



Class II Permissive Change Certification Test Report

FCC ID: MWC406WIFI

FCC Rule Part: 15.247

ISED Canada Radio Standards Specification: RSS-247

ACS Report Number: 16-3095.W04.1A

Manufacturer: Sealevel Systems Inc.
Model: 406

Test Begin Date: December 13, 2016
Test End Date: December 21, 2016

Report Issue Date: January 3, 2017



FOR THE SCOPE OF ACCREDITATION UNDER LAB Code AT-1921

This report must not be used by the client to claim product certification, approval, or endorsement by ANAB, ANSI, or any agency of the Federal Government.

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This report contains 15 pages

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1 GENERAL**1.1 Purpose**

The purpose of this report is a class 2 change to add a new external antenna / host combination and demonstrate continued compliance with Part 15 Subpart C of the FCC's Code of Federal Regulations and ISED Canada's Radio Standards Specification RSS-247 Certification.

1.2 Product Description

Technical Information:

Detail	Description
Frequency Range	2412 – 2462 MHz
Number of Channels	11
Modulation Format	DSSS, CCK, OFDM
802.11b Data Rates	1 - 11 Mbps
802.11g Data Rates	6 – 54 Mbps
802.11n Data Rates	6.5 – 72.2 Mbps
Number of Inputs/Outputs	1
Operating Voltage	120Vac
Antenna Type / Gain	Quarter wave dipole/ 2 dBi

Manufacturer Information:

Sealevel Systems Inc.
2779 Greenville Highway
Liberty, SC 29657

EUT Serial Numbers: ACS #1

Test Sample Condition: The test samples were provided in good working order with no visible defects.

1.3 Test Methodology and Considerations

All modes of operation, including all available data rates, were evaluated. The data presented in this report represents the worst case where applicable.

The EUT uses a new external antenna / host combination. Therefore, the EUT was evaluated installed in the host. The host will be table top mounted in a single orientation. Therefore, a single orientation representative of the installation position was tested. Unit ACS #1 was used for all measurements.

Worst Case Modes of Operation:

WiFi Type	Modulation	Worst case data rates
802.11b	DSSS	1 Mbps
802.11g	OFDM	6 Mbps
802.11n	OFDM	6.5 Mbps

The client provided test software (TI Radio Tool) to exercise the EUT. The power level was set to 0 which was maximum power.

The EUT was evaluated in the host and meets the requirements of FCC Part 15 Subpart B. The results have been documented in a separate report.

2 TEST FACILITIES

2.1 Location

The radiated and conducted emissions test sites are located at the following address:

Advanced Compliance Solutions
2320 Presidential Drive, Suite 101
Durham, NC 27703
Phone: (919) 381-4235

2.2 Laboratory Accreditations/Recognitions/Certifications

ACS is accredited to ISO/IEC 17025 by ANSI-ASQ National Accreditation Board under their ANAB program and has been issued certificate number AT-1921 in recognition of this accreditation. Unless otherwise specified, all test methods described within this report are covered under the ISO/IEC 17025 scope of accreditation.

FCC Registered Test Site Number: 637011
ISED Canada Test Site Registration Number: 20446

2.3 Radiated Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site

The Semi-Anechoic Chamber Test Site consists of a 18' x 28' x 18' shielded enclosure. The chamber is lined with Samwha Electronics Co. LTD Ferrite Absorber, model number SFA300 (HSN-1). The ferrite tile is 10cm x 10 cm and weighs approximately 1.4lbs. These tiles are mounted on steel panels and installed directly on the inner walls of the chamber. On top of the ferrite tiles is DMAS HT-45 (Dutch Microwave Absorber Solutions) hybrid absorber on all walls except the wall behind the antenna mast which has a shorter DMAS HT-25 absorber.

The turntable is 1.50m in diameter and is located 150cm from the back wall of the chamber. The chamber is grounded via 1 - 8' copper ground rod, installed at the center of the back wall, it is bound to the ground plane using short #6 copper wire. The turntable is aluminum, flush mounted table installed in an all steel frame. The table is remotely operated from inside the control room located 25' from the turntable. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane.

Behind the turntable is a 2' x 6' x 1.5' deep shielded pit used for support equipment if necessary. The pit is equipped with 2 - 4" PVC chase from the turntable to the pit that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit.

A diagram of the Semi-Anechoic Chamber Test Site is shown in Figure 2.3-1 below:

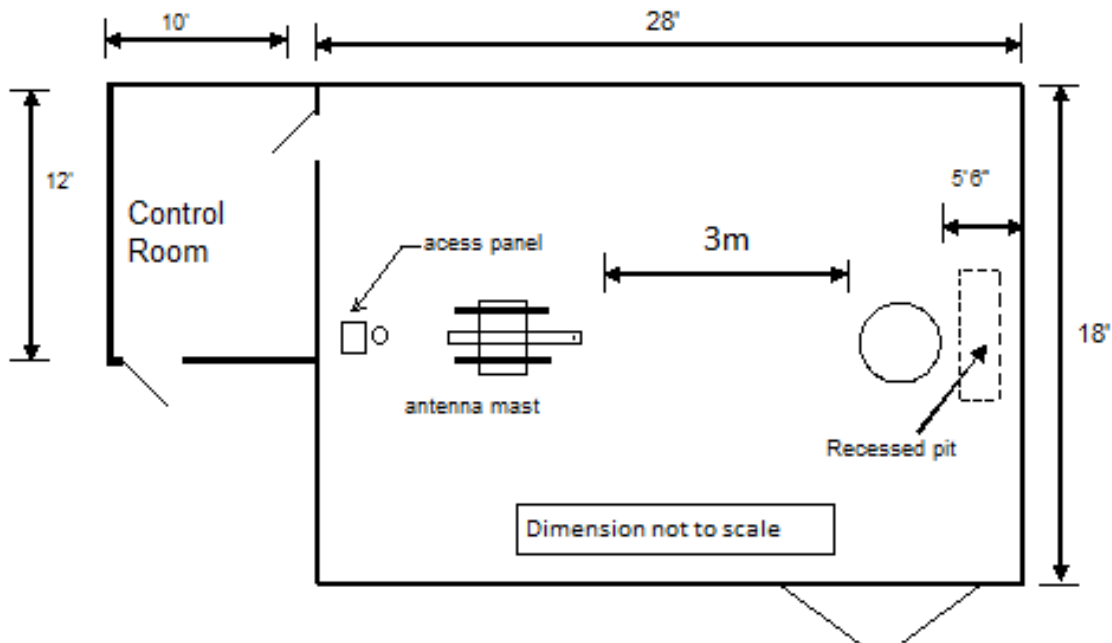


Figure 2.3-1: Semi-Anechoic Chamber Test Site

2.4 Conducted Emissions Test Site Description

The AC mains conducted EMI site is located in the main EMC lab. It consists of an 8' x 10' sheet galvanized steel horizontal ground reference plane (GRP) bonded every 6" to an 8' X 8' aluminum vertical ground plane.

A diagram of the room is shown below in figure 2.4-1:

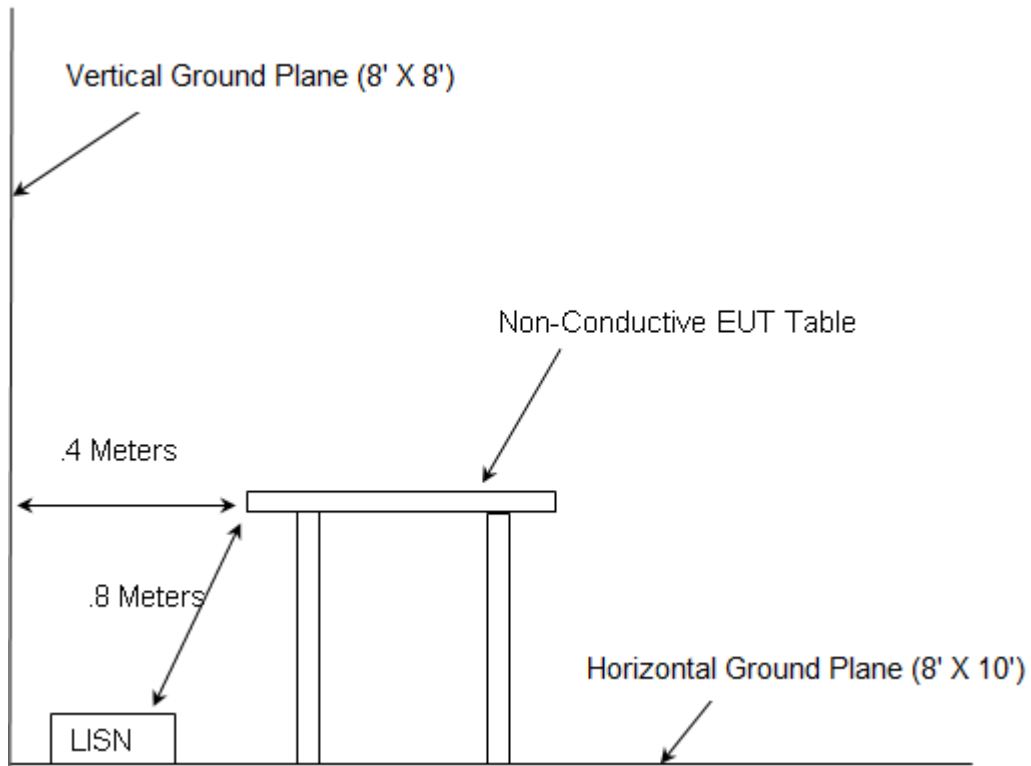


Figure 2.4-1: AC Mains Conducted EMI Site

3 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ❖ ANSI C63.4-2014 - American National Standard for Methods of Measurement of Radio-Noise Emissions from low-voltage electrical and electronic equipment in the range of 9 kHz to 40 GHz.
- ❖ ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
- ❖ US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2016
- ❖ US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2016
- ❖ FCC KDB 558074 D01 DTS Meas Guidance v03r05 - Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247, April 8, 2016
- ❖ ISED Canada Radio Standards Specification: RSS-247, Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and License-Exempt Local Area Network (LE-LAN) Devices, Issue 1, May 2015
- ❖ ISED Canada Radio Standards Specification: RSS-GEN – General Requirements for Compliance of Radio Apparatus, Issue 4, Nov 2014

4 LIST OF TEST EQUIPMENT

The calibration interval of test equipment is annually or the manufacturer's recommendations. Where the calibration interval deviates from the annual cycle based on the instrument manufacturer's recommendations, it shall be stated below.

Table 4-1: Test Equipment

Asset ID	Manufacturer	Model #	Equipment Type	Serial #	Last Calibration Date	Calibration Due Date
277	EMCO	93146	Antennas	9904-5199	9/12/2016	9/12/2018
626	EMCO	3110B	Antennas	9411-1945	2/29/2016	2/28/2017
3002	Rohde & Schwarz	ESU40	Receiver	100346	1/8/2016	1/8/2017
3006	Rohde & Schwarz	TS-PR18	Amplifiers	122006	6/29/2015	12/29/2016
3012	Rohde & Schwarz	EMC32-EB	Software	100731	8/2/2016	2/2/2017
3007	Rohde & Schwarz	TS-PR26	Amplifiers	100051	6/29/15	12/29/16
3059	Mountain View	3059	Coax Cable	3059	8/20/2015	12/29/2016
3057	ATM	42-441-6/BR	Antenna	R110602-01	NCR	NCR
3016	Fei Teng Wireless Technology	HA-07M18G-NF	Antennas	2013120203	1/26/2016	1/26/2018
3027	Micro-Tronics	BRM50702	Filter	175	12/21/2015	12/21/2016
3031	Hasco, Inc.	HLL335-S1-S1-96	Cables	3074	12/30/2015	12/30/2016
3033	Hasco, Inc.	HLL142-S1-S1-36	Cables	1435	1/7/2016	1/7/2017
3038	Florida RF Labs	NMSE-290AW-60.0-NMSE	Cable Set	1448	12/22/2015	12/22/2016
3039	Florida RF Labs	NMSE-290AW-396.0-NMSE	Cable Set	1447	12/22/2015	12/22/2016
3042	Aeroflex Inmet	18N10W-10	Cable Set	1444	1/8/2016	1/8/2017
3055	Rohde & Schwarz	3005	Cables	3055	12/30/2015	12/30/2016
3085	Rohde & Schwarz	FSW43	Spectrum Analyzer	103997	8/9/2016	8/9/2017

NCR = No Calibration Required

DMAS MT-25 RF absorber material was used on the floor for all final measurements above 1 GHz.

Asset 3002: Firmware Version: ESU40 is 4.73 SP4

Asset 3012: Software Version: EMC32-B is 9.15

Asset 3020: Firmware Rev: 2.20.382.113

Asset 3085: Instrument Firmware 2.41 SP1

5 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Item	Equipment Type	Manufacturer	Model Number	Serial Number
1	EUT	Sealevel	406	ACS #1
2	Power Adapter	Adapter Tech	ATS012T-W240U	ACS #2
3	Laptop	DELL	E6520	38896037677
4	Power Supply	DELL	DA130PE1-00	CN-0JU012-48661-143-2YQW-A04

6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

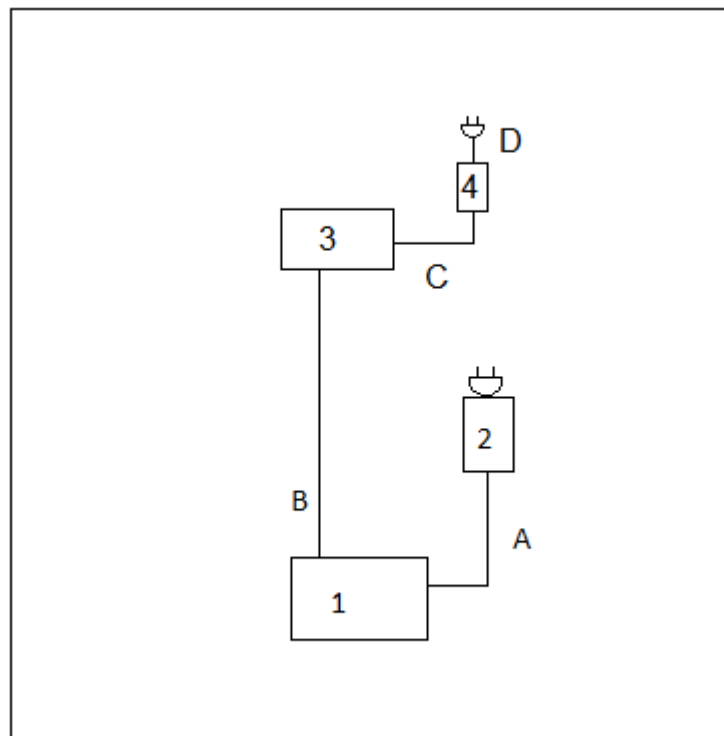


Figure 6-1: Test Setup Block Diagram

Table 6-1: Cable Description

Cable #	Cable Type	Length	Shield	Termination
A	Power Supply	1.8m	No	EUT
B	USB to serial converter	1.8m	No	EUT to Laptop
C	Laptop Power	1.8m	No	power adapter
D	Power Adapter	1.0m	No	Mains

7 SUMMARY OF TESTS

Along with the tabular data shown below, plots were taken of all signals deemed important enough to document.

7.1 Antenna Requirement – FCC 15.203

The antenna is a quarter wave dipole with a reverse SMA type connector, therefore satisfying the requirements of Section 15.203. The peak gain of the antenna is 2 dBi.

7.2 Power Line Conducted Emissions – FCC 15.207, ISED Canada: RSS-Gen 8.8

7.2.1 Measurement Procedure

ANSI C63.4-2014 sections 6 and 7 were the guiding documents for this evaluation. Conducted emissions were performed from 150 kHz to 30 MHz with the spectrum analyzer's resolution bandwidth set to 9 kHz and the video bandwidth set to 30 kHz. The calculation for the conducted emissions is as follows:

Corrected Reading = Analyzer Reading + LISN Loss + Cable Loss

Margin = Applicable Limit - Corrected Reading

7.2.2 Measurement Results

Table 7.2.2-1: Conducted EMI Results – Line 1

Frequency (MHz)	QuasiPeak (dBμV)	Average (dBμV)	Limit (dBμV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.150000	47.14	---	66.00	18.86	2000.0	9.000	L1	OFF	9.5
0.150000	---	29.22	56.00	26.78	2000.0	9.000	L1	OFF	9.5
0.158000	---	30.59	55.53	24.94	2000.0	9.000	L1	OFF	9.5
0.158000	46.75	---	65.53	18.78	2000.0	9.000	L1	OFF	9.5
0.166000	45.67	---	65.09	19.42	2000.0	9.000	L1	OFF	9.5
0.166000	---	30.08	55.08	25.00	2000.0	9.000	L1	OFF	9.5
0.332000	---	39.94	49.18	9.24	2000.0	9.000	L1	OFF	9.6
0.332000	46.72	---	59.22	12.50	2000.0	9.000	L1	OFF	9.6
0.496000	---	28.54	46.06	17.52	2000.0	9.000	L1	OFF	9.6
0.496000	36.12	---	56.06	19.94	2000.0	9.000	L1	OFF	9.6
0.868000	---	27.89	46.00	18.11	2000.0	9.000	L1	OFF	9.6
0.868000	34.84	---	56.00	21.16	2000.0	9.000	L1	OFF	9.6
2.004000	---	24.35	46.00	21.65	2000.0	9.000	L1	OFF	9.7
2.004000	35.00	---	56.00	21.00	2000.0	9.000	L1	OFF	9.7
2.020000	---	23.32	46.00	22.68	2000.0	9.000	L1	OFF	9.7
2.020000	34.22	---	56.00	21.78	2000.0	9.000	L1	OFF	9.7
2.956000	---	27.19	46.00	18.81	2000.0	9.000	L1	OFF	9.7
2.956000	34.88	---	56.00	21.12	2000.0	9.000	L1	OFF	9.7
4.204000	---	26.68	46.00	19.32	2000.0	9.000	L1	OFF	9.7
4.204000	34.43	---	56.00	21.57	2000.0	9.000	L1	OFF	9.7

Table 7.2.2-2: Conducted EMI Results – Line 2

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.150000	---	29.02	56.00	26.98	2000.0	9.000	N	OFF	9.7
0.150000	47.83	---	66.00	18.17	2000.0	9.000	N	OFF	9.7
0.154000	---	29.65	55.76	26.11	2000.0	9.000	N	OFF	9.7
0.154000	47.89	---	65.76	17.87	2000.0	9.000	N	OFF	9.7
0.158000	---	30.40	55.53	25.13	2000.0	9.000	N	OFF	9.7
0.158000	47.80	---	65.53	17.73	2000.0	9.000	N	OFF	9.7
0.336000	---	39.25	49.09	9.84	2000.0	9.000	N	OFF	9.7
0.336000	46.42	---	59.12	12.70	2000.0	9.000	N	OFF	9.7
0.492000	---	28.11	46.12	18.01	2000.0	9.000	N	OFF	9.7
0.492000	35.62	---	56.12	20.50	2000.0	9.000	N	OFF	9.7
0.960000	---	23.58	46.00	22.42	2000.0	9.000	N	OFF	9.8
0.960000	34.44	---	56.00	21.56	2000.0	9.000	N	OFF	9.8
2.060000	---	23.83	46.00	22.17	2000.0	9.000	N	OFF	9.8
2.060000	34.07	---	56.00	21.93	2000.0	9.000	N	OFF	9.8
3.248000	---	23.28	46.00	22.72	2000.0	9.000	N	OFF	9.9
3.248000	32.79	---	56.00	23.21	2000.0	9.000	N	OFF	9.9
4.260000	---	24.84	46.00	21.16	2000.0	9.000	N	OFF	10.0
4.260000	33.50	---	56.00	22.50	2000.0	9.000	N	OFF	10.0
7.058000	---	16.88	50.00	33.12	2000.0	9.000	N	OFF	10.1
7.058000	25.42	---	60.00	34.58	2000.0	9.000	N	OFF	10.1

7.3 Emissions into Restricted Frequency Bands

7.3.1 Measurement Procedure

The unwanted emissions into restricted bands were measured radiated over the frequency range of 30 MHz to 25 GHz, 10 times the highest fundamental frequency.

The EUT was rotated through 360° and the receive antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. For frequencies below 1000MHz, quasi-peak measurements were made using a RBW of 120 kHz and a VBW of 300 kHz. For frequencies above 1000MHz, peak and average measurements were made with RBW and VBW of 1 MHz and 3 MHz respectively.

Each emission found to be in a restricted band as defined by section 15.205, including any emission at the operational band-edge, was compared to the radiated emission limits as defined in section 15.209.

7.3.1.1 Duty Cycle Correction

The Duty Cycle Correction was not required.

7.3.2 Measurement Results

802.11b

Table 7.3.2-1: Radiated Spurious Emissions Tabulated Data

Frequency (MHz)	Level (dBuV)		Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg			pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Low Channel										
4824	47.50	41.50	H	6.16	53.66	47.66	74.0	54.0	20.3	6.3
4824	51.50	46.30	V	6.16	57.66	52.46	74.0	54.0	16.3	1.5
2390	51.30	39.50	H	-1.80	49.50	37.70	74.0	54.0	24.5	16.3
2390	67.60	43.00	V	-1.80	65.80	41.20	74.0	54.0	8.2	12.8
Middle Channel										
4874	47.00	40.90	V	6.17	53.17	47.07	74.0	54.0	20.8	6.9
7311	40.00	26.40	V	8.96	48.96	35.36	74.0	54.0	25.0	18.6
High Channel										
4924	49.00	43.70	V	6.18	55.18	49.88	74.0	54.0	18.8	4.1
2483.5	51.70	39.30	H	-1.57	50.13	37.73	74.0	54.0	23.9	16.3
2483.5	53.70	43.70	V	-1.57	52.13	42.13	74.0	54.0	21.9	11.9

802.11g

Table 7.3.2-2: Radiated Spurious Emissions Tabulated Data

Frequency (MHz)	Level (dBuV)		Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg			pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Low Channel										
4824	46.50	28.20	V	6.16	52.66	34.36	74.0	54.0	21.3	19.6
2390	56.90	31.70	V	-1.80	55.10	29.90	74.0	54.0	18.9	24.1
Middle Channel										
4874	47.60	29.30	V	6.17	53.77	35.47	74.0	54.0	20.2	18.5
High Channel										
4924	47.50	28.70	V	6.18	53.68	34.88	74.0	54.0	20.3	19.1
2483.5	60.00	39.10	H	-1.57	58.43	37.53	74.0	54.0	15.6	16.5
2483.5	68.00	43.10	V	-1.57	66.43	41.53	74.0	54.0	7.6	12.5

802.11n

Table 7.3.2-3: Radiated Spurious Emissions Tabulated Data

Frequency (MHz)	Level (dBuV)		Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg			pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Low Channel										
4824	41.70	25.90	H	6.16	47.86	32.06	74.0	54.0	26.1	21.9
4824	47.90	28.00	V	6.16	54.06	34.16	74.0	54.0	19.9	19.8
2390	50.50	27.30	H	-1.80	48.70	25.50	74.0	54.0	25.3	28.5
2390	59.40	32.30	V	-1.80	57.60	30.50	74.0	54.0	16.4	23.5
Middle Channel										
4874	47.00	28.80	V	6.17	53.17	34.97	74.0	54.0	20.8	19.0
7311	43.20	25.70	V	8.96	52.16	34.66	74.0	54.0	21.8	19.3
High Channel										
4924	44.90	28.90	H	6.18	51.08	35.08	74.0	54.0	22.9	18.9
4924	48.20	30.50	V	6.18	54.38	36.68	74.0	54.0	19.6	17.3
2483.5	60.10	39.30	H	-1.57	58.53	37.73	74.0	54.0	15.5	16.3
2483.5	66.00	42.80	V	-1.57	64.43	41.23	74.0	54.0	9.6	12.8

7.3.2.1 Sample Calculation:

$$R_C = R_U + CF_T$$

Where:

CF_T	=	Total Correction Factor (AF+CA+AG)-DC (Average Measurements Only)
R_U	=	Uncorrected Reading
R_C	=	Corrected Level
AF	=	Antenna Factor
CA	=	Cable Attenuation
AG	=	Amplifier Gain
DC	=	Duty Cycle Correction Factor

Example Calculation: Peak

$$\text{Corrected Level: } 41.70 + 6.16 = 47.86\text{dBuV/m}$$

$$\text{Margin: } 74\text{dBuV/m} - 47.86\text{dBuV/m} = 26.1\text{dB}$$

Example Calculation: Average

$$\text{Corrected Level: } 25.90 + 6.16 - 0 = 32.06\text{dBuV}$$

$$\text{Margin: } 54\text{dBuV} - 32.06\text{dBuV} = 21.9\text{dB}$$

8 CONCLUSION

In the opinion of ACS, Inc. the 406, manufactured by Sealevel Systems Inc. meets the requirements of FCC Part 15 subpart C and ISED Canada's Radio Standards Specification RSS-247.

END REPORT