FCC & ISED CANADA CERTIFICATION

TEST REPORT

for the

CRANE PAYMENT INNOVATIONS, INC.

FCC ID: QP8SMART7

IC ID: 1297A-SMART7

WLL REPORT# 16485-01 REV 1

Prepared for:

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Testing Certificate AT-1448

FCC & ISED Canada Certification Test Report

for the

Crane Payment Innovations, Inc.

SMART7 MDB

FCC ID: QP8SMART7

ISED ID: 1297A-SMART7

June 22, 2020

WLL Report# 16485-01 Rev 1

Prepared by:

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President

Abstract

This report has been prepared on behalf of Crane Payment Innovations, Inc. to support the attached Application for Equipment Authorization. The test report and application are submitted for an Intentional Radiator under Part 15.225 of the FCC Rules and Regulations and RSS 210 of Innovation, Science and Economic Development (ISED) Canada. This Certification Test Report documents the test configuration and test results for the Crane Payment Innovations, Inc. SMART7 MDB.

Testing was performed on an Open Area Test Site (OATS) of Washington Laboratories, Ltd, 4840 Winchester Boulevard, Frederick, MD 21703. 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. (ISED Canada number 3035A).

The Crane Payment Innovations, Inc. SMART7 MDB complies with the limits for an intentional radiator device under FCC Part 15.225 and ISED Canada RSS 210.

Revision History	Description of Change	Date
Rev 0	Initial Release	June 22, 2020
Rev 1	Edited per ACB Comments	July 16, 2020

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1 Introduction

1.1 Compliance Statement

The Crane Payment Innovations, Inc. SMART7 MDB complies with the limits under FCC Part 15.225 (4/2020) and (ISED) Canada RSS 210 (Issue 10).

1.2 Test Scope

Tests for radiated and conducted emissions were performed. All measurements were performed in accordance with the 2014 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	Result	Modifications (Y/N)
CFR47 Part 15.207, RSS Gen section 7.2.4	Class B Conducted Emissions – AC Power Ports	OK	No
CFR47 Part 15.209, RSS Gen section 7.2.5	Class B Radiated Emissions	OK	No
RSS Gen section 6	Receiver Spurious Emissions	OK	No
CFR47 Part 15.225, RSS 210 section A2.6	Field Strength	OK	No
CFR47 Part 15.225, RSS GEN section 4.7	Frequency Stability	OK	No
CFR47 Part 2.1049	Occupied Bandwidth	OK	No

1.3 Contract Information

Customer:	Crane Payment Innovations, Inc.
Purchase Order Number:	4500658760
Quotation Number:	71861

1.4 Test and Support Personnel

Washington Laboratories, LTD	Mike Violette
Customer Representative	Robert Carney

2 Equipment Under Test

2.1 EUT Identification & Description

Table 1: Device Summary

Manufacturer:	Crane Payment Innovations, Inc.
FCC ID:	QP8SMART7
ISED ID:	1297A-SMART7
Model:	SMART7 MDB
Serial Number of Unit Tested	N/A
FCC Rule Parts:	§15.225
ISED Rule Parts:	RSS-210
Frequency Range:	13.56 MHz
Maximum Output Power:	40.2 dBuV/m
Modulation:	CW
Occupied Bandwidth (99%):	21.53 kHz
Keying:	Automatic
Type of Information:	RFID
Number of Channels:	1
Power Output Level	Fixed
Highest TX Spurious Emission:	0.46 uV/m @ 3 m @27.12 MHz (-6.8 dBuV/m)
Highest RX Spurious Emission:	136 uV/m @ 8
Antenna Connector	NA
Antenna Type	Integral
Interface Cables:	None
Power Source & Voltage:	24VDC
Emissions Designator	21K5F1D

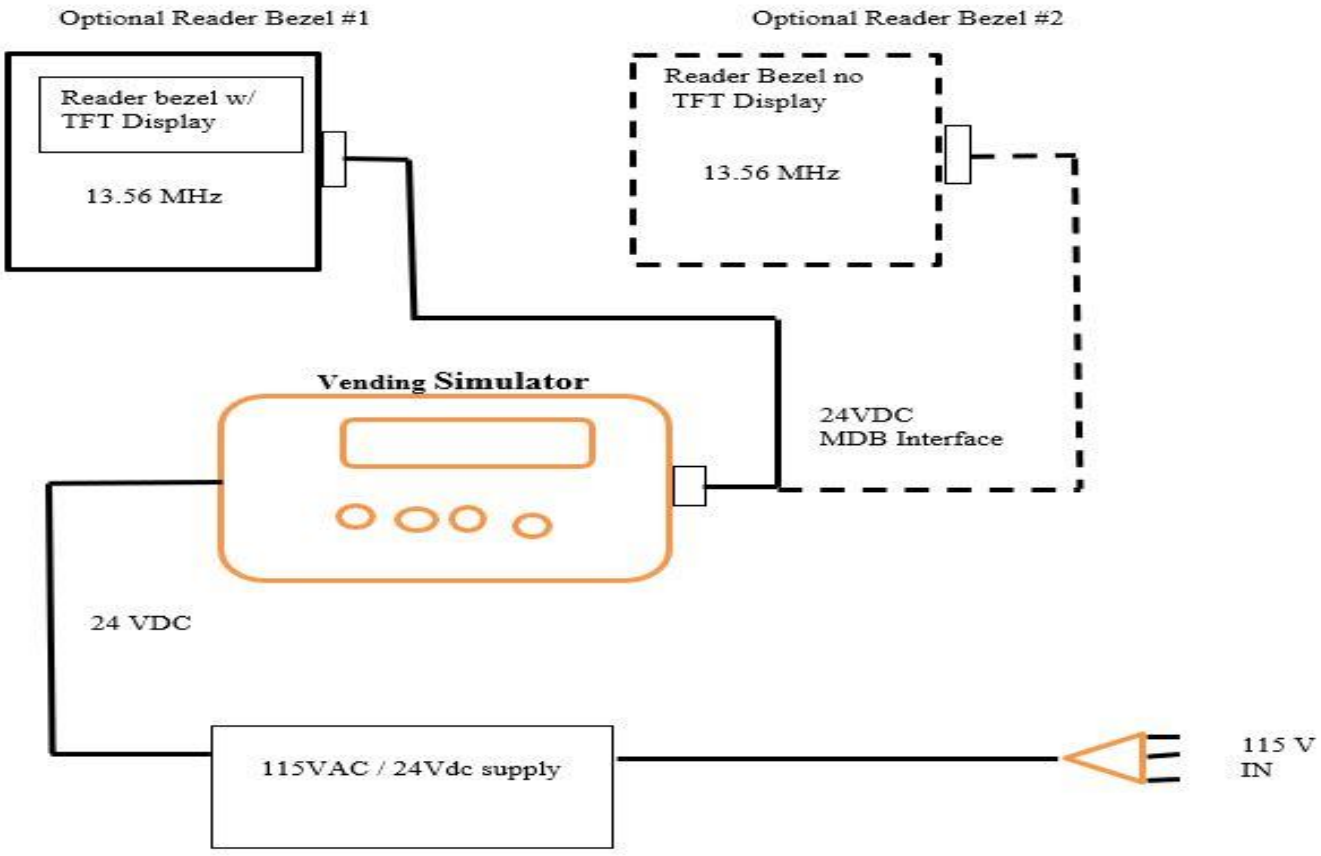
2.2 EUT Description

The Crane Payment Innovations, Inc. SMART7 MDB is a 13.56 MHz contactless RFID card reader bezel. It utilized the NXP PN512 full NFC Forum-compliant front-end Transceiver for contactless card communications in the near field. The Smart7 integrates into customer end-use-equipment in support of closed site cashless sales. There are two versions, one with integrated TFT display and one version with TFT display depopulated.

2.3 Test Configuration

The SMART7 MDB has only one configuration while powered on.

Figure 1: Test Configuration



2.4 EUT Configuration

The EUT was comprised of the following equipment. All Modules, PCBs, etc. listed were considered as part of the EUT, as tested.

Table 2: EUT Test Configuration

Name / Description	Part Number	Serial Number
Smart7 MDB	8274.2550.1121	202002000161
Vending Simulator w/ PS		

2.4.1 Support Equipment

The following support equipment was used during testing.

Table 3: Support Equipment

Name / Description	Manufacturer	*Customer Supplied Calibration Data
Vending Simulator w/ PS	MEI	NA
Vending Simulator w/ PS	MEI	NA

2.4.2 Interface Cables

Table 4: Interface Cables

Ref. ID	Port name on EUT	Cable Description or reason for no cable	Qty.	Length (m)	Shielded?	Termination Box ID & Port ID
1	MDB	MDB Interface cable	1	1270	No	Simulator

EUT Modifications

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

2.5 Testing Algorithm

The SMART7 MDB was tested to the worst case situations possible.

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

2.6 Test Location

All measurements herein were performed at Washington Laboratories, Ltd. test center in Frederick, 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. The ISED Canada number is for Washington Laboratories, Ltd. Washington Laboratories, Ltd. has been accepted by the FCC and approved by ANAB under Certificate AT-1448 as an independent FCC test laboratory.

2.7 Measurements

2.7.1 References

ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation

ANSI C63.4 American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

2.8 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

uc = standard uncertainty

a, b, c, = individual uncertainty elements

Diva, 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 ≤ 2 for 95% coverage (ANSI/NCSL Z540-2 Annex G)

uc = 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 Equipment

Table 6 shows a list of the test equipment used for measurements along with the calibration information.

Table 6: Test Equipment List

Test Name:	**Conducted Emissions Voltage**	Test Date:	**04/28/2020**
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
00528	AGILENT	E4446A	1/21/2021
00125	SOLAR	8028-50-TS-24-BNC	7/15/2020
00126	SOLAR	8028-50-TS-24-BNC	7/15/2020
Test Name:	**Radiated Emissions**	Test Date:	**04/28/2020**
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
00528	AGILENT	E4446A	1/21/2021
00382	SUNOL SCIENCES CORPORATION	JB1	5/1/2020
00558	HP	8447D	7/21/2020
00626	ARA	DRG-118/A	5/7/2020
00276	ELECTRO-METRICS	BPA-1000	5/3/2020

4 Test Results

4.1 Occupied Bandwidth: FCC §15.225, §2.1049

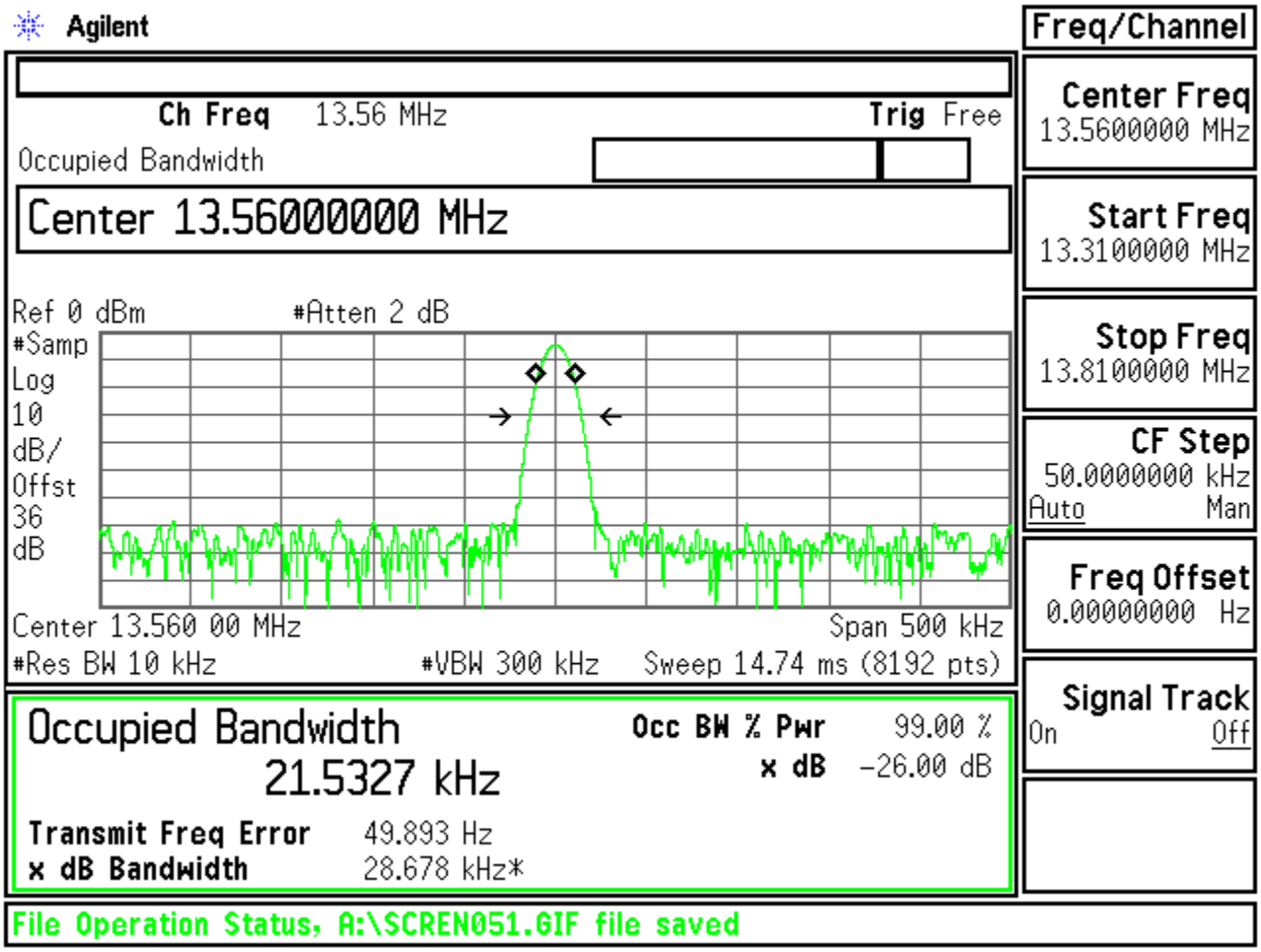
Occupied bandwidth measurement was performed by coupling the output of the EUT to the input of a spectrum analyzer using a near field probe. Table 4 provides a summary of the Occupied Bandwidth Results.

Table 7: Occupied Bandwidth Results

Frequency	Bandwidth	Limit	Pass/Fail
13.56 MHz	21.53 kHz	None	NA

The occupied bandwidth was measured as shown:

Figure 2: Occupied Bandwidth



Radiated Spurious Emissions: FCC §15.225, §15.209 & ISED RSS 210 §A2.6, RSS GEN §7.2.5

Radiated emissions from the EUT must comply with the field strength limits as specified in FCC Part 15.225 and 15.209 and IC RSS 210 and RSS GEN. The limits for the radiated emissions are as shown in the following table.

Table 8: Radiated Spurious Emissions Limits

Frequency (MHz)	Limit (μV/m)	Rule Part Reference
13.553 - 13.567	15,848 (@ 30m)	§15.225(a), §RSS 210 A2.6(a)
13.410 – 13.553	334 (@ 30m)	§15.225(b), §RSS 210 A2.6(b)
13.567 – 13.710	334 (@ 30m)	§15.225(b), §RSS 210 A2.6(b)
13.110 – 13.410	106 (@ 30m)	§15.225(c), §RSS 210 A2.6(c)
13.710 – 14.010	106 (@ 30m)	§15.225(c), §RSS 210 A2.6(c)
1.705 – 13.110 14.010 – 30.0	30 (@ 30m)	§15.225(d), §RSS 210 A2.6(c) §15.209, RSS GEN 7.2.5
30.00 – 88.00	100 (@ 3m)	§15.225(d), §RSS 210 A2.6(d) §15.209, RSS GEN 7.2.5
88.00 – 216.00	150 (@ 3m)	§15.225(d), §RSS 210 A2.6(d) §15.209, RSS GEN 7.2.5
216.00 – 960.00	200 (@ 3m)	§15.225(d), §RSS 210 A2.6(d) §15.209, RSS GEN 7.2.5
Above 960	500 (@ 3m)	§15.225(d), §RSS 210 A2.6(d) §15.209, RSS GEN 7.2.5

4.1.1 Test Procedure

The EUT was placed on motorized turntable for radiated testing on an Open Area Test Site. The emissions from the EUT were measured continuously at every azimuth by rotating the turntable. For frequencies below 30MHz, the loop antenna was mounted on a tripod at a height of 1 meter and a distance of 10m from the EUT. Above 30MHz, Biconical and log periodic broadband receiving 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 at a distance of 3 meters from the EUT. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured.

Below 150 kHz, bandwidths used were 300Hz RBW and 10 kHz VBW. Between 150 kHz and 30MHz, bandwidths used were 10kHz RBW and 30kHz VBW. The reading was taken at 10m. A correction factor was used to adjust the 10-meter results to the equivalent at 30 meters using the 40dB/decade roll-off. Three orientations of the loop antenna were tested. Above 30MHz, bandwidths used were 100 kHz RBW and 30kHz VBW.

Emissions were scanned from 9 kHz to 1GHz. Emissions from were measured using a peak detector. Worst case emissions are reported in the data table.

The following is a sample calculation used in the data tables for calculating the final field strength of spurious emissions and comparing these levels to the specified limits.

Sample Calculation:

Spectrum Analyzer Voltage (SA Level):	VdBµV
Antenna Factor (Ant Corr):	AFdB/m
Cable Loss Correction (Cable Corr):	CCdB
Amplifier Gain:	GdB (if applicable)
Electric Field (Corr Level):	EdBµV/m = VdBµV + AFdB/m + CCdB - GdB
To convert to linear units:	EµV/m = antilog (EdBµV/m/20)

4.1.2 Test Results

The EUT complies with the radiated emission requirements of §15.225 and RSS-210. The following tables provide the test data.

Table 9: Radiated Emissions below 30MHz

Frequency (MHz)	Polarity (H/V)	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Det	Note
13.56	X	180.0	1.5	55.5	-15.3	40.2	104.0	-63.8	Peak	Loop || to table
27.12	X	180.0	1.5	5.3	-16.5	-11.2	49.4	-60.6	Peak	
13.56	Y	180.0	1.5	48.0	-15.3	32.7	104.0	-71.3	Peak	
27.12	Y	180.0	1.5	9.7	-16.5	-6.8	49.4	-56.2	Peak	
13.56	Z	180.0	1.5	34.0	-15.3	18.7	104.0	-85.3	Peak	
27.12	Z	180.0	1.5	6.0	-16.5	-10.5	49.4	-59.9	Peak	

Table 10: Radiated Emissions above 30MHz

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)	Comments
40.60	V	0.0	0.0	24.9	-12.5	4.2	100.0	-27.5	noise floor
54.24	V	0.0	0.0	27.6	-18.9	2.7	100.0	-31.3	noise floor
67.80	V	0.0	0.0	27.2	-18.0	2.9	100.0	-30.8	noise floor
81.36	V	0.0	0.0	25.7	-18.2	2.4	100.0	-32.4	noise floor
94.92	V	0.0	0.0	26.7	-16.7	3.2	150.0	-33.5	noise floor
152.22	V	180.0	3.0	32.8	-13.1	9.7	100.0	-20.3	noise floor
40.68	H	0.0	0.0	24.9	-12.5	4.2	100.0	-27.6	noise floor
54.24	H	0.0	0.0	27.6	-18.9	2.7	100.0	-31.3	noise floor
67.80	H	0.0	0.0	27.2	-18.0	2.9	100.0	-30.8	noise floor
81.36	H	0.0	0.0	25.7	-18.2	2.4	100.0	-32.4	noise floor
94.92	H	0.0	0.0	26.7	-16.7	3.2	150.0	-33.5	noise floor
108.48	H	0.0	0.0	26.0	-12.7	4.6	150.0	-30.3	noise floor
40.68	H	0.0	0.0	24.9	-12.5	4.2	100.0	-27.6	noise floor

Table 11: Radiated Emissions Receive Only

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)	Comments
40.60	V	0.0	0.0	24.9	-12.5	4.2	100.0	-27.5	noise floor
54.24	V	0.0	0.0	27.6	-18.9	2.7	100.0	-31.3	noise floor
67.80	V	0.0	0.0	27.2	-18.0	2.9	100.0	-30.8	noise floor
81.36	V	0.0	0.0	25.7	-18.2	2.4	100.0	-32.4	noise floor
94.92	V	0.0	0.0	26.7	-16.7	3.2	150.0	-33.5	noise floor
152.22	V	180.0	3.0	32.8	-13.1	9.7	100.0	-20.3	noise floor
40.68	H	0.0	0.0	24.9	-12.5	4.2	100.0	-27.6	noise floor
54.24	H	0.0	0.0	27.6	-18.9	2.7	100.0	-31.3	noise floor
67.80	H	0.0	0.0	27.2	-18.0	2.9	100.0	-30.8	noise floor
81.36	H	0.0	0.0	25.7	-18.2	2.4	100.0	-32.4	noise floor
94.92	H	0.0	0.0	26.7	-16.7	3.2	150.0	-33.5	noise floor
108.48	H	0.0	0.0	26.0	-12.7	4.6	150.0	-30.3	noise floor
40.68	H	0.0	0.0	24.9	-12.5	4.2	100.0	-27.6	noise floor

4.3 Conducted Emissions (AC Power Line) FCC §15.225, §15.207 & ISED RSS GEN §7.2.4

The EUT was 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 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 or peak, as appropriate, and the resolution bandwidth during testing was at least 9 kHz, with all post-detector filtering no less than 10 times the resolution bandwidth.

All emissions were measured with the EUT intact apart from the fundamental transmit frequency of 13.56MHz. To measure 13.56MHz, the internal antenna was replaced with a resistive load.

Tested with a CUIinc model SDI65-24-U 100 – 240V~ 50-60Hz to 24VDC wall adaptor.

AC Power Line conducted emissions test data are included in the following table.

Table 12: AC Power Conducted Emissions 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	36.0	34.0	10.2	0.2	46.3	44.3	66.0	56.0	-19.7	-11.7
0.460	30.0	6.0	10.2	0.3	40.5	16.5	56.7	46.7	-16.2	-30.2
8.700	14.0	6.0	11.1	0.1	25.2	17.2	60.0	50.0	-34.8	-32.8
13.600	13.7	5.7	11.3	0.5	25.5	17.5	60.0	50.0	-34.5	-32.5
17.400	16.0	14.0	11.4	0.8	28.2	26.2	60.0	50.0	-31.8	-23.8
22.000	12.0	6.2	11.6	1.1	24.6	18.8	60.0	50.0	-35.4	-31.2
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	17.0	8.0	10.2	0.2	27.4	18.4	66.0	56.0	-38.6	-37.6
0.460	30.0	29.0	10.2	0.2	40.4	39.4	56.7	46.7	-16.3	-7.3
8.700	14.0	7.0	11.1	0.1	25.2	18.2	60.0	50.0	-34.8	-31.8
13.600	13.7	6.0	11.3	0.4	25.4	17.7	60.0	50.0	-34.6	-32.3
18.300	21.0	19.0	11.5	0.6	33.0	31.0	60.0	50.0	-27.0	-19.0
21.200	23.0	20.0	11.6	0.7	35.3	32.3	60.0	50.0	-24.7	-17.7

4.4 Frequency Stability: FCC §15.225, §2.1055, & ISED RSS GEN §4.7, RSS 210 §A2.6

Frequency as a function of temperature and voltage variation shall be maintained within the FCC-prescribed tolerances. Per §15.225(e) and RSS 210 A2.6, the frequency tolerance shall be maintained within ±0.01% of the reference frequency.

4.4.1 Test Procedure

The temperature stability was measured with the unit in an environmental chamber used to vary the temperature of the sample. The sample was held at each temperature step to allow the temperature of the sample to stabilize.

The frequency stability of the transmitter was examined at the voltage extremes and for the temperature range of -20°C to +50°C. The carrier frequency was measured while the EUT was in the temperature chamber. The reference frequency of the EUT was measured at the ambient room temperature with the frequency counter.

The frequency stabilities can be maintained to a lesser temperature range provided that the transmitter is automatically inhibited from operating outside the lesser temperature range.

The RF carrier frequency shall not depart from the reference frequency (reference frequency is the frequency at 20ºC and rated supply voltage) in excess of +/-1356 Hz.

The EUT was powered by 24Vdc voltage.

Per ANSI 63.10 the EUT was tested at each temperature at the turn on point, 2-minute point, 5-minute point, and 10-minute point.

4.4.2 Test Results

The EUT complies with the temperature stability requirements of the specified standards. Test results are given in the following tables.

Table 13. Frequency Stability vs Voltage

Temperature (Centigrade)	Frequency (MHz)	Deviation (Hz)	Limit (+/- Hz)	Pass/Fail
22(ambient)	13.560000	0	136	**NA**
-30	13.560000	0	136	Pass
-20	13.560000	0	136	Pass
-10	13.560000	0	136	Pass
0	13.560000	0	136	Pass

10	13.560000	0	136	Pass
20	13.560000	0	136	Pass
30	13.560000	0	136	Pass
40	13.560000	0	136	Pass

Table 14. Frequency Stability vs Voltage

Voltage	**Frequency (MHz)**	**Deviation (Hz)**	**Limit (+/-Hz)**	**Pass/Fail**
Nominal Voltage	13.560000	0	136	**NA**
110% of Nominal Voltage (132VAC)	13.560000	0	136	Pass
85% of Nominal Voltage (102VAC)	13.560000	0	136	Pass