

Electromagnetic Compatibility Test Report

Prepared in accordance with

FCC Part 15 Subpart B: 2019

On

September 18th, 2019




Prepared for:

**JAET2L Holdings
8555 Hollyhock St.
Lafayette, CO 80026**

Prepared by:

**TUV Rheinland of North America, Inc.
5015 Brandin Ct. Fremont CA 94538 USA**

ATTESTATION OF TEST RESULTS

Client:	JAET2L Holdings 8555 Hollyhock St. Lafayette, CO 80026	Isaac Davenport isaac@isaacdavenport.com	
Model Name:	Accelerometer Sensor	Serial Number:	N/A
Model Numbers:	A, ISS001US	Date(s) Tested:	August 14th, 2019 to August 23rd, 2019
Test Location:	TUV Rheinland of North America Inc. 5015 Brandin Ct. Fremont CA 94538 USA		
Test Specifications:	Emissions:	FCC Part 15 Subpart B: 2019	
	Immunity:	N/A	
Test Result:	The above product was found to be Compliant to the above test standard(s)		
Prepared by: Osvaldo Casorla		Reviewed by:	
<u>9/23/2019</u> <u>Osvaldo Casorla</u> <i>Date</i> <i>Name</i> <i>Signature</i>		<u>9/23/2019</u> <u>Josie Sabado</u> <i>Date</i> <i>Name</i> <i>Signature</i>	
Other aspects:	None		
FREMONT			
	 Testing Cert #3331.02	INDUSTRY CANADA 2932D	 1097 (A-0268)

The test results contained in this report refer exclusively to the product(s) presented for testing. No liability may be assumed for models or products not referred to herein. This test report may not be published or duplicated in part without permission of the testing body. This test report by itself does not constitute authorization for the use of any TÜV Rheinland test mark. The report must not be used by the client to claim product certification, approval, or endorsement

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1 General Information

1.1 Scope

This report is intended to document the status of conformance with the listed standards based on the results of testing performed on August 14th, 2019 to August 23rd, 2019 on the nrf52810 manufactured by JAET2L Holdings This report only applies to the specific samples tested under the stated test conditions. It is the responsibility of the manufacturer to assure that additional production units of this model are manufactured with identical or EMI equivalent electrical and mechanical components. This report is further intended to document changes and modifications to the EUT throughout its life cycle. All documentation will be included as a supplement.

1.2 Purpose

Testing was performed to evaluate the EMC performance of the EUT (Equipment Under Test) in accordance with the applicable requirements, procedures, and criteria defined in the application of regulations and application of standards listed in this report.

1.3 Summary of Test Results


Applicant	JAET2L Holdings 8555 Hollyhock St. Lafayette, CO 80026
Description	Bluetooth BLE
Model Name	Accelerometer Sensor
Model Number	A, ISS001US
Serial Number	N/A
Input Power	3 VDC
Test Date(s)	August 14th, 2019 to August 23rd, 2019

Standards	Description	Severity Level or Limit	Criteria	Test Result
FCC Part 15 Subpart B: 2019	Radiated Emissions	Class B 30 MHz - 18 GHz	Limit	Complies

Laboratory Information

1.4 Accreditations & Endorsements

1.4.1 US Federal Communications Commission

 TUV Rheinland of North America EMC test facilities located at 1279 Quarry Lane, Ste. A, Pleasanton, CA, 94566, and 5015 Brandin Ct, Fremont, CA 94538, are recognized by the Commission for performing testing services for the general public on a fee basis. These laboratory test facilities have been fully described in reports submitted to and accepted by the FCC (Registration No. US1131). The laboratory Scopes of Accreditation include Title 47 CFR Parts 15, 18 and 90. The accreditations are updated every three years.

1.4.2 A2LA



TUV Rheinland of North America EMC test facilities are accredited by the American Association for Laboratory Accreditation (A2LA). The laboratories have been assessed and accredited by A2LA in accordance with ISO Standard 17025:2017 (Testing Certificate #3331.02). The Scope of Laboratory Accreditation includes emission and immunity testing. The accreditations are

updated annually.

1.4.3 Industry Canada



The Pleasanton 5-meter Semi-Anechoic Chamber, Registration No. 2932M-1, has been accepted by Industry Canada to perform testing to 3 and 5 meters based on the test procedures described in ANSI C63.4-2009. The Fremont 10-meter Semi-Anechoic Chamber, Registration No. 2932D-1, has been accepted by Industry Canada to perform testing to 3 and 10 meters based on the test procedures described in ANSI C63.4-2009.

1.4.4 Japan – VCCI



The Voluntary Control Council for Interference by Information Technology Equipment (VCCI) is a group that consists of Information Technology Equipment (ITE) manufacturers and EMC test laboratories. The purpose of the Council is to take voluntary control measures against electromagnetic interference from Information Technology Equipment, and thereby contribute to the development of a socially beneficial and responsible state of affairs in the realm of Information Technology Equipment in Japan. TUV Rheinland of North America EMC test facilities located at 1279 Quarry Lane, Ste. A, Pleasanton, CA, 94566, and 5015 Brandin Ct, Fremont, CA 94538, have been assessed and approved in accordance with the Regulations for Voluntary Control Measures.

VCCI Registration No. for Pleasanton: A-0268

VCCI Registration No. for Fremont: A-0268

1.5 Test Facilities and EMC Software

Test facilities are located at 1279 Quarry Lane, Ste. A, Pleasanton, California 94566, U.S.A. and 5015 Brandin Ct. Fremont CA 94538 USA (Fremont is the Pleasanton Annex).

1.5.1 Emission Test Facility

The Semi-Anechoic Chambers and AC Line Conducted measurement facilities used to collect radiated and conducted emissions data have been constructed in accordance with ANSI C63.7:1992. The Fremont 10 meter semi-anechoic chamber has been measured in accordance with and verified to comply with the theoretical volumetric normalized site attenuation of ANSI C63.4:2014 and SVSWR requirements of CISPR 16-1-4 Consol. Ed. 3.0 (2010-04), at test distances of 3 and 10 meters. This site has been described in reports dated November 1st, 2006, submitted to the FCC, and accepted by letter dated November 28, 2006. The site is listed with the FCC and accredited by A2LA (Testing Certificate #3331.02). The Pleasanton 5 meter semi-anechoic chamber has been verified to comply with the theoretical volumetric normalized site attenuation of ANSI C63.4:2009 and SVSWR requirements of CISPR 16-1-4 Consol. Ed. 3.0 (2010-04) at a test distance of 3 meters. This site has been described in reports dated November 1st, 2006, submitted to the FCC, and accepted by letter dated November 28, 2006. The site is listed with the FCC and accredited by A2LA (Testing Certificate #3331.02).

1.5.2 Immunity Test Facility

ESD, EFT, Surge, PQF: These tests are performed in an environmentally controlled room with a 3.7 m x 3.7 m x 3.175 mm thick aluminum floor connected to PE ground. For ESD testing, tabletop equipment is placed on an insulated mat with a surface resistivity of 10^9 Ohms/square on a 1.6 m x 0.8 m x 0.8 m high non-conductive table with a 3.175 mm aluminum top (Horizontal Coupling Plane). The HCP is connected to the main ground plane via a low impedance ground strap through two 470 k Ω resistors. The Vertical Coupling Plane consists of an aluminum plate 50 cm x 50 cm x 3.175 mm thick. The VCP is connected to the main ground plane via a low impedance ground strap through two 470 k Ω resistors. For each of the other tests, the HCP is removed.

RF Field Immunity testing is performed in a 10m semi-anechoic chamber with absorber added to floor.

RF Conducted and Magnetic Field Immunity testing is performed on a 4.9 m x 3.7 m x 3.175 mm thick aluminum ground plane which is connected to one end of the anechoic chamber.

All test areas allow a minimum distance of 1 meter from the EUT to walls or conducting objects.

1.5.3 EMC Software - Fremont

Manufacturer	Name	Version	Test Type
EMISoft	Vasona	5.0	Radiated & Conducted Emissions
ETS-Lindgren	TILE	4.2.A	Radiated Emissions > 1 GHz
ETS-Lindgren	TILE	V.3.4.K.22	Radiated & Conducted Immunity
Haefely	WinFEAT	1.6.3	Surge
Thermo Electron - Keytek	CEWare32	3.0	EFT/Surge/Voltage Dips & Interrupt
Voltech	IEC61000-3	1.15.07RC	Harmonic & Flicker

1.5.4 EMC Software - Pleasanton

Manufacturer	Name	Version	Test Type
ETS-Lindgren	TILE	3.4.K.14 @ 4.0.A.5	Radiated & Conducted Emissions
EMISoft	Vasona	5.0	Radiated & Conducted Emissions
Agilent	Agilent MXE	A.11.02	Radiated & Conducted Emissions
ETS-Lindgren	TILE	3.4.K.14	Radiated & Conducted Immunity
Thermo Electron - Keytek	CEWare32	4.00	EFT/Surge/Voltage Dips & Interrupt
Voltech	IEC61000-3	1.21.07RC2	Harmonic & Flicker

1.6 Measurement Uncertainty

Two types of measurement uncertainty are expressed in this report, per *ISO Guide To The Expression Of Uncertainty In Measurement*, 1st Edition, 1995.

The Combined Standard Uncertainty is the standard uncertainty of the result of a measurement when that result is obtained from the values of a number of other quantities, equal to the positive square root of a sum of terms, the terms being the variances or co-variances of these other quantities weighted according to how the measurement result varies with changes in these quantities. The term standard uncertainty is the result of a measurement expressed as a standard deviation.

The Expanded Uncertainty defines an interval about the result of a measurement that may be expected to encompass a large fraction of the distribution of values that could reasonably be attributed to the measurement and the fraction may be viewed as the coverage probability or level of confidence of the interval.

1.6.1 Sample Calculation – radiated & conducted emissions

The field strength is calculated by subtracting the Amplifier Gain and adding the Cable Loss and Antenna Correction Factor to the measured reading. The basic equation is as follows:

$$\text{Field Strength (dB}\mu\text{V/m)} = \text{RAW} - \text{AMP} + \text{CBL} + \text{ACF}$$

Where: RAW = Measured level before correction (dB μ V)

AMP = Amplifier Gain (dB)

CBL = Cable Loss (dB)

ACF = Antenna Correction Factor (dB/m)

$$\mu\text{V/m} = 10^{\frac{\text{dB } \mu\text{V / m}}{20}}$$

Sample radiated emissions calculation @ 30 MHz

Measurement +Antenna Factor–Amplifier Gain+Cable loss=Radiated Emissions (dBuV/m)

$$25 \text{ dBuV/m} + 17.5 \text{ dB} - 20 \text{ dB} + 1.0 \text{ dB} = 23.5 \text{ dBuV/m}$$

1.6.2 Measurement Uncertainty Emissions

Per CISPR 16-4-2	U_{lab}	U_{cispr}
Radiated Disturbance @ 10 meters		
30 – 1,000 MHz	2.25 dB	4.51 dB
Radiated Disturbance @ 3 meters		
30 – 1,000 MHz	2.26 dB	4.52 dB
1 – 6 GHz	2.12 dB	4.25 dB
6 – 18 GHz	2.47 dB	4.93 dB
Conducted Disturbance @ Mains Terminals		
150 kHz – 30 MHz	1.09 dB	2.18 dB
Disturbance Power		

Voltech PM6000A

The estimated combined standard uncertainty for harmonic current and flicker measurements is $\pm 5.0\%$.	Per CISPR 16-4-2
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1.6.3 Measurement Uncertainty Immunity

The estimated expanded uncertainty for ESD immunity measurements is $\pm 8.2\%$.	Per IEC 61000-4-2
The estimated expanded uncertainty for radiated immunity measurements is ± 4.10 dB.	Per IEC 61000-4-3
The estimated expanded uncertainty for EFT fast transient immunity measurements is $\pm 5.84\%$.	Per IEC 61000-4-4
The estimated expanded uncertainty for surge immunity measurements is $\pm 5.84 \%$.	Per IEC 61000-4-4
The estimated expanded uncertainty for conducted immunity measurements with CDN is ± 3.66 dB	Per IEC 61000-4-6
The estimated expanded uncertainty for power frequency magnetic field immunity is $\pm 11.6\%$.	Per IEC 61000-4-8
The estimated expanded uncertainty for voltage variation and interruption measurements is $\pm 3.48\%$.	Per IEC 61000-4-11

The expanded uncertainty at a level of 95% confidence is obtained by multiplying the combined standard uncertainty by a coverage factor of 2. Compliance criteria are not based on measurement uncertainty.

1.7 Calibration Traceability

All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Measurement method complies with ANSI/NCSL Z540-1-1994 and ISO Standard 17025:2017. Equipment calibration records are kept on file at the test facility.

1.8 Measurement Equipment Used

Equipment	Manufacturer	Model #	Serial/Inst #	Last Cal mm/dd/yyyy	Next Cal mm/dd/yyyy
Spectrum Analyzer	Rohde & Schwarz	FSU26.5	200050	11/20/2018	11/20/2019
Spectrum Analyzer	Rohde & Schwarz	FSU8	101358	12/07/2018	12/07/2019
EMI Receiver	Rohde & Schwarz	ESIB40	100180	05/31/2018	05/31/2020
L.I.S.N.	Com-Power	LI-215	192000	01/16/2019	01/16/2020
Transient Limiter	Com-Power	LIT-930	531582	01/16/2019	01/16/2020
EMI Receiver	Agilent	MXE N9038A	MY51210195	01/16/2019	01/16/2020
Preamplifier, 9 kHz – 1 GHz	Sonoma	310N	213221	01/16/2019	01/16/2020
Bilog Antenna	Sunol Sciences	JB3	A060502	05/27/2018	05/27/2020
Amplifier	Miteq	TTA1800-30-HG	1842452	01/15/2019	01/15/2020
Horn Antenna	Sunol Sciences	DRH-118	A040806	03/05/2019	03/05/2020
Amplifier	HP	8449B	3008A01013	01/15/2019	01/15/2020
Amplifier	Sonoma	310N	185516	N/A (See Note)	
1.6 GHz Low Pass Filter	K&L Microwave	8L120-X1600-0/09135-0249	UA691-35	N/A (See Note)	
3.5 GHz High Pass Filter	Hewlett Packard	84300-80038	820004	N/A (See Note)	

Note: CE=Conducted Emissions, CI=Conducted Immunity, DP=Disturbance Power, EFT=Electrical Fast Transients, ESD=Electrostatic Discharge, FLI=Flicker, HAR=Harmonics, MF=Magnetic Field Immunity, NCR=No Calibration Required, RE=Radiated Emissions, RI=Radiated Immunity, SI=Surge Immunity, VDSI=Voltage Dips and Short Interruptions

2 Product Information

2.1 Product Description

See Section 4.

2.2 Equipment Modifications

No modifications were needed to bring product into compliance.

2.3 Test Plan

The EUT product information, test configuration, mode of operation, test types, test procedures, test levels, pass/failure criteria, in this report were carried out per the product test plan located in Appendix A of this report.

3 Emissions

3.1 Radiated Emissions

This test measures the electromagnetic levels of spurious signals generated by the EUT that radiated from the EUT and may affect the performance of other nearby electronic equipment.

3.1.1 Overview of Test

Results	Compliant (as tested per this report)		Test Date(s)		August 14th, 2019 to August 23rd, 2019		
Standard	FCC Part 15 Subpart B: 2019						
Model Number	A		Serial #	N/A			
Configuration	Unintentional Radiated Emissions						
Test Setup	Tested in the 10-meter Semi-Anechoic chamber, placed on table: see test plan for details.						
EUT Powered By							
Environmental Conditions	August 13 th , 2019	Temp	21.1° C	Humidity	38.8%	Pressure	1017 mbar
Frequency Range	30 MHz to 18 GHz						
Perf. Criteria	Class B		Perf. Verification		Readings under limit		
Mod. to EUT	None		Test Performed By		Osvaldo Casorla		

3.1.2 Test Procedure

Unintentional Radiated emissions tests were performed using the procedures of ANSI C63.4:2014 including methods for signal maximizations and EUT configuration. The photos included with the report show the EUT in its maximized configuration.

The frequency range from 30 MHz to 18 GHz was investigated for radiated emissions.

3.1.3 Deviations

There were no deviations from the test methodology listed in the test plan for the radiated emission test.

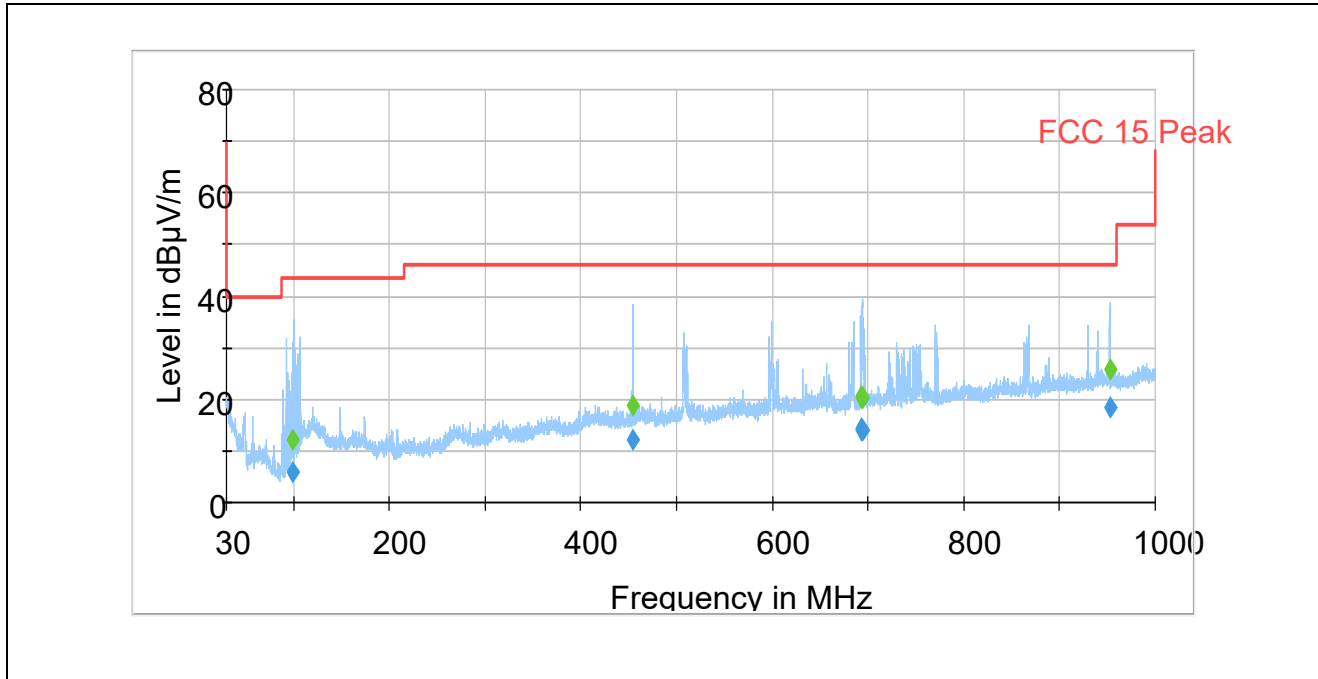
3.1.4 Final Test

All final radiated emissions measurements were below the specification limits.

3.1.5 Plots

NOTES:

Radiated Emissions Full Scan
30 MHz – 1000 MHz
Vertical / Horizontal



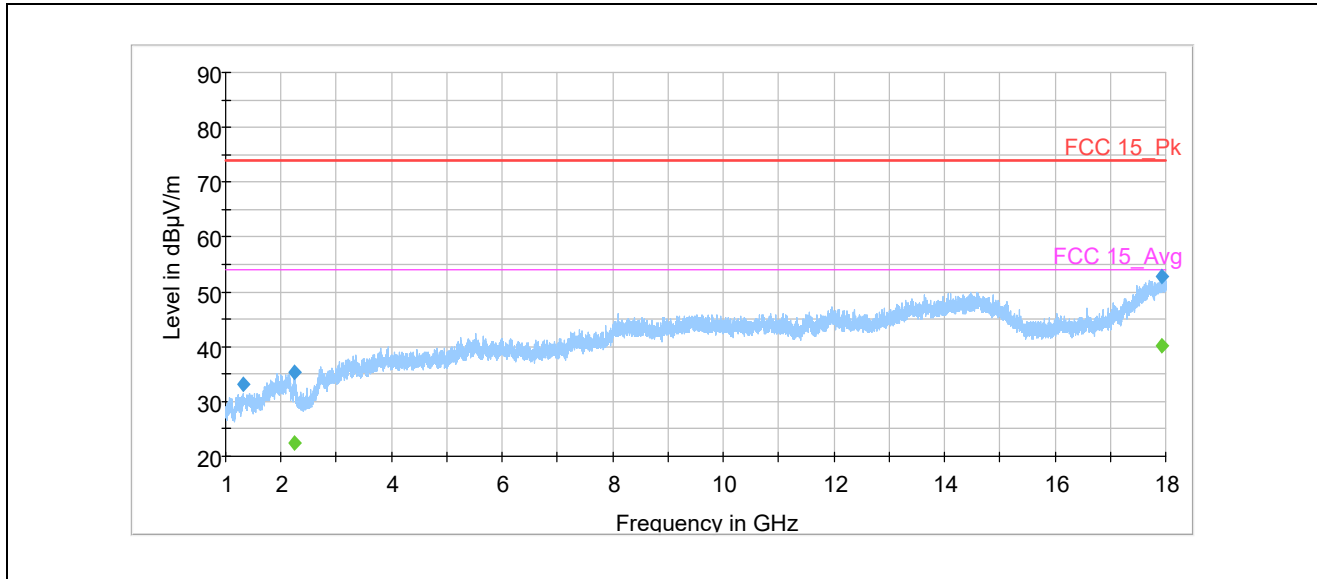
3.1.6 Final Tabulated Data

30 MHz – 1000 MHz

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
99.79	5.95	43.52	37.57	1000.0	120.000	155.0	V	175.0	-16.2
454.39	12.25	46.00	33.75	1000.0	120.000	101.0	V	180.0	-8.4
693.25	14.30	46.00	31.70	1000.0	120.000	200.0	V	179.0	-5.1
693.76	13.95	46.00	32.05	1000.0	120.000	101.0	V	175.0	-5.1
694.25	14.06	46.00	31.94	1000.0	120.000	100.0	V	175.0	-5.0
952.62	18.56	46.00	27.44	1000.0	120.000	200.0	V	180.0	-0.2

NOTES:

Radiated Emissions Full Scan
1000 MHz – 18,000 MHz
Vertical / Horizontal



3.1.1 Final Tabulated Data

1000 MHz – 18,000 MHz

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	PoI	Azimuth (deg)	Corr. (dB/m)
1313.60	33.05	---	74.00	40.95	1000.0	1000.000	200.0	V	-28.0	-35.4
1313.60	---	19.62	54.00	34.38	1000.0	1000.000	200.0	V	-28.0	-35.4
2247.07	35.42	---	74.00	38.58	1000.0	1000.000	250.0	H	-180.0	-31.6
2247.067	---	22.42	54.00	31.58	1000.0	1000.000	250.0	H	-180.0	-31.6
17941.11	---	40.14	54.00	13.86	1000.0	1000.000	150.0	V	97.0	-6.9
17941.11	52.77	---	74.00	21.23	1000.0	1000.000	150.0	V	97.0	-6.9

3.1.2 Photos

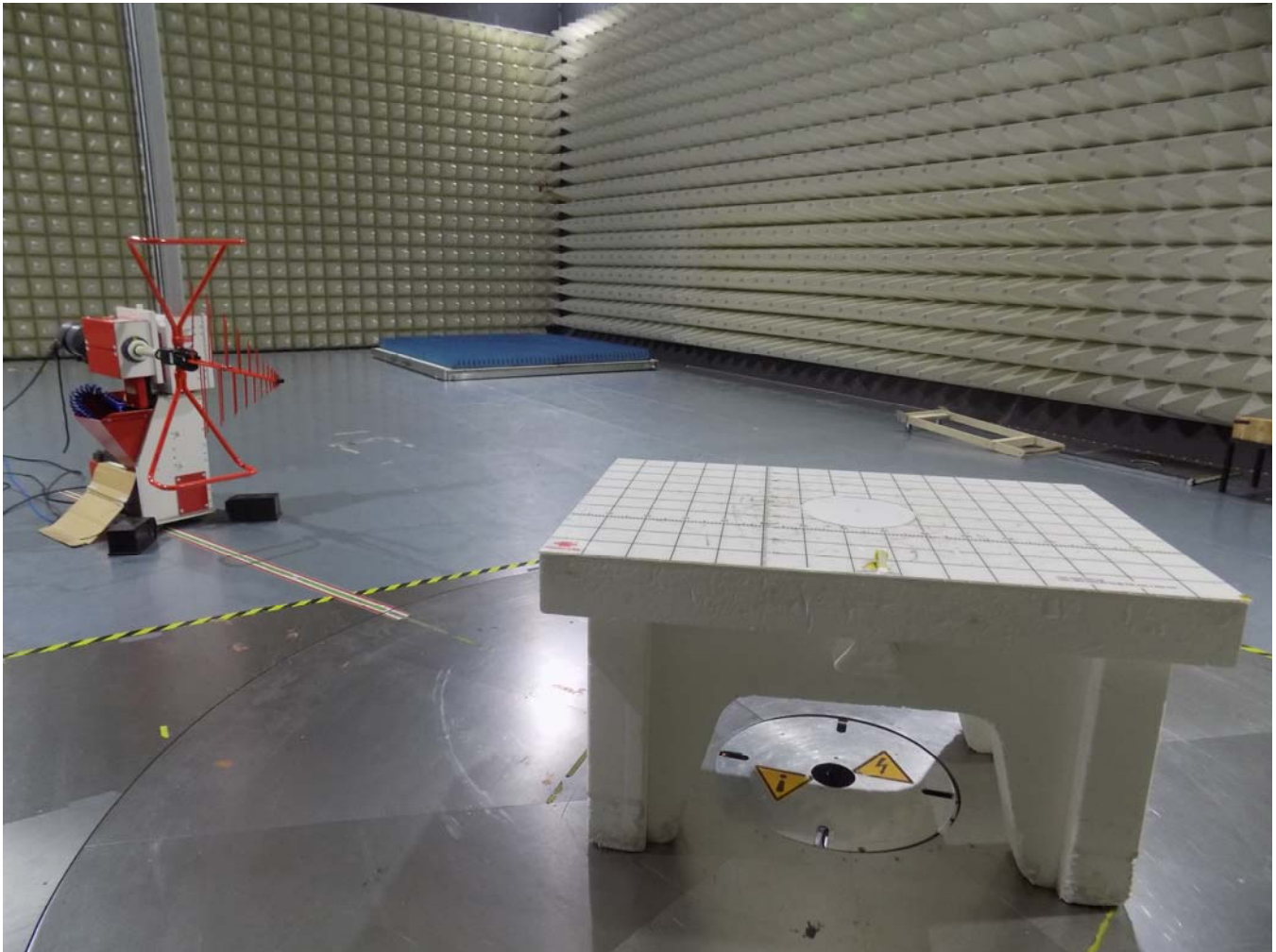


Figure 1 - Radiated Emissions Test Setup 30 - 1000 MHz – Front

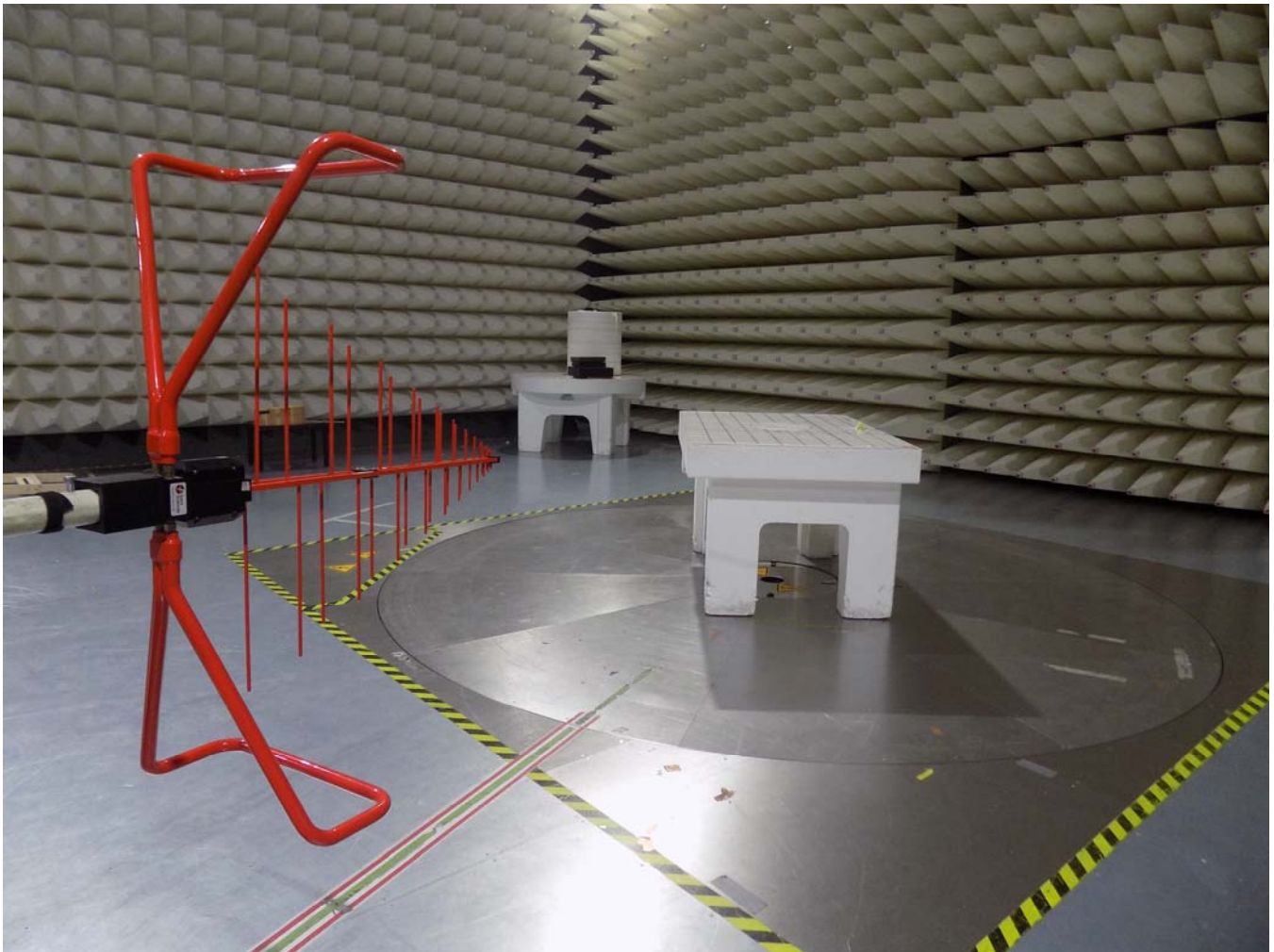


Figure 2 - Radiated Emissions Test Setup 30 - 1000 MHz - Back

Appendix A

4 Test Plan

This test report is intended to follow this test plan outlined here in unless otherwise stated in this here report. The following test plan will give details on product information, standards to be used, test set ups and refer to TUV test procedures. The test procedures will give the steps to be taken when performing the stated test. The product information below came via client, product manual, product itself and or the internet.

4.1 General Information

Client	JAET2L Holdings
Address	8555 Hollyhock St. Lafayette, CO 80026, USA

4.2 EUT Designation

Model Name	Accelerometer Sensor
Model Number(s)	A, ISS001US

4.3 EUT Description

Configuration		Description
1		TX mode
Notes	Bluetooth BLE	

4.4 Equipment Under Test (EUT) Description

The EUT operates in 2.4GHz Bluetooth BLE in a continuous transmissions mode.

4.5 Product Environment(s)

<input checked="" type="checkbox"/>	Domestic/Residential	<input type="checkbox"/>	Hospital
<input type="checkbox"/>	Light Industrial/Commercial	<input type="checkbox"/>	Small Clinic
<input type="checkbox"/>	Industrial	<input type="checkbox"/>	Doctor's office
<input type="checkbox"/>	Telecommunications Center	<input type="checkbox"/>	Other than Telecommunications Center
<input type="checkbox"/>	Other		

*Check all that apply

4.6 Applicable Documents

Standards	Description
FCC Part 15 Subpart B: 2019	Radiated Emissions

4.7 EUT Electrical Power Information

Name	# of Phases	Type	Input Voltage		AC Voltage Frequency	Current Max.	Power
			Min	Max			
DC powered	1 <input type="checkbox"/> 3 <input type="checkbox"/> None <input checked="" type="checkbox"/>	AC <input type="checkbox"/> DC <input checked="" type="checkbox"/> Host <input type="checkbox"/> Batteries <input type="checkbox"/>	-	3	-	-	-
Notes							

4.8 EUT Clock/Oscillator Frequencies

Reference Designation	Speed (MHz)	Type
Highest oscillator	< 108	<input checked="" type="checkbox"/> Oscillator <input type="checkbox"/> Microprocessor

4.8.1 Radiated Emissions, Upper Frequency

<input checked="" type="checkbox"/>	Less than 108 MHz	Scan to 1 GHz
<input type="checkbox"/>	Less than 500 MHz	Scan to 2 GHz
<input type="checkbox"/>	Less than 1000 MHz	Scan to 5 GHz
<input type="checkbox"/>	Greater than 1000 MHz	Scan to 5 th Harmonic or 40 GHz (whichever is lower)

4.9 Electrical Support Equipment

Reference Designation	Manufacturer	Model	Serial Number	BSMI #
N/A	N/A	N/A	N/A	N/A

4.10 Non - Electrical Support Equipment N/A

Reference Designation	Manufacturer	Model	Serial Number or Description (e.g., Type of Gas or Liquid)
N/A	N/A	N/A	N/A

4.11 EUT Equipment/Cabling Information N/A

EUT Port	Connected To	Cable Type				
		Length (Meters)	Shielded Yes / No	Bead Yes / No		
N/A	N/A	N/A	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

4.12 EUT Test Program

nRFgo Studio – Direct Test Mode UART interface.

4.13 EUT Modes of Operation

Continuous transmission mode.

4.14 Monitoring of EUT during Testing

The EUT will be monitored by visual observation using a spectrum analyzer.

Prior to each tests the EUT is set to idle mode with no transmission.

4.15 EUT Configuration

EUT is configured in normal operational mode and set to a continuous data traffic using software nRFgo Studio – Direct Test Mode UART interface.

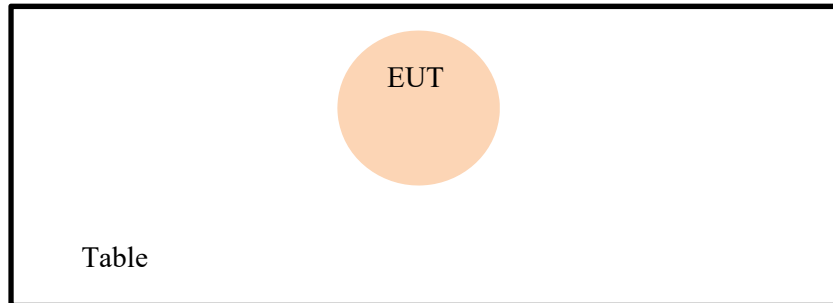
4.16 Description

Configuration	Description
Tabletop	EUT is a standalone equipment placed on tabletop
Notes	

4.17 Subassemblies

Reference Designation	Manufacturer	Model No.	Revision	Serial No.	Description
N/A					

4.17.1 Block Diagram



4.18 Emissions

4.18.1 Radiated Emissions

4.18.1.1 Preliminary Radiated Emissions Test Setup

Standard	FCC Part 15 Subpart B: 2019			Procedure	ANSI C63.4
Limit	Class B	Emissions Verification		Emissions Under Limit	
Frequency Range	30 MHz – 18 GHz				
Scan #1	Final Scan 30 – 1000 MHz	Antenna Distance	3m	Detector	Peak Scan
Scan #2	Final Scan 1 – 18 GHz	Antenna Distance	3m	Detector	N/A
Configuration	See Section 4.16				
Notes	None				

4.18.1.2 Final Radiated Emissions Test Setup

Standard	FCC Part 15 Subpart B: 2019			Procedure	ANSI C63.4
Limit	Class B	Emissions Verification	Emissions Under Limit		
Frequency Range	30 MHz – 18 GHz				
Scan #1	Final Scan 30 – 1000 MHz	Antenna Distance	3m	Detector	Quasi Peak
Scan #2	Final Scan 1 – 18 GHz	Antenna Distance	3m	Detector	Peak/Average
Configuration	See Section 4.16				
Notes	None				

Appendix B

5 Modification(s)

N/A

END OF REPORT