



1250 Peterson Dr., Wheeling, IL 60090

Company: Churchill Navigation  
Model Tested: ARS-500C-2012  
Report Number: 18688  
Project No. 5739

TEST SPECIFICATIONS:  
RTCA/DO-160G (December 8, 2010)

RADIO TECHNICAL COMMISSION FOR AERONAUTICS

ENVIRONMENTAL CONDITIONS

AND

TEST PROCEDURE FOR AIRBORNE EQUIPMENT

THE FOLLOWING **MEETS** Section 21 OF THE ABOVE TEST SPECIFICATION

Formal Name: Churchill Augmented Reality System 500C  
Kind of Equipment: Computer for avionics navigation  
Test Configuration: Tabletop (device is typically hard mounted to airframe) (Tested at 28 V dc)  
Model Number(s): ARS-500C-2012  
Model(s) Tested: ARS-500C-2012  
Serial Number(s): ARS-500C-201220  
Date of Tests: January 23 & 24, 2013  
Test Conducted for: Churchill Navigation  
1919 14th St  
Boulder, CO 80305

**NOTICE:** "This report must not be used by the client to claim product endorsement by NVLAP or any agency of the U.S. Government". Please see the "Additional Description of Equipment Under Test" page listed inside of this report.

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United States Department of Commerce  
National Institute of Standards and Technology



## Certificate of Accreditation to ISO/IEC 17025:2005

NVLAP LAB CODE: 100276-0

**D.L.S. Electronic Systems, Inc.**  
Wheeling, IL

*is accredited by the National Voluntary Laboratory Accreditation Program for specific services,  
listed on the Scope of Accreditation, for:*

### **ELECTROMAGNETIC COMPATIBILITY AND TELECOMMUNICATIONS**

*This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005.  
This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality  
management system (refer to joint ISO-ILAC-IAF Communique dated January 2009).*

2012-10-01 through 2013-09-30

*Effective dates*



*For the National Institute of Standards and Technology*

NVLAP-01C (REV. 2009-01-28)



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## 1.0 INTRODUCTION:

On January 23 & 24, 2013, a series of emissions tests were made to demonstrate that the Churchill Augmented Reality System 500C, Model Number(s) ARS-500C-2012, serial number ARS-500C-201220, manufactured by Boulder Engineering Studio was tested to the requirements of RTCA/DO-160G (December 8, 2010), Environmental conditions and Test Procedures for Airborne Equipment using the following test procedure(s): Section 21.

## 2.0 TEST FACILITY:

D.L.S. Electronic Systems, Inc. is a full service EMC Testing Laboratory accredited to ISO Guide 17025. NVLAP Certificate and Scope can be viewed at <http://www.dlsemc.com/certificate>. Our facilities are registered with the FCC, Industry Canada, and VCCI. All tests were performed by personnel of D.L.S. Electronic Systems, Inc. at the following location(s):

### **Main Test Facility:**

D.L.S. Electronic Systems, Inc.  
1250 Peterson Drive  
Wheeling, Illinois 60090

A list of the test equipment used, along with identification and calibration data, is included in the Table of each Appendix of this report. All primary equipment was calibrated against known reference standards with a verified traceable path to NIST.

## 3.0 TEST SET-UP:

All emissions tests were performed at D.L.S. Electronic Systems, Inc. The Churchill Augmented Reality System 500C was placed on a copper bench measuring 24' long and 40" wide. The following describes the various Labs that are used for testing:

LAB C      26' long x 16' wide x 16' high semi-ferrite lined enclosure.

The tests were run in the following labs:

LAB C      Section 21, Emission of Radio Frequency Energy



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#### 4.0 OPERATING CONDITIONS OF TEST SAMPLE:

All test measurements were made at a laboratory temperature of **68°F** at **31%** humidity with the following mode of operation:

Assembly should be performed with fuse (10A) pulled outward. The ARS-500C should be supplied 28 V DC power capable of a peak current draw near 8A. The unit should be hard-mounted with provided angle brackets and case-grounded using the case-ground point on the rear side of the device.

An HD-SDI camera, supplied, should be connected to V1 with the provided coaxial cable and powered by an external AC-DC power supply, also supplied. An external monitor, not supplied, should be connected to the unit's VGA port (J11) to monitor software during testing. Please use a well-shielded VGA cable. Attach a USB keyboard, not provided, to any of the unit's USB ports. Be sure that all connectors are tightened into each port, where applicable. For testing, power the unit on by pressing the fuse-switch into the unit. Wait for the ARS software to boot up; a map screen should be displayed on the VGA monitor. Press F1; video from the camera will appear overlaid on top of the map screen. Remove the USB keyboard to begin testing.

For EMI/EMF testing only, please also attach the following provided cables to their respective ports as a "worst-case scenario":

- Auxiliary power; J2
- HDMI; J12
- USB; J5
- Ethernet; J14

#### 5.0 PERFORMANCE MONITORED:

The Churchill Augmented Reality System 500C performance was monitored as follows:

During testing, the powered unit should output to a VGA monitor and display continuously streaming video from the HD-SDI camera. The system fan should run at ambient temperatures above room temperature. The 28V, 12V, and 5V LEDs should remain lit. The unit should also respond to user input over any USB port. Use keyboard F1 and F5 keys turn the video feed on and off and test I/O.



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## 6.0 DESCRIPTION OF TEST SAMPLE: (See also Paragraph 7.0)

6.1 The unit is powered by a 28V source through a circular-type Lemo connector. The maximum power draw is 200W. The aluminum case houses a computer system design for non-flight-critical aircraft navigation. In a typical setup, the unit is connected to a camera on the underside of the aircraft and overlays map information on top of the real-time video feed.

## 6.2 PHYSICAL DIMENSIONS OF EQUIPMENT UNDER TEST:

Length: 8 in x Width: 7 in x Height: 5 in

## 6.3 LINE FILTER USED:

## 6.4 INTERNAL CLOCK FREQUENCIES:

Switching Power Supply Frequencies:

400 kHz

Clock Frequencies:

2.3 GHz

## 6.5 DESCRIPTION OF ALL CIRCUIT BOARDS:

|                                       |                  |
|---------------------------------------|------------------|
| Industrial motherboard                | KINO-QM670       |
| Switching power supply board, 12V->5V | Vicor-BES-R1124  |
| USB I/O board                         | USBRJ45-BES-1074 |
| Video I/O board                       | Decklink Quad    |



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## 7.0 ADDITIONAL DESCRIPTION OF EQUIPMENT UNDER TEST AND BONDING CHECK:

(See also Paragraph 6.0)

There were no additional descriptions noted at the time of test.

Chassis Ground screq -> GND : 0.71mohm

Video 2 -> GND : 34mohm

J8 Screw -> GND : 57mohm

J7 Screw -> GND : 121mohm

## 8.0 PHOTO INFORMATION AND TEST SET-UP:

The test set up can be seen in the accompanying photograph.

Item 0 Churchill Augmented Reality System 500C  
Model Number: ARS-500C-2012

Item 1 Shielded AC Power, 1 m long

Item 2 Shielded Ethernet

Item 3 USB cable

Item 4 Shielded HDMI cable

Item 5 Auxiliary cable

Item 6 Shielded Video Cable

Item 7 Shielded VGA Output



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## 9.0 PHOTO ID TAKEN DURING TESTING:

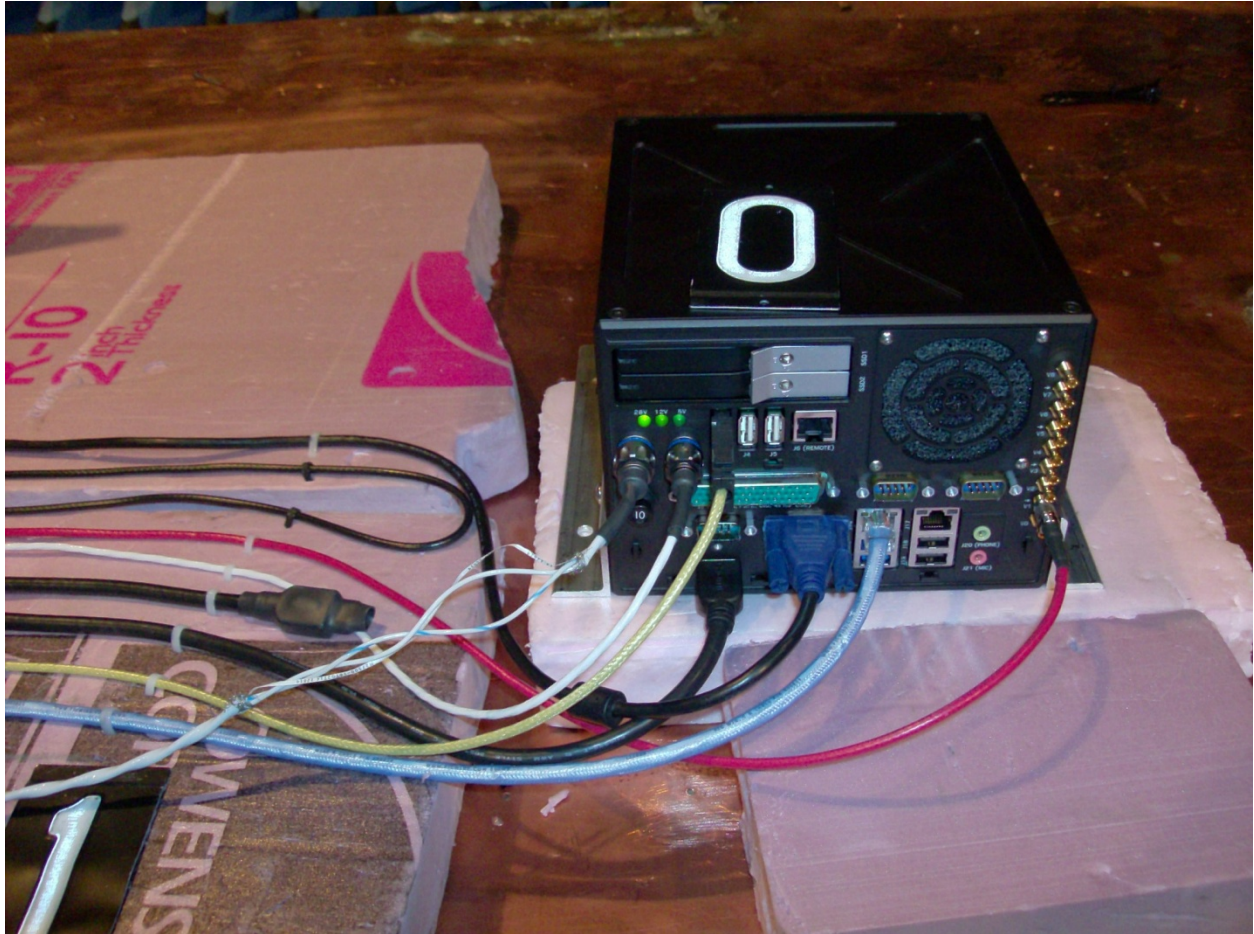


Photo ID 1



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## 9.0 PHOTO ID TAKEN DURING TESTING:

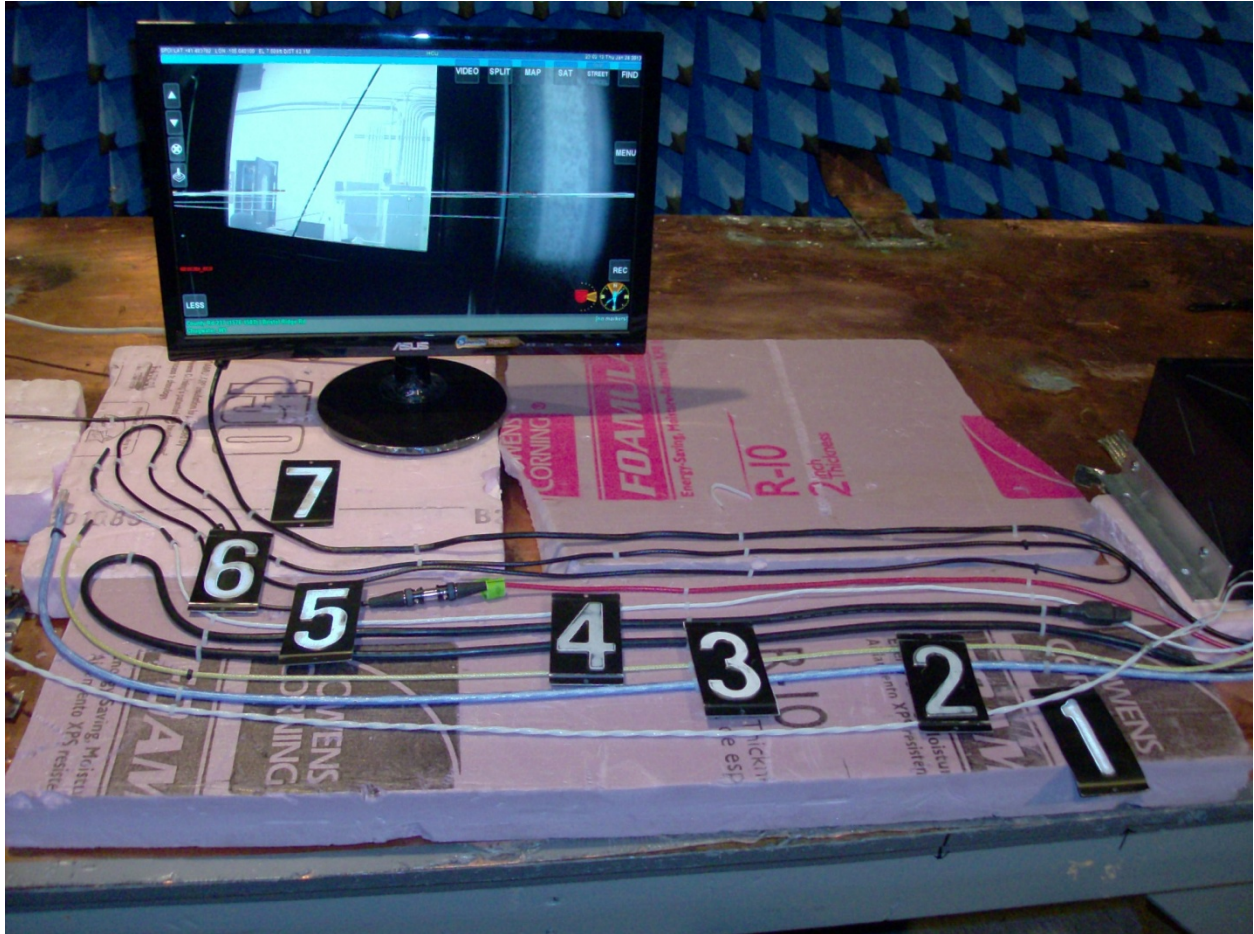


Photo ID 2



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## 9.0 TEST SETUP PHOTOS TAKEN DURING TESTING:



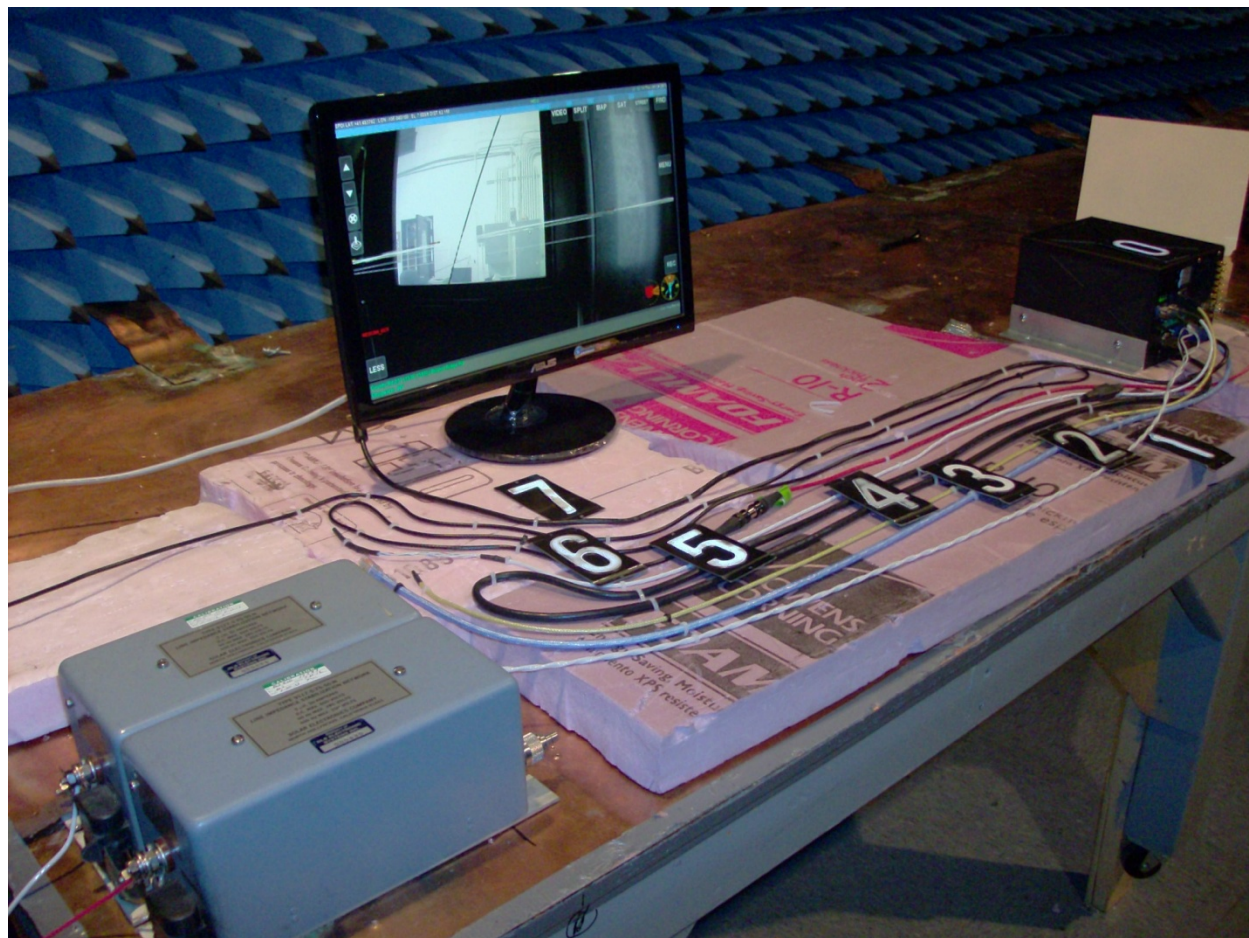
Setup 1



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## 9.0 TEST SETUP PHOTOS TAKEN DURING TESTING:



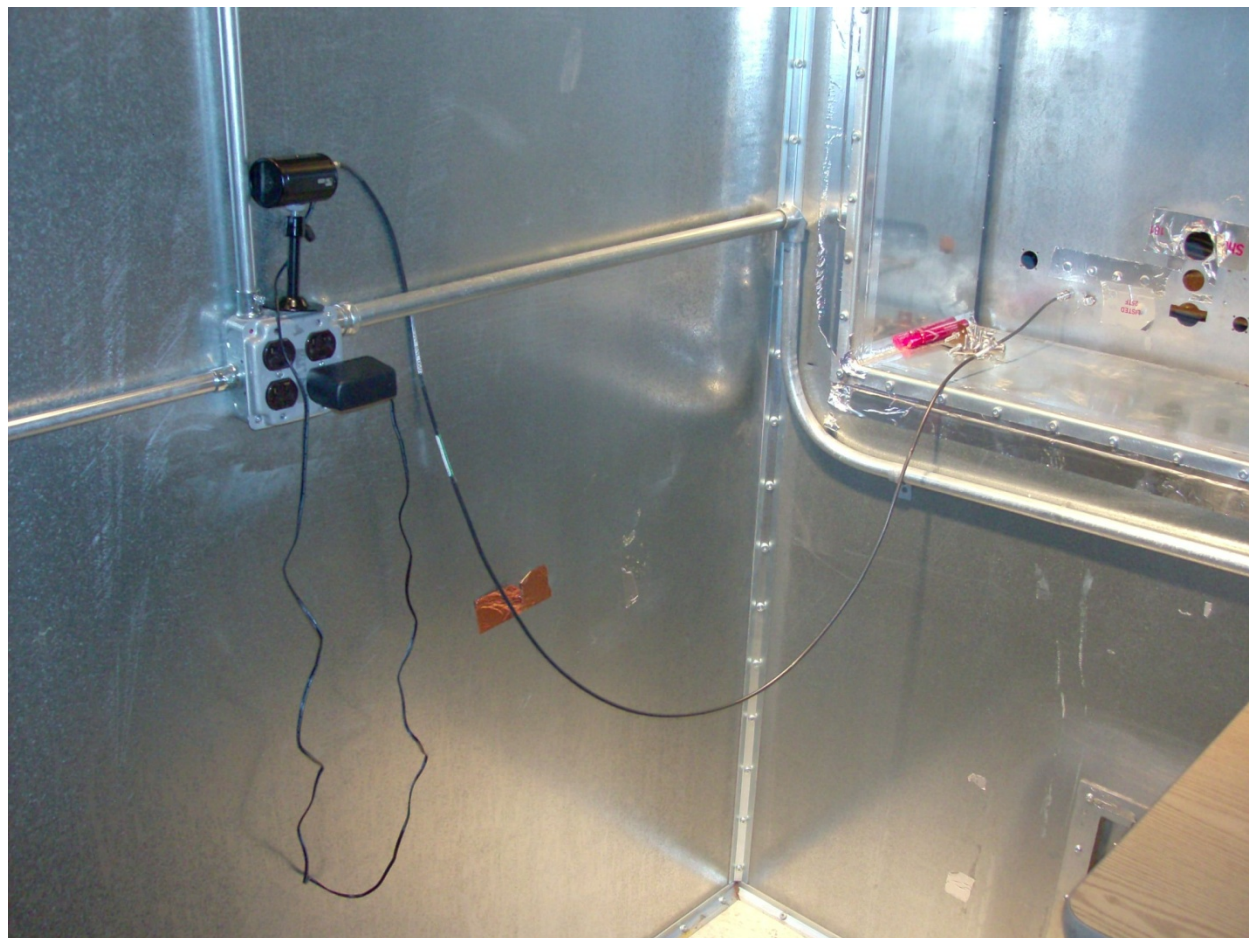
Setup 2



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## 9.0 TEST SETUP PHOTOS TAKEN DURING TESTING:



Setup 3



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## 9.0 TEST SETUP PHOTOS TAKEN DURING TESTING:



Bonding



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## 10.0 REFERENCES:

1. Document No. RTCA/DO-160G, December 8, 2010  
Prepared by: SC-135

## 11.0 TEST RESULTS:

The Churchill Augmented Reality System 500C was subject to the test procedure(s) Section 21. A detailed explanation of how these tests and their measurements were made is shown in Appendix(es) A at the end of this report.

## 12.0 CONCLUSION OF EMISSIONS TESTS:

The Churchill Augmented Reality System 500C, Model Number(s) ARS-500C-2012, **meets** RTCA/DO-160G (December 8, 2010), Environmental conditions and Test Procedures for Airborne Equipment using test procedure(s) Section 21. See the Appendix(es) A for a detailed explanation of the test results.



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# APPENDIX A

## RTCA/DO-160G

### SECTION 21

#### PARAGRAPH(S) 21.4 & 21.5

#### EMISSION OF RADIO FREQUENCY ENERGY



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## 1.0 PURPOSE OF THE TEST:

These tests determine that the equipment does not emit undesired RF noise in excess of the levels specified.

## 2.0 EQUIPMENT CATEGORIES:

Categories are defined in terms of location and separation between the equipment and aircraft radio antennas. As these parameters are widely linked to aircraft type and size, some examples are given with each category definition.

The Churchill Augmented Reality System 500C was subjected to the requirements of **Category B:**

### Category B

This category is intended primarily for equipment where interference should be controlled to tolerable levels.

### 3.0 TEST SETUP AND APPARATUS:

The conducted setup can be seen in Figure 21-6 shown below:

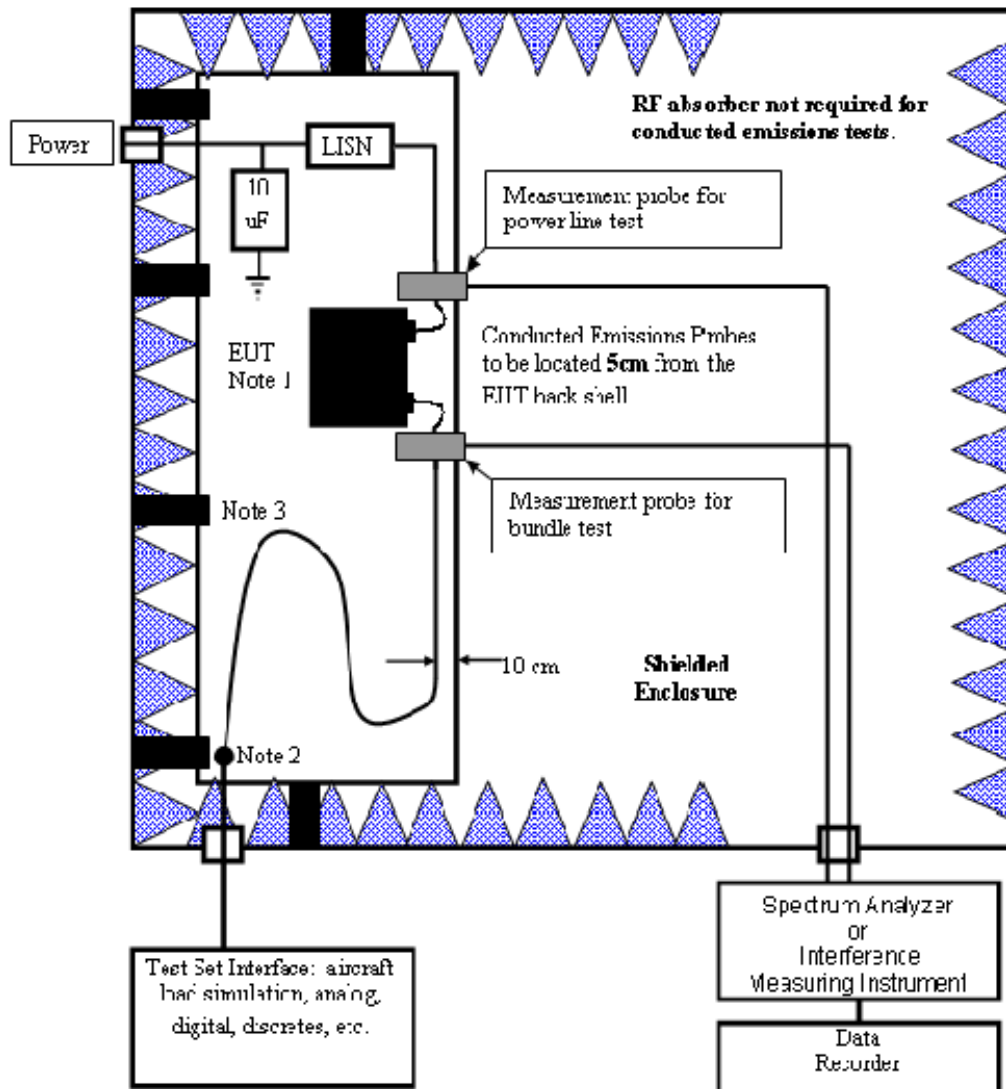


**Figure 21-6 Typical Setup for Conducted RF Interference Test**

**Note 1** See Section 20.3 for EUT general requirements.

**Note 2** End of exposed cable. Unshielded cable may be shielded from here to the wall.

**Note 3** Bonding strap.

### 3.0 TEST SETUP AND APPARATUS:

The radiated setup can be seen in Figure 21-11 shown below:

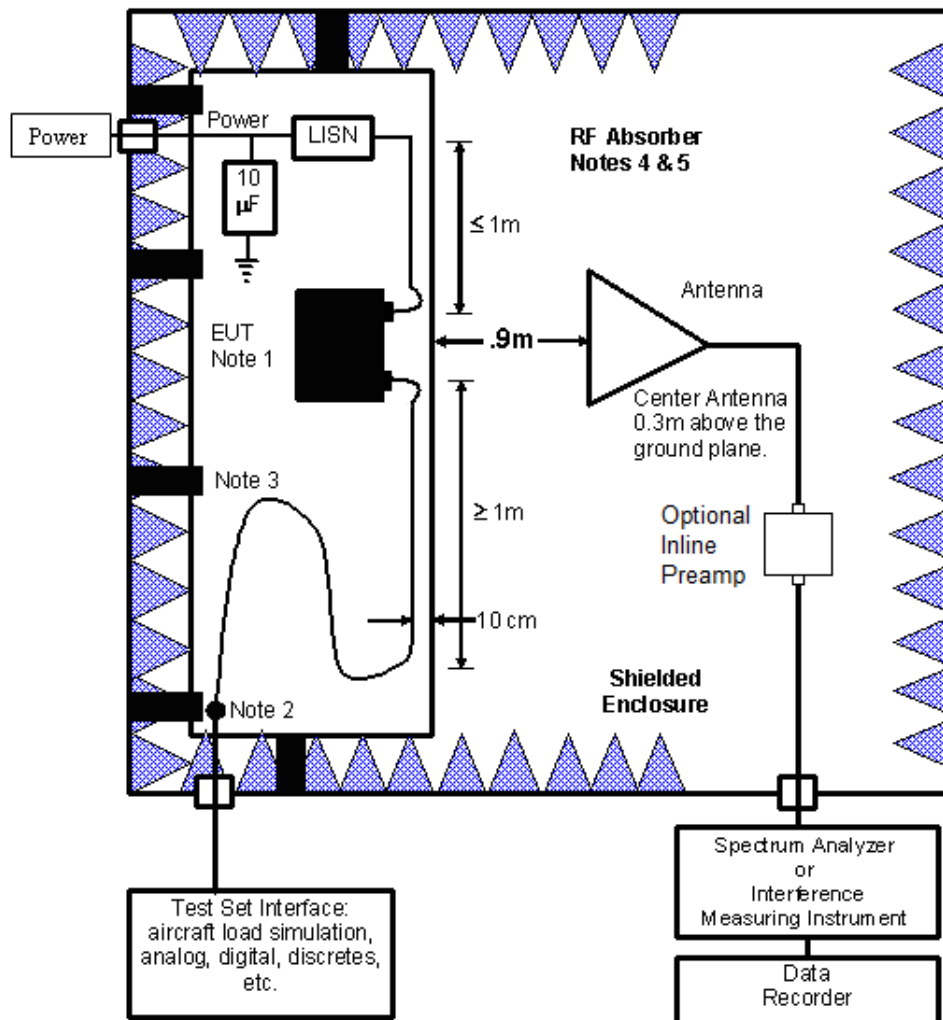


**Figure 21-11 – Radiated Emissions Test Setup**

- Note 1** See Section 20.3 for EUT general requirements.
- Note 2** End of exposed cable. Unshielded cable may be shielded from here to the wall.
- Note 3** Bonding strap.
- Note 4** RF absorber shall be placed above, behind, and on both sides of test setup boundary, from ceiling to ground plane. The absorber shall extend  $\geq 50\text{ cm}$  in front of the ground plane.
- Note 5** RF absorber shall be placed behind the test antenna, from ceiling to floor. The distance between the absorber and the antenna shall be  $\geq 30\text{ cm}$ .



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#### 4.0 TEST PROCEDURE:

##### **Conducted RF Emission:**

Measure conducted emissions from 150 kHz to 152 MHz. Interference currents generated by the equipment shall be measured by using a clamp-on interference measuring device.

- a. EUT emissions within the frequency ranges and in excess of the values given in Figure 21-1 shall not appear on any power line normally connected to an aircraft bus.
- b. EUT Emissions within the frequency ranges and in excess of the values given in Figure 21-2 shall not appear on any interconnecting cable bundles. Primary power lines are not considered to be interconnecting cable bundles. Antenna feed cables are considered to be interconnecting cables while in a non-transmitting or receive mode.
- c. Figure 21-6 shows a simplified test arrangement for the use of the current probe.
- d. Install the current probe five centimeters from the EUT. If the EUT connector plus back shell length exceeds five centimeters the probe shall be placed as close to the connector back shell as possible and the position noted.
- e. Measure and record the EUT emissions and apply the appropriate limit from Figures 21-1 or -2 for the selected category.



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#### 4.0 TEST PROCEDURE (CON'T):

##### **Radiated RF Emission:**

Measure radiated emissions from 100 MHz to 6000 MHz.

- a. Radiated interference fields generated by the equipment within the frequency ranges, and in excess of the values shown in Figure 21-7 for the appropriate categories, shall not be radiated from any unit, cable or interconnecting wiring.
- b. A typical arrangement of equipment for conducting the radiated RF emission test is shown in Figure 21-11.
- c. Field strength units are obtained by using any appropriate antenna and adding the appropriate antenna factor to the measured voltage in dB microvolts. Appropriate correction factor for cable losses and matching networks must also be applied.
- d. Linearly polarized antennas are required for radiated tests. Measure radiated emissions using both vertically and horizontally polarized orientations.
- e. Directly expose apertures in the EUT (e.g. displays, CRTs, connectors) to the receiving antenna, which may require additional EUT orientations or receive antenna positions. If all EUT apertures are not exposed to the receive antenna, justification must be documented in the test report.
- f. Consider EUT realistic operating modes which produce maximum emission.
- g. Radiated ambient data (EUT “off” and test support equipment “on”) is required only if EUT emissions are greater than 3 dB below the selected category limit.
- h. It is good engineering practice to check ambient radiated emissions prior to a radiated emissions test, and it is desirable that the ambient emissions be at least 6 dB below the selected limit time.
- i. Measure and record the EUT emissions conditions and apply the appropriate limit from Figure 21-7 for the selected category.



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#### 4.0 TEST PROCEDURE (CON'T):

##### General Requirements:

The equipment under test shall be set up on a ground plane and operated in accordance with the criteria in Subsection 20.3 subparagraph a and parts 1, 2 and 5 of subparagraph b, with the following additions:

- a. For radiated emission measurements as in Subsection 21.5, antenna spacing to the ground plane edge and the EUT spacing from the ground plane edge shall be maintained as shown in Figure 21-11.
- b. Interference shall be measured using the peak detector function of the interference measuring equipment. Interference measuring instruments with selectable IF bandwidths (BW) may be used, and the selected BW must be the values given in the following table.

| Frequency Bands | BW      |
|-----------------|---------|
| 0.15 – 30 MHz   | 1 kHz   |
| 30 – 100 MHz    | 10 kHz  |
| 100 – 400 MHz   | 10 kHz  |
| 400 – 960 MHz   | 100 kHz |
| 960 – 6000 MHz  | 1 MHz   |

**Note 1:** It may be necessary to use an in-line low noise preamplifier at the sense antenna output in cascade with the measurement receiver to lower the measurement noise floor for proper measurements in the notches above 960 MHz defined for categories M, H, P & Q.

**Note 2:** For measurement receivers or spectrum analyzers with a “maximum hold” feature that retain maximum detected levels after multiple scans over a given frequency range, multiple faster sweeps that produce the same minimum test times as shown in Table 1 are acceptable.

- c. Line Impedance Stabilization Networks (LISNs) shall be used as shown in Figure 21-6.
- d. Power return wires tied locally to the ground plane as noted in Section 20.3.a (6) are not tested.
- e. The time constant of the peak detector must be lower or equal to  $1/BW$ . Where applicable, video bandwidths shall be selected to be greater than or equal to the resolution bandwidth.
- f. Longer dwell, sweep and measurement times than those shown in Table 1 may be necessary to detect time-varying emissions. Dwell times in Table 1 are associated with a potential rate of variation of approximately 60Hz.



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#### 4.0 TEST PROCEDURE (CON'T):

- g. For emission measurements, the entire frequency range for each applicable test shall be scanned. Minimum measurement time for analog measurement receivers during emission testing shall be as specified in the above table. Larger receiver bandwidths may be used; however, they may result in higher measured emission levels.

**NOTE:** No bandwidth correction factors shall be applied to test data due to the use of larger bandwidths.

- h. Recorded data shall provide a minimum frequency resolution of 1% or twice the measurement receiver bandwidth, whichever is less stringent, and minimum amplitude resolution of 1 dB.
- i. Amplitude versus frequency profiles of emission data shall be automatically generated and shall be continuous.



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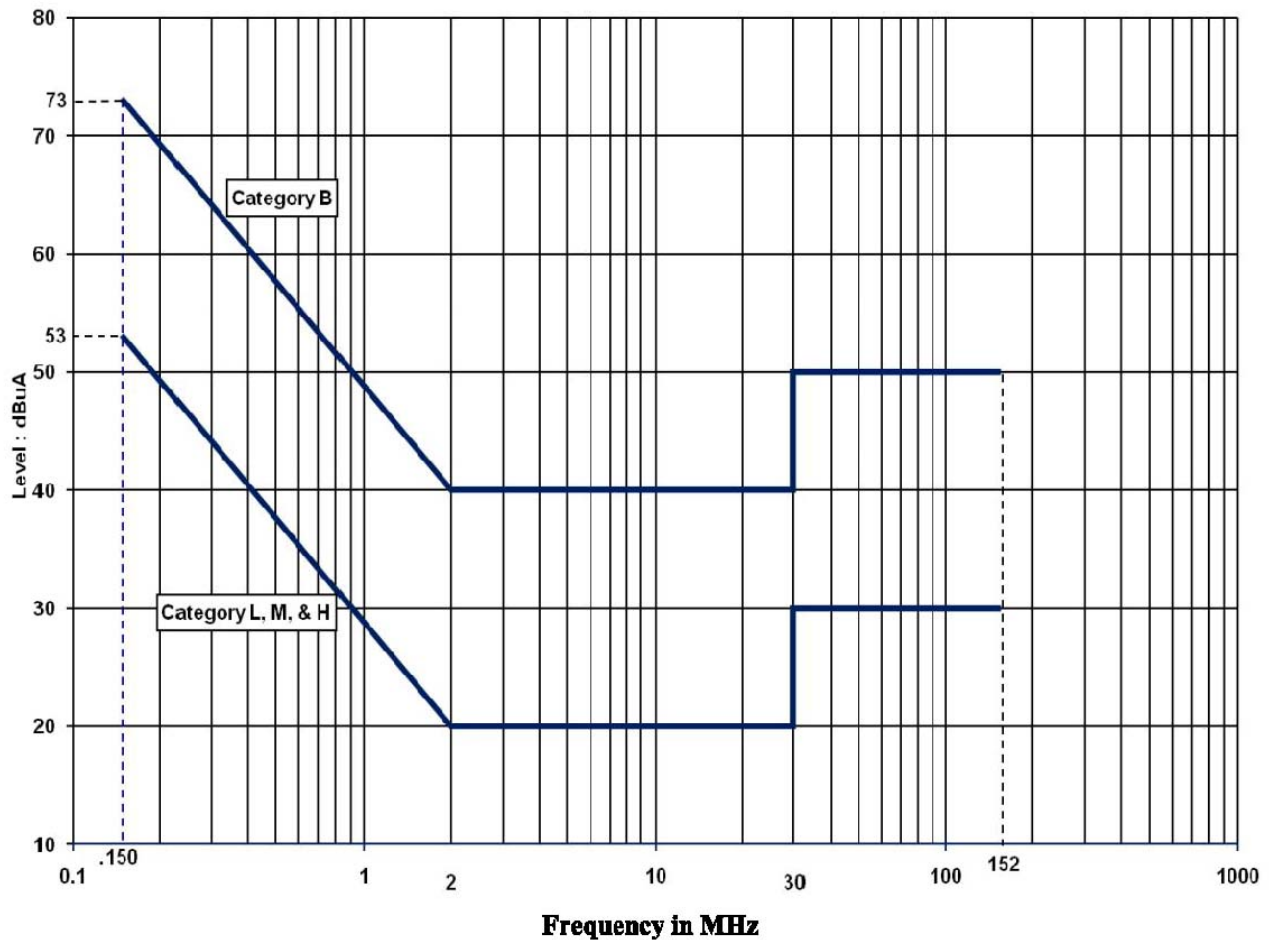
Company: Churchill Navigation  
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## 5.0 LIMITS & RESULTS:

### 5.1 LIMITS:

The maximum level of conducted RF interference on the power lines is shown in **Figure 21-1** using **Category B**:



Curve definition : Limit Level = slope \* log(freq in MHz) + intercept  
Category B: F<1 MHz slope = -29.335, intercept = 48.83  
Category L,M,&H: F<2 MHz slope = -29.335, intercept = 28.83

**Figure 21-1 : Maximum Level of Conducted RF Interference – Power Lines**



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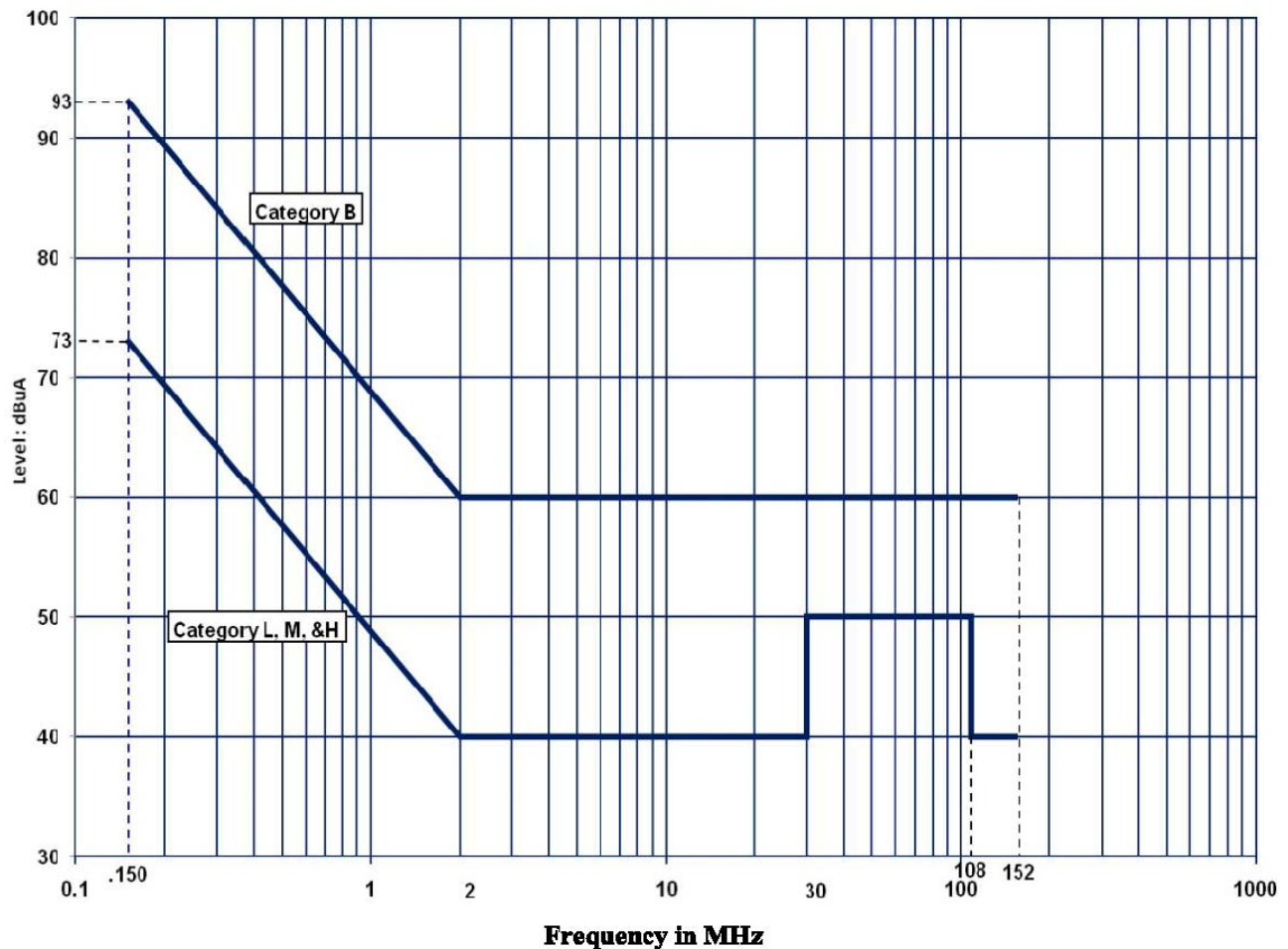
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## 5.0 LIMITS & RESULTS (CON'T):

### 5.1 LIMITS:

The maximum level of conducted RF interference on interconnecting bundles is shown in **Figure 21-2** using **Category B**:



Curve definition : Limit Level = slope \* log(freq in MHz) + intercept  
Category B: F<2 MHz slope = -29.335, intercept = 68.83  
Category L,M&H: F<2 MHz slope = -29.335, intercept = 48.83

**Figure 21-2 : Maximum Level of Conducted RF Interference – Interconnecting Bundles**



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## 5.0 LIMITS & RESULTS (CON'T):

### 5.1 LIMITS:

The maximum level of radiated RF interference is shown in **Figure 21-7**:

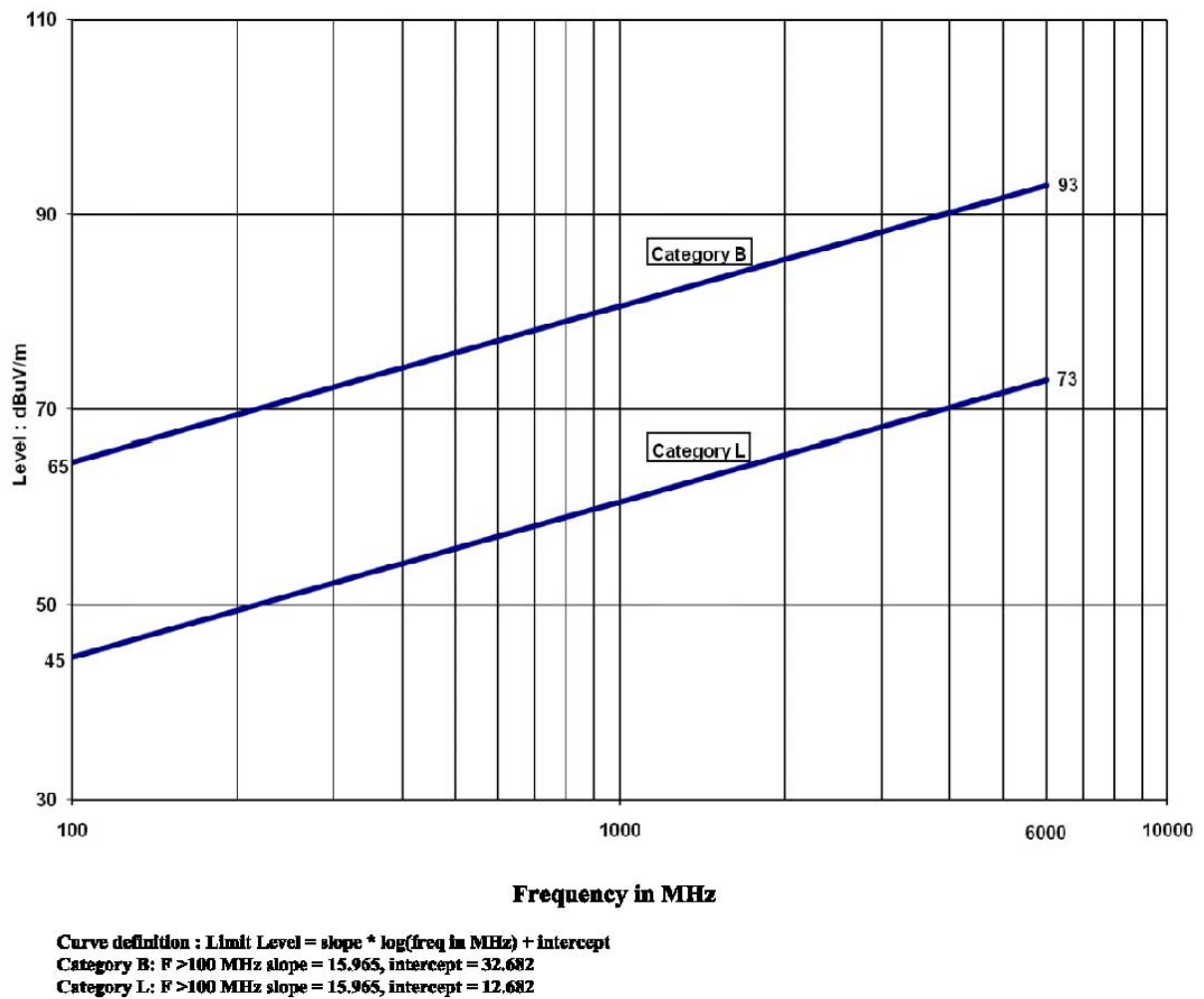


**Figure 21-7 : Maximum Level of Radiated RF Interference – Category B & L**



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## 5.0 LIMITS & RESULTS: (CON'T)

### 5.2 RESULTS:

The Churchill Augmented Reality System 500C **meets** the following conditions:

RTCA/DO-160G Section 21 Category B

**Lab used: C**

#### **Summary:**

Video transmission was verified using a monitor attached via a VGA cable.  
Monitor was unplugged during radiated emission scans.



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## 6.0 CONDUCTED PHOTOS TAKEN DURING TESTING



CE 150kHz-152MHz System Verification

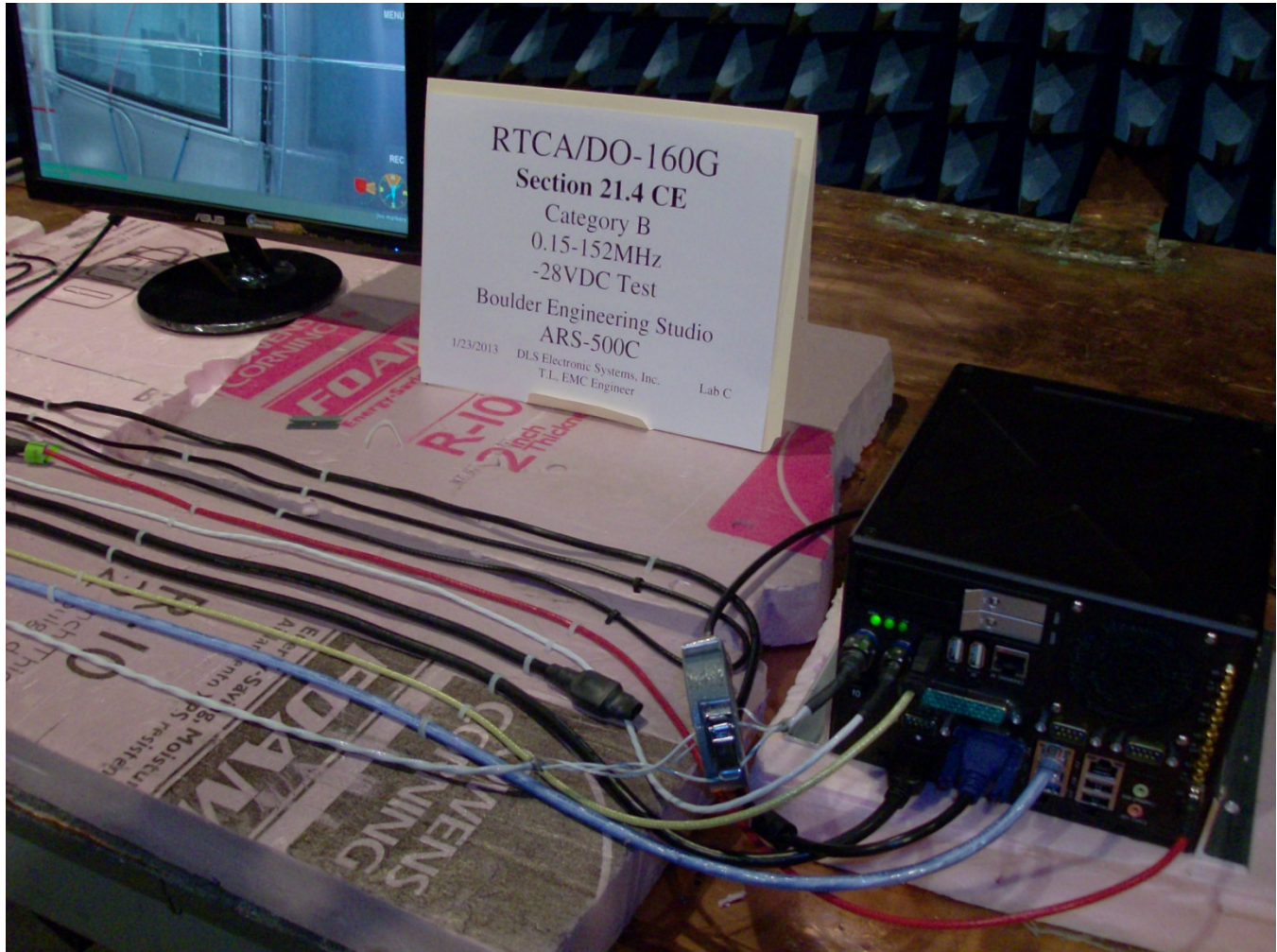


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## 6.0 CONDUCTED PHOTOS TAKEN DURING TESTING



CE -28VDC Test

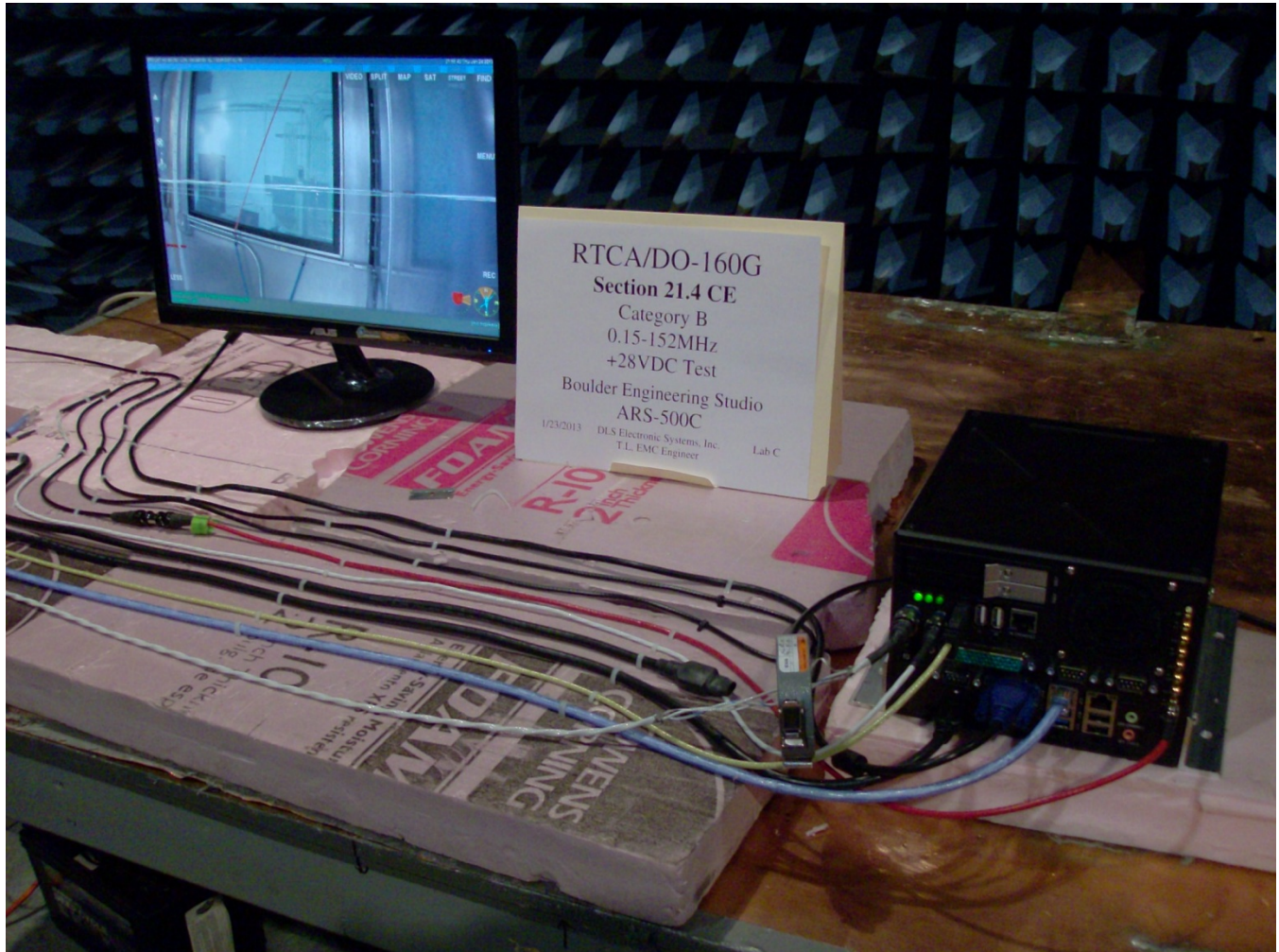


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## 6.0 CONDUCTED PHOTOS TAKEN DURING TESTING



CE +28VDC Test

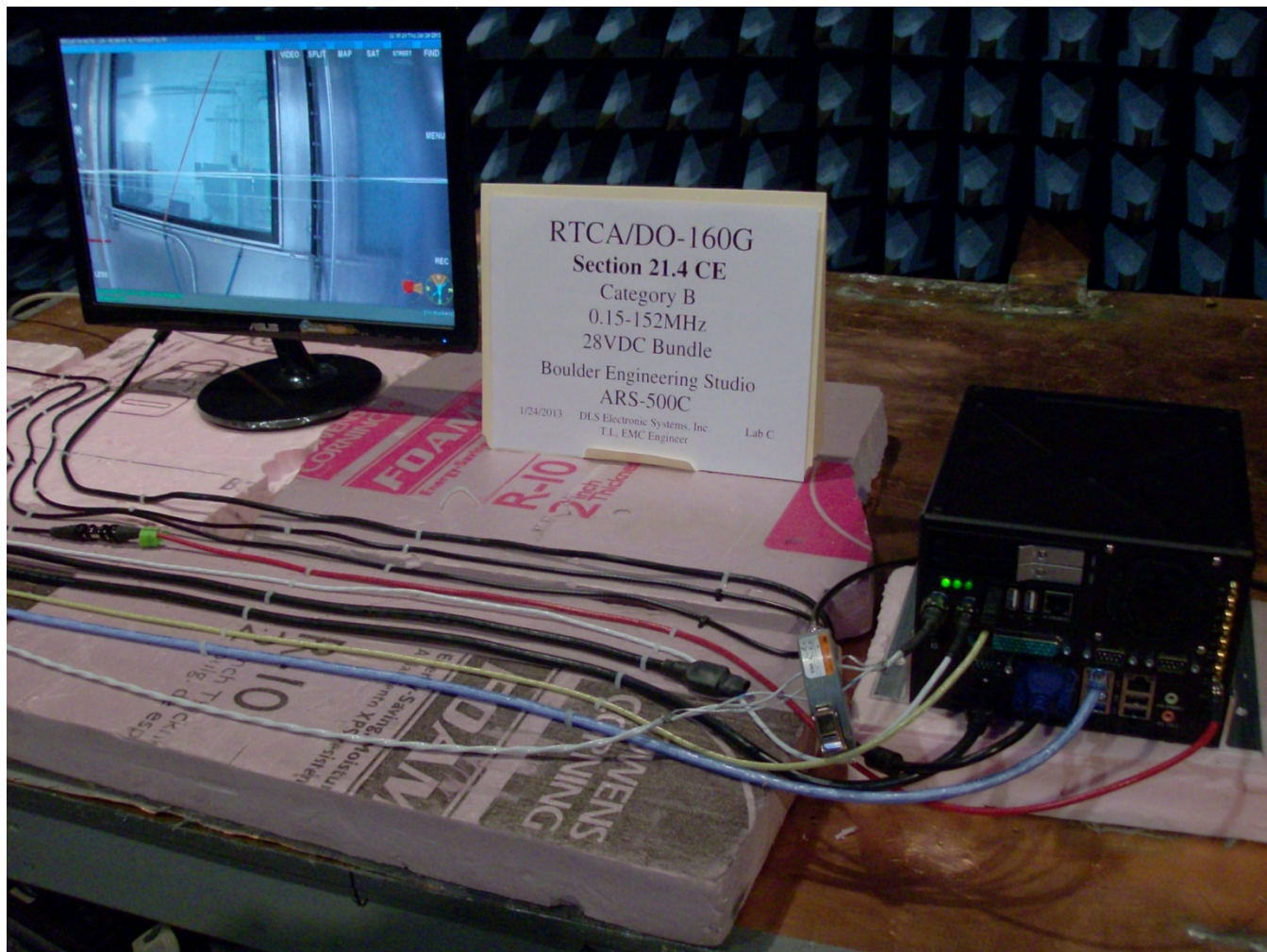


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## 6.0 CONDUCTED PHOTOS TAKEN DURING TESTING



CE 28VDC Bundle Test

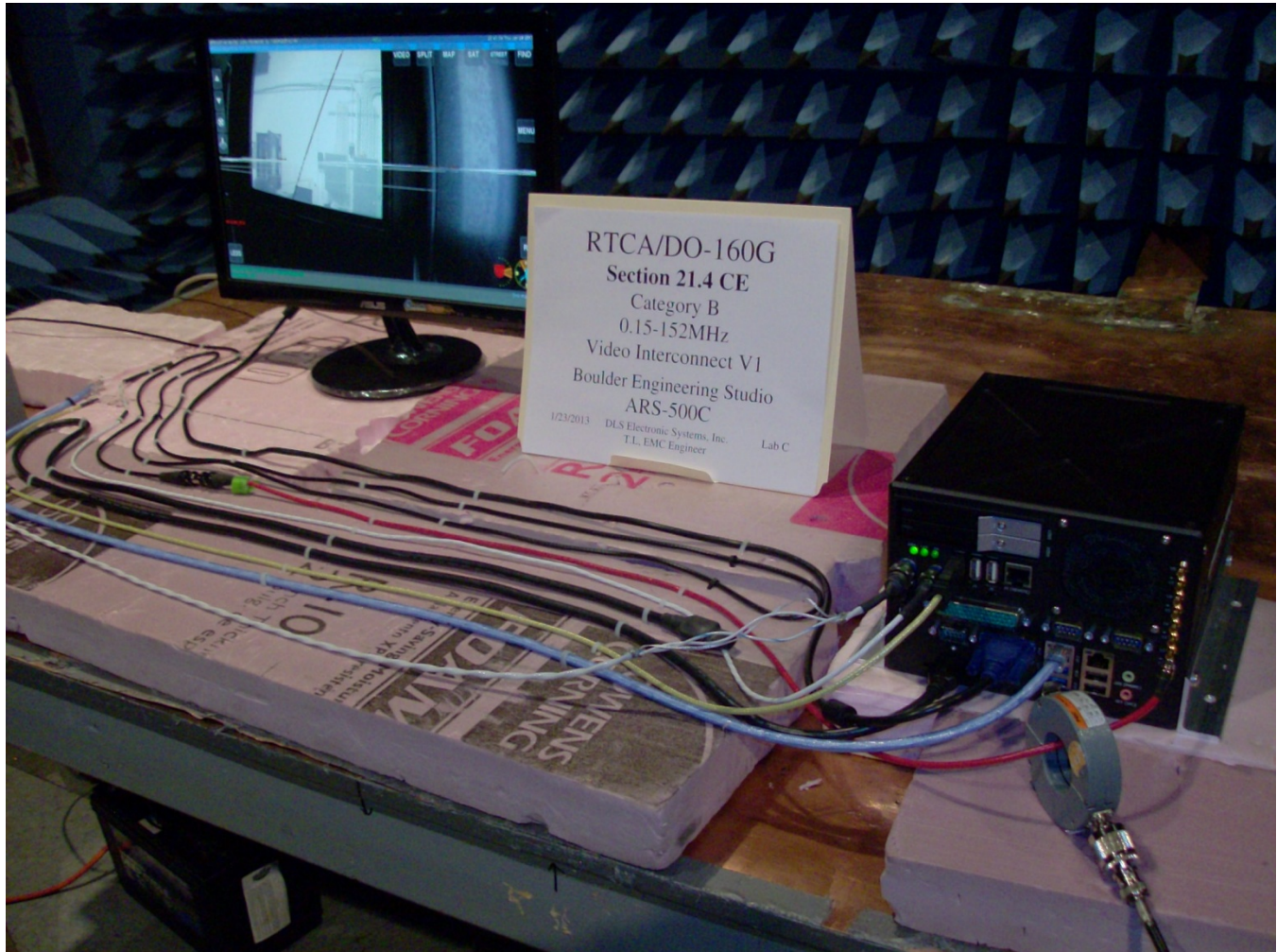


1250 Peterson Dr., Wheeling, IL 60090

Company: Churchill Navigation  
Model Tested: ARS-500C-2012  
Report Number: 18688  
Standard: RTCA/DO-160G Section 21 Emission of Radio Frequency Energy

Appendix: A

## 6.0 CONDUCTED PHOTOS TAKEN DURING TESTING



CE V1 Interconnect Test



1250 Peterson Dr., Wheeling, IL 60090

Company: Churchill Navigation  
Model Tested: ARS-500C-2012  
Report Number: 18688  
Standard: RTCA/DO-160G Section 21 Emission of Radio Frequency Energy

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## 6.0 CONDUCTED PHOTOS TAKEN DURING TESTING



CE -28VDC Ambient

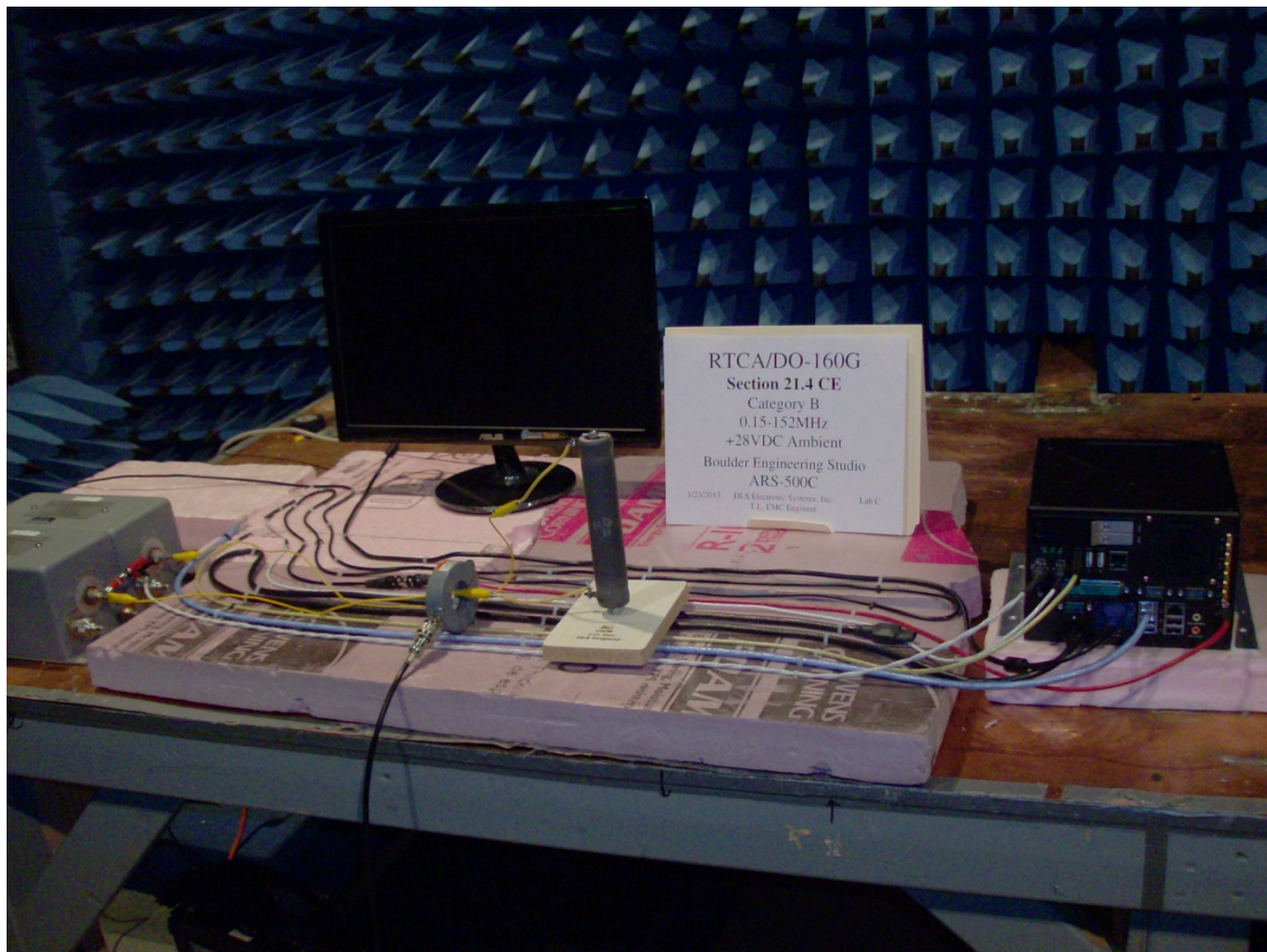


1250 Peterson Dr., Wheeling, IL 60090

Company: Churchill Navigation  
Model Tested: ARS-500C-2012  
Report Number: 18688  
Standard: RTCA/DO-160G Section 21 Emission of Radio Frequency Energy

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## 6.0 CONDUCTED PHOTOS TAKEN DURING TESTING



CE +28VDC Ambient



1250 Peterson Dr., Wheeling, IL 60090

Company: Churchill Navigation  
Model Tested: ARS-500C-2012  
Report Number: 18688  
Standard: RTCA/DO-160G Section 21 Emission of Radio Frequency Energy

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## 7.0 RADIATED PHOTOS TAKEN DURING TESTING



### RE 100-1000MHz System Verification



1250 Peterson Dr., Wheeling, IL 60090

Company: Churchill Navigation  
Model Tested: ARS-500C-2012  
Report Number: 18688  
Standard: RTCA/DO-160G Section 21 Emission of Radio Frequency Energy

Appendix: A

## 7.0 RADIATED PHOTOS TAKEN DURING TESTING



## RE 1-6GHz System Verification

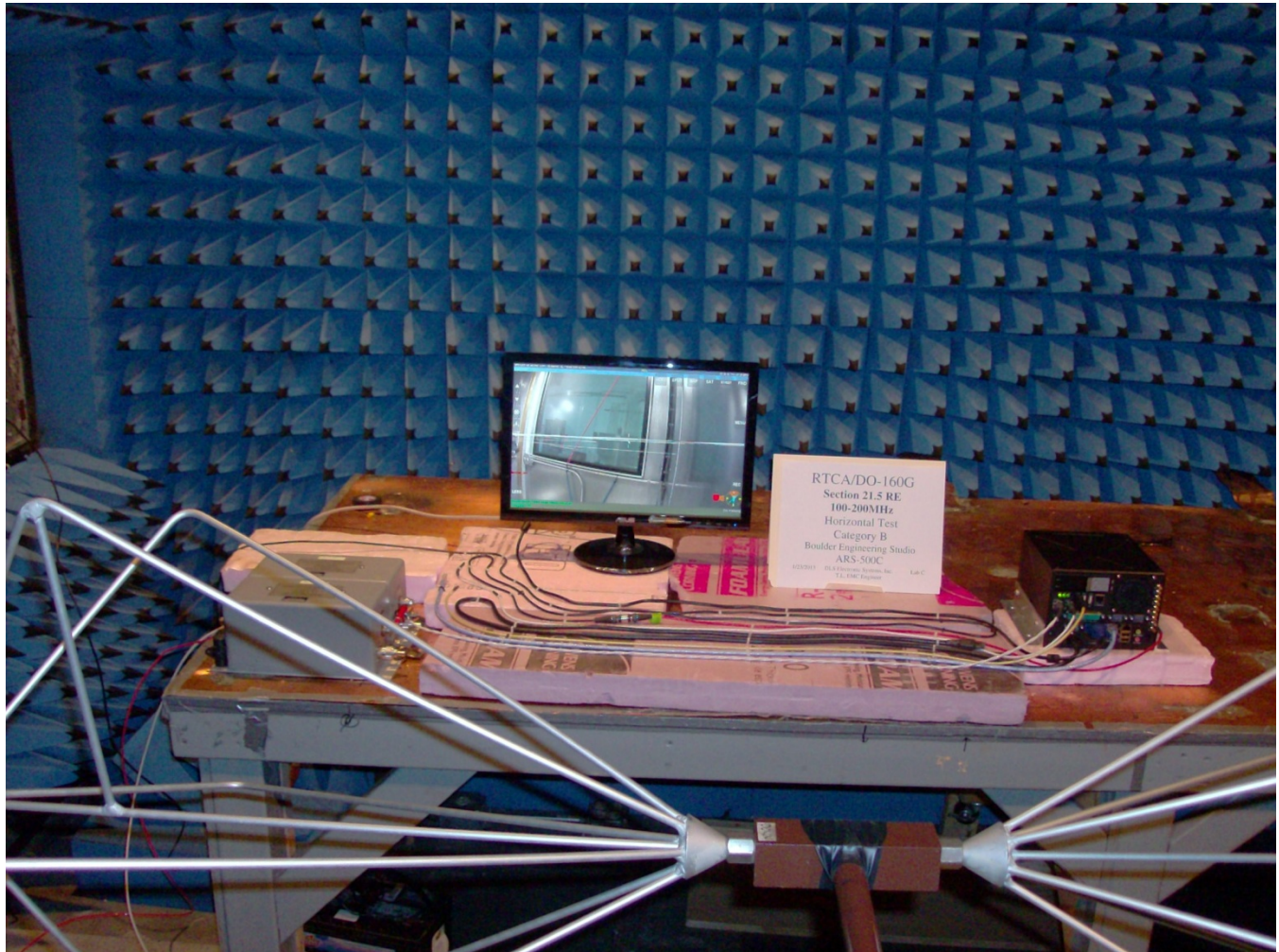


1250 Peterson Dr., Wheeling, IL 60090

Company: Churchill Navigation  
Model Tested: ARS-500C-2012  
Report Number: 18688  
Standard: RTCA/DO-160G Section 21 Emission of Radio Frequency Energy

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## 7.0 RADIATED PHOTOS TAKEN DURING TESTING



RE 100-200MHz Horizontal Test

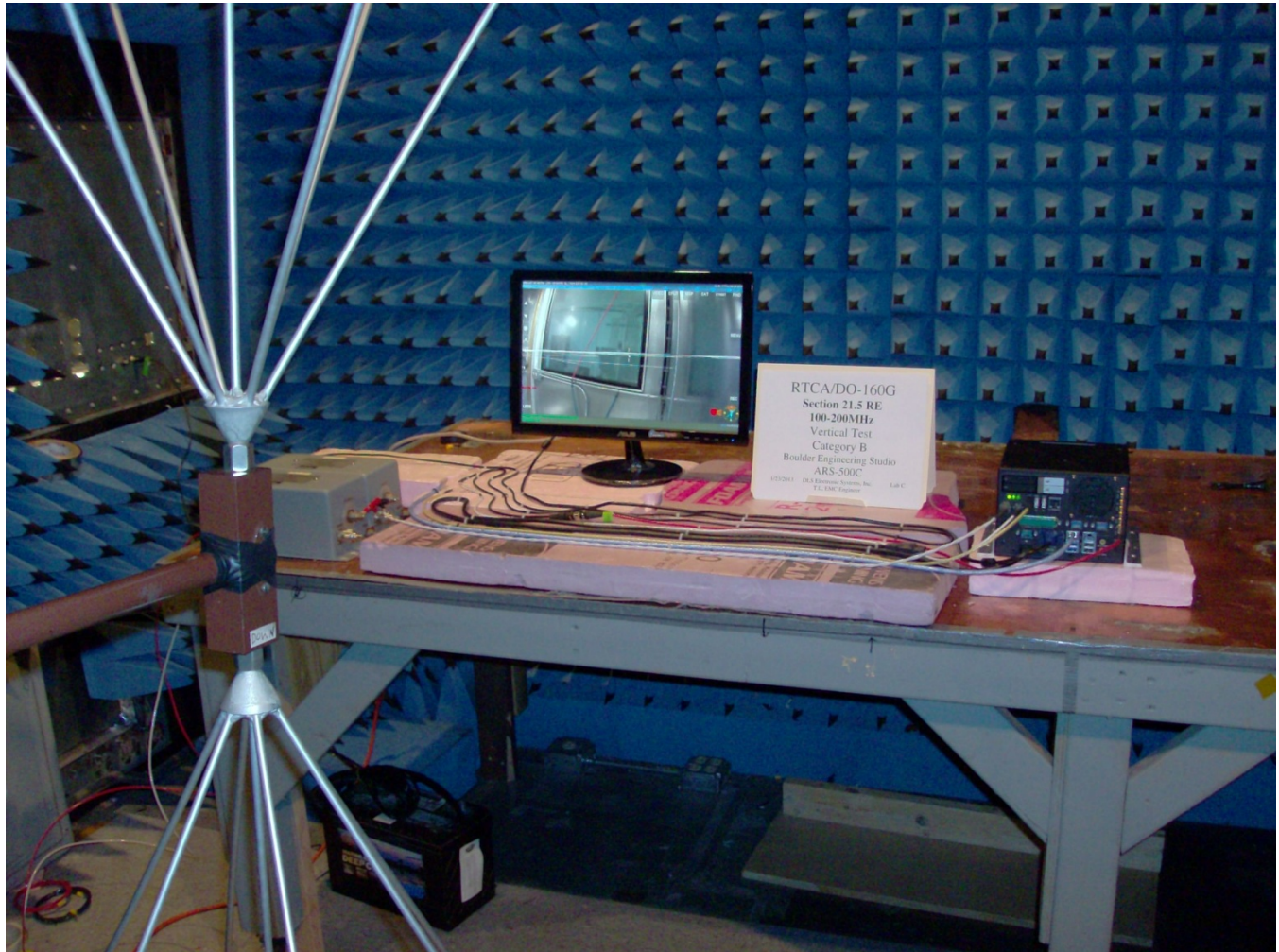


1250 Peterson Dr., Wheeling, IL 60090

Company: Churchill Navigation  
Model Tested: ARS-500C-2012  
Report Number: 18688  
Standard: RTCA/DO-160G Section 21 Emission of Radio Frequency Energy

Appendix: A

## 7.0 RADIATED PHOTOS TAKEN DURING TESTING



RE 100-200MHz Vertical Test

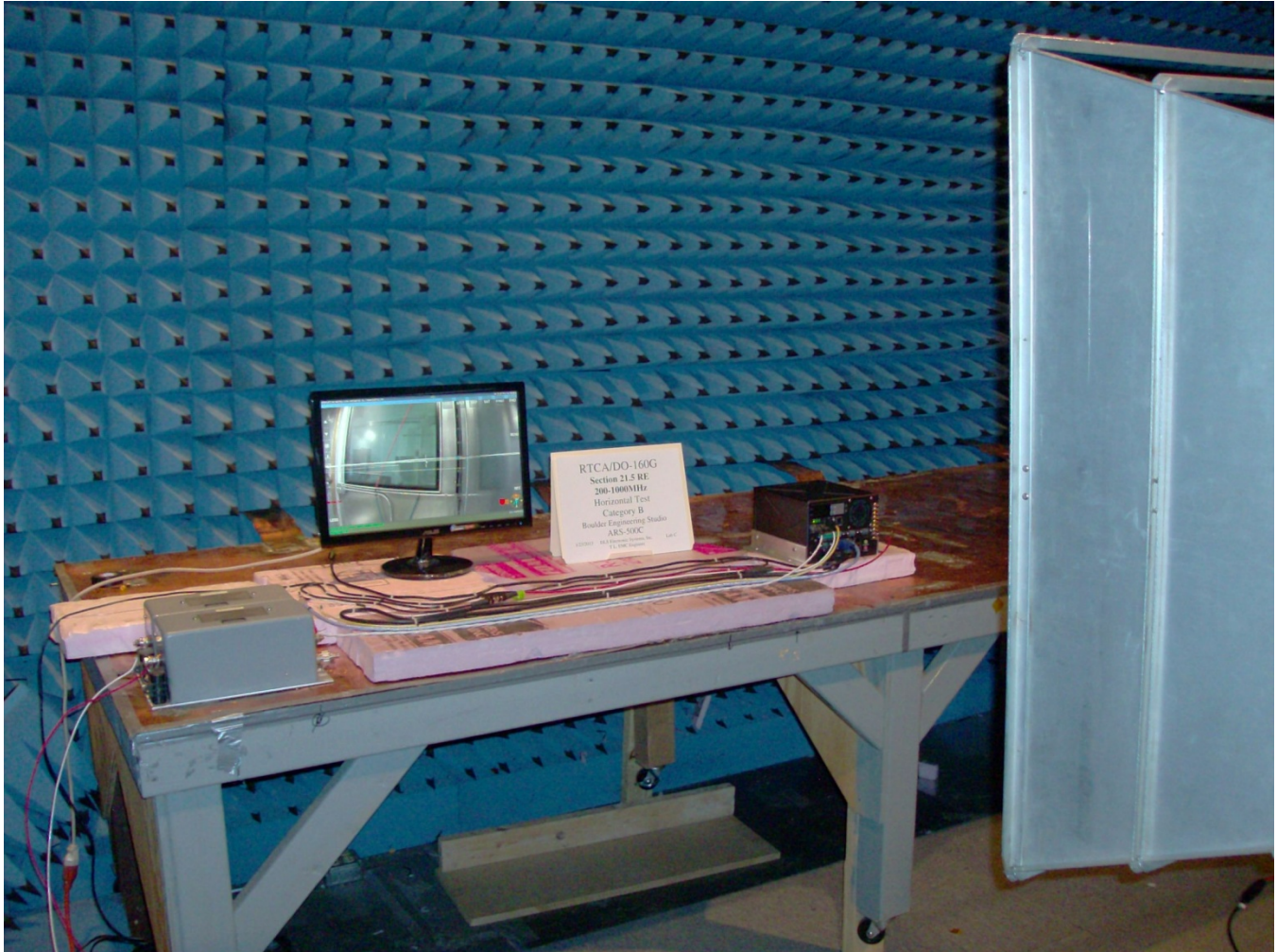


1250 Peterson Dr., Wheeling, IL 60090

Company: Churchill Navigation  
Model Tested: ARS-500C-2012  
Report Number: 18688  
Standard: RTCA/DO-160G Section 21 Emission of Radio Frequency Energy

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## 7.0 RADIATED PHOTOS TAKEN DURING TESTING



RE 200-1000MHz Horizontal Test

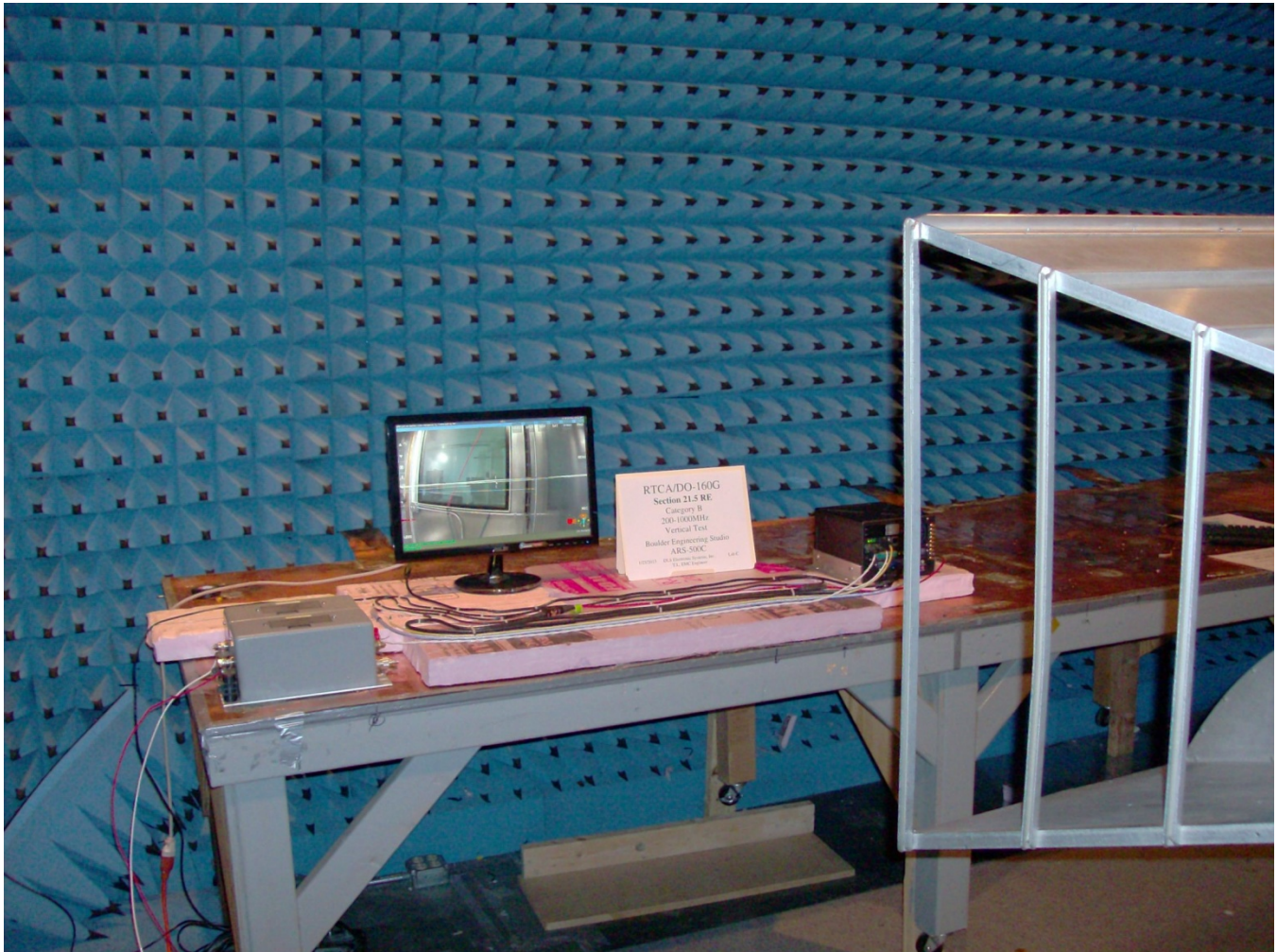


1250 Peterson Dr., Wheeling, IL 60090

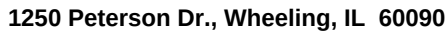
Company: Churchill Navigation  
Model Tested: ARS-500C-2012  
Report Number: 18688  
Standard: RTCA/DO-160G Section 21 Emission of Radio Frequency Energy

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## 7.0 RADIATED PHOTOS TAKEN DURING TESTING



RE 200-1000MHz Vertical Test



## Appendix: A

### Radio Frequency Energy

## RE 1-6GHz Horizontal Test



1250 Peterson Dr., Wheeling, IL 60090

Company: Churchill Navigation  
Model Tested: ARS-500C-2012  
Report Number: 18688  
Standard: RTCA/DO-160G Section 21 Emission of Radio Frequency Energy

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## 7.0 RADIATED PHOTOS TAKEN DURING TESTING



RE 1-6GHz Vertical Test

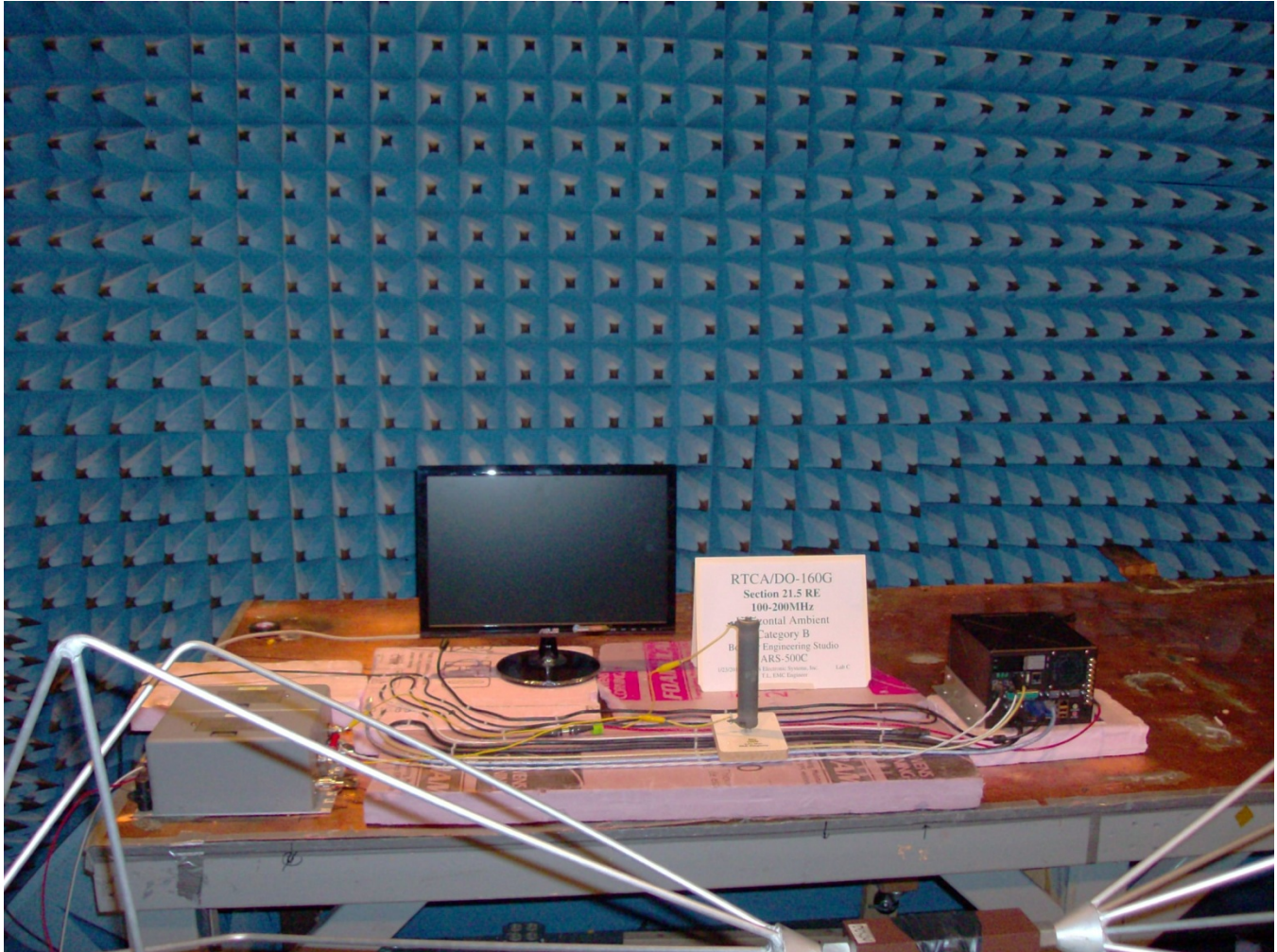


1250 Peterson Dr., Wheeling, IL 60090

Company: Churchill Navigation  
Model Tested: ARS-500C-2012  
Report Number: 18688  
Standard: RTCA/DO-160G Section 21 Emission of Radio Frequency Energy

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## 7.0 RADIATED PHOTOS TAKEN DURING TESTING



RE 100-200MHz Horizontal Ambient

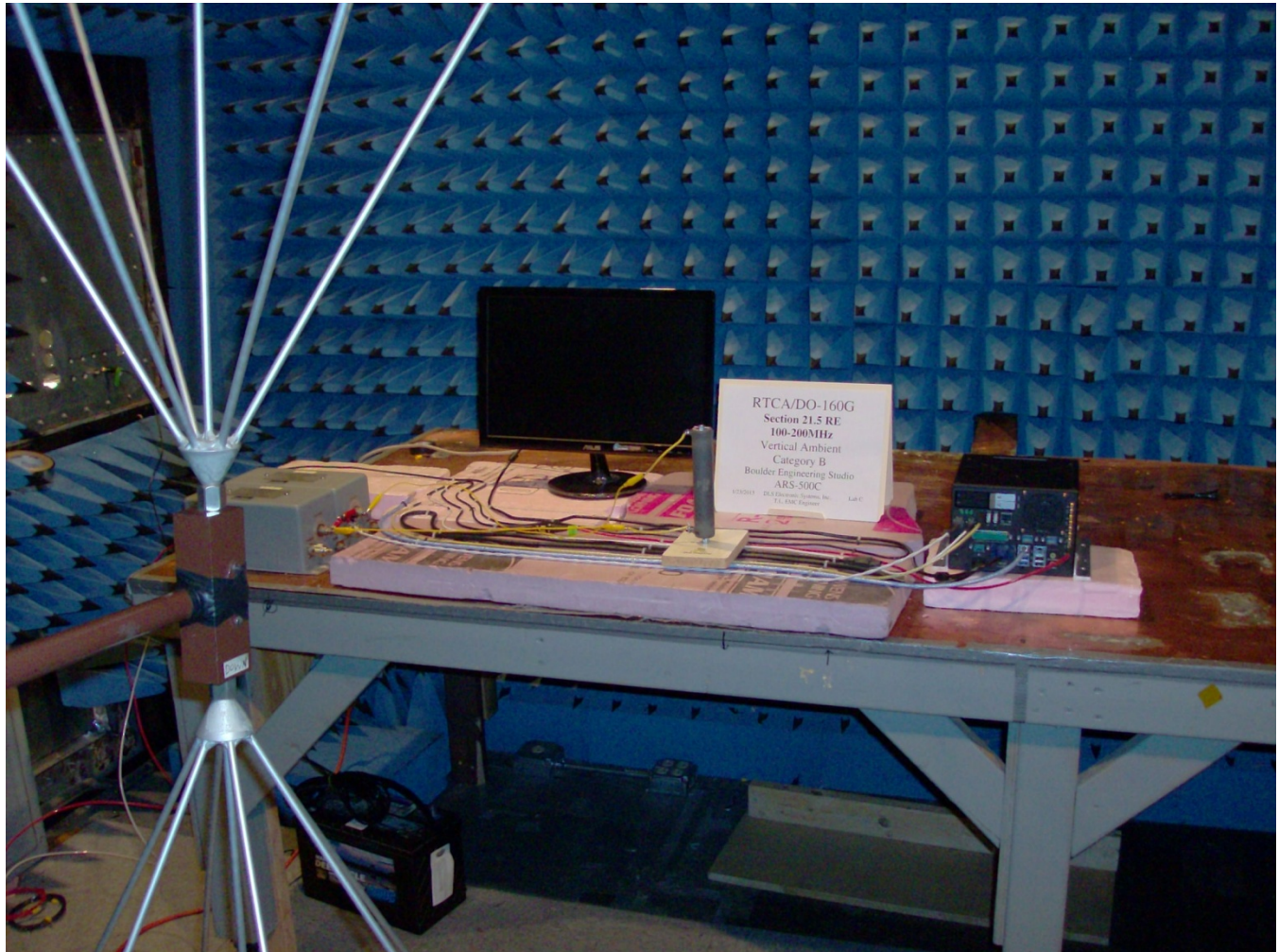


1250 Peterson Dr., Wheeling, IL 60090

Company: Churchill Navigation  
Model Tested: ARS-500C-2012  
Report Number: 18688  
Standard: RTCA/DO-160G Section 21 Emission of Radio Frequency Energy

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## 7.0 RADIATED PHOTOS TAKEN DURING TESTING



RE 100-200MHz Vertical Ambient



1250 Peterson Dr., Wheeling, IL 60090

Company: Churchill Navigation  
Model Tested: ARS-500C-2012  
Report Number: 18688  
Standard: RTCA/DO-160G Section 21 Emission of Radio Frequency Energy

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## 7.0 RADIATED PHOTOS TAKEN DURING TESTING



RE 200-1000MHz Horizontal Ambient

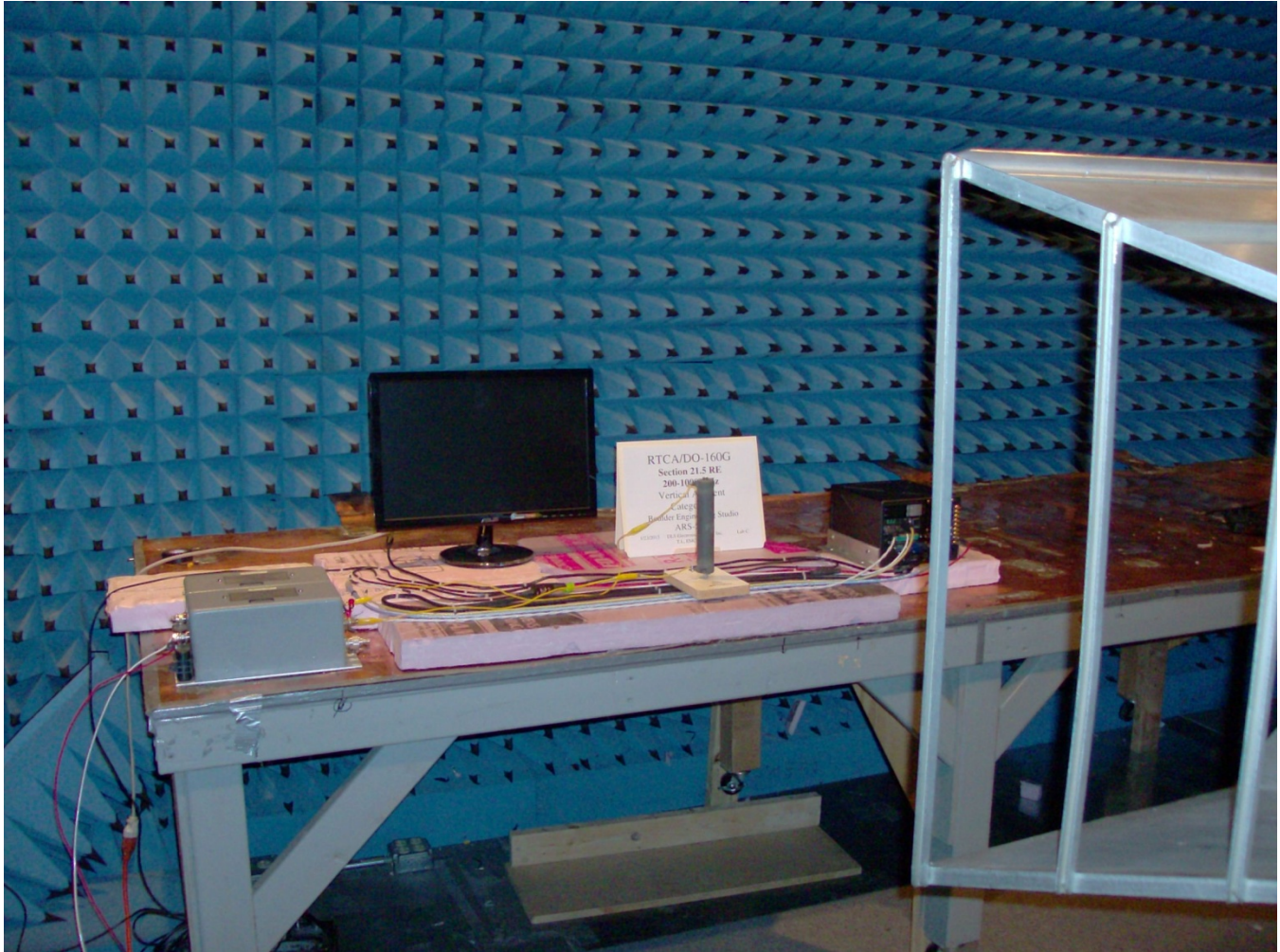


1250 Peterson Dr., Wheeling, IL 60090

Company: Churchill Navigation  
Model Tested: ARS-500C-2012  
Report Number: 18688  
Standard: RTCA/DO-160G Section 21 Emission of Radio Frequency Energy

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## 7.0 RADIATED PHOTOS TAKEN DURING TESTING



RE 200-1000MHz Vertical Ambient

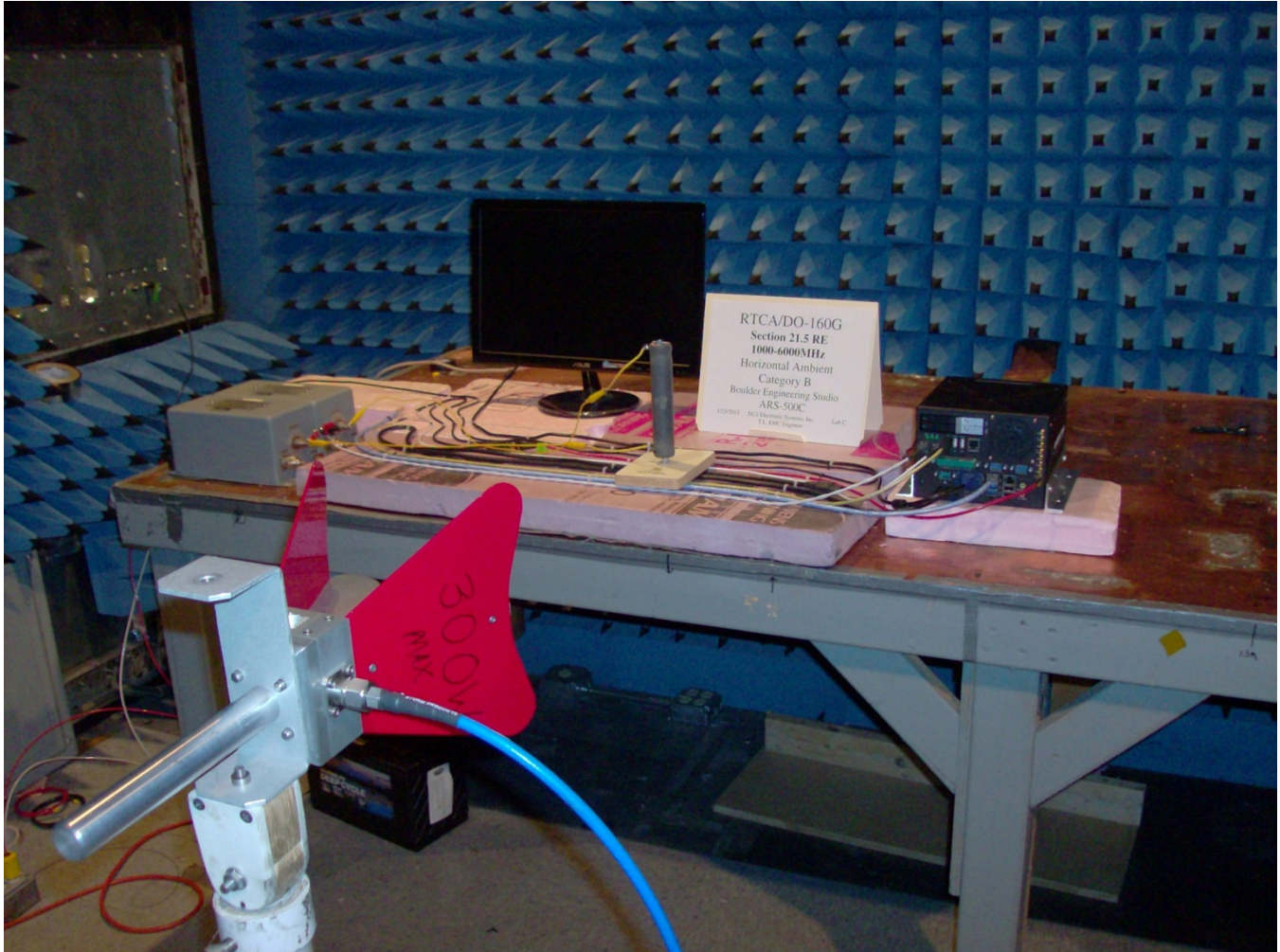


1250 Peterson Dr., Wheeling, IL 60090

Company: Churchill Navigation  
Model Tested: ARS-500C-2012  
Report Number: 18688  
Standard: RTCA/DO-160G Section 21 Emission of Radio Frequency Energy

Appendix: A

## 7.0 RADIATED PHOTOS TAKEN DURING TESTING



RE 1-6GHz Horizontal Ambient



1250 Peterson Dr., Wheeling, IL 60090

Company: Churchill Navigation  
Model Tested: ARS-500C-2012  
Report Number: 18688  
Standard: RTCA/DO-160G Section 21 Emission of Radio Frequency Energy

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## 7.0 RADIATED PHOTOS TAKEN DURING TESTING



RE 1-6GHz Vertical Ambient



1250 Peterson Dr., Wheeling, IL 60090

Company: Churchill Navigation  
 Model Tested: ARS-500C-2012  
 Report Number: 18688  
 Standard: RTCA/DO-160G Section 21 Emission of Radio Frequency Energy

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# SECTIONS 21.4 & 21.5 CONDUCTED AND RADIATED EMISSIONS

## TEST INSTRUMENTATION

TABLE 1

| Description        | Manufacturer    | Model Number     | Serial Number | Range          | Cal On     | Cal Due Dates |
|--------------------|-----------------|------------------|---------------|----------------|------------|---------------|
| Spectrum Analyzer  | Agilent         | E4446A           | MY46180377    | 3Hz – 44GHz    | 10/12/2012 | 10/12/2013    |
| Bicon Antenna      | EMCO            | 3104             | 2369          | 100 – 200MHz   | 10/26/2012 | 10/26/2013    |
| Horn Antenna       | EMCO            | 3106             | 2607          | 200MHz – 1GHz  | 07/02/2012 | 07/02/2013    |
| Small Horn Antenna | ETS             | 3117             | 55158         | 1-6GHz         | 07/02/2012 | 07/02/2013    |
| Signal Generator   | Rohde & Schwarz | SML-03           | 103784        | 9kHz – 3.3GHz  | 06/26/2012 | 06/26/2013    |
| Signal Generator   | Rohde & Schwarz | SMR-20           | 100052        | 1-20GHz        | 06/29/2012 | 06/29/2013    |
| RF Cables          | Pasternack      | RG223/U          | SN BNC 06/11  | 10kHz-1GHz     | 07/02/2012 | 07/02/2013    |
| RF Cable           | Pasternack      | RG223/U          | SN BNC 25/52  | 10kHz – 1GHz   | 03/07/2012 | 03/07/2013    |
| RF Cable           | Micro Coax      | UFB311A          | 005           | 1-18GHz        | 05/19/2012 | 05/19/2013    |
| Pre-Amp            | Miteq           | AMF-6D-010100-50 | 580257        | 1-10GHz        | 05/11/2012 | 05/11/2013    |
| LISN               | Solar           | 9117-5-TS-50-N   | DLS#454       | 10kHz – 10MHz  | 07/30/2012 | 07/30/2013    |
| LISN               | Solar           | 9117-5-TS-50-N   | DLS#430       | 10kHz – 10MHz  | 07/30/2012 | 07/30/2013    |
| Current Probe      | FCC             | F-55             | 62            | 10kHz – 250MHz | 04/25/2012 | 04/25/2013    |

All primary equipment is calibrated against known reference standards with a verified traceable path NIST.



1250 Peterson Dr., Wheeling, IL 60090

Company: Churchill Navigation  
Model Tested: ARS-500C-2012  
Report Number: 18688  
Standard: RTCA/DO-160G Section 21 Emission of Radio Frequency Energy

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SECTIONS 21.4 & 21.5

CONDUCTED AND RADIATED EMISSIONS

TEST EQUIPMENT

TABLE 2

| Description            | Manufacturer   | Model Number    | Serial Number   | Range |
|------------------------|----------------|-----------------|-----------------|-------|
| Computer               | Dell           | Dimentions 1100 | DLS#823         | N/A   |
| EMI Software (T.I.L.E) | Quantum Change | 3.4.K.19        | N/A             | N/A   |
| Monitor                | Dell           | N/A             | CNOGC8117287026 | N/A   |

\*NOTE: The above test equipment is verified upon use.

\*\*NOTE: The above test equipment does not require calibration



1250 Peterson Dr., Wheeling, IL 60090

Company: Churchill Navigation  
Model Tested: ARS-500C-2012  
Report Number: 18688  
Standard: RTCA/DO-160G Section 21 Emission of Radio Frequency Energy

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# RTCA/DO-160G

## SECTION 21.4

CONDUCTED EMISSION OF RADIO

FREQUENCY ENERGY

VERIFICATION TEST DATA

AND CHARTS



1250 Peterson Dr., Wheeling, IL 60090

Company: Churchill Navigation  
 Model Tested: ARS-500C-2012  
 Report Number: 18688  
 Standard: RTCA/DO-160G Section 21 Emission of Radio Frequency Energy

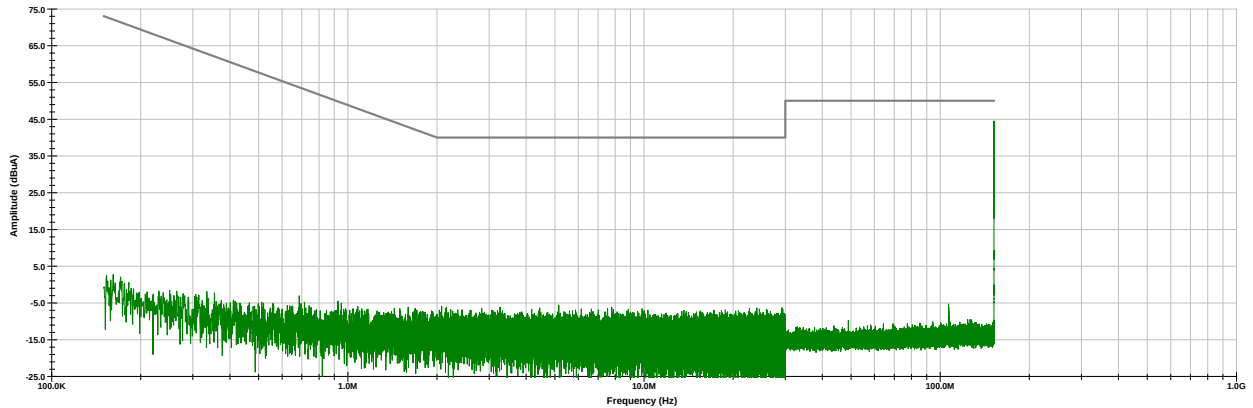
Appendix: A

D.L.S. Electronic Systems, Inc.

RTCA/DO-160G Section 21 CE

150kHz-152MHz Emissions (peak)

Company - Boulder Engineering Studio  
 EUT - ARS-500C  
 Limit - Power Leads Category B 0.15-152MHz  
 Mode - System Verification (6dB under limit @ 152 MHz)  
 Power Lead/Phase - N/A



03:30:32 PM, Wednesday, January 23, 2013

| 03:30:32 PM<br>Frequency<br>MHz | January 23, 2013<br>Complying Emissions<br>(dB below limit) | Excessive Emissions<br>(dB exceeding limit) | Highest Emissions<br>(amplitude in dBuV) |
|---------------------------------|-------------------------------------------------------------|---------------------------------------------|------------------------------------------|
| 2.07E+6                         | -45.914                                                     | 0.000                                       | -05.914                                  |
| 2.14E+6                         | -46.586                                                     | 0.000                                       | -06.586                                  |
| 2.14E+6                         | -46.659                                                     | 0.000                                       | -06.659                                  |
| 2.15E+6                         | -46.280                                                     | 0.000                                       | -06.280                                  |
| 2.83E+6                         | -46.447                                                     | 0.000                                       | -06.447                                  |
| 3.26E+6                         | -46.196                                                     | 0.000                                       | -06.196                                  |
| 4.44E+6                         | -46.412                                                     | 0.000                                       | -06.412                                  |
| 5.16E+6                         | -45.665                                                     | 0.000                                       | -05.665                                  |
| 6.14E+6                         | -46.686                                                     | 0.000                                       | -06.686                                  |
| 6.64E+6                         | -46.668                                                     | 0.000                                       | -06.668                                  |
| 7.53E+6                         | -46.601                                                     | 0.000                                       | -06.601                                  |
| 7.78E+6                         | -46.204                                                     | 0.000                                       | -06.204                                  |
| 8.86E+6                         | -46.718                                                     | 0.000                                       | -06.718                                  |
| 9.86E+6                         | -46.589                                                     | 0.000                                       | -06.589                                  |
| 2.27E+7                         | -46.480                                                     | 0.000                                       | -06.480                                  |
| 2.40E+7                         | -46.417                                                     | 0.000                                       | -06.417                                  |
| 2.45E+7                         | -46.668                                                     | 0.000                                       | -06.668                                  |
| 2.92E+7                         | -46.322                                                     | 0.000                                       | -06.322                                  |
| 1.52E+8                         | -05.499                                                     | 0.000                                       | 44.501                                   |
| 1.52E+8                         | -15.364                                                     | 0.000                                       | 34.636                                   |



1250 Peterson Dr., Wheeling, IL 60090

Company: Churchill Navigation  
Model Tested: ARS-500C-2012  
Report Number: 18688  
Standard: RTCA/DO-160G Section 21 Emission of Radio Frequency Energy

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# RTCA/DO-160G

## SECTION 21.4

### CONDUCTED EMISSION OF RADIO

### FREQUENCY ENERGY

### TEST DATA AND CHARTS

12 Vdc



1250 Peterson Dr., Wheeling, IL 60090

Company: Churchill Navigation  
 Model Tested: ARS-500C-2012  
 Report Number: 18688  
 Standard: RTCA/DO-160G Section 21 Emission of Radio Frequency Energy

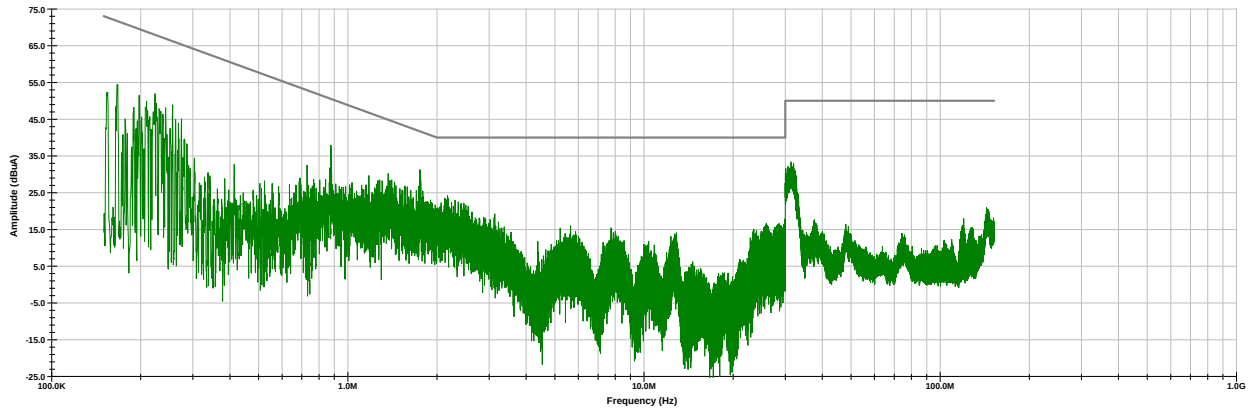
Appendix: A

D.L.S. Electronic Systems, Inc.

RTCA/DO-160G Section 21 CE

150kHz-152MHz Emissions (peak)

Company - Boulder Engineering Studio  
 EUT - ARS-500C  
 Limit - Power Leads Category B 0.15-152MHz  
 Mode - ON, Video Monitored  
 Power Lead/Phase - -28VDC Lead Only



04:22:42 PM, Wednesday, January 23, 2013

| 01:42:19 PM<br>Frequency<br>MHz | February 05, 2013<br>Complying Emissions<br>(dB below limit) | Excessive Emissions<br>(dB exceeding limit) | Highest Emissions<br>(amplitude in dBuV) |
|---------------------------------|--------------------------------------------------------------|---------------------------------------------|------------------------------------------|
| 2.24E+5                         | -16.021                                                      | 0.000                                       | 51.888                                   |
| 8.78E+5                         | -12.617                                                      | 0.000                                       | 37.877                                   |
| 8.79E+5                         | -13.765                                                      | 0.000                                       | 36.715                                   |
| 1.37E+6                         | -14.691                                                      | 0.000                                       | 30.137                                   |
| 1.39E+6                         | -16.376                                                      | 0.000                                       | 28.275                                   |
| 1.41E+6                         | -16.028                                                      | 0.000                                       | 28.461                                   |
| 1.44E+6                         | -16.350                                                      | 0.000                                       | 27.851                                   |
| 1.56E+6                         | -16.358                                                      | 0.000                                       | 26.831                                   |
| 1.59E+6                         | -16.393                                                      | 0.000                                       | 26.547                                   |
| 1.70E+6                         | -16.452                                                      | 0.000                                       | 25.591                                   |
| 1.74E+6                         | -15.084                                                      | 0.000                                       | 26.715                                   |
| 1.75E+6                         | -16.014                                                      | 0.000                                       | 25.692                                   |
| 1.75E+6                         | -10.441                                                      | 0.000                                       | 31.252                                   |
| 1.75E+6                         | -15.783                                                      | 0.000                                       | 25.893                                   |
| 1.76E+6                         | -11.117                                                      | 0.000                                       | 30.542                                   |
| 1.76E+6                         | -14.068                                                      | 0.000                                       | 27.561                                   |
| 1.76E+6                         | -13.142                                                      | 0.000                                       | 28.469                                   |
| 1.79E+6                         | -15.980                                                      | 0.000                                       | 25.428                                   |
| 2.17E+6                         | -15.845                                                      | 0.000                                       | 24.155                                   |
| 3.00E+7                         | -14.190                                                      | 0.000                                       | 25.810                                   |



1250 Peterson Dr., Wheeling, IL 60090

Company: Churchill Navigation  
 Model Tested: ARS-500C-2012  
 Report Number: 18688  
 Standard: RTCA/DO-160G Section 21 Emission of Radio Frequency Energy

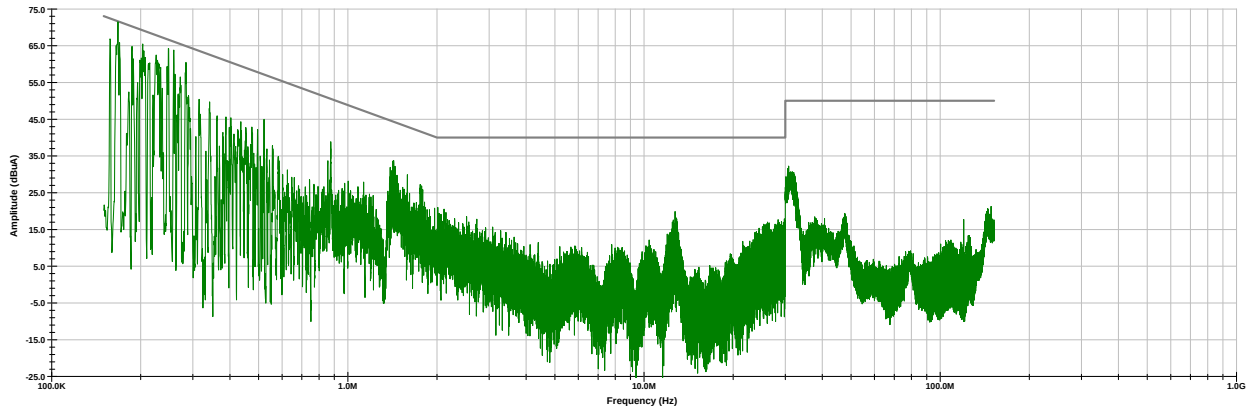
Appendix: A

D.L.S. Electronic Systems, Inc.

RTCA/DO-160G Section 21 CE

150kHz-152MHz Emissions (peak)

Company - Boulder Engineering Studio  
 EUT - ARS-500C  
 Limit - Power Leads Category B 0.15-152MHz  
 Mode - ON, Video Monitored  
 Power Lead/Phase - +28VDC Lead Only



08:18:48 AM, Thursday, January 24, 2013

| 01:44:53 PM<br>Frequency<br>MHz | February 05, 2013<br>Complying Emissions<br>(dB below limit) | Excessive Emissions<br>(dB exceeding limit) | Highest Emissions<br>(amplitude in dBuV) |
|---------------------------------|--------------------------------------------------------------|---------------------------------------------|------------------------------------------|
| 1.57E+5                         | -05.553                                                      | 0.000                                       | 66.828                                   |
| 1.68E+5                         | -00.083                                                      | 0.000                                       | 71.494                                   |
| 1.70E+5                         | -05.627                                                      | 0.000                                       | 65.809                                   |
| 1.87E+5                         | -05.414                                                      | 0.000                                       | 64.788                                   |
| 1.89E+5                         | -08.681                                                      | 0.000                                       | 61.395                                   |
| 1.99E+5                         | -08.352                                                      | 0.000                                       | 61.049                                   |
| 2.01E+5                         | -07.633                                                      | 0.000                                       | 61.648                                   |
| 2.03E+5                         | -03.689                                                      | 0.000                                       | 65.445                                   |
| 2.05E+5                         | -05.430                                                      | 0.000                                       | 63.588                                   |
| 2.07E+5                         | -07.124                                                      | 0.000                                       | 61.779                                   |
| 2.14E+5                         | -08.140                                                      | 0.000                                       | 60.312                                   |
| 2.26E+5                         | -05.364                                                      | 0.000                                       | 62.439                                   |
| 2.27E+5                         | -06.705                                                      | 0.000                                       | 60.993                                   |
| 2.30E+5                         | -07.281                                                      | 0.000                                       | 60.287                                   |
| 2.33E+5                         | -08.250                                                      | 0.000                                       | 59.113                                   |
| 2.46E+5                         | -07.391                                                      | 0.000                                       | 59.327                                   |
| 2.48E+5                         | -02.362                                                      | 0.000                                       | 64.236                                   |
| 2.59E+5                         | -02.270                                                      | 0.000                                       | 63.787                                   |
| 2.61E+5                         | -08.703                                                      | 0.000                                       | 57.240                                   |
| 2.84E+5                         | -04.390                                                      | 0.000                                       | 60.463                                   |



1250 Peterson Dr., Wheeling, IL 60090

Company: Churchill Navigation  
 Model Tested: ARS-500C-2012  
 Report Number: 18688  
 Standard: RTCA/DO-160G Section 21 Emission of Radio Frequency Energy

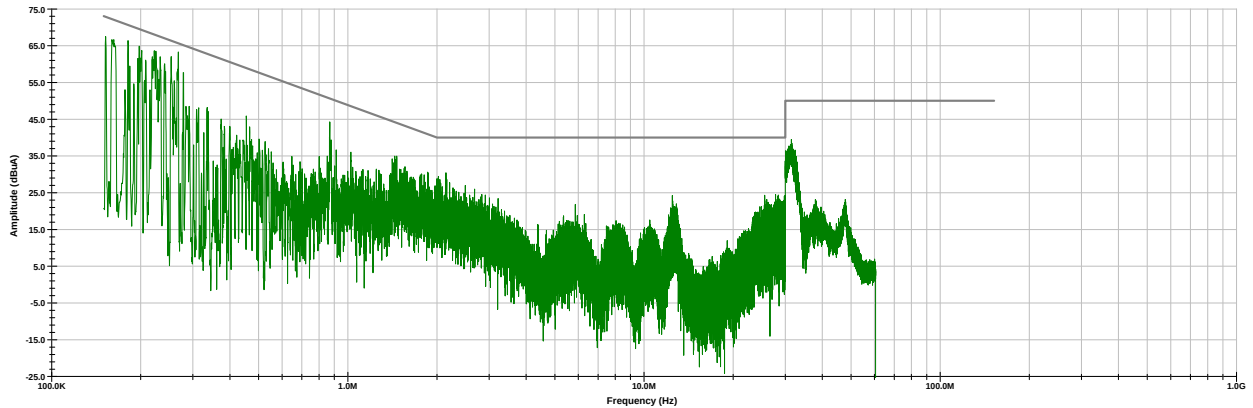
Appendix: A

D.L.S. Electronic Systems, Inc.

RTCA/DO-160G Section 21 CE

150kHz-152MHz Emissions (peak)

Company - Boulder Engineering Studio  
 EUT - ARS-500C  
 Limit - Power Leads Category B 0.15-152MHz  
 Mode - ON, Video Monitored  
 Power Lead/Phase - 28VDC Bundle



08:31:28 AM, Thursday, January 24, 2013

| 01:18:41 PM<br>Frequency<br>MHz | February 05, 2013<br>Complying Emissions<br>(dB below limit) | Excessive Emissions<br>(dB exceeding limit) | Highest Emissions<br>(amplitude in dBuV) |
|---------------------------------|--------------------------------------------------------------|---------------------------------------------|------------------------------------------|
| 1.52E+5                         | -05.364                                                      | 0.000                                       | 67.439                                   |
| 1.62E+5                         | -05.382                                                      | 0.000                                       | 66.628                                   |
| 1.81E+5                         | -04.210                                                      | 0.000                                       | 66.379                                   |
| 1.96E+5                         | -08.162                                                      | 0.000                                       | 61.449                                   |
| 1.98E+5                         | -04.634                                                      | 0.000                                       | 64.856                                   |
| 2.02E+5                         | -05.548                                                      | 0.000                                       | 63.675                                   |
| 2.08E+5                         | -07.798                                                      | 0.000                                       | 61.047                                   |
| 2.19E+5                         | -06.238                                                      | 0.000                                       | 61.939                                   |
| 2.22E+5                         | -04.371                                                      | 0.000                                       | 63.618                                   |
| 2.25E+5                         | -04.323                                                      | 0.000                                       | 63.506                                   |
| 2.33E+5                         | -05.432                                                      | 0.000                                       | 61.981                                   |
| 2.41E+5                         | -06.911                                                      | 0.000                                       | 60.051                                   |
| 2.42E+5                         | -08.907                                                      | 0.000                                       | 57.981                                   |
| 2.54E+5                         | -04.318                                                      | 0.000                                       | 61.995                                   |
| 2.68E+5                         | -02.343                                                      | 0.000                                       | 63.286                                   |
| 2.78E+5                         | -07.465                                                      | 0.000                                       | 57.663                                   |
| 8.69E+5                         | -06.417                                                      | 0.000                                       | 44.199                                   |
| 1.44E+6                         | -09.269                                                      | 0.000                                       | 34.911                                   |
| 1.46E+6                         | -09.067                                                      | 0.000                                       | 34.913                                   |
| 3.00E+7                         | -07.769                                                      | 0.000                                       | 32.231                                   |



1250 Peterson Dr., Wheeling, IL 60090

Company: Churchill Navigation  
 Model Tested: ARS-500C-2012  
 Report Number: 18688  
 Standard: RTCA/DO-160G Section 21 Emission of Radio Frequency Energy

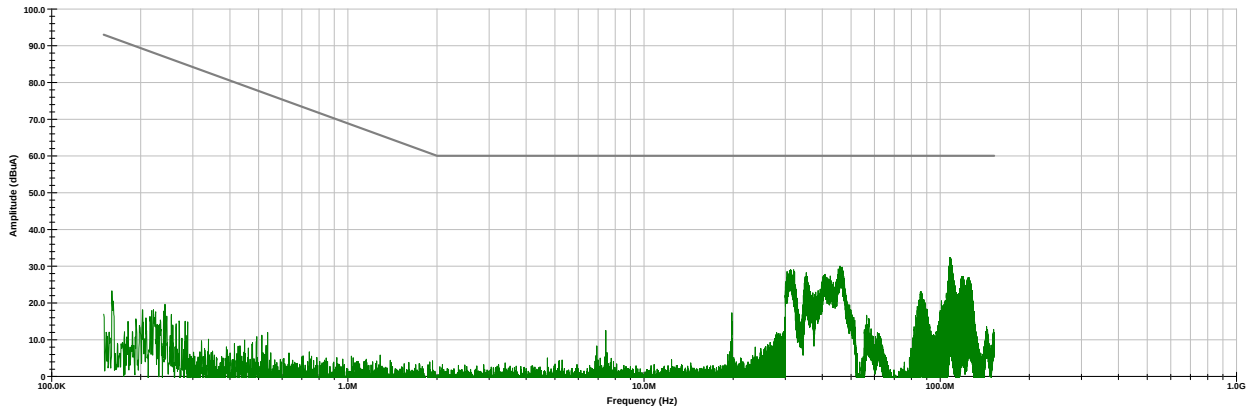
Appendix: A

D.L.S. Electronic Systems, Inc.

RTCA/DO-160G Section 21 CE

150kHz-152MHz Emissions (peak)

Company - Boulder Engineering Studio  
 EUT - ARS-500C  
 Limit - Interconnects Category B 0.15-152MHz  
 Mode - ON, Video Monitored  
 Power Lead/Phase - Video V1 Interconnect Cable



08:52:01 AM, Thursday, January 24, 2013

| 03:15:18 PM<br>Frequency<br>MHz | January 24, 2013<br>Complying Emissions<br>(dB below limit) | Excessive Emissions<br>(dB exceeding limit) | Highest Emissions<br>(amplitude in dBuV) |
|---------------------------------|-------------------------------------------------------------|---------------------------------------------|------------------------------------------|
| 1.08E+8                         | -08.238                                                     | 0.000                                       | 31.762                                   |
| 1.08E+8                         | -14.685                                                     | 0.000                                       | 25.315                                   |
| 1.09E+8                         | -13.186                                                     | 0.000                                       | 26.814                                   |
| 1.09E+8                         | -08.085                                                     | 0.000                                       | 31.915                                   |
| 1.09E+8                         | -09.819                                                     | 0.000                                       | 30.181                                   |
| 1.10E+8                         | -09.799                                                     | 0.000                                       | 30.201                                   |
| 1.10E+8                         | -12.146                                                     | 0.000                                       | 27.854                                   |
| 1.10E+8                         | -11.892                                                     | 0.000                                       | 28.108                                   |
| 1.10E+8                         | -13.398                                                     | 0.000                                       | 26.602                                   |
| 1.11E+8                         | -13.751                                                     | 0.000                                       | 26.249                                   |
| 1.11E+8                         | -13.987                                                     | 0.000                                       | 26.013                                   |
| 1.17E+8                         | -13.486                                                     | 0.000                                       | 26.514                                   |
| 1.18E+8                         | -12.778                                                     | 0.000                                       | 27.222                                   |
| 1.19E+8                         | -12.801                                                     | 0.000                                       | 27.199                                   |
| 1.20E+8                         | -13.726                                                     | 0.000                                       | 26.274                                   |
| 1.23E+8                         | -13.767                                                     | 0.000                                       | 26.233                                   |
| 1.24E+8                         | -13.140                                                     | 0.000                                       | 26.860                                   |
| 1.24E+8                         | -13.169                                                     | 0.000                                       | 26.831                                   |
| 1.25E+8                         | -13.141                                                     | 0.000                                       | 26.859                                   |
| 1.26E+8                         | -14.018                                                     | 0.000                                       | 25.982                                   |



1250 Peterson Dr., Wheeling, IL 60090

Company: Churchill Navigation  
Model Tested: ARS-500C-2012  
Report Number: 18688  
Standard: RTCA/DO-160G Section 21 Emission of Radio Frequency Energy

Appendix: A

# RTCA/DO-160G

## SECTION 21.4

CONDUCTED EMISSION OF RADIO

FREQUENCY ENERGY

AMBIENT TEST DATA AND CHARTS



1250 Peterson Dr., Wheeling, IL 60090

Company: Churchill Navigation  
 Model Tested: ARS-500C-2012  
 Report Number: 18688  
 Standard: RTCA/DO-160G Section 21 Emission of Radio Frequency Energy

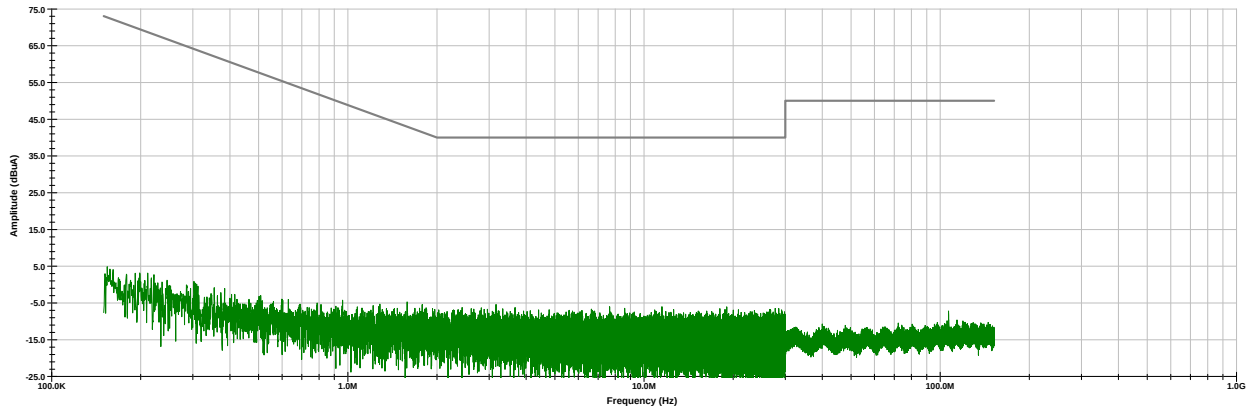
Appendix: A

D.L.S. Electronic Systems, Inc.

RTCA/DO-160G Section 21 CE

150kHz-152MHz Emissions (peak)

Company - Boulder Engineering Studio  
 EUT - ARS-500C  
 Limit - Power Leads Category B 0.15-152MHz  
 Mode - Ambient Scan (5 Amp R Load)  
 Power Lead/Phase - -28VDC



03:58:46 PM, Wednesday, January 23, 2013

| 03:58:47 PM<br>Frequency<br>MHz | January 23, 2013<br>Complying Emissions<br>(dB below limit) | Excessive Emissions<br>(dB exceeding limit) | Highest Emissions<br>(amplitude in dBuV) |
|---------------------------------|-------------------------------------------------------------|---------------------------------------------|------------------------------------------|
| 2.43E+6                         | -46.299                                                     | 0.000                                       | -06.299                                  |
| 2.61E+6                         | -46.610                                                     | 0.000                                       | -06.610                                  |
| 2.66E+6                         | -46.669                                                     | 0.000                                       | -06.669                                  |
| 2.82E+6                         | -46.374                                                     | 0.000                                       | -06.374                                  |
| 2.89E+6                         | -46.792                                                     | 0.000                                       | -06.792                                  |
| 2.96E+6                         | -46.726                                                     | 0.000                                       | -06.726                                  |
| 3.16E+6                         | -45.398                                                     | 0.000                                       | -05.398                                  |
| 3.33E+6                         | -46.655                                                     | 0.000                                       | -06.655                                  |
| 3.66E+6                         | -46.712                                                     | 0.000                                       | -06.712                                  |
| 3.67E+6                         | -46.255                                                     | 0.000                                       | -06.255                                  |
| 6.64E+6                         | -46.736                                                     | 0.000                                       | -06.736                                  |
| 7.65E+6                         | -46.085                                                     | 0.000                                       | -06.085                                  |
| 8.61E+6                         | -46.458                                                     | 0.000                                       | -06.458                                  |
| 1.15E+7                         | -46.081                                                     | 0.000                                       | -06.081                                  |
| 1.80E+7                         | -46.621                                                     | 0.000                                       | -06.621                                  |
| 1.88E+7                         | -46.822                                                     | 0.000                                       | -06.822                                  |
| 1.90E+7                         | -46.143                                                     | 0.000                                       | -06.143                                  |
| 2.65E+7                         | -46.760                                                     | 0.000                                       | -06.760                                  |
| 2.77E+7                         | -46.512                                                     | 0.000                                       | -06.512                                  |
| 2.85E+7                         | -46.573                                                     | 0.000                                       | -06.573                                  |



1250 Peterson Dr., Wheeling, IL 60090

Company: Churchill Navigation  
 Model Tested: ARS-500C-2012  
 Report Number: 18688  
 Standard: RTCA/DO-160G Section 21 Emission of Radio Frequency Energy

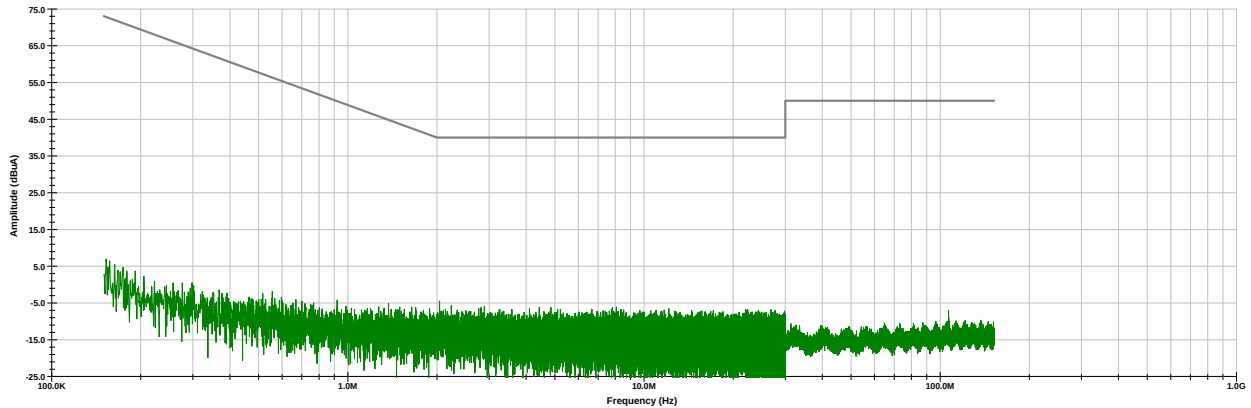
Appendix: A

D.L.S. Electronic Systems, Inc.

RTCA/DO-160G Section 21 CE

150kHz-152MHz Emissions (peak)

Company - Boulder Engineering Studio  
 EUT - ARS-500C  
 Limit - Power Leads Category B 0.15-152MHz  
 Mode - Ambient Scan  
 Power Lead/Phase - +28VDC



| 03:48:28 PM<br>Frequency<br>MHz | January 23, 2013<br>Complying Emissions<br>(dB below limit) | Excessive Emissions<br>(dB exceeding limit) | Highest Emissions<br>(amplitude in dBuV) |
|---------------------------------|-------------------------------------------------------------|---------------------------------------------|------------------------------------------|
| 2.04E+6                         | -44.556                                                     | 0.000                                       | -04.556                                  |
| 2.14E+6                         | -46.833                                                     | 0.000                                       | -06.833                                  |
| 2.24E+6                         | -45.743                                                     | 0.000                                       | -05.743                                  |
| 2.77E+6                         | -46.626                                                     | 0.000                                       | -06.626                                  |
| 2.82E+6                         | -46.314                                                     | 0.000                                       | -06.314                                  |
| 2.89E+6                         | -45.935                                                     | 0.000                                       | -05.935                                  |
| 3.26E+6                         | -46.703                                                     | 0.000                                       | -06.703                                  |
| 3.58E+6                         | -46.746                                                     | 0.000                                       | -06.746                                  |
| 4.11E+6                         | -46.641                                                     | 0.000                                       | -06.641                                  |
| 4.43E+6                         | -46.257                                                     | 0.000                                       | -06.257                                  |
| 4.85E+6                         | -46.288                                                     | 0.000                                       | -06.288                                  |
| 5.11E+6                         | -46.769                                                     | 0.000                                       | -06.769                                  |
| 5.22E+6                         | -46.753                                                     | 0.000                                       | -06.753                                  |
| 6.67E+6                         | -46.726                                                     | 0.000                                       | -06.726                                  |
| 7.76E+6                         | -46.776                                                     | 0.000                                       | -06.776                                  |
| 7.82E+6                         | -46.251                                                     | 0.000                                       | -06.251                                  |
| 8.07E+6                         | -46.159                                                     | 0.000                                       | -06.159                                  |
| 8.36E+6                         | -46.751                                                     | 0.000                                       | -06.751                                  |
| 1.21E+7                         | -46.593                                                     | 0.000                                       | -06.593                                  |
| 2.68E+7                         | -46.840                                                     | 0.000                                       | -06.840                                  |



1250 Peterson Dr., Wheeling, IL 60090

Company: Churchill Navigation  
Model Tested: ARS-500C-2012  
Report Number: 18688  
Standard: RTCA/DO-160G Section 21 Emission of Radio Frequency Energy

Appendix: A

# RTCA/DO-160G

## SECTION 21.5

RADIATED EMISSION OF RADIO

FREQUENCY ENERGY

VERIFICATION TEST DATA

AND CHARTS



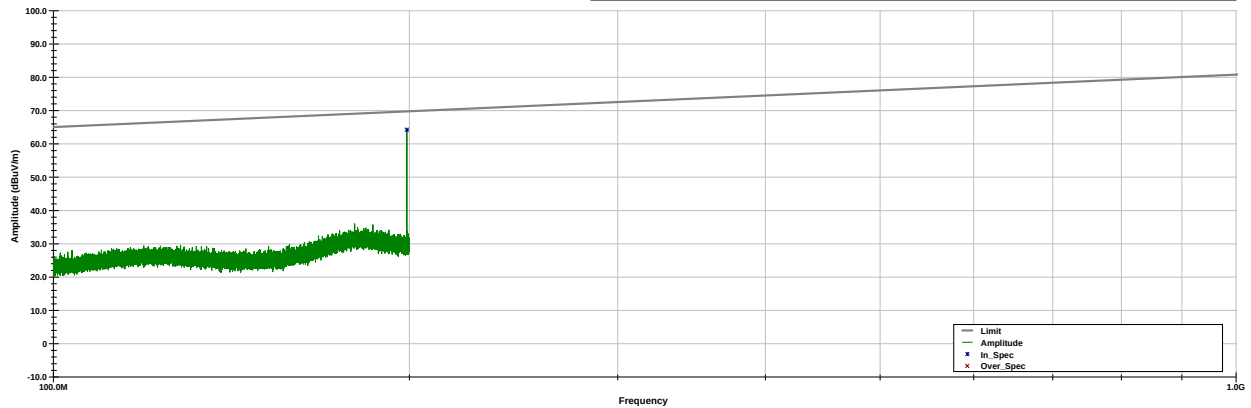
1250 Peterson Dr., Wheeling, IL 60090

Company: Churchill Navigation  
Model Tested: ARS-500C-2012  
Report Number: 18688  
Standard: RTCA/DO-160G Section 21 Emission of Radio Frequency Energy

Appendix: A

D.L.S. Electronic Systems, Inc.  
RTCA/DO-160G Section 21 Radiated Emissions  
100MHz-200MHz Emissions (peak)

EUT - Boulder Engineering Studio ARS-500C  
Limit - DO-160G Category B  
Frequency Range - 100-200 MHz Bicon Ant. 2617  
Antenna Positionion - Center of Boundary  
Mode - System Verification (6dB below limit @ 200MHz)



10:54:37 AM, Wednesday, January 23, 2013

| 10:54:37 AM<br>Frequency<br>MHz | January 23, 2013<br>Complying Emissions<br>(dB below limit) | Excessive Emissions<br>(dB exceeding limit) | Highest Emissions<br>(amplitude in dBuV) |
|---------------------------------|-------------------------------------------------------------|---------------------------------------------|------------------------------------------|
| 1.99E+8                         | -05.492                                                     | 0.000                                       | 64.214                                   |



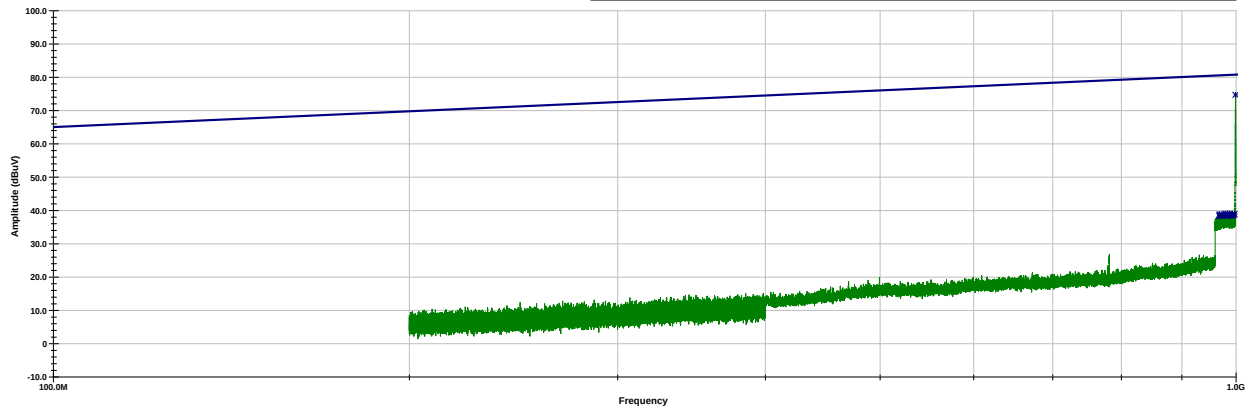
1250 Peterson Dr., Wheeling, IL 60090

Company: Churchill Navigation  
 Model Tested: ARS-500C-2012  
 Report Number: 18688  
 Standard: RTCA/DO-160G Section 21 Emission of Radio Frequency Energy

Appendix: A

D.L.S. Electronic Systems, Inc.  
 RTCA/DO-160G Section 21 Radiated Emissions  
 200MHz-1000MHz Emissions (peak)

Customer - Boulder Engineering Studio ARS-500C  
 Limit - DO-160G Category B  
 Frequency Range - 200-1000MHz 3106 Horn Ant.  
 Antenna Position - EUT  
 Mode - System Verification (6dB below limit @ 1GHz)



02:28:48 PM, Wednesday, January 23, 2013

| 02:28:48 PM<br>Frequency<br>MHz | January 23, 2013<br>Complying Emissions<br>(dB below limit) | Excessive Emissions<br>(dB exceeding limit) | Highest Emissions<br>(Amplitude in dBuV) |
|---------------------------------|-------------------------------------------------------------|---------------------------------------------|------------------------------------------|
| 9.67E+8                         | -42.085                                                     | 0.000                                       | 38.436                                   |
| 9.68E+8                         | -41.732                                                     | 0.000                                       | 38.795                                   |
| 9.69E+8                         | -42.255                                                     | 0.000                                       | 38.278                                   |
| 9.72E+8                         | -41.789                                                     | 0.000                                       | 38.761                                   |
| 9.72E+8                         | -41.875                                                     | 0.000                                       | 38.681                                   |
| 9.73E+8                         | -42.056                                                     | 0.000                                       | 38.501                                   |
| 9.73E+8                         | -42.215                                                     | 0.000                                       | 38.347                                   |
| 9.79E+8                         | -41.558                                                     | 0.000                                       | 39.047                                   |
| 9.80E+8                         | -42.159                                                     | 0.000                                       | 38.448                                   |
| 9.83E+8                         | -42.260                                                     | 0.000                                       | 38.370                                   |
| 9.84E+8                         | -42.008                                                     | 0.000                                       | 38.626                                   |
| 9.84E+8                         | -41.863                                                     | 0.000                                       | 38.771                                   |
| 9.87E+8                         | -41.636                                                     | 0.000                                       | 39.024                                   |
| 9.89E+8                         | -41.983                                                     | 0.000                                       | 38.687                                   |
| 9.90E+8                         | -42.159                                                     | 0.000                                       | 38.516                                   |
| 9.91E+8                         | -42.236                                                     | 0.000                                       | 38.451                                   |
| 9.94E+8                         | -42.176                                                     | 0.000                                       | 38.530                                   |
| 9.95E+8                         | -42.109                                                     | 0.000                                       | 38.607                                   |
| 9.97E+8                         | -41.801                                                     | 0.000                                       | 38.926                                   |
| 9.99E+8                         | -06.039                                                     | 0.000                                       | 74.700                                   |



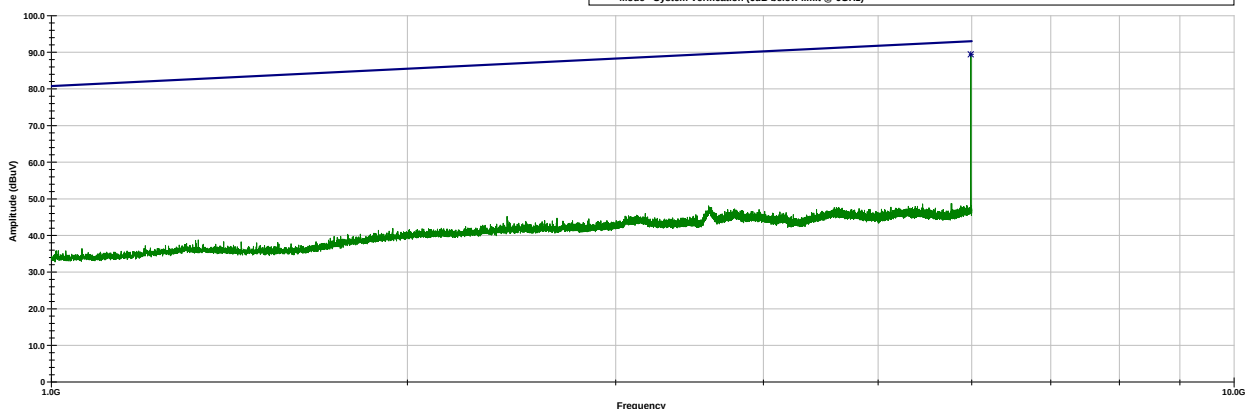
1250 Peterson Dr., Wheeling, IL 60090

Company: Churchill Navigation  
Model Tested: ARS-500C-2012  
Report Number: 18688  
Standard: RTCA/DO-160G Section 21 Emission of Radio Frequency Energy

Appendix: A

D.L.S. Electronic Systems, Inc.  
RTCA/DO-160G Section 21 Radiated Emissions  
1GHz-6GHz Emissions (peak)

Customer - Boulder Engineering Studio ARS-500C  
Limit - DO-160G Category B  
Frequency Range - 1-6GHz Standard Horn Ant. 3115  
Antenna Position - Center of Boundary  
Mode - System Verification (6dB below limit @ 6GHz)



| 01:18:17 PM<br>Frequency<br>MHz | January 23, 2013<br>Complying Emissions<br>(dB below limit) | Excessive Emissions<br>(dB exceeding limit) | Highest Emissions<br>(amplitude in dBuV) |
|---------------------------------|-------------------------------------------------------------|---------------------------------------------|------------------------------------------|
| 5.99E+9                         | -03.571                                                     | 0.000                                       | 89.417                                   |



1250 Peterson Dr., Wheeling, IL 60090

Company: Churchill Navigation  
Model Tested: ARS-500C-2012  
Report Number: 18688  
Standard: RTCA/DO-160G Section 21 Emission of Radio Frequency Energy

Appendix: A

# RTCA/DO-160G

## SECTION 21.5

### RADIATED EMISSION OF RADIO FREQUENCY ENERGY

### TEST DATA AND CHARTS



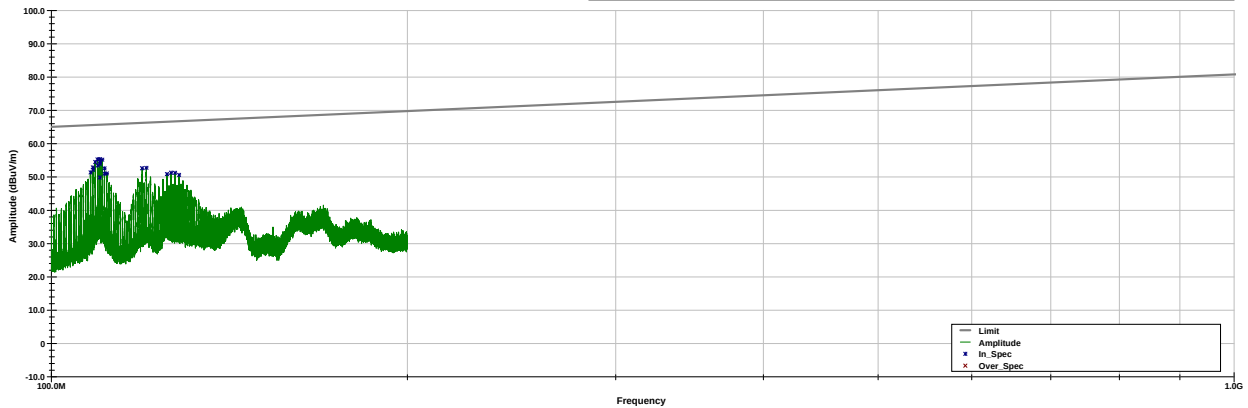
1250 Peterson Dr., Wheeling, IL 60090

Company: Churchill Navigation  
 Model Tested: ARS-500C-2012  
 Report Number: 18688  
 Standard: RTCA/DO-160G Section 21 Emission of Radio Frequency Energy

Appendix: A

D.L.S. Electronic Systems, Inc.  
 RTCA/DO-160G Section 21 Radiated Emissions  
 100MHz-200MHz Emissions (peak)

EUT - Boulder Engineering Studio ARS-500C  
 Limit - DO-160G Category B  
 Frequency Range - 100-200 MHz Bicon Ant. 2617 Horizontal  
 Antenna Position - Center of Boundary  
 Mode - ON, Video Monitored



12:38:18 PM, Wednesday, January 23, 2013

| 12:38:18 PM<br>Frequency<br>MHz | January 23, 2013<br>Complying Emissions<br>(dB below limit) | Excessive Emissions<br>(dB exceeding limit) | Highest Emissions<br>(amplitude in dBuV) |
|---------------------------------|-------------------------------------------------------------|---------------------------------------------|------------------------------------------|
| 1.08E+8                         | -14.169                                                     | 0.000                                       | 51.353                                   |
| 1.08E+8                         | -12.676                                                     | 0.000                                       | 52.877                                   |
| 1.08E+8                         | -13.422                                                     | 0.000                                       | 52.132                                   |
| 1.09E+8                         | -11.104                                                     | 0.000                                       | 54.480                                   |
| 1.09E+8                         | -10.349                                                     | 0.000                                       | 55.266                                   |
| 1.09E+8                         | -12.193                                                     | 0.000                                       | 53.424                                   |
| 1.10E+8                         | -15.831                                                     | 0.000                                       | 49.812                                   |
| 1.10E+8                         | -10.292                                                     | 0.000                                       | 55.353                                   |
| 1.10E+8                         | -11.098                                                     | 0.000                                       | 54.550                                   |
| 1.10E+8                         | -11.699                                                     | 0.000                                       | 53.949                                   |
| 1.10E+8                         | -10.506                                                     | 0.000                                       | 55.171                                   |
| 1.11E+8                         | -13.141                                                     | 0.000                                       | 52.566                                   |
| 1.11E+8                         | -14.744                                                     | 0.000                                       | 50.965                                   |
| 1.11E+8                         | -14.714                                                     | 0.000                                       | 51.024                                   |
| 1.19E+8                         | -13.625                                                     | 0.000                                       | 52.583                                   |
| 1.20E+8                         | -13.537                                                     | 0.000                                       | 52.727                                   |
| 1.25E+8                         | -15.677                                                     | 0.000                                       | 50.863                                   |
| 1.26E+8                         | -15.348                                                     | 0.000                                       | 51.246                                   |
| 1.27E+8                         | -15.420                                                     | 0.000                                       | 51.227                                   |
| 1.28E+8                         | -16.085                                                     | 0.000                                       | 50.616                                   |



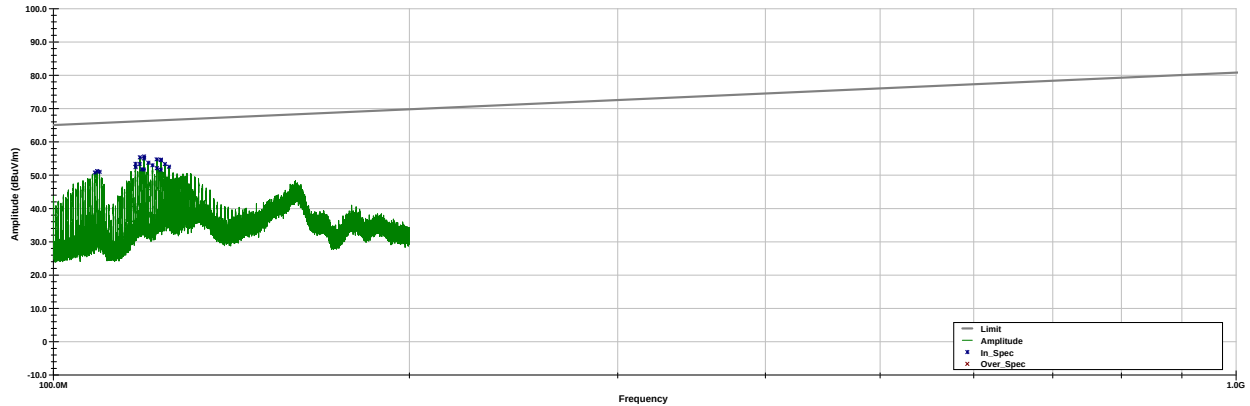
1250 Peterson Dr., Wheeling, IL 60090

Company: Churchill Navigation  
 Model Tested: ARS-500C-2012  
 Report Number: 18688  
 Standard: RTCA/DO-160G Section 21 Emission of Radio Frequency Energy

Appendix: A

D.L.S. Electronic Systems, Inc.  
 RTCA/DO-160G Section 21 Radiated Emissions  
 100MHz-200MHz Emissions (peak)

EUT - Boulder Engineering Studio ARS-500C  
 Limit - DO-160G Category B  
 Frequency Range - 100-200 MHz Bicon Ant. 2617 Vertical  
 Antenna Positionion - Center of Boundary  
 Mode - ON, Video Monitored



12:45:58 PM, Wednesday, January 23, 2013

| 12:45:58 PM<br>Frequency<br>MHz | January 23, 2013<br>Complying Emissions<br>(dB below limit) | Excessive Emissions<br>(dB exceeding limit) | Highest Emissions<br>(amplitude in dBuV) |
|---------------------------------|-------------------------------------------------------------|---------------------------------------------|------------------------------------------|
| 1.08E+8                         | -14.800                                                     | 0.000                                       | 50.753                                   |
| 1.09E+8                         | -14.389                                                     | 0.000                                       | 51.194                                   |
| 1.09E+8                         | -14.651                                                     | 0.000                                       | 50.964                                   |
| 1.17E+8                         | -12.739                                                     | 0.000                                       | 53.354                                   |
| 1.17E+8                         | -13.701                                                     | 0.000                                       | 52.393                                   |
| 1.18E+8                         | -12.824                                                     | 0.000                                       | 53.325                                   |
| 1.18E+8                         | -10.841                                                     | 0.000                                       | 55.310                                   |
| 1.19E+8                         | -14.414                                                     | 0.000                                       | 51.764                                   |
| 1.19E+8                         | -14.560                                                     | 0.000                                       | 51.645                                   |
| 1.19E+8                         | -11.200                                                     | 0.000                                       | 55.007                                   |
| 1.19E+8                         | -10.621                                                     | 0.000                                       | 55.588                                   |
| 1.20E+8                         | -12.543                                                     | 0.000                                       | 53.721                                   |
| 1.21E+8                         | -13.353                                                     | 0.000                                       | 52.967                                   |
| 1.22E+8                         | -11.658                                                     | 0.000                                       | 54.718                                   |
| 1.22E+8                         | -14.310                                                     | 0.000                                       | 52.067                                   |
| 1.23E+8                         | -14.790                                                     | 0.000                                       | 51.639                                   |
| 1.23E+8                         | -11.807                                                     | 0.000                                       | 54.624                                   |
| 1.23E+8                         | -11.924                                                     | 0.000                                       | 54.508                                   |
| 1.24E+8                         | -13.188                                                     | 0.000                                       | 53.296                                   |
| 1.25E+8                         | -14.001                                                     | 0.000                                       | 52.538                                   |



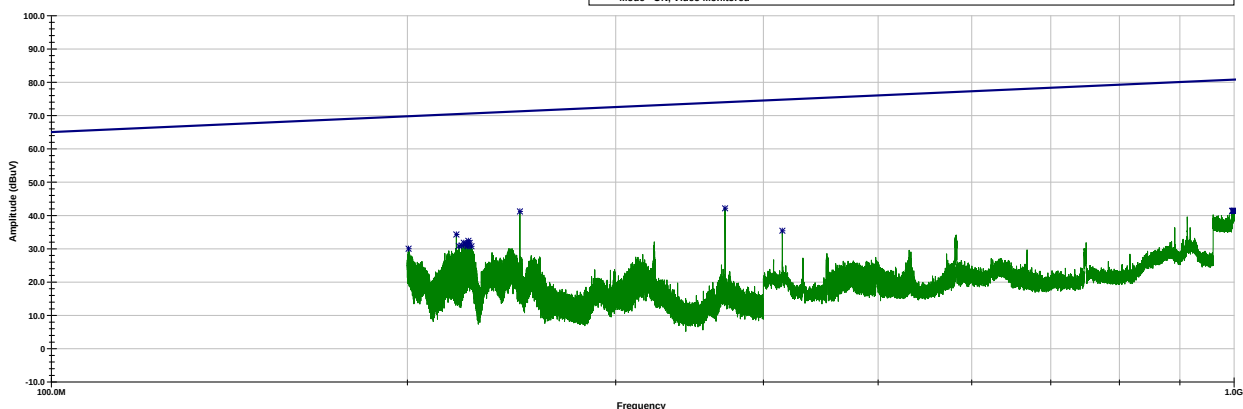
1250 Peterson Dr., Wheeling, IL 60090

Company: Churchill Navigation  
 Model Tested: ARS-500C-2012  
 Report Number: 18688  
 Standard: RTCA/DO-160G Section 21 Emission of Radio Frequency Energy

Appendix: A

D.L.S. Electronic Systems, Inc.  
 RTCA/DO-160G Section 21 Radiated Emissions  
 200MHz-1000MHz Emissions (peak)

Customer - Boulder Engineering Studio ARS-500C  
 Limit - DO-160G Category B  
 Frequency Range - 200-1000MHz 3106 Horn Ant.  
 Antenna Position - EUT, Horizontal Polarization  
 Mode - ON, Video Monitored



02:40:51 PM, Wednesday, January 23, 2013

| 02:40:51 PM<br>Frequency<br>MHz | January 23, 2013<br>Complying Emissions<br>(dB below limit) | Excessive Emissions<br>(dB exceeding limit) | Highest Emissions<br>(Amplitude in dBuV) |
|---------------------------------|-------------------------------------------------------------|---------------------------------------------|------------------------------------------|
| 2.00E+8                         | -39.757                                                     | 0.000                                       | 29.999                                   |
| 2.20E+8                         | -36.110                                                     | 0.000                                       | 34.283                                   |
| 2.21E+8                         | -39.603                                                     | 0.000                                       | 30.824                                   |
| 2.22E+8                         | -39.507                                                     | 0.000                                       | 30.959                                   |
| 2.23E+8                         | -38.726                                                     | 0.000                                       | 31.767                                   |
| 2.24E+8                         | -39.356                                                     | 0.000                                       | 31.157                                   |
| 2.24E+8                         | -38.970                                                     | 0.000                                       | 31.554                                   |
| 2.25E+8                         | -39.821                                                     | 0.000                                       | 30.720                                   |
| 2.25E+8                         | -38.846                                                     | 0.000                                       | 31.704                                   |
| 2.25E+8                         | -38.175                                                     | 0.000                                       | 32.377                                   |
| 2.26E+8                         | -38.837                                                     | 0.000                                       | 31.733                                   |
| 2.27E+8                         | -39.852                                                     | 0.000                                       | 30.739                                   |
| 2.49E+8                         | -30.057                                                     | 0.000                                       | 41.182                                   |
| 3.71E+8                         | -31.843                                                     | 0.000                                       | 42.127                                   |
| 4.15E+8                         | -39.325                                                     | 0.000                                       | 35.407                                   |
| 9.96E+8                         | -39.380                                                     | 0.000                                       | 41.340                                   |
| 9.97E+8                         | -39.356                                                     | 0.000                                       | 41.370                                   |
| 9.99E+8                         | -39.386                                                     | 0.000                                       | 41.351                                   |
| 9.99E+8                         | -39.491                                                     | 0.000                                       | 41.251                                   |
| 1.00E+9                         | -39.295                                                     | 0.000                                       | 41.451                                   |



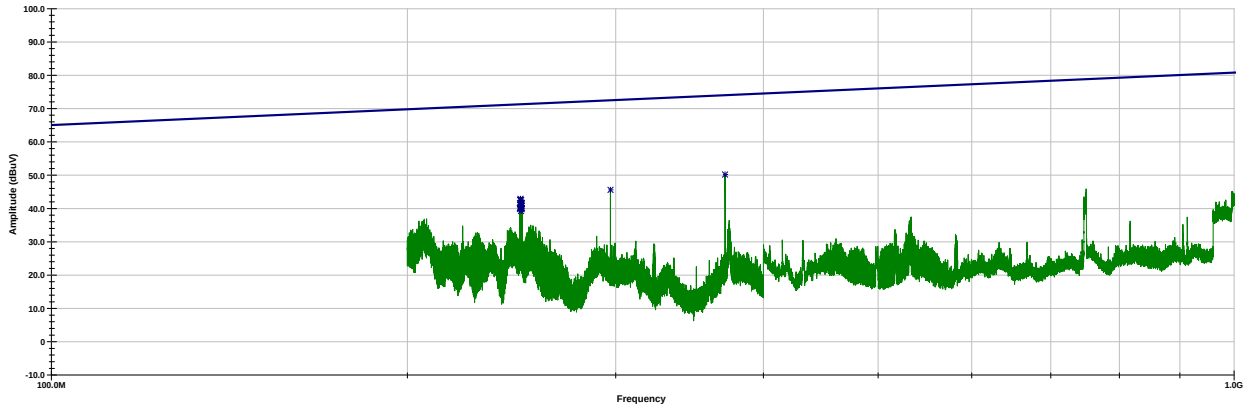
1250 Peterson Dr., Wheeling, IL 60090

Company: Churchill Navigation  
 Model Tested: ARS-500C-2012  
 Report Number: 18688  
 Standard: RTCA/DO-160G Section 21 Emission of Radio Frequency Energy

Appendix: A

D.L.S. Electronic Systems, Inc.  
 RTCA/DO-160G Section 21 Radiated Emissions  
 200MHz-1000MHz Emissions (peak)

Customer - Boulder Engineering Studio ARS-500C  
 Limit - DO-160G Category B  
 Frequency Range - 200-1000MHz 3106 Horn Ant.  
 Antenna Position - EUT, Vertical Polarization  
 Mode - ON, Video Monitored



02:49:30 PM, Wednesday, January 23, 2013

| 02:49:30 PM<br>Frequency<br>MHz | January 23, 2013<br>Complying Emissions<br>(dB below limit) | Excessive Emissions<br>(dB exceeding limit) | Highest Emissions<br>(Amplitude in dBuV) |
|---------------------------------|-------------------------------------------------------------|---------------------------------------------|------------------------------------------|
| 2.49E+8                         | -31.227                                                     | 0.000                                       | 40.010                                   |
| 2.49E+8                         | -28.704                                                     | 0.000                                       | 42.535                                   |
| 2.49E+8                         | -29.683                                                     | 0.000                                       | 41.556                                   |
| 2.49E+8                         | -31.370                                                     | 0.000                                       | 39.871                                   |
| 2.49E+8                         | -30.848                                                     | 0.000                                       | 40.395                                   |
| 2.49E+8                         | -30.264                                                     | 0.000                                       | 40.980                                   |
| 2.49E+8                         | -28.370                                                     | 0.000                                       | 42.877                                   |
| 2.49E+8                         | -31.252                                                     | 0.000                                       | 39.997                                   |
| 2.49E+8                         | -31.081                                                     | 0.000                                       | 40.170                                   |
| 2.50E+8                         | -32.040                                                     | 0.000                                       | 39.212                                   |
| 2.50E+8                         | -30.457                                                     | 0.000                                       | 40.797                                   |
| 2.50E+8                         | -28.711                                                     | 0.000                                       | 42.544                                   |
| 2.50E+8                         | -29.860                                                     | 0.000                                       | 41.398                                   |
| 2.50E+8                         | -29.711                                                     | 0.000                                       | 41.548                                   |
| 2.50E+8                         | -31.469                                                     | 0.000                                       | 39.792                                   |
| 2.50E+8                         | -29.640                                                     | 0.000                                       | 41.622                                   |
| 2.50E+8                         | -29.771                                                     | 0.000                                       | 41.492                                   |
| 2.50E+8                         | -31.147                                                     | 0.000                                       | 40.117                                   |
| 2.97E+8                         | -26.860                                                     | 0.000                                       | 45.584                                   |
| 3.71E+8                         | -23.798                                                     | 0.000                                       | 50.172                                   |



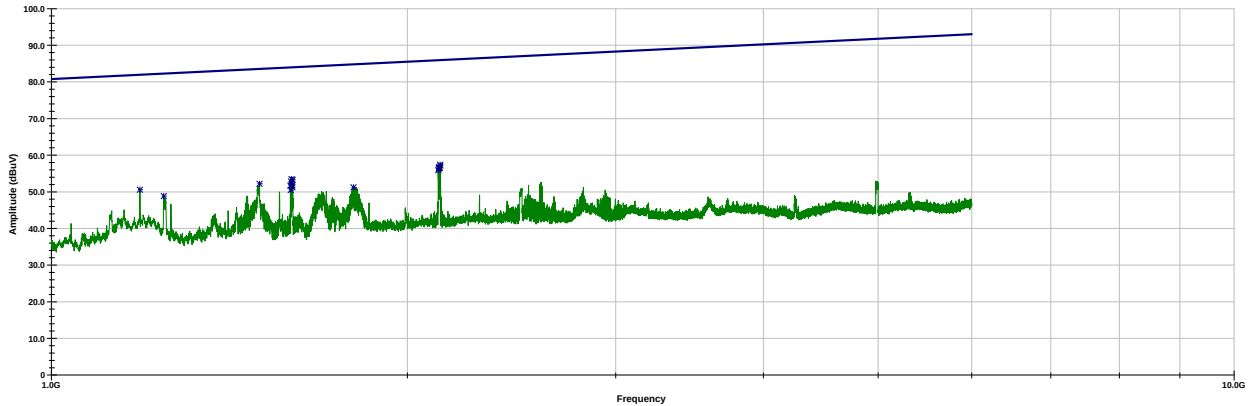
1250 Peterson Dr., Wheeling, IL 60090

Company: Churchill Navigation  
 Model Tested: ARS-500C-2012  
 Report Number: 18688  
 Standard: RTCA/DO-160G Section 21 Emission of Radio Frequency Energy

Appendix: A

D.L.S. Electronic Systems, Inc.  
 RTCA/DO-160G Section 21 Radiated Emissions  
 1GHz-6GHz Emissions (peak)

Customer - Boulder Engineering Studio ARS-500C  
 Limit - DO-160G Category B  
 Frequency Range - 1-6GHz Standard Horn Ant. 3117  
 Antenna Position - EUT, Horizontal Polarization  
 Mode - ON, Video Mode



01:59:41 PM, Wednesday, January 23, 2013

| 01:59:41 PM<br>Frequency<br>MHz | January 23, 2013<br>Complying Emissions<br>(dB below limit) | Excessive Emissions<br>(dB exceeding limit) | Highest Emissions<br>(amplitude in dBuV) |
|---------------------------------|-------------------------------------------------------------|---------------------------------------------|------------------------------------------|
| 1.19E+9                         | -31.383                                                     | 0.000                                       | 50.542                                   |
| 1.24E+9                         | -33.438                                                     | 0.000                                       | 48.806                                   |
| 1.50E+9                         | -31.347                                                     | 0.000                                       | 52.171                                   |
| 1.59E+9                         | -32.286                                                     | 0.000                                       | 51.644                                   |
| 1.59E+9                         | -33.473                                                     | 0.000                                       | 50.461                                   |
| 1.59E+9                         | -31.149                                                     | 0.000                                       | 52.789                                   |
| 1.60E+9                         | -30.485                                                     | 0.000                                       | 53.460                                   |
| 1.60E+9                         | -32.136                                                     | 0.000                                       | 51.813                                   |
| 1.60E+9                         | -32.283                                                     | 0.000                                       | 51.669                                   |
| 1.60E+9                         | -32.703                                                     | 0.000                                       | 51.253                                   |
| 1.60E+9                         | -30.716                                                     | 0.000                                       | 53.244                                   |
| 1.80E+9                         | -33.564                                                     | 0.000                                       | 51.206                                   |
| 2.12E+9                         | -30.045                                                     | 0.000                                       | 55.853                                   |
| 2.13E+9                         | -29.663                                                     | 0.000                                       | 56.240                                   |
| 2.13E+9                         | -29.387                                                     | 0.000                                       | 56.521                                   |
| 2.13E+9                         | -29.222                                                     | 0.000                                       | 56.690                                   |
| 2.13E+9                         | -29.340                                                     | 0.000                                       | 56.573                                   |
| 2.13E+9                         | -29.337                                                     | 0.000                                       | 56.580                                   |
| 2.13E+9                         | -28.553                                                     | 0.000                                       | 57.369                                   |
| 2.13E+9                         | -28.803                                                     | 0.000                                       | 57.125                                   |



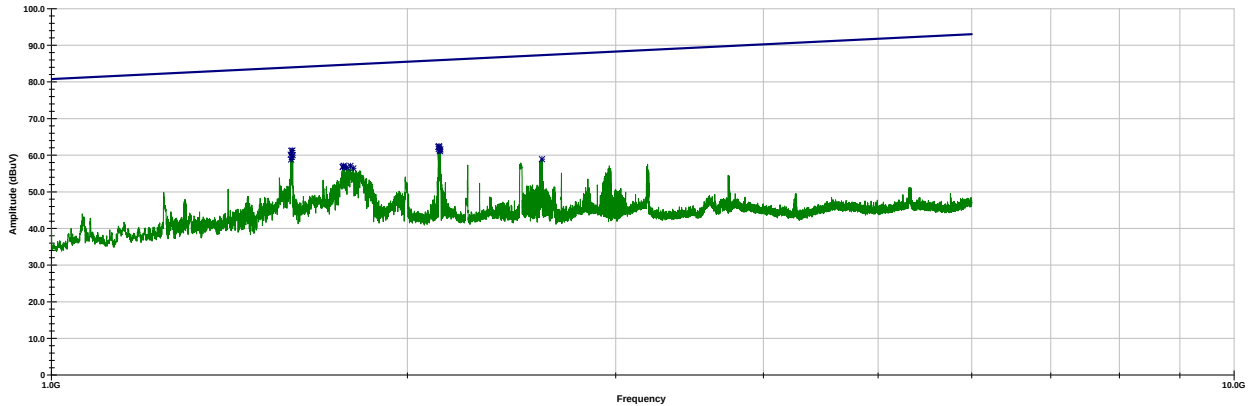
1250 Peterson Dr., Wheeling, IL 60090

Company: Churchill Navigation  
 Model Tested: ARS-500C-2012  
 Report Number: 18688  
 Standard: RTCA/DO-160G Section 21 Emission of Radio Frequency Energy

Appendix: A

D.L.S. Electronic Systems, Inc.  
 RTCA/DO-160G Section 21 Radiated Emissions  
 1GHz-6GHz Emissions (peak)

Customer - Boulder Engineering Studio ARS-500C  
 Limit - DO-160G Category B  
 Frequency Range - 1-6GHz Standard Horn Ant. 3115  
 Antenna Position - EUT, Vertical Polarization  
 Mode - ON, Video Mode



01:52:26 PM, Wednesday, January 23, 2013

| 01:52:26 PM<br>Frequency<br>MHz | January 23, 2013<br>Complying Emissions<br>(dB below limit) | Excessive Emissions<br>(dB exceeding limit) | Highest Emissions<br>(amplitude in dBuV) |
|---------------------------------|-------------------------------------------------------------|---------------------------------------------|------------------------------------------|
| 1.59E+9                         | -23.818                                                     | 0.000                                       | 60.117                                   |
| 1.59E+9                         | -25.114                                                     | 0.000                                       | 58.824                                   |
| 1.60E+9                         | -22.752                                                     | 0.000                                       | 61.189                                   |
| 1.60E+9                         | -24.399                                                     | 0.000                                       | 59.550                                   |
| 1.60E+9                         | -22.672                                                     | 0.000                                       | 61.284                                   |
| 1.60E+9                         | -23.949                                                     | 0.000                                       | 60.010                                   |
| 1.76E+9                         | -27.884                                                     | 0.000                                       | 56.741                                   |
| 1.76E+9                         | -27.775                                                     | 0.000                                       | 56.855                                   |
| 1.77E+9                         | -27.532                                                     | 0.000                                       | 57.109                                   |
| 1.78E+9                         | -28.008                                                     | 0.000                                       | 56.671                                   |
| 1.79E+9                         | -27.661                                                     | 0.000                                       | 57.067                                   |
| 1.80E+9                         | -28.363                                                     | 0.000                                       | 56.404                                   |
| 2.12E+9                         | -23.639                                                     | 0.000                                       | 62.260                                   |
| 2.13E+9                         | -24.249                                                     | 0.000                                       | 61.655                                   |
| 2.13E+9                         | -23.470                                                     | 0.000                                       | 62.438                                   |
| 2.13E+9                         | -23.754                                                     | 0.000                                       | 62.158                                   |
| 2.13E+9                         | -24.677                                                     | 0.000                                       | 61.240                                   |
| 2.13E+9                         | -24.859                                                     | 0.000                                       | 61.064                                   |
| 2.13E+9                         | -24.386                                                     | 0.000                                       | 61.542                                   |
| 2.60E+9                         | -28.386                                                     | 0.000                                       | 58.893                                   |



1250 Peterson Dr., Wheeling, IL 60090

Company: Churchill Navigation  
Model Tested: ARS-500C-2012  
Report Number: 18688  
Standard: RTCA/DO-160G Section 21 Emission of Radio Frequency Energy

Appendix: A

# RTCA/DO-160G

## SECTION 21.5

RADIATED EMISSION OF RADIO

FREQUENCY ENERGY

AMBIENT TEST DATA AND CHARTS



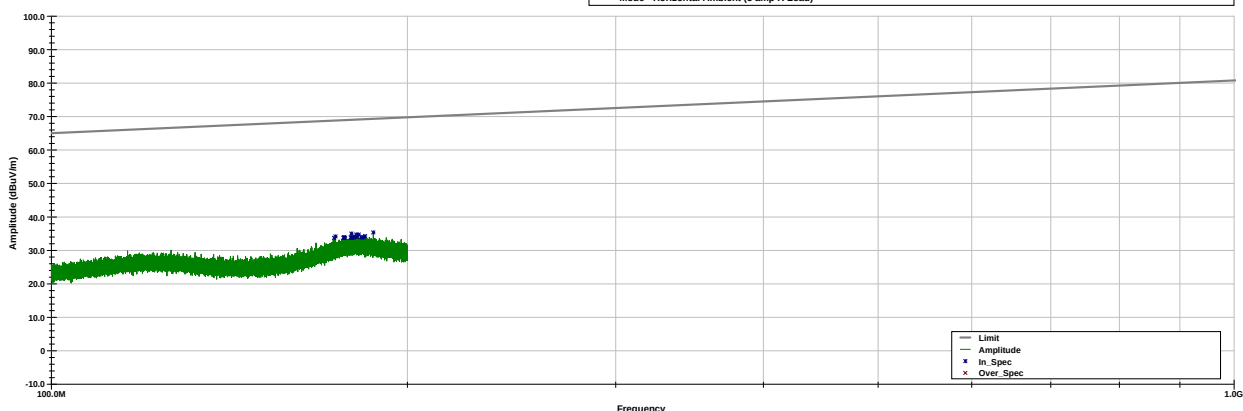
1250 Peterson Dr., Wheeling, IL 60090

Company: Churchill Navigation  
 Model Tested: ARS-500C-2012  
 Report Number: 18688  
 Standard: RTCA/DO-160G Section 21 Emission of Radio Frequency Energy

Appendix: A

D.L.S. Electronic Systems, Inc.  
 RTCA/DO-160G Section 21 Radiated Emissions  
 100MHz-200MHz Emissions (peak)

EUT - Boulder Engineering Studio ARS-500C  
 Limit - DO-160G Category B  
 Frequency Range - 100-200 MHz Bicon Ant. 2617  
 Antenna Positionion - Center of Boundary  
 Mode - Horizontal Ambient (5 amp R Load)



12:22:15 PM, Wednesday, January 23, 2013

| 12:22:15 PM<br>Frequency<br>MHz | January 23, 2013<br>Complying Emissions<br>(dB below limit) | Excessive Emissions<br>(dB exceeding limit) | Highest Emissions<br>(amplitude in dBuV) |
|---------------------------------|-------------------------------------------------------------|---------------------------------------------|------------------------------------------|
| 1.73E+8                         | -35.042                                                     | 0.000                                       | 33.722                                   |
| 1.74E+8                         | -34.613                                                     | 0.000                                       | 34.170                                   |
| 1.77E+8                         | -35.104                                                     | 0.000                                       | 33.787                                   |
| 1.77E+8                         | -35.120                                                     | 0.000                                       | 33.772                                   |
| 1.77E+8                         | -34.921                                                     | 0.000                                       | 33.978                                   |
| 1.77E+8                         | -35.174                                                     | 0.000                                       | 33.737                                   |
| 1.79E+8                         | -35.120                                                     | 0.000                                       | 33.864                                   |
| 1.79E+8                         | -33.987                                                     | 0.000                                       | 35.007                                   |
| 1.79E+8                         | -35.229                                                     | 0.000                                       | 33.769                                   |
| 1.80E+8                         | -35.163                                                     | 0.000                                       | 33.842                                   |
| 1.80E+8                         | -35.257                                                     | 0.000                                       | 33.767                                   |
| 1.80E+8                         | -34.881                                                     | 0.000                                       | 34.150                                   |
| 1.81E+8                         | -34.322                                                     | 0.000                                       | 34.736                                   |
| 1.81E+8                         | -35.079                                                     | 0.000                                       | 33.987                                   |
| 1.82E+8                         | -34.376                                                     | 0.000                                       | 34.716                                   |
| 1.83E+8                         | -35.222                                                     | 0.000                                       | 33.905                                   |
| 1.83E+8                         | -35.247                                                     | 0.000                                       | 33.888                                   |
| 1.84E+8                         | -35.296                                                     | 0.000                                       | 33.861                                   |
| 1.84E+8                         | -34.933                                                     | 0.000                                       | 34.244                                   |
| 1.87E+8                         | -33.911                                                     | 0.000                                       | 35.374                                   |



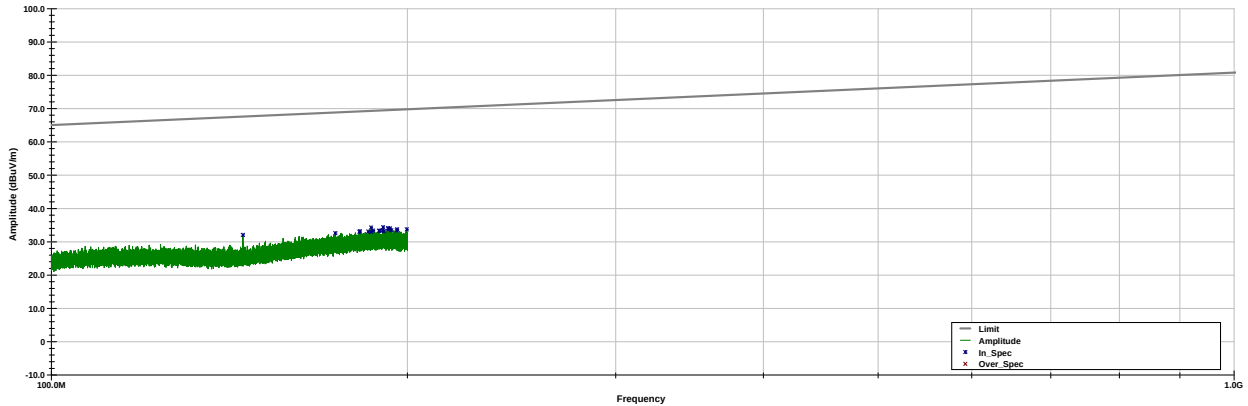
1250 Peterson Dr., Wheeling, IL 60090

Company: Churchill Navigation  
 Model Tested: ARS-500C-2012  
 Report Number: 18688  
 Standard: RTCA/DO-160G Section 21 Emission of Radio Frequency Energy

Appendix: A

D.L.S. Electronic Systems, Inc.  
 RTCA/DO-160G Section 21 Radiated Emissions  
 100MHz-200MHz Emissions (peak)

EUT - Boulder Engineering Studio ARS-500C  
 Limit - DO-160G Category B  
 Frequency Range - 100-200 MHz Bicon Ant. 2617 Vertical  
 Antenna Positionion - Center of Boundary  
 Mode - Vertical Ambient (5 amp R Load)



12:55:26 PM, Wednesday, January 23, 2013

| 12:55:26 PM<br>Frequency<br>MHz | January 23, 2013<br>Complying Emissions<br>(dB below limit) | Excessive Emissions<br>(dB exceeding limit) | Highest Emissions<br>(amplitude in dBuV) |
|---------------------------------|-------------------------------------------------------------|---------------------------------------------|------------------------------------------|
| 1.45E+8                         | -35.507                                                     | 0.000                                       | 32.043                                   |
| 1.74E+8                         | -36.196                                                     | 0.000                                       | 32.584                                   |
| 1.82E+8                         | -36.164                                                     | 0.000                                       | 32.937                                   |
| 1.82E+8                         | -35.945                                                     | 0.000                                       | 33.163                                   |
| 1.85E+8                         | -36.170                                                     | 0.000                                       | 33.049                                   |
| 1.86E+8                         | -34.972                                                     | 0.000                                       | 34.284                                   |
| 1.86E+8                         | -36.272                                                     | 0.000                                       | 32.985                                   |
| 1.87E+8                         | -35.947                                                     | 0.000                                       | 33.336                                   |
| 1.89E+8                         | -36.076                                                     | 0.000                                       | 33.287                                   |
| 1.89E+8                         | -36.078                                                     | 0.000                                       | 33.290                                   |
| 1.91E+8                         | -35.988                                                     | 0.000                                       | 33.422                                   |
| 1.91E+8                         | -35.034                                                     | 0.000                                       | 34.382                                   |
| 1.91E+8                         | -36.281                                                     | 0.000                                       | 33.150                                   |
| 1.93E+8                         | -35.407                                                     | 0.000                                       | 34.074                                   |
| 1.93E+8                         | -35.711                                                     | 0.000                                       | 33.778                                   |
| 1.93E+8                         | -35.468                                                     | 0.000                                       | 34.040                                   |
| 1.94E+8                         | -36.100                                                     | 0.000                                       | 33.427                                   |
| 1.96E+8                         | -36.210                                                     | 0.000                                       | 33.390                                   |
| 1.96E+8                         | -35.900                                                     | 0.000                                       | 33.703                                   |
| 2.00E+8                         | -36.009                                                     | 0.000                                       | 33.723                                   |



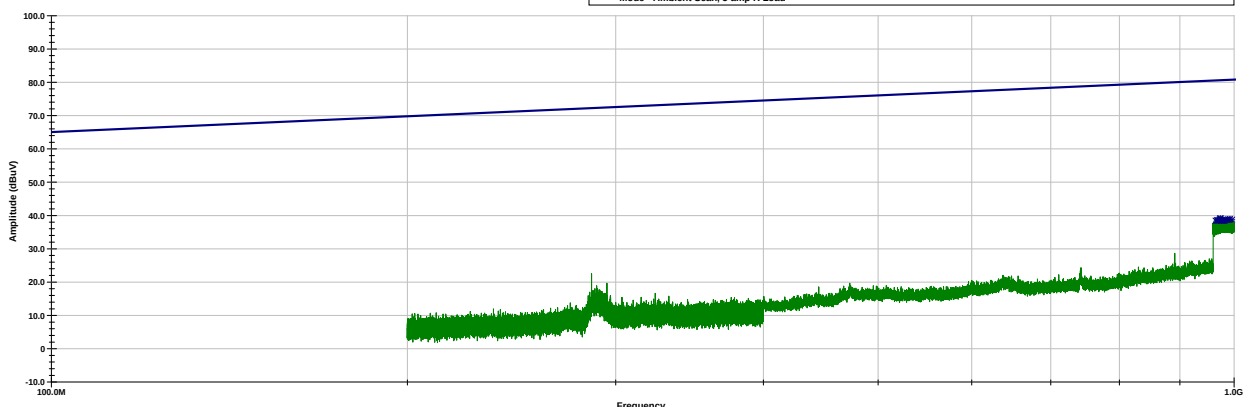
1250 Peterson Dr., Wheeling, IL 60090

Company: Churchill Navigation  
 Model Tested: ARS-500C-2012  
 Report Number: 18688  
 Standard: RTCA/DO-160G Section 21 Emission of Radio Frequency Energy

Appendix: A

D.L.S. Electronic Systems, Inc.  
 RTCA/DO-160G Section 21 Radiated Emissions  
 200MHz-1000MHz Emissions (peak)

Customer - Boulder Engineering Studio ARS-500C  
 Limit - DO-160G Category B  
 Frequency Range - 200-1000MHz 3106 Horn Ant.  
 Antenna Position - EUT, Horizontal Polarization  
 Mode - Ambient Scan, 5 amp R Load



03:02:08 PM, Wednesday, January 23, 2013

| 03:02:08 PM<br>Frequency<br>MHz | January 23, 2013<br>Complying Emissions<br>(dB below limit) | Excessive Emissions<br>(dB exceeding limit) | Highest Emissions<br>(Amplitude in dBuV) |
|---------------------------------|-------------------------------------------------------------|---------------------------------------------|------------------------------------------|
| 9.65E+8                         | -42.086                                                     | 0.000                                       | 38.416                                   |
| 9.67E+8                         | -42.069                                                     | 0.000                                       | 38.451                                   |
| 9.68E+8                         | -41.890                                                     | 0.000                                       | 38.634                                   |
| 9.71E+8                         | -42.058                                                     | 0.000                                       | 38.487                                   |
| 9.73E+8                         | -41.720                                                     | 0.000                                       | 38.838                                   |
| 9.73E+8                         | -41.967                                                     | 0.000                                       | 38.592                                   |
| 9.74E+8                         | -41.427                                                     | 0.000                                       | 39.136                                   |
| 9.74E+8                         | -41.533                                                     | 0.000                                       | 39.036                                   |
| 9.75E+8                         | -41.977                                                     | 0.000                                       | 38.600                                   |
| 9.76E+8                         | -42.130                                                     | 0.000                                       | 38.448                                   |
| 9.76E+8                         | -42.102                                                     | 0.000                                       | 38.481                                   |
| 9.78E+8                         | -42.129                                                     | 0.000                                       | 38.468                                   |
| 9.80E+8                         | -42.195                                                     | 0.000                                       | 38.415                                   |
| 9.81E+8                         | -42.198                                                     | 0.000                                       | 38.420                                   |
| 9.82E+8                         | -42.088                                                     | 0.000                                       | 38.534                                   |
| 9.85E+8                         | -42.029                                                     | 0.000                                       | 38.617                                   |
| 9.88E+8                         | -41.890                                                     | 0.000                                       | 38.773                                   |
| 9.89E+8                         | -41.972                                                     | 0.000                                       | 38.702                                   |
| 9.92E+8                         | -41.790                                                     | 0.000                                       | 38.900                                   |
| 9.96E+8                         | -42.016                                                     | 0.000                                       | 38.704                                   |



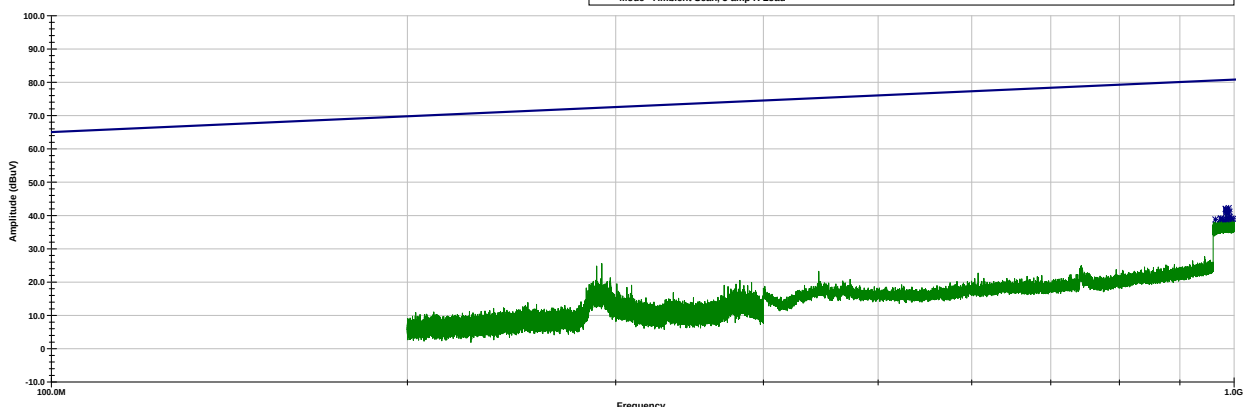
1250 Peterson Dr., Wheeling, IL 60090

Company: Churchill Navigation  
 Model Tested: ARS-500C-2012  
 Report Number: 18688  
 Standard: RTCA/DO-160G Section 21 Emission of Radio Frequency Energy

Appendix: A

D.L.S. Electronic Systems, Inc.  
 RTCA/DO-160G Section 21 Radiated Emissions  
 200MHz-1000MHz Emissions (peak)

Customer - Boulder Engineering Studio ARS-500C  
 Limit - DO-160G Category B  
 Frequency Range - 200-1000MHz 3106 Horn Ant.  
 Antenna Position - EUT, Vertical Polarization  
 Mode - Ambient Scan, 5 amp R Load



02:55:51 PM, Wednesday, January 23, 2013

| 02:55:51 PM<br>Frequency<br>MHz | January 23, 2013<br>Complying Emissions<br>(dB below limit) | Excessive Emissions<br>(dB exceeding limit) | Highest Emissions<br>(Amplitude in dBuV) |
|---------------------------------|-------------------------------------------------------------|---------------------------------------------|------------------------------------------|
| 9.64E+8                         | -41.715                                                     | 0.000                                       | 38.783                                   |
| 9.74E+8                         | -41.612                                                     | 0.000                                       | 38.957                                   |
| 9.75E+8                         | -41.446                                                     | 0.000                                       | 39.125                                   |
| 9.78E+8                         | -41.785                                                     | 0.000                                       | 38.809                                   |
| 9.84E+8                         | -41.809                                                     | 0.000                                       | 38.826                                   |
| 9.84E+8                         | -38.647                                                     | 0.000                                       | 41.989                                   |
| 9.84E+8                         | -38.728                                                     | 0.000                                       | 41.908                                   |
| 9.85E+8                         | -39.087                                                     | 0.000                                       | 41.555                                   |
| 9.85E+8                         | -39.316                                                     | 0.000                                       | 41.327                                   |
| 9.85E+8                         | -39.683                                                     | 0.000                                       | 40.960                                   |
| 9.85E+8                         | -39.877                                                     | 0.000                                       | 40.766                                   |
| 9.85E+8                         | -41.833                                                     | 0.000                                       | 38.814                                   |
| 9.89E+8                         | -41.592                                                     | 0.000                                       | 39.077                                   |
| 9.89E+8                         | -39.916                                                     | 0.000                                       | 40.754                                   |
| 9.90E+8                         | -38.444                                                     | 0.000                                       | 42.231                                   |
| 9.90E+8                         | -41.288                                                     | 0.000                                       | 39.388                                   |
| 9.91E+8                         | -39.582                                                     | 0.000                                       | 41.103                                   |
| 9.91E+8                         | -41.103                                                     | 0.000                                       | 39.584                                   |
| 9.95E+8                         | -41.650                                                     | 0.000                                       | 39.064                                   |
| 9.98E+8                         | -41.735                                                     | 0.000                                       | 39.000                                   |



1250 Peterson Dr., Wheeling, IL 60090

Company: Churchill Navigation  
Model Tested: ARS-500C-2012  
Report Number: 18688  
Standard: RTCA/DO-160G Section 21 Emission of Radio Frequency Energy

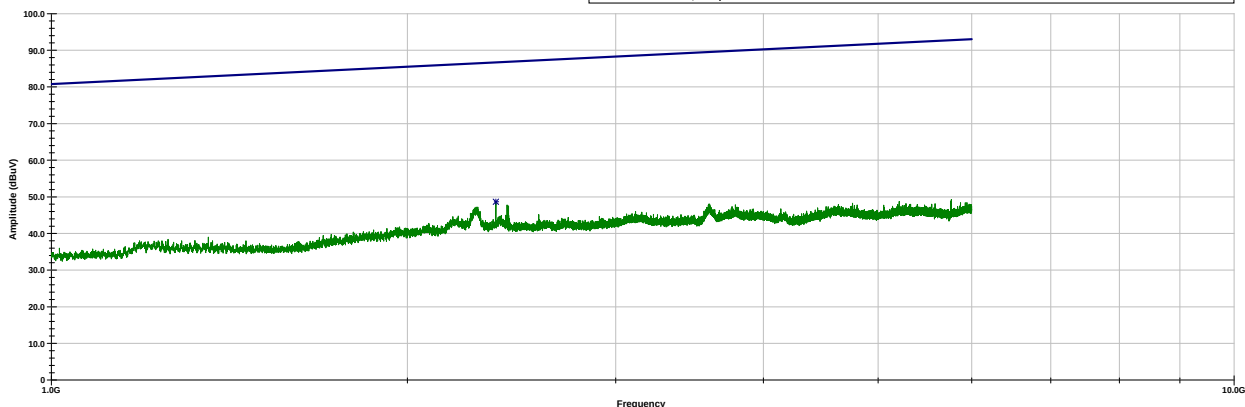
Appendix: A

D.L.S. Electronic Systems, Inc.

RTCA/DO-160G Section 21 Radiated Emissions

1GHz-6GHz Emissions (peak)

Customer - Boulder Engineering Studio ARS-500C  
Limit - DO-160G Category B  
Frequency Range - 1-6GHz Standard Horn Ant. 3115 Horizontal  
Antenna Position - Center of Boundary  
Mode - Ambient, 5 amp R Load



| 01:35:23 PM<br>Frequency<br>MHz | January 23, 2013<br>Complying Emissions<br>(dB below limit) | Excessive Emissions<br>(dB exceeding limit) | Highest Emissions<br>(amplitude in dBuV) |
|---------------------------------|-------------------------------------------------------------|---------------------------------------------|------------------------------------------|
| 2.38E+9                         | -38.027                                                     | 0.000                                       | 48.638                                   |



1250 Peterson Dr., Wheeling, IL 60090

Company: Churchill Navigation  
Model Tested: ARS-500C-2012  
Report Number: 18688  
Standard: RTCA/DO-160G Section 21 Emission of Radio Frequency Energy

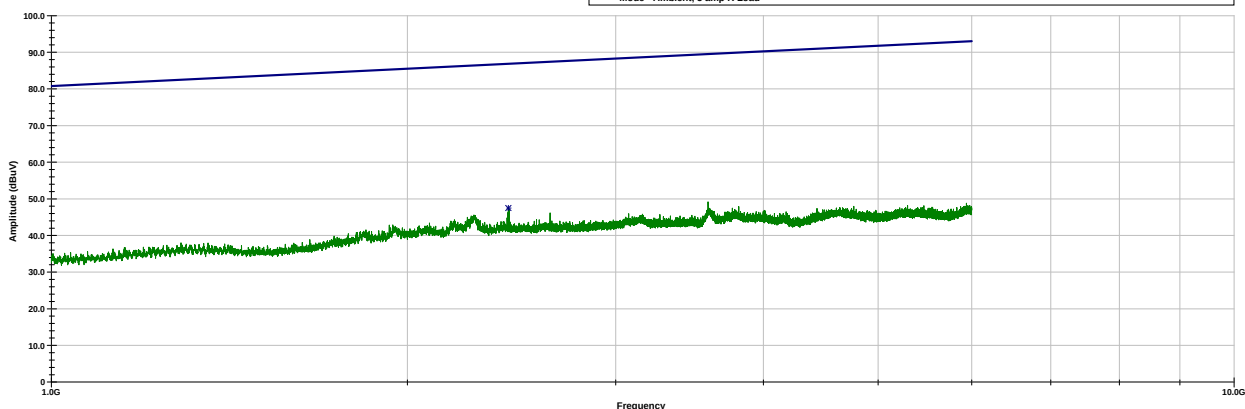
Appendix: A

D.L.S. Electronic Systems, Inc.

RTCA/DO-160G Section 21 Radiated Emissions

1GHz-6GHz Emissions (peak)

Customer - Boulder Engineering Studio ARS-500C  
Limit - DO-160G Category B  
Frequency Range - 1-6GHz Standard Horn Ant. 3115 Vertical  
Antenna Position - Center of Boundary  
Mode - Ambient, 5 amp R Load



| 01:42:29 PM<br>Frequency<br>MHz | January 23, 2013<br>Complying Emissions<br>(dB below limit) | Excessive Emissions<br>(dB exceeding limit) | Highest Emissions<br>(amplitude in dBuV) |
|---------------------------------|-------------------------------------------------------------|---------------------------------------------|------------------------------------------|
| 2.43E+9                         | -39.360                                                     | 0.000                                       | 47.471                                   |