ENGINEERING TEST REPORT

IXM TITAN
Model: IXM501
FCC ID: S38-TIENXP

Applicant:

Invixium Access Inc.
50 Acadia Avenue, Suite 310
Markham, Ontario
Canada L3R 0B3

In Accordance With
Federal Communications Commission (FCC)
Part 15, Subpart C, Section 15.209

UltraTech's File No.: 19INVX080_FCC15C209

This Test report is Issued under the Authority of Tri M. Luu Vice President of Engineering UltraTech Group of Labs Date: July 15, 2019	
Report Prepared by: Dan Huynh Issued Date: July 15, 2019	Tested by: Nimisha Desai Test Date(s): May 23 & 24, 2019

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EXHIBIT 1. INTRODUCTION

1.1. SCOPE

Reference:	FCC Part 15, Subpart C
Title:	Code of Federal Regulations (CFR), Title 47 – Telecommunication, Part 15 – Radio Frequency Devices
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	2018	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:	Invixium Access Inc.
Address:	#310-50 Acadia Avenue Markham, Ontario Canada L3R 0B3
Contact Person:	Shiraz Kapadia Phone #: 1-647-282-1745 Fax #: N/A Email Address: skapadia@invixium.com

Manufacturer	
Name:	Mara Technologies Inc.
Address:	5680 14th Avenue Markham, Ontario Canada L3S 3K8
Contact Person:	Matthew Ruscica Phone #: 1-905-201-1787 Fax #: 1-905-201-9114 Email Address: matthew@maratech.ca

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:	Invixium Access Inc.
Product Name:	IXM TITAN
Model Name or Number:	IXM501
Serial Number:	Test sample
Type of Equipment:	Part 15 Low Power Transmitter Below 1705 kHz
Input Power Supply Type:	12-24V DC external power supply / Power over Ethernet (PoE)
Primary User Functions of EUT:	Identify person based on fingerprint, and/or face, and/or smart or proximity card, send data to Access Control Panel to open the door. Device can control the door by itself. Device can send the data to a Time & Attendance software.

2.3. EUT'S TECHNICAL SPECIFICATIONS

Transmitter	
Intended Operating Environment:	Residential Commercial, light industry & heavy industry
Power Supply Requirement:	5V, 3.3V DC
RF Output Power Rating:	61.11 dBµV/m peak at 3m distance
Operating Frequency Range:	128 kHz
20 dB Bandwidth:	4.73 kHz
Modulation Type:	Unmodulated carrier
Oscillator Frequencies:	24 MHz +/-2%
Antenna Connector Type:	Integral, Invixium Access Inc. 125 kHz Loop antenna (860uH coil)

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	Vin+, Vin- Power (12-24VDC)	1	J8 (header 32x2)	Non-shielded
2	Wiegand Input (2 Lines)	1	J8	Non-shielded
3	Wiegand Output (2 Lines)	1	J8	Non-shielded
4	RS-485 (3 lines)	1	J8	Non-shielded
5	*RS-232 (Tx, Rx)	1	J8	Non-shielded
6	*USB 2.0 OTG	1	USB uAB	Shielded
7	Ethernet	1	RJ-45	Non-shielded
8	Form C Relay, 3 lines	1	J8	Non-shielded
9	General Purpose Output	3	J7 (header 30x2)	Non-shielded
10	General Purpose Input	3	J7	Non-shielded
11	General Purpose I/O for Door control (open/closed, ReX, Fire Alarm)	4	J7	Non-shielded
12	GND for different interfaces	4	J7, J8	Non-shielded
13	RS-485 GND	1	J8	Non-shielded
14	EGND Earth Ground	1	J8	Non-shielded
15	DS_OUT	1	J7	Non-shielded
16	HDMI	1	HDMI	Non-shielded
17	HS USB	2	J7	Non-shielded

* Used for service by administrator only.

2.5. ANCILLARY EQUIPMENT

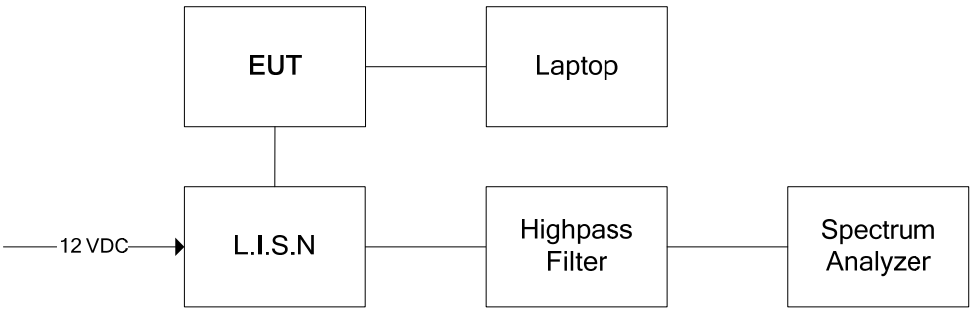
The EUT was tested while connected to the following representative configuration of ancillary equipment necessary to exercise the ports during tests:

1) Invixium Proximity Card
2) Gigabit PoE+ Injector, Model: POE-I100G, S/N: 201811011167

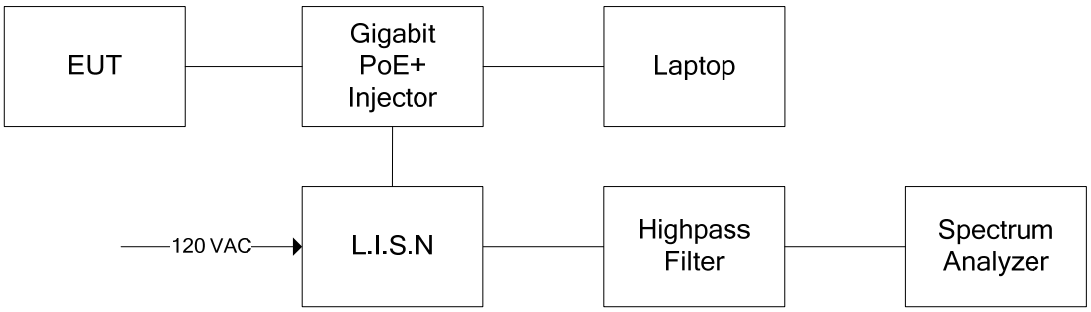
2.6. TEST SETUP BLOCK DIAGRAM

2.6.1. Conducted Emissions

EUT Powered by External DC Power Supply

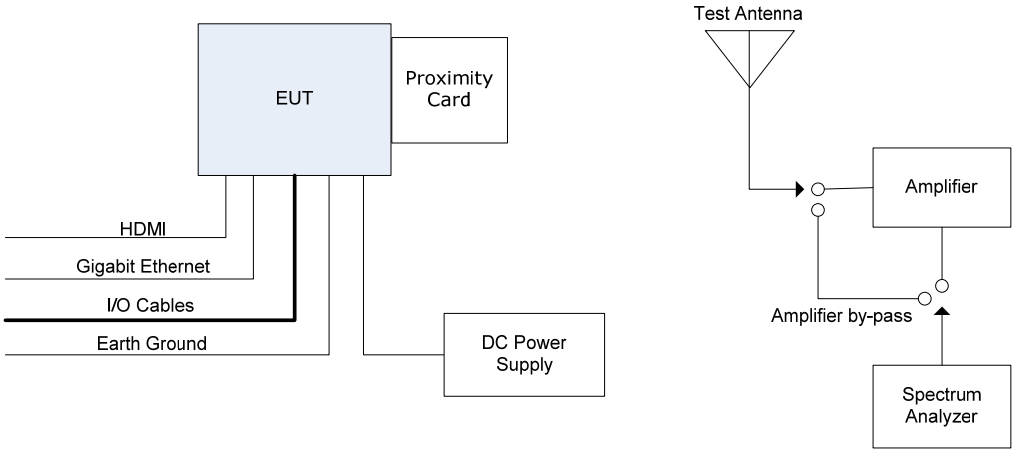


EUT Powered by PoE Injector Power over Ethernet



2.6.2. Radiated Emissions

EUT Powered by External DC Power Supply



EUT Powered by PoE Injector Power over Ethernet

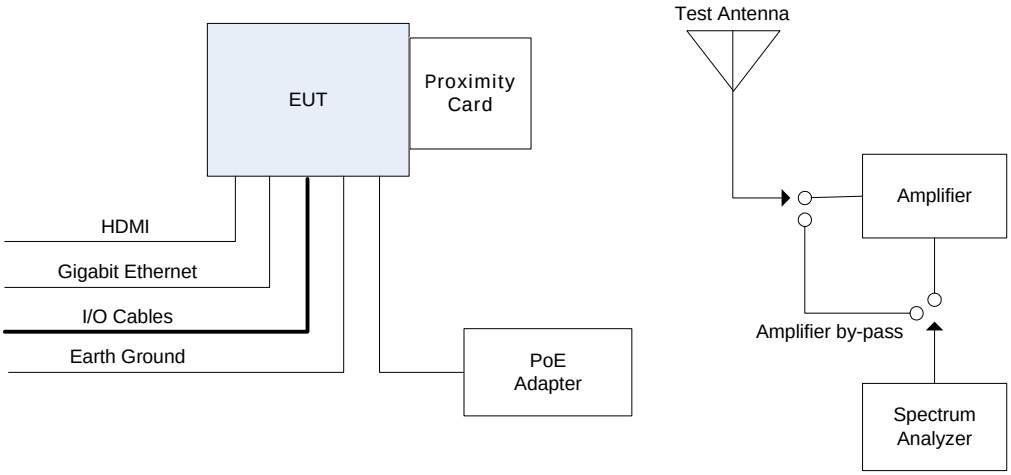


EXHIBIT 3. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

3.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

Temperature:	21 to 23 ^{o}C
Humidity:	45 to 58%
Pressure:	102 kPa
Power input source:	12-24V DC / Power over Ethernet (PoE)

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:	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):	128 kHz
Test Frequency(ies):	128 kHz
RF Power Output:	61.11 dBµV/m Peak at 3m distance
Normal Test Modulation:	Unmodulated carrier
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

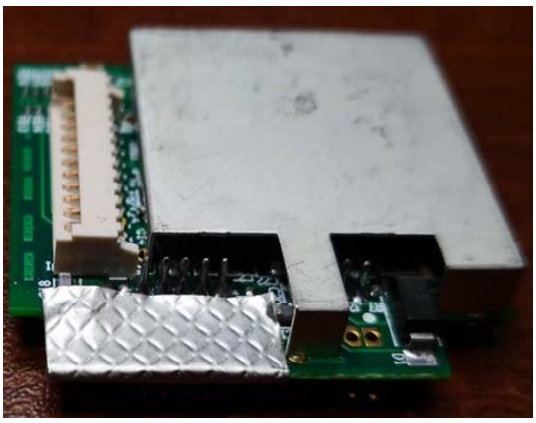
FCC Section(s)	Test Requirements	Compliance (Yes/No)
15.203	Antenna Requirement	Yes*
15.207(a)	Power Line Conducted Emissions	Yes
15.209(a)	20 dB Bandwidth	Yes
15.209	Transmitter Radiated Emissions - Fundamental, Harmonic and Spurious Emissions	Yes

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

4.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

The following modification(s) implemented for compliance:

EMI Tape, P/N 10X11.7-10-AB6005S, (3M) is applied on 5-pin through-hole connector between the RFID module and antenna.



- Introduced 4.7KOhm on EGND line. R307 (0R 0805) becomes 4K7 0805 (on SOM Carrier Board)
- Pieces of ferrite absorber sheet (AB5050S, Mfg. 3M) placed on 4 places

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

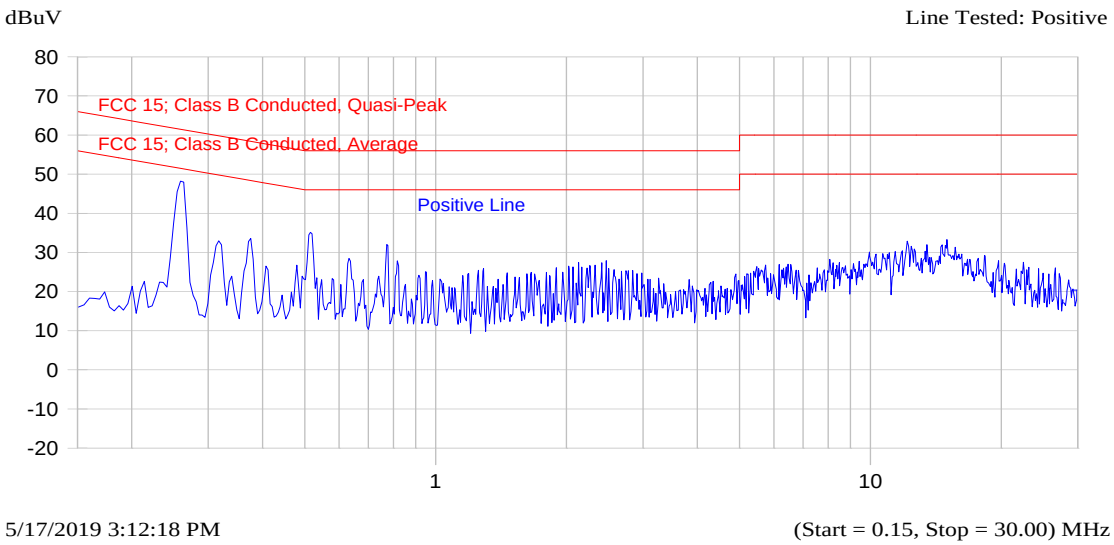
5.1.2. Method of Measurements

ANSI C63.4

5.1.3. Test Data

Plot 5.1.3.1. Power Line Conducted Emissions (EUT with a dummy load)
Line Voltage: 12 VDC; Line Tested: Positive

Current Graph

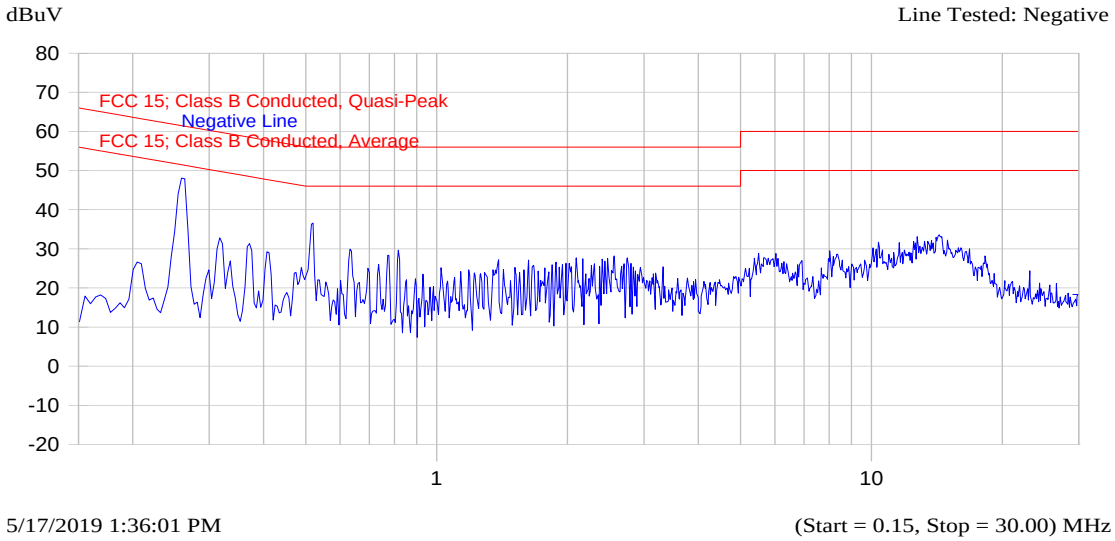


Current List

Frequency MHz	Peak dBuV	QP dBuV	Qp_Qp Limit dB	Avg dBuV	Avg_Avg Limit dB	Trace Name
0.257	48.8	48.0	-13.6	47.9	-3.7	Positive Line
0.314	37.2	33.3	-26.6	32.5	-17.3	Positive Line
0.370	33.0	31.3	-27.2	29.0	-19.5	Positive Line
0.513	39.3	36.0	-20.0	35.1	-10.9	Positive Line
0.771	32.7	31.5	-24.5	30.2	-15.8	Positive Line
14.998	26.6	21.8	-38.2	16.9	-33.1	Positive Line

Plot 5.1.3.2. Power Line Conducted Emissions (EUT with a dummy load)
Line Voltage: 12 VDC; Line Tested: Negative

Current Graph

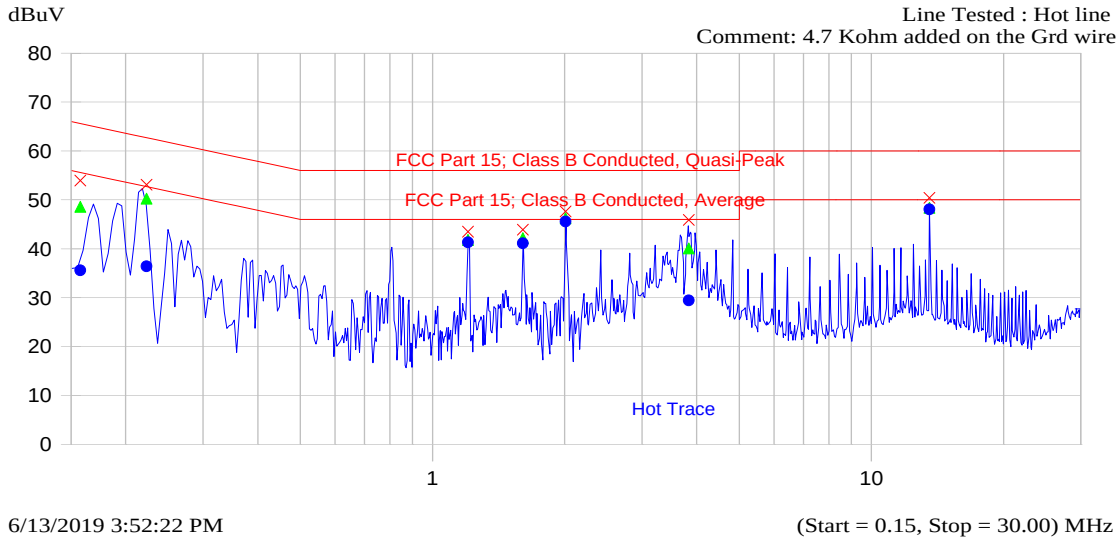


Current List

Frequency MHz	Peak dBuV	QP dBuV	Qp_Qp Limit dB	Avg dBuV	Avg_Avg Limit dB	Trace Name
0.257	48.3	47.9	-13.6	47.8	-3.7	Negative Line
0.314	36.7	32.9	-27.0	32.3	-17.5	Negative Line
0.371	26.8	26.8	-31.6	12.3	-36.1	Negative Line
0.399	28.4	25.8	-32.1	21.8	-26.1	Negative Line
0.514	39.2	36.4	-19.6	35.6	-10.4	Negative Line
0.629	31.1	28.0	-28.0	26.7	-19.3	Negative Line
0.814	29.5	26.2	-29.8	25.0	-21.0	Negative Line
14.092	34.6	30.0	-30.0	22.2	-27.8	Negative Line

Plot 5.1.3.3. Power Line Conducted Emissions (EUT with the antenna connected)
PoE, Line Voltage120 VAC; Line Tested: Hot

Current Graph

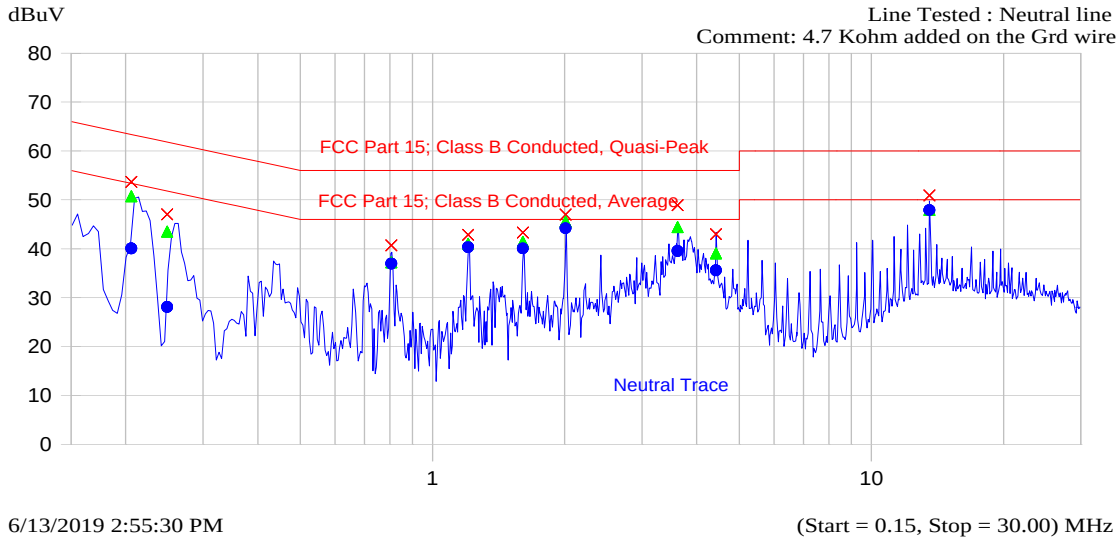


Current List

Frequency MHz	Peak dBuV	QP dBuV	Qp-Qp Limit dB	Avg dBuV	Avg-Avg Limit dB	Trace Name
0.158	54.0	48.6	-17.0	35.6	-20.0	Hot Trace
0.223	53.1	50.2	-12.5	36.4	-16.3	Hot Trace
1.205	43.5	41.8	-14.2	41.3	-4.7	Hot Trace
1.606	43.9	42.2	-13.8	41.1	-4.9	Hot Trace
2.009	47.6	46.2	-9.8	45.6	-0.4	Hot Trace
3.834	45.9	40.1	-15.9	29.4	-16.6	Hot Trace
13.563	50.4	48.4	-11.6	48.1	-1.9	Hot Trace

Plot 5.1.3.4. Emissions (EUT with the antenna connected)
PoE, Line Voltage120 VAC; Line Tested: Neutral

Current Graph



Current List

Frequency MHz	Peak dBuV	QP dBuV	Qp-Qp Limit dB	Avg dBuV	Avg-Avg Limit dB	Trace Name
0.206	53.7	50.7	-12.6	40.1	-13.3	Neutral Trace
0.248	47.0	43.5	-18.3	28.1	-23.7	Neutral Trace
0.806	40.7	37.2	-18.8	37.0	-9.0	Neutral Trace
1.205	42.9	41.0	-15.0	40.3	-5.7	Neutral Trace
1.606	43.3	41.4	-14.6	40.1	-5.9	Neutral Trace
2.010	47.0	45.6	-10.4	44.2	-1.8	Neutral Trace
3.617	48.9	44.4	-11.6	39.5	-6.5	Neutral Trace
4.424	43.0	39.1	-16.9	35.6	-10.4	Neutral Trace
13.563	50.9	48.0	-12	47.9	-2.1	Neutral Trace

5.2. TRANSMITTER RADIATED EMISSIONS [47 CFR §§ 15.209 & 15.205]

5.2.1. Limit(s)

§ 15.209 Radiated emission limits; general requirements.

(a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/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

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§ 15.231 and 15.241.

(b) In the emission table above, the tighter limit applies at the band edges.

(c) The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission. For intentional radiators which operate under the provisions of other sections within this part and which are required to reduce their unwanted emissions to the limits specified in this table, the limits in this table are based on the frequency of the unwanted emission and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.

(d) The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

(e) The provisions in §§15.31, 15.33, and 15.35 for measuring emissions at distances other than the distances specified in the above table, determining the frequency range over which radiated emissions are to be measured, and limiting peak emissions apply to all devices operated under this part.

(f) In accordance with §15.33(a), in some cases the emissions from an intentional radiator must be measured to beyond the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator because of the incorporation of a digital device. If measurements above the tenth harmonic are so required, the radiated emissions above the tenth harmonic shall comply with the general radiated emission limits applicable to the incorporated digital device, as shown in §15.109 and as based on the frequency of the emission being measured, or, except for emissions contained in the restricted frequency bands shown in §15.205, the limit on spurious emissions specified for the intentional radiator, whichever is the higher limit. Emissions which must be measured above the tenth harmonic of the highest fundamental frequency designed to be emitted by the

intentional radiator and which fall within the restricted bands shall comply with the general radiated emission limits in §15.109 that are applicable to the incorporated digital device.

(g) Perimeter protection systems may operate in the 54-72 MHz and 76-88 MHz bands under the provisions of this section. The use of such perimeter protection systems is limited to industrial, business and commercial applications.

5.2.2. Method of Measurements

ANSI C63.10 for measurement methods.

5.2.3. Test Data

Remarks:

- The measuring receiver shall be tuned over the frequency range 10 kHz to 1 GHz.
- All spurious emissions that are in excess of 20 dB below the specified limit shall be recorded.
- EUT was initially tested at 3m and the value measured at 3m shall be extrapolated as applicable to compare with limit and measurement distance specified in section 15.209(a).

5.2.3.1. Fundamental Emissions

Remarks:

- Field strength limit of the fundamental 128 kHz at 300m distance is 20*log(2400/128) = 25.5 dBµV/m
- For frequency band 0.009- 0.490 MHz, the measured E-Field at 3m (column 2) will be extrapolated to 300m E-Field Level (column 3) using the extrapolation factor of 40*log(3/300) = -80 dB

EUT Powered by External DC Power Supply					
Frequency (MHz)	**Peak E-Field @ 3m (dBµV/m)**	**Extrapolated E-Field Level @ 300m (dBµV/m)**	**Antenna Plane (H/V)**	**§ 15.209 (a) Limits @ 300m (dBµV/m)**	**Margin (dB)**
128	57.45	-22.55	V	25.5	-48.1
128	61.11	-18.89	H	25.5	-44.4

EUT Powered by PoE Injector Power over Ethernet					
Frequency (MHz)	**Peak E-Field @ 3m (dBµV/m)**	**Extrapolated E-Field Level @ 300m (dBµV/m)**	**Antenna Plane (H/V)**	**§ 15.209 (a) Limits @ 300m (dBµV/m)**	**Margin (dB)**
128	59.29	-20.71	V	25.5	-46.2
128	61.09	-18.91	H	25.5	-44.4

5.2.3.2. Harmonic/Spurious Emissions

Remarks:

- For frequency band 0.009- 0.490 MHz, the measured E-Field at 3m (column 2) will be extrapolated to 300m E-Field Level (column 3) using the extrapolation factor of 40*log(3/300) = -80 dB
- For frequency bands 0.490-1.705 MHz and 1.705-30.0 MHz, the measured E-Field at 3m (column 2) will be extrapolated to 30m E-Field Level (column 3) using the extrapolation factor of 40*log(3/30) = -40 dB

Frequency (MHz)	Peak E-Field @ 3m (dBµV/m)	Extrapolated E-Field Level (dBµV/m)	Antenna Plane (H/V)	§ 15.209 (a) Limits (dBµV/m)	Margin (dB)
0.009 - 0.490	*	*	H / V	*	*
0.490 - 1.705	*	*	H / V	*	*
1.705 - 30.0	*	*	H / V	*	*

* No emissions or harmonics were detected within 20 dB of the limit.

5.3. 20 dB BANDWIDTH [47 CFR 15.209 (a)]

5.3.1. Limit(s)

Emission bandwidth shall not be located in the restricted bands in 15.205 and the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz.

5.3.2. Method of Measurements

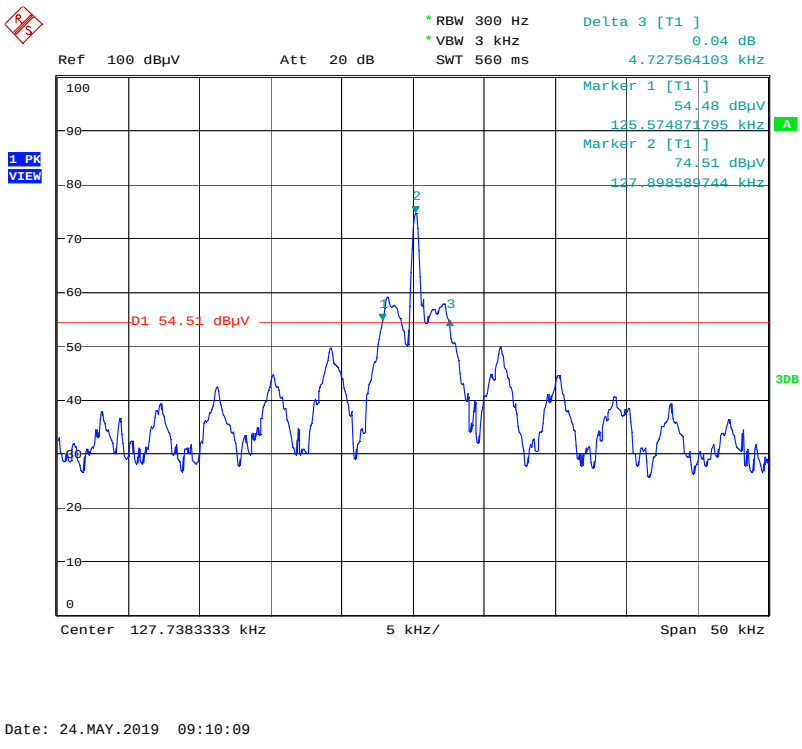
ANSI C63.10

5.3.3. Test Data

Channel Frequency	20 dB Bandwidth	99 %Occupied Bandwidth
128 kHz	4.73 kHz	12.34 kHz

See the following plot for details.

Plot 5.3.3.1. 20 dB Bandwidth, Fc: 128 kHz



Plot 5.3.3.2. 99% Occupied Bandwidth, Fc: 128 kHz

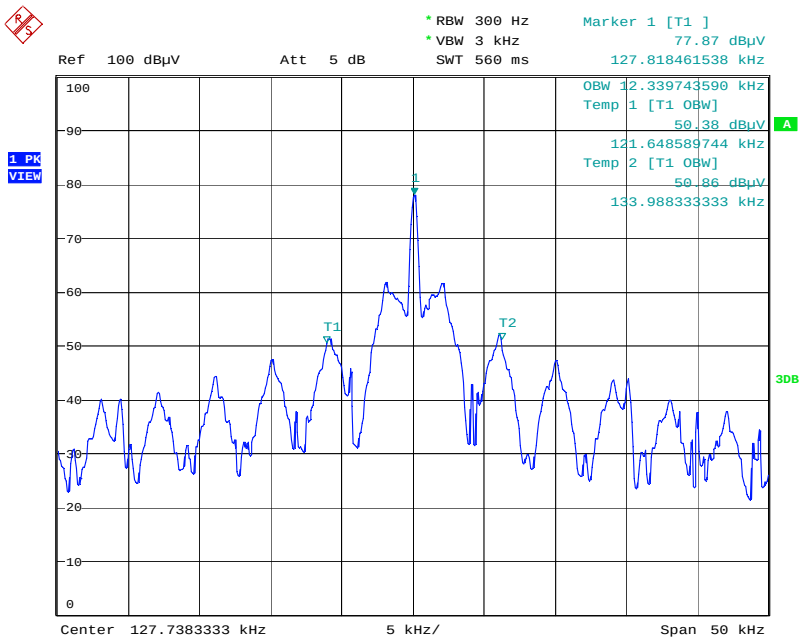


EXHIBIT 6. TEST EQUIPMENT LIST

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range	Cal. Due Date
Spectrum Analyzer	Rohde & Schwarz	FSU26	100398	20 Hz – 26.5 GHz	06 Oct 2019
Loop Antenna	EMCO	6502	9104-2611	0.01 – 30 MHz	15 Dec 2019
EMI Receiver	Rohde & Schwarz	ESU40	100037	20 Hz – 40 GHz	15 Mar 2020
RF Amplifier	Com-Power	PAM-0118A	551052	0.5 – 18 GHz	26 Jul 2019
Loop Antenna	EMCO	6502	9104-2611	0.01 – 30 MHz	15 Dec 2019
Biconilog	EMCO	3142B	1575	26 - 2000 MHz	10 May 2020
Horn Antenna	EMCO	3115	9701-5061	1 - 18 GHz	30 Apr 2020
Power Supply	BK Precision	1740	1550497	0 - 60V, DC	See Note 1
Multimeter	Fluke	8842A	4142058	---	05 Sep 2020
Spectrum Analyzer	Hewlett Packard	HP 8593EM	3710A00223	9 kHz - 22 GHz	13 May 2020
Highpass Filter	Rohde & Schwarz	EZ-25	100064	150 kHz - 30 MHz	17 Jul 2019
LISN	EMCO	3825/2R	1165	10 kHz - 30 MHz	18 Oct 2019
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.

7.1. 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**

7.2. RADIATED EMISSION MEASUREMENT UNCERTAINTY

	Radiated Emission Measurement Uncertainty (10 kHz - 30 MHz):	**Measured (dB)**	**Limit (dB)**
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{I=1}^{m} u_i^2(y)}$	**± 1.30**	**± 2.6**
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 2.60**	**± 5.2**

	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**