Washington Laboratories, Ltd.
www.wll.com
7560 Lindbergh Drive . Gaithersburg, MD 20879
301.216.1500 . info@wll.com

FCC / Industry Canada Declaration of Conformity
Test Report

BROADCAST SPORTS INTERNATIONAL
HD IN-CAR TRANSMITTER

WLL REPORT# **14329-03 Rev 0**
January 5, 2016

Prepared for:

Broadcast Sports International
7455 Race Road
Hanover, MD 21076

Prepared By:

Washington Laboratories, Ltd.
7560 Lindbergh Drive
Gaithersburg, Maryland 20879

ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY

Testing Certificate AT-1448

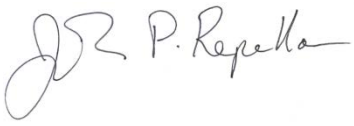
FCC / Industry Canada Declaration of Conformity
Test Report

For the

BROADCAST SPORTS INTERNATIONAL
HD IN-CAR TRANSMITTER

WLL REPORT# **14329-03 Rev 0**
January 5, 2016

Prepared by:



John P. Repella
Compliance Engineer

Reviewed by:

Steven D. Koster
President

Abstract

This report has been prepared on behalf of Broadcast Sports International to support their FCC "Declaration of Conformity". The purpose of this testing is to determine compliance with emissions requirements set forth by the Federal Communication Commission (FCC) for a Class B Digital Device under Part 15 (10/2014) of the FCC Rules and Regulations. This FCC Part 15 Declaration of Conformity Test Report documents the test configuration and test results for the Broadcast Sports International HD In-Car Transmitter.

Testing was performed on an Open Area Test Site (OATS) of Washington Laboratories, Ltd, 7560 Lindbergh Drive, Gaithersburg, MD 20879. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. Washington Laboratories, Ltd. has been accepted by the FCC and approved by ACLASS under Certificate AT-1448 as an independent FCC test laboratory.

The Broadcast Sports International HD In-Car Transmitter complies with the requirements for a Class B digital device.

Revision History	Reason	Date
Rev 0	Initial Release	1/5/2016

Table of Contents

List of Tables

List of Figures

List of Photographs

1.1 Compliance Statement

The Broadcast Sports International HD In-Car Transmitter complies with the requirements for a Class B digital device under Part 15 of the FCC Rules and Regulations.

1.2 Test Scope Summary

Tests for radiated and conducted emissions were performed. All measurements were performed according to the 2003 version of ANSI C63.4. The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

Test Specification	Specific Description	Date Completed	Result	Modifications (Y/N)
CFR47 Part 15.107	Class B Conducted Emissions – AC Power Ports	NA	NA	DC powered
CFR47 Part 15.109	Class B Radiated Emissions	11/15/2015	Complied	NA

1.3 Contract Information

Customer:	Broadcast Sports International 7455 Race Road Hanover, MD, 21076
Purchase Order Number:	24920
Quotation Number:	68605C

1.4 Test Dates

Testing was performed on the following date(s):	11/15/2015

1.5 Test and Support Personnel

Washington Laboratories, LTD	John P. Repella
Customer Representative	Dave Starsoneck

1.6 Abbreviations

A	**A**mpere
ac	**a**lternating **c**urrent
AM	Amplitude Modulation
Amps	**Amp**ere**s**
b/s	**b**its per **s**econd
BW	**B**and**W**idth
CE	**C**onducted **E**mission
cm	**c**enti**m**eter
CW	**C**ontinuous **W**ave
dB	**d**eci**B**el
dc	**d**irect **c**urrent
EMI	**E**lectro**m**agnetic **I**nterference
EUT	**E**quipment **U**nder **T**est
FM	**F**requency **M**odulation
G	**g**iga - prefix for 10^9 multiplier
Hz	**H**ertz
IF	**I**ntermediate **F**requency
k	**k**ilo - prefix for 10^3 multiplier
LISN	**L**ine **I**mpedance **S**tabilization **N**etwork
M	**M**ega - prefix for 10^6 multiplier
m	**m**eter
µ	**m**icro - prefix for 10^{-6} multiplier
NB	**N**arrow**b**and
QP	**Q**uasi-**P**eak
RE	**R**adiated **E**missions
RF	**R**adio **F**requency
rms	**r**oot-**m**ean-**s**quare
SN	**S**erial **N**umber
S/A	**S**pectrum **A**nalyzer
V	**V**olt

2 Equipment Under Test

2.1 EUT Identification

The results obtained relate only to the item(s) tested.

Table 1: Overview of HD In-Car Transmitter, Equipment Under Test

Model(s) Tested:	HD In-Car Transmitter
EUT Specifications:	Primary Power (*as tested*): 12Vdc
	Equipment Emissions Class: B
Test Date(s):	11/15/2015

2.2 Test Configuration

The Broadcast Sports International HD In-Car Transmitter, Equipment Under Test (EUT), was operated from a 12Vdc power supply.

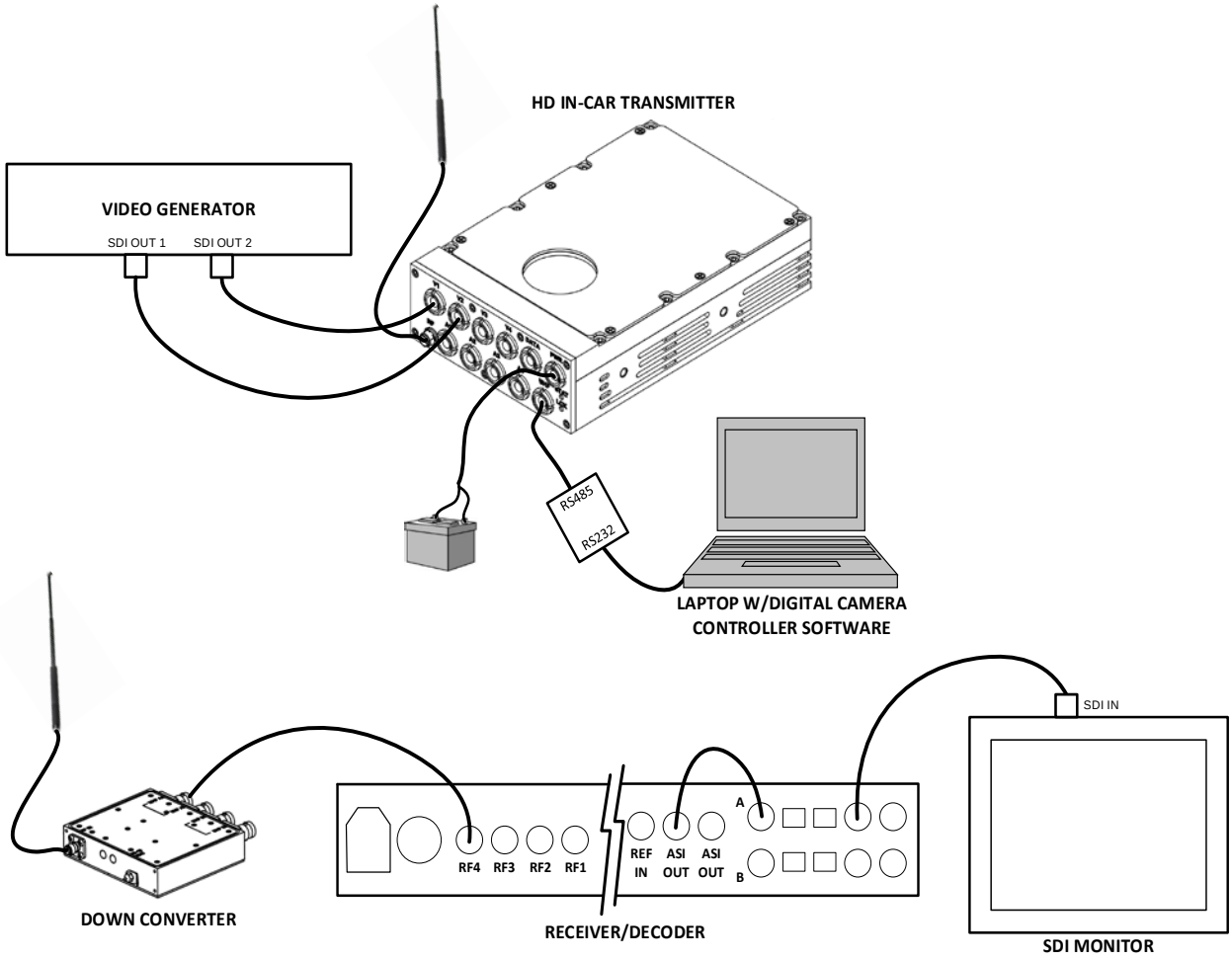


Figure 1: Test Configuration

2.3 Equipment Configuration

The EUT was set up as outlined in Figure 1. The EUT was comprised of the following equipment. (All Modules, PCBs, etc. listed were considered as part of the EUT, as tested.)

Table 2: Equipment Configuration

Name / Description	Model Number	Part Number	Serial Number	Rev. #
HD In-Car Transmitter	-	13418-9-001	12530	N/A

2.4 Support Equipment

The following support equipment was used during testing:

Table 3: Support Equipment

Name / Description	Manufacturer	Model Number	*Customer Supplied Calibration Data
Video Generator	Leader	LT 443D	N/A
Down Converter	BSI	-	N/A
Receiver/Decoder	BSI	-	N/A
SDI Monitor	Marshall	V-R10420P-TE4U	N/A
RS232-RS485 Converter	B&B	485SD9R	N/A
Laptop	Dell	E4310	N/A
USB-RS232 Converter	Assmann	Digitus	N/A

2.5 Interface Cables

Table 4: Interface Cables

Ref. ID	EUT Port	Cable Description or reason for no cable	Qty.	Length (m)	Shielded?
1	V1	7-pin LEMO to BNC	1		Y
2	V2	7-pin LEMO to BNC	1		Y
3	V3	None – 2 video output max	-		N/A
4	V4	None – 2 video output max	-		N/A
5	A1	None – audio not needed	-		N/A
6	A2	None – audio not needed	-		N/A
7	A3	None – audio not needed	-		N/A
8	A4	None – audio not needed	-		N/A
9	RF	SMA-M to SMA-M	1		Y
10	DATA	Configuration Only	-		N/A
11	UHF	5-pin LEMO to DB-9	1		Y
12	PWR	2-pin LEMO to 4-pin XLR	1		Y

2.6 EUT Modifications

No modifications were performed in order to meet the test requirements:.

2.7 Testing Algorithm

With all equipment connected as shown in Figure 1 and the HD In-Car TX transmitting. With all equipment connected as shown in the block diagram and the TX transmitting, the decoder status "GOOD" LED should be green and the monitor should display the test pattern being fed to the TX.

Worst case emission levels are provided in the test results data.

2.8 Test Location

All measurements herein were performed at Washington Laboratories, Ltd. test center in Gaithersburg, MD. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. Washington Laboratories, Ltd. has been accepted by the FCC and approved by ANAB under Testing Certificate AT-1448 as an independent FCC test laboratory.

2.9 Measurements

2.9.1 Measurement Method

All measurements herein were performed according to the 2014 version of ANSI C63.4. The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation. Calibration checks are made periodically to verify proper performance of the measuring instrumentation.

2.10 Measurement Uncertainty

All results reported herein relate only to the equipment tested. The basis for uncertainty calculation uses ANSI/NCSL Z540-2-1997 (R2002) with a type B evaluation of the standard uncertainty. Elements contributing to the standard uncertainty are combined using the method described in Equation 1 to arrive at the total standard uncertainty. The standard uncertainty is multiplied by the coverage factor to determine the expanded uncertainty which is generally accepted for use in commercial, industrial, and regulatory applications and when health and safety are concerned (see Equation 2). A coverage factor was selected to yield a 95% confidence in the uncertainty estimation.

Equation 1: Standard Uncertainty

$$u_c = \pm\sqrt{\frac{a^2}{div_a{}^2} + \frac{b^2}{div_b{}^2} + \frac{c^2}{div_c{}^2} + ...}$$

Where u_c = standard uncertainty

a, b, c,.. = individual uncertainty elements

$div_{a,\ b,\ c}$ = the individual uncertainty element divisor based on the probability distribution

Divisor = 1.732 for rectangular distribution

Divisor = 2 for normal distribution

Divisor = 1.414 for trapezoid distribution

Equation 2: Expanded Uncertainty

$$U = ku_c$$

Where U = expanded uncertainty

k = coverage factor

$k \leq 2$ for 95% coverage (ANSI/NCSL Z540-2 Annex G)

u_c = standard uncertainty

The measurement uncertainty complies with the maximum allowed uncertainty from CISPR 16-4-2. Measurement uncertainty is not used to adjust the measurements to determine compliance. The expanded uncertainty values for the various scopes in the WLL accreditation are provided in Table 5 below.

Table 5: Expanded Uncertainty List

Scope	Standard(s)	Expanded Uncertainty
Conducted Emissions	CISPR11, CISPR22, CISPR14, FCC Part 15	±2.63 dB
Radiated Emissions	CISPR11, CISPR22, CISPR14, FCC Part 15	±4.55 dB

3 Test Results

3.1 Conducted Emissions

3.1.1 Requirements

Test Arrangement: Table Top

Compliance Standard: FCC Part 15 (10/2014), Class B

FCC Compliance Limits		
Frequency	**Quasi-peak**	**Average**
0.15-0.5MHz	66 to 56dBµV	56 to 46dBµV
0.5 to 5MHz	56dBµV	46dBµV
0.5-30MHz	60dBµV	50dBµV

3.1.2 Test Data

This unit is vehicle battery powered at 12VDC. This test is not applicable.

3.2 Radiated Emissions

3.2.1 Requirements

Test Arrangement: Table Top

Compliance Standard: FCC Part 15 Class B (3 meter)

FCC Compliance Limits	
Frequency	**Limits**
30-88 MHz	100 µV/m
88-216 MHz	150 µV/m
216-960 MHz	200 µV/m
>960MHz (3 meters)	500 µV/m

3.2.2 Test Equipment

Test Name: **Radiated Emissions**		Test Date: **11/15/2015**	
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
644	SUNOL SCIENCES CORPORATION - JB1 925-833-9936	BICONALOG ANTENNA	8/14/2017
849	AH SYSTEMS - SAC-18G-16	16 METER CABLE	8/22/2016
528	AGILENT - E4446A	3HZ - 44GHZ ANALYZER SPECTRUM	7/15/2016
4	ARA - DRG-118/A	ANTENNA DRG 1-18GHZ	10/8/2016
558	HP - 8447D	AMPLIFIER	2/20/2016

3.2.3 Test Procedure

The requirements of FCC Part call for the EUT to be placed on an 80 cm high 1 X 1.5 meters non-conductive motorized turntable for radiated testing on a 3meter open field test site. The emissions from the EUT were measured continuously at every azimuth by rotating the turntable. Bi-conical and log periodic broadband antennas were mounted on an antenna mast to determine the height of maximum emissions. The height of the antenna was varied between 1 and 4 meters. The output of the antenna was connected to the input of the spectrum analyzer and the emissions in the frequency range of 30 MHz to 25 GHz were measured. The peripherals were placed on the table in accordance with ANSI C63.4-2003. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured.

The output from the antenna was connected, via a preamplifier, to the input of the spectrum analyzer. The detector function was set to quasi-peak or peak, as appropriate. The measurement bandwidth of the spectrum analyzer system was set to at least 120 kHz, with all post-detector filtering no less than 10 times the measurement bandwidth.

All measurements above 1GHz were made at a distance of 3m with a Resolution Bandwidth of 1MHz and a Video bandwidth of 10Hz.

3.2.4 Test Data

The EUT complied with the Class B Radiated Emissions requirements. Table 2 provides the test results for radiated conducted emissions. Figure 2 and Figure 3 show the radiated emission test configuration.

3.2.5 Radiated Data Reduction and Reporting

To convert the raw spectrum analyzer radiated data into a form that can be compared with the FCC limits, it is necessary to account for various calibration factors that are supplied with the antennas and other measurement accessories. These factors are included into the antenna factor (AF) column of the table and in the cable factor (CF) column of the table. The AF (in dB/m) and the CF (in dB) is algebraically added to the raw Spectrum Analyzer Voltage in dBµV to obtain the Radiated Electric Field in dBµV/m. This logarithm amplitude is converted to a linear amplitude, then compared to the FCC limit.

Example:

Spectrum Analyzer Voltage:	VdBµV		
Antenna Correction Factor:	AFdB/m		
Cable Correction Factor:	CFdB		
Electric Field:		EdBV/m =	V dBµV + AFdB/m + CFdB

To convert to linear units of measure: EdBV/m/20 Inv log

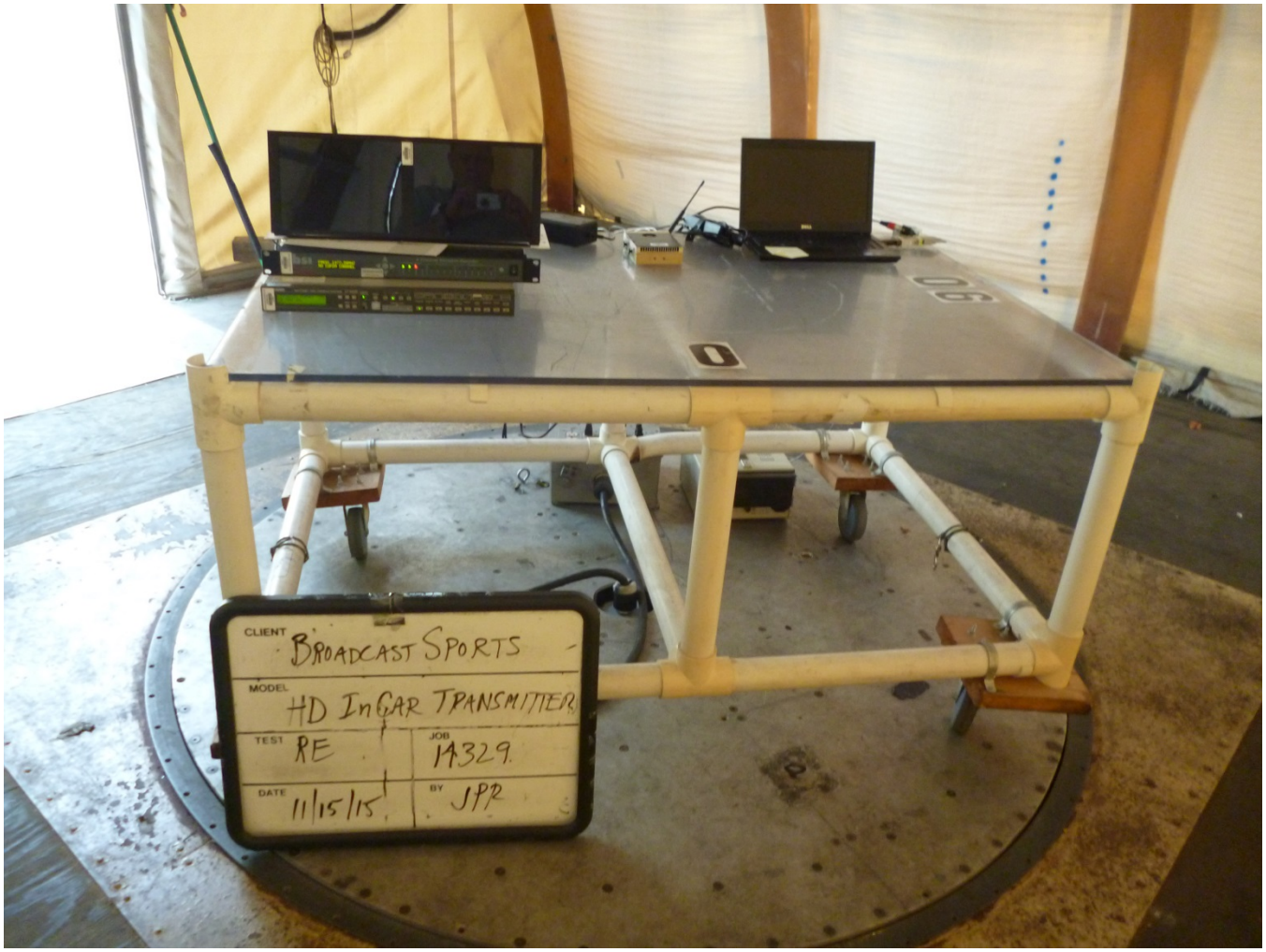
Table 6: Radiated Emission Test Data

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)
38.18	V	90.00	1.00	32.91	-11.3	12.0	100.0	-18.4
43.08	V	0.00	1.00	33.50	-15.0	8.5	100.0	-21.5
47.66	V	180.00	1.10	34.20	-17.8	6.6	100.0	-23.6
73.25	V	0.00	1.20	31.20	-18.4	4.4	100.0	-27.2
112.95	V	165.00	1.20	27.77	-14.0	4.9	150.0	-29.8
133.50	V	10.00	1.20	32.17	-13.4	8.7	150.0	-24.7
255.56	V	270.00	2.73	37.91	-15.2	13.6	200.0	-23.4
38.18	H	90.00	3.90	29.10	-11.3	7.8	100.0	-22.2
47.66	H	270.0	3.9	34.0	-17.8	6.5	100.0	-23.8
48.48	H	90.0	3.9	33.6	-18.2	5.9	100.0	-24.6
73.25	H	0.00	3.80	33.70	-18.4	5.8	100.0	-24.7
112.95	H	10.00	3.80	32.30	-14.0	8.2	150.0	-25.2
133.50	H	190.00	3.50	30.10	-13.4	6.9	150.0	-26.8

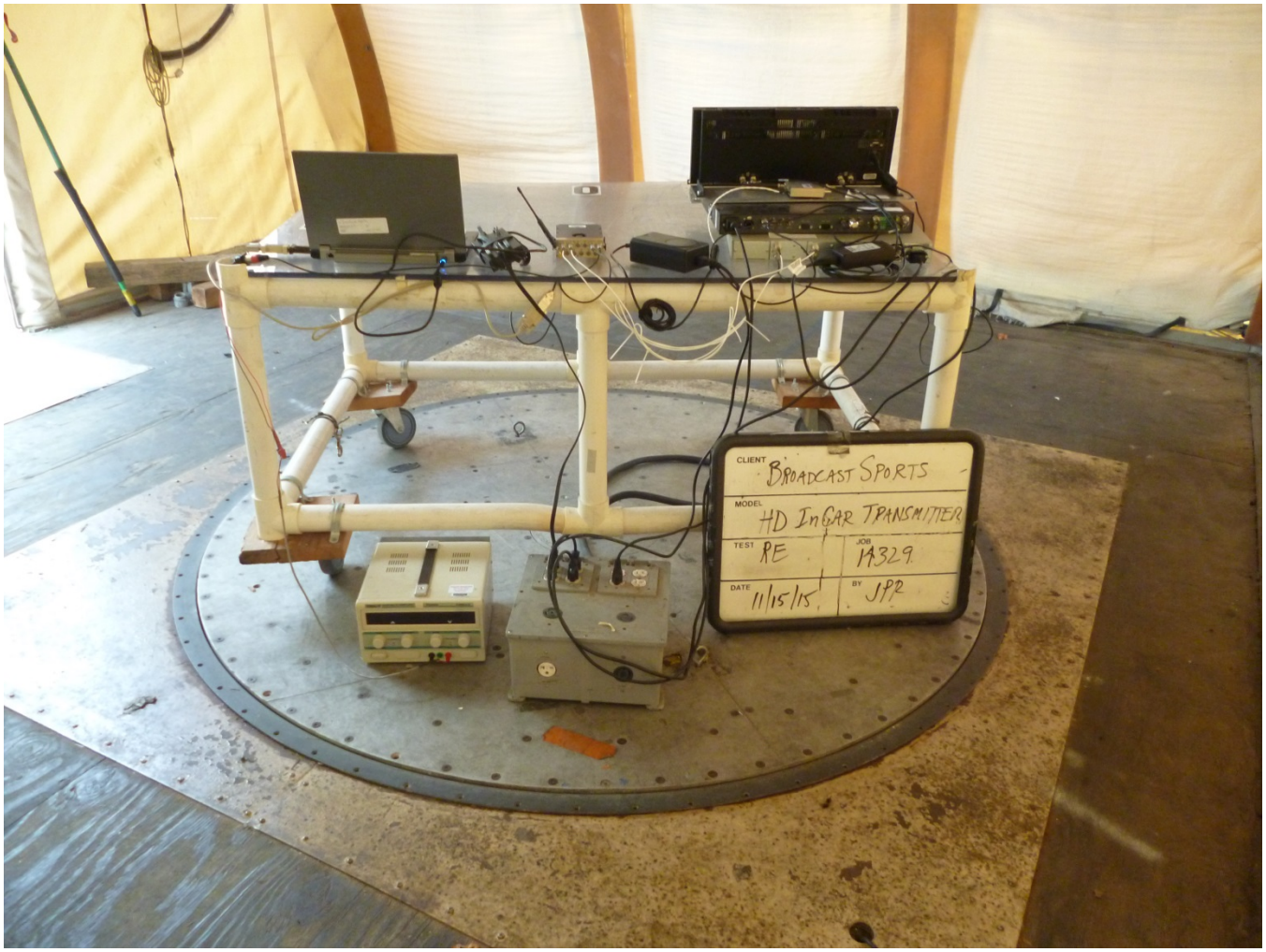
No other emissions were observed from this equipment.

Test Engineer(s): John Repella

Test Date(s): 11/15/2015



Photograph 1: Radiated Emission Test Configuration, Front



Photograph 2: Radiated Emission Test Configuration, Back

4 Declaration of Conformity

According to the Federal Communications Commission the conformity of a device to the requirements shall be certified by a "Declaration of Conformity", issued by the party responsible for ensuring compliance. This declaration shall be included as a separate document or in the user's manual supplied with the product.

The compliance information statement shall be supplied with the product at the time of marketing or importation, containing the following information:

1. Identification of the product, e.g., name and model number. The identification, by name, address and telephone number, of the responsible party. The responsible party for a Declaration of Conformity must be located within the United States.
2. A statement that the product complies with Part 15 of the regulations. The following is an example of this statement:

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

5 Marketing and Labeling Instructions

5.1 Manual Warning Statement

All of the warning statements regarding interference potential shall be placed in the user manual. An informational statement shall be included in the user's manual regarding actions the user can take to resolve any interference that may occur from use of the device. The following is an example of the statement:

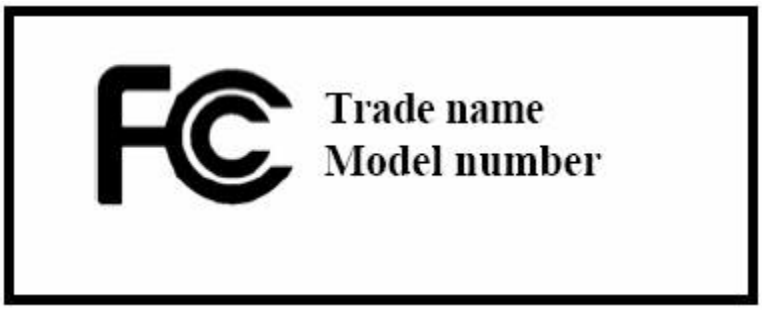
> **This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instruction manual may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:**
>
> - **Reorient or relocate the receiving antenna.**
> - **Increase the separation distance between the equipment and the receiver.**
> - **Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.**
> - **Consult the dealer or an experienced radio TV technician for help.**

The manual should also caution the user that changes or modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment. Finally, the manual should instruct the user to utilize any special accessories, i.e. shielded cables, that are necessary for compliance with the standards.

In cases where the manual is provided only in a form other than paper, such as on a computer disk or over the Internet, the information required above may be included in the manual in that alternative form, provided that the user can be reasonably expected to have the capability to access information in that form.

5.2 Labeling Requirements

The label shall be located in a conspicuous location on the device and shall contain the following logo:



When the device is so small or for such use that it is not practicable to place the statement specified above, such as for a CPU board or a plug-in circuit board peripheral device, the text associated with the logo may be placed in a prominent location in the instruction manual or pamphlet supplied to the user. However, the unique identification (trade name and model number) and the logo must be displayed on the device.

The label shall not be a stick-on, paper label. The label on these products shall be permanently affixed to the product and shall be readily visible to the purchaser at the time of purchase. "Permanently affixed" means that the label is etched, engraved, stamped, silk-screened, indelibly printed, or otherwise permanently marked on a permanently attached part of the equipment or on a nameplate of metal, plastic, or other material fastened to the equipment by welding, riveting, or a permanent adhesive. The label must be designed to last the expected lifetime of the equipment in the environment in which the equipment may be operated and must not be readily detachable.

5.3 Marketing Requirements

The party responsible for ensuring compliance will be required to submit, upon request, documentation verifying compliance, including test reports, to the Commissions within 14 days of such a request. This 14-day period begins upon receipt of the request to the responsible party. The manufacturer is required to retain a record of all documentation for a period of two years after manufacturing is discontinued.

If changes to the original equipment are made, then these changes should be reviewed to ensure that they do not effect compliance with the technical standards. If the changes are determined to change the EMC characteristics of the device then the device should be retested.

Please note that Washington Laboratories, Ltd. (WLL) operates as a contract-testing laboratory and provides test results to support the FCC declaration of conformity. However, under the current regulations, it is up to the party responsible for compliance to declare conformity to the standards.

5.4 Canadian Labeling Requirements

If your device is marketed in Canada, this report also shows compliance with the Industry Canada Interference-Causing Equipment Standard ICES-003. A copy of this report must be retained by the manufacturer or the manufacturer's representative for a period of at least five years.

Each unit of an ITE model shall bear a label that represents the manufacturer's or the importer's SDoC with Innovation, Science and Economic Development Canada's ICES-003. This label shall be permanently affixed to the ITE or displayed electronically and its text must be clearly legible. If the dimensions of the device are too small or if it is not practical to place the label on the ITE and electronic labelling has not been implemented, the label shall be, upon agreement with Innovation, Science and Economic Development Canada, placed in a prominent location in the user manual supplied with the ITE. The user manual may be in an electronic format and must be readily available.

Innovation, Science and Economic Development Canada ICES-003 Compliance Label: *CAN ICES-3 (*)/NMB-3(*)*

* Insert either "A" or "B" but not both to identify the applicable Class of ITE.

