



Element Materials Technology Morgan Hill

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MEASUREMENT REPORT FCC PART 15.517 / ISED RSS-220 Ultra-Wideband

Applicant Name:

Apple Inc.
One Apple Park Way
Cupertino, CA 95014
United States

Date of Testing:

6/30/2022 - 9/22/2022

Test Site/Location:

Element Materials Technology Morgan Hill, CA, USA

Test Report Serial No.:

1C2206300045-08.BCG

FCC ID:	BCGA2825
IC:	579C-A2825
APPLICANT:	Apple Inc.

Application Type:	Certification
Model/HVIN:	A2825
EUT Type:	Smart Speaker
Operational Frequency:	7987.2MHz (Ch 9)
FCC Classification:	Ultra-Wideband Transmitter (UWB)
FCC Rule Part(s):	Part 15 Subpart F (15.517)
ISED Specification:	RSS-Gen Issue 5, RSS-220 Issue 1
RSS-220 Subclass:	5.2 Indoor Communication Devices
Test Procedure(s):	ANSI C63.10-2013, KDB 393764 D01 v02r01

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.10-2013 and KDB 393764 D01 v02r01. Test results reported herein relate only to the item(s) tested.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

RJ Ortanez
Executive Vice President



FCC ID: BCGA2825 IC: 579C-A2825	element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2206300045-08.BCG	Test Dates: 6/30/2022 - 9/22/2022	EUT Type: Smart Speaker	Page 1 of 57

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V 10.5 12/15/2021

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1.0 INTRODUCTION

1.1 Scope

Measurement and determination of electromagnetic emissions (EMC) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission and the Innovation, Science and Economic Development Canada.

1.2 Element Materials Technology Morgan Hill Test Location

These measurement tests were conducted at the Element Materials Technology Morgan Hill facility located at 18855 Adams Court, Morgan Hill, CA 95037. The measurement facility is compliant with the test site requirements specified in ANSI C63.4-2014 and KDB 414788 D01 v01r01.

1.3 Test Facility / Accreditations

Measurements were performed at Element Materials Technology located in Morgan Hill, CA 95037, U.S.A.

- Element Materials Technology Morgan Hill is an ISO 17025-2017 accredited test facility under the American Association for Laboratory Accreditation (A2LA) with Certificate number 2041.02 for Specific Absorption Rate (SAR), Hearing Aid Compatibility (HAC) testing, where applicable, and Electromagnetic Compatibility (EMC) testing for FCC and Innovation, Science, and Economic Development Canada rules.
- Element Washington DC LLC TCB is a Telecommunication Certification Body (TCB) accredited to ISO/IEC 17065-2012 by A2LA (Certificate number 2041.03) in all scopes of FCC Rules and ISED Standards (RSS).
- Element Materials Technology Morgan Hill facility is a registered (22831) test laboratory with the site description on file with ISED.
- Element Materials Technology Morgan Hill is a Recognized U.S. Certification Assessment Body (CAB # US0110) for ISED Canada as designated by NIST under the U.S. and Canada Mutual Recognition Agreements (MRAs).

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2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Apple Smart Speaker** FCC ID: **BCGA2825** and IC: **579C-A2825**. The test data contained in this report pertains only to the emissions due to the EUT's Ultra-Wideband (UWB) transmitter.

Test Device Serial No.: *GY9YGK3GVM, LD632YXR23, GP3HTQ664M*

2.2 Device Capabilities

This device contains the following capabilities:

802.11b/g/n WLAN, 802.11a/n/ac UNII, Bluetooth (1x, EDR, LE1M, LE2M, HDR4, HDR8), UWB, 802.15.4

For ISED, this device is under subclass 5.2 Indoor Communication Devices of RSS-220

Data Port UWB Radio Terminal Access: No

Ch.	Frequency (MHz)	Config	Payload
9	8000	0	25
			65
			125
		1	45
			85
			125
		4	0
		5	0

Table 2-1. UWB Frequency / Channel Operations

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**Notes:**

1. This device supports simultaneous transmission feature, which allows multiple radios to transmit simultaneously at the same antenna. The table below shows all the possible.

Simultaneous Tx Config	Bluetooth	UNII
BDR, EDR, LE1M/2M, HDR4/8		802.11a/n/ac
Config 1	✓	✓

Table 2-2. Simultaneous Transmission Configuration

✓ = Support; ✗ = NOT Support

2. Simultaneous Tx Configuration was tested, and the worst case has been included in the RF Bluetooth Report and RF UNII Report.

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2.3 Antenna Description

Following antenna gains provided by manufacturer were used for testing.

Frequency [GHz]	Antenna Gain (dBi)	
	Antenna 0	Antenna 1
7.750-8.250	2.2	2.9

Table 2-3. Highest Antenna Gain

2.4 Test Support Equipment

Test Support Equipment					
1	Apple Macbook w/ AD/DC Adapter	Model: A2289	S/N: C02DV7VGMD6T		
		Model: A2164	S/N: N/A		
2	USB-C Cable	Model: N/A	S/N: N/A		
3	Gordo Cable	Model: N/A	S/N: 10282A		

Table 2-4. Test Support Equipment Used

2.5 Test Configuration

The EUT was tested per the guidance of ANSI C63.10-2013 and KDB 393764 D01 v02r01. ANSI C63.10-2013 was used to reference the appropriate EUT setup for radiated spurious emissions testing and AC line conducted testing. See Sections 3.2 for AC line conducted emissions test setups, 3.3 for radiated emissions test setups.

For emissions from 960MHz – 18GHz, channel 9 was tested with highest power and worst case configuration. The emissions below 960MHz and above 18GHz were tested with the highest transmitting power and the worst case configuration.

The EUT was manipulated through two orthogonal planes of X-orientation (flatbed) and Y-orientation (landscape). Only the worst case emissions were reported in this test report.

For AC line conducted and radiated test below 1GHz, following configuration were investigated and the worst case was reported.

- EUT powered by an AC power source.

2.6 Software and Firmware

The test was conducted with firmware version 20J373 installed on the EUT.

2.7 EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and/or no modifications were made during testing.

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3.0 DESCRIPTION OF TESTS

3.1 Evaluation Procedure

The measurement procedures described in the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices (ANSI C63.10-2013) and the guidance provided in KDB 393764 D01 v02R01 were used in the measurement of the EUT.

Deviation from measurement procedure.....None

3.2 AC Line Conducted Emissions

The line-conducted facility is located inside a 7m x 3.66m x 2.7m shielded enclosure. The shielded enclosure is manufactured by AP Americas. The shielding effectiveness of the shielded room is in accordance with MIL-Std-285 or NSA 65-5. A 1m x 1.5m wooden table 80cm high is placed 40cm away from the vertical wall and 80cm away from the sidewall of the shielded room. Two 10kHz-30MHz, 50Ω/50µH Line-Impedance Stabilization Networks (LISNs) are bonded to the shielded room floor. Power to the LISNs is filtered by external high-current high-insertion loss power line filters. The external power line filter is EPCOS 2X60A Power Line Filter (100dB Attenuation, 14kHz-18GHz) and the two EPCOs 2X48A filters (100dB Minimum Insertion Loss, 14kHz – 10GHz). These filters attenuate ambient signal noise from entering the measurement lines. These filters are also bonded to the shielded enclosure.

The EUT is powered from one LISN and the support equipment is powered from the second LISN. If the EUT is a DC-powered device, power will be derived from the source power supply it normally will be powered from and this supply line(s) will be connected to the second LISN. All interconnecting cables more than 1 meter were shortened to a 1 meter length by non-inductive bundling (serpentine fashion) and draped over the back edge of the test table. All cables were at least 40cm above the horizontal reference groundplane. Power cables for support equipment were routed down to the second LISN while ensuring that that cables were not draped over the second LISN.

Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The RF output of the LISN was connected to the spectrum analyzer and exploratory measurements were made to determine the frequencies producing the maximum emission from the EUT. The spectrum was scanned from 150kHz to 30MHz with a spectrum analyzer. The detector function was set to peak mode for exploratory measurements while the bandwidth of the analyzer was set to 10kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Once the worst case emissions have been identified, the one EUT cable configuration/arrangement and mode of operation that produced these emissions is used for final measurements on the same test site. The analyzer is set to CISPR quasi-peak and average detectors with a 9kHz resolution bandwidth for final measurements.

Line conducted emissions test results are shown in Section 7.7. Automated test software was used to perform the AC line conducted emissions testing. Automated measurement software utilized is Rohde & Schwarz EMC32, Version 10.50.40.

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3.3 Radiated Emissions

The radiated test facilities consisted of an indoor 3 meter semi-anechoic chamber used for final measurements and exploratory measurements, when necessary. The measurement area is contained within the semi-anechoic chamber which is shielded from any ambient interference. The test site inside the chamber is a 6m x 5.2m elliptical, obstruction-free area in accordance with Figure 5.7 of Clause 5 in ANSI C63.4-2014. Absorbers are arranged on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections for measurements above 1GHz. An 80cm tall test table made of Styrodur is placed on top of the turn table. For measurements above 1GHz, an additional Styrodur pedestal is placed on top of the test table to bring the total table height to 1.5m.

Per KDB 414788, radiated emission test sites other than open-field test sites (e.g., shielded anechoic chambers), may be employed for emission measurements below 30MHz if characterized so that the measurements correspond to those obtained at an open-field test site. To determine test site equivalency, a reference sample transmitting at 149kHz was measured on an open field test site (asphalt with no ground plane) and then measured in the 3m semi-anechoic chamber. A calibrated 60cm loop antenna was rotated about its vertical axis while the reference device was rotated through the X, Y and Z axis in order to capture the worst case level. A maximum deviation of 2.77dB at 149kHz was measured when comparing the 3 meter semi-anechoic chamber to the open field site.

For all measurements, the spectrum was scanned through all EUT azimuths and from 1 to 4 meter receive antenna height using a broadband antenna from 30MHz up to the upper frequency shown in 15.33 depending on the highest frequency generated or used in the device or on which the device operates or tunes. For frequencies above 1GHz, linearly polarized double ridge horn antennas were used. For frequencies below 30MHz, a calibrated loop antenna was used. When exploratory measurements were necessary, they were performed at 1 meter test distance inside the semi-anechoic chamber using broadband antennas, broadband amplifiers, and spectrum analyzers to determine the frequencies and modes producing the maximum emissions. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The test set-up was placed on top of the 1 x 1.5 meter table. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Appropriate precaution was taken to ensure that all emissions from the EUT were maximized and investigated. The system configuration, mode of operation, turntable azimuth, and receive antenna height was noted for each frequency found.

Final measurements were made in the semi-anechoic chamber using calibrated, linearly polarized broadband and horn antennas. The test setup was configured to the setup that produced the worst case emissions. The spectrum analyzer was set to investigate all frequencies required for testing to compare the highest radiated disturbances with respect to the specified limits. The turntable containing the EUT was rotated through 360 degrees and the height of the receive antenna was varied 1 to 4 meters and stopped at the azimuth and height producing the maximum emission. Each emission was maximized by changing the orientation of the EUT through two orthogonal planes and changing the polarity of the receive antenna, whichever produced the worst-case emissions.

3.4 Environmental Conditions

The temperature is controlled within range of 15°C to 35°C. The relative humidity is controlled within range of 10% to 75%. The atmospheric pressure is monitored within the range 86-106kPa (860-1060mbar).

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4.0 ANTENNA REQUIREMENTS

Excerpt from §15.203 of the FCC Rules/Regulations:

"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can 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 antenna(s) of the EUT are **permanently attached**.
- There are no provisions for connection to an external antenna.

Conclusion:

The EUT complies with the requirement of §15.203.

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5.0 MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.23-2012. All measurement uncertainty values are shown with a coverage factor of $k = 2$ to indicate a 95% level of confidence. The measurement uncertainty shown below meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Contribution	Expanded Uncertainty (\pm dB)
Conducted Bench Top Measurements	1.77
Line Conducted Disturbance	2.70
Radiated Disturbance (<30MHz)	4.38
Radiated Disturbance (30MHz - 1GHz)	4.75
Radiated Disturbance (1 - 18GHz)	5.20
Radiated Disturbance (>18GHz)	4.72

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6.0 TEST EQUIPMENT CALIBRATION DATA

Test Equipment Calibration is traceable to the National Institute of Standards and Technology (NIST). Measurements antennas used during testing were calibrated in accordance to the requirements of ANSI C63.5-2017.

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent Technologies	N9030A	3Hz-44GHz PXA Signal Analyzer	6/10/2022	Annual	6/10/2023	MY49430244
Agilent Technologies	N9020A	MXA Signal Analyzer	4/26/2022	Annual	4/26/2023	MY56470202
ATM	180-442A-KF	20dB Nominal Gain Horn Antenna	1/19/2022	Annual	1/19/2023	T058701-02
Com-Power Corporation	LIN-120A	Line Impedance Stabilization Network (LISN)	3/7/2022	Annual	3/7/2023	241296
ETS-Lindgren	3142E	Biconilog Antenna (26-6000MHz)	10/21/2021	Annual	10/21/2022	208204
ETS-Lindgren	3117	Double Ridged Guide Horn Antenna (1-18GHz)	10/25/2021	Annual	10/25/2022	227597
Rohde & Schwarz	TS-PR8	Pre-Amplifier (30MHz-6GHz)	1/6/2022	Annual	1/6/2023	102328
Rohde & Schwarz	ESW44	EMI Test Receiver	12/2/2021	Annual	12/2/2022	101570
Rohde & Schwarz	HFH2-Z2	Loop Antenna	4/3/2022	Annual	4/3/2023	100546
Rohde & Schwarz	TC-TA18	Cross-Polarized Antenna 400MHz-18GHz	1/25/2022	Annual	1/25/2023	101063
Rohde & Schwarz	TS-PR18	Pre-Amplifier (1GHz-18GHz)	1/6/2022	Annual	1/6/2023	101639
Rohde & Schwarz	TS-PR1840	Pre-Amplifier (18GHz-40GHz)	4/18/2022	Annual	4/18/2023	100050

Table 6-1. Test Equipment List

Note:

For equipment listed above that has a calibration date or calibration due date that falls within the test date range, care was taken to ensure that this equipment was used after the calibration date and before the calibration due date.

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7.0 TEST RESULTS

7.1 Summary

Company Name: Apple Inc.
 FCC ID: BCGA2825
 IC: 579C-A2825
 FCC Classification: Ultra-Wideband Transmitter

FCC Part Section(s)	RSS Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
§15.503, §15.517 (b)	RSS-220 [2]	10dBc Bandwidth	≥ 500MHz	RADIATED	PASS	Section 7.2, 7.3
§ 2.1049	RSS-Gen [6.7]	Occupied Bandwidth	N/A		N/A	Section 7.3
§15.517 (e)	RSS-220 [5.2.1(g)]	Maximum Peak Power Spectral Density (Peak EIRP)	< 0 dBm/50MHz EIRP		PASS	Section 7.4.1
§15.517 (c)	RSS-220 [5.2.1(d)]	Maximum Average Emission (Average EIRP)	< -41.3 dBm/MHz EIRP		PASS	Section 7.4.2
§15.517 (c)	RSS-220 [5.2.1(d)]	Radiated Emissions Above 960MHz	See §15.517 (c) and RSS-220 [5.2.1(d)] for details		PASS	Sections 7.5
§15.517 (d)	RSS-220 [5.2.1(e)]	Radiated Emissions in the 1164 – 1240MHz and 1559 – 1610MHz GPS Bands	See §15.517 (d) and RSS-220 [5.2.1(e)] for details		PASS	Sections 7.5
§15.517 (c), §15.209	RSS-220 [3.4] RSS-Gen [8.9]	Radiate Emissions Below 960MHz	Emissions in restricted bands must meet the radiated limits detailed in §15.209 (RSS-Gen [8.9])		PASS	Sections 7.6
§15.207	RSS-Gen [8.8]	AC Line Conducted Emissions 150kHz – 30MHz	< FCC 15.207 limits (RSS-Gen [8.8])	AC LINE CONDUCTED	PASS	Section 7.7

Table 7-1. Summary of Test Results

Notes:

1. All modes of operation were investigated. The test results shown in the following sections represent the worst case emissions.
2. The analyzer plots shown in this section were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables and attenuators used as part of the system to connect the EUT to the analyzer at all frequencies of interest.

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7.2 10dBc Bandwidth Measurement

§15.503 §15.517 (b)

Test Overview and Limit

The UWB bandwidth is the frequency band bounded by the points that are 10 dB below the highest radiated emission, as based on the complete transmission system including the antenna. The upper boundary is designated F_H and the lower boundary is designated F_L . The Frequency at which the highest radiated emission occurs is designated F_M .

- The center frequency, F_C , equals $(F_H + F_L) / 2$
- The fractional bandwidth equals $2(F_H - F_L) / (F_H + F_L)$

The UWB bandwidth of a device operating under provisions of this section must be contained between 3100MHz and 10,600MHz.

- a) ***The minimum permissible 10dBc Bandwidth is 500MHz***
- b) ***Fractional bandwidth is equal or greater than 0.20***

Test Procedure Used

ANSI C63.10-2013 – Section 10.1
KDB 393764 D01 v02r01

Test Settings

1. RBW = 1MHz
2. VBW = 3MHz
3. Detector = Peak
4. Trade mode = Max Hold
5. Sweep = auto couple
6. The trace was allowed to stabilize

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Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

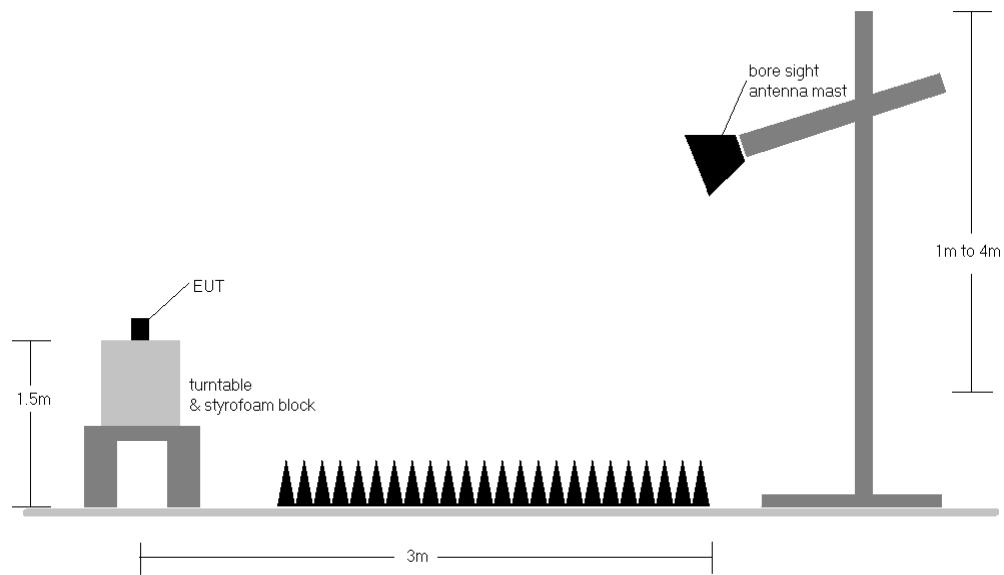


Figure 7-1. Test Setup

Test Notes

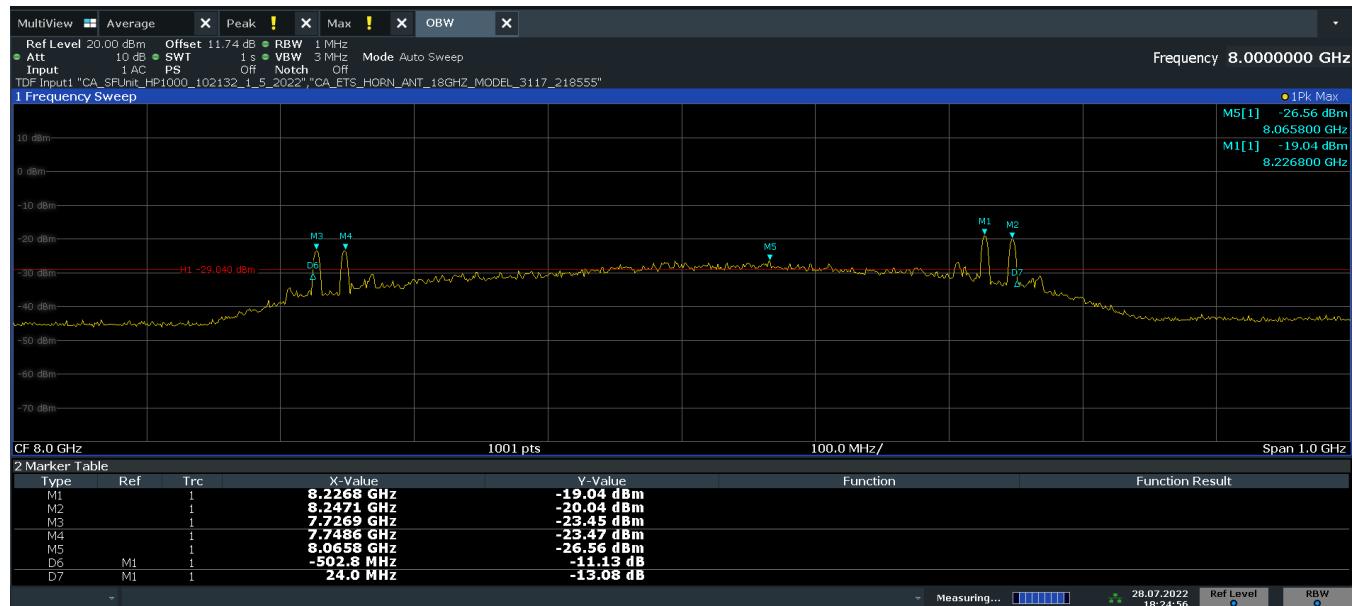
1. In those cases where the measured emission spectrum contains multiple (more than two) -10dBc points, the outermost points define the UWB bandwidth (i.e., the widest bandwidth is reported).
2. All modes of operation were investigated and the worst-case emissions are reported.

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Antenna 0

Frequency [GHz]	Channel	Config	Payload	F _M [GHz]	F _L [GHz]	F _H [GHz]	F _C [GHz]	Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
8	9	0	125	8.227	7.724	8.251	7.987	526.8	500	Pass

Table 7-2. 10dBc Bandwidth Measurements (UWB Antenna 0, Ch.9, 8GHz)



Plot 7-1. 10dBc Bandwidth Plot (UWB Antenna 0, Ch. 9, Config 0/Payload 125)

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Antenna 1

Frequency [GHz]	Channel	Config	Payload	F _M [GHz]	F _L [GHz]	F _H [GHz]	F _C [GHz]	Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
8	9	0	125	7.748	7.724	8.251	7.987	527.5	500	Pass

Table 7-3. 10dBc Bandwidth Measurements (UWB Antenna 1, Ch.9, 8GHz)



Plot 7-2. 10dBc Bandwidth Plot (UWB Antenna 1, Ch. 9, Config 0/Payload 125)

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Test Report S/N: 1C2206300045-08.BCG	Test Dates: 6/30/2022 - 9/22/2022	EUT Type: Smart Speaker	Page 16 of 57

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7.3 Bandwidth Measurement

RSS-220 [2], RSS-Gen [6.7]

Test Overview

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured. All modes of operation were investigated and the worst case configuration results are reported in this section.

Test Procedure Used

ANSI C63.10-2013 – Section 6.9

RSS-Gen [6.7]

Test Settings

1. The signal analyzer's automatic bandwidth measurement capability was used to perform the 99% occupied bandwidth and the 10dB bandwidth. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. RBW = 1 – 5% of the expected OBW
3. VBW \geq 3 x RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. The trace was allowed to stabilize
8. If necessary, steps 2 – 7 were repeated after changing the RBW such that it would be within 1 – 5% of the 99% occupied bandwidth observed in Step 7

FCC ID: BCGA2825 IC: 579C-A2825	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2206300045-08.BCG	Test Dates: 6/30/2022 - 9/22/2022	EUT Type: Smart Speaker	Page 17 of 57

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

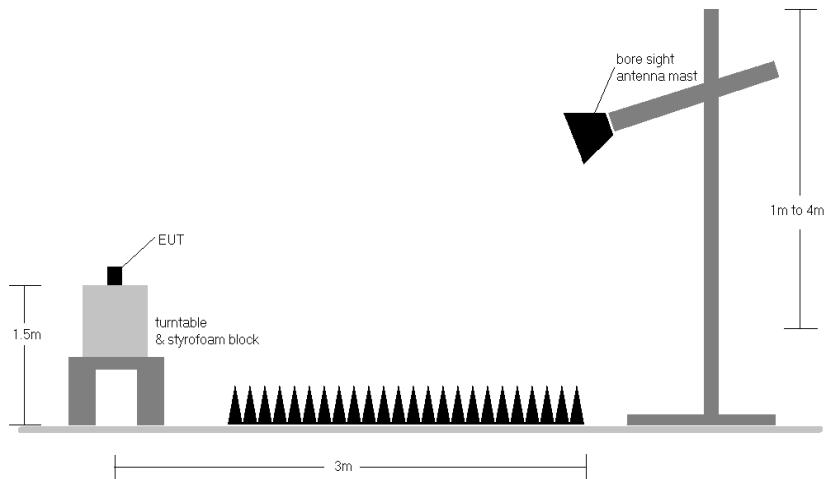


Figure 7-2. Test Instrument & Measurement Setup

Test Notes:

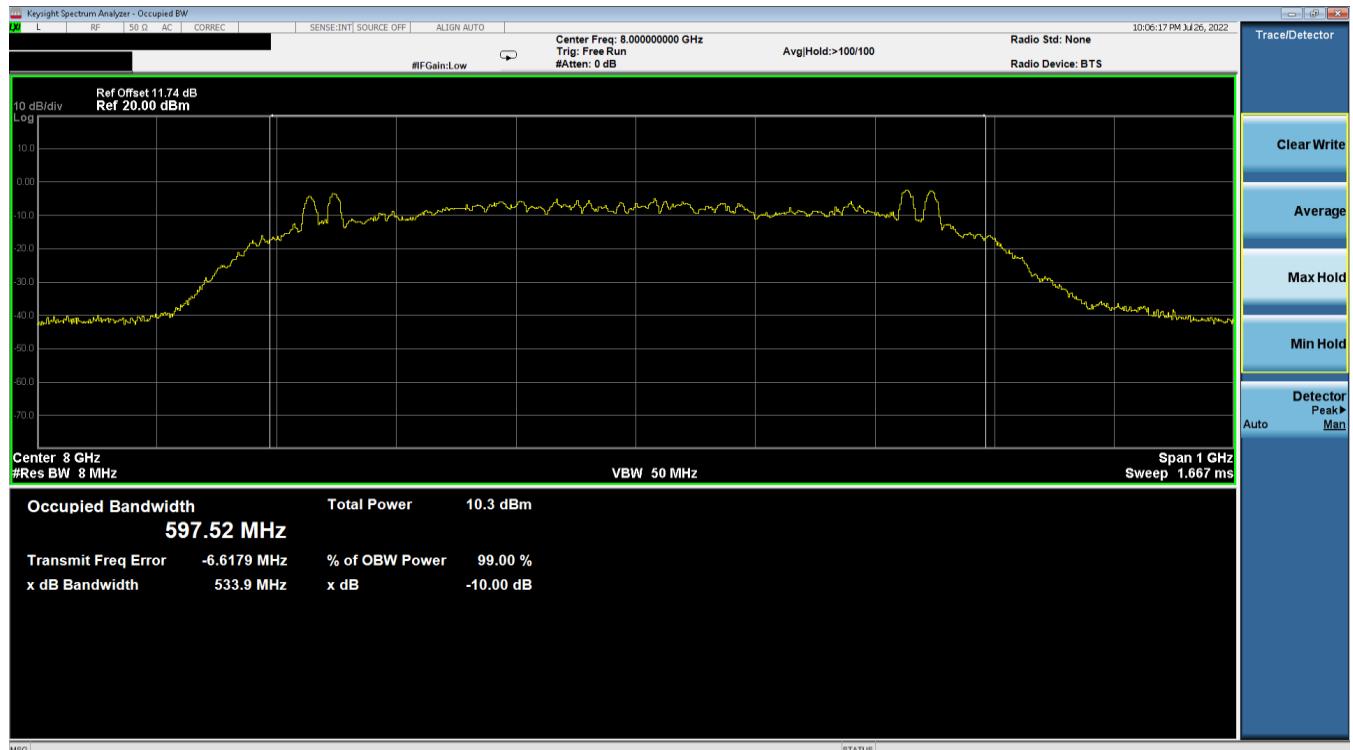
1. All modes of operation were investigated and the worst-case emissions are reported.

FCC ID: BCGA2825 IC: 579C-A2825	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2206300045-08.BCG	Test Dates: 6/30/2022 - 9/22/2022	EUT Type: Smart Speaker	Page 18 of 57

Antenna 0

Frequency [GHz]	Channel	Config	Payload	Measured OBW [MHz]	Measured 10dBc Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
8	9	0	125	597.5	533.9	500	Pass

Table 7-4. ISED 10dBc Bandwidth & 99% OBW Measurements (UWB Antenna 0, Ch.9, 8GHz)



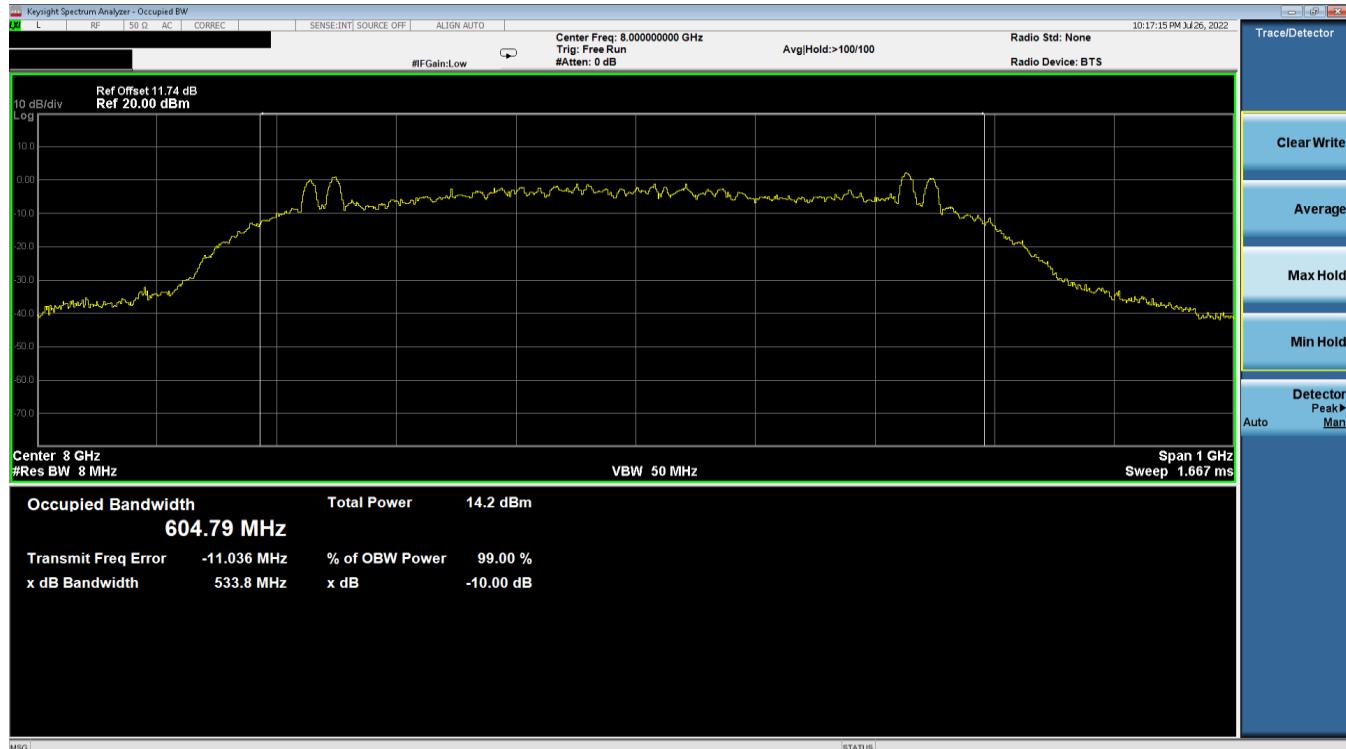
Plot 7-3. ISED 10dBc Bandwidth & 99% OBW (UWB Antenna 0, Ch. 9, Config 0/Payload 125)

FCC ID: BCGA2825 IC: 579C-A2825	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2206300045-08.BCG	Test Dates: 6/30/2022 - 9/22/2022	EUT Type: Smart Speaker	Page 19 of 57

Antenna 1

Frequency [GHz]	Channel	Config	Payload	Measured OBW [MHz]	Measured 10dBc Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
8	9	0	125	604.8	533.8	500	Pass

Table 7-5. ISED 10dBc Bandwidth & 99% OBW Measurements (UWB Antenna 1, Ch.9, 8GHz)



Plot 7-4. ISED 10dBc Bandwidth & 99% OBW (UWB Antenna 1, Ch. 9, Config 0/Payload 125)

FCC ID: BCGA2825 IC: 579C-A2825	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2206300045-08.BCG	Test Dates: 6/30/2022 - 9/22/2022	EUT Type: Smart Speaker	Page 20 of 57

7.4 Maximum Peak and Average Radiated Power (EIRP)

§15.517 (c) §15.517 (e); RSS-220 [5.2.1(d)] RSS-220 [5.2.1(g)]

Test Overview and Limits

15.517 (e) There is a limit on the peak level of the emissions contained within a 50 MHz bandwidth centered on the frequency at which the highest radiated emission occurs, F_M . That limit is 0 dBm for Peak EIRP.

15.517 (c) The radiated emissions above 960 MHz from a device operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz:

Frequency [MHz]	EIRP [dBm]
3100-10600	-41.3

Table 7-6. FCC 15.517 Average EIRP limit

Frequency [MHz]	EIRP [dBm]
4750-10600	-41.3

Table 7-7. RSS-220 Average EIRP limit

Test Procedure Used

ANSI C63.10-2013 – Section 10.3.5 and 10.3.7

KDB 393764 D01 v02r01

Test Settings

Average EIRP Measurements

1. RBW = 1MHz
2. VBW = 3MHz
3. Detector = Average (RMS)
4. Sweep time = No more than a 1 ms integration period over each measurement bin
5. Trace mode = Max hold
6. Trace was allowed to stabilize

Peak EIRP Measurements

1. RBW = 50MHz
2. VBW = 50MHz
3. Detector = Peak
4. Sweep time = auto couple
5. Trace mode = Max hold
6. Trace was allowed to stabilize

FCC ID: BCGA2825 IC: 579C-A2825	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

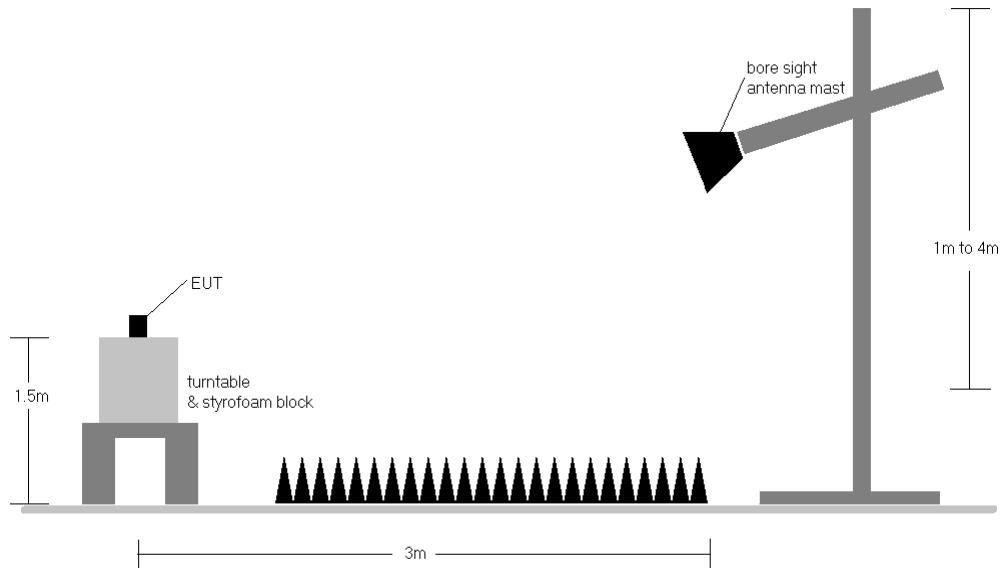


Figure 7-3. Test Instrument & Measurement Setup

Test Notes

1. The antenna is manipulated through typical positions, polarity and length during the tests. The EUT is manipulated through three orthogonal planes.
2. All modes of operation were investigated and the worst-case emissions are reported.

FCC ID: BCGA2825 IC: 579C-A2825	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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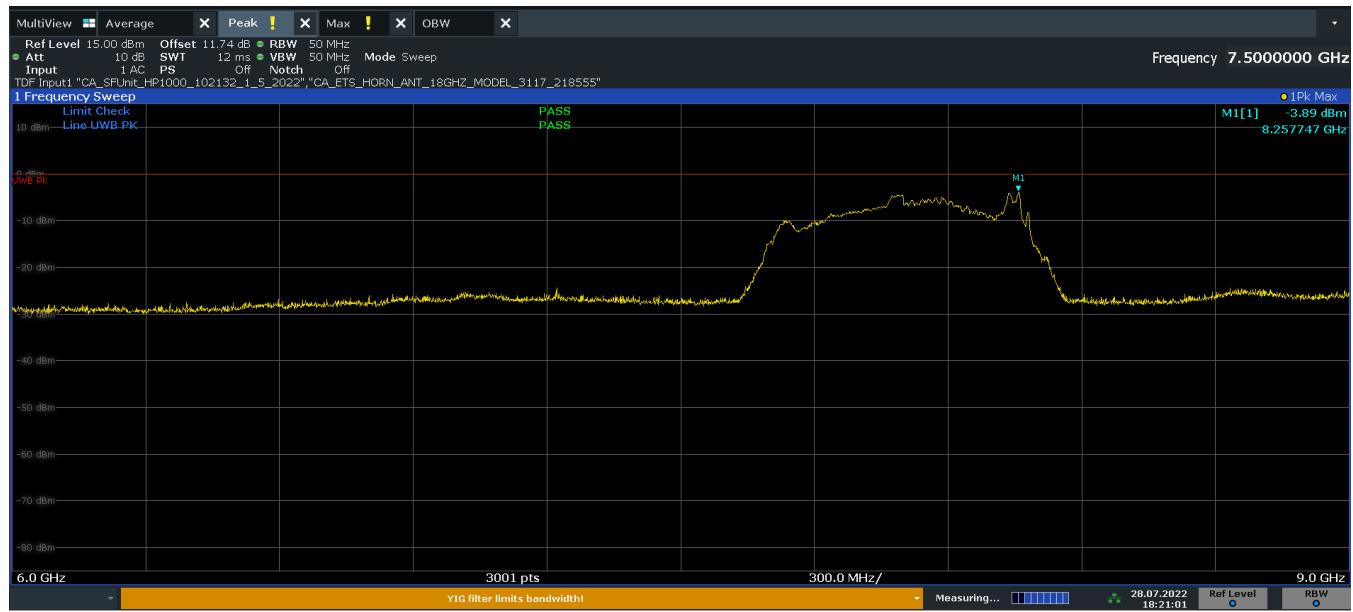
7.4.1 Peak Radiated Power Measurement

§15.517(e)); RSS-220 [5.2.1(g)]

Antenna 0

Frequency [GHz]	Channel	Config	Payload	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	F _M [GHz]	Peak EIRP [dBm/50MHz]	Peak EIRP Limit [dBm/50MHz]	Margin [dB]
8.0	9	0	125	H	209	272	8.2577	-3.89	0.00	-3.89

Table 7-8. Peak EIRP Measurements (UWB Antenna 0, Ch.9, 8GHz)



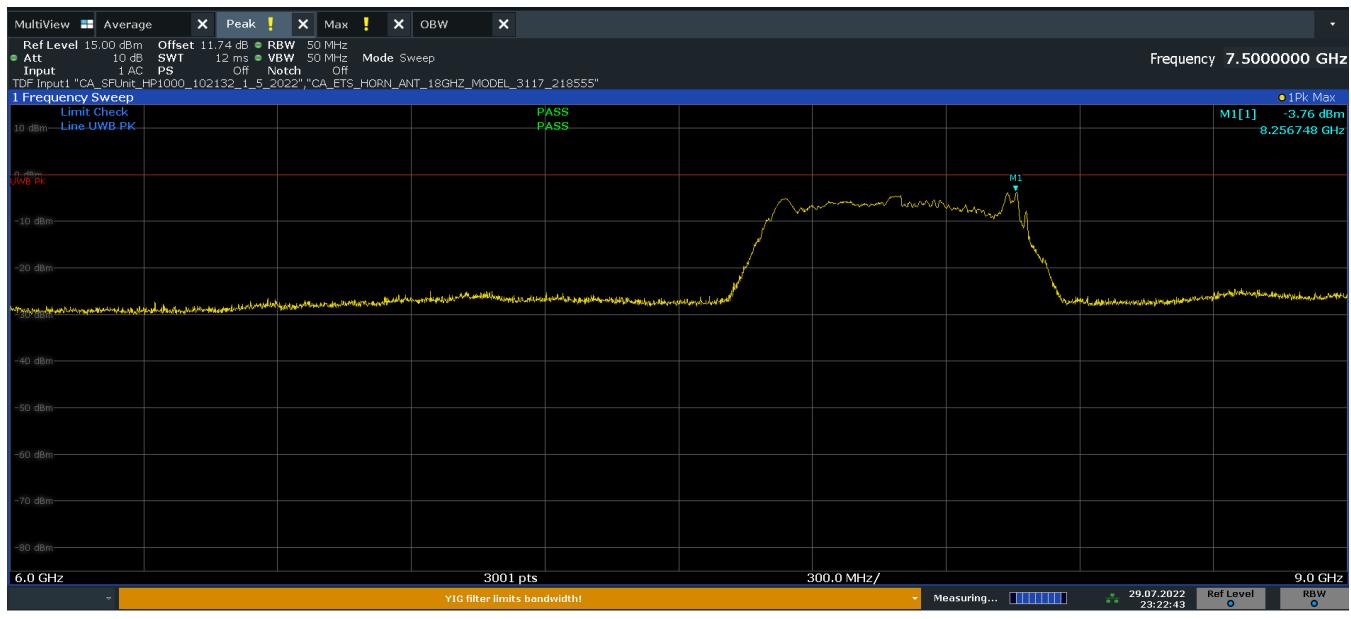
Plot 7-5. Peak Radiated Power (UWB Antenna 0, Ch. 9, Config 0/Payload 125)

FCC ID: BCGA2825 IC: 579C-A2825	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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Antenna 1

Frequency [GHz]	Channel	Config	Payload	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	F _M [GHz]	Peak EIRP [dBm/50MHz]	Peak EIRP Limit [dBm/50MHz]	Margin [dB]
8.0	9	0	125	V	229	348	8.2567	-3.76	0.00	-3.76

Table 7-9. Peak EIRP Measurements (UWB Antenna 1, Ch.9, 8GHz)



Plot 7-6. Peak Radiated Power (UWB Antenna 1, Ch. 9, Config 0/Payload 125)

FCC ID: BCGA2825 IC: 579C-A2825	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2206300045-08.BCG	Test Dates: 6/30/2022 - 9/22/2022	EUT Type: Smart Speaker	Page 24 of 57

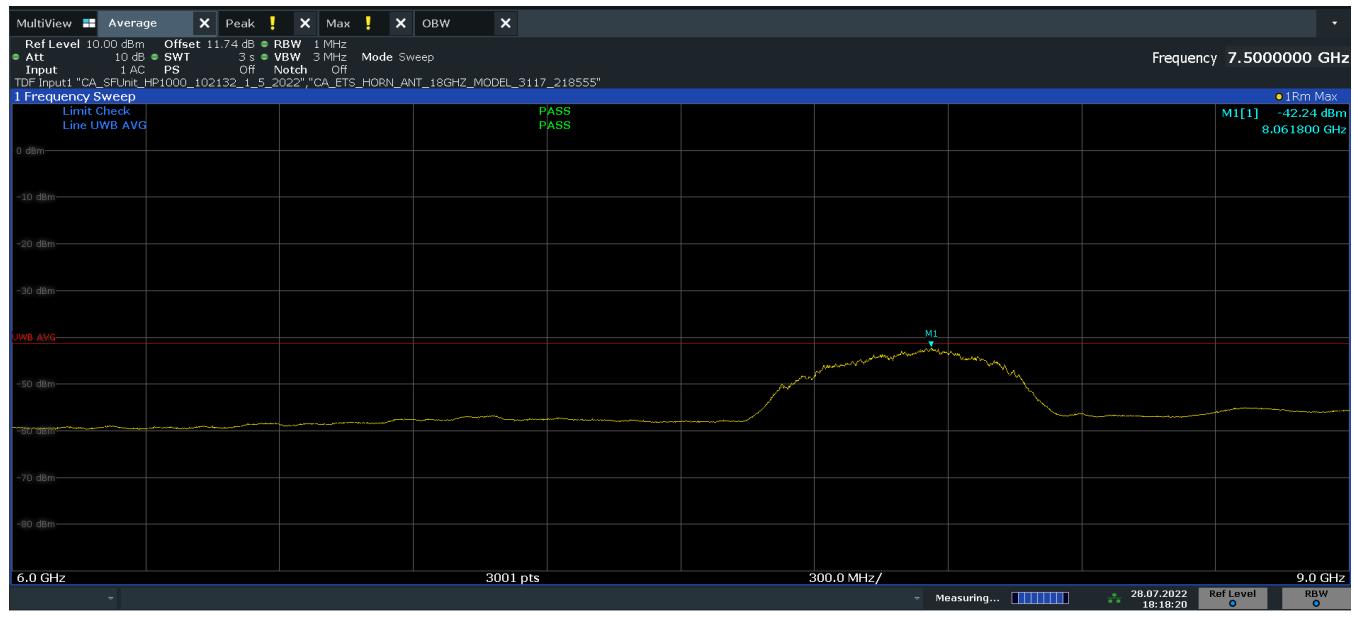
7.4.2 Average Radiated Power Measurement

§15.517(c); RSS-220 [5.2.1(d)]

Antenna 0

Frequency [GHz]	Channel	Config	Payload	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	F _M [GHz]	Average EIRP [dBm/MHz]	Average EIRP Limit [dBm/MHz]	Margin [dB]
8.0	9	0	125	H	209	272	8.0618	-42.24	-41.30	-0.94

Table 7-10. Average EIRP Measurements (UWB Antenna 0, Ch.9, 8GHz)



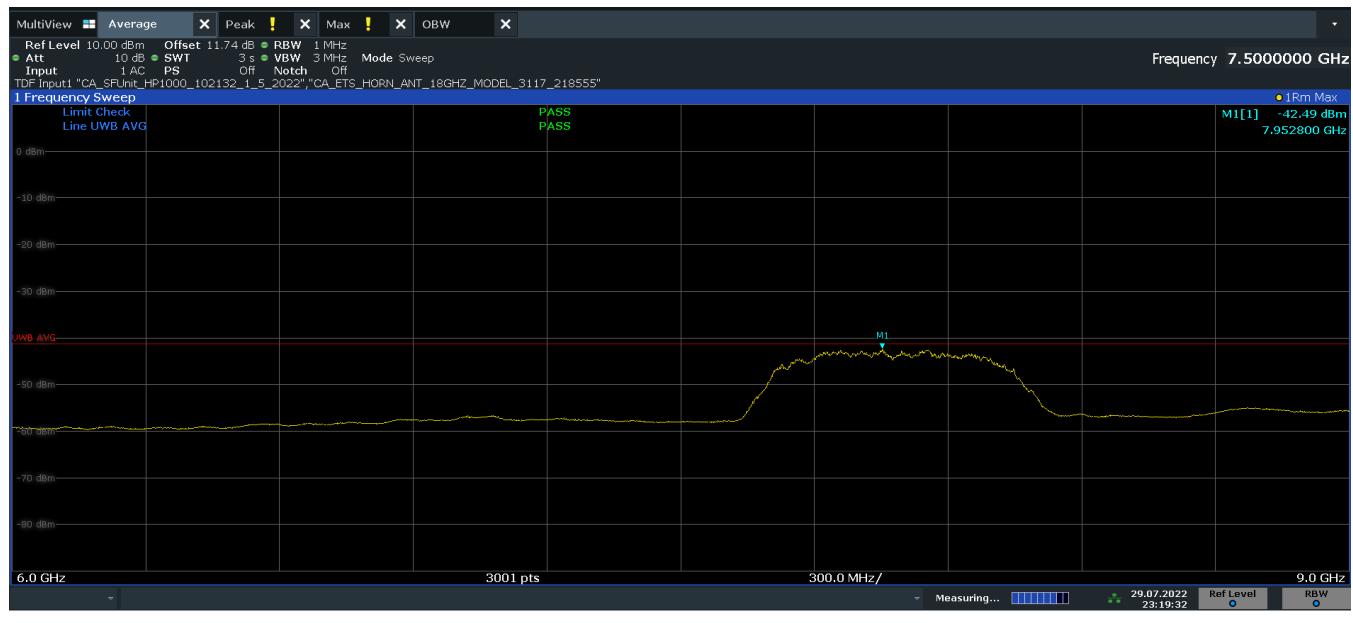
Plot 7-7. Average Radiated Power (UWB Antenna 0, Ch. 9, Config 0/Payload 125)

FCC ID: BCGA2825 IC: 579C-A2825	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2206300045-08.BCG	Test Dates: 6/30/2022 - 9/22/2022	EUT Type: Smart Speaker	Page 25 of 57

Antenna 1

Frequency [GHz]	Channel	Config	Payload	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	F _M [GHz]	Average EIRP [dBm/MHz]	Average EIRP Limit [dBm/MHz]	Margin [dB]
8.0	9	0	125	V	229	348	7.9528	-42.49	-41.30	-1.19

Table 7-11. Average EIRP Measurements (UWB Antenna 1, Ch.9, 8GHz)



Plot 7-8. Average Radiated Power (UWB Antenna 1, Ch. 9, Config 0/Payload 125)

FCC ID: BCGA2825 IC: 579C-A2825	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2206300045-08.BCG	Test Dates: 6/30/2022 - 9/22/2022	EUT Type: Smart Speaker	Page 26 of 57

7.5 Radiated Spurious Emissions Measurements - Above 960MHz

§15.517 (c) §15.517 (d); RSS-220 [5.2.1(d)] RSS-220 [5.2.1(e)]

Test Overview and Limit

All out of band radiated spurious emissions are measured with a spectrum analyzer connected to a receive antenna while the EUT is operating at maximum power and at the appropriate frequencies. Only the radiated emissions of the configuration that produced the worst case emissions are reported in this section.

All out of band emissions must not exceed the average limits shown in Table 7-12 and Table 7-13 per Section 15.517 (C) and RSS-220[5.2.1(d)] when measured using a resolution bandwidth of 1 MHz:

Frequency [MHz]	EIRP [dBm]
960-1610	-75.3
1610-1990	-63.3
1990-3100	-61.3
3100-10600	-41.3
Above 10600	-61.3

Table 7-12. FCC 15.517 Radiated Spurious Emissions Limits

Frequency [MHz]	EIRP [dBm]
960-1610	-75.3
1610-4750	-70.0
4750-10600	-41.3
Above 10600	-61.3

Table 7-13. RSS 220 Radiated Spurious Emissions Limits

All out of band emissions must not exceed the average limits shown in Table 7-14 per Section 15.517 (d) and RSS-220(5.2.1)(e) when measured using a resolution bandwidth greater than or equal to 1 kHz. The measurements shall demonstrate compliance with the stated limits at whatever resolution bandwidth is used.

Frequency [MHz]	EIRP [dBm]
1164-1240	-85.3
1559-1610	-85.3

Table 7-14. FCC 15.517/RSS-220 Radiated Spurious Emissions Limits for GPS frequency bands

Test Procedures Used

ANSI C63.10-2013 – Section 10.3
KDB 393764 D01 v02r01

FCC ID: BCGA2825 IC: 579C-A2825	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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Test Settings

Average RSE Measurements

1. RBW = 1MHz (30kHz for emissions in the GPS band)
2. VBW = 3MHz (100kHz for emissions in the GPS band)
3. Detector = Average (RMS)
4. Sweep time = No more than a 1 ms integration period over each measurement bin
5. Trace mode = Max hold
6. Trace was allowed to stabilize

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

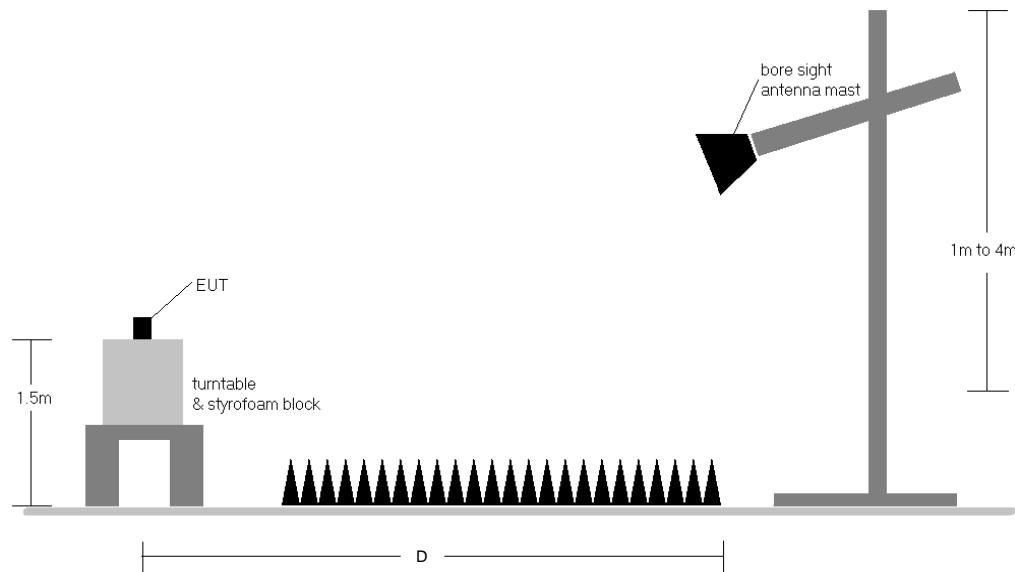


Figure 7-4. Radiated Test Setup > 960MHz

Test Notes

1. All modes of operation were investigated and the worst-case emissions are reported.
2. This unit was tested while powered by an AC power source.
3. The RBW for measurements in the GPS Bands were reduced to 30kHz in order to show compliance.
4. D is the measurement test distance and emissions from 960MHz - 18GHz were measured at 0.6 meter test distance while emissions above 18GHz were measured at 0.5 meter test distance with the application of a distance correction factor.
5. The "-" shown in the following RSE tables are used to denote a noise floor measurement.
6. 6GHz - 9GHz RSE is covered in EIRP section (Section 7.4).

FCC ID: BCGA2825 IC: 579C-A2825	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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Sample Calculations**Determining Spurious Emissions Levels**

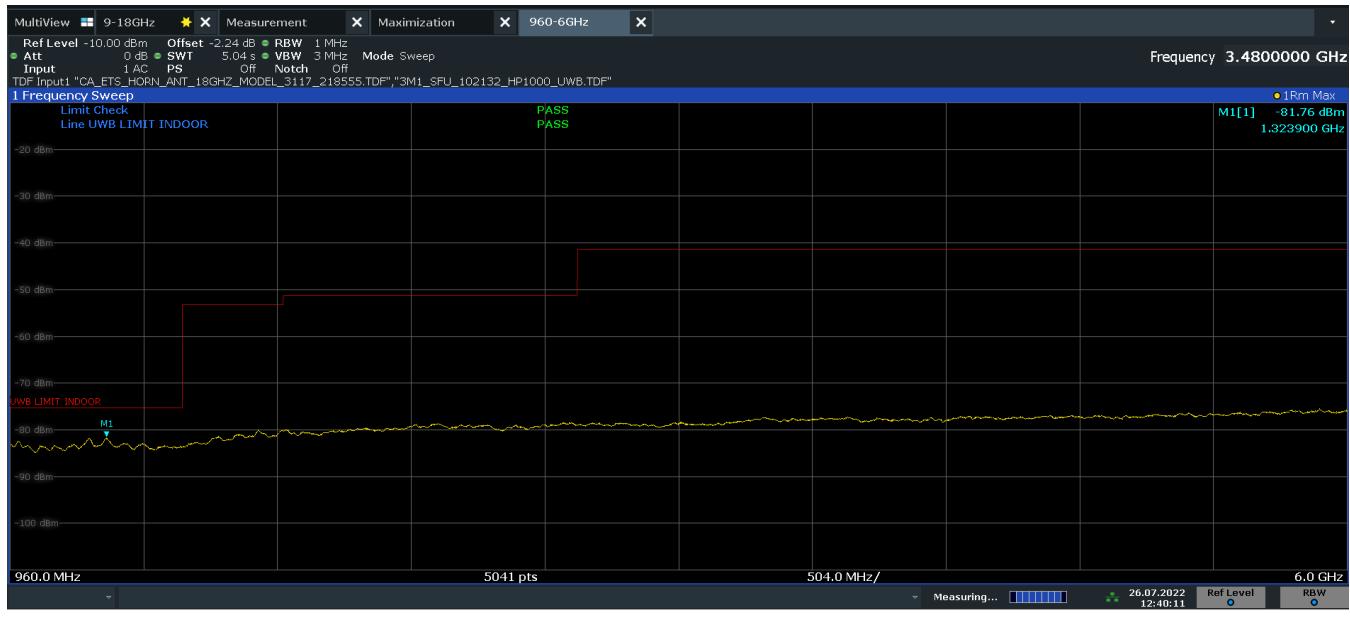
- $E \text{ [dB}\mu\text{V/m]} = \text{Analyzer level [dBm]} + 107 + \text{AFCL [dB/m]}$
- $\text{Spurious Emission Level [dBm]} = E \text{ [dB}\mu\text{V/m]} + 20 \log (D \text{ Meas}) - 104.8$
- $\text{Spurious Emission Level [dBm]} = \text{Analyzer Level [dBm]} + \text{AFCL [dB/m]} + \text{Conversion Factor [dB]}$
- $\text{AFCL [dB/m]} = (\text{Antenna Factor [dB/m]} + \text{Cable Loss [dB]} + \text{Attenuator [dB]}) - \text{Preamplifier Gain [dB]}$
- $\text{Conversion Factor [dB]} = 107 - 104.8 + 20 \log (D \text{ Meas})$
- $\text{Margin [dB]} = \text{Spurious Emission Level [dBm]} - \text{Limit [dBm]}$

FCC ID: BCGA2825 IC: 579C-A2825	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2206300045-08.BCG	Test Dates: 6/30/2022 - 9/22/2022	EUT Type: Smart Speaker	Page 29 of 57

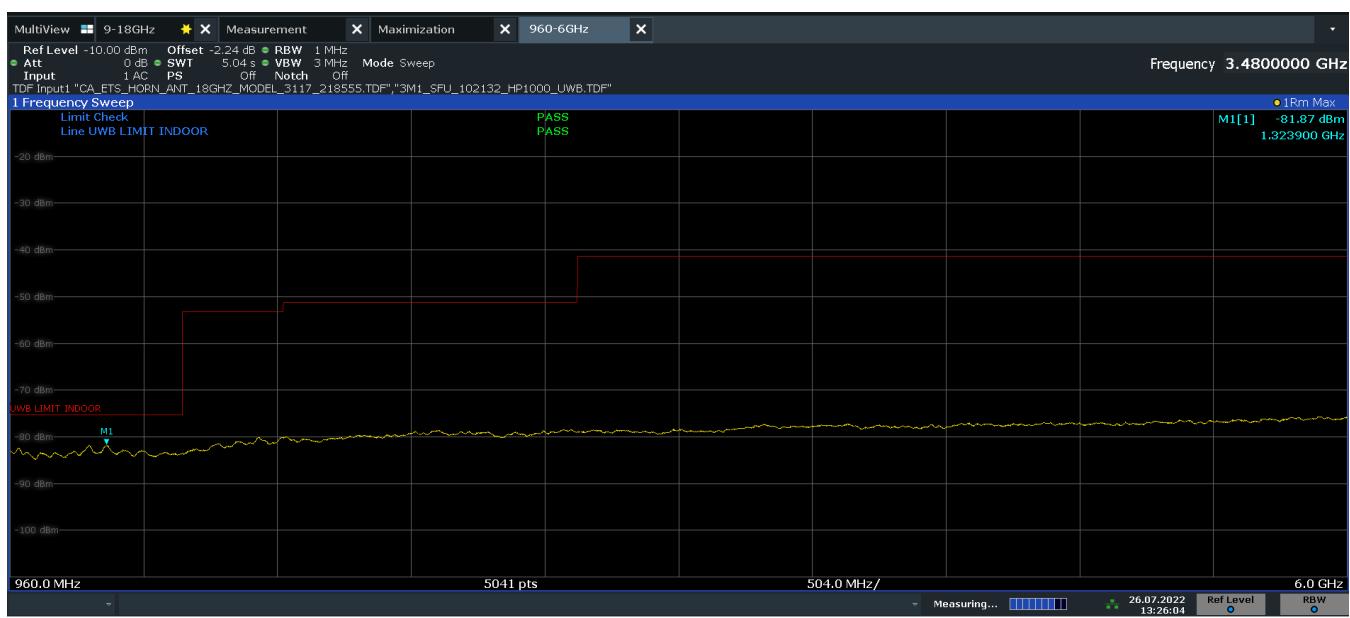
7.5.1 Radiated Spurious Emissions (960MHz-18GHz)

§15.517(c); RSS-220 [5.2.1(d)]

Antenna 0

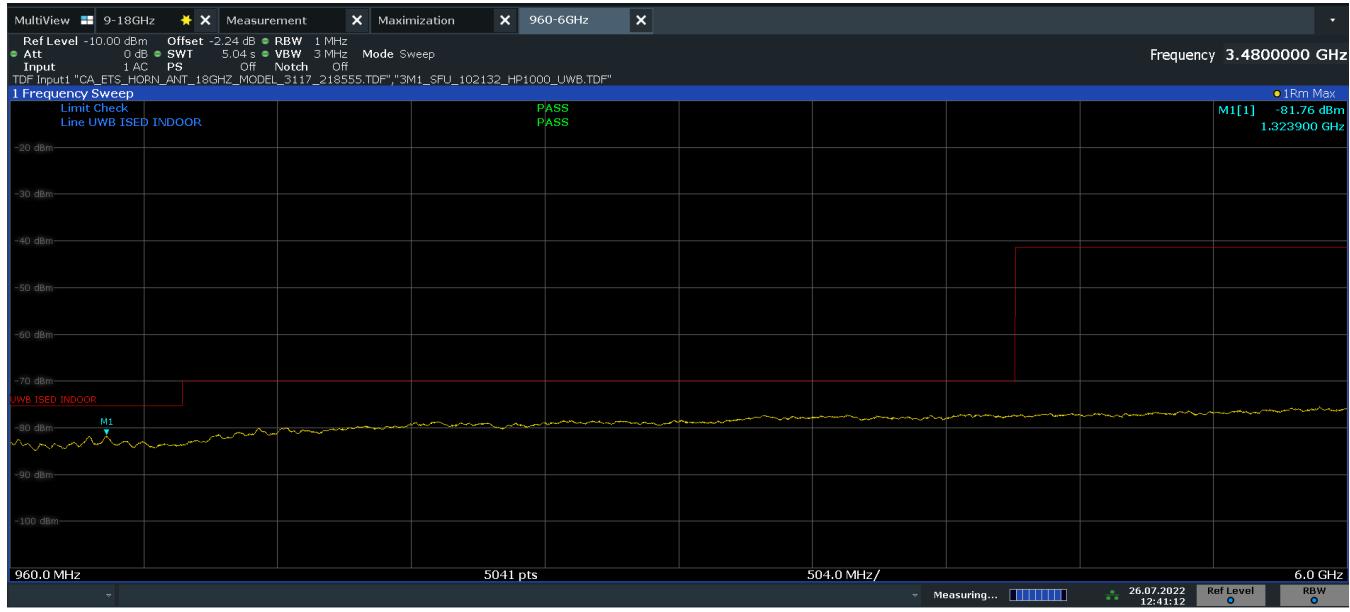


Plot 7-9. FCC Radiated Spurious Emission 960-6000MHz (Antenna 0, Ch. 9, Config 0, Payload 125, Pol. H)

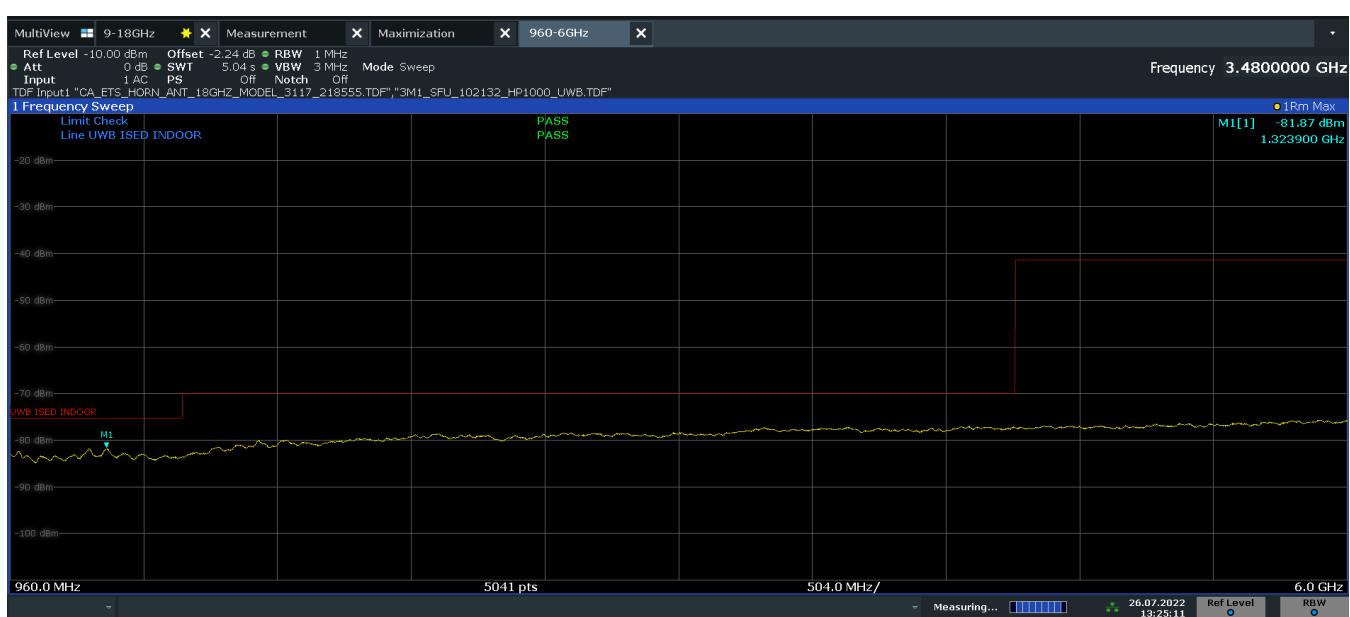


Plot 7-10. FCC Radiated Spurious Emission 960-6000MHz (Antenna 0, Ch. 9, Config 0, Payload 125, Pol. V)

FCC ID: BCGA2825 IC: 579C-A2825		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2206300045-08.BCG	Test Dates: 6/30/2022 - 9/22/2022	EUT Type: Smart Speaker	Page 30 of 57

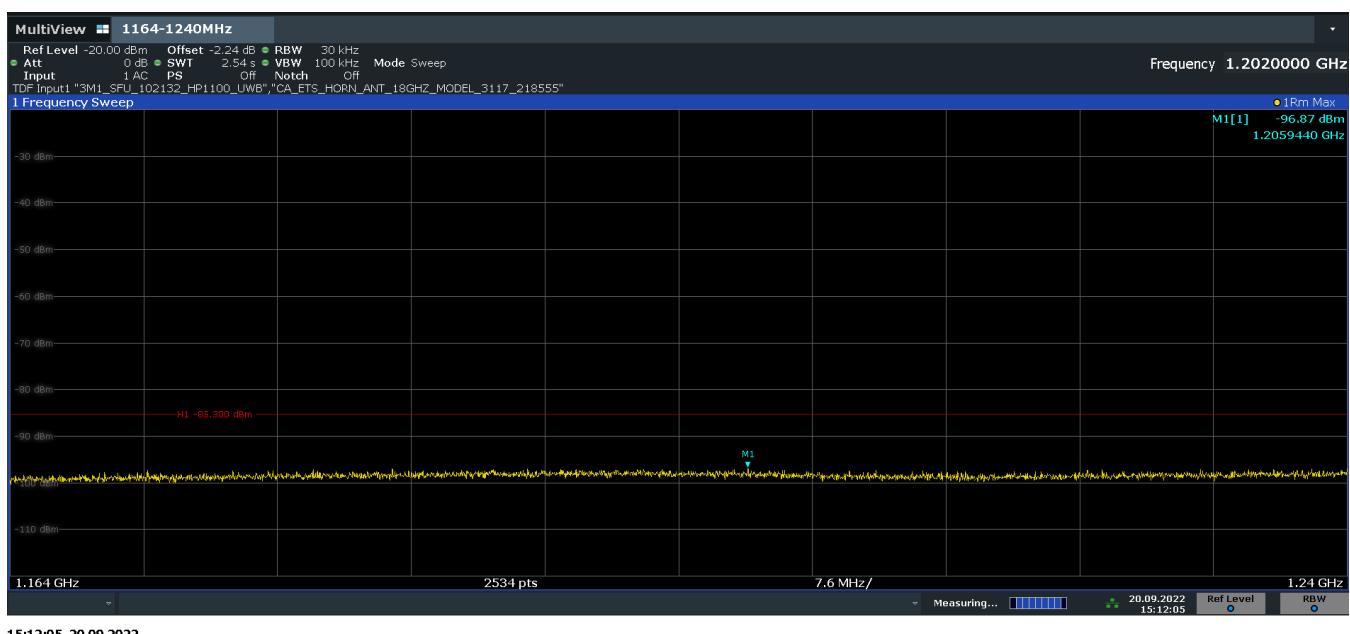
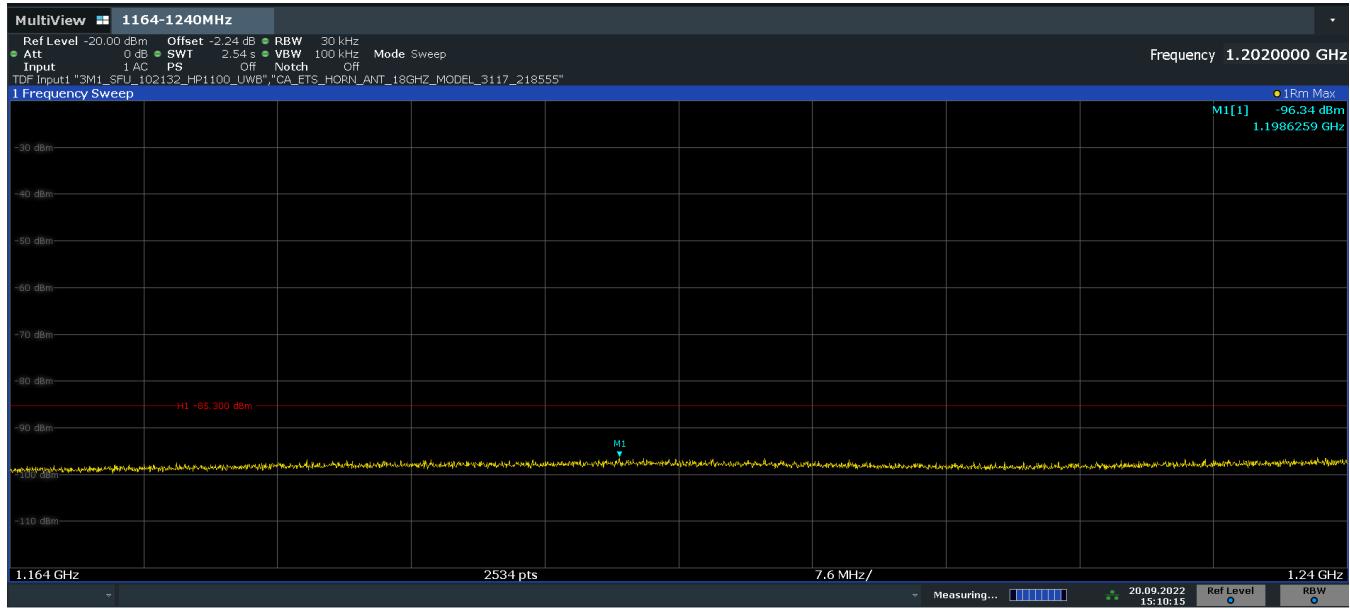


Plot 7-11. ISED Radiated Spurious Emission 960-6000MHz (Antenna 0, Ch. 9, Config 0, Payload 125 Pol. H)

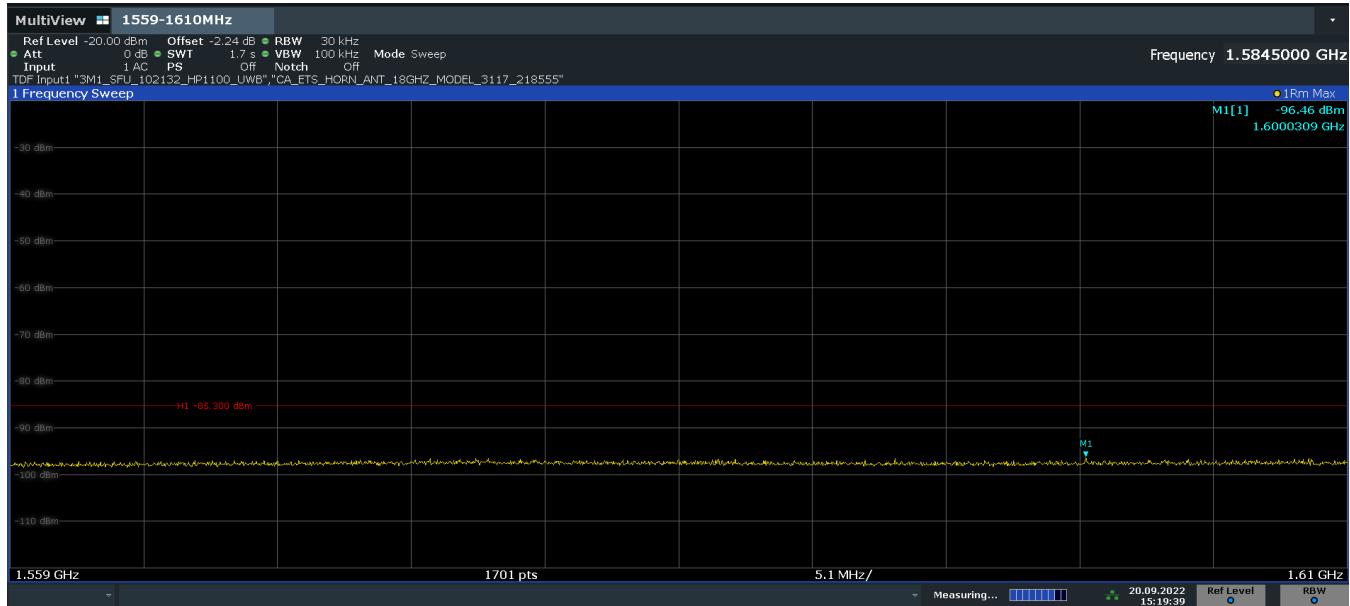


Plot 7-12. ISED Radiated Spurious Emission 960-6000MHz (Antenna 0, Ch. 9, Config 0, Payload 125 Pol. V)

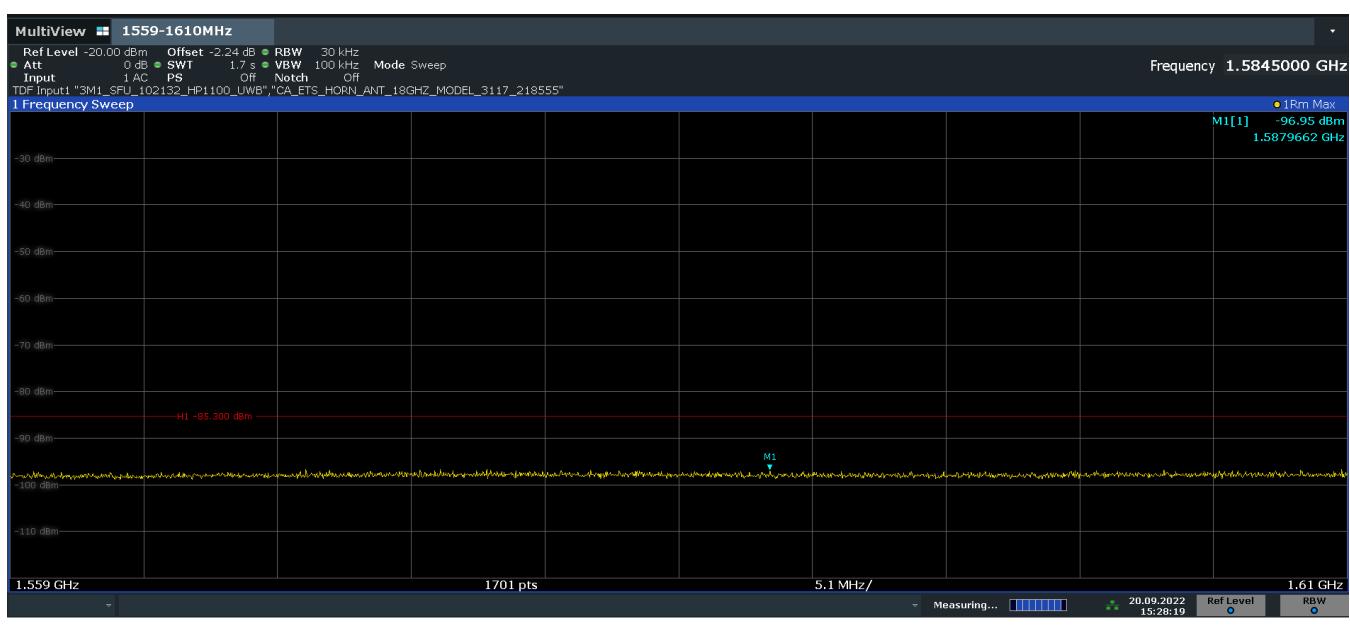
FCC ID: BCGA2825 IC: 579C-A2825	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2206300045-08.BCG	Test Dates: 6/30/2022 - 9/22/2022	EUT Type: Smart Speaker	Page 31 of 57



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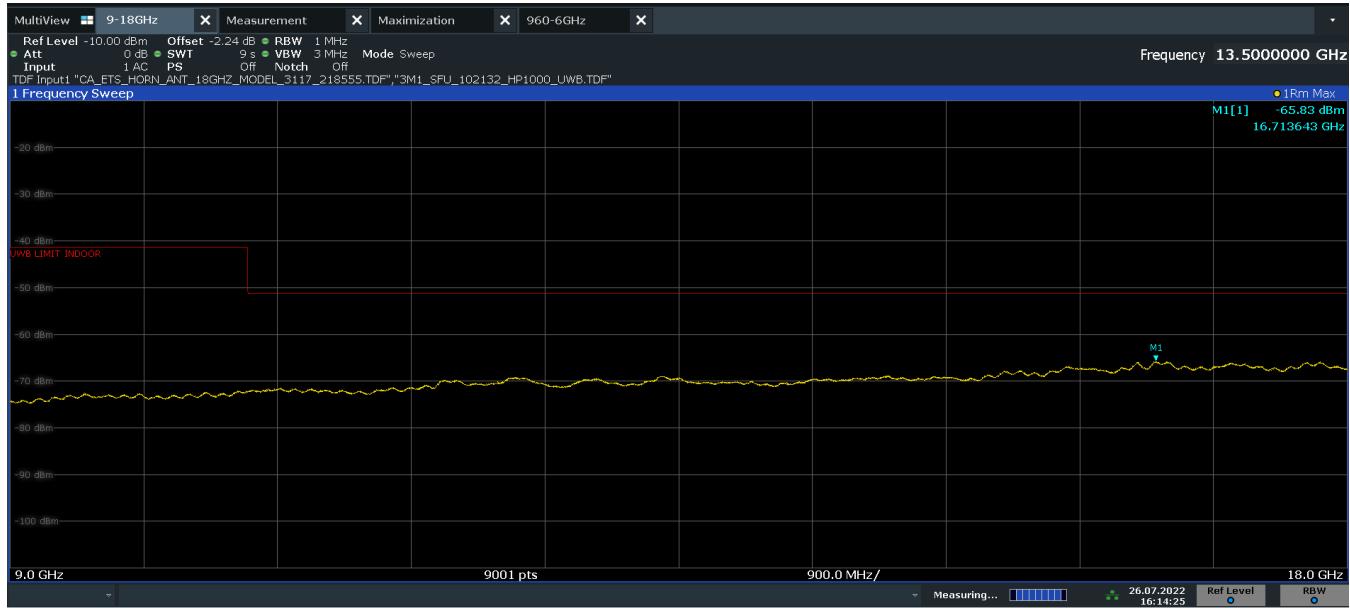


Plot 7-15. Radiated Spurious Emission 1559-1610MHz (Antenna 0, Ch. 9, Config 0, Payload 0, Pol H)

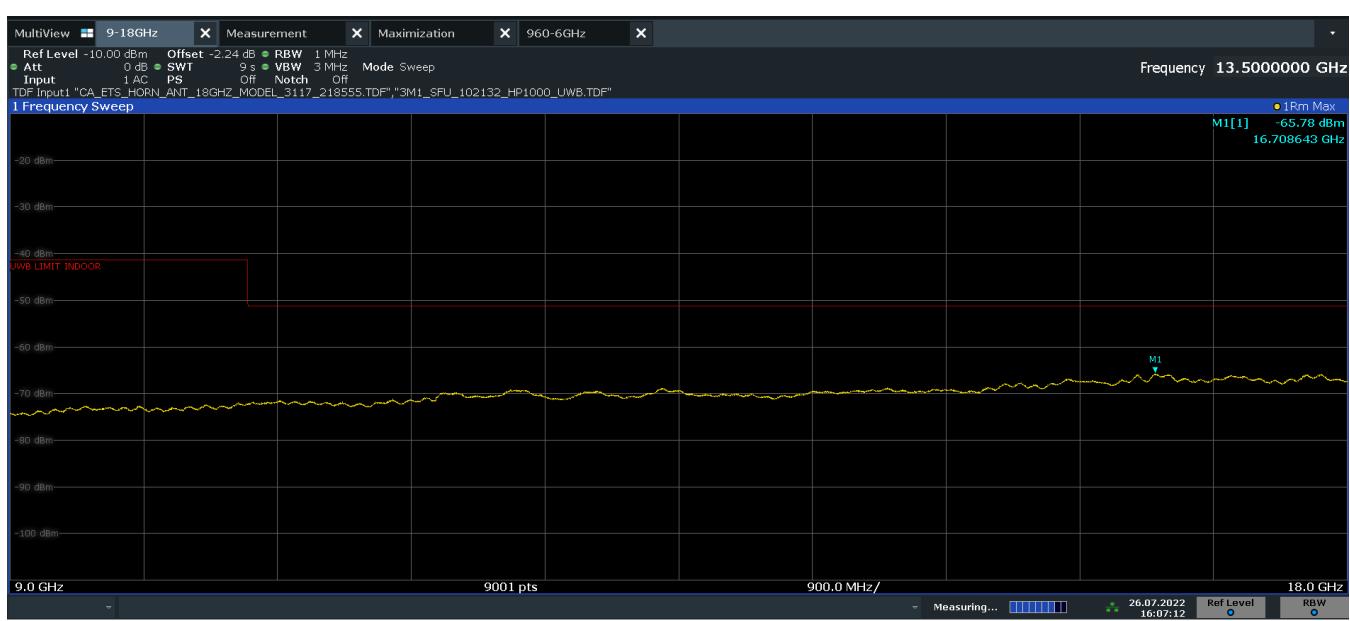


Plot 7-16. Radiated Spurious Emission 1559-1610MHz (Antenna 0, Ch. 9, Config 0, Payload 0, Pol V)

FCC ID: BCGA2825 IC: 579C-A2825	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2206300045-08.BCG	Test Dates: 6/30/2022 - 9/22/2022	EUT Type: Smart Speaker	Page 33 of 57



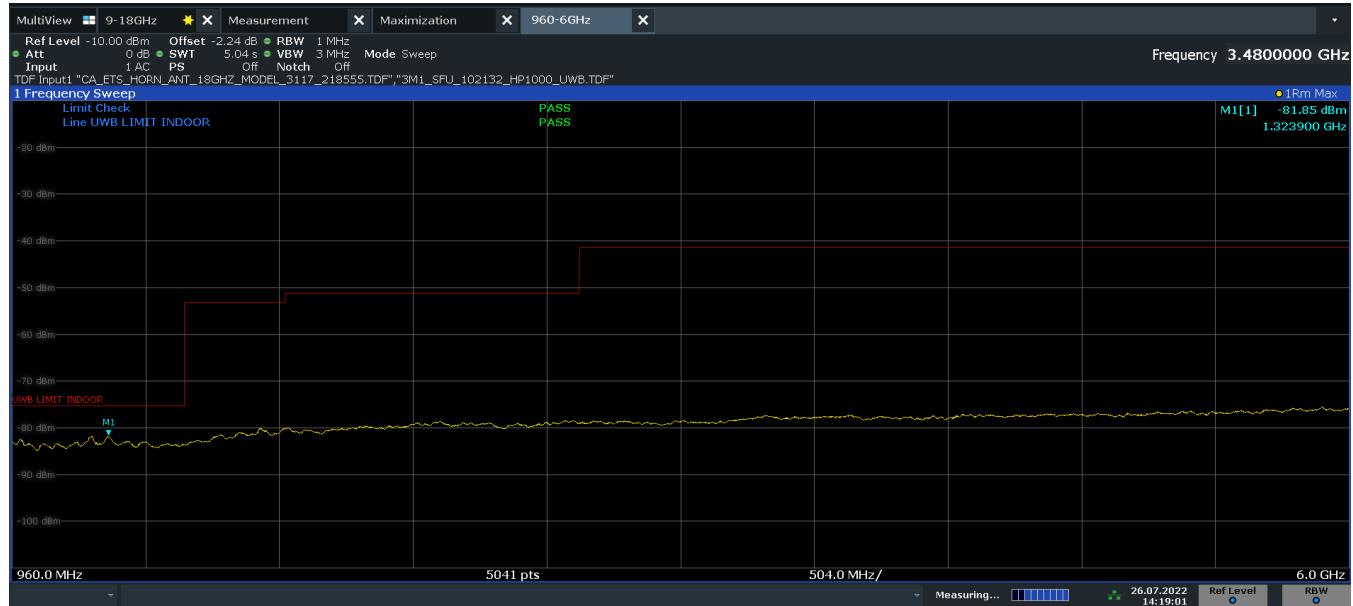
Plot 7-17. Radiated Spurious Emission 9-18GHz (Antenna 0, Ch. 9, Config 0, Payload 125, Pol. H)



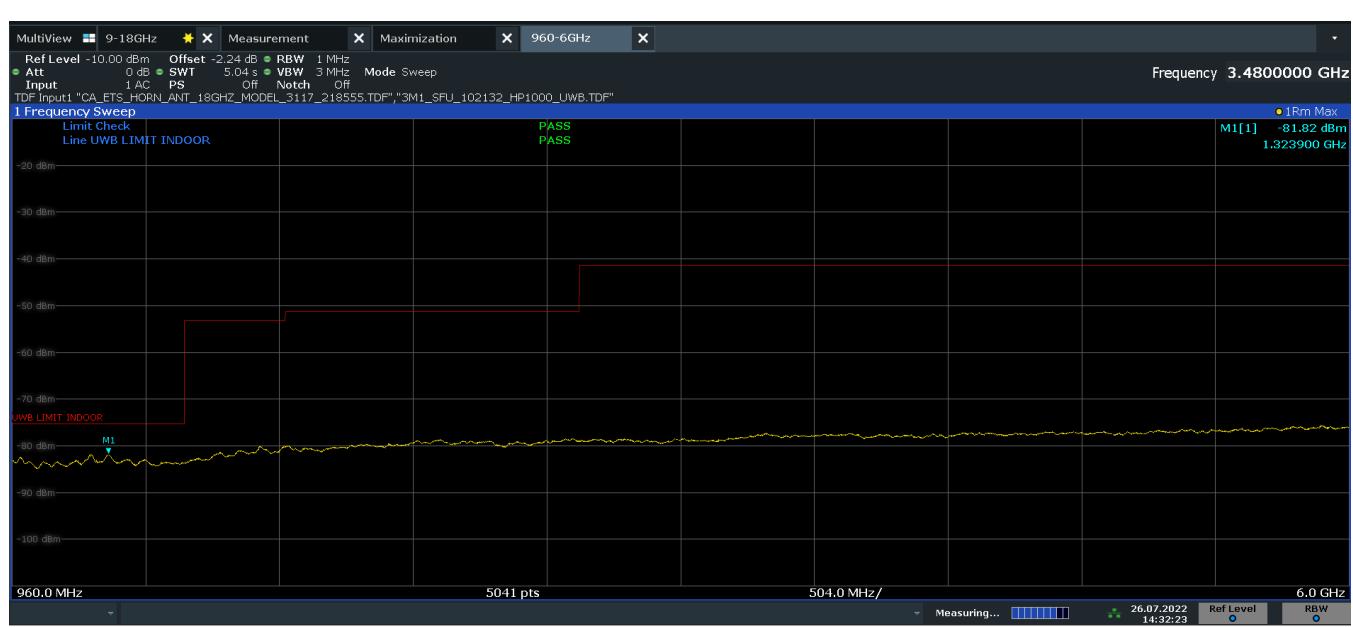
Plot 7-18. Radiated Spurious Emission 9-18GHz (Antenna 0, Ch. 9, Config 0, Payload 125, Pol. V)

FCC ID: BCGA2825 IC: 579C-A2825	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2206300045-08.BCG	Test Dates: 6/30/2022 - 9/22/2022	EUT Type: Smart Speaker	Page 34 of 57

Antenna 1

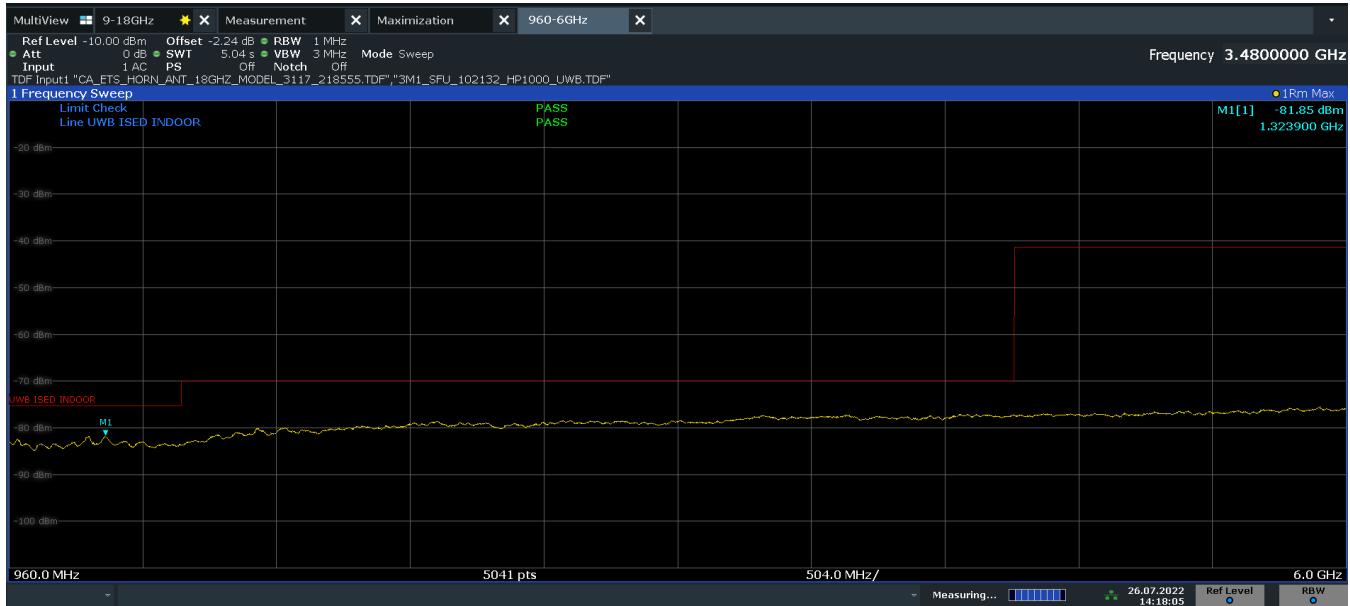


Plot 7-19. FCC Radiated Spurious Emission 960-6000MHz (Antenna 1, Ch. 9, Config 0, Payload 125, Pol. H)

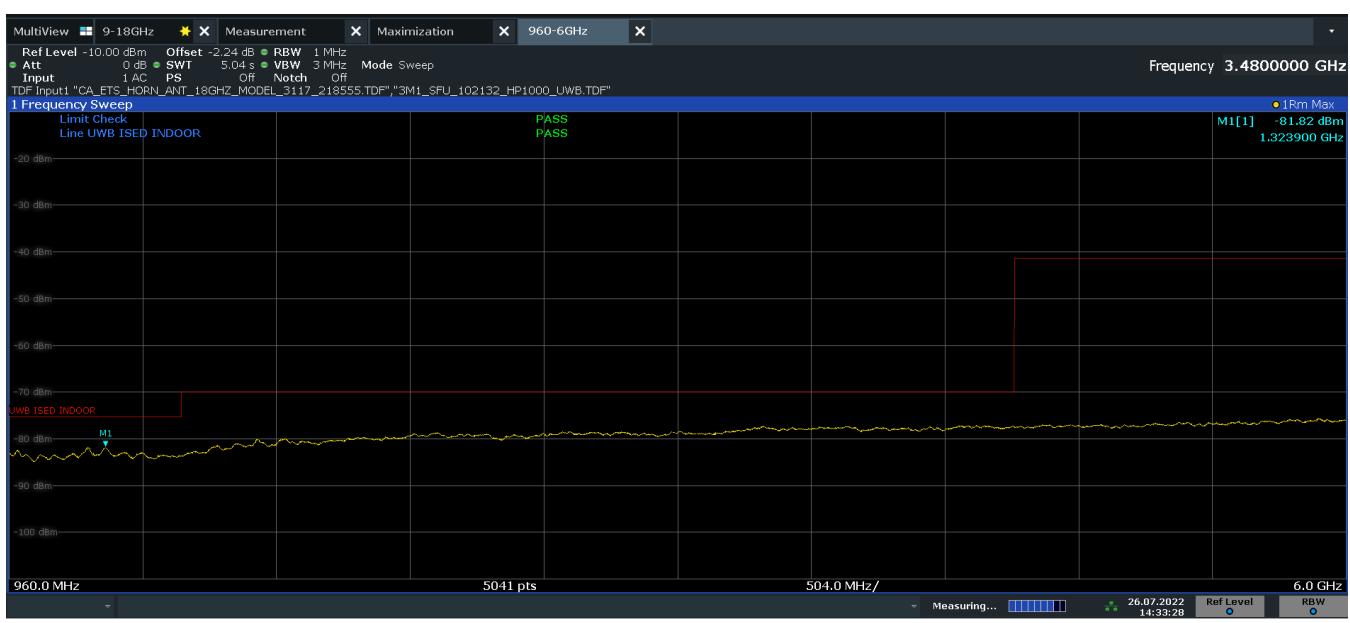


Plot 7-20. FCC Radiated Spurious Emission 960-6000MHz (Antenna 1, Ch. 9, Config 0, Payload 125, Pol. V)

FCC ID: BCGA2825 IC: 579C-A2825		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2206300045-08.BCG	Test Dates: 6/30/2022 - 9/22/2022	EUT Type: Smart Speaker	Page 35 of 57

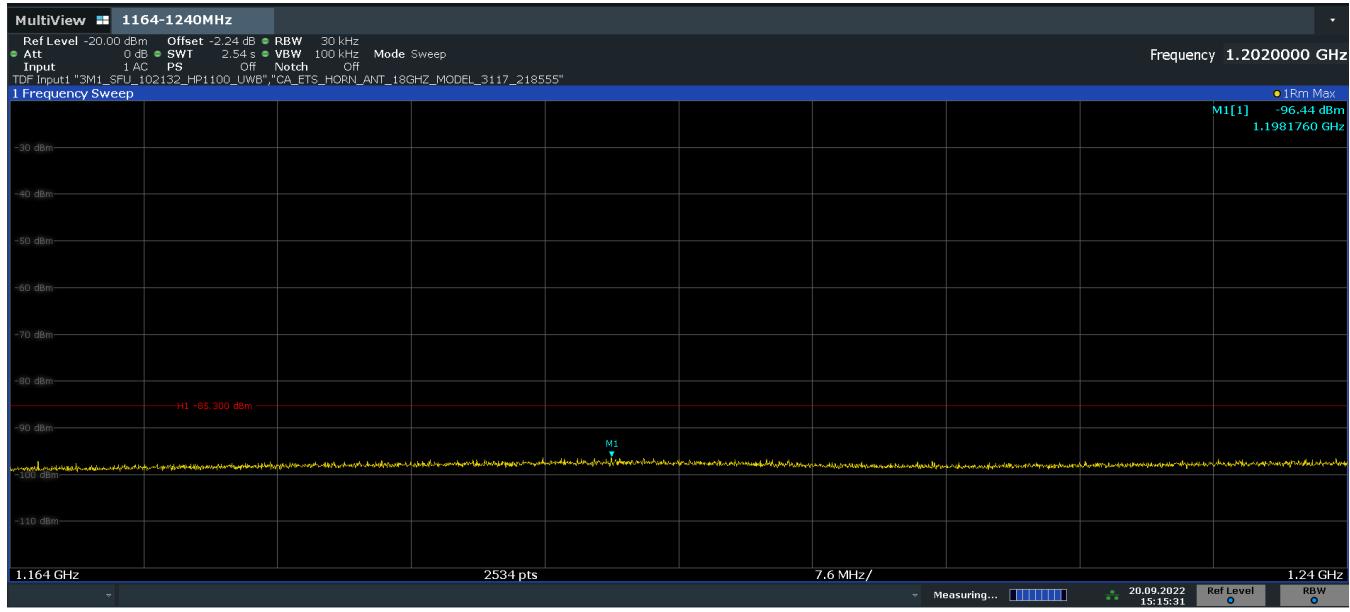


Plot 7-21. ISED Radiated Spurious Emission 960-6000MHz (Antenna 1, Ch. 9, Config 0, Payload 125, Pol. H)

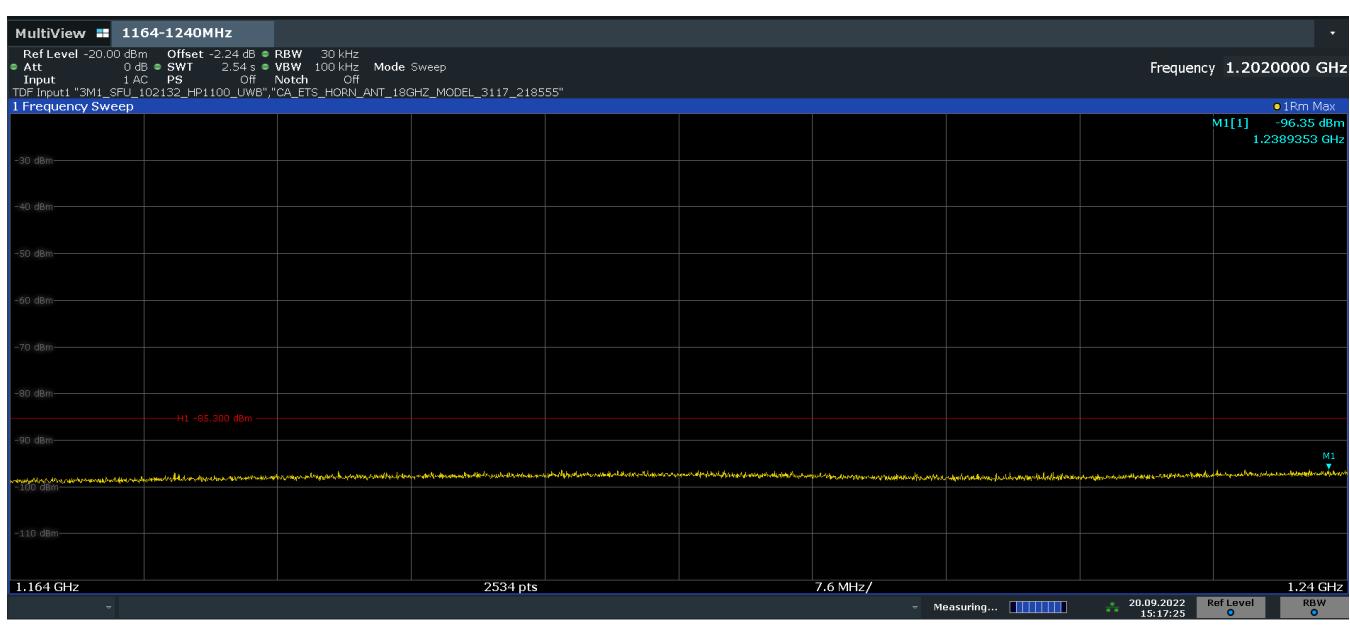


Plot 7-22. ISED Radiated Spurious Emission 960-6000MHz (Antenna 1, Ch. 9, Config 0, Payload 125, Pol. V)

FCC ID: BCGA2825 IC: 579C-A2825	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2206300045-08.BCG	Test Dates: 6/30/2022 - 9/22/2022	EUT Type: Smart Speaker	Page 36 of 57

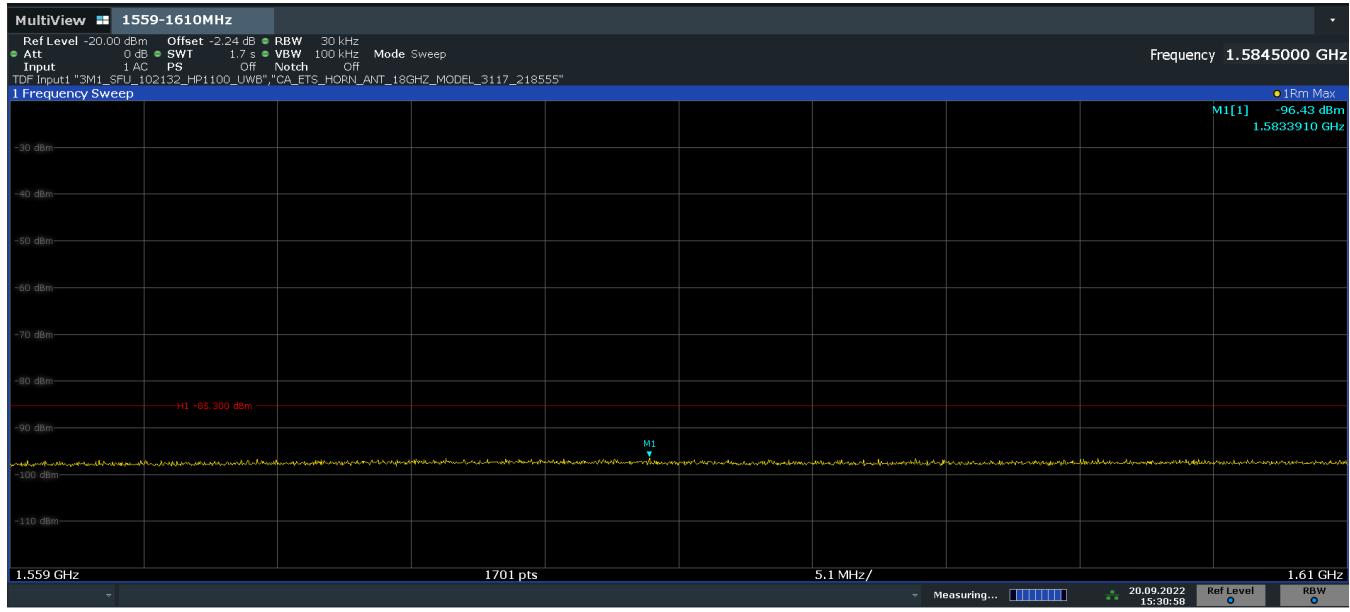


Plot 7-23. Radiated Spurious Emission 1164-1240MHz (Antenna 1, Ch. 9, Config 0, Payload 0, Pol H)

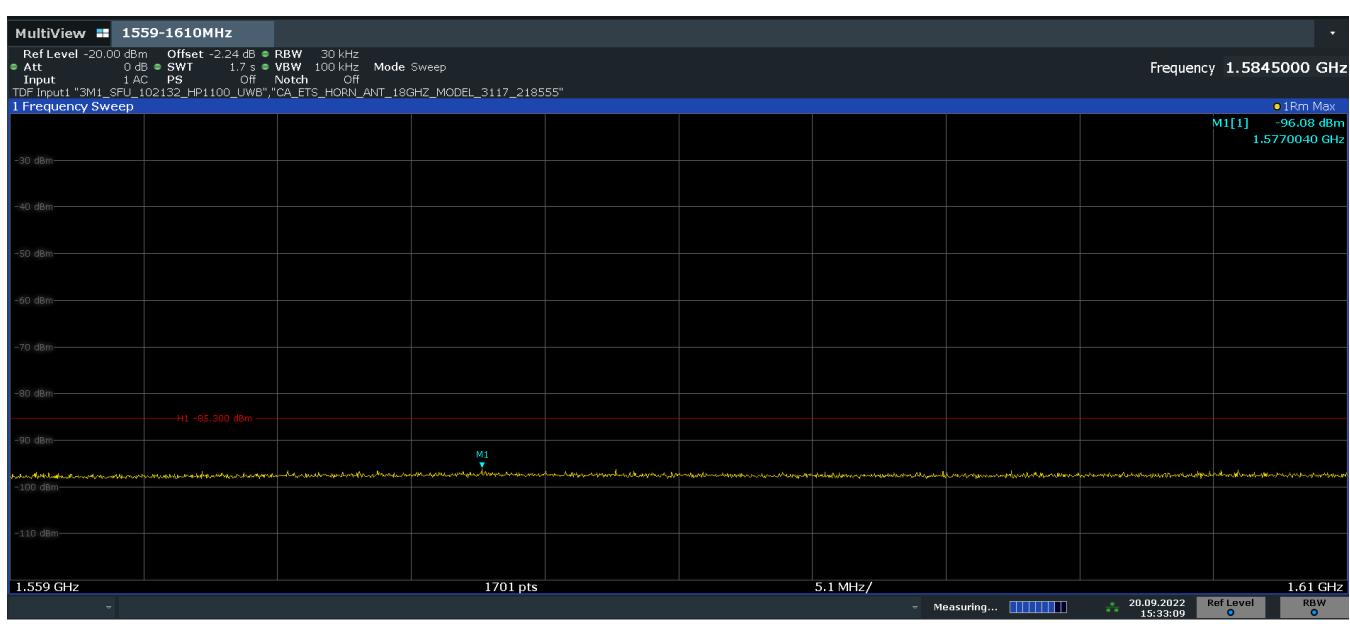


Plot 7-24. Radiated Spurious Emission 1164-1240MHz (Antenna 1, Ch. 9, Config 0, Payload 0, Pol V)

FCC ID: BCGA2825 IC: 579C-A2825	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2206300045-08.BCG	Test Dates: 6/30/2022 - 9/22/2022	EUT Type: Smart Speaker	Page 37 of 57

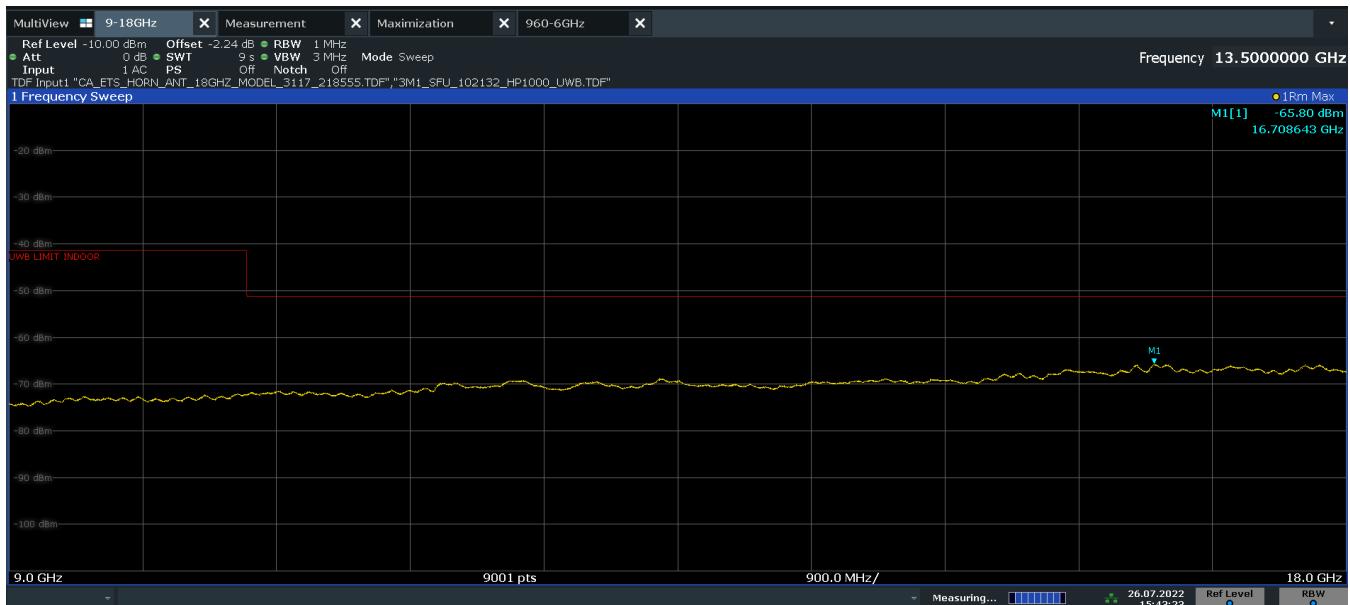


Plot 7-25. Radiated Spurious Emission 1559-1610MHz (Antenna 1, Ch. 9, Config 0, Payload 0, Pol H)

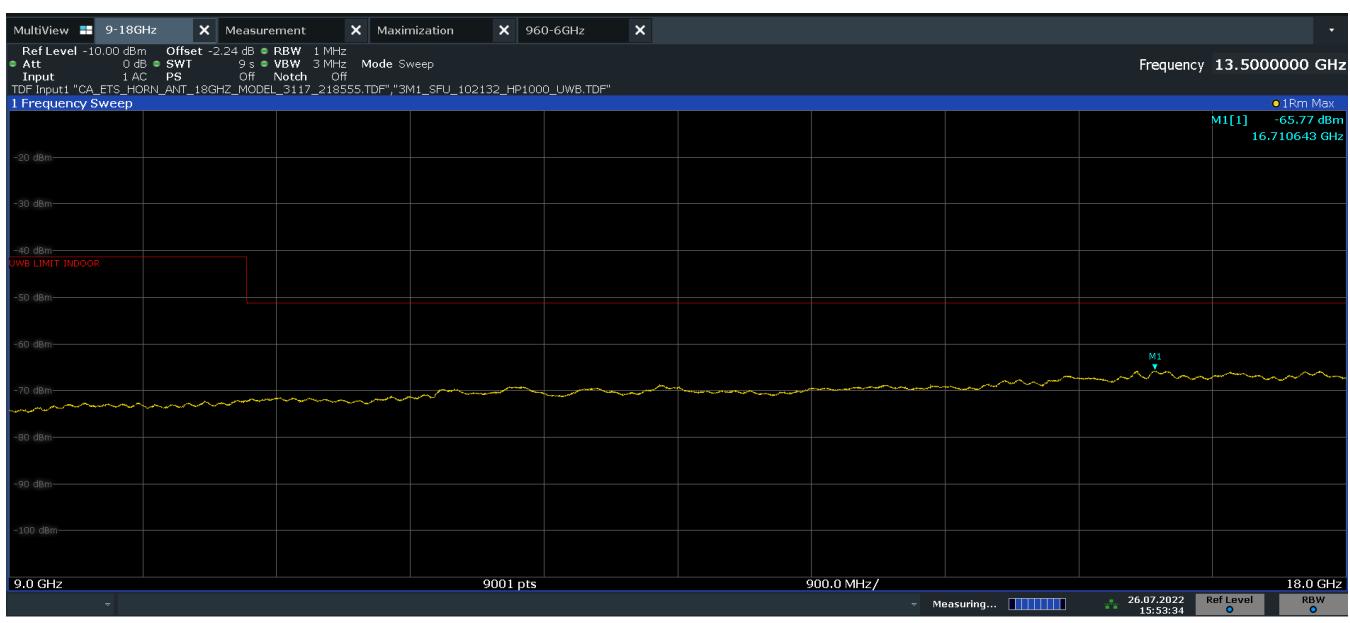


Plot 7-26. Radiated Spurious Emission 1559-1610MHz (Antenna 1, Ch. 9, Config 0, Payload 0, Pol V)

FCC ID: BCGA2825 IC: 579C-A2825	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2206300045-08.BCG	Test Dates: 6/30/2022 - 9/22/2022	EUT Type: Smart Speaker	Page 38 of 57



Plot 7-27. Radiated Spurious Emission 9-18GHz (Antenna 1, Ch. 9, Config 0, Payload 125, Pol. H)



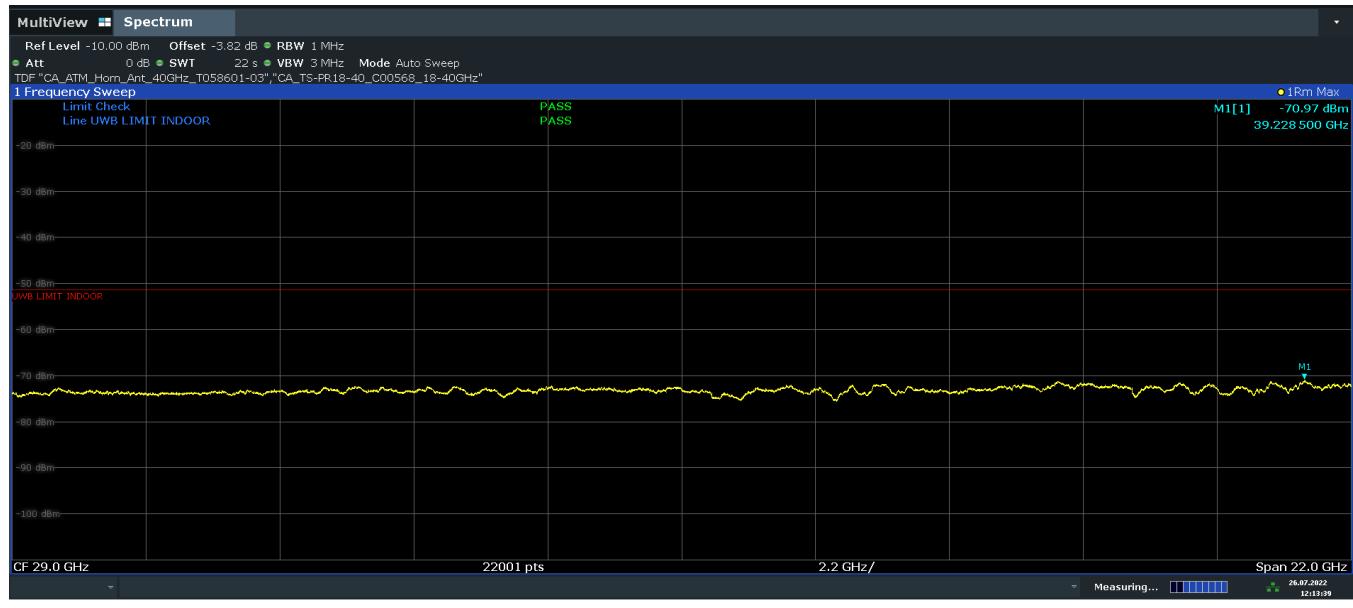
Plot 7-28. Radiated Spurious Emission 9-18GHz (Antenna 1, Ch. 9, Config 0, Payload 125, Pol. V)

FCC ID: BCGA2825 IC: 579C-A2825	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2206300045-08.BCG	Test Dates: 6/30/2022 - 9/22/2022	EUT Type: Smart Speaker	Page 39 of 57

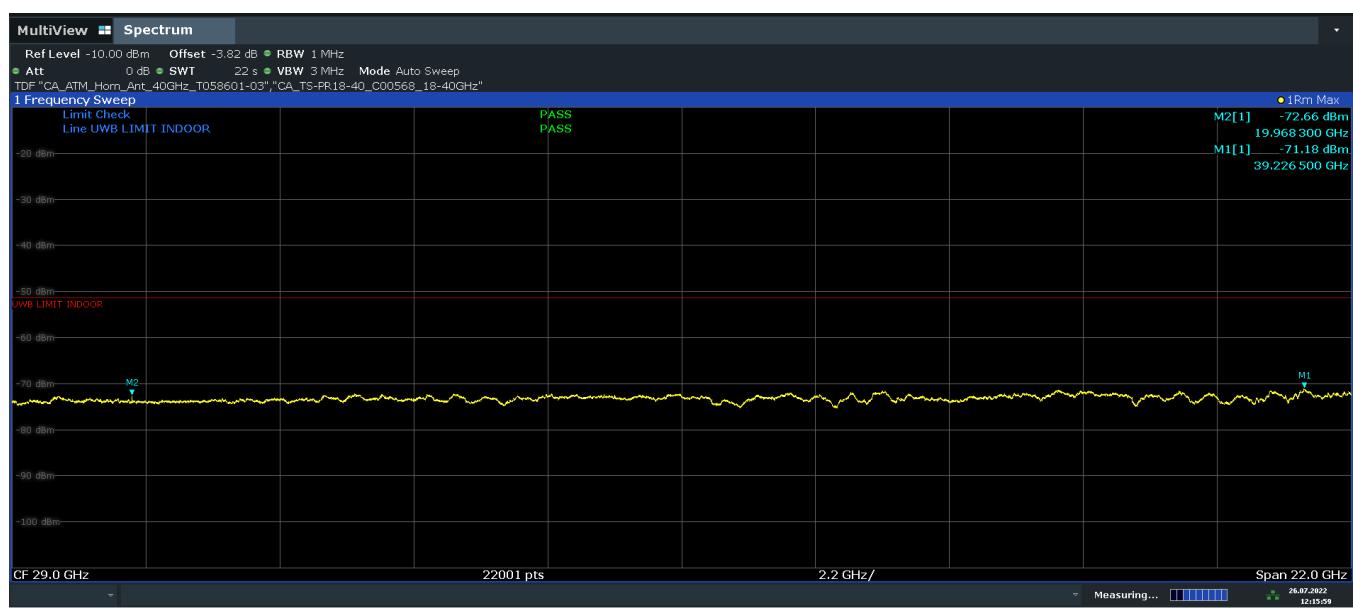
Radiated Spurious Emission (Above 18GHz)

§15.517(c); RSS-220 [5.2.1(d)]

Antenna 0



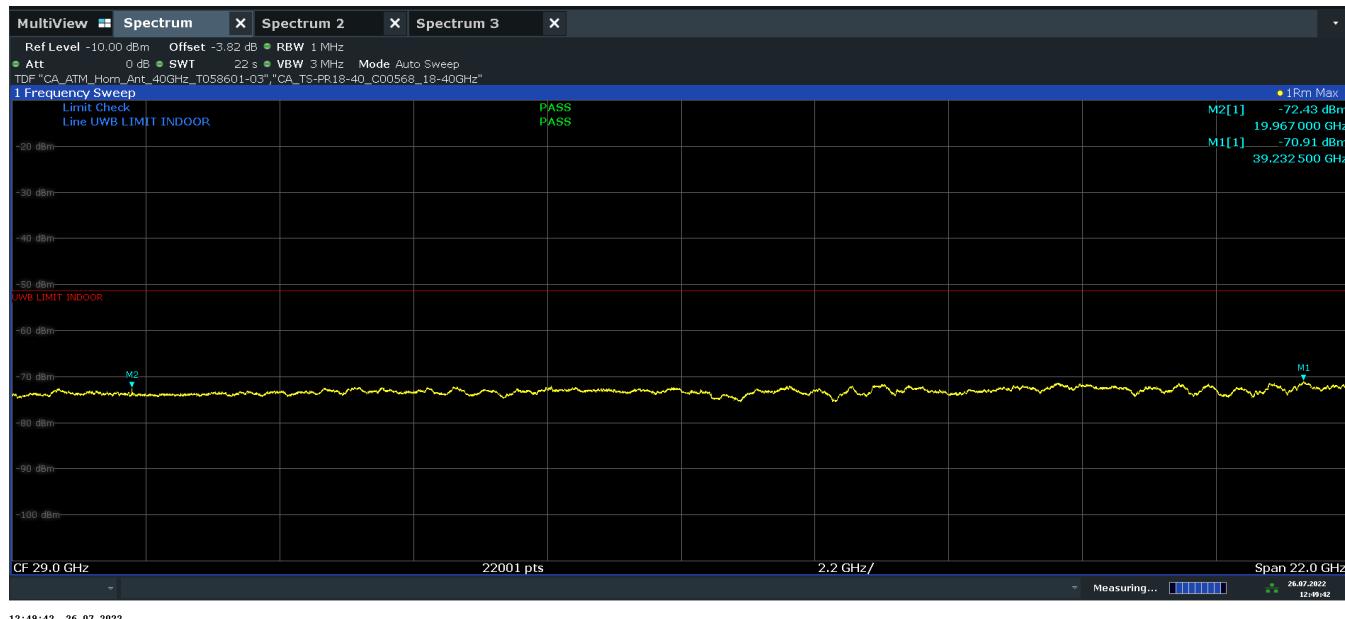
Plot 7-29. Radiated Spurious Emission 18-40GHz (Antenna 0, Ch.9, Config 0, Payload 125, Pol. H)



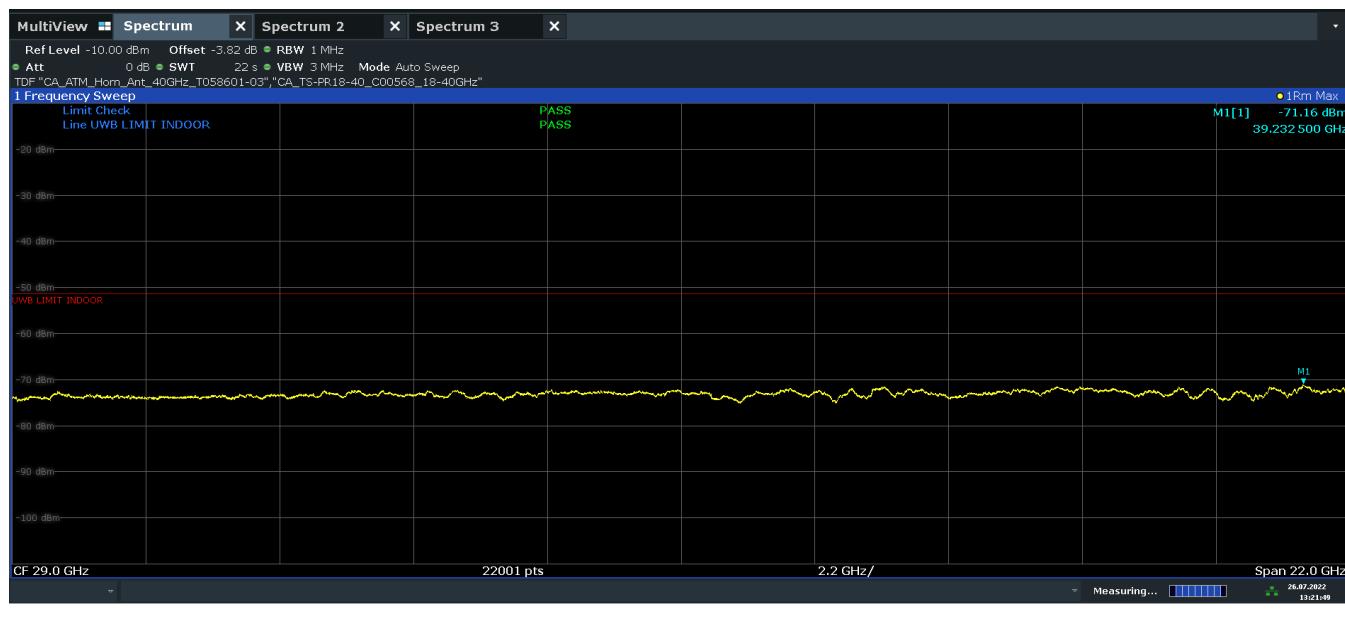
Plot 7-30. Radiated Spurious Emission 18-40GHz (Antenna 0, Ch.9, Config 0, Payload 125, Pol. V)

FCC ID: BCGA2825 IC: 579C-A2825	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2206300045-08.BCG	Test Dates: 6/30/2022 - 9/22/2022	EUT Type: Smart Speaker	Page 40 of 57

Antenna 1



Plot 7-31. Radiated Spurious Emission 18-40GHz (Antenna 1, Ch.9, Config 0, Payload 125, Pol. H)



Plot 7-32. Radiated Spurious Emission 18-40GHz (Antenna 1, Ch.9, Config 0, Payload 125, Pol. V)

FCC ID: BCGA2825 IC: 579C-A2825	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2206300045-08.BCG	Test Dates: 6/30/2022 - 9/22/2022	EUT Type: Smart Speaker	Page 41 of 57

Radiated Spurious Emission Measurements (960MHz-18GHz)

§15.517(c); RSS-220 [5.2.1(d)]

Antenna 0

Distance of Measurements:	0.6 Meters
Operating Frequency:	8000 MHz
Channel:	9
Config	0
Payload	125

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Conversion Factor [dB]	Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
1323	Avg	V	-	-	-74.78	-4.74	-2.24	-81.76	-75.30	-6.46
1824	Avg	V	-	-	-75.59	-3.38	-2.24	-81.21	-53.30	-27.91
2000	Avg	V	-	-	-76.30	-2.11	-2.24	-80.65	-51.30	-29.35
11921	Avg	V	-	-	-75.55	7.86	-2.24	-69.93	-51.30	-18.63
14546	Avg	V	-	-	-76.37	8.70	-2.24	-69.91	-51.30	-18.61
16709	Avg	V	-	-	-74.25	10.71	-2.24	-65.78	-51.30	-14.48

Table 7-15. Radiated Spurious Emission Measurements 960MHz-18GHz (FCC)

Distance of Measurements:	0.6 Meters
Operating Frequency:	8000 MHz
Channel:	9
Config	0
Payload	125

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Conversion Factor [dB]	Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
1323	Avg	V	-	-	-74.78	-4.74	-2.24	-81.76	-75.30	-6.46
1824	Avg	V	-	-	-75.59	-3.38	-2.24	-81.21	-70.00	-11.21
2000	Avg	V	-	-	-76.30	-2.11	-2.24	-80.65	-70.00	-10.65
11921	Avg	V	-	-	-75.55	7.86	-2.24	-69.93	-51.30	-18.63
14546	Avg	V	-	-	-76.37	8.70	-2.24	-69.91	-51.30	-18.61
16709	Avg	V	-	-	-74.25	10.71	-2.24	-65.78	-51.30	-14.48

Table 7-16. Radiated Spurious Emission Measurements 960MHz-18GHz (ISED)

FCC ID: BCGA2825 IC: 579C-A2825	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2206300045-08.BCG	Test Dates: 6/30/2022 - 9/22/2022	EUT Type: Smart Speaker	Page 42 of 57 V 10.5 12/15/2021

Antenna 1

Distance of Measurements:	0.6 Meters
Operating Frequency:	8000 MHz
Channel:	9
Config	0
Payload	125

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Conversion Factor [dB]	Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
1321	Avg	V	-	-	-74.78	-4.72	-2.24	-81.74	-75.30	-6.44
1896	Avg	V	-	-	-76.31	-2.68	-2.24	-81.23	-53.30	-27.93
2168	Avg	V	-	-	-75.65	-2.39	-2.24	-80.28	-51.30	-28.98
10796	Avg	V	-	-	-76.61	7.17	-2.24	-71.68	-51.30	-20.38
14566	Avg	V	-	-	-76.37	8.74	-2.24	-69.87	-51.30	-18.57
17647	Avg	V	-	-	-75.45	10.42	-2.24	-67.27	-51.30	-15.97

Table 7-17. Radiated Spurious Emission Measurements 960MHz-18GHz (FCC)

Distance of Measurements:	0.6 Meters
Operating Frequency:	8000 MHz
Channel:	9
Config	0
Payload	125

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Conversion Factor [dB]	Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
1321	Avg	V	-	-	-74.78	-4.72	-2.24	-81.74	-75.30	-6.44
1896	Avg	V	-	-	-76.31	-2.68	-2.24	-81.23	-70.00	-11.23
2168	Avg	V	-	-	-75.65	-2.39	-2.24	-80.28	-70.00	-10.28
10796	Avg	V	-	-	-76.61	7.17	-2.24	-71.68	-51.30	-20.38
14566	Avg	V	-	-	-76.37	8.74	-2.24	-69.87	-51.30	-18.57
17647	Avg	V	-	-	-75.45	10.42	-2.24	-67.27	-51.30	-15.97

Table 7-18. Radiated Spurious Emission Measurements 960MHz-18GHz (ISED)

FCC ID: BCGA2825 IC: 579C-A2825	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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Radiated Spurious Emission Measurements (Above 18GHz)

§15.517(c); RSS-220 [5.2.1(d)]

Antenna 0

Distance of Measurements:	0.5 Meters
Operating Frequency:	8000 MHz
Channel:	9
Config	0
Payload	125

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Conversion Factor [dB]	Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
19968	Avg	V	150	35	-61.46	-7.11	-3.82	-72.39	-51.30	-21.09
23216	Avg	V	-	-	-62.24	-7.03	-3.82	-73.09	-51.30	-21.79
26330	Avg	V	-	-	-63.33	-5.54	-3.82	-72.69	-51.30	-21.39
31229	Avg	V	-	-	-65.13	-3.84	-3.82	-72.79	-51.30	-21.49
34944	Avg	V	-	-	-63.86	-5.28	-3.82	-72.96	-51.30	-21.66
37192	Avg	V	-	-	-62.62	-5.34	-3.82	-71.78	-51.30	-20.48

Table 7-19. Radiated Spurious Emission Measurements 18-40GHz

FCC ID: BCGA2825 IC: 579C-A2825	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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Antenna 1

Distance of Measurements:	0.5 Meters
Operating Frequency:	8000 MHz
Channel:	9
Config	0
Payload	125

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Conversion Factor [dB]	Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
19968	Avg	V	150	260	-60.94	-7.11	-3.82	-71.87	-51.30	-20.57
23154	Avg	V	-	-	-62.36	-6.97	-3.82	-73.15	-51.30	-21.85
26487	Avg	V	-	-	-63.62	-5.34	-3.82	-72.78	-51.30	-21.48
31526	Avg	V	-	-	-65.27	-3.73	-3.82	-72.82	-51.30	-21.52
34865	Avg	V	-	-	-63.31	-5.43	-3.82	-72.56	-51.30	-21.26
37234	Avg	V	-	-	-62.35	-5.42	-3.82	-71.59	-51.30	-20.29

Table 7-20. Radiated Spurious Emission Measurements 18-40GHz

FCC ID: BCGA2825 IC: 579C-A2825	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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7.6 Radiated Spurious Emissions Measurements – Below 960MHz

§15.209; RSS-Gen [8.9]

Test Overview and Limit

All out of band radiated spurious emissions are measured with a spectrum analyzer connected to a receive antenna while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates and modes were investigated for radiated spurious emissions. Only the radiated emissions of the configuration that produced the worst case emissions are reported in this section.

All out of band emissions appearing in a restricted band as specified in Section 15.205 of the Title 47 CFR and Table 6 of RSS-Gen (8.10) must not exceed the limits shown in Table 7-21 per Section 15.209 and RSS-Gen (8.9).

Frequency	Field Strength [μ V/m]	Measured Distance [Meters]
0.009 – 0.490 MHz	2400/F (kHz)	300
0.490 – 1.705 MHz	24000/F (kHz)	30
1.705 – 30.00 MHz	30	30
30.00 – 88.00 MHz	100	3
88.00 – 216.0 MHz	150	3
216.0 – 960.0 MHz	200	3
Above 960.0 MHz	500	3

Table 7-21. Radiated Limits

Test Procedures Used

ANSI C63.10-2013

Test Settings

Quasi-Peak Field Strength Measurements

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 120kHz (for emissions from 30MHz – 1GHz)
3. Detector = quasi-peak
4. Sweep time = auto couple
5. Trace mode = max hold
6. Trace was allowed to stabilize

Peak Field Strength Measurements

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 120kHz (for emissions from 30MHz – 1GHz)
3. VBW = 300kHz
4. Detector = peak
5. Sweep time = auto couple
6. Trace mode = max hold
7. Trace was allowed to stabilize

FCC ID: BCGA2825 IC: 579C-A2825	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2206300045-08.BCG	Test Dates: 6/30/2022 - 9/22/2022	EUT Type: Smart Speaker	Page 46 of 57

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Test Setup

The EUT and measurement equipment were set up as shown in the diagrams below.

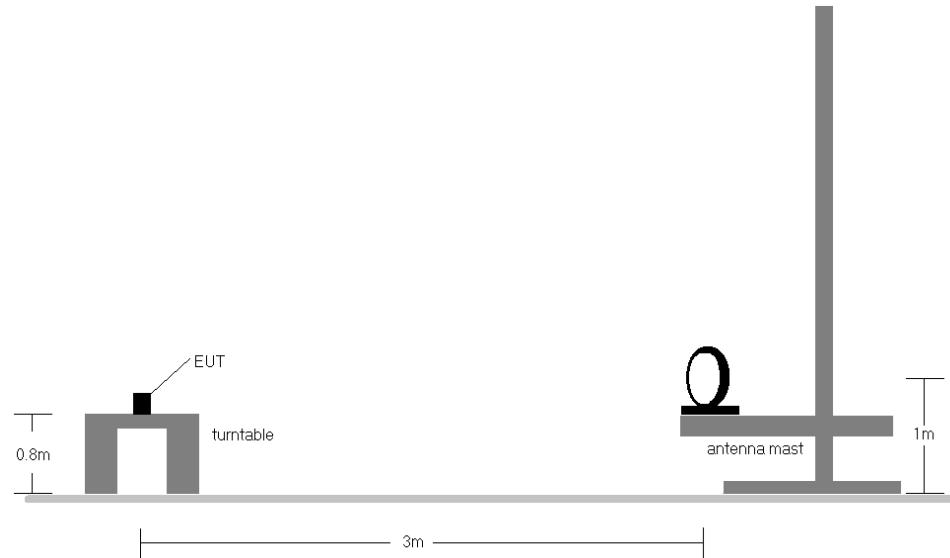


Figure 7-5. Radiated Test Setup < 30Mhz

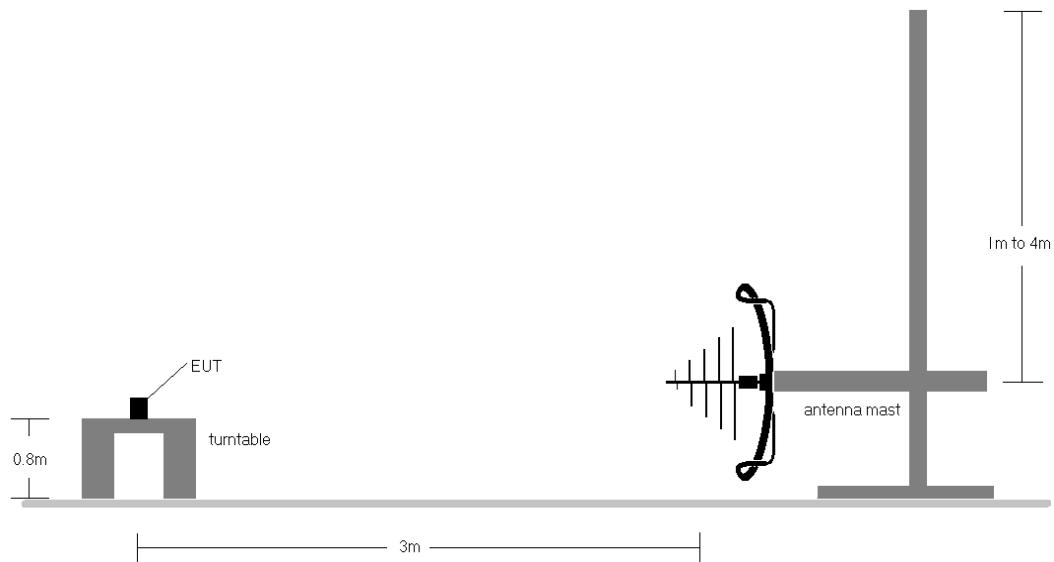


Figure 7-6. Radiated Test Setup < 1GHz

FCC ID: BCGA2825 IC: 579C-A2825	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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Test Notes

1. All emissions lying in restricted bands specified in §15.205 and RSS-Gen(8.10) are below the limit shown in Table 7-21.
2. The broadband receive antenna is manipulated through vertical and horizontal polarizations during the tests. The EUT is manipulated through three orthogonal planes. For below 30MHz the loop antenna was positioned in 3 orthogonal planes X front, Y side, Z top) to determine the orientation resulting in the worst-case emissions.
3. This unit was tested while powered by an AC power source.
4. The spectrum is investigated using a peak detector and final measurements are recorded using CISPR quasi peak detector for emissions within 6dB of the limit.
5. Emissions were measured at a 3-meter test distance.
6. Emissions are investigated while operating on the center channel of the mode, band, and modulation that produced the worst-case results during the transmitter spurious emissions testing.
7. No spurious emissions were detected within 20dB of the limit below 30MHz.
8. The results recorded using the broadband antenna is known to correlate with the results obtained by using a tuned dipole with an acceptable degree of accuracy. The VSWR for the measurement antenna was found to be less than 2:1.
9. All modes of operation were investigated and the worst-case emissions are reported.

Sample Calculations

Determining Spurious Emissions Levels

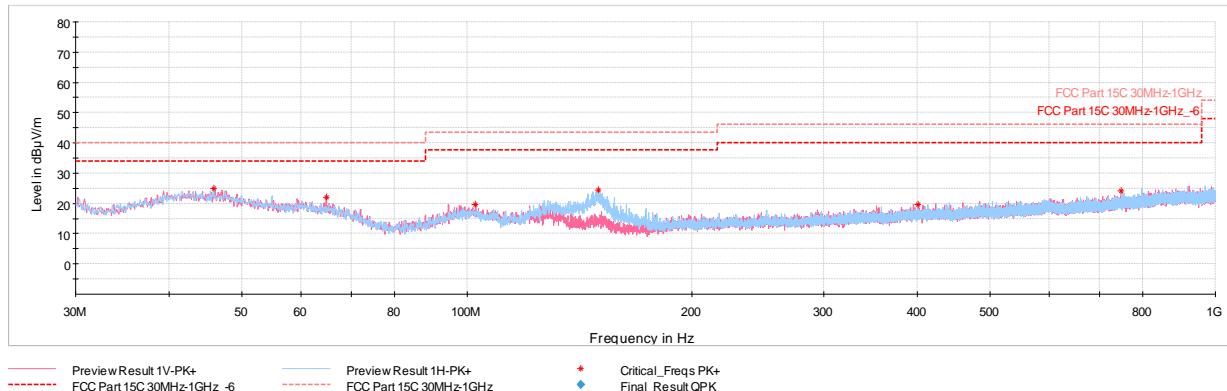
- o Field Strength Level $[\text{dB}_{\mu\text{V/m}}] = \text{Analyzer Level } [\text{dBm}] + 107 + \text{AFCL } [\text{dB/m}]$
- o AFCL $[\text{dB/m}] = (\text{Antenna Factor } [\text{dB/m}] + \text{Cable Loss } [\text{dB}] + \text{Attenuator } [\text{dB}]) - \text{Preamplifier Gain } [\text{dB}]$
- o Margin $[\text{dB}] = \text{Field Strength Level } [\text{dB}_{\mu\text{V/m}}] - \text{Limit } [\text{dB}_{\mu\text{V/m}}]$

FCC ID: BCGA2825 IC: 579C-A2825	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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7.6.1 Radiated Spurious Emissions (Below 960MHz)

§15.209; RSS-Gen [8.9]

Antenna 0

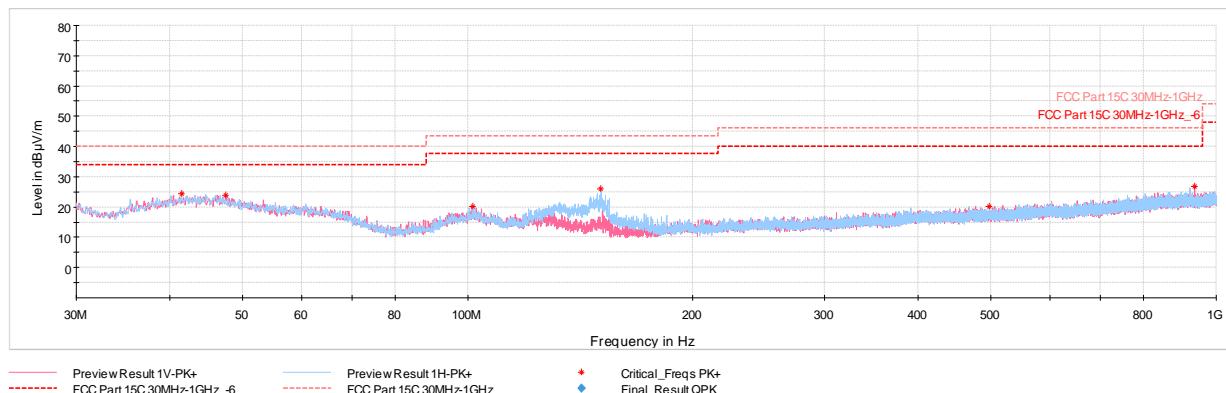


Plot 7-33. Radiated Spurious Emission 30-960MHz (Antenna 0, Ch. 9, Config 0, Payload 125 with AC power source)

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
45.86	Max Peak	H	300	32	-66.29	-15.77	24.94	40.00	-15.06
64.87	Max Peak	V	300	272	-66.46	-18.40	22.14	40.00	-17.86
102.70	Max Peak	V	200	53	-69.56	-17.71	19.73	43.52	-23.79
149.99	Max Peak	H	200	15	-61.11	-21.37	24.52	43.52	-19.00
400.35	Max Peak	V	300	100	-74.71	-12.51	19.78	46.02	-26.24
747.32	Max Peak	V	300	15	-76.42	-6.41	24.17	46.02	-21.85

Table 7-22. Radiated Spurious Emission 30-960MHz (Antenna 0, Ch. 9, Config 0, Payload 125 with AC power source)

FCC ID: BCGA2825 IC: 579C-A2825	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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Antenna 1

Plot 7-34. Radiated Spurious Emission 30-960MHz (Antenna 1, Ch. 9, Config 0, Payload 125 with AC power source)

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
41.49	Max Peak	H	200	253	-66.15	-16.48	24.37	40.00	-15.63
47.51	Max Peak	V	300	266	-67.54	-15.46	24.00	40.00	-16.00
101.49	Max Peak	H	300	354	-68.94	-17.82	20.24	43.52	-23.28
150.72	Max Peak	H	200	89	-59.77	-21.19	26.04	43.52	-17.48
497.69	Max Peak	H	300	330	-76.10	-10.65	20.25	46.02	-25.77
936.71	Max Peak	V	300	16	-75.76	-4.46	26.78	46.02	-19.24

Table 7-23. Radiated Spurious Emission 30-960MHz (Antenna 0, Ch. 9, Config 0, Payload 125 with AC power source)

FCC ID: BCGA2825 IC: 579C-A2825	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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7.7 AC Line-Conducted Emission Measurement

§15.207; RSS-Gen [8.8]

Test Overview and Limit

All AC line conducted spurious emissions are measured with a receiver connected to a grounded LISN while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates and modes were investigated for conducted spurious emissions. Only the conducted emissions of the configuration that produced the worst case emissions are reported in this section.

All conducted emissions must not exceed the limits shown in the table below, per Section 15.207 and RSS-Gen (8.8).

Frequency of emission (MHz)	Conducted Limit (dB μ V)	
	Quasi-peak	Average
0.15 – 0.5	66 to 56*	56 to 46*
0.5 – 5	56	46
5 – 30	60	50

Table 7-24. Conducted Limits

*Decreases with the logarithm of the frequency.

Test Procedures Used

ANSI C63.10-2013, Section 6.2

Test Settings

Quasi-Peak Measurements

1. Analyzer center frequency was set to the frequency of the spurious emission of interest
2. RBW = 9kHz (for emissions from 150kHz – 30MHz)
3. Detector = quasi-peak
4. Sweep time = auto couple
5. Trace mode = max hold
6. Trace was allowed to stabilize

Average Measurements

1. Analyzer center frequency was set to the frequency of the spurious emission of interest
2. RBW = 9kHz (for emissions from 150kHz – 30MHz)
3. Detector = RMS
4. Sweep time = auto couple
5. Trace mode = max hold
6. Trace was allowed to stabilize

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Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

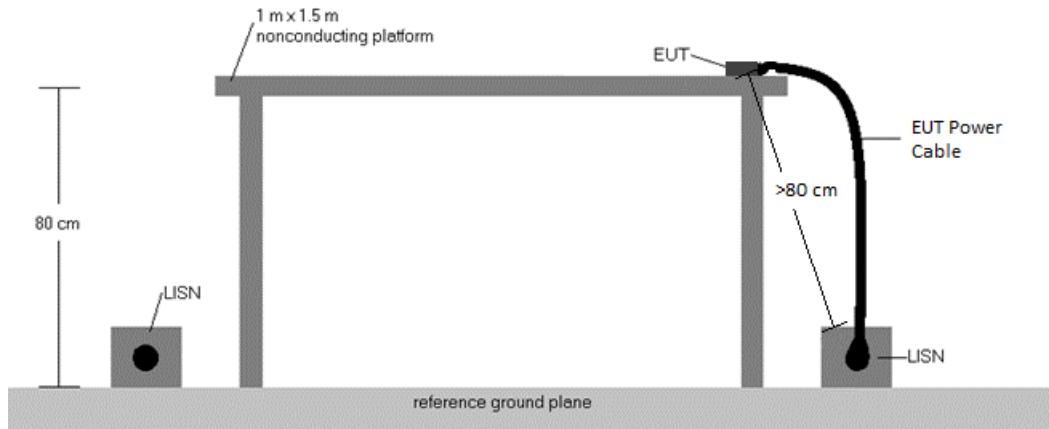


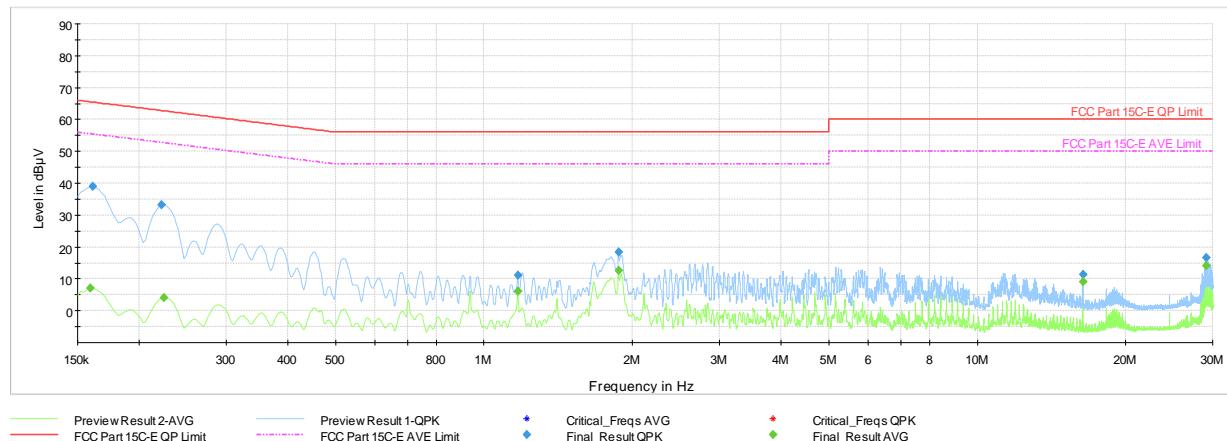
Figure 7-7. Test Instrument & Measurement Setup

Test Notes

1. All modes of operation were investigated and the worst-case emissions are reported. The emissions found were not affected by the choice of channel used during testing.
2. The limit for an intentional radiator from 150kHz to 30MHz are specified in Part 15.207 and RSS-Gen (8.8).
3. Corr. (dB) = Cable loss (dB) + LISN insertion factor (dB)
4. QP/AV Level (dB μ V) = QP/AV Analyzer/Receiver Level (dB μ V) + Corr. (dB)
5. Margin (dB) = QP/AV Level (dB μ V) - QP/AV Limit (dB μ V)
6. Traces shown in plot are made using a quasi-peak and average detectors
7. Deviations to the Specifications: None.

FCC ID: BCGA2825 IC: 579C-A2825	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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Antenna 0

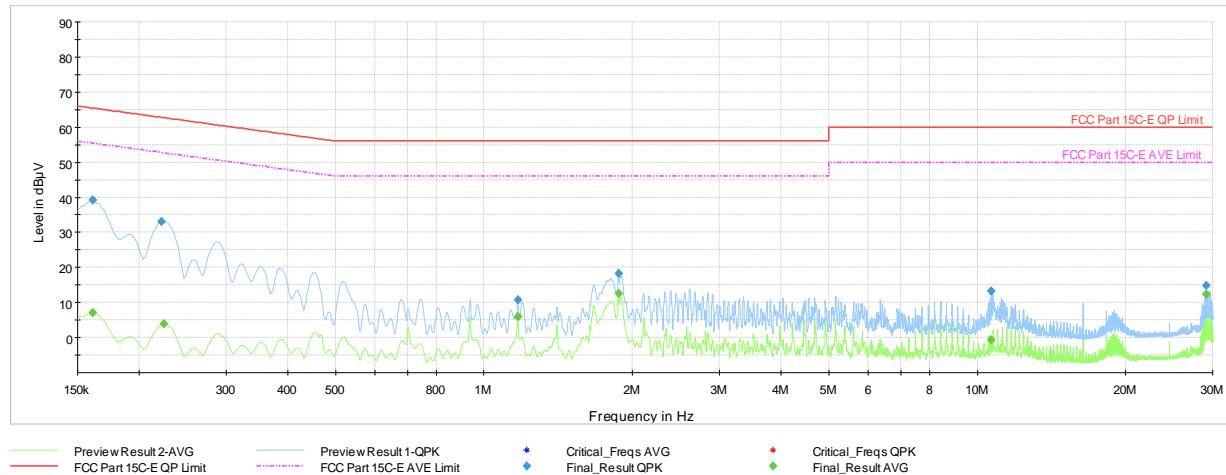


Plot 7-35. AC Line Conducted (Antenna 0, Ch.9, Config 0, Payload 125, L1, with AC power source)

Frequency [MHz]	Process State	QuasiPeak [dBμV]	Average [dBμV]	Limit [dBμV]	Margin [dB]	Line	PE
0.159	FINAL	—	6.97	55.52	-48.55	L1	GND
0.161	FINAL	39.0	—	65.40	-26.41	L1	GND
0.222	FINAL	33.1	—	62.74	-29.64	L1	GND
0.224	FINAL	—	4.14	52.66	-48.52	L1	GND
1.172	FINAL	11.0	—	56.00	-44.99	L1	GND
1.172	FINAL	—	5.98	46.00	-40.02	L1	GND
1.874	FINAL	18.4	—	56.00	-37.56	L1	GND
1.874	FINAL	—	12.56	46.00	-33.44	L1	GND
16.361	FINAL	—	9.04	50.00	-40.97	L1	GND
16.364	FINAL	11.5	—	60.00	-48.52	L1	GND
29.155	FINAL	—	14.07	50.00	-35.93	L1	GND
29.155	FINAL	16.5	—	60.00	-43.47	L1	GND

Table 7-25. AC Line Conducted Data (Antenna 0, Ch.9, Config 0, Payload 125, L1, with AC power source)

FCC ID: BCGA2825 IC: 579C-A2825	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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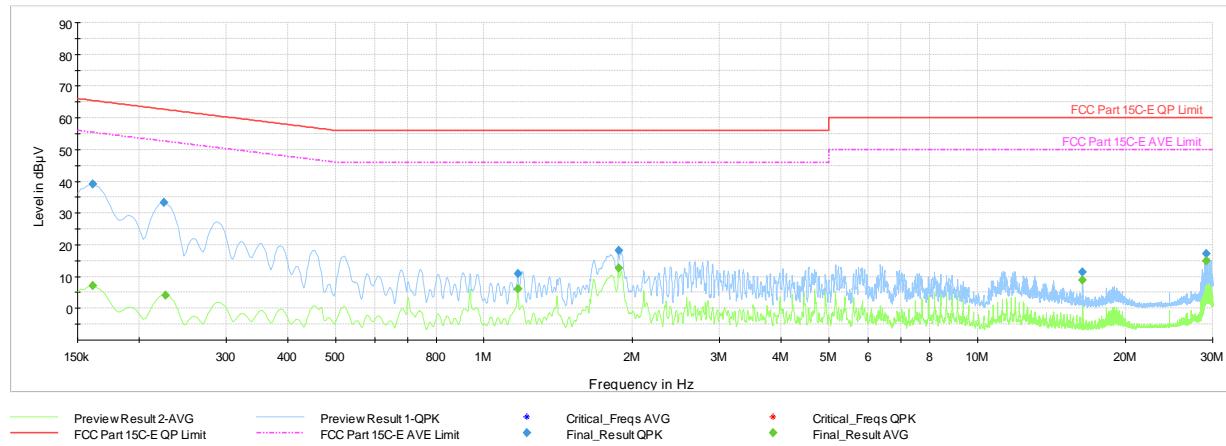
Plot 7-36. AC Line Conducted (Antenna 0, Ch.9, Config 0, Payload 125, N, with AC power source)

Frequency [MHz]	Process State	QuasiPeak [dB μ V]	Average [dB μ V]	Limit [dB μ V]	Margin [dB]	Line	PE
0.161	FINAL	—	7.11	55.40	-48.29	N	GND
0.161	FINAL	39.1	—	65.40	-26.28	N	GND
0.222	FINAL	33.2	—	62.74	-29.60	N	GND
0.224	FINAL	—	3.86	52.66	-48.80	N	GND
1.172	FINAL	—	5.90	46.00	-40.10	N	GND
1.172	FINAL	10.8	—	56.00	-45.24	N	GND
1.874	FINAL	18.3	—	56.00	-37.67	N	GND
1.874	FINAL	—	12.56	46.00	-33.44	N	GND
10.691	FINAL	13.2	—	60.00	-46.85	N	GND
10.691	FINAL	—	-0.69	50.00	-50.69	N	GND
29.153	FINAL	—	12.44	50.00	-37.56	N	GND
29.153	FINAL	14.8	—	60.00	-45.20	N	GND

Table 7-26. AC Line Conducted Data (Antenna 0, Ch.9, Config 0, Payload 125, N, with AC power source)

FCC ID: BCGA2825 IC: 579C-A2825		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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Antenna 1

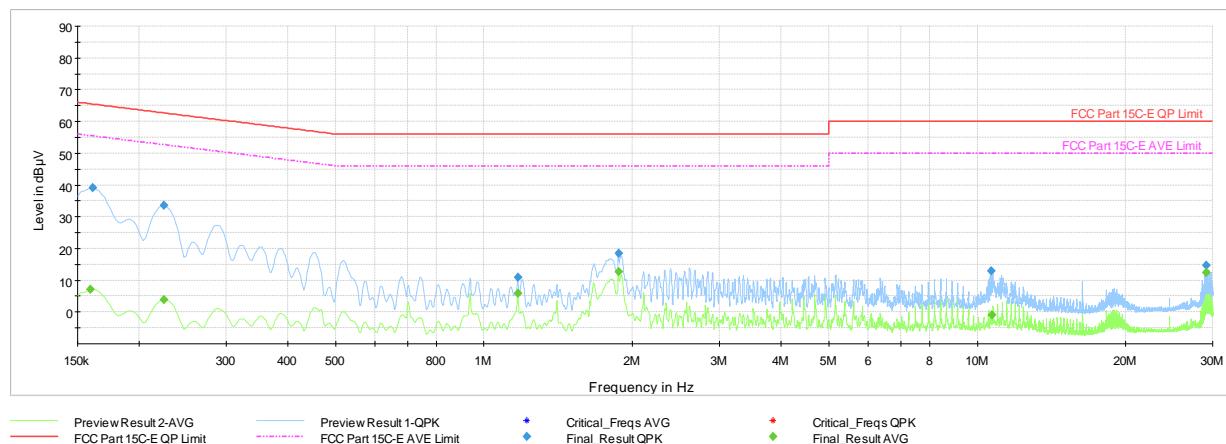


Plot 7-37. AC Line Conducted (Antenna 1, Ch.9, Config 0, Payload 125, L1, with AC power source)

Frequency [MHz]	Process State	QuasiPeak [dB μ V]	Average [dB μ V]	Limit [dB μ V]	Margin [dB]	Line	PE
0.161	FINAL	—	7.14	55.40	-48.26	L1	GND
0.161	FINAL	39.2	—	65.40	-26.16	L1	GND
0.224	FINAL	33.3	—	62.66	-29.34	L1	GND
0.227	FINAL	—	4.16	52.58	-48.42	L1	GND
1.172	FINAL	—	6.04	46.00	-39.96	L1	GND
1.172	FINAL	11.0	—	56.00	-45.05	L1	GND
1.874	FINAL	18.3	—	56.00	-37.66	L1	GND
1.874	FINAL	—	12.64	46.00	-33.36	L1	GND
16.352	FINAL	11.5	—	60.00	-48.53	L1	GND
16.355	FINAL	—	9.02	50.00	-40.98	L1	GND
29.159	FINAL	—	14.95	50.00	-35.05	L1	GND
29.159	FINAL	17.2	—	60.00	-42.78	L1	GND

Table 7-27. AC Line Conducted Data (Antenna 1, Ch.9, Config 0, Payload 125, L1, with AC power source)

FCC ID: BCGA2825 IC: 579C-A2825	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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Plot 7-38. AC Line Conducted (Antenna 1, Ch.9, Config 0, Payload 125, N, with AC power source)

Frequency [MHz]	Process State	QuasiPeak [dBµV]	Average [dBµV]	Limit [dBµV]	Margin [dB]	Line	PE
0.159	FINAL	—	7.15	55.52	-48.37	N	GND
0.161	FINAL	39.2	—	65.40	-26.23	N	GND
0.224	FINAL	—	3.97	52.66	-48.69	N	GND
0.224	FINAL	33.5	—	62.66	-29.20	N	GND
1.172	FINAL	—	5.96	46.00	-40.04	N	GND
1.172	FINAL	10.8	—	56.00	-45.16	N	GND
1.874	FINAL	18.4	—	56.00	-37.61	N	GND
1.874	FINAL	—	12.69	46.00	-33.31	N	GND
10.691	FINAL	12.8	—	60.00	-47.16	N	GND
10.694	FINAL	—	-0.92	50.00	-50.92	N	GND
29.162	FINAL	—	12.31	50.00	-37.69	N	GND
29.162	FINAL	14.6	—	60.00	-45.39	N	GND

Table 7-28. AC Line Conducted Data (Antenna 1, Ch.9, Config 0, Payload 125, N, with AC power source)

FCC ID: BCGA2825 IC: 579C-A2825	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2206300045-08.BCG	Test Dates: 6/30/2022 - 9/22/2022	EUT Type: Smart Speaker	Page 56 of 57

8.0 CONCLUSION

The data collected relate only the item(s) tested and show that the **Apple Smart Speaker** **FCC ID: BCGA2825** and **IC: 579C-A2825** is in compliance with Part 15 Subpart F (15.517) of the FCC Rules and RSS-220 of the Innovation, Science and Economic Development Canada Rules.

FCC ID: BCGA2825 IC: 579C-A2825	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2206300045-08.BCG	Test Dates: 6/30/2022 - 9/22/2022	EUT Type: Smart Speaker	Page 57 of 57