ENGINEERING TEST REPORT

NFCVAC
Model: NFCVAC01
FCC ID: WSSNFCVAC

Applicant:

Mitech Integrated Systems Inc.
219 Robert Hicks Drive
Toronto, Ontario
Canada M2R 3R3

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.: 21MTRD013_FCC15C225

This Test report is Issued under the Authority of Tri M. Luu Vice President of Engineering UltraTech Group of Labs Date: November 23, 2021	
Report Prepared by: Dan Huynh Issued Date: November 23, 2021	Tested by: Hung Trinh Test Date(s): October 21, 22 & 27, 2021 November 17.2021

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EXHIBIT 1. INTRODUCTION

1.1. SCOPE

Reference:	FCC Part 15, Subpart C, Sec. 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 FCC Part 15C.
Test Procedures:	ANSI C63.4 and ANSI C63.10
Environmental Classification:	Residential Commercial, industrial or business environment

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

None.

1.3. NORMATIVE REFERENCES

Publication	Year	Title
FCC 47 CFR 15	2021	Code of Federal Regulations (CFR), Title 47 – Telecommunication, Part 15 – Radio Frequency Devices
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	2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1. CLIENT INFORMATION

Applicant	
Name:	Mitech Integrated Systems Inc.
Address:	219 Robert Hicks Drive Toronto, Ontario Canada M2R 3R3
Contact Person:	Michael Stepanov Phone #: 416-605-4915 Fax #: N/A Email Address: mstepanov@mitechisys.com

Manufacturer	
Name:	Mitech Integrated Systems Inc.
Address:	219 Robert Hicks Drive Toronto, Ontario Canada M2R 3R3
Contact Person:	Michael Stepanov Phone #: 416-605-4915 Fax #: N/A Email Address: mstepanov@mitechisys.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:	Mitech Integrated Systems Inc.
Product Name:	NFCVAC
Model Name or Number:	NFCVAC01
Serial Number:	Test sample
Type of Equipment:	Part 15 Low Power Communication Device Transmitter
Input Power Supply Type:	5 VDC external power supply
Primary User Functions of EUT:	RFID card reader

2.3. EUT'S TECHNICAL SPECIFICATIONS

Transmitter	
Intended Operating Environment:	Residential Commercial, light industry & heavy industry
Power Supply Requirement:	5 VDC
Field Strength:	52.49 dBµV/m at 10 m
Operating Frequency Range:	13.56 MHz
RF Output Impedance:	50 Ω
20 dB Bandwidth:	1.474 kHz
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	DC and I/O ports	1	5pin connector	Direct connection

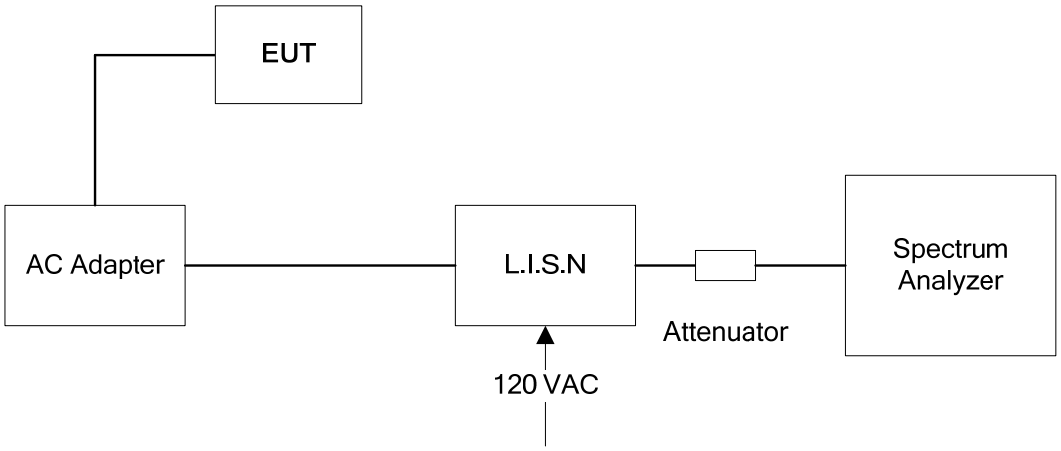
2.5. ANCILLARY EQUIPMENT

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

1) CUI Inc AC Adapter, Model: SWI 10-5-E, S/N: SWI 10-5-E-P5

2.6. GENERAL TEST SETUP

2.6.1. Conducted Emissions



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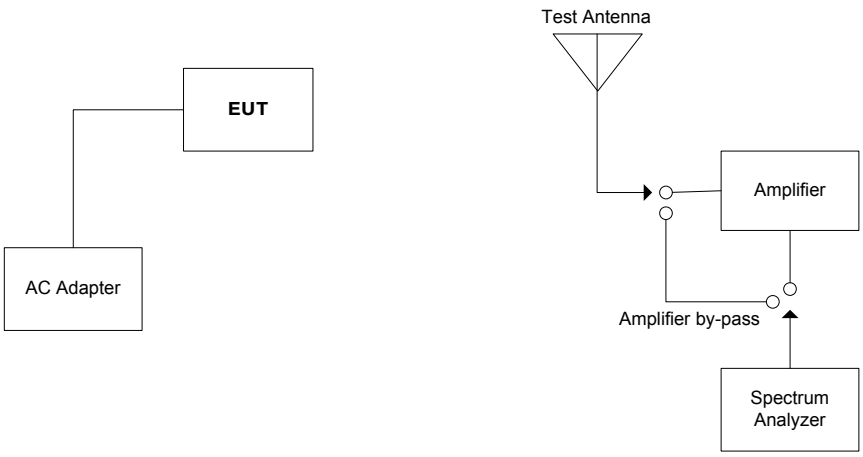
2.6.2. Emission Bandwidth / Radiated Emissions



2.6.3. Frequency Stability

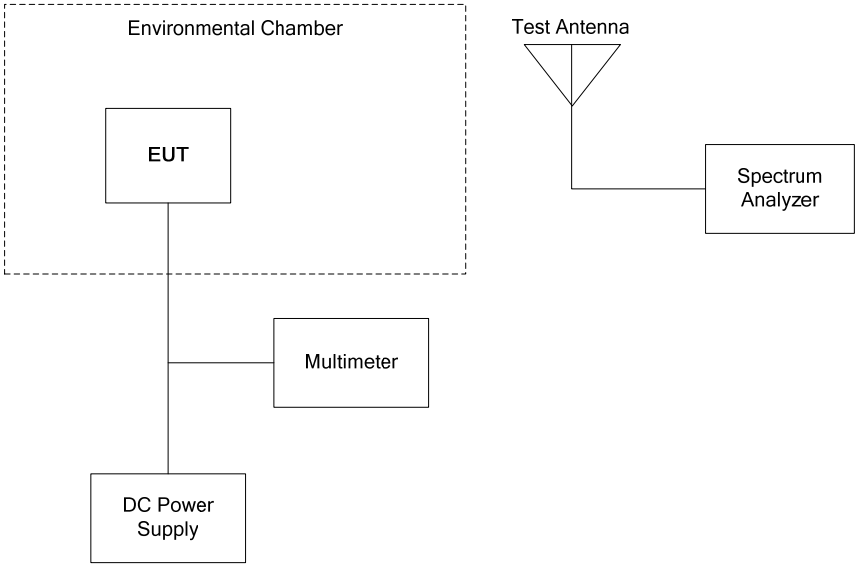


EXHIBIT 3. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

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 via AC Adapter

3.2. OPEPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS

Operating Modes:	The EUT was configured for continuous transmission for the duration of testing.
Special Test Software:	N/A
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 Band(s):	13.56 MHz
Test Frequency(ies):	13.56 MHz
Transmitter Wanted Output Test Signals:	
▪ RF Power Output (measured maximum output power):	52.49 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 ANAB File No.: AT-1945.

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*
15.207(a)	Class B - Power Line Conducted Emissions	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

* The EUT complies with the requirement; it employs integral antenna.

4.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None.

EXHIBIT 5. TEST DATA

5.1. POWER LINE CONDUCTED EMISSIONS [§15.207(a)]

5.1.1. Limit(s)

The equipment shall meet the limits of the following table:

Frequency of emission (MHz)	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 the logarithm of the frequency

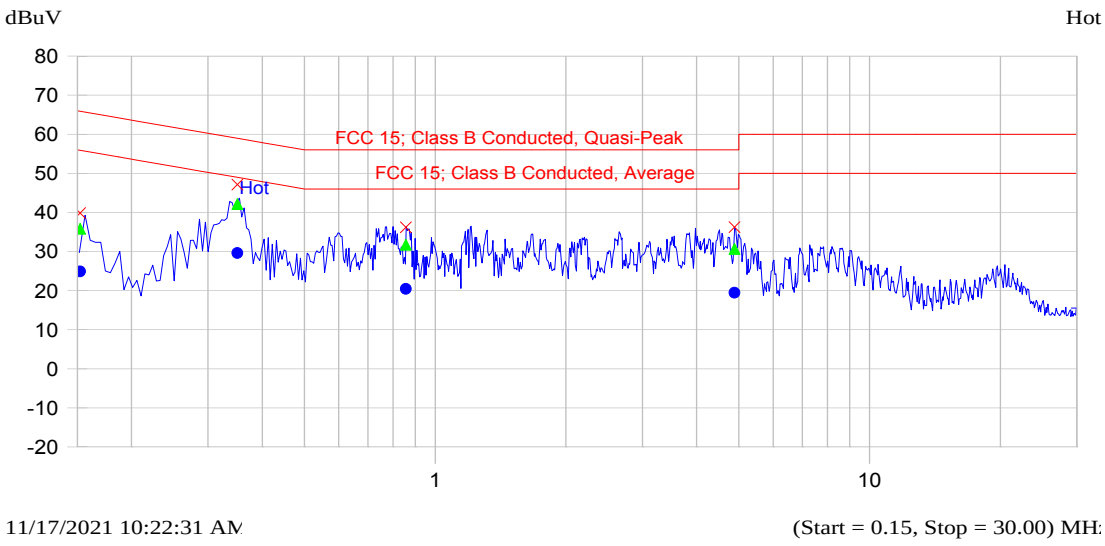
5.1.2. Method of Measurements

ANSI C63.4

5.1.3. Test Data

Plot 5.1.3.1. Power Line Conducted Emissions (EUT with the antenna connected)
Line Voltage120 VAC; Line Tested: Hot

Current Graph

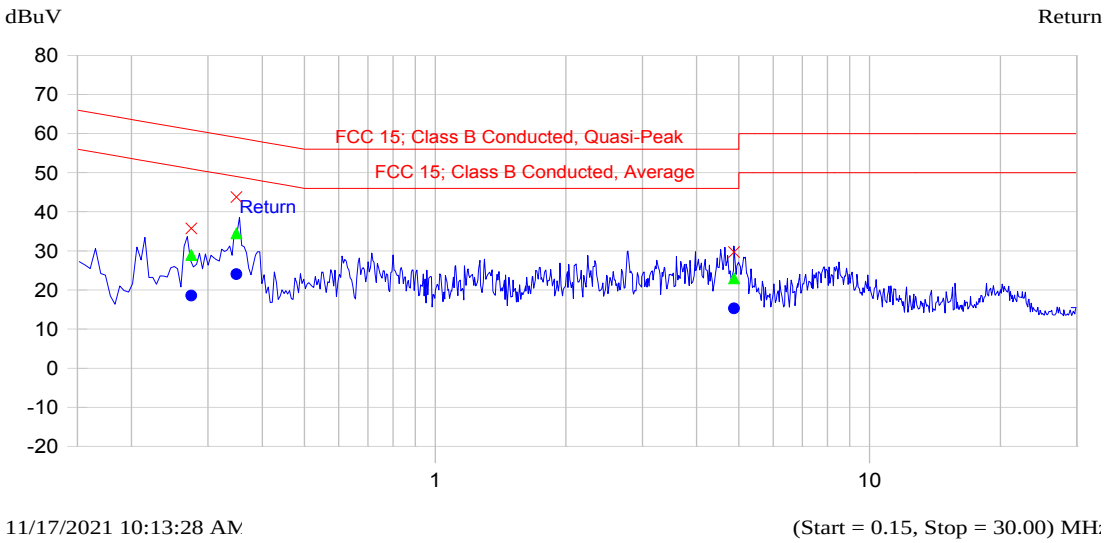


Current List

Frequency MHz	Peak dBuV	QP dBuV	QP-QP Limit dB	Avg dBuV	Avg-Avg Limit dB	Trace Name
0.152	39.8	35.8	-30.1	24.9	-31.0	Hot
0.351	47.1	42.1	-16.8	29.6	-19.3	Hot
0.856	36.2	31.7	-24.3	20.5	-25.5	Hot
4.886	36.3	30.7	-25.3	19.5	-26.5	Hot

Plot 5.1.3.2. Power Line Conducted Emissions (EUT with the antenna connected)
Line Voltage120 VAC; Line Tested: Return

Current Graph



Current List

Frequency MHz	Peak dBuV	QP dBuV	QP-QP Limit dB	Avg dBuV	Avg-Avg Limit dB	Trace Name
0.275	35.7	29.0	-32.0	18.6	-32.4	Return
0.349	43.7	34.5	-24.5	24.1	-24.9	Return
4.875	29.7	23.0	-33.0	15.3	-30.7	Return

5.2. EMISSION BANDWIDTH

5.2.1. Limit(s)

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

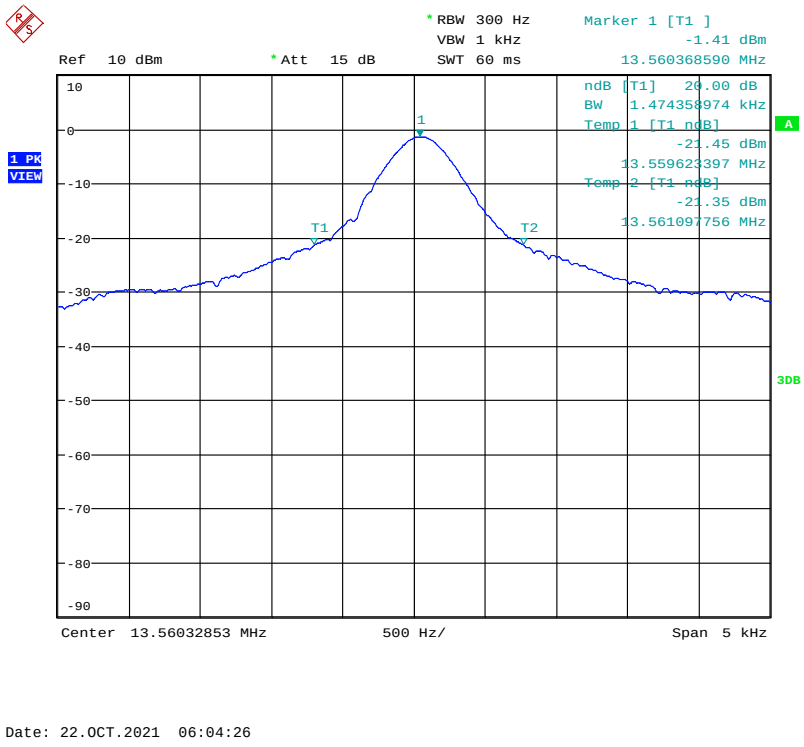
5.2.2. Method of Measurements

ANSI C63.10.

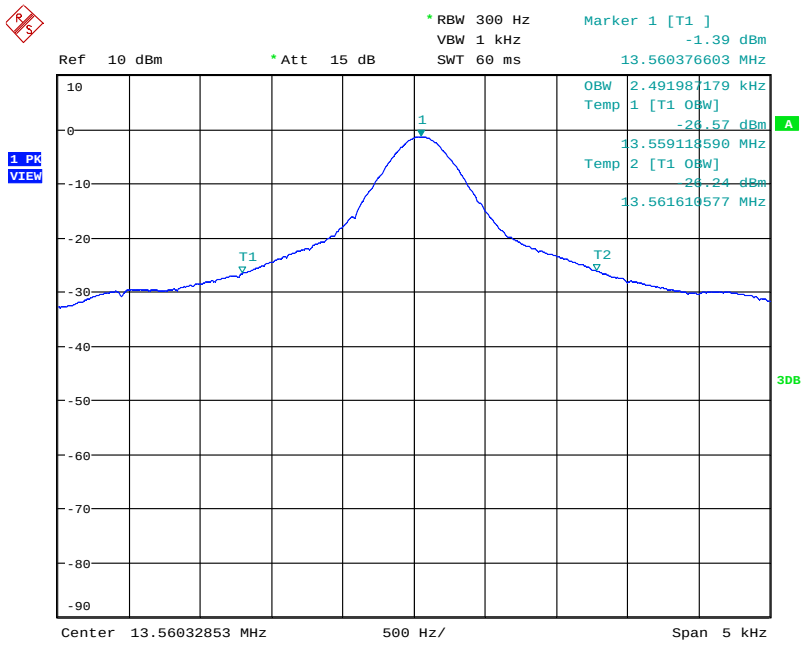
5.2.3. Test Data

Test Frequency	20 dB Bandwidth	99 %Occupied Bandwidth
13.56 MHz	1.474 kHz	2.492 kHz

Plot 5.2.3.1. 20 dB Bandwidth, Fc: 13.56 MHz



Plot 5.2.3.2. 99% Occupied Bandwidth, Fc: 13.56 MHz



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

5.3.1. 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.
(b) Within the bands 13.410-13.553 MHz and 13.567-13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.
(c) Within the bands 13.110-13.410 MHz and 13.710-14.010 MHz the field strength of any emissions shall not exceed 106 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

5.3.2. Method of Measurements

ANSI C63.10 and ANSI C63.4 for measurement methods.

5.3.3. Test Data

Remarks:

- Radiated spurious emissions measurements were performed at a measuring distance of 10 m or 3 m, from 10 kHz – 10th harmonic of the fundamental 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 using an extrapolation factor of 40 dB/decade for determining compliance.

5.3.3.1. 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 (dBµV/m)	§ 15.225 Field Strength Limits (dBµV/m)	Margin (dB)
13.56	52.49	Peak	V	33.41	84.0	-50.6
13.56	43.93	Peak	H	24.85	84.0	-59.2

5.3.3.2. 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 (dBµV/m)	§ 15.209 Field Strength Limits (dBµV/m)	Margin (dB)
All spurious emissions are more than 20 dB below the specified limit.						

5.3.3.3. 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)
40.68	23.74	Peak	V	40.0	-16.3
40.68	20.96	Peak	H	40.0	-19.0
54.24	20.97	Peak	V	40.0	-19.0
81.36	36.70	QP	V	40.0	-3.3
81.36	38.70	QP	H	40.0	-1.3
108.48	26.90	Peak	V	43.5	-16.6
135.60	24.58	Peak	H	43.5	-18.9

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

5.4.1. Limit(s)

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.

5.4.2. Method of Measurements

ANSI C63.10.

5.4.3. Test Data

Frequency Band:	13.56 MHz
Center Frequency:	13.56 MHz
Frequency Tolerance Limit:	± 0.01% (±1356 Hz)
Max. Frequency Tolerance Measured:	-161 Hz
Input Voltage Rating:	5 VDC

Ambient Temperature (°C)	Frequency Drift (Hz)		
	Supply Voltage (Nominal) 5 VDC	Supply Voltage (85 % of Nominal) 4.25 VDC	Supply Voltage (115% of Nominal) 5.75 VDC
-20	-161	--	--
-10	-161	--	--
0	-1	--	--
+10	-1	--	--
+20	0	-1	-1
+30	-161	--	--
+40	-81	--	--
+50	-81	--	--
+60	-81	--	--

EXHIBIT 6. TEST EQUIPMENT LIST

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range	Cal. Due Date
EMI Receiver	Rohde & Schwarz	FSU26	200946	20Hz–26.5 GHz	Jan 25, 2022
Loop Antenna	EMCO	6502	9104-2611	0.01 – 30 MHz	Jan 24, 2022
EMI Receiver	Rohde & Schwarz	ESU40	100037	20Hz–40 GHz	Sep 01, 2022
RF Amplifier	Com-Power	PAM-0118A	551052	0.5 – 18 GHz	Sep 11, 2022
Biconilog	EMCO	3142C	00034792	26-2000 MHz	May 16, 2022
Environmental Chamber	Envirotronics	SSH32C	11994847-S-11059	-60 to 177□C	Aug 25, 2023
Multi-meter	Fluke	8842A	4142058	20mV - 1kV	Oct 01, 2022
DC Power Supply	HQ Power	PS613U	NSN	0-30V	See Note 1
Spectrum Analyzer	Hewlett Packard	HP 8593EM	3412800103	9 kHz–26.5 GHz	Jan 22, 2022
Attenuator	Rhode & Schwarz	EZ-25	830164/07	150kHz-30MHz	Aug 06, 2022
LISN Used	EMCO	3825-2	8907-1531	10 kHz–30 MHz	Feb 01, 2022
Note 1: Internal Verification/Calibration check					

EXHIBIT 7. 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.

Test Description	Expanded Uncertainty, K=2 for 95% Confidence Level
Power Line Conducted Emissions	± 2.62
Occupied Bandwidth	±0.18 Hz
Radiated Emissions	±2.60 dB (10 kHz – 30 MHz)
	±4.30 dB (30 MHz – 1 GHz)
Frequency Stability	±0.18 Hz