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FCC / Industry Canada Certification Test Report

CRANE PAYMENT INNOVATIONS, INC

eCHOICE 5 IN 1 CREDIT CARD BEZEL

WLL REPORT# **14382-01 Rev 1**
February 3, 2016
Revised February 19, 2016

FCC ID: QP8-ECHOICE

IC ID: 1297A-ECHOICE

Prepared for:

CRANE PAYMENT INNOVATIONS, INC
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Malvern, PA, 19355

Prepared By:

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7560 Lindbergh Drive
Gaithersburg, Maryland 20879

ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY

Testing Certificate AT-1448

FCC / Industry Canada Certification Test Report

For the

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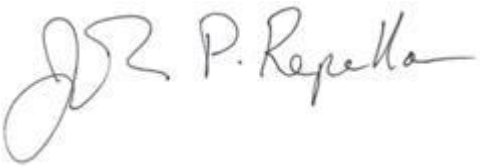
Prepared by:

James Ritter
Compliance Engineer

Reviewed by:



John P. Repella
EMC & Wireless Lab Manager

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 Industry Canada RSS210. This Certification Test Report documents the test configuration and test results for a eChoice 5 in 1 Credit Card Bezel.

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.

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

The eChoice 5 in 1 Credit Card Bezel complies with the limits for an Intentional Radiator device under FCC Part 15.225 and Industry Canada RSS 210.

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Revision History	Reason	Date
Rev 0	Initial Release	February 3, 2016
Rev 1	Revised Model name to eChoice	February 19, 2016

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1.1 Compliance Statement

The eChoice 5 in 1 Credit Card Bezel complies with the limits for an Intentional Radiator device under FCC Part 15.225 (10/2010) and Industry Canada RSS 210 (Issue 8).

1.2 Test Scope Summary

Tests for radiated and conducted emissions were performed. All measurements were performed in accordance with the 2013 version of ANSI C63.10. 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, RSS Gen section 7.2.4	Class B Conducted Emissions – AC Power Ports	2/3/2016	Complied	No
CFR47 Part 15.209, RSS Gen section 7.2.5	Class B Radiated Emissions	1/27/2016	Complied	No
RSS Gen section 6	Receiver Spurious Emissions	2/3/2016	Complied	No
CFR47 Part 15.225, RSS 210 section A2.6	Field Strength	1/27/2016	Complied	No
CFR47 Part 15.225, RSS GEN section 4.7	Frequency Stability	1/28/2016	Complied	No
CFR47 Part 2.1049	Occupied Bandwidth	1/26/2016	Complied	No

1.3 Contract Information

Customer: Crane Payment Innovations, Inc
1301 Wilson Drive
West Chester, PA 19380

Purchase Order Number: 4500369071

Quotation Number: 69244A

1.4 Test Dates

Testing was performed on the following date(s): 1/27/2016- 2/3/2016

1.5 Test and Support Personnel

Washington Laboratories, LTD James Ritter

Customer Representative Robert Carney, Daniel Mitchell

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 & Description

The CPI eChoice 5 in 1 Credit Card Bezel used in the vending industry to author magnetic stripe, contact (EMV) & contactless (RFID) credit cards in support of unattended sales. Mechanically it can mount to the front of the CPI Series 2000 bill acceptor or be operate standalone. The RFID emission is based on ISO 14443 standard with a carrier center frequency of 13.56 MHz..

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Table 1: Device Summary

ITEM	DESCRIPTION
Manufacturer:	CRANE PAYMENT INNOVATIONS, INC
FCC ID:	QP8-ECHOICE
IC ID:	1297A-ECHOICE
Model:	eChoice
FCC Rule Parts:	§15.225
IC Rule Part	§RSS 210 A2.6 & RSS Gen
Frequency Range:	13.56MHz
Maximum Output Power:	131.2 uV/m at 30 meters
Modulation:	ASK
Occupied Bandwidth:	1.558 kHz
Type of Information:	Data
Number of Channels:	1
Power Output Level	Fixed
Antenna Type	Internal PCB
Frequency Tolerance:	>±0.01% (±100 ppm)
Interface Cables:	Power, I/O
Highest TX Spurious Emission	27.12MHz: 9.8 uV/m @ 30m
Highest RX Spurious Emission	291.27MHz: 30.7 uV/m @ 3m
Power Source & Voltage:	5Vdc from Host device

2.2 Test Configuration

The eChoice 5 in 1 Credit Card Bezel was configured for testing as indicated in the figure below. Power from a support AC115 to 5VDC power adaptor (EUT normally receives 5VDC from host unit) was provided to EUT. In addition a RS232 (DB9) line was connected between the EUT and a support laptop. No other connections were necessary.

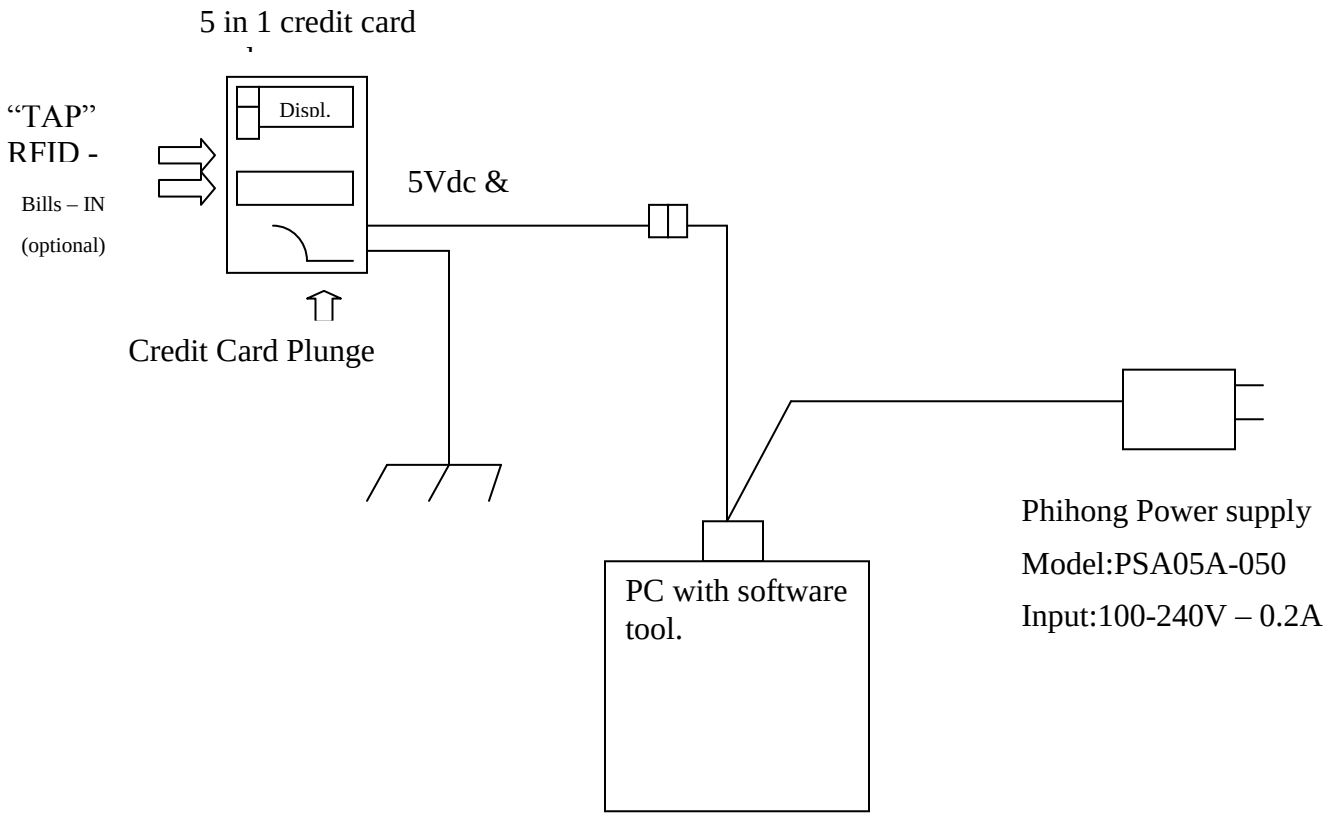

Figure 1: Test Configuration

2.3 Testing Algorithm

The Reader operates at a fixed frequency of 13.56MHz. A support laptop sent commands via RS232 to continuously transmit characters using "CRANE PAYMENT INNOVATIONS, MEIDBX1X" test utility program.

2.4 Measurements

2.4.1 References

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

ANSI C63.10:2013 American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

2.5 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 ACLASS under Certificate AT-1448 as an independent FCC test laboratory.

2.6 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 ≤ 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 Equipment

Table 3 shows a list of the test equipment used for measurements along with the calibration information.

Table 3: Test Equipment

Test Name: **Conducted Emissions Voltage**		Test Date: **2/3/2016**	
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
125	SOLAR - 8028-50-TS-24-BNC	LISN	10/10/2016
126	SOLAR - 8028-50-TS-24-BNC	LISN	10/10/2016
528	AGILENT - E4446A	3HZ - 44GHZ ANALYZER SPECTRUM	7/15/2016
78	HP - 11947A	LIMITER TRANSIENT	2/28/2016

Test Name: **Radiated Emissions**		Test Date: **01/27/2016**	
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
528	AGILENT - E4446A	3HZ - 44GHZ ANALYZER SPECTRUM	7/15/2016
65	HP - 8447D	PRE-AMPLIFIER RF 50KHZ-1GHZ	6/6/2016
382	SUNOL SCIENCES CORPORATION - JB1	ANTENNA BICONLOG	8/31/2017
856	EMCO - 6507	ACTIVE LOOP 1KHZ - 30MHZ	11/12/2017

Test Name: **Temperature Stability**		Test Date: **1/29/2016**	
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
00117	RACAL DANA - 1992 -	COUNTER - FREQUENCY	2/7/2016
776	TENNY - TJR-A-WS4	1.22 CUFT	5/22/2016
00093	KIKISUI - PCR2000L	SUPPLY POWER AC/DC	02/28/2016

4 Test Results

4.1 Occupied Bandwidth

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.

The occupied bandwidth was measured as shown:

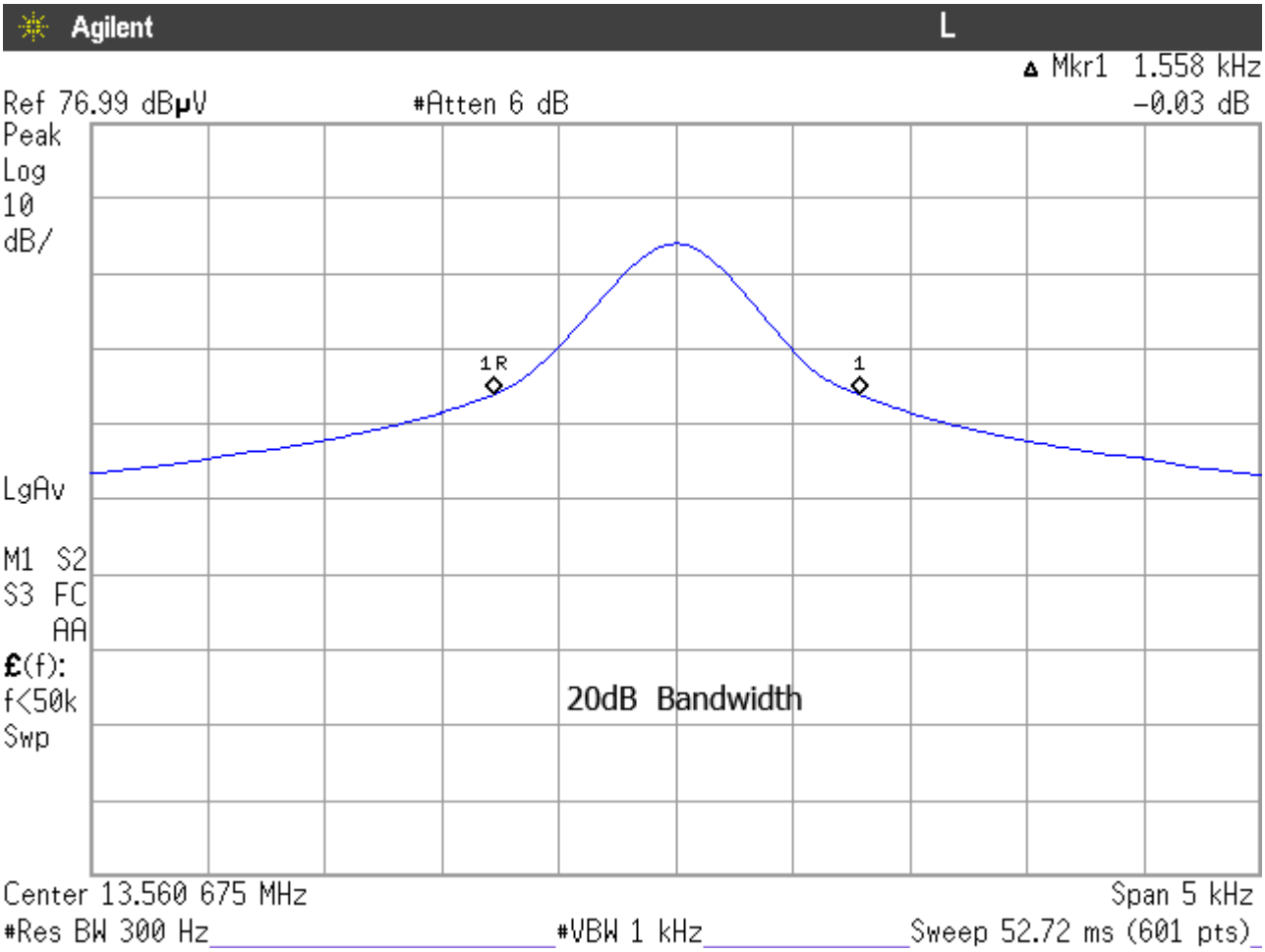

Figure 2: Occupied Bandwidth

Table 4: Occupied Bandwidth Results

Frequency	Bandwidth	Limit	Pass/Fail
13.560MHz	1.558 kHz	N/A	Pass

4.2 Radiated Spurious Emissions: FCC §15.225, §15.209, 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 5: 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

4.2.1 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 Quasi-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)

4.2.2 Test Results

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

Table 6: Radiated Emissions below 30MHz

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	10 mtr. Corr. Level (uV/m)	Distance Correction (dB)	30m Level With Distance Correction (uV/m)	Limit (uV/m)	Margin (dB)
13.560	X	180.00	1.00	38.51	16.8	581.5	19.1	64.6	15848.0	-47.8
13.560	Y	90.00	1.00	43.88	16.8	1079.0	19.1	119.7	15848.0	-42.4
13.560	Z	0.00	1.00	44.68	16.8	1183.1	19.1	131.2	15848.0	-41.6
13.553	X	190.00	1.00	20.22	16.8	70.8	19.1	7.9	334.0	-32.6
13.553	Y	90.00	1.00	24.05	16.8	110.0	19.1	12.2	334.0	-28.7
13.553	Z	0.00	1.00	17.80	16.8	53.6	19.1	5.9	334.0	-35.0
13.567	X	180.00	1.00	26.58	16.8	147.2	19.1	16.3	334.0	-26.2
13.567	Y	10.00	1.00	31.09	16.8	247.5	19.1	27.4	334.0	-21.7
13.567	Z	0.00	1.00	26.85	16.8	151.9	19.1	16.8	334.0	-25.9
13.348	X	180.00	1.00	18.48	16.8	58.0	19.1	6.4	106.0	-24.3
13.348	Y	270.00	1.00	27.98	16.8	173.2	19.1	19.2	106.0	-14.8
13.348	Z	90.00	1.00	22.55	16.8	92.7	19.1	10.3	106.0	-20.3
13.773	X	180.00	1.00	17.72	16.8	53.0	19.1	5.9	106.0	-25.1
13.773	Y	10.00	1.00	19.20	16.8	62.9	19.1	7.0	106.0	-23.6
13.773	Z	0.00	1.00	14.63	16.8	37.1	19.1	4.1	106.0	-28.2
27.120	X	90.00	1.00	12.80	16.1	27.9	19.1	3.1	30.0	-19.7
27.120	Y	180.00	1.00	14.32	16.1	33.3	19.1	3.7	30.0	-18.2
27.120	Z	45.00	1.00	22.83	16.1	88.7	19.1	9.8	30.0	-9.7

Table 7: 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)
34.258	V	90.00	1.00	34.19	-6.5	24.2	100.0	-12.3
49.767	V	270.00	1.20	44.92	-16.7	25.9	100.0	-11.7
59.800	V	90.00	1.00	45.10	-17.3	24.6	100.0	-12.2
74.700	V	90.00	1.20	40.77	-16.4	16.5	100.0	-15.6
110.820	V	270.00	1.40	39.80	-11.2	26.8	150.0	-15.0
115.780	V	90.00	1.30	43.54	-10.5	44.9	150.0	-10.5
169.580	V	180.00	2.20	35.90	-12.4	15.0	150.0	-20.0
184.750	V	45.00	2.00	43.39	-12.9	33.5	150.0	-13.0
217.530	V	180.00	2.30	39.10	-13.4	19.3	200.0	-20.3
248.730	V	90.00	2.30	34.60	-12.3	13.1	200.0	-23.7
54.250	H	10.00	3.80	39.21	-17.5	12.1	100.0	-18.3
61.330	H	180.00	4.00	41.23	-17.1	16.1	100.0	-15.9
67.787	H	0.00	3.80	40.55	-16.5	16.0	100.0	-15.9
87.230	H	180.00	3.80	42.57	-16.7	19.7	100.0	-14.1
108.467	H	180.00	4.00	40.19	-11.6	26.7	150.0	-15.0
108.570	H	180.00	3.80	39.20	-11.6	23.9	150.0	-16.0
145.120	H	190.00	3.20	33.90	-11.5	13.2	150.0	-21.1
173.300	H	180.00	3.00	36.90	-12.6	16.4	150.0	-19.2
217.530	H	190.00	3.00	35.60	-13.4	12.9	200.0	-23.8
324.200	H	190.00	2.40	32.79	-9.3	14.9	200.0	-22.6

Table 8: 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)
35.000	V	45.00	1.20	29.96	-7.2	13.8	100.0	-17.2
58.400	V	0.00	1.00	36.23	-17.4	8.7	100.0	-21.2
69.000	V	180.00	1.00	36.40	-16.4	10.0	100.0	-20.0
86.520	V	45.00	1.10	35.16	-16.8	8.3	100.0	-21.6
115.725	V	0.00	1.20	34.90	-10.5	16.6	150.0	-19.1
167.319	V	0.00	1.20	33.49	-12.3	11.5	150.0	-22.3
184.450	V	90.00	1.20	32.71	-12.9	9.8	150.0	-23.7
291.270	V	180.00	1.50	39.90	-10.2	30.7	200.0	-16.3
318.670	V	90.00	1.60	28.39	-9.5	8.8	200.0	-27.1
58.400	H	90.00	4.00	32.53	-17.4	5.7	100.0	-24.9
70.190	H	90.00	4.00	35.11	-16.3	8.7	100.0	-21.2
86.520	H	180.00	3.80	35.90	-16.8	9.0	100.0	-20.9
114.050	H	180.00	3.30	33.19	-10.7	13.3	150.0	-21.1
130.900	H	90.00	3.60	29.20	-10.4	8.7	150.0	-24.8
167.330	H	45.00	3.60	37.92	-12.3	19.1	150.0	-17.9
184.450	H	90.00	3.20	28.92	-12.9	6.3	150.0	-27.5
318.670	H	180.00	2.70	26.80	-9.5	7.3	200.0	-28.7

4.3 Conducted Emissions (AC Power Line) FCC §15.207, 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 with the exception of the fundamental transmit frequency of 13.56MHz. To measure 13.56MHz, the internal antenna was replaced with a resistive load.

Tested with a Philhong model PSA05A-050 00-240VAC to 5VDC wall adaptor.

AC Power Line conducted emissions test data are included in Table 9.

Table 9: AC Power Conducted Emissions Test Data

With Integral Antenna

NEUTRAL -With 13.56MHz Integral Antenna attached

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)
13.560	50.8	45.8	11.4	0.5	62.7	57.7	60.0	50.0	**2.7**	**7.7**
27.120	40.8	36.5	12.2	1.2	54.2	49.9	60.0	50.0	-5.8	-0.1
0.202	34.8	34.6	10.1	0.2	45.1	44.9	63.5	53.5	-18.5	-8.7
0.911	35.7	31.7	10.1	0.2	46.0	42.0	56.0	46.0	-10.0	-4.0
1.010	32.2	28.5	10.1	0.3	42.5	38.9	56.0	46.0	-13.5	-7.1
6.275	26.7	18.9	11.0	0.1	37.8	30.0	60.0	50.0	-22.2	-20.0
29.852	23.9	14.9	12.5	1.3	37.7	28.7	60.0	50.0	-22.3	-21.3

Phase -With 13.56MHz Integral Antenna attached

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)
13.560	49.6	45.0	11.4	0.4	61.3	56.8	60.0	50.0	**1.3**	**6.8**
27.120	39.2	34.1	12.2	1.3	52.7	47.6	60.0	50.0	-7.3	-2.4
0.205	31.3	28.1	10.1	0.0	41.5	38.3	63.4	53.4	-21.9	-15.1
0.911	34.1	31.4	10.1	0.2	44.4	41.7	56.0	46.0	-11.6	-4.3
4.961	28.9	22.5	10.7	0.2	39.8	33.4	56.0	46.0	-16.2	-12.6
11.545	26.8	15.8	11.2	0.3	38.3	27.3	60.0	50.0	-21.7	-22.7
28.450	21.9	14.6	12.3	1.4	35.6	28.3	60.0	50.0	-24.4	-21.7

With Antenna replaced with Load

NEUTRAL- With integral antenna replaced with non-inductive load Per ANSI 63.10

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)
13.560	23.3	11.5	11.4	0.5	35.2	23.4	60.0	50.0	-24.8	-26.6
27.120	29.3	21.8	12.2	1.2	42.7	35.2	60.0	50.0	-17.3	-14.8
0.202	34.3	31.2	10.1	0.2	44.6	41.5	63.5	53.5	-19.0	-12.0
0.809	29.2	27.5	10.1	0.1	39.4	37.7	56.0	46.0	-16.6	-8.3
1.009	36.4	30.2	10.1	0.3	46.7	40.6	56.0	46.0	-9.3	-5.4
6.259	30.4	21.9	11.0	0.1	41.5	33.0	60.0	50.0	-18.5	-17.0

29.810	30.0	14.9	12.5	1.3	43.8	28.7	60.0	50.0	-16.2	-21.3

Phase- With integral antenna replaced with non-inductive load

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)
13.560	24.4	13.7	11.4	0.4	36.1	25.5	60.0	50.0	-23.9	-24.5
27.120	33.2	28.1	12.2	1.3	46.7	41.6	60.0	50.0	-13.3	-8.4
0.205	31.3	28.1	10.1	0.0	41.5	38.3	63.4	53.4	-21.9	-15.1
0.909	22.8	18.4	10.1	0.2	33.1	28.7	56.0	46.0	-22.9	-17.3
5.360	38.6	34.1	10.8	0.1	49.6	45.0	60.0	50.0	-10.4	-5.0
11.420	27.5	17.9	11.2	0.3	39.0	29.4	60.0	50.0	-21.0	-20.6
28.826	30.8	17.4	12.4	1.4	44.6	31.3	60.0	50.0	-15.4	-18.7

4.4 Frequency Stability: FCC Part §2.1055, §15.225, 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 -30°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 5Vdc 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 Table 10.

.

Table 10: Frequency Stability Test Data

Start-up

Temperature (Centigrade)	Frequency (MHz)	Deviation (Hz)	Limit (+/- Hz)	Pass/Fail
26 (ambient)	13.560727	0	1356	NA
-30	13.560799	72	1356	Pass
-20	13.560785	58	1356	Pass
-10	13.560813	86	1356	Pass
0	13.560809	82	1356	Pass
10	13.560788	61	1356	Pass
20	13.560747	20	1356	Pass
30	13.560686	-41	1356	Pass
40	13.560666	-61	1356	Pass
50	13.560658	-69	1356	Pass

2 minutes after turn on

Temperature (Centigrade)	Frequency (MHz)	Deviation (Hz)	Limit (+/- Hz)	Pass/Fail
-30	13.560807	80	1356	Pass
-20	13.560811	84	1356	Pass
-10	13.560812	85	1356	Pass
0	13.560797	70	1356	Pass
10	13.560763	36	1356	Pass
20	13.560715	-12	1356	Pass
30	13.560670	-57	1356	Pass
40	13.560660	-67	1356	Pass
50	13.560655	-72	1356	Pass

5 minutes after turn on

Temperature (Centigrade)	Frequency (MHz)	Deviation (Hz)	Limit (+/- Hz)	Pass/Fail
-30	13.560810	83	1356	Pass
-20	13.560814	87	1356	Pass
-10	13.560808	81	1356	Pass
0	13.560782	55	1356	Pass
10	13.560744	17	1356	Pass
20	13.560699	-28	1356	Pass
30	13.560667	-60	1356	Pass
40	13.560656	-71	1356	Pass
50	13.560659	-68	1356	Pass

10 minutes after turn on

Temperature (Centigrade)	Frequency (MHz)	Deviation (Hz)	Limit (+/- Hz)	Pass/Fail
-30	13.560816	89	1356	Pass
-20	13.560814	87	1356	Pass
-10	13.560802	75	1356	Pass
0	13.560772	45	1356	Pass
10	13.560731	4	1356	Pass
20	13.560686	-41	1356	Pass
30	13.560665	-62	1356	Pass
40	13.560653	-74	1356	Pass
50	13.560666	-61	1356	Pass