
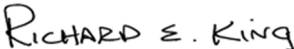


**Engineering Test Report No. 2103172-01**

Report Date		
Manufacturer Name	Soundwave Hearing	
Manufacturer Address	619 Enterprise Dr # 205 Oak Brook, IL 60523	
Model No.	AI	
Date Received	9/20/2021	
Test Dates	9/20/2021 – 9/24/2021	
Specifications	FCC "Code of Federal Regulations" Title 47 Part 15, Subpart C, Section 15.247 Innovation, Science, and Economic Development Canada, RSS-247	
Test Facility	Elite Electronic Engineering, Inc. 1516 Centre Circle, Downers Grove, IL 60515	FCC Reg. Number: 269750 IC Reg. Number: 2987A CAB Identifier: US0107
Signature		
Tested by	Ian F Carnegie	
Signature		
Approved by	For Raymond J. Klouda, Registered Professional Engineer of Illinois – 44894	
PO Number	PO00000080	

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1. Report Revision History

Revision	Date	Description
–	14 OCT 2021	Initial Release of Engineering Test Report No. 2103172-01

2. Introduction

2.1. Scope of Tests

This document presents the results of a series of RF emissions tests that were performed on 2 Soundwave Hearing Sontro Hearing Aids (hereinafter referred to as the Equipment Under Test (EUT)). The EUT was manufactured and submitted for testing by Soundwave Hearing located in Oak Brook, IL.

2.2. Purpose

The test series was performed to determine if the EUTs meet the RF emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Sections 15.247 for a Digital Modulation intentional radiator operating within the 2400-2483.5MHz band.

The test series was also performed to determine if the EUTs meet the RF emission requirements of the Innovation, Science, and Economic Development Canada Radio Standards Specification RSS-Gen and Innovation, Science, and Economic Development Canada Radio Standards Specification RSS-247 for a Digital Modulation intentional radiator operating within the 2400-2483.5MHz band.

Testing was performed in accordance with ANSI C63.10-2013.

2.3. Identification of the EUT

The EUTs were identified as follows:

EUT Identification	
Product Description	Sontro Hearing Aid
Model/Part No.	AI
S/N	1
Device Type	Digitally Modulated Transmission Device
Band of Operation	2400-2483.5MHz
Software/Firmware Version	Firmware Version 1.34.6478.0
Conducted Output Power	-20.9dBm
Antenna Type	Trace
Manufacturer Supplied* Antenna Gain (dBi)	0dBi
6dB Bandwidth	750kHz
Occupied Bandwidth (99% CBW)	1.075MHz
Size of EUT	3cmx3cm
Product Description	Sontro Hearing Aid
Model/Part No.	AI
S/N	3
Device Type	Digitally Modulated Transmission Device
Band of Operation	2400-2483.5MHz
Modulation Type	Firmware Version 1.34.6478.0
Software/Firmware Version	Digitally Modulated Transmission Device
Conducted Output Power	-20.9dBm
Antenna Type	Trace
Manufacturer Supplied* Antenna Gain (dBi)	0dBi
6dB Bandwidth	750kHz
Occupied Bandwidth (99% CBW)	1.075MHz
Size of EUT	3cmx3cm

*- Antenna gain is supplied by the manufacturer and Elite is not responsible for the accuracy of the antenna

gain.

The EUTs listed above was used throughout the test series.

3. Power Input

The EUTs were powered by 1.3VDC from internal batteries.

4. Grounding

The EUTs were not connected to ground.

5. Support Equipment

The EUTs were submitted for testing along with the following support equipment:

Description	Model #	S/N
Support Laptop	-	-

6. Interconnect Leads

No interconnect leads were used during the tests.

7. Modifications Made to the EUT

No modifications were made to the EUTs during the testing.

8. Modes of Operation

The EUTs and all peripheral equipment were energized. The units were programmed to transmit in one of the following modes:

Mode	Description
BT CH 0	2402MHz
BT CH 38	2440MHz
BT CH 78	2480MHz

9. Test Specifications

The tests were performed to selected portions of, and in accordance with the following test specifications:

- Federal Communications Commission "Code of Federal Regulations", Title 47, Part 15, Subpart C
- ANSI C63.4-2014, "American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40 GHz"
- ANSI C63.10-2013, "American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices"
- Federal Communications Commission Office of Engineering and Technology Laboratory Division, Guidance For Compliance Measurements On Digital Transmission Systems, Frequency Hopping Spread Spectrum System, and Hybrid System Devices Operating Under Section 15.247 April 2, 2019 KDB 558074 D01v05r02
- RSS-247 Issue 2, February 2017, "Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSs) and License-Exempt Local Area Network (LE-LAN) Devices"

- RSS-Gen Issue 5, March 2019, Amendment 1, Innovation, Science, and Economic Development Canada, "Spectrum Management and Telecommunications, Radio Standards Specification, General Requirements for Compliance of Radio Apparatus"

10. Test Plan

No test plan was provided. Instructions were provided by personnel from Soundwave Hearing and used in conjunction with the FCC "Code of Federal Regulations" Title 47 Part 15, Subpart C, Section 15.247, Innovation, Science, and Economic Development Canada, RSS-247, and ANSI C63.4-2014 specifications.

11. Deviation, Additions to, or Exclusions from Test Specifications

There were no deviations, additions to, or exclusions from the test specifications during this test series.

12. Laboratory Conditions

Ambient Parameters	Value
Temperature	24°C
Relative Humidity	31%
Atmospheric Pressure	1011.1mb.

13. Summary

The following EMC tests were performed, and the results are shown below:

Test Description	Requirements	Test Methods	S/N	Results
6dB Bandwidth	FCC 15C 15.247 ISED RSS-247	ANSI C63.10: 2013	1	Conforms
99% Bandwidth	FCC 15C 15.247 ISED RSS-247	ANSI C63.10: 2013	1	---
Output Power	FCC 15C 15.247 ISED RSS-247	ANSI C63.10: 2013	1	Conforms
Power Spectral Density	FCC 15C 15.247 ISED RSS-247	ANSI C63.10: 2013	1	Conforms
Low Band Edge	FCC 15C 15.247 ISED RSS-247	ANSI C63.10: 2013	1	Conforms
Duty Cycle Correction Factor	FCC 15C 15.247 ISED RSS-247	ANSI C63.10: 2013	3	---
EIRP	FCC 15C 15.247 ISED RSS-247	ANSI C63.10: 2013	3	Conforms
Spurious Radiated Emissions	FCC 15C 15.247 ISED RSS-247	ANSI C63.10: 2013	3	Conforms
High Band Edge	FCC 15C 15.247 ISED RSS-247	ANSI C63.10: 2013	3	Conforms

14. Sample Calculations

For Powerline Conducted Emissions:

The resultant voltage level (VL) is a summation in decibels (dB) of the receiver meter reading (MTR) and the cable loss factor (CF).

$$\text{Formula 1: VL (dBuV) = MTR (dBuV) + CF (dB).}$$

For Radiated Emissions:

The resultant field strength (FS) is a summation in decibels (dB) of the receiver meter reading (MTR), the antenna correction factor (AF), and the cable loss factor (CF). If an external preamplifier is used, the total is reduced by its gain (-PA). If a distance correction (DC) is required, it is added to the total.

$$\text{Formula 1: FS (dBuV/m)} = \text{MTR (dBuV)} + \text{AF (dB/m)} + \text{CF (dB)} + (-\text{PA (dB)}) + \text{DC (dB)}$$

To convert the Field Strength dBuV/m term to uV/m, the dBuV/m is first divided by 20. The Base 10 AntiLog is taken of this quotient. The result is the Field Strength value in uV/m terms.

$$\text{Formula 2: FS (uV/m)} = \text{AntiLog}[(\text{FS (dBuV/m)})/20]$$

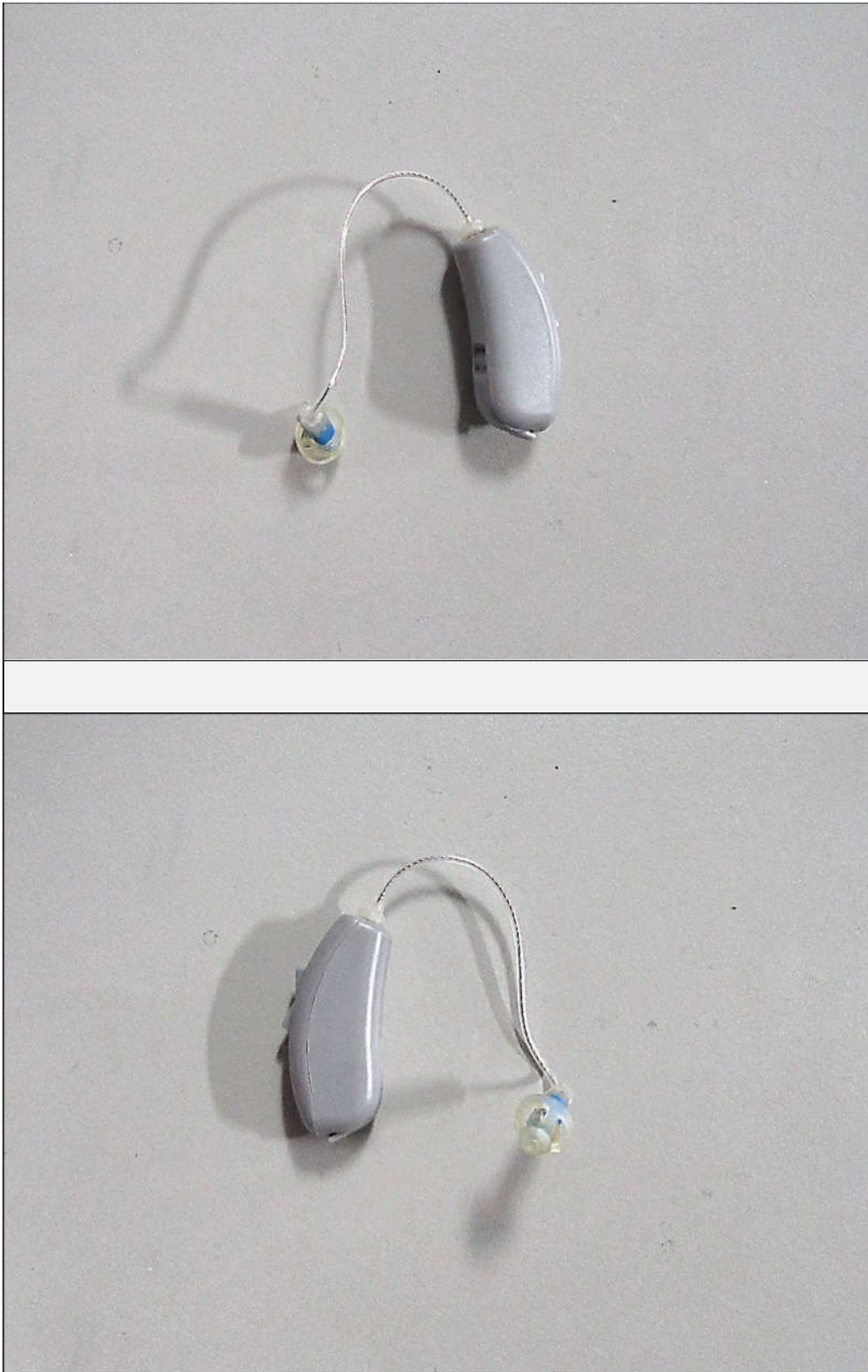
15. Statement of Conformity

The Soundwave Hearing Sontro Hearing Aids, Model No. AI, Serial No. 1 and Serial No. 3, did fully conform to the selected requirements of FCC "Code of Federal Regulations" Title 47 Part 15, Subpart C, Section 15.247 and Innovation, Science, and Economic Development Canada, RSS-247.

16. Certification

Elite Electronic Engineering Incorporated certifies that the information contained in this report was obtained under conditions which meet or exceed those specified in the FCC "Code of Federal Regulations" Title 47 Part 15, Subpart C, Section 15.247 and Innovation, Science, and Economic Development Canada, RSS-247 test specifications. The data presented in this test report pertains to the EUTs on the test date specified. Any electrical or mechanical modifications made to the EUTs after the specified test date will serve to invalidate the data and void this certification.

17. Photographs of EUT



18. Equipment List

Eq ID	Equipment Description	Manufacturer	Model No.	Serial No.	Frequency Range	Cal Date	Due Date
APW0	PREAMPLIFIER	PLANAR ELECTRONICS	PE2-30-20G20R6G	PL2926/0646	20GHZ-26.5GHZ	9/21/2021	9/21/2022
APW14	PREAMPLIFIER	PLANAR	PE2-35-120-5R0-10-12-SFF	PL22671	1-20GHZ	9/21/2021	9/21/2022
CDZ3	LAB WORKSTATION	ELITE	LWS-10		WINDOWS 10	CNR	
NHG1	STANDARD GAIN HORN ANTENNA	NARDA	638	---	18-26.5GHZ	NOTE 1	
NTA4	BILOG ANTENNA	TESEQ	6112D	46660	20-2000GHZ	10/5/2020	10/5/2021
NWQ1	DOUBLE RIDGED WAVEGUIDE ANTENNA	ETS-LINDGREN	3117	66655	1GHZ-18GHZ	4/28/2020	4/28/2022
RBG2	EMI ANALYZER	ROHDE & SCHWARZ	ESW44	101591	2HZ-44GHZ	3/11/2021	3/11/2022
SES0	24VDC POWER SUPPLY	P-TRANS	FS-32024-1M	001	18-27VDC	NOTE 1	

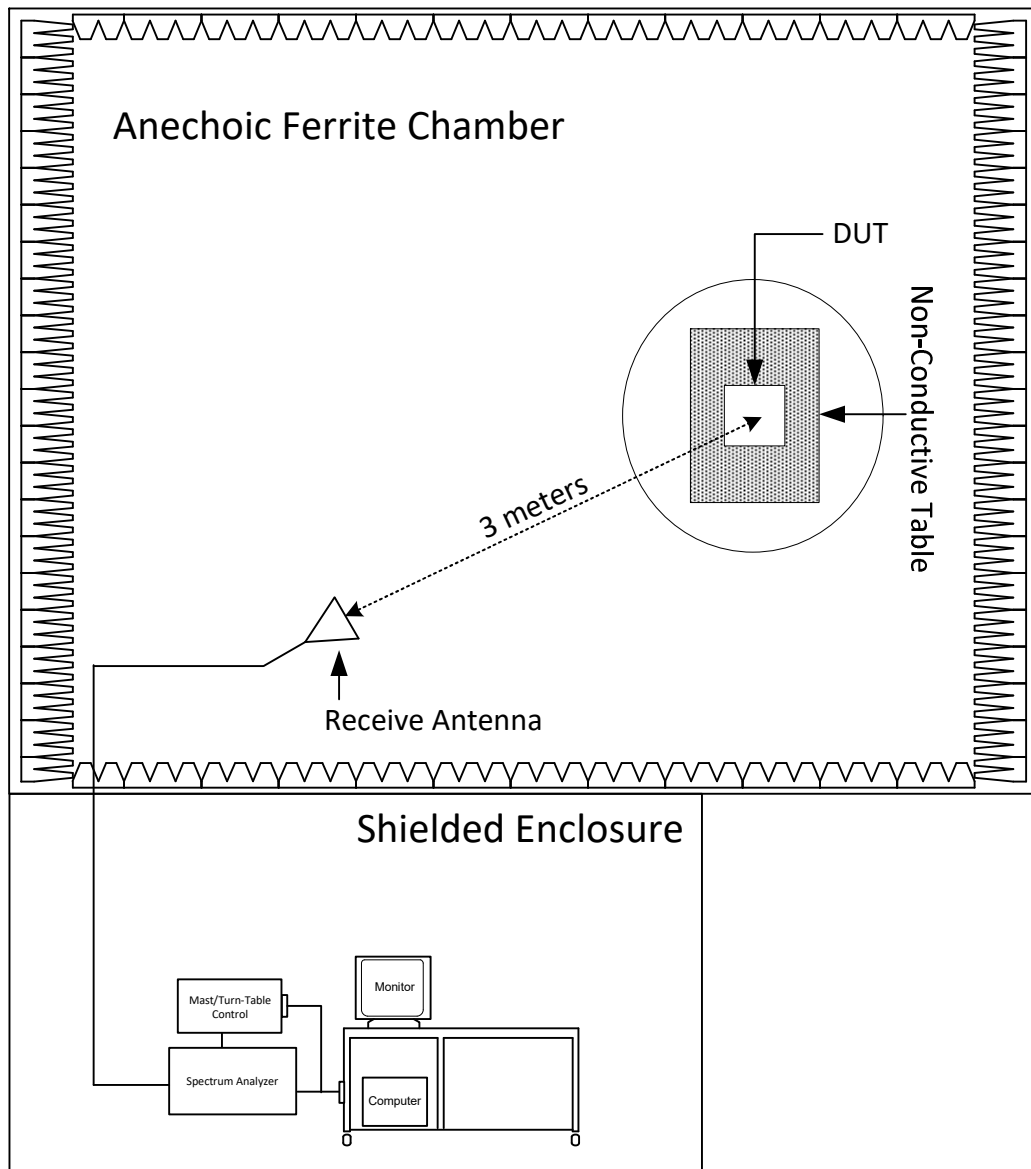
N/A: Not Applicable

I/O: Initial Only

CNR: Calibration Not Required

NOTE 1: For the purpose of this test, the equipment was calibrated over the specified frequency range, pulse rate, or modulation prior to the test or monitored by a calibrated instrument.

19. Block Diagram of Test Setup



Radiated Measurements Test Setup

20. Antenna Port Conducted Emissions Tests

Manufacturer	Soundwave Hearing
Product	Sontro Hearing Aid
Model	AI
Serial No	1
Mode	Normal Operation

Parameter	Measurement Uncertainty
Occupied Channel Bandwidth	+/- 224kHz
Power Spectral Density	+/- 0.372Hz
RF Output Power, Conducted	+/- 0.349 dB
Unwanted Emissions, Conducted	+/- 1.39 dB
All Emissions Radiated Below 1GHz	+/- 2.629 dB
All Emissions Radiated Above 1GHz	+/- 2.710 dB
Temperature	+/- 0.165 °C
Humidity	+/- 1.7% RH
DC and Low Frequency Voltages	+/- 0.115 Volts
Time	+/- 0.05%

Requirements

6dB Bandwidth (DTS Bandwidth):

Per FCC 15.247, Section (a)(2), and ISSED RSS-247, Section 5.2(a), the minimum 6dB bandwidth shall be at least 500kHz for all systems using digital modulation techniques.

99% Bandwidth:

RSS-Gen requires the measurement of the 99% bandwidth (Occupied Bandwidth).

If measuring the maximum conducted (average) output power for FCC 15.247, the 99% bandwidth is used as the reference for power integration.

Peak Conducted Output Power:

Per FCC 15.247, Section (b)(3) and ISSED RSS-247, Section 5.4(d), for systems using digital modulation, the maximum peak conducted output power shall not exceed 1 watt.

Peak Power Spectral Density:

Per FCC 15.247, Section (e), and ISSED RSS-247, Section 5.2(b), for digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. If peak conducted output power was measured, the same method must be used to measure the power spectral density.

Low Band Edge:

Per FCC 15.247, Section (d) and ISSED RSS-247, Section 5.5, in any 100 kHz bandwidth outside the frequency band in which the digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. Attenuation below the general limits specified in FCC 15.209, Section (a) and ISSED RSS-Gen is not required.

Duty Cycle Correction Factor:

Per ANSI C63.10, Section 11.6, duty cycle refers to the fraction of time over which the transmitter is ON and is transmitting at its maximum power control level.

When continuous transmission cannot be achieved, measurement of the duty cycle can be used to measure the average power.

Procedures

6dB Bandwidth (DTS Bandwidth):

C63.10-2013 section 11.8 Option 1:

- a) The following settings were employed on the EMI Test Receiver:
 1. Center Frequency = Transmit Frequency of the EUT
 2. Frequency Span = 2 x Occupied Channel Bandwidth
 3. RBW = 100kHz
 4. VBW = 3 x RBW
 5. Detector Mode = Max Peak
 6. Trace Mode = Max Hold
- b) Allow the trace to stabilize.
- c) Set the spectrum analyzer marker to the highest level of the displayed trace (this is the reference value).
- d) Determine the 6dB down amplitude.
- e) Place two markers, one at the lowest frequency and the other at the highest frequency of the envelope trace, such that each marker is at or slightly below the 6dB down amplitude determined in step d). If a marker is below this 6dB down amplitude value, then it shall be as close as possible to this value. The occupied bandwidth is the frequency difference between the two markers.

99% Bandwidth:

C63.10-2013 section 6.9.3:

- a) The following settings were employed on the EMI Test Receiver:
 1. Center Frequency = Transmit Frequency of the EUT
 2. Frequency Span = Between 1.5 and 5 times the OBW
 3. RBW = Between 1% to 5% of the OBW
 4. VBW = Approximately 3 x RBW
 5. Steps 1) through 4) might require iterations to adjust within the specified range
 6. Detector Mode = Max Peak
 7. Trace Mode = Max Hold
- b) Allow the trace to stabilize.
- c) Use the 99% power bandwidth function of the EMI receiver.

Peak Conducted Output Power:

C63.10-2013 section 11.9.1.1:

- a) The following settings were employed on the EMI Test Receiver:
 1. Center Frequency = Transmit Frequency of the EUT
 2. RBW \geq DTS Bandwidth
 3. VBW \geq 3 x RBW
 4. Span \geq 3 x RBW
 5. Sweep Time = Auto couple
 6. Detector Mode = Max Peak
 7. Trace Mode = Max Hold

- b) Allow the trace to stabilize.
- c) Use the peak marker function to determine the peak amplitude level.

Peak Power Spectral Density:

C63.10-20013 section 11.10.2:

- a) The following settings were employed on the EMI Test Receiver:
 - 1. Center Frequency = Transmit Frequency of the EUT
 - 2. Frequency Span = At least 1.5 times the OBW
 - 3. RBW = $3\text{kHz} \leq \text{RBW} \leq 100\text{kHz}$
 - 4. VBW $\geq 3 \times \text{RBW}$
 - 5. Detector Mode = Max Peak
 - 6. Sweep Time = Auto Couple
 - 7. Trace Mode = Max Hold
- b) Allow the trace to stabilize.
- c) Use the peak marker function to determine the maximum amplitude level within the RBW.
- d) If measured value exceeds requirement, then reduce RBW (but no less than 3 kHz) and repeat.

Low Band Edge:

C63.10-2013 section 11.11:

- a) Reference Level Measurement
 - 1. Start Frequency = 2400MHz
 - 2. Stop Frequency = 2483.5MHz
 - 3. RBW = 100kHz
 - 4. VBW $\geq 3 \times \text{RBW}$
 - 5. Detector Mode = Max Peak
 - 6. Trace Mode = Max Hold
 - 7. Sweep Time = Auto
- b) Allow the trace to stabilize
- c) Use the peak marker function to determine the maximum level
- d) Emission Level Measurement
 - 1. Start Frequency = 2310MHz
 - 2. Stop Frequency = 2400MHz
 - 3. RBW = 100kHz
 - 4. VBW $\geq 3 \times \text{RBW}$
 - 5. Detector Mode = Max Peak
 - 6. Trace Mode = Max Hold
 - 7. Sweep Time = Auto
- e) Allow the trace to stabilize
- f) Use the peak marker function to determine the maximum level
- g) The two sweeps were combined and plotted.
- h) Ensure that the amplitude of all unwanted emissions is attenuated by at least 20dB.

Duty Cycle Correction Factor:

C63.10-2013 section 7.5 and 11.6

a) The following settings were employed on the EMI Test Receiver:

1. Center Frequency = Transmit Frequency of the EUT
2. Frequency Span = 0Hz
3. RBW \geq OBW if possible; otherwise set RBW as large as possible
4. VBW \geq RBW
5. Detector Mode = Peak or RMS
6. Number of Measurement Points $\geq 2 \times \text{span/RBW}$

b) Measure the ON and OFF times of the transmitted signal

c) Duty Cycle (D) = ((ON TIME)/((ON TIME) + (OFF TIME)))

FCC Part 47 §15.247 2400-2483.5 MHz 2018

Emission Bandwidth 20 dB (2402 MHz)

Test according to FCC title 47 part 15 §15.247(a), KDB 558074 D01 DTS Meas Guidance v05 and ANSI C63.10-2013 11.8.1

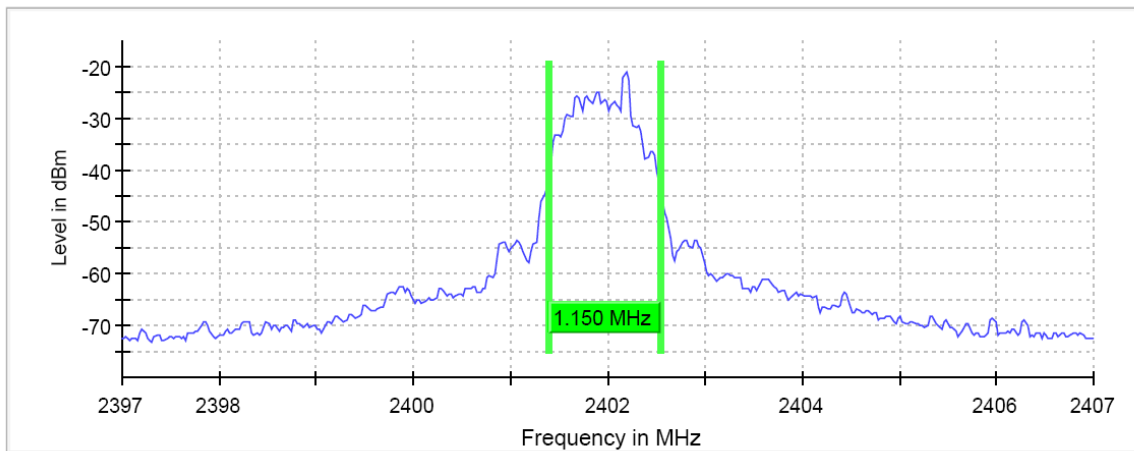
20 dB Bandwidth

DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Limit Max (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)
2402.000000	1.150000	---	---	2401.387500	2402.537500

(continuation of the "20 dB Bandwidth" table from column 6 ...)

DUT Frequency (MHz)	Max Level (dBm)	Result
2402.000000	-21.1	PASS

20 dB Bandwidth



FCC Part 47 §15.247 2400-2483.5 MHz 2018

Minimum Emission Bandwidth 6 dB (2402 MHz)

Test according to FCC title 47 part 15 §15.247(a), KDB 558074 D01 DTS Meas Guidance v05 and ANSI C63.10-2013 11.8.1

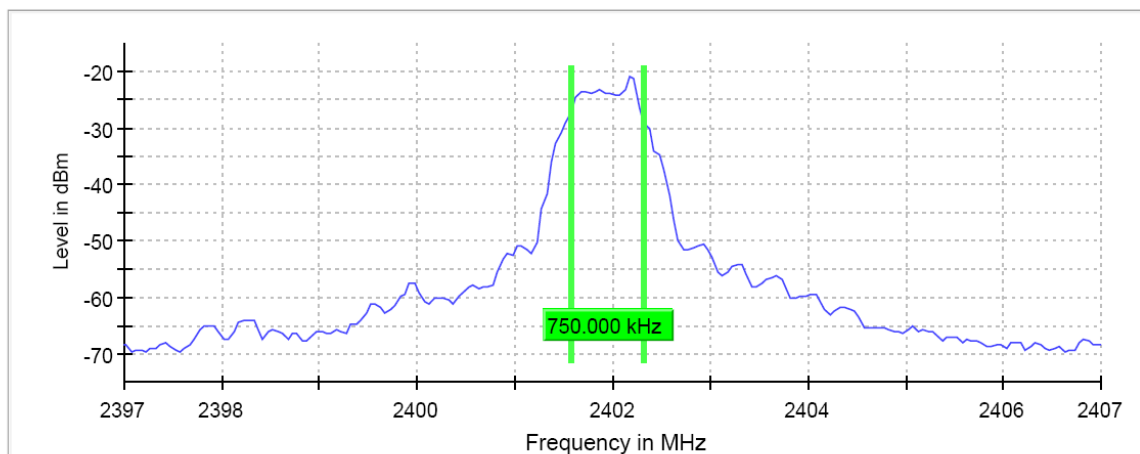
6 dB Bandwidth

DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Limit Max (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)
2402.000000	0.750000	0.500000	---	2401.575000	2402.325000

(continuation of the "6 dB Bandwidth" table from column 6 ...)

DUT Frequency (MHz)	Max Level (dBm)	Result
2402.000000	-21.1	PASS

6 dB Bandwidth



FCC Part 47 §15.247 2400-2483.5 MHz 2018

Minimum Emission Bandwidth 6 dB (2440 MHz)

Test according to FCC title 47 part 15 §15.247(a), KDB 558074 D01 DTS Meas Guidance v05 and ANSI C63.10-2013 11.8.1

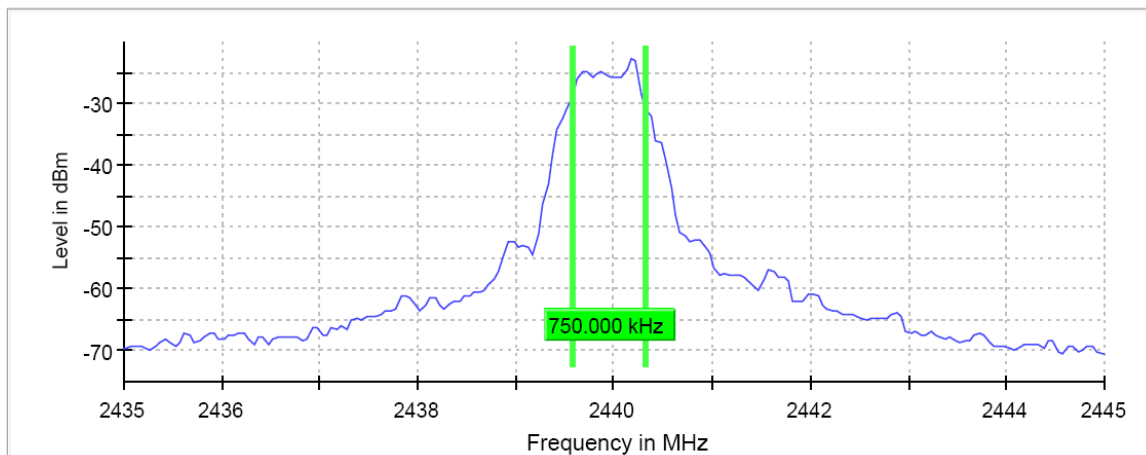
6 dB Bandwidth

DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Limit Max (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)
2440.000000	0.750000	0.500000	---	2439.575000	2440.325000

(continuation of the "6 dB Bandwidth" table from column 6 ...)

DUT Frequency (MHz)	Max Level (dBm)	Result
2440.000000	-22.7	PASS

6 dB Bandwidth



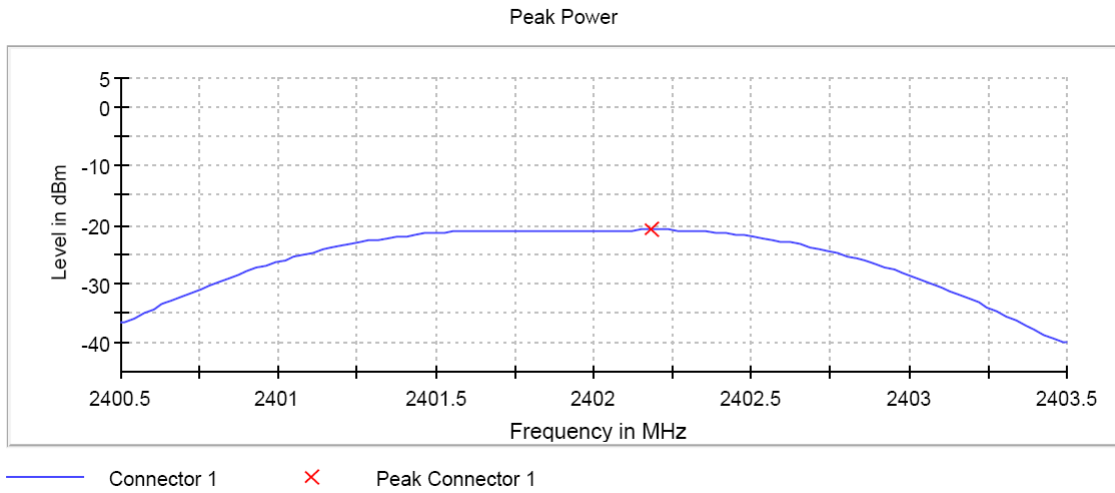
FCC Part 47 §15.247 2400-2483.5 MHz 2018

Peak output power (Sweep) (2402 MHz)

Test according to FCC title 47 part 15 §15.247(b), KDB 558074 D01 DTS Meas Guidance v05 and ANSI C63.10-2013 11.9.1.1

Result

DUT Frequency (MHz)	Peak Power (dBm)	Limit Max (dBm)	Result
2402.000000	-20.9	30.0	PASS



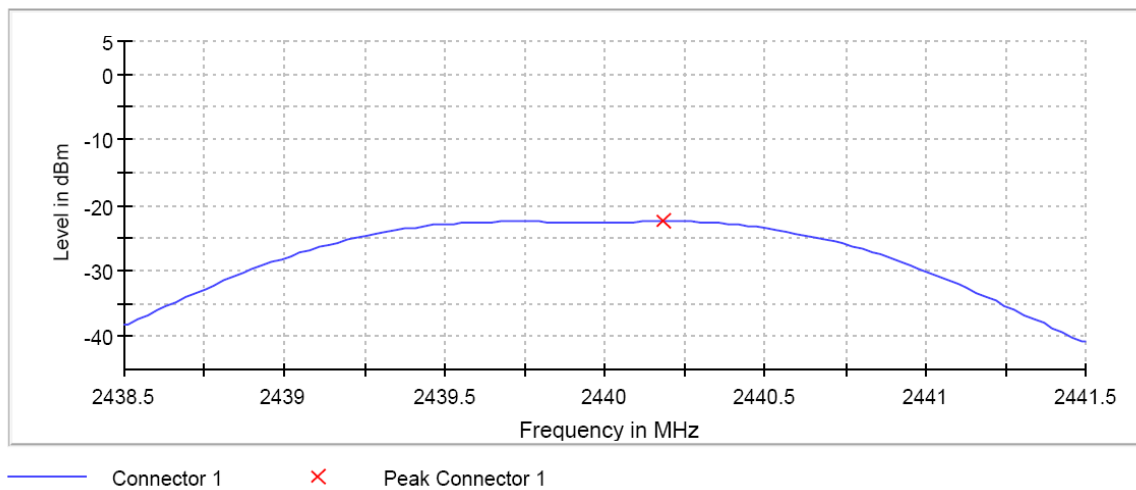
FCC Part 47 §15.247 2400-2483.5 MHz 2018

Peak output power (Sweep) (2440 MHz)

Test according to FCC title 47 part 15 §15.247(b), KDB 558074 D01 DTS Meas Guidance v05 and ANSI C63.10-2013 11.9.1.1

Result

DUT Frequency (MHz)	Peak Power (dBm)	Limit Max (dBm)	Result
2440.000000	-22.4	30.0	PASS



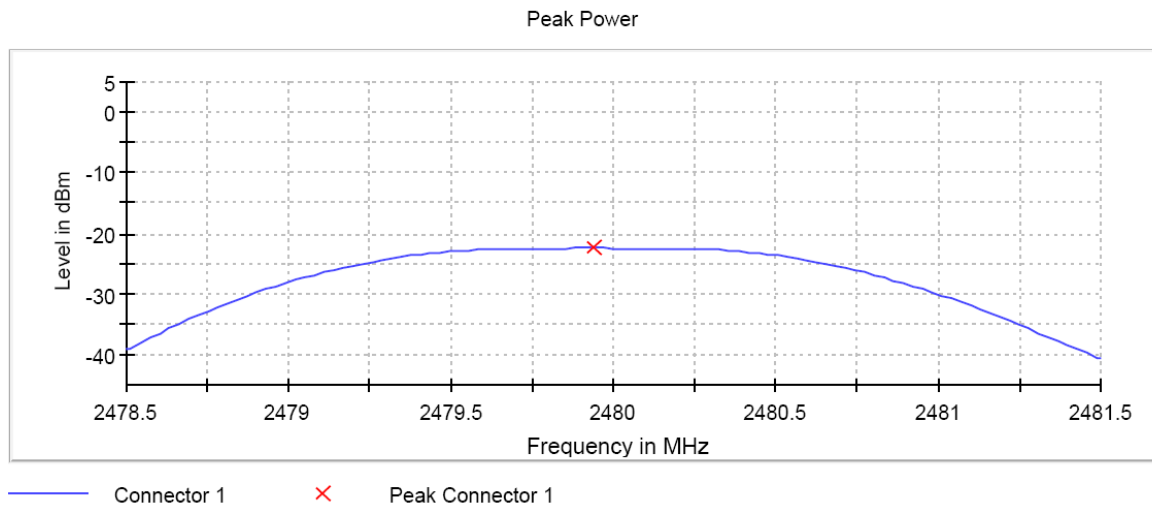
FCC Part 47 §15.247 2400-2483.5 MHz 2018

Peak output power (Sweep) (2480 MHz)

Test according to FCC title 47 part 15 §15.247(b), KDB 558074 D01 DTS Meas Guidance v05 and ANSI C63.10-2013 11.9.1.1

Result

DUT Frequency (MHz)	Peak Power (dBm)	Limit Max (dBm)	Result
2480.000000	-22.4	30.0	PASS



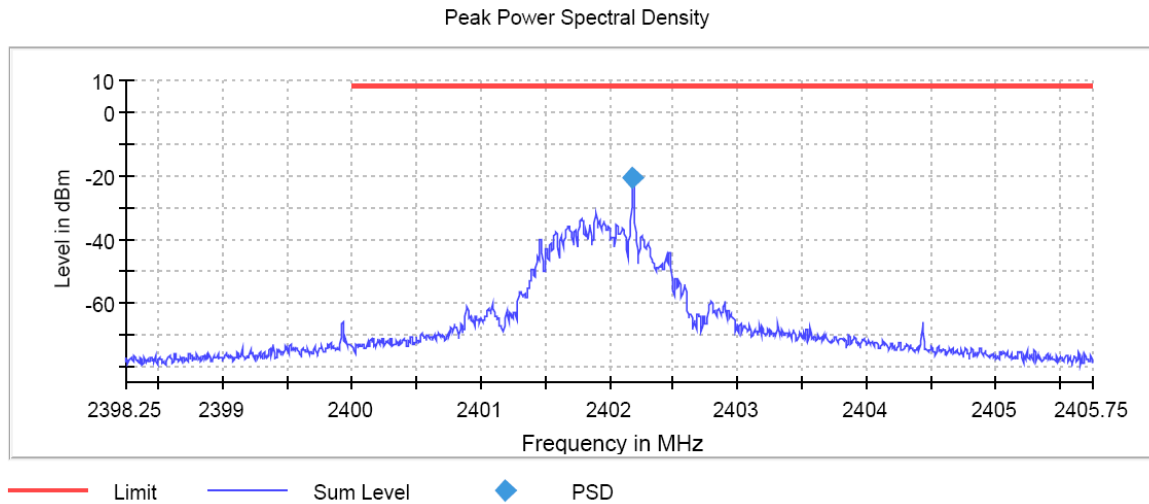
FCC Part 47 §15.247 2400-2483.5 MHz 2018

Peak Power Spectral Density (2402 MHz)

Test according to FCC title 47 part 15 §15.247(a),(e), KDB 558074 D01 DTS Meas Guidance v05 F and ANSI C63.10-2013

Result

DUT Frequency (MHz)	Frequency (MHz)	PSD (dBm)	Limit Max (dBm)	Result
2402.000000	2402.187500	-20.917	8.0	PASS



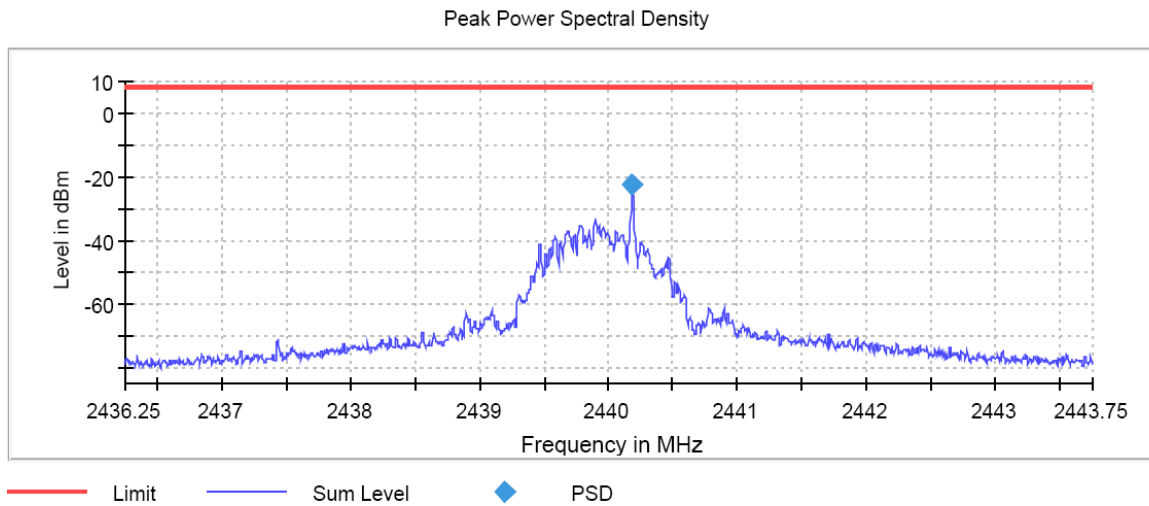
FCC Part 47 §15.247 2400-2483.5 MHz 2018

Peak Power Spectral Density (2440 MHz)

Test according to FCC title 47 part 15 §15.247(a),(e), KDB 558074 D01 DTS Meas Guidance v05 F and ANSI C63.10-2013

Result

DUT Frequency (MHz)	Frequency (MHz)	PSD (dBm)	Limit Max (dBm)	Result
2440.000000	2440.182500	-22.410	8.0	PASS



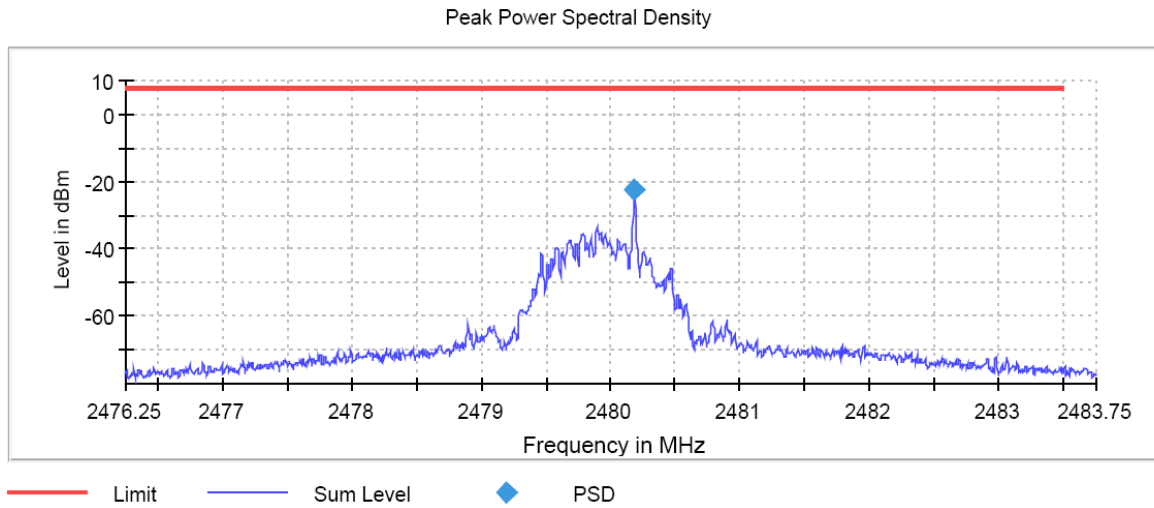
FCC Part 47 §15.247 2400-2483.5 MHz 2018

Peak Power Spectral Density (2480 MHz)

Test according to FCC title 47 part 15 §15.247(a),(e), KDB 558074 D01 DTS Meas Guidance v05 F and ANSI C63.10-2013

Result

DUT Frequency (MHz)	Frequency (MHz)	PSD (dBm)	Limit Max (dBm)	Result
2480.000000	2480.182500	-22.492	8.0	PASS



FCC Part 47 §15.247 2400-2483.5 MHz 2018

Occupied Channel Bandwidth 99% (2402 MHz)

Test according to FCC title 47 part 15 §15.247(a), KDB 558074 D01 DTS Meas Guidance v05 and ANSI C63.10-2013 11.8.1

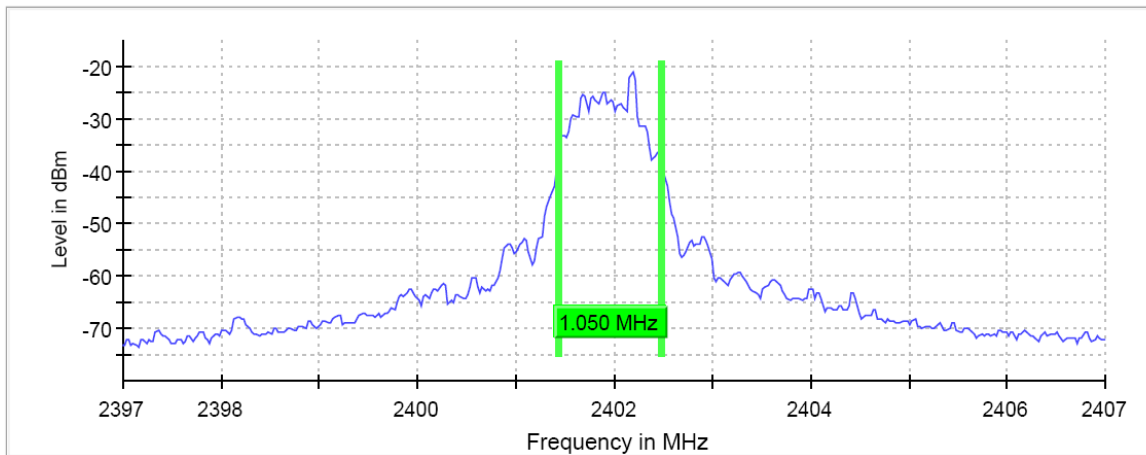
99 % Bandwidth

DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Limit Max (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)
2402.000000	1.050000	---	---	2401.437500	2402.487500

(continuation of the "99 % Bandwidth" table from column 6 ...)

DUT Frequency (MHz)	Result
2402.000000	PASS

99 % Bandwidth



FCC Part 47 §15.247 2400-2483.5 MHz 2018

Occupied Channel Bandwidth 99% (2440 MHz)

Test according to FCC title 47 part 15 §15.247(a), KDB 558074 D01 DTS Meas Guidance v05 and ANSI C63.10-2013 11.8.1

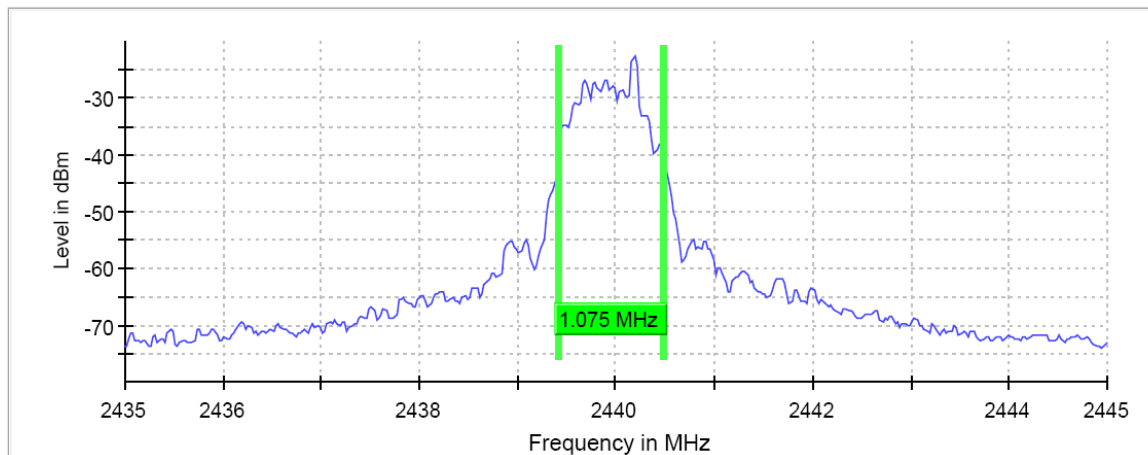
99 % Bandwidth

DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Limit Max (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)
2440.000000	1.075000	---	---	2439.412500	2440.487500

(continuation of the "99 % Bandwidth" table from column 6 ...)

DUT Frequency (MHz)	Result
2440.000000	PASS

99 % Bandwidth



FCC Part 47 §15.247 2400-2483.5 MHz 2018

Occupied Channel Bandwidth 99% (2480 MHz)

Test according to FCC title 47 part 15 §15.247(a), KDB 558074 D01 DTS Meas Guidance v05 and ANSI C63.10-2013 11.8.1

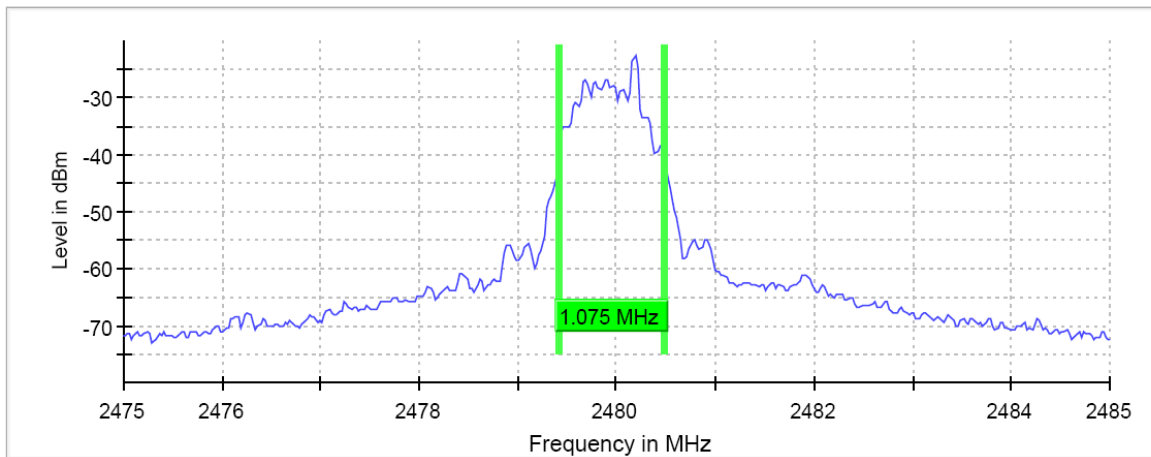
99 % Bandwidth

DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Limit Max (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)
2480.000000	1.075000	---	---	2479.412500	2480.487500

(continuation of the "99 % Bandwidth" table from column 6 ...)

DUT Frequency (MHz)	Result
2480.000000	PASS

99 % Bandwidth



FCC Part 47 §15.247 2400-2483.5 MHz 2018

Band Edge low (2402 MHz)

Test according to FCC title 47 part 15 §15.247(d), KDB 558074 D01 DTS Meas Guidance v05 8.7 and ANSI C63.10-2013

Result

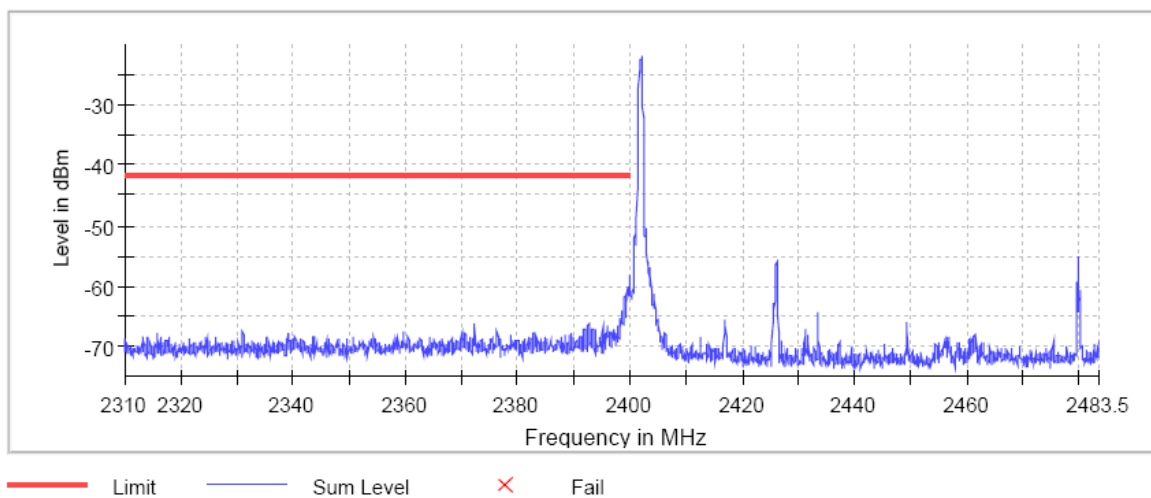
DUT Frequency (MHz)	Result
2402.000000	PASS

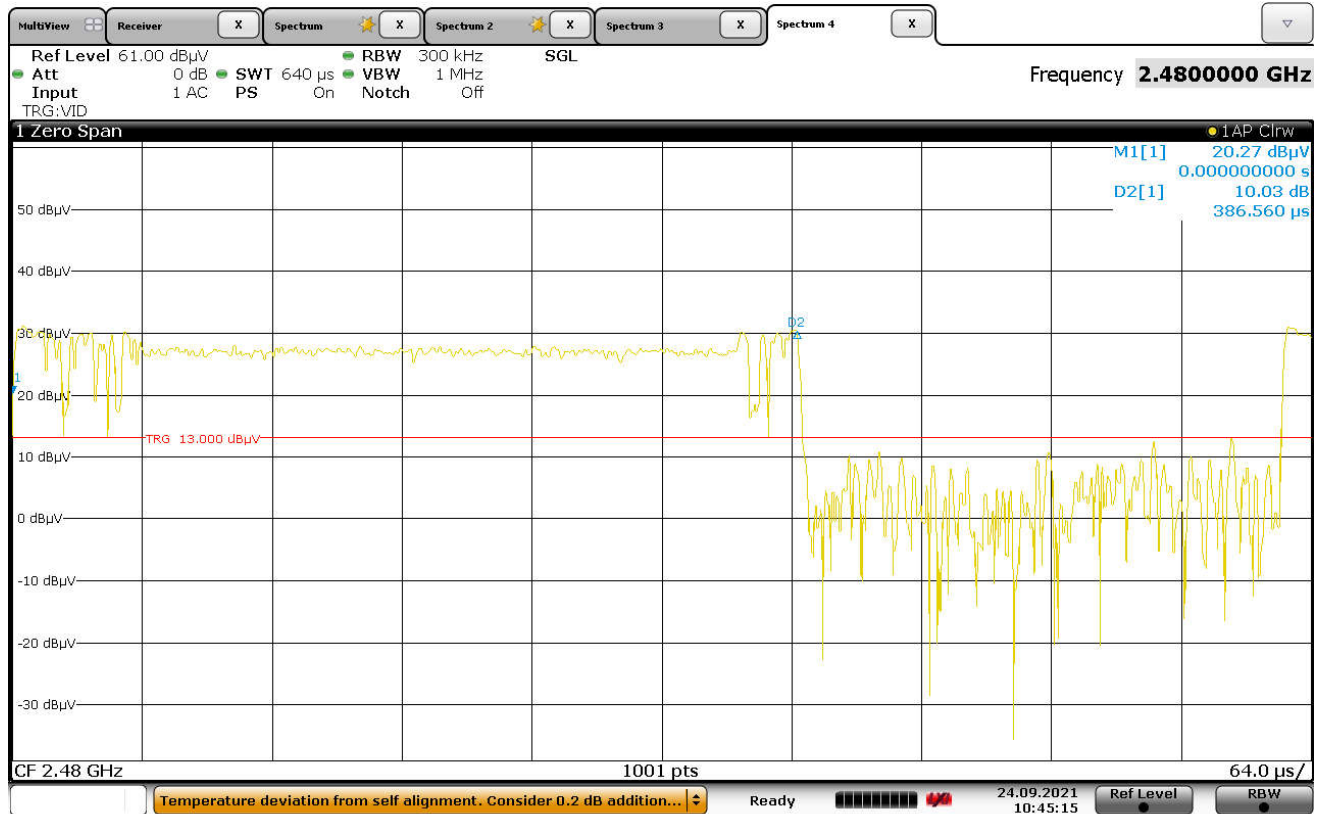
Inband Peak

Frequency (MHz)	Level (dBm)
2402.175000	-21.8

Measurements

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2399.975000	-58.2	16.4	-41.8	PASS
2399.925000	-59.4	17.6	-41.8	PASS
2399.875000	-59.9	18.1	-41.8	PASS
2399.825000	-59.9	18.1	-41.8	PASS
2399.775000	-60.1	18.3	-41.8	PASS
2399.725000	-60.1	18.3	-41.8	PASS
2399.675000	-60.2	18.4	-41.8	PASS
2399.625000	-60.4	18.6	-41.8	PASS
2399.575000	-61.2	19.4	-41.8	PASS
2399.525000	-61.4	19.6	-41.8	PASS
2399.475000	-61.7	19.9	-41.8	PASS
2399.425000	-61.8	20.0	-41.8	PASS
2399.375000	-61.8	20.0	-41.8	PASS
2399.325000	-62.0	20.2	-41.8	PASS
2399.275000	-62.8	21.0	-41.8	PASS





Date: 24-SEP-2021 10:45:15

21. Radiated Emissions Tests

Test Information	
Manufacturer	Soundwave Hearing
Product	Sontro Hearing Aid
Model	AI
Serial No	3
Mode	Normal Operation
Test site used	Room 29

Measurement Uncertainty	
Measurement Type	Expanded Measurement Uncertainty
Radiated disturbance (electric field strength on an open area test site or alternative test site) (30 MHz – 1000 MHz)	4.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (1 GHz – 6 GHz)	3.1
Radiated disturbance (electric field strength on an open area test site or alternative test site) (6 GHz – 18 GHz)	3.2
Radiated disturbance (electric field strength on an open area test site or alternative test site) (18 GHz – 25 GHz)	3.3

Requirements
<p><u>Peak EIRP:</u></p> <p>Per FCC 15.247, Section (b)(3) and ISSED RSS-247, Section 5.4(d), for systems using digital modulation, the maximum peak conducted output power shall not exceed 1 watt.</p> <p>Per FCC 15.247, Section (b)(4), and ISSED RSS-247, Section 5.4(d), the conducted output power limit is based on the use of antennas with directional gains that do not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.</p> <p><u>Radiated Emissions Not In Restricted Bands:</u></p> <p>Per FCC 15.247, Section (d), and ISSED RSS-247, Section 5.5, in any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated emissions measurement. Attenuation below the general limits specified in §15.209(a) is not required.</p> <p><u>Radiated Emissions In Restricted Bands:</u></p> <p>Per 15.247, Section (d), radiated emissions which fall in the restricted bands, as defined in FCC 15.205, Section (a), must comply with the radiated emission limits specified in FCC 15.209, Section (a).</p>

Per ISSED RSS-247, Section 3.3, radiated emissions which fall in the restricted bands, as defined in ISSED RSS-Gen, Section 8.10, must comply with the radiated emission limits specified in RSS-Gen, Section 8.9.

High Band Edge:

Per 15.247, Section (d), radiated emissions which fall in the restricted band beginning at 2483.5MHz, as defined in FCC 15.205, Section (a), must comply with the radiated emission limits specified in FCC 15.209, Section (a).

Per ISSED RSS-247, Section 3.3, radiated emissions which fall in the restricted band beginning at 2483.5MHz, as defined in ISSED RSS-Gen, Section 8.10, must comply with the radiated emission limits specified in RSS-Gen, Section 8.9.

Procedures

Peak EIRP:

C63.10 Annex G and Section 11.9.1.1:

The EUT was placed on a 1.5 meter high non-conductive stand and set to transmit. A double ridged waveguide antenna was placed at a test distance of 3 meters from the EUT.

a) The following settings were employed on the EMI Test Receiver:

- | | |
|------------------------------|--------------------------------------------|
| 1) Center Frequency | = Transmit frequency of EUT |
| 2) Span | $\geq 3 \times \text{RBW}$ |
| 3) RBW | $\geq \text{DTS Bandwidth}$ |
| 4) VBW | $\geq 3 \times \text{RBW}$ |
| 5) Number of points in sweep | $\geq (2 \times \text{span} / \text{RBW})$ |
| 6) Sweep time | = Auto |
| 7) Detector | = Peak |
| 8) Trace | = Max hold |

b) Allow trace to stabilize

c) Use peak marker function to determine the peak amplitude level.

The equivalent power was determined using equation G.1 in C63.10 to convert field intensity levels measured at 3 meters into EIRP readings.

Radiated Emissions Not In Restricted Bands:

C63.10-2013 Section 11.11

Radiated measurements were performed in a 32ft. x 20ft. x 14ft. high shielded enclosure. The shielded enclosure prevents emissions from other sources, such as radio and TV stations from interfering with the measurements. All powerlines and signal lines entering the enclosure pass through filters on the enclosure wall. The powerline filters prevent extraneous signals from entering the enclosure on these leads.

Preliminary radiated emissions tests were performed to determine the emission characteristics of the EUT. For the preliminary test, a broadband measuring antenna was positioned at a 3 meter distance from the EUT. The entire frequency range from 30MHz to 25GHz was investigated using a peak detector function.

The final radiated emission tests were then manually performed over the frequency range of 30MHz to 25GHz.

- a) The field strength of the fundamental was measured using a double ridged waveguide antenna. The waveguide antenna was positioned at a 3 meter distance from the EUT. The EUT was placed on a 1.5 meter high non-conductive stand and set to transmit. A peak detector with a resolution bandwidth of 100 kHz was used on the spectrum analyzer.
- b) The field strengths of all of the harmonics not in the restricted band were then measured using a double-ridged waveguide antenna. The waveguide antenna was positioned at a 3 meter distance from the EUT. The EUT was placed on a 1.5 meter high non-conductive stand and set to transmit. A peak detector with a resolution bandwidth of 100 kHz was used on the spectrum analyzer.
- c) To ensure that maximum or worst case emission levels at the fundamental and harmonics were measured, the following steps were taken when measuring the fundamental emissions and the spurious emissions:
 - i) The EUT was rotated so that all of its sides were exposed to the receiving antenna.
 - ii) Since the measuring antenna is linearly polarized, both horizontal and vertical field components were measured.
 - iii) The measuring antenna was raised and lowered for each antenna polarization to maximize the readings.
 - iv) In instances where it was necessary to use a shortened cable between the measuring antenna and the spectrum analyzer. The measuring antenna was not raised or lowered to ensure maximized readings, instead the EUT was rotated through all axis to ensure the maximum readings were recorded for the EUT.
- d) All harmonics not in the restricted bands must be at least 20 dB below levels measured at the fundamental. However, attenuation below the general limits specified in §15.209(a) is not required.

Radiated Emissions In Restricted Bands:

C63.10-2013 Section 11.12

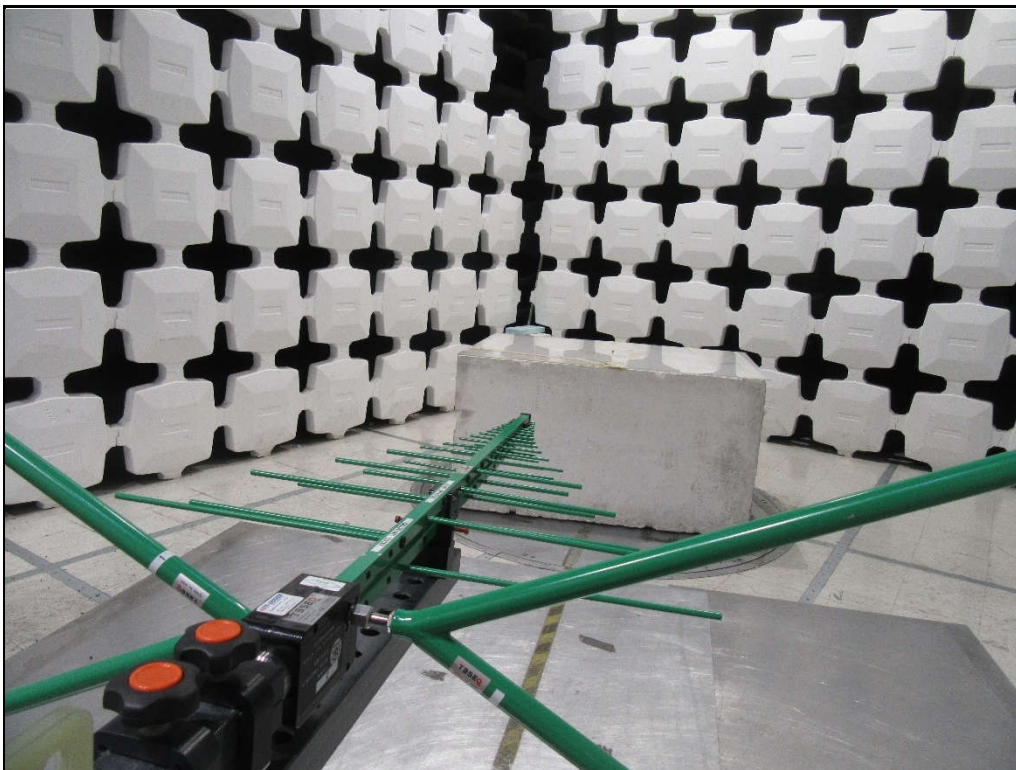
- a) The field strengths of all emissions below 1 GHz were measured using a bi-log antenna. The bi-log antenna was positioned at a 3 meter distance from the EUT. The EUT was placed on an 80 cm high non-conductive stand and set to transmit. A peak detector with a resolution bandwidth of 100 kHz was used on the spectrum analyzer.
- b) The field strengths of all emissions above 1 GHz were measured using a double-ridged waveguide antenna. The waveguide antenna was positioned at a 3 meter distance from the EUT. The EUT was placed on a 1.5 meter high non-conductive stand and set to transmit. A peak detector with a resolution bandwidth of 1 MHz was used on the spectrum analyzer.
- c) To ensure that maximum or worst-case emission levels were measured, the following steps were taken when taking all measurements:
 - i) The EUT was rotated so that all of its sides were exposed to the receiving antenna.
 - ii) Since the measuring antenna is linearly polarized, both horizontal and vertical field components were measured.
 - iii) The measuring antenna was raised and lowered for each antenna polarization to maximize the readings.
 - iv) In instances where it was necessary to use a shortened cable between the measuring antenna and the spectrum analyzer. The measuring antenna was not raised or lowered to ensure maximized readings, instead the EUT was rotated through all axis to ensure the maximum readings were recorded for the EUT.
- d) For all radiated emissions measurements below 1 GHz, if the peak reading is below the limits listed in 15.209(a), no further measurements are required. If however, the peak readings exceed the limits listed in 15.209(a), then the emissions are remeasured using a quasi-peak detector.
- e) For all radiated emissions measurements above 1 GHz, the peak readings must comply with the 15.35(b) limits. 15.35(b) states that when average radiated emissions measurements are specified, there also is a limit on the peak level of the radiated emissions. The limit on the peak radio frequency emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test. Therefore, all peak readings above 1 GHz must be no greater than 20 dB above the limits specified in 15.209(a).

- f) Next, for all radiated emissions measurements above 1GHz, the resolution bandwidth was set to 1MHz. The analyzer was set to linear mode with a 10Hz video bandwidth in order to simulate an average detector. An average reading was taken. The duty cycle correction $[(DCCF) = 20 \log (1/D)]$ factor was added to the measurement results.

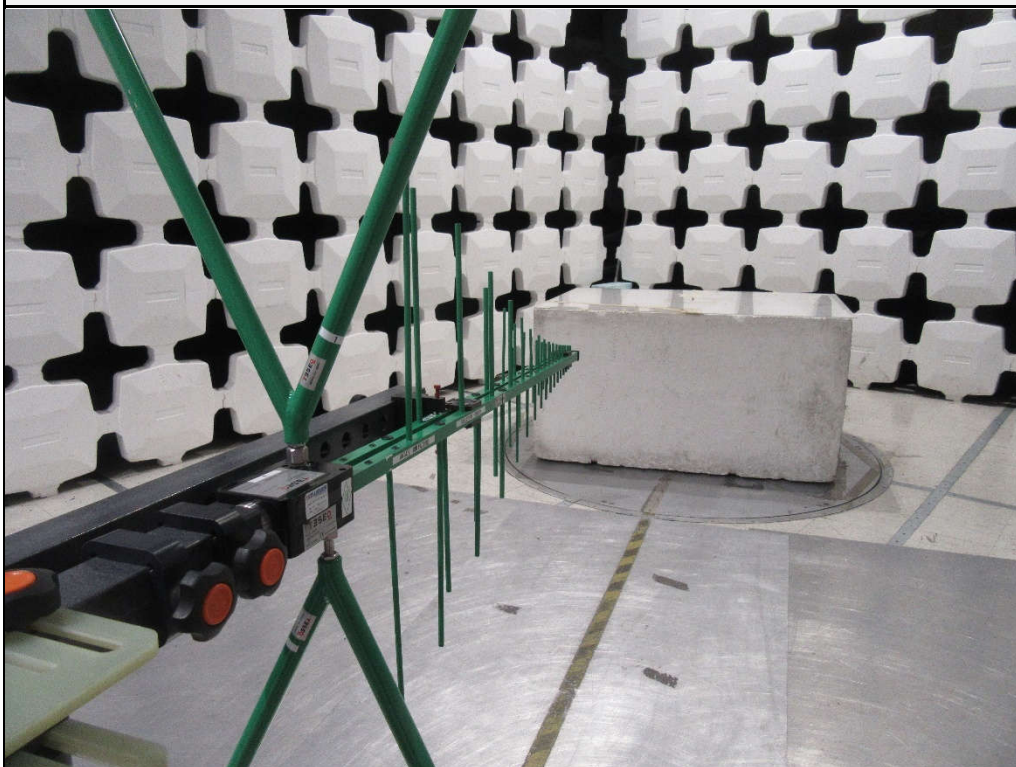
High Band Edge:

C63.10-2013 section 6.10.5:

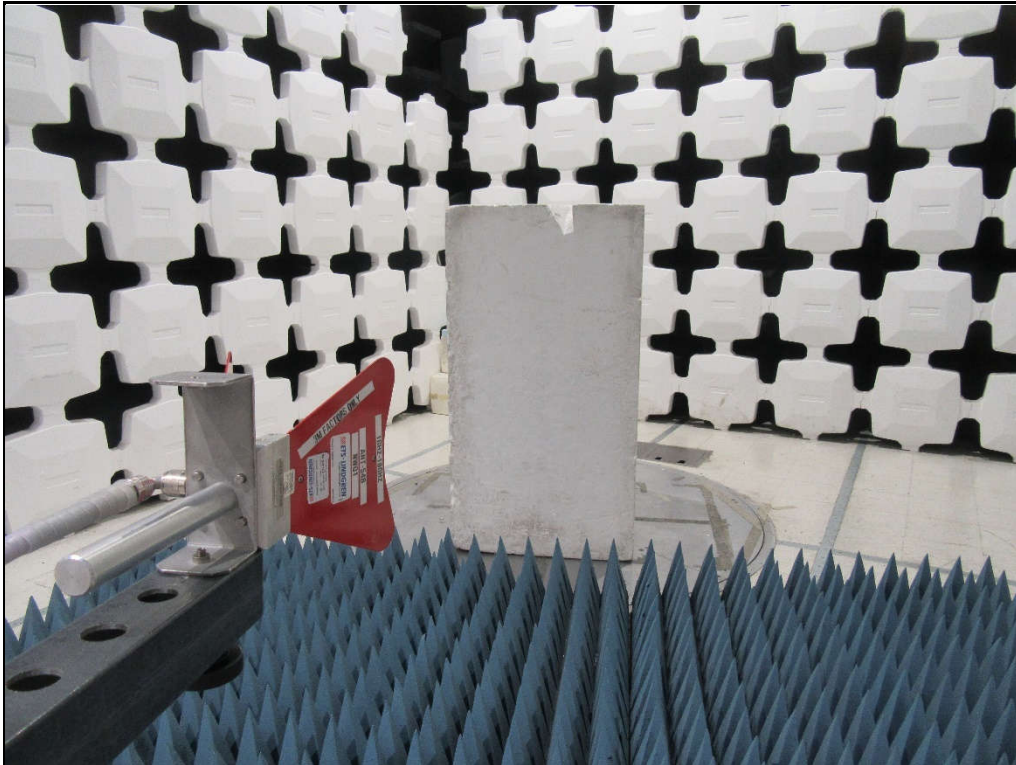
- a) The EUT was set to transmit continuously at the channel closest to the high band-edge.
- b) The waveguide antenna was positioned at a 3 meter distance from the EUT. The EUT was placed on a 1.5 meter high non-conductive stand and set to transmit. A peak detector with a resolution bandwidth of 1 MHz was used on the spectrum analyzer.
- c) To ensure that maximum or worst case emission levels were measured, the following steps were taken when taking all measurements:
 - i) The EUT was rotated so that all of its sides were exposed to the receiving antenna.
 - ii) Since the measuring antenna is linearly polarized, both horizontal and vertical field components were measured.
 - iii) The measuring antenna was raised and lowered for each antenna polarization to maximize the readings.
- d) The peak readings must comply with the 15.35(b) limits. 15.35(b) states that when average radiated emissions measurements are specified, there also is a limit on the peak level of the radiated emissions. The limit on the peak radio frequency emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test. Therefore, all peak readings above 1 GHz must be no greater than 20 dB above the limits specified in 15.209(a).
- e) Next, the resolution bandwidth was set to 1MHz. The analyzer was set to linear mode with a 10Hz video bandwidth in order to simulate an average detector. An average reading was taken. The duty cycle correction $[(DCCF) = 20 \log (1/D)]$ factor was added to the measurement results.



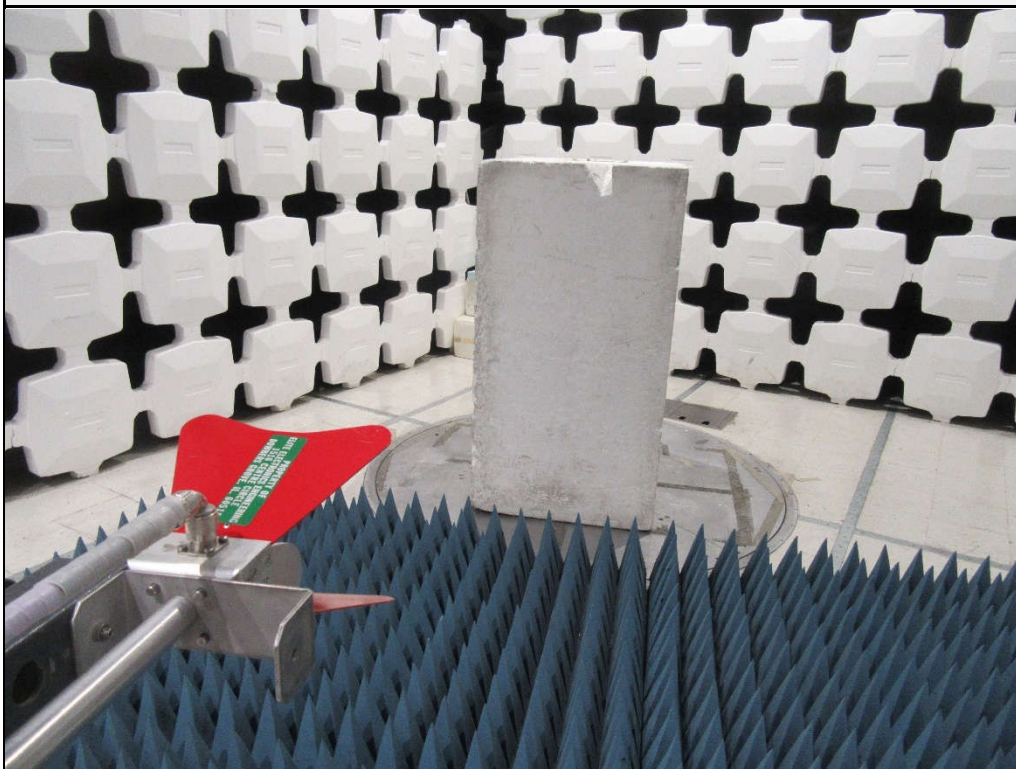
Test Setup for Spurious Radiated Emissions, 30-1000MHz – Antenna Polarization Horizontal



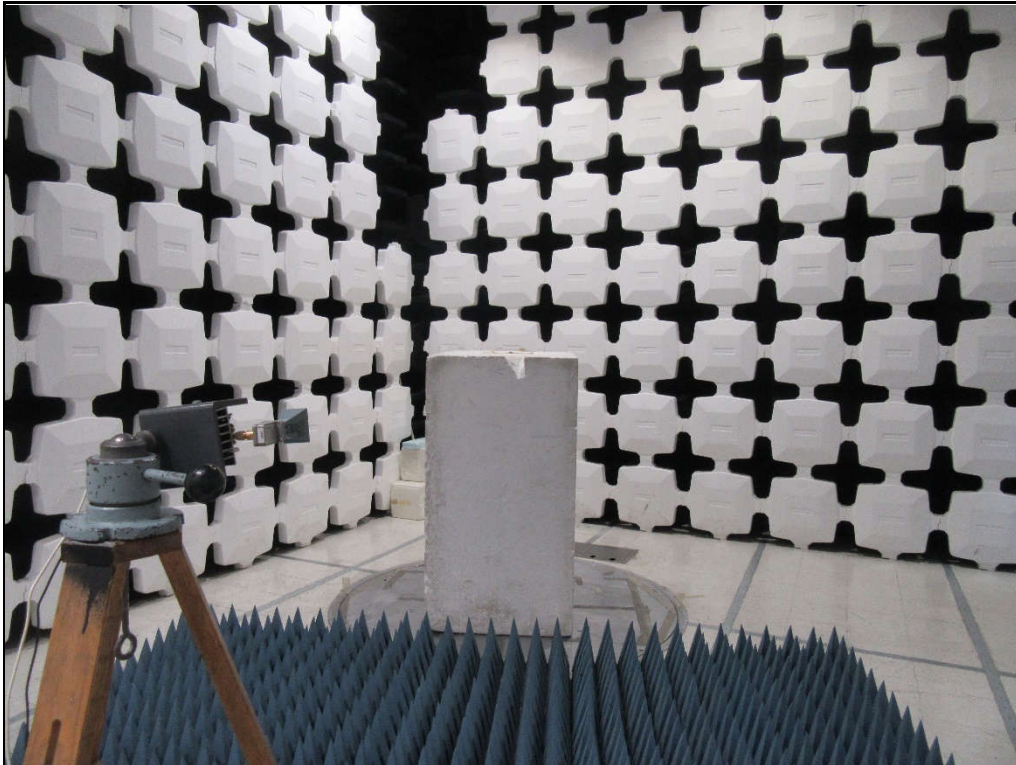
Test Setup for Spurious Radiated Emissions, 30-1000MHz – Antenna Polarization Vertical



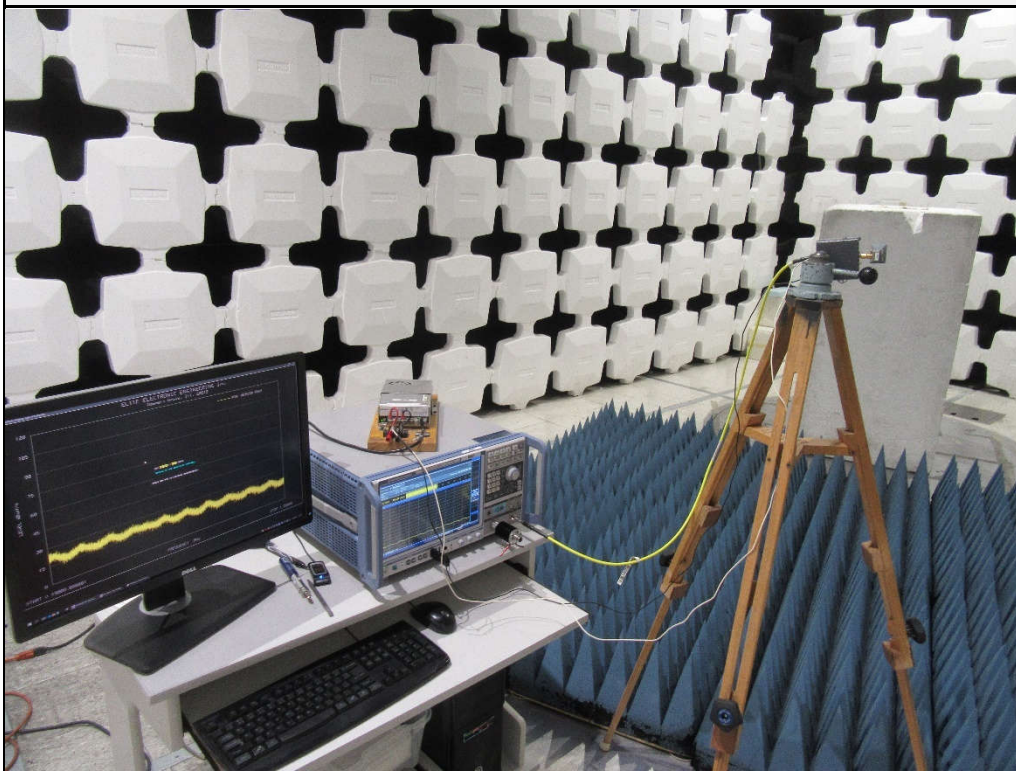
Test Setup for Spurious Radiated Emissions, 1GHz to 18GHz – Antenna
Polarization Horizontal



Test Setup for Spurious Radiated Emissions, 1GHz to 18GHz – Antenna
Polarization Vertical



Test Setup for Spurious Radiated Emissions, 18GHz to 25GHz – Antenna Polarization Horizontal



Test Setup for Spurious Radiated Emissions, 18GHz to 25GHz – Full Setup

Test Details	
Manufacturer	Soundwave Hearing
Model	AI
S/N	1
Mode	Tx
Parameters	Peak EIRP
Notes	

Freq. (MHz)	Ant Pol	Meter Reading (dBuV)	CBL Fac (dB)	Ant Fac (dB/m)	Pre Amp (dB)	Peak Total dBuV/m at 3m	EIRP (dBm)	Limit (dBm)	Margin (dBm)
2402.00	H	42.6	2.6	32.2	0.0	77.4	-17.6	36.0	-53.6
2402.00	V	40.3	2.6	32.2	0.0	75.1	-19.9	36.0	-55.9
2440.00	H	43.5	2.6	32.5	0.0	78.7	-16.3	36.0	-52.3
2440.00	V	40.1	2.6	32.5	0.0	75.3	-19.7	36.0	-55.7
2480.00	H	43.4	2.7	32.5	0.0	78.6	-16.4	36.0	-52.4
2480.00	V	40.2	2.7	32.5	0.0	75.4	-19.6	36.0	-55.6

Peak Total (dBuV/m) = Meter Reading (dBuV) + CBL Fac (dB) + Ant Fac (dB/m) + Pre Amp (dB)

EIRP (dBm) = Peak Total (dBuV/m) – 95dB

Test Details	
Manufacturer	Soundwave Hearing
Model	AI
S/N	3
Mode	Tx
Transmit Frequency	2402 MHz
Parameters	Peak Measurements in the Restricted Bands
Notes	

Frequency (MHz)	Ant Pol	Meter Reading (dBμV)	Ambient	CBL Fac (dB)	Ant Fac (dB/m)	Pre Amp (dB)	Peak Total dBμV/m at 3m	Peak Total μV/m at 3 m	Peak Limit μV/m at 3 m	Margin (dB)
4804.00	H	48.1	Ambient	3.7	34.5	-39.7	46.6	212.8	5000.0	-27.4
4804.00	V	49.7	Ambient	3.7	34.5	-39.7	48.1	255.3	5000.0	-25.8
12010.00	H	48.7		6.1	38.6	-39.0	54.4	527.1	5000.0	-19.5
12010.00	V	47.4	Ambient	6.1	38.6	-39.0	53.1	453.8	5000.0	-20.8
19216.00	H	34.3	Ambient	2.2	40.4	-28.2	48.7	271.8	5000.0	-25.3
19216.00	V	32.0	Ambient	2.2	40.4	-28.2	46.4	209.0	5000.0	-27.6

Test Details	
Manufacturer	Soundwave Hearing
Model	AI
S/N	3
Mode	Tx
Transmit Frequency	2402 MHz
Parameters	Average Measurements in the Restricted Bands
Notes	

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB/m)	Pre Amp (dB)	Duty Cycle (dB)	Average Total dBuV/m at 3m	Average Total uV/m at 3 m	Average Limit uV/m at 3 m	Margin (dB)
4804.00	H	35.5	Ambient	3.7	34.5	-39.7	0.2	34.1	50.9	500.0	-19.8
4804.00	V	37.1		3.7	34.5	-39.7	0.2	35.7	61.2	500.0	-18.2
12010.00	H	36.3		6.1	38.6	-39.0	0.2	42.2	129.4	500.0	-11.7
12010.00	V	35.7		6.1	38.6	-39.0	0.2	41.6	120.3	500.0	-12.4
19216.00	H	20.0	Ambient	2.2	40.4	-28.2	0.2	34.6	53.5	500.0	-19.4
19216.00	V	16.5	Ambient	2.2	40.4	-28.2	0.2	31.1	35.8	500.0	-22.9

Test Details	
Manufacturer	Soundwave Hearing
Model	AI
S/N	3
Mode	Tx
Transmit Frequency	2402 MHz
Parameters	Peak Measurements not in the Restricted Bands
Notes	

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB/m)	Pre Amp (dB)	Peak Total dBuV/m at 3m	Peak Total uV/m at 3 m	Peak Limit uV/m at 3 m	Margin (dB)
2402.00	H	40.7		2.6	32.2	0.0	75.5	5968.5		
2402.00	V	38.1		2.6	32.2	0.0	72.9	4419.4		
7206.00	H	39.9		4.6	35.7	-39.7	40.6	106.9	596.8	-14.9
7206.00	V	40.4		4.6	35.7	-39.7	41.0	112.6	596.8	-14.5
9608.00	H	40.0		5.2	36.7	-39.3	42.6	134.4	596.8	-13.0
9608.00	V	42.0		5.2	36.7	-39.3	44.5	168.4	596.8	-11.0
14412.00	H	38.2	Ambient	6.6	39.8	-38.6	46.0	200.5	596.8	-9.5
14412.00	V	36.5	Ambient	6.6	39.8	-38.6	44.4	165.1	596.8	-11.2
16814.00	H	36.7	Ambient	7.2	43.4	-37.4	49.9	313.4	596.8	-5.6
16814.00	V	36.4	Ambient	7.2	43.4	-37.4	49.6	302.7	596.8	-5.9
21618.00	H	24.2	Ambient	2.2	40.6	-28.5	38.5	84.2	596.8	-17.0
21618.00	V	21.3	Ambient	2.2	40.6	-28.5	35.6	60.3	596.8	-19.9
24020.00	H	21.3	Ambient	2.2	40.6	-29.3	34.8	55.2	596.8	-20.7
24020.00	V	21.9	Ambient	2.2	40.6	-29.3	35.4	59.2	596.8	-20.1

Test Details	
Manufacturer	Soundwave Hearing
Model	AI
S/N	3
Mode	Tx
Transmit Frequency	2440MHz
Parameters	Peak Measurements in the Restricted Bands
Notes	

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB/m)	Pre Amp (dB)	Peak Total dBuV/m at 3m	Peak Total uV/m at 3 m	Peak Limit uV/m at 3 m	Margin (dB)
4880.00	H	48.7	Ambient	3.7	34.4	-39.6	47.2	227.8	5000.0	-26.8
4880.00	V	49.8		3.7	34.4	-39.6	48.3	259.4	5000.0	-25.7
7320.00	H	48.2	Ambient	4.7	35.7	-39.6	48.9	280.0	5000.0	-25.0
7320.00	V	48.4	Ambient	4.7	35.7	-39.6	49.1	285.6	5000.0	-24.9
12200.00	H	49.2		6.1	38.9	-38.9	55.3	580.2	5000.0	-18.7
12200.00	V	46.9	Ambient	6.1	38.9	-38.9	53.0	445.2	5000.0	-21.0
19520.00	H	33.0	Ambient	2.2	40.4	-27.8	47.8	246.6	5000.0	-26.1
19520.00	V	31.9	Ambient	2.2	40.4	-27.8	46.8	218.3	5000.0	-27.2

Test Details	
Manufacturer	Soundwave Hearing
Model	AI
S/N	3
Mode	Tx
Transmit Frequency	2440MHz
Parameters	Average Measurements in the Restricted Bands
Notes	

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB/m)	Pre Amp (dB)	Duty Cycle (dB)	Average Total dBuV/m at 3m	Average Total uV/m at 3 m	Average Limit uV/m at 3 m	Margin (dB)
4880.00	H	35.9		3.7	34.4	-39.6	0.2	34.6	53.6	500.0	-19.4
4880.00	V	37.3		3.7	34.4	-39.6	0.2	35.9	62.7	500.0	-18.0
7320.00	H	35.57		4.7	35.7	-39.6	0.2	36.5	67.0	500.0	-17.5
7320.00	V	35.8		4.7	35.7	-39.6	0.2	36.8	68.8	500.0	-17.2
12200.00	H	38.7		6.1	38.9	-38.9	0.2	45.0	176.8	500.0	-9.0
12200.00	V	35.4		6.1	38.9	-38.9	0.2	41.7	121.2	500.0	-12.3
19520.00	H	16.2		2.2	40.4	-27.8	0.2	31.3	36.5	500.0	-22.7
19520.00	V	15.9		2.2	40.4	-27.8	0.2	30.9	35.1	500.0	-23.1

Test Details	
Manufacturer	Soundwave Hearing
Model	AI
S/N	3
Mode	Tx
Transmit Frequency	2440MHz
Parameters	Peak Measurements not in the Restricted Bands
Notes	

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB/m)	Pre Amp (dB)	Peak Total dBuV/m at 3m	Peak Total uV/m at 3 m	Peak Limit uV/m at 3 m	Margin (dB)
2440.00	H	41.6		2.6	32.5	0.0	76.8	6890.8		
2440.00	V	40.6		2.6	32.5	0.0	75.8	6134.4		
9760.00	H	40.8		5.2	36.9	-39.3	43.6	151.2	689.1	-13.2
9760.00	V	42.6		5.2	36.9	-39.3	45.4	187.1	689.1	-11.3
14640.00	H	35.7	Ambient	6.7	40.2	-38.6	43.9	157.3	689.1	-12.8
14640.00	V	36.7	Ambient	6.7	40.2	-38.6	45.0	177.5	689.1	-11.8
17080.00	H	36.6	Ambient	7.3	43.0	-37.4	49.4	296.6	689.1	-7.3
17080.00	V	35.7	Ambient	7.3	43.0	-37.4	48.5	267.4	689.1	-8.2
21960.00	H	22.0	Ambient	2.2	40.6	-28.9	35.9	62.0	689.1	-20.9
21960.00	V	27.1	Ambient	2.2	40.6	-28.9	41.0	112.7	689.1	-15.7
24400.00	H	22.2	Ambient	2.2	40.6	-29.3	35.8	61.5	689.1	-21.0
24400.00	V	21.8	Ambient	2.2	40.6	-29.3	35.4	58.7	689.1	-21.4

Test Details	
Manufacturer	Soundwave Hearing
Model	AI
S/N	3
Mode	Tx
Transmit Frequency	2480MHz
Parameters	Peak Measurements in the Restricted Bands
Notes	

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB/m)	Pre Amp (dB)	Peak Total dBuV/m at 3m	Peak Total uV/m at 3 m	Peak Limit uV/m at 3 m	Margin (dB)
4960.00	H	49.1	Ambient	3.7	34.3	-39.6	47.5	237.6	5000.0	-26.5
4960.00	V	47.9	Ambient	3.7	34.3	-39.6	46.3	207.2	5000.0	-27.7
7440.00	H	48.0	Ambient	4.7	35.6	-39.6	48.8	274.7	5000.0	-25.2
7440.00	V	47.9	Ambient	4.7	35.6	-39.6	48.7	272.8	5000.0	-25.3
12400.00	H	46.4	Ambient	6.1	39.0	-38.8	52.7	432.8	5000.0	-21.3
12400.00	V	46.6	Ambient	6.1	39.0	-38.8	52.9	442.9	5000.0	-21.1
19840.00	H	32.1	Ambient	2.2	40.4	-28.0	46.7	216.7	5000.0	-27.3
19840.00	V	31.9	Ambient	2.2	40.4	-28.0	46.5	211.7	5000.0	-27.5
22320.00	H	32.2	Ambient	2.2	40.6	-28.8	46.2	203.8	5000.0	-27.8
22320.00	V	31.4	Ambient	2.2	40.6	-28.8	45.4	185.2	5000.0	-28.6

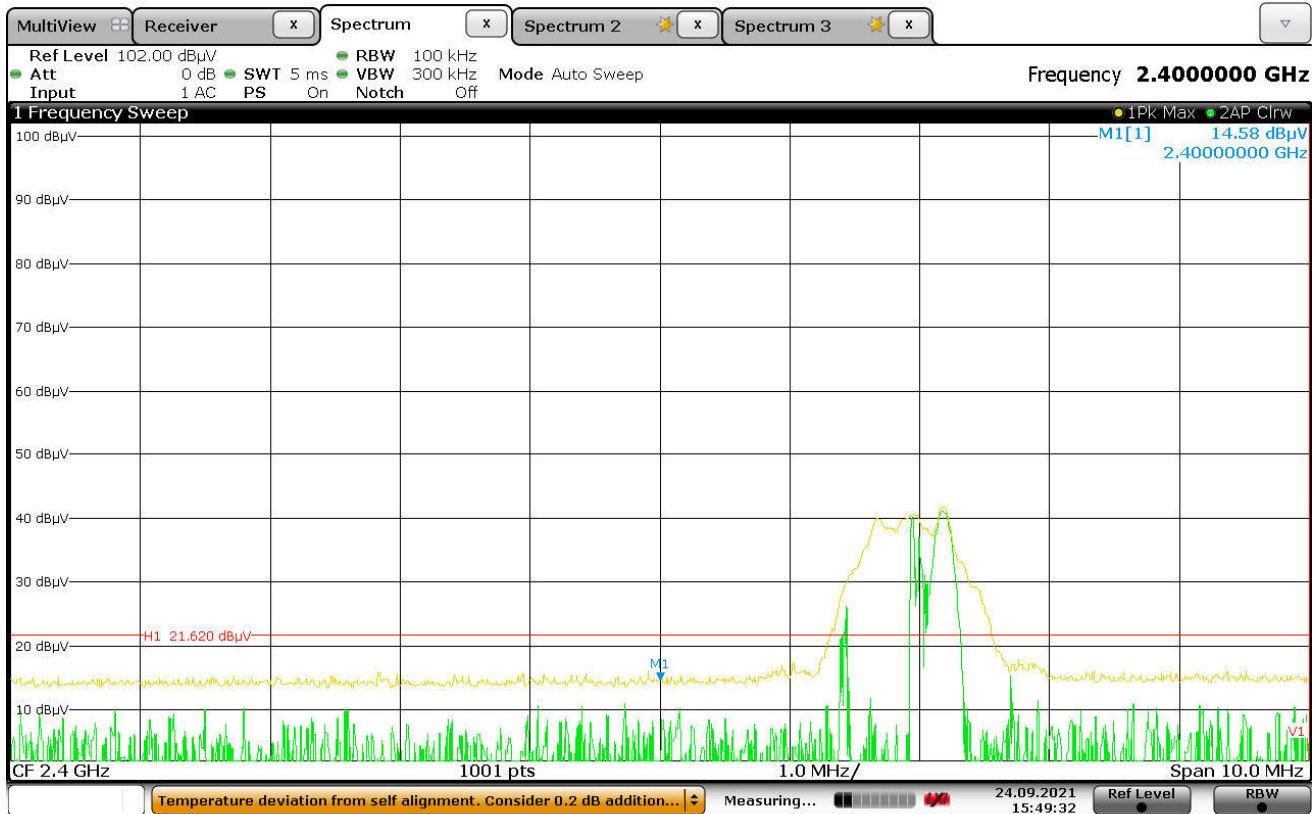
Test Details	
Manufacturer	Soundwave Hearing
Model	AI
S/N	3
Mode	Tx
Transmit Frequency	2480MHz
Parameters	Average Measurements in the Restricted Bands
Notes	

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB/m)	Pre Amp (dB)	Duty Cycle (dB)	Average Total dBuV/m at 3m	Average Total uV/m at 3 m	Average Limit uV/m at 3 m	Margin (dB)
4960.00	H	38.3		3.7	34.3	-39.6	0.2	36.9	70.0	500.0	-17.1
4960.00	V	35.2	Ambient	3.7	34.3	-39.6	0.2	33.9	49.3	500.0	-20.1
7440.00	H	34.53		4.7	35.6	-39.6	0.2	35.5	59.9	500.0	-18.4
7440.00	V	34.8		4.7	35.6	-39.6	0.2	35.8	61.6	500.0	-18.2
12400.00	H	34.0		6.1	39.0	-38.8	0.2	40.5	105.6	500.0	-13.5
12400.00	V	34.9		6.1	39.0	-38.8	0.2	41.4	117.9	500.0	-12.6
19840.00	H	16.5	Ambient	2.2	40.4	-28.0	0.2	31.3	36.6	500.0	-22.7
19840.00	V	16.5	Ambient	2.2	40.4	-28.0	0.2	31.3	36.8	500.0	-22.7
22320.00	H	16.6	Ambient	2.2	40.6	-28.8	0.2	30.8	34.7	500.0	-23.2
22320.00	V	16.6	Ambient	2.2	40.6	-28.8	0.2	30.7	34.4	500.0	-23.2

Test Details	
Manufacturer	Soundwave Hearing
Model	AI
S/N	3
Mode	Tx
Transmit Frequency	2480MHz
Parameters	Peak Measurements not in the Restricted Bands
Notes	

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB/m)	Pre Amp (dB)	Peak Total dBuV/m at 3m	Peak Total uV/m at 3 m	Peak Limit uV/m at 3 m	Margin (dB)
2480.00	H	41.4		2.7	32.5	0.0	76.6	6755.7		
2480.00	V	40.2		2.7	32.5	0.0	75.4	5884.0		
9920.00	H	38.5	Ambient	5.3	37.0	-39.2	41.5	119.4	675.6	-15.1
9920.00	V	42.8		5.3	37.0	-39.2	45.9	197.0	675.6	-10.7
14880.00	H	36.6	Ambient	6.8	40.4	-38.5	45.2	181.9	675.6	-11.4
14880.00	V	36.6	Ambient	6.8	40.4	-38.5	45.3	183.8	675.6	-11.3
17360.00	H	35.3	Ambient	7.4	42.4	-37.4	47.6	241.1	675.6	-8.9
17360.00	V	35.6	Ambient	7.4	42.4	-37.4	47.9	248.4	675.6	-8.7
24800.00	H	22.0	Ambient	2.2	40.6	-29.3	35.5	59.8	675.6	-21.1
24800.00	V	22.6	Ambient	2.2	40.6	-29.3	36.1	63.9	675.6	-20.5

Test Details	
Manufacturer	Soundwave Hearing
Model	AI
S/N	3
Mode	Tx
Transmit Frequency	2402MHz
Parameters	Low Band-Edge
Notes	



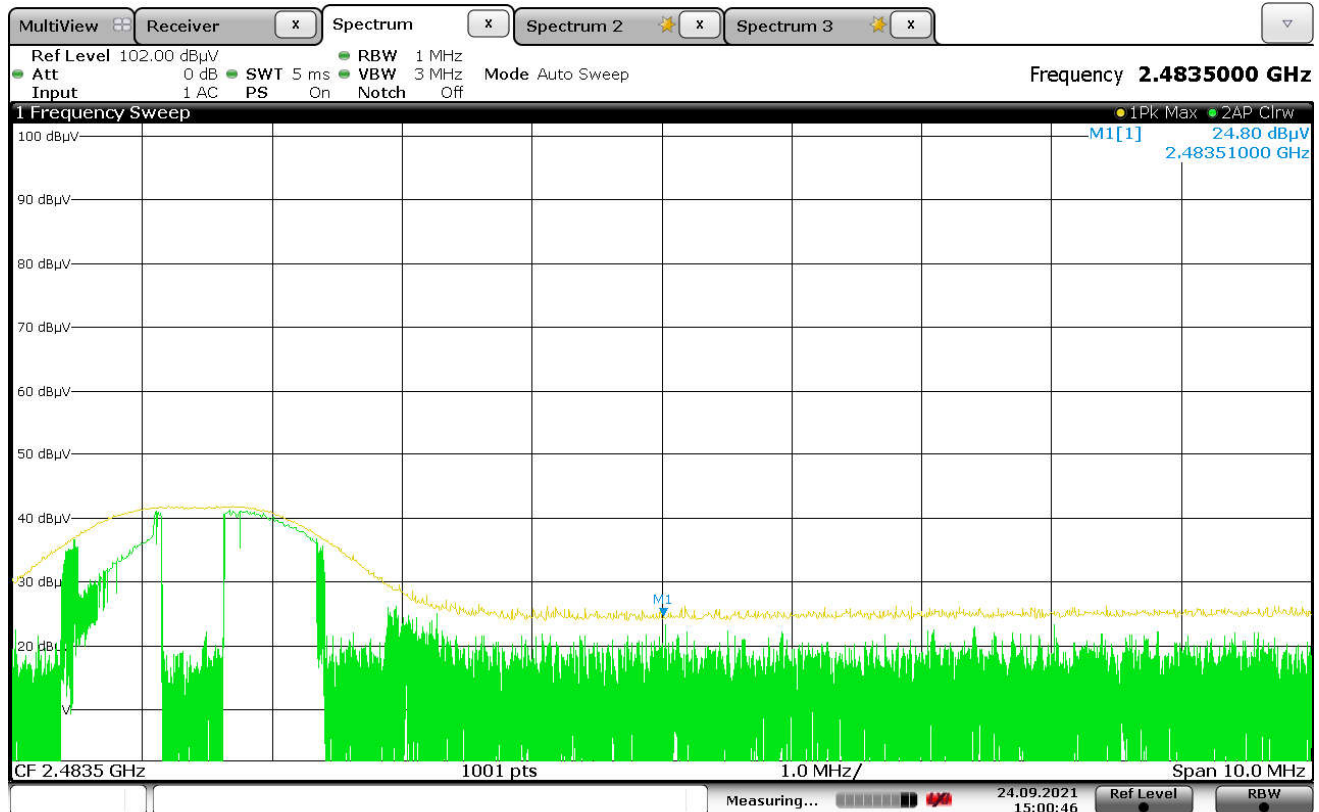
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Test Details	
Manufacturer	Soundwave Hearing
Model	AI
S/N	3
Mode	Tx
Transmit Frequency	2480MHz
Parameters	High Band-Edge, Peak Readings
Notes	

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB/m)	Pre Amp (dB)	Peak Total dBuV/m at 3m	Peak Total uV/m at 3 m	Peak Limit uV/m at 3 m	Margin (dB)
2483.50	H	23.9	Ambient	2.7	32.5	0.0	59.0	896.1	5000.0	-14.9
2483.50	V	23.4	Ambient	2.7	32.5	0.0	58.6	853.8	5000.0	-15.4

Test Details	
Manufacturer	Soundwave Hearing
Model	AI
S/N	3
Mode	Tx
Transmit Frequency	2480MHz
Parameters	High Band-Edge, Average Readings
Notes	

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB/m)	Pre Amp (dB)	Duty Cycle (dB)	Average Total dBuV/m at 3m	Average Total uV/m at 3 m	Average Limit uV/m at 3 m	Margin (dB)
2483.50	H	8.7	Ambient	2.7	32.5	0.0	0.2	43.8	155.7	500.0	-10.1
2483.50	V	8.5	Ambient	2.7	32.5	0.0	0.2	43.7	153.2	500.0	-10.3



Date: 24.SEP.2021 15:00:46

22. Scope of Accreditation



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

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Valid To: June 30, 2023

ELECTRICAL

Certificate Number: 1786.01

In recognition of the successful completion of the A2LA Accreditation Program evaluation process, accreditation is granted to this laboratory to perform the following automotive electromagnetic compatibility and other electrical tests:

Test Technology:

Test Method(s) ¹:

Transient Immunity

ISO 7637-2 (including emissions); ISO 7637-3;
ISO 16750-2:2012, Sections 4.6.3 and 4.6.4;
CS-11979, Section 6.4; CS.00054, Section 5.9;
EMC-CS-2009.1 (CI220); FMC1278 (CI220, CI221, CI222);
GMW 3097, Section 3.5; SAE J1113-11; SAE J1113-12;
ECE Regulation 10.06 Annex 10

Electrostatic Discharge (ESD)

ISO 10605 (2001, 2008);
CS-11979 Section 7.0; CS.00054, Section 5.10;
EMC-CS-2009.1 (CI 280); FMC1278 (CI280); SAE J1113-13;
GMW 3097 Section 3.6

Conducted Emissions

CISPR 25 (2002, 2008), Sections 6.2 and 6.3;
CISPR 25 (2016), Sections 6.3 and 6.4;
CS-11979, Section 5.1; CS.00054, Sections 5.6.1 and 5.6.2;
GMW 3097, Section 3.3.2;
EMC-CS-2009.1 (CE 420); FMC1278 (CE420, CE421)

Radiated Emissions Anechoic

CISPR 25 (2002, 2008), Section 6.4;
CISPR 25 (2016), Section 6.5;
CS-11979, Section 5.3; CS.00054, Section 5.6.3;
GMW 3097, Section 3.3.1;
EMC-CS-2009.1 (RE 310); FMC1278 (RE310);
ECE Regulation 10.06 Annex 7 (Broadband)
ECE Regulation 10.06 Annex 8 (Narrowband)

(A2LA Cert. No. 1786.01) Revised 06/24/2021



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5202 Presidents Court, Suite 220 | Frederick, MD 21703-8515 | Phone: 301 644 3248 | Fax: 240 454 9449 | www.A2LA.org

<u>Test Technology:</u>	<u>Test Method(s) ¹:</u>
<i>Vehicle Radiated Emissions</i>	CISPR 12; CISPR 36; ICES-002; ECE Regulation 10.06 Annex 5
<i>Bulk Current Injection (BCI)</i>	ISO 11452-4; CS-11979, Section 6.1; CS.00054, Section 5.8.1; GMW 3097, Section 3.4.1; SAE J1113-4; EMC-CS-2009.1 (RI112); FMC1278 (RI112); ECE Regulation 10.06 Annex 9
<i>Radiated Immunity Anechoic (Including Radar Pulse)</i>	ISO 11452-2; ISO 11452-5; CS-11979, Section 6.2; CS.00054, Section 5.8.2; GMW 3097, Section 3.4.2; EMC-CS-2009.1 (RI114); FMC1278 (RI114); SAE J1113-21; ECE Regulation 10.06 Annex 9
<i>Radiated Immunity Magnetic Field</i>	ISO 11452-8
<i>Radiated Immunity Reverb</i>	ISO/IEC 61000-4-21; GMW 3097, Section 3.4.3; EMC-CS-2009.1 (RI114); FMC1278 (RI114); ISO 11452-11
<i>Radiated Immunity (Portable Transmitters)</i>	ISO 11452-9; EMC-CS-2009.1 (RI115); FMC1278 (RI115)
<i>Vehicle Radiated Immunity (ALSE)</i>	ISO 11451-2; ECE Regulation 10.06 Annex 6
<i>Vehicle Product Specific EMC Standards</i>	EN 14982; EN ISO 13309; ISO 13766; EN 50498; EC Regulation No. 2015/208; EN 55012
<i>Electrical Loads</i>	ISO 16750-2
Emissions Radiated and Conducted (3m Semi-anechoic chamber, up to 40 GHz)	47 CFR, FCC Part 15 B (using ANSI C63.4:2014); 47 CFR, FCC Part 18 (using FCC MP-5:1986); ICES-001; ICES-003; ICES-005; IEC/CISPR 11, Ed. 4.1 (2004-06); AS/NZS CISPR 11 (2004); IEC/CISPR 11 Ed 5 (2009-05) + A1 (2010); KN 11 (2008-5) with RRL Notice No. 2008-3 (May 20, 2008); CISPR 11; EN 55011; KS C 9811; CNS 13803 (1997, 2003); CISPR 14-1; EN 55014-1; AS/NZS CISPR 14.1; KS C 9814-1; KN 14-1; IEC/CISPR 22 (1997); EN 55022 (1998) + A1(2000); EN 55022 (1998) + A1(2000) + A2(2003); EN 55022 (2006); IEC/CISPR 22 (2008-09); AS/NZS CISPR 22 (2004); AS/NZS CISPR 22, 3rd Edition (2006); KN 22 (up to 6 GHz); CNS 13438 (up to 6 GHz); VCCI V-3 (up to 6 GHz); CISPR 32; EN 55032; KS C 9832; KN 32; ECE Regulation 10.06 Annex 14
Cellular Radiated Spurious Emissions	ETSI TS 151 010-1 GSM; 3GPP TS 51.010-1, Sec 12; ETSI TS 134 124 UMTS; 3GPP TS 34.124; ETSI TS 136 124 LTE; E-UTRA; 3GPP TS 36.124

Test Technology:
Test Method(s) ¹:
Emissions (cont'd)

Current Harmonics

IEC 61000-3-2; EN 61000-3-2; KN 61000-3-2;
KS C 9610-3-2; ECE Regulation 10.06 Annex 11

Flicker and Fluctuations

IEC 61000-3-3; EN 61000-3-3; KN 61000-3-3;
KS C 9610-3-3; ECE Regulation 10.06 Annex 12

Immunity

Electrostatic Discharge

IEC 61000-4-2, Ed. 1.2 (2001);
IEC 61000-4-2 (1995) + A1(1998) + A2(2000);
EN 61000-4-2 (1995); EN 61000-4-2 (2009-05);
KN 61000-4-2 (2008-5);
RRL Notice No. 2008-4 (May 20, 2008);
IEC 61000-4-2; EN 61000-4-2; KN 61000-4-2;
KS C 9610-4-2; IEEE C37.90.3 2001

Radiated Immunity

IEC 61000-4-3 (1995) + A1(1998) + A2(2000);
IEC 61000-4-3, Ed. 3.0 (2006-02);
IEC 61000-4-3, Ed. 3.2 (2010);
KN 61000-4-3 (2008-5);
RRL Notice No. 2008-4 (May 20, 2008);
IEC 61000-4-3; EN 61000-4-3; KN 61000-4-3;
KS C 9610-4-3; IEEE C37.90.2 2004

Electrical Fast Transient/Burst

IEC 61000-4-4, Ed. 2.0 (2004-07);
IEC 61000-4-4, Ed. 2.1 (2011);
IEC 61000-4-4 (1995) + A1(2000) + A2(2001);
KN 61000-4-4 (2008-5);
RRL Notice No. 2008-5 (May 20, 2008);
IEC 61000-4-4; EN 61000-4-4; KN 61000-4-4;
KS C 9610-4-4; ECE Regulation 10.06 Annex 15

Surge

IEC 61000-4-5 (1995) + A1(2000);
IEC 61000-4-5, Ed 1.1 (2005-11);
EN 61000-4-5 (1995) + A1(2001);
KN 61000-4-5 (2008-5);
RRL Notice No. 2008-4 (May 20, 2008);
IEC 61000-4-5; EN 61000-4-5; KN 61000-4-5;
KS C 9610-4-5;
IEEE C37.90.1 2012; IEEE STD C62.41.2 2002;
ECE Regulation 10.06 Annex 16

Conducted Immunity

IEC 61000-4-6 (1996) + A1(2000);
IEC 61000-4-6, Ed 2.0 (2006-05);
IEC 61000-4-6 Ed. 3.0 (2008);
KN 61000-4-6 (2008-5);
RRL Notice No. 2008-4 (May 20, 2008);
EN 61000-4-6 (1996) + A1(2001); IEC 61000-4-6;
EN 61000-4-6; KN 61000-4-6; KS C 9610-4-6

Test Technology:
Test Method(s) ¹:
Immunity (cont'd)

Power Frequency Magnetic Field
Immunity (*Down to 3 A/m*)

IEC 61000-4-8 (1993) + A1(2000); IEC 61000-4-8 (2009);
EN 61000-4-8 (1994) + A1(2000);
KN 61000-4-8 (2008-5);
RRL Notice No. 2008-4 (May 20, 2008);
IEC 61000-4-8; EN 61000-4-8; KN 61000-4-8; KS C 9610-4-8

Voltage Dips, Short Interrupts, and Line
Voltage Variations

IEC 61000-4-11, Ed. 2 (2004-03);
KN 61000-4-11 (2008-5);
RRL Notice No. 2008-4 (May 20, 2008);
IEC 61000-4-11; EN 61000-4-11; KN 61000-4-11;
KS C 9610-4-11

Ring Wave

IEC 61000-4-12, Ed. 2 (2006-09);
EN 61000-4-12:2006;
IEC 61000-4-12; EN 61000-4-12; KN 61000-4-12;
IEEE STD C62.41.2 2002

Generic and Product Specific EMC
Standards

IEC/EN 61000-6-1; AS/NZS 61000-6-1; KN 61000-6-1;
KS C 9610-6-1; IEC/EN 61000-6-2; AS/NZS 61000-6-2;
KN 61000-6-2; KS C 9610-6-2; IEC/EN 61000-6-3;
AS/NZS 61000-6-3; KN 61000-6-3; KS C 9610-6-3;
IEC/EN 61000-6-4; AS/NZS 61000-6-4; KN 61000-6-4;
KS C 9610-6-4; EN 50130-4; EN 61326-1; EN 50121-3-2;
EN 12895; EN 50270; EN 50491-1; EN 50491-2; EN 50491-3;
EN 55015; EN 60730-1; EN 60945; IEC 60533;
EN 61326-2-6; EN 61800-3; IEC/CISPR 14-2; EN 55014-2;
AS/NZS CISPR 14-2; KN 14-2; KS C 9814-2;
IEC/CISPR 24; AS/NZS CISPR 24; EN 55024; KN 24;
IEC/CISPR 35; AS/NZS CISPR 35; EN 55035; KN 35;
KS C 9835; IEC 60601-1-2; JIS T0601-1-2

TxRx EMC Requirements

EN 301 489-1; EN 301 489-3; EN 301 489-9; EN 301 489-17;
EN 301 489-19; EN 301 489-20

European Radio Test Standards

ETSI EN 300 086-1; ETSI EN 300 086-2;
ETSI EN 300 113-1; ETSI EN 300 113-2;
ETSI EN 300 220-1; ETSI EN 300 220-2;
ETSI EN 300 220-3-1; ETSI EN 300 220-3-2;
ETSI EN 300 330-1; ETSI EN 300 330-2;
ETSI EN 300 440-1; ETSI EN 300 440-2;
ETSI EN 300 422-1; ETSI EN 300 422-2;
ETSI EN 300 328; ETSI EN 301 893;
ETSI EN 301 511; ETSI EN 301 908-1;
ETSI EN 908-2; ETSI EN 908-13;
ETSI EN 303 413; ETSI EN 302 502;
EN 303 340; EN 303 345-2; EN 303 345-3; EN 303 345-4

Test Technology:
Test Method(s) ¹:
Canadian Radio Tests

RSS-102 (RF Exposure Evaluation only); RSS-111; RSS-112; RSS-117; RSS-119; RSS-123; RSS-125; RSS-127; RSS-130; RSS-131; RSS-132; RSS-133; RSS-134; RSS-135; RSS-137; RSS-139; RSS-140; RSS-141; RSS-142; RSS-170; RSS-181; RSS-182; RSS-191; RSS-192; RSS-194; RSS-195; RSS-196; RSS-197; RSS-199; RSS-210; RSS-211; RSS-213; RSS-215; RSS-216; RSS-220; RSS-222; RSS-236; RSS-238; RSS-243; RSS-244; RSS-247; RSS-251; RSS-252; RSS-287; RSS-288; RSS-310; RSS-GEN

Mexico Radio Tests

IFT-008-2015; NOM-208-SCFI-2016

Japan Radio Tests

Radio Law No. 131, Ordinance of MPT No. 37, 1981, MIC Notification No. 88:2004, Table No. 22-11; ARIB STD-T66, Regulation 18

Taiwan Radio Tests

LP-0002 (July 15, 2020)

Australia/New Zealand Radio Tests

AS/NZS 4268; Radiocommunications (Short Range Devices) Standard (2014)

Hong Kong Radio Tests

HKCA 1039 Issue 6; HKCA 1042; HKCA 1033 Issue 7; HKCA 1061; HKCA 1008; HKCA 1043; HKCA 1057; HKCA 1073

Korean Radio Test Standards

KN 301 489-1; KN 301 489-3; KN 301 489-9; KN 301 489-17; KN 301 489-52; KS X 3124; KS X 3125; KS X 3130; KS X 3126; KS X 3129

Vietnam Radio Test Standards

QCVN 47:2015/BTTTT; QCVN 54:2020/BTTTT; QCVN 55:2011/BTTTT; QCVN 65:2013/BTTTT; QCVN 73:2013/BTTTT; QCVN 74:2020/BTTTT; QCVN 112:2017/BTTTT; QCVN 117:2020/BTTTT

Vietnam EMC Test Standards

QCVN 18:2014/BTTTT; QCVN 86:2019/BTTTT; QCVN 96:2015/BTTTT; QCVN 118:2018/BTTTT

***Unlicensed Radio Frequency Devices
(3 Meter Semi-Anechoic Room)***

47 CFR FCC Part 15C, 15D, 15E, 15F, 15G, 15H (using ANSI C63.10:2013, ANSI C63.17:2013 and FCC KDB 905462 D02 (v02))

Licensed Radio Service Equipment

47 CFR FCC Parts 20, 22, 24, 25, 27, 30, 73, 74, 80, 87, 90, 95, 96, 97, 101 (using ANSI/TIA-603-E, TIA-102.CAAA-E, ANSI C63.26:2015)

Test Technology:

OIA (Over the Air) Performance
GSM, GPRS, EGPRS
UMTS (W-CDMA)
LTE including CAT M1
A-GPS for UMTS/GSM
LTS A-GPS, A-GLONASS,
SIB8/SIB16
Large Device/Laptop/Tablet Testing
Integrated Device Testing
WiFi 802.11 a/b/g/n/a

Test Method(s) ¹:

CTIA Test Plan for Wireless Device Over-the-Air
Performance (Method for Measurement for Radiated Power
and Receiver Performance) V3.8.2;
CTIA Test Plan for RF Performance Evaluation of WiFi
Mobile Converged Devices V2.1.0

**Electrical Measurements and
Simulation**
AC Voltage / Current

(1mV to 5kV) 60 Hz

(0.1V to 250V) up to 500 MHz

(1μA to 150A) 60 Hz

FAA AC 150/5345-10H

FAA AC 150/5345-43J

FAA AC 150/5345-44K

DC Voltage / Current

(1mV to 15-kV) / (1μA to 10A)

FAA AC 150/5345-46E

FAA AC 150/5345-47C

Power Factor / Efficiency / Crest Factor

(Power to 30kW)

FAA EB 67D

Resistance

(1mΩ to 4000MΩ)

Surge

(Up to 10 kV / 5 kA) (Combination
Wave and Ring Wave)

On the following products and materials:

Telecommunications Terminal Equipment (TTE), Radio Equipment, Network Equipment, Information Technology Equipment (ITE), Automotive Electronic Equipment, Automotive Hybrid Electronic Devices, Maritime Navigation and Radio Communication Equipment and Systems, Vehicles, Boats and Internal Combustion Engine Driven Devices, Automotive, Aviation, and General Lighting Products, Medical Electrical Equipment, Motors, Industrial, Scientific and Medical (ISM) Radio-Frequency Equipment, Household Appliances, Electric Tools, Low-voltage Switchgear and Control gear, Programmable Controllers, Electrical Equipment for Measurement, Control and Laboratory Use, Base Materials, Power and Data Transmission Cables and Connectors

¹ When the date, edition, version, etc. is not identified in the scope of accreditation, laboratories may use the version that immediately precedes the current version for a period of one year from the date of publication of the standard measurement method, per part C., Section 1 of A2LA R101 - General Requirements - Accreditation of ISO-IEC 17025 Laboratories.

Testing Activities Performed in Support of FCC Certification in Accordance with 47 Code of Federal Regulations and FCC KDB 974614, Appendix A, Table A.1²

Rule Subpart/Technology
Test Method
**Maximum
Frequency
(MHz)**
Unintentional Radiators

Part 15B

ANSI C63.4:2014

40000

Testing Activities Performed in Support of FCC Certification in Accordance with 47 Code of Federal Regulations and FCC KDB 974614, Appendix A, Table A.1²

Rule Subpart/Technology	Test Method	Maximum Frequency (MHz)
<u>Industrial, Scientific, and Medical Equipment</u> Part 18	FCC MP-5 (February 1986)	40000
<u>Intentional Radiators</u> Part 15C	ANSI C63.10:2013	40000
<u>Unlicensed Personal Communication Systems Devices</u> Part 15D	ANSI C63.17:2013	40000
<u>U-NII without DFS Intentional Radiators</u> Part 15E	ANSI C63.10:2013	40000
<u>U-NII with DFS Intentional Radiators</u> Part 15E	FCC KDB 905462 D02 (v02)	40000
<u>UWB Intentional Radiators</u> Part 15F	ANSI C63.10:2013	40000
<u>BPL Intentional Radiators</u> Part 15G	ANSI C63.10:2013	40000
<u>White Space Device Intentional Radiators</u> Part 15H	ANSI C63.10:2013	40000
<u>Commercial Mobile Services (FCC Licensed Radio Service Equipment)</u> Parts 22 (cellular), 24, 25 (below 3 GHz), and 27	ANSI/TIA-603-E; TIA-102.CAAA-E; ANSI C63.26:2015	40000
<u>General Mobile Radio Services (FCC Licensed Radio Service Equipment)</u> Parts 22 (non-cellular), 90 (below 3 GHz), 95, 97, and 101 (below 3 GHz)	ANSI/TIA-603-E; TIA-102.CAAA-E; ANSI C63.26:2015	40000
<u>Citizens Broadband Radio Services (FCC Licensed Radio Service Equipment)</u> Part 96	ANSI/TIA-603-E; TIA-102.CAAA-E; ANSI C63.26:2015	40000

Testing Activities Performed in Support of FCC Certification in Accordance with 47 Code of Federal Regulations and FCC KDB 974614, Appendix A, Table A.1²

Rule Subpart/Technology	Test Method	Maximum Frequency (MHz)
<u>Maritime and Aviation Radio Services</u> Parts 80 and 87	ANSI/TIA-603-E; ANSI C63.26:2015	40000
<u>Microwave and Millimeter Bands Radio Services</u> Parts 25, 30, 74, 90 (above 3 GHz), 97 (above 3 GHz), and 101	ANSI/TIA-603-E; TIA-102.CAAA-E; ANSI C63.26:2015	40000
<u>Broadcast Radio Services</u> Parts 73 and 74 (below 3 GHz)	ANSI/TIA-603-E; TIA-102.CAAA-E; ANSI C63.26:2015	40000
<u>Signal Boosters</u> Part 20 (Wideband Consumer Signal Boosters, Provider-specific signal boosters, and Industrial Signal Boosters) Section 90.219	ANSI C63.26:2015	40000

² Accreditation does not imply acceptance to the FCC equipment authorization program. Please see the FCC website (<https://apps.fcc.gov/oetcf/eas/>) for a listing of FCC approved laboratories.



Accredited Laboratory

A2LA has accredited

ELITE ELECTRONIC ENGINEERING INC.

Downers Grove, IL

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).



Presented this 19th day of May 2021.



Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 1786.01
Valid to June 30, 2023

For the tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.