ENGINEERING TEST REPORT

NFC Reader (NFCR)
Model: NFCR
FCC ID: XU6-NFCR

Applicant:

Christie Digital Systems Canada Inc.
809 Wellington Street North
Kitchener, Ontario
Canada N2G 4Y7

In Accordance With

Federal Communications Commission (FCC)
Part 15, Subpart C
Unlicensed Low Power Transmitter Operating in the Band 13.110-14.010 MHz

UltraTech's File No.: CDS-501F15C225

This Test report is Issued under the Authority of Tri M. Luu Vice President of Engineering UltraTech Group of Labs Date: December 12, 2014	
Report Prepared by: Dharmajit Solanki Issued Date: December 12, 2014	Tested by: Hung Trinh & Phuong Luu Test Dates: December 10 -11, 2014

- *The results in this Test Report apply only to the sample(s) tested, and the sample tested is randomly selected.*
- *This report must not be used by the client to claim product endorsement by NVLAP or any agency of the US Government.*

UltraTech

3000 Bristol Circle, Oakville, Ontario, Canada, L6H 6G4
Tel.: (905) 829-1570 Fax.: (905) 829-8050
Website: www.ultratech-labs.com, Email: vic@ultratech-labs.com, Email: tri@ultratech-labs.com

91038	1309	46390-2049	NVLAP LAB CODE 200093-0	SL2-IN-E-1119R	CA2049	TL363_B	TPTDP DA1300

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EXHIBIT 1. INTRODUCTION

1.1. SCOPE

Reference:	FCC Part 15, Subpart C, Section 15.225 - Operation within the band 13.110 - 14.010 MHz.
Title:	Code of Federal Regulations (CFR), Title 47 Telecommunication, Part 15, Subpart C - Intentional Radiators
Purpose of Test:	Equipment Certification for Devices in Section 15.225 - Operation within the Band 13.110 - 14.010 MHz.
Test Procedures:	American National Standards Institute 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
Environmental Classification:	Commercial, industrial or business environment

1.2. RELATED SUBMITTAL(S)/GRANT(S)

None

1.3. NORMATIVE REFERENCES

Publication	Year	Title
47 CFR Parts 0-19	2014	Code of Federal Regulations (CFR), Title 47 – Telecommunication
ANSI C63.4	2014	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
ANSI C63.10	2009	American National Standard for Testing Unlicensed Wireless Devices
CISPR 22 & EN 55022	2008-09, Edition 6.0 2006	Information Technology Equipment - Radio Disturbance Characteristics - Limits and Methods of Measurement
CISPR 16-1-1 +A1 +A2	2006 2006 2007	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-1: Measuring Apparatus
CISPR 16-1-2 +A1 +A2	2003 2004 2006	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-2: Conducted disturbances

EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1. CLIENT INFORMATION

APPLICANT	
Name:	Christie Digital Systems Canada Inc.
Address:	809 Wellington Street North Kitchener, Ontario Canada N2G 4Y7
Contact Person:	Dana Ograda-Bratu Phone #: 519-744-8005x7066 Fax #: 519-749-3164 Email Address: dana.ograda-bratu@christiedigital.com

MANUFACTURER	
Name:	Christie Digital Systems Canada Inc.
Address:	809 Wellington Street North Kitchener, Ontario Canada N2G 4Y7
Contact Person:	Dana Ograda-Bratu Phone #: 519-744-8005x7066 Fax #: 519-749-3164 Email Address: dana.ograda-bratu@christiedigital.com

2.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information (with the exception of the Date of Receipt) has been supplied by the applicant.

Brand Name:	Christie Digital Systems Canada Inc.
Product Name:	NFC Reader (NFCR)
Model Name or Number:	NFCR
Serial Number:	Test sample
Type of Equipment:	Low Power Communication Device Transmitter (Module)
Input Power Supply Type:	5 Vdc, Less than 100mA
Primary User Functions of EUT:	Information Technology Equipment

2.3. EUT'S TECHNICAL SPECIFICATIONS

Transmitter	
Equipment Type:	Low Power Communication Device Transmitter (Module)
Intended Operating Environment:	Commercial, light industry & heavy industry
Power Supply Requirement:	5 Vdc, Less than 100mA
Field Strength:	41.3 dBµV/m at 10 m
Operating Frequency Range:	13.56 MHz
RF Output Impedance:	27 Ω
20 dB Bandwidth:	801.6 Hz
Modulation Type:	ASK
Oscillator Frequencies:	27.12 MHz
Antenna Connector Type:	Integral

2.4. LIST OF EUT'S PORTS

Port Number	EUT's Port Description	Number of Identical Ports	Connector Type	Cable Type (Shielded/Non-shielded)
1	Connector P1	1	Power, Communications	Non-shielded

2.5. ANCILLARY EQUIPMENT

The EUT was tested while connected to the following representative configuration of ancillary equipment necessary to exercise the ports during tests:

Ancillary Equipment # 1	
Equipment Make and Name:	Dell Laptop
Model Name or Number:	PP18L
Part/Serial Number:	PF329A01
Cable Type:	Custom (see Ancillary Equipment # 3)
Connected to EUT's Port #: *(See above table 2)*	1 (via Ancillary Equipment # 3)

Ancillary Equipment # 2	
Equipment Make and Name:	Phihong – 5V Supply - 5W Interchangeable Plug Series
Model Name or Number:	PSAC05R
Serial Number:	N/A
Cable Type:	Custom (see Ancillary Equipment # 3)
Connected to EUT's Port #: *(See above table 2)*	1 (via Ancillary Equipment # 3)

Ancillary Equipment # 3	
Equipment Make and Name:	Custom Harness
Model Name or Number:	N/A
Serial Number:	N/A
Cable Type:	Power and RS-232 UART Communication
Connected to EUT's Port #: *(See above table 2)*	1

EXHIBIT 3. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

3.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

Temperature:	21 to 23 °C
Humidity:	45 to 58%
Pressure:	102 kPa
Power Input Source:	5 Vdc

3.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS

Operating Modes:	The EUT was configured for continuous transmission for the duration of testing.
Special Test Software:	Special firmware is used to turn on the field and perform data transfers at user's defined periods
Special Hardware Used:	N/A
Transmitter Test Antenna:	The EUT was tested with the antenna fitted in a manner typical of normal intended use as integral antenna equipment.

Transmitter Test Signals:	
Frequency:	13.56 MHz
Transmitter Wanted Output Test Signals:	
▪ RF Power Output (measured maximum output power):	41.3 dBµV/m at 10 m
▪ Normal Test Modulation:	ASK
▪ Modulating signal source:	Internal

EXHIBIT 4. SUMMARY OF TEST RESULTS

4.1. LOCATION OF TESTS

All of the measurements described in this report were performed at Ultratech Group of Labs located in the city of Oakville, Province of Ontario, Canada.

- AC Power Line Conducted Emissions were performed in UltraTech's shielded room, 24'(L) by 16'(W) by 8'(H).

- Radiated Emissions were performed at the Ultratech's 3-10 TDK Semi-Anechoic Chamber situated in the Town of Oakville, province of Ontario. This test site been calibrated in accordance with ANSI C63.4, and found to be in compliance with the requirements of Sec. 2.948 of the FCC Rules. The descriptions and site measurement data of the Oakville 3-10 TDK Semi-Anechoic Chamber has been filed with FCC office (FCC File No.: 91038) and Industry Canada office (Industry Canada File No.: 2049A-3). Expiry Date: 2017-04-02.

4.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC Regulations	Test Requirements	Compliance (Yes/No)
15.203 & 15.204	The transmitter shall use a transmitting antenna that is an integral part of the device	Yes
15.215(c)	Emission Bandwidth	Yes
15.225(a) – (d)	Field Strength of Emissions Inside and Outside the Permitted Band 13.110 - 14.010 MHz	Yes
15.225(e)	Frequency Stability	Yes
15.107 & 15.207	Class B - Power Line Conducted Emissions	Yes

4.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

N/A

EXHIBIT 5. TEST DATA

5.1. EMISSION BANDWIDTH [§15.215(c)]

5.1.1. Limits

The 20 dB bandwidth of the emission shall be contained within the band 13.110–14.010 MHz.

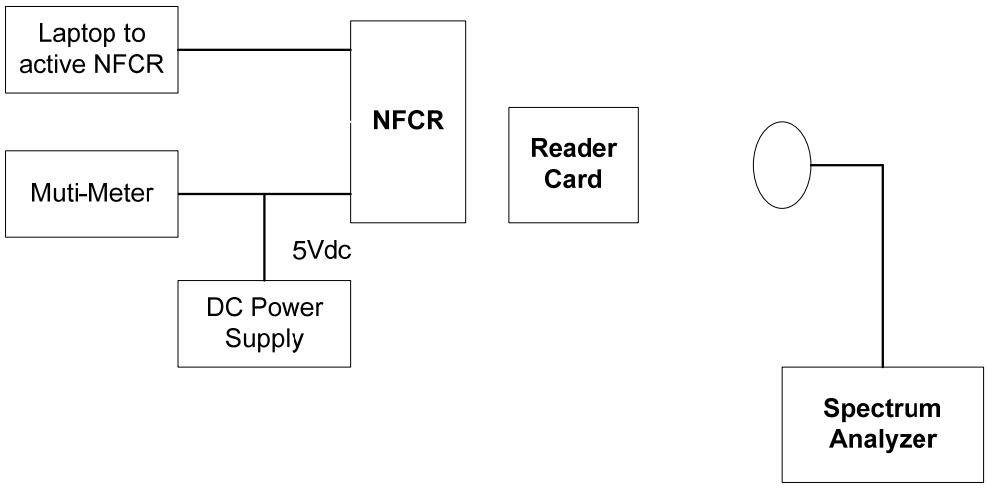
5.1.2. Method of Measurements

Refer to Ultratech Test Procedures, File # ULTR P001 and ANSI C63.4 for measurement methods

5.1.3. Test Instruments

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range	Calibration Due Date
Spectrum Analyzer	Rohde & Schwarz	FSEK30	100077	20 Hz – 40 GHz	Nov 21 2015
Loop Antenna	Emco	6502	9104-2611	10 kHz – 30 MHz	Aug 25 2015
Multi-meter	Extech	EX530	12070737	0.01mV - 1kV	Apr 15, 2015
DC Power Supply	Tenma	72-7295	490300297	1 – 40 Vdc	Cal on use

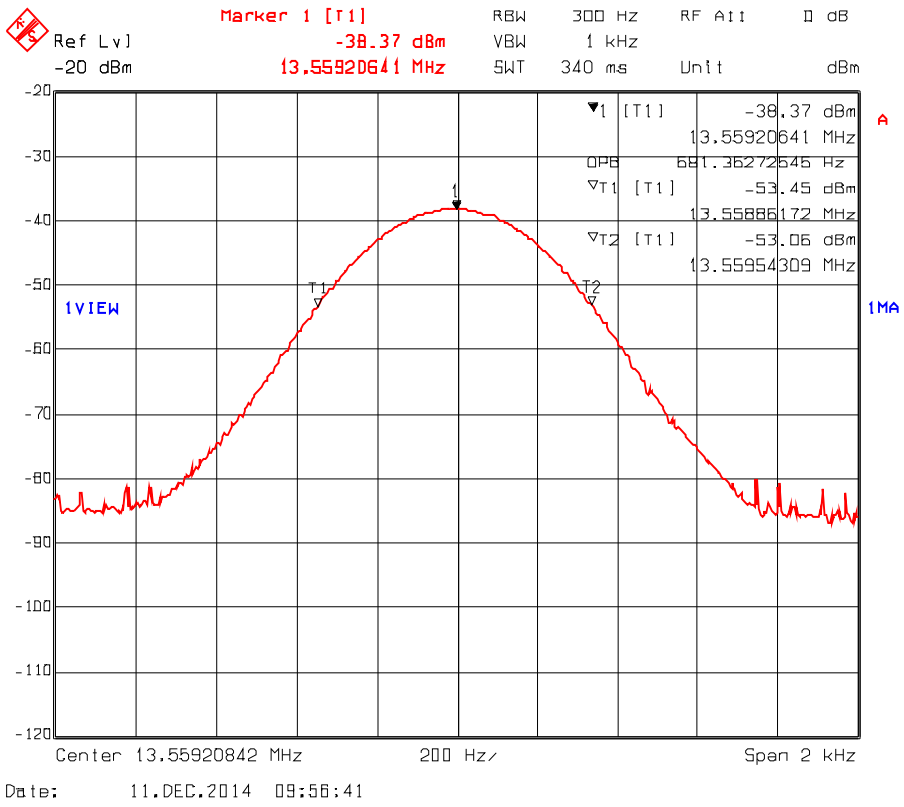
5.1.4. Test Set-up



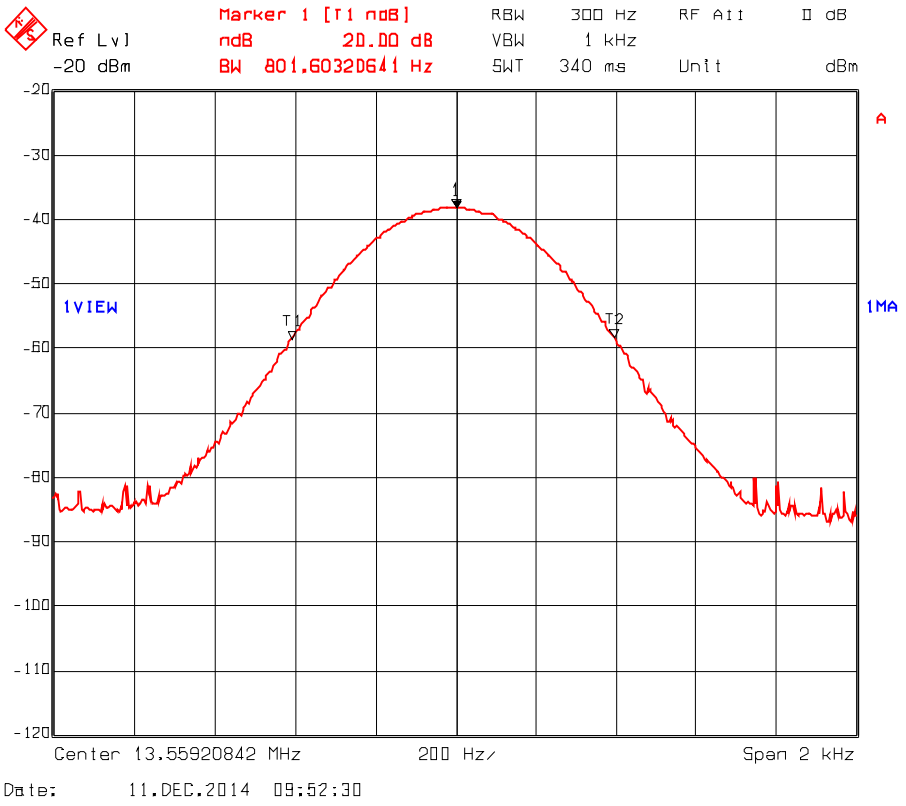
5.1.5. Test Data

Test Frequency (MHz)	Occupied Bandwidth (Hz)	
	20 dB BW	99 % BW
13.56	801.6	681.4

Plot 5.1.5.1. 99% Occupied Bandwidth, 13.56 MHz



Plot 5.1.5.2. 20 dB Emission Bandwidth, 13.56 MHz



5.2. FIELD STRENGTH OF EMISSIONS WITHIN & OUTSIDE THE PERMITTED BAND 13.110-14.010 MHz [47 CFR 15.225 (a) to (d)]

5.2.1. Limits

(a) The field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.
(d) The field strength of any emissions appearing outside of the 13.110 – 14.010 MHz band shall not exceed the general radiated emission limits in § 15.209.

47 CFR 15.209(a) – Radiated Emission Limts; general requirements

Frequency (MHz)	Field Strength Limits (microvolts/m)	Distance (Meters)
0.009 - 0.490	2,400 / F (KHz)	300
0.490 - 1.705	24,000 / 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

5.2.2. Method of Measurements

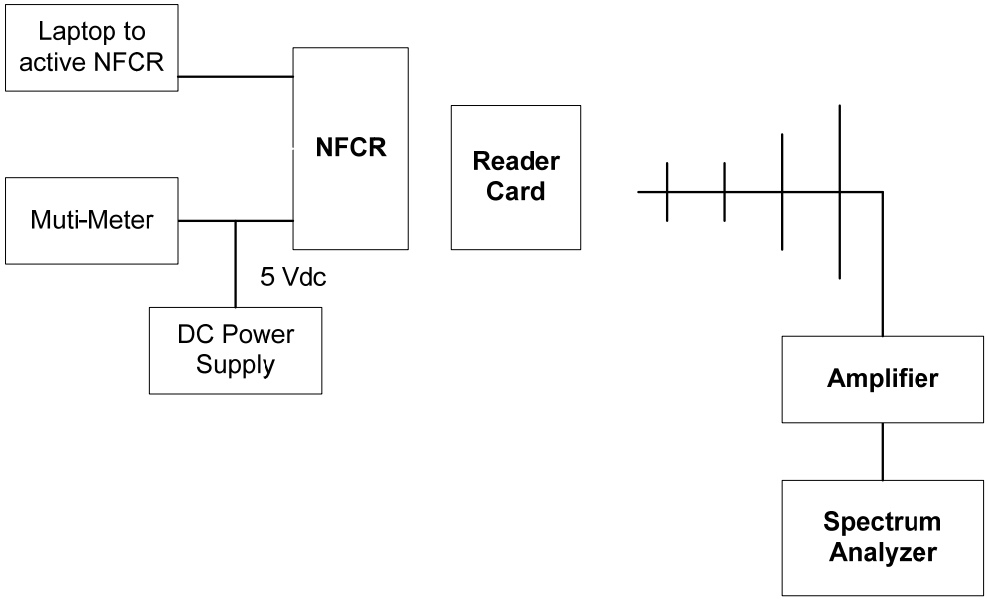
Refer to Ultratech Test Procedures, File # ULTR P001 and ANSI C63.4 for measurement methods

5.2.3. Test Instruments

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range	Calibration Due Date
Spectrum Analyzer	Rohde & Schwarz	ESU40	100037	20 Hz – 40 GHz	05 Apr 2015
RF Amplifier	AH System	PAM-0118	225	20 MHz – 18 GHz	07 Apr 2015
Loop Antenna	Emco	6502	9104-2611	10 kHz – 30 MHz	27 Aug 2015
Biconi-Log Antenna	ETS Lindgren	3142C	26873	26 – 3000 MHz	14 Apr 2015
Multi-meter	Extech	EX530	12070737	0.01mV - 1kV	Apr 15, 2015
DC Power Supply	Tenma	72-7295	490300297	1 – 40 Vdc	Cal on use

5.2.4. Test Set-up

Radiated Emission



5.2.5. Test Data

Remarks:

- Radiated spurious emissions measurements were performed at a measuring distance of 10 m (for frequencies below 30 MHz) and 3 m (for frequencies at or above 30 MHz), from 10 kHz – 10th harmonic of the fundamental or the range applicable to the digital device, whichever is the higher frequency range and all spurious emissions that are in excess of 20 dB below the specified limit shall be recorded.
- For frequencies below 30 MHz, the results measured at 10 m distance shall be extrapolated to the specified distance of 30m using an extrapolation factor of -20 dB/decade for determining compliance.

5.2.5.1. Field Strength of Emissions Within the Permitted Band at 10 m

Frequency (MHz)	Measured Field Strength @ 10 m (dBµV/m)	Detector Used (Peak/QP)	Antenna Plane (H/V)	Field Strength Extrapolated Value @30m (dBµV/m)	§ 15.225 Field Strength Limits @30m (dBµV/m)	Margin (dB)
13.56	41.2	Peak	V	31.2	84.0	-52.8
13.56	41.3	Peak	H	31.3	84.0	-52.7

5.2.5.2. Field Strength of Emissions Outside the Permitted Band Below 30 MHz at 10 m

Frequency (MHz)	Measured Field Strength @ 10 m (dBµV/m)	Detector Used (Peak/QP)	Antenna Plane (H/V)	Field Strength Extrapolated Value @30m (dBµV/m)	§ 15.209 Field Strength Limits @30m (dBµV/m)	Margin (dB)
27.12	21.11	Peak	V	1.11	28.6	-27.5
27.12	29.36	Peak	H	9.36	28.6	-19.2
All spurious emissions are more than 20 dB below the specified limit.						

5.2.5.3. Field Strength of Emissions Outside the Permitted Band at or Above 30 MHz at 3 m

Frequency (MHz)	Measured Field Strength @ 3 m (dBµV/m)	Detector Used (Peak/QP)	Antenna Plane (H/V)	§ 15.209 Field Strength Limits (dBµV/m)	Margin (dB)
40.7	26.2	QP	V	40.0	-13.8
40.7	15.5	QP	H	40.0	-24.5
54.2	36.3	QP	V	40.0	-3.7
54.2	18.4	QP	H	40.0	-21.6
67.8	28.1	QP	V	40.0	-11.9
67.8	10.1	QP	H	40.0	-29.9
81.4	34.8	QP	V	40.0	-5.2
81.4	17.9	QP	H	40.0	-22.1

Continued next page

Frequency (MHz)	Measured Field Strength @ 3 m (dBµV/m)	Detector Used (Peak/QP)	Antenna Plane (H/V)	§ 15.209 Field Strength Limits (dBµV/m)	Margin (dB)
94.9	24.7	QP	V	43.5	-18.8
94.9	12.1	QP	H	43.5	-31.4
108.5	24.9	QP	V	43.5	-18.6
108.5	15.7	QP	H	43.5	-27.8
122.0	20.6	QP	V	43.5	-22.9
122.0	12.3	QP	H	43.5	-31.2
135.6	15.9	QP	V	40.0	-24.1
135.6	15.9	QP	H	43.5	-27.6
176.3	30.7	PEAK	V	43.5	-12.8
176.3	18.6	PEAK	H	43.5	-24.9
216.7	33.0	PEAK	V	46.0	-13.0
216.7	21.6	PEAK	H	46.0	-24.4
257.7	28.6	PEAK	V	46.0	-17.4
257.7	23.6	PEAK	H	46.0	-22.4
284.6	34.8	PEAK	V	46.0	-11.2
284.6	29.6	PEAK	H	46.0	-16.4
311.9	32.8	PEAK	V	46.0	-13.2
311.9	31.8	PEAK	H	46.0	-14.2
339.1	30.7	PEAK	V	46.0	-15.3
339.1	31.1	PEAK	H	46.0	-14.9
366.3	33.9	PEAK	V	46.0	-12.1
366.3	31.6	PEAK	H	46.0	-14.4
393.3	32.4	PEAK	V	46.0	-13.6
393.3	27.3	PEAK	H	46.0	-18.8
432.4	33.3	PEAK	V	46.0	-12.8
432.4	29.0	PEAK	H	46.0	-17.1
631.4	33.1	PEAK	V	46.0	-12.9
631.4	31.1	PEAK	H	46.0	-14.9
699.4	36.5	PEAK	V	46.0	-9.5
699.4	34.5	PEAK	H	46.0	-11.5
764.7	36.1	PEAK	V	46.0	-9.9
764.7	34.6	PEAK	H	46.0	-11.4
1000.0	39.8	PEAK	V	46.0	-6.2
1000.0	42.1	QP	H	46.0	-3.9
1328.5	45.4	PEAK	H	54.0	-8.7

5.3. FREQUENCY STABILITY [47 CFR 15.225(e)]

5.3.1. Limits

The frequency tolerance of the carrier signal shall be maintained within +/- 0.01% of the operating frequency over a temperature variation of –20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

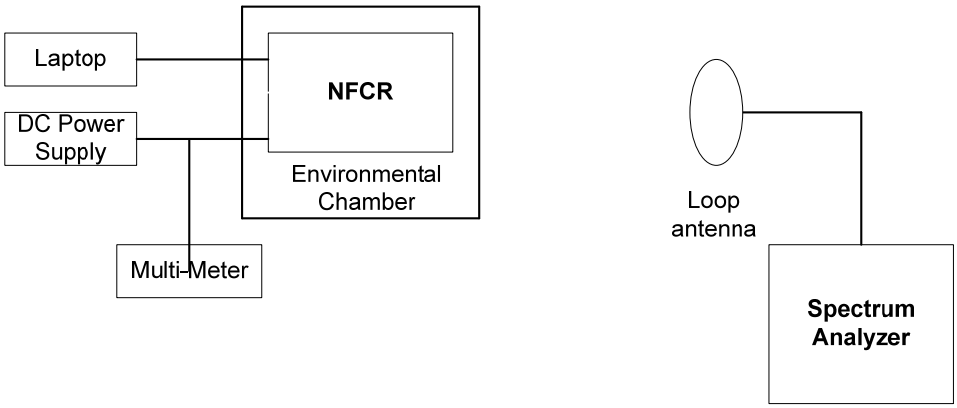
5.3.2. Method of Measurements

ANSI C63.4.

5.3.3. Test Instruments

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range	Calibration Due Date
Spectrum Analyzer	Rohde & Schwarz	FSEK30	100077	20 Hz – 40 GHz	Nov 21, 2015
Loop Antenna	Emco	6502	9104-2611	10 kHz – 30 MHz	Aug 27, 2015
Environmental Chamber	Envirotronics	SSH32C	11994847-S-11059	-60 to 177 degree C	01 May 2015
Multi-meter	Extech	EX530	12070737	0.01mV - 1kV	Apr 15, 2015
DC Power Supply	Tenma	72-7295	490300297	1 – 40 Vdc	Cal on use

5.3.4. Test Set-up



5.3.5. Test Data

Frequency Band:	13.56 MHz
Center Frequency:	13.56 MHz
Frequency Tolerance Limit:	± 0.01% (±1356 Hz)
Max. Frequency Tolerance Measured:	-44 Hz
Input Voltage Rating:	5 Vdc

Ambient Temperature (°C)	Frequency Drift (Hz)		
	Supply Voltage 5 Vdc	85% Supply Voltage 4.25 Vdc	115% Supply Voltage 5.75 Vdc
-20	-8	N/A	N/A
-10	24	N/A	N/A
0	32	N/A	N/A
10	16	N/A	N/A
20	0	0	0
30	-24	N/A	N/A
40	**-44**	N/A	N/A
50	-34	N/A	N/A

5.4. POWER LINE CONDUCTED EMISSIONS [47 CFR 15.107(a) & 15.207]

5.4.1. Limits

The equipment shall meet the limits of the following table:

Frequency of emission (MHz)	Class B Conducted Limits (dBμV)	
	Quasi-peak	Average
0.15–0.5 .....……..	66 to 56*	56 to 46*
0.5–5 .....……..	56	46
5-30 ……..	60 ..……..	50

* Decreases linearly with logarithm of the frequency

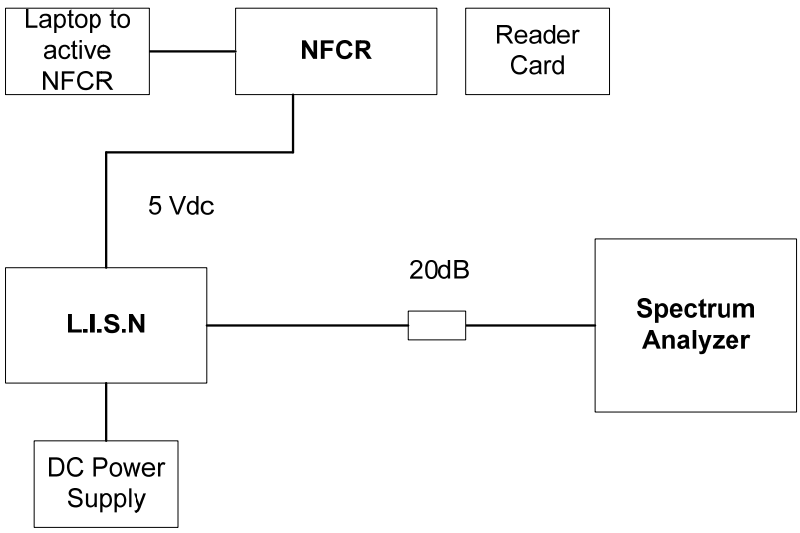
5.4.2. Method of Measurements

Refer to Ultratech Test Procedures, File # ULTR P001 and ANSI C63.4 for measurement methods

5.4.3. Test Instruments

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range	Calibration Due Date
Spectrum Analyzer	Agilent	E7401A	US40240432	9 kHz–1.5 GHz	14 Mar 2015
Attenuator	Pasternack	PE7010-20	-	DC–2 GHz	02 Jan 2015
L.I.S.N	Schwarzbeck	NSLK8127	8127276	0.01 -30 MHz	25 Mar 2015

5.4.4. Test Set-up

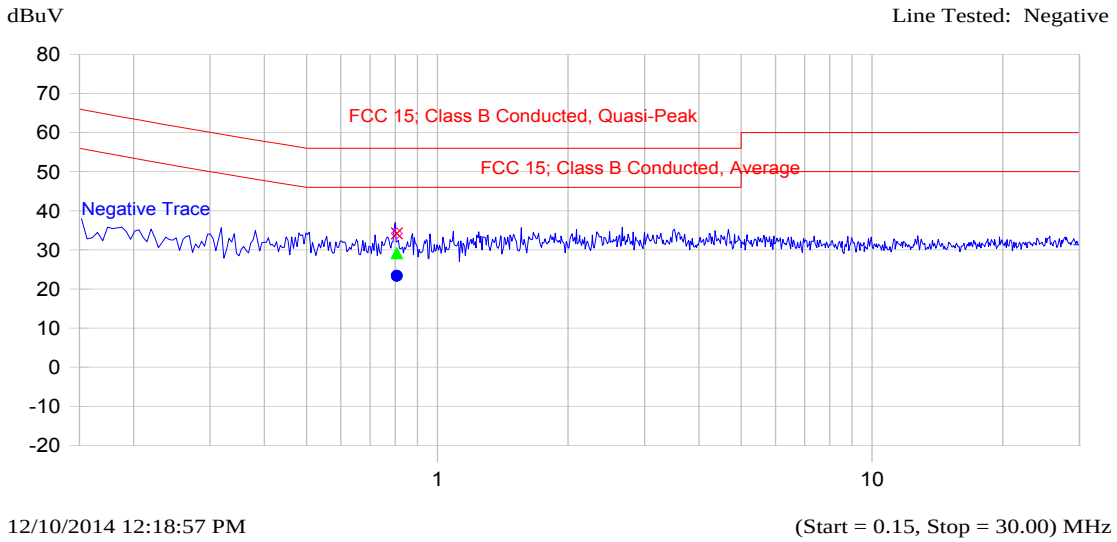


5.4.5. Test Data

Plot 5.4.5.1. Power Line Conducted Emissions
Voltage: 5 Vdc, Line Tested: Negative

Description: Line Voltage: 5 Vdc
Setup Name: FCC 15 Class B
Customer Name: Christie Digital Systems Canada
Project Number: CDS-501Q
Operator Name: Phuong Luu
EUT Name: NFC Reader (NFCR)
Date Created: 12/10/2014 12:10:15 PM

Current Graph



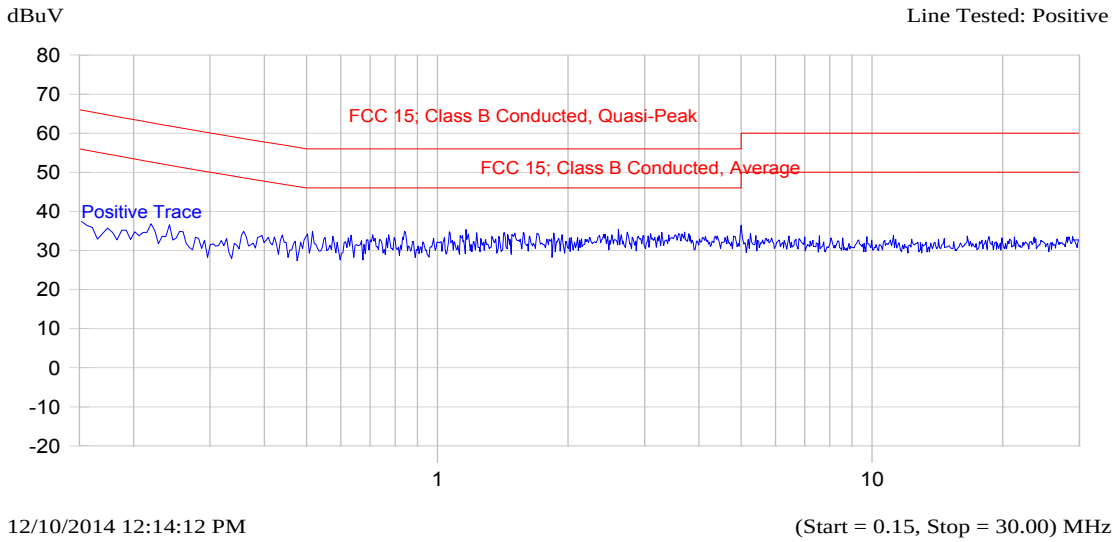
Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.807	34.2	29.1	-26.9	23.3	-22.7	Negative Trace

Plot 5.4.5.2. Power Line Conducted Emissions
Voltage: 5 Vdc, Line Tested: Positive

Description: Line Voltage: 5 Vdc
Setup Name: FCC 15 Class B
Customer Name: Christie Digital Systems Canada
Project Number: CDS-501Q
Operator Name: Phuong Luu
EUT Name: NFC Reader (NFCR)
Date Created: 12/10/2014 12:10:15 PM

Current Graph



Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name

EXHIBIT 6. MEASUREMENT UNCERTAINTY

The measurement uncertainties stated were calculated in accordance with the requirements of CISPR 16-4-2 @ IEC:2003 and JCGM 100:2008 (GUM 1995) – Guide to the Expression of Uncertainty in Measurement.

6.1. LINE CONDUCTED EMISSION MEASUREMENT UNCERTAINTY

	Line Conducted Emission Measurement Uncertainty (9 kHz – 30 MHz):	**Measured**	**Limit**
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{i=1}^{m} u_i^2(y)}$	**± 1.44**	**± 1.8**
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 2.89**	**± 3.6**

6.2. RADIATED EMISSION MEASUREMENT UNCERTAINTY

	Radiated Emission Measurement Uncertainty @ 3m, Horizontal (30-1000 MHz):	**Measured (dB)**	**Limit (dB)**
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{i=1}^{m} u_i^2(y)}$	**± 2.39**	**± 2.6**
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 4.79**	**± 5.2**

	Radiated Emission Measurement Uncertainty @ 3m, Vertical (30-1000 MHz):	**Measured (dB)**	**Limit (dB)**
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{i=1}^{m} u_i^2(y)}$	**± 2.39**	**± 2.6**
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 4.78**	**± 5.2**

	Radiated Emission Measurement Uncertainty @ 3 m, Horizontal & Vertical (1 – 18 GHz):	**Measured (dB)**	**Limit (dB)**
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{i=1}^{m} u_i^2(y)}$	**± 1.87**	**Under consideration**
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 3.75**	**Under consideration**