APPLIED TEST LAB INC.

FCC Part 15C, Section 15.225 TEST REPORT

FCC ID:QCIIDS686P1

Limits Applied: FCC 15C, Section 15.225

Report#: S002E050-43-P

Manufacturer: Smart Technologies Inc.

Model: IDS686-1

Serial Number: K060LW25A0002

EUT Received Date: 2020-03-06

Test Start Date: 2020-04-07

Test Completion Date: 2020-05-20

Test Result: PASS

Report Issue Date: 2020-05-29

Tested by	Approved by:
Jaeheon Yun, Test specialist	Adiseshu Nyshadham, Quality Prime

Report Issued to	Report Issued by
Smart Technologies Inc. 3636 Research Road NW, Calgary, AB, T2L 1Y1, Canada	Applied Test Lab Inc. Unit 4174-3961 52 Ave NE Calgary, AB, T3J 0J8

Report Revision History

Rev	Description of Change	Date
Draft01	Initial	2020-05-22
Release	Title page and information(Page 1,25)	2020-05-22
Release2	Title page and information(Page 1, 4, 7)	2020-05-29

This report contains **43** pages

Table of Contents

1.0 General

1.1 Purpose

The purpose of this report is to document conformance with **FCC 15C, Section 15.225** and to detail the results of testing performed on the sample Model: **IDS686-1** manufactured by **Smart Technologies Inc.**. The test sample was received in good condition. Testing began **2020-04-07** on and was completed on **2020-05-20**.

1.2 Relevant Standards and References

One or more of the following standards were used to evaluate the EUT:

1. **ANSI C63.4-2014:** American National Standard for Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the 9 kHz to 40 GHz
2. **US Code of Federal Regulations (CFR):** Part 15.225 Operation within band 13.110 – 14.010MHz.
3. **ANSI C63.10-2013** American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

1.3 Performance Requirement

The EUT is marketed as **FCC Pat15 Subpart C** equipment and must comply with the **FCC 15C, Section 15.225** emission limits or requirements.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product which may result in increase emission levels should be checked and verified to ensure continuous compliance has been maintained (i.e., printed circuit board layout changes, changes to filter performance, power supply changes, I/O cable and interface changes, critical component changes etc.)

1.4 Measurement Uncertainty

Test Case	Uncertainty
AC Line Conducted Emissions	± 1.50 dB
20dB Bandwidth	±10 kHz
Radiated Spurious Emissions	± 3.44 dB
Radio Frequency	±1x10-6
Temperature	±2 °C
Humidity	±5%

The measurement uncertainties are evaluated for tests performed on the EUT as specified in CISPR 16-4-2.

The measurement uncertainties reported above relates to the measurement setups and procedures.
It does not take into account EUT performance variations from sample to sample.

1.5 Test Results Summary

Test Case	Test Type	Basic Standard	FCC Part Clause	Result
6.1	20dB Bandwidth	**FCC 15C, Section 15.225**	15.215(c)	PASS
6.2	Antenna Requirement	**FCC 15C, Section 15.225**	15.203	PASS
6.3	AC Power Line Conducted Emissions	**FCC 15C, Section 15.225**	15.207	PASS
6.4	Radiated Spurious Emissions	**FCC 15C, Section 15.225**	15.225(a) - (c)	PASS
6.5	Radiated Spurious Emissions	**FCC 15C, Section 15.225**	15.209, 15.205, 15.225(d)	PASS
6.6	Frequency Stability	**FCC 15C, Section 15.225**	15.225(e)	PASS

Note:
The above judgment is only based on the measurement data and does not include the measurement uncertainty. Accordingly, the statement below is applied to the test result.

The EUT complies with the limit required in the standard in case that the margin is not less than the measurement uncertainty in the laboratory.

The compliance of the EUT is more probable than non-compliance in case that the margin is less than the measurement uncertainty in the laboratory.

1.6 Test Facility Information

Name	Applied Test Lab Inc.				
Address	Unit 4174-3961 52nd Avenue NE, Calgary, Alberta, T3J 0J8, Canada				
Telephone	403 590 8701	**Fax**		403 590 8570	
Email	emctesting@appliedtestlab.com	**Website**		www.appliedtestlab.com	
FCC Registration	950875	Designation Number	**CA0004**	**IC Recognition**	10988A

1.7 Client Information

Name	**Smart Technologies Inc.**		
Address	**3636 Research Road NW, Calgary, AB, T2L 1Y1, Canada**		
Telephone	+1-403-681-8483	**Website**	www.smarttech.com
Contact Name	Todd Gallagher	**Contact Email**	toddgallagher@smarttech.com

2.0 Test Sample Information

The **IDS686-1** was only operated and exercised in the mode(s) and configuration(s) described in this report. All inputs and outputs to and from support equipment associated with the **IDS686-1** were provided or simulated under the direction and responsibility of **Smart Technologies Inc.**. A description of these signals and their provision is included in Appendix A.

2.1 Equipment Under Test (EUT)

Product Description	SMART board Interactive display.
Manufacturer	**Smart Technologies Inc.**
Trade Name	SMART Board 6000S series interactive display
Model Number	**IDS686-1 (SBID-6086S)**
Serial Number	**K060LW25A0002**
Model discrepancy/Variations	None
FCC ID	QCIIDS686P1
Power Supply and Requirements	120VAC 60Hz
Hardware Version	DVT
Firmware Version	Touch Controller Firmware Version: 0.6.0.11 Scaler MCU Firmware Version: 1.0.41.0 Pen Firmware Version: 9.9.9.9
Software Version	Build Number: 33.5.9021 HD-M-EdiQ
Antenna Type	Panel Antenna
Antenna Connection Type	Soldered, Integral
Operating Frequency	13.56MHz +/- 423.75 kHz
Number of Channels	1
Modulation Type	10% 30% ASK
Modulation Technology	13.56MHz using 10 to 30% ASK with Manchester Coding
Setup	Micro USB cable was used to place an RFID antenna in continuous transmitting using the test software build 1.1.4.99 from the customer RFID antenna is set to transmit continuously
Other Information	See Smart Test Plan Latest Version EMC-RF_Test_plan_2019-10-21_V4
Product Manufacturing Status	☒Production Unit ☐Pre-Production Unit

Note: For a more detailed features description, please refer to the manufacturer's specifications or the user's manual.

2.2 Support Equipment and Details

☒**Applicable**

Manufacturer	Description	Model No.	Serial Number	Other Info
SMART	Kansas Touch Controller	Kansas Touch Controller #28	1032405-04	To Verify panel RFID functionality
S.I Tech	USB-Fiber optic converter	2181	97777	-
S.I Tech	USB-Fiber optic converter	2182	97778	-

2.3 I/O Ports and Details

☒**Applicable**

Port Type	Description	Filter Info	Shielding Info	Other Info
USB Micro B	USB Micro B	No	N/A	-

2.4 I/O Cable Descriptions

☒**Applicable**

Cable Description	Length (m)	Port From	Port To	Cable Type	Remarks
USB Micro B cable	2	RFID controller	USB optic converter	Shielded	-
Fiber Optic cable	10	USB Optic converter	Test PC	Optic	-

3.0 Test Facilities

Laboratory Location

The radiated and conducted emission test sites are located at the following address:

Applied Test Lab,
Unit 4174, 3961-52 Ave N.E., Calgary, AB T3J 0J8

Laboratory Accreditation/Recognitions/Certifications

The Semi-Anechoic Chamber Test Site and Conducted Emission Site have been fully described, submitted to, and accepted by the FCC and Industry Canada for testing Interference by information technology equipment. In addition, ATL has implemented an interim in-house quality system which is based on the ISO 17025 standard and is actively pursuing to achieve its accreditation. The following certification numbers have been issued in recognition of the certifications:

FCC Registration Number: **950875**
Designation Number: **CA0004**
Industry Canada Lab Code: **IC 10988A**

Country	Agency	Accreditation/Certification	LOGO
USA	FCC	3 (m) Semi-Anechoic Chamber to perform FCC Part 15/18 measurements	
Canada	Industry Canada	3 (m) Semi-Anechoic Chamber to perform ICES-004 and RSS measurements	Industry Canada Industrie Canada

Note: Unless otherwise specified, ATL performs the tests using standard test methods to evaluate the EUT for compliance to the defined International standards. However, the report is not to be used to claim compliance, certification or endorsement by FCC or Industry Canada or any other government agency unless specifically submitted to such agency for such purpose.

3.1 Semi-Anechoic Chamber Test Site Description

The Semi-Anechoic Chamber Test Site consists of a 6.24 x 9.144 x 5.79 (m) shielded enclosure. The chamber is lined with SAMWAH Ferrite Grid Absorber, model number SN-20. The ferrite tile grid is 100 x 100x 6.7 (mm) thick and weighs approximately 200 (grams). These tiles are mounted on steel panels and installed directly on the inner walls of the chamber. Inner side Wall is lined by 600H Foam Absorber with White Cap. Chamber is illuminated by set of 12 Incandescent Bulbs.

The turntable is 198 (cm) in diameter and is located 160 (cm) from the back wall of the chamber. The chamber is grounded via Utility Ground installed at the side of the back East wall, it is bound to the Chamber ground Stud using 1/2" copper braided cable.

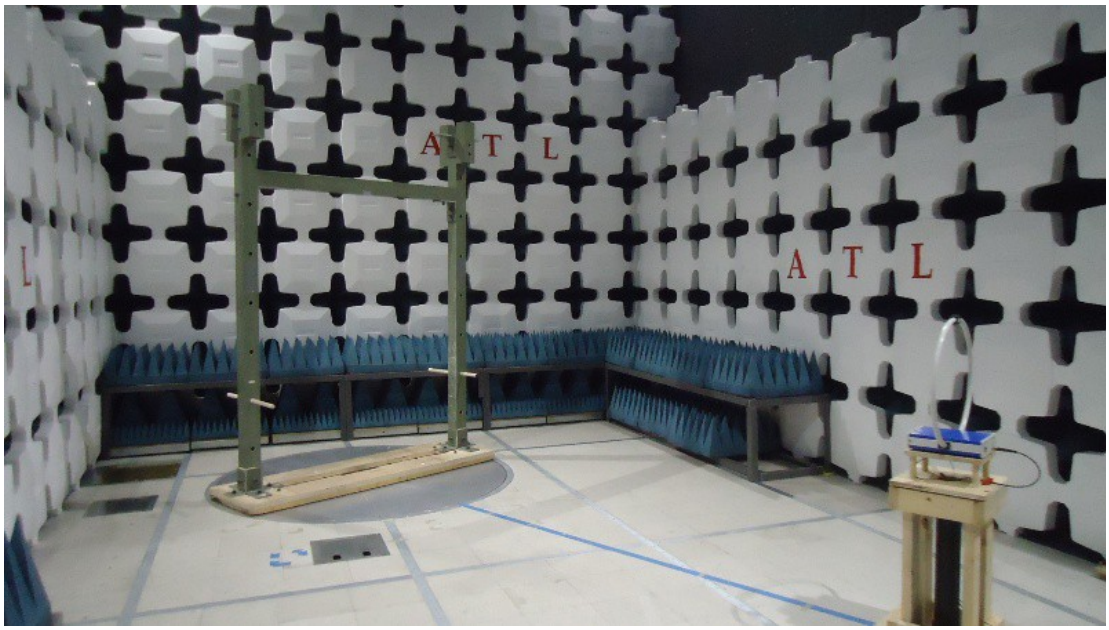

Figure 3.1 - Test Facility (Setup for 9kHz - 30MHz)

The turntable is all aluminum, flush mounted table installed in an all steel frame. The table is remotely operated from the control area located outside the Semi Anechoic Chamber. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

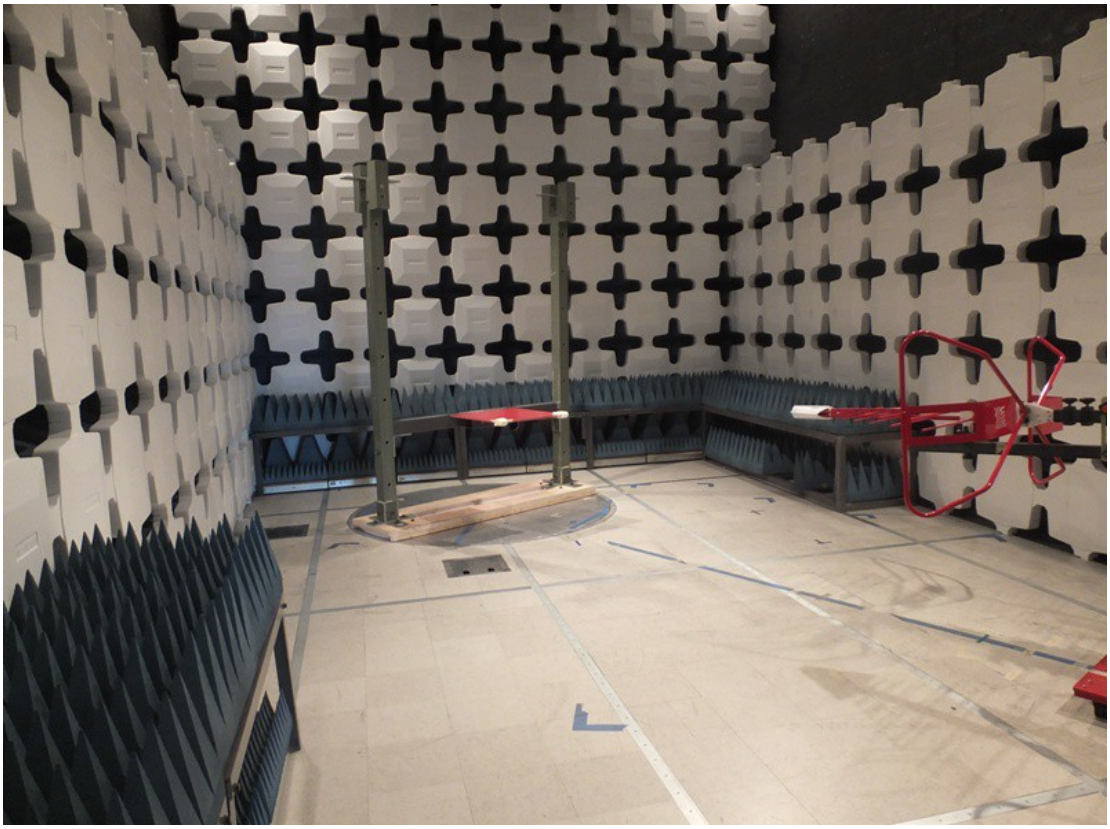

Figure 3.2 - Test Facility (Setup for 30MHz – 1000MHz)

3.2 A diagram of the Semi-Anechoic Chamber Test Site

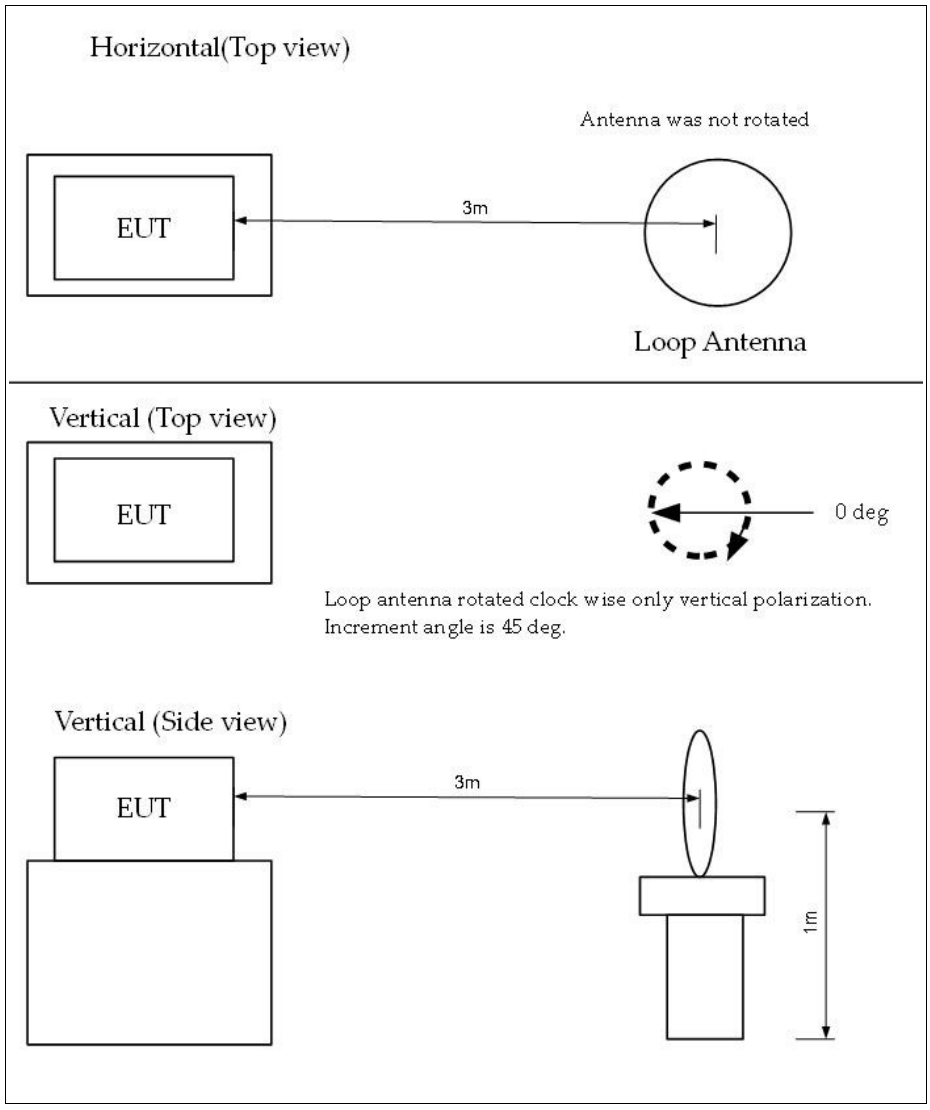

Figure 3.3 - Semi- Anechoic chamber diagram(9kMHz - 30MHz)

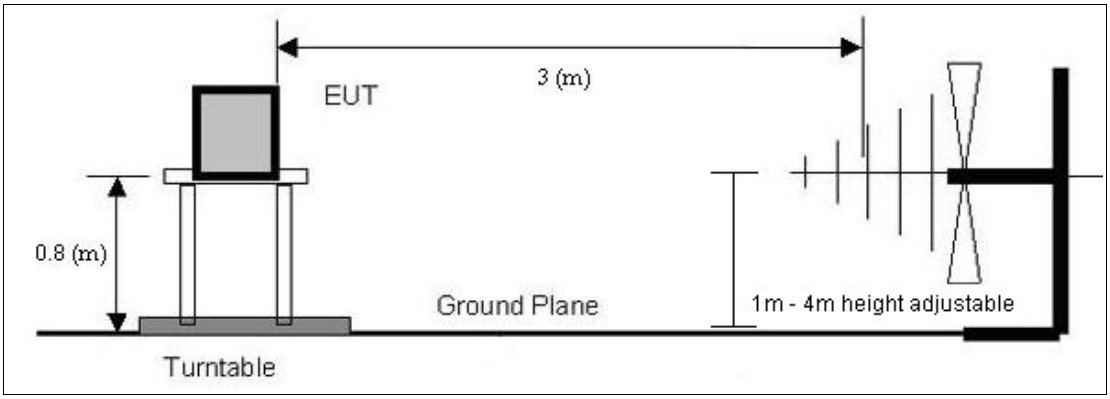

Figure 3.4 - Semi- Anechoic chamber diagram(30MHz – 1000MHz)

3.3 Test Equipment List

Table 3.1 - Test Equipment used for 20dB Bandwidth

Description	Manufacturer	Model Number	Serial Number	Next Cal
Active loop antenna	Com-power	AL130	121035	July 06, 2021
MXA Signal Analyzer	Keysight	N9020B-526	SG56080714	October 13, 2021
Cable	Micro Coax UTIFLEX	UFB311A	SFC220863	PV
Cable	Micro Coax UTIFLEX	UFA210B-0-0120-50250	96G1557	PV
Turntable	ETS Lindgren	2187	NA	NCR
Antenna Bore-sight Mast	ETS Lindgren	2071B	136243	NCR
Multi Device Controller	ETS Lindgren	ETS 2090	148017	NCR
3 Meter chamber	ETS Lindgren	FACT 3-2.0	N/A	July 18, 2020
Test SW	DVT Solutions Inc	WirelessV1.1.exe - (20191113)		

NCR: No Calibration required.
PV:Periodic Verification

Table 3.2 - Test Equipment used for AC Power Line Conducted Emission

Description	Manufacturer	Model Number	Serial Number	Next Cal
LISN	Com-Power	LI-215A	191933	July 18, 2021
EMI Receiver & RF filter section	Hewlett Packard	8546A, 85460A	3545A00306, 3330A00109	July 10, 2021
Cable	ATL	N/A	N/A	PV
Transient Limiter	Com-Power	LIT-930	531577	PV
Test SW	DVT Solutions Inc	RECEDvtAtlV3p41.exe - (20190618)		

PV:Periodic Verification

Table 3.3 - Test Equipment used for Radiated Spurious Emissions

Description	Manufacturer	Model Number	Serial Number	Next Cal
Bi-Log antenna	ETS Lindgren	3142E	144760	July 07, 2020
Active loop antenna	Com-power	AL130	121035	July 06, 2021
EMI Receiver & RF filter section	Hewlett Packard	8546A, 85460A	3448A00267, 3448A00245	June 26, 2021
Cable	Micro Coax UTIFLEX	UFB311A	SFC220863	PV
Cable	Micro Coax UTIFLEX	UFA210B-0-0120-50250	96G1557	PV
Turntable	ETS Lindgren	2187	NA	NCR
Antenna Bore-sight Mast	ETS Lindgren	2071B	136243	NCR
Multi Device Controller	ETS Lindgren	ETS 2090	148017	NCR
3 Meter chamber	ETS Lindgren	FACT 3-2.0	N/A	July 18, 2020
Test SW	DVT Solutions Inc	RECEDvtAtlV3p41.exe - (20190917)		

NCR: No Calibration required.
PV:Periodic Verification

Table 3.4 - Test Equipment used for Frequency Stability

Description	Manufacturer	Model Number	Serial Number	Next Cal
Active loop antenna	Com-power	AL-130	121035	July 06, 2021
Spectrum Analyzer	Hewlett Packard	Hp8593EM	3639A00172	April 16, 2023
RF Cable(N-N)	Huber Shunner	Sucoflex	NA	NCR
RF Cable(N-BNC)	4meters	NA	NA	NCR
Multi meter	FLUKE	Fluke 87	30430063	April 13, 2023
Temperature probe	FLUKE	NA	NA	April 13, 2023
Multi Meter	FLUKE	Fluke 87	15690178	PV
Programmable AC Source	Chroma	61504	61504001061	PV (Note)
Temperature Chamber	Thermotron	WP-605-THCM2-10-10	47401	PV (note)

NOTE: The test equipment belongs to Smart Technologies Inc.
NCR: No Calibration required.
PV:Periodic Verification

4.0 Test Setup Description

4.1 EUT System Block Diagram and Support Equipment

☒**Applicable**

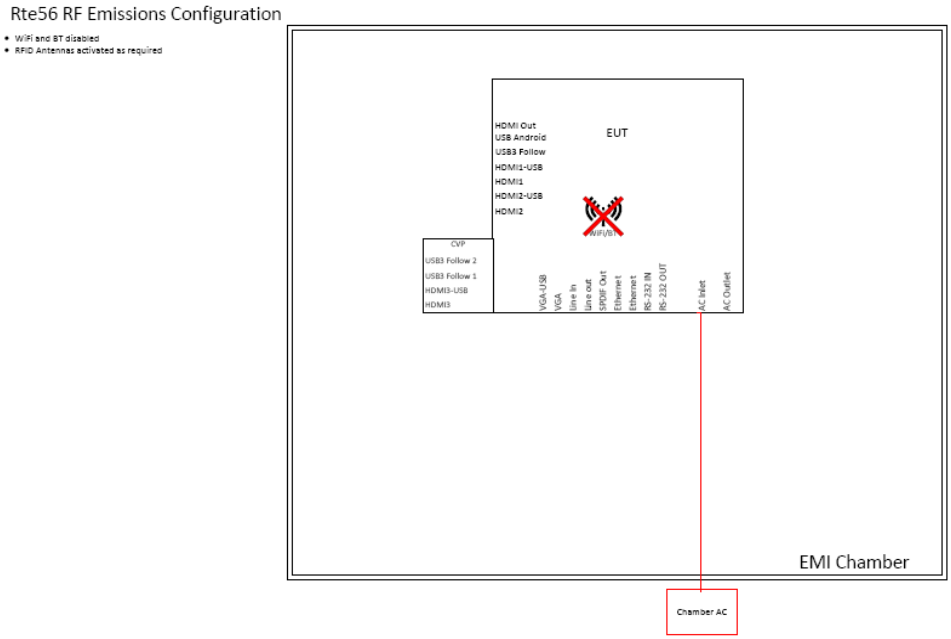

Figure 4.1– Test setup for RF Testing

4.2 Test Setup Photographs 20dB Bandwidth

☒**Applicable**

Figure 4.2 - Test Setup - Front View

Figure 4.3 - Test Setup - Side View

4.3 Test Setup Photographs AC Power Line Conducted Emission(0.15MHz – 30MHz)

☒**Applicable**

Figure 4.4 - Test Setup - Front View

Figure 4.5 - Test Setup - Side View

4.4a Test Setup Photographs Radiated Spurious Emissions(0.009MHz – 30MHz)

☒**Applicable**

Figure 4.6a - Test Setup - Front View

Figure 4.7a - Test Setup - Side View

4.4b Test Setup Photographs Radiated Spurious Emissions(30MHz – 1000MHz)

☒**Applicable**

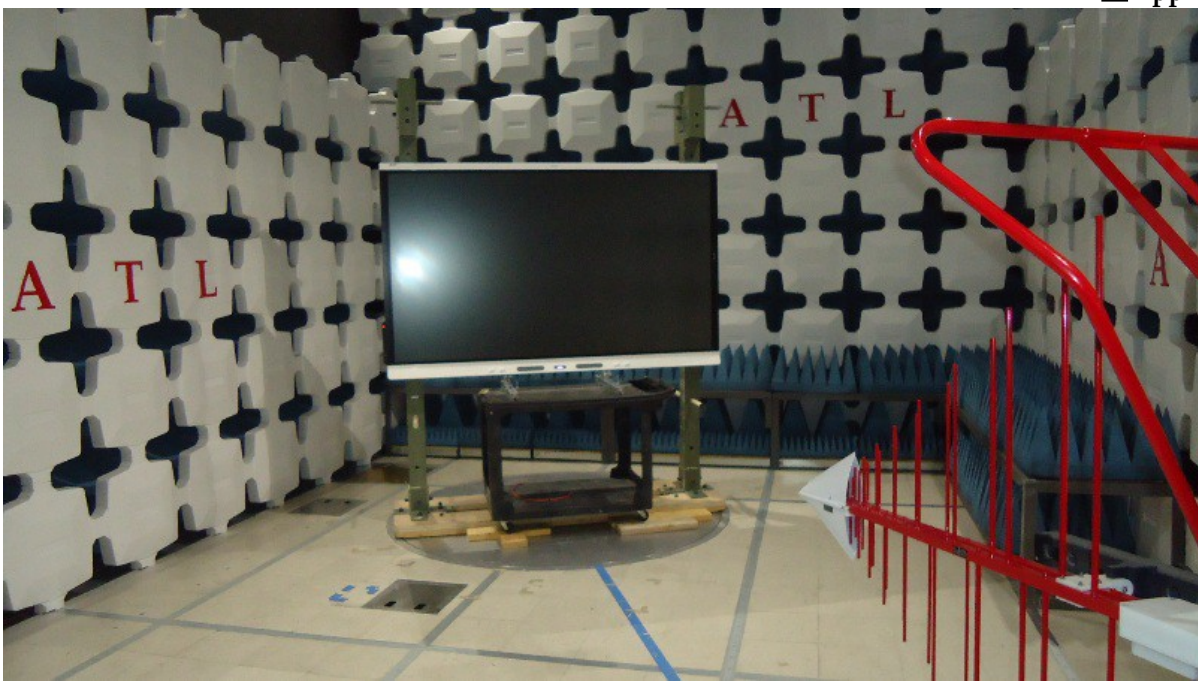

Figure 4.6b - Test Setup - Front View

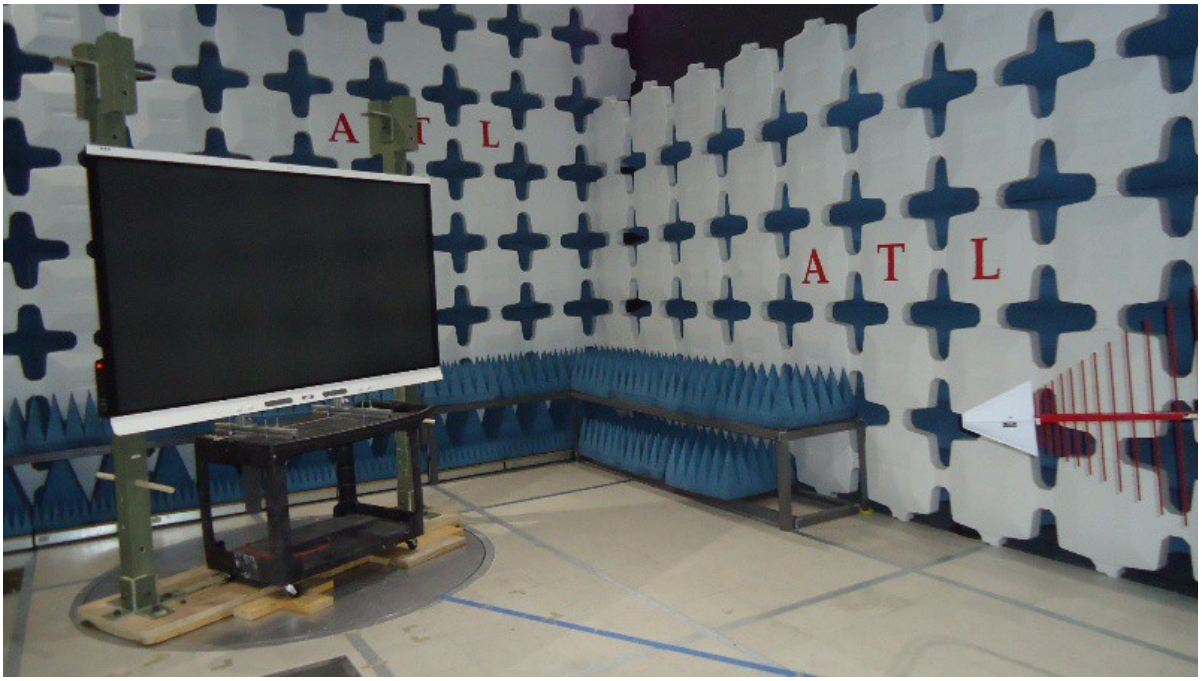

Figure 4.7b - Test Setup - Side View

4.5 Test Setup Photographs Frequency Stability

☒**Applicable**

Figure 4.8 - Test Setup - Power system

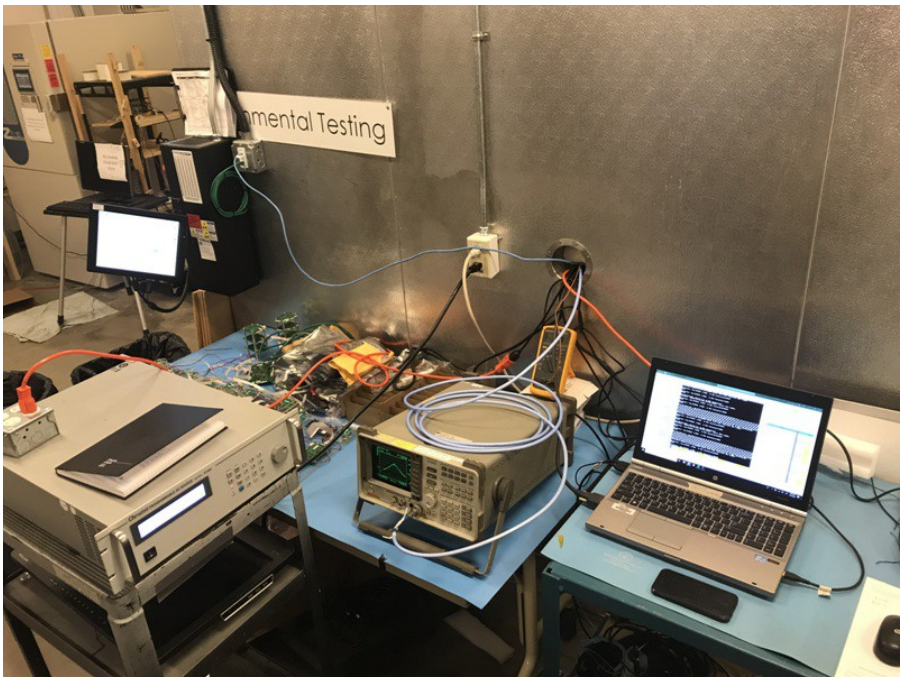

Figure 4.9 - Test Setup - Measurement system

5.0 Test Methodology

5.1 Method of measurement of 20dB Bandwidth

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in Subpart E of Part 15, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage.

5.2 Method of measurement of AC Power Line Conducted Emission

The setup of EUT is according with per [1] measurement procedure. The specification used was with the FCC Part 15.207.

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle. The spacing between the peripherals was 10 cm. The EUT was connected to a 120 VAC/60 Hz power source. Support equipment of EUT, if any, were connected through the second LISN.

The LISN is placed 0.8 m from the boundary of EUT and bonded to a ground reference plane for LISN mounted on top of the ground reference plane. This distance is between the closest points of the LISN and the EUT. All other units of the EUT and associated equipment are placed at least 0.8m from the LISN. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.

AC Power Line Conducted emission measurements were made over the frequency range of 150 (kHz) to 30 (MHz). The software is programmed to perform a peak sweep of the frequency band using the max hold function. This sweep is performed for every power conductor of the power line. During the sweep measurement the Spectrum Analyzer/Receiver's resolution bandwidth set to 9 (kHz) and the video bandwidth set to 30 (kHz). Although not a fully maximized scan, this type of scan provides emission data with a good indication of pass or fail.

Table 5.1: FCC 15. 207 – AC Power Line Conducted Emission limits.

Frequency (MHz)	Quasi-peak (dBuV)	Average (dBuV)
0.15 – 0.5	66 to 56 *	56 to 46 *
0.5 – 5	56	46
5 – 30	60	50

[NOTE] * Decreases with the logarithm of the frequency.

Quasi- Peak measurements are taken with the Spectrum Analyzer/Receiver's resolution bandwidth set to 9 (kHz) and Video Bandwidth set to 30 (kHz). Average measurements are taken with the resolution bandwidth set to 9 (kHz) and the video bandwidth set to 30 (kHz): The calculation for the AC Power Line conducted emission level

is as follows:

Corrected Reading (dBuV) = Analyzer/Receiver Reading(dBuV) + Correction Factor (dB)
Correction Factor (dB) = LISN Insertion Loss(dB) + Cable Insertion Loss(dB) + Transient Limiter Insertion Loss(dB)
Margin(dB) = Corrected Reading(dBuV) – Applicable Limit(dBuV)

5.3 Method of measurement of Radiated Spurious Emissions

Below 30MHz：

The EUT is placed on a turntable 0.8 meters above the ground in the chamber, 3 meter away from the test antenna (loop antenna). The test antenna is positioned with its plane vertical at the specified distance from the EUT and rotated about its vertical axis for maximum response at each azimuth about the EUT. The center of the loop is adjusted to 1 m above the ground. Additional tests are performed by placing the the loop antenna plane positioned horizontally at the specified distance from the EUT.

Above 30MHz：

The EUT is placed on a turntable 0.8 meters above the ground in the chamber, 3 meter away from the test antenna. The maximal emission value is acquired by adjusting the antenna height, polarization and turntable azimuth. Normally, the height range of antenna is 1 m to 4 m, the azimuth range of turntable is 0° to 360°, and the receive antenna has two polarization Vertical (V) and Horizontal (H).

As per FCC 15C, section 15.225

a) The field strength of any emissions within the band 13.553–13.567 MHz shall not exceed 15,848 μV/m (84 dBμV/m) at 30 m.
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 μV/m (50.5 dBμV/m) at 30 m.
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 μV/m (40.5 dBμV/m) at 30 m.
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. The limits are shown below in Table 5.2:

According to FCC Part15.205, the level of any transmitter spurious emission in Restricted bands shown in the following table shall not exceed the level of the emission specified in the Table 5.2

According to FCC Part15.205, Restricted bands

Table 5.2: FCC 15. 205 – Restricted bands

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	>38.6
13.36-13.41			

Table 5.3: FCC 15. 209 – Radiated Emission limits**.**

Frequency (MHz)	Field Strength (uV/m)	Field Strength (dBuV/m)	Measurement Distance (m)
0.009 – 0.490	2400/F(kHz)	67 – 20 x Log 10(F)	300
0.490 – 1.705	24000/F(kHz)	87 – 20 x Log 10(F)	30
1.705 – 30	30	29.5	30
30 – 88	100	40	3
88 – 216	150	43.5	3
216 – 960	200	46.0	3
Above 960	500	54.0	3

Testing Setup/Configuration

Unless otherwise indicated, the following configuration steps are used for the equipment setup: The cable(s) were routed consistent with the typical application and installation instructions provided with the test sample. Interface cables were connected to the available ports of the test unit. The effect of varying the position of the cable(s) was investigated to find the configuration that produced maximum emissions. Cable(s) were of the type and length as specified in the individual requirements. The length(s) of cable(s) that produced maximum emissions was selected.

The equipment under test(EUT) was set up in a manner that is represented its normal use, as shown in the setup photographs. Any special conditions required for the EUT to operate normally are identified in the comments

that accompany the emissions tables.

The emissions data was measured with a spectrum analyzer or receiver using the applicable correction factors for distance, antenna, cable loss and amplifier gain, the data was reduced as shown below. The corrected data was then compared to the applicable emission limits. Preliminary and final measurements were performed in order to ensure that all emissions from the EUT were detected and maximized.

Correction Factors

The highest emission reading from spectrum analyzer was converted using correction factors as shown (Analyzer/Receiver) in the formula. For radiated emissions in dBuV/m, the spectrum analyzer reading in dBuV was corrected by using the following formula. This corrected reading was then compared to the applicable specification limit and the results are presented in the margin column. The margin was calculated based on subtracting the specification limit value from the corrected measurement data; a positive margin represents a measurement exceeding the specification limit, while a negative margin represents a measurement less the the specification limit.

Corrected Reading (dBuV/m) = Analyzer/Receiver Reading(dBuV) + Correction Factor(dB/m)
Correction Factor (dB/m) = Cable Loss(dB) + Antenna Factor(dB/m)-((Preamplifier Gain)(dB))
Margin (dB) = Corrected Reading(dBuV/m) - Applicable Limit(dBuV/m)

Test Instrumentation and Analyzer settings

The test instrumentation and equipment listed were used to collect the emissions data. A spectrum analyzer or receiver was used for all measurements. Unless otherwise specified, the following table shows the measuring equipment bandwidth settings that were in designated frequency bands. For testing emissions, an appropriate reference level and a vertical scale size of 10dB per division were used.

Table 5.4: Measuring equipment bandwidth setting per frequency range

Measuring equipment bandwidth setting per frequency range			
Test	Start	Stop	Band width setting
Conducted Emissions	150kHz	30MHz	9kHz
Radiated Emissions	9kHz	150kHz	200Hz
Radiated Emissions	150kHz	30MHz	9kHz
Radiated Emissions	30MHz	1000MHz	120kHz
Radiated Emissions	1000MHz	>1GHz	1MHz

Spectrum Analyzer / Receiver Detector Functions

The notes that accompany the measurements contained in the emissions tables indicate the type of the detector function used to obtain the given readings. Unless otherwise noted, all readings were made in the “positive peak” detector mode. Whenever a “quasi-peak” or “average” reading was recorded, the measurement was annotated with a “QP or an “AVG” on appropriate rows of the data sheets. In case where quasi-peak or average limits were employed and exits for multiple measurement types for the same frequency then the peak measurement was retained in the report for reference.

5.4 Method of measurement of Frequency Stability

Applicable Standard
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.

Frequency measurements shall be made at the extremes of the specified temperature range and at intervals of not more than 10o centigrade through the range. A period of time sufficient (approximately 30minutes) to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. The short-term transient effects on the frequency of the transmitter due to keying (except for broadcast transmitters) and any heating element cycling normally occurring at each ambient temperature level also shall be shown. Only the portion or portions of the transmitter containing the frequency determining and stabilizing circuitry need be subjected to the temperature variation test.

Test Procedure
Frequency Stability vs. Temperature: The equipment under test was connected to PC and is powered by an external AC programmable power supply. An active loop antenna was connected to a Spectrum Analyzer to measure the magnetic field strength . The EUT and the Active Loop Antenna was placed inside the temperature chamber.

The temperature of the chamber is adjusted from −20 degrees to +50 degrees C in steps of 10 degrees C. After the temperature is stabilized for approximately 30 minutes at every step, the frequency output was recorded from the Spectrum Analyzer, and the temperature chamber temperature is recorded

Frequency Stability vs. Voltage: Using an external AC programmable power supply source the voltage was set to 115% of the nominal value. The temperature of the chamber is adjusted to 20 degrees C. After the temperature is stabilized for approximately 30 minutes, the frequency output was recorded from the Spectrum Analyzer, and the temperature chamber temperature is recorded.

Using an external AC programmable power supply source the voltage was set to 85% of the nominal value. The temperature of the chamber is adjusted to 20 degrees C. After the temperature is stabilized for approximately 30 minutes, the frequency output was recorded from the Spectrum Analyzer, and the temperature chamber temperature is recorded..

6.0 Test Results

6.1 FCC 15.225(a) 20dB Bandwidth

☒**Applicable**

Table 6.1 - 20dB Bandwidth Test Setup Information (FCC 15C, Section 15.225(a))

CLIENT:	**Smart Technologies Inc.**	**TEST STANDARD:**	**FCC 15C, Section 15.225**
MODEL NUMBER:	**IDS686-1**	**PRODUCT:**	**IDS686-1**
SERIAL NUMBER:	**K060LW25A0002**	**CLASS/LIMIT APPLIED:**	**FCC 15C, Section 15.225**
TEMPERATURE:	26°C	**HUMIDITY:**	20%
TESTED BY:	Adiseshu Nyshadham	**DATE OF TEST:**	April 12, 2020
TEST REFERENCE:	FCC 15C, Section 15.225(a)		
TEST VOLTAGE:	120VAC 60Hz		
SETUP:	The EUT is AC powered through an AC power supply. And is connected to a support laptop via USB using a Fiber optic extender link. The EUT is controlled by PC software to emit the specified signals for the purpose of measurements. The EUT is continuously transmitting at maximum power The EUT was tested in Ready mode. In this mode all RFID Tx and Rx circuitry is powered up and active. All Panel antennas were investigated. Antenna with worst case radiation was configured for this test. The test was performed with a spectrum analyzer and using an Active loop antenna. continuously. The RBW was set to 3 kHz, the VBW was set to 10 kHz, ref level 77 dBuV, Attenuation 0dB, span 20kHz and detector was set to Peak. All emissions from the EUT are within the 13.553 – 13.567 MHz frequency range.		
CHANNEL FREQUENCY	13.56MHz		
FREQUENCY RANGE	13.55-13.57 MHz		
MODULATION MODE	ASK		
FIRMWARE POWER SETTING	NA		
CHANNEL NUMBER	1		
ANTENNA TYPE	Integral Loop		
20dB BANDWIDTH	4.8kHz (Measured Value. See Figure 6.1)		
RESULTS:	**PASS**		

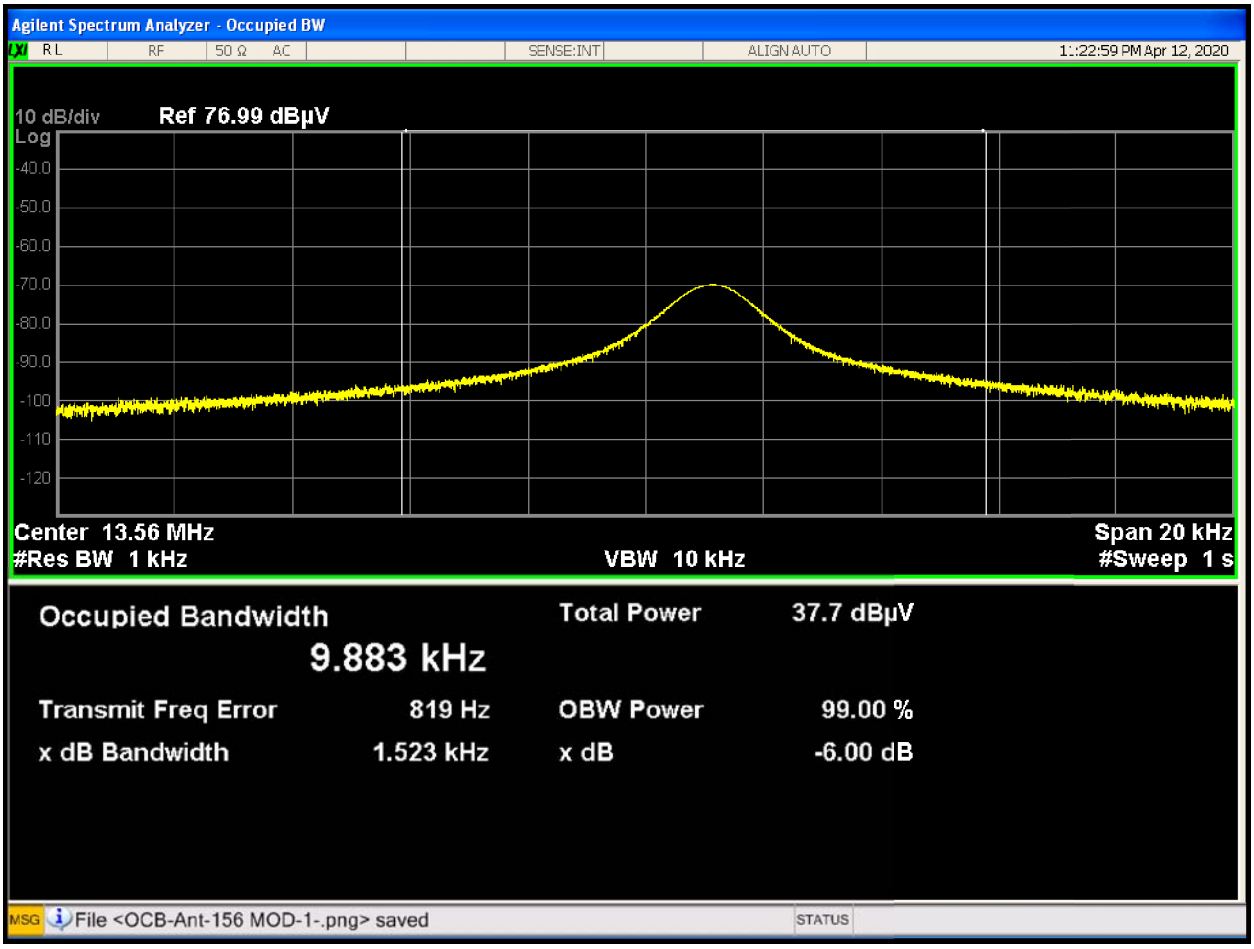

Figure 6.1 - 20dB Bandwidth data plot

Modulation	Channel #	Channel Frequency (MHz)	20 dB Bandwidth (kHz)	Limit (kHz)	Remarks
ASK	1	13.56	4.8	14	PASS

[NOTE]
In the above figure, the 6 dB band width is shown. The 20 dB bandwidth is determined from the trace data of above signal as follows:

Max Level :37.0748dBuV at 13.5611MHz
Lower 20 dB down data point:17.0653dBuV at 13.5587MHz
Upper 20 dB down data point:17.0728dBuV at 13.5635MHz

20 dB bandwidth: 13.5635MHz - 13.5587MHz = 0.0048MHz

6.2 FCC 15.203 Antenna Requirement

☒**Applicable**

Table 6.2 - Antenna Requirement Test Setup Information (FCC 15.203)

CLIENT:	**Smart Technologies Inc.**	**TEST STANDARD:**	**FCC 15C, Section 15.225**
MODEL NUMBER:	**IDS686-1**	**PRODUCT:**	**IDS686-1**
SERIAL NUMBER:	**K060LW25A0002**	**CLASS/LIMIT APPLIED:**	**FCC 15C, Section 15.225**
TEST REFERENCE:	FCC Part 15.203		
REQUIREMENT	An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.		
REMARK	A permanently attached antenna was used which is not replaceable.		
RESULTS:	**PASS**		

6.3 FCC 15.207 AC Power Line Conducted Emission

☒**Applicable**

Table 6.3 – AC Power Line Conducted Emission Test Setup Information (FCC 15.207)

CLIENT:	**Smart Technologies Inc.**	**TEST STANDARD:**	**FCC 15C, Section 15.225**
MODEL NUMBER:	**IDS686-1**	**PRODUCT:**	**IDS686-1**
SERIAL NUMBER:	**K060LW25A0002**	**CLASS/LIMIT APPLIED:**	**FCC 15C, Section 15.225**
TEMPERATURE:	26°C	**HUMIDITY:**	20%
TESTED BY:	Jaeheon Yun	**DATE OF TEST:**	2020-05-20
TEST REFERENCE:	FCC Part 15.207		
TEST RANGE	0.15MHz - 30MHz		
TEST VOLTAGE:	120VAC 60Hz		
SETUP	The EUT is AC powered through an AC power supply. And is connected to a support laptop via USB. The EUT is controlled by PC software to emit the specified signals for the purpose of measurements. The EUT is continuously transmitting at maximum power. The EUT was tested in Normal mode with all ports are terminated with cables In this mode all RFID Tx and Rx circuitry is powered up and active. Bluetooth and Wi-Fi modes were disabled. All Panel antennas were investigated. Antenna with worst case radiation was configured for this test. The test was performed with a spectrum analyzer with a transient limiter. The RBW was set to 9 kHz, the VBW was set to 30 kHz, ref level 97 dBuV, Attenuation 30dB, span 1.493 MHz and detector was set to Peak.		
CHANNEL FREQUENCY	13.56MHz		
MODULATION MODE	ASK		
FIRMWARE POWER SETTING	N/A		
CHANNEL NUMBER	1		
ANTENNA TYPE	Integral Loop		
MAXIMUM EMISSION LEVEL	41.26 dBuV on Line 1		
RESULTS:	**PASS**		
CHANGE OR REMARKS:	NA		

Table 6.4 - **AC Power Line** Conducted Emission Line 1 **– AVG** FCC

Emission Type	Frequency (MHz)	Measured Reading (dBuV)	Correction Factor (dB)	Corrected Reading (dBuV)	FCC 15.207 AVG Limit (dBuV)	FCC and ICES-003 Margin (dB)
Conducted Emission	0.1726	25.35	10.18	35.53	55.01	-19.48
	3.995	8.93	10.21	19.14	46	-26.86
	11.6772	30.95	10.31	41.26	50	-8.74

Table 6.5 - AC Power Line Conducted Emission Line 2 **– AVG** FCC

Emission Type	Frequency (MHz)	Measured Reading (dBuV)	Correction Factor (dB)	Corrected Reading (dBuV)	FCC 15.207 AVG Limit (dBuV)	FCC and ICES-003 Margin (dB)
Conducted Emission	0.1726	24.8	10.18	34.98	55.01	-20.03
	3.9946	9.92	10.21	20.13	46	-25.87
	11.6761	29.07	10.31	39.38	50	-10.62

Note: Emissions with Peak detector were found to be less than the Average limits and were not tested using quasi-peak detector.

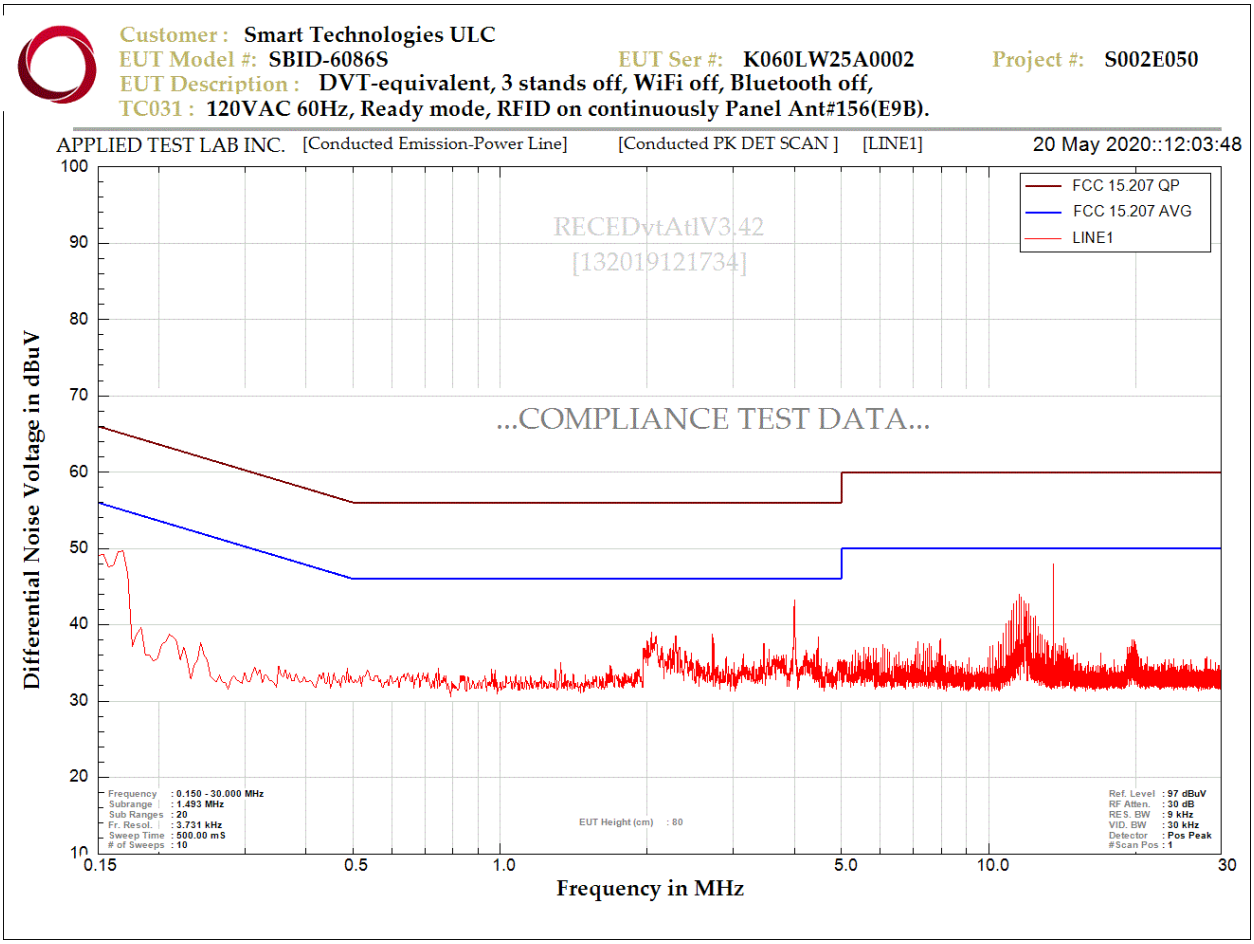

Figure 6.2 - AC Power Line Conducted Emission Scan Line 1 (Line L)

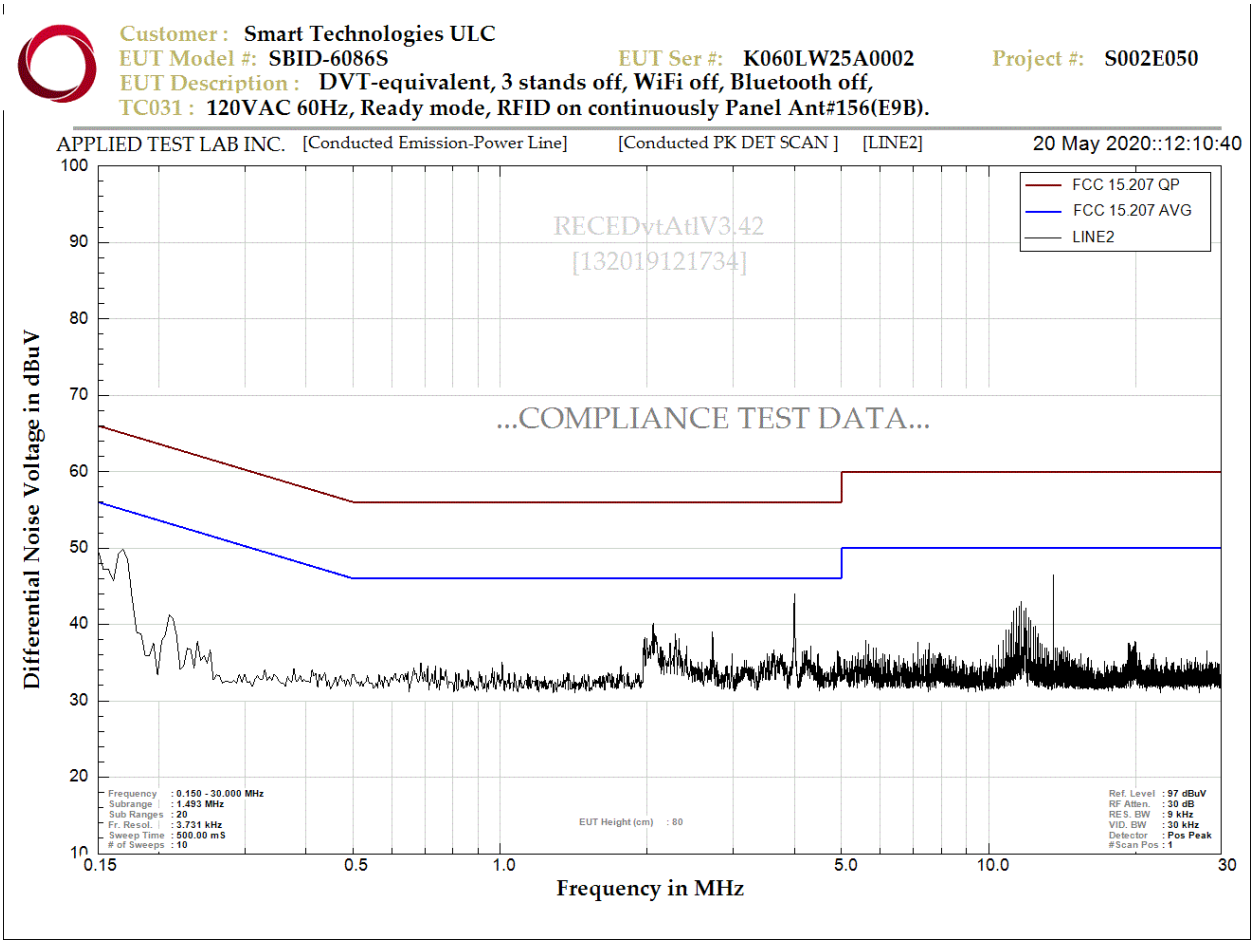

Figure 6.3 - AC Power Line Conducted Emission Scan Line 2 (Line N)

6.4 FCC 15 225(a) – (c) Radiated Spurious Emissions

☒**Applicable**

Table 6.6 - Radiated Spurious Emissions Test Setup Information (FCC 15C, section 15.225(a)-(c))

CLIENT:	**Smart Technologies Inc.**	**TEST STANDARD:**	**FCC 15C, Section 15.225**
MODEL NUMBER:	**IDS686-1**	**PRODUCT:**	**IDS686-1**
SERIAL NUMBER:	**K060LW25A0002**	**CLASS/LIMIT APPLIED:**	**FCC 15C, Section 15.225**
TEMPERATURE:	26°C	**HUMIDITY:**	20%
TESTED BY:	Adiseshu Nyshadham	**DATE OF TEST:**	2020-04-12
TEST REFERENCE:	FCC 15C, Section 15.225(a)-(c)		
TEST VOLTAGE:	120VAC 60Hz		
SETUP	The EUT is AC powered through an AC power supply. And is connected to a support laptop via USB using a Fiber optic extender link. The EUT is controlled by PC software to emit the specified signals for the purpose of measurements. The EUT is continuously transmitting at maximum power The EUT was tested in Ready mode. In this mode all RFID Tx and Rx circuitry is powered up and active. All Panel antennas were investigated. Antenna with worst case radiation was configured for this test. The test was performed with a spectrum analyzer and using an Active loop antenna. The RBW was set to 3 kHz, the VBW was set to 3kHz, ref level 77 dBuV, Attenuation 0dB, span 1.112MHz and detector was set to Peak.		
CHANNEL FREQUENCY	13.56MHz		
FREQUENCY RANGE	13.008-14.12 MHz		
MODULATION MODE	ASK		
FIRMWARE POWER SETTING	N/A		
CHANNEL NUMBER	1		
ANTENNA TYPE	Integral Loop		
MAX SPURIOUS EMISSION LEVEL	34.57 dBuV/m		
RESULTS:	**PASS**		

Table 6.7 - Radiated Spurious Emissions data (FCC 15C, Section 15.225(a)-(c))

Frequency range (MHz)	Frequency (MHz)	Field Strength at 3m (dBuV/m)	Limit @ 3m (dBuV/m)	Margin (dB)
13.008 – 13.110	13.09696	24.99	69.5	-44.51
13.110 – 13.410	13.29378	24.6	80.5	-55.9
13.410 – 13.553	13.55288	34.54	90.5	-55.96
13.553 – 13.567	13.56066	55.34	124	-68.66
13.567 – 13.710	13.56845	34.57	90.5	-55.93
13.710 – 14.010	13.87647	24.12	80.5	-56.38
14.010 – 14.120	14.01214	23.62	69.5	-45.88

Sample calculation
15,848 microvolts per meter at 30 m = 20*LOG10(15848) dBuV/m at 30 m
= 84.0 dBuV/m
Limit at 3m = Limit at 30m+40log(30/3)
124.0 dBuV/m = 84.0 dBuV/m +40 dB

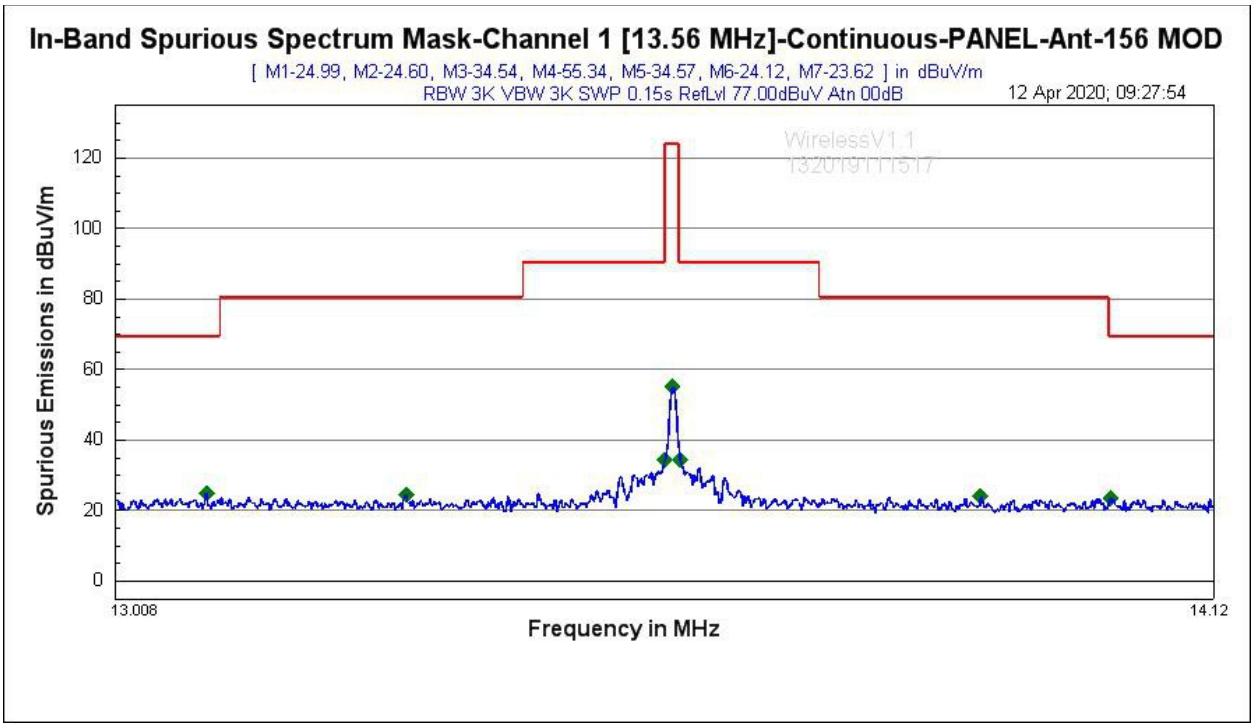

Figure 6.4 – In-band Spurious Spectrum Mask

6.5 FCC 15.209, 15 225(d) Radiated Spurious Emissions

☒**Applicable**

Table 6.8 - Radiated Spurious Emissions Test Setup Information (FCC 15C, Section 15.225(d))

CLIENT:	**Smart Technologies Inc.**	**TEST STANDARD:**	**FCC 15C, Section 15.225**
MODEL NUMBER:	**IDS686-1**	**PRODUCT:**	**IDS686-1**
SERIAL NUMBER:	**K060LW25A0002**	**CLASS/LIMIT APPLIED:**	**FCC 15C, Section 15.225**
TEMPERATURE:	26°C	**HUMIDITY:**	23%
TESTED BY:	Jaeheon Yun	**DATE OF TEST:**	2020-04-08 - 2020-04-09
TEST REFERENCE:	FCC 15C, Section 15.225(d)		
TEST VOLTAGE:	120VAC 60Hz		
SETUP	The EUT is AC powered through an AC power supply. And is connected to a support laptop via USB using a Fiber optic extender link. The EUT is controlled by PC software to emit the specified signals for the purpose of measurements. The EUT is continuously transmitting at maximum power The EUT was tested in Ready mode. In this mode all RFID Tx and Rx circuitry is powered up and active. All Panel antennas were investigated. Antenna with worst case radiation was configured for this test. The test was performed with a spectrum analyzer and using an Active loop antenna. The RBW was set to 3 kHz, the VBW was set to 3 kHz, ref level 77 dBuV, Attenuation 0dB, span 0.6MHz and detector was set to Peak for 9k-30M range and RBW was set to 100 kHz, the VBW was set to 300 kHz, ref level 77 dBuV, Attenuation 0dB, span 20.208MHz and detector was set to Peak for 30M -1000M range		
CHANNEL FREQUENCY	13.56MHz		
FREQUENCY RANGE	0.009MHz - 1000MHz		
MODULATION MODE	ASK		
FIRMWARE POWER SETTING	N/A		
CHANNEL NUMBER	1		
ANTENNA TYPE	Integral Loop		
MAX SPURIOUS EMISSION LEVEL	46.82 dBuV/m at 1.35 MHz 42.53 dBuV/m at 374.789 MHz		
RESULTS:	**PASS**		

Table 6.9 Radiated Emissions - **Vertical Polarization** Quasi-peak

Frequency (MHz)	Azimuth Angle (deg)	Antenna Height(cm)	Measured Reading (dBuV)	Correction Factor (dB)	Corrected Reading (dBuV/m)	FCC 15.209 Limit (dBuV/m)	Margin (dB)
1.35	273.9	100	31.77	15.05	46.82	65.02	-18.20

Table 6.10 - Radiated Emission - Horizontal Polarization Quasi-peak FCC

Frequency (MHz)	Azimuth Angle (deg)	Antenna Height (cm)	Measured Reading (dBuV)	Correction Factor (dB)	Corrected Reading (dBuV/m)	FCC 15.209 Limit (dBuV/m)	Margin (dB)
130.6438	292.2	248	23.33	14.52	37.85	43.52	-5.67
367.6208	28.9	300.3	16.32	22.75	39.07	46.02	-6.95
374.926	26.5	264.7	18.02	22.82	40.84	46.02	-5.18
570.008	213.9	112.7	9.17	27.25	36.42	46.02	-9.6
626.6935	226	399.7	0.17	29.16	29.33	46.02	-16.69
636.2233	25.8	399.9	2.11	29.23	31.34	46.02	-14.68

Table 6.11 - Radiated Emission - **Vertical** Polarization Quasi-peak FCC

Frequency (MHz)	Azimuth Angle (deg)	Antenna Height (cm)	Measured Reading (dBuV)	Correction Factor (dB)	Corrected Reading (dBuV/m)	FCC 15.209 Limit (dBuV/m)	Margin (dB)
70.16	256.9	103.3	19.12	13.48	32.6	40	-7.4
115.5975	39	100	23.75	14.63	38.38	43.52	-5.14
130.2165	253.6	103.1	25.53	14.44	39.97	43.52	-3.55
299.393	307.3	232.1	13.57	19.77	33.34	46.02	-12.68
374.789	116.2	175.3	19.71	22.82	42.53	46.02	-3.49
636.0563	313.9	100.2	7.95	29.23	37.18	46.02	-8.84

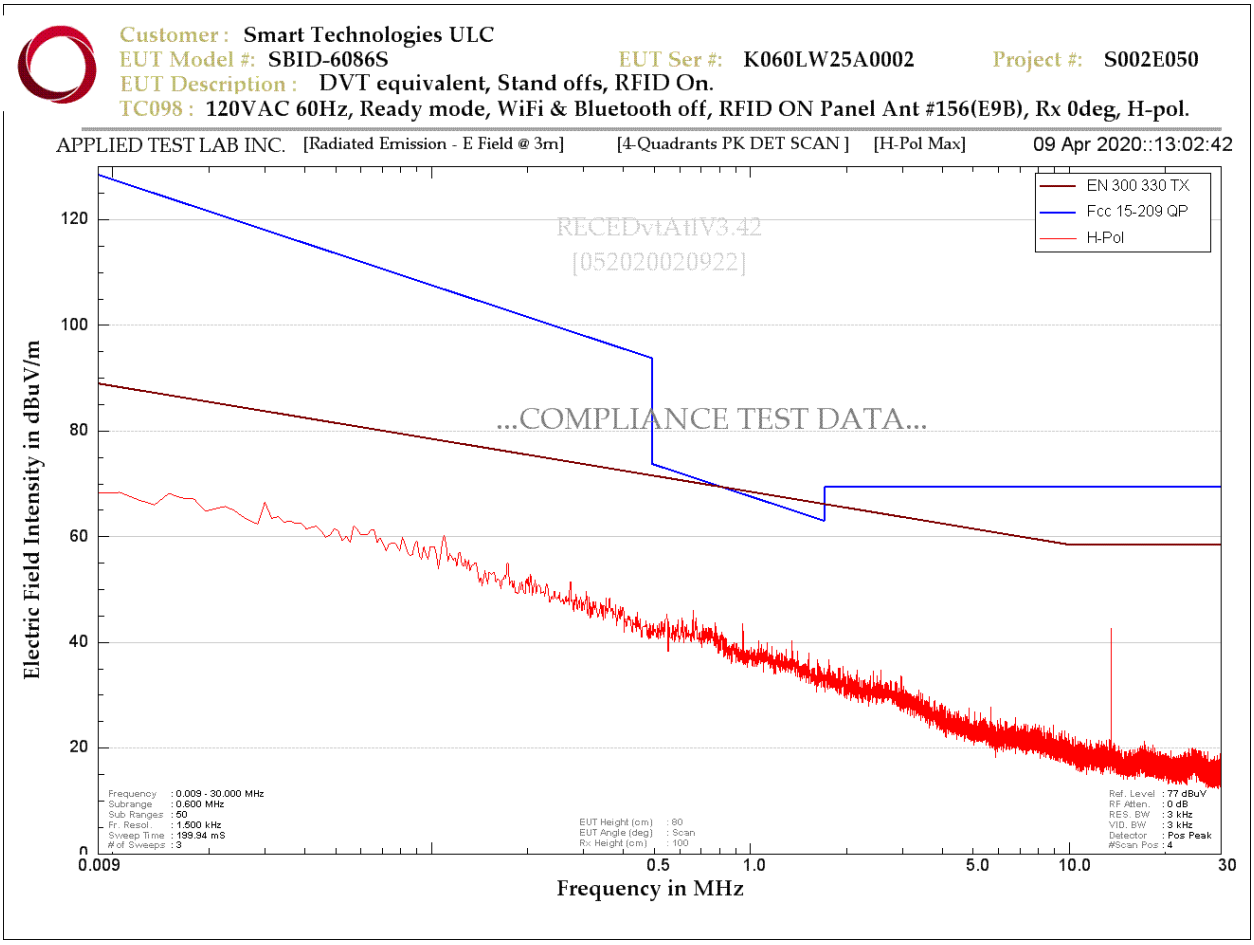

Figure 6.5 - Radiated Emission (FCC) - Scan Horizontal Polarization (0.009MHz – 30MHz)

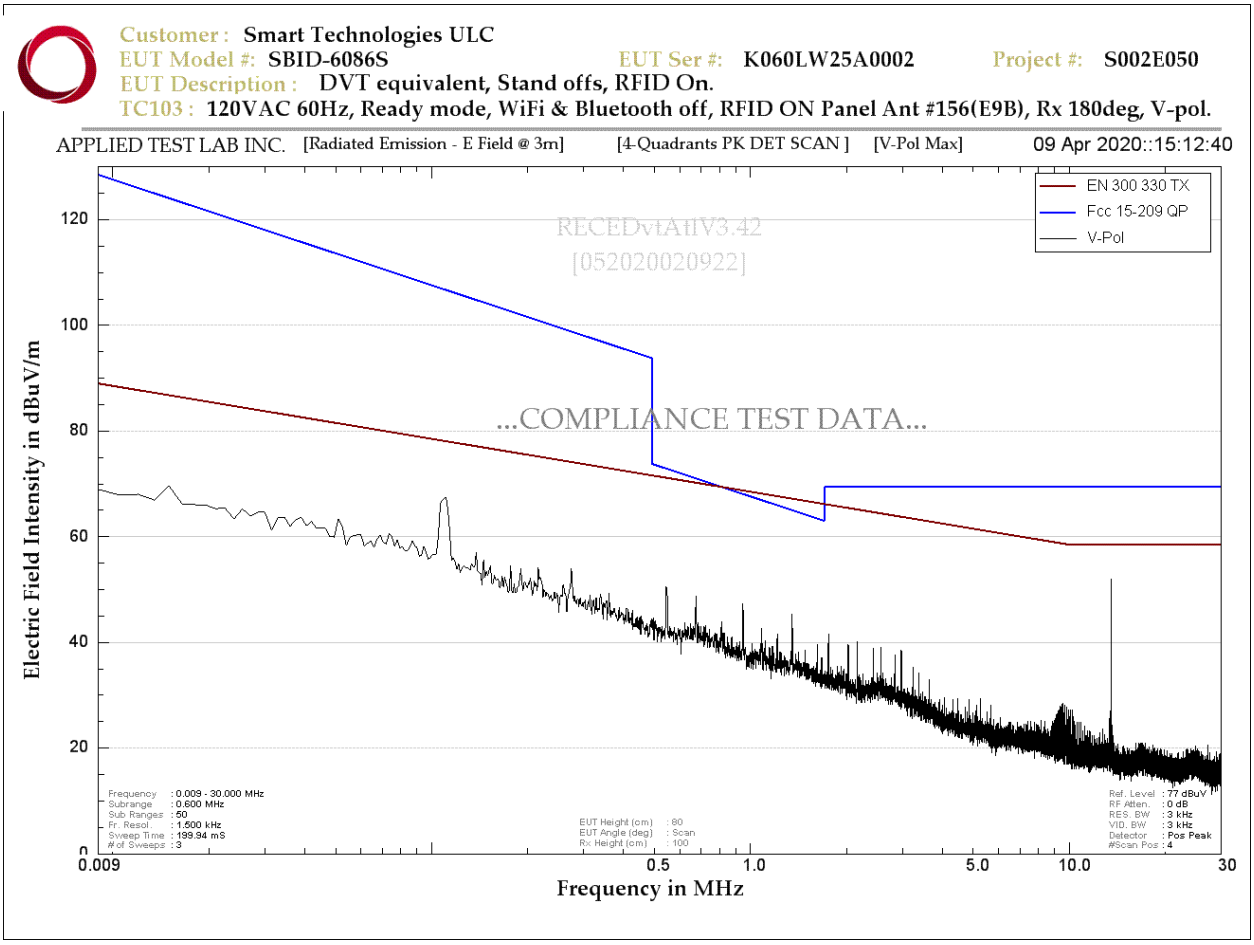

Figure 6.6 - Radiated Emission (FCC) - Scan Vertical Polarization (0.009MHz - 30MHz)

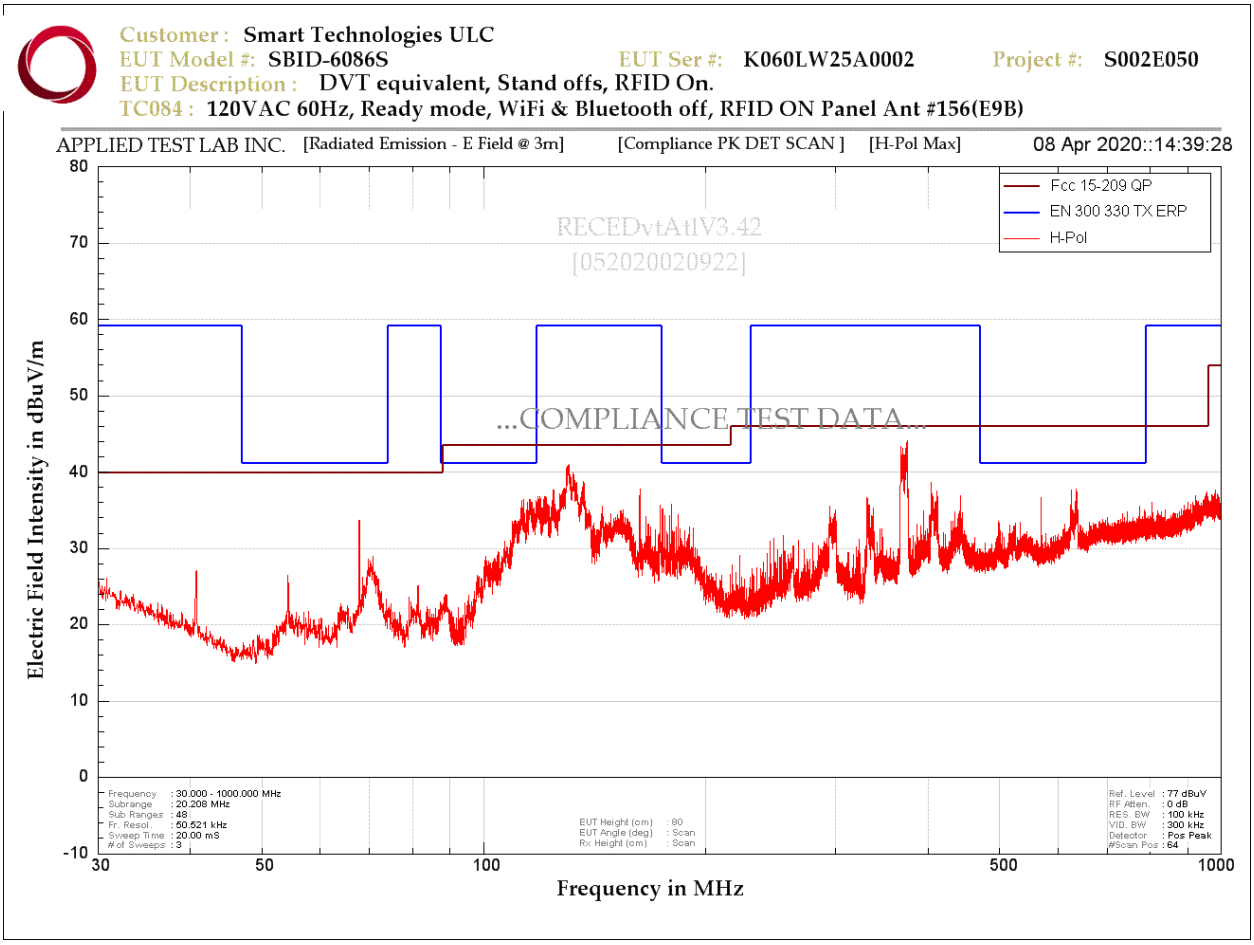

Figure 6.7 - Radiated Emission (FCC) - Scan Horizontal Polarization (30MHz - 1000MHz)

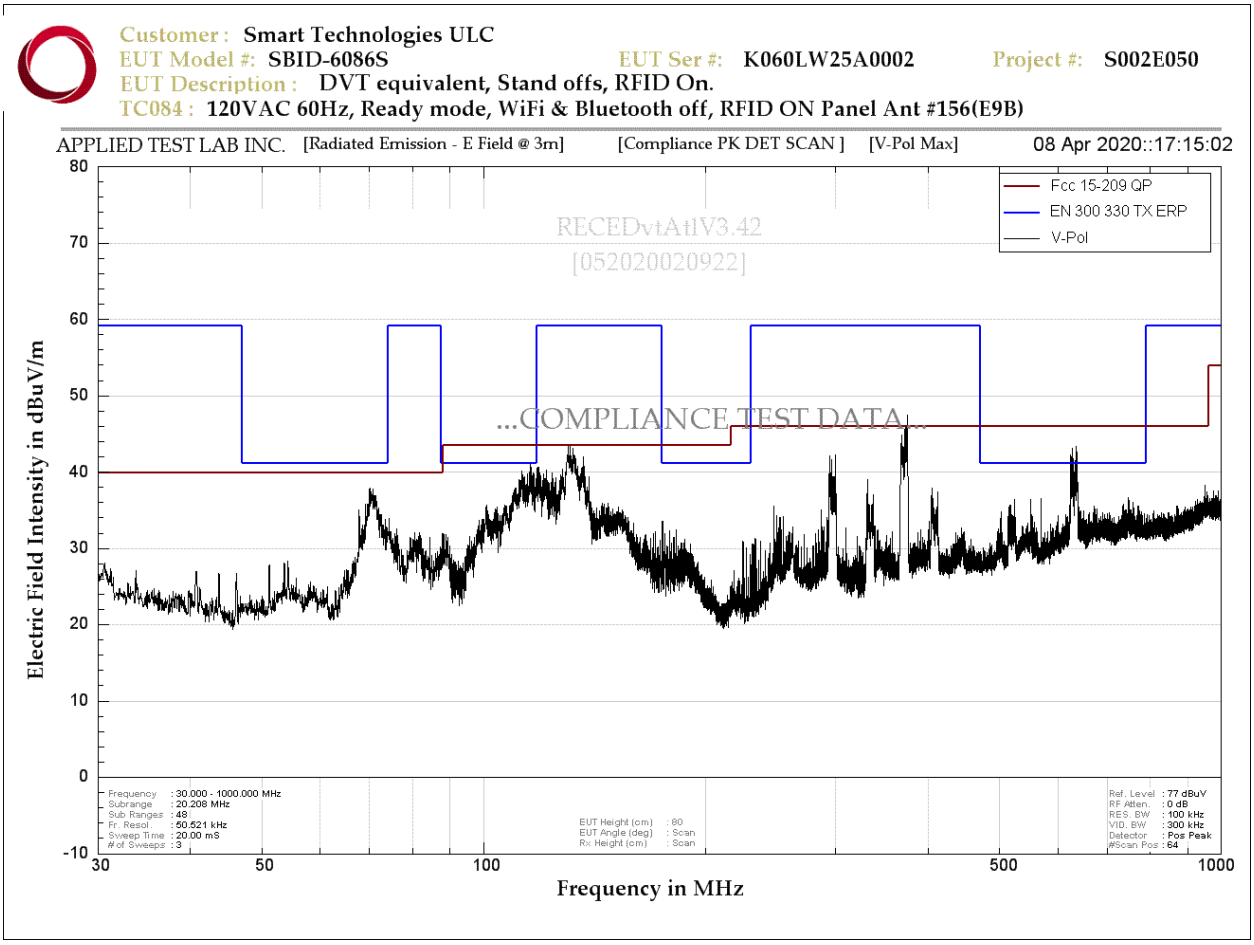

Figure 6.8 - Radiated Emission (FCC) - Scan Vertical Polarization (30MHz - 1000MHz)

6.6 FCC 15 225(e) Frequency Stability

☒**Applicable**

Table 6.12 - Frequency Stability Test Setup Information (FCC 15C, Section 15.225(e))

CLIENT:	**Smart Technologies Inc.**	**TEST STANDARD:**	**FCC 15C, Section 15.225**
MODEL NUMBER:	**IDS686-1**	**PRODUCT:**	**IDS686-1**
SERIAL NUMBER:	**K060LW25A0002**	**CLASS/LIMIT APPLIED:**	**FCC 15C, Section 15.225**
TEMPERATURE:	25°C	**HUMIDITY:**	56%
TESTED BY:	Jeremy Hebert	**DATE OF TEST:**	2020-04-20 – 2020-04-22
TESTREFERENCE:	FCC 15C, Section 15.225(e)		
TEST VOLTAGE:	120VAC 60Hz		
SETUP	The EUT is AC powered through an AC power supply. And is connected to a support laptop via USB. The EUT is controlled by PC software to emit the specified signals for the purpose of measurements. The EUT is continuously transmitting at maximum RF power. The EUT was tested in Normal mode. In this mode all RFID Tx and Rx circuitry is powered up and active. All Panel antennas were investigated. Antenna with worst case radiation was configured for this test. The test was performed with a spectrum analyzer and using an Active loop antenna. The RBW was set to 3 kHz, the VBW was set to 10 kHz, ref level 77 dBuV, Attenuation 0dB, span 20kHz and detector was set to Peak. The span, RBW, and VBW on the spectrum analyzer were adjusted to ensure significant accuracy when measuring the center frequency.		
CHANNEL FREQUENCY	13.56MHz		
MODULATION MODE	ASK		
FIRMWARE POWER SETTING	N/A		
CHANNEL NUMBER	1		
ANTENNA TYPE	Integral Loop		
FREQUENCY DEVIATION	0.009152%		
RESULTS:	**PASS**		

Table 6.13 – Frequency over a temperature variation of -20 degree to +50 degrees C

Power Supply	Temperature (℃)	Measured Frequency (MHz)	Frequency Error	FCC 15C, Section 15.225 Limit
120VAC	50	13.561104	0.008038%	+/- 0.01%
	40	13.561252	0.008429%	+/- 0.01%
	30	13.561220	0.008732%	+/- 0.01%
	20	13.561220	0.008709%	+/- 0.01%
	10	13.561220	0.008923%	+/- 0.01%
	0	13.561236	0.009062%	+/- 0.01%
	-10	13.561252	0.009152%	+/- 0.01%
	-20	13.561252	0.009122%	+/- 0.01%

Table 6.14 – Variation in the primary voltage from 85% to 115% of the rated supply voltage at 20 degree C

Power Supply	Temperature (℃)	Measured Frequency (MHz)	Frequency Error	FCC 15C, Section 15.225 Limit
102V(85 %)	20	13.561200	0.008850%	+/- 0.01%
138V(115 %)	20	13.561168	0.008614%	+/- 0.01%

7.0 Appendix A – Test Sample Description

EUT Description

The SMART Technologies Interactive Flat Panel (Regulatory model IDS686-1) provides an innovative touch and tool experience in a 4K Ultra HD LED display. The proprietary simultaneous tool differentiation and unlimited tool ID technology, you can assign and use a wide range of accessories at the display's surface. Multitouch capabilities enable up to 20 simultaneous interaction points. provides optimal image clarity and wide viewing angles.

8.0 Appendix B – List of Abbreviations and Acronyms

Industrial, scientific and medical (ISM) applications (of radio frequency energy)
operation of equipment or appliances designed to generate and use locally radio frequency energy for industrial, scientific, medical, domestic or similar purposes, excluding applications in the field of telecommunications

ISM equipment and appliances
equipment or appliances designed to generate and/or use locally radio-frequency energy for industrial, scientific, medical, domestic or similar purposes, excluding applications in the field of telecommunications and information technology and other applications covered by other CISPR publications

Electromagnetic radiation

1. phenomenon by which energy in the form of electromagnetic waves emanates from a source into space
2. energy transferred through space in the form of electromagnetic waves

Boundary of the equipment under test
imaginary straight line periphery describing a simple geometric configuration encompassing the equipment under test. All interconnecting cables are included within this boundary

Electro-discharge machining (EDM) equipment
all the necessary units for the spark erosion process including the machine tool, the generator, control circuits, the working fluid container and integral devices

Spark erosion
removal of material in a dielectric working fluid by electro-discharges, which are separated in time and randomly distributed in space, between two electrically conductive electrodes (the tool electrode and the work piece electrode), and where the energy in the discharge is controlled

Arc welding equipment
equipment for applying current and voltage and having the required characteristics suitable for arc welding and allied processes

Equipment for resistance welding and allied processes
all equipment associated with carrying out the processes of resistance welding or allied processes consisting of e.g. power source, electrodes, tooling and associated control equipment, which may be a separate unit or part of a complex machine

Low voltage LV
a set of voltage levels used for the distribution of electricity and whose upper limit is generally accepted to be 1 000 V a.c.

End of document