INTENTIONAL RADIATOR
TEST REPORT

Report Reference Number:	E10676-2201_VersaWireless_Shock319_FCC_Rev1.0
Total Number of Pages:	30
Date of Issue:	December 21, 2022
EMC Test Laboratory:	**QAI Laboratories Ltd.**
Address:	3980 North Fraser Way, Burnaby, BC, V5J 5K5 Canada
Phone:	(604) 527-8378
Fax:	(604) 527-8368

Laboratory Accreditations (per ISO/IEC 17025:2017)

CERT #3657.02

This report has been completed in accordance with the requirements of ISO/IEC 17025.
Test results contained in this report are within QAI Laboratories ISO/IEC 17025 accreditations.
QAI Laboratories authorizes the applicant to reproduce this report, provided it is reproduced in its entirety and for the use by the company's employees only.

Manufacturer:	**Versa Wireless**
Address:	#103-19292 60th Ave Surrey, BC, V3S 3M2
Equipment Tested:	**Wireless Shock Sensor**
Model Number(s):	Shock-319
FCC ID:	2AD9XSHOCK319

REVISION HISTORY

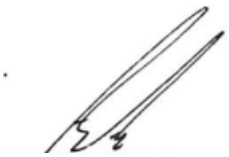
Date	Report Number	Details	Author's Initials
November 4, 2022	E10676-2201_VersaWireless_Shock319_FCC_Rev0.0	Initial draft	AH
December 21, 2022	E10676-2201_VersaWireless_Shock319_FCC_Rev1.0	Final Report	AH
All previous versions of this report have been superseded by the latest dated revision as listed in the above table. Please dispose of all previous electronic and paper printed revisions accordingly.			

REPORT AUTHORIZATION

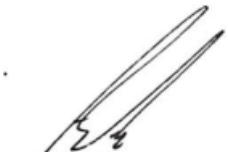
The data documented in this report is for the test equipment provided by the manufacturer. The tests were conducted on the sample equipment as requested by the manufacturer for the purpose of demonstrating compliance with the standards outlined in Section I of this report as agreed upon by the Manufacturer under the quote 22RH10242.

The Manufacturer is responsible for the tested product configurations, continued product compliance, and for the appropriate auditing of subsequent products as required.

This report may comprise a partial list of tests that are required for FCC and ISED Declaration of Conformity can only be produced by the manufacturer. This is to certify that the following report is true and correct to the best of our knowledge.



Testing Performed by
Alec Hope
Senior RF/EMC Engineer



Report Prepared by
Alec Hope
Senior RF/EMC Engineer

Report Reviewed by
Alireza Nezam
RF/EMC Test Engineer

QAI FACILITIES

British Columbia

QAI Laboratories Inc.
Main Laboratory/Headquarters
3980 North Fraser Way,
Burnaby, BC V5J Canada

Ontario

QAI Laboratories Inc.
25 Royal Group Crescent #3,
Vaughan,
ON L4H 1X9 Canada

Virginia

QAI Laboratories Ltd.
1047 Zachary Taylor Hwy,
Suite A Huntly,
VA 22640 USA

China

QAI Laboratories Ltd
Room 408, No. 228, Jiangchang 3rd Road Jing'An District,
Shanghai, China 200436

California

QAI Laboratories Ltd.
8385 White Oak Avenue Rancho
Cucamonga, CA 91730 USA

Oklahoma

QAI Laboratories Ltd.
5110 North Mingo Road
Tulsa, OK 74117, USA

Miami

QAI Laboratories Ltd.
8148 NW 74th Ave,
Medley, FL 33166 USA

South Korea

QAI Laboratories Ltd
#502, 8, Sanbon-ro 324beon-gil
Gunpo-si, Gyeonggi-do, 15829,
South Korea

QAI EMC ACCREDITATION

QAI EMC is your one-stop regulatory compliance partner for electromagnetic compatibility (EMC) and electromagnetic interference (EMI). Products are tested to the latest and applicable EMC/EMI requirements for domestic and international markets. QAI EMC goes above and beyond being a testing facility—we are your regulatory compliance partner. QAI EMC has the capability to perform RF Emissions and Immunity for all types of electronics manufacturing including Industrial, Scientific, Medical, Information Technology, Telecom, Wireless, Automotive, Marine and Avionics.

EMC Laboratory Location	FCC Designation (3m SAC)	IC Registration (3m SAC)	A2LA Certificate
Burnaby, BC, Canada	CA9543	9543A	3657.02

EMC Facility Burnaby BC, Canada

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 EXECUTIVE SUMMARY

1.1 Purpose

The purpose of this report is to demonstrate and document the compliance of SHOCK-319 as per Sections 1.2 and 1.3.

1.2 Scope

The information documented in this report is based on the test methods and levels as per Quote 22RH10242:

- **FCC Title 47 Part 15** – Radio Frequency Devices, Subpart C – Intentional Radiators 15.203: Antenna Requirement
- **FCC Title 47 Part 15** – Radio Frequency Devices, Subpart C – Intentional Radiators 15.205: Restricted bands of operation
- **FCC Title 47 Part 15** – Radio Frequency Devices, Subpart C – Intentional Radiators 15.209: Radiated emission limits; general requirements
- **FCC Title 47 Part 15** – Radio Frequency Devices, Subpart C – Intentional Radiators 15.231: Periodic Operation in the Band 40.66-40.70 MHz and Above 70 MHz

1.3 Summary of Results

The following testing was performed pursuant to FCC Title 47 Part 15 and Industry Canada ICES-003 to demonstrate the testimony to "FCC, IC, & CE" mark Electromagnetic Compatibility testing for the product.

No.	Test	Applicable Standard	Description	Result
1	Antenna Requirement	FCC 47 CFR Part 15.203	Soldered, non-replaceable antenna	Complies
2	Transmitter Deactivation	FCC 47 CFR Part 15.231 (a)(2)	A transmitter activated automatically shall cease transmission within 5 seconds after activation	Complies
3	Duty Cycle	FCC 47 CFR Part 15.231 (a)(3)	Polling transmissions are permitted … provided the total transmission time does not exceed two seconds per hour	Complies
4	20 dB Bandwidth	FCC 47 CFR Part 15.231 (c)	The bandwidth of the emission shall be no wider than 0.25% of the center frequency	Complies
5	Radiated Emissions	FCC 47 CFR Part 15.33 (a)(1), (5) FCC 47 CFR Part 15.205 (a), (b) FCC 47 CFR Part 15.209 (a) FCC 47 CFR Part 15.231 (b)	Radiated emissions requirements as stated in the Standards	Complies

Table 1: Applicable test standards and descriptions

Note: The gain of the antenna(s) is provided by the client to measure or calculate test results and is not independently measured by QAI.

2 GENERAL INFORMATION

2.1 Product Description

The information provided in this section is for the Equipment Under Test (EUT) and the corresponding Auxiliary Equipment needed to perform the tests as a complete system.

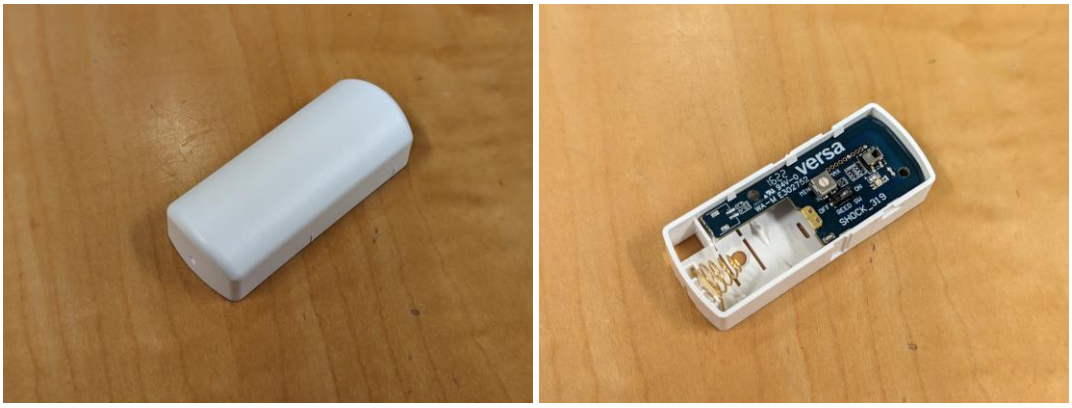


Figure 1: EUT, Left: Case Closed, Right: Case Open

Equipment Under Test (EUT)

Equipment	Shock sensor
Description	Wireless home security shock sensor used on sliding glass doors.
Manufacturer	Versa Wireless
Model No.	Shock319
Serial No.	FCC Sample Only
Clock frequencies tuned upon within the EUT:	8 MHz, 13 MHz
Highest frequency generated within the EUT:	319.5 MHz

Equipment Under Test (EUT) – RF Information

RF device type	Security device
Operating frequency	319.5 MHz
Number of available channels/transmitter	1
Channel separation	N/A
Channel bandwidth	415 kHz
Output Power/Transmitter	13 dBm into loop antenna of -20dB gain
Modulation type	ASK - OOK
Test Channels (L, M, H)	319.5 MHz – Single channel
Data Rate	4 kbps
Adaptive	No
Geo-location-capable	No
Number of antennas	1
Antenna type	Loop
Antenna gain	-20 dBi

Equipment Under Test (EUT) – General Information

Tested as	Tabletop
Dimensions	74 x 30 x 19 cm
Declared operating temperature range:	0 °C - 50 °C
Input power	3.0 VDC, CR2 Battery
Grounded	No
Device use	Fixed Location – Physically secured and not easily moved

Notes: None.

Test Modes

Test	Transmitter State	Power
1	On	Battery

2.2 Environmental Conditions

The equipment under test was operated and tested under the following environmental conditions:

Parameter	Conditions
Location	QAI Burnaby - Indoors
Temperature	22 °C
Relative Humidity	31% rh

2.3 Measurement Uncertainty

Parameter	Uncertainty
Radiated Emissions, 30MHz-1GHz	± 2.40 dB
Radiated Emissions, 1GHz-40GHz	± 2.48 dB
Radio Frequency	±1.5 x 10-5 MHz
Total RF Power Conducted	±1.36 dB
Spurious Emissions, Conducted	±1.36 dB
RF Power Density, Conducted	±1.36 dB
Temperature	±1ºC
Humidity	±5 %
DC and low frequency voltages	±3 %

2.4 Worst Test Case

Worst-case orientation was determined during the preliminary testing. The final radiated emissions were performed in the worst-case orientation.

2.5 Sample Calculations of Emissions Data

Radiated and conducted emissions were performed using EMC32 software developed by Rohde & Schwarz. Transducer factors such as antenna factors, cable losses and amplifier gains were stored in the test templates which are used to perform the emissions measurements. After the test is finished, data is generated from the EMC32 consisting of product details, emission plots and final data tables as shown below.

Frequency (MHz)	Q-Peak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Ant. Ht. (cm)	Pol	Turntable Position (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
42.663900	33.0	1000.000	120.000	100.0	H	70.0	13.2	7.5	40.5

Table 2: Sample Quasi-Peak Correction Data - Radiated

Quasi-Peak reading shown in the table above is already corrected by the software using the correction factor shown in column "Corr." The correction factor listed under "Corr." table calculated as:

Corr.(dB) = Antenna factor + Cable loss

Or

Corr.(dB) = Antenna factor + Cable Loss - Amp gain (if pre-amplifier was used)

The final Quasi peak reading shown in the data is calculated by the software using following equation:

Corrected Quasi-Peak (dBµV/m) = Raw Quasi-Peak Reading + Antenna factor + Cable loss

To obtain the final Quasi-Peak or Average reading during power line conducted emissions, transducer factors are included in the final measurement as shown below.

Frequency (MHz)	Q-Peak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150	44.3	1000.000	9.000	GND	0.6	21.7	66.0

Table 3: Sample Quasi-Peak Correction Data - Conducted Emissions

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150	27.2	1000.000	9.000	GND	0.6	28.8	56.0

Table 4: Sample Average Correction Data- Radiated Emissions

Quasi Peak or Average reading shown in above table is already corrected by the software using the correction factor shown in column "Corr." The correction factor listed under "Corr." table calculated as:

Corr.(dB) = Antenna factor + Cable loss

The final Quasi-peak or Average reading shown in the data is calculated by the software using following equation:

Corr. Quasi-Peak/Average Reading (dBµV) = Raw Quasi-Peak/Average Reading + Antenna factor + Cable loss

The allowable margin from the limits, as per the standards, were calculated for both radiated and conducted emissions:

Margin(dB) = Limit – Quasi-Peak or Average reading

2.6 Test Equipment List

The tables below contain all the equipment used by QAI Laboratories in conducting all tests on the Equipment Under Test (EUT) as per Section 1.

Emissions Test Equipment

Measurement Software List Emissions Test Equipment

Sl. NO.	Manufacturer	Model	Description	Serial No.	S/W Version	Calibration Due Date
2	ETS Lindgren	2165	Turntable	00043677	N/A	N/A
3	ETS Lindgren	2125	Mast	00077487	N/A	N/A
4	ETS Lindgren	S201	5-meter Semi-Anechoic Chamber	1030	N/A	N/A
5	Hewlett Packard	8449B	Preamplifier (1-26 GHz)	2933A00198	N/A	2025-Feb-15
6	Rohde & Schwarz	ESW44	EMI Receiver	101604	EMC32 v10.35.10/ FV 4.73 SP4	2025-Jul-20
7	Sunol Sciences	DRH-118	Horn Antenna, 1.0-18 GHz	A050905	N/A	2023-07-28
8	Sunol Sciences	SM46C	Turntable	051204-2	N/A	N/A
9	Sunol Sciences	TWR95	Mast	TREML0001	N/A	N/A
10	Sunol Sciences	JB3	Biconilog Antenna 30MHz – 3GHz	A042004	N/A	2023-Jul-30

Note: Equipment listed above have 3 years calibration interval.

Measurement Software List

Sl. No.	Manufacturer	Model	Version	Description
1	Rhode & Schwarz	EMC 32	10.35.10	Emissions Test Software

3 DATA & TEST RESULTS

3.1 Antenna Requirements

Date Performed: October 28, 2022

Test Standard: FCC CFR 47 Part 15.203

Test Method: ANSI C63.10:2013

Modifications: None

Final Result: Complies

Applicable Regulations:

The purpose of this requirement is to make certain that no other antenna, except for that provided by the responsible party, shall be used with the Equipment-Under-Test (EUT) as defined in Section 1.1.

"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 manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited. "The installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded."

Measurement Data and Plots:

EUT utilizes a fixed loop antenna on the PCB with a gain of -20dB.

Antenna is not replaceable: Complies.

Ant.	Manufacturer	Part Number	Type	Connection	Max Gain (dBi)
1	Versa Wireless	N/A	Loop	PCB	-20

3.2 Transmitter Deactivation

Date Performed:	November 1, 2022
Test Standard:	FCC 47 CFR Part 15.231 (a)(2)
Test Method:	ANSI C63.10:2013 Sweep Time: > 5s Trig: Video RBW: 100 kHz, VBW: 300 kHz
Modifications:	None
Final Result:	Complies

Applicable Regulations:

A transmitter activated automatically shall cease transmission within 5 seconds after activation.

Test Setup:

The EUT was tested outside the SAC via output conducted measurements per ANSI C63.10: 2013, 7.4. A spectrum analyzer sweep was triggered and the EUT was manually activated.

Manufacturers Description of Operation:

The processor samples the reed switch and tamper switch approximately 4 times per second. After detecting a change of state, it constructs the packet (1ms), then enables the VCO on the transmitter to power up (5ms) but does not transmit during that time. After the VCO warmup time, 8 identical packets of 20ms each are sent with a random timeout between them of 100ms to 450ms.

Therefor the total duration of the worst-case transmission is 4.316 seconds:

0.000s Trigger
1.000s Microprocessor sample time (worst-case)
0.001s Packet construction
0.005s Transmitter warmup
0.020s Packet 1
0.450s Worst-case delay (no transmission)
0.020s Packet 2
0.450s Worst-case delay (no transmission)
0.020s Packet 3
0.450s Worst-case delay (no transmission)
0.020s Packet 4
0.450s Worst-case delay (no transmission)
0.020s Packet 5
0.450s Worst-case delay (no transmission)
0.020s Packet 6
0.450s Worst-case delay (no transmission)
0.020s Packet 7
0.450s Worst-case delay (no transmission)
0.020s Packet 8

Measurement Data and Plots:

Frequency (MHz)	Deactivation Time Measured (s)	Maximum Deactivation Theoretical Deactivation (s)	Limit (s)	Result
319.5	1.981	4.316	5.0	Complies

Table 5: Deactivation Time Measured Result

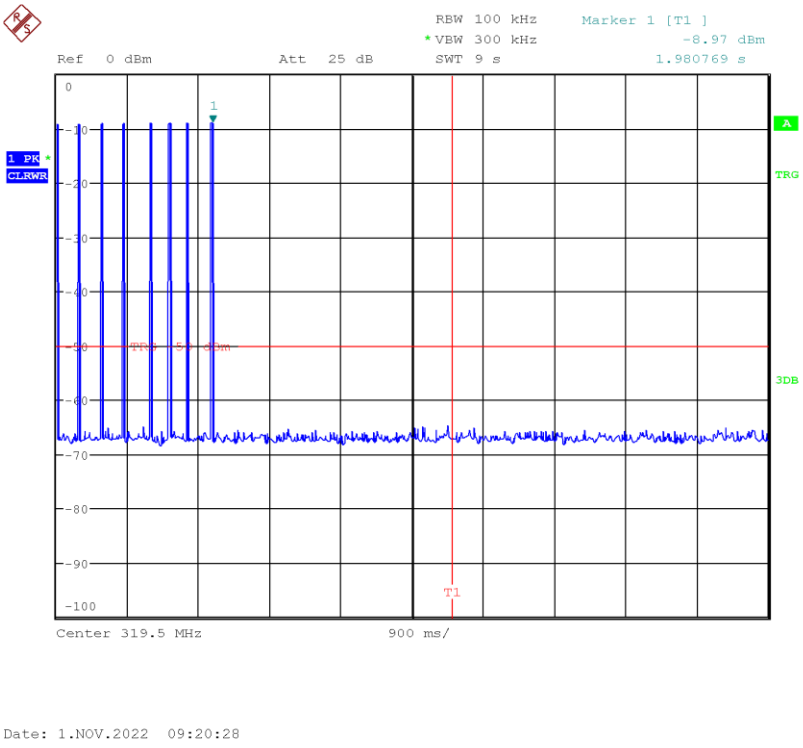


Figure 2: Transmitter Deactivation

3.3 Duty Cycle

Date Performed:	October 28, 2022
Test Standard:	FCC 47 CFR Part 15.231 (a)(2)
Test Method:	ANSI C63.10:2013 Sweep Time: > 5s Trig: Video RBW: 100 kHz, VBW: 300 kHz
Modifications:	None
Final Result:	Complies

Applicable Regulations:

Periodic transmissions at regular predetermined intervals are not permitted. However, polling or supervision transmissions, including data, to determine system integrity of transmitters used in security or safety applications are allowed if the total duration of transmissions does not exceed more than two seconds per hour for each transmitter. There is no limit on the number of individual transmissions, provided the total transmission time does not exceed two seconds per hour.

Test Setup:

The equipment manufacturer and/or responsible party shall confirm that the equipment is not a radio control device or toy, and is not capable of generating continuous transmissions, voice, or video transmissions. Data shall be sent only along with a control signal.

Manufacturers Description:

The sensor is in a sleep mode most of the time, and only Transmits on an EVENT (reed switch change of state, motion change of state, tamper switch change of state, or periodic supervisory (heartbeat) transmission once every 72 minutes if no events occur in that time frame. The sensor has no receive capability.

3.4 20 dB Bandwidth

Date Performed: October 28, 2022

Test Standard: FCC 47 CFR Part 15.231 (c)

Test Method: ANSI C63.10:2013
Span = 2 to 5 x OBW, RBW = 1 to 5% of OBW, VBW = 3 x RBW
Ref Level > 10log(OBW/RBW) above signal peak

Modifications: None

Final Result: Complies

Applicable Regulations:

The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

$$Max\ BW = f_{center} * 0.25\%$$

Test Setup:

The EUT was tested outside the SAC via output conducted measurements per ANSI C63.10: 2013, 7.4.

A spectrum analyzer or other instrument providing a spectral display is recommended for these measurements. When using a spectrum analyzer or other instrument providing a spectral display, the video bandwidth shall be set to a value at least three times greater than the IF bandwidth of the measuring instrument to avoid the introduction of unwanted amplitude smoothing. Video filtering is not used during occupied bandwidth tests.

Measurement Data and Plots:

Carrier Frequency (MHz)	20dB Bandwidth (kHz)	Limit (kHz)	Result
319.5	415.06	798.75	Complies

Table 6: 20 dB Bandwidth Results

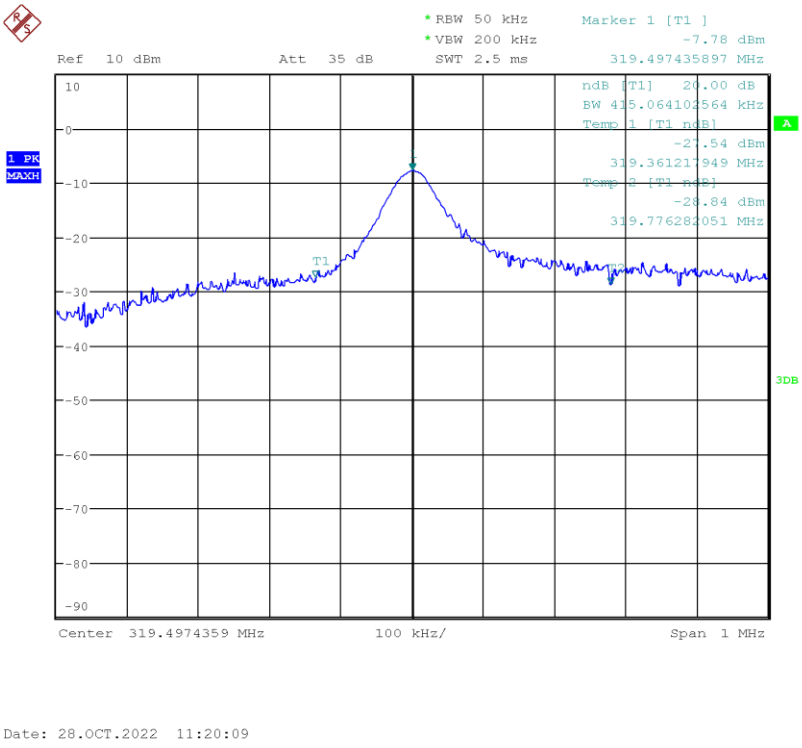


Figure 3: 20 dB Bandwidth

3.5 Radiated Emissions

Date Performed: November 1, 2022

Test Standard: FCC 47 CFR Part 15.33 (a)(1), (5)
FCC 47 CFR Part 15.205 (a), (b)
FCC 47 CFR Part 15.209 (a)
FCC 47 CFR Part 15.231 (b)

Test Method: ANSI C63.10:2013

Modifications: None

Final Result: Complies

Applicable Standard:

FCC 47 CFR Part 15.33 (a)(1), (5): Frequency range of radiated measurements

For an intentional radiator, the spectrum shall be investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to at least the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

FCC 47 CFR Part 15.205 (a), (b): Restricted bands of operation

Only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	
13.36-13.41			

The field strength of emissions appearing within these frequency bands shall not exceed the limits show in § 15.209

FCC 47 CFR Part 15.209 (a): Radiated emission limits; general requirements

The emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency, *f* (MHz)	Maximum Field strength Quasi-peak (dBµV/m at 3 m)
0.009 – 0.490	20*log(2400/F(kHz)) + 40 dB
0.490 – 1.705	20*log(24000/F(kHz)) + 20 dB
1.705 – 30.0	49.5
30 – 88	40.0
88 – 216	43.5
216 – 960	46.0
above 960	54.0
Note 1: The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges.	
Note 2: The emissions limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz., 110-490 kHz. and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector	

FCC 47 CFR Part 15.231 (b): Periodic operation in the band 40.66-40.70 MHz and above 70 MHz

In addition to the provisions of § 15.205, the field strength of emissions from intentional radiators operated under this section shall not exceed the following, based on an average value of the measured emission:

Frequency, *f* (MHz)	Maximum Field strength of Fundamental (µV/m at 3 m)	Maximum Field strength of Spurious Emissions (µV/m at 3 m)
40.66 – 40.70	2250	225
70 – 130	1250	125
130 – 174	1250 – 3750 [1]	125 – 375 [1]
174 – 260	3750	375
260 – 470	3750 – 12500 [1]	375 – 1250 [1]
above 960	12500	1250
[1] Linearly interpolated		

Calculation of the effective limit at 319.5 MHz is found by linearly interpolating using the slope-intercept formula, y = mx + b, rewritten as:

$$Limit = Lim_{Lower} + (f_c - f_{lower}) * \left[\frac{Lim_{Upper} - Lim_{Lower}}{f_{upper} - f_{lower}}\right]$$

Where,

Lim_{Lower}	is the limit at the lower frequency of the intended band of operation
Lim_{Upper}	is the limit at the upper frequency of the intended band of operation
f_{lower}	is the lower frequency of the intended band of operation
f_{upper}	is the upper frequency of the intended band of operation
f_c	is the center frequency of the emission signal

The maximum field strength of fundamental then becomes:

$$Limit = 3750\ \frac{uV}{m} + (319.5MHz - 260MHz) * \left[\frac{12500\frac{uV}{m} - 3750\frac{uV}{m}}{470MHz - 260MHz}\right] = 6229.2\ \frac{uV}{m}$$

Converting the limit to a log space, the limit becomes

$$Limit(dB) = 20\log(6229.2) = 75.89\frac{dBuV}{m}$$

The above calculations can be repeated for the spurious emission limit, yielding a max spur limit of $55.89\frac{dBuV}{m}$. This spurious limit is greater than the limit specified in FCC 47 CFR Part 15.209 (a): Radiated emission limits; general requirements, therefore the lower limit of 15.209 will be used to evaluate the spurious emissions.

Calculation of Duty Cycle Correction Factor for Pulsed Emissions:

Per FCC 47 CFR 15.35 (c) and Ansi C63.10:2013, when the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 s (100 ms). In cases where the pulse train exceeds 0.1 s, the measured field strength shall be determined during a 0.1 s interval. The average field strength may be found by measuring the peak pulse amplitude (in log equivalent units) and determining the duty cycle correction factor (in dB) associated with the pulse modulation as shown below:

$$\delta(dB) = 20\log(\Delta)$$

Where

δ is the duty cycle correction factor (dB)
Δ is the duty cycle (dimensionless)

This correction factor may then be subtracted from the peak pulse amplitude to find the average value of the emission.

If the pulse train is comprised of more than one pulse duration, the duty cycle correction factor is calculated from the sum of the individual ON times, per the following equation:

$$\delta(dB) = 20\log\left[\frac{\sum(nt_1 + mt_2 + \cdots + \xi t_x)}{T}\right]$$

Where

n is the number of pulses of duration t_1
m is the number of pulses of duration t_2
ξ is the number of pulses of duration t_x
T is the period of the pulse train, or 100ms if the pulse train length is greater than 100ms

Manufacturers Description:

On a change of state from the reed switch or tamper switch, 8 identical packets are transmitted at random intervals. Each packet is PWM-ASK. Each packet consists of a porch pulse, a stop pulse, and 59 data bits. Each bit in the protocol begins with a carrier pulse of one-half bit-time: 122us. In a zero bit, the pulse is followed by a gap of one-half bit time, and in a one bit it's followed by a gap of one full bit-time.

Test Setup:

The EUT was tested in our 3 m SAC and was positioned on the front of the turntable. The transmitter was set for continuous transmission. The radiated output of the device was measured for all emissions from 150 kHz up to the 10th harmonic of the highest fundamental frequency. The EUT was pre-scanned in 3 different orthogonal orientations and was found to radiate highest when placed as indicated in the test photos.

Measurement Data and Plots:

Pulse	Measured Duration (us)	Number of pulses
t_1	1099.4	1
t_2	118.6	59
t_3	484.0	1

Table 7: Pulse Durations

Using the duty cycle correction factor calculation with the pulses measured above, the pulse modulation correction is:

$$\delta(dB) = 20\log\left[\frac{1.0994 + (59 * 0.1186) + 0.484}{100ms}\right] = -21.33dB$$

Note that the minimum spacing between packets as described in section 3.2 is 100ms.

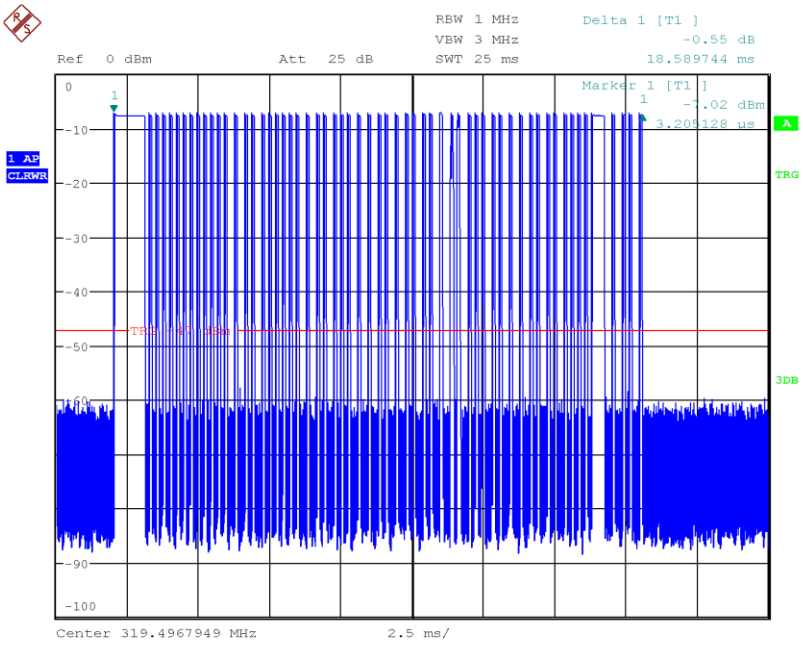


Figure 4: Sample Packet

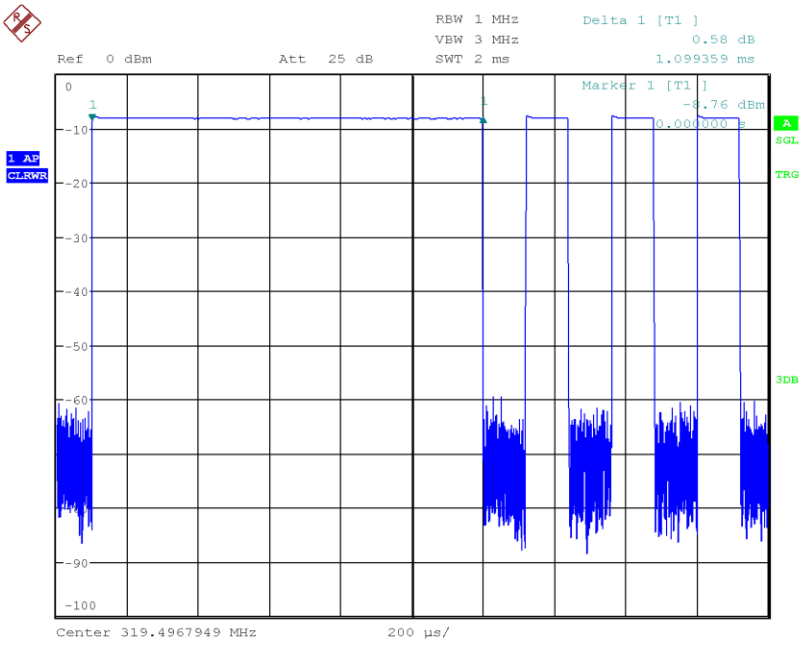


Figure 5: Pulse 1 ON time

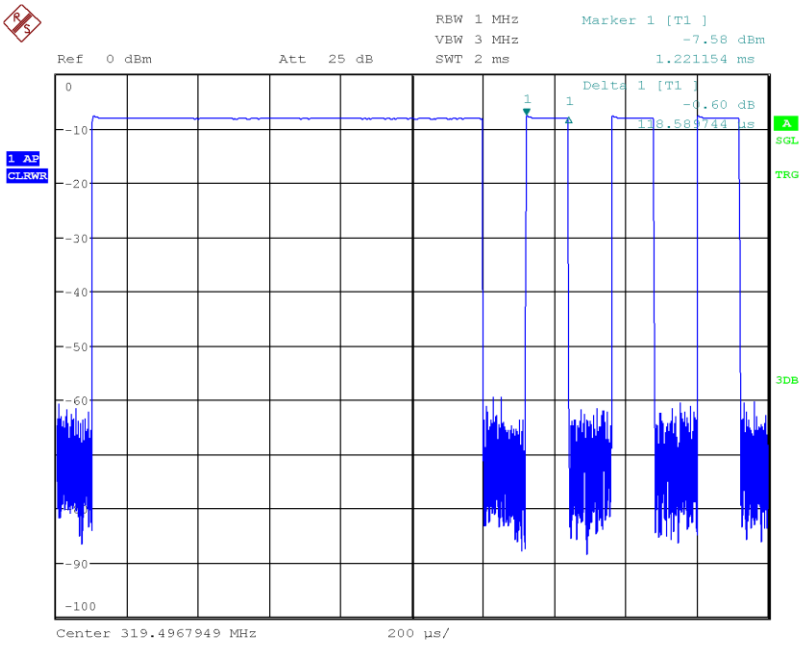


Figure 6: Pulse 2 ON time

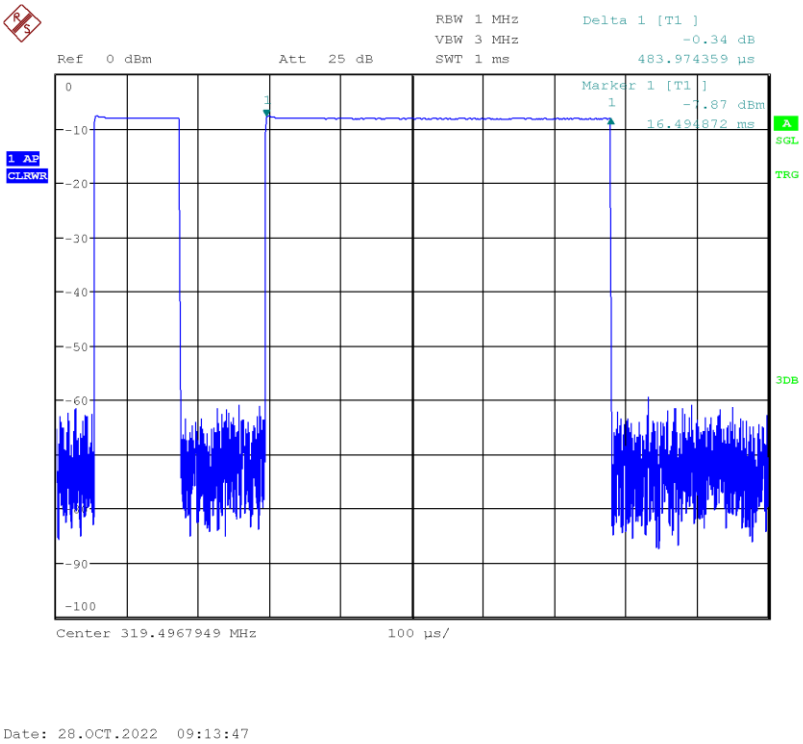


Table 8: Pulse 3 ON time

3.5.1 150 kHz – 30 MHz

Tested November 1, 2022:

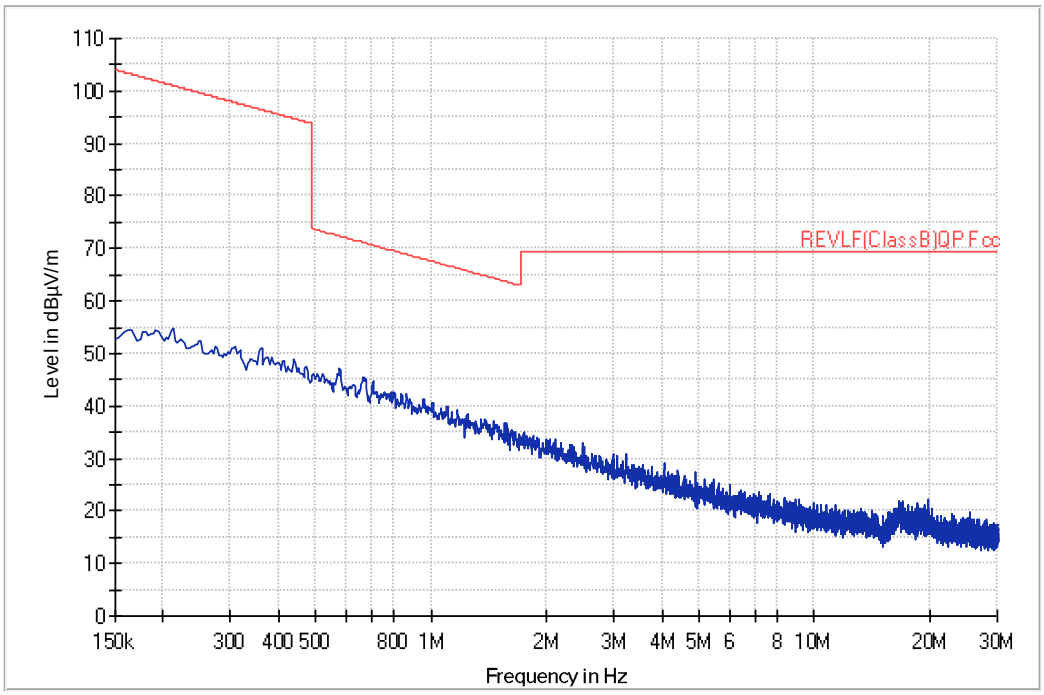


Figure 7: Radiated Emissions from 0.15-30MHz Measured at 3m, Horizontally Polarized

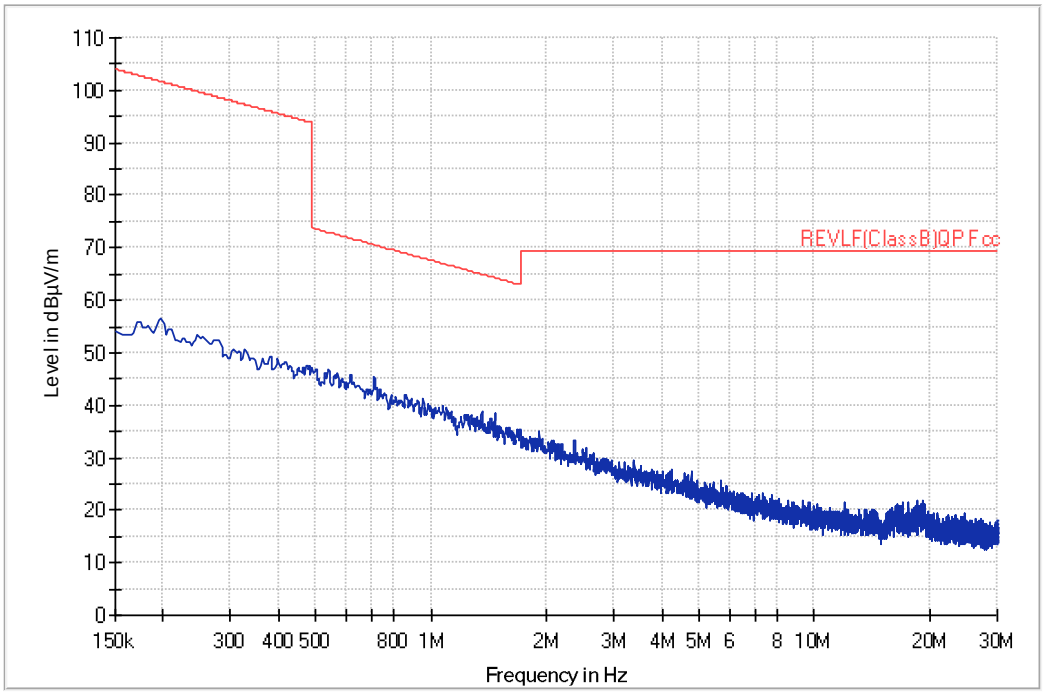


Figure 8: Radiated Emissions from 0.15-30MHz Measured at 3m, Vertically Polarized

No significant emissions were seen in either vertical or horizontal polarizations.

3.5.2 30 MHz to 1 GHz

Tested November 1, 2022:

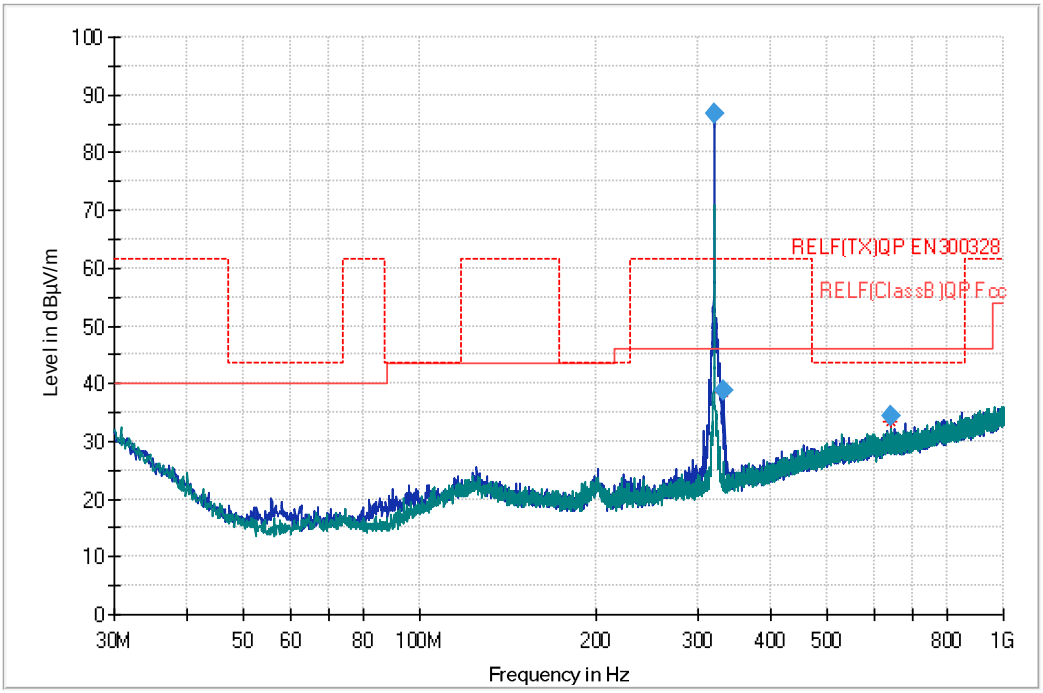


Figure 9: Radiated Emissions from 30-1000MHz Measured at 3m

Frequency (MHz)	QuasiPeak (dBµV/m)	Height (cm)	Pol	Azimuth (°)	Corr. Factor[1] (dB)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
319.5003	86.71	100.0	H	15	-21.33	65.38	75.89	10.51	Complies
332.5055	38.82	110.0	H	0	-21.33	17.49	46.00	28.51	Complies
638.9991	34.31	132.0	H	18	-21.33	12.98	46.00	33.02	Complies

[1] Correction factor includes system gains and losses, as well as duty cycle correction factor calculated above

Table 9: Radiated Emissions (30-1000 MHz) Measured at 3m

3.5.3 1 GHz to 6 GHz

Tested November 1, 2022:

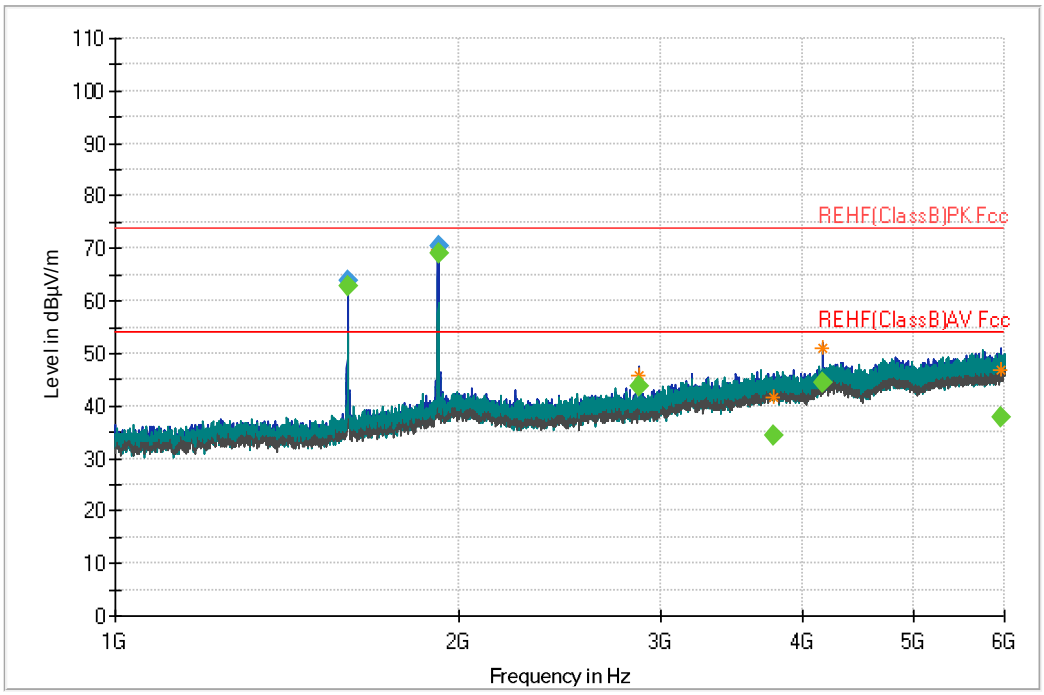


Figure 10: Radiated Emissions from 1-6GHz Measured at 3m

Frequency (MHz)	Average (dBµV/m)	Height (cm)	Pol	Azimuth (°)	Corr. Factor[1] (dB)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
1597.5520	62.63	99.0	H	219	-20.93	41.70	54.00	12.30	Complies
1917.0400	68.96	99.0	H	186	-20.93	48.03	54.00	5.97	Complies
2875.4840	43.80	149.0	H	303	-21.03	22.77	54.00	31.23	Complies
3772.9160	34.22	99.0	V	248	-19.83	14.39	54.00	39.61	Complies
4154.1720	44.54	99.0	H	235	-19.63	24.91	54.00	29.09	Complies
5952.8680	37.93	149.0	H	55	-19.63	18.30	54.00	35.70	Complies

[1] Correction factor includes system gains and losses, as well as duty cycle correction factor calculated above

Table 10: Radiated Emissions (1-6 GHz) Measured at 3m, Average

Frequency (MHz)	Peak (dBµV/m)	Height (cm)	Pol	Azimuth (°)	Corr. Factor (dB)	Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
1597.5080	63.69	99.0	H	219	0.40	64.09	74.00	9.91	Complies
1917.0400	70.48	99.0	H	153	0.40	70.88	74.00	3.12	Complies

Table 11: Radiated Emissions (1-6 GHz) Measured at 3m, Peak

Appendix A: TEST SETUP PHOTOS

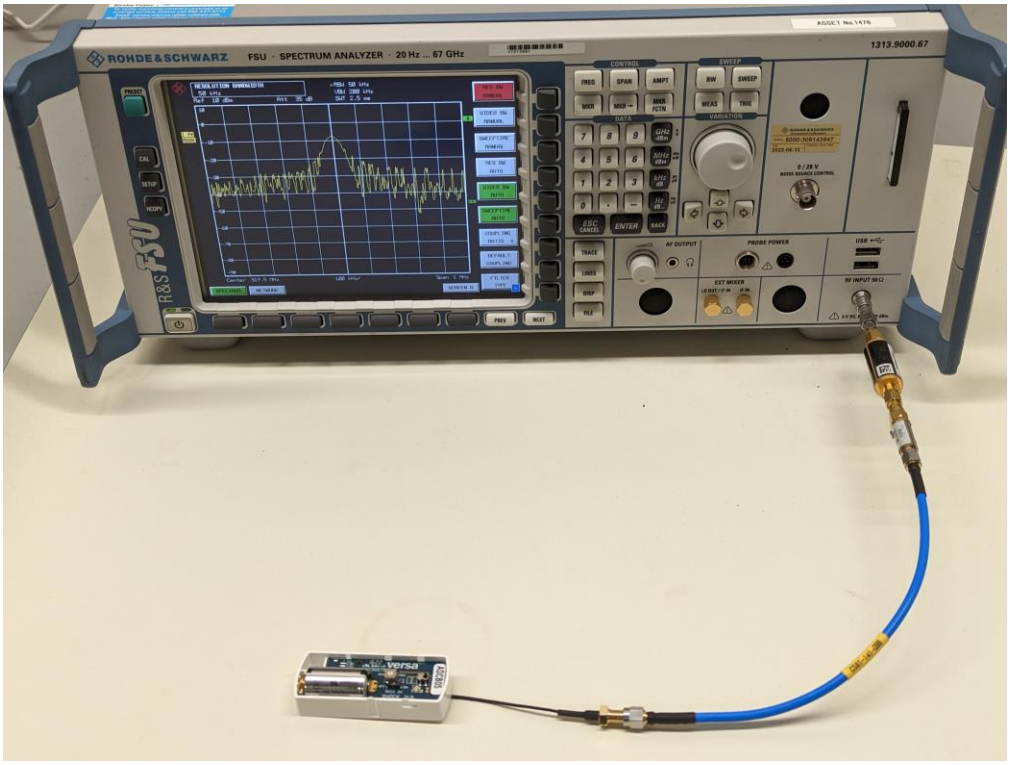


Figure 11: Conducted Radio Measurements Setup

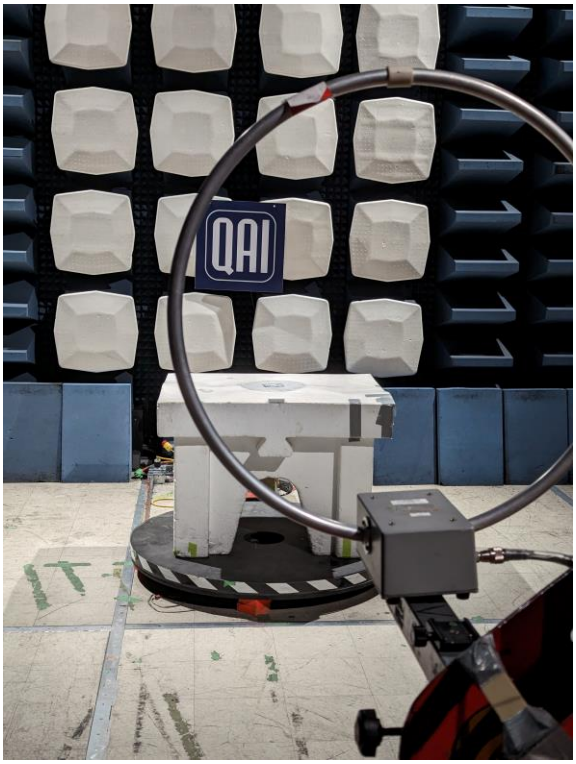


Figure 12: Radiated Emissions From 0.15 MHz - 30 MHz Setup

Figure 13: Radiated Emissions From 30 MHz to 1000 MHz Setup

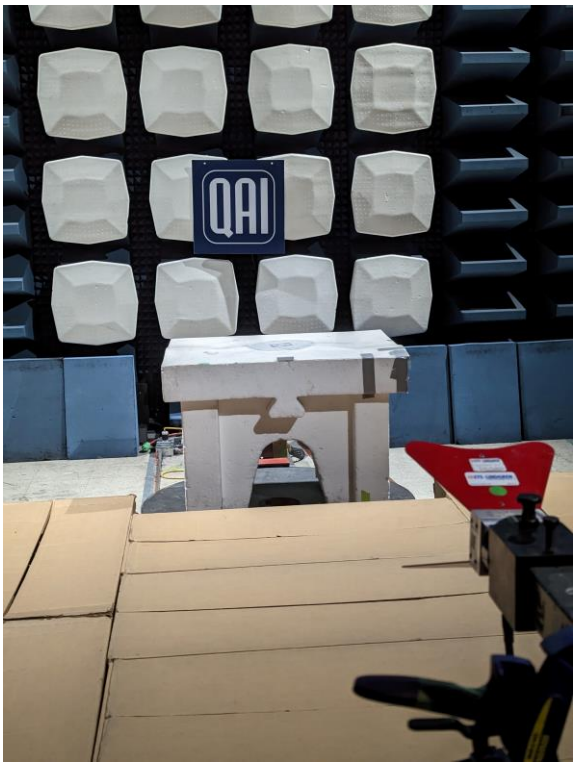


Figure 14: Radiated Emissions from 1 GHz to 6 GHz Setup

Appendix B: ABBREVIATIONS

Abbreviation	Definition
AC	Alternating Current
AM	Amplitude Modulation
CE	European Conformity
CISPR	Comité International Spécial des Perturbations Radioélectriques (International Special Committee on Radio Interference)
DC	Direct Current
EFT	Electrical Fast Transient
EMC	Electro Magnetic Compatibility
EMI	Electro Magnetic Interference
ESD	Electrostatic Discharge
EUT	Equipment Under Test
FCC	Federal Communications Commission
FVIN	Firmware Version Identification Number FVIN
IC	Industry Canada
ICES	Interference Causing Equipment Standard
IEC	International Electrotechnical Commission
LISN	Line Impedance Stabilizing Network
OATS	Open Area Test Site
RF	Radio Frequency
RMS	Root-Mean-Square
SAC	Semi-Anechoic Chamber

END OF REPORT