TEST REPORT

Report Number: 105081748MIN-001
Project Number: G105081748

Testing performed on the
Motowinch System

to
47 CFR, Part 15:2022, §15.107 and §15.109, Class B
47 CFR, Part 15.209:2022 / KDB 996369 D04 Module Integration Guide v02:2020

For
Bearaxe, LLC

Test Performed by:
Intertek Testing Services NA, Inc.
40 51st Way NE, Suite 100
Fridley, MN 55421 USA

Test Authorized by:
Bearaxe, LLC
2542 NW Upshur St
Portland, OR 97210

Prepared by: _____
Peter Kutkiewicz, EMC Project Engineer

Reviewed by: _____
Uri Spector, EMC Team Lead

Date of issue: 29 June, 2022

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1.0 DESCRIPTION OF THE SAMPLE (EUT)

Model:	Motowinch, E-box, and Handle
Type of EUT:	Tow Sports Winch System
Intertek Sample IDs:	MIN2206031003-001, 002, 004 MIN2206061035-001, 002, 003, 004
Company:	Bearaxe, LLC
Customer:	Joshua Baltaxe
Address:	2542 NW Upshur St Portland, OR 97210
Phone:	1.818.293.8338
e-mail:	josh@bearaxe.co
Test Standards:	☒ 47 CFR, Part 15:2022, §15.107 and §15.109, Class B, test method: ANSI C63.4-2014 ☒ 47 CFR, Part 15.209:2022 / KDB 996369 D04 Module Integration Guide v02:2020
Date Sample Submitted:	06/06/2022
Test Work Started:	06/09/2022
Test Work Completed:	06/14/2022
Test Sample Conditions:	☐ Damaged ☐Poor (Usable) ☒ Good ☐ Prototype ☒Production ☐ Used

2.0 TEST SUMMARY

Referring to the performance criteria and the operating mode during the tests specified in this report, the equipment complies with the requirements according to the following standards.

TEST STANDARD	TEST	RESULT
Subpart B – 15.107	Conducted Emissions	N/A
Subpart B – 15.109	Radiated Emissions	Pass
47 CFR, Part 15.209:2022 / KDB 996369 D04 Module	Radiated Spurious Emissions Verification	Complies

2.1 Measurement Uncertainty

Radiated Emissions:

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
Radiated Emissions, 3m	30-1000 MHz	4.5 dB	6.3 dB
Radiated Emissions, 3m	1-6 GHz	4.6 dB	5.2 dB
Radiated Emissions, 3m	6-18 GHz	4.6 dB	5.5 dB

As shown above our radiated emissions Measurement Uncertainty is less than the corresponding reference value U_{cispr} in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required.

AC Mains Conducted Emissions:

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
AC Line Conducted Emissions	150 kHz - 30 MHz	2.6 dB	3.4 dB

As shown above our conducted emissions Measurement Uncertainty is less than the corresponding reference value *Ucispr* in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required.

3.0 EQUIPMENT UNDER TEST

3.1 Power Configuration

Rated voltage:	☒ 5VDC (Handle); 86.4VDC (E-Box)	☒ Other
Rated power:	8kW Max	
Rated frequency:	☐ 50Hz ☐ 60Hz	
Number of phases:	☐ 1 Phase ☐ 3 Phases	

3.2 EUT Configuration

The equipment under test was operated during the measurement under the following conditions:

☐ - Standby
☐ - Test program (H - Pattern)
☒ - Continuous Operation
☐ - Specific test program
☐ -

Operating modes of the EUT:

No.	Description
1	Continuous operation mode with E-box with chipset FCC ID: MCQ-XBEE3 and Handle with chipset FCC ID: MCQ-XBS2C. Handle is set to drive motor to maximum speed. Handle wirelessly communicates with E-box.
2	Continuous operation mode with E-box with chipset FCC ID: MCQ-XBS2C and Handle with chipset FCC ID: MCQ-XBS2C. Handle is set to drive motor to maximum speed. Handle wirelessly communicates with E-box.
3	Continuous transmit mode for spurious verification of Handle with chipset FCC ID: MCQ-XBS2C.
4	Continuous transmit mode for spurious verification for E-box with chipset FCC ID: MCQ-XBS2C

Cables:

No.	Type	Length	Designation	Note
1	None			

Support equipment/Services:

No.	Item	Description
1	None	

General notes: The EUT was setup as tabletop equipment for all tests.

3.3 Environmental conditions

During the measurement the environmental conditions were within the required ranges and shown in the test data sections

4.0 TEST CONDITIONS AND RESULTS

4.1 Line Conducted Emissions

Test result: **N/A**

Frequency range: 0.15MHz-30MHz

Max. Emissions margin: dB below the limits

Notes: It was determined from consideration of the electrical characteristics and usage of this particular apparatus that Conducted Emissions testing is inappropriate and therefore unnecessary (as EUT is battery operated equipment).

Sample Calculations

The following is how net line-conducted readings were determined:

NF = RF + LF + CF + AF

Where NF = Net Reading in dBµV
RF = Reading from receiver in dBµV
LF = LISN or ISN Correction Factor in dB
CF = Cable Correction Factor in dB
AF = Attenuator Loss Factor in dB

Example:

NF = RF + LF + CF + AF = 28.5 + 0.2 + 0.4 + 20.0 = 49.1 dBµV

4.2 Radiated Emissions

Test location:	☐ OATS	☒ Anechoic Chamber
Test distance:	☐ 10 meters	☒ 3 meters
Test result:	**Pass**	
Frequency range:		30MHz - 13GHz
Max. Emissions margin:		1.52 dB below the limits

Notes: The Radiated Emissions scan was performed in the Anechoic chamber at 3m measurement distance (see Graphs 1-12; Tables 1-5).

Transmitter fundamental frequency, harmonics, and spurious radiated emissions related with transmitting operation were excluded from the tables. No radiated emissions related with unintentional operation were detected above 1GHz.

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured emissions reading on the EMI Receiver.
The basic equation with a sample calculation is as follows:
FS = RA + AF + CF - AG

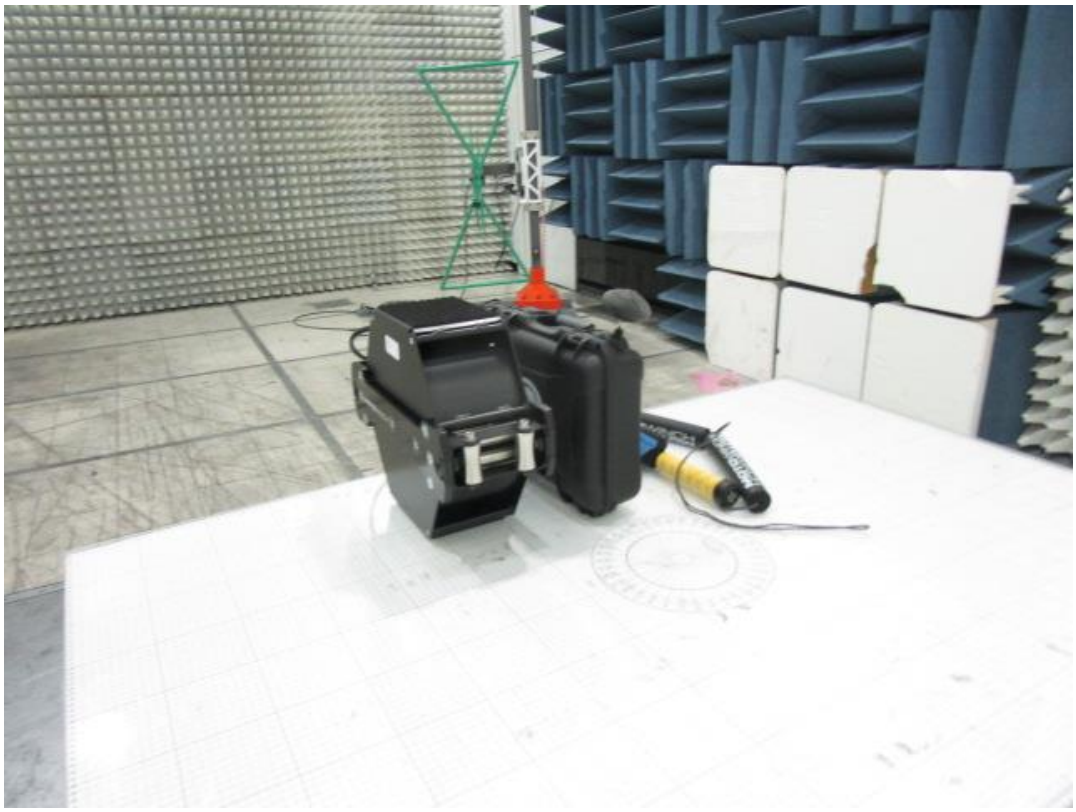
Where: FS = Field Strength in dB(µV/m)
RA = Receiver Amplitude in dB(µV)
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB(m^{-1})
AG = Amplifier Gain in dB

Assume a receiver reading of 52.0 dBµV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dBµV/m. This value in dBµV/m was converted to its corresponding level in µV/m.

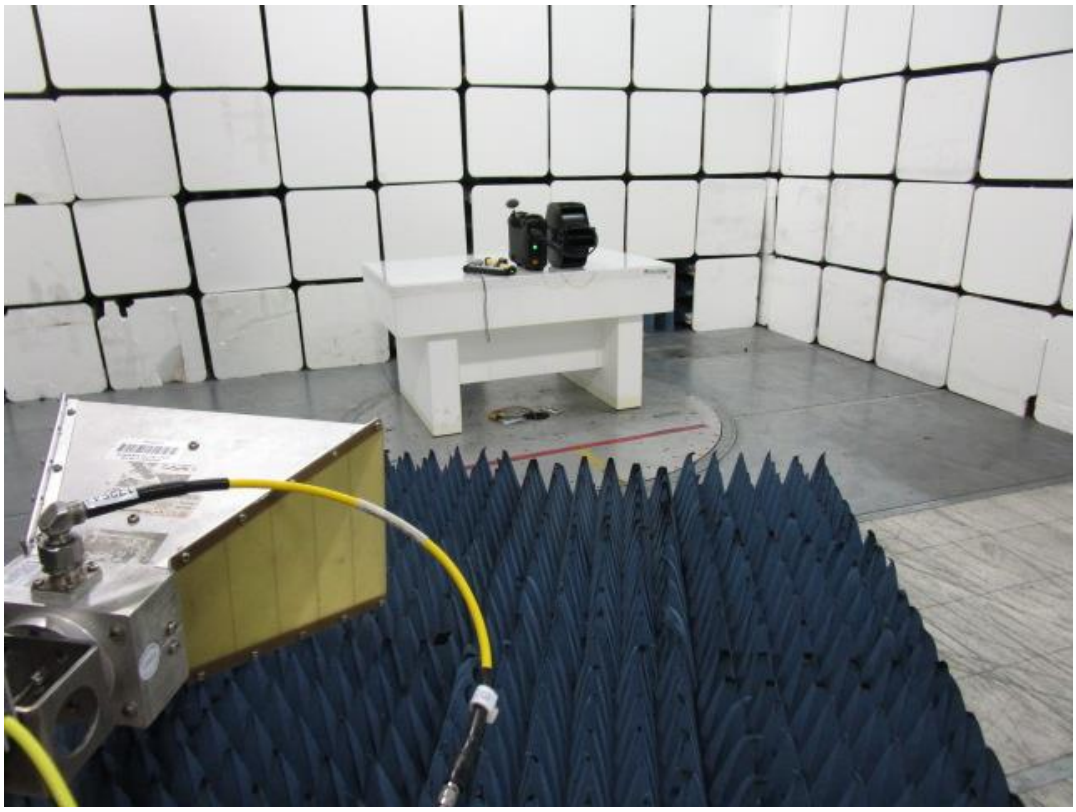
RA = 52.0 dBµV
AF = 7.4 dB/m
CF = 1.6 dB
AG = 29.0 dB
FS = 32 dBµV/m

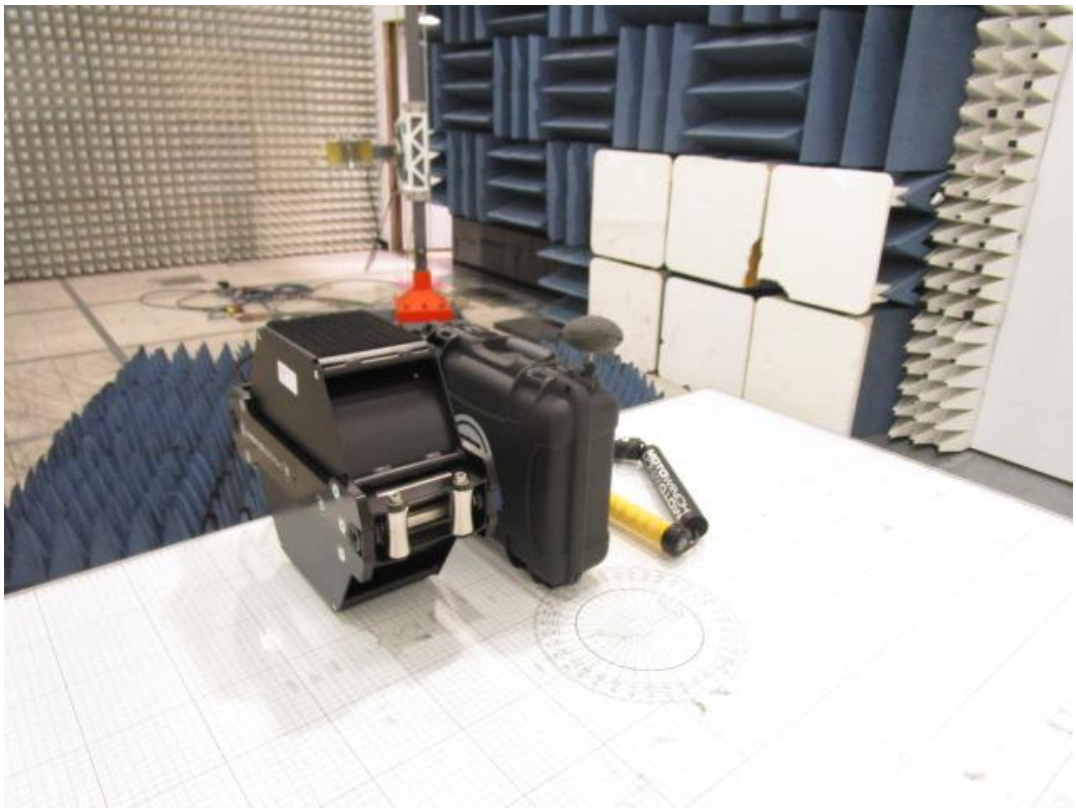
To convert from dBµV to µV or mV the following was used:
UF = $10^{(NF / 20)}$ where UF = Net Reading in µV
NF = Net Reading in dBµV

Example:
FS = RA + AF + CF – AG = 52.0 + 7.4 + 1.6 – 29.0 = 32.0
UF = $10^{(32\ dB\mu V / 20)}$ = 39.8 µV/m



Test Setup Photos





Test Setup Photos

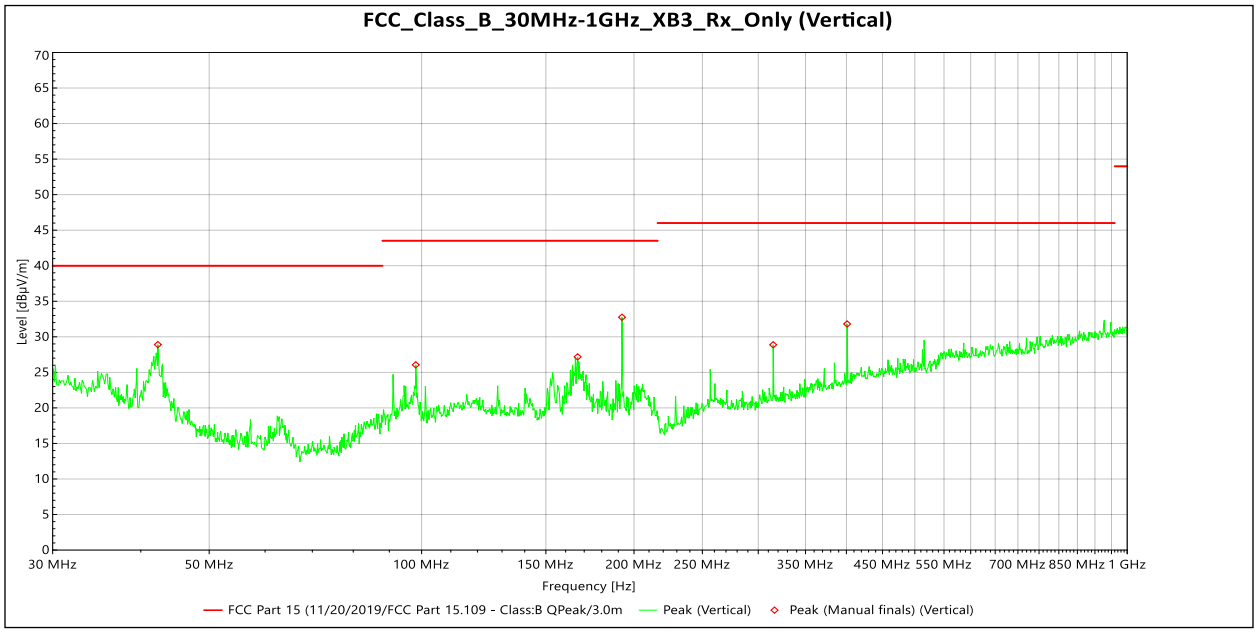
Date:	06/13/2022	**Result: Pass**
Tested by:	Peter Kutkiewicz	
Standard:	FCC Part 15.109, Class B	
Test Point:	Enclosure	
Operation mode:	See page 5	
Environmental Conditions:	23°C; 52%(RH); 97kPa	
Equipment Verification:	☒	
Note:	Analyzer Settings: RBW: 120kHz VBW: 300kHz (30MHz – 1GHz) RBW: 1MHz VBW: 3MHz (1GHz – 13GHz) Configuration: MCQ-XBEE3 (E-Box) and MCQ-XBS2C (Handle) 30MHz – 13GHz Fundamental frequency of 2.41GHz was removed from this test data.	

Table 1

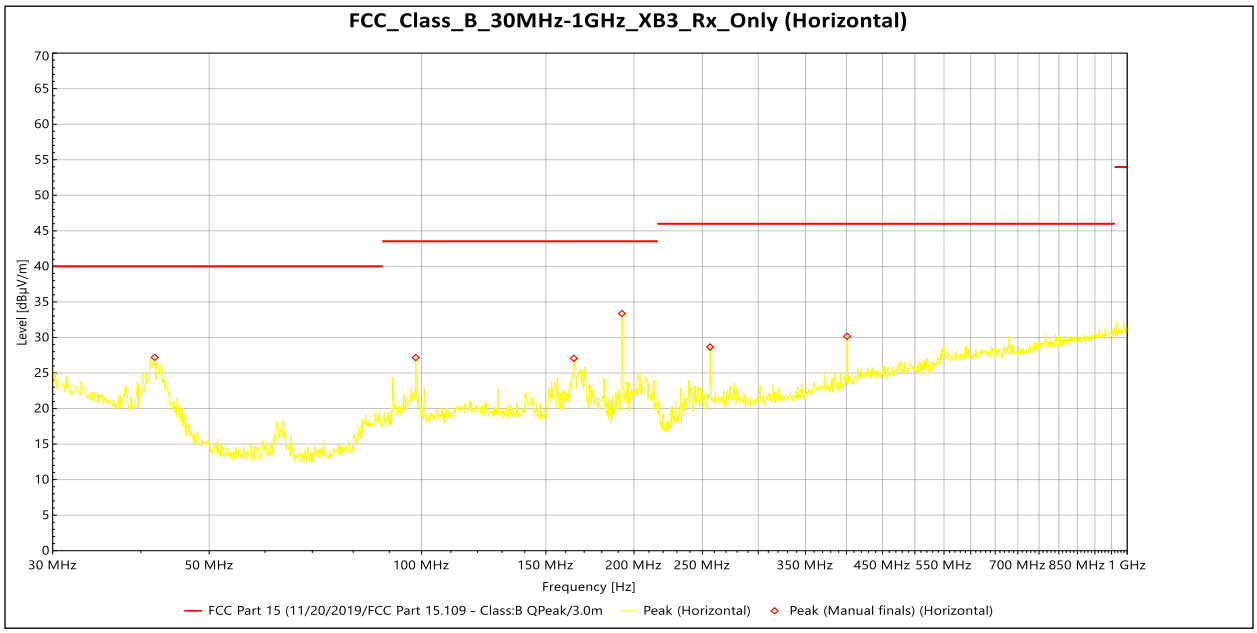
Frequency	Pol.	Height (m)	Total Correction (dB)	Total Peak Level (dBµV/m)	QP Limit (dBµV/m)	Margin (dB)
42.28 MHz	Vertical	1.00	16.78	28.90	40.00	-11.09
98.11 MHz	Vertical	2.00	15.66	26.05	43.52	-17.46
166.39 MHz	Vertical	2.00	15.28	27.17	43.52	-16.34
192.31 MHz	Vertical	2.00	14.51	32.75	43.52	-10.77
314.96 MHz	Vertical	1.00	19.38	28.88	46.00	-17.11
400.91 MHz	Vertical	3.00	21.78	31.80	46.00	-14.19
41.85 MHz	Horizontal	4.00	17.00	27.20	40.00	-12.79
98.11 MHz	Horizontal	3.00	15.66	27.15	43.52	-16.36
164.34 MHz	Horizontal	1.00	15.31	27.06	43.52	-16.46
192.31 MHz	Horizontal	1.00	14.51	33.36	43.52	-10.15
256.38 MHz	Horizontal	1.00	18.85	28.64	46.00	-17.35
400.86 MHz	Horizontal	1.00	21.78	30.15	46.00	-15.84

Table 2

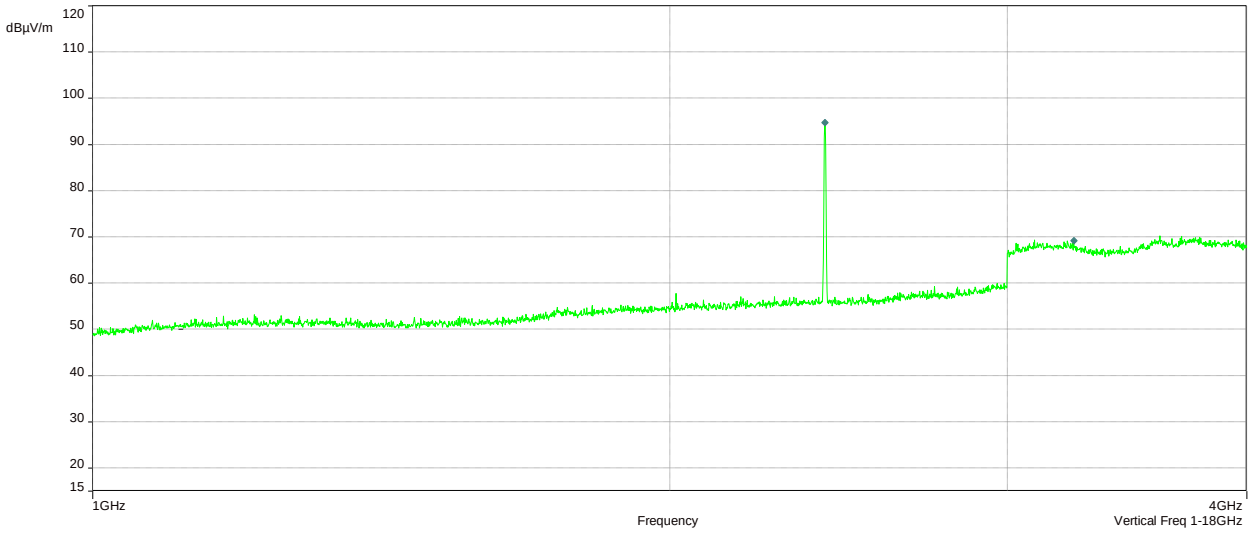
Frequency	Pol.	Height (cm)	Total Correction (dB)	Total Reading (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Type of Reading
1500 MHz	V	100	29.44	50.64	74.00	-23.36	Peak
1500 MHz	V	100	29.44	39.00	54.00	-15.00	Average
2900 MHz	V	100	35.54	57.68	74.00	-16.32	Peak
2900 MHz	V	100	35.54	47.50	54.00	-6.50	Average
3500 MHz	V	100	37.61	66.55	74.00	-7.45	Peak
3500 MHz	V	100	37.61	50.30	54.00	-3.70	Average
1500 MHz	H	100	29.44	50.49	74.00	-23.52	Peak
1500 MHz	H	100	29.44	39.00	54.00	-15.00	Average
2900 MHz	H	100	35.54	57.24	74.00	-16.76	Peak
2900 MHz	H	100	35.54	47.50	54.00	-6.50	Average
3500 MHz	H	100	37.61	65.99	74.00	-8.01	Peak
3500 MHz	H	100	37.61	50.30	54.00	-3.70	Average



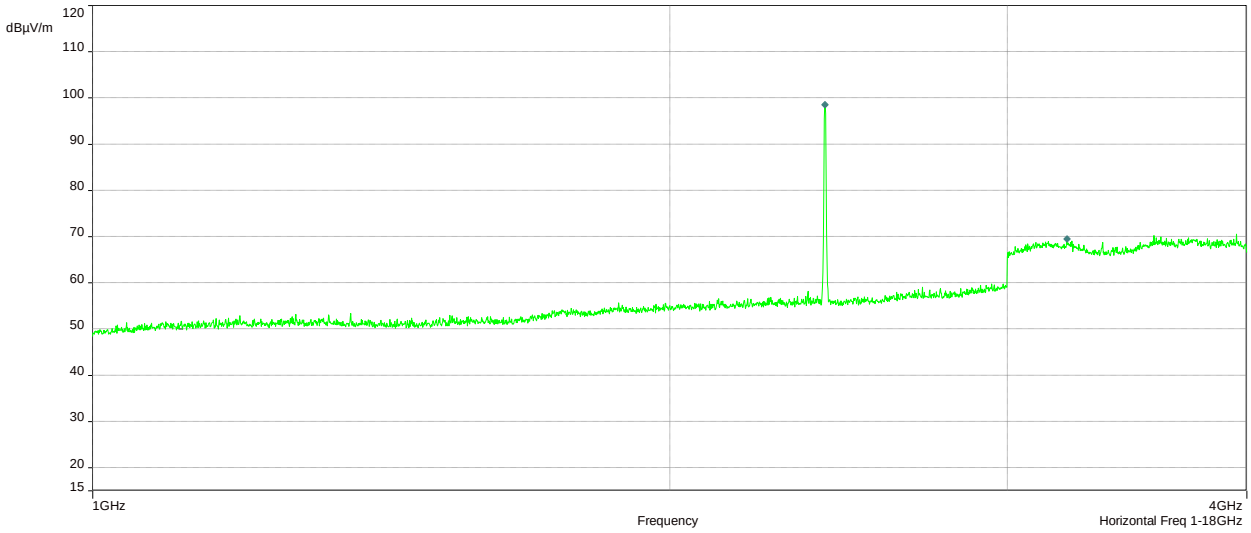
Graph 1 (Peak Readings)



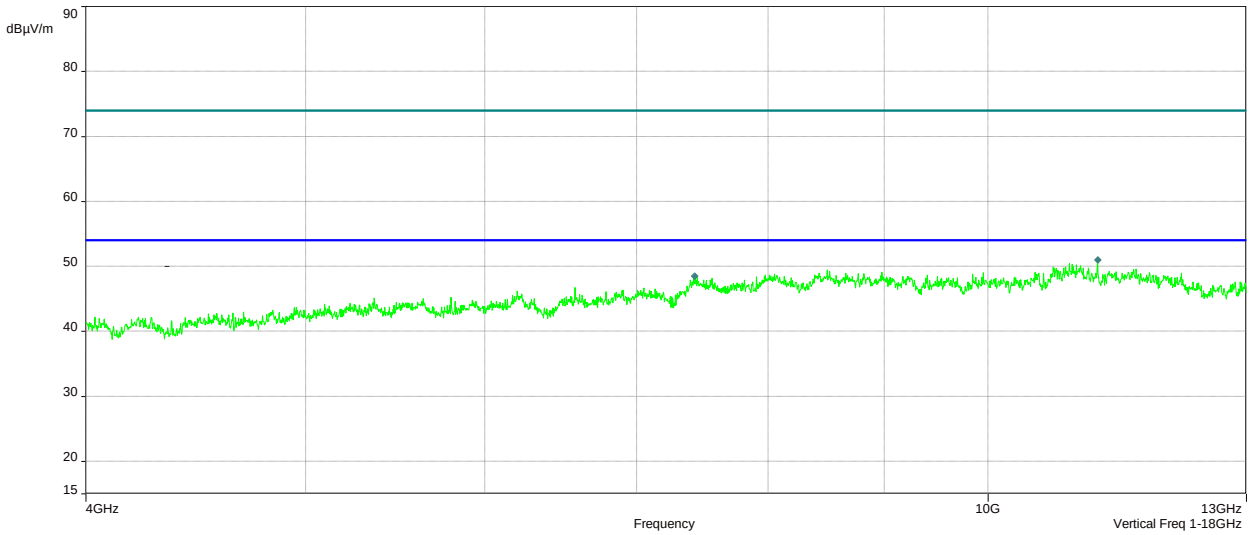
Graph 2 (Peak Readings)



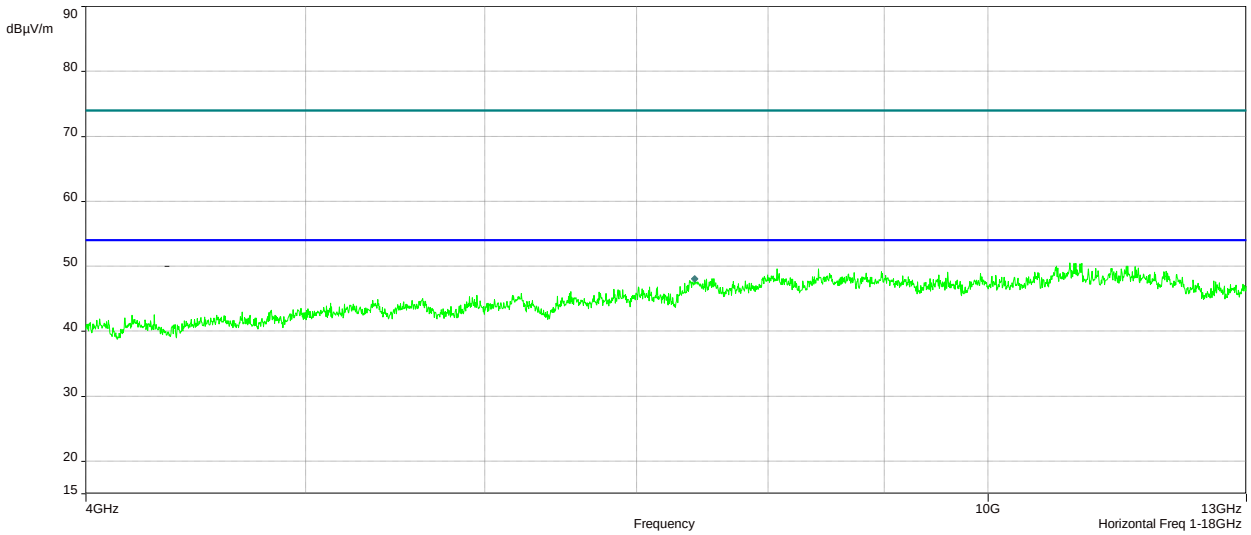
Graph 3 (Peak Readings)



Graph 4 (Peak Readings)



Graph 5 (Peak Readings)



Graph 6 (Peak Readings)

Date:	06/13/2022	**Result: Pass**
Tested by:	Peter Kutkiewicz	
Standard:	FCC Part 15.109, Class B	
Test Point:	Enclosure	
Operation mode:	See page 5	
Environmental Conditions:	23°C; 52%(RH); 97kPa	
Equipment Verification:	☒	
Note:	Analyzer Settings: RBW: 120kHz VBW: 300kHz Configuration: MCQ-XBS2C (E-Box) and MCQ-XBS2C (Handle) 30MHz – 1GHz Fundamental frequency of 2.41GHz was removed from this test data.	

Table 3

Frequency	Polarization	Height (m)	Total Correction (dB)	Total QP Level (dBµV/m)	QP Limit (dBµV/m)	Margin (dB)
44.14 MHz	Vertical	1.03	15.86	36.794	40	-3.21
43.94 MHz	Horizontal	3.56	15.96	38.476	40	-1.52

Table 4

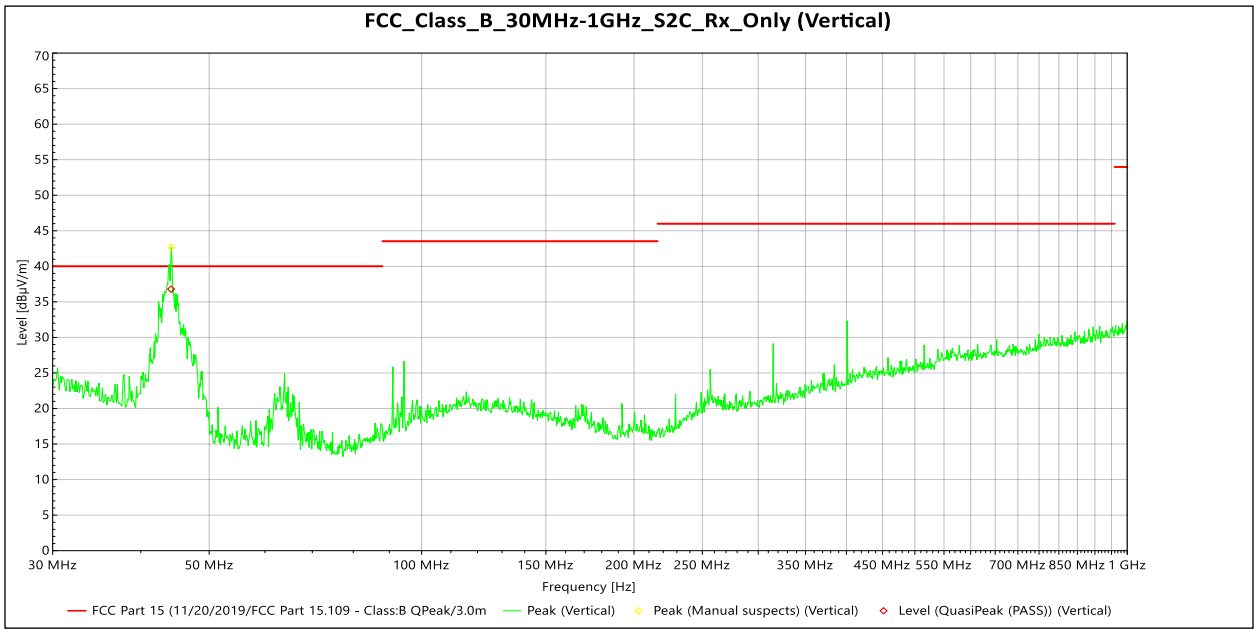
Frequency	Polarization	Height (m)	Correction (dB)	Total Peak Level (dBµV/m)	QP Limit (dBµV/m)	Margin (dB)
63.95 MHz	Vertical	4	11.16	24.9	40	-15.1
91.05 MHz	Vertical	3	14.32	25.87	43.52	-17.65
94.45 MHz	Vertical	1.01	14.97	26.69	43.52	-16.83
315.01 MHz	Vertical	1.01	19.38	29.14	46	-16.86
400.86 MHz	Vertical	3	21.78	32.37	46	-13.63
62.22 MHz	Horizontal	3	11.15	25.63	40	-14.37
91.11 MHz	Horizontal	3	14.33	27.07	43.52	-16.45
168.44 MHz	Horizontal	2	15.23	29.02	43.52	-14.5
192.25 MHz	Horizontal	1	14.51	29.29	43.52	-14.23
256.38 MHz	Horizontal	1	18.85	29.44	46	-16.56

Notes: Quasi-peak readings are shown in Table 3; Peak readings are shown in Table 4;

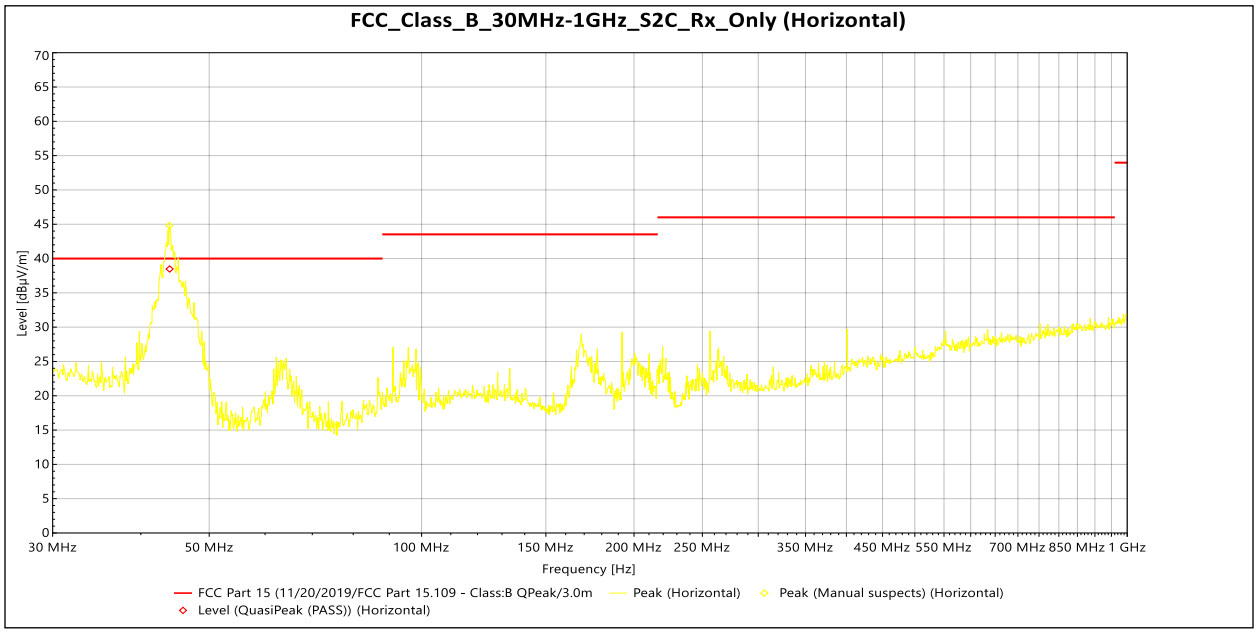
Date:	06/13/2022	**Result: Pass**
Tested by:	Peter Kutkiewicz	
Standard:	FCC Part 15.109, Class B	
Test Point:	Enclosure	
Operation mode:	See page 5	
Environmental Conditions:	23°C; 52%(RH); 97kPa	
Equipment Verification:	☒	
Note:	Analyzer Settings: RBW: 1MHz VBW: 3MHz Configuration: MCQ-XBS2C (E-Box) and MCQ-XBS2C (Handle) 1GHz – 13GHz Fundamental frequency of 2.41GHz was removed from this test data.	

Table 5

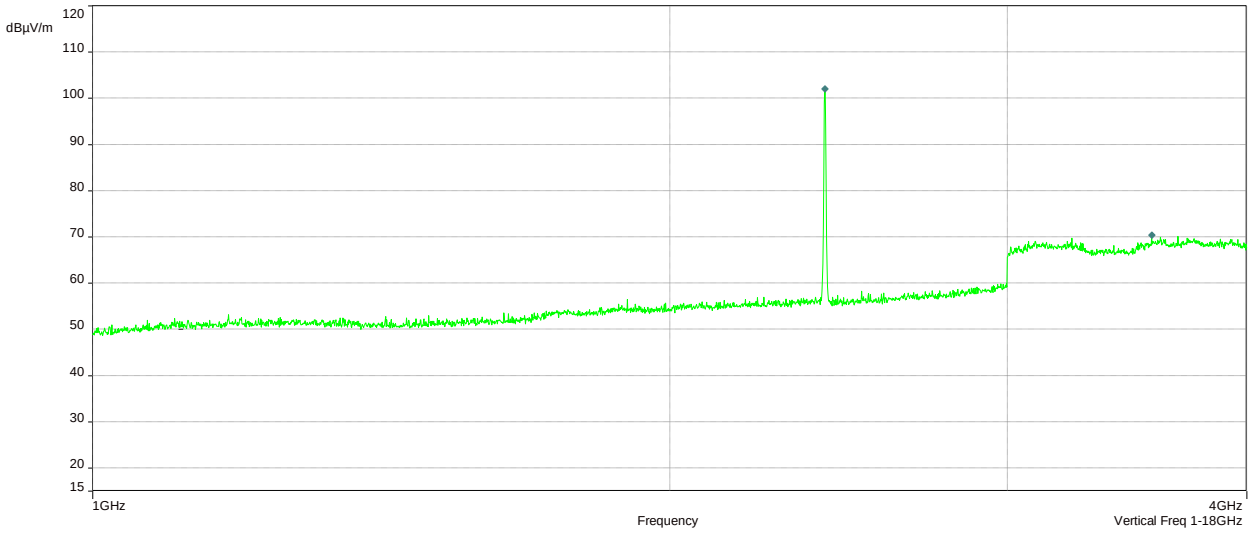
Frequency	Pol.	Height (cm)	Total Correction (dB)	Total Reading (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Type of Reading
1500 MHz	V	100	29.44	50.45	74.00	-23.55	Peak
1500 MHz	V	100	29.44	39.00	54.00	-15.00	Average
2900 MHz	V	100	35.54	57.79	74.00	-16.21	Peak
2900 MHz	V	100	35.54	47.50	54.00	-6.50	Average
3500 MHz	V	100	37.61	66.32	74.00	-7.68	Peak
3500 MHz	V	100	37.61	50.30	54.00	-3.70	Average
1500 MHz	H	100	29.44	51.11	74.00	-22.89	Peak
1500 MHz	H	100	29.44	39.00	54.00	-15.00	Average
2900 MHz	H	100	35.54	57.82	74.00	-16.18	Peak
2900 MHz	H	100	35.54	47.50	54.00	-6.50	Average
3500 MHz	H	100	37.61	65.64	74.00	-8.36	Peak
3500 MHz	H	100	37.61	50.30	54.00	-3.70	Average



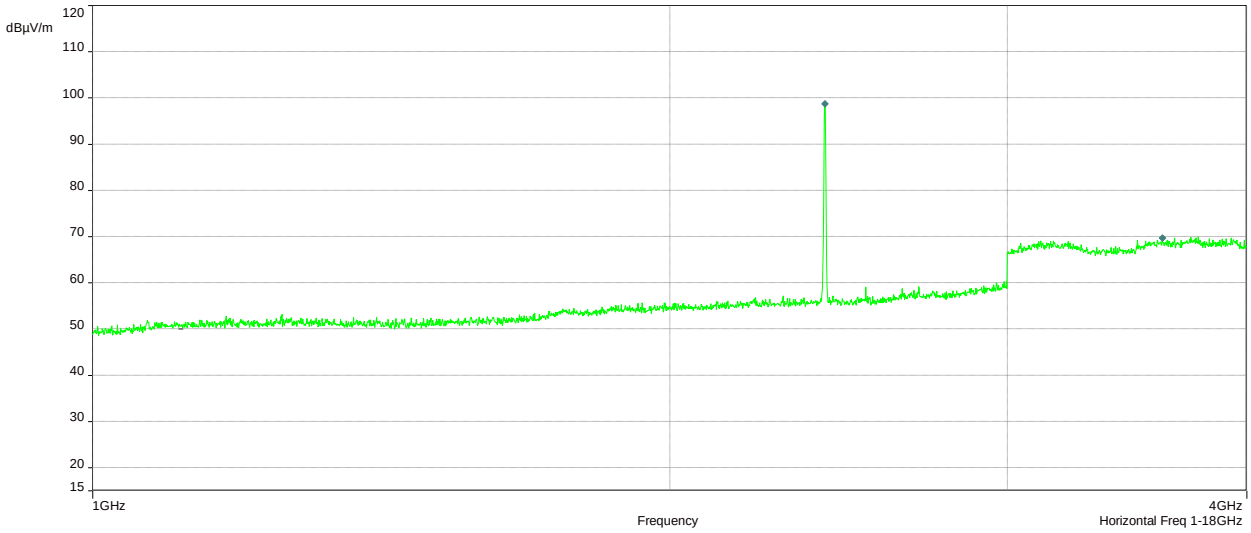
Graph 7 (Peak Readings)



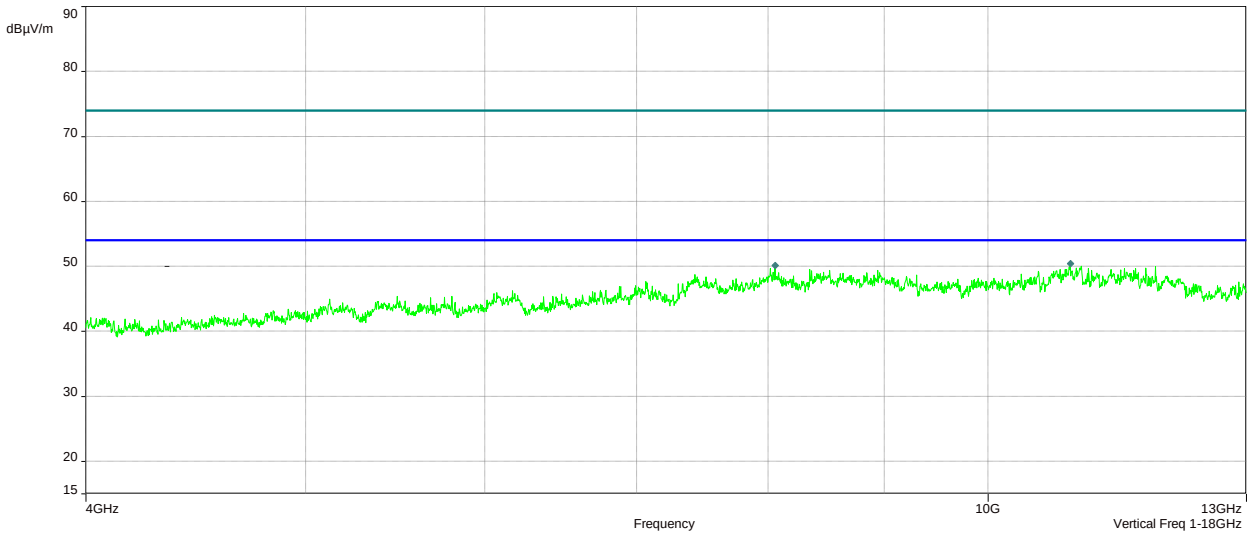
Graph 8 (Peak Readings)



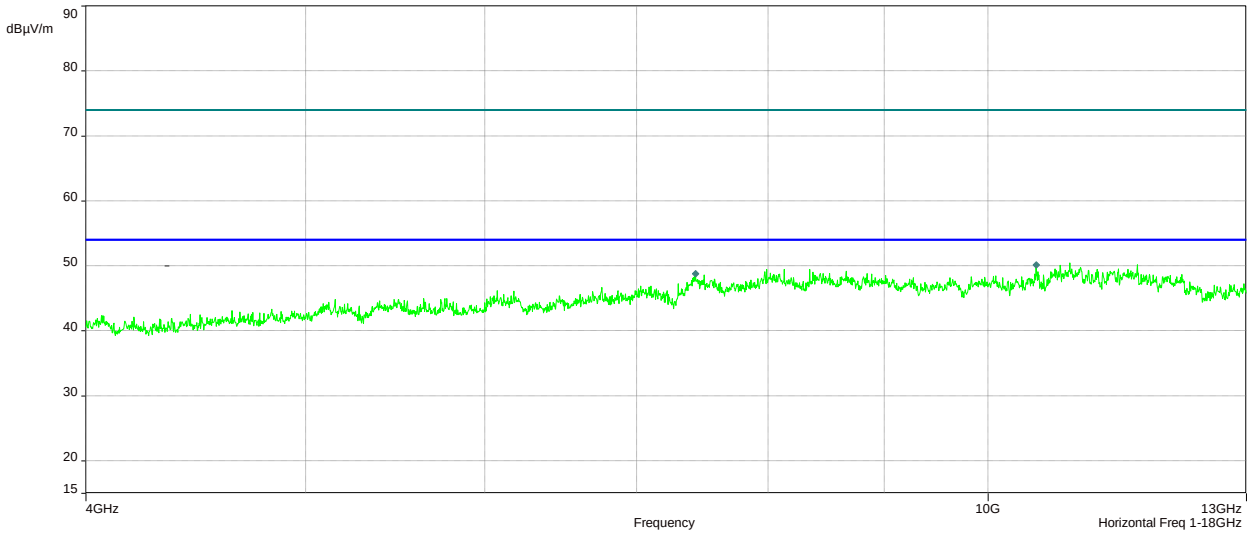
Graph 9 (Peak Readings)



Graph 10 (Peak Readings)



Graph 11 (Peak Readings)



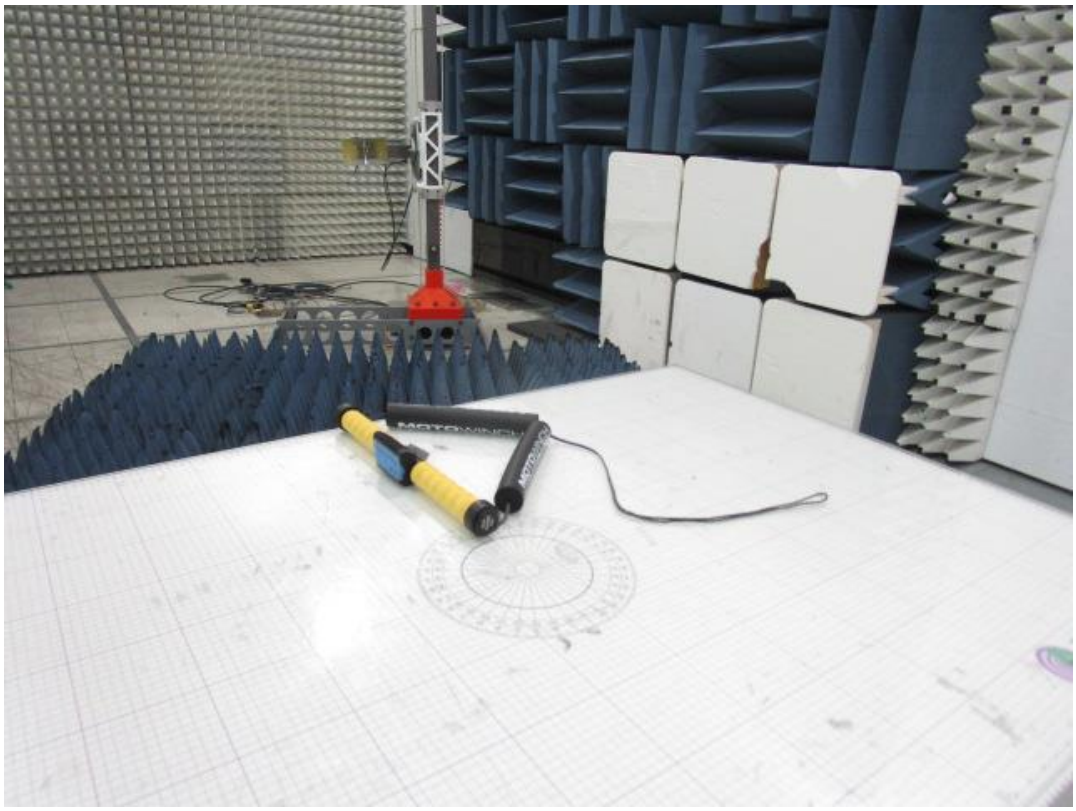
Graph 12 (Peak Readings)

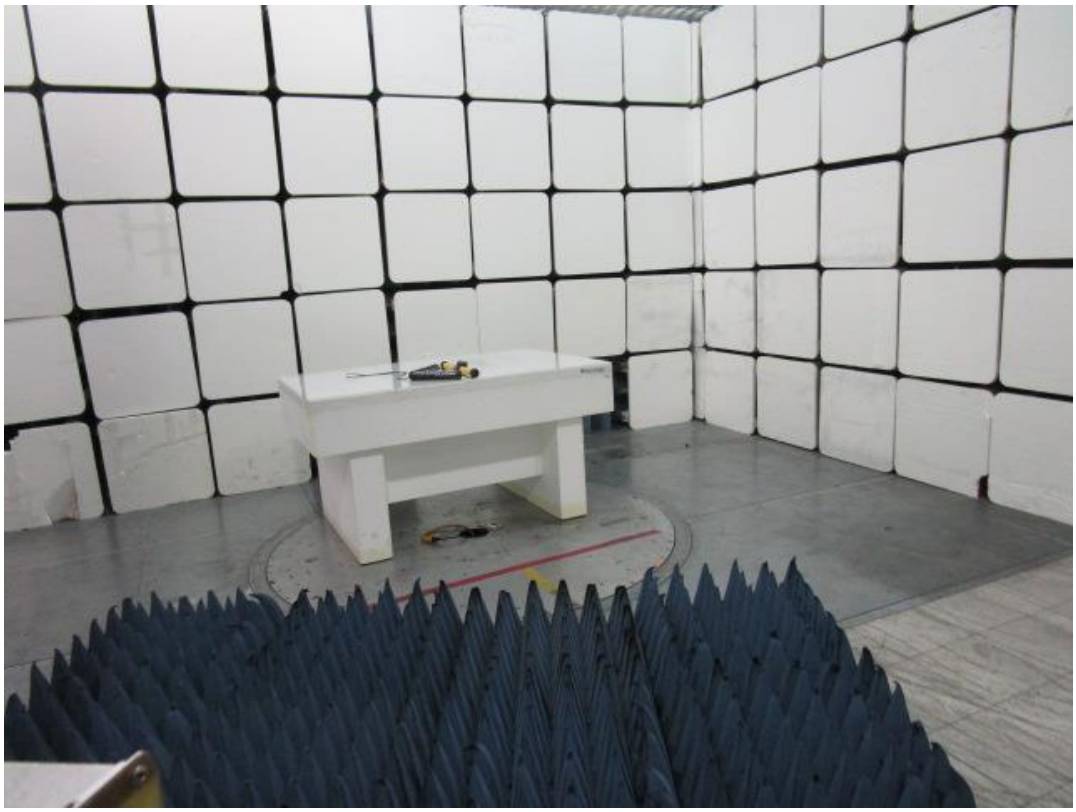
4.2.1 Host Device with Incorporated RF Module Radiated Emissions

Scope of testing:	FCC 15.209 / KDB 996369 D04 v02
Test result:	**Complied**
Frequency range:	1-26.5GHz
Host Units:	Bearaxe Handle and E-Box
Test Engineer:	Peter Kutkiewicz
Date(s) of Measurements:	June 14, 2022

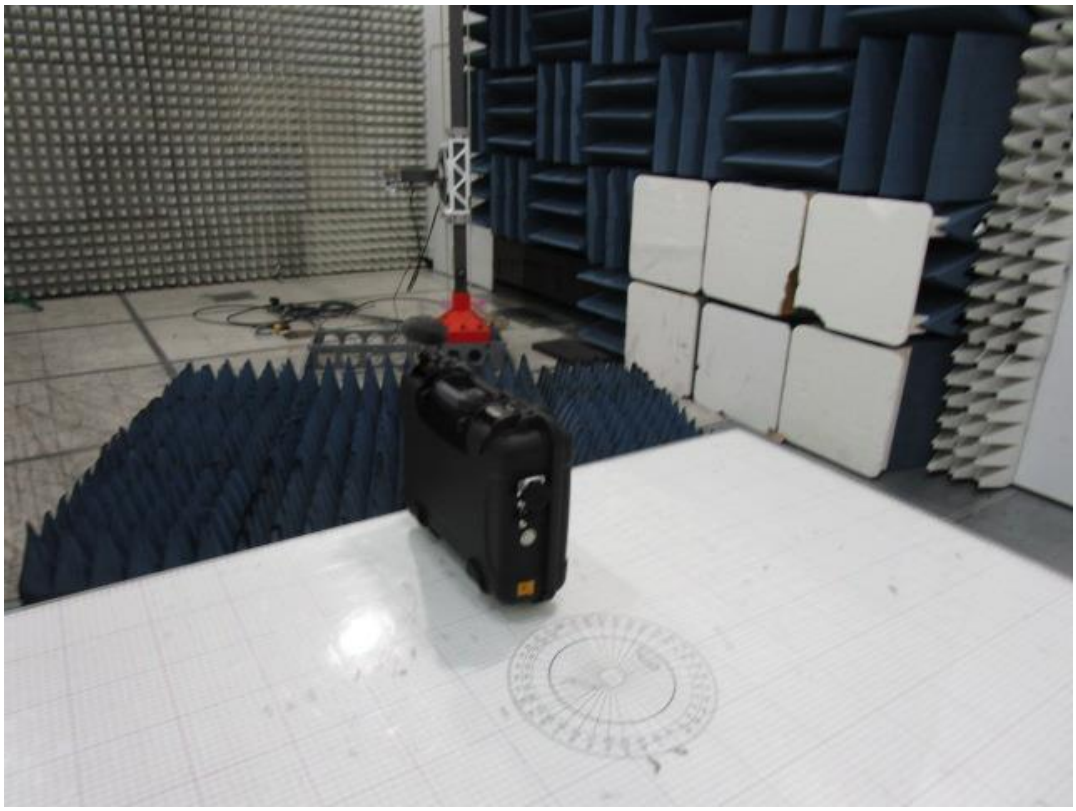
Notes:

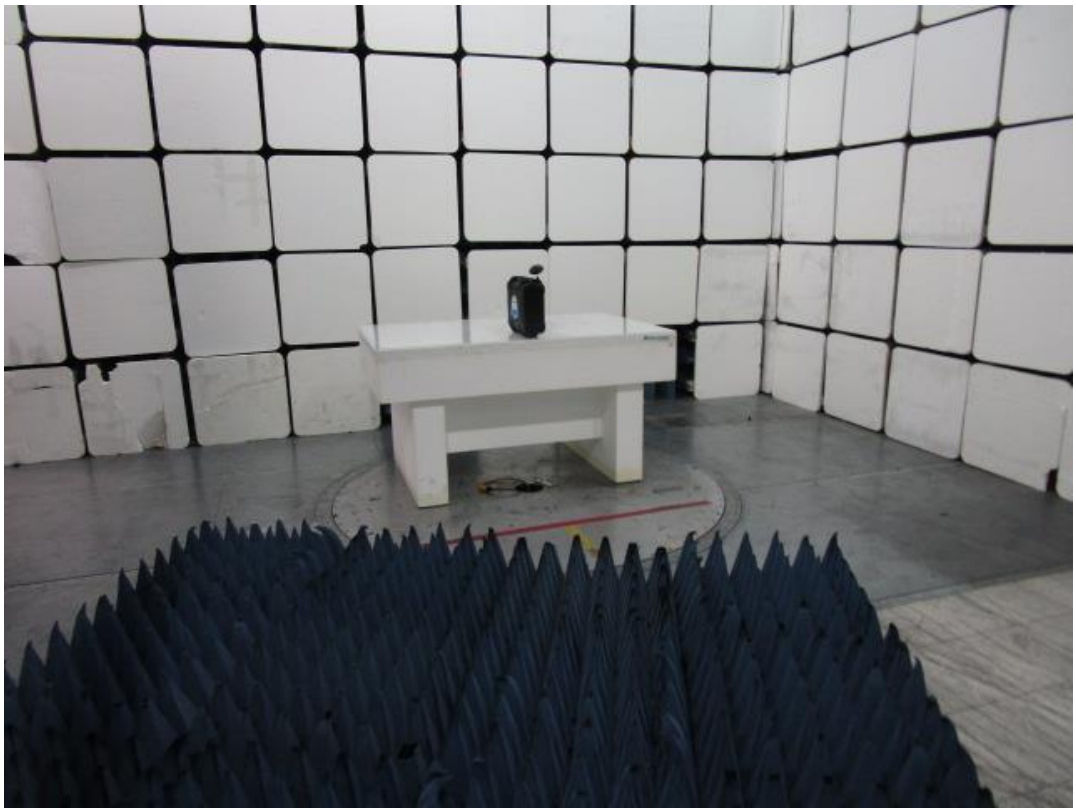
1. Radiated Spurious Emissions and Harmonics Emissions verification in the frequency range 1-26.5GHz was performed on the Host Units with the RF Modules in normal operation. The fundamental frequencies were excluded from measurement.
2. No RF external pre-amp and RF Filter were used in the range 1-4GHz; RF external pre-amp and high pass RF filter were used in the range above 4GHz.
3. No radiated spurious emissions were detected in the frequency range of 1-26.5GHz (see graphs 13-18 for E-box and graphs 19-24 for Handle).
4. Analyzer Settings: RBW: 1MHz, VBW: 3MHz



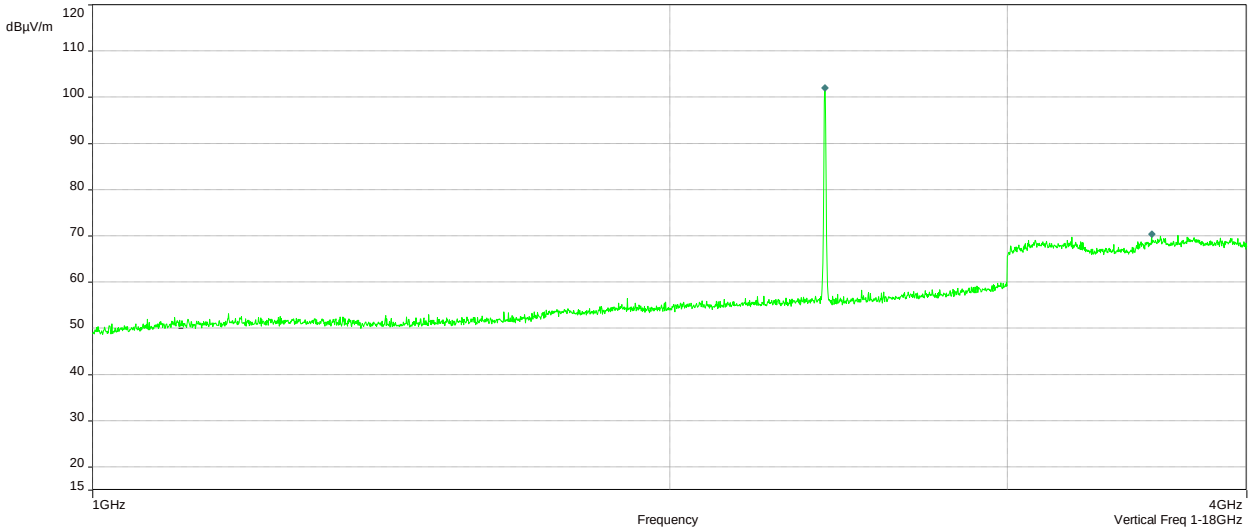


Test Setup Photos

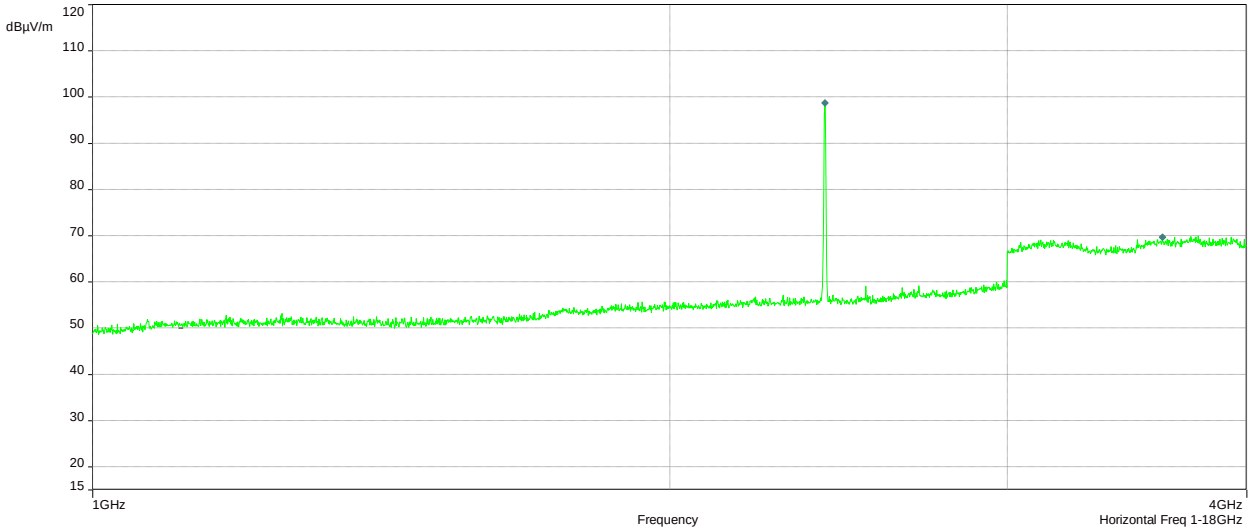




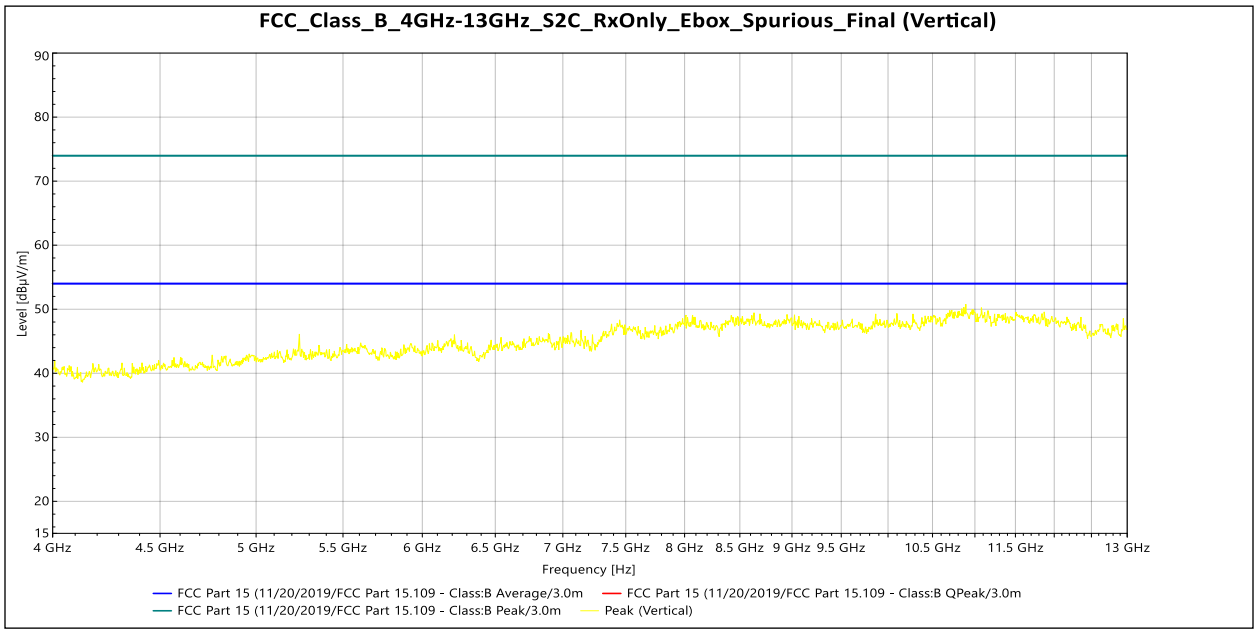
Test Setup Photos



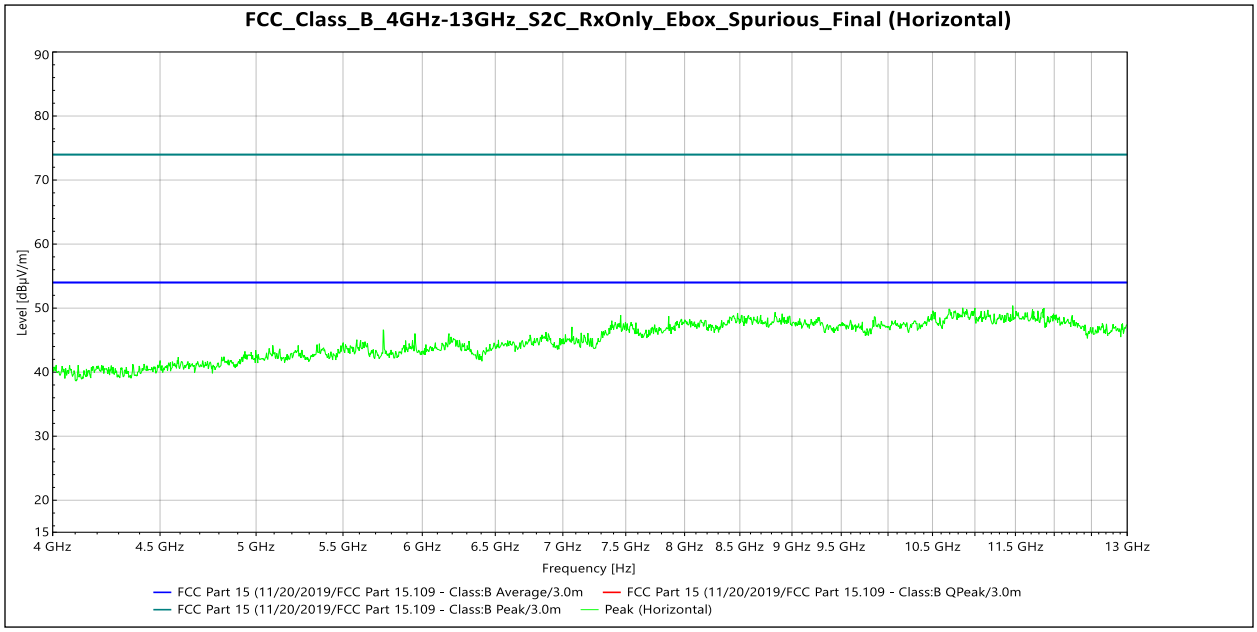
Graph 13 (Peak Readings)



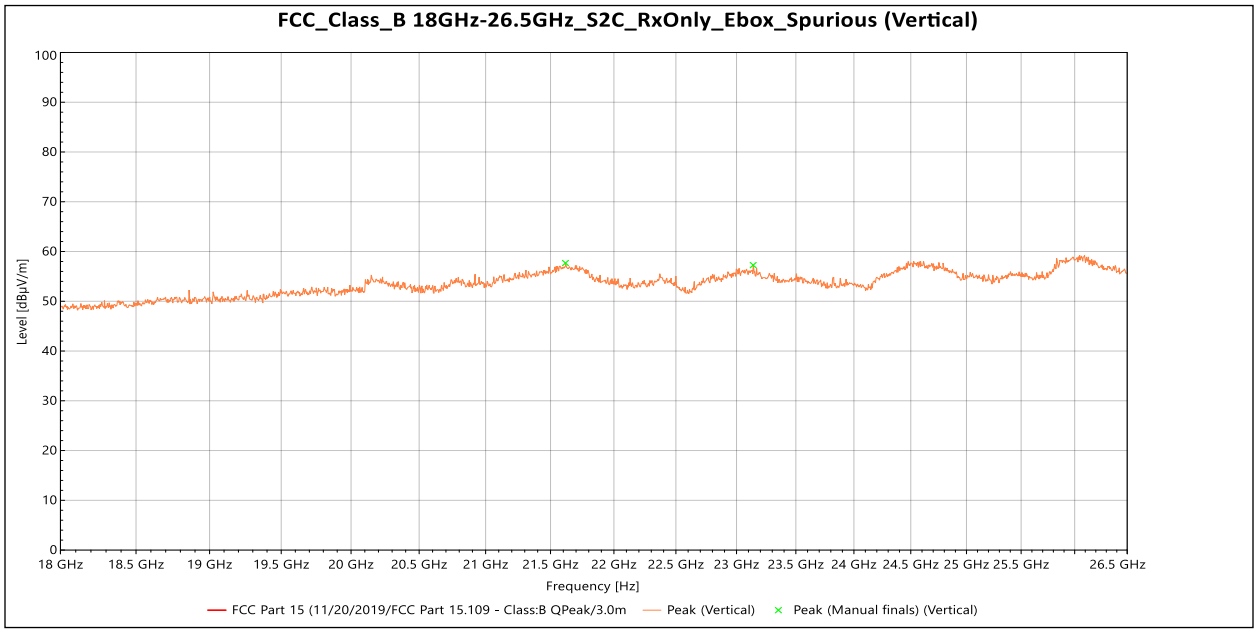
Graph 14 (Peak Readings)



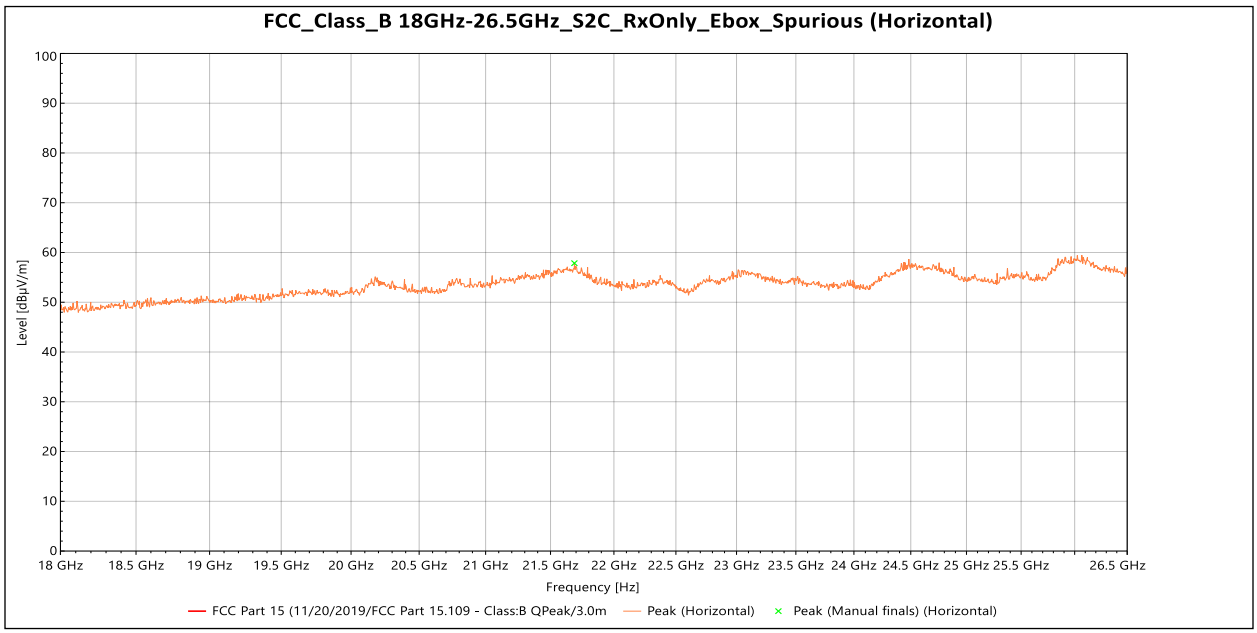
Graph 15 (Peak Readings)



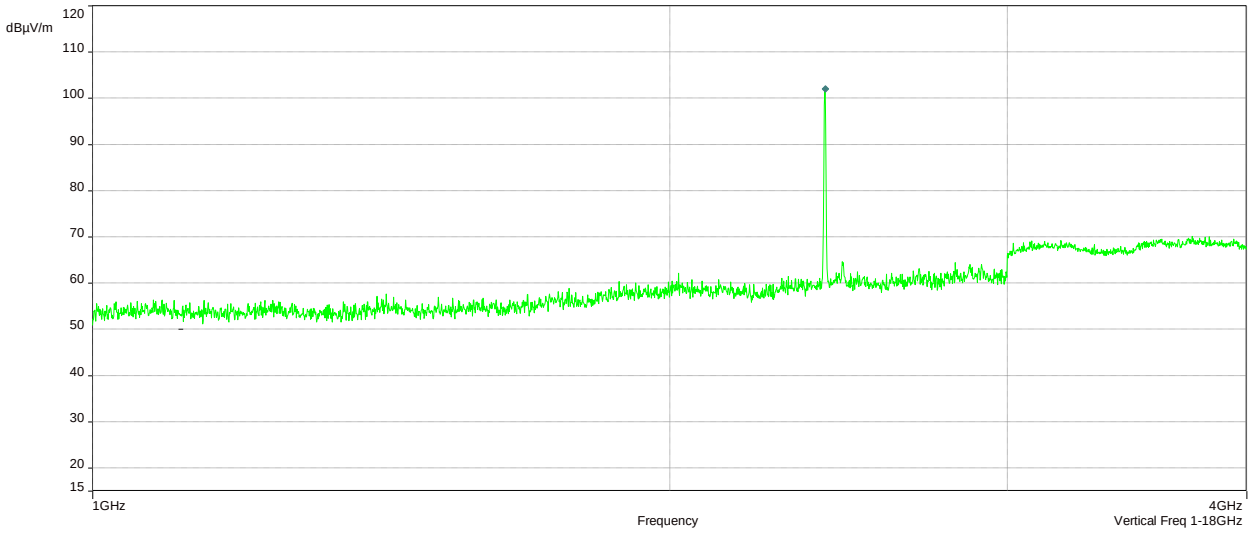
Graph 16 (Peak Readings)



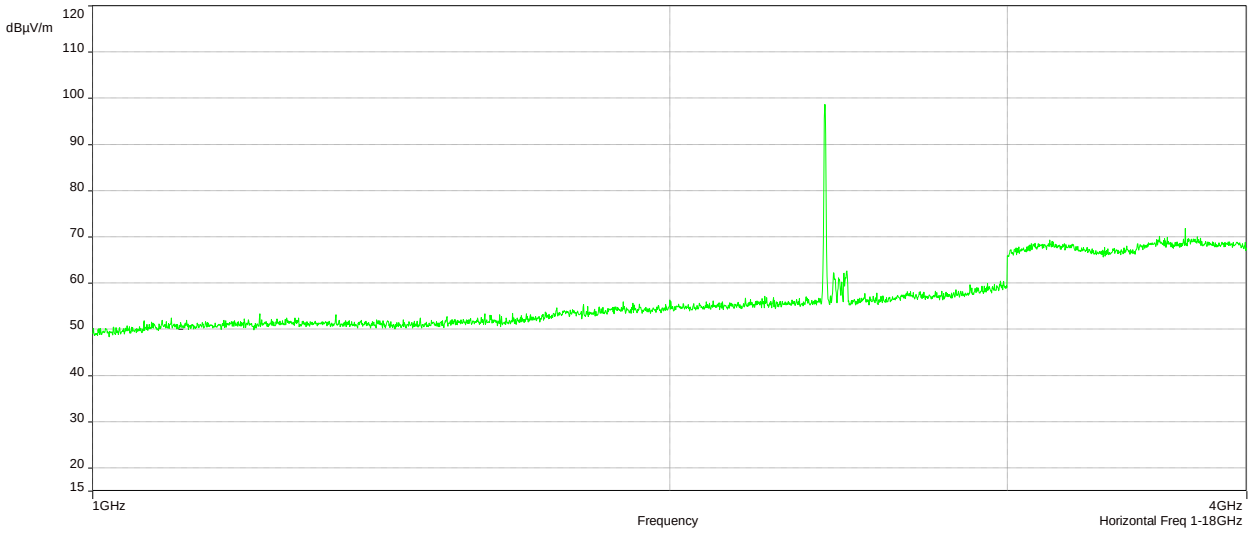
Graph 17 (Peak Readings)



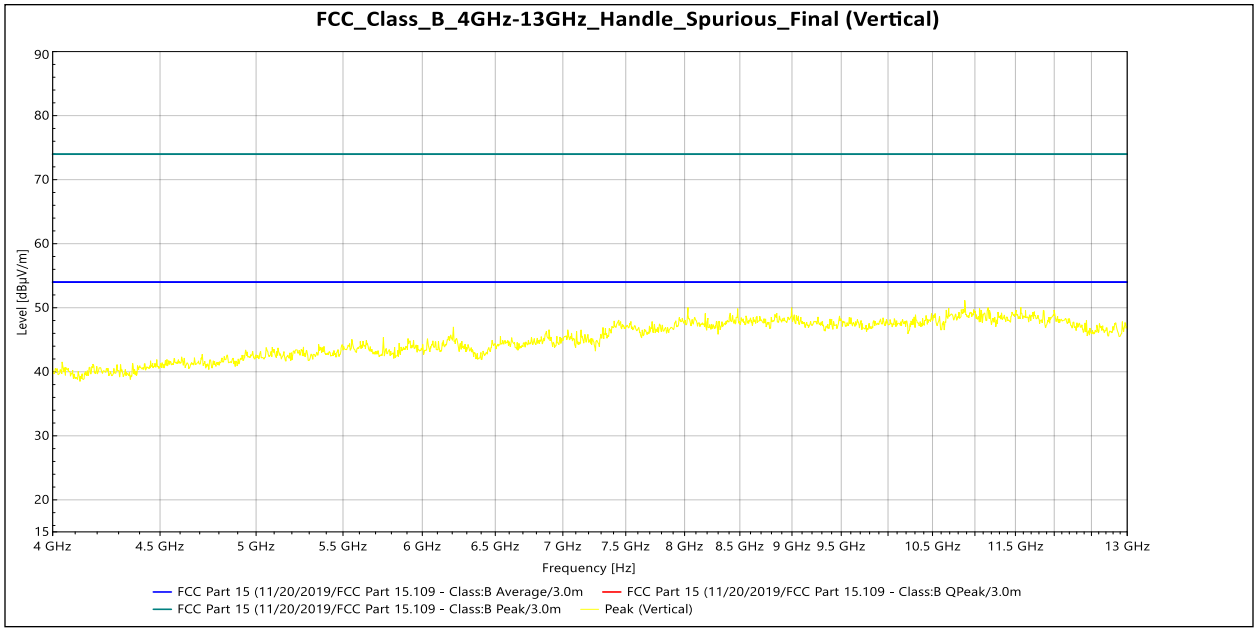
Graph 18 (Peak Readings)



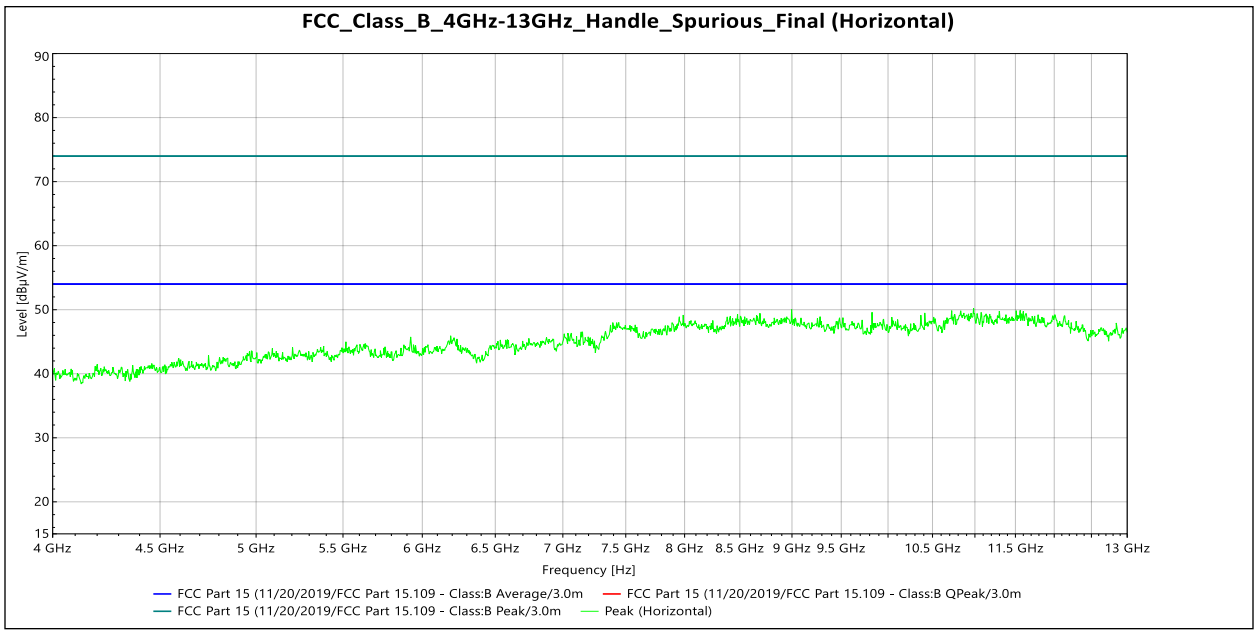
Graph 19 (Peak Readings)



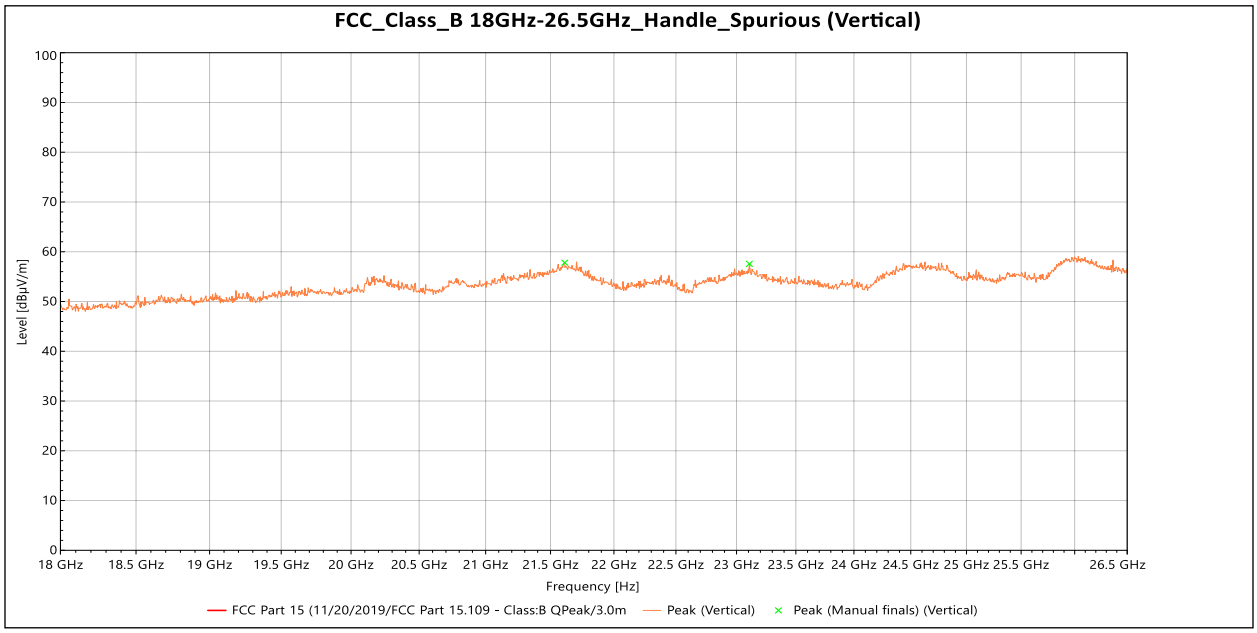
Graph 20 (Peak Readings)



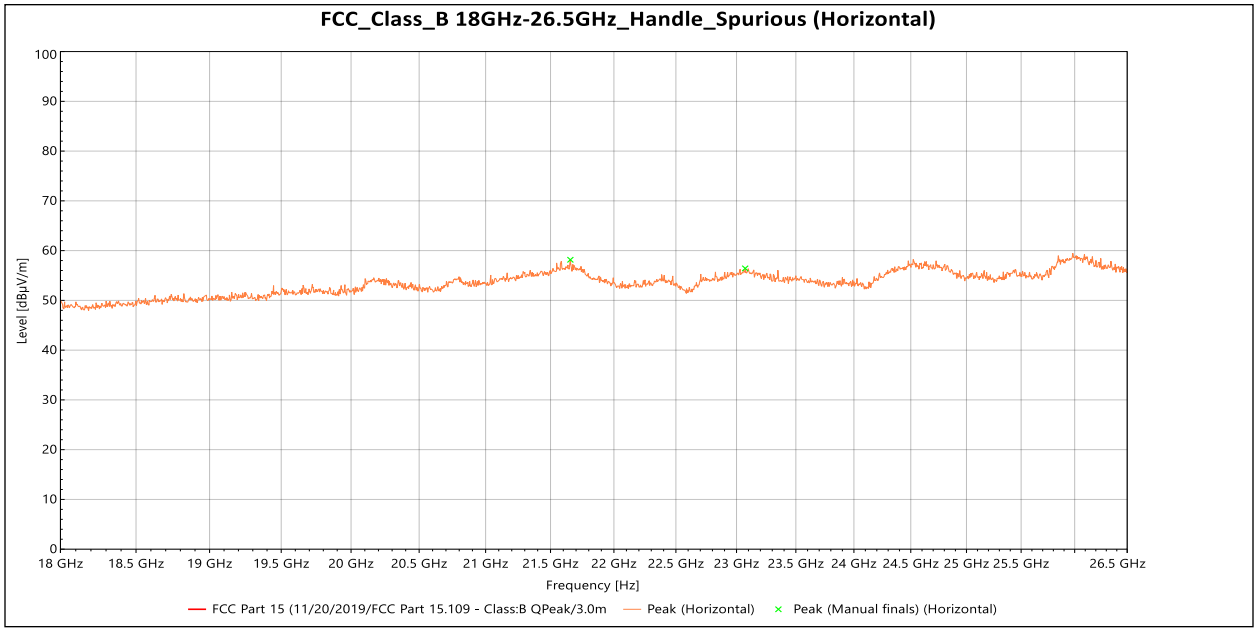
Graph 21 (Peak Readings)



Graph 22 (Peak Readings)



Graph 23 (Peak Readings)

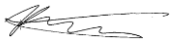


Graph 24 (Peak Readings)

5.0 TEST EQUIPMENT

DESCRIPTION	MANUFACTURER	MODEL	SERIAL NO.	INTERTEK ID	LAST CAL DATE	CAL DUE
Spectrum Analyzer	R & S	ESU	100398	25283	04/20/2022	04/20/2023
Spectrum Analyzer	R & S	FSP 40	100024	12559	02/16/2022	02/16/2023
Bicono-Log Antenna	Teseq	CBL6112D	32859	25289	05/03/2022	05/03/2023
Chamber HF Cable	Insulated Wire Inc.	KPS-1571-3600-KPS		172516-1	04/20/2022	04/20/2023
Horn Antenna	EMCO	3115	9507-4513	9936	04/22/2022	04/22/2023
Waveguide Horn Antenna	EMCO	3116	9904-2423	9705	01/25/2022	01/25/2023
High Pass Filter	Reactel	9HS-4G/24-S12	20-01	172538	04/20/2022	04/20/2023
Chamber RE Cable	Coleman	RG214/U M17/164-00001		172505	04/20/2022	04/20/2023
Pre-Amplifier	MITEQ	AMF-5D-00501800-28-13P	1402232	172081	04/20/2022	04/20/2023
Pre-Amplifier	MITEQ	AMF-6F-16002600-25-10P	1222383	MIN-0065	01/25/2022	01/25/2023
System	Nexio Inc.	BAT-EMC	Ver. 3.17.0.21	172Nexio	VBU	VBU

6.0 Revision History

REVISION LEVEL	DATE	REPORT NUMBER	PREPARED	REVIEWED	NOTES
0	06-29-2022	105081748MIN-001	PK	US	Original Issue
1	06-30-2022	105081748MIN-001	PK 	US 	Added Peak and Average readings for 1-4GHz measurements; adjusted table numbers
2	09-15-2022	105081748MIN-001	PK 	US 	Corrected FCC IDs from MCQ-XBEE-3 to MCQ-XBEE3 Corrected MCQ-PS2C to MCQ-XBS2C
3	09-15-2022	105081748MIN-001	PK 	US 	Corrected MCQ-PS2C to MCQ-XBS2C on page 5