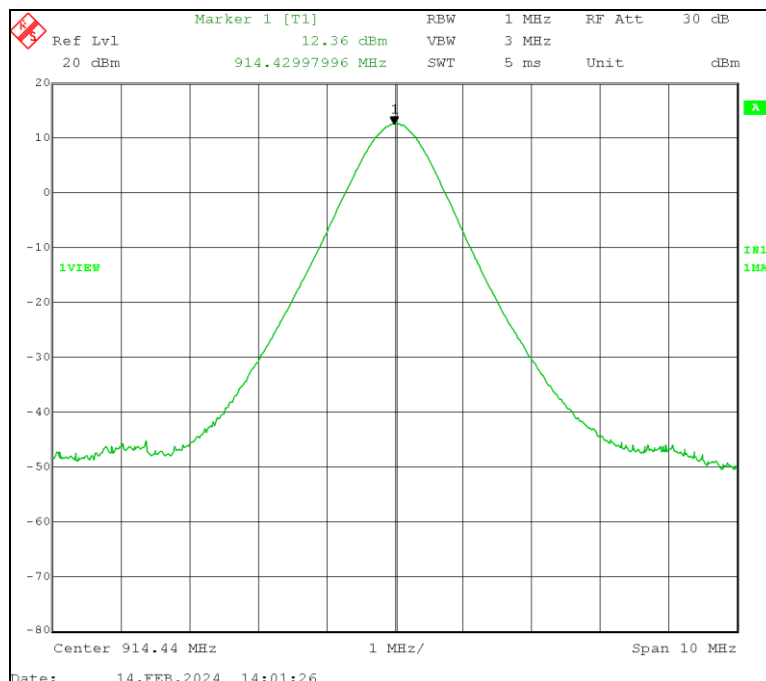
4.3.3 Maximum Peak Output Power Analyzer Screen Captures

Below are the spectrum analyzer screen captures of the maximum peak output power measurements.

Channel 0: 903.244 MHz No Modulation

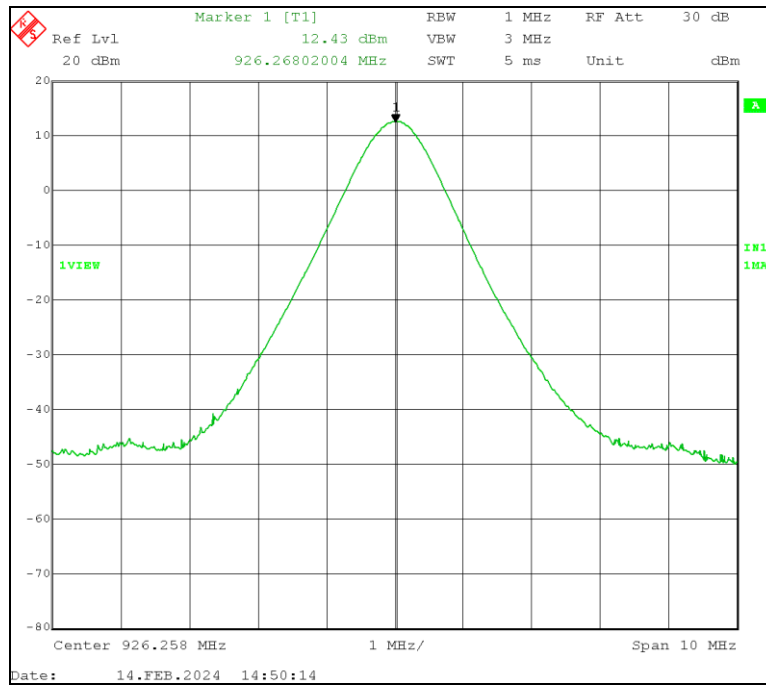


Channel 18: 914.44 MHz No Modulation

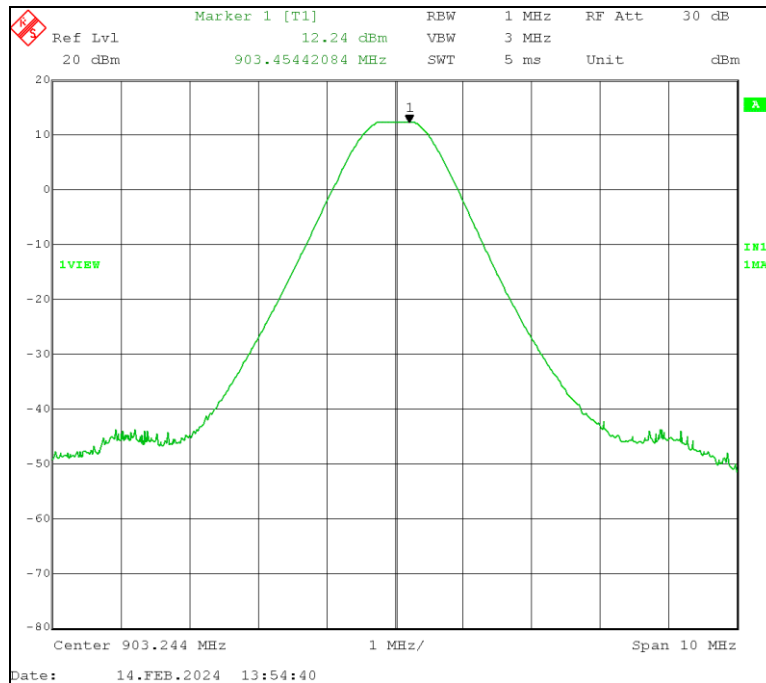




Channel 37: 926.258 MHz No Modulation

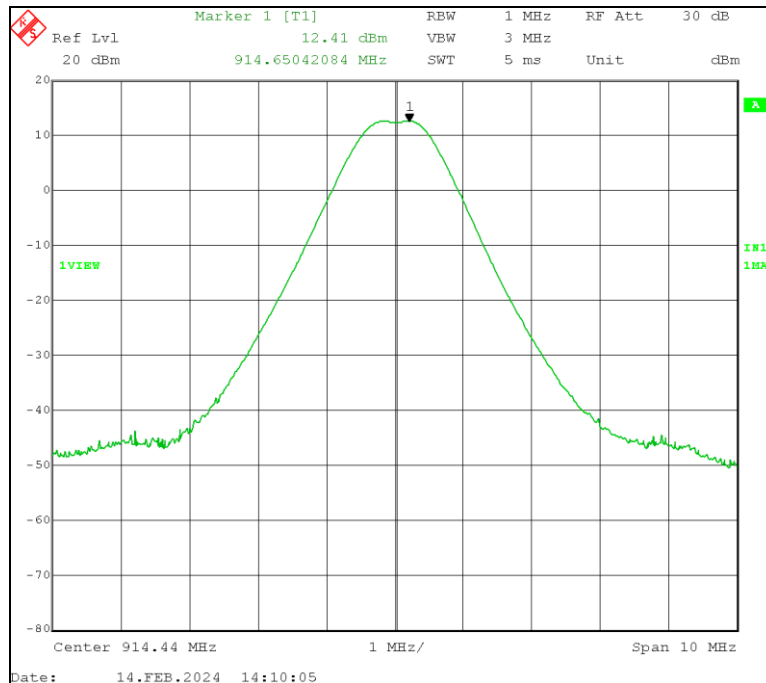


Channel 0: 903.244 MHz WB-DSSS Modulation

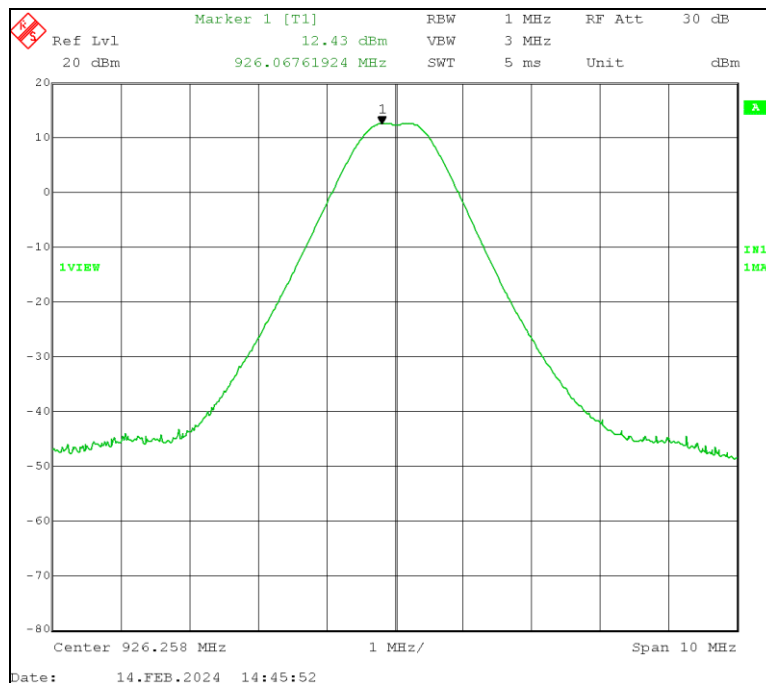




Channel 18: 914.44 MHz WB-DSSS Modulation



Channel 37: 926.258 MHz WB-DSSS Modulation



Test Results: The Maximum Peak Output Power measurements for the Peacock I-QUBE IceCube Wireless Sensor, with and without modulation, are compliant with the limits specified in FCC Section 15.247(b)(3).



4.4 DTS 6 dB Occupied Bandwidth FCC Section 15.247(a)(2)

4.4.1 6 dB Occupied Bandwidth – Test Procedure

The minimum DTS (6 dB) bandwidth, specified in FCC Section 15.247(a) (2) was measured using a Spectrum Analyzer with 100 kHz resolution bandwidth and 300 kHz video bandwidth. The Peacock I-QUBE IceCube Wireless Sensor was tested at three frequencies: Low Frequency 903.244 MHz (Channel 0), Middle Frequency 914.44 MHz (Channel 18) and High Frequency 926.258 MHz (Channel 37). The EUT was set to transmit a signal at maximum output power setting of + 12 dBm in a Continuous High Duty Cycle Stream Mode with WB-DSSS modulation. The test procedure of ANSI C63.10, Section 11.8, Option 1, was used.

Spectrum Analyzer Settings:

RBW	100	kHz
VBW	300	kHz
Span	2	MHz
Sweep Time	5	ms

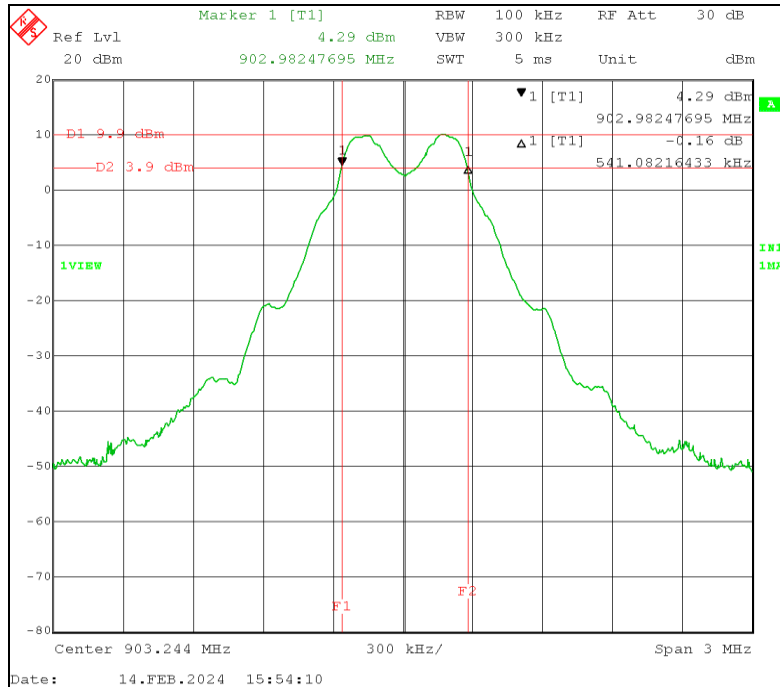
4.4.2 DTS (6 dB) Occupied Bandwidth Test Results (02/14/2024)

Channel	Frequency	LoRa Modulation Settings	6 dB BW Measurements	15.247 (a)(2) BW (Minimum)	Margin	Result
#	MHz	#	kHz	kHz	kHz	
0	903.244	Firmware 3.012 Output Max @ +12 dBm	541.08	500.00	41.08	Pass
18	914.440		541.08		41.08	Pass
37	926.258		541.08		41.08	Pass

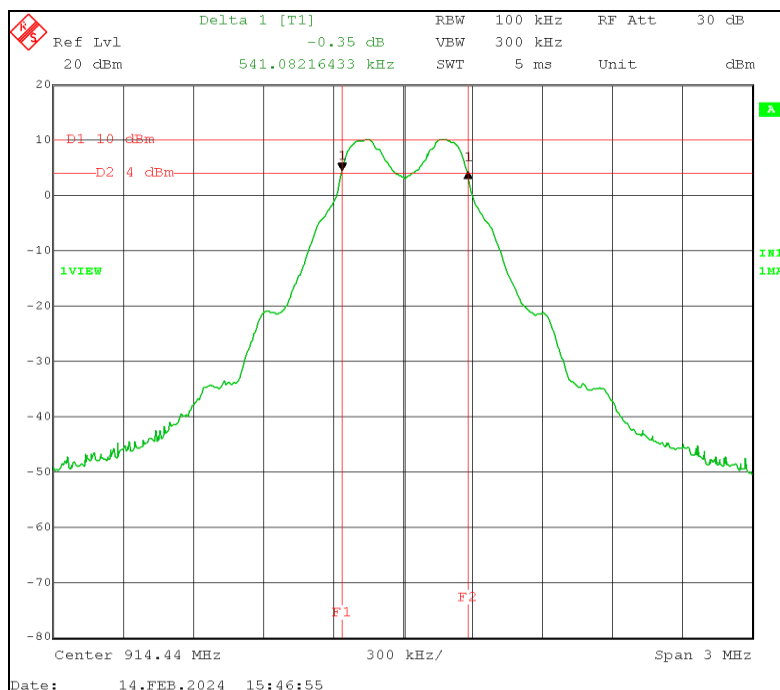


4.4.3 DTS (6 dB) Occupied Bandwidth Analyzer Screen Captures

Channel 0: 903.244 MHz

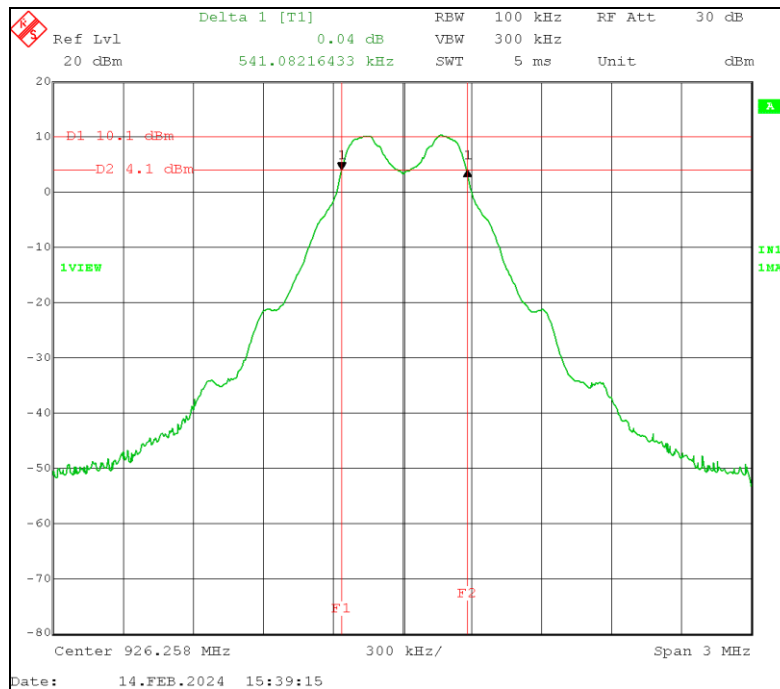


Channel 18: 914.44 MHz





Channel 37: 926.258 MHz



Test Results: The DTS, 6 dB Occupied Bandwidth measurements for the Peacock I-QUBE IceCube Wireless Sensor were measured and are compliant to FCC requirements.



4.5 Power Spectral Density FCC Section 15.247(e)

4.5.1 Power Spectral Density Test Procedure

A conducted power measurement of the output frequency was measured using a peak detector for the Power Spectral Density testing. The Peacock I-QUBE IceCube Wireless Sensor was tested at three frequencies: Low Frequency 903.244 MHz (Channel 0), Middle Frequency 914.44 MHz (Channel 18) and High Frequency 926.258 MHz (Channel 37). The EUT was set to transmit a signal at maximum output power setting of + 12 dBm in a Continuous High Duty Cycle Stream Mode with WB-DSSS modulation. The test procedure of ANSI C63.10, Section 11.10.2 (PKPSD) was used.

Spectrum Analyzer Settings:

RBW	3	kHz
VBW	10	kHz
Span	1.5	MHz
Sweep (Auto)	420	ms

4.5.2 Power Spectral Density Test Results (02/21/2024)

Channel	Transmission Parameters	Frequency (MHz)	Measured Level	Cable # 962 Loss	Total	Limit	Margin
			dBm	dB	dBm	dBm	dBm
0	Firmware 3.012 Output Max @ +12 dBm	903.244	3.30	0.209	3.51	8.00	-4.49
18		914.440	3.29	0.211	3.50	8.00	-4.50
37		926.258	3.62	0.212	3.83	8.00	-4.17



4.5.3 Power Spectral Density Analyzer Screen Captures

Channel 0: 903.244 MHz



Channel 18: 914.44 MHz





Channel 37: 926.258 MHz



Test Results: The Power Spectral Density measurements of the Peacock I-QUBE IceCube Wireless Sensor are compliant with the limits specified in FCC Section 15.247(e).



Appendix A – Test Equipment

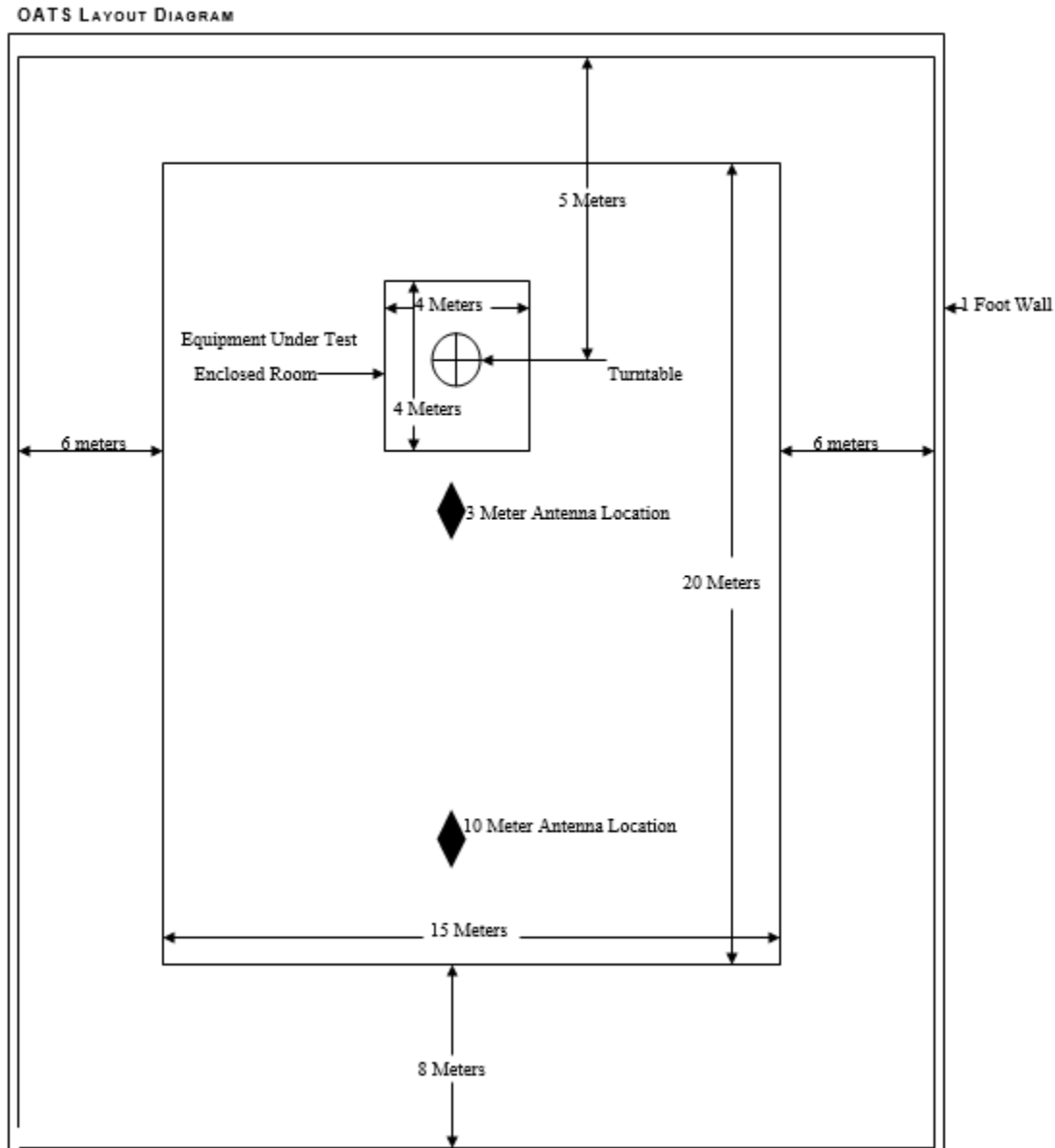
Equipment	Manufacturer	Model #	Serial #	BEC #	Calibration Date	Calibration Cycle	Calibration Due Date
EMI Receiver (20 Hz – 26.5 GHz)	Rohde & Schwarz	ESIB 26	836119/006	1010	12/09/22	3 Years	12/09/25
Antenna (30 MHz - 6 GHz)	Sunol Sciences	JB6	A022108	712	06/21/21	3 Years	06/21/24
9kHz-3GHz EMC Analyzer	Agilent	E7402A	US39440162	883	06/21/21	5 Years	06/21/26
Antenna (30 MHz - 6 GHz)	Sunol Sciences	JB6	A020714	882	05/24/21	3 Years	05/24/24
Amplifier (.09 – 1300 MHz)	Hewlett Packard	8447F	3313A06658	807	01/13/21	5 Years	01/13/26
EMC Analyzer (9 kHz - 26.5 GHz)	Hewlett Packard	8593EM	3710A00214	1026	03/23/20	5 Years	03/23/25
Amplifier System (0.5 – 50 GHz)	Hewlett Packard	83015A 83017A	3123A00360 & 3332A00219	1027	06/16/21	3 Years	06/16/24
Double Ridged Horn Antenna (1 - 18 GHz)	EMCO	3115	9705-5225	1028	11/24/21	3 Years	11/21/24
Antenna (18 - 26.5 GHz)	Hewlett Packard	84125- 80008	N/A	1056	01/18/22	3 Years	01/18/25
OATS Site (30 MHz – 1 GHz)	BEC	N/A	N/A	705	10/06/23	1 Year	10/06/24
Temp/Humidity Meter	Control Company	4096	151872672	780	07/21/22	3 Years	07/21/25



1.5 GHz High Pass Filter	Hewlett Packard	84300-80037	US36432007	927	08/04/22	3 Years	08/04/25
902 MHz to 928 MHz Notch Filter	Anatech Electronics	AE915N S2095	10	923	No Cal. Required	No Cal. Required	No Cal. Required
Software (Tile Instrument Control System)	Quantum Change/EMC Systems	Version 3	N/A	N/A	No Cal. Required	No Cal. Required	No Cal. Required
Radiated Emissions Test Software	BEC	RADE	2.2	N/A	No Cal. Required	No Cal. Required	No Cal. Required



Appendix B – Open Area Test Site Layout Diagram





Appendix C – Emissions Shielded Room Layout Diagram

SITE DESCRIPTION

The chamber is a 3 Meter semi-anechoic chamber with the ferrite absorbers on all walls and ceiling and is re-categorized as a Fully anechoic chamber when absorbers are added in between the test area and measurement antenna. The turn-table and mast are controlled externally by the ETS Lindgren 2090 Controller. The metal computer floor provides the ground plane for the site. Inside room dimensions are 22' Long by 13' Wide by 11'5" High. Outside room dimensions are 22'8" Long by 14' Wide by 12'9" High.

