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FCC / ISED Certification

Test Report

FCC ID: TMEPR5000X011
ISED ID: 8327A-PR5000X011

BLACKBOARD, INC.

PR5000

WLL REPORT# **15148-01 Rev 3**
December 12, 2017

Re-issued February 9, 2018

Prepared for:

Blackboard, Inc
22601 N. 19th Ave Suite 200
Pheonix, AZ 85027

Prepared By:
Washington Laboratories, Ltd.
7560 Lindbergh Drive
Gaithersburg, Maryland 20879

ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY

Testing Certificate AT-1448

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Prepared by:

Michael F. Violette, P.E.
CEO

Reviewed by:

Steve Koster
President

Abstract

This report has been prepared on behalf of Blackboard, Inc. to document compliance with the limits for a Radio Frequency Near Field Communications Device under the FCC Rules and Regulations Part 15.209 and Industry Science and Economic Development ISED RSS-GEN.

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 ISED and approved by ANAB under Testing Certificate AT-1448 as an independent FCC test laboratory.

These tests are accredited and meet the requirements of ISO/IEC 17025 as verified by the ANSI-ASQ National Accreditation Board/ANAB. Refer to certificate and scope of accreditation AT-1448.

The Blackboard, Inc. PR5000 complies with the requirements for a near field communications device.

Revision History	Reason	Date
Rev 0	Initial Release	December 12, 2017
Rev 1	Edited per ACB Comments	January 8, 2018
Rev 2	Edited for more comments and added new emissions data	February 1, 2018
Rev 3	Updated to include a statement clarifying the radiated emissions above 30MHz	February 9, 2018

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1 Introduction

1.1 Compliance Statement

The Blackboard, Inc. PR5000 complies with the requirements for a near field communications device.

1.2 Test Scope Summary

Tests for radiated and conducted emissions were performed. All measurements were performed according to the 2013 version of ANSI C63.10 and RSS-GEN. 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 15.207	Class A Conducted Emissions – AC Power Ports	06/20/2017	Complied	No
CFR47 Part 15.209 and 15.109	Radiated Emissions	01/30/2018	Complied	No

1.3 Contract Information

Customer:	Inhand Electronics Inc. 30 West Gude Dr. Suite 5500 Rockville, MD 20850
On Behalf of:	Blackboard, Inc. 22601 N. 19th Ave Suite 200 Pheonix, AZ 85027
Purchase Order Number:	INH15148-1 PO#: 9129
Quotation Number:	69905E

1.4 Test Dates

Testing was performed on the following date(s): 06/19/2017, 06/20/2017, & 1/30/2018

1.5 Test and Support Personnel

Washington Laboratories, Ltd.	Thuan Ta, John Reidell, Nikolas Allen
Customer Representative	Paul Sayles

2 Equipment Under Test

2.1 EUT Identification

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

Table 1: Overview of PR5000, Equipment Under Test

Model(s) Tested:	PR5000
EUT Specifications:	Primary Power (*as tested*): 12VDC via POE or AC-DC Supply
Test Date(s):	06/19/2017 to 06/20/2017 & 1/30/2018

2.2 EUT Description

The Device is an Android-based embedded computer with an enclosure for various products with the initial item as a Point of Sale (PR5000) of several categories. Features include a USB type C interface (power and USB 2.0 signaling), 2-USB 2.0 interfaces, camera, speakers, microphone, Bluetooth interface, WiFi interface, magnetic card reader, NFC and motion sensor.

The internal Modules have the following certification information:

WiFi: FCC ID: VPYLB1DX ISED ID: 772C-LB1DX

Bluetooth: FCC ID: WAP2005 ISED ID: 7922A-2005

An external power supply (providing 12Vdc with at least 15W) can be used for mains connectivity to power the PR5000.

RJ-45 Ethernet connector for signaling and Power over Ethernet (POE) at 48-57Vdc is available.

The PR5000 includes a 7-inch TFT LCD display with touchscreen capability.

The PR5000 is classified as a fixed use device (i.e., not vehicle or handheld).

2.3 Test Configuration

The Blackboard, Inc. PR5000, Equipment Under Test (EUT), was operated from a 115Vac power supply that provided power over Ethernet (POE). The client has stated that they do not provide a power supply with the unit.

2.4 Equipment Configuration

The EUT was comprised of the Figure 1. (All Modules, PCBs, etc. listed were considered as part of the EUT, as tested.)

Table 2: Equipment Configuration.

Name / Description	Model Number	Serial Number	Revision
Trendnet PoE, Power over Ethernet Injector	TPE-113GI/A	BW16393G00215	2.2R
PoE Power Supply	MU24A5480050-A1	N/A	N/A
HDP/Wall wart Power Supply	HDP24-1BK01T	N/A	N/A

2.5 EUT Modifications

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

2.6 Testing Algorithm

The PR5000 will run continuously as long as power is applied to the inputs.

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

2.7 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 Certificate AT-1448 as an independent FCC test laboratory.

2.8 Measurements

2.8.1 Measurement Method

All measurements herein were performed according to the 2013 version of ANSI C63.10. 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.

2.9 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 2 below.

Table 2: 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 15.207 (10/2014)

FCC Compliance Limits		
Frequency	**Quasi-peak**	**Average**
0.15-0.5MHz	79dBµV	66dBµV
0.5-30MHz	73dBµV	60dBµV

3.1.2 Test Equipment

Test Name: **Conducted Emissions Voltage**			Test Date: **6/20/2017**
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
823	AGILENT - N9010A	EXA SPECTRUM ANALYZER	12/21/2017
125	SOLAR - 8028-50-TS-24-BNC	LISN	2/16/2018
126	SOLAR - 8028-50-TS-24-BNC	LISN	2/16/2018
78	HP - 11947A	LIMITER TRANSIENT	2/15/2018

3.1.3 Test Procedure

The requirements of FCC Part 15 and RSS-GEN call for the EUT to be placed on an 80 cm high 1 X 1.5 m non-conductive table above a ground plane. Power to the EUT was provided through a Solar Corporation 50 Ω/50 µH Line Impedance Stabilization Network bonded to a 3 X 2 meter ground plane. The LISN has its AC input supplied from a filtered AC power source. Power was supplied to the peripherals through a second LISN. The peripherals were placed on the table in accordance with ANSI C63.4-2010. Power and data cables were moved about to obtain maximum emissions.

The 50 Ω output of the LISN was connected to the input of the spectrum analyzer and the emissions in the frequency range of 150 kHz to 30 MHz were measured. The detector function was set to quasi-peak, peak, or average as appropriate, and the resolution bandwidth during testing was at least 9 kHz, with all PR5000t-detector filtering no less than 10 times the resolution bandwidth. For average measurements the PR5000t-detector filter was set to 10 Hz.

At frequencies where quasi-peak or peak measurements comply with the average limit, no average measurements need be performed.

3.1.4 Conducted Data Reduction and Reporting

At frequencies where quasi-peak or peak measurements comply with the average limit, no average measurements need be performed. The Conducted emissions level to be compared to the FCC limit is calculated as shown in the following example.

Example:

Spectrum Analyzer Voltage: VdBµV

LISN Correction Factor: LISN dB

Cable Correction Factor: CF dB

Electric Field: EdBµV = V dBµV + LISN dB + CF dB

3.1.5 Test Data

The EUT complied with the Class A Conducted Emissions requirements. Table 3 and Table 4 provide the test results for phase and neutral line power line conducted emissions.

Test Engineer(s): Thuan Ta

Test Date(s): 06/20/2017

Table 3: Conducted Emission Test Data, Wall Plug

NEUTRAL

Frequency (MHz)	Level QP (dBµV)	Level AVG (dBµV)	Cable Loss (dB)	LISN Corr (dB)	Level QP Corr (dBµV)	Level Corr Avg (dBµV)	Limit QP (dBµV)	Limit AVG (dBµV)	Margin QP (dB)	Margin AVG (dB)
0.258	38.7	34.9	10.2	0.3	49.1	45.3	61.5	51.5	-12.4	-6.2
7.000	39.4	36.4	10.9	0.0	50.4	47.4	60.0	50.0	-9.6	-2.6
8.038	39.8	37.4	11.0	0.1	50.9	48.5	60.0	50.0	-9.1	-1.5
8.816	41.4	37.3	11.1	0.1	52.6	48.5	60.0	50.0	-7.4	-1.5
9.338	42.4	38.2	11.1	0.1	53.6	49.4	60.0	50.0	-6.4	-0.6
9.856	44.7	41.3	11.1	0.1	55.9	52.5	60.0	50.0	-4.1	**2.5****
12.187	47.8	44.6	11.2	0.4	59.4	56.2	60.0	50.0	-0.6	**6.2****
15.561	50.7	47.8	11.4	0.7	62.7	59.8	60.0	50.0	**2.7****	**9.8****

PHASE

Frequency (MHz)	Level QP (dBµV)	Level AVG (dBµV)	Cable Loss (dB)	LISN Corr (dB)	Level QP Corr (dBµV)	Level Corr Avg (dBµV)	Limit QP (dBµV)	Limit AVG (dBµV)	Margin QP (dB)	Margin AVG (dB)
0.199	32.1	19.9	10.2	0.0	42.3	30.1	63.6	53.6	-21.4	-23.6
0.262	37.1	33.7	10.2	0.1	47.4	44.0	61.4	51.4	-14.0	-7.4
7.003	39.8	36.8	10.9	0.0	50.8	47.8	60.0	50.0	-9.2	-2.2
8.038	40.5	38.1	11.0	0.1	51.6	49.2	60.0	50.0	-8.4	-0.8
8.299	39.4	34.7	11.0	0.1	50.5	45.8	60.0	50.0	-9.5	-4.2
8.816	41.8	37.6	11.1	0.1	53.0	48.8	60.0	50.0	-7.0	-1.2
9.338	42.4	38.6	11.1	0.2	53.7	49.9	60.0	50.0	-6.3	-0.1
16.596	49.4	47.0	11.4	0.5	61.3	58.9	60.0	50.0	**1.3****	**8.9****

** Denotes emission is not associated to the transmitter, it is from the Class A Host electronics.

Table 4: Conducted Emission Test Data

NEUTRAL

Frequency (MHz)	Level QP (dBµV)	Level AVG (dBµV)	Cable Loss (dB)	LISN Corr (dB)	Level QP Corr (dBµV)	Level Corr Avg (dBµV)	Limit QP (dBµV)	Limit AVG (dBµV)	Margin QP (dB)	Margin AVG (dB)
0.150	50.5	36.2	10.2	0.2	60.8	46.5	66.0	56.0	-5.2	-9.5
0.173	45.2	30.3	10.2	0.3	55.7	40.7	64.8	54.8	-9.1	-14.1
0.260	43.4	37.5	10.2	0.3	53.9	47.9	61.4	51.4	-7.6	-3.5
0.346	36.4	26.6	10.2	0.2	46.8	37.0	59.0	49.0	-12.3	-12.1
0.519	34.1	32.4	10.2	0.3	44.6	42.9	56.0	46.0	-11.4	-3.1
2.854	38.6	37.2	10.2	0.3	49.1	47.7	56.0	46.0	-6.9	**1.7****
4.150	39.2	38.0	10.5	0.3	50.0	48.8	56.0	46.0	-6.0	**2.8****
10.895	30.2	26.6	11.2	0.2	41.6	38.0	60.0	50.0	-18.4	-12.0

PHASE

Frequency (MHz)	Level QP (dBµV)	Level AVG (dBµV)	Cable Loss (dB)	LISN Corr (dB)	Level QP Corr (dBµV)	Level Corr Avg (dBµV)	Limit QP (dBµV)	Limit AVG (dBµV)	Margin QP (dB)	Margin AVG (dB)
0.150	50.9	36.1	10.2	0.2	61.4	46.5	66.0	56.0	-4.6	-9.5
0.157	48.9	35.5	10.2	0.2	59.3	45.9	65.6	55.6	-6.3	-9.8
0.259	43.3	37.4	10.2	0.1	53.5	47.7	61.5	51.5	-7.9	-3.8
0.389	38.9	29.5	10.2	0.3	49.3	40.0	58.1	48.1	-8.8	-8.1
0.519	35.0	32.5	10.2	0.2	45.4	42.9	56.0	46.0	-10.6	-3.1
1.819	35.2	33.7	10.2	0.3	45.6	44.2	56.0	46.0	-10.4	-1.8
4.150	38.6	37.3	10.5	0.3	49.4	48.1	56.0	46.0	-6.6	**2.1****
29.236	27.3	23.1	12.0	1.5	40.7	36.6	60.0	50.0	-19.3	-13.4

** Denotes emission is not associated to the transmitter, it is from the Class A Host electronics.

3.2 Radiated Emissions

3.2.1 15.209 Requirements

Test Arrangement: Table Top

(a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100**	3
88-216	150**	3
216-960	200**	3
Above 960	500	3

3.2.2 Test Equipment

Test Name: **Radiated Emissions**			Test Date: **6/19/2017**
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
823	AGILENT - N9010A	EXA SPECTRUM ANALYZER	12/21/2017
644	SUNOL SCIENCES CORPORATION - JB1 925-833-9936	BICONALOG ANTENNA	08/14/2017
276	ELECTRO-METRICS - BPA-1000	RF PRE-AMPLIFIER	01/18/2018
425	ARA – DRG-118/A	ANTENNA DRG 1-18GHz	11/23/2017
627	AGILENT – 8449B	AMPLIFIER 1-26GHz	11/07/2017
066	ETS-Lindgren	LOOP ANTENNA 10kHz-30MHz	2/14/2018

3.2.3 Test Procedure

The requirements of FCC Part 15 and RSS-GEN 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 3-meter 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 1 GHz were measured. The peripherals were

placed on the table in accordance with ANSI C63.10-2013. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured.

Below 30 MHz, an active loop antenna was set up and adjusted to measure three orientations.

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. Above 1GHz average measurement are recorded. 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. Frequencies above 1GHz were performed using a measurement bandwidth of 1MHz with a video bandwidth setting of 10 Hz for the average measurement.

3.2.4 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
Pre-Amplifier Gain (*if applicable*):	GdB
Electric Field:	EdBµV/m = V dBµV + AFdB/m + CFdB - GdB
To convert to linear units of measure:	invlog (EdBV/m/20)

3.2.5 Test Data

The EUT complied with the emissions requirements under FCC 15.209 and RSS-GEN general emissions requirements. Table 5 provides the test results for radiated emissions.

Test Engineer(s): Thuan Ta, John Reidell, Nikolas Allen

Test Date(s): 06/19/2017, 6/20/2017, 1/30/2018

Table 5: Radiated Emission Test Data

The emissions at the fundamental were barely detected at 3 m. The loop antenna was moved into 1 m and the following measurements collected. The 30 meter limits were adjusted using the following formula: Limit @1m = Limit@30m + 40 log30, using a 40 dB/decade adjustment.
Hence, the limit at 1 meter is 30X30 = 26915 uV/m or 88.6dBuV/m.

Emissions below 30 MHz

Frequency (MHz)	Pol H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)
13.5600	V	180	1	27.87	12.2	101.1	26915	-48.5
13.5600	H	135	1	25.33	12.2	75.5	26915	-51.5
13.5600	P	180	1	22.03	12.2	51.6	26915	-54.3

Emissions above 30 MHz

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)
61.38	V	0.00	1.00	48.60	-16.3	41.4	90.0	-6.7
68.64	V	0.00	1.00	45.67	-15.5	32.4	90.0	-8.9
114.54	V	0.00	1.00	42.94	-9.6	46.7	150.0	-10.1
126.97	V	45.00	1.00	42.27	-8.9	46.7	150.0	-10.1
163.26	V	45.00	1.00	38.57	-10.4	25.7	150.0	-15.3
217.52	V	0.00	1.00	38.25	-11.2	22.6	210.0	-19.4
244.07	V	0.00	1.00	30.48	-10.0	10.6	210.0	-26.0
1498.91	V	0.00	1.50	60.84	-21.5	92.5	1000.0	-20.7
1546.65	V	0.00	2.00	60.62	-21.5	90.1	1000.0	-20.9
3132.50	V	180.00	1.10	60.13	-13.6	213.1	1000.0	-13.4
3132.50	V	180.00	1.10	53.13	-13.6	95.3	1000.0	-20.4
3330.85	V	180.00	1.00	58.78	-13.3	188.1	1000.0	-14.5
3330.85	V	180.00	1.00	46.50	-13.3	45.8	1000.0	-26.8
4540.08	V	45.00	1.00	56.02	-9.2	219.2	1000.0	-13.2
4540.08	V	45.00	1.00	45.46	-9.2	65.0	1000.0	-23.7
5822.59	V	0.00	1.00	51.04	-5.2	195.8	1000.0	-14.2
5822.59	V	0.00	1.00	49.45	-5.2	163.2	1000.0	-15.7
61.38	H	0.00	1.00	30.88	-16.3	5.4	90.0	-24.5
68.64	H	0.00	1.00	30.59	-15.5	5.7	90.0	-24.0
114.54	H	0.00	2.00	36.23	-9.6	21.6	150.0	-16.9
126.97	H	0.00	2.50	38.15	-8.9	29.1	150.0	-14.3
163.26	H	0.00	1.00	37.84	-10.4	23.6	150.0	-16.1
217.52	H	0.00	1.00	39.80	-11.2	27.0	210.0	-17.8
244.07	H	0.00	1.00	36.84	-10.0	22.0	210.0	-19.6
3132.50	H	0.00	3.00	62.69	-13.6	286.3	1000.0	-10.9
3132.50	H	0.00	3.00	49.21	-13.6	60.7	1000.0	-24.3
3330.85	H	180.00	3.20	61.85	-13.3	267.9	1000.0	-11.4
3330.85	H	180.00	3.20	54.35	-13.3	113.0	1000.0	-18.9
4540.08	H	0.00	4.00	57.71	-9.2	266.1	1000.0	-11.5
4540.08	H	0.00	4.00	42.58	-9.2	46.6	1000.0	-26.6
5822.59	H	0.00	4.00	54.25	-5.2	283.5	1000.0	-11.0
5822.59	H	0.00	4.00	45.29	-5.2	101.0	1000.0	-19.9

Note: The emission contained in this table are not associated to the transmitter, they are from the host electronics.

3.3 Bandwidth

The bandwidth of the signal was measured to be 642 Hz. There is no limit for the bandwidth so the unit complies.