Testing Tomorrow's Technology

Application

For

Class 2 Permissive Change

Title 47 USC Part 2, Subpart J, Paragraph 2.907, 2.1043 Equipment Authorization of Certification for an Intentional Radiator per Part 15, Subpart C, Paragraphs 15.207 , 15.209 and 15.249

For

Clean Hands Safe Hands
Model: CHSH Badge
FCC ID: 2AHQD-BADGE

UST Project: 19-0029
Issue Date: February 22, 2019

Total Pages in This Report: 31

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Testing Tomorrow's Technology

I certify that I am authorized to sign for the Test Agency and that all of the statements in this report and in the Exhibits attached hereto are true and correct to the best of my knowledge and belief:

US TECH (Agent Responsible For Test):

By: Alan Ghasiani

Name: 

Title: Consulting Engineer – President

Date: February 22, 2019

NVLAP

TESTING

NVLAP LAB CODE 200162-0

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MEASUREMENT TECHNICAL REPORT

COMPANY NAME: Clean Hands Safe Hands

MODEL: CHSH Badge

FCC ID: 2AHQD-BADGE

DATE: February 22, 2019

This report concerns (check one): Original [ ] Class II Change [X]

Equipment type: Low Power 2.4 GHz Radio transceiver

Deferred grant requested per 47 CFR 0.457(d)(1)(ii)? yes_____ No X

If yes, defer until:_____N/A_____
date
agrees to notify the Commission by N/A
date
of the intended date of announcement of the product so that the grant can be issued on that date.

Report prepared by:

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Alpharetta, GA30004

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1 General Information

1.1 Purpose of this Report

The purpose of this report is to file for a Class II permissive change for the following reasons:

The form factor and core functionality remain the same as the previously certified design, but with a few performance improvements and some extended functionality.

1. P1 has gone from 4-pin interface to a 6-pin interface, allowing simple access to 2 GPIO pins on U1 (U1-22, U1-11)
2. The GPIO from U1-10 has been brought out to a pad
3. Adjusted values for C1/C2 from 12pF up to 15pF to correctly tune the X1 clock
4. New PCB antenna pattern (IFA vs previous PCB whip)

Based on the changes outline above the following tests were performed to show that the radio will continue to meet the requirements:

1. Intentional Spurious emissions
2. Unintentional Spurious emissions

Test results are presented herein.

1.2 Characterization of Test Sample

The sample used for testing was received by US Tech on February 4, 2019 in good operating condition.

1.3 Product Description

The Equipment Under Test (EUT) is the Clean Hands Safe Hands Model CHSH Badge. The CHSH Badge is an integral part of the Clean Hands Safe Hands hand hygiene monitoring system. It functions as both replacement reel hardware to hold provider identification, and a BLE transmitter that broadcasts a unique identification string every 100 ms whenever the badge is in motion. This identification string allows the user to connect provider interaction with other system hardware (dispenser sensors) back to their individual profile.

Antenna: PCB IFA Antenna
Modulation: GFSK

1.4 Configuration of Tested System

The Test Sample was tested per *ANSI C63.4:2014 and ANSI C63.4:2013, Methods of Measurement of Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz* for FCC subpart A Digital equipment Verification requirements and per *ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices* for FCC subpart C Intentional Radiators.

A list of EUT and Peripherals is found in Table 1. A block diagram of the tested system is shown in Figure 1. Test configuration photographs are provided in separate Appendices.

1.5 Test Facility

Testing was performed at US Tech's measurement facility at 3505 Francis Circle, Alpharetta, GA 30004. This site has been fully described and registered with the FCC. Its designation number is US5301. Additionally this site has also been fully described and submitted to Industry Canada (ISED), and has been approved under file number 9900A-1.

1.6 Related Submittals

The EUT is subject to the following FCC authorizations:

a) Certification under section 15.207 and 15.209 as a transmitter.
b) Verification under 15.101 as a digital device.

The Verification requirement shares many common report elements with the Certification report. Therefore, though this report is mostly intended to provide data for the Certification process, the Verification authorization report (Parts 15.107 and 15.109) for the EUT is included herein.

Table 1. EUT and Peripherals

PERIPHERAL MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	FCC ID	CABLES P/D
Clean Hands Safe Hands	CHSH Badge	Engineering Sample	2AHQD-BADGE	N/A
Antenna See antenna details	--	--	--	--

U= Unshielded S= Shielded P= Power D= Data

2 Tests and Measurements

2.1 Test Equipment

The table below lists test equipment used to evaluate this product. Model numbers, serial numbers and their calibration status are indicated.

Table 2. Test Instruments

TEST INSTRUMENT	MODEL NUMBER	MANUFACTURER	SERIAL NUMBER	CALIBRATION DUE DATE
SPECTRUM ANALYZER	8593E	HEWLETT-PACKARD	3205A00124	10/25/2019
RF PREAMP 100 kHz to 1.3 GHz	8447D	HEWLETT-PACKARD	1937A02980	3/7/2019
PREAMP 1.0 GHz to 26.0 GHz	8449B	HEWLETT-PACKARD	3008A00480	2/28/2019
LOOP ANTENNA	SAS-200/562	A. H. Systems	142	1/22/2020 2 yr.
BICONICAL ANTENNA	3110B	EMCO	9307-1431	5/2/2019 2 yr
LOG PERIODIC ANTENNA	3146	EMCO	9305-3600	5/1/2019 2 yr
HORN ANTENNA	3115	EMCO	9107-3723	11/28/2020 2 yr
HIGH PASS FILTER	H3R020G2	MICROWAVE CIRCUITS	001DC9528	3/08/2019

Note: The calibration interval of the above test instruments are 12 months unless stated otherwise and all calibrations are traceable to NIST/USA.

2.2 Modifications to EUT Hardware

No physical modifications were made by US Tech in order to bring the EUT into compliance with FCC Part 15, Subpart C Intentional Radiator Limits for the transmitter portion of the EUT or the Subpart B Unintentional Radiator Limits (Receiver and Digital Device) Requirements.

2.3 Number of Measurements for Intentional Radiators (15.31(m))

Measurements of intentional radiators or receivers shall be performed and reported for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in Table 3 below.

Table 3. Number of Test Frequencies for Intentional Radiators

Frequency Range over which the device operates	Number of Frequencies	Location in the Range of operation
1 MHz or less	1	Middle
1 to 10 MHz	2	1 near the top 1 near the bottom
Greater than 10 MHz	3	1 near top 1 near middle 1 near bottom

Because the EUT operates at 2402 MHz to 2480 MHz, 3 test frequencies were used.

2.4 Frequency Range of Radiated Measurements (Part 15.33)

2.4.1 Intentional Radiator

The spectrum shall be investigated for the intentional radiator from the lowest RF signal generated in the EUT, without going below 9 kHz to the 10^{th} harmonic of the highest fundamental frequency generated or 40 GHz, whichever is the lowest.

2.4.2 Unintentional Radiator

For the digital device, an unintentional radiator, the frequency range shall be 30 MHz to 1000 MHz, or to 5 times the highest internal clock frequency.

2.5 Measurement Detector Function and Bandwidth (CFR 15.35)

The radiated and conducted emissions limits shown herein are based on the parameters outlined following.

2.5.1 Detector Function and Associated Bandwidth

On frequencies below 1000 MHz, the limits herein are based upon measurement equipment employing a CISPR Quasi-peak detector function and related measurement bandwidths (i.e. 9 kHz from 150 kHz to 30 MHz and 120 kHz from 30 MHz to 1000 MHz). Alternatively, measurements may be made with equipment employing a peak detector function as long as the same bandwidths specified for the quasi-peak device are used.

2.5.2 Corresponding Peak and Average Requirements

Above 1000 MHz, radiated limits are based on measuring instrumentation employing an average detector function. When average radiated emissions are specified there is also a corresponding Peak requirement, as measured using a peak detector, of 20 dB greater than the average limit. For all measurements above 1000 MHz the Resolution Bandwidth shall be at least 1 MHz.

2.5.3 Pulsed Transmitter Averaging

When the radiated emissions limit is expressed as an average value, and the transmitter is pulsed, the measured field strength shall be determined by applying a Duty Cycle Correction Factor based upon dividing the total ON time during the first 100 ms period by 100 ms (or by the period if less than 100 ms). The duty cycle may be expressed logarithmically in dB.

NOTE: If the transmitter was programmed to transmit at >98% duty cycle, then, wherever applicable (where the detection mode was AVG), the duty cycle factor calculated will be applied.

2.6 Transmitter Duty Cycle (CFR 15.35 (c))

The operating duty cycle of the transmitter under normal operation did not change from the originally certified radio.

Pulse transmitter averaging as detailed in clause 2.5.3 above is considered whenever the EUT operation involves pulse transmission signals.

2.7 EUT Antenna Requirements (CFR 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. Only the antenna(s) listed in Table 4 will be used with this module.

Table 4. Allowed Antenna(s)

REPORT REFERENCE	MANUFACTURER	TYPE OF ANTENNA	MODEL	GAIN dB_i	TYPE OF CONNECTOR
Antenna 1	Clean Hands Safe Hands	IFA trace	Engineering Sample	N/A	PCB Trace

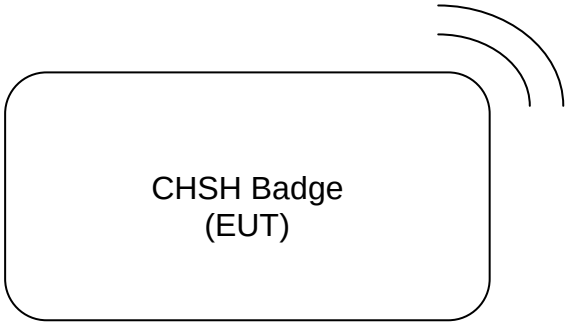


Figure 1. Block Diagram of Test Configuration

2.8 Restricted Bands of Operation (CFR 15.205)

Only spurious emissions can fall in the frequency bands of CFR 15.205. The field strength of these spurious emissions cannot exceed the limits of 15.209. Radiated Harmonics and other Spurious Emissions are examined for this requirement; see paragraph 2.1.

2.9 Intentional Radiator, Power Line Conducted Emissions (CFR 15.207)

Since the EUT is battery powered, this test was not applied. The EUT is powered by a coin cell battery, CR2450, rated 3VDC.

2.10 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.249(a),(c)) (IC RSS 210, A2.9 (a))

Radiated Radio measurements: the EUT was placed into a continuous transmit mode of operation and a preliminary scan was performed on the EUT to find signal frequencies that were caused by the transmitter part of the product. To obtain the worst case results, the EUT was placed on a table top of a non-conductive table, 80 cm above the ground floor. The EUT was positioned 3 meters away from the receiving antenna during testing (1 meter at frequencies above 6 GHz and if the emissions were less than 6 dB from the noise floor). The EUT was tested in X, Y and Z axes or the position of normal operation to determine the worst case orientation. Radiated measurements below 30 MHz were tested with a RBW = 9 kHz; emissions below 1 GHz were tested with a RBW = 120 kHz and radiated measurements above 1 GHz were measured using a RBW =1 MHz. VBW was set to three times the RBW value.

Table 5. Spurious Radiated Emissions below 30 MHz

9 kHz to 30 MHz, 15.209 limits							
Test: Radiated Emissions				**Client:** Clean Hands Safe Hands			
Project: 19-0029				**Model:** CHSH Badge			
Frequency (MHz)	**Test Data (dBuv)**	**AF+CA-AMP (dB/m)**	**Results (dBuV/m)**	**AVG Limits (dBuV/m)**	**Antenna Distance/ Polarization**	**Margin (dB)**	**Detector PK, or AVG**
No emissions found greater than 20 dB below the applicable limit from the lowest clock frequency (9 kHz to 30 MHz).							

Test Date: February 4, 2019

Tested By
Signature: Afzal Fazal Name: Afzal Fazal

Table 6. Intentional Radiator, Radiated Emissions (CFR 15.209), 30 MHz to 25 GHz

30 MHz to 1000 MHz with Class B Limits							
Test: Radiated Emissions				**Client:** Clean Hands Safe Hands			
Project: 19-0029				**Model:** CHSH Badge			
Frequency (MHz)	**Test Data (dBuv)**	**AF+CA-AMP (dB/m)**	**Results (dBuV/m)**	**Limits (dBuV/m)**	**Antenna Distance/ Polarization**	**Margin (dB)**	**Detector PK or QP**
No emissions found greater than 20 dB below the applicable limit besides fundamental and harmonic emissions							

Test Date: February 4, 2019

Tested By
Signature: Afzal Fazal Name: Afzal Fazal

Table 7. Peak Radiated Fundamental & Harmonic Emissions

Test: FCC Part 15, Para 15.209, 15.249(a)					**Client:** Clean Hands Safe Hands			
Project: 19-0029					**Model:** CHSH Badge			
Frequency (MHz)	**Test Data (dBuV)**	**Factor (dB)**	**AF+CA -AMP (dB/m)**	**Results (dBuV/m)**	**Limits (dBuV/m)**	**Antenna Distance/ Polarization**	**Margin (dB)**	**Detector Mode**
Low - Channel								
2402.00	58.59	--	30.54	89.13	--	3.0m./VERT	--	**PK**
4804.00	50.91	--	2.38	53.29	74.0	3.0m./VERT	20.7	**PK**
7206.00	50.77	-9.50	9.39	50.66	74.0	1.0m./VERT	23.3	**PK**
Mid - Channel								
2426.00	55.63	--	30.54	86.17	--	3.0m./VERT	--	**PK**
4852.00	49.59	--	1.29	50.88	74.0	3.0m./VERT	23.1	**PK**
7278.00	50.67	-9.50	10.11	51.28	74.0	1.0m./VERT	22.7	**PK**
High - Channel								
2480.00	51.84	--	30.56	82.40	--	3.0m./VERT	--	**PK**
4960.00	48.58	--	2.33	50.91	74.0	3.0m./VERT	23.1	**PK**
7440.00	50.65	-9.50	10.15	51.30	74.0	1.0m./VERT	22.7	**PK**

Notes:
1. (*) Falls within the restricted bands of CFR 15.205. Limits based on CFR15.209 & 20 dB relaxation for peak measurements of CFR 15.35.
2. No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10th harmonic
3. (~) Measurements taken at 1 meter were extrapolated to 3 meters using a factor of (-9.5 dB).
4. The EUT was placed in three orthogonal positions and the transmitter was in constant broadcast mode, with a duty cycle of greater than 98%. The emissions were measured with the receive antenna in vertical and horizontal polarizations. The data listed in the above table was worst case.

Sample Calculation at 2402.00 MHz:

Magnitude of Measured Frequency	58.59	dBuV
+Antenna Factor + Cable Loss - Amplifier Gain	30.54	dB/m
Corrected Result	89.13	dBuV/m

Test Date: February 4, 2019

Tested By
Signature: Afzal Fazal Name: Afzal Fazal

Table 8. Average Radiated Fundamental & Harmonic Emissions

Test: FCC Part 15, Para 15.209, 15.249(a)					**Client:** Clean Hands Safe Hands			
Project: 19-0029					**Model:** CHSH Badge			
Frequency (MHz)	**Test Data (dBuV)**	**Factor (dB)**	**AF+CA -AMP (dB/m)**	**Results (dBuV/m)**	**Limits (dBuV/m)**	**Antenna Distance/ Polarization**	**Margin (dB)**	**Detector Mode**
Low - Channel								
2402.00	40.68	--	30.54	71.22	--	3.0m./VERT	--	**AVG**
4804.00	36.08	--	2.38	38.46	54.0	3.0m./VERT	15.5	**AVG**
7206.00	35.20	-9.50	9.39	35.09	54.0	1.0m./VERT	18.9	**AVG**
Mid - Channel								
2426.00	38.18	--	30.54	68.72	--	3.0m./VERT	--	**AVG**
4852.00	34.85	--	1.29	36.14	54.0	3.0m./VERT	17.9	**AVG**
7278.00	35.16	-9.50	10.11	35.77	54.0	1.0m./VERT	18.2	**AVG**
High - Channel								
2480.00	33.61	--	30.56	64.17	--	3.0m./VERT	--	**AVG**
4960.00	32.92	--	2.33	35.25	54.0	3.0m./VERT	18.8	**AVG**
7440.00	35.32	-9.50	10.15	35.97	54.0	1.0m./VERT	18.0	**AVG**

Notes:
1. (*) Falls within the restricted bands of CFR 15.205. Limits based on CFR15.209 & 20 dB relaxation for peak measurements of CFR 15.35.
2. No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10th harmonic
3. (~) Measurements taken at 1 meter were extrapolated to 3 meters using a factor of (-9.5 dB).
4. The EUT was placed in three orthogonal positions and the transmitter was in constant broadcast mode, with a duty cycle of greater than 98%. The emissions were measured with the receive antenna in vertical and horizontal polarizations. The data listed in the above table was worst case.
5. Duty Cycle factor of -20 dB is added to the additional factor column.

Sample Calculation at 2402.0 MHz:

Magnitude of Measured Frequency	40.68	dBuV
+Antenna Factor + Cable Loss+ Amplifier Gain	30.54	dB/m
Corrected Result	71.22	dBuV/m

Test Date: February 4, 2019

Tested By
Signature: Afzal Fazal Name: Afzal Fazal

2.11 Band Edge Measurements – (CFR 15.249 (d))

Band Edge measurements are made following the guidelines in FCC KDB Publication No. 558074 with the EUT initially operating on the Lowest Channel and then operating on the Highest Channel within its band of operation. Radiated measurements are performed to demonstrate compliance with the requirement of 15.249(d) that all emissions outside of the band edges be attenuated by at least 50 dB or 15.209 limits, when compared to its highest in-band value (contained in a 100 kHz band).

To capture the band edge, set the Spectrum Analyzer frequency span set to 2 MHz to capture the peak level of the emission operating on the channel closest to the band edge as well as any modulation products falling outside of the authorized band of operation. See figure and calculations below for more detail.

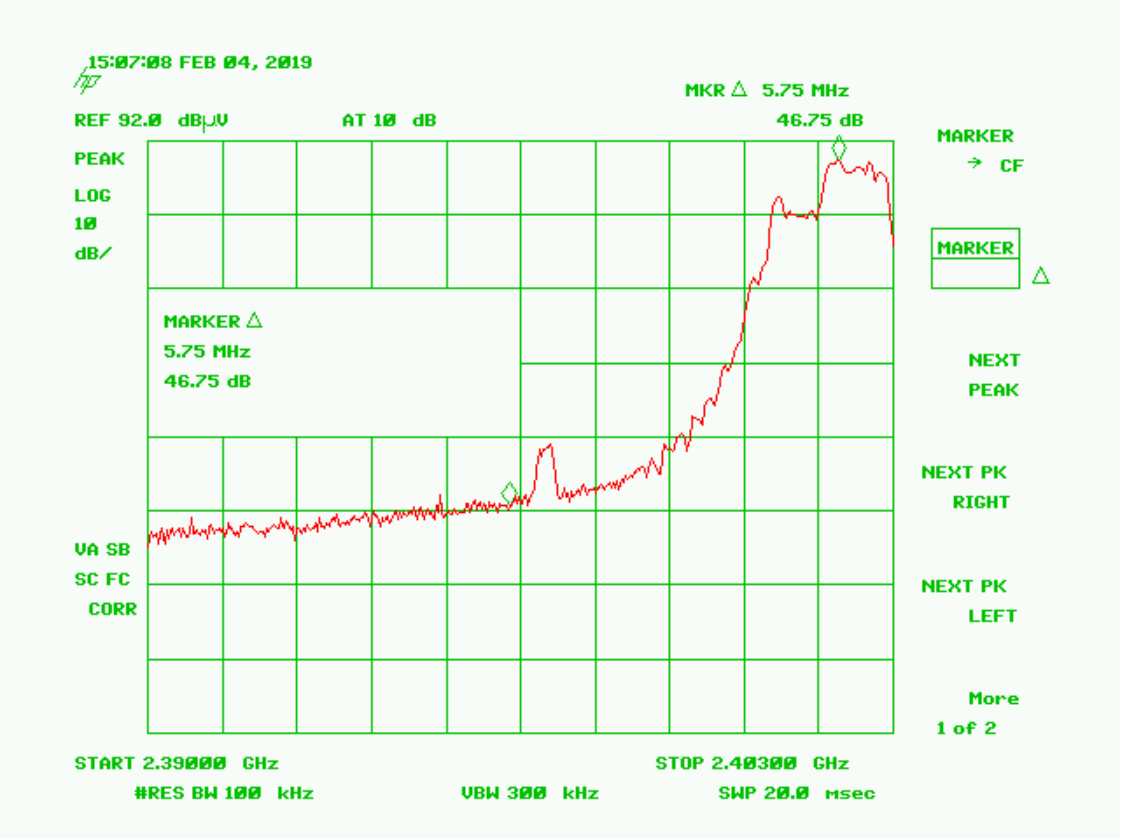


Figure 2. Band Edge Compliance, Low Channel Delta – Peak

Low Channel Corrected Measured Value from Table 6	89.13	dBuV
Low Channel Band Edge Delta from Figure 4	-46.75	dB
Calculated Result (PEAK)	42.38	dBuV/m
Band Edge Limit (AVG)	54.00	dBuV/m
Calculated Result (PEAK)	-42.38	dBuV/m
Band Edge Margin	11.62	dBuV/m

Note: Peak meets AVG limits.

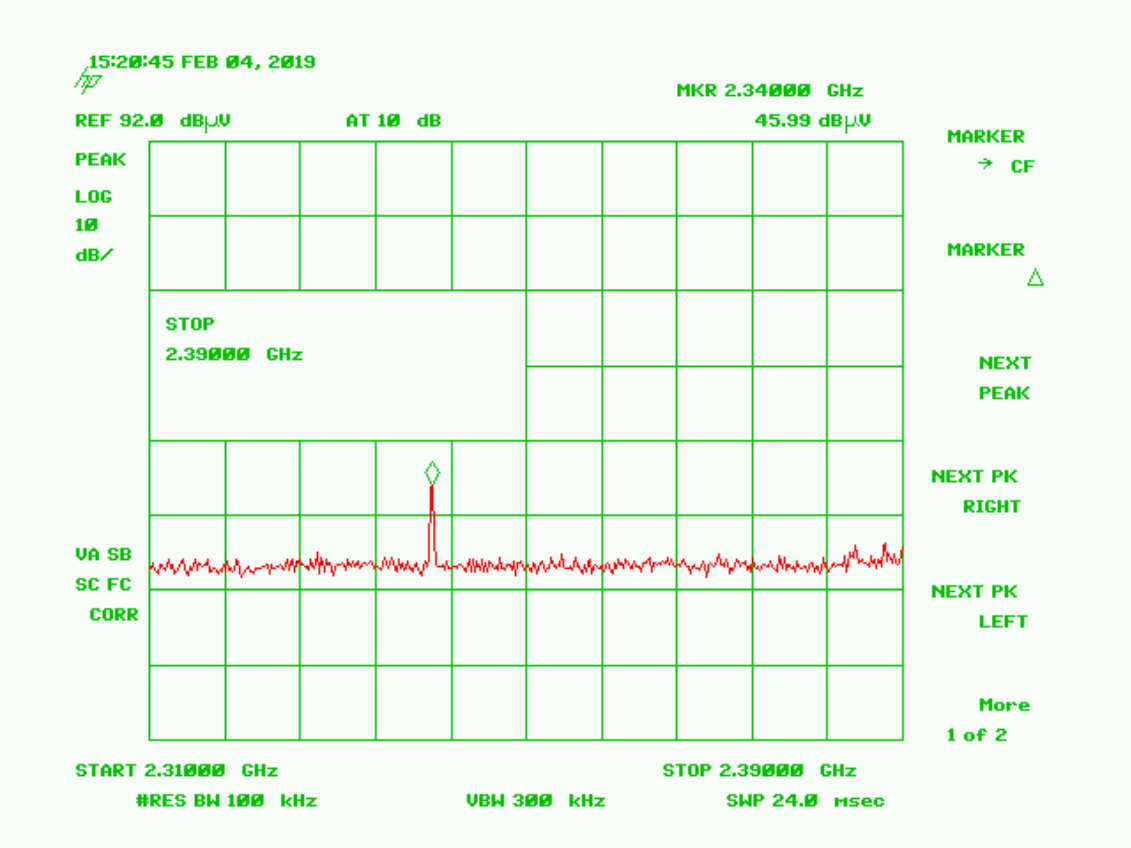


Figure 3. Radiated Restricted Band 2310 MHz to 2390 MHz, Peak

Table 9. Radiated Restricted Band 2310 MHz to 2390 MHz, Peak

2310 MHz to 2390 MHz Restricted Band Peak Measurements							
Test: Radiated Emissions				**Client:** CHSH			
Project: 16-0058				**Model:** CHSH Badge			
Frequency (MHz)	**Test Data (dBuv)**	**AF+CA-AMP (dB/m)**	**Results (dBuV/m)**	**Limits (dBuV/m)**	**Antenna Distance/ Polarization**	**Margin (dB)**	**Detector PK, or AVG**
PEAK value vs. PK limit							
2340.00	45.99	-4.76	41.25	74.0	3.0m./VERT	32.7	**PK**
PEAK value vs. AVG limit							
2340.00	45.99	-4.76	41.25	54.0	3.0m./VERT	12.7	**PK**

Test Date: February 4, 2019
Tested By
Signature: Afzal Fazal Name: Afzal Fazal

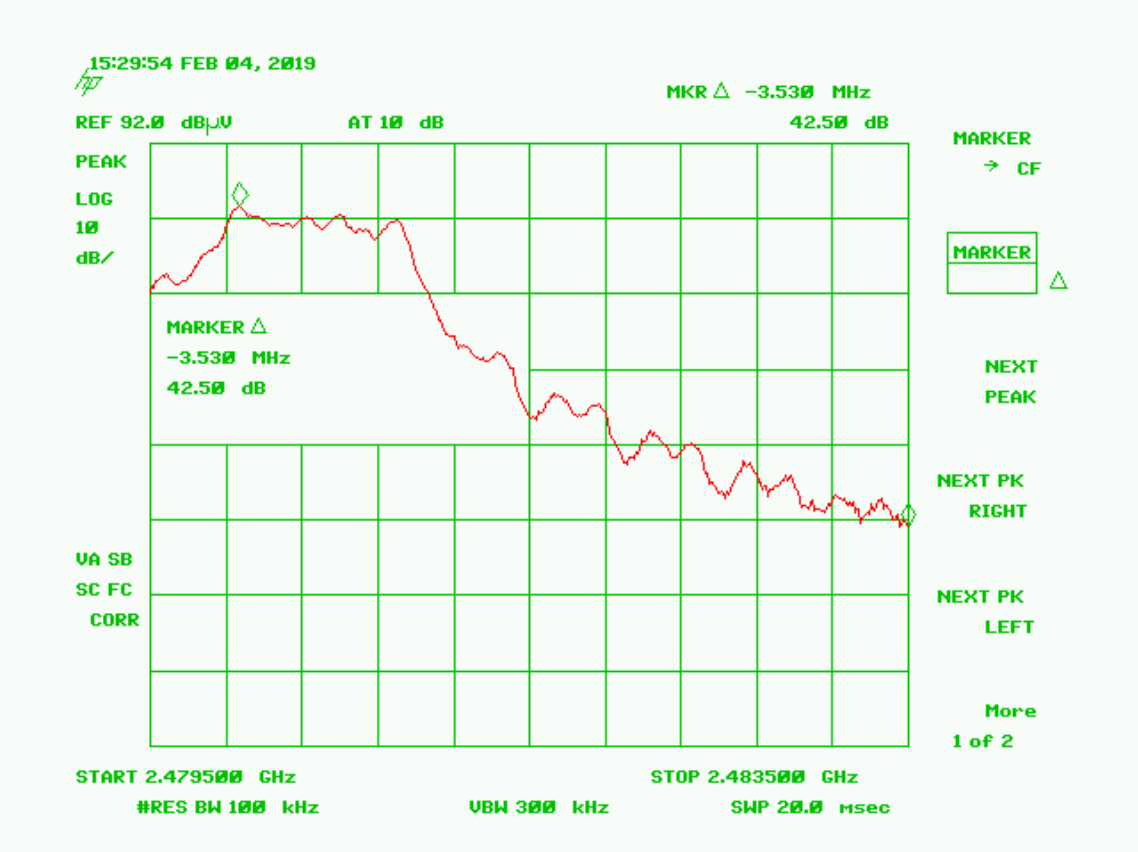


Figure 4. Band Edge Compliance, High Channel Delta, Peak

High Channel Corrected Measured Value from Table 6	82.40	dBuV
High Channel Band Edge Delta from Figure 6	-42.50	dB
Calculated Result (PEAK)	39.90	dBuV/m
Band Edge Limit (AVG)	54.00	dBuV/m
Calculated Result (PEAK)	-39.90	dBuV/m
Band Edge Margin	14.10	dBuV/m

Note: Peak meets AVG limits

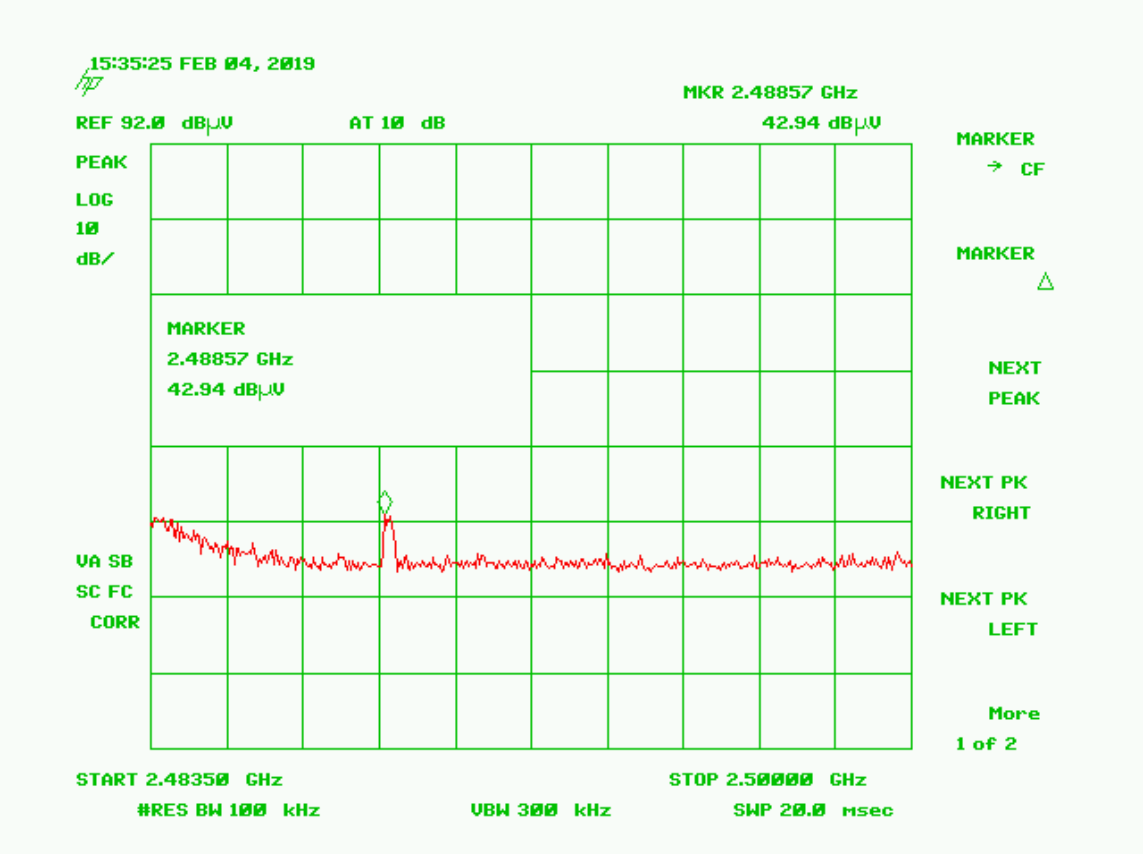


Figure 5. Radiated Restricted Band 2483.5 MHz to 2500 MHz, Peak

Table 10. Radiated Restricted Band 2483.5 MHz to 2500 MHz, Peak

2483.5 MHz to 2500 MHz Restricted Band Peak Measurements							
Test: Radiated Emissions				**Client:** CHSH			
Project: 16-0058				**Model:** CHSH Badge			
Frequency (MHz)	**Test Data (dBuv)**	**AF+CA-AMP (dB/m)**	**Results (dBuV/m)**	**PK Limits (dBuV/m)**	**Antenna Distance/ Polarization**	**Margin (dB)**	**Detector PK, or AVG**
PEAK value vs. PK limit							
2489.00	42.94	-4.01	38.93	74.0	3.0m./VERT	35.1	**PK**
PEAK value vs. AVG limit							
2489.00	42.94	-4.01	38.93	54.0	3.0m./VERT	15.1	**PK**

Test Date: February 4, 2019
Tested By
Signature: Afzal Fazal Name: Afzal Fazal

2.12 Occupied Bandwidth (CFR 15.215 (c))

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in CFR 15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

The changes do not affect the emissions bandwidth therefore the originally recorded measurements are presented herein.

Table 11. 20 dB Bandwidth

Frequency (MHz)	20 dB Bandwidth (MHz)
2402	1.2742
2426	1.4973
2480	1.4691

Test Date: March 13, 2019
Tested By
Signature: Afzal Fazal Name: Afzal Fazal

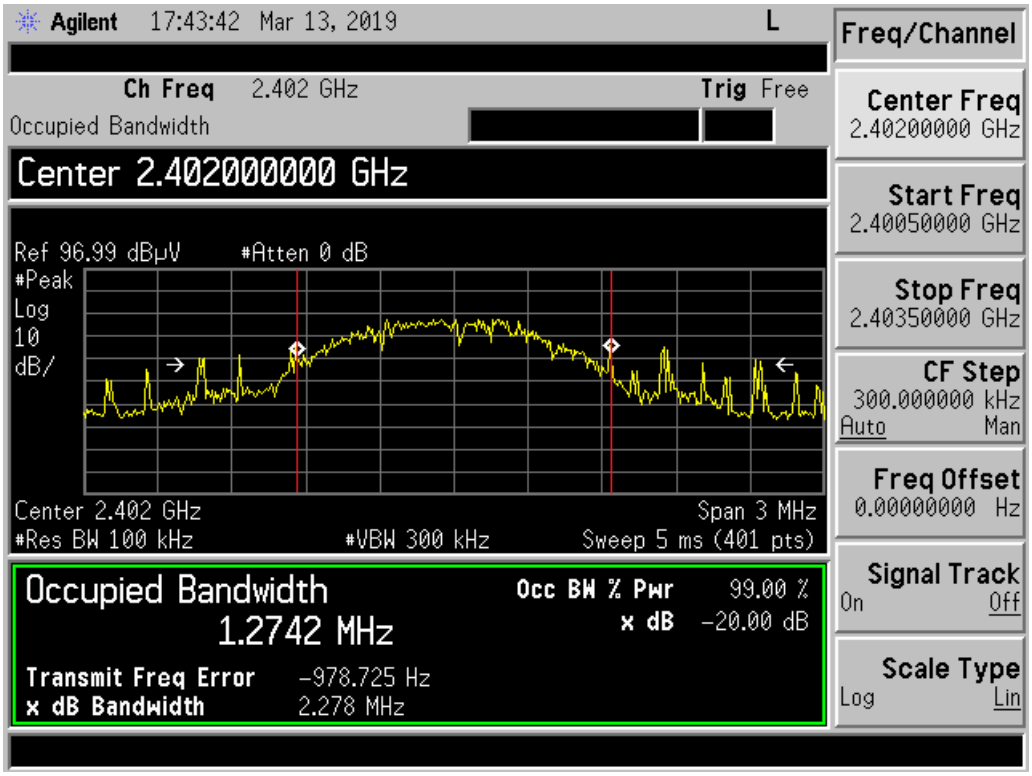


Figure 6. Occupied Bandwidth Low Channel

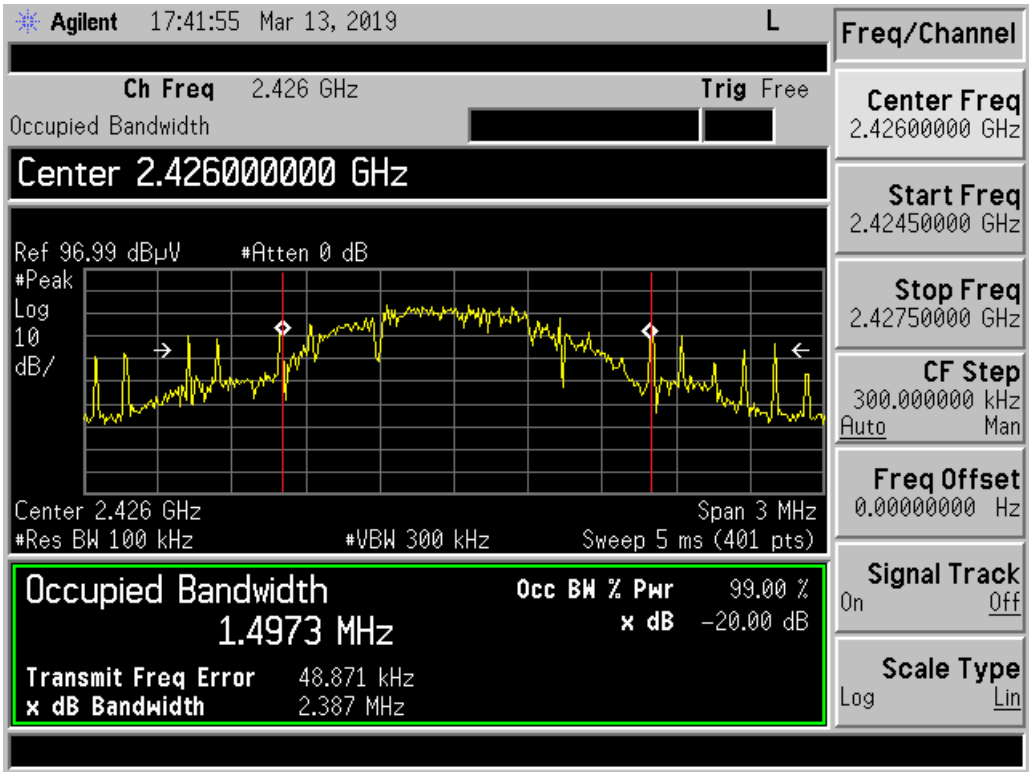


Figure 7. Occupied Bandwidth Mid Channel

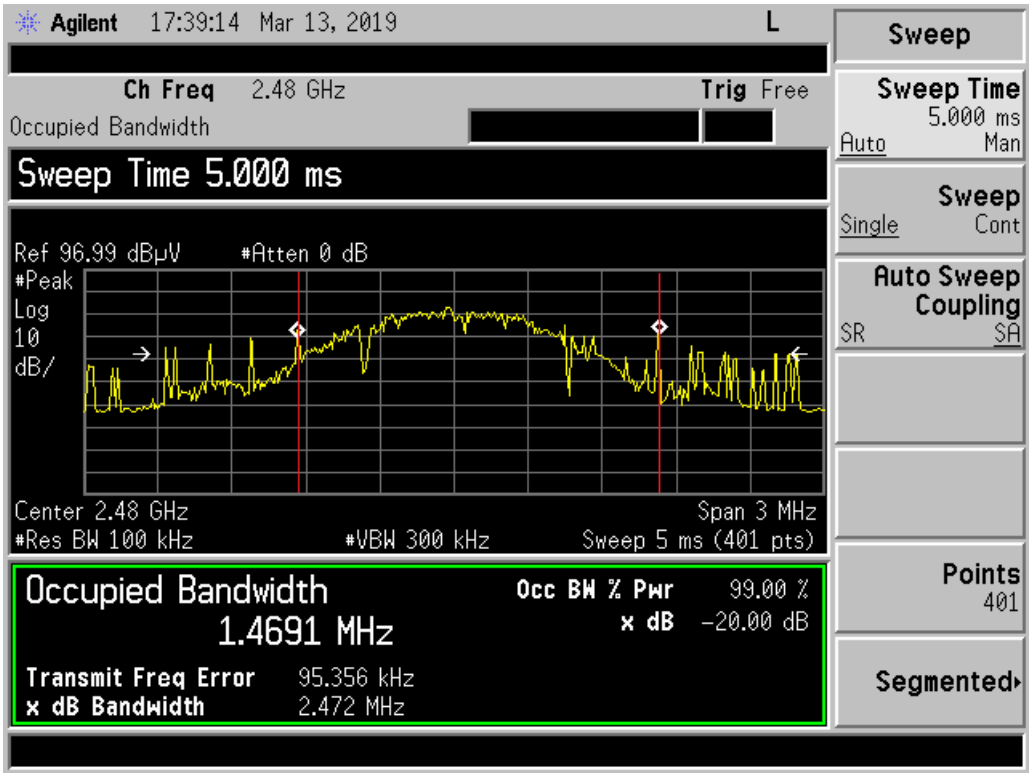


Figure 8. Occupied Bandwidth High Channel

2.13 Unintentional Radiator, Powerline Emissions (CFR 15.107)

The power line conducted voltage emission measurements have been carried out in accordance with CFR 15.107, per ANSI C63.4:2014, Paragraph 7, with a spectrum analyzer connected to a LISN and the EUT placed into a continuous mode of transmission.

Since the EUT is battery powered, this test was not applied. The EUT is powered by a coin cell battery, CR2450, rated 3VDC.

NOTE: The test data provided in this section is to support the requirement for the digital apparatus.

Table 12. Transmitter Power Line Conducted Emissions Test Data, Part 15.107

9kHz to 30 MHz with Class B Limits						
Test: Power Line Conducted Emissions				**Client:** Clean Hands Safe Hands		
Project: 19-0029				**Model:** CHSH Badge		
Frequency (MHz)	**Test Data (dBuv)**	**LISN+CL-PA (dB)**	**Results (dBuV)**	**AVG Limits (dBuV)**	**Margin (dB)**	**Detector PK, QP, or AVG**
The EUT is battery powered: therefore this test is not applicable.						

SAMPLE CALCULATION: N/A

Test Date: February 4, 2019
Tested By
Signature: Afzal Fazal Name: Afzal Fazal

2.14 Unintentional Radiator, Radiated Emissions (CFR 15.109)

Radiated emissions disturbance Measurements were performed with an instrument having both peak and quasi-peak detectors over the frequency range of 30 MHz to 12.5 GHz. Measurements of the radiated emissions were made with the receiver antenna at a distance of 3 m from the boundary of the test unit.

The test antenna was varied from 1 m to 4 m in height while watching the analyzers' display for the maximum magnitude of the signal at the test frequency. The antenna polarization (horizontal or vertical) and test sample azimuth were varied during the measurements to find the maximum field strength readings to record.

The worst-case radiated emissions in the range of 30 MHz to 12.5 GHz are more than 20 dB below the limit.

NOTE: The test data provided in this section is to support the requirement for the digital apparatus.

Table 13. Unintentional Radiator, Peak Radiated Emissions (CFR 15.109), 30 MHz to 1000 MHz

30 MHz to 1000 MHz with Class B Limits							
Test: Radiated Emissions				**Client:** Clean Hands Safe Hands			
Project: 19-0029				**Model:** CHSH Badge			
Frequency (MHz)	**Test Data (dBuv)**	**AF+CA-AMP (dB/m)**	**Results (dBuV/m)**	**Limits (dBuV/m)**	**Antenna Distance/ Polarization**	**Margin (dB)**	**Detector PK or QP**
33.48	40.88	-14.50	26.38	40.0	3m./VERT	13.6	**PK**
108.40	42.23	-15.43	26.80	43.5	3m./VERT	16.7	**PK**
307.10	39.00	-8.85	30.15	46.0	3m./VERT	15.9	**PK**
774.00	34.78	-1.80	32.98	46.0	3m./HORZ	13.0	**PK**
971.70	33.89	-1.95	31.94	46.0	3m./VERT	14.1	**PK**
No other emissions seen greater than 20 dB from the applicable limit.							

Tested from 30 MHz to 1 GHz

SAMPLE CALCULATION at 33.48 MHz:

Magnitude of Measured Frequency	40.88	dBuV
+Antenna Factor + Cable Loss+ Amplifier Gain	-14.50	dB/m
Corrected Result	26.38	dBuV/m

Test Date: February 4, 2019

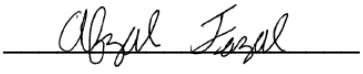
Tested By
Signature:  Name: Afzal Fazal

Table 14. Unintentional Radiator, Peak Radiated Emissions (CFR 15.109), 1 GHz to 12.5 GHz

1 GHz to 12.5 GHz with Class B Limits							
Test: Radiated Emissions				**Client:** Clean Hands Safe Hands			
Project: 19-0029				**Model:** CHSH Badge			
Frequency (MHz)	**Test Data (dBuv)**	**AF+CA-AMP (dB/m)**	**Results (dBuV/m)**	**Limits (dBuV/m)**	**Antenna Distance/ Polarization**	**Margin (dB)**	**Detector PK or AVG**
1158.00	51.28	-9.22	42.06	54.0	3.0m./VERT	11.9	**PK**
1224.00	50.62	-8.81	41.81	54.0	3.0m./HORZ	12.2	**PK**
3204.00	46.01	1.34	47.35	54.0	3.0m./HORZ	6.7	**PK**
3536.00	45.10	2.59	47.69	54.0	3.0m./VERT	6.3	**PK**
7970.00	27.04	9.26	36.30	54.0	1.0m./HORZ	17.7	**AVG**
11410.00	22.92	14.50	37.42	54.0	1.0m./VERT	16.6	**AVG**

Tested from 1 GHz to 12.5 GHz

SAMPLE CALCULATION at 1158 MHz:

Magnitude of Measured Frequency	51.28	dBuV
+ Cable Loss+ LISN Loss	-9.22	dB
=Corrected Result	42.06	dBuV
Limit	54.00	dBuV
-Corrected Result	42.06	dBuV
Margin	11.94	dB

Test Date: February 4, 2019

Tested By
Signature:  Name: Afzal Fazal

2.15 Measurement Uncertainty

The measurement uncertainties given were calculated using the method detailed in CISPR 16-4-2: 2011. A coverage factor of k=2 was used to give a level of confidence of approximately 95%.

2.15.1 Conducted Emissions Measurement Uncertainty

Measurement Uncertainty (within a 95% confidence level) for this test is ± 2.85 dB.

This EUT is battery powered; therefore this tested was deemed not applicable.

2.15.2 Radiated Emissions Measurement Uncertainty

For a measurement distance of 3 m the measurement uncertainty (with a 95% confidence level) for this test using a Biconical Antenna (30 MHz to 200 MHz) is ± 5.40 dB. This value includes all elements of measurement.

The measurement uncertainty (with a 95% confidence level) for this test using a Log Periodic Antenna (200 MHz to 1000 MHz) is ± 5.19 dB.

The measurement uncertainty (with a 95% confidence level) for this test using a Horn Antenna is ± 5.08 dB.

The data listed in this test report does have sufficient margin to negate the effects of uncertainty. Therefore, the EUT unconditionally meets this requirement.