



REPORT

For

Shearwater Research Inc.

100-10200 Shellbridge Way
Richmond, BC
V6X 2W7, Canada

Date: 03 MAY 2021
Report No.: 20.01.20181-2
Revision No.: 1
Project No.: 20181
Equipment: Air integration pressure transmitter
Model No.: SWIFT
FCC ID: 2AO24-17001

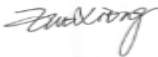

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TEST REPORT_FCC 15, Subpart C	
38kHz Transmitter	
Report Reference No.:	20.01.20181-2
Report Revision History.:	✓ Rev. 0: 10 March 2021 ✓ Rev. 1: 03 MAY 2021
Conclusion	We hereby certify that the submitted sample was found to COMPLY with the test requirement below standards.
Compiled by (+ signature)	Zuo Xiong 
Approved by (+ signature)	Jeremy Lee 
Date of issue.....	03 May 2021
Total number of pages	19
FCC Site Registration No.:	721268
IC Site Registration No.:	5970
Testing Laboratory	LabTest Certification Inc.
Address	Unit 205 – 8291 92ST. Delta, B.C. V4G 0A4, Canada
Applicant's name	Shearwater Research Inc.
Address	100-10200 Shellbridge Way, Richmond, BC, V6X 2W7 Canada
Manufacturer's Name	Same as Applicant
Address	Same as Applicant
Test specification:	
Standards	➤ FCC Part 15, Subpart C, 2021 ➤ RSS-GEN, Issue 5, April 2018
Test procedure.....	➤ ANSI C63.4:2014 ➤ ANSI C63.10:2013
Non-standard test method.....	N/A
Test Report Form(s) Originator ..:	Jeremy Lee
Master TRF.....	1036_Rev2 – RF Report Template
Test item description :	
Trade Mark	n/p
Model/Type reference	SWIFT
Serial Number.....	445166

FCC ID	2AO24-17001
IC ID	n/p
Possible test case verdicts:	
- test case does not apply to the test object	N/A
- test object does meet the requirement	P (Pass)
- test object does not meet the requirement	F (Fail)
Testing:	
Date of receipt of test item	09 FEBURARY 2021
Date (s) of performance of tests .:	10 to 26 FEBURARY 2021

Revision History

Revision	Date	Reason For Change	Author(s)
0	10 March 2021	Initial Data	Zuo Xiong
1	03 May 2021	Add occupied Bandwidth	Jeremy Lee

Device Under Test Description

Application for	Part 15 Low Power Transmitter Below 1705 kHz
Operating Transmit Frequency	38kHz
Operating Receive Frequency	n/a
Number of Channels	1
Occupied Bandwidth	5.929kHz
Modulation Type	None
Antenna Type	Internal Inductive Loop Coil
Equipment mobility	Yes
Nominal Voltages for:	<input checked="" type="checkbox"/> stand-alone equipment <input type="checkbox"/> combined (or host) equipment
Supply Voltage:	3VDC
If DC Power:	<input type="checkbox"/> Internal Power Supply <input type="checkbox"/> External Power Supply or AC/DC adapter <input checked="" type="checkbox"/> Battery

Program details

Testing Facility by procedure:	
<input checked="" type="checkbox"/>	All Testing: LabTest Certification Inc.
Testing location/ address..... :	Unit 3128-20800 Westminster HWY, Richmond, B.C. V6V 2W3 Canada

Summary of testing:	
Tests performed (name of test and test clause): Radiated Field strength and Emissions	Testing location: In SAC, Richmond
<p>The tests indicated in Test Summary were performed on the product constructed as described below. The test sections are the verbatim text from the actual data sheets used during the investigation. These test sections include the test name, the specified test Method, a list of the actual Test Equipment Used, documentation Photos, Results and raw Data. No additions, deviations, or exclusions have been made from the standard(s) unless specifically noted.</p> <p>Based on the results of our investigation, we have concluded the product tested complies with the requirements of the standard(s) indicated. The results obtained in this test report pertain only to the item(s) tested. LabTest does not make any claims of compliance for samples or variants which were not tested.</p>	

Description of Equipment Under Test and Variant Models

<p>Description: The Shearwater SWIFT is an advanced air integration pressure transmitter for open and closed circuit divers, which providing wireless pressure monitoring of 1 to 4 or more scuba tanks, units in PSI or BAR, optional gas time remaining and surface air consumption rate, logging of pressure, reserve and critical gas pressure warnings, battery level indicators from each transmitter.</p>
<p>Variant Models: The following variant models were not tested as part of this evaluation, but have been identified by the manufacturer as being electrically identical models, depopulated models, or with reasonable similarity to the model(s) tested. Intertek does not make any claims of compliance for samples or variants which were not tested.</p>
None

EUT Internal Operating Frequencies

Frequency (MHz)	Description	Frequency (MHz)	Description
0.038	Transmitter	4	Micro-Controller

Client Equipment Used During Test

Use*	Product Type	Manufacturer	Model	Comments
EUT	Pressure Transmitter	Shearwater Research Inc.	SWIFT	

SIM	SCUBA air tank	Catalina Cylinders	3000 Series – 3000 PSI	
SIM	SCUBA Communicator	Shearwater Research Inc.	PERDIX	
Abbreviations: EUT - Equipment Under Test, AE - Auxiliary/Associated Equipment, or SIM - Simulator (Not Subjected to Test)				

Software and Firmware

Use*	Description	Version
n/p		
Abbreviations: EUT - Equipment Under Test, AE - Auxiliary/Associated Equipment, or SIM - Simulator (Not Subjected to Test)		

Input/Output Ports

Port #	Name	Type*	Cable Max. >3m	Cable Shielded	Comments
	n/a				
*Note: AC = AC Power Port DC = DC Power Port N/E = Non-Electrical I/O = Signal Input or Output Port (Not Involved in Process Control) TP = Telecommunication Ports					

Power Interface

Mode #	Voltage (V)	Current (A)	Power (W)	Frequency (DC/AC-Hz)	Phases (#)	Comments
n/a						Battery operated

EUT Operation Modes

Mode #	Description
1	The EUT is on Air Integration mode and sends data to PERDIX AI every 5 seconds, PERDIX AI accepts data and formats it for display.

EUT Configuration Modes

Mode #	Description
1	The EUT is installed to SCUBA air tank and wireless communicating with PERDIX.

Test Equipment Verified for function

Model #	Description	Checked Function	Results
N9038A	Spectrum Analyzer	Frequency and Amplitude	In Tolerance
JB1	Antenna, 30 to 2000MHz	Checked structure	Normal – no damage.
AL-130	Antenna, 9kHz to 30MHz	Checked structure	Normal – no damage.

Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests:

Parameter	Uncertainty
Radio Frequency	± 1 ppm
Radiated Emission, 30 to 250MHz	± 4.37 dB
Radiated Emission, 250 to 1000MHz	± 4.29 dB

Uncertainty figures are valid to a confidence level of 95%.

Result Summary

The Compliance Status is a judgment based on the direct measurements and calculated highest emissions to appropriate standard limits. Measurement uncertainty values, provided on calibration certificates, were not be used in the judgment of the final status of compliance.

FCC Part 15, Subpart C			
Test Type	Regulation	Measurement Method	Result
Occupied Bandwidth	n/a	ANSI C63.10:2013	n/a
Field Strengths	FCC Part 15.209	ANSI C63.10:2013	P
Spurious Emissions (Unwanted Emissions)	FCC Part 15.209	ANSI C63.4:2013	P

FCC Part 15, Subpart B and RSS-Gen			
Test Type	Regulation	Measurement Method	Result
General			
AC Power Line Conducted Emissions	FCC 15.207(a)	ANSI C63.4:2014	n/a
Radiated Emissions for Digital Parts & Receiver	FCC 15.109	ANSI C63.4:2014	P
Antenna Requirement	FCC 15.203	-	P

Occupied Bandwidth

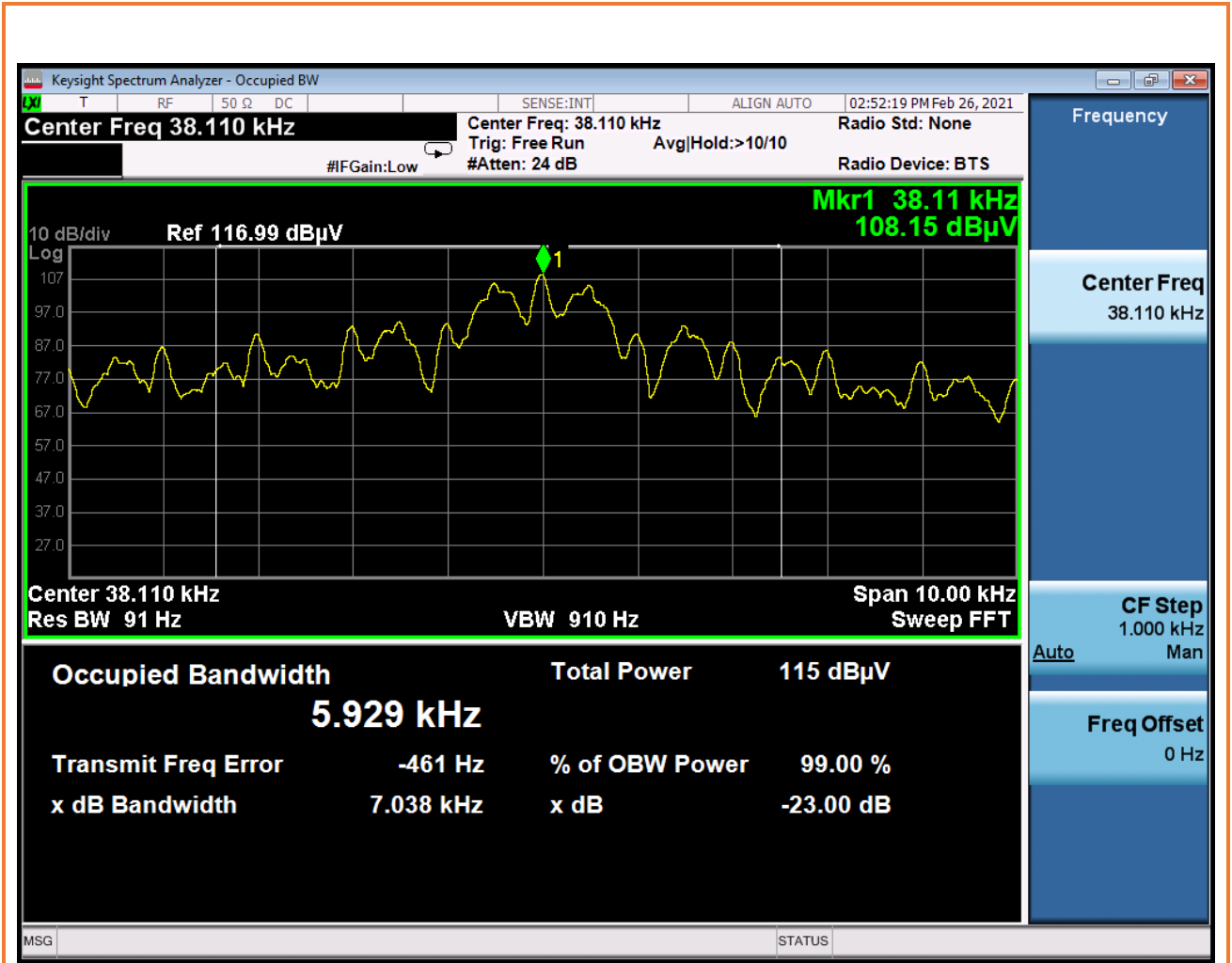
Governing Doc	n/a	Room Temperature (°C)	20.7		
Basic Standard	ANSI C63.10	Relative Humidity (%)	30.0		
Test Location	Richmond	Barometric Pressure (kPa)	101.4		
Test Engineer	Zuo Xiong	Date	26 Feb. 2021		
EUT Voltage	<input checked="" type="checkbox"/> Internal Battery <input type="checkbox"/> 120VAC @ 60Hz				
Test Equipment Used	Manufacturer	Model	Identifier	Calibration	Calibration due
Spectrum Analyzer	Keysight	N9038A	702	27-May-2020	27-May-2021
Loop Antenna	ComPower	AL-130	241	18-Nov-2019	18-Nov-2021
RF Cable	MRO	n/a	n/a	IHC ¹	IHC ¹
EMC Shielded Enclosure	USC	USC-26	374	n/a	n/a
Note1) In House Calibration Ref. # 6					

Test Method

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission. Adjust the spectrum analyzer for the following setting:

- Center frequency: 38kHz
- Span: 10kHz
- RBW: 91Hz
- VBW: 910Hz
- Captured Occupied Bandwidth as see below;

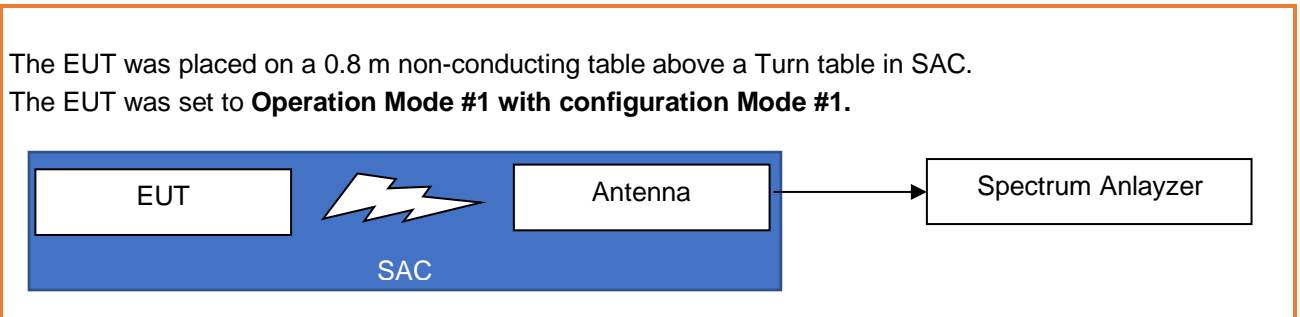
Results



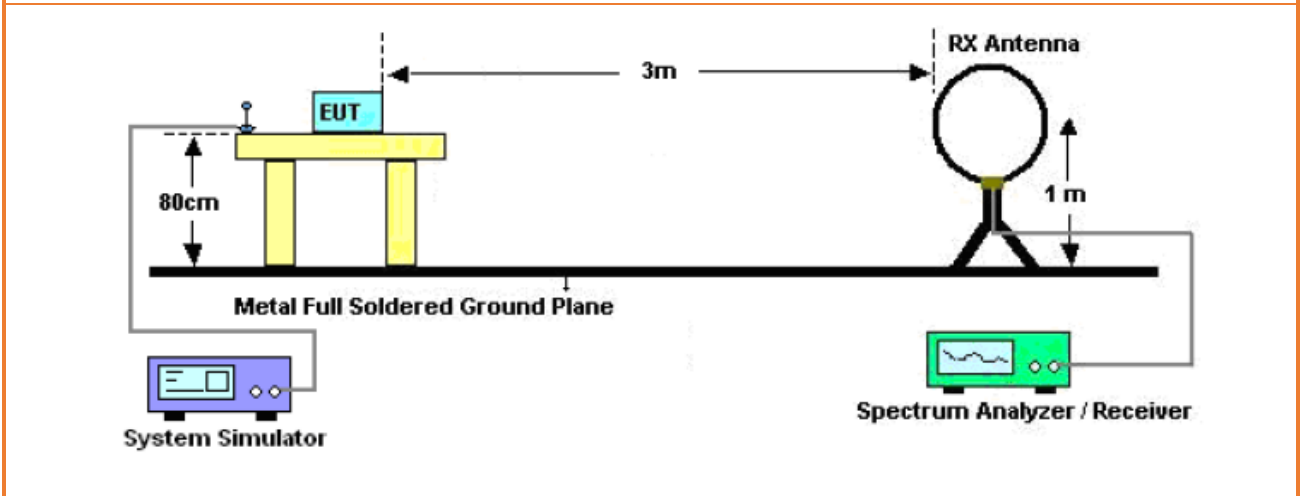
Field Strengths

Governing Doc	FCC 15.209 & RSS-Gen	Room Temperature (°C)	20.7				
Basic Standard	ANSI C63.10	Relative Humidity (%)	30.0				
Test Location	Richmond	Barometric Pressure (kPa)	101.4				
Test Engineer	Zuo Xiong	Date	26 Feb. 2021				
EUT Voltage	<input checked="" type="checkbox"/> Internal Battery <input type="checkbox"/> 120VAC @ 60Hz						
Test Equipment Used	Manufacturer	Model	Identifier	Calibration	Calibration due		
Spectrum Analyzer	Keysight	N9038A	702	27-May-2020	27-May-2021		
Loop Antenna	ComPower	AL-130	241	18-Nov-2019	18-Nov-2021		
RF Cable	MRO	n/a	n/a	IHC ¹	IHC ¹		
EMC Shielded Enclosure	USC	USC-26	374	n/a	n/a		
Note1) In House Calibration Ref. # 6							
Detector:	<input checked="" type="checkbox"/> Peak <input type="checkbox"/> Quasi-Peak/AVG						
RBW/VBW:	<input checked="" type="checkbox"/> 100/300Hz <input type="checkbox"/> 9/30kHz						
Type of Facility:	<input checked="" type="checkbox"/> SAC <input type="checkbox"/> FSOATS <input type="checkbox"/> <i>in-situ</i>						
Distance:	<input checked="" type="checkbox"/> 3meter <input type="checkbox"/> 10meter <input type="checkbox"/> 1meter						
Arrangement of EUT:	<input checked="" type="checkbox"/> Table-top only <input type="checkbox"/> Floor-standing only <input type="checkbox"/> Rack Mounted						
Frequency (kHz)	Orthogonal	Detector ¹	POL	Emissions (dBuV/m)	Limit ^{2, 3} (dBuV/m)	Margin (dB)	Comments
38	n/a	Peak	n/a	74.49	116.00	41.51	P
Note 1) Measured by Peak detector.							
Note 2) Converted from 2400/F(kHz)uV/m at 300 meter to dBuV at 3meter under FCC 15.209.							
Note 3) Converted from 6.37/F(kHz)uA/m at 300 meter to dBuV at 3meter under RSS-Gen, Table 6.							
Compliant <input checked="" type="checkbox"/> Non-Compliant <input type="checkbox"/> Not Applicable <input type="checkbox"/>							

Test setup



- Radiated Emission with AL-130



Measurement Procedure

This test measures the radiating levels from the EUT, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices. Testing was performed in accordance with the test standard(s) referenced in the test summary section of this report. The Equipment Under Test (EUT) was configured based upon the requirements of the applicable test standard. Initially, the primary emission frequencies are identified by positioning a broadband receive antenna three meter from the EUT.

A test was made with an Spectrum Analyzer, controlled by Test Software, Tile7!, at 38kHz with the Analyzer in the peak mode. To ensure that the maximum emission at each discrete frequency of interest is observed, the turntable was rotated to determine the worst emitting configuration. Measurements were then made using CISPR quasi peak (and Averaging) when the peak level under 20dB of Limit line. The numerical results are included herein to demonstrate compliance.

Test Result

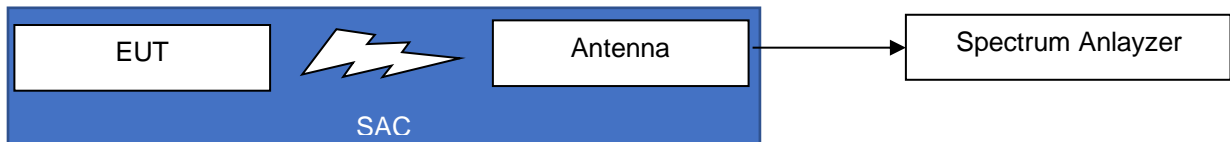
- Radiated Emissions level (dB μ V/m) = Analyzer level (dB μ V) + AFCL (dB/m)
- AFCL (dB/m) = Antenna Factor (dB/m) + Cable Loss (dB) - Pre-Amplifier Gain (dB)
- Margin (dB) = Limit (dB μ V/m) - Field Strength level (dB μ V/m)

Spurious Emissions (Unwanted Emissions up to 10th harmonics)

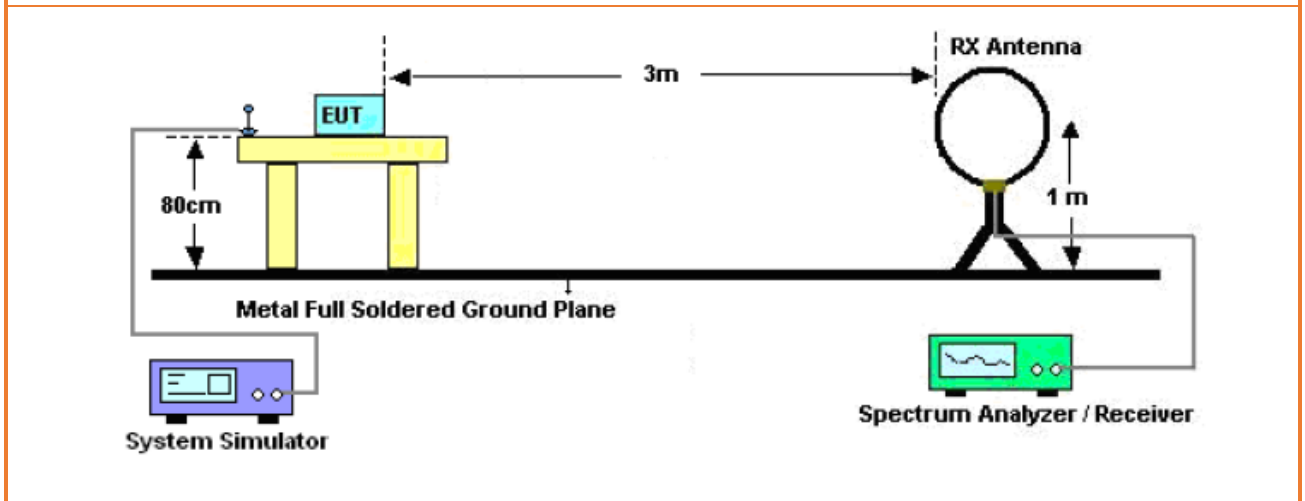
Governing Doc	FCC 15.209 & RSS-Gen	Room Temperature (°C)	20.7				
Basic Standard	ANSI C63.10	Relative Humidity (%)	30.0				
Test Location	Richmond	Barometric Pressure (kPa)	101.4				
Test Engineer	Zuo Xiong	Date	26 Feb. 2021				
EUT Voltage	<input checked="" type="checkbox"/> Internal Battery <input type="checkbox"/> 120VAC @ 60Hz						
Test Equipment Used	Manufacturer	Model	Identifier	Calibration	Calibration due		
Spectrum Analyzer	Keysight	N9038A	702	27-May-2020	27-May-2021		
Loop Antenna	ComPower	AL-130	241	18-Nov-2019	18-Nov-2021		
RF Cable	MRO	n/a	n/a	IHC ¹	IHC ¹		
EMC Shielded Enclosure	USC	USC-26	374	n/a	n/a		
Note1) In House Calibration Ref. # 6							
Detector:	<input checked="" type="checkbox"/> Peak <input type="checkbox"/> Quasi-Peak/AVG						
RBW/VBW:	<input checked="" type="checkbox"/> 100/300Hz <input checked="" type="checkbox"/> 9/30kHz						
Type of Facility:	<input checked="" type="checkbox"/> SAC <input type="checkbox"/> FSOATS <input type="checkbox"/> <i>in-situ</i>						
Distance:	<input checked="" type="checkbox"/> 3meter <input type="checkbox"/> 10meter <input type="checkbox"/> 1meter						
Arrangement of EUT:	<input checked="" type="checkbox"/> Table-top only <input type="checkbox"/> Floor-standing only <input type="checkbox"/> Rack Mounted						
Frequency (kHz)	Orthogonal	Detector ¹	POL	Emissions (dBuV/m)	Limit ^{2,3} (dBuV/m)	Margin (dB)	Comments
595.3987	n/a	Peak	n/a	51.56	72.11	20.55	P
Note 1) Measured by Peak detector. Note 2) Converted from 2400/F(kHz)uV/m at 300 meter to dBuV at 3meter under FCC 15.209. Note 3) Converted from 6.37/F(kHz)uA/m at 300 meter to dBuV at 3meter under RSS-Gen, Table 6.							
Compliant <input checked="" type="checkbox"/> Non-Compliant <input type="checkbox"/> Not Applicable <input type="checkbox"/>							

Test setup

The EUT was placed on a 0.8 m non-conducting table above a Turn table in SAC.
 The EUT was set to **Operation Mode #1 with configuration Mode #1.**



- Radiated Emission with AL-130



Measurement Procedure

This test measures the radiating levels from the EUT, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices. Testing was performed in accordance with the test standard(s) referenced in the test summary section of this report. The Equipment Under Test (EUT) was configured based upon the requirements of the applicable test standard. Initially, the primary emission frequencies are identified by positioning a broadband receive antenna three meter from the EUT.

A test was made with an Spectrum Analyzer, controlled by Test Software, Tile7!, 9kHz to 30MHz with the Analyzer in the peak mode. To ensure that the maximum emission at each discrete frequency of interest is observed, the turntable was rotated to determine the worst emitting configuration. Measurements were then made using CISPR quasi peak (and Averaging) when the peak level under 20dB of Limit line. The numerical results are included herein to demonstrate compliance.

Test Result

- Radiated Emissions level (dB μ V/m) = Analyzer level (dB μ V) + AFCL (dB/m)
- AFCL (dB/m) = Antenna Factor (dB/m) + Cable Loss (dB) - Pre-Amplifier Gain (dB)
- Margin (dB) = Limit (dB μ V/m) - Field Strength level (dB μ V/m)

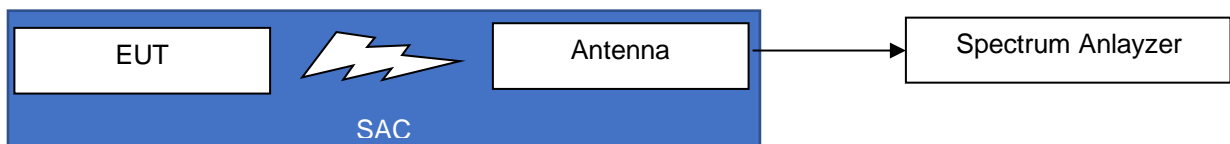
Radiated Emissions for Digital Parts and/or Receiver

Governing Doc	FCC 15.109(a) & ICES-003	Room Temperature (°C)	20.1 to 21.4		
Basic Standard	ANSI C63.4	Relative Humidity (%)	30.0		
Test Location	Richmond	Barometric Pressure	102.3 to 102.4		
Test Engineer	Zuo Xiong	Date	10 Feb. 2021		
EUT Voltage	<input checked="" type="checkbox"/> Internal Battery <input type="checkbox"/> 120VAC @ 60Hz				
Test Equipment Used	Manufacturer	Model	Identifier	Calibration	Calibration due
Spectrum Analyzer	KeySight	N9038A	702	27-May-2020	27-May-2021
LPDA Antenna	Schwarzbeck Mess	VUSLP9111B	996	26-Mar-2019	26-Mar-2021
BiCon Antenna	A.H Systems	SAS-540	1115	29-Apr-2019	29-Apr-2021
RF Cable	MRO	n/a	n/a	IHC ¹	IHC ¹
EMC Shielded Enclosure	USC	USC-26	374	IHC ²	IHC ²
Used Software	<input checked="" type="checkbox"/> Tile! 7 v7.3.0.6				
Used Template	_FCC_RadEmi_30-250MHz_Final_20200727 _FCC_RadEmi_250-1000MHz_Final_20190716				
Note1) In House Calibration Ref. # 6					
Note2) In House Calibration Ref. # 4					
Frequency Range:	<input type="checkbox"/> 9kHz-30MHz	<input checked="" type="checkbox"/> 30-1000MHz	<input type="checkbox"/> 1-6GHz		
Detector:	<input checked="" type="checkbox"/> Peak (for Prescan)	<input type="checkbox"/> Quasi-Peak(for Formal)			
RBW/VBW:	<input type="checkbox"/> 9/30kHz	<input checked="" type="checkbox"/> 120/300kHz	<input type="checkbox"/> 1/3MHz		
Type of Facility:	<input checked="" type="checkbox"/> SAC	<input type="checkbox"/> FSOATS	<input type="checkbox"/> <i>in-situ</i>		
Distance:	<input checked="" type="checkbox"/> 3meter	<input type="checkbox"/> 10meter	<input type="checkbox"/> 1meter		
Arrangement of EUT:	<input checked="" type="checkbox"/> Table-top only	<input type="checkbox"/> Floor-standing only	<input type="checkbox"/> Rack Mounted		
Classification:	<input checked="" type="checkbox"/> Class B	<input type="checkbox"/> Class A			
Compliant <input checked="" type="checkbox"/> Non-Compliant <input type="checkbox"/> Not Applicable <input type="checkbox"/>					

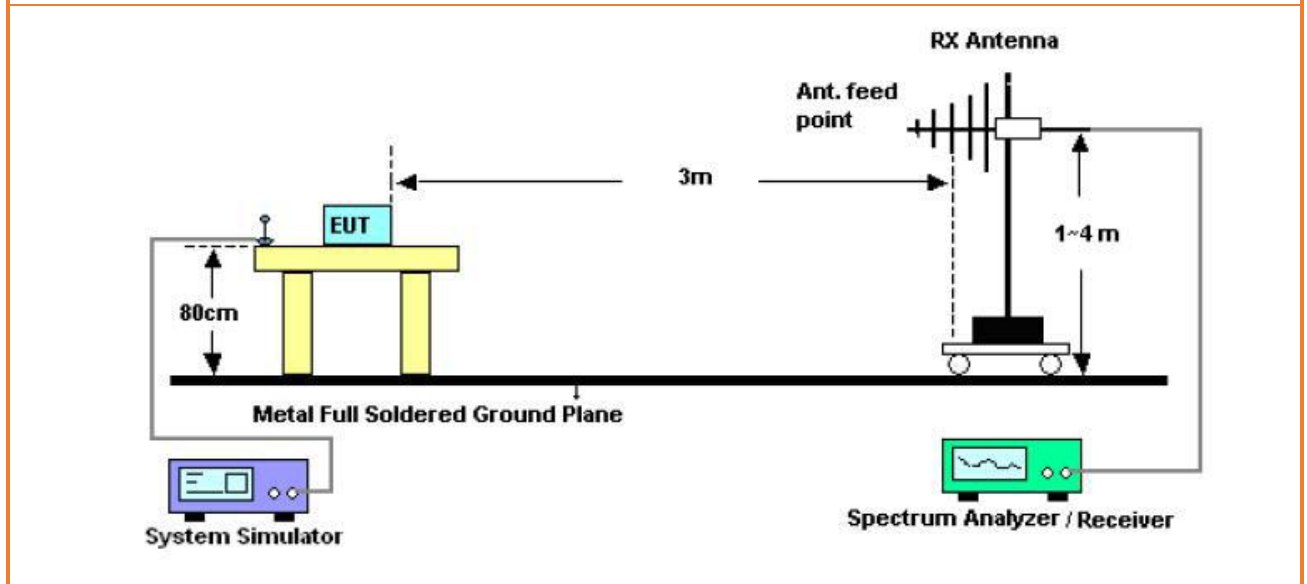
Test setup

Description of test set-up:

The EUT was placed on a 0.8 m non-conducting table above a Turn table in SAC.
 The EUT was set to **Operation Mode #1 with configuration Mode #1.**



- Radiated Emission 30 to 100MHz



Measurement Procedure

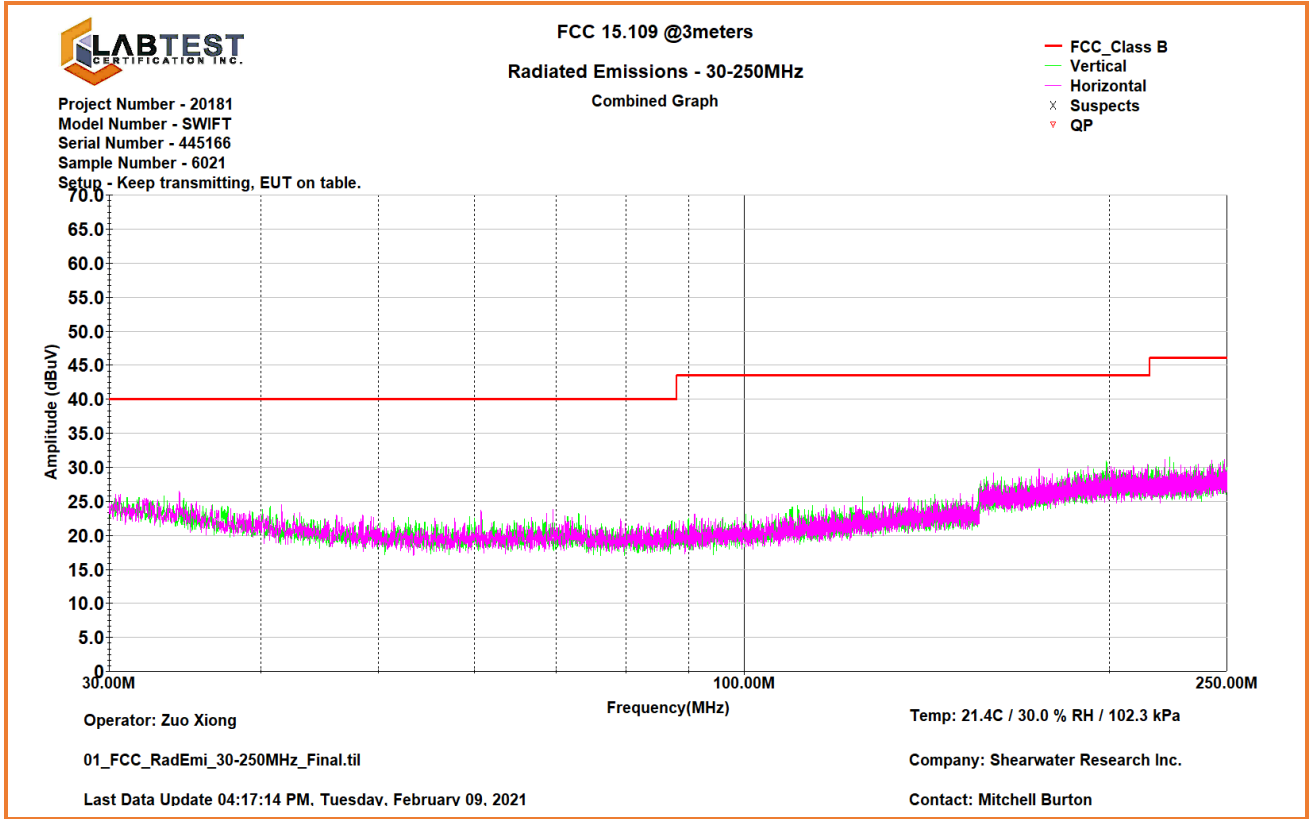
This test measures the radiating levels from the EUT, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices. Testing was performed in accordance with the test standard(s) referenced in the test summary section of this report. The Equipment Under Test (EUT) was configured based upon the requirements of the applicable test standard. Initially, the primary emission frequencies are identified by positioning a broadband receive antenna three meter from the EUT.

A scan was made with an EMC Analyzer, controlled by EMC Test Software, Tile7!, from 30kHz to 1000 MHz with the receiver in the peak mode. The receiver IF bandwidth was 120 kHz and scan step was about 30kHz. To ensure that the maximum emission at each discrete frequency of interest is observed, the receive antenna is varied in height from one to four meters and rotated to produce horizontal and vertical polarities while the turntable is rotated to determine the worst emitting configuration. Under 30MHz was only tested at 1meter height and Antenna was changed both polarization, Horizontal and Vertical. Measurements were then made using CISPR quasi peak when the peak readings were within 10dB of the limit line. The numerical results are included herein to demonstrate compliance.

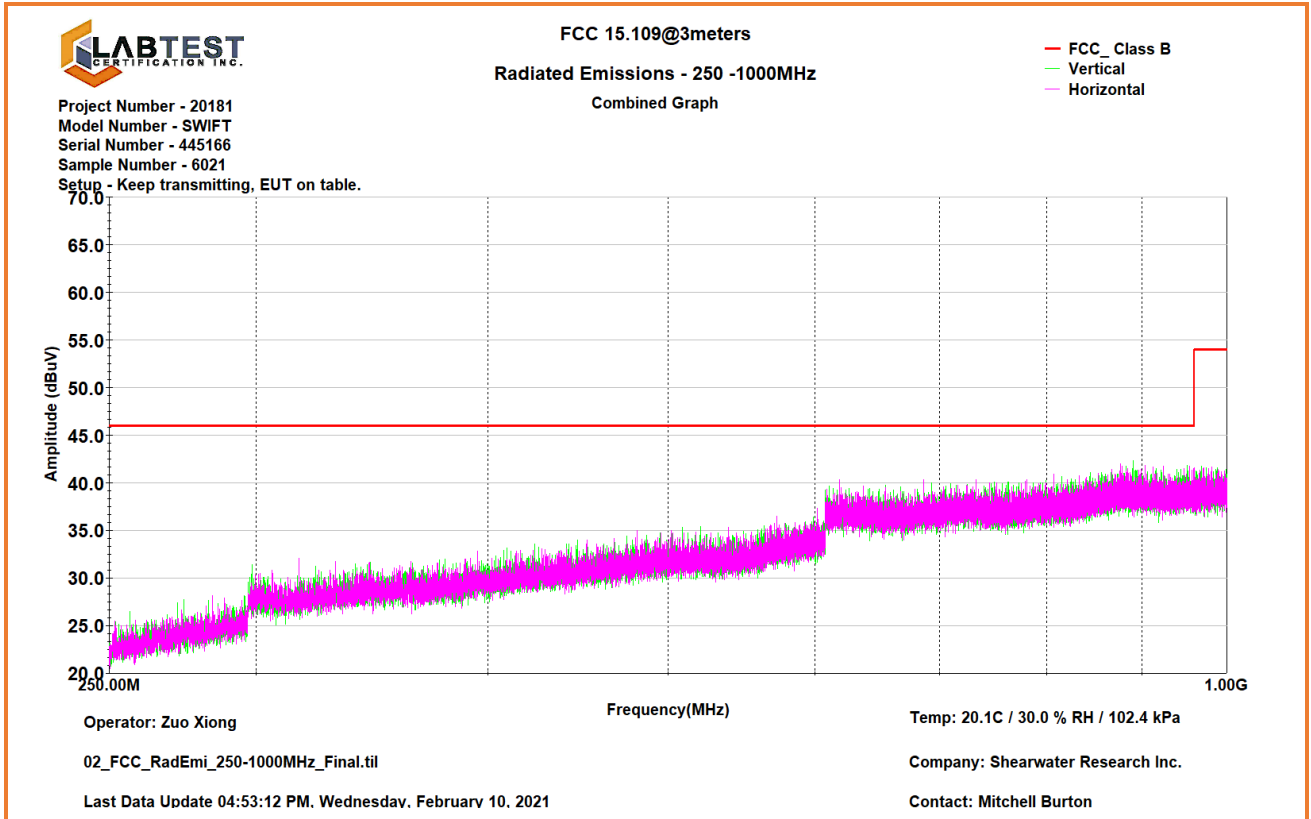
Test Result

- Radiated Emissions level (dB μ V/m) = Analyzer level (dB μ V) + AFCL (dB/m)
- AFCL (dB/m) = Antenna Factor (dB/m) +Cable Loss (dB) - Pre-Amplifier Gain(dB)
- Margin (dB) = Limit (dB μ V/m) - Field Strength level (dB μ V/m)

Graphical Representation for Emission - Radiated
- 30-250MHz with SAS-540



- 250-1000MHz with SAS-540



Antenna Requirement

Governing Doc	FCC 15.203	Room Temperature (°C)	20.1
Basic Standard	n/a	Relative Humidity (%)	30.0
Test Location	Richmond	Barometric Pressure (kPa)	102.3
Test Engineer	Zuo Xiong	Date	10 Feb. 2021
EUT Voltage	<input checked="" type="checkbox"/> Internal Battery <input type="checkbox"/> 120VAC @ 60Hz		
Compliant <input checked="" type="checkbox"/> Non-Compliant <input type="checkbox"/> Not Applicable <input type="checkbox"/>			

Results

According to §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

The EUT has internal inductive loop coil antenna, which accordance to the above sections, is considered sufficient to comply with the provisions of these sections.

END REPORT