

Element U.S. Space & Defense Test Report for RTCA/DO-160G Radiated RF Emissions Testing of the Bluetooth Low Energy (BLE) Beacon Tag

Prepared For

Descartes Systems (USA) LLC | 2030 Powers Ferry Road SE, Suite 350 | Atlanta, GA 30339

Performed By

Element U.S. Space & Defense | 6881 Kingspointe Parkway, Suite 15 | Orlando, FL 32819 | 407-293-5844

www.elementdefense.com

Jamie Lilley
Technical Writer

Scott Williamson
Principal EMI Test Engineer

Revision History

Rev.	Description	Issue Date
0	Initial Release	08/30/2024

Table of Contents

1.0 Introduction 4

2.0 References 4

3.0 Product Selection and Description 4

 3.1 Security Classification 4

4.0 General Test Requirements 4

 4.1 Test Equipment 4

5.0 Test Description and Results 5

 5.1 Radiated RF Emissions 6

 5.1.1 Test Procedure 6

 5.1.2 Test Result 6

 5.1.3 Test Datasheets 6

 5.1.4 Test Photographs 8

 5.1.5 Test Data 15

 5.1.6 Test Equipment List 19

List of Tables

Table 3.0-1: Product Identification - Equipment Under Test (EUT) 4

Table 5.0-1: Summary of Test Information & Results 5

Table 5.1-1: Radiated RF Emissions Test Equipment List 19

1.0 Introduction

This document presents the test procedures used and the results obtained during the performance of RTCA/DO-160G Radiated RF Emissions testing. The testing was conducted to assess the ability of the specified Equipment Under Test (EUT) to successfully satisfy the requirements listed in Section 2.0.

2.0 References

The following references listed below form a part of this document to the extent specified herein.

- Test Specification: Customer email from Maria Vivas Suarez, dated 7/22/2024 at 4:06 PM (initial RFQ email), and RTCA/DO-160G, *Environmental Conditions and Test Procedures for Airborne Equipment*, dated 12/8/2010, Section 21.5, Category H
- Descartes Systems (USA) LLC Purchase Order 4500043423, dated 07/26/2024
- Element U.S. Space & Defense Quote OH000020500, dated 07/23/2024
- ISO/IEC 17025:2017(E) *General Requirements for the Competence of Testing and Calibration Laboratories*, dated 11/1/2017

3.0 Product Selection and Description

Descartes Systems (USA) LLC selected and provided the test sample to be used as the Equipment Under Test.

Table 3.0-1: Product Identification - Equipment Under Test (EUT)

Item	Qty.	Name/Description	Part Number	Serial Number
1	1	Bluetooth Low Energy (BLE) Beacon Tag	STD001	0xC14726A51820

3.1 Security Classification

Unclassified

4.0 General Test Requirements

4.1 Test Equipment

The instrumentation used in the performance of these tests is periodically calibrated and standardized within manufacturer's rated accuracies and are traceable to the National Institute of Standards and Technology. The calibration procedures and practices are in accordance with ISO 17025:2017. Certification of calibration is on file subject to inspection by authorized personnel.

5.0 Test Description and Results

Table 5.0-1: Summary of Test Information & Results

Section	Test	Specification	Test Facility	Test Date	Part #	Serial #	Test Result
5.1	Radiated RF Emissions	Customer email from Maria Vivas Suarez, dated 7/22/2024 at 4:06 PM (initial RFQ email), and RTCA/DO-160G, Section 21.5, Category H	Orlando	08/28/2024 - 08/29/2024	STD001	0xC14726A51820	Complied

The decision rule for Test Results was based on the Test Specification used for testing.

5.1 Radiated RF Emissions

5.1.1 Test Procedure

The EUT was tested to Customer email from Maria Vivas Suarez, dated 7/22/2024 at 4:06 PM (initial RFQ email), and RTCA/DO-160G, Section 21.5, Category H requirements.

5.1.2 Test Result

The EUT radiated emissions did not emit undesired RF noise in excess of the specified limits over the frequency range from 100 MHz to 6 GHz. The EUT was compliant with the RTCA/DO-160G, Section 21.5, Category H requirements.

5.1.3 Test Datasheets

Element U.S. Space & Defense					
Section 21 Radiated RF Emissions System Verification					
RE Limit		Category H			
Frequency (MHz)	Limit (dB μ V/m)	Calibrated Signal Amplitude (dB μ V)	Measured Signal Amplitude (dB μ V)	Deviation (dB)	Result
197	49.31	43.31	44.17	0.85	Complied
950	60.22	54.22	55.21	0.99	Complied
5500	72.40	66.40	65.98	-0.42	Complied
Test Performed By: Scott C. Williamson			Date: 8/28/2024		

Element U.S. Space & Defense							
Section 21 Radiated RF Emissions Bandwidth, Measurement Time and Frequency Resolution							
Spectrum Analyzer Used:				Agilent E4440A			
Start Frequency (MHz)	Stop Frequency (MHz)	Table II Minimum Measurement Time (sec/MHz)	Table II 6dB Resolution BW (MHz)	Minimum Measurement time for this band (sec)	Minimum Number of ranges needed	Minimum Measurement Time per Range (sec)	Frequency Resolution (MHz)
100	200	1.5	0.01	150	20	7.50	0.00499500
200	400	1.5	0.01	300	40	7.50	0.00499500
400	960	0.15	0.1	84	12	7.00	0.04662005
960	1000	0.015	1	0.6	1	0.60	0.03996004
1000	6000	0.015	1	75	10	7.50	0.49950050

Element U.S. Space & Defense						
Section 21 Radiated RF Emissions Data Sheet						
Remarks: All operational scan data can be found in file -002.						
Service Branch: Aerospace				Test Level: Category H		
Tile Software Version:		7.3.4.7				
Start Frequency (MHz)	Stop Frequency (MHz)	6dB Bandwidth (kHz)	Limit	Mode of Operation	Complied / Did Not Comply	Remarks
100	200	10	Category H	Active	Complied	Vertical; Antenna Height: 120.5 cm
100	200	10	Category H	Active	Complied	Horizontal; Antenna Height: 120.5 cm
200	400	10	Category H	Active	Complied	Vertical; Antenna Height: 120.5 cm
200	400	10	Category H	Active	Complied	Horizontal; Antenna Height: 119.5 cm
400	960	100	Category H	Active	Complied	Vertical; Antenna Height: 120.5 cm
400	960	100	Category H	Active	Complied	Horizontal; Antenna Height: 119.5 cm
960	1000	1000	Category H	Active	Complied	Vertical; Antenna Height: 120.5 cm
960	1000	1000	Category H	Active	Complied	Horizontal; Antenna Height: 119.5 cm
1000	6000	1000	Category H	Active	Complied	Vertical; Antenna Height: 121 cm
1000	6000	1000	Category H	Active	Complied	Horizontal; Antenna Height: 121 cm
Test Performed By: Scott C. Williamson						

Element U.S. Space & Defense							
Section 21 Radiated RF Emissions Log							
Temperature:	23.6	° C	Humidity:	45	% RH	Barometer:	SITE Pressure
Date	Time	Log Entries				Initials	
8/28/24	1038	Setting up in Chamber #5.				SCW	
	1130	Break for Lunch.				SCW	
	1234	Back from Lunch. Resuming setup.				SCW	
	1256	Setting up for System Verification.				SCW	
	1325	Starting System Verification. Reference File -001.				SCW	
	1352	System Verification points for the 100-200 MHz and 200 MHz to 1 GHz frequency ranges complete and good. Setting up for verification of the 1-6 GHz frequency range.				SCW	
	1406	Software is having a problem resolving the 5.5 GHz test point. Investigating.				SCW	
	1418	Problem resolved.				SCW	
	1420	System Verification point for the 1-6 GHz frequency range complete and good. Setting up for measurement scans. Per customer email (sent by Maria Vivas Suarez on 8/27/2024 at 2:24 PM), EUT is already in "Active" mode.				SCW	
	1447	Ready to begin scanning the 100-200 MHz range. Reference File -002.				SCW	
	1459	Starting 100-200 MHz scans.				SCW	
	1507	Vertical scan complete. No over-limit emissions recorded.				SCW	
	1520	Horizontal scan complete. No over-limit emissions recorded.				SCW	
	1521	Setting up for 1-6 GHz. Reference File -002.				SCW	
	1531	Pause for a meeting.				SCW	
	1557	Meeting done, resuming testing.				SCW	
	1603	Vertical scan complete. No over-limit emissions recorded.				SCW	
	1610	Horizontal scan complete. No over-limit emissions recorded.				SCW	
	1611	Setting up for 200 MHz to 1 GHz.				SCW	
	1624	Done for the day.				SCW	
8/29/24	0753	Ready to resume testing.				SCW	
	0756	Starting 200 MHz to 1 GHz scans. Reference File -002.				SCW	
	0817	Vertical scan complete. No over-limit emissions recorded.				SCW	
	0846	Horizontal scan complete. No over-limit emissions recorded.				SCW	
	0847	Operational scans complete. Compiling data.				SCW	
	0927	Data compilation complete.				SCW	
Witnessed By:		None present					
Test Performed By:		Scott C. Williamson					

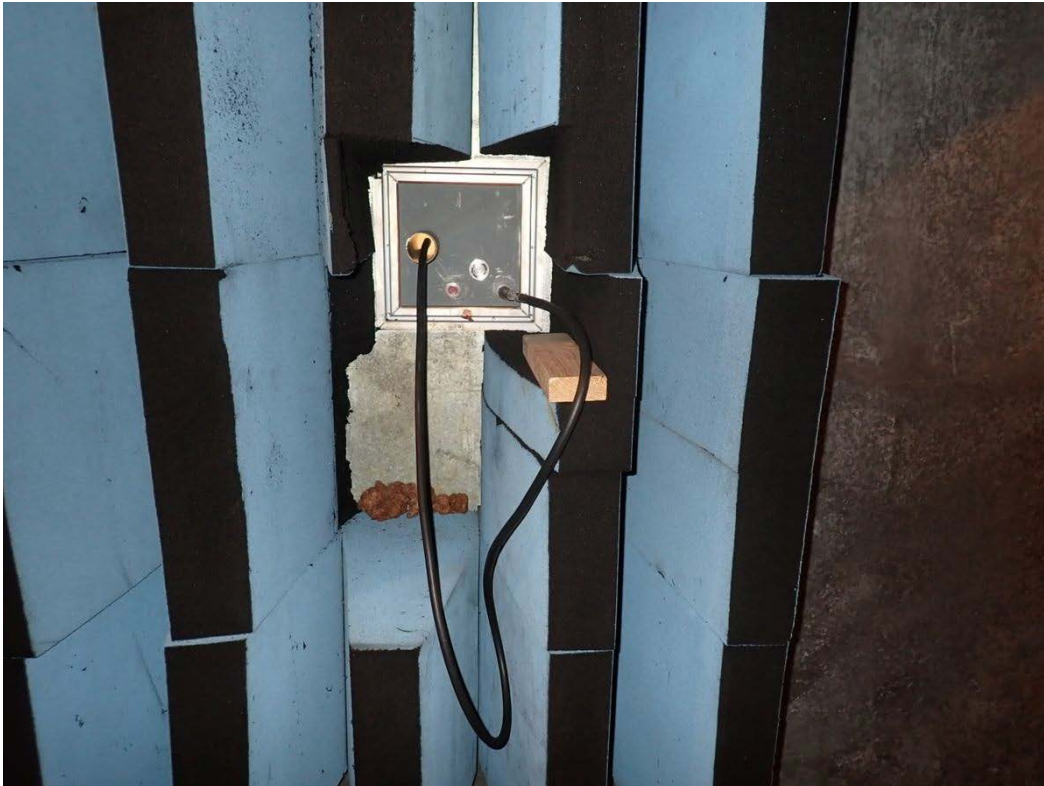
5.1.4 Test Photographs



EUT Identification Label



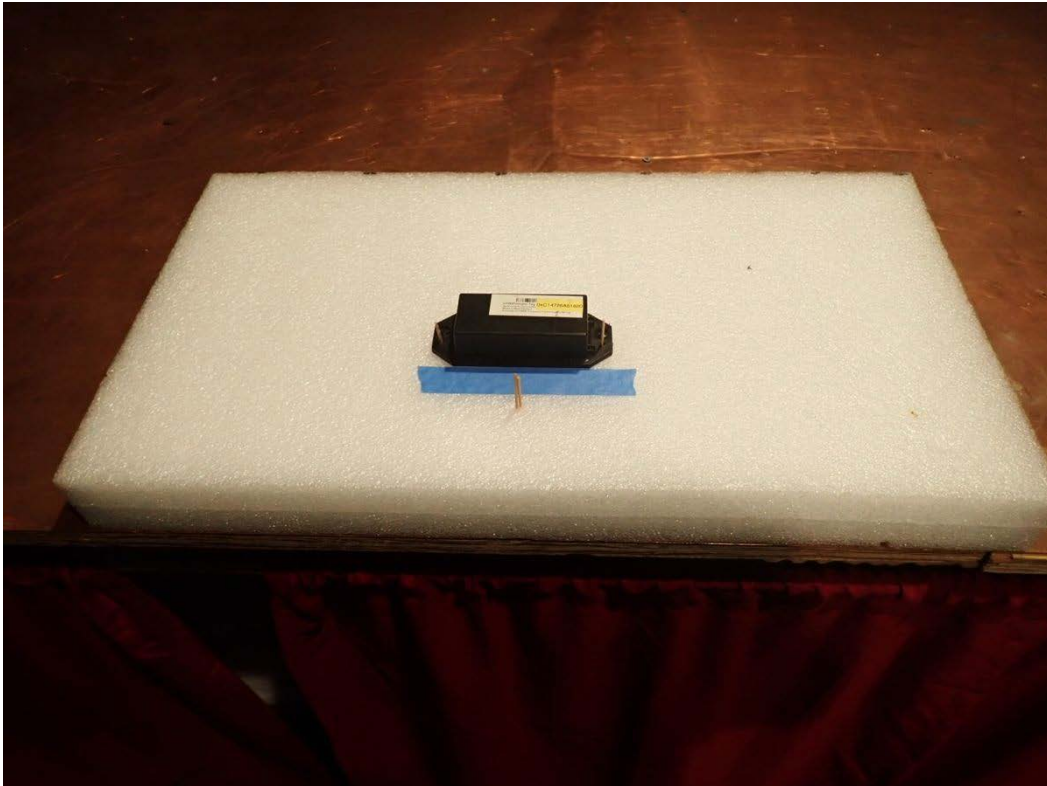
Section 21 RE System Verification Test Equipment (100 MHz - 1 GHz)



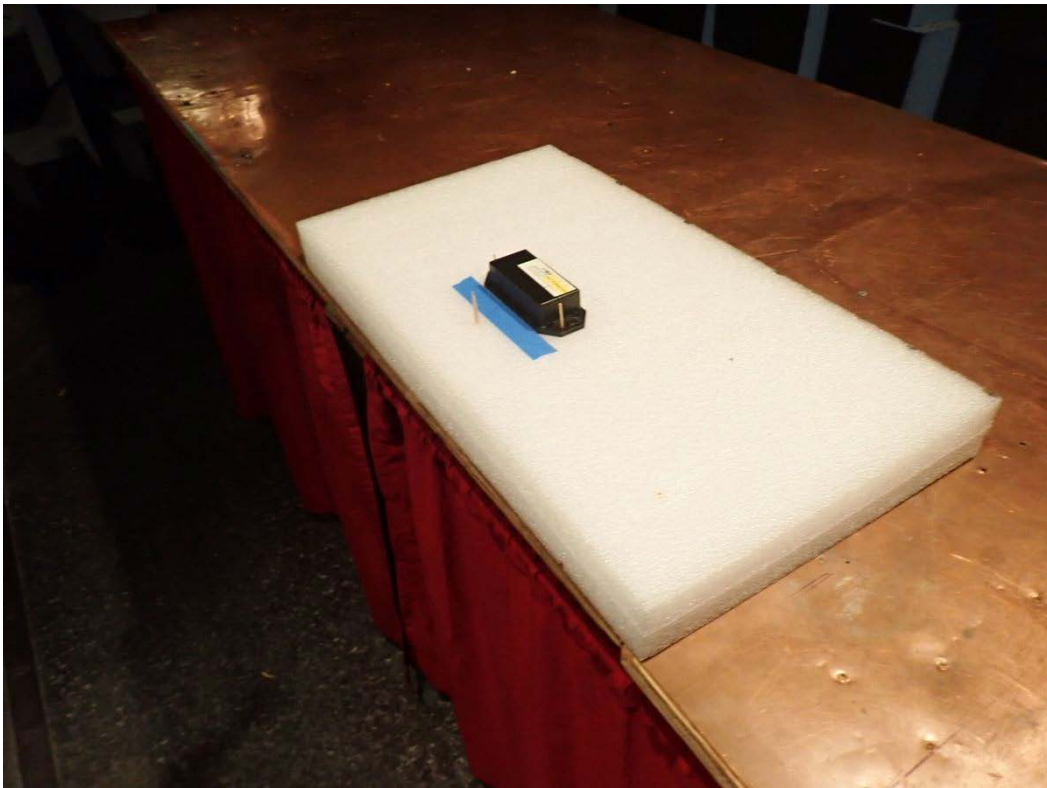
Section 21 RE System Verification Setup (Cable Loop to Signal Source)



Section 21 RE System Verification Test Equipment (1 GHz - 6 GHz)



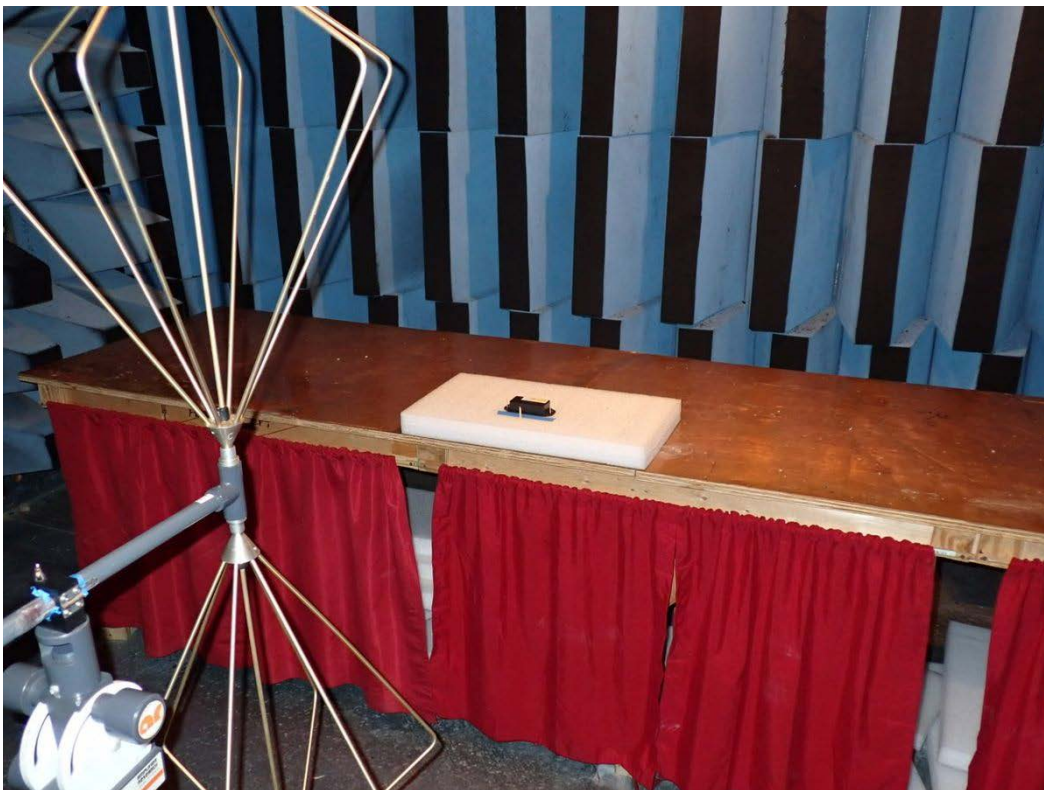
EUT On Test Bench (View 1)



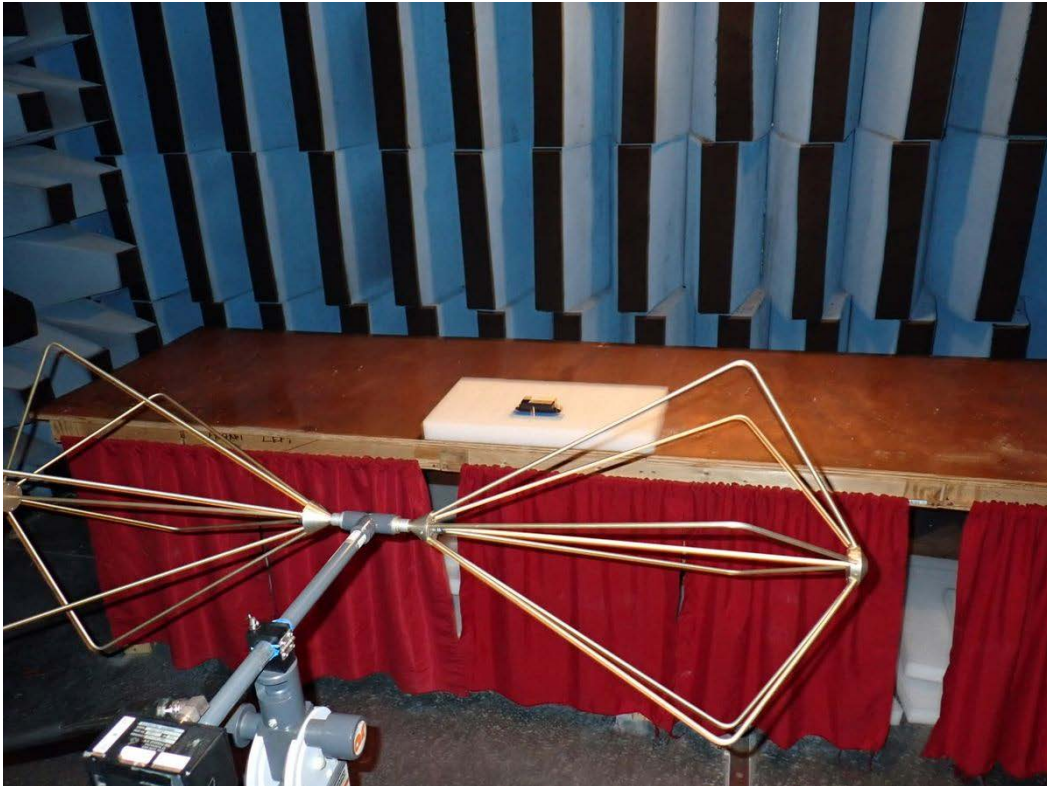
EUT On Test Bench (View 2)



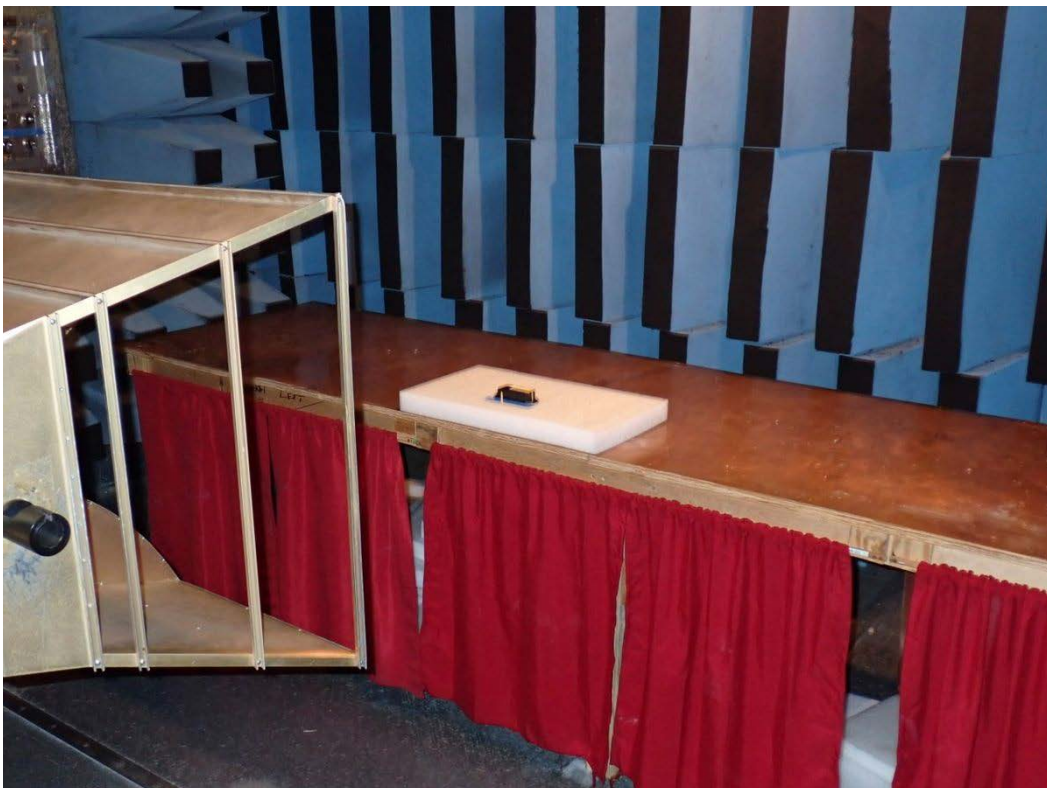
Section 21 RE Measurement Test Equipment (100 MHz - 1 GHz)



Section 21 RE Test Setup (100 MHz - 200 MHz, Vertical)



Section 21 RE Test Setup (100 MHz - 200 MHz, Horizontal)



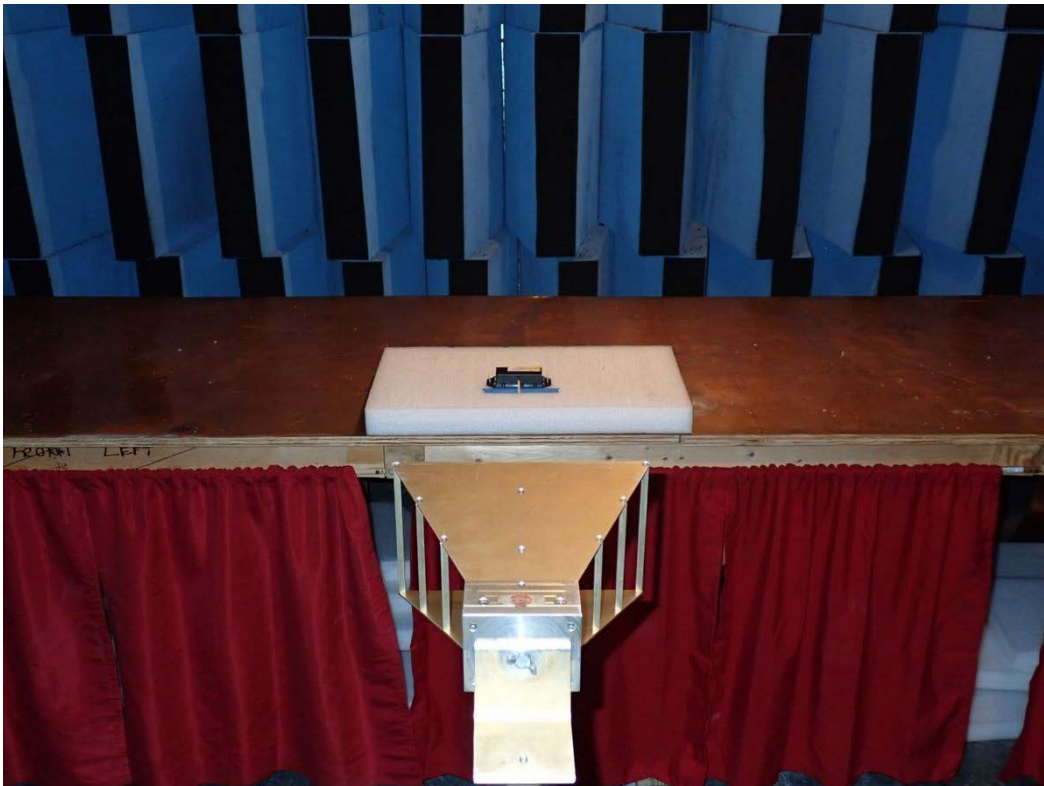
Section 21 RE Test Setup (200 MHz - 1 GHz, Vertical)



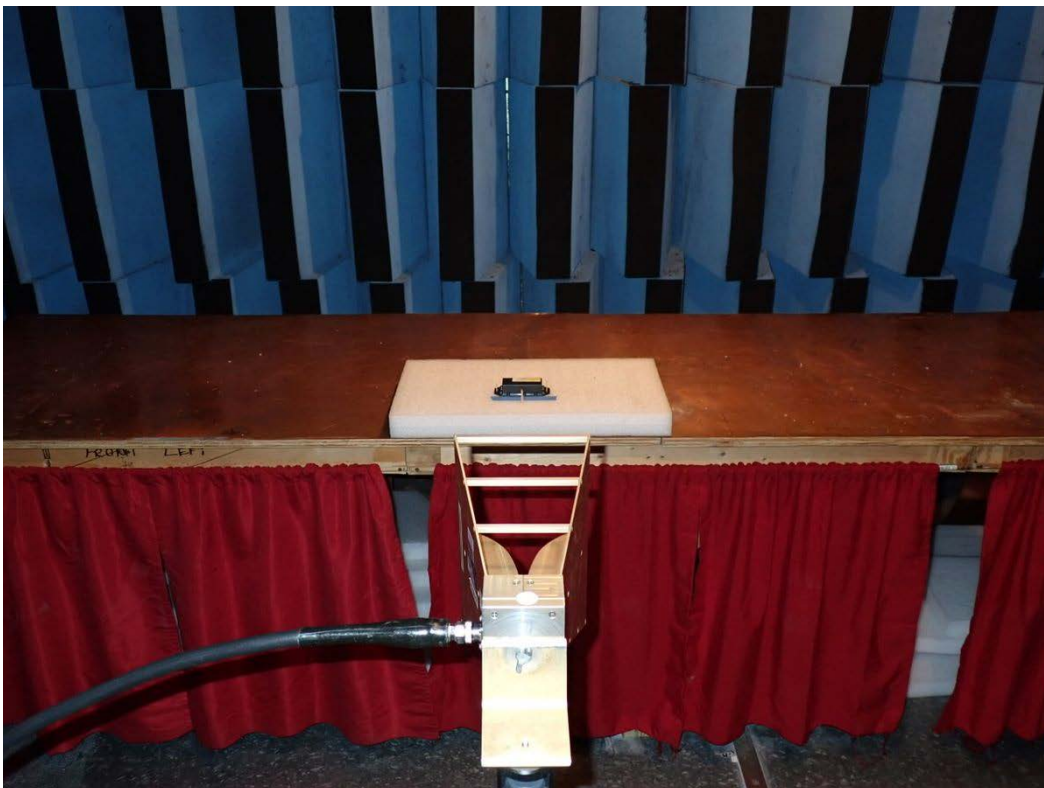
Section 21 RE Test Setup (200 MHz - 1 GHz, Horizontal)



Section 21 RE Measurement Test Equipment (1 GHz - 6 GHz)

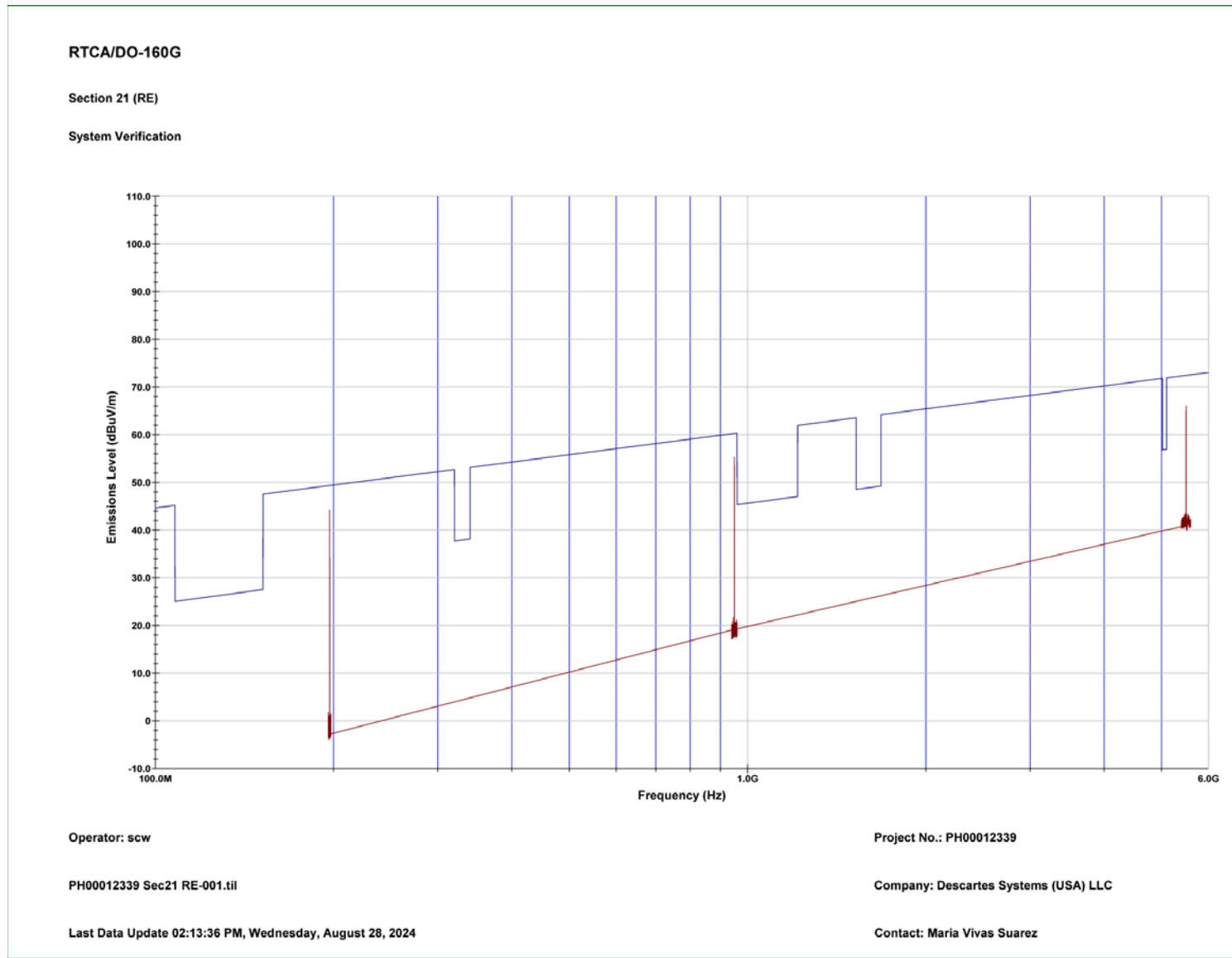


Section 21 RE Test Setup (1 GHz - 6 GHz, Vertical)



Section 21 RE Test Setup (1 GHz - 6 GHz, Horizontal)

5.1.5 Test Data



RTCA/DO-160G

Section 21 (RE)

Vertical Scan

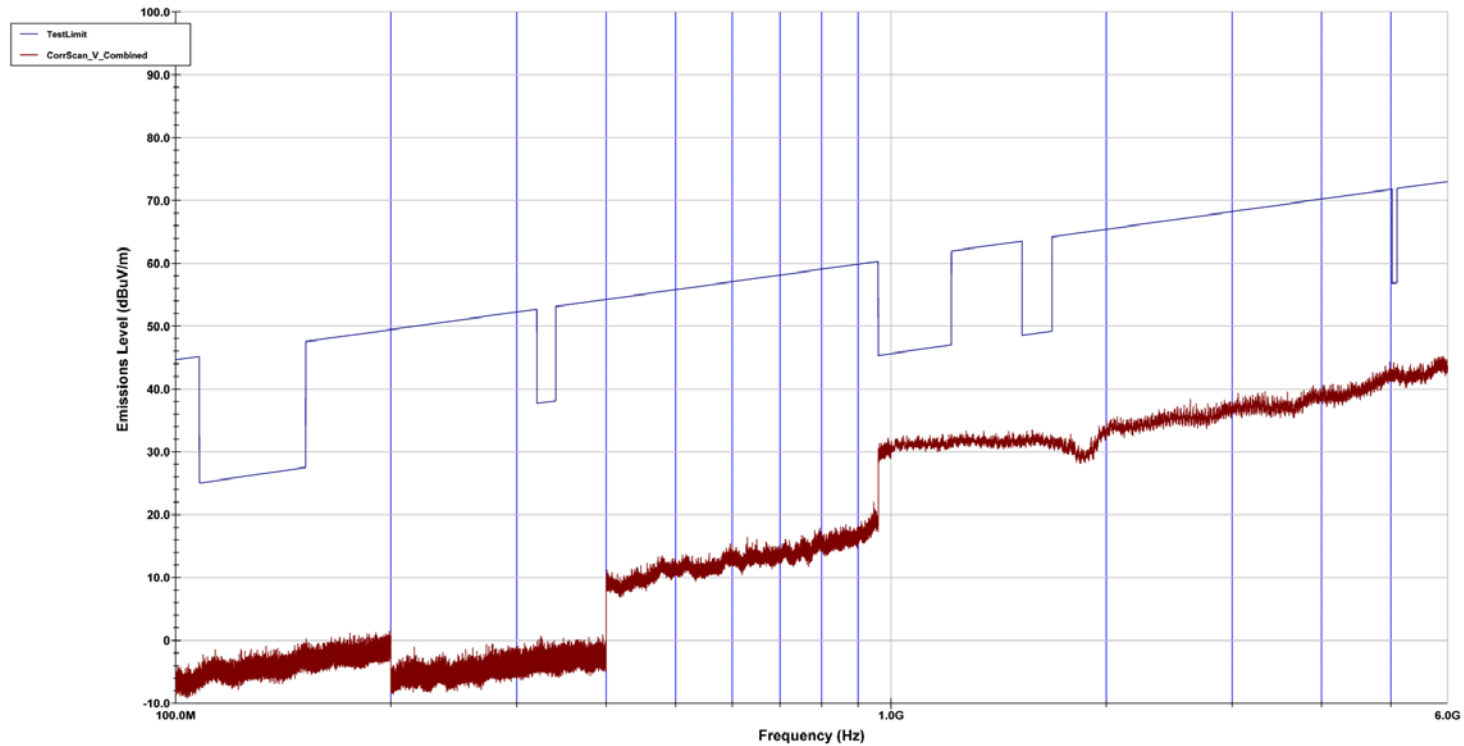
Project No. - PH00012339

Test Item - Bluetooth Low Energy (BLE) Beacon Tag

Model/Part No. - STD001

Serial No. - 0xC14726A51820

Mode of Operation - Active



Operator: scw

PH00012339 Sec21 RE-002.til

Last Data Update 08:11:39 AM, Thursday, August 29, 2024

Operational Scan

Company: Descartes System (USA) LLC

Contact: Maria Vivas Suarez

RTCA/DO-160G

Section 21 (RE)

Horizontal Scan

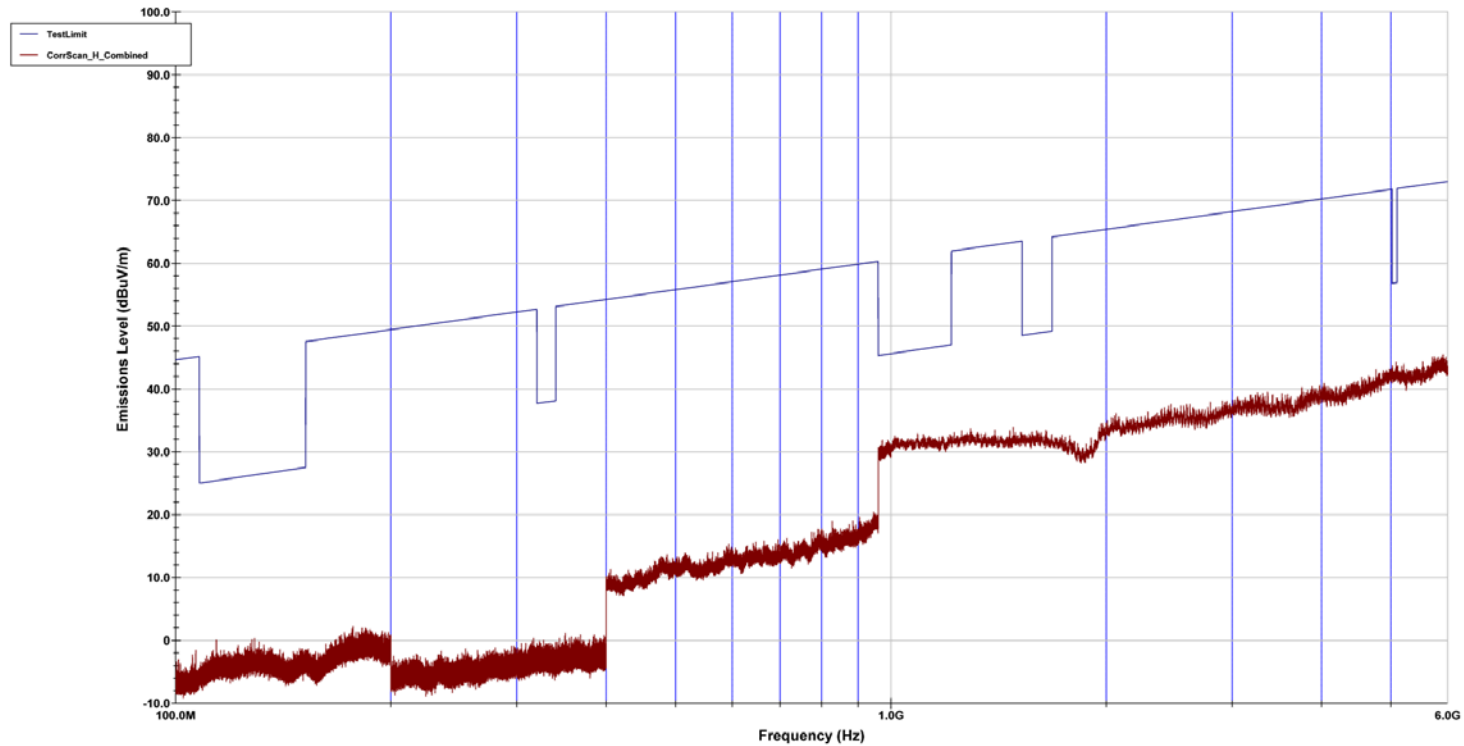
Project No. - PH00012339

Test Item - Bluetooth Low Energy (BLE) Beacon Tag

Model/Part No. - STD001

Serial No. - 0xC14726A51820

Mode of Operation - Active



Operator: scw

PH00012339 Sec21 RE-002.til

Last Data Update 08:40:17 AM, Thursday, August 29, 2024

Operational Scan

Company: Descartes System (USA) LLC

Contact: Maria Vivas Suarez

5.1.6 Test Equipment List

Table 5.1-1: Radiated RF Emissions Test Equipment List

Asset Number	Asset Type	Manufacturer	Model	Calibrated	Due
WC021614	Analyzer (Spectrum)	Agilent Technologies	E4440A	12/13/2023	12/13/2024
WC057069	Amplifier (Pre/RF/Low Noise)	Sonoma Instrument	310N	10/25/2023	10/25/2024
WC057070	Generator (Signal)	Agilent Technologies	AT/E8257C/F	10/05/2023	10/05/2024
WC057083	Antenna (Double Ridge Guide)	A. H. Systems	SAS-570	05/03/2023	05/03/2025
WC057204	Antenna (Double Ridge Guide)	A. H. Systems	SAS-571	05/03/2023	05/03/2025
WC057275	Antenna (Biconical)	A. H. Systems	SAS-540	09/25/2023	09/25/2025
WC057303	Amplifier (Pre/RF/Low Noise)	A. H. Systems	PAM-0118	06/10/2024	06/10/2025
WC057310	Chamber (EMI, Semi-Anechoic)	Unknown	CH 5 (PS16T20)	NCR	NCR
WC057830	Cable (Test)	Megaphase	EMC3-N1N1- 180	06/07/2024	06/07/2025
WC067567	Monitor (Thermometer/Clock/Humidity)	Extech Instruments	445703	06/17/2024	06/17/2025
WC071949	Measurement Tools (Tape Measure)	Stanley	33-158	NCR	NCR
WC076397	Cable (Test)	Megaphase	TM18-N1N1- 36-V	06/07/2024	06/07/2025
WC076399	Cable (Test)	Megaphase	TM18-N1N1- 42-V	12/13/2023	12/13/2024
EUSSD-001	TILE Software	ETSLindgren	7347	NCR	NCR

Calibration Abbreviation

NCR: No Calibration Required

End of Test Report