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CERTIFICATION TEST REPORT

Manufacturer: SEAL Innovation, Inc.
3801 Computer Drive, Suite 201
Raleigh, North Carolina 27609 USA

Applicant: Same as Above

Product Name: SEAL SwimSafe 2.0 Band

Product Description: Sensor that communicates to a base station (hub) in a swim safety monitoring system.

Model: SB200

FCC ID: 2AFCI-SB200

Testing Commenced: July 30, 2019

Testing Ended: Oct. 1, 2019

Summary of Test Results: **In Compliance**

The EUT complies with the EMC requirements when manufactured identically as the unit tested in this report, including any required modifications and/or manufacturer's statement. Any changes to the design or build of this unit subsequent to this testing may deem it non-compliant.

Standards:

- **FCC Part 15 Subpart C, Section 15.247**
- **FCC Part 15.31(e)**
- **ANSI C63.10:2013**



Order Number: F2P18946E

Applicant: SEAL Innovation, Inc.

Model: SB200

Evaluation Conducted by:

Julius Chiller, EMC/Wireless Engineer

Report Reviewed by:

Ken Littell, Director of EMC & Wireless Operations

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1 ADMINISTRATIVE INFORMATION

1.1 Measurement Location:

F2 Labs in Middlefield, Ohio. Site description and attenuation data are on file with the FCC's Sampling and Measurement Branch at the FCC Laboratory in Columbia, MD.

1.2 Measurement Procedure:

All measurements were performed according to the 2013 version of ANSI C63.10 and recommended FCC procedure of measurement of DTS operating under Section 15.247 and in KDB558074. A list of the measurement equipment can be found in Section 6.

1.3 Uncertainty Budget:

The uncertainty in EMC measurements arises from several factors which affect the results, some associated with environmental conditions in the measurement room, the test equipment being used, and the measurement techniques adopted.

The measurement uncertainty budgets detailed below are calculated from the test and calibration data and are expressed with a 95% confidence factor. Note: Only measurements listed below which relate to tests included in this Test Report are applicable to it.

Measurement Range	Expanded Uncertainty	Combined Uncertainty
Radiated Emissions <1 GHz @ 3m	$\pm 5.07\text{dB}$	± 2.54
Radiated Emissions <1 GHz @10m	$\pm 5.09\text{dB}$	± 2.55
Radiated Emissions 1 GHz to 2.7 GHz	$\pm 3.62\text{dB}$	± 1.81
Radiated Emissions 2.7 GHz to 18 GHz	$\pm 3.10\text{dB}$	± 1.55
AC Power Line Conducted Emissions, 150kHz to 30 MHz	$\pm 2.76\text{dB}$	± 1.38

This Uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k=2$.

1.4 Document History

Document Number	Description	Issue Date	Approved By
F2P18946E-01E	First Issue	Aug. 19, 2019	K. Littell

**2 SUMMARY OF TEST RESULTS**

Test Name	Standard(s)	Results
Occupied Bandwidth	CFR 47 Part 15.247(a)(2) / KDB558074	Complies
Conducted Output Power	CFR 47 Part 15.247(b)(3) / KDB558074	Complies
Voltage Variations	CFR 47 Part 15.31(e)	Complies*
Conducted Spurious Emissions	CFR 47 Part 15.247(d) / Part 15.207 / KDB558074	Complies
Radiated Spurious Emission with 2.15dBi Integral Antenna	CFR 47 Part 15.247(d) / Part 15.209 / KDB558074	Complies
Peak Power Spectral Density	CFR 47 Part 15.247(e) / KDB558074	Complies

**Requirements were met by using new batteries.*

Modifications Made to the Equipment
None

**3 TABLE OF MEASURED RESULTS**

Test	Low Channel 906 MHz	Mid Channel 916 MHz	High Channel 924 MHz
Conducted Output Power	15.6dBm	14.3dBm	12.63dBm
Conducted Output Power Limit	1 Watt, (30dBm)	1 Watt, (30dBm)	1 Watt, (30dBm)
E.I.R.P. with 2.15dBi Integral Antenna	49.4mW (16.94dBm)	50.8mW (17.06dBm)	53.1mW (17.25dBm)
E.I.R.P. Limit	4 Watts, (36.02dBm)	4 Watts, (36.02dBm)	4 Watts, (36.02dBm)
Peak Power Spectral Density	5.49dBm	3.29dBm	2.63dBm
Peak Power Spectral Density Limit	8 dBm	8 dBm	8 dBm
-6dB Occupied Bandwidth	0.613 MHz	0.617 MHz	0.617 MHz
-6dB Occupied Bandwidth Limit	≥ 500KHz	≥ 500KHz	≥ 500KHz



4 ENGINEERING STATEMENT

This report has been prepared on behalf of SEAL Innovation, Inc. to provide documentation for the testing described herein. This equipment has been tested and found to comply with Part 15.247 of the FCC Rules using ANSI C63.10:2013 and KDB558074 standards. The test results found in this test report relate only to the items tested.



5 EUT INFORMATION AND DATA

5.1 Equipment Under Test:

Product: **SEAL SwimSafe 2.0 Band**

Model: SB200

Serial No.: None Specified

FCC ID: **2AFCI-SB200**

5.2 Trade Name:

SEAL Innovation, Inc.

5.3 Power Supply:

Battery-Operated

5.4 Applicable Rules:

CFR 47, Part 15.247, subpart C

5.5 Equipment Category:

Radio Transmitter-DTS

5.6 Antenna:

2.15dBi Integral

5.7 Accessories:

N/A

5.8 Test Item Condition:

The equipment to be tested was received in good condition.

5.9 Testing Algorithm:

The EUT is set to transmit a continuous modulated carrier in the 915 MHz band on a low, mid and high channel (906/916/924 MHz).

**6 LIST OF MEASUREMENT INSTRUMENTATION**

Equipment Type	Asset Number	Manufacturer	Model	Serial Number	Calibration Due Date
Shielded Chamber	CL166-E	AlbatrossProjects	B83117-DF435-T261	US140023	Oct. 31, 2019
Shield Room	0175-3V	Ray Proof	N/A	11645	Apr. 23, 2020
Temp/Hum. Recorder	CL262	Extech	445814	05	Mar. 6, 2020
Receiver	CL151	Rohde & Schwarz	ESU40	100319	Oct. 25, 2019
Antenna 1-Chamber	0142	ETS/EMCO	3142B	9811-1330	Verified
Software:	Tile Version 3.4.B.3		Software Verified: July 30-31, 2019		
Antenna, JB3 Combination	CL175	Sunol Sciences	JB3	A030315	Oct. 11, 2019
Antenna, Horn	CL098	Emco	3115	9809-5580	Jan. 31, 2021
Pre-Amplifier	0197	Hewlett Packard	8447D	1726A01006	Oct. 25, 2019
Amplifier w/Monopole & 18" Loop	CL194	AH Systems, Inc.	EHA-52B	281	May 23, 2020
Pre-Amplifier	CL250	Com-Power	PAM-118A	18040011	Oct. 26, 2019



7 FCC PART 15.247(a)(2) – OCCUPIED BANDWIDTH

7.1 Requirements:

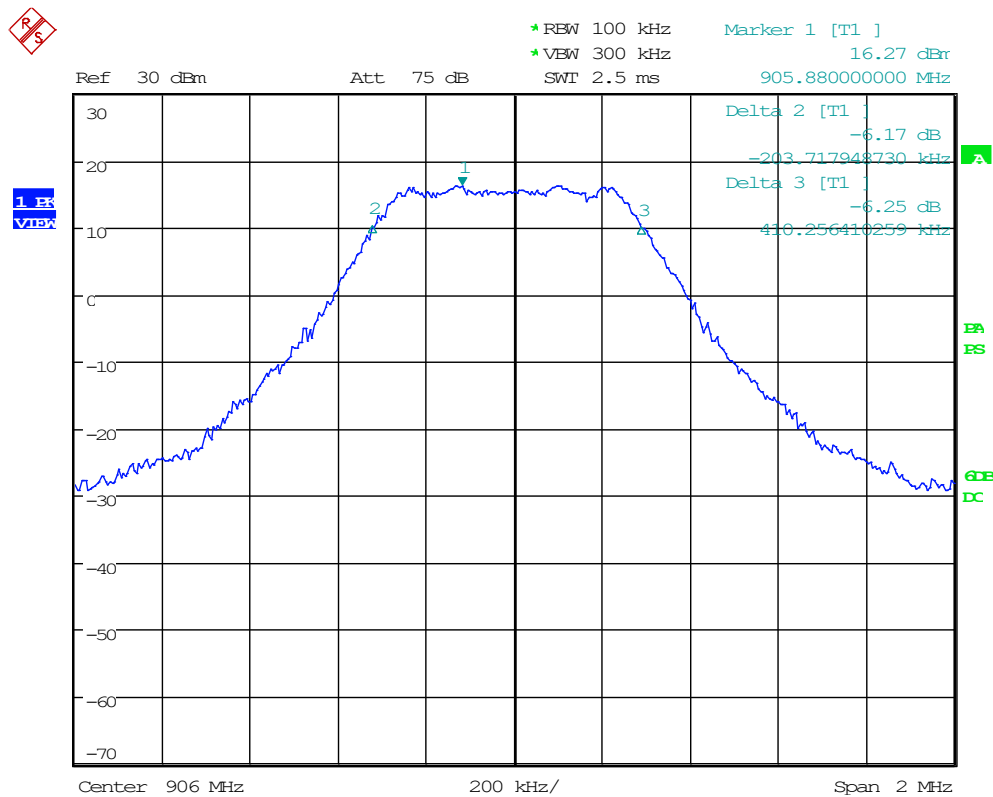
The 6dB bandwidth shall be greater than 500 kHz.

Bandwidth measurements were made at the low, mid and upper frequencies with the resolution Bandwidth set at 100 kHz (video bandwidth set at 300 kHz) while the span was set at 2MHz. The bandwidth was measured using the analyzer's marker function.



7.2 Occupied Bandwidth Test Data

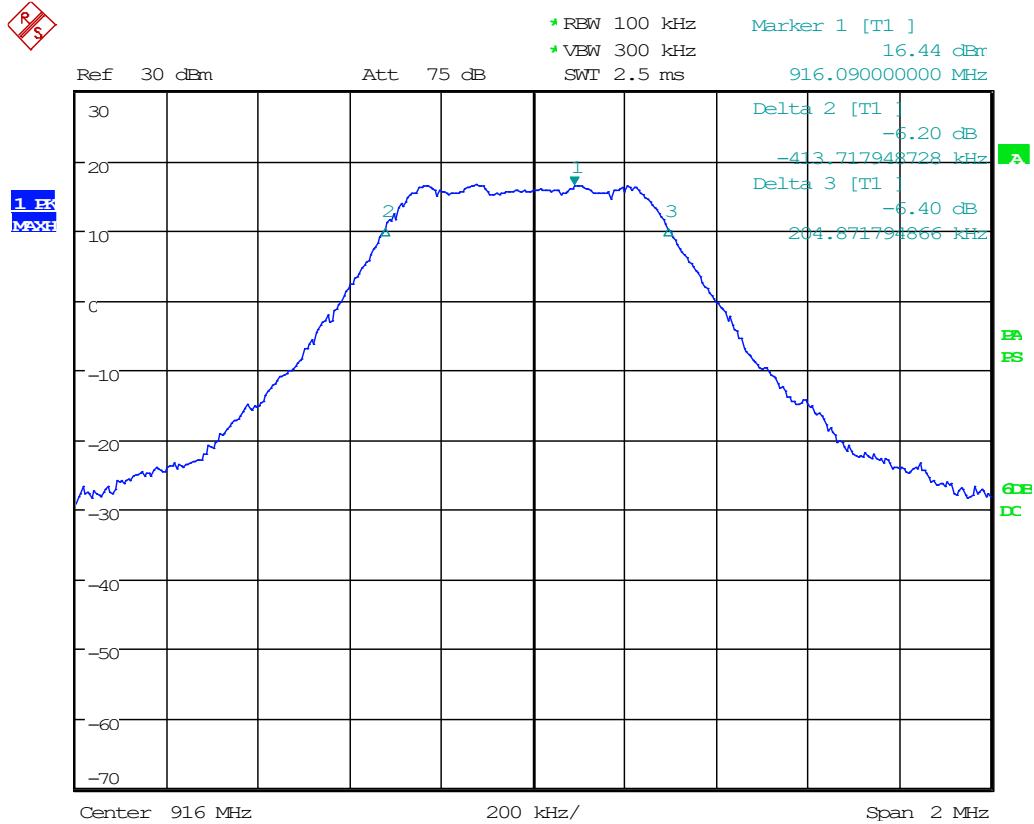
Test Date:	July 31, 2019	Test Engineer:	J. Chiller
Standards:	CFR 47 Part 15.247(a)(2); KDB558074	Air Temperature:	22.4°C
		Relative Humidity:	42%

-6dB, Low Channel

Date: 31.JUL.2019 11:29:22

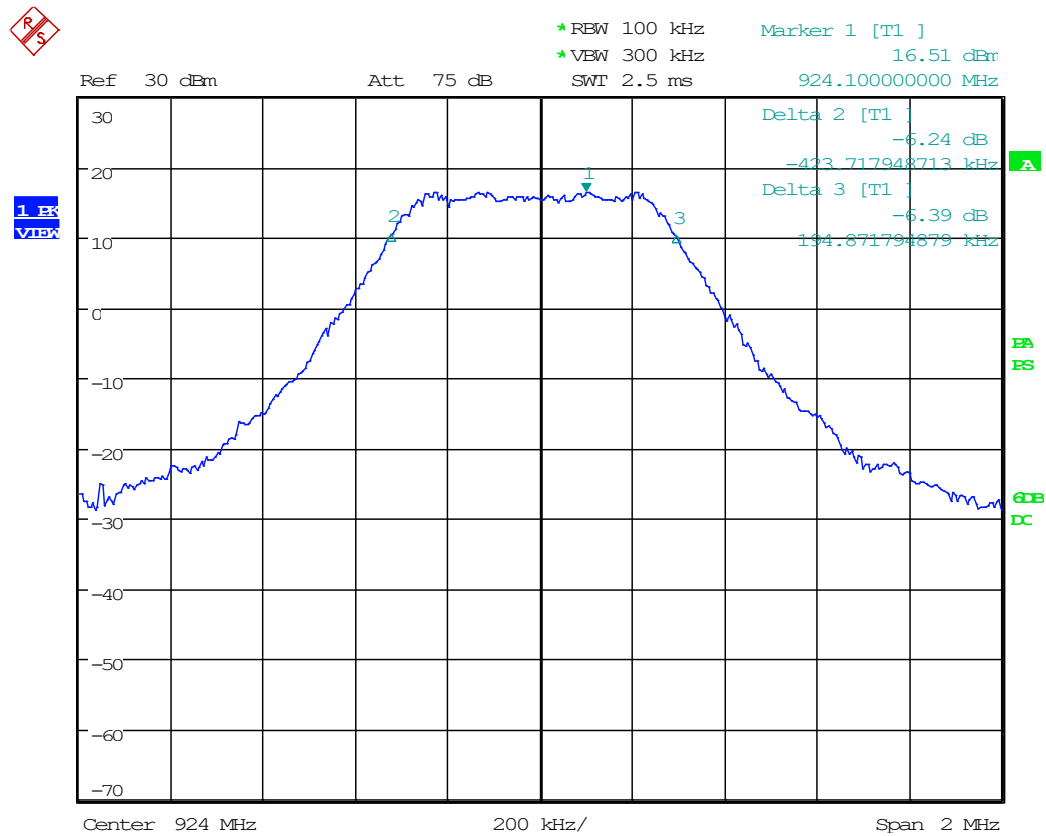


-6dB, Mid Channel



Date: 31.JUL.2019 11:35:15

-6dB, High Channel



Date: 31.JUL.2019 11:36:50



8 FCC PART 15.247(b)(3) – CONDUCTED OUTPUT POWER

The EUT antenna port was fitted with an SMA connector and directly connected to the input of the receiver. The peak power output was measured.

8.1 Requirements:

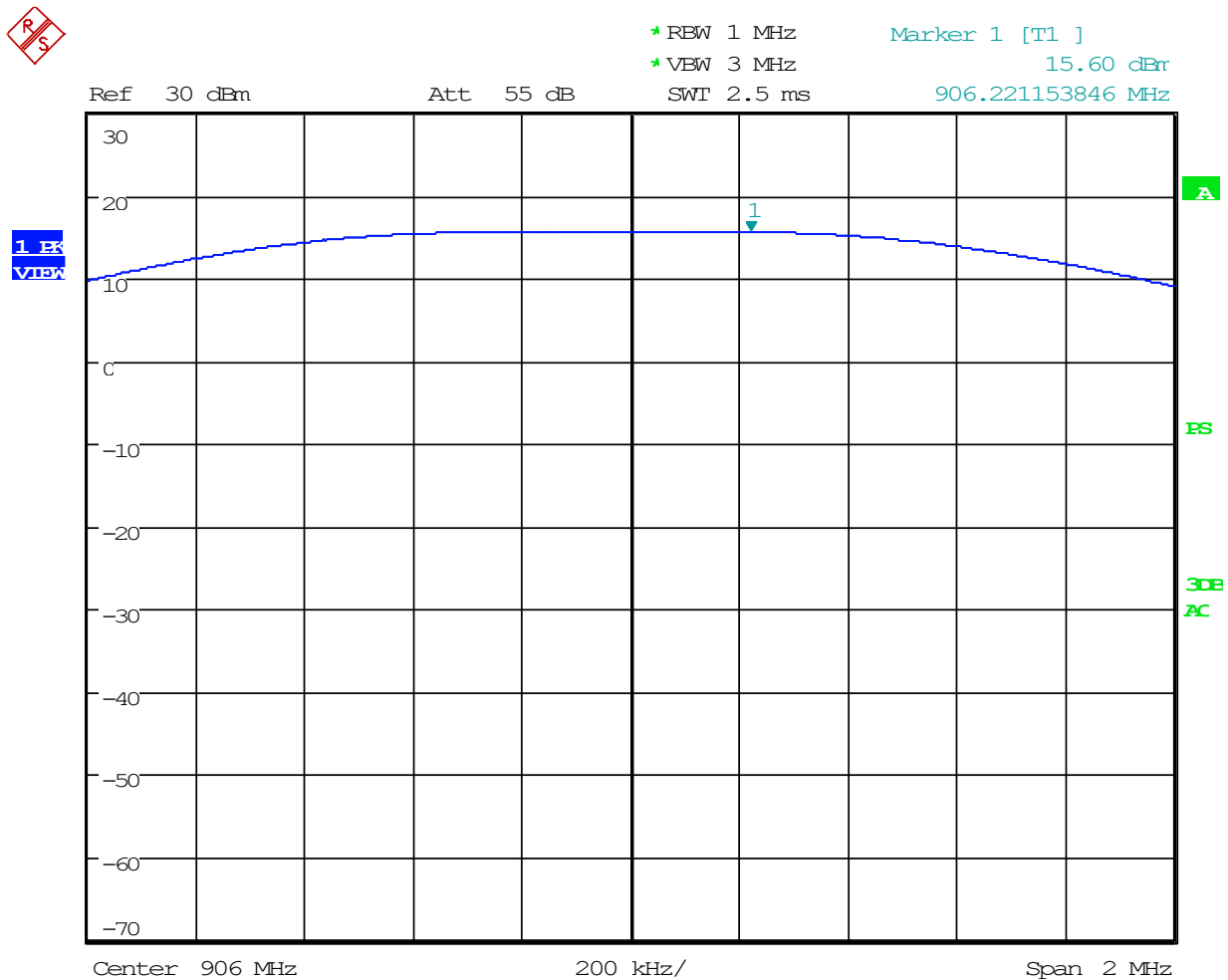
The peak power output shall be 1 watt (30 dBm) or less when using an antenna with a gain of less than 6dBi. For antennas having a gain of more than 6dBi, the limit is reduced by 1dB for every dB the antenna gain is over 6dBi.



8.2 Conducted Output Power Test Data

Test Date:	Oct. 1, 2019	Test Engineer:	J. Chiller
Standards:	CFR 47 Part 15.247(b)(3); KDB558074	Air Temperature:	19.9°C
		Relative Humidity:	50%

Low Channel



Date: 1.OCT.2019 10:59:38



Mid Channel



REBW 1 MHz

Marker 1 [T1]

VBW 3 MHz

14.29 dBm

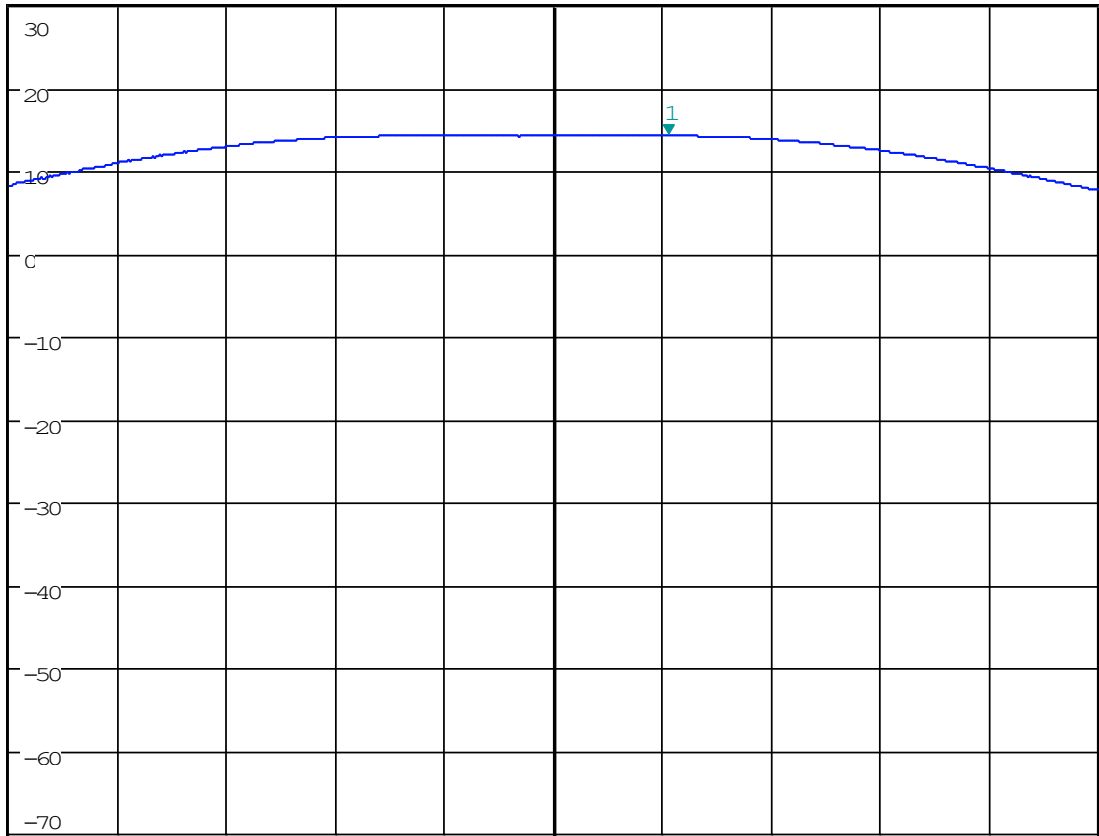
SWT 2.5 ms

916.211538462 MHz

Ref 30 dBm

Att 55 dB

1.83
V18A



Center 916 MHz

200 kHz/

Span 2 MHz

Date: 1.OCT.2019 11:05:05

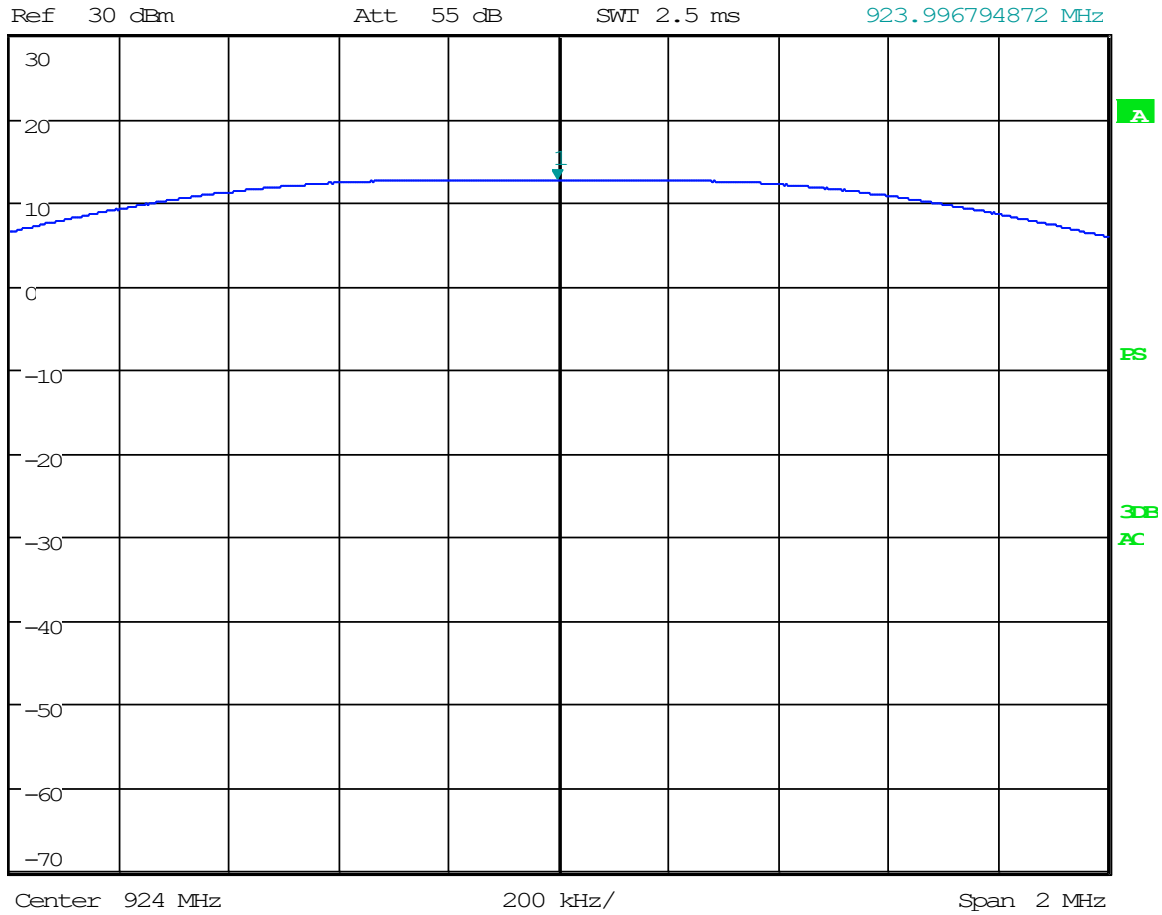


High Channel



★ RBW 1 MHz
★ VBW 3 MHz
SWT 2.5 ms

Marker 1 [T1]
12.63 dBm
923.996794872 MHz



Date: 1.OCT.2019 12:53:01



9 FCC Part 15.247(d) – CONDUCTED SPURIOUS EMISSIONS

The following tests were performed to demonstrate compliance.

RF Antenna Conducted Test

The EUT antenna port was fitted with an SMA connector and directly connected to the input of the spectrum analyzer.

9.1 Requirements:

All Spurious Emissions must be at least 20dB down from the highest emission level measured within the authorized band up through the tenth harmonic.

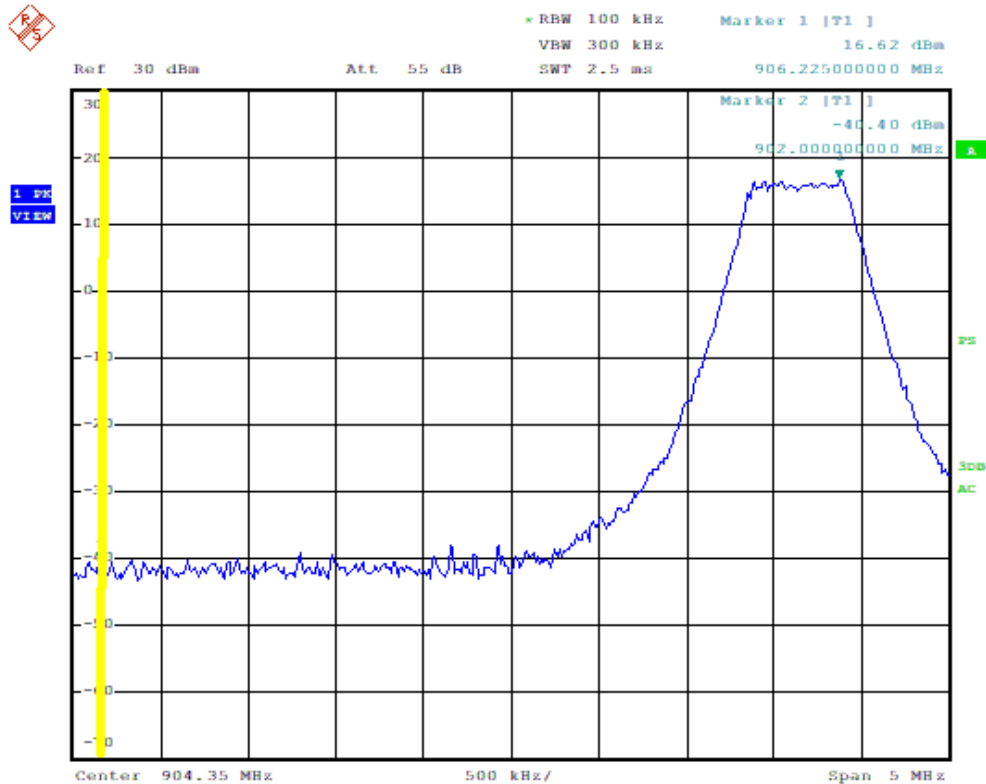
Spurious emissions measurements were made at the low, mid, and upper channels with the appropriate spectrum analyzer impulse bandwidth. Additionally, 20dB down points were measured for the low and high channels to verify band edge compliance.



9.2 Conducted Spurious Emissions Test Data

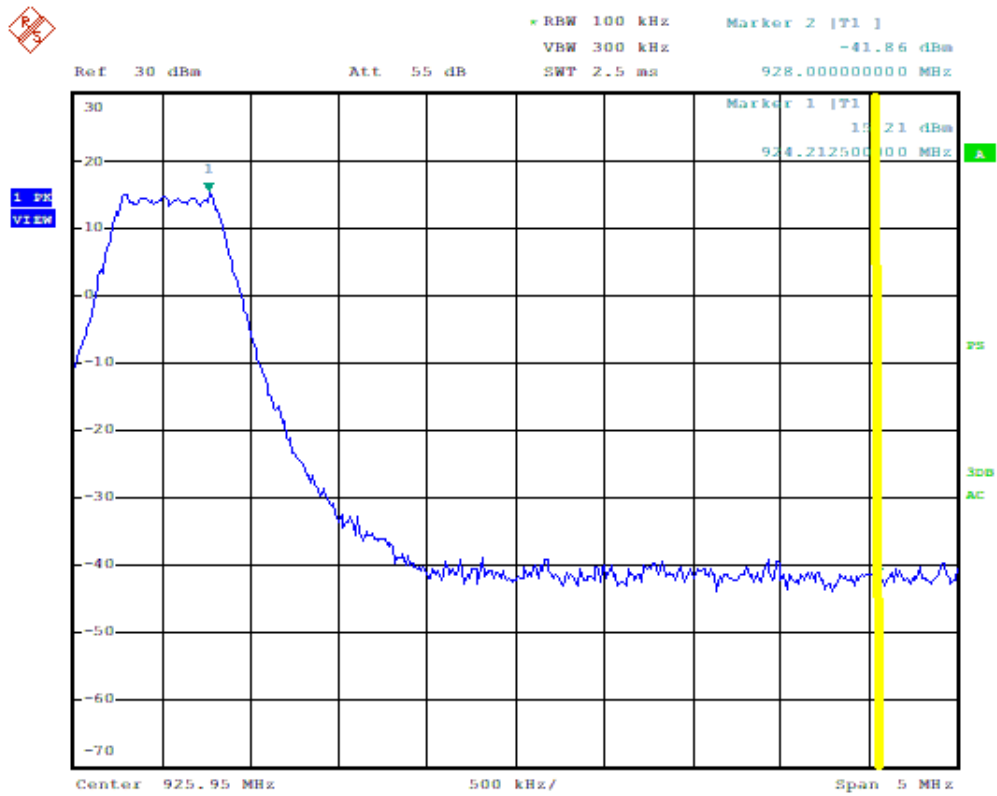
Test Date(s):	July 31, 2019; Oct. 1, 2019	Test Engineer:	J. Chiller
Standards:	CFR 47 Part 15.247(d) / Part 15.207; KDB558074	Air Temperature:	20.7°C
		Relative Humidity:	47%

Low Band Edge



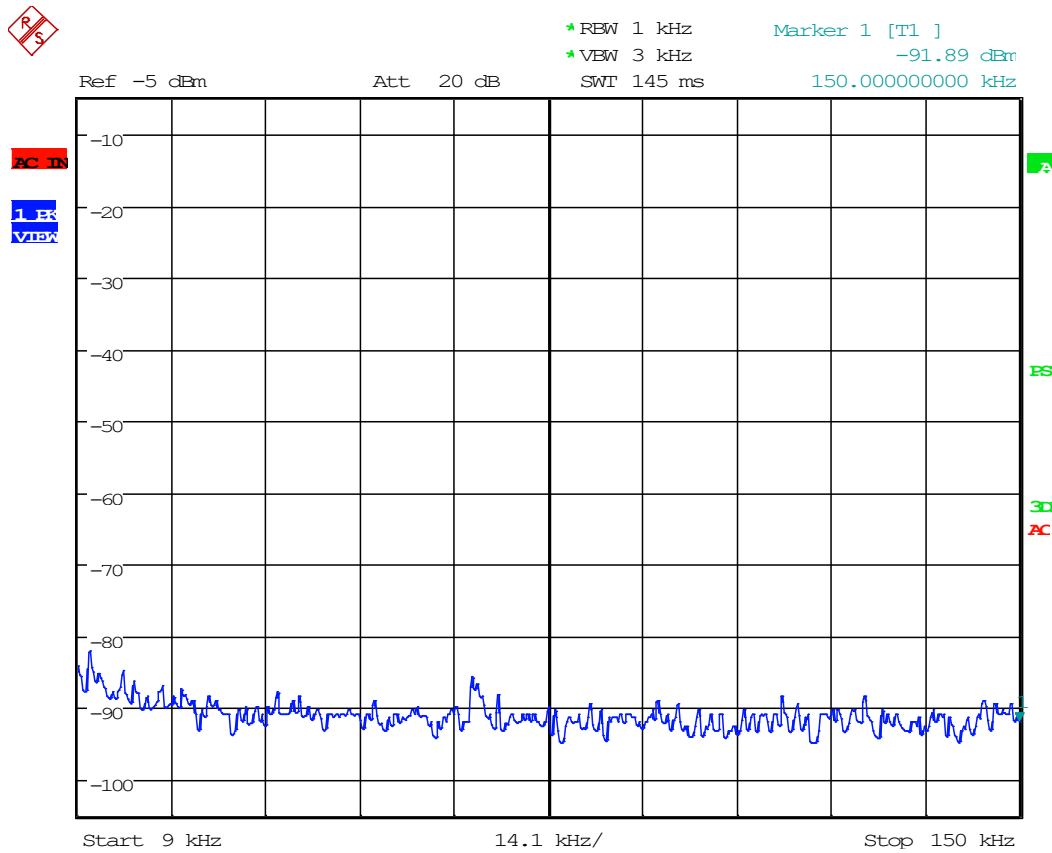


High Band Edge

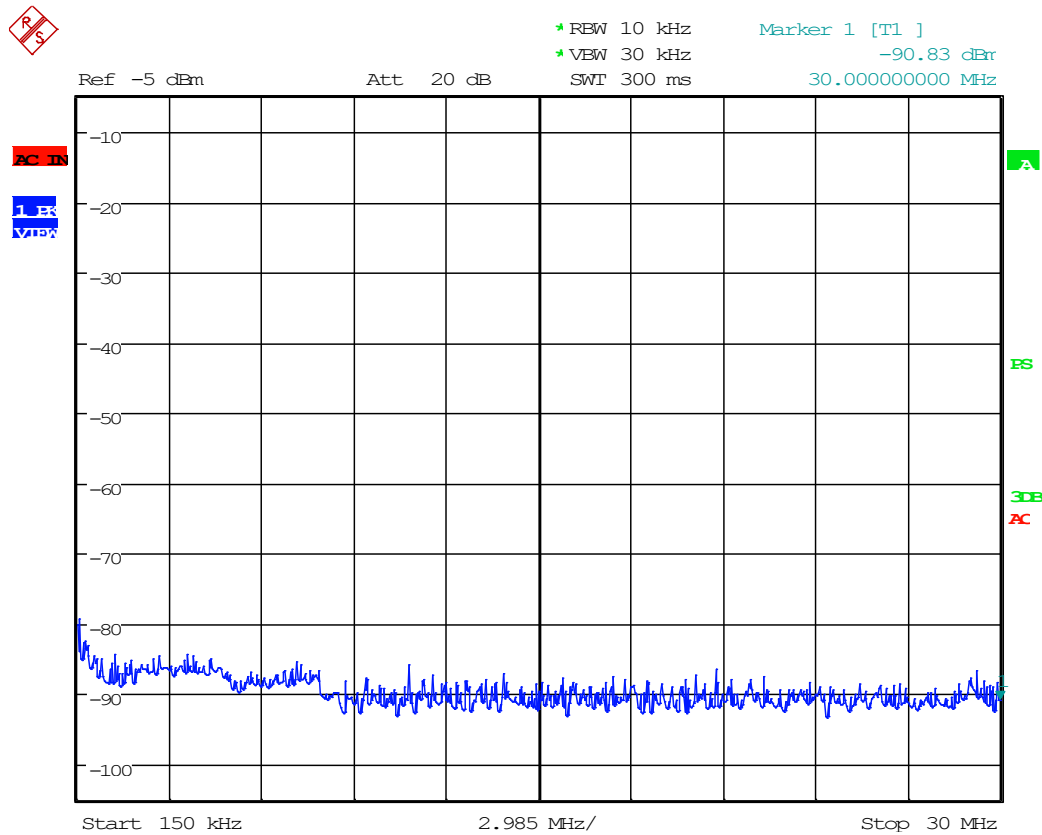




Low Channel: 0.009 MHz to 0.15 MHz



Low Channel: 0.15 MHz to 30 MHz



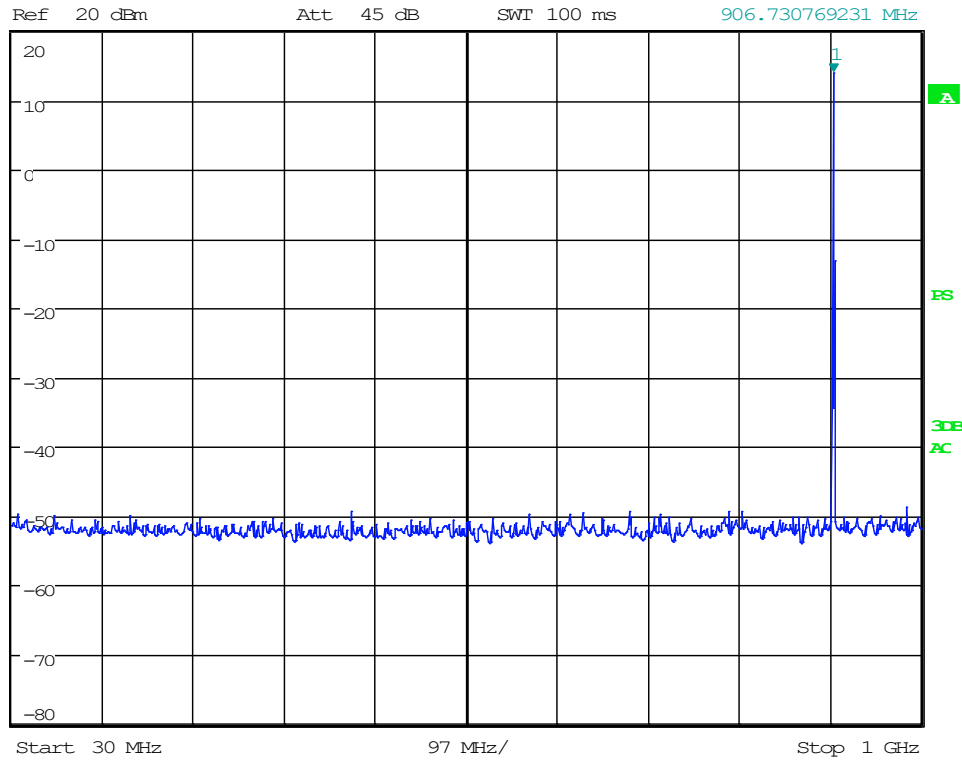


Low Channel: 30 MHz to 1000 MHz



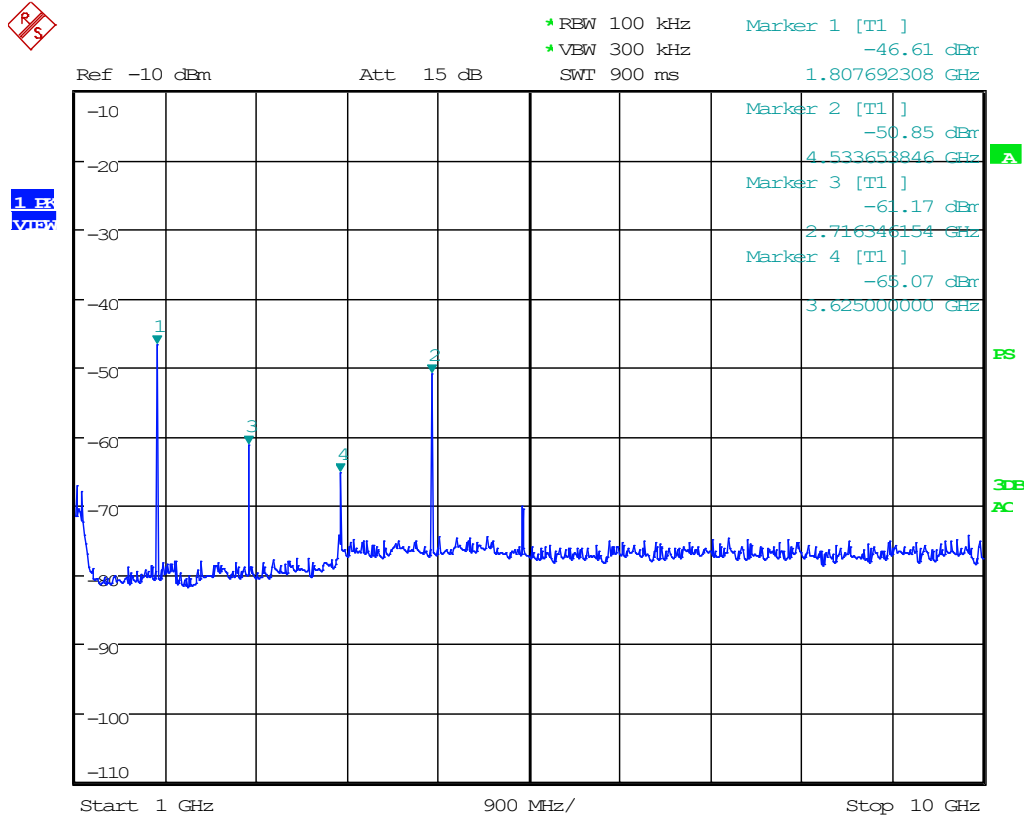
REW 100 kHz Marker 1 [T1]
VBW 300 kHz 13.95 dB
SWT 100 ms 906.730769231 MHz

1.8
VdB





Low Channel: 1 GHz to 10 GHz



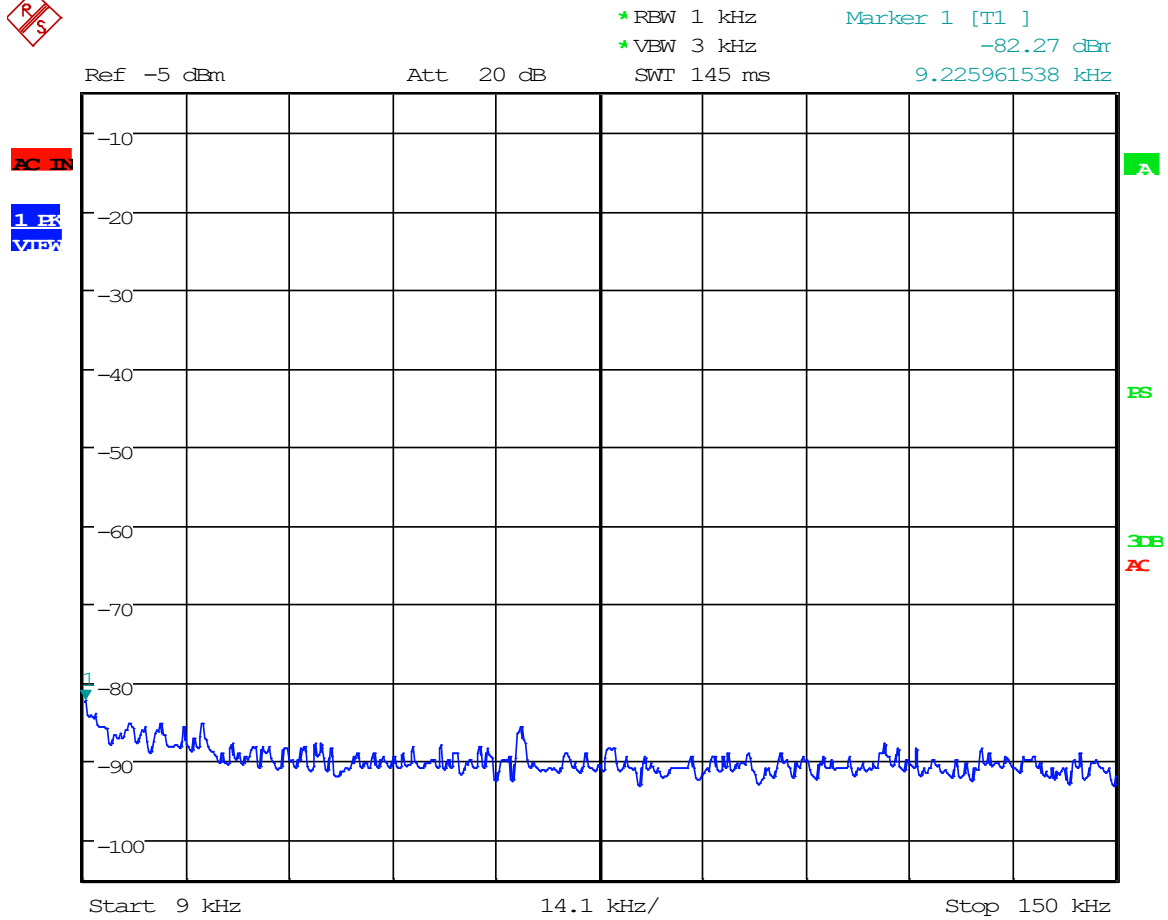


Order Number: F2P18946E

Applicant: SEAL Innovation, Inc.

Model: SB200

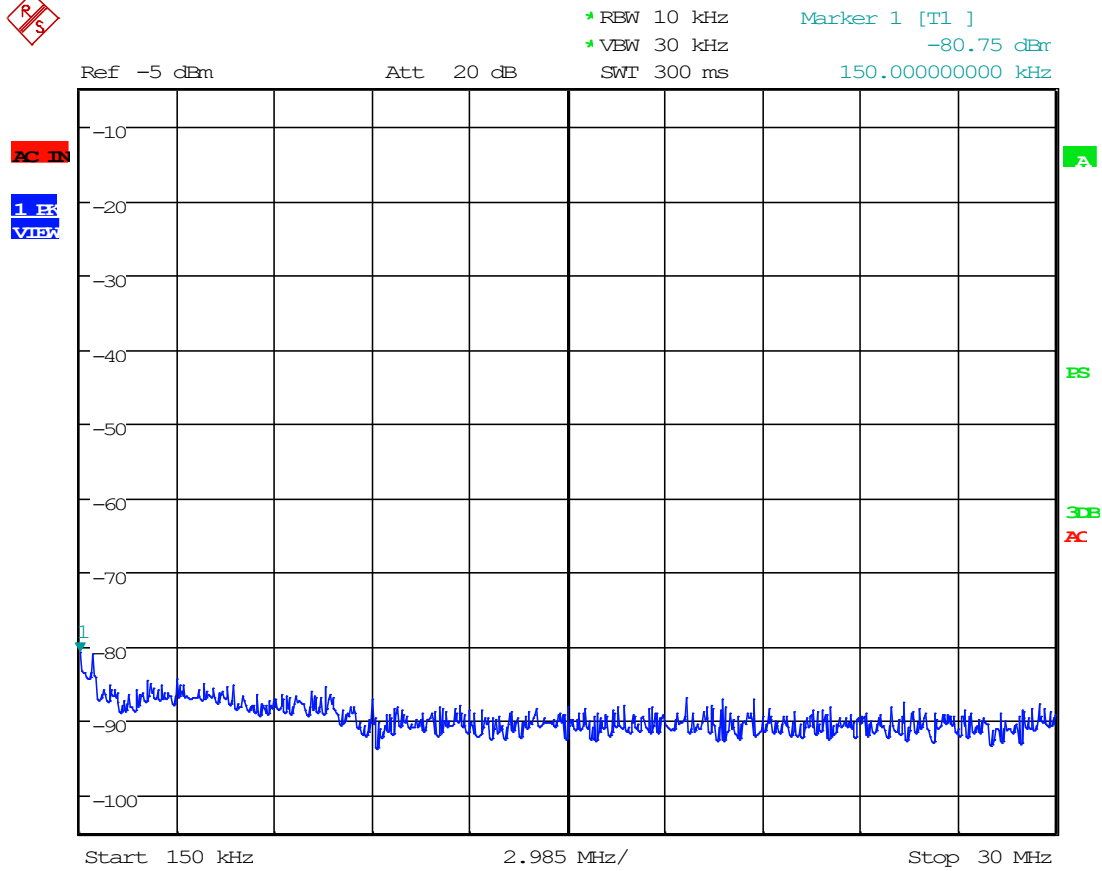
Mid Channel: 0.009 MHz to 0.15 MHz



Date: 1.OCT.2019 11:09:17



Mid Channel: 0.15 MHz to 30 MHz



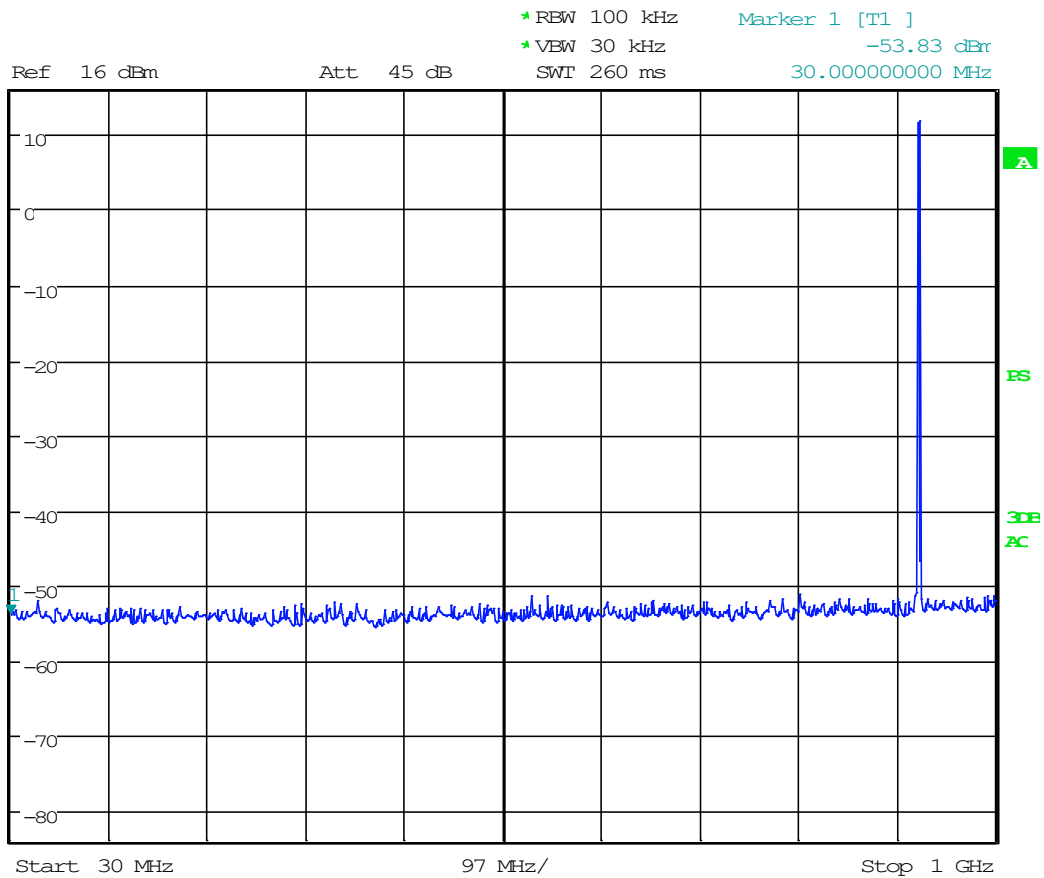
Date: 1.OCT.2019 11:10:10



Mid Channel: 30 MHz to 1000 MHz



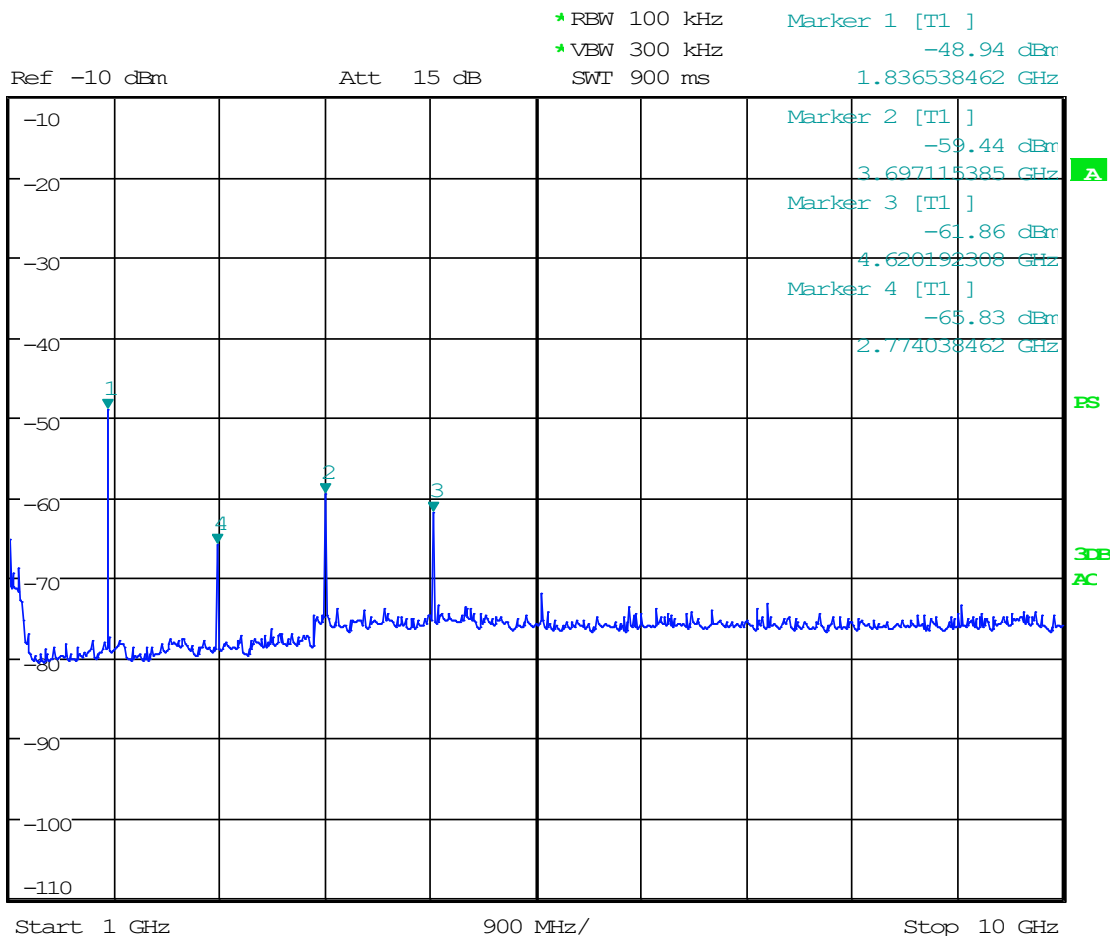
1 PK
V187



Date: 1.OCT.2019 11:10:56



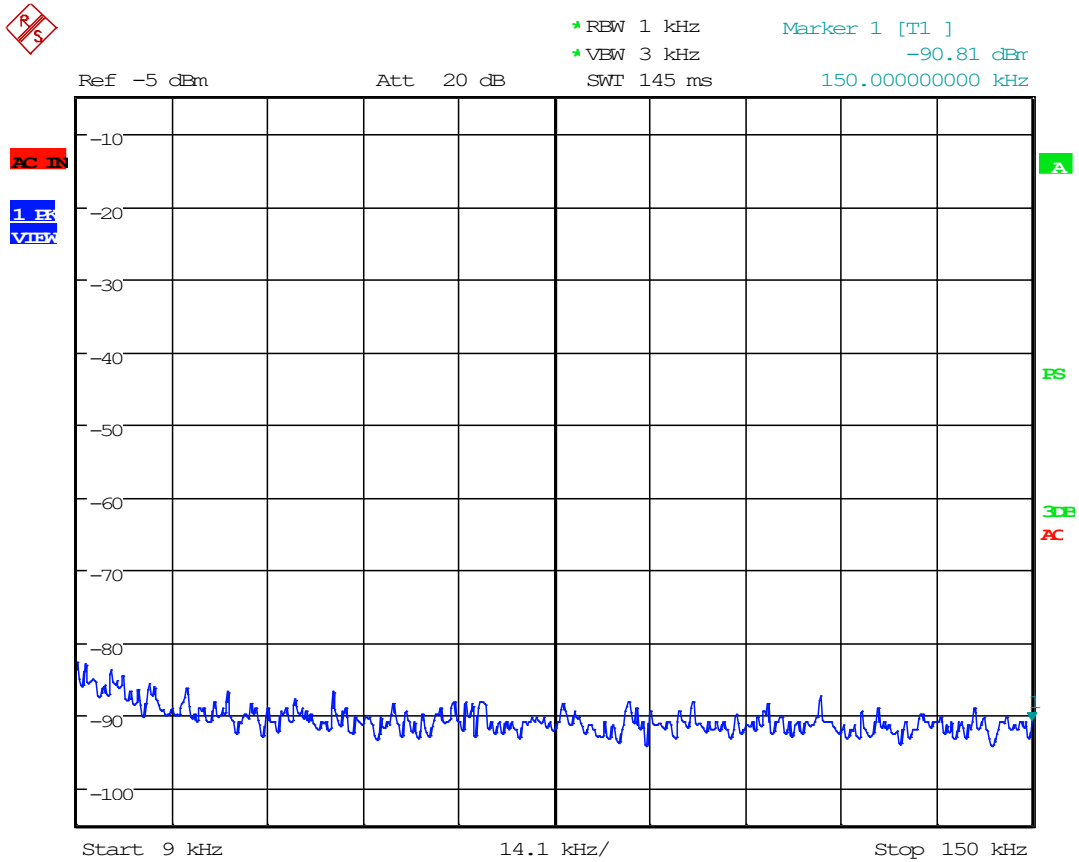
Mid Channel: 1 GHz to 10 GHz



Date: 1.OCT.2019 11:13:38



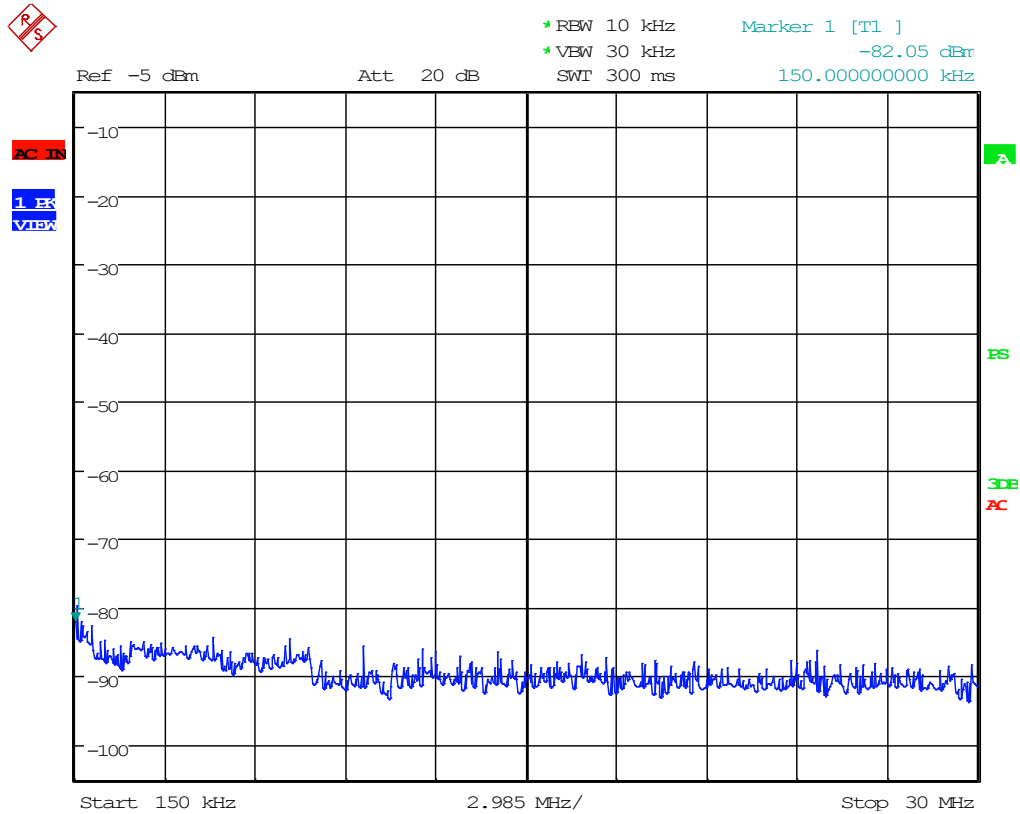
High Channel: 0.009 MHz to 0.15 MHz



Date: 1.OCT.2019 12:55:09



High Channel: 0.15 MHz to 30 MHz



Date: 1.OCT.2019 12:55:40



Order Number: F2P18946E

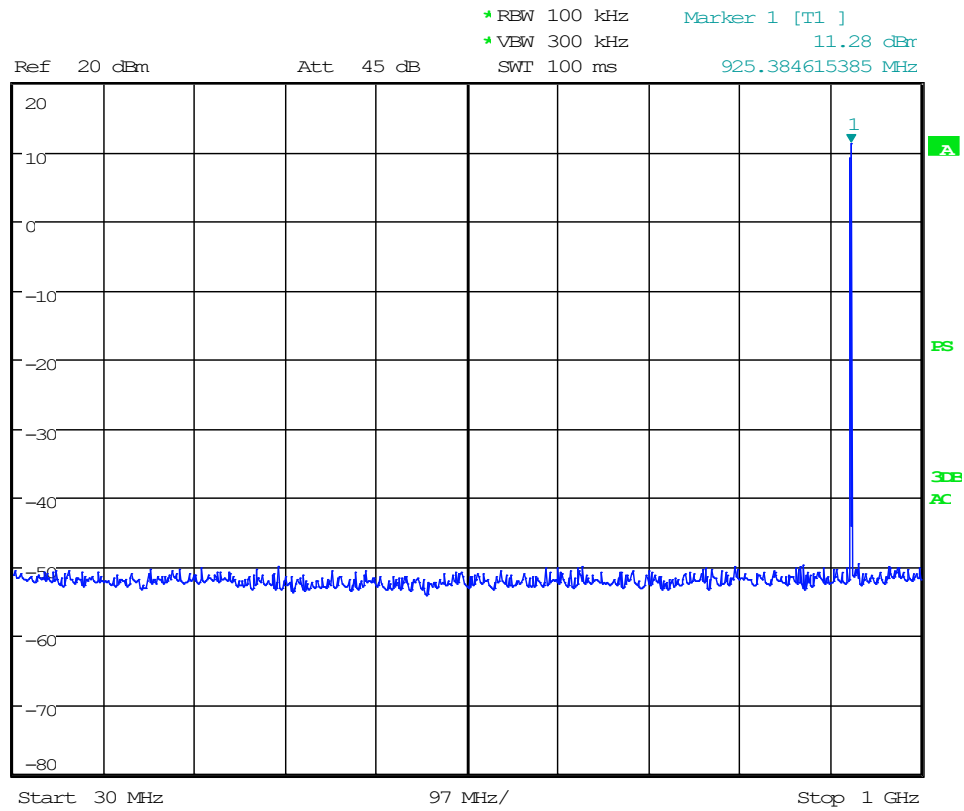
Applicant: SEAL Innovation, Inc.

Model: SB200

High Channel: 30 MHz to 1000 MHz



1.8
V183



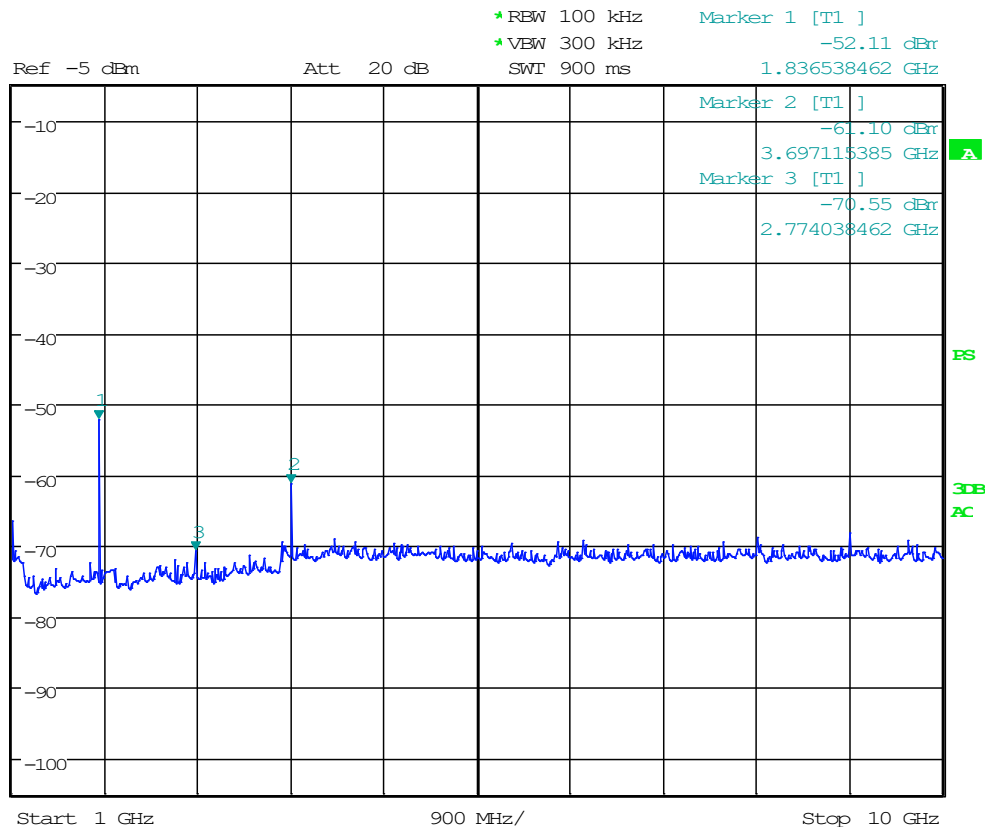
Date: 1.OCT.2019 12:58:36



High Channel: 1 GHz to 10 GHz



1. PS
View



Date: 1.OCT.2019 12:59:39



10 RADIATED SPURIOUS EMISSION

The EUT antenna port was fitted with its integral/internal chip antenna. Radiated emissions were measured in a Semi-Anechoic Chamber. All emissions generated that fall in the restricted bands per FCC Part 15.205 were examined.

10.1 Requirements:

All emissions that fall in the restricted bands defined in FCC Part 15.205 shall not exceed the maximum field strength listed in FCC Part 15.209(a).



10.2 Radiated Spurious Emission Test Data

Test Date(s):	July 31, 2019	Test Engineer:	J. Chiller
Standards:	CFR 47 Part 15.247(d); Part 15.209 / KDB558074	Air Temperature:	20.8°C
		Relative Humidity:	49%

Notes: Plots are peak, max hold pre-scan data included only to determine what frequencies to investigate and measure. The EUT was initially placed in a semi-anechoic chamber, and rotated in all three orthogonal positions to maximize the emissions. Characterization measurements were then performed to determine at which frequencies significant emissions occurred. These graphs are shown below.

The equipment was fully exercised with all cabling attached to the EUT and was positioned on the OATS for maximum emissions. While the equipment was energized, the receiving antenna was scanned from 1.0 meter to 4.0 meters in both vertical and horizontal polarities while the turntable was adjusted 360 degrees to determine the maximum field strength. The tables of measured results can be found below.

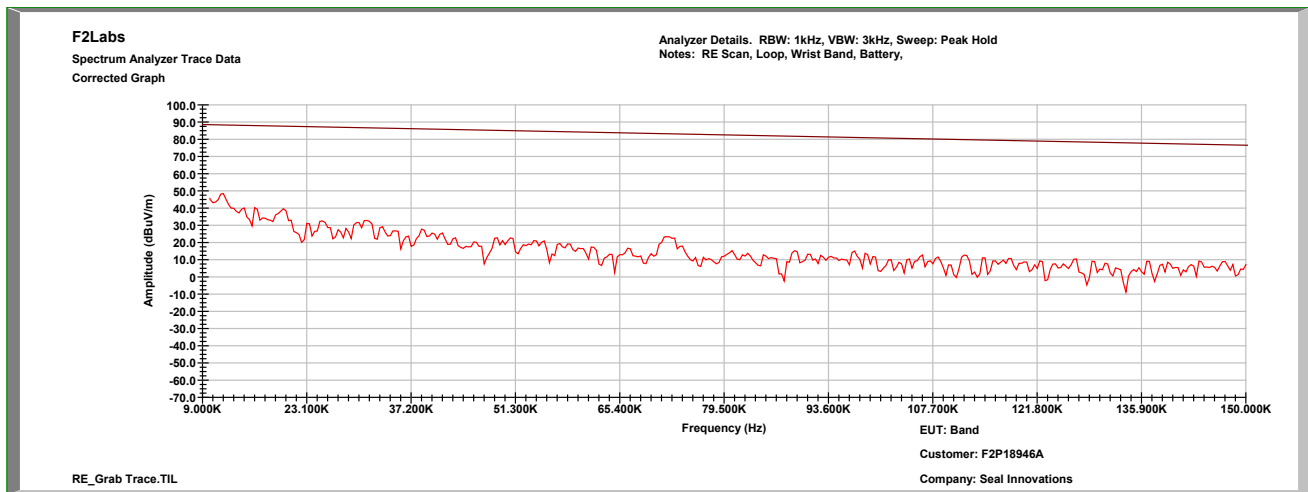
Some of the frequencies did not change with the EUT on or off. At those frequencies, the test distance was shortened to 1 meter and still no emissions from the EUT were visible or over the ambient or limit.

In the following plots, the black trace indicates the active scan and the green trace indicates the MaxPk measurement with the EUT on. Emissions to be found by the EUT were measured and listed in tables. The plots are for reference only and the limit lines are not actual limit lines but merely a guide.

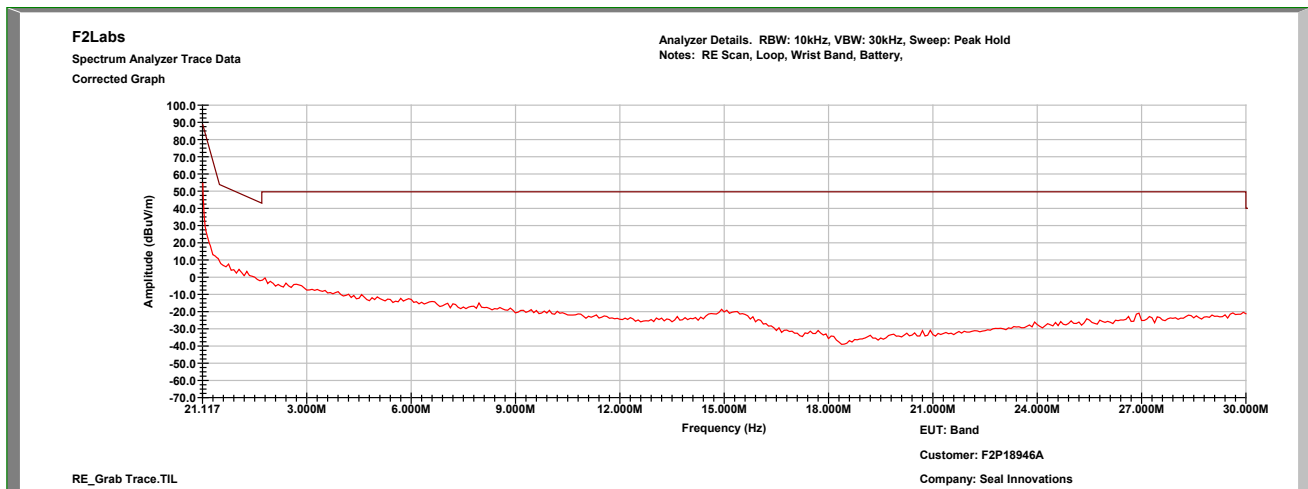
The following graphs are from a representative channel, as there were no spurious emissions on any channel observed. Measurements were taken on all three channels and the data is included in the table.



Characterization Scan, 0.009 MHz to 0.15 MHz

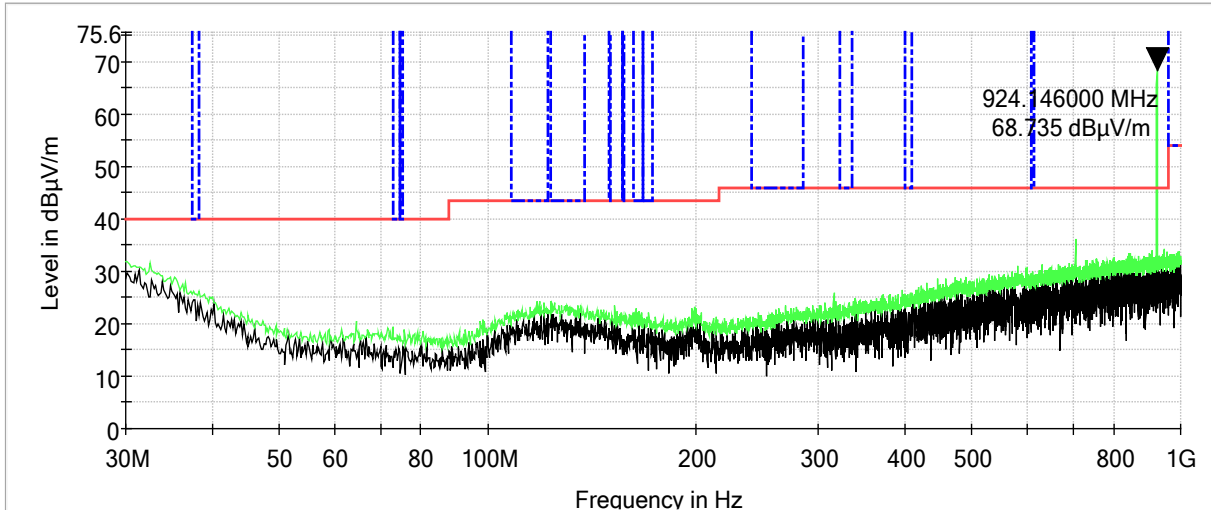


Characterization Scan, 0.15 MHz to 30.0 MHz

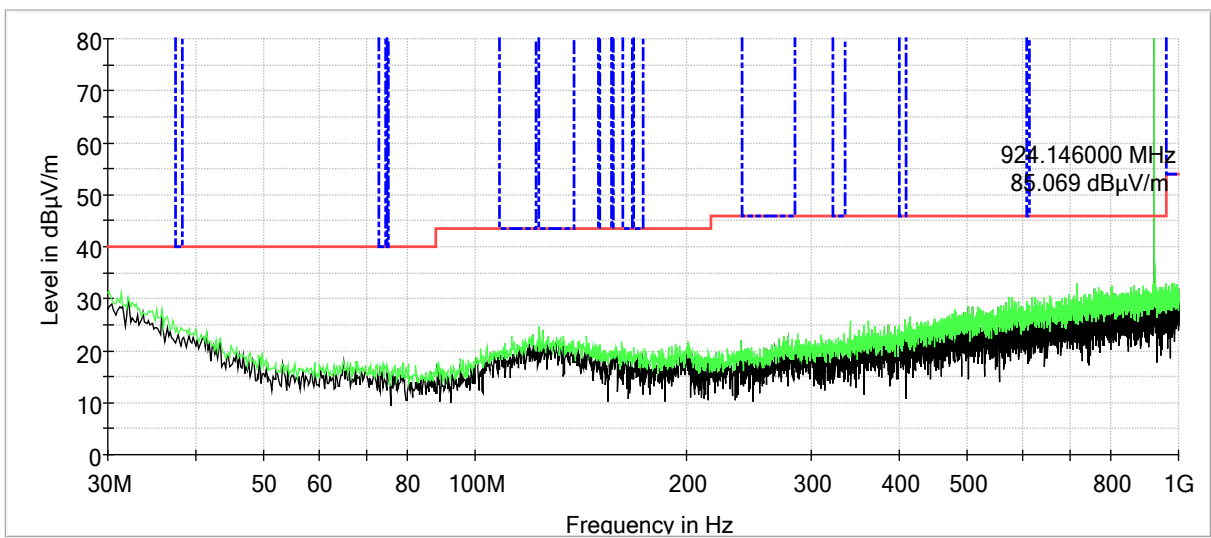




Characterization Scan, 30 MHz to 1000 MHz, Vertical



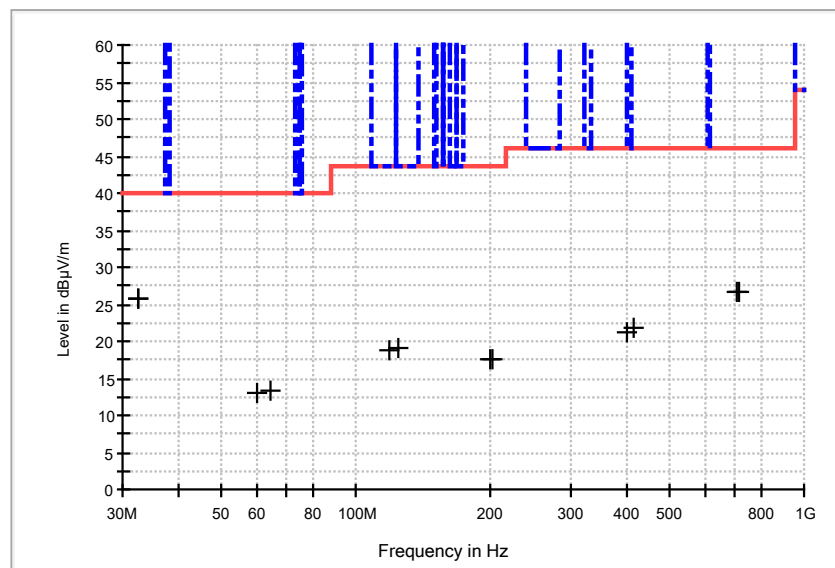
Characterization Scan, 30 MHz to 1000 MHz, Horizontal





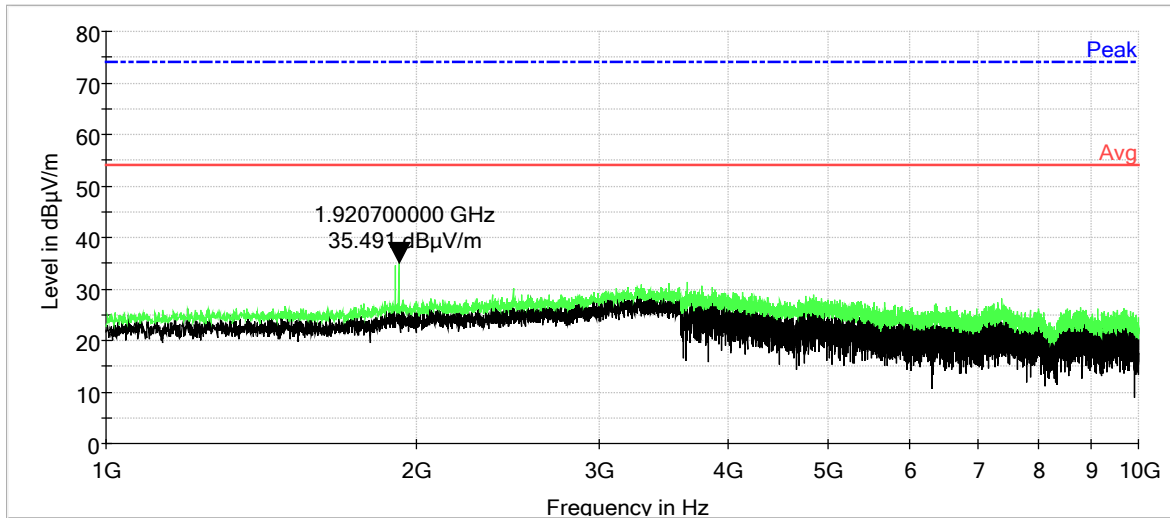
QuasiPeak Measurements from all three channels.

Frequency (MHz)	Antenna Polarization	Antenna Height (cm)	Azimuth (degrees)	Reading (dBμV)	Cable Loss & Antenna Factor (dB)	Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
32.520000	H	100.00	0.00	20.9	4.9	25.80	40.0	-14.2
32.520000	V	100.00	356.00	20.9	4.9	25.80	40.0	-14.2
60.280000	H	100.00	0.00	20.7	-7.6	13.10	40.0	-26.9
64.520000	V	100.00	356.00	20.7	-7.3	13.40	40.0	-26.6
117.880000	V	100.00	5.00	20.7	-2.0	18.70	43.5	-24.8
123.320000	H	100.00	0.00	20.8	-1.7	19.10	43.5	-24.4
198.400000	V	100.00	5.00	20.3	-2.7	17.60	43.5	-25.9
201.680000	H	100.00	0.00	20.2	-2.7	17.50	43.5	-26.0
400.360000	V	100.00	5.00	20.7	0.6	21.30	46.0	-24.7
415.880000	H	100.00	0.00	20.8	1.1	21.90	46.0	-24.1
704.920000	V	100.00	5.00	21.5	5.2	26.70	46.0	-19.3
716.760000	H	100.00	0.00	21.4	5.2	26.60	46.0	-19.4

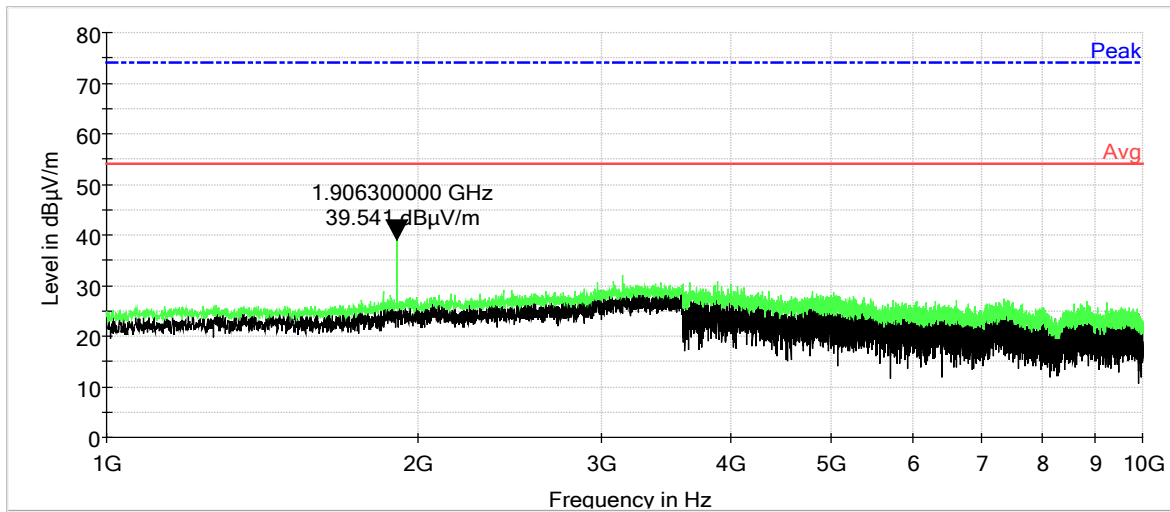




Characterization Scan, 1 GHz to 10 GHz, Vertical



Characterization Scan, 1 GHz to 10 GHz, Horizontal





11 FCC PART 15.247(e) – PEAK POWER SPECTRAL DENSITY (PSD)

Peak power spectral density measurements were performed.

11.1 Requirements:

The peak power spectral density shall not exceed +8dBm in any 3 kHz band during any time interval of continuous transmission.

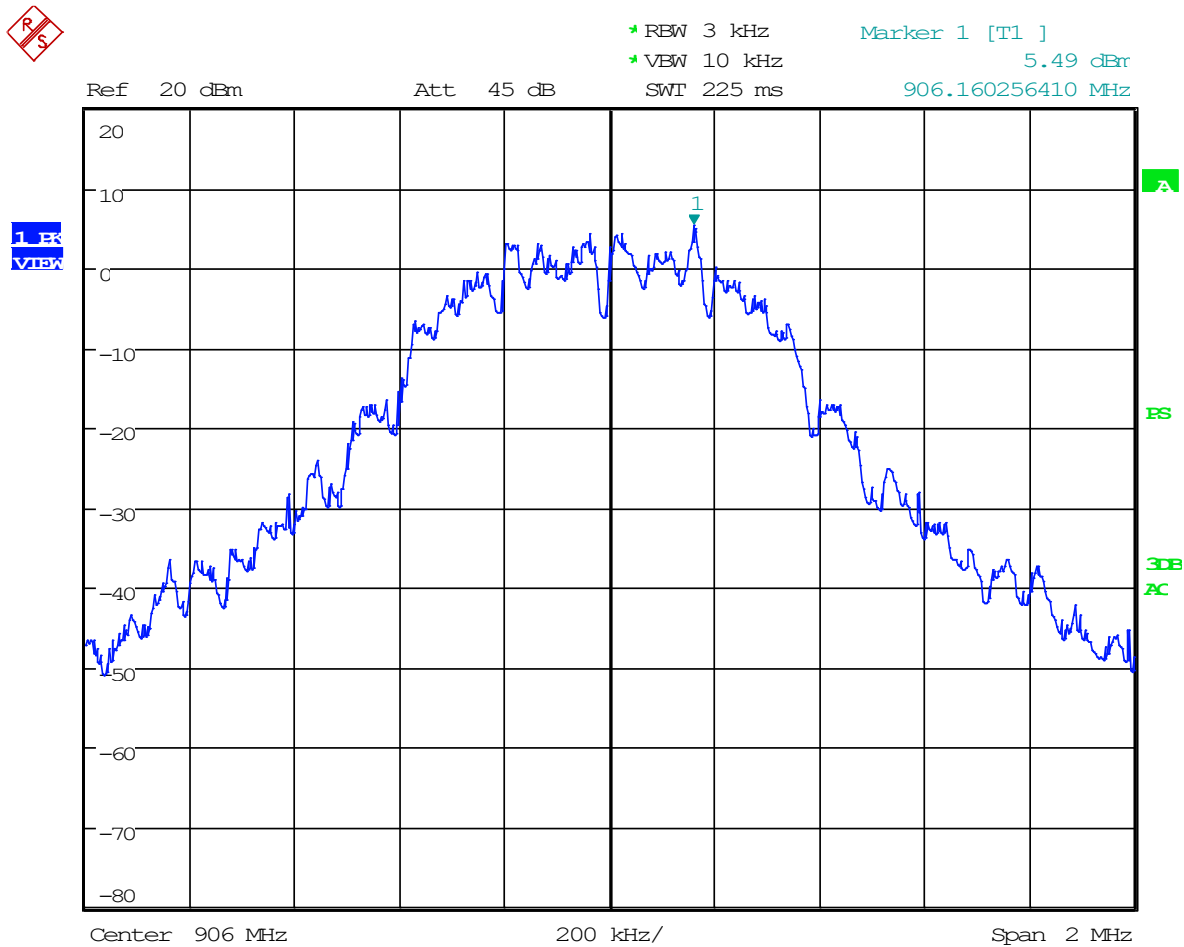
Power spectral density measurements were performed at a resolution bandwidth of 3kHz (video bandwidth set at 10kHz). The peak spectral densities were measured at the low, mid, and upper channels.



11.2 Peak Power Spectral Density Test Data

Test Date(s):	Oct. 1, 2019	Test Engineer:	J. Chiller
Standards:	CFR 47 Part 15.247(e); KDB558074	Air Temperature:	19.9°C
		Relative Humidity:	50%

Low Channel



Date: 1.OCT.2019 11:01:16



Order Number: F2P18946E

Applicant: SEAL Innovation, Inc.

Model: SB200

Mid Channel



RBW 3 kHz

Marker 1 [T1]

VBW 10 kHz

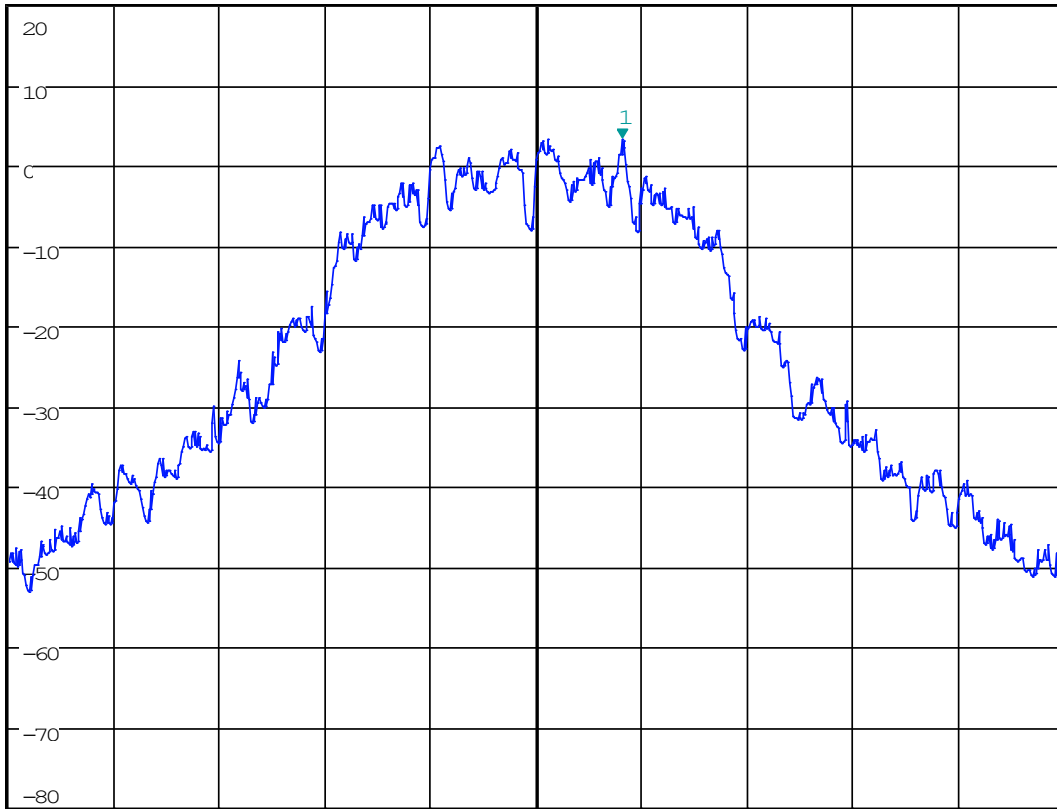
3.29 dBm

SWT 225 ms

916.163461538 MHz

Ref 20 dBm

Att 45 dB



Center 916 MHz

200 kHz/

Span 2 MHz

Date: 1.OCT.2019 11:04:15



High Channel



RBW 3 kHz

Marker 1 [T1]

VBW 10 kHz

2.63 dB

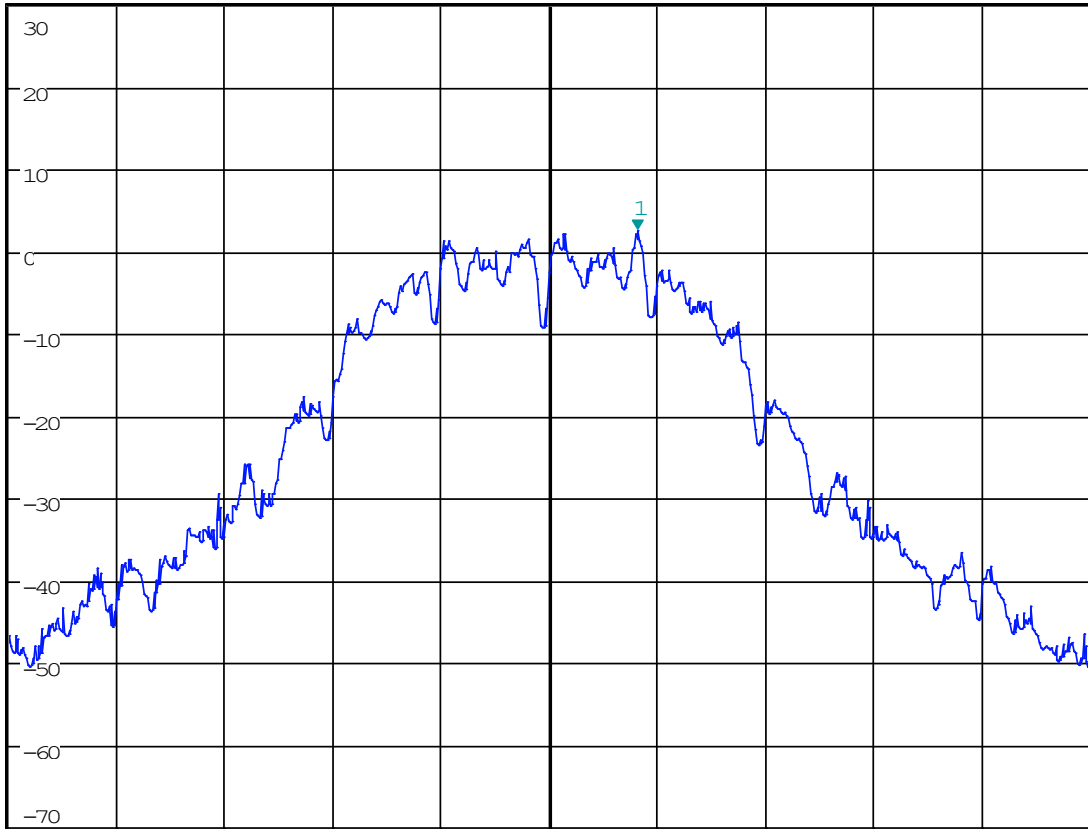
SWT 225 ms

924.163461538 MHz

Ref 30 dBm

Att 55 dB

1 ER
MAX



Center 924 MHz

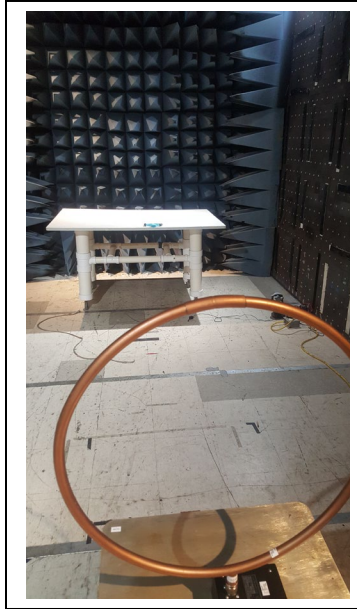
200 kHz/

Span 2 MHz

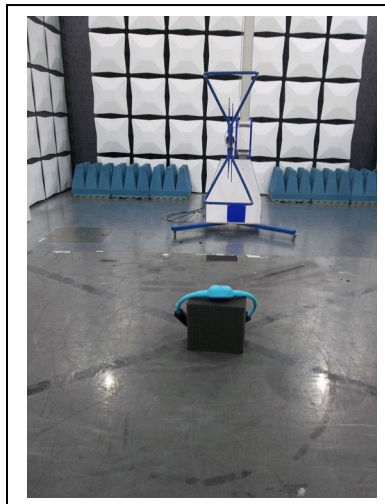
Date: 1.OCT.2019 12:54:10

12 PHOTOGRAPHS

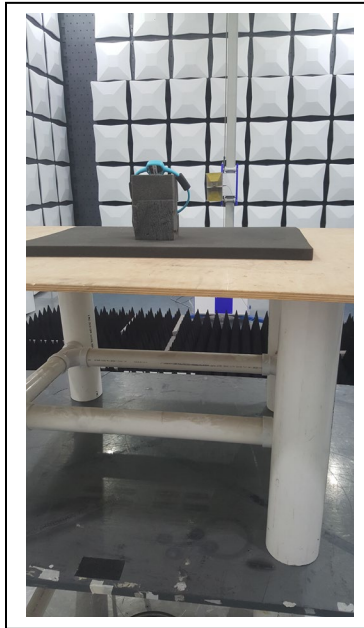
Radiated Spurious Emission: 0.15 MHz to 30 MHz



Radiated Spurious Emission: 30 MHz to 1000 MHz



Radiated Spurious Emission: 1 GHz to 10 GHz



Conducted Output Power, Peak Power Spectral Density, Occupied Bandwidth, and Conducted Spurious Emissions

