Element U.S. Space & Defense Test Report for RTCA/DO-160G Radiated RF Emissions Testing of the COREInsight BLE Standard Tag

Prepared For
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Performed By
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Principal EMI Test Engineer

Revision History

Rev.	Description	Issue Date
0	Initial Release	05/06/2024

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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: RTCA/DO-160G, *Environmental Conditions and Test Procedures for Airborne Equipment,* dated 12/8/2010, Section 21.5, Category H (Figure 21-9), and Customer Email from Maria Vivas Suarez, Dated 04/30/2024 at 10:40 A.M (confirming the operational mode of the EUT)
- Descartes Systems Group Purchase Order 4500042056, dated 04/10/2024
- Element U.S. Space & Defense Quote OH000018087, dated 04/02/2024
- 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 Group 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	COREInsight BLE Standard Tag	STD003	0000300085

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	RTCA/DO-160G, Section 21.5, Category H (Figure 21-9), and Customer Email from Maria Vivas Suarez, Dated 04/30/2024 at 10:40 A.M (confirming the operational mode of the EUT)	Orlando	04/29/2024 - 04/30/2024	STD003	0000300085	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 RTCA/DO-160G, Section 21.5, Category H (Figure 21-9) requirements, and Customer Email from Maria Vivas Suarez, Dated 04/30/2024 at 10:40 A.M (confirming the operational mode of the EUT).

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

5.1.3.1 Test Setup Information

Test Setup				
Chamber:	The testing was performed in a 4.88 meters by 4.88 meters by 3.05 meters (height) semi-anechoic shielded chamber. RF absorber material covered the walls and the ceiling of the chamber, to a distance at least 0.50 meters beyond the edge of the ground plane. Additionally, the wall opposite the ground plane was covered with RF absorber material. No absorber material was placed on the floor of the chamber.			
Ground Plane:	The ground plane consisted of a 0.64 millimeter thick copper sheet that sat on top of a test bench 90 centimeters above the floor of the chamber, and had a minimum surface area of 2.5 square meters. This sheet was bonded to ground via the floor of the shielded chamber (which was grounded to earth) in multiple places, using bond straps with a length to width ratio no greater than 5:1. The bond straps were positioned so that no bond strap was more than 1 meter from the next closest bond strap. The bonding resistance between the ground plane and the chamber floor was verified to be ≤2.5 milliohms. The actual bonding results as measured on 2024-04-18 were (facing the ground plane):			
	Far Left: 0.7 mΩ	**Center Left: 0.7 mΩ**	**Center Right: 1 mΩ**	**Far Right: 0.7 mΩ**
EUT Bonding:	The EUT sat directly on a piece of 5cm high support foam. The EUTs chassis is comprised of plastic and it is not normally bonded at any point.			
Input Power Leads:	DC power to the EUT is provided by a self-contained, 3.6V (2700mAh) lithium thionyl chloride metal battery. The EUT does not have any provisions for input power leads.			
LISNs and Feedthrough Capacitors (DO-160 Setup):	DC power to the EUT is provided by a self-contained, 3.6V (2700mAh) lithium thionyl chloride metal battery. LISNs and feedthrough capacitors are not required.			
Mode of Operation:	Short Sleep Mode			
EUT Power requirements:	The EUT has a self-contained ER14505 lithium thionyl chloride metal battery rated at 3.6VDC and 2700mAh			

5.1.3.2 Test Activities and Results

Element U.S. Space and Defense					
Section 21 Radiated Emissions System Verification					
Test Limit:	**Category H**				
Frequency (MHz)	**Limit (dBµV)**	**Calibrated Signal Amplitude (dBµV)**	**Measured Signal Amplitude (dBµV)**	**Deviation (dB)**	**Result**
197	49.3	43.3	43.8	-0.5	Complied
990	45.5	39.5	42.3	-2.8	Complied
5500	72.4	66.4	66.5	-0.1	Complied
Test Performed By:	**Howard Herhold**		**Date:**	**4/29/2024**	

Element U.S. Space and Defense							
DO-160G 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	7.5	0.004995
200	400	1.5	0.01	300	40	7.5	0.004995
400	960	0.15	0.1	84	12	7	0.04662005
960	6000	0.015	1	75.6	11	6.87	0.45772409

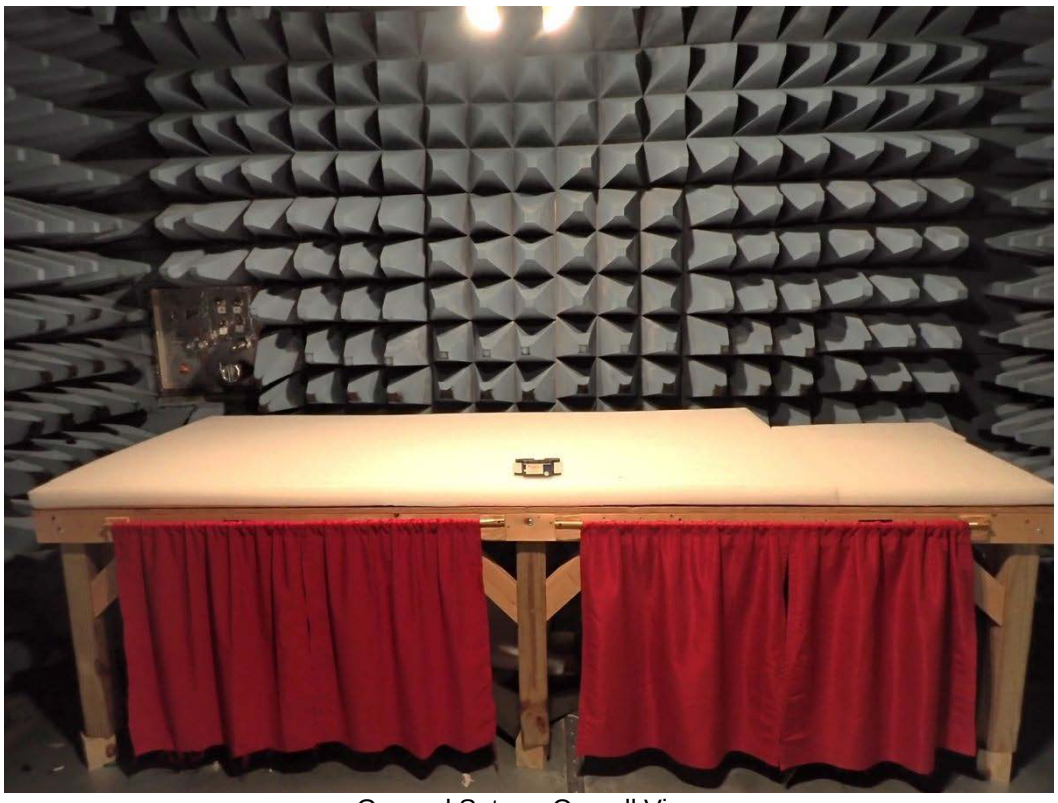
	Element U.S. Space and Defense					
	Section 21 Radiated Emissions Data Sheet					
Remarks: The EUT was placed into the "Short Sleep" operating mode during testing.						
Service Branch:	**Aerospace**		**Test Level:**	**Category H**		
Tile Software Version:	**7.3.4.7**					
Start Frequency (MHz)	**Stop Frequency (MHz)**	**6dB Bandwidth (kHz)**	**Limit**	**Mode of Operation**	**Test Result**	**Antenna Polarization**
100	200	10	Category H	Short Sleep	Complied	Vertical
100	200	10	Category H	Short Sleep	Complied	Horizontal
200	400	10	Category H	Short Sleep	Complied	Vertical
200	400	10	Category H	Short Sleep	Complied	Horizontal
400	960	100	Category H	Short Sleep	Complied	Vertical
400	960	100	Category H	Short Sleep	Complied	Horizontal
960	1000	1000	Category H	Short Sleep	Complied	Vertical
960	1000	1000	Category H	Short Sleep	Complied	Horizontal
1000	6000	1000	Category H	Short Sleep	Complied	Vertical
1000	6000	1000	Category H	Short Sleep	Complied	Horizontal
Test Performed By:	**Howard Herhold**					

		Element U.S. Space and Defense					
		Section 21 Radiated Emissions Log					
Temperature:	**22.3**	**° C**	**Humidity:**	**49**	**% RH**	**Barometric Pressure:**	**Site Pressure**

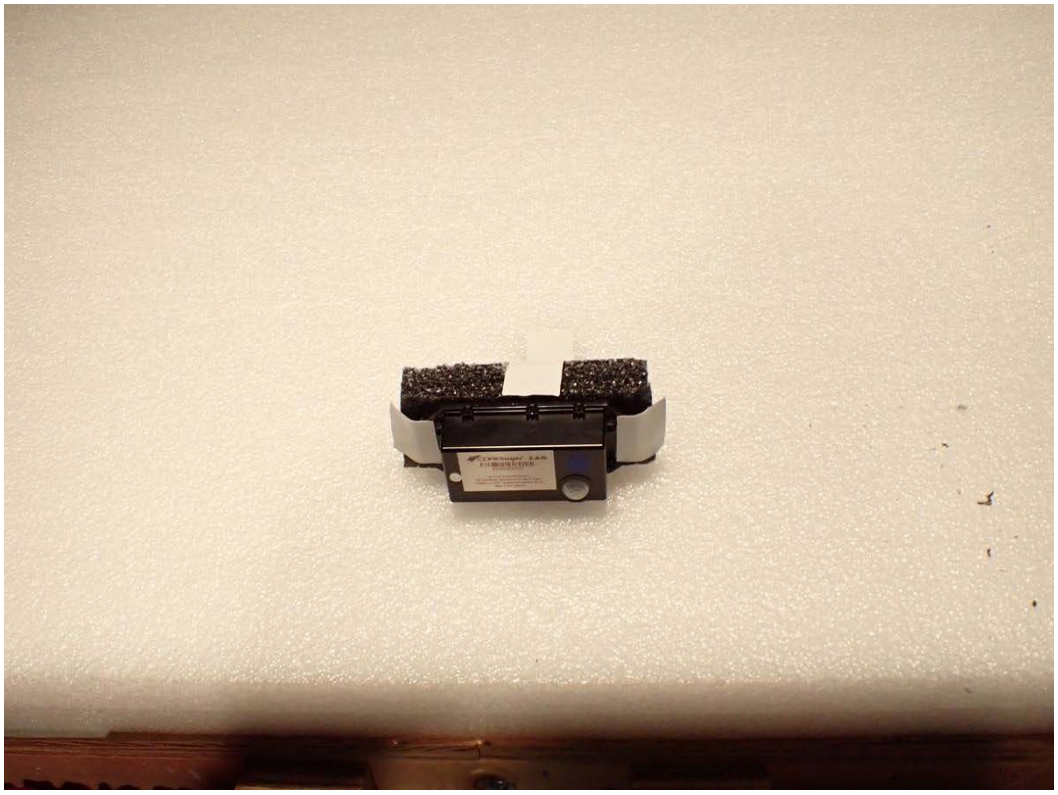
Date	Time	Log Entries	Initials
4/29/24	1028	Start. System Verification.	HH
	1044	Completed. All measured values are within tolerance. Reference Files: 001 and 001_TBL	HH
	1055	Awaiting arrival of customer shipped EUT.	HH
	1500	EUT has arrived. Documenting EUT M/N and S/N on vLab receiving tab.	HH
	1544	Start. Section 21.5 RE, Category H. 100MHz to 200MHz with biconical antenna. Biconical antenna height: 120cm above floor (30cm above bench), vertical and horizontal.	HH
	1601	Vertical and horizontal scans completed. All emissions are >3dB under limit. Reference Files: 002_V and 002_H	HH
	1622	Start. Section 21.5 RE, Category H. 200MHz-1GHz with large double ridged waveguide antenna. Large double ridged waveguide antenna height: 120cm above floor (30cm above bench), vertical.	HH
	1641	Vertical scan completed. All emissions are >3dB under limit. Reference File: 002_V	HH
4/30/24	0902	Start. Section 21.5 RE, Category H. 200MHz-1GHz with large double ridged waveguide antenna. Large double ridged waveguide antenna height: 120cm above floor (30cm above bench), horizontal.	HH
	0941	Horizontal scan completed. All emissions are >3dB under limit. Reference File: 002_H	HH
	0959	Start. Section 21.5 RE, Category H. 1GHz-6GHz with small double ridged waveguide antenna. Small double ridged waveguide antenna height: 120cm above floor (30cm above bench), vertical and horizontal.	HH
	1054	Vertical and Horizontal scans completed. All emissions are >3dB under limit. Reference Files: 002_V and 002_H	HH
Witnessed By:		**N/A**	
Test Performed By:		**Howard Herhold**	
Engineering Manager:		**Scott Williamson**	

5.1.4 Test Photographs

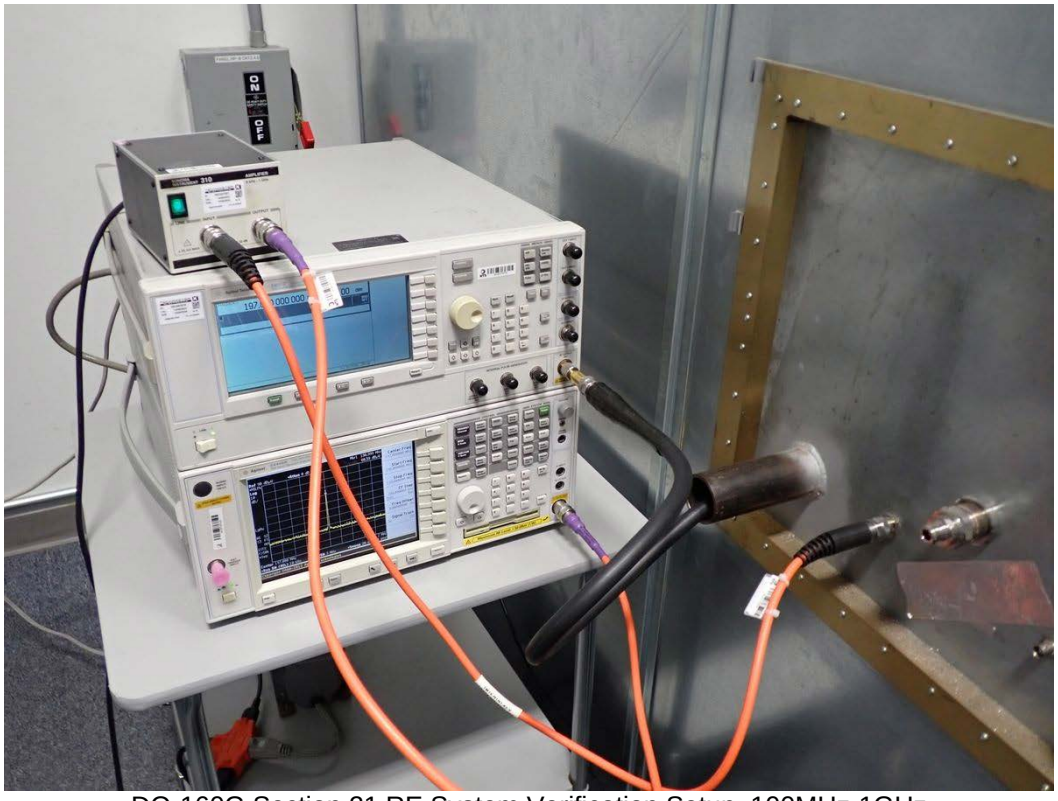
EUT Identification Label



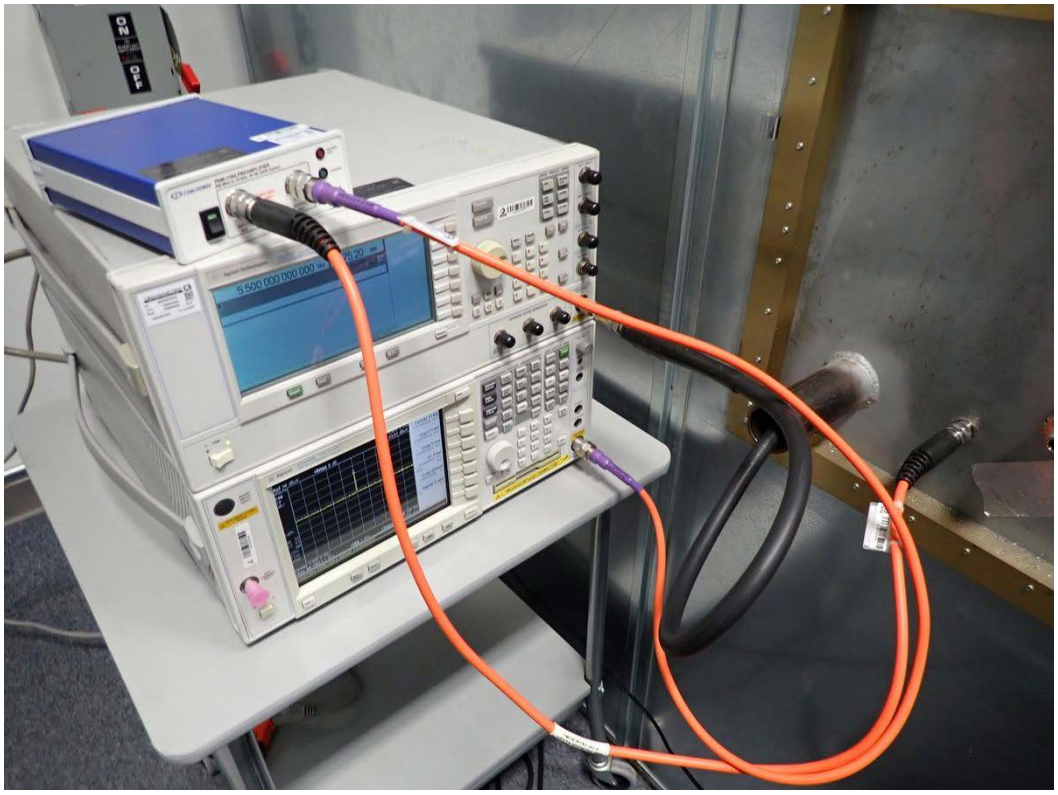
General Setup - Overall View



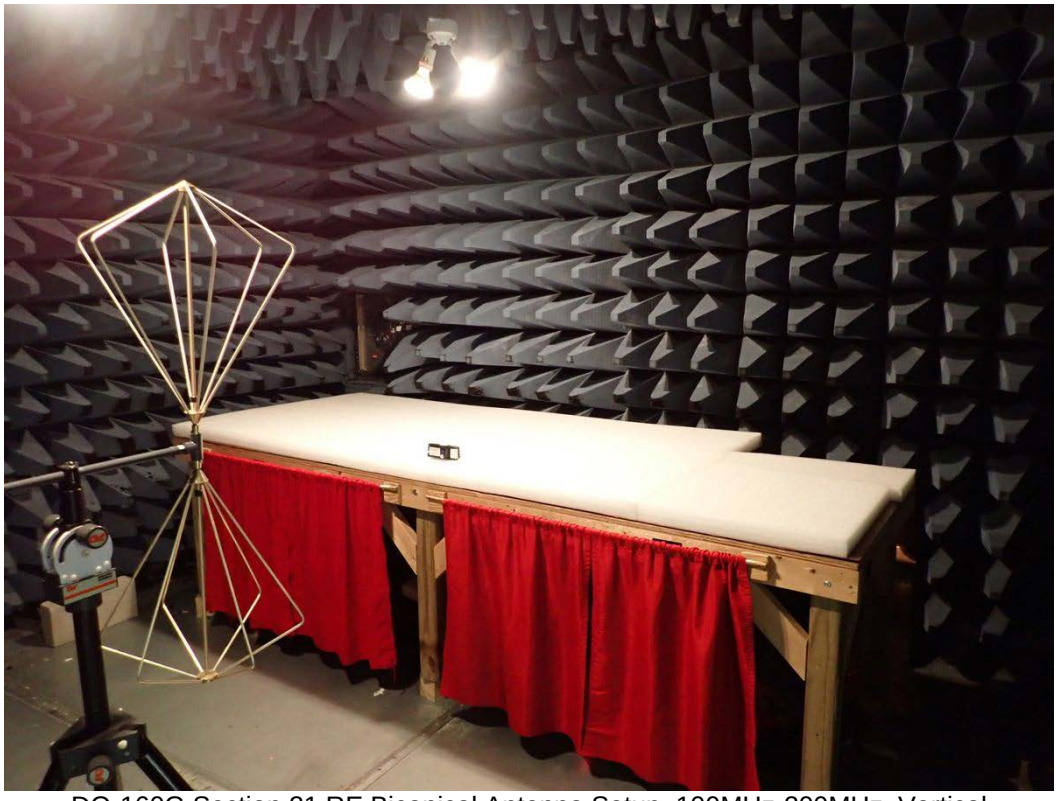
General Setup - EUT Configuration for Testing



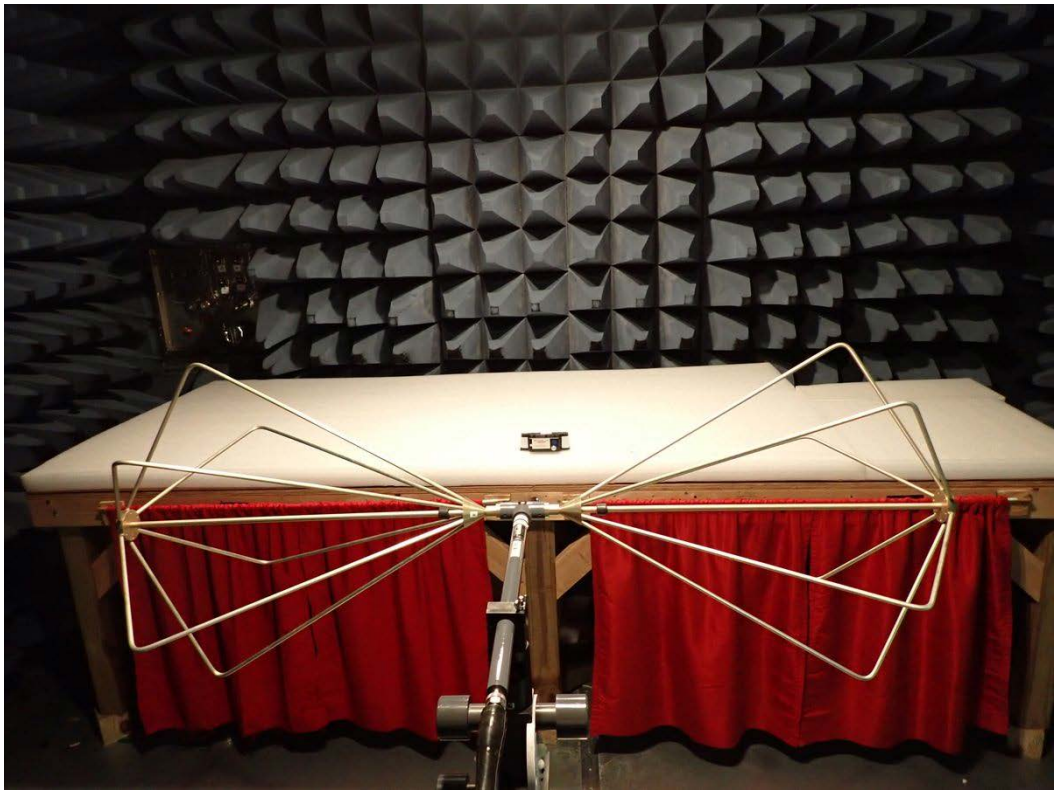
DO-160G Section 21 RE System Verification Setup, 100MHz-1GHz



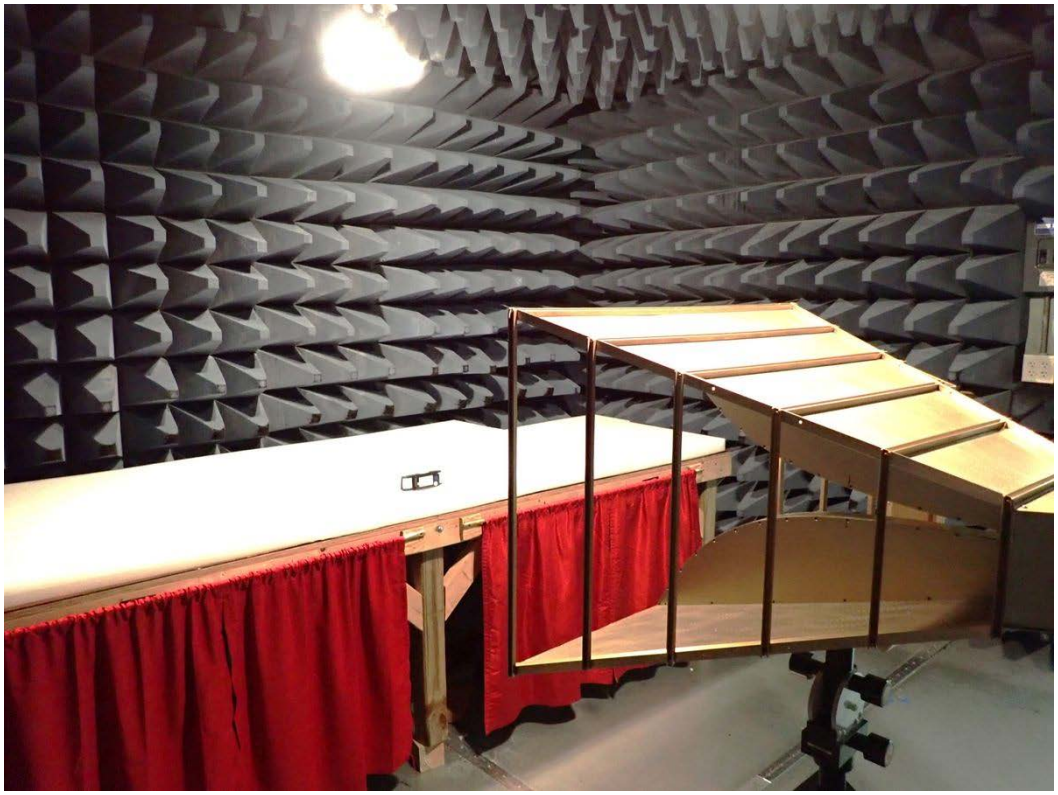
DO-160G Section 21 RE System Verification Setup, 1GHz-6GHz



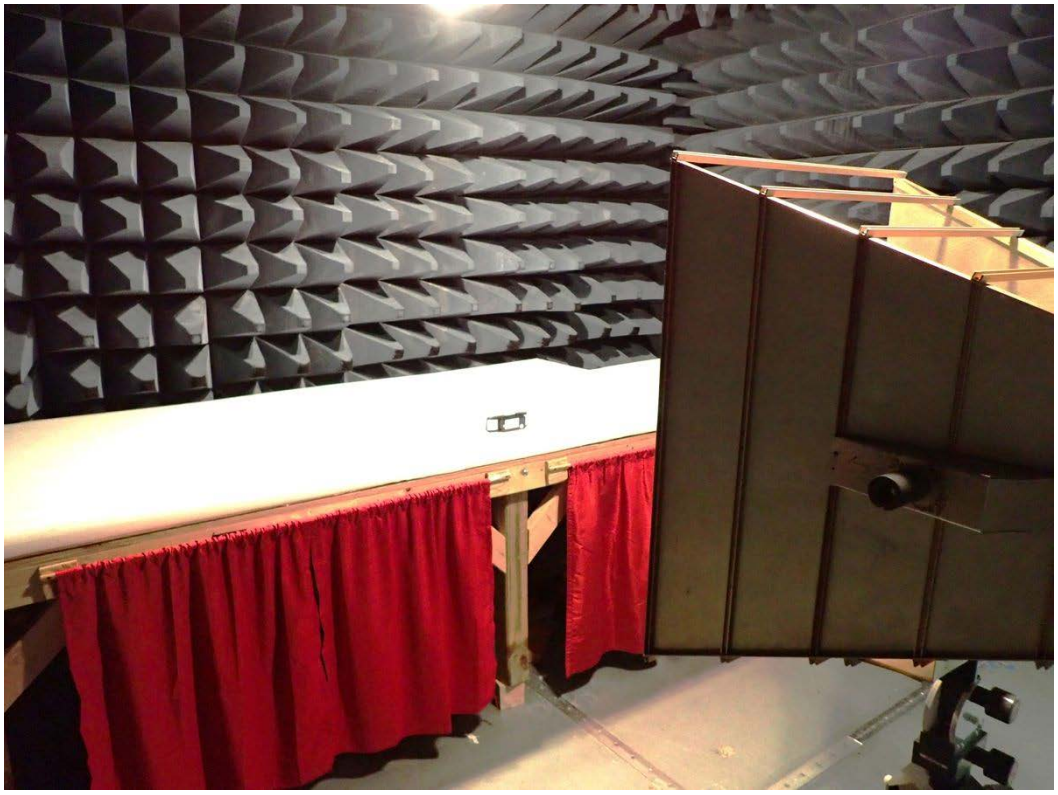
DO-160G Section 21 RE Biconical Antenna Setup, 100MHz-200MHz, Vertical



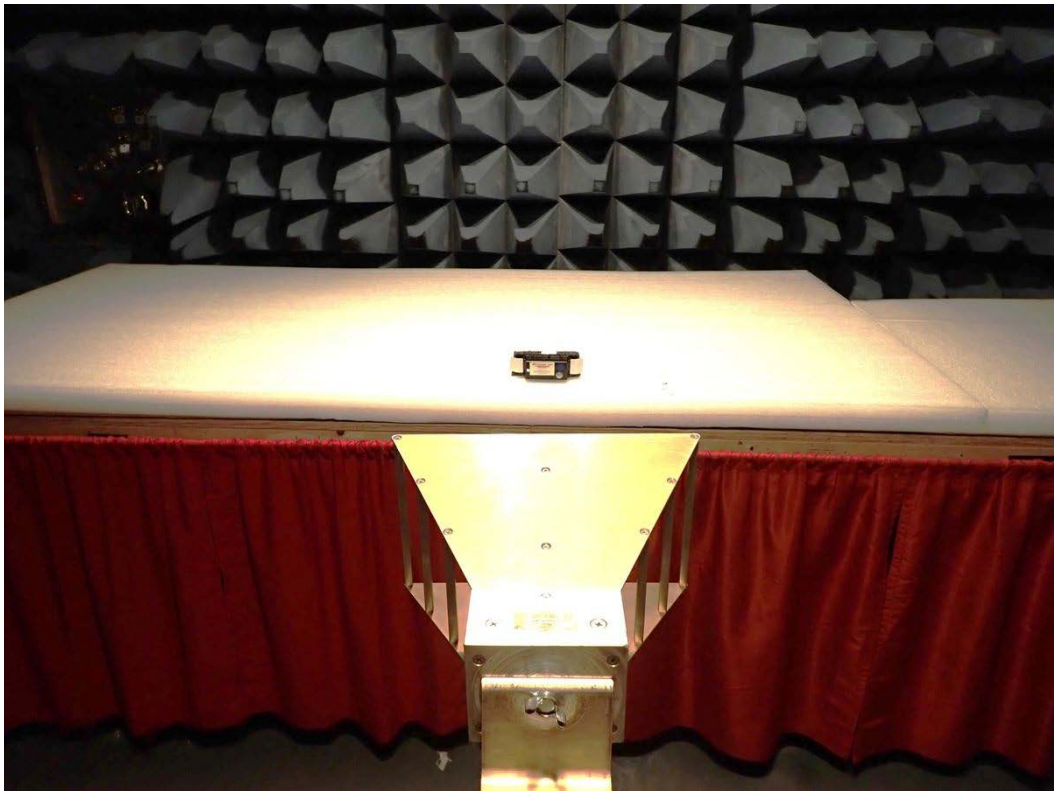
DO-160G Section 21 RE Biconical Antenna Setup, 100MHz-200MHz, Horizontal



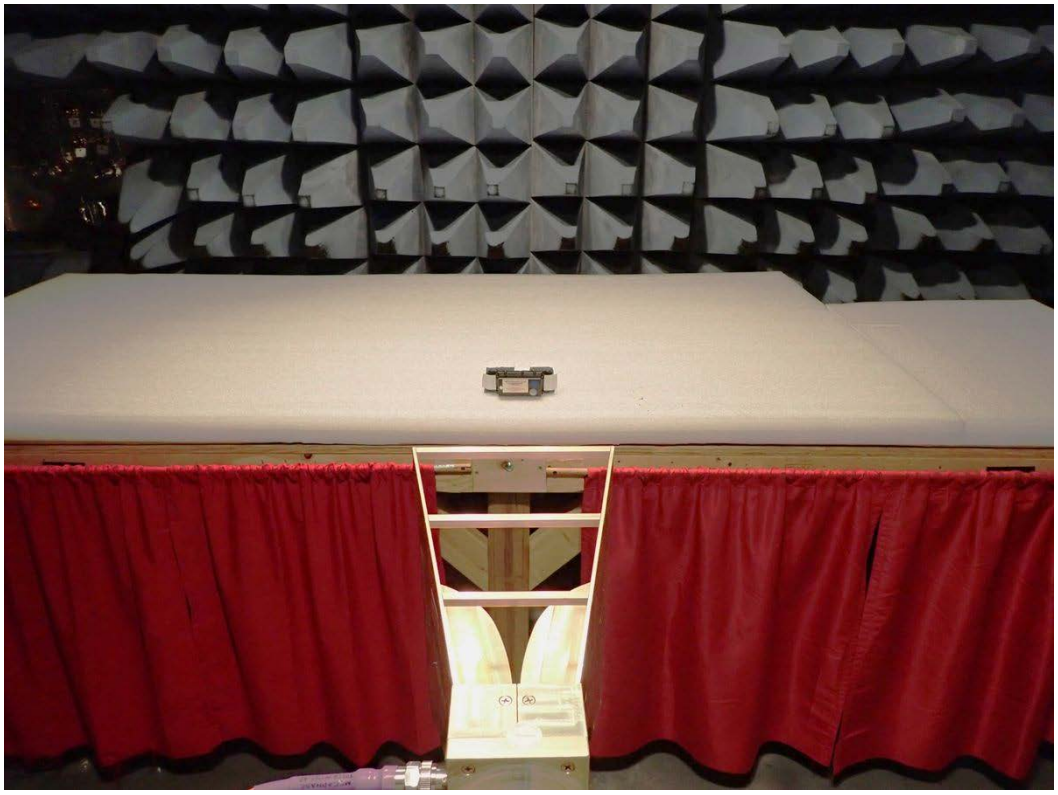
DO-160G Section 21 RE Large DRG Antenna Setup, 200MHz-1GHz, Vertical



DO-160G Section 21 RE Large DRG Antenna Setup, 200MHz-1GHz, Horizontal



DO-160G Section 21 RE Small DRG Antenna Setup, 1GHz-6GHz, Vertical



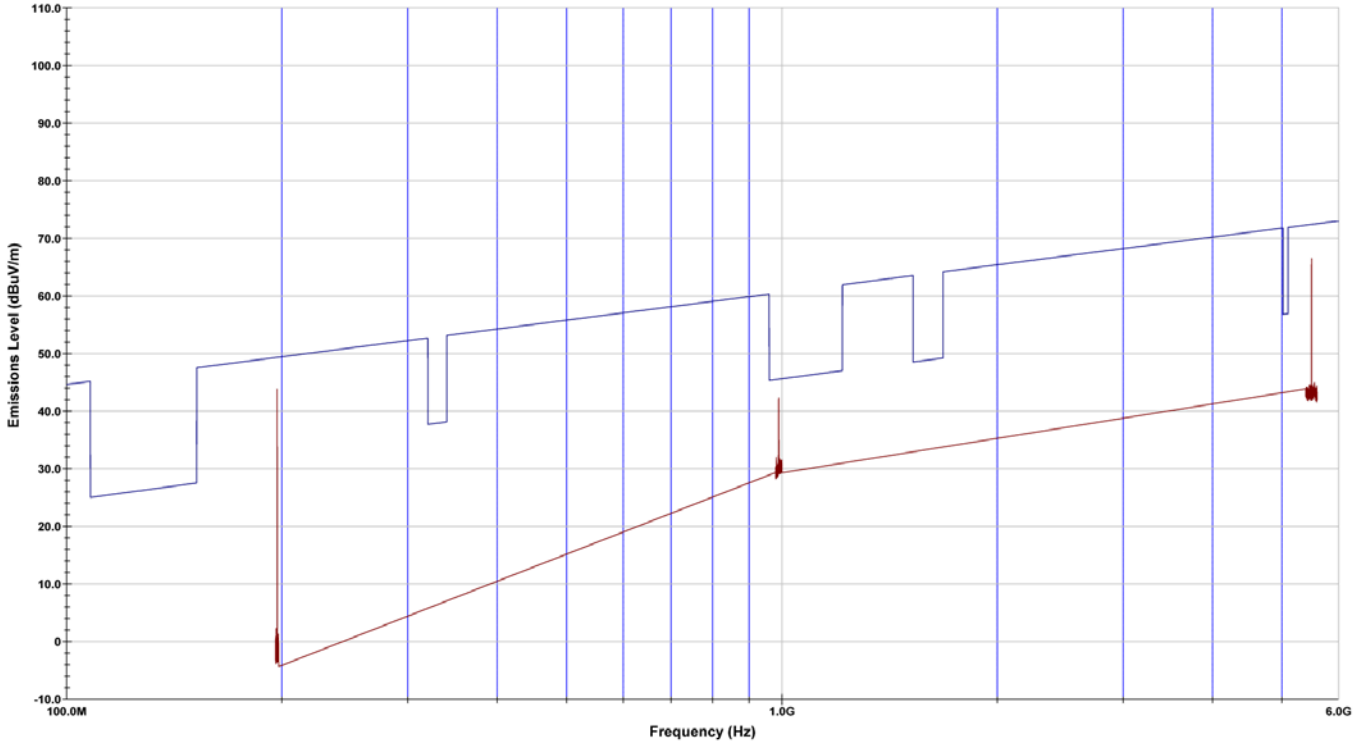
DO-160G Section 21 RE Small DRG Antenna Setup, 1GHz-6GHz, Horizontal

5.1.5 Test Data

RTCA/DO-160G

Section 21 (RE)

System Verification



Operator: Howard Herhold

PH00011232 Sec 21 5 RE-001.til

Last Data Update 10:41:36 AM, Monday, April 29, 2024

Project No.: PH00011232

Company: Descartes Systems Group

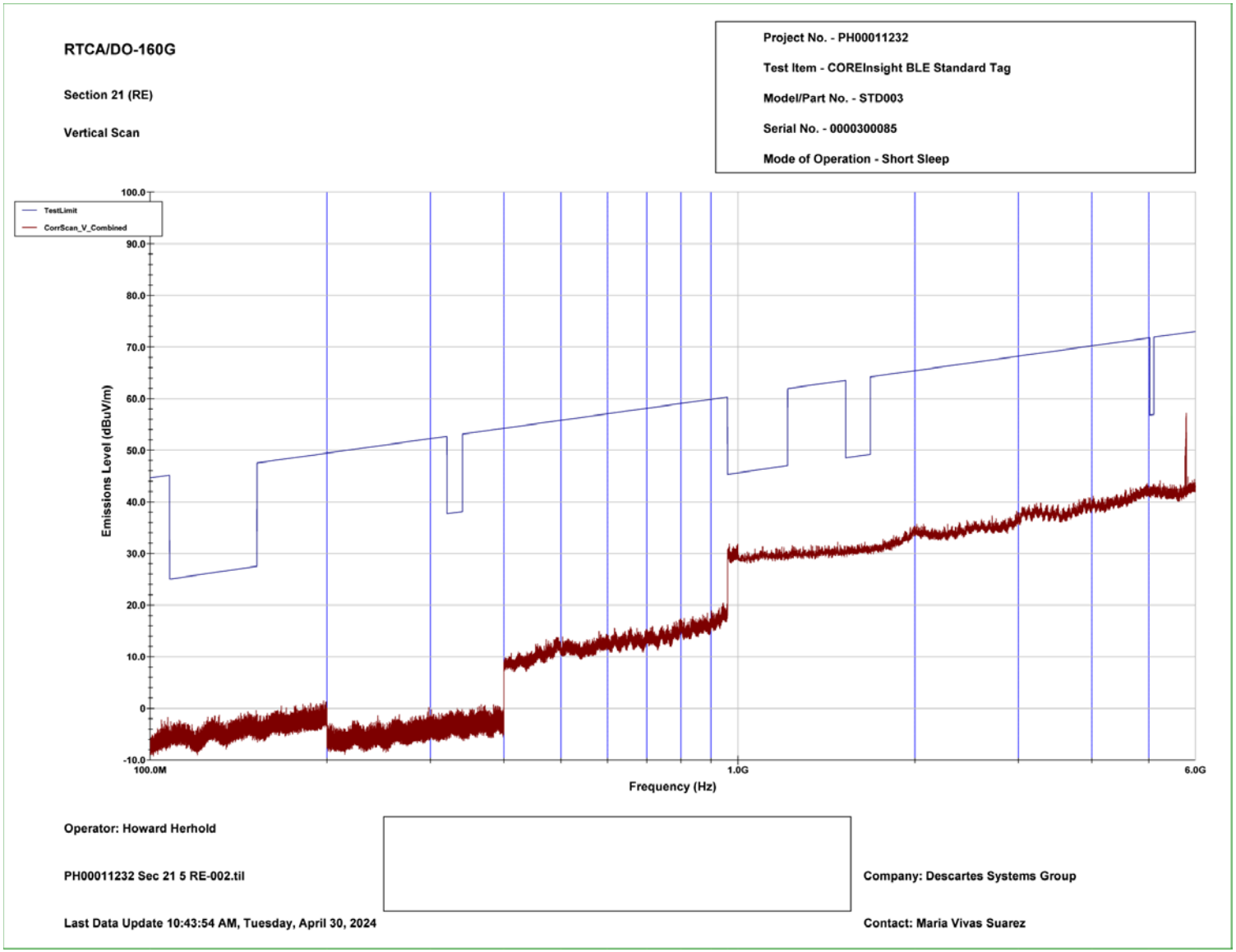
Contact: Maria Vivas Suarez

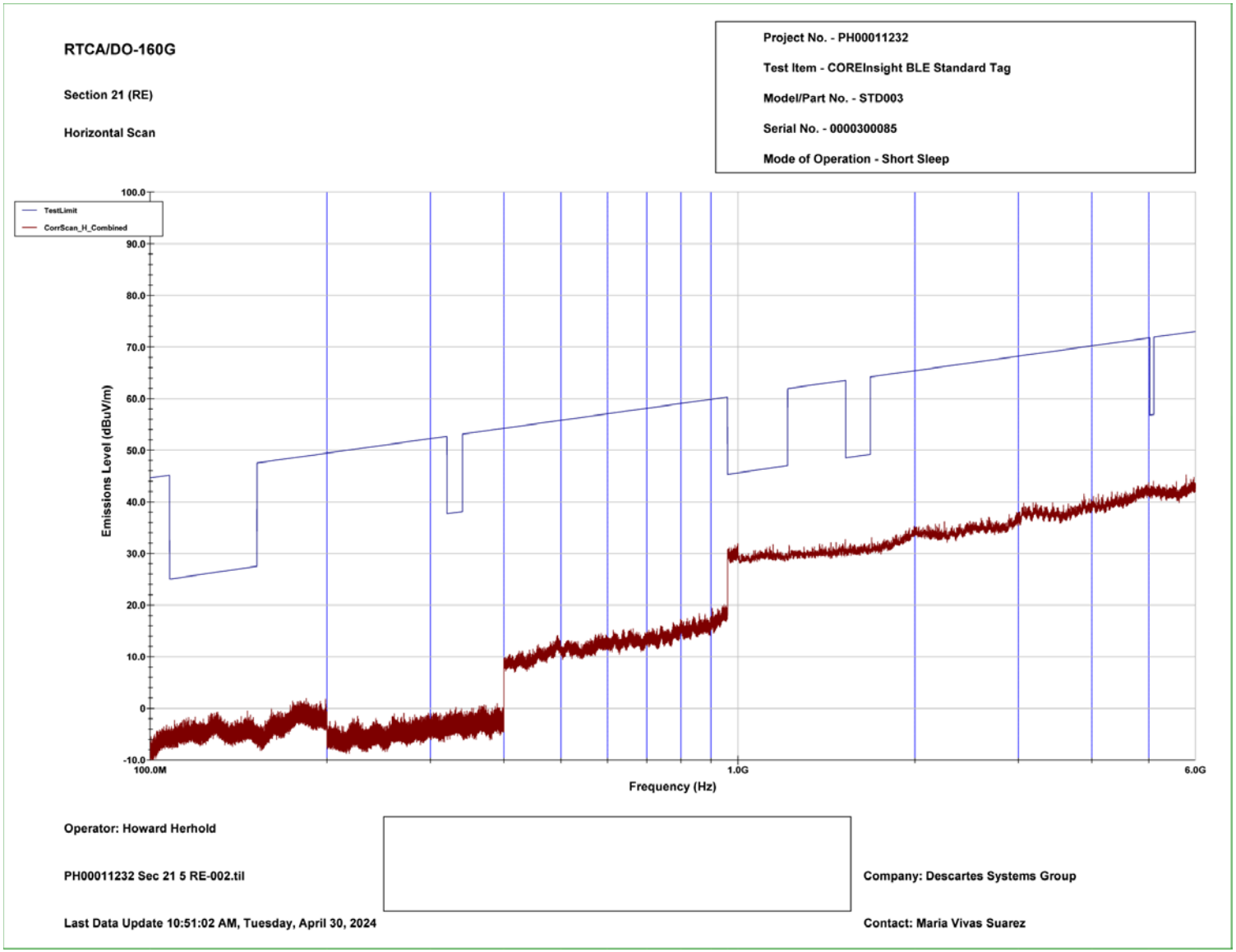
RTCA/DO-160G
Section 21 (RE)
System Verification

Operator: Howard Herhold
PH00011232 Sec 21 5 RE-001.til
10:41:36 AM, Monday, April 29, 2024

Project No.: PH00011232
Contact: Maria Vivas Suarez
Company: Descartes Systems Group

Frequency (MHz)	Limit (dBuV/m)	Peaks (dBuV/m)	Delta (dB)
197.000 MHz	49.311	43.769	-5.542
990.080 MHz	45.523	42.281	-3.242
5.500 GHz	72.397	66.462	-5.934


RTCA/DO-160G
Section 21 (RE)
Vertical Scan
Project No. - PH00011232
Test Item - COREInsight BLE Standard Tag
Model/Part No. - STD003
Serial No. - 0000300085
Mode of Operation - Short Sleep
TestLimit
CorrScan_V_Combined
Emissions Level (dBuV/m)
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0
-10.0
100.0M
1.0G
6.0G
Frequency (Hz)
Operator: Howard Herhold
PH00011232 Sec 21 5 RE-002.til
Last Data Update 10:43:54 AM, Tuesday, April 30, 2024
Company: Descartes Systems Group
Contact: Maria Vivas Suarez


RTCA/DO-160G
Section 21 (RE)
Horizontal Scan
Project No. - PH00011232
Test Item - COREInsight BLE Standard Tag
Model/Part No. - STD003
Serial No. - 0000300085
Mode of Operation - Short Sleep
TestLimit
CorrScan_H_Combined
Emissions Level (dBuV/m)
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0
-10.0
100.0M
1.0G
6.0G
Frequency (Hz)
Operator: Howard Herhold
PH00011232 Sec 21 5 RE-002.til
Last Data Update 10:51:02 AM, Tuesday, April 30, 2024
Company: Descartes Systems Group
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
WC057066	Chamber (EMI, Semi-Anechoic)	Universal Shielding	CH 2 (USC-26)	NCR	NCR
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
WC057307	Amplifier (Pre/RF/Low Noise)	Sonoma Instrument	310N	10/05/2023	10/05/2024
WC057656	Meter (Hygrometer)	Extech Instruments	445702	05/31/2023	05/31/2024
WC057685	Measurement Tools (Tape Measure)	Stanley	33-428	NCR	NCR
WC061857	Cable (Test)	Megaphase	TM18-N1N1-48	12/13/2023	12/13/2024
WC076399	Cable (Test)	Megaphase	TM18-N1N1-42-V	12/13/2023	12/13/2024
WC076464	Amplifier (Pre/RF/Low Noise)	Com-Power	PAM-118A	11/13/2023	11/13/2024
WC076465	Antenna (Biconical)	A. H. Systems	SAS-540	01/27/2024	01/27/2026
WC076469	Cable (Test)	Megaphase	EMC-N1N1-180	12/12/2023	12/12/2024
WC076540	Analyzer (Spectrum)	Agilent Technologies	E4440A	05/10/2023	05/10/2024
EL-001	TILE Software	ETS Lindgren	7347	NCR	NCR

Calibration Abbreviation
NCR: No Calibration Required

End of Test Report