



BEC INCORPORATED

CERTIFICATION APPLICATION TEST REPORT

TEST STANDARDS:

**FCC Part 15 Subpart C, IC RSS-Gen, IC RSS-247
DSS Intentional Radiator**

**Woodstream Corporation Model V400M LoRa Radio Control Unit
With Models V450 and V460 Connected Control Rodent Traps**

**FCC ID: SNA-V400MR1
ISED ID: 9458A-V400M**

REPORT BEC-2065-03 REV1

TEST DATES: 02/04/2020 – 02/27/2020

CUSTOMER:

**Woodstream Corporation
69 North Locust Street
Lititz, PA 17543**

PREPARED BY: _____

Paul Banker, Test Engineer

REVIEWED and APPROVED BY: _____

Steve Fanella, Quality Manager

The results described in this report relate only to the item(s) tested. This document shall not be reproduced except in full without prior written permission of BEC Incorporated





TABLE OF CONTENTS

Notice To Customer	4
Revision History	4
1.0 Administrative Information.....	5
1.1 Project Details	5
1.2 Preface.....	6
1.3 Laboratory and Customer Information.....	6
1.4 Measurement Uncertainty	6
1.5 Test Result Summary Table	7
1.6 Condition of Received Sample.....	8
1.7 Climatic Environment	8
1.8 Test Equipment	8
2.0 Equipment Under Test	9
2.1 EUT Description	9
2.2 Product Category.....	9
2.3 Product Classification	9
2.4 Test Configuration.....	9
2.5 Test Configuration Rationale	9
2.6 Test Configuration Diagram (Transmitter Conducted Measurements).....	10
2.7 Test Configuration Diagrams (Radiated Measurements).....	10
2.8 EUT Information, Interconnection Cabling and Support Equipment	11
2.9 Test Signals and Test Modulation.....	12
2.10 Grounding.....	12
2.11 EUT Modifications	12
2.12 EUT Pictures Woodstream Model V400M LoRa Radio Control Unit	12
3.0 Applicable Requirements, Methods, and Procedures	13
3.1 Applicable Requirements	13
3.1.1 FCC Requirements	13
3.1.1 Industry Canada Requirements.....	13
3.1.2 Basic Test Methods and Test Procedures	13
3.2 Deviations or Exclusions from the Requirements.....	13
4.0 Test Results.....	14
4.1 Antenna Requirement (47 CFR 15.203)(RSS-GEN ANNEX A (10)(g)).....	14
4.2 External RF power amplifiers and antenna modifications (47 CFR 15.204)(RSS-GEN 8.3)	14
4.3 Restricted Bands of Operation 30 MHz - 10 GHz (47 CFR 15.205 and RSS-Gen 8.10)	15
4.3.1 Restricted Bands of Operation 30 MHz – 1000 MHz (02/06/2020 – 02/21/2020)	15
4.3.1.1 Non-Hopping Mode Measurements.....	15
4.3.1.2 Normal Hopping Mode Measurements.....	16
4.3.2 Restricted Bands of Operation 1 to 10 GHz (02/06/2020 – 02/21/2020).....	17
4.3.2.2 Non-Hopping Mode	17
4.3.2.2 Normal Hopping Mode.....	18
4.4 Spurious Radiated Emissions 30 MHz – 10 GHz (47 CFR 15.209(a) and RSS-Gen 8.10)	20



4.4.1	Spurious Radiated Emissions 30 MHz to 1 GHz Measurement (02/12/2020 – 02/21/2020)	21
4.4.1.1	Spurious Radiated Emissions 30 MHz to 1 GHz Measurement Non-Hopping Mode	21
4.4.1.2	Spurious Radiated Emissions 30 MHz to 1 GHz Measurement Normal Hopping Mode	23
4.4.2	Spurious Radiated Emissions 1 to 10 GHz Test Results (02/06/2020 – 02/21/2020)	25
4.4.2.1	Spurious Radiated Emissions 1 to 10 GHz Measurement Non-Hopping Mode	25
4.4.2.2	Spurious Radiated Emissions 1 to 10 GHz Measurement Normal Hopping Mode	27
4.5	20 dB Bandwidth Measurement 47 CFR 15.247(a)(1) and RSS-247 Section (5.1)(c) (02/04/2020)	28
4.6	Carrier Frequency Separation 47 CFR 15.247(a)(1) RSS-247 (5.1)(c) (02/17/2020)	30
4.7	Number of Hopping Frequencies 47 CFR 15.247(a)(1)(iii), RSS-247 (5.1)(c) (02/25/2020 and 02/26/2020)	31
4.8	Time of Occupancy (Dwell Time) 47 CFR 15.247(a)(1)(i) RSS-247 (5.1)(c) (02/26/2020)	32
4.9	Maximum Conducted Output Power and EIRP (FCC Part 15.247(b)(3), RSS-247 Section 5.4(d))	34
4.9.1	Maximum Conducted Output Power Test Procedure	34
4.9.2	Maximum Conducted Output Power Test Results (02/04/2020)	34
4.9.3	EIRP Calculation RSS-247 (02/04/2020)	37
4.10	Band Edge Measurement 47 CFR 15.247(d) and RSS-247 (5.5) (02/26/2020)	38
4.11	Spurious RF Conducted Emissions 47 CFR 15.247(d) and RSS-247 (5.5) (02/14/2020)	41
5.0	Test Setup Photos	44
	Appendix A – Test Equipment	45



Notice To Customer

This report and any recommendations it contains represent the result of BEC's testing and assessment on behalf of your company. Testing has been conducted according to accepted engineering standards and practices. This report reflects testing and assessment of product samples provided by your company and may not reflect the characteristics of other samples, especially those produced at different times. Therefore this report and its findings and recommendations, if implemented, should not be construed as an assurance or implied warranty for the continuing electromagnetic compatibility (EMC) of the product. **BEC shall not be liable for incidental or consequential damages, even if advised of the possibility thereof.**

BEC will not disseminate this report to other parties without your express permission. You may reproduce this report in its entirety including this notice and the entireties of any supplemental test reports on the same product (e.g. reports on additional testing following modification). However 'you may not reproduce portions of the report (except for the entirety of the summary section) or quote from it for any purpose without specific prior written permission from BEC'.

Revision History

Revision #	Description of Changes	Date of Changes	Date Released
0	Test Report Initial Release	N/A	03/05/2020
1	Tested Frequencies are added to Section 1.1 of the test report	03/10/2020	03/10/2020



1.0 Administrative Information

1.1 Project Details

Project Number	BEC-2065	
Manufacturer	Woodstream Corporation	
Chassis Model Numbers	Connected Control Rodent Traps V450 (Small) and V460 (Large)	
Chassis Model Serial Numbers	None	
LoRa Radio Control Unit Model Number	V400M	
LoRa Radio Control Unit Type	Unmodified Sample	Modified with SMA connector on transmitter output port
LoRa Radio Control Unit Sample Numbers	2065-02	2065-01
LoRa Radio Control Unit Serial #s	None	
FCC ID	SNA-V400MR1	
ISED ID	9458A-V400M	
Radio Chip Manufacturer	Semtech Corporation	
Radio Chip Model Number	SX1272	
Frequency of Operation	902 – 915 MHz	
Frequencies Tested	Low (902.3 MHz), Middle (908.7 MHz) and High (914.9 MHz)	
Antenna Gain	+ 3 dBi	
FCC Classification	DSS	
Date Samples Received	02/04/2020	
Condition Samples Received	Suitable for test	
Sample Type	Production unit	
EUT Description	Connected Control Rodent Traps with LoRa Radio Communication	
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	
Applicable ISED Rules	RSS-Gen: General Requirements for Compliance of Radio Apparatus & RSS-247: Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices	



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
Test Personnel	Paul Banker / Steve Fanella / JR Fanella
BEC Laboratory Number FCC Registration	US1118
BEC Laboratory Number ISED Registration	7342A-1
Test Performed For	Woodstream Corporation 69 North Locust Street Lititz, PA 17543
Customer Technical Contact	Dwayne Arrighy
Customer Reference Number	PO # 175123

1.4 Measurement Uncertainty

Measurement	Measurement Distance	Frequency Range	Measurement Limit	Expanded Uncertainty
Radiated Disturbance	3 Meter	30 MHz – 1 GHz	Class B	4.12
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 16-4-2:2011 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



1.5 Test Result Summary Table

The Woodstream Model V400M LoRa Radio Control Unit was tested to the following standards:

Report Section	FCC Part 15, Subpart C	IC RSS-Gen	IC RSS-247	Test Description	Result
N/A	15.207(b)	7.2		Conducted Emissions, AC 150 kHz to 30 MHz	N/A
4.1	15.203(b)	Annex A 10(g)		Antenna Requirement	PASS
4.3	15.205(a)	8.9	3.3	Restricted Bands of Operation 30 MHz to 10 GHz	PASS
4.4	15.209	8.10		Radiated Emissions, 30 MHz to 10GHz	PASS
4.5	15.247(a)(1)		5.1 c)	20 dB Occupied Bandwidth	PASS
4.6	15.247(a)(1)		5.1 c)	Carrier Frequency Separation	PASS
4.7	15.247(a)(1)(iii)		5.1 c)	Number of Hopping Frequencies	PASS
4.8	15.247(a)(1)(i)		5.1 c)	Time of Occupancy	PASS
4.9	15.247(b)(2)		5.4 a)	Maximum Peak Power Output and EIRP	PASS
4.10	15.247(d)		5.5	Band Edge Measurement	PASS
4.11	15.247(d)		5.5	Antenna Port, Conducted Spurious Emissions	PASS

Interpretation of Test Results: The EUT was tested using LoRa modulation. Also, the modulation scheme was tested in hopping and non-hopping modes as required by FCC and ICES rules. The resultant data is presented by showing the worst-case levels for each modulation type and/or frequency. All recorded results are maintained at BEC Inc.



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

Unless noted elsewhere in this report, the following were the ambient conditions in the laboratory during testing:

Temperature: $22^{\circ} \pm 5^{\circ}$

Humidity: $50\% \pm 20\%$

Barometric Pressure: $1000\text{mb} \pm 20\%$

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 Connected Rodent Control Trap utilizes a Woodstream Model V400M LoRa Radio Control Unit to communicate trap status to a smart phone or network application. The LoRa Radio Control Unit Model V400M can be used with either Model Number V450 Mouse Trap, or Model V460 Rat Trap Enclosure.

2.2 Product Category

FCC Part 15, Subpart C (Section 15.247), IC RSS-Gen, IC RSS-247

2.3 Product Classification

Intentional Radiator Testing Requirements DSS for Frequency Hopper Operation within the band of 902 - 928 MHz.

2.4 Test Configuration

The Woodstream Model V400M LoRa Radio Control Unit Sample # 2065-02 was tested in both the small (Model V450) and large (Model V460) trap enclosures for all radiated emissions tests. The Woodstream Model V400M LoRa Radio Control Unit Sample # 2065-01 was tested without a trap enclosure for all antenna terminal measurements.

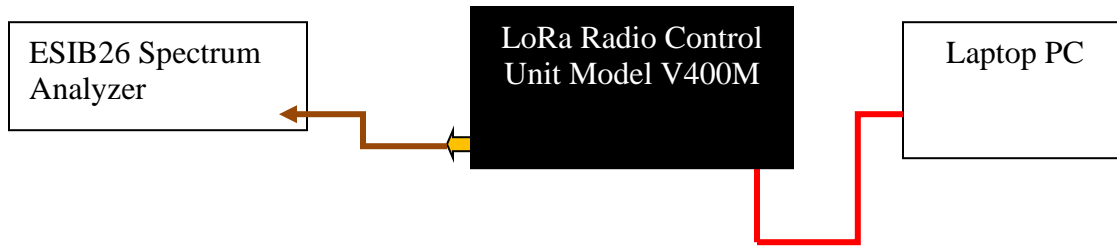
2.5 Test Configuration Rationale

The tested configurations are the two sizes of trap enclosures available by the manufacturer. The modified radio Control Unit allows direct access to the output of the radio, without a transmission antenna.



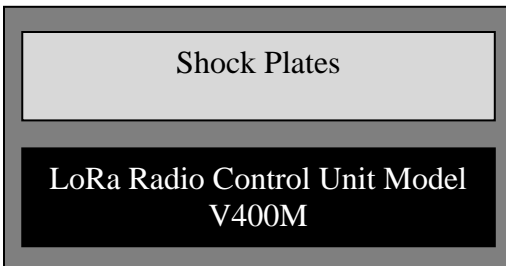
2.6 Test Configuration Diagram (Transmitter Conducted Measurements)

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

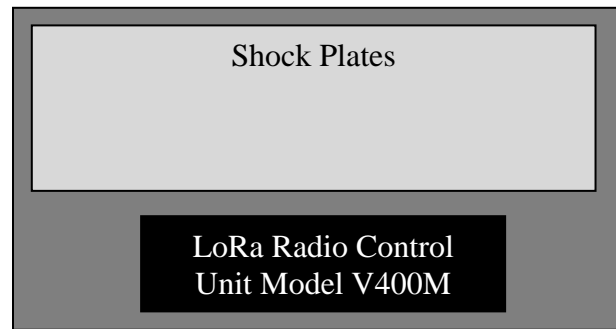


2.7 Test Configuration Diagrams (Radiated Measurements)

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



Small Enclosure (Model V450)



Large Enclosure (Model V460)



2.8 EUT Information, Interconnection Cabling and Support Equipment

EUT Hardware

Description	Manufacturer	Model	Serial Number	Sample Number
Lora Radio Control Unit (unmodified)	Woodstream Corporation	V400M	None	2065-02
Lora Radio Control Unit (modified with SMA)				2065-01

Interconnection Cable List (Conducted Test Setup)

Manufacturer	Model	Type	Shielding	Length	Description
Workhorse	WHU18-3636-036	High Frequency RF Cable 1 to 40 GHz	Double Braid	1 Meter	Measurement Cable from the Antenna SMA Connector to the Rohde and Schwarz ESIB26 Receiver. Asset # BEC-814

Support Equipment

Description	Manufacturer	Model	Serial Number
USB to Serial Port Adapter	Sparkfun	FTDI Basic	None
Lap Top Computer	Dell	PP04X	CN-OHN338-48643-84F-0307
Mouse Trap Enclosure	Woodstream	V450	N/A
Rat Trap Enclosure	Woodstream	V460	N/A



2.9 Test Signals and Test Modulation

The following table lists the individual hopping frequencies for the transmitter. The EUT utilizes provide LoRa modulation. The frequency hopping could be enabled and modulated by selection. The transmitter also could be programmed to control the output at Low, Medium and Maximum Output levels.

Channel	Frequency MHz	Channel	Frequency MHz	Channel	Frequency MHz	Channel	Frequency MHz
0	902.3	16	905.5	32	909.7	48	911.9
1	902.5	17	905.7	33	909.9	49	912.1
2	902.7	18	905.9	34	909.1	50	912.3
3	902.9	19	906.1	35	909.3	51	912.5
4	903.1	20	906.3	36	909.5	52	912.7
5	903.3	21	906.5	37	909.7	53	912.9
6	903.5	22	906.7	38	909.9	54	913.1
7	903.7	23	906.9	39	910.1	55	913.3
8	903.9	24	907.1	40	910.3	56	913.5
9	904.1	25	907.3	41	910.5	57	913.7
10	904.3	26	907.5	42	910.7	58	913.9
11	904.5	27	907.7	43	910.9	59	914.1
12	904.7	28	907.9	44	911.1	60	914.3
13	904.9	29	908.1	45	911.3	61	914.5
14	905.1	30	909.3	46	911.5	62	914.7
15	905.3	31	909.5	47	911.7	63	914.9

For the required testing, the EUT was configured to transmit at low Channel 0 (902.3 MHz), middle Channel 32 (908.7 MHz) and high Channel 63 (914.9 MHz). Spread factors values of 7 and 12 were examined. Evidence in the DSS Bandwidth Test (Section 4.5) and the Maximum Peak Power Output Test (Section 4.6), demonstrates that a spread factor of 12 produces the greatest amplitude.

2.10 Grounding

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

2.11 EUT Modifications

Except for the attachment of a SMA connector directly to the antenna output on the main board of the Woodstream Model V400M LoRa Radio Control Unit (Sample # 2065-01), no modifications were made to the EUT.

2.12 EUT Pictures Woodstream Model V400M LoRa Radio Control Unit

See Appendix B Woodstream V400M External Photos



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

3.1.1 Industry Canada Requirements

RSS-Gen Issue 5 March 2019 Amendment 1: General Requirements for Compliance of Radio Apparatus

RSS-247 Issue 2 February 2017: Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

3.1.2 Basic Test Methods and Test Procedures

ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

FCC Public Notice FCC DA 00-705, Released March 30, 2000, “Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems.”

3.2 Deviations or Exclusions from the Requirements

No deviations or exclusions were made.



4.0 Test Results

4.1 Antenna Requirement (47 CFR 15.203)(RSS-GEN ANNEX A (10)(g))

The antenna used by the Woodstream Model V400M LoRa Radio Control Unit is a quarter-wave, inverted F wire antenna. The antenna is mounted perpendicular to the PCB inside the enclosure. There are no detachable parts of the antenna. The antenna is not replaceable, nor changeable, and therefore complies with the requirements of this section.

4.2 External RF power amplifiers and antenna modifications (47 CFR 15.204)(RSS-GEN 8.3)

There are no RF power amplifier kits available to be used with the Woodstream LoRa Radio Control Unit Model V400M. There are no detachable parts of the antenna. The antenna is not replaceable, nor changeable, and therefore complies with the requirements of this section.



4.3 Restricted Bands of Operation 30 MHz - 10 GHz (47 CFR 15.205 and RSS-Gen 8.10)

The Woodstream Model V400M LoRa Radio Control Unit was tested with each of the two enclosures; Model V450 and Model V460. 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 listed in the tables below. The Woodstream Model V400M LoRa Radio Control Unit operated in non-hopping and normal hopping modes.

4.3.1 Restricted Bands of Operation 30 MHz – 1000 MHz (02/06/2020 – 02/21/2020)

4.3.1.1 Non-Hopping Mode Measurements

WOODSTREAM MODEL V400M IN THE SMALL ENCLOSURE (MODEL V450)

Frequency	Peak	QP	Polarity	TT angle	Ant Height	Correction Factors	FCC Part 15.205 Limit	Margin		Source
MHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	Result	Chan#/MHz
405.166	32.19	29.36	H	184	115	-7.73	46.02	-16.66	PASS	32/908.7
407.114	31.27	29.44	H	165	250	-7.73	46.02	-16.58	PASS	63/914.9
960.022	21.26	17.80	H	244	161	-3.47	53.98	-36.18	PASS	63/914.9

WOODSTREAM MODEL V400M IN THE LARGE ENCLOSURE (MODEL V460)

Frequency	Peak	QP	Polarity	TT angle	Ant Height	Correction Factors	FCC Part 15.205 Limit	Margin		Source
MHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	Result	Chan#/MHz
165.225	16.51	16.13	V	145	145	-7.52	43.52	-27.39	PASS	63/914.9
324.539	30.21	29.94	H	018	111	-7.96	46.02	-16.08	PASS	63/914.9
960.010	20.75	17.92	V	304	105	-3.47	53.98	-36.06	PASS	63/914.9
165.882	19.00	18.20	V	037	130	-7.58	43.52	-25.32	PASS	32/908.7
166.882	33.60	28.47	H	086	200	-7.67	43.52	-15.05	PASS	32/908.7
326.682	31.95	29.82	H	027	114	-7.97	46.02	-16.20	PASS	32/908.7
324.370	34.31	31.42	H	023	101	-7.96	46.02	-14.60	PASS	0/902.3
328.024	34.12	29.85	H	033	104	-7.98	46.02	-16.17	PASS	0/902.3
330.668	32.01	30.00	H	025	119	-7.98	46.02	-16.02	PASS	0/902.3

Test Results: The Woodstream Model V400M LoRa Radio Control Unit, in non-hopping mode, complies with the requirements of 47 CFR Part 15.205 and RSS-Gen Section 8.10 for restricted bands of operation with margin of 14.60 dB.



4.3.1.2 Normal Hopping Mode Measurements

WOODSTREAM MODEL V400M IN THE SMALL ENCLOSURE (MODEL V450)

Frequency	Peak	QP	Polarity	TT angle	Ant Height	Correction Factors	FCC Part 15.205 Limit	Margin	Results
MHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	
322.060	13.27	10.62	H	025	201	-7.94	46.02	-35.40	PASS

WOODSTREAM MODEL V400M IN THE LARGE ENCLOSURE (MODEL V460)

Frequency	Peak	QP	Polarity	TT angle	Ant Height	Correction Factors	FCC Part 15.205 Limit	Margin	Results
MHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	
165.380	12.10	10.83	V	324	129	-7.53	43.52	-32.69	PASS
960.842	18.47	15.63	H	351	103	-3.44	53.98	-38.35	PASS

Test Results: The Woodstream Model V400M LoRa Radio Control Unit, in normal, hopping mode, complies with the requirements of 47 CFR Part 15.205 and RSS-Gen Section 8.10 for restricted bands of operation with margin of 32.69 dB.



4.3.2 Restricted Bands of Operation 1 to 10 GHz (02/06/2020 – 02/21/2020)

4.3.2.2 Non-Hopping Mode

WOODSTREAM MODEL V400M IN THE SMALL ENCLOSURE (MODEL V450)

Frequency	Peak	Average	Polarity	TT angle	Ant Height	Correction Factors	FCC Part 15.205 Limit	Margin		Source
GHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	Result	Chan#/MHz
1.0005	32.89	22.44	H	045	103	-13.35	53.98	-31.54	PASS	0/902.3
1.0242	35.46	24.37	H	231	101	-13.19	53.98	-29.61	PASS	63/914.9
1.0303	33.28	23.70	H	236	170	-13.15	53.98	-30.28	PASS	32/908.7
1.0444	28.92	21.56	V	134	100	-13.05	53.98	-32.42	PASS	32/908.7
1.0495	32.88	22.29	V	106	123	-13.02	53.98	-31.69	PASS	0/902.3
1.0649	30.94	21.96	V	111	145	-12.91	53.98	-32.02	PASS	63/914.9
2.3892	35.27	24.93	V	239	175	-5.00	53.98	-29.05	PASS	32/908.7
2.7072	40.47	39.62	V	148	126	-3.37	53.98	-14.36	PASS	0/902.3
2.7075	39.74	37.25	H	053	147	-3.37	53.98	-16.73	PASS	0/902.3
2.7260	46.09	43.52	V	111	134	-3.27	53.98	-10.46	PASS	32/908.7
2.7263	45.25	45.47	H	052	101	-3.27	53.98	-8.51	PASS	32/908.7
2.7447	46.19	43.93	V	152	103	-3.16	53.98	-10.05	PASS	63/914.9
4.5119	43.07	36.28	H	149	206	1.86	53.98	-17.70	PASS	0/902.3
4.5127	41.69	33.14	V	226	116	1.86	53.98	-20.84	PASS	0/902.3
4.5457	39.78	29.50	V	159	134	1.99	53.98	-24.48	PASS	32/908.7
4.5745	42.44	33.99	V	185	190	2.10	53.98	-19.99	PASS	63/914.9
8.0901	48.42	39.24	H	316	185	7.43	53.98	-14.74	PASS	32/908.7
8.1451	49.02	39.50	H	359	141	7.50	53.98	-14.48	PASS	63/914.9
8.1776	48.88	39.31	V	105	100	7.54	53.98	-14.67	PASS	0/902.3
8.1784	52.03	42.81	V	037	120	7.54	53.98	-11.17	PASS	32/908.7
8.2344	50.83	42.21	V	217	102	7.61	53.98	-11.77	PASS	63/914.9
9.1049	50.49	39.68	H	262	153	8.84	53.98	-14.30	PASS	0/902.3



WOODSTREAM MODEL V400M IN THE LARGE ENCLOSURE (MODEL V460)

Frequency	Peak	Average	Polarity	TT angle	Ant Height	Correction Factors	FCC Part 15.205 Limit	Margin		Source
GHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	Result	Chan#/MHz
1.0492	32.18	22.63	V	360	189	-13.02	53.98	-31.35	PASS	0/902.3
1.0243	35.07	25.19	H	202	167	-13.19	53.98	-28.79	PASS	63/914.9
1.0360	32.00	21.68	V	017	108	-13.11	53.98	-32.31	PASS	63/914.9
1.0430	31.21	22.22	V	261	196	-13.06	53.98	-31.76	PASS	32/908.7
1.0532	35.07	25.59	H	183	136	-12.99	53.98	-28.39	PASS	0/902.3
1.0688	35.07	26.32	H	179	141	-12.89	53.98	-27.66	PASS	32/908.7
1.2162	30.25	21.00	H	324	135	-11.89	53.98	-32.98	PASS	63/914.9
1.3882	30.96	21.57	V	211	185	-10.73	53.98	-32.41	PASS	0/902.3
2.7068	47.68	45.41	H	023	180	-3.37	53.98	-8.57	PASS	0/902.3
2.7070	45.44	41.06	V	154	102	-3.37	53.98	-12.92	PASS	0/902.3
2.7260	45.35	41.77	V	154	100	-3.27	53.98	-12.21	PASS	32/908.7
2.7343	34.95	25.69	H	255	164	-3.22	53.98	-28.29	PASS	32/908.7
2.7445	46.67	44.40	H	139	161	-3.17	53.98	-9.58	PASS	63/914.9
2.7468	35.38	25.04	V	130	108	-3.15	53.98	-28.94	PASS	63/914.9
3.7676	38.86	28.68	V	235	113	1.01	53.98	-25.30	PASS	63/914.9
4.5112	44.17	45.18	V	245	099	1.85	53.98	-8.80	PASS	0/902.3
4.5437	45.95	40.73	V	248	203	1.98	53.98	-13.25	PASS	32/908.7
8.1257	48.71	39.31	V	254	103	7.48	53.98	-14.67	PASS	0/902.3
8.1782	53.75	47.70	V	167	197	7.54	53.98	-6.28	PASS	32/908.7

Test Results: The Woodstream Model V400M LoRa Radio Control Unit, in Non-Hopping Mode, complies with the requirements of 47 CFR Part 15.205 and RSS-Gen Section 8.10 with margin of 6.28 dB.

4.3.2.2 Normal Hopping Mode

WOODSTREAM MODEL V400M IN THE SMALL ENCLOSURE (MODEL V450)

Frequency	Peak	Average	Polarity	TT angle	Ant Height	Correction Factors	FCC Part 15.205 Limit	Margin	
GHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	Result
1.0494	31.57	21.04	V	024	132	-13.02	53.98	-32.95	PASS
1.0561	31.12	21.29	H	033	116	-12.97	53.98	-32.69	PASS
1.6710	31.29	22.62	H	054	205	-8.85	53.98	-31.36	PASS
7.5353	48.21	37.20	H	120	207	7.00	53.98	-16.78	PASS
8.0376	48.57	38.42	V	095	100	7.37	53.98	-15.56	PASS
8.0856	48.65	39.33	H	000	148	7.43	53.98	-14.65	PASS



WOODSTREAM MODEL V400M IN THE LARGE ENCLOSURE (MODEL V460)

Frequency	Peak	Average	Polarity	TT angle	Ant Height	Correction Factors	FCC Part 15.205 Limit	Margin	Result
GHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	
1.0374	31.54	20.87	V	251	121	-13.10	53.98	-33.11	PASS
1.0631	30.42	21.07	H	192	132	-12.92	53.98	-32.92	PASS
1.2180	31.69	21.09	V	351	186	-11.88	53.98	-32.89	PASS
1.3863	30.61	21.53	H	198	102	-10.75	53.98	-32.45	PASS
1.4094	30.64	21.86	V	340	182	-10.59	53.98	-32.12	PASS
2.7407	35.62	25.64	V	351	106	-3.19	53.98	-28.34	PASS
3.2665	38.04	28.17	H	097	184	-0.74	53.98	-25.81	PASS
3.8240	39.48	29.74	V	118	135	1.19	53.98	-24.24	PASS
4.5410	40.34	29.73	H	271	206	1.97	53.98	-24.25	PASS
8.0729	48.25	38.82	H	101	179	7.41	53.98	-15.16	PASS
8.4047	49.01	39.15	V	000	157	7.82	53.98	-14.83	PASS

Test Results: The Woodstream Model V400M LoRa Radio Control Unit, in Normal Hopping Mode, complies with the requirements of 47 CFR Part 15.205 and RSS-Gen Section 8.10 with margin of 14.65 dB.



4.4 Spurious Radiated Emissions 30 MHz – 10 GHz (47 CFR 15.209(a) and RSS-Gen 8.10)

SR#1

The Semi-Anechoic Shielded Room (SR#1) is an 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 80 cm high for tabletop equipment or directly on the turntable surface for floor standing equipment.

The test site complies with the attenuation measurements specified in ANSI C63.4:2014

Radiated Emissions 30MHz – 10 GHz

The EMI receiver was set to quasi-peak mode for frequencies from 30MHz to 1GHz and the appropriate CISPR bandwidths were employed. The receiver was set to average mode for frequencies above 1GHz with 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)



4.4.1 Spurious Radiated Emissions 30 MHz to 1 GHz Measurement (02/12/2020 – 02/21/2020)

The spurious signal measurements made between 30 MHz and 1 GHz are listed below, those signals which are contained in a restricted band are also displayed in Section 4.3.1.

4.4.1.1 Spurious Radiated Emissions 30 MHz to 1 GHz Measurement Non-Hopping Mode

WOODSTREAM MODEL V400M IN THE SMALL ENCLOSURE (MODEL V450)

Frequency	Peak	QP	Polarity	TT angle	Ant Height	Correction Factors	FCC Part 15.209 Limit	Margin		Source
MHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	Result	Chan#/MHz
370.353	34.12	34.63	H	217	101	-7.81	46.02	-11.39	PASS	32/908.7
373.841	34.46	33.96	H	197	101	-7.76	46.02	-12.06	PASS	63/914.9
374.335	33.72	32.65	H	210	100	-7.75	46.02	-13.37	PASS	32/908.7
376.115	37.44	35.60	H	207	102	-7.74	46.02	-10.42	PASS	32/908.7
376.668	38.10	34.98	H	186	109	-7.74	46.02	-11.04	PASS	0/902.3
385.999	34.68	32.81	H	202	102	-7.72	46.02	-13.21	PASS	63/914.9
393.521	33.77	31.00	H	188	103	-7.74	46.02	-15.02	PASS	0/902.3
395.556	31.41	31.05	H	161	105	-7.74	46.02	-14.97	PASS	32/908.7
398.443	34.62	31.61	H	180	104	-7.71	46.02	-14.41	PASS	63/914.9
405.166	32.19	29.36	H	184	115	-7.73	46.02	-16.66	PASS	32/908.7
410.368	31.73	30.78	H	190	250	-7.72	46.02	-15.24	PASS	63/914.9
411.027	30.80	29.58	H	191	255	-7.73	46.02	-16.44	PASS	32/908.7
413.182	28.04	27.19	H	215	100	-7.75	46.02	-18.83	PASS	32/908.7
477.440	38.35	36.64	H	201	203	-7.83	46.02	-9.38	PASS	63/914.9
479.873	37.82	35.99	H	192	158	-7.77	46.02	-10.03	PASS	63/914.9
483.337	38.25	36.80	H	189	205	-7.72	46.02	-9.22	PASS	32/908.7
483.569	38.10	35.14	H	184	203	-7.72	46.02	-10.88	PASS	0/902.3
500.085	34.21	32.34	H	159	203	-7.21	46.02	-13.68	PASS	0/902.3
502.385	35.81	34.61	H	175	166	-7.17	46.02	-11.41	PASS	63/914.9
505.022	38.93	37.22	H	180	172	-7.12	46.02	-8.80	PASS	0/902.3
507.845	39.09	37.03	H	180	171	-6.99	46.02	-8.99	PASS	0/902.3
512.125	39.08	35.92	H	174	177	-6.87	46.02	-10.10	PASS	0/902.3
514.321	37.28	35.46	H	185	176	-6.84	46.02	-10.56	PASS	0/902.3
517.169	32.11	32.15	H	174	161	-6.78	46.02	-13.87	PASS	32/908.7
519.751	34.85	33.23	H	197	220	-6.73	46.02	-12.79	PASS	0/902.3



WOODSTREAM MODEL V400M IN THE LARGE ENCLOSURE (MODEL V460)

Frequency	Peak	QP	Polarity	TT angle	Ant Height	Correction Factors	FCC Part 15.209 Limit	Margin		Source
MHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	Result	Chan#/MHz
395.412	33.25	31.12	H	014	108	-7.74	46.02	-14.90	PASS	63/914.9
422.595	34.85	32.48	H	014	214	-7.82	46.02	-13.54	PASS	63/914.9
425.602	33.27	33.34	H	016	225	-7.83	46.02	-12.68	PASS	63/914.9
445.404	34.53	34.17	H	000	240	-7.98	46.02	-11.85	PASS	32/908.7
448.047	38.64	36.21	H	022	235	-8.00	46.02	-9.81	PASS	32/908.7
451.480	35.99	35.83	H	036	235	-8.03	46.02	-10.19	PASS	0/902.3
457.301	40.91	39.18	H	008	188	-8.05	46.02	-6.84	PASS	32/908.7
463.260	42.97	39.90	H	000	198	-8.06	46.02	-6.12	PASS	63/914.9
466.099	40.84	39.34	H	000	203	-8.04	46.02	-6.68	PASS	63/914.9
466.699	39.74	39.74	H	014	194	-8.03	46.02	-6.28	PASS	32/908.7
469.394	33.40	31.55	V	113	229	-7.97	46.02	-14.47	PASS	32/908.7
471.016	39.60	38.19	H	000	248	-7.94	46.02	-7.83	PASS	0/902.3
471.840	32.39	32.12	V	107	225	-7.93	46.02	-13.90	PASS	63/914.9
472.282	34.04	33.20	V	105	225	-7.92	46.02	-12.82	PASS	32/908.7
474.849	33.57	33.47	V	100	222	-7.88	46.02	-12.55	PASS	32/908.7
478.344	39.12	37.38	H	193	192	-7.81	46.02	-8.64	PASS	63/914.9
479.226	38.77	38.05	H	203	203	-7.79	46.02	-7.97	PASS	32/908.7
481.408	34.22	31.81	V	116	225	-7.75	46.02	-14.21	PASS	32/908.7
482.900	35.96	35.06	H	022	197	-7.73	46.02	-10.96	PASS	0/902.3
502.342	35.73	35.39	H	046	177	-7.17	46.02	-10.63	PASS	0/902.3
515.777	34.78	33.57	H	324	200	-6.81	46.02	-12.45	PASS	63/914.9
520.376	40.35	37.24	H	321	172	-6.71	46.02	-8.78	PASS	32/908.7
528.000	36.87	35.69	H	319	162	-6.52	46.02	-10.33	PASS	0/902.3

Test Results: The Woodstream Model V400M LoRa Radio Control Unit, in Non-Hopping Mode, complies with the requirements of 47 CFR Part 15.209 and RSS-Gen Section 8.10 with a margin of 6.12 dB.



4.4.1.2 Spurious Radiated Emissions 30 MHz to 1 GHz Measurement Normal Hopping Mode

WOODSTREAM MODEL V400M IN THE SMALL ENCLOSURE (MODEL V450)

Frequency MHz	Peak dBuV/m	QP dBuV/m	Polarity H/V	TT angle degrees	Ant Height cm	Correction Factors dB	FCC Part 15.209 Limit dBuV/m	Margin dB	Results
30.366	20.53	18.06	H	081	119	-0.67	40.00	-21.94	PASS
30.983	22.61	17.65	V	295	210	-0.97	40.00	-22.35	PASS
157.746	11.81	11.26	V	111	120	-7.18	43.52	-32.26	PASS
214.525	11.33	10.17	V	155	223	-7.98	43.52	-33.35	PASS
316.844	19.00	15.22	H	036	107	-7.99	46.02	-30.80	PASS
379.996	17.67	15.39	H	193	203	-7.74	46.02	-30.63	PASS
399.397	16.03	13.42	H	173	187	-7.70	46.02	-32.60	PASS
415.812	14.87	11.71	H	190	192	-7.78	46.02	-34.31	PASS
426.356	14.45	12.84	H	181	103	-7.83	46.02	-33.18	PASS
476.693	20.89	17.31	H	202	212	-7.84	46.02	-28.71	PASS
477.494	14.53	12.44	V	295	221	-7.83	46.02	-33.58	PASS
479.810	14.52	12.05	V	336	192	-7.77	46.02	-33.97	PASS
486.291	35.18	18.79	H	170	217	-7.67	46.02	-27.23	PASS
498.907	22.69	20.08	H	188	212	-7.25	46.02	-25.94	PASS
512.146	15.32	12.82	V	098	104	-6.87	46.02	-33.20	PASS
540.008	16.18	14.31	V	313	156	-6.41	46.02	-31.71	PASS
552.479	10.37	12.34	V	271	204	-6.33	46.02	-33.68	PASS
849.140	17.23	14.74	V	269	192	-4.42	46.02	-31.28	PASS
958.863	18.92	15.53	V	215	171	-3.48	46.02	-30.49	PASS



WOODSTREAM MODEL V400M IN THE LARGE ENCLOSURE (MODEL V460)

Frequency	Peak	QP	Polarity	TT angle	Ant Height	Correction Factors	FCC Part 15.209 Limit	Margin	Results
MHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	
30.374	19.75	17.92	V	236	183	-0.67	40.00	-22.08	PASS
30.471	20.28	17.85	H	289	224	-0.72	40.00	-22.15	PASS
202.469	12.37	11.00	V	098	124	-7.20	43.52	-32.52	PASS
295.543	12.42	11.87	H	359	185	-8.10	46.02	-34.15	PASS
434.411	11.48	11.26	V	105	255	-7.96	46.02	-34.76	PASS
450.664	17.98	15.09	H	060	243	-8.02	46.02	-30.93	PASS
459.429	18.52	14.77	H	201	114	-8.06	46.02	-31.25	PASS
461.191	16.95	15.44	H	186	136	-8.06	46.02	-30.58	PASS
472.021	20.18	17.87	H	360	225	-7.93	46.02	-28.15	PASS
477.947	19.26	25.63	H	197	108	-7.82	46.02	-20.39	PASS
486.538	15.02	11.85	V	142	152	-7.67	46.02	-34.17	PASS
508.146	13.07	12.44	V	254	208	-6.98	46.02	-33.58	PASS
521.116	13.94	12.97	V	306	177	-6.69	46.02	-33.05	PASS
573.457	17.07	13.66	V	325	109	-6.23	46.02	-32.36	PASS
582.043	12.69	13.39	V	290	121	-6.21	46.02	-32.63	PASS
588.639	14.87	13.44	V	319	140	-6.11	46.02	-32.58	PASS
589.318	15.31	14.50	H	359	108	-6.10	46.02	-31.52	PASS
904.003	14.98	15.29	H	274	249	-4.07	46.02	-30.73	PASS

Test Results: The Woodstream Model V400M LoRa Radio Control Unit, in Normal Hopping Mode, complies with the requirements of 47 CFR Part 15.209 and RSS-Gen Section 8.10 with a margin of 20.39 dB.



4.4.2 Spurious Radiated Emissions 1 to 10 GHz Test Results (02/06/2020 – 02/21/2020)

The spurious signal measurements made between 1 GHz and 10 GHz are listed below, those signals which are contained in a restricted band are also displayed in Section 4.3.2.

4.4.2.1 Spurious Radiated Emissions 1 to 10 GHz Measurement Non-Hopping Mode

WOODSTREAM MODEL V400M IN THE SMALL ENCLOSURE (MODEL V450)

Frequency	Peak	Average	Polarity	TT angle	Ant Height	Correction Factors	FCC Part 15.209 Limit	Margin		Source
GHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	Result	Chan#/MHz
1.8044	48.08	47.38	V	111	191	-7.98	53.98	-6.60	PASS	0/902.3
1.8045	44.34	38.48	H	128	101	-7.98	53.98	-15.50	PASS	0/902.3
1.8174	48.64	47.41	V	239	103	-7.89	53.98	-6.57	PASS	32/908.7
1.8174	47.53	45.86	H	113	101	-7.89	53.98	-8.12	PASS	32/908.7
1.8297	49.92	48.60	V	109	172	-7.81	53.98	-5.38	PASS	63/914.9
1.8297	46.05	44.54	H	115	100	-7.81	53.98	-9.44	PASS	63/914.9
2.1627	32.81	24.57	V	360	196	-5.98	53.98	-29.41	PASS	32/908.7
2.4082	35.92	25.43	V	351	181	-4.92	53.98	-28.55	PASS	0/902.3
2.4089	35.26	26.09	H	290	126	-4.92	53.98	-27.89	PASS	0/902.3
2.4141	33.84	25.01	H	142	102	-4.89	53.98	-28.97	PASS	32/908.7
2.4159	33.57	24.91	H	180	102	-4.88	53.98	-29.07	PASS	63/914.9
2.4196	35.62	25.25	V	200	189	-4.87	53.98	-28.73	PASS	63/914.9
3.5077	39.52	28.40	V	236	129	0.17	53.98	-25.58	PASS	0/902.3
3.5178	39.03	28.92	V	178	190	0.21	53.98	-25.06	PASS	63/914.9
3.5262	37.99	28.49	H	230	183	0.23	53.98	-25.49	PASS	63/914.9
3.5270	37.69	28.91	H	337	107	0.24	53.98	-25.07	PASS	0/902.3



WOODSTREAM MODEL V400M IN THE LARGE ENCLOSURE (MODEL V460)

Frequency	Peak	Average	Polarity	TT angle	Ant Height	Correction Factors	FCC Part 15.209 Limit	Margin		Source
GHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	Result	Chan#/MHz
1.8045	46.61	44.56	H	132	174	-7.98	53.98	-9.42	PASS	0/902.3
1.8046	47.67	46.54	V	241	143	-7.98	53.98	-7.44	PASS	0/902.3
1.8173	47.26	46.09	V	248	119	-7.89	53.98	-7.90	PASS	32/908.7
1.8174	46.97	45.54	H	308	106	-7.89	53.98	-8.44	PASS	32/908.7
1.8298	47.71	46.26	V	247	101	-7.81	53.98	-7.72	PASS	63/914.9
1.8299	46.59	45.31	H	308	113	-7.81	53.98	-8.67	PASS	63/914.9
2.4042	35.03	25.58	V	161	150	-4.94	53.98	-28.40	PASS	32/908.7
2.4097	35.07	25.46	H	091	101	-4.91	53.98	-28.52	PASS	0/902.3
2.4098	34.98	25.56	V	014	143	-4.91	53.98	-28.42	PASS	63/914.9
2.4146	34.02	24.89	H	354	183	-4.89	53.98	-29.09	PASS	63/914.9
2.4147	35.28	25.24	V	360	140	-4.89	53.98	-28.74	PASS	0/902.3
2.4159	34.83	24.82	H	280	103	-4.89	53.98	-29.16	PASS	32/908.7
3.5191	38.27	28.63	V	175	127	0.21	53.98	-25.35	PASS	63/914.9
3.5328	38.04	28.84	V	302	160	0.26	53.98	-25.15	PASS	32/908.7
4.3025	38.69	29.27	V	239	200	1.79	53.98	-24.71	PASS	63/914.9
8.2338	50.36	48.95	V	333	171	7.61	53.98	-5.03	PASS	63/914.9
8.5143	48.46	39.01	H	084	115	7.97	53.98	-14.97	PASS	0/902.3
8.6795	48.32	39.34	H	184	134	8.27	53.98	-14.64	PASS	32/908.7

Test Results: The Woodstream Model V400M LoRa Radio Control Unit, in Non-Hopping Mode, complies with the requirements of 47 CFR Part 15.209 and RSS-Gen Section 8.10 with a margin of 5.03 dB.



4.4.2.2 Spurious Radiated Emissions 1 to 10 GHz Measurement Normal Hopping Mode

WOODSTREAM MODEL V400M IN THE SMALL ENCLOSURE (MODEL V450)

Frequency	Peak	Average	Polarity	TT angle	Ant Height	Correction Factors	FCC Part 15.209 Limit	Margin	Result
GHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	
1.4309	32.13	21.97	H	231	209	-10.45	53.98	-32.01	PASS
1.4324	31.59	21.87	V	108	135	-10.44	53.98	-32.11	PASS
1.9616	33.90	23.88	H	321	181	-6.94	53.98	-30.10	PASS
2.1002	34.94	24.40	V	332	198	-6.26	53.98	-29.58	PASS
2.1536	34.60	25.01	H	355	120	-6.02	53.98	-28.97	PASS
2.4144	37.15	25.41	H	324	109	-4.89	53.98	-28.57	PASS
2.4186	35.38	25.26	V	229	163	-4.87	53.98	-28.72	PASS
2.5694	34.73	25.07	H	125	106	-4.14	53.98	-28.91	PASS
2.6049	34.80	25.59	V	270	103	-3.94	53.98	-28.39	PASS
3.2275	37.37	28.22	V	334	158	-0.89	53.98	-25.76	PASS
3.5345	38.87	28.57	V	030	208	0.26	53.98	-25.41	PASS
4.8415	41.86	31.03	V	146	113	3.16	53.98	-22.95	PASS
6.8045	44.79	35.25	V	111	180	5.09	53.98	-18.73	PASS
9.8159	47.86	39.29	H	276	170	8.76	53.98	-14.69	PASS

WOODSTREAM MODEL V400M IN THE LARGE ENCLOSURE (MODEL V460)

Frequency	Peak	Average	Polarity	TT angle	Ant Height	Correction Factors	FCC Part 15.209 Limit	Margin	Result
GHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	
1.8109	31.91	23.30	H	059	180	-7.93	53.98	-30.68	PASS
2.0068	33.45	23.45	V	010	160	-6.66	53.98	-30.53	PASS
2.0952	32.86	24.02	V	114	152	-6.28	53.98	-29.96	PASS
2.4102	34.22	25.44	H	184	102	-4.91	53.98	-28.54	PASS
2.4341	34.65	24.87	V	127	103	-4.81	53.98	-29.11	PASS
2.6124	35.83	25.14	V	177	208	-3.90	53.98	-28.84	PASS
3.5752	39.22	28.56	H	335	179	0.39	53.98	-25.42	PASS
8.7235	47.50	38.90	H	358	125	8.35	53.98	-15.08	PASS
9.9905	50.81	39.68	H	214	148	8.74	53.98	-14.30	PASS

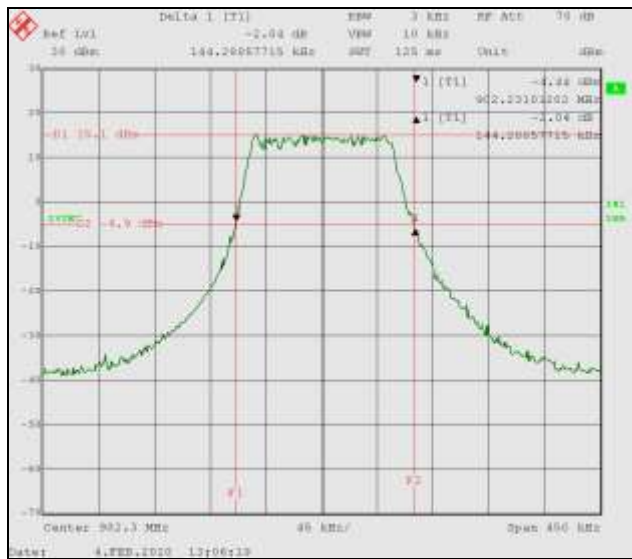
Test Results: The Woodstream Model V400M LoRa Radio Control Unit, in Normal Hopping Mode, complies with the requirements of 47 CFR Part 15.209 and RSS-Gen Section 8.10 with a margin of 14.30 dB.



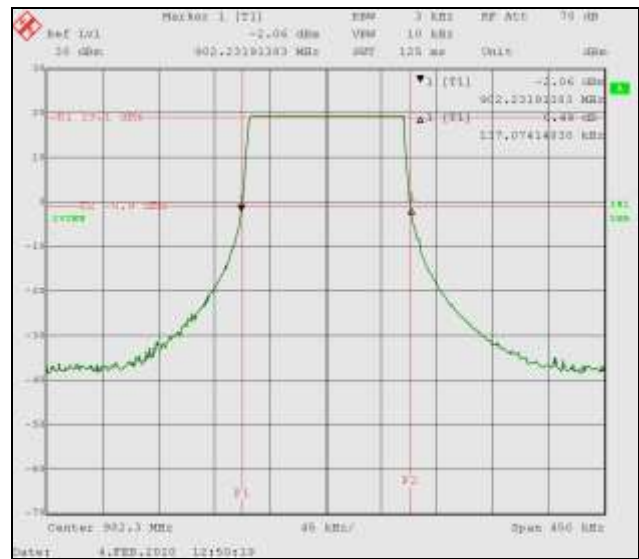
4.5 20 dB Bandwidth Measurement 47 CFR 15.247(a)(1) and RSS-247 Section (5.1)(c) (02/04/2020)

The Woodstream Model V400M LoRa Radio Control Unit was connected to a spectrum analyzer, through the SMA connector attached to the transmitter output. Measurements were made, using a peak detector, at low, middle and high channels at the lowest and highest Spread Factor options of LoRa Modulation. The transmitter was set to its highest output level.

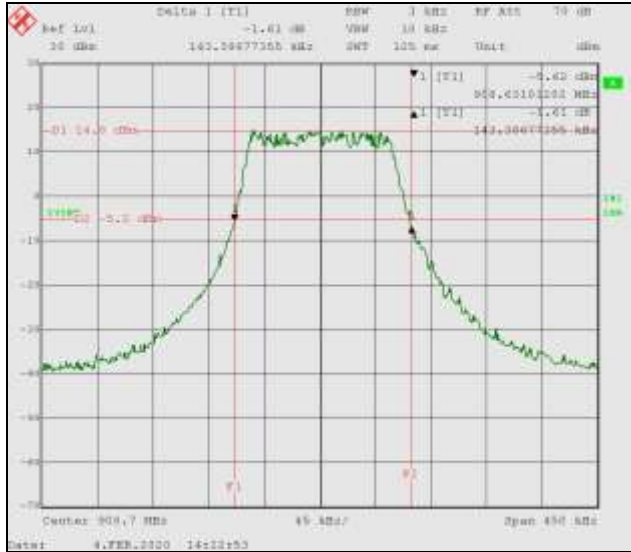
TX Channel	Spread Factor	Modulation	Frequency (MHz)	Measured 20 dB BW (kHz)	RSS-247 & FCC BW Limit (kHz)	Margin
0	Spread = 7	LoRa	902.3	144.29	500.00	-355.71
32	Spread = 7		908.7	143.39	500.00	-356.61
63	Spread = 7		914.9	143.39	500.00	-356.61
0	Spread = 12	LoRa	902.3	137.07	500.00	-362.93
32	Spread = 12		908.7	135.27	500.00	-364.73
63	Spread = 12		914.9	136.17	500.00	-363.83



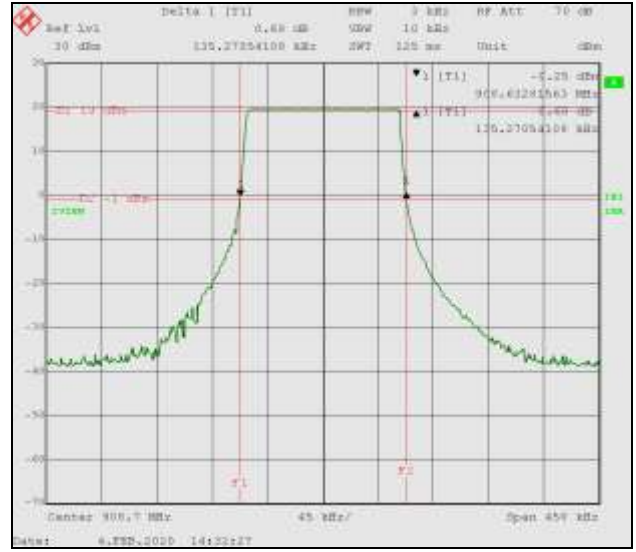
Channel 0, Spread = 7



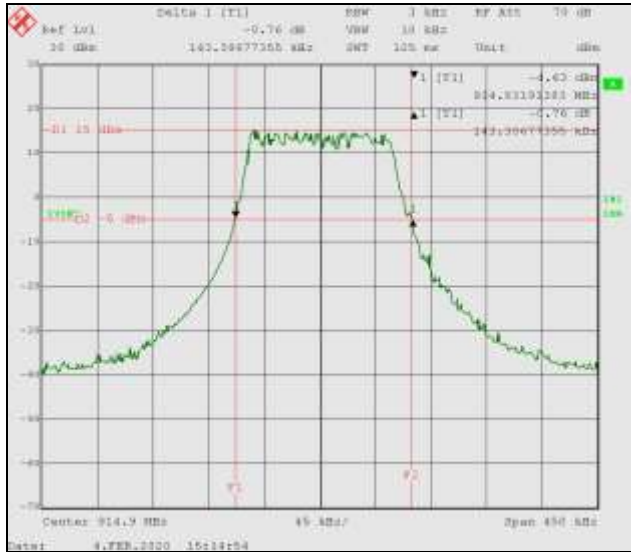
Channel 0, Spread = 12



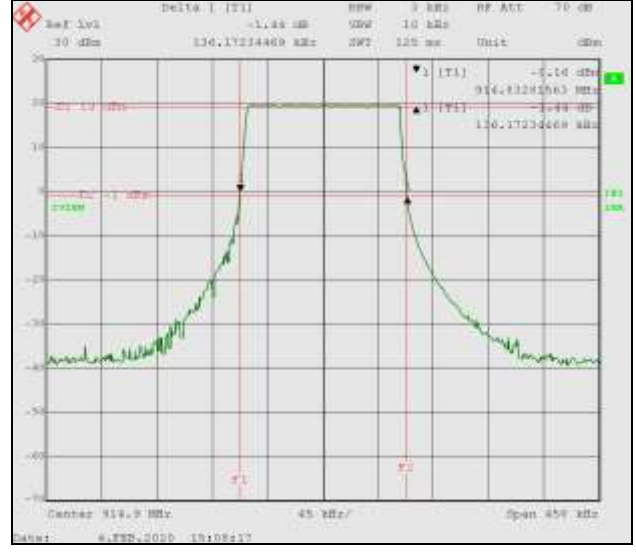
Channel 32, Spread = 7



Channel 32, Spread = 12



Channel 63, Spread = 7



Channel 63, Spread = 12

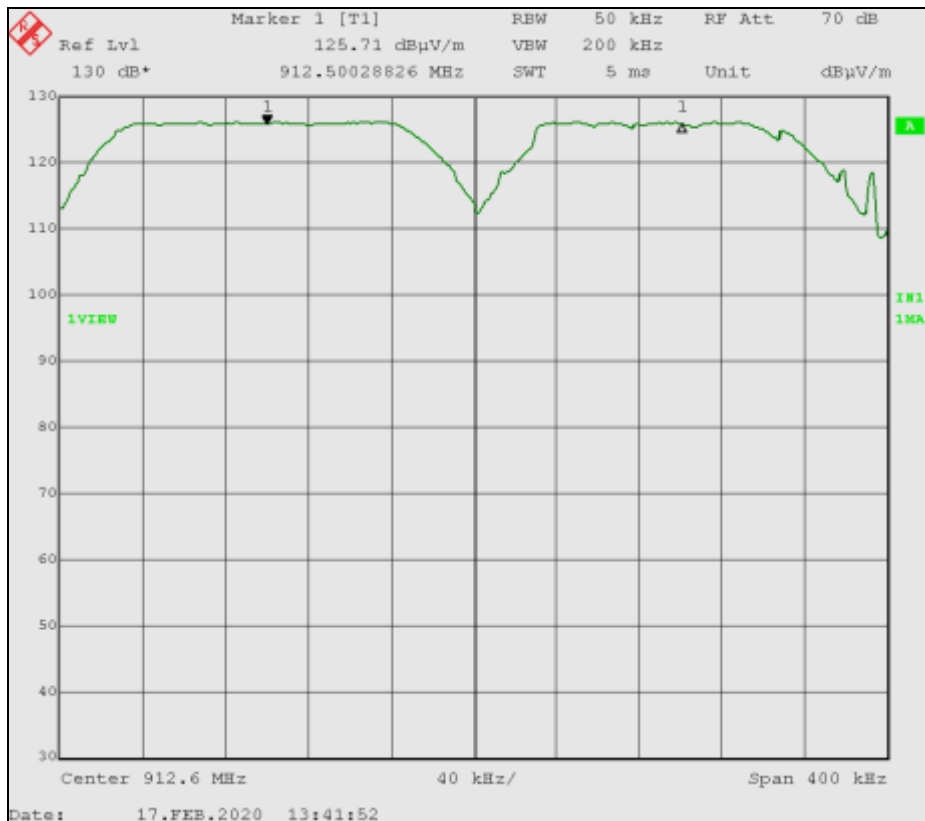
Test Results: The Woodstream Model V400M LoRa Radio Control Unit complies with the requirements of 47 CFR Part 15.247 (1) (a) and RSS-247 Section 5.1.3. Measurements made at low, middle and high channels, with minimum and maximum Spread Factors, are compliant to the 20 dB bandwidth limit of 500 kHz.



4.6 Carrier Frequency Separation 47 CFR 15.247(a)(1) RSS-247 (5.1)(c) (02/17/2020)

Hopping Channels must be separated by a minimum of 25 kHz or the 20 dB bandwidth whichever is greater.

Hopping Channel	Channel Frequency	Channel Separation (Marker 1 - Delta 1)	Minumum Separation Limit (20 dB Bandwidth)	Margin
#	MHz	kHz	kHz	kHz
51	912.5	200.3	135.27	65.03
52	912.7			

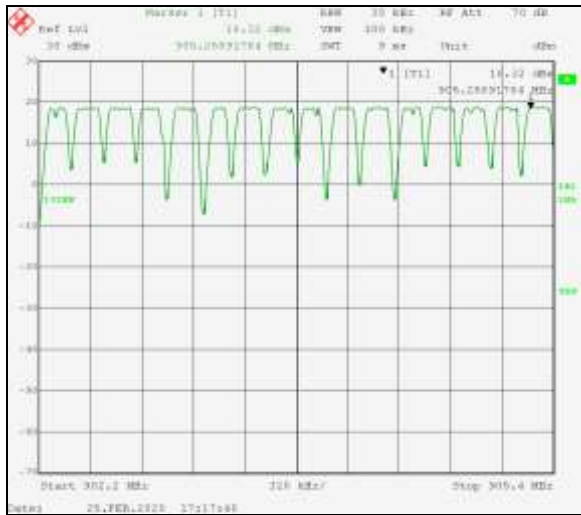


Test Results: The spacing between adjacent, hopping, channels of the Woodstream Model V400M LoRa Radio Control Unit are 200.3 kHz. This value is greater than the minimum separation of 135.27 kHz (20 dB bandwidth). 47 CFR Part 15.247 (a) (1) specifies a channel separation greater than 25 kHz or the 20 dB Bandwidth, whichever is greater. The Woodstream Model V400M LoRa Radio Control Unit complies with the requirement.

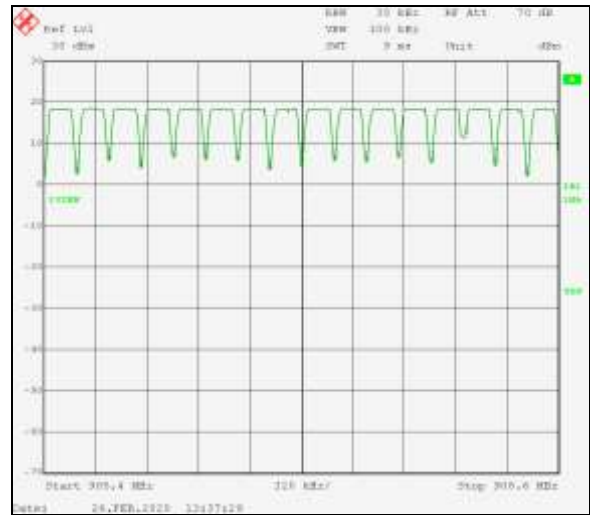


4.7 Number of Hopping Frequencies 47 CFR 15.247(a)(1)(iii), RSS-247 (5.1)(c) (02/25/2020 and 02/26/2020)

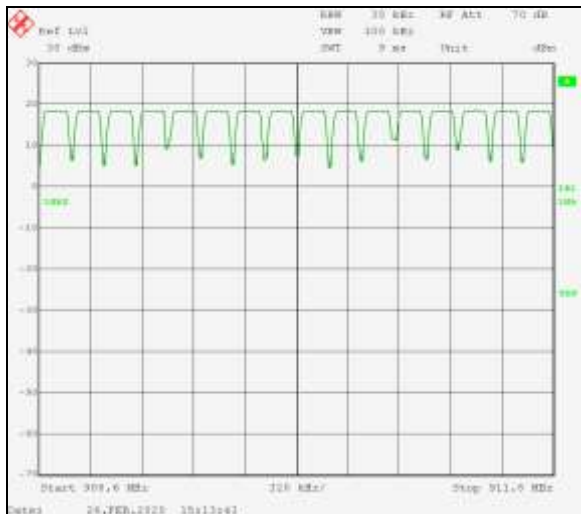
Section 2.9 contains the table of 64 hopping frequencies used by the Woodstream Model V400M LoRa Radio Control Unit. The Spectrum Analyzer screens below show the hopping frequencies in a Max Hold function.



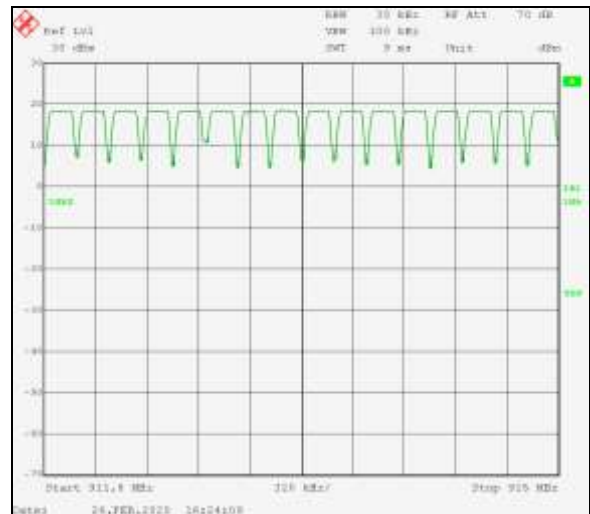
Channels 0-15 (902.3 MHz to 905.3 MHz)



Channels 16-31 (905.4 MHz to 908.6 MHz)



Channels 32-47 (908.6 MHz to 911.8 MHz)



Channels 48-63 (911.8 MHz to 915.0 MHz)

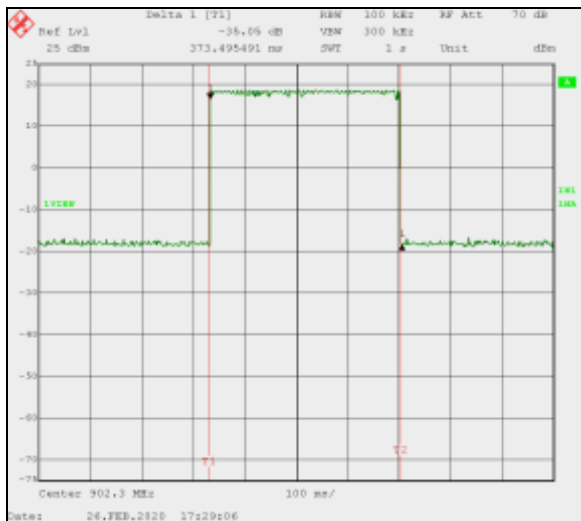
Test Results: The 64 Hopping Channels measured complies with the requirement of 47 CFR Part 15.247(a) (1) (i) and RSS-247 by using at least 50 hopping channels for a device with a 20 dB bandwidth less than 250 kHz.



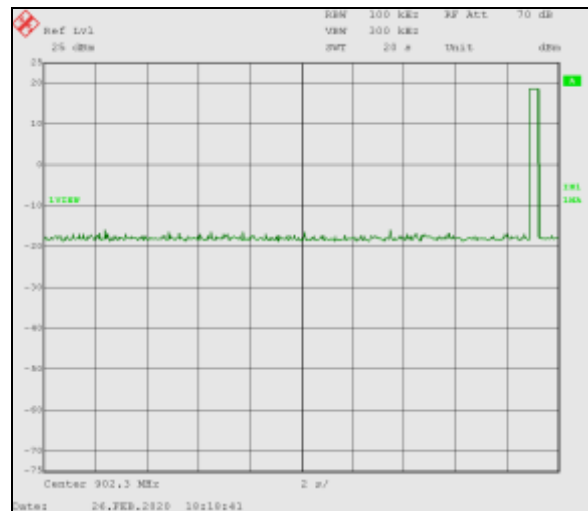
4.8 Time of Occupancy (Dwell Time) 47 CFR 15.247(a)(1)(i) RSS-247 (5.1)(c) (02/26/2020)

Section (a)(1)(iii) of 15.247 requires the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. Below are spectrum analyzer screens at low, middle and high frequencies that demonstrate the dwell time and period. LoRa Modulation Spread Factor value had no effect on Time of Occupancy.

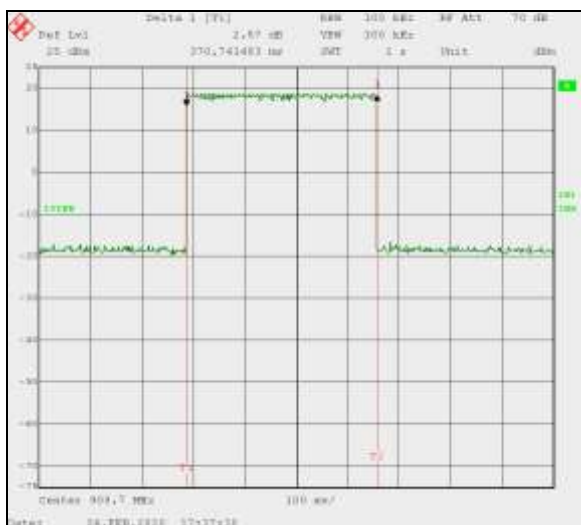
Channel	Modulation	Freq (MHz)	Measured Dwell Time (msec)	FCC Part 15.247 & RSS-247 Limit (msec)	Margin (msec)
0	LoRa	902.3	373.49	400	-26.51
32		908.7	370.74	400	-29.26
63		914.9	372.75	400	-27.25



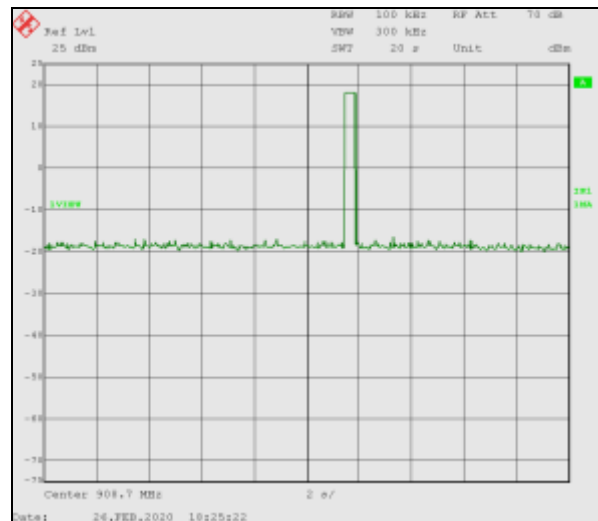
Channel 0, 902.3 MHz Dwell



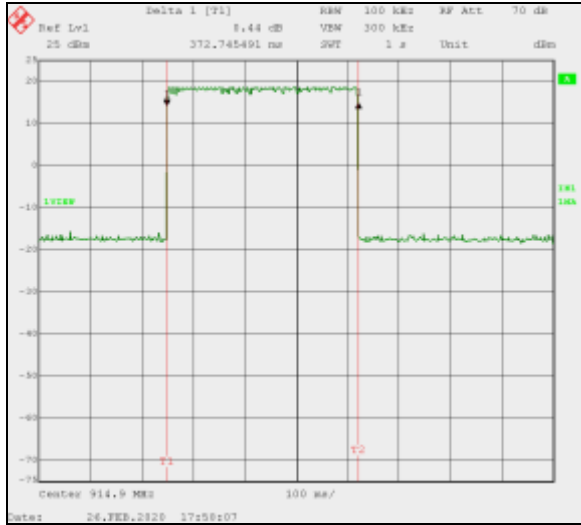
Channel 0, 902.3 MHz period



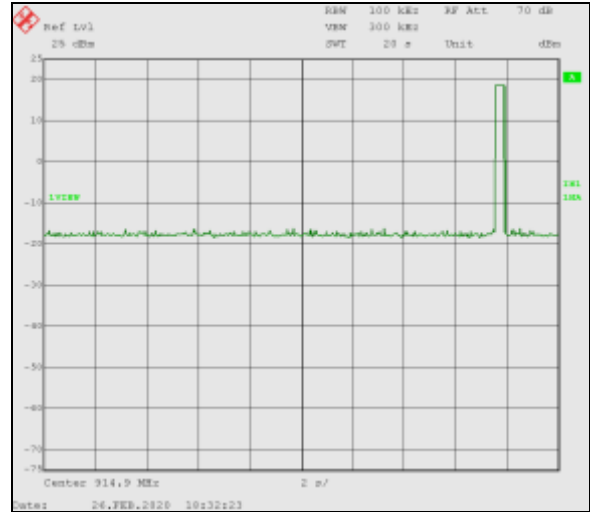
Channel 32, 908.7 MHz Dwell



Channel 32, 908.7 MHz Period



Channel 64, 914.9 MHz Dwell



Channel 64, 914.9 MHz Period

Test Results: The average dwell time is less than 400 msec and the period is greater than 10 seconds. The Woodstream Model V400M LoRa Radio Control Unit is compliant to the required parameters of 47 CFR Part 15.247 (a) (1) (i) and RSS-247.



4.9 Maximum Conducted Output Power and EIRP (FCC Part 15.247(b)(3), RSS-247 Section 5.4(d))

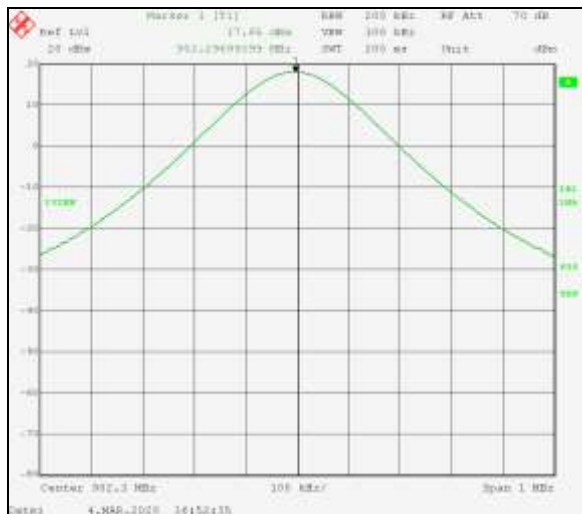
4.9.1 Maximum Conducted Output Power Test Procedure

Measurements of the Maximum Peak Power Output of the Woodstream Model V400M LoRa Radio Control Unit were made with the spectrum analyzer connected directly to the transmitter output in place of the antenna. The table contains the power levels for modulation schemes at low, middle and high frequencies.

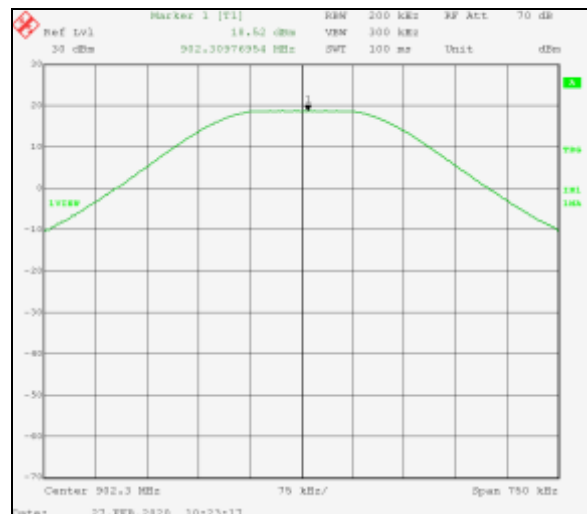
4.9.2 Maximum Conducted Output Power Test Results (02/04/2020)

Channel	Modulation	Frequency (MHz)	Measured Level (dBm)	Cable # 814 Loss (dB)	Total		Limit		Margin	
					dBm	Watts	dBm	Watts	dBm	Watts
0	Unmodulated	902.3	17.85	0.37	18.22	0.066	30.00	1.000	-11.78	-0.934
32		908.7	17.81	0.38	18.19	0.066	30.00	1.000	-11.81	-0.934
63		914.9	17.80	0.38	18.18	0.066	30.00	1.000	-11.82	-0.934
0	LoRa 125 kHz BW SF=7	902.3	18.52	0.37	18.89	0.077	30.00	1.000	-11.11	-0.923
32		908.7	18.35	0.38	18.73	0.075	30.00	1.000	-11.27	-0.925
63		914.9	18.31	0.38	18.69	0.074	30.00	1.000	-11.31	-0.926
0	LoRa 125 kHz BW SF=12	902.3	18.39	0.37	18.76	0.075	30.00	1.000	-11.24	-0.925
32		908.7	18.32	0.38	18.70	0.074	30.00	1.000	-11.30	-0.926
63		914.9	18.32	0.38	18.70	0.074	30.00	1.000	-11.30	-0.926

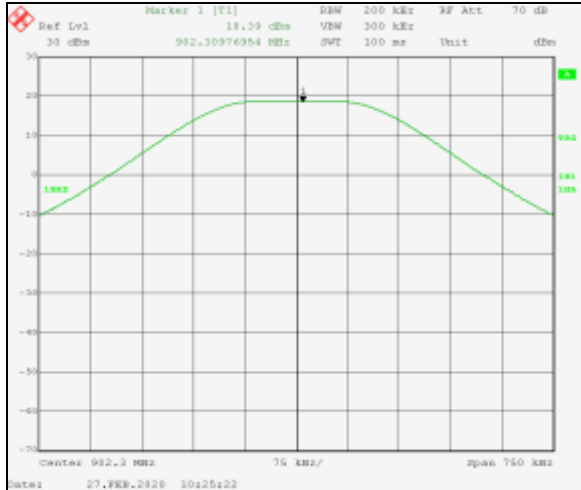
Below are the spectrum analyzer screens of the peak output power measurements.



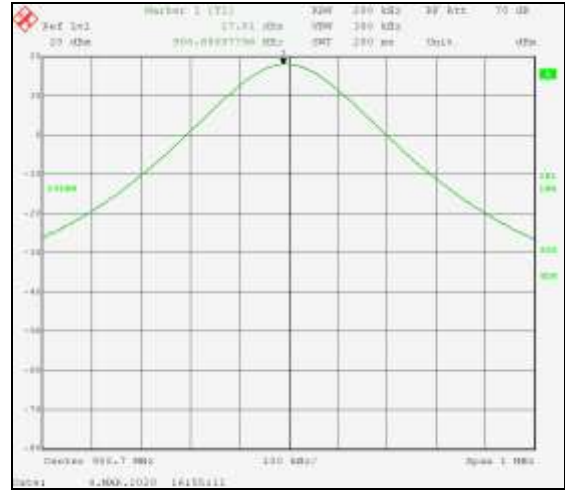
Channel 0, 902.3 MHz Unmodulated



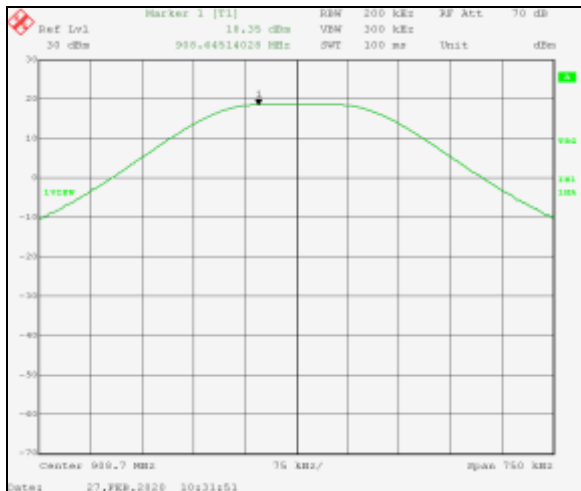
Channel 0, 902.3 MHz, LoRa Modulation SF=7



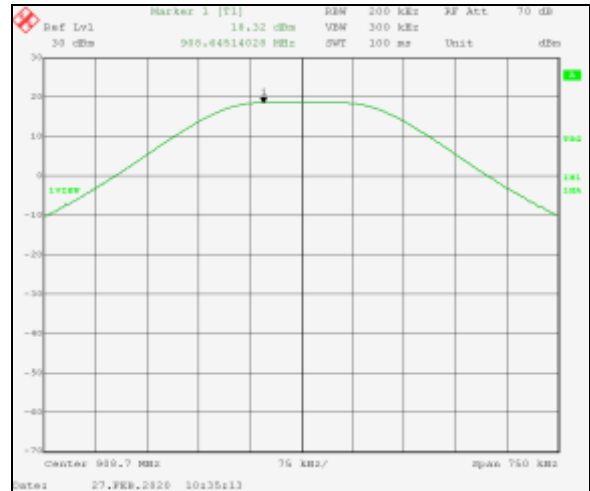
Channel 0, 902.3 MHz, LoRa Modulation
SF=12



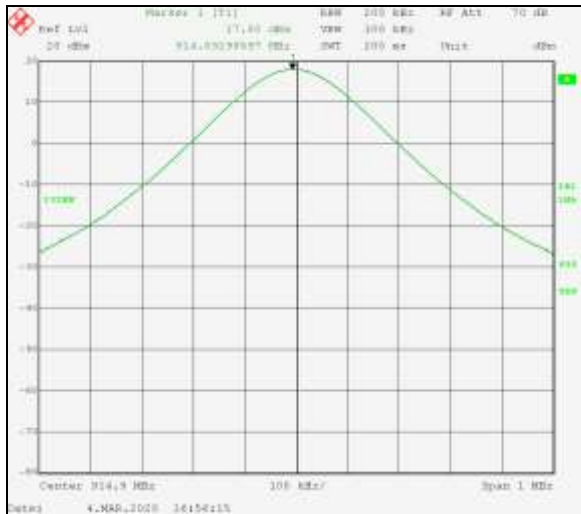
Channel 32, 908.7 MHz, Un-modulated



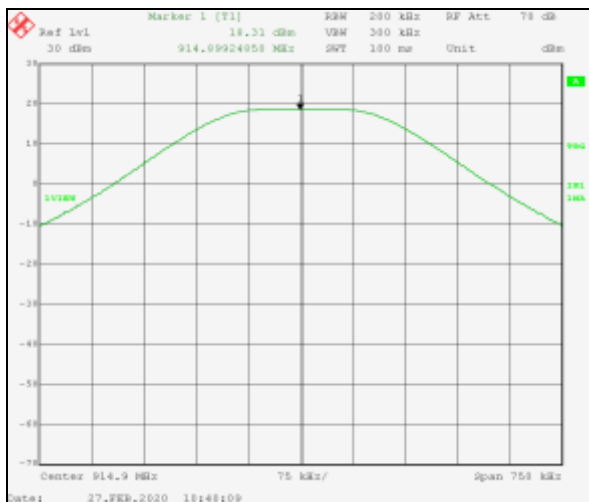
Channel 32, 908.7 MHz, LoRa Modulation
SF=7



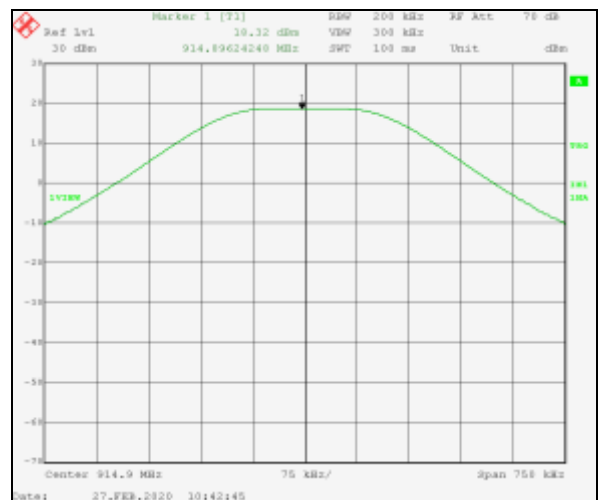
Channel 32, 908.7 MHz, LoRa Modulation
SF=12



Channel 63, 914.9 MHz, Un-modulated



Channel 63, 914.9 MHz, LoRa Modulation SF=7



Channel 63, 914.9 MHz, LoRa Modulation SF=

Test Results: The peak output power of the Woodstream Model V400M LoRa Radio Control Unit varied .67 dB between channels and modulations. The highest levels were measured un-modulated at Channel 0 and LoRa modulated at Channel 0. The maximum peak power output level was compliant to the 1 Watt limit imposed by 47 CFR Part 15.247 (b) (2).



4.9.3 EIRP Calculation RSS-247 (02/04/2020)

The gain of the antenna, used in the Woodstream Model V400M LoRa Radio Control Unit is 3.0 dB. Applying the antenna gain to the maximum peak transmitter output produces the following values of EIRP.

Channel	Modulation and Settings	Frequency (MHz)	Transmitter Output Total		Antenna Gain		EIRP		EIRP Limit	Margin
			dBm	Watts	Isotropic	Numeric	dBm	Watts	Watts	Watts
0	Unmodulated	902.3	18.22	0.066	3.00	1.995	21.22	0.132	4.00	-3.868
32		908.7	18.19	0.066	3.00	1.995	21.19	0.132	4.00	-3.868
63		914.9	18.18	0.066	3.00	1.995	21.18	0.131	4.00	-3.869
0	LoRa 125 kHz BW SF=7	902.3	18.89	0.077	3.00	1.995	21.89	0.155	4.00	-3.845
32		908.7	18.73	0.075	3.00	1.995	21.73	0.149	4.00	-3.851
63		914.9	18.69	0.074	3.00	1.995	21.69	0.148	4.00	-3.852
0	LoRa 125 kHz BW SF=12	902.3	18.76	0.075	3.00	1.995	21.76	0.150	4.00	-3.850
32		908.7	18.70	0.074	3.00	1.995	21.70	0.148	4.00	-3.852
63		914.9	18.70	0.074	3.00	1.995	21.70	0.148	4.00	-3.852

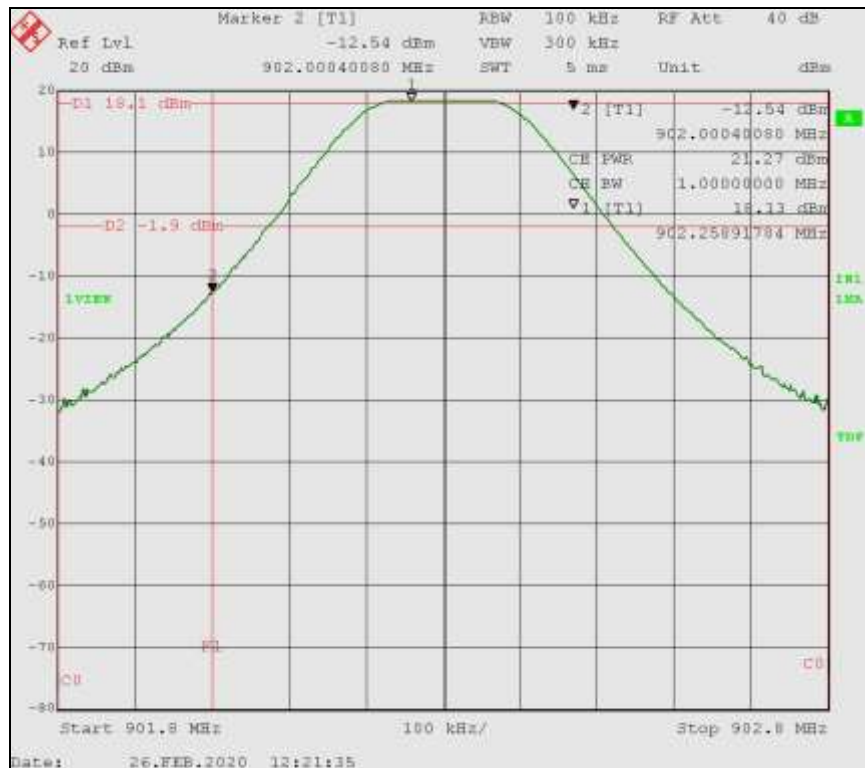
The results in the above table show compliance to the ISED requirements for EIRP limits per RSS-247.



4.10 Band Edge Measurement 47 CFR 15.247(d) and RSS-247 (5.5) (02/26/2020)

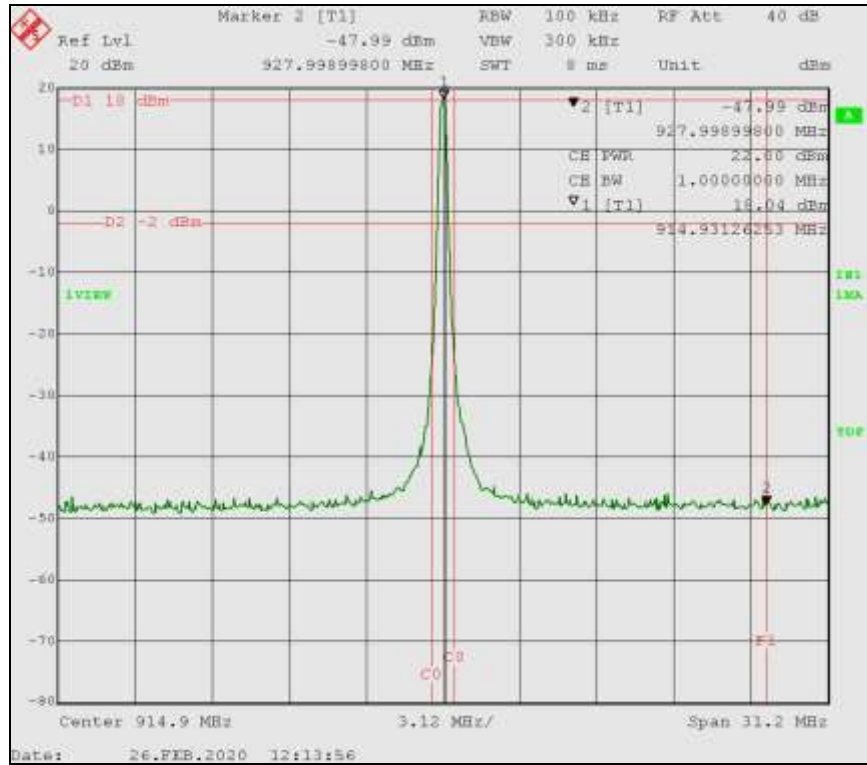
Band edge measurements were recorded on the EUT while operating with a modulated carrier at 902.3 MHz (Channel 0). This frequency is the emission that falls within 2 MHz of the lower band edge of the operating bandwidth of the device. The Band Edge measurements were made using the Integration Method of Section 11.13.3.2 of ANSI C63.10. The Spectrum Analyzer Screens below show emissions between the modulated carrier, at low and high frequencies and the lower and upper band edges.

Low Channel 0, 902.3 MHz, 125 kHz BW, Spread Factor = 7

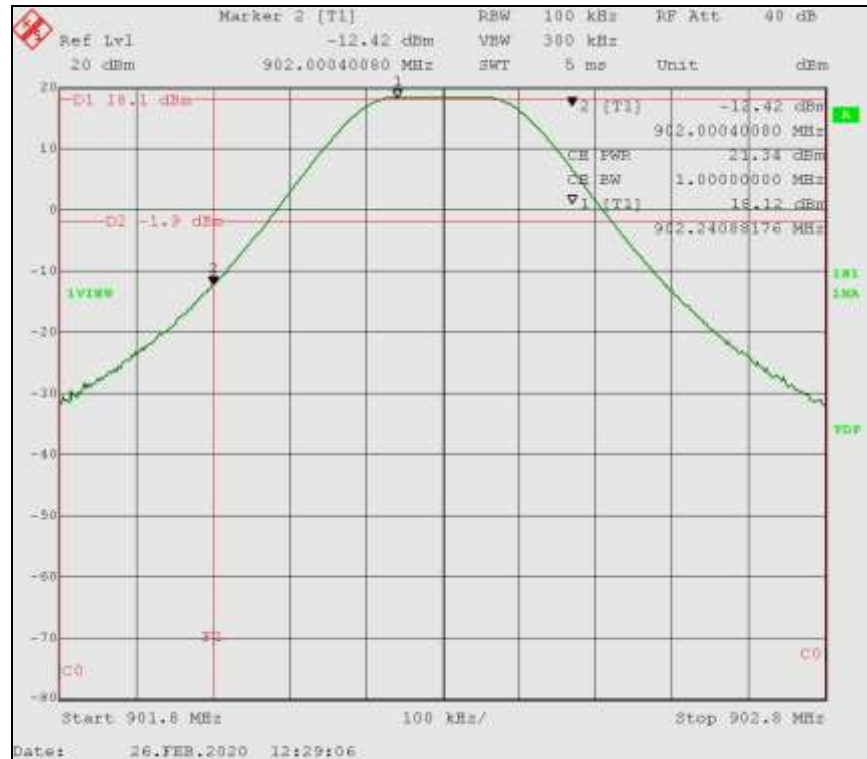




High Channel 63, 914.9 MHz, 125 kHz BW, Spread Factor = 7

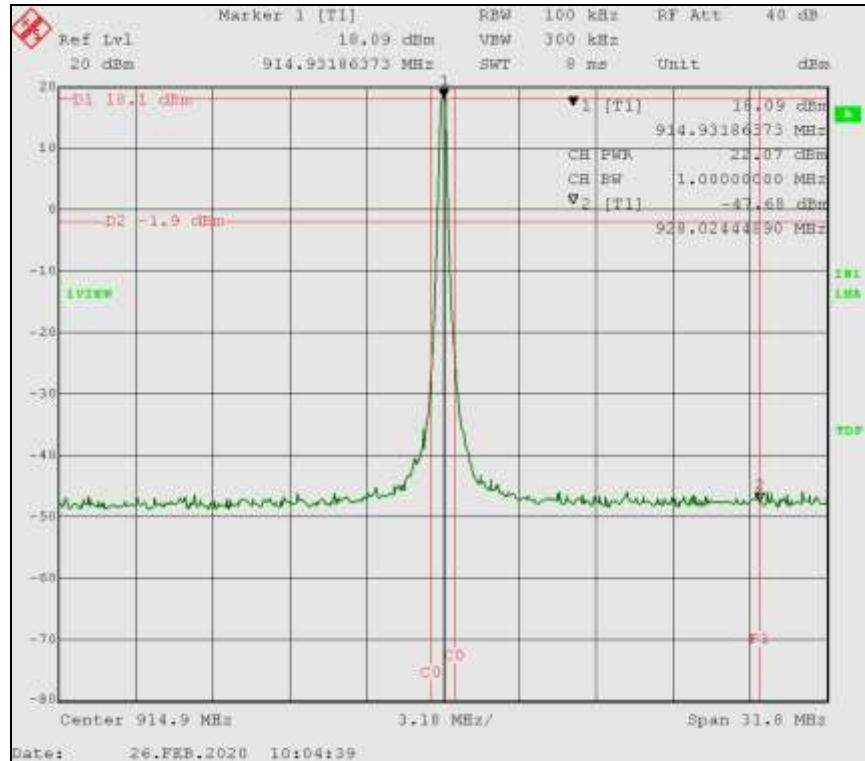


Low Channel 0, 902.3 MHz, 125 kHz BW, Spread Factor = 12





High Channel 63, 914.9 MHz, 125 kHz BW, Spread Factor = 12

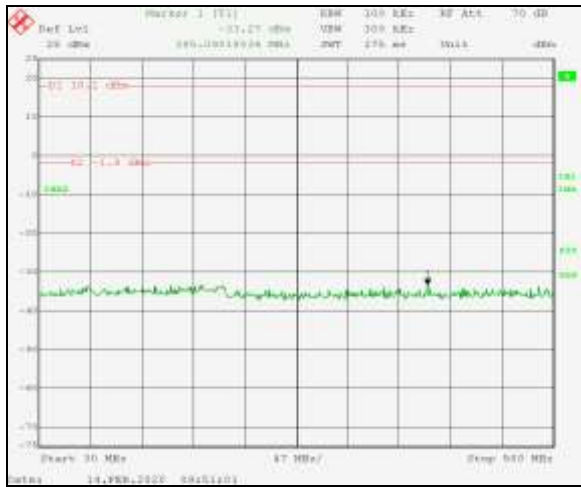


Test Results: The Band Edge measurements of the Woodstream Model V400M LoRa Radio Control Unit LoRa Radio Control Unit show that emissions at the band edges of the Operating Frequency Bandwidth are below the Carrier Peak Level – 20 dB required by 47 CFR Part 15.205.

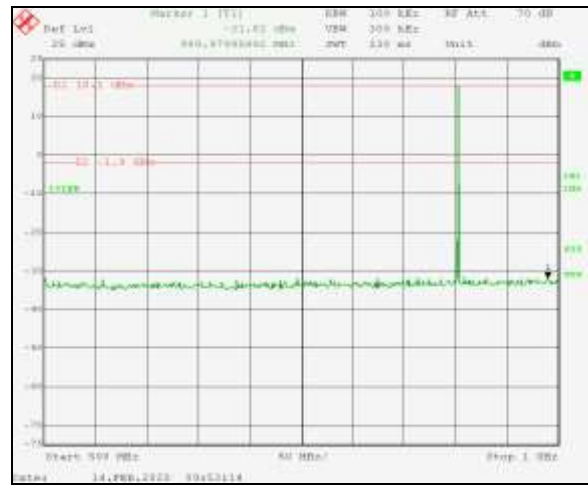


4.11 Spurious RF Conducted Emissions 47 CFR 15.247(d) and RSS-247 (5.5) (02/14/2020)

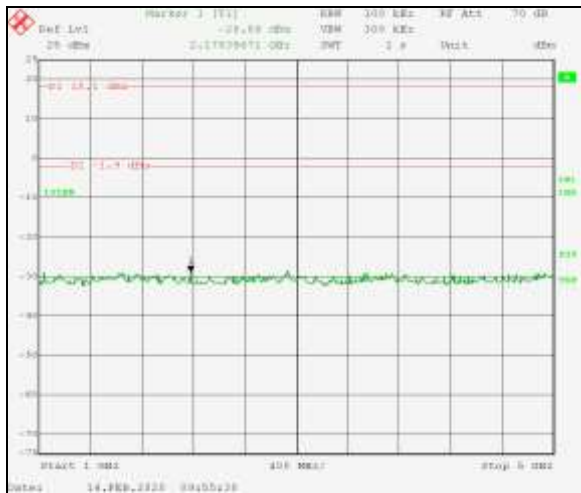
The antenna port of the Woodstream Model V400M LoRa Radio Control Unit was tested for compliance to the requirement that emissions, between 30 MHz and 10 GHz, outside the operating band, are 20 dB below the peak level of signals inside the operating band. The highest amplitude was seen with the EUT programmed for DSS Channel 63 914.9 MHz with a setting of Spread Factor 12.



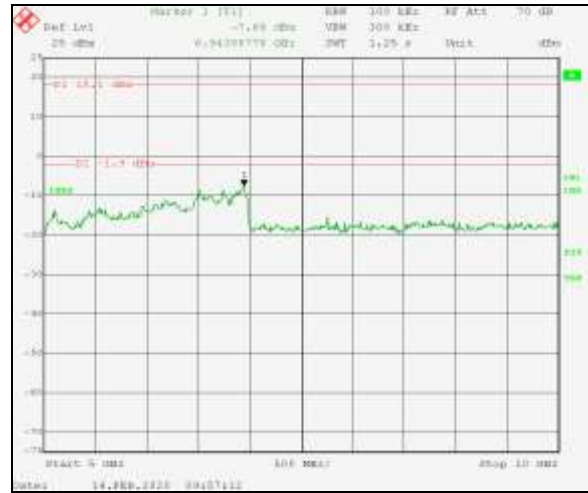
Channel 0, 902.3 MHz, 30 – 500 MHz



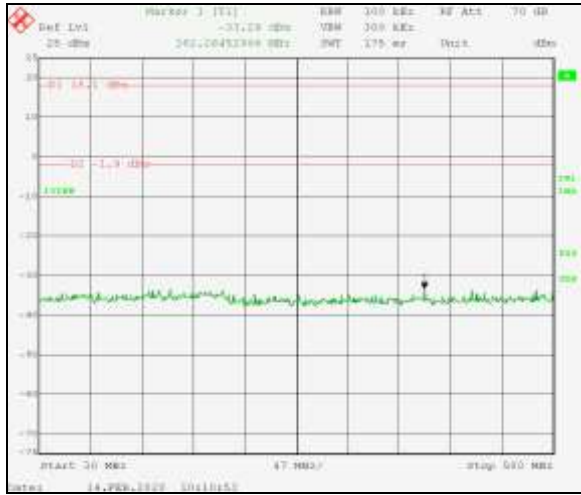
Channel 0, 902.3 MHz, 500 MHz – 1 GHz



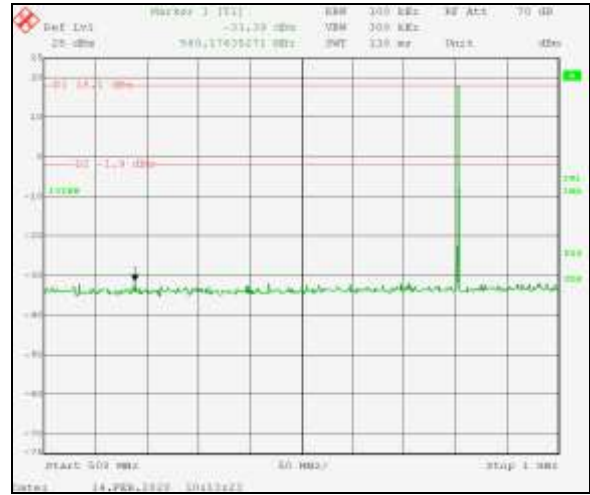
Channel 0, 902.3 MHz, 1 – 5 GHz



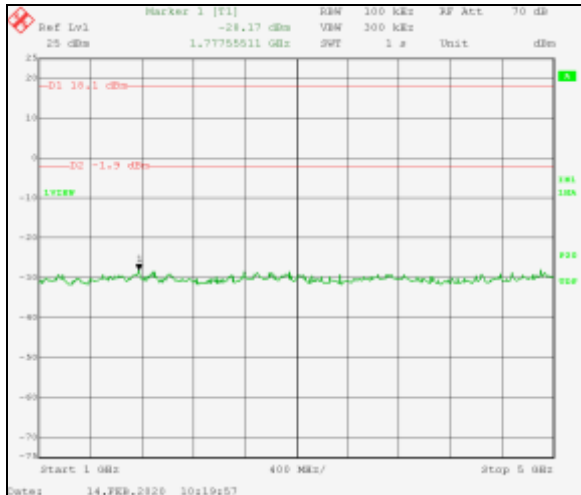
Channel 0, 902.3 MHz, 5 – 10 GHz



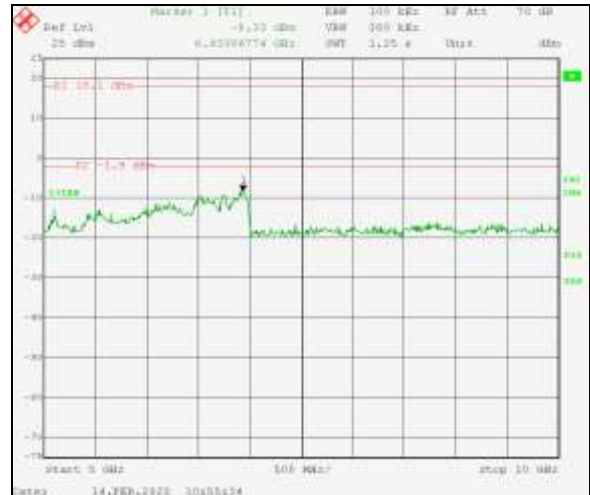
Channel 32, 908.7 MHz, 30 – 500 MHz



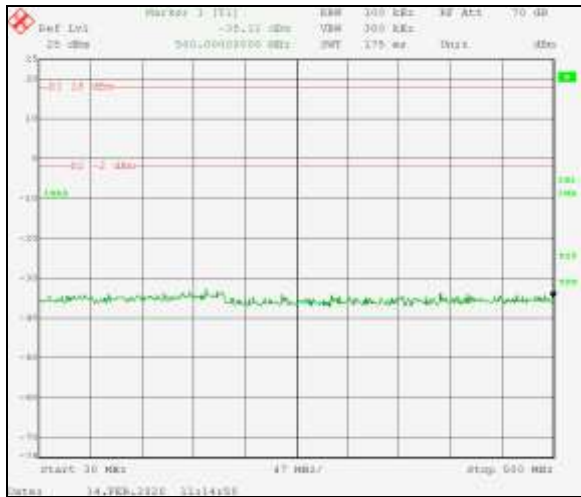
Channel 32, 908.7 MHz, 500 MHz – 1 GHz



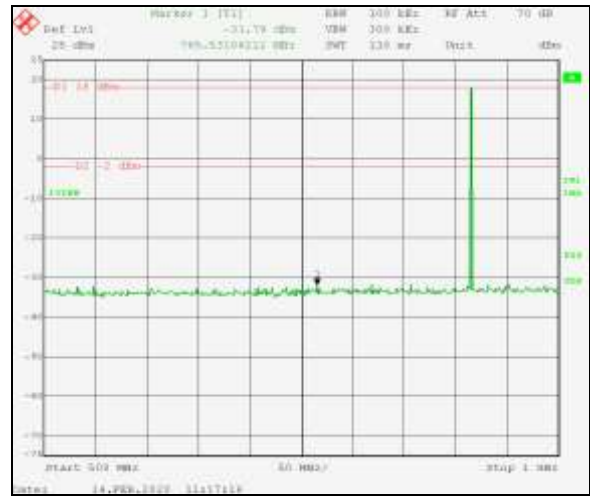
Channel 32, 908.7 MHz, 1 – 5 GHz



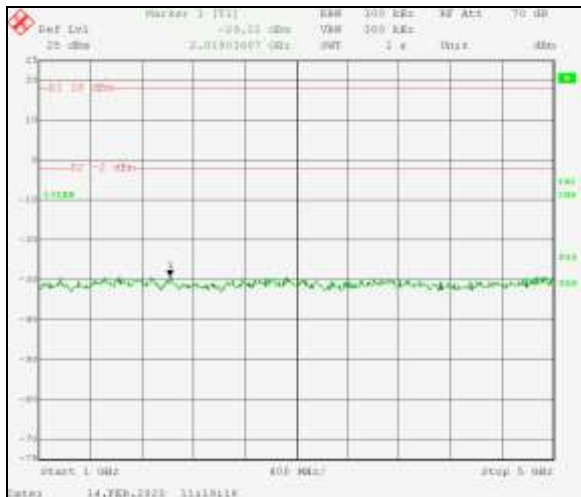
Channel 32, 908.7 MHz, 5 – 10 GHz



Channel 63, 914.9 MHz, 30 – 500 MHz



Channel 63, 914.9 MHz, 500 MHz – 1 GHz



Channel 63, 914.9 MHz, 1 – 5 GHz



Channel 63, 914.9 MHz, 5 – 10 GHz

Test Results: Signals, measured from the Woodstream Model V400M LoRa Radio Control Unit antenna port, comply with the requirements of 47 CFR Part 15.247(d) and RSS-247 for Conducted Spurious Emissions.



5.0 Test Setup Photos

See Appendix C Woodstream V400M Test Setup Photos



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	07/02/19	3 Years	07/02/22
Antenna (30 MHz - 6 GHz)	Sunol Sciences	JB6	A022108	712	06/26/18	2 Years	06/26/20
9kHz-3GHz EMC Analyzer	Agilent	E7402A	US39440162	883	02/27/18	3 Years	02/27/21
Antenna (30 MHz - 6 GHz)	Sunol Sciences	JB6	A020714	882	05/16/18	2 Years	05/16/20
Amplifier (.09 – 1300 MHz)	Hewlett Packard	8447F	3313A06658	807	01/09/19	2 Years	01/09/21
EMC Analyzer (9 kHz - 1.8 GHz)	Hewlett Packard	8593EM	3710A00214	1026	03/02/17	3 Years	03/02/20
Amplifier System (0.5 – 50 GHz)	Hewlett Packard	83015A 83017A	3123A00360 & 3332A00219	1027	10/04/18	2 Years	10/04/20
Double Ridged Horn Antenna (1 - 18 GHz)	EMCO	3115	9705-5225	1028	11/19/18	2 Years	11/19/21
Shielded Room #1	ETS Lindgren	12-2/2-0	4078	859	05/17/18	2 Years	05/17/20
OATS Site (30 MHz – 1 GHz)	BEC	N/A	N/A	705	05/16/19	1 Year	05/16/20
Intentional Radiator Testing High Frequency RF Test Cable	Workhorse	WHU18- 3636-036	N/A	814	12/29/18	2 Years	12/29/20



Temp/Humidity Meter	Control Company	4096	151872672	780	04/08/19	2 Years	04/08/21
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