313 West 12800 South, Suite 311

Draper, UT 84020

(801) 260-4040

Test Report

Certification

FCC ID	2BA2Z-PURAWALLV4
Equipment Under Test	810-00016
Test Report Serial No	V068290_01
Dates of Test	April 18, 24 and May 4, 2023
Report Issue Date	May 08, 2023

Test Specifications:	Applicant:
FCC Part 15, Subpart C, 15.225	Pura 2100 Pleasant Grove Blvd #600 Pleasant Grove, Utah 84062 U.S.A.

NVLAP TESTING
NVLAP LAB CODE 100272-0

ilac-MRA

Certification of Engineering Report

This report has been prepared by VPI Laboratories, Inc. to document compliance of the device described below with the requirements of Federal Communications Commission (FCC) Part 15, Subpart C. This report may be reproduced in full. Partial reproduction of this report may only be made with the written consent of the laboratory. The results in this report apply only to the sample tested.

Applicant	Pura
Manufacturer	Pura
Brand Name	Pura
Model Number	810-00016
FCC ID	2BA2Z-PURAWALLV4

On this 8th day of May 2023, I, individually and for VPI Laboratories, Inc., certify that the statements made in this engineering report are true, complete, and correct to the best of my knowledge, and are made in good faith.

Although NVLAP has accredited the VPI Laboratories, Inc. EMC testing facilities, this report must not be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.

VPI Laboratories, Inc.

Tested by: Benjamin N. Antczak

Reviewed by: Jason Stewart

Revision History		
Revision	**Description**	**Date**
01	Original Report Release	May 08, 2023

Table of Contents

1 Client Information

1.1 Applicant

Company Name	Pura 2100 Pleasant Grove Blvd #600 Pleasant Grove, Utah 84062 U.S.A.
Contact Name	Clint Cook
Title	Electrical Engineering Manager

1.2 Manufacturer

Company Name	Pura 2100 Pleasant Grove Blvd #600 Pleasant Grove, Utah 84062 U.S.A.
Contact Name	Clint Cook
Title	Electrical Engineering Manager

2 Equipment Under Test (EUT)

2.1 Identification of EUT

Brand Name	Pura
Model Number	810-00016
Serial Numbers	Radiated: JX230009004 AC Mains with Antenna: JX230000962 AC Mains with Dummy Load: JX230000963
Dimensions (cm)	6 x 10 diameter

2.2 Description of EUT

The 810-00016 is a scent diffuser for use in homes and commercial spaces. It contains an NFC reader that operates at 13.56MHz and interfaces with passive tags on scent bottles. EUT was tested with and without tags present. The EUT also contains a BLE Module operating in the 2400 MHz to 2483.5MHz ISM Band containing FCCID 2AC7Z-ESP32WROVERE. Because EUT contains liquid scents, there is only a single orientation for use. EUT is powered directly by AC Mains.

This report covers the transmitter circuitry of the devices subject to FCC Part 15, Subpart C, §15.225.

2.3 EUT and Support Equipment

The EUT and support equipment used during the test are listed below.

Brand Name **Model Number** **Serial Number**	**Description**	**Name of Interface Ports / Interface Cables**
BN: Pura MN: 810-00016 (Note 1) SN: See Section 2.1 Above	Scent Diffuser with NFC	See Section 2.4
BN: Pura MN: N/A SN: N/A	Scent Bottle with NFC Tag	Wireless NFC Interface

Notes: (1) EUT

The support equipment listed above was not modified in order to achieve compliance with this standard.

2.4 Interface Ports on EUT

There are no interface ports on the EUT.

2.5 Modification Incorporated/Special Accessories on EUT

The following modifications were made to the EUT by the Client during testing to comply with the specification. This report is not complete without an accompanying signed attestation, that the product will have all of the documented modifications incorporated into the product when manufactured and placed on the market.

- NFC Transmit Power set to “R0”

2.6 Deviation from Test Standard

There were no deviations from the test specification.

3 Test Specification, Methods and Procedures

3.1 Test Specification

Title	FCC PART 15, Subpart C (47 CFR 15) 15.203, 15.207, and 15.225 KDB174176 D01 Line Conducted FAQ v01r01
Purpose of Test	The tests were performed to demonstrate initial compliance

3.2 Methods & Procedures

3.2.1 §15.203 Antenna Requirement

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 a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

3.2.2 §15.207 Conducted Limits

(a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency range (MHz)	Limit (dBμV)	
	Quasi-peak	Average
0.15 to 0.50*	66 to 56*	56 to 46*
0.50 to 5	56	46
5 to 30	60	50

*Decreases with the logarithm of the frequency.

Table 1: Limits for conducted emissions at mains ports of Class B ITE.

3.2.3 KDB174176 AC Mains Conducted Procedure for Devices Operating Below 30MHz

For a device with a permanent or detachable antenna operating at or below 30 MHz, the FCC will accept measurements performed with a suitable dummy load in lieu of the antenna under the following conditions:

(1) perform the AC power-line conducted tests with the antenna connected to determine compliance with Section 15.207 limits outside the transmitter's fundamental emission band;

(2) retest with a dummy load in lieu of the antenna to determine compliance with Section 15.207 limits within the transmitter's fundamental emission band.

For a detachable antenna, remove the antenna and connect a suitable dummy load to the antenna connector. For a permanent antenna, remove the antenna and terminate the RF output with a dummy load or network which simulates the antenna in the fundamental frequency band.

3.2.4 §15.225 Operation Within the Band 13.110 – 14.010

a) The field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.

b) Within the bands 13.410-13.553 MHz and 13.567-13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.

c) Within the bands 13.110-13.410 MHz and 13.710-14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.

d) The field strength of any emissions appearing outside of the 13.110-14.010 MHz band shall not exceed the general radiated emission limits in § 15.209.

e) The frequency tolerance of the carrier signal shall be maintained within +/- 0.01% of the operating frequency over a temperature variation of –20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

f) In the case of radio frequency powered tags designed to operate with a device authorized under this section, the tag may be approved with the device or be considered as a separate device subject to its own authorization. Powered tags approved with a device under a single application shall be labeled with the same identification number as the device.

3.3 Test Procedure

VPI Laboratories, Inc. is accredited by National Voluntary Laboratory Accreditation Program (NVLAP); NVLAP Lab Code: 100272-0, which is effective until September 30, 2023. VPI Laboratories, Inc. carries FCC Accreditation Designation Number US5263. VPI Laboratories main office is located at 313 W 12800 S, Suite 311, Draper, UT 84020. The testing was performed according to the procedures in ANSI C63.10-2013, KDB 558074, and 47 CFR Part 15.

4 Operation of EUT During Testing

4.1 Operating Environment

Power Supply	120 VAC
AC Mains Frequency	60 Hz

4.2 Operating Modes

Since EUT contains liquids and is only to be used in single orientation, the transmitter was tested in that orientation while in a constant transmit mode at 13.56MHz. EUT contains two antennas, but cannot transmit on both antennas at once. Tests were repeated on both antennas, with and without tags. Worst-case unintentional emissions above 30MHz were with "Left Antenna" transmitting. No changes were detected above 30MHz with the presence of tags. The BLE transmitter was active and transmitting in the 2400-2483.5MHz band.

AC Mains Conducted Emissions were tested twice, with a dummy load for general limits, and again with the antennas to ensure band-edge compliance according to KDB 174176.

The AC mains voltage to the AC adapter was varied as required by §15.31(e) with no change seen in the voltage supplied to the transmitter or in transmitter characteristics.

4.3 EUT Exercise Software

Internal firmware was used to activate the 13.56MHz transmitter and control which antenna is transmitting.

5 Summary of Test Results

5.1 FCC Part 15, Subpart C

5.1.1 Summary of Tests

Section	Environmental Phenomena	Frequency Range (MHz)	Result
15.203	Antenna Requirements	Structural requirement	Complied
15.207	Conducted Disturbance at Mains Ports	0.15 to 30	Complied
15.225(a)	Field Strength	13.11 – 14.01	Complied
15.225(b)	Field Strength	13.11 – 14.01	Complied
15.225(c)	Field Strength	13.11 – 14.01	Complied
15.225(d)	Field Strength	13.11 – 14.01	Complied
15.225(e)	Frequency Stability	13.11 – 14.01	Complied
---	Emission Bandwidth	13.56	Reported

5.2 Result

In the configuration tested, the EUT complied with the requirements of the specification.

6 Measurements, Examinations and Derived Results

6.1 General Comments

This section contains the test results only. Details of the test methods used and a list of the test equipment used during the measurements can be found in Section 7 of this report.

When calculations in this report require EUT antenna gains, those values have been provided by the manufacturer unless otherwise noted.

6.2 Test Results

6.2.1 §15.203 Antenna Requirements

The EUT uses a printed coil on a PCB. The antenna feed lines are soldered to connect to the transmission board via pogo pins.

Result

The EUT complied with the specification.

6.2.2 Conducted Emissions at Mains Ports Data (Hot Lead) with Dummy Load

With Tag

Frequency (MHz)	Detector	Receiver Reading (dBµV)	Correction Factor (dB)	Measured Level (dBµV)	Class B Limit (dBµV)	Margin (dB)
0.18	Quasi-Peak (Note 2)	37.9	9.9	47.8	64.3	-16.5
0.18	Average (Note 2)	24.1	9.9	34.0	54.3	-20.3
0.39	Peak (Note 1)	31.2	9.9	41.2	48.1	-7.0
0.55	Peak (Note 1)	33.4	10.0	43.3	46.0	-2.7
0.65	Quasi-Peak (Note 2)	30.5	10.0	40.4	56.0	-15.6
0.65	Average (Note 2)	21.0	10.0	31.0	46.0	-15.0
0.68	Quasi-Peak (Note 2)	31.2	10.0	41.2	56.0	-14.8
0.68	Average (Note 2)	22.6	10.0	32.6	46.0	-13.5
0.80	Quasi-Peak (Note 2)	29.4	10.0	39.4	56.0	-16.6
0.80	Average (Note 2)	20.1	10.0	30.1	46.0	-15.9
1.1	Peak (Note 1)	33.1	10.0	43.1	46.0	-2.9
1.2	Peak (Note 1)	31.4	10.0	41.4	46.0	-4.6
1.8	Peak (Note 1)	31.2	10.0	41.2	46.0	-4.8
2.7	Peak (Note 1)	30.9	10.1	41.0	46.0	-5.1
13.6	Quasi-Peak (Note 2)	39.3	10.8	50.1	60.0	-9.9

Frequency (MHz)	Detector	Receiver Reading (dBµV)	Correction Factor (dB)	Measured Level (dBµV)	Class B Limit (dBµV)	Margin (dB)
13.6	Average (Note 2)	24.5	10.8	35.3	50.0	-14.7
27.1	Peak (Note 1)	21.9	11.9	33.8	50.0	-16.2

Note 1: The reference detector used for the measurements was Quasi-Peak or Peak and the data was compared to the average limit; therefore, the EUT was deemed to meet both the average and quasi-peak limits.
Note 2: The reference detector used for the measurements was quasi-peak and average and the data was compared to the respective limits.

Without Tag

Frequency (MHz)	Detector	Receiver Reading (dBµV)	Correction Factor (dB)	Measured Level (dBµV)	Class B Limit (dBµV)	Margin (dB)
0.15	Quasi-Peak (Note 2)	38.6	9.9	48.5	65.7	-17.2
0.15	Average (Note 2)	22.1	9.9	32.0	55.7	-23.7
0.19	Quasi-Peak (Note 2)	45.5	9.9	55.4	64.1	-8.7
0.19	Average (Note 2)	31.2	9.9	41.1	54.1	-13.0
0.28	Quasi-Peak (Note 2)	38.1	9.9	48.0	60.8	-12.8
0.28	Average (Note 2)	26.2	9.9	36.1	50.8	-14.7
0.40	Quasi-Peak (Note 2)	31.6	9.9	41.5	57.9	-16.4
0.40	Average (Note 2)	19.7	9.9	29.7	47.9	-18.2
0.68	Quasi-Peak (Note 2)	31.4	10.0	41.4	56.0	-14.6
0.68	Average (Note 2)	22.7	10.0	32.6	46.0	-13.4
0.94	Peak (Note 1)	32.1	10.0	42.1	46.0	-3.9
1.7	Peak (Note 1)	31.5	10.0	41.5	46.0	-4.5
2.0	Peak (Note 1)	31.4	10.0	41.5	46.0	-4.6
13.6	Quasi-Peak (Note 2)	39.0	10.8	49.8	60.0	-10.2
13.6	Average (Note 2)	24.5	10.8	35.3	50.0	-14.7
27.1	Peak (Note 1)	21.3	11.9	33.2	50.0	-16.8

Note 1: The reference detector used for the measurements was Quasi-Peak or Peak and the data was compared to the average limit; therefore, the EUT was deemed to meet both the average and quasi-peak limits.
Note 2: The reference detector used for the measurements was quasi-peak and average and the data was compared to the respective limits.

6.2.3 Conducted Emissions at Mains Ports Data (Neutral Lead) with Dummy Load

With Tag

Frequency (MHz)	Detector	Receiver Reading (dBµV)	Correction Factor (dB)	Measured Level (dBµV)	Class B Limit (dBµV)	Margin (dB)
0.20	Quasi-Peak (Note 2)	40.1	9.9	50.0	63.7	-13.7
0.20	Average (Note 2)	25.1	9.9	35.0	53.7	-18.6
0.30	Quasi-Peak (Note 2)	31.8	9.9	41.8	60.2	-18.5
0.30	Average (Note 2)	21.2	9.9	31.1	50.2	-19.1
0.53	Peak (Note 1)	29.7	10.0	39.7	46.0	-6.3
0.65	Quasi-Peak (Note 2)	26.4	10.0	36.4	56.0	-19.6
0.65	Average (Note 2)	17.4	10.0	27.3	46.0	-18.7
0.82	Peak (Note 1)	30.2	10.0	40.1	46.0	-5.9
1.8	Peak (Note 1)	30.2	10.0	40.2	46.0	-5.8
2.7	Peak (Note 1)	28.6	10.1	38.7	46.0	-7.3
3.8	Peak (Note 1)	28.6	10.2	38.8	46.0	-7.2
13.6	Quasi-Peak (Note 2)	38.0	10.8	48.8	60.0	-11.2
13.6	Average (Note 2)	26.6	10.8	37.4	50.0	-12.6
27.1	Peak (Note 1)	19.3	11.9	31.2	50.0	-18.8

Note 1: The reference detector used for the measurements was Quasi-Peak or Peak and the data was compared to the average limit; therefore, the EUT was deemed to meet both the average and quasi-peak limits.
Note 2: The reference detector used for the measurements was quasi-peak and average and the data was compared to the respective limits.

Without Tag

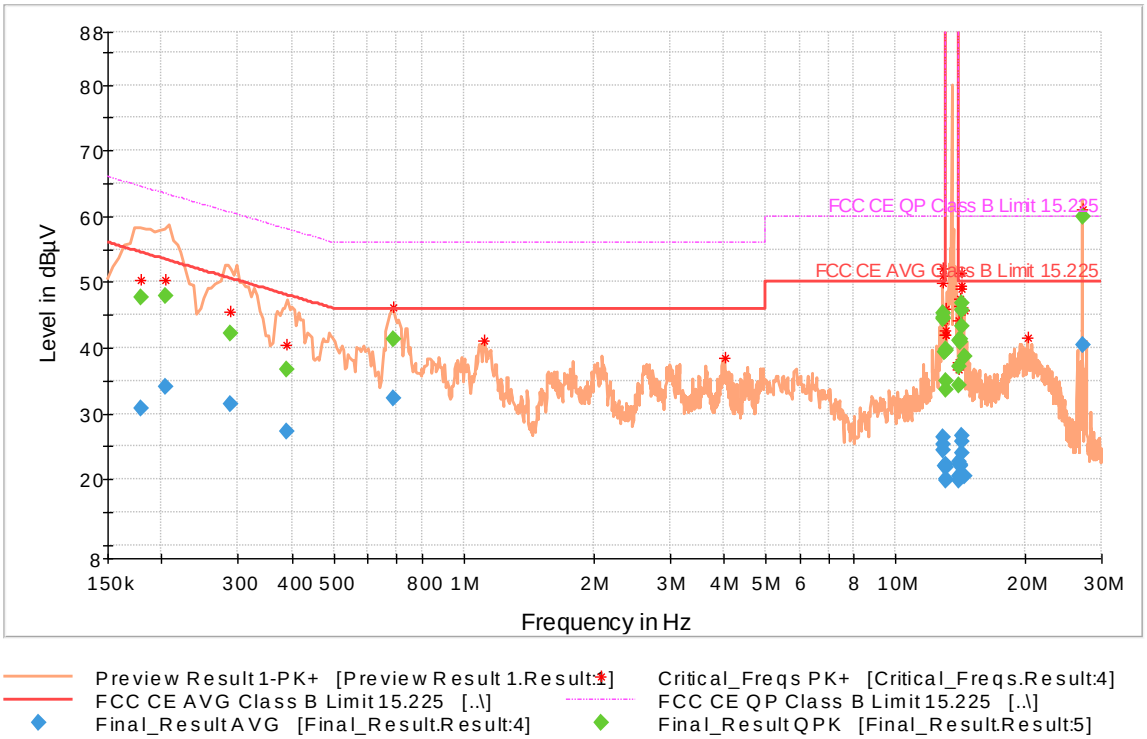
Frequency (MHz)	Detector	Receiver Reading (dBµV)	Correction Factor (dB)	Measured Level (dBµV)	Class B Limit (dBµV)	Margin (dB)
0.19	Quasi-Peak (Note 2)	39.8	9.9	49.7	64.2	-14.5
0.19	Average (Note 2)	26.1	9.9	36.0	54.2	-18.2
0.20	Quasi-Peak (Note 2)	41.8	9.9	51.7	63.7	-12.0
0.20	Average (Note 2)	26.3	9.9	36.2	53.7	-17.5
0.23	Quasi-Peak (Note 2)	36.3	9.9	46.2	62.6	-16.4
0.23	Average (Note 2)	19.5	9.9	29.4	52.6	-23.2
0.29	Quasi-Peak (Note 2)	34.2	9.9	44.1	60.7	-16.5
0.29	Average (Note 2)	21.6	9.9	31.6	50.7	-19.1
0.47	Quasi-Peak (Note 2)	23.0	9.9	32.9	56.6	-23.7
0.47	Average (Note 2)	11.5	9.9	21.5	46.6	-25.1
0.65	Quasi-Peak (Note 2)	27.9	10.0	37.9	56.0	-18.1
0.65	Average (Note 2)	18.7	10.0	28.6	46.0	-17.4
0.96	Peak (Note 1)	29.3	10.0	39.3	46.0	-6.7
1.8	Peak (Note 1)	29.0	10.0	39.0	46.0	-7.0
2.8	Peak (Note 1)	28.7	10.1	38.9	46.0	-7.2
13.6	Quasi-Peak (Note 2)	38.0	10.8	48.8	60.0	-11.3
13.6	Average (Note 2)	26.6	10.8	37.4	50.0	-12.6
27.1	Peak (Note 1)	27.7	11.9	39.6	50.0	-10.4

Note 1: The reference detector used for the measurements was Quasi-Peak or Peak and the data was compared to the average limit; therefore, the EUT was deemed to meet both the average and quasi-peak limits.
Note 2: The reference detector used for the measurements was quasi-peak and average and the data was compared to the respective limits.

6.2.4 Conducted Emissions at Mains Ports Data (Hot Lead) with Antenna

No conducted AC mains emissions were detected exceeding Section 15.207 limits outside the transmitter's fundamental emission band while transmitting with an antenna at 13.56MHz.

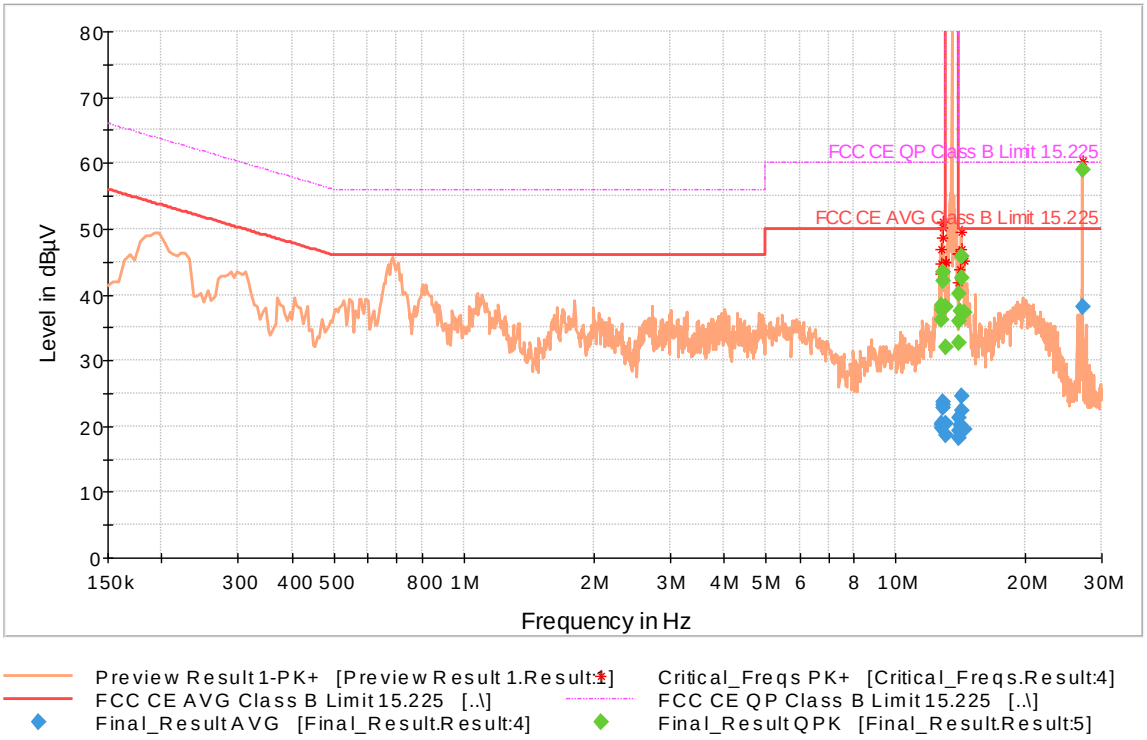
With Tag



Frequency (MHz)	Detector	Receiver Reading (dBµV)	Correction Factor (dB)	Measured Level (dBµV)	Class B Limit (dBµV)	Margin (dB)
12.870	Quasi-Peak	34.4	10.7	45.2	60.0	-14.8
12.870	Average	15.6	10.7	26.3	50.0	-23.7
12.902	Quasi-Peak	33.7	10.7	44.4	60.0	-15.6
12.902	Average	13.7	10.7	24.4	50.0	-25.6
13.075	Quasi-Peak	29.1	10.8	39.8	60.0	-20.2
13.075	Average	11.5	10.8	22.2	50.0	-27.8
13.100	Quasi-Peak	24.2	10.8	34.9	60.0	-25.1
13.100	Average	9.3	10.8	20.1	50.0	-30.0
13.110	Quasi-Peak	22.9	10.8	33.6	60.0	-26.4
13.110	Average	9.1	10.8	19.8	50.0	-30.2
14.010	Quasi-Peak	23.6	10.8	34.4	60.0	-25.6
14.010	Average	9.0	10.8	19.8	50.0	-30.2
14.025	Quasi-Peak	26.4	10.8	37.2	60.0	-22.8

Frequency (MHz)	Detector	Receiver Reading (dBµV)	Correction Factor (dB)	Measured Level (dBµV)	Class B Limit (dBµV)	Margin (dB)
14.025	Average	9.7	10.8	20.5	50.0	-29.5
14.125	Quasi-Peak	30.4	10.8	41.2	60.0	-18.8
14.125	Average	11.2	10.8	22.0	50.0	-28.0
14.240	Quasi-Peak	15.9	10.8	26.7	50.0	-23.3
14.240	Average	36.1	10.8	46.9	60.0	-13.1
14.258	Quasi-Peak	15.0	10.8	25.8	50.0	-24.2
14.258	Average	34.9	10.8	45.7	60.0	-14.3
27.120	Quasi-Peak	48.1	11.9	59.9	60.0	-0.1
27.120	Average	28.6	11.9	40.4	50.0	-9.6

Without Tag



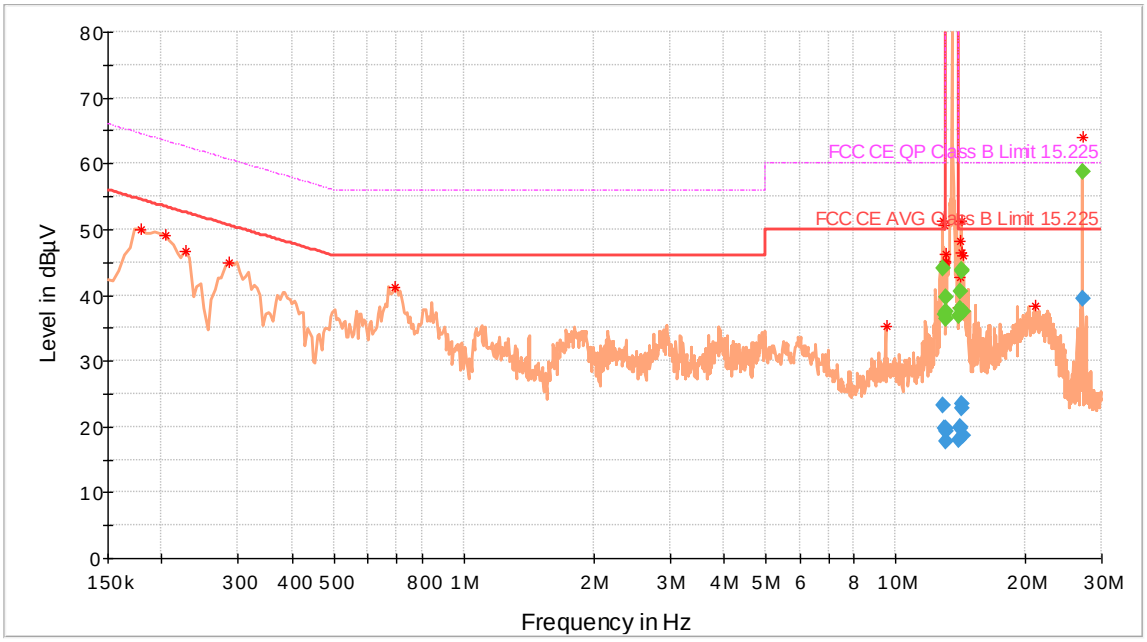
Frequency (MHz)	Detector	Receiver Reading (dBµV)	Correction Factor (dB)	Measured Level (dBµV)	Class B Limit (dBµV)	Margin (dB)
12.850	31.4	10.7	42.2	60.0	-17.8	31.4
12.850	12.2	10.7	22.9	50.0	-27.1	12.2
12.900	32.8	10.7	43.5	60.0	-16.5	32.8
12.900	12.6	10.7	23.3	50.0	-26.7	12.6
13.025	27.4	10.8	38.1	60.0	-21.9	27.4

Frequency (MHz)	Detector	Receiver Reading (dBµV)	Correction Factor (dB)	Measured Level (dBµV)	Class B Limit (dBµV)	Margin (dB)
13.025	9.7	10.8	20.4	50.0	-29.6	9.7
13.110	21.3	10.8	32.1	60.0	-27.9	21.3
13.110	7.8	10.8	18.5	50.0	-31.5	7.8
14.010	21.8	10.8	32.6	60.0	-27.4	21.8
14.010	7.5	10.8	18.3	50.0	-31.7	7.5
14.025	25.1	10.8	35.9	60.0	-24.1	25.1
14.025	8.4	10.8	19.2	50.0	-30.8	8.4
14.050	29.2	10.8	40.1	60.0	-20.0	29.2
14.050	10.4	10.8	21.3	50.0	-28.8	10.4
14.235	35.1	10.8	45.9	60.0	-14.1	35.1
14.235	13.8	10.8	24.7	50.0	-25.4	13.8
14.275	31.7	10.8	42.5	60.0	-17.5	31.7
14.275	11.6	10.8	22.4	50.0	-27.6	11.6
27.120	47.1	11.9	58.9	60.0	-1.1	47.1
27.120	26.2	11.9	38.1	50.0	-11.9	26.2

6.2.5 Conducted Emissions at Mains Ports Data (Neutral Lead) with Antenna

No conducted AC mains emissions were detected exceeding Section 15.207 limits outside the transmitter's fundamental emission band while transmitting with an antenna at 13.56MHz.

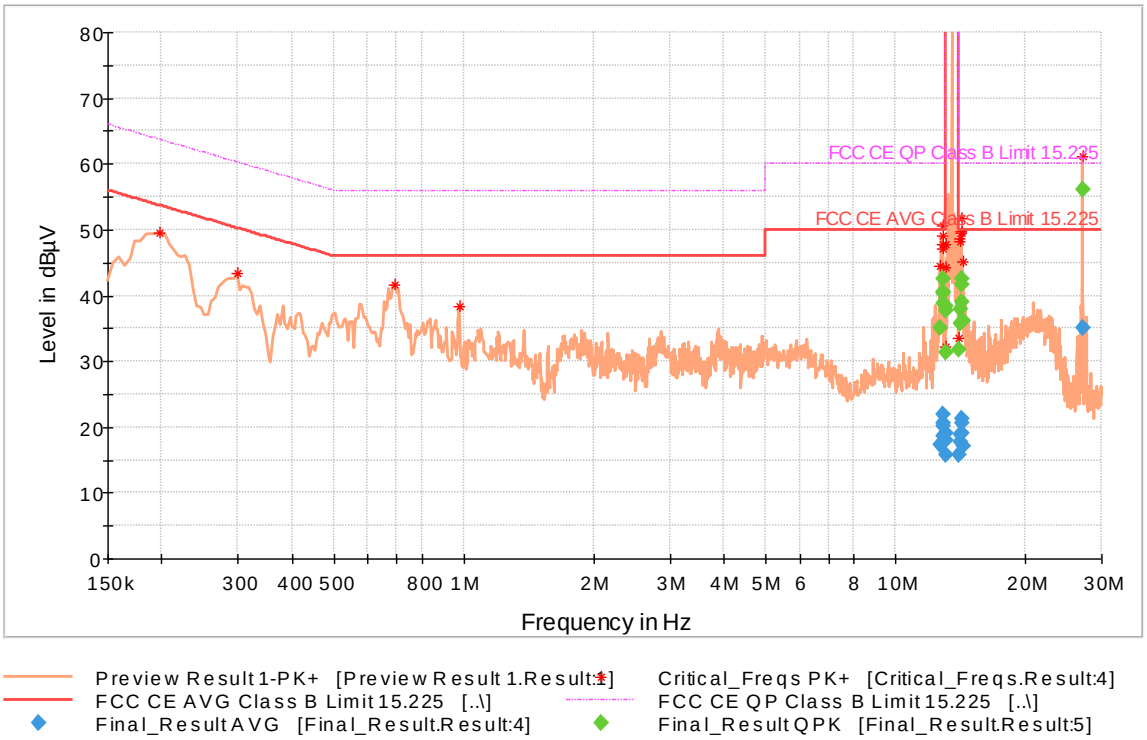
With Tag



Frequency (MHz)	Detector	Receiver Reading (dBµV)	Correction Factor (dB)	Measured Level (dBµV)	Class B Limit (dBµV)	Margin (dB)
12.875	Quasi-Peak	33.4	10.7	44.1	60.0	-15.9
12.875	Average	12.5	10.7	23.2	50.0	-26.8
13.025	Quasi-Peak	8.5	10.8	19.3	50.0	-30.8
13.025	Average	26.7	10.8	37.5	60.0	-22.5
13.075	Quasi-Peak	28.9	10.8	39.7	60.0	-20.3
13.075	Average	9.1	10.8	19.8	50.0	-30.2
13.110	Quasi-Peak	25.7	10.8	36.4	60.0	-23.6
13.110	Average	7.0	10.8	17.8	50.0	-32.2
14.010	Quasi-Peak	26.1	10.8	36.9	60.0	-23.1
14.010	Average	7.1	10.8	17.9	50.0	-32.1
14.075	Quasi-Peak	9.2	10.8	20.0	50.0	-30.0
14.075	Average	29.8	10.8	40.6	60.0	-19.4
14.225	Quasi-Peak	32.7	10.8	43.5	60.0	-16.5
14.225	Average	12.0	10.8	22.8	50.0	-27.2
14.250	Quasi-Peak	12.7	10.8	23.5	50.0	-26.5
14.250	Average	33.1	10.8	43.9	60.0	-16.1
27.120	Quasi-Peak	46.9	11.9	58.8	60.0	-1.2

Frequency (MHz)	Detector	Receiver Reading (dBµV)	Correction Factor (dB)	Measured Level (dBµV)	Class B Limit (dBµV)	Margin (dB)
27.120	Average	27.5	11.9	39.4	50.0	-10.6

Without Tag



Frequency (MHz)	Detector	Receiver Reading (dBµV)	Correction Factor (dB)	Measured Level (dBµV)	Class B Limit (dBµV)	Margin (dB)
12.881	Quasi-Peak	11.1	10.7	21.8	50.0	-28.2
12.881	Average	31.8	10.7	42.6	60.0	-17.5
12.900	Quasi-Peak	9.8	10.7	20.6	50.0	-29.4
12.900	Average	29.8	10.7	40.6	60.0	-19.4
13.050	Quasi-Peak	8.3	10.8	19.1	50.0	-30.9
13.050	Average	27.7	10.8	38.4	60.0	-21.6
13.110	Quasi-Peak	5.1	10.8	15.8	50.0	-34.2
13.110	Average	20.6	10.8	31.4	60.0	-28.6
14.010	Quasi-Peak	4.9	10.8	15.7	50.0	-34.3
14.010	Average	21.0	10.8	31.8	60.0	-28.2
14.208	Quasi-Peak	8.3	10.8	19.1	50.0	-30.9
14.208	Average	28.2	10.8	39.0	60.0	-21.0
14.246	Quasi-Peak	31.8	10.8	42.6	60.0	-17.4

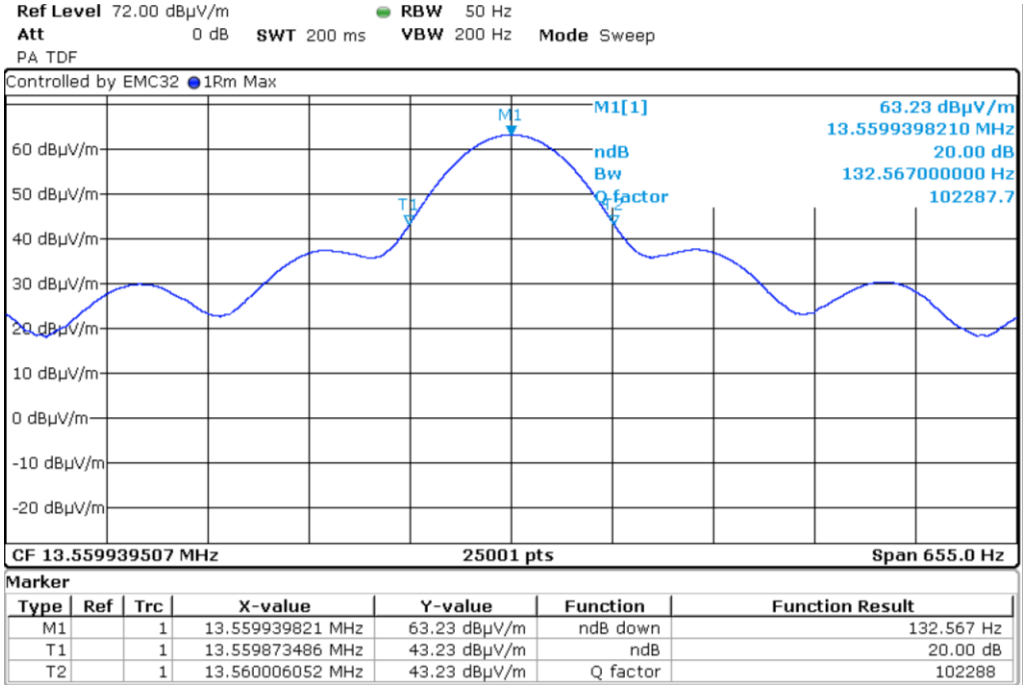
Frequency (MHz)	Detector	Receiver Reading (dBµV)	Correction Factor (dB)	Measured Level (dBµV)	Class B Limit (dBµV)	Margin (dB)
14.246	Average	10.4	10.8	21.2	50.0	-28.8
14.264	Quasi-Peak	9.9	10.8	20.7	50.0	-29.3
14.264	Average	30.9	10.8	41.7	60.0	-18.3
27.123	Quasi-Peak	44.3	11.9	56.2	60.0	-3.8
27.123	Average	23.2	11.9	35.1	50.0	-14.9

Result

The EUT complied with the specification limit.

6.2.6 20dB Emissions Bandwidth

Mode	Frequency (MHz)	Emissions 20dB Bandwidth (Hz)
Left Antenna, with Tag	13.56	131.6
Left Antenna, without Tag	13.56	132.6
Right Antenna, with Tag	13.56	131.1
Right Antenna, without Tag	13.56	132.0

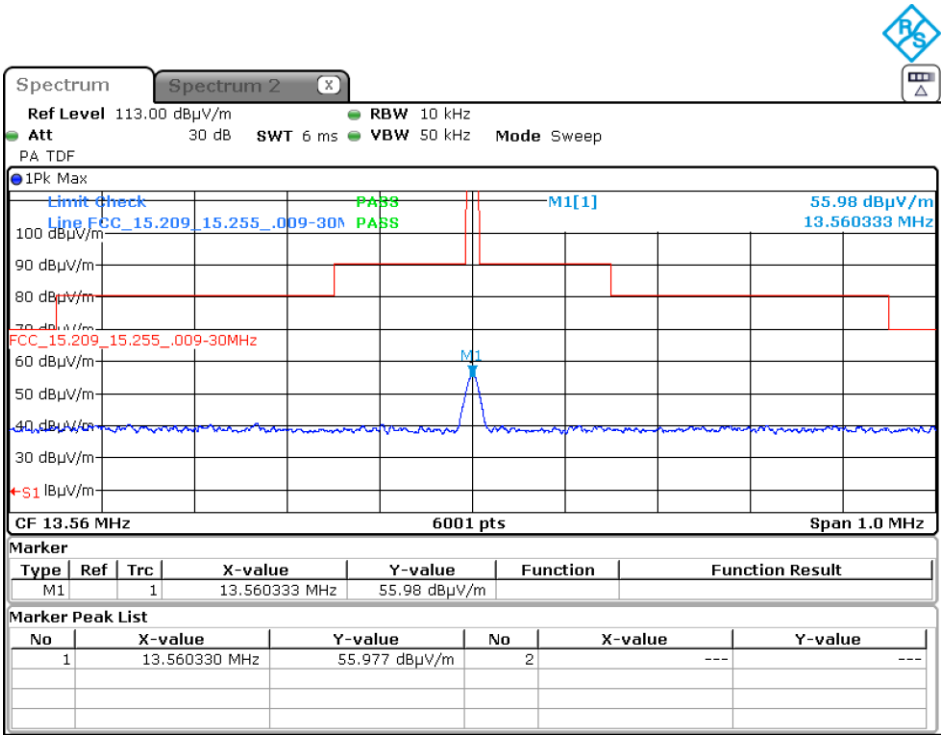


Graph 1: Worst-Case 20dB Bandwidth

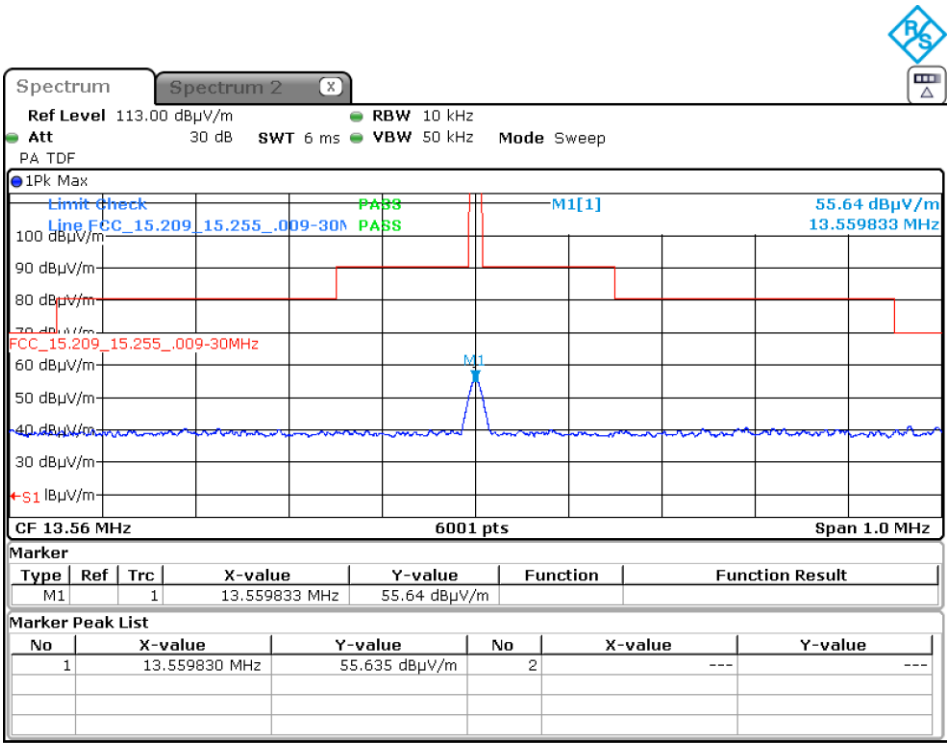
6.2.7 §15.255(a)-(c) In-Band Radiated Disturbance Data (13.110 MHz – 14.010 MHz)

The maximum field strength shall not exceed 15,848.0 µV/m at 30 meters. Test data was taken at 3 meters and extrapolated to the limit distance according to ANSI C63.10.

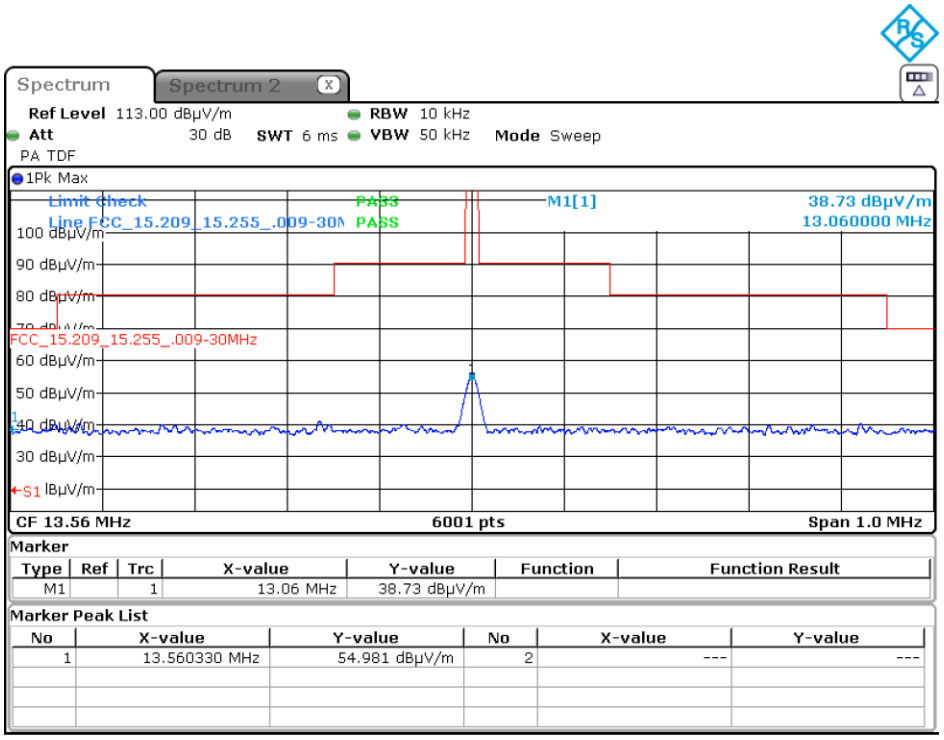
The plots below show compliance with the full band compared to the limits of 47 CFR §15.255(a)-(c).



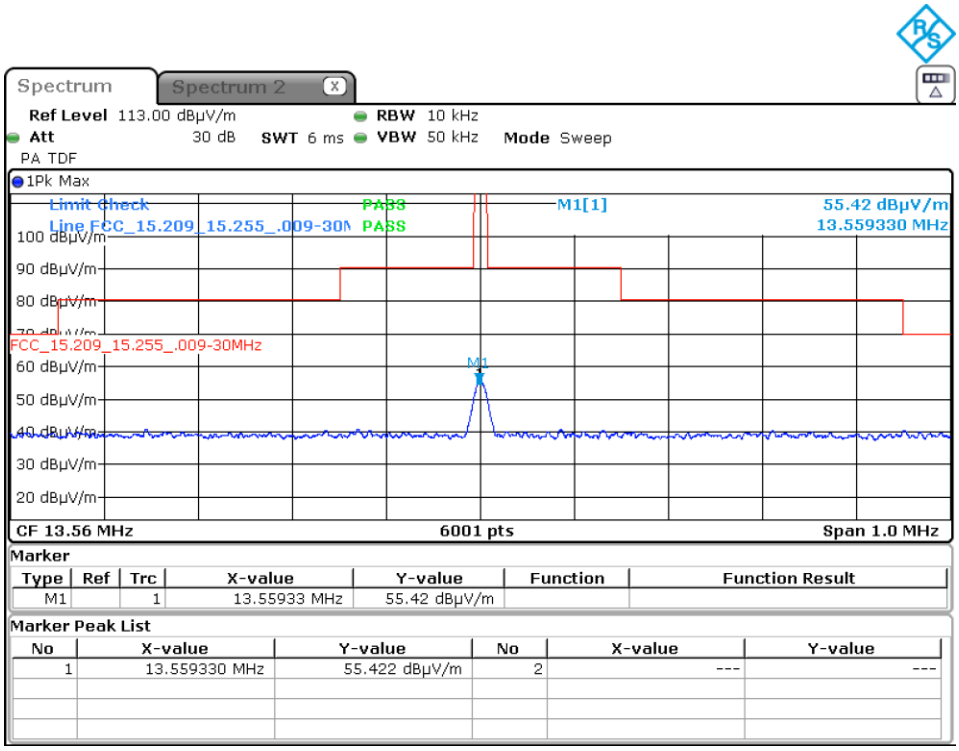
Graph 2: 'Left Antenna' with Tag



Graph 3: 'Left Antenna' without Tag



Graph 4: 'Right Antenna' with Tag



Graph 5: 'Right Antenna' without Tag

6.2.8 §15.225 (d) Radiated Disturbance Data (0.009 – 25000 MHz, excluding the range 13.110 – 14.010 MHz)

Worst-case emissions were detected with the EUT transmitting from the Right antenna with a Tag in place. Emissions below 30MHz were tested with a Loop antenna. Due to the low power of the device's transmission, it was evaluated at three meters to keep the signal above the noise-floor, and then extrapolated to the limit distance according to ANSI C63.10.

Radiated Emissions Data (Vertical Polarity)

Frequency (MHz)	Detector	Receiver Reading (dBµV)	Correction Factor (dB/m)	Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
27.1	Peak (Notes 1 & 3)	9.3	12.1	21.4	29.5	-8.1
32.5	Peak (Note 1)	30.9	-4.6	26.3	40.0	-13.7
40.7	Peak (Note 1)	43.1	-9.0	34.1	40.0	-5.9
44.8	Peak (Note 1)	41.6	-11.1	30.5	40.0	-9.5
53.0	Peak (Note 1)	45.5	-13.0	32.5	40.0	-7.5
65.0	Peak (Note 1)	36.6	-12.1	24.6	40.0	-15.5
143.7	Peak (Note 1)	45.2	-9.5	35.7	43.5	-7.8
393.2	Peak (Note 1)	35.5	1.0	36.4	46.0	-9.6
433.9	Peak (Note 1)	38.7	0.9	39.6	46.0	-6.4
447.5	Peak (Note 1)	38.5	1.4	39.9	46.0	-6.1
464.5	Peak (Note 1)	36.7	2.4	39.2	46.0	-6.8
678.0	Peak (Note 1)	29.2	8.4	37.7	46.0	-8.3
705.1	Peak (Note 1)	30.2	8.7	38.9	46.0	-7.2
800.1	Peak (Note 1)	29.4	9.5	38.9	46.0	-7.1

Note 1: The reference detector used for the measurements was peak or quasi-peak and the data was compared to the quasi-peak limit.
Note 2: For radiated emissions above 1000 MHz, the reference detector used for the measurements was average and peak and the data was compared to the respective limits.
Note 3: Emissions below 30MHz were tested with a Loop antenna. Due to the low power of the device's transmission power, it was evaluated at three meters to keep the signal above the noise-floor, and then extrapolated to the limit distance according to ANSI C63.10.

Result

The EUT complied with the specification limit by a margin of 5.9 dB.

Radiated Emissions Data (Horizontal Polarity)

Frequency (MHz)	Detector	Receiver Reading (dBµV)	Correction Factor (dB/m)	Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
40.7	Peak (Note 1)	28.5	-9.0	19.4	40.0	-20.6
55.5	Peak (Note 1)	30.5	-13.0	17.5	40.0	-22.5
142.8	Peak (Note 1)	34.3	-9.5	24.8	43.5	-18.7
186.4	Peak (Note 1)	29.5	-7.9	21.6	43.5	-21.9

Frequency (MHz)	Detector	Receiver Reading (dBµV)	Correction Factor (dB/m)	Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
269.9	Peak (Note 1)	27.3	-3.6	23.7	46.0	-22.3
393.3	Peak (Note 1)	29.3	1.0	30.3	46.0	-15.7
433.9	Peak (Note 1)	31.2	0.9	32.1	46.0	-13.9
447.5	Peak (Note 1)	30.5	1.4	31.8	46.0	-14.2
464.2	Peak (Note 1)	30.9	2.4	33.3	46.0	-12.7
800.1	Peak (Note 1)	27.7	9.5	37.2	46.0	-8.8
827.1	Peak (Note 1)	28.8	9.4	38.2	46.0	-7.8

Note 1: The reference detector used for the measurements was peak or quasi-peak and the data was compared to the quasi-peak limit.
Note 2: For radiated emissions above 1000 MHz, the reference detector used for the measurements was average and peak and the data was compared to the respective limits.

Result

The EUT complied with the specification limit by a margin of 7.8 dB.

6.2.9 §15.225(e) Frequency Stability

The EUT was tested for frequency stability as specified in §15.225(e). The 13.56 MHz module has its own voltage regulation. The transmitter transmits at 13559949 Hz. The transmitter is allowed a deviation of 0.01% or 1355.9 Hz. Varying the voltage ±15% does not change the transmitter fundamental frequency.

(ºC)	Frequency (Hz) over Time (Minutes)				Deviation (Hz)			
	Startup	2 min	5 min	10 min	Min Freq	Deviation	Max Freq	Deviation
50	13559909	13559904	13559903	13559904	13559903	-46	13559909	-40
40	13559929	13559915	13559912	13559910	13559910	-39	13559929	-20
30	13559956	13559937	13559930	13559926	13559926	-23	13559956	7
20	13559972	13559960	13559955	13559949	13559949	0	13559972	23
10	13559988	13559982	13559980	13559979	13559979	30	13559988	39
0	13559956	13559998	13559997	13559995	13559956	7	13559998	49
-10	13559965	13559981	13559987	13559990	13559965	16	13559990	41
-20	13559908	13559945	13559952	13559956	13559908	-41	13559956	7

Result

The EUT complied with the specification as the fundamental frequency was maintained with $\pm$ 0.01% of the operating frequency through the tests.

6.3 Sample Measurement Calculations

6.3.1 Field Strength Calculations

The field strength is calculated by adding the *Correction Factor* (*Antenna Factor* + *Cable Factor*), to the measured level from the receiver. The receiver amplitude reading is compensated for any amplifier gain. The basic equation with a sample calculation is shown below:

$$Receiver\ Amplitude\ Reading = Receiver\ Reading - Amplifier\ Gain$$
$$Correction\ Factor = Antenna\ Factor\ +\ Cable\ Factor$$
$$Field\ Strength = Receiver\ Amplitude\ Reading\ +\ Correction\ Factor$$

Example

Assuming a *Receiver Reading* of 42.5 dBµV is obtained from the receiver, the *Amplifier Gain* is 26.5 dB the *Antenna Factor* is 4.5 dB, and the *Cable Factor* is 4.0 dB. The *Field Strength* is calculated by subtracting the *Amplifier Gain* and adding the *Correction Factor*, giving a *Field Strength* of 24.5 dBµV/m.

$$Receiver\ Amplitude\ Reading\ =\ 42.5 - 26.5\ =\ 16.0\ \text{dBµV/m}$$
$$Correction\ Factor\ =\ 4.5 + 4.0\ =\ 8.5\ \text{dB}$$
$$Field\ Strength\ =\ 16.0 + 8.5\ =\ 24.5\ \text{dBµV/m}$$

6.3.2 Conducted Measurement Value Calculations

A conducted emission value is calculated by adding the *Correction Factor* (*LISN Transducer Factor* + *Cable Factor*) to the measured value from the receiver. The LISN contains an internal 10dB (nominal) attenuation accounted for in the LISN Transducer Factor. Amplifiers are not utilized for this measurement. The basic equation with a sample calculation is shown below:

$$Correction\ Factor\ =\ LISN\ Transducer\ Factor\ +\ Cable\ Factor$$
$$Conducted\ Emission\ Value\ =\ Receiver\ Amplitude\ Reading\ +\ Correction\ Factor$$

Example

Assuming a *Receiver Reading* of 20.8 dBµV is obtained from the receiver, *LISN Transducer Factor* is 10.1 dB, and the *Cable Factor* is 0.3 dB. The *Conducted Emissions Value* is calculated by adding the *Correction Factor*, giving a *Conducted Emissions Value* of 31.2 dBµV.

$$Receiver\ Amplitude\ Reading\ =\ 20.8\ \text{dBµV}$$
$$Correction\ Factor\ =\ 10.1 + 0.3\ =\ 10.4\ \text{dB}$$
$$Conducted\ Emissions\ Value\ =\ 20.8 + 10.4\ =\ 31.2\ \text{dBµV}$$

7 Test Procedures and Test Equipment

7.1 Conducted Emissions at Mains Ports

The conducted emissions at mains and telecommunications ports from the EUT were measured using a spectrum analyzer with a quasi-peak adapter for peak, quasi-peak and average readings. The quasi-peak adapter uses a bandwidth of 9 kHz, with the spectrum analyzer's resolution bandwidth set at 100 kHz, for readings in the 150 kHz to 30 MHz frequency ranges.

The conducted emissions at mains ports measurements are performed in a screen room using a (50 Ω/50 µH) Line Impedance Stabilization Network (LISN).

Where mains flexible power cords are longer than 1 m, the excess cable is folded back and forth as far as possible so as to form a bundle not exceeding 0.4 m in length.

Where the EUT is a collection of devices with each device having its own power cord, the point of connection for the LISN is determined from the following rules:

- Each power cord, which is terminated in a mains supply plug, shall be tested separately.
- Power cords, which are not specified by the manufacturer to be connected via a host unit, shall be tested separately.
- Power cords which are specified by the manufacturer to be connected via a host unit or other power supplying equipment shall be connected to that host unit and the power cords of that host unit connected to the LISN and tested.
- Where a special connection is specified, the necessary hardware to effect the connection is supplied by the manufacturer for the testing purpose.
- When testing equipment with multiple mains cords, those cords not under test are connected to an artificial mains network (AMN) different than the AMN used for the mains cord under test.

For testing, desktop EUT are placed on a non-conducting table at least 0.8 meters from the metallic floor and placed 40 cm from the vertical coupling plane (copper plating in the wall behind EUT table). Floor standing equipment is placed directly on the earth grounded floor.

Type of Equipment	Manufacturer	Model Number	Asset Number	Date of Last Calibration	Due Date of Calibration
Spectrum Analyzer/Receiver	Rohde & Schwarz	ESU40	V033119	08/24/2022	08/24/2023
Spectrum Analyzer/ Signal Analyzer	Rohde & Schwarz	FSV40	V044352	03/08/2022	03/08/2024
LISN	Teseq	NNB 51	V045406	12/05/2022	12/05/2023
Conductance Cable Wanship Upper Site	VPI Labs	Cable J	V034832	12/23/2022	12/23/2023
EMC32 Test Software	Rohde & Schwarz	10.60.20	N/A	N/A	N/A

Table 2: List of equipment used for conducted emissions testing at mains ports.

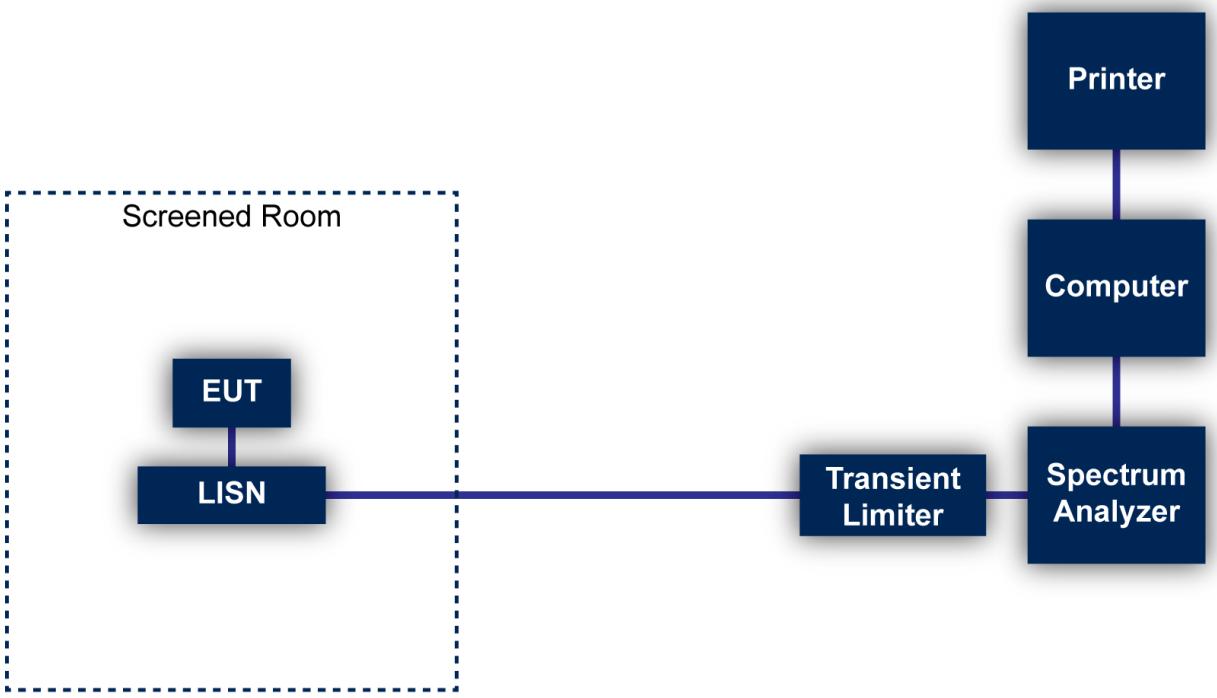


Figure 1: Conducted Emissions Test

7.1.1 Test Configuration Block Diagram

Figure 2: Direct Connection at the Antenna Port Test

7.2 Radiated Emissions

The radiated emissions from the EUT were measured using a spectrum analyzer with a quasi-peak adapter for peak and quasi-peak readings.

A preamplifier with a fixed gain of 51 dB was used to increase the sensitivity of the measuring instrumentation. The quasi-peak adapter uses a bandwidth of 120 kHz, with the spectrum analyzer's resolution bandwidth set at 1 MHz, for readings in the 30 to 1000 MHz frequency ranges. For frequencies below 30 MHz, a 9 kHz resolution Bandwidth was used.

A loop antenna was used to measure frequencies below 30 MHz. A biconilog antenna was used to measure the frequency range of 30 to 1000 MHz, at a distance of 3 meters from the EUT. The readings obtained by these antennas are correlated to the levels obtained with a tuned dipole antenna by adding antenna factors.

A double-ridged guide antenna was used to measure the emissions at frequencies above 1000 MHz at a distance of 3 and/or 1 meter from the EUT.

The configuration of the EUT was varied to find the maximum radiated emission. The EUT was connected to the peripherals listed in Section 2.3 via the interconnecting cables listed in Section 2.4. A technician manually manipulated these interconnecting cables to obtain worst-case radiated emissions. The EUT was rotated 360 degrees, and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission. Where there were multiple interface ports all of the same type, cables are either placed on all of the ports or cables added to these ports until the emissions do not increase by more than 2 dB.

Desktop EUT are measured on a non-conducting table 0.8 meters above the ground plane. For frequencies above 1000 MHz, the EUT is placed on a table 1.5 meters above the ground plane. The table is placed on a turntable, which is level with the ground plane. For equipment normally placed on floors, the equipment shall be placed directly on the turntable.

For radiated emissions testing that is performed at distances closer than the specified distance; an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

Type of Equipment	Manufacturer	Model Number	Asset Number	Date of Last Calibration	Due Date of Calibration
Spectrum Analyzer/Receiver	Rohde & Schwarz	ESU40	V033119	08/24/2022	08/24/2023
Spectrum Analyzer/ Signal Analyzer	Rohde & Schwarz	FSV40	V044352	03/08/2022	03/08/2024
Loop Antenna	COM-POWER	AL-130R	N/A	12/16/2022	12/16/2024
Biconilog Antenna	EMCO	3142E	V057461	07/21/2021	07/21/2023
Power Amplifier	HP	5086-7005	V067767	03/14/2023	03/14/2024
Double Ridged Guide Antenna	EMCO	3115	V033469	01/25/2021	01/25/2023
Standard Gain Horn	ETS-Lindgren	3160-09	V034223	ICO	ICO
High Frequency Amplifier	Miteq	AFS4-001018000-35-10P-4	V033997	12/23/2022	12/23/2023
900 MHz High Pass Filter	Micro-Tronics	HPM50108-03	V034185	12/23/2022	12/23/2023
2.4 GHz High Pass Filter	Micro-Tronics	HPM50111-03	V034183	12/23/2022	12/23/2023
2.4 GHz Notch Filter	Micro-Tronics	BRM50702-03	V034213	12/23/2022	12/23/2023
6’ High Frequency Cable	Microcoax	UFB197C-0-0720-000000	V033638	12/23/2022	12/23/2023
20’ High Frequency Cable	Microcoax	UFB197C-1-3120-000000	V033979	12/23/2022	12/23/2023
3 Meter Radiated Emissions Cable Wanship Upper Site	Microcoax	UFB205A-0-4700-000000	V033639	12/23/2022	12/23/2023
EMC32 Test Software	Rohde & Schwarz	10.60.20	N/A	N/A	N/A

Table 3: List of equipment used for radiated emissions testing.

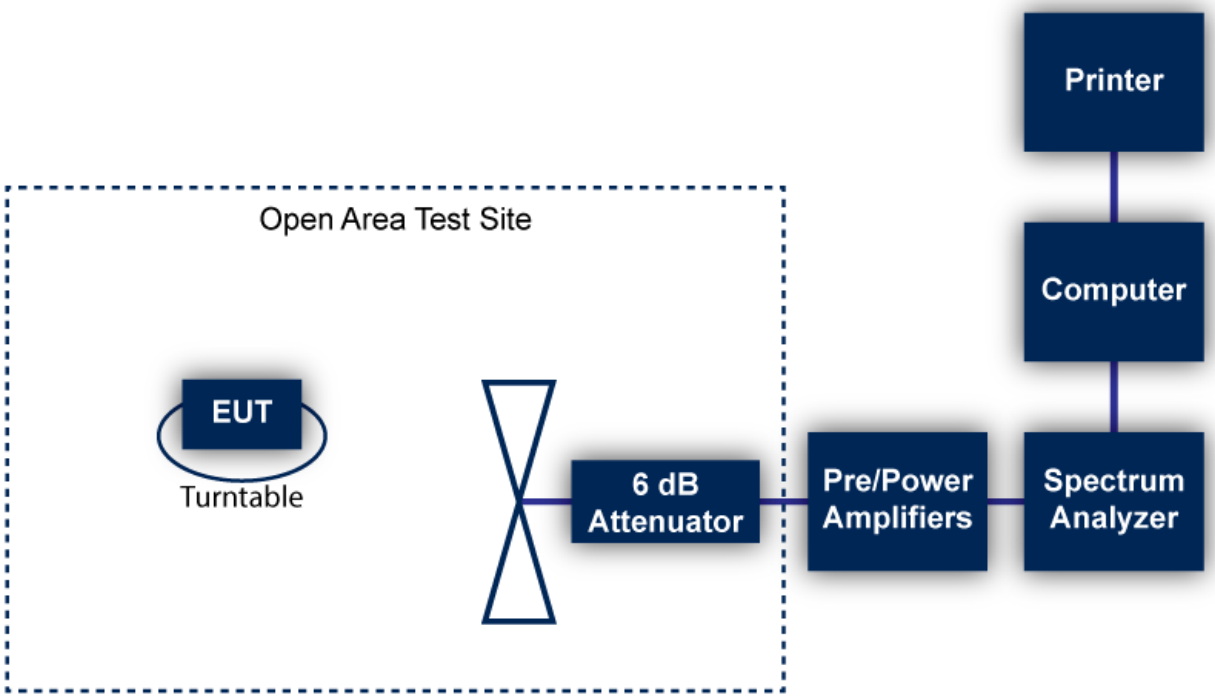


Figure 3: Radiated Emissions Test

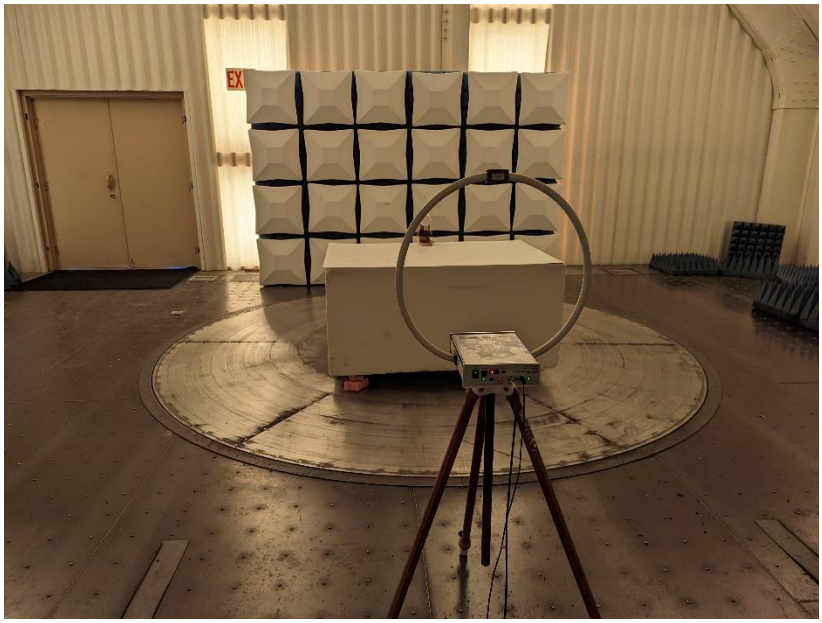
7.3 Equipment Calibration

All applicable equipment is calibrated using either an independent calibration laboratory or VPI Laboratories, Inc. personnel at intervals defined in ANSI C63.4:2014 following outlined calibration procedures. All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Supporting documentation relative to tractability is on file and is available for examination upon request.

7.4 Measurement Uncertainty

Test	Uncertainty (±dB)	Confidence (%)
Conducted Emissions	2.8	95
Radiated Emission (9 kHz to 30 MHz)	3.3	95
Radiated Emissions (30 MHz to 1 GHz)	3.4	95
Radiated Emissions (1 GHz to 18 GHz)	5.0	95
Radiated Emissions (18 GHz to 40 GHz)	4.1	95

8 Photographs



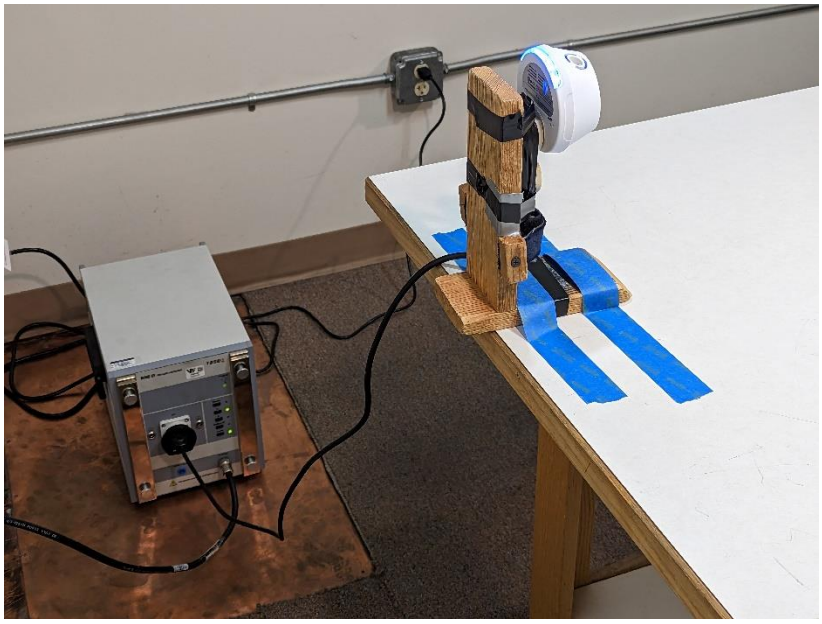
Photograph 1: Front View Radiated Emissions Worst-Case Configuration – Frequencies Below 30 MHz

Photograph 2: Back View Radiated Emissions Worst-Case Configuration - Frequencies Below 30MHz

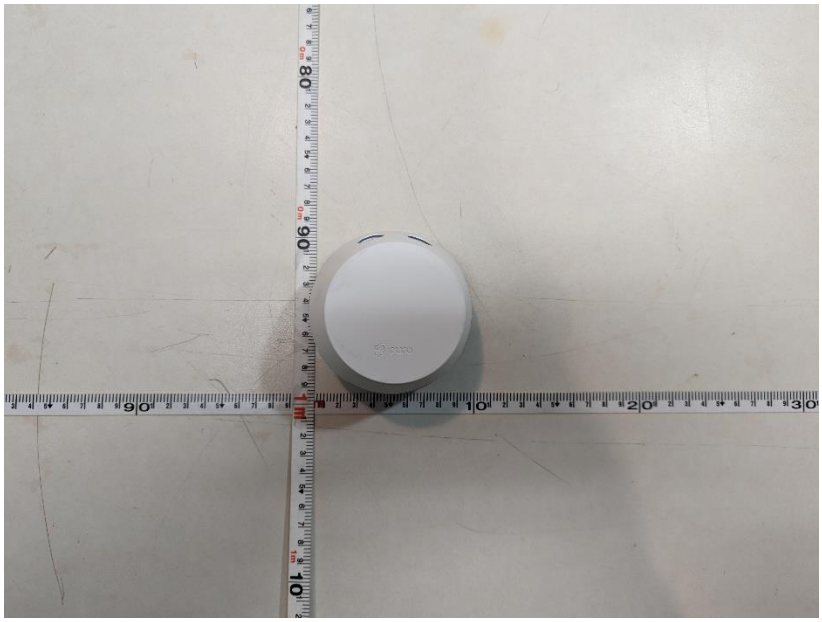
Photograph 3: Front View Radiated Emissions Worst-Case Configuration

Photograph 4: Back View Radiated Emissions Worst-Case Configuration

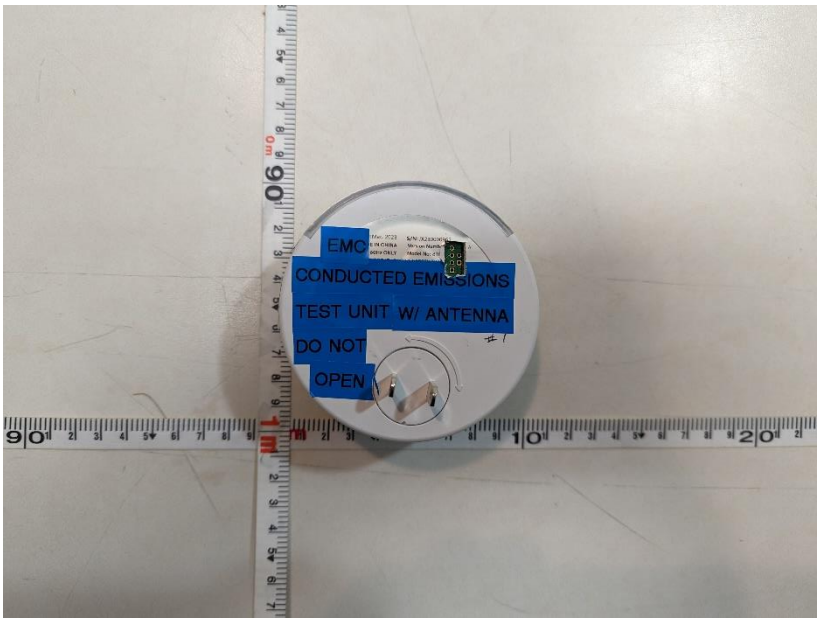
Photograph 5: Front View Conducted Emissions Worst-Case Configuration



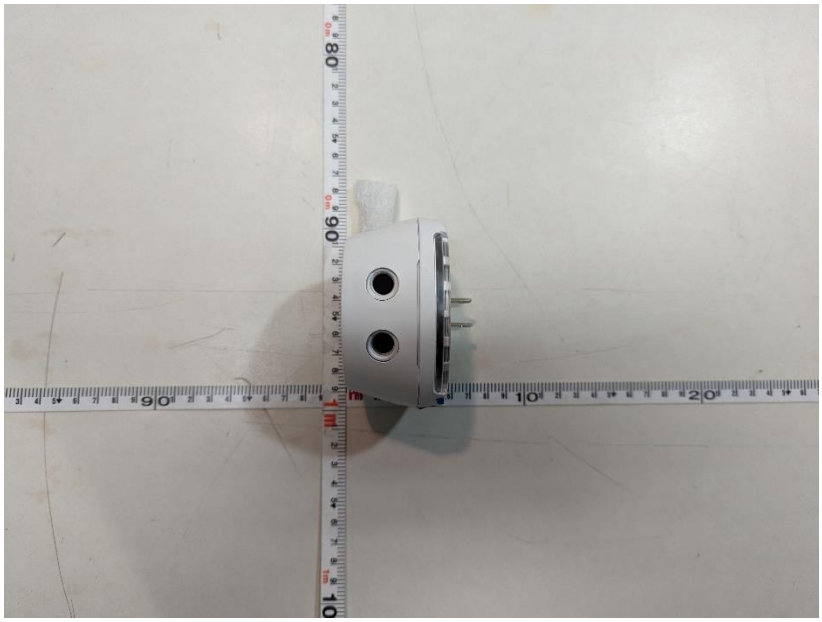
Photograph 6: Back View Conducted Emissions Worst-Case Configuration



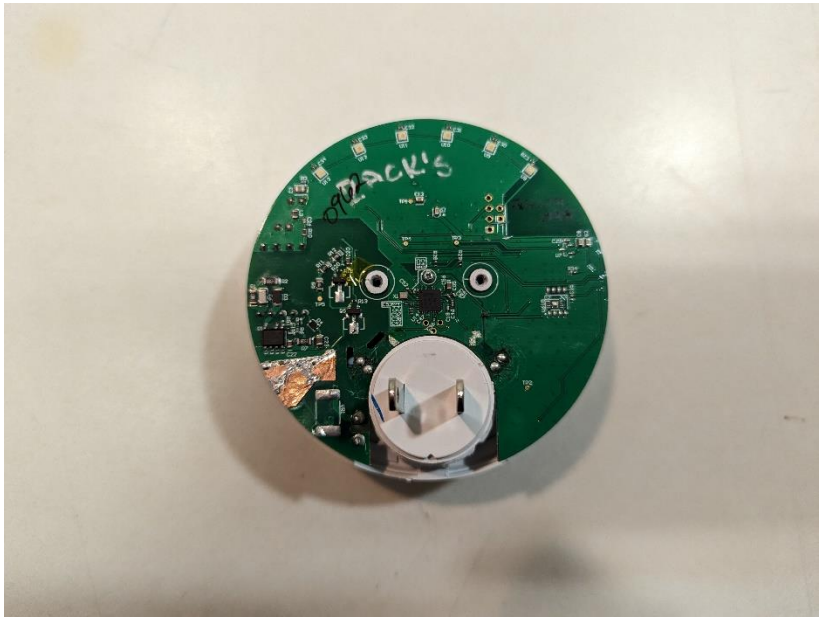
Photograph 7: Front View of the EUT



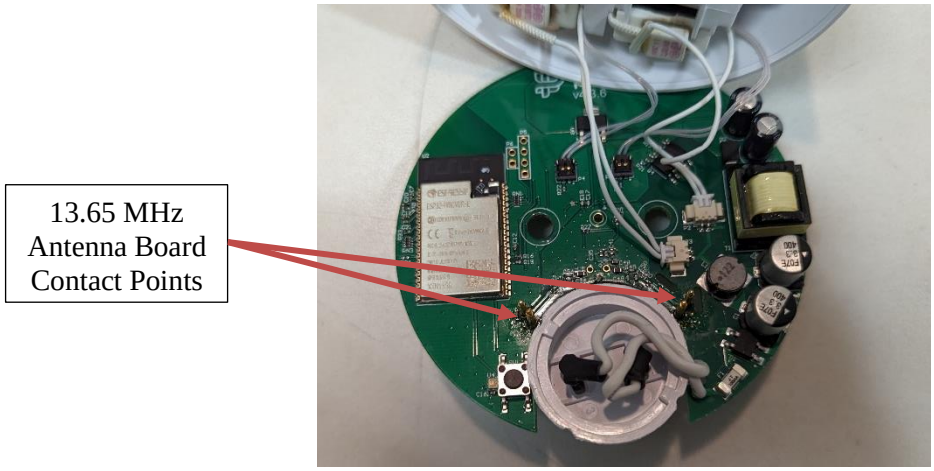
Photograph 8: Back View of the EUT



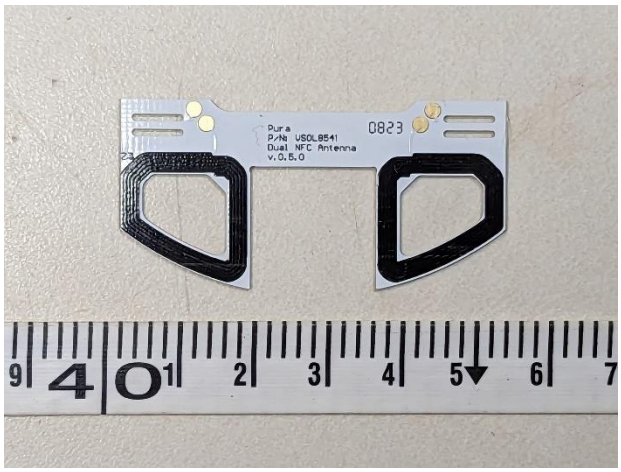
Photograph 9: Side View of the EUT



Photograph 10: Internal View of the EUT with 13.56MHz Transmitter Circuitry



Photograph 11: Internal View of the EUT with 13.56MHz Antenna Connections



Photograph 12: 13.56MHz Transmitter Antenna Board

--- End of Report ---