

Fiber Mountain, Inc.

TEST REPORT

SCOPE OF WORK

EMC TESTING – SENSUS

REPORT NUMBER

103382409BOX-010

ISSUE DATE

05-June-2018

[REVISED DATE]

PAGES

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DOCUMENT CONTROL NUMBER

Non-Specific Radio Report Shell Rev. December 2017

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EMISSIONS TEST REPORT
(FULL COMPLIANCE)

Report Number: 103382409BOX-010

Project Number: G103382409

Report Issue Date: 06/05/2018

Model(s) Tested: SENSUS

Model(s) Partially Tested: None

Model(s) Not Tested but declared equivalent by the client: None

Standards: CFR47 FCC Part 15 Subpart C:2018 Section 15.225,
CFR47 FCC Part 15 Subpart B:2018,
ISED RSS-210 Issue 9 August 2016 (Amendment), Annex B.6,
ISED RSS-Gen Issue 5 April 2018,
ISED ICES-003 Issue 6 April 2017

Tested by:
Intertek Testing Services NA, Inc.
70 Codman Hill Road
Boxborough, MA 01719
USA

Client:
Fiber Mountain, Inc.
700 W Johnson Avenue
Cheshire, CT 06410
USA

Report prepared by



Kouma Sinn / EMC Staff Engineer

Report reviewed by



Vathana Ven / EMC Staff Engineer

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1 Introduction and Conclusion

The tests indicated in section 2.0 were performed on the product constructed as described in section 4.0. The remaining test sections are the verbatim text from the actual data sheets used during the investigation. These test sections include the test name, the specified test Method, a list of the actual Test Equipment Used, documentation Photos, Results and raw Data. No additions, deviations, or exclusions have been made from the standard(s) unless specifically noted.

Based on the results of our investigation, we have concluded the product tested **complies** with the requirements of the standard(s) indicated. The results obtained in this test report pertain only to the item(s) tested. Intertek does not make any claims of compliance for samples or variants which were not tested.

2 Test Summary

Section	Test full name	Result
3	Client Information	--
4	Description of Equipment Under Test	--
5	System Setup and Method	--
6	Fundamental Radiated Emissions FCC Part 15 Subpart C:2018 15.225(a), (b), (c), (d) ISED RSS-210 Issue 9 August 2016 (Amendment), Annex B.6 (a), (b), (c)	Pass
7	Transmitter Spurious Emissions Below 30MHz FCC Part 15 Subpart C:2018 15.209, 15.225(d) ISED RSS-210 Issue 9 August 2016 (Amendment), Annex B.6 (d)	Pass
8	Transmitter Spurious Emissions Above 30MHz FCC Part 15 Subpart C:2018 15.209, 15.225(d) ISED RSS-210 Issue 9 August 2016 (Amendment), Annex B.6 (d)	Pass
--	Receiver Spurious Emissions Below 30MHz FCC Part 15 Subpart B:2018 15.109 ISED RSS-Gen Issue 5 April 2018, Section 7.3	N/A*
9	Receiver Spurious Emissions Above 30MHz FCC Part 15 Subpart B:2018 15.109, CFR47 FCC Part 15 Subpart B:2018 ISED ICES-003 Issue 6 April 2017, ISED RSS-Gen Issue 5 April 2018, Section 7.3	Pass
10	20dB Bandwidth FCC Part 15 Subpart C:2018 15.215 ISED RSS-210 Issue 9 August 2016 (Amendment), Annex B.6 (d) ISED RSS-Gen Issue 5 April 2018, Section 6.7	Pass
11	Frequency Stability FCC Part 15 Subpart C:2018 15.225(e) ISED RSS-210 Issue 9 August 2016 (Amendment), Annex B.6 ISED RSS-Gen Issue 5 April 2018, Section 6.11	Pass
12	AC Mains Conducted Emissions FCC Part 15 Subpart C:2018 15.207 ISED RSS-Gen Issue 5 April 2018, Section 8.8, ISED ICES-003 Issue 6 April 2017	--
13	Revision History	--

* - no limits below 30 MHz

3 Client Information

This EUT was tested at the request of:

Client: Fiber Mountain, Inc.
700 W Johnson Avenue
Cheshire, CT 06410
USA

Contact: David Stone
Telephone: 203-806-4048
Fax: None
Email: david@fibermountain.com

4 Description of Equipment Under Test and Variant Models

Manufacturer: Fiber Mountain, Inc
700 W Johnson Avenue
Cheshire, CT 06410
USA

Equipment Under Test			
Description	Manufacturer	Model Number	Serial Number
Sensus	Fiber Mountain, Inc	SENSUS	5781328101429

Receive Date:	01/29/2018
Received Condition:	Good
Type:	Production

Description of Equipment Under Test (provided by client)
The Sensus Fiber Port Aggregator chassis contains one management module and two fiber patching modules. An Ethernet interface provides management functions into the chassis to communicate with the onboard processor to enable LEDs to provide alarm and status information. It is powered by redundant 100-240 Vac internal power supplies by detachable cords for indoor use only or by Power Over Ethernet. The device is not containing the laser, but the fiber optic connections can be connect to external equipment which contains Class 1 or Class 1M laser.

Equipment Under Test Power Configuration			
Rated Voltage	Rated Current	Rated Frequency	Number of Phases
100-240 VAC	0.5 Amps	50/60 Hz	1

Operating modes of the EUT:

No.	Descriptions of EUT Exercising
1	Transmit mode
2	Receive/Idle mode

Software used by the EUT:

No.	Descriptions of EUT Exercising
1	None

Variant Models:

The following variant models were not tested as part of this evaluation, but have been identified by the manufacturer as being electrically identical models, depopulated models, or with reasonable similarity to the model(s) tested. Intertek does not make any claims of compliance for samples or variants which were not tested.

None

5 System Setup and Method

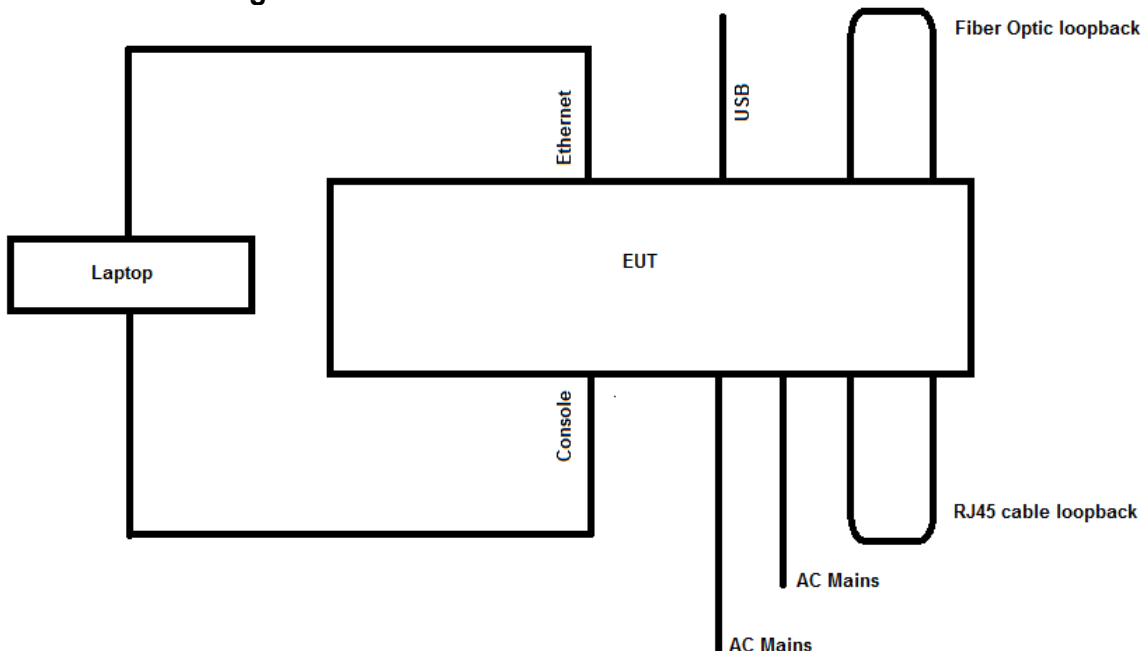
Cables					
ID	Description	Length (m)	Shielding	Ferrites	Termination
--	AC Mains	2	None	None	AC Mains
--	AC Mains	2	None	None	AC Mains
--	Ethernet Cable	10	No	None	Laptop
--	Console Cable	10+	No	None	Laptop
--	RJ 45 Loopback	3	None	None	EUT
--	USB	3	Yes	None	Not terminated
--	Fiber Optic Cable	3	No	None	EUT
--	Fiber Optic Cable 2	1	No	None	EUT

Support Equipment			
Description	Manufacturer	Model Number	Serial Number
HP Laptop	HP	TPN-C125	BOX1712180907

5.1 Method:

Configuration as required by CFR47 FCC Part 15 Subpart C:2018 Section 15.225, ISED RSS-210 Issue 9 August 2016 (Amendment), Annex B.6, ISED RSS-Gen Issue 5 April 2018, ANSI C63.10-2013, and ANSI C63.4:2014.

5.2 EUT Block Diagram:



6 Fundamental Radiated Emissions

6.1 Method

Tests are performed in accordance with FCC Part 15 Subpart C 15.225, ISED RSS-210, ANSI C63.10, and ANSI C63.4.

TEST SITE: 10m ALSE

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

Sample Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF - AG$$

Where

- FS = Field Strength in dB μ V/m
- RA = Receiver Amplitude (including preamplifier) in dB μ V
- CF = Cable Attenuation Factor in dB
- AF = Antenna Factor in dB
- AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dB μ V is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dB μ V/m. This value in dB μ V/m was converted to its corresponding level in μ V/m.

RA = 52.0 dB μ V
 AF = 7.4 dB/m
 CF = 1.6 dB
 AG = 29.0 dB
 FS = 32 dB μ V/m

To convert from dB μ V to μ V or mV the following was used:

$$UF = 10^{(NF / 20)} \text{ where } UF = \text{Net Reading in } \mu\text{V}$$

$$NF = \text{Net Reading in dB}\mu\text{V}$$

Example:

$$FS = RA + AF + CF - AG = 52.0 + 7.4 + 1.6 - 29.0 = 32.0$$

$$UF = 10^{(32 \text{ dB}\mu\text{V} / 20)} = 39.8 \mu\text{V/m}$$

6.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV002	Weather Station	Davis Instruments	7400	PE80519A93	06/14/2017	06/14/2018
145128	EMI Receiver (20 Hz - 40 Ghz)	Rohde & Schwarz	ESIB 40	839283/001	03/22/2018	03/22/2019
145-416	Cables 145-420 145-423 145-425 145-408	Huber + Suhner	3m Track B cables	multiple	07/25/2017	07/25/2018
ETS003	9kHz-30MHz Active Loop Antenna	ETS Lindgren	6502	00143396	05/23/2017	05/23/2018

Software Utilized:

Name	Manufacturer	Version
None	--	--

6.3 Results:

The sample tested was found to Comply.

§15.225 Operation within the band 13.110-14.010 MHz.

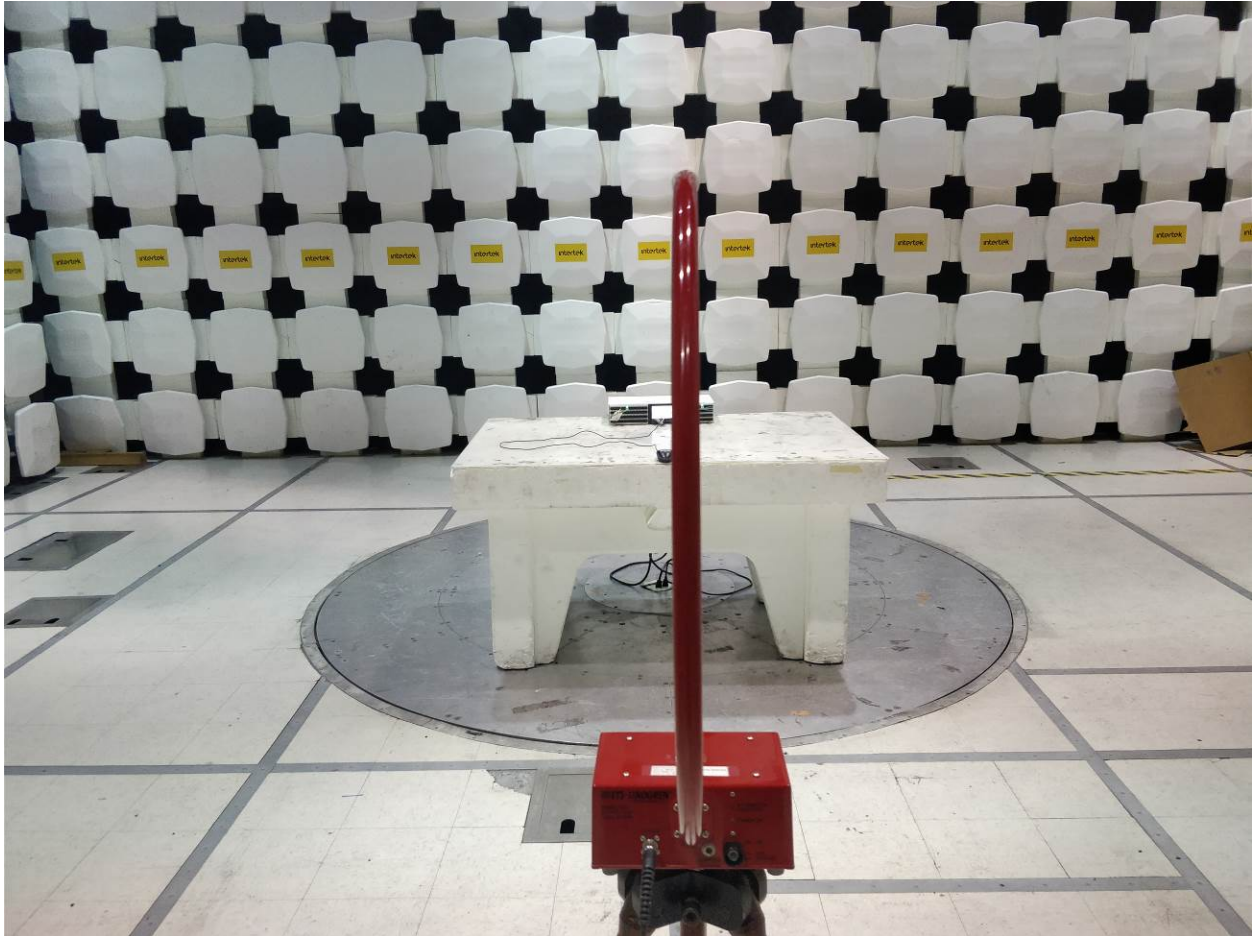
(a) The field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.

(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.

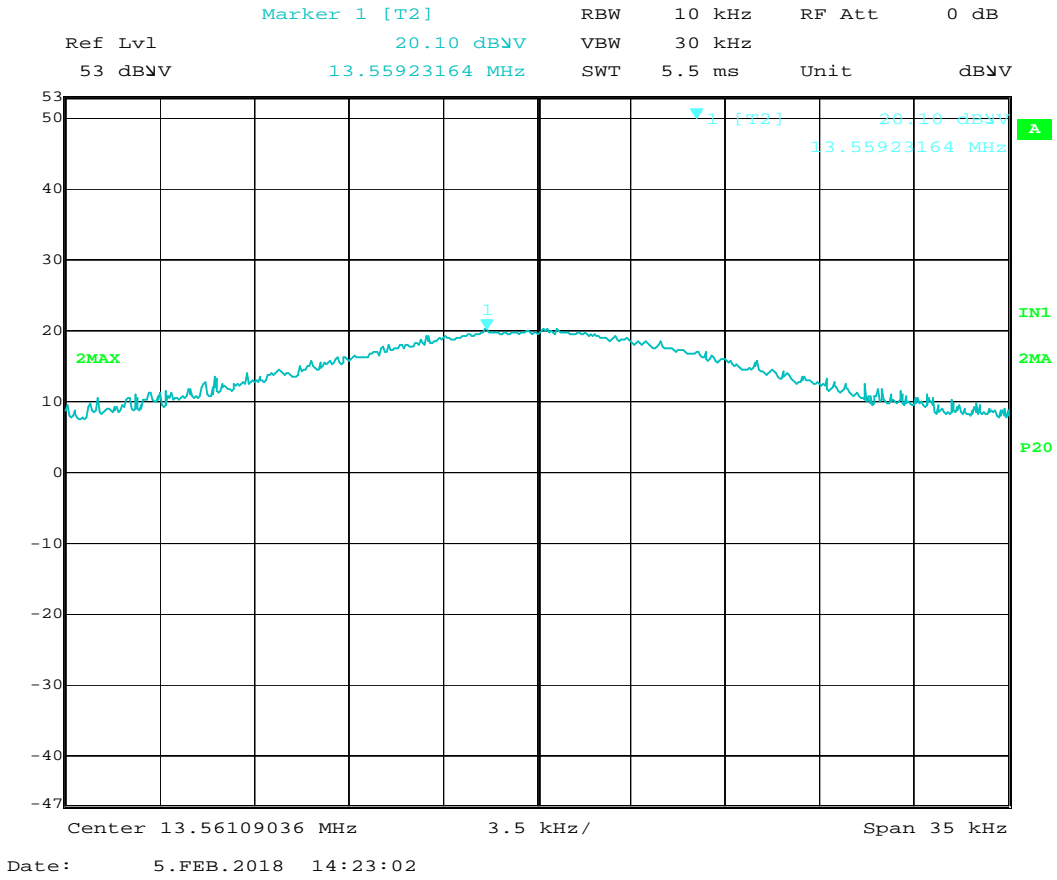
Notes: The limit for ISED RSS-210 are identical to FCC Part 15.225.

6.4 Setup Photograph:



6.5 Plots/Data:

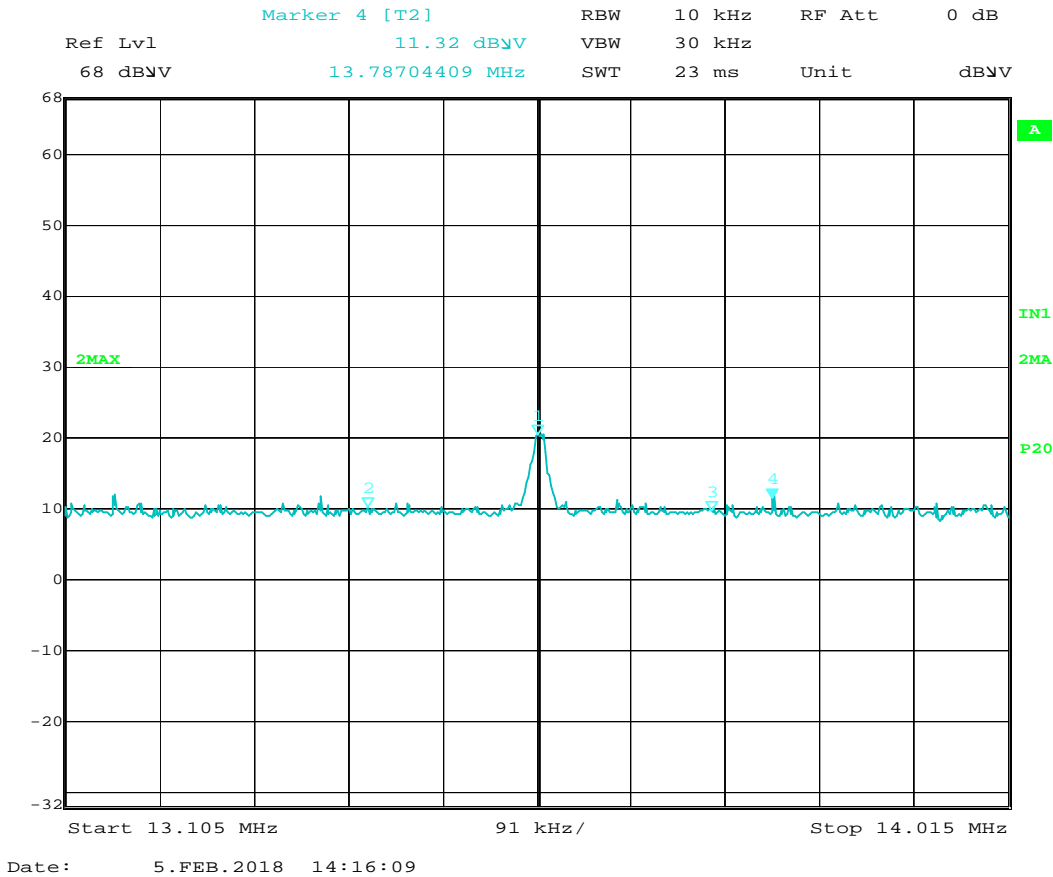
Fundamental Radiated Field Strength



Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth
13.559	20.10	10.64	0.31	0.00	40.00	-8.94	84.00	-92.94	10/30 kHz

Notes: Test was performed at 3 meters.

Out of Band Radiated Spurious Field Strength



Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth
13.787	11.32	10.62	0.32	0.00	40.00	-17.74	40.51	-58.25	10/30 kHz

Notes: Test was performed at 3 meters.

Test Personnel: Naga Suryadevara N.S
 Supervising/Reviewing Engineer: _____
 (Where Applicable) N/A
 Product Standard: FCC 47CFR Part 15.225
ISED RSS-210
 Input Voltage: 120VAC 60Hz
 Pretest Verification w/ Ambient Signals or BB Source: BB Source

Test Date: 02/05/2018
 Limit Applied: See Report Section 6.3
 Ambient Temperature: 22 °C
 Relative Humidity: 22 %
 Atmospheric Pressure: 999 mbars

Deviations, Additions, or Exclusions: None

7 Transmitter Spurious Emissions Below 30MHz

7.1 Method

Tests are performed in accordance with FCC Part 15 Subpart C 15.225, ISED RSS-210, ANSI C63.10, and ANSI C63.4.

TEST SITE: 10m ALSE

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

Sample Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF - AG$$

Where

- FS = Field Strength in dB μ V/m
- RA = Receiver Amplitude (including preamplifier) in dB μ V
- CF = Cable Attenuation Factor in dB
- AF = Antenna Factor in dB
- AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dB μ V is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dB μ V/m. This value in dB μ V/m was converted to its corresponding level in μ V/m.

RA = 52.0 dB μ V
 AF = 7.4 dB/m
 CF = 1.6 dB
 AG = 29.0 dB
 FS = 32 dB μ V/m

To convert from dB μ V to μ V or mV the following was used:

$$UF = 10^{(NF / 20)} \text{ where } UF = \text{Net Reading in } \mu\text{V}$$

$$NF = \text{Net Reading in dB}\mu\text{V}$$

Example:

$$FS = RA + AF + CF - AG = 52.0 + 7.4 + 1.6 - 29.0 = 32.0$$

$$UF = 10^{(32 \text{ dB}\mu\text{V} / 20)} = 39.8 \mu\text{V/m}$$

7.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV002	Weather Station	Davis Instruments	7400	PE80519A93	06/14/2017	06/14/2018
145128	EMI Receiver (20 Hz - 40 Ghz)	Rohde & Schwarz	ESIB 40	839283/001	03/22/2018	03/22/2019
145-416	Cables 145-420 145-423 145-425 145-408	Huber + Suhner	3m Track B cables	multiple	07/25/2017	07/25/2018
ETS003	9kHz-30MHz Active Loop Antenna	ETS Lindgren	6502	00143396	05/23/2017	05/23/2018

Software Utilized:

Name	Manufacturer	Version
None	--	--

7.3 Results:

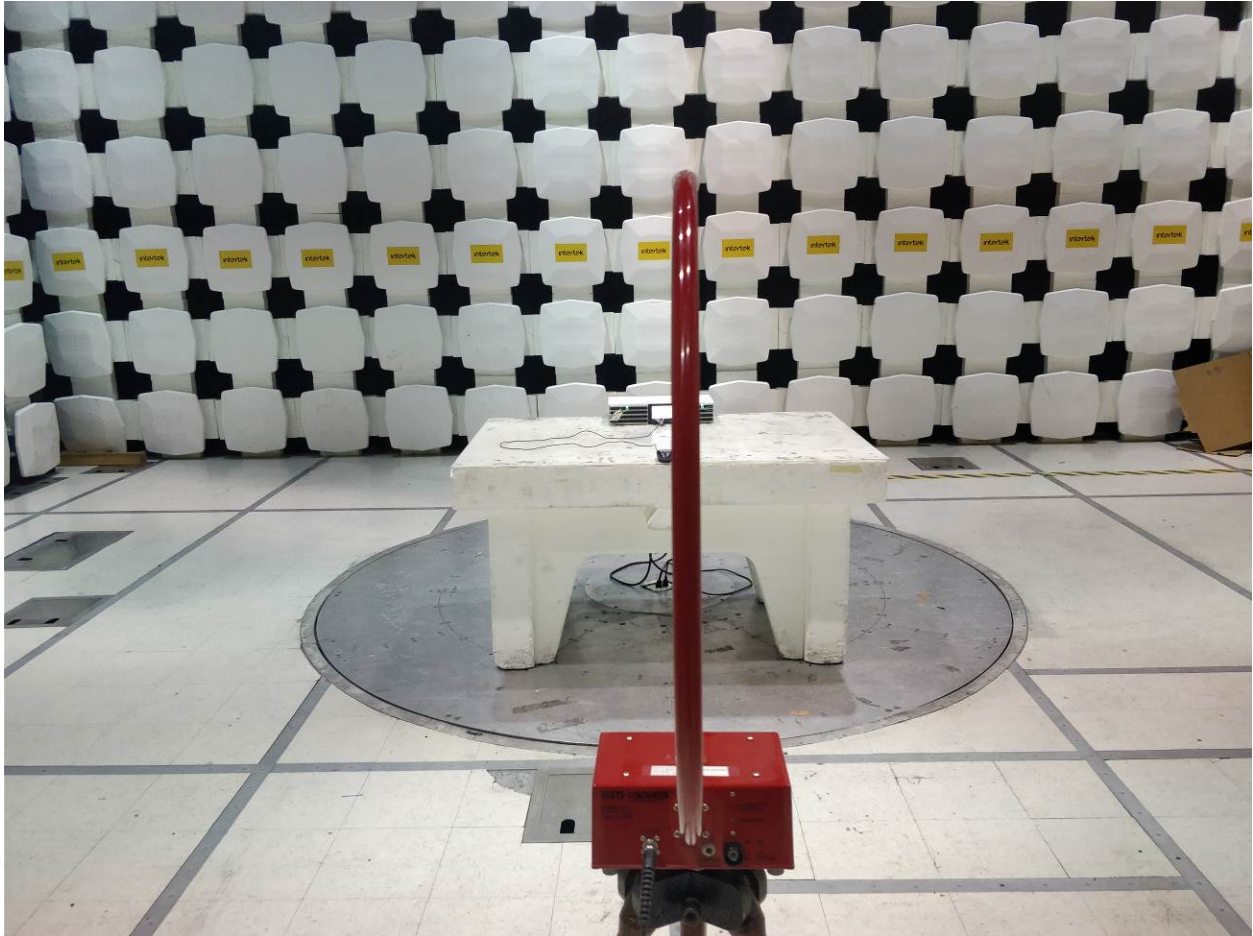
The sample tested was found to Comply.

§15.225 Operation within the band 13.110-14.010 MHz.

(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.

Notes: The limit for ISED RSS-210 are identical to FCC Part 15.225.

7.4 Setup Photograph:

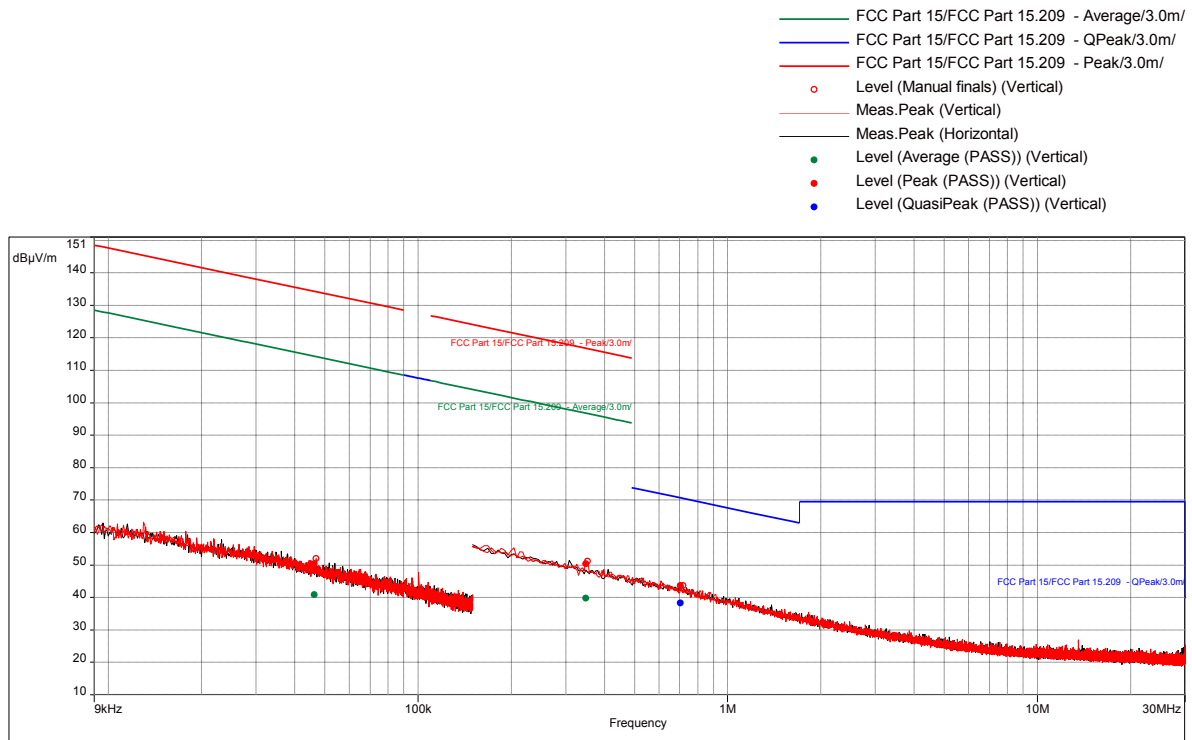


7.5 Plots/Data:

Test Information:

Date and Time	2/9/2018 10:21:50 AM
Client and Project Number	Fiber Mountain G103382409
Engineer	Naga Suryadevara
Temperature	22C
Humidity	25%
Atmospheric Pressure	995mbars
Comments	Scan 2RE 9kHz-30MHz Loop antenna, Electric Field, 3M Location

Graph:



Results:

QuasiPeak (PASS) (1)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW	Correction (dB)
0.7051578947	38.28	70.66	-32.38	342.00	1.00	Vertical	9000.00	11.29

Peak (PASS) (3)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW	Correction (dB)
0.3501315789	50.37	116.77	-66.41	158.00	1.00	Vertical	9000.00	11.06
0.04621578947	50.32	134.31	-83.99	108.00	1.00	Vertical	200.00	12.39
0.7051578947	43.60	70.66	-27.06	342.00	1.00	Vertical	9000.00	11.29

Average (PASS) (2)

Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW	Correction (dB)
0.3501315789	2	39.76	96.77	-57.01	158.00	1.00	Vertical	9000.00	11.06
0.04621578947	3	40.81	114.31	-73.50	108.00	1.00	Vertical	200.00	12.39

Test Personnel: Naga Suryadevara N.S
Supervising/Reviewing
Engineer: N/A
(Where Applicable) FCC 47CFR Part 15.225
Product Standard: ISED RSS-210
Input Voltage: 120VAC 60Hz
Pretest Verification w/
Ambient Signals or
BB Source: BB Source

Test Date: 02/09/2018
Limit Applied: See Report Section 7.3
Ambient Temperature: 22 °C
Relative Humidity: 25 %
Atmospheric Pressure: 995 mbars

Deviations, Additions, or Exclusions: None

8 Transmitter Spurious Emissions Above 30MHz

8.1 Method

Tests are performed in accordance with FCC Part 15 Subpart C 15.225, ISED RSS-210, RSS-GEN, and ANSI C63.4, and ANSI C63.10.

TEST SITE: 10m ALSE

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucisp
Radiated Emissions, 10m	30-1000 MHz	5.6 dB	6.3 dB
Radiated Emissions, 3m	30-1000 MHz	4.9 dB	6.3 dB
Radiated Emissions, 3m	1-6 GHz	4.4 dB	5.2 dB
Radiated Emissions, 3m	6-15 GHz	4.9 dB	5.5 dB
Radiated Emissions, 3m	15-18 GHz	4.6 dB	5.5 dB
Radiated Emissions, 3m	18-40 GHz	4.6 dB	N/A

As shown in the table above our radiated emissions U_{lab} is less than the corresponding U_{CISPR} reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

Sample Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF - AG$$

Where

- FS = Field Strength in dB μ V/m
- RA = Receiver Amplitude (including preamplifier) in dB μ V
- CF = Cable Attenuation Factor in dB
- AF = Antenna Factor in dB
- AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dB μ V is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dB μ V/m. This value in dB μ V/m was converted to its corresponding level in μ V/m.

RA = 52.0 dB μ V
 AF = 7.4 dB/m
 CF = 1.6 dB
 AG = 29.0 dB
 FS = 32 dB μ V/m

To convert from dB μ V to μ V or mV the following was used:

$$UF = 10^{(NF / 20)} \text{ where } UF = \text{Net Reading in } \mu\text{V}$$

NF = Net Reading in dB μ V

Example:

$$FS = RA + AF + CF - AG = 52.0 + 7.4 + 1.6 - 29.0 = 32.0$$

$$UF = 10^{(32 \text{ dB}\mu\text{V} / 20)} = 39.8 \mu\text{V/m}$$

Alternately, when BAT-EMC Emission Software is used, the "Level" includes all losses and gains and is compared directly in the "Margin" column to the "Limit". The "Correction" includes Antenna Factor, Preamp, and Cable Loss. These are already accounted for in the "Level" column.

8.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV002'	Weather Station	Davis Instruments	7400	PE80519A93	06/14/2017	06/14/2018
PRE11'	50dB gain pre-amp	Keith H	PRE11	PRE11	12/02/2017	12/02/2018
145106'	Bilog Antenna (30MHz - 5GHz)	Sunol Sciences	JB5	A111003	05/31/2017	05/31/2018
145128'	EMI Receiver (20 Hz - 40 Ghz)	Rohde & Schwarz	ESIB 40	839283/001	03/22/2018	03/22/2019
145-416'	Cables 145-420 145-423 145-425 145-408	Huber + Suhner	3m Track B cables	multiple	07/25/2017	07/25/2018

Software Utilized:

Name	Manufacturer	Version
BAT.EMC	Nexio	3.16.0.69

8.3 Results:

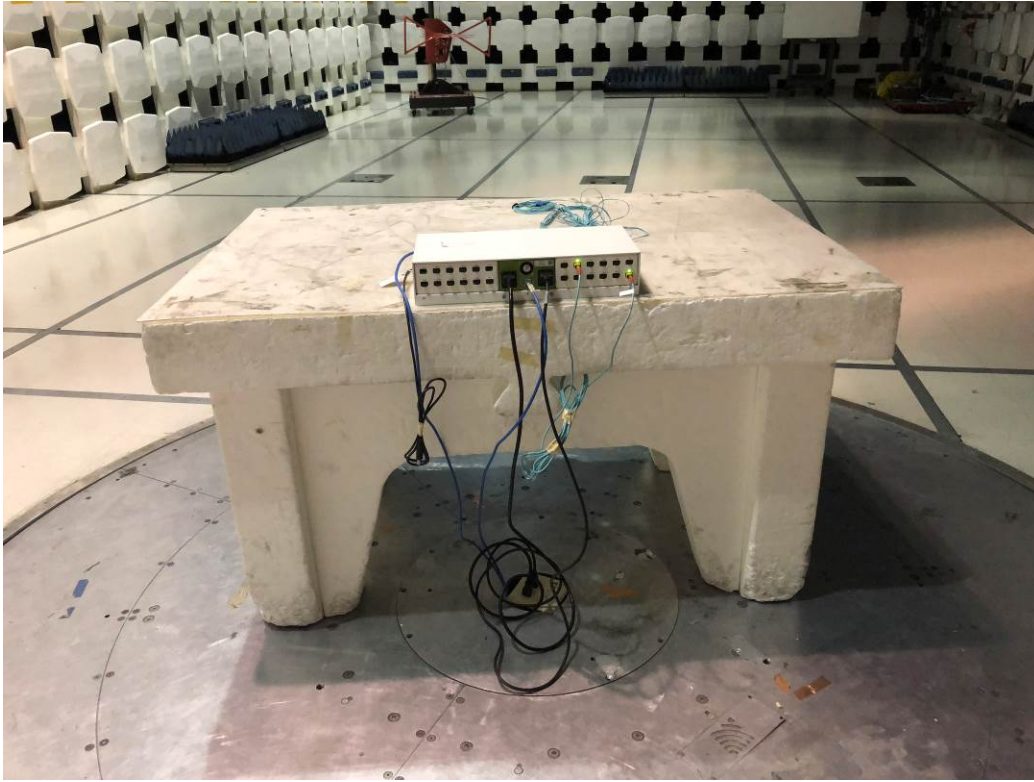
The sample tested was found to Comply.

§15.225 Operation within the band 13.110-14.010 MHz.

(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.

Notes: The limit for ISSED RSS-210 are identical to FCC Part 15.225.

8.4 Setup Photographs:

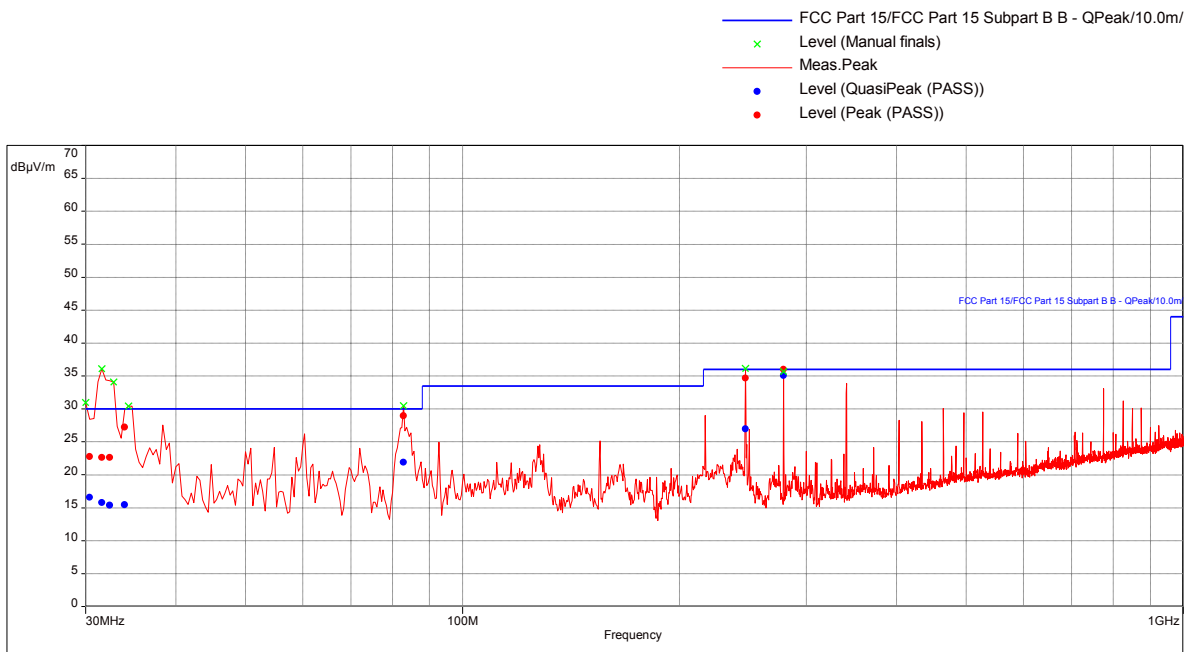


8.5 Plots/Data:

Test Information:

Date and Time	5/18/2018 5:01:24 PM
Client and Project Number	Fiber Mountain
Engineer	Kouma Sinn
Temperature	23 C
Humidity	31 %
Atmospheric Pressure	1018 mbar
Comments	

Graph:



Results:

QuasiPeak (PASS) (7)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW	Correction (dB)
30.50526316	16.55	30.00	-13.45	233.00	3.45	Vertical	120000.00	-23.06
31.6	15.76	30.00	-14.24	98.00	2.48	Vertical	120000.00	-23.71
32.57894737	15.35	30.00	-14.65	76.00	3.24	Vertical	120000.00	-24.33
33.83157895	15.45	30.00	-14.55	298.00	3.30	Vertical	120000.00	-25.23
82.73684211	21.91	30.00	-8.09	47.00	1.00	Vertical	120000.00	-36.06
246.7684211	26.94	36.00	-9.06	179.00	3.42	Horizontal	120000.00	-30.66
278.9894737	35.04	36.00	-0.96	277.00	3.74	Horizontal	120000.00	-28.69

Test Personnel: Kouma Sinn *KPS*
Supervising/Reviewing Engineer: _____
(Where Applicable) N/A
Product Standard: FCC 47CFR Part 15.225
Input Voltage: ISED RSS-210
120VAC 60Hz
Pretest Verification w/
Ambient Signals or
BB Source: BB Source

Test Date: 05/18/2018
Limit Applied: See report section 8.3
Ambient Temperature: 23 °C
Relative Humidity: 31 %
Atmospheric Pressure: 1018 mbars

Deviations, Additions, or Exclusions: None

9 Receiver Spurious Emissions Above 30MHz

9.1 Method

Tests are performed in accordance with FCC Part 15 Subpart C 15.225, ISED RSS-210, RSS-GEN, and ANSI C63.4, and ANSI C63.10.

TEST SITE: 10m ALSE

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucisprr
Radiated Emissions, 10m	30-1000 MHz	5.6 dB	6.3 dB
Radiated Emissions, 3m	30-1000 MHz	4.9 dB	6.3 dB
Radiated Emissions, 3m	1-6 GHz	4.4 dB	5.2 dB
Radiated Emissions, 3m	6-15 GHz	4.9 dB	5.5 dB
Radiated Emissions, 3m	15-18 GHz	4.6 dB	5.5 dB
Radiated Emissions, 3m	18-40 GHz	4.6 dB	N/A

As shown in the table above our radiated emissions U_{lab} is less than the corresponding U_{CISPR} reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

Sample Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF - AG$$

Where

- FS = Field Strength in dB μ V/m
- RA = Receiver Amplitude (including preamplifier) in dB μ V
- CF = Cable Attenuation Factor in dB
- AF = Antenna Factor in dB
- AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dB μ V is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dB μ V/m. This value in dB μ V/m was converted to its corresponding level in μ V/m.

RA = 52.0 dB μ V
 AF = 7.4 dB/m
 CF = 1.6 dB
 AG = 29.0 dB
 FS = 32 dB μ V/m

To convert from dB μ V to μ V or mV the following was used:

$$UF = 10^{(NF / 20)} \text{ where } UF = \text{Net Reading in } \mu\text{V}$$

NF = Net Reading in dB μ V

Example:

$$FS = RA + AF + CF - AG = 52.0 + 7.4 + 1.6 - 29.0 = 32.0$$

$$UF = 10^{(32 \text{ dB}\mu\text{V} / 20)} = 39.8 \mu\text{V/m}$$

Alternately, when BAT-EMC Emission Software is used, the "Level" includes all losses and gains and is compared directly in the "Margin" column to the "Limit". The "Correction" includes Antenna Factor, Preamp, and Cable Loss. These are already accounted for in the "Level" column.

9.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV002'	Weather Station	Davis Instruments	7400	PE80519A93	06/14/2017	06/14/2018
PRE11'	50dB gain pre-amp	Keith H	PRE11	PRE11	12/02/2017	12/02/2018
145106'	Bilog Antenna (30MHz - 5GHz)	Sunol Sciences	JB5	A111003	05/31/2017	05/31/2018
145128'	EMI Receiver (20 Hz - 40 Ghz)	Rohde & Schwarz	ESIB 40	839283/001	03/22/2018	03/22/2019
145-416'	Cables 145-420 145-423 145-425 145-408	Huber + Suhner	3m Track B cables	multiple	07/25/2017	07/25/2018

Software Utilized:

Name	Manufacturer	Version
BAT.EMC	Nexio	3.16.0.69

9.3 Results:

The sample tested was found to Comply.

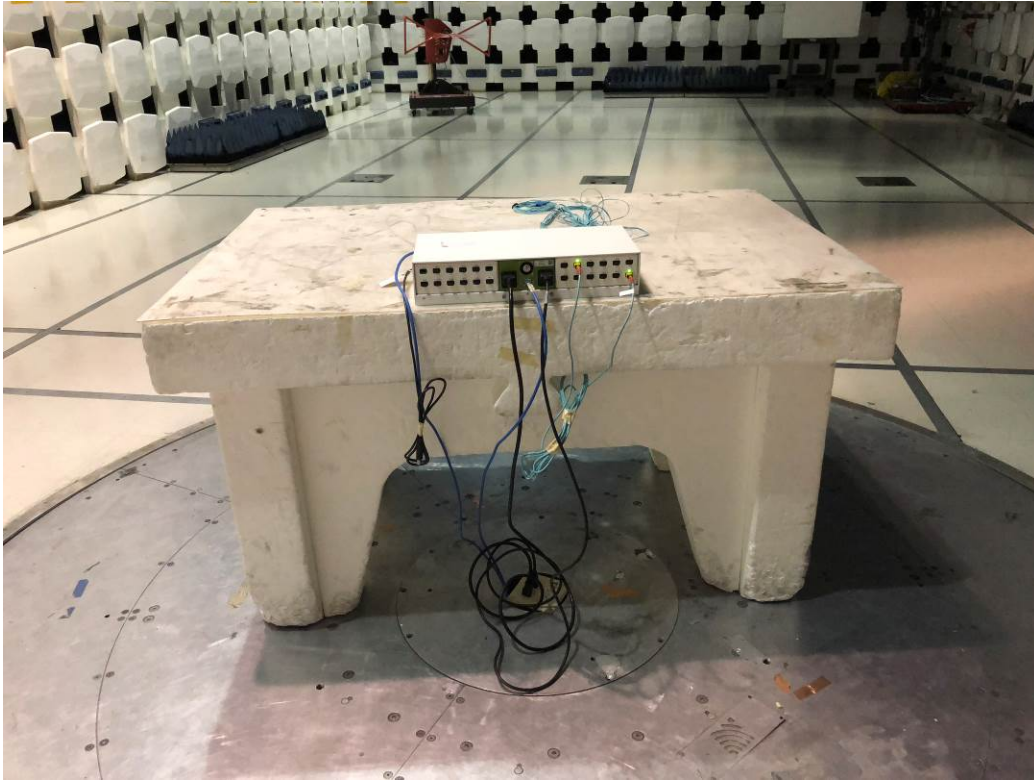
§15.109 Radiated emission limits.

(a) The field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency of emission (MHz)	Field strength (microvolts/meter)
30-88	100
88-216	150
216-960	200
Above 960	500

Notes: The limit for ISED RSS-210 are identical to FCC Part 15.225.

9.4 Setup Photographs:

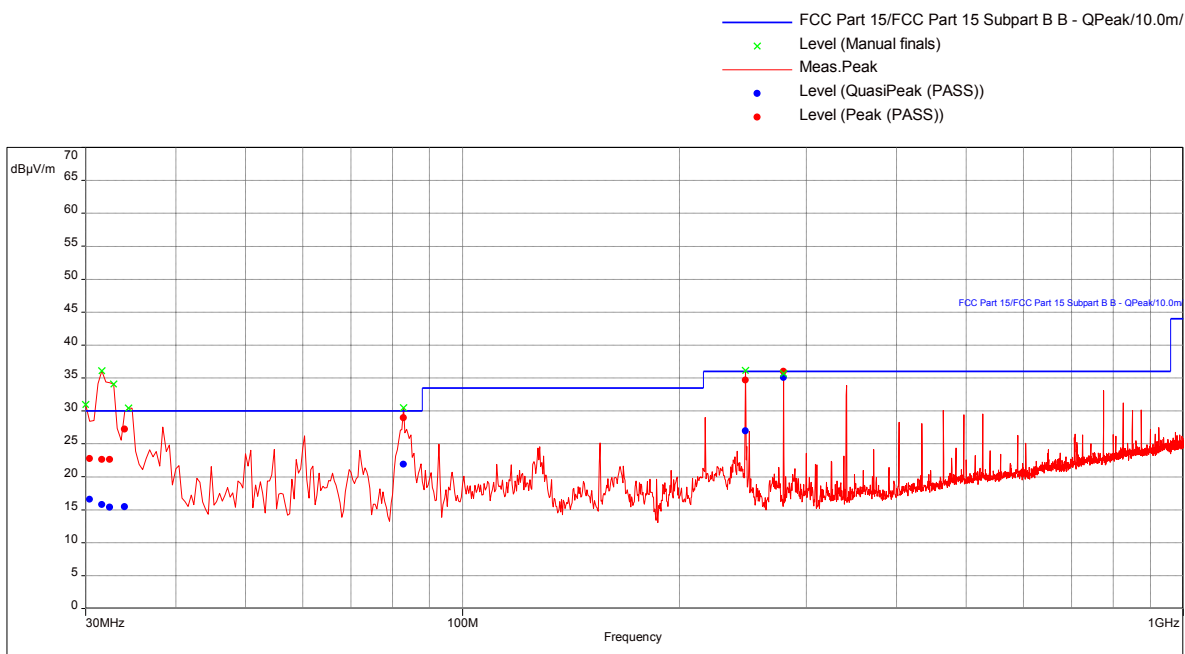


9.5 Plots/Data:

Test Information:

Date and Time	5/18/2018 5:01:24 PM
Client and Project Number	Fiber Mountain
Engineer	Kouma Sinn
Temperature	23 C
Humidity	31 %
Atmospheric Pressure	1018 mbar
Comments	

Graph:



Results:

QuasiPeak (PASS) (7)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW	Correction (dB)
30.50526316	16.55	30.00	-13.45	233.00	3.45	Vertical	120000.00	-23.06
31.6	15.76	30.00	-14.24	98.00	2.48	Vertical	120000.00	-23.71
32.57894737	15.35	30.00	-14.65	76.00	3.24	Vertical	120000.00	-24.33
33.83157895	15.45	30.00	-14.55	298.00	3.30	Vertical	120000.00	-25.23
82.73684211	21.91	30.00	-8.09	47.00	1.00	Vertical	120000.00	-36.06
246.7684211	26.94	36.00	-9.06	179.00	3.42	Horizontal	120000.00	-30.66
278.9894737	35.04	36.00	-0.96	277.00	3.74	Horizontal	120000.00	-28.69

Notes: The receiver emissions are identical to transmitter emissions as both the receiver and transmitter were active during testing.

Test Personnel: Kouma Sinn *KPS*
Supervising/Reviewing Engineer:
(Where Applicable) N/A
Product Standard: FCC 47CFR Part 15.225
Input Voltage: ISED RSS-210
120VAC 60Hz
Pretest Verification w/
Ambient Signals or
BB Source: BB Source

Test Date: 05/18/2018
Limit Applied: See Report Section 9.3
Ambient Temperature: 23 °C
Relative Humidity: 31 %
Atmospheric Pressure: 1018 mbars

Deviations, Additions, or Exclusions: None

10 20 dB Bandwidth

10.1 Method

Tests are performed in accordance with FCC Part 15 Subpart C 15.225, ISED RSS-210, and ANSI C63.10.

TEST SITE: 10m ALSE

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

10.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV002	Weather Station	Davis Instruments	7400	PE80519A93	06/14/2017	06/14/2018
145128	EMI Receiver (20 Hz - 40 Ghz)	Rohde & Schwarz	ESIB 40	839283/001	03/22/2018	03/22/2019
145-416	Cables 145-420 145-423 145-425 145-408	Huber + Suhner	3m Track B cables	multiple	07/25/2017	07/25/2018
ETS003	9kHz-30MHz Active Loop Antenna	ETS Lindgren	6502	00143396	05/23/2017	05/23/2018

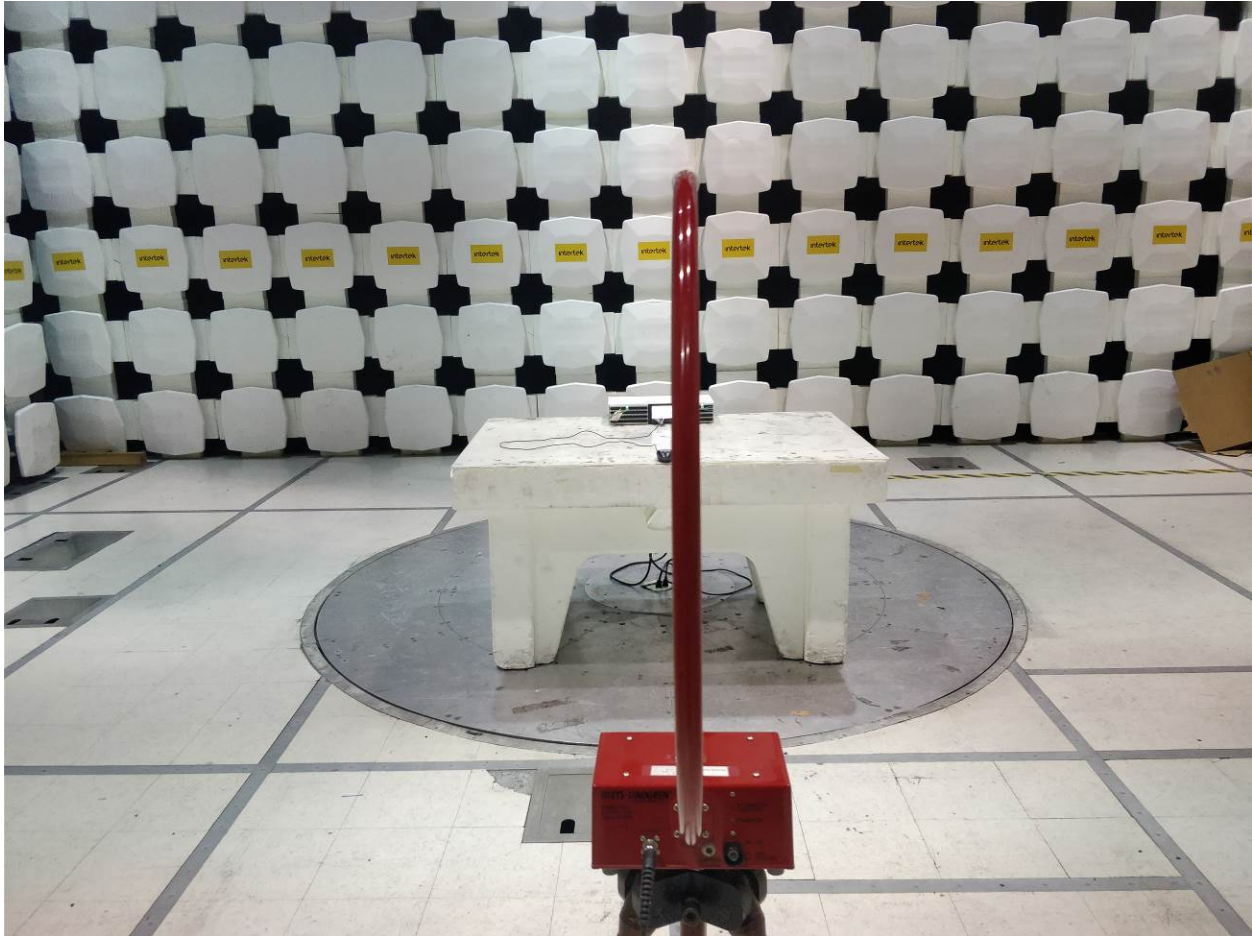
Software Utilized:

Name	Manufacturer	Version
None	--	--

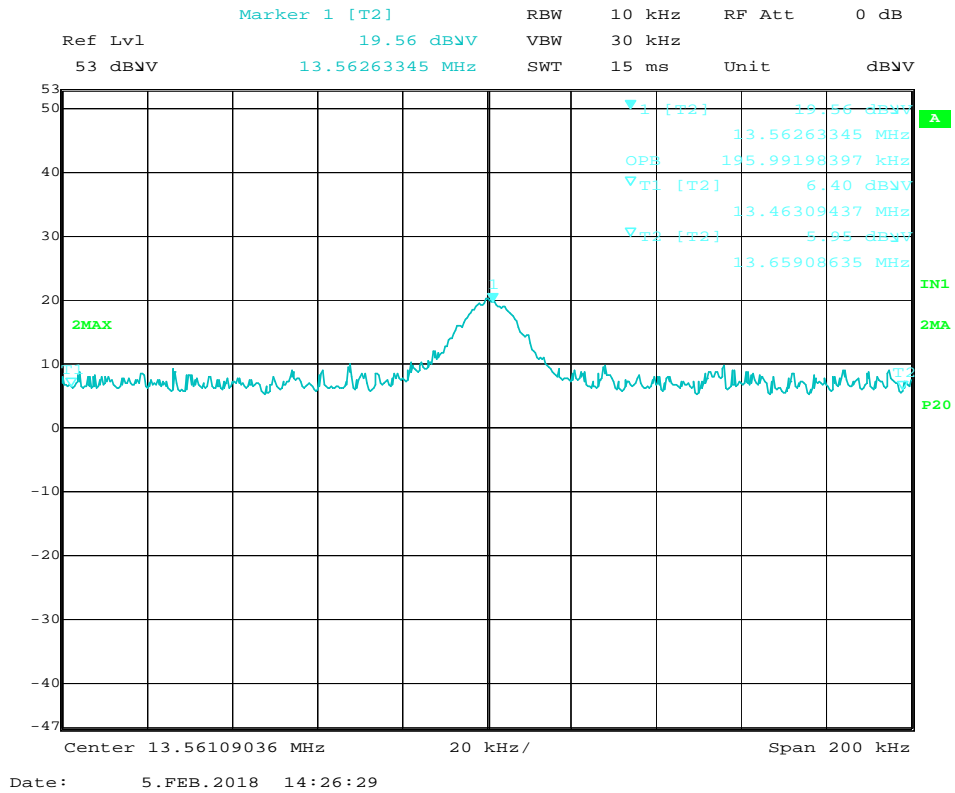
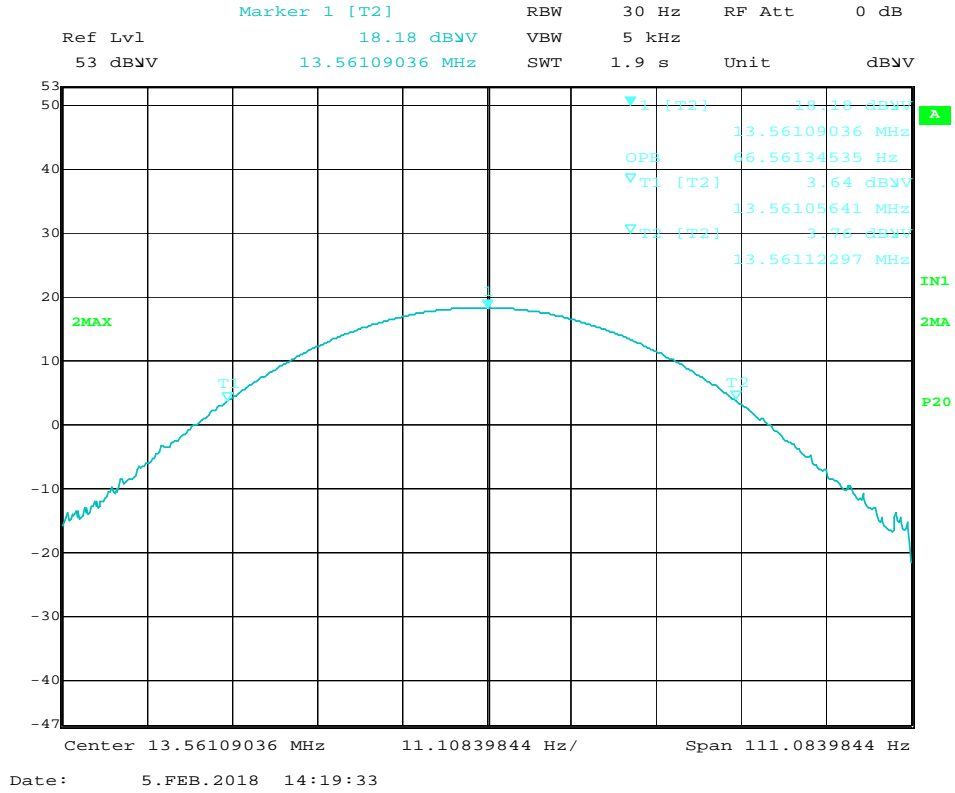
10.3 Results:

The sample tested was found to Comply.

10.4 Setup Photograph:



10.5 Plots/Data:



Test Personnel: Naga Suryadevara N.S
Supervising/Reviewing Engineer: _____
(Where Applicable) N/A
Product Standard: FCC 47CFR Part 15.225
ISED RSS-210
Input Voltage: 120VAC 60Hz
Pretest Verification w/
Ambient Signals or
BB Source: BB Source

Test Date: 02/05/2018
Limit Applied: Lower and upper edge frequencies remain in assigned band
Ambient Temperature: 22 °C
Relative Humidity: 22 %
Atmospheric Pressure: 999 mbars

Deviations, Additions, or Exclusions: None

11 Frequency Stability

11.1 Method

Tests are performed in accordance with FCC Part 15 Subpart C 15.225 and ISED RSS-210.

TEST SITE: Safety Lab

11.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
148012'	Temp/Humidity Chamber	Envirotronics	SH27C	08015563S11 263	09/14/2017	09/14/2018
SAF1238'	True RMS meter	Fluke	117	27291467	07/28/2017	07/28/2018
SAF580'	Variav Input 120V 50/60Hz Output 0-120/140 10A 1.4KVA	Staco Energy	SAF580	005079	VBU	Verified
CBLSHF205'	Cable, SMA-SMA, 9kHz-40GHz, (Cable Kit5)	Huber + Suhner	Sucoflex 102EA	234715001	08/23/2017	08/23/2018
ETS003'	9kHz-30MHz Active Loop Antenna	ETS Lindgren	6502	00143396	05/23/2017	05/23/2018
ROS005-1'	Signal and Spectrum Analyzer	Rohde and Shwartz	FSW43	100646	09/15/2016	09/15/2017

Software Utilized:

Name	Manufacturer	Version
EMI Boxborough.xls	Intertek	08/27/2010

11.3 Results:

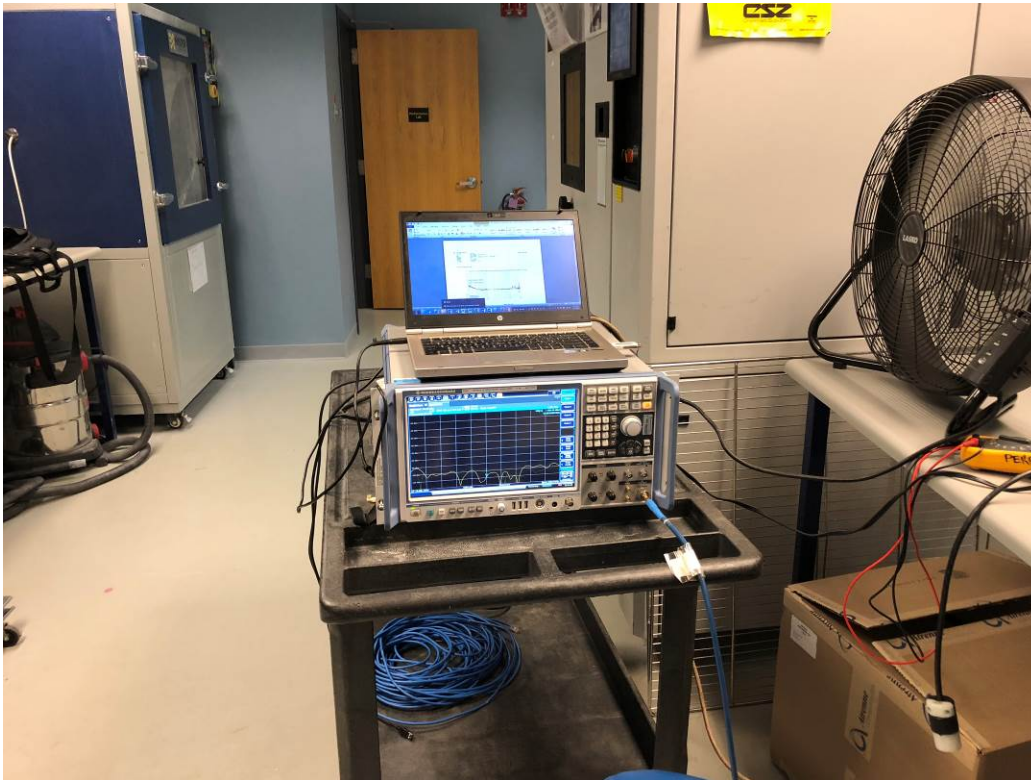
The sample tested was found to Comply.

§15.225 Operation within the band 13.110-14.010 MHz.

The frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ 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.

Notes: The limit for ISED RSS-210 are identical to FCC Part 15.225.

11.4 Setup Photographs:



11.5 Test Data:

Frequency Stability

Company: Fiber Mountain

Model #: DX2100

Serial #: Not Labelled

Engineer(s): Kouma Sinn

Project #: G103382409

Standard: FCC Part 15/Cispr22 Class B

Limit: 100 PPM

Nominal f: 13.56 MHz

Test Equipment Used:

148-012 SAF1238 SAF580

CBLSHF205 ETS003 ROS005-1

Location: Safety

Date(s): 05/23/18

Voltage: 120 VDC

%	Voltage Volts	Frequency MHz	Deviation kHz	Limit kHz
-15%	102	13.561200	0.2	1.36
-10%	--	--	--	--
-5%	--	--	--	--
+0%	120	13.561000	0	1.36
+5%	--	--	--	--
+10%	--	--	--	--
+15%	138	13.561200	0.2	1.36

Temp Celsius	Frequency MHz	Deviation kHz	Limit kHz
-30	13.561200	0.2	1.36
-20	13.561200	0.2	1.36
-10	13.561200	0.2	1.36
0	13.561200	0.2	1.36
10	13.561200	0.2	1.36
20	13.561000	0	1.36
30	13.561000	0	1.36
40	13.561000	0	1.36
50	13.561000	0	1.36

Test Personnel: Kouma Sinn *KPS*
 Supervising/Reviewing Engineer: N/A
 (Where Applicable) FCC 47CFR Part 15.225
 Product Standard: ISED RSS-210
 Input Voltage: 120VAC 60Hz
 Pretest Verification w/ Ambient Signals or BB Source: N/A

Test Date: 05/23/2018
 Limit Applied: 100 PPM
 Ambient Temperature: N/A
 Relative Humidity: N/A
 Atmospheric Pressure: N/A

Deviations, Additions, or Exclusions: None

12 AC Mains Conducted Emissions

12.1 Method

Tests are performed in accordance with FCC Part 15 Subpart C 15.225, ISED RSS-210, ISED RSS-GEN, and ANSI C63.4:2014.

TEST SITE: EMC Lab

The EMC Lab has one Semi-anechoic Chamber and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	U _{CISPR}
AC Line Conducted Emissions	150 kHz - 30 MHz	2.8dB	3.4dB
Telco Port Emissions	150 kHz - 30 MHz	3.2dB	5.0dB

As shown in the table above our conducted emissions U_{lab} is less than the corresponding U_{CISPR} reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

Sample Calculations

The following is how net line-conducted readings were determined:

$$NF = RF + LF + CF + AF$$

Where NF = Net Reading in dB μ V

RF = Reading from receiver in dB μ V

LF = LISN or ISN Correction Factor in dB

CF = Cable Correction Factor in dB

AF = Attenuator Loss Factor in dB

To convert from dB μ V to μ V or mV the following was used:

$$UF = 10^{(NF / 20)} \text{ where } UF = \text{Net Reading in } \mu\text{V}$$

$$NF = \text{Net Reading in dB}\mu\text{V}$$

Example:

$$NF = RF + LF + CF + AF = 28.5 + 0.2 + 0.4 + 20.0 = 49.1 \text{ dB}\mu\text{V}$$

$$UF = 10^{(49.1 \text{ dB}\mu\text{V} / 20)} = 285.1 \mu\text{V/m}$$

Alternately, when C5 Software is used, the "Level" includes all losses and gains and is compared directly in the "Margin" column to the "Limit". "TF" is the Transducer Factor; in this case LISN or ISN loss.

12.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV001'	Weather Station	Davis Instruments	7400	PE80519A61	12/07/2017	12/07/2018
ROS002'	9kHz to 3GHz EMI Test Receiver	Rohde & Schwartz	ESCI 1166.5950K03	100067	08/03/2017	08/03/2018
DS27'	Attenuator, 20dB	Mini Circuits	20dB, 50 ohm	DS27	10/17/2017	10/17/2018
LISN32'	LISN - CISPR16 Compliant 9kHz-30MHz	Com-Power	LI-215A	191955	05/03/2018	05/03/2019
CBLBNC2012-2'	50 Ohm Coaxial Cable	Pomona	RG-58 C/U	CBLBNC2012-2	01/05/2018	01/05/2019

Software Utilized:

Name	Manufacturer	Version
Compliance 5	Teseq	5.26.46.46

12.3 Results:

The sample tested was found to Comply.

§15.207 Conducted limits.

The radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of emission (MHz)	Conducted limit (dB μ V)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

Notes: The limit for ISED RSS-210 are identical to FCC Part 15.225.

12.4 Setup Photographs:

One Power Supply



Two Power Supplies



12.5 Plots/Data:

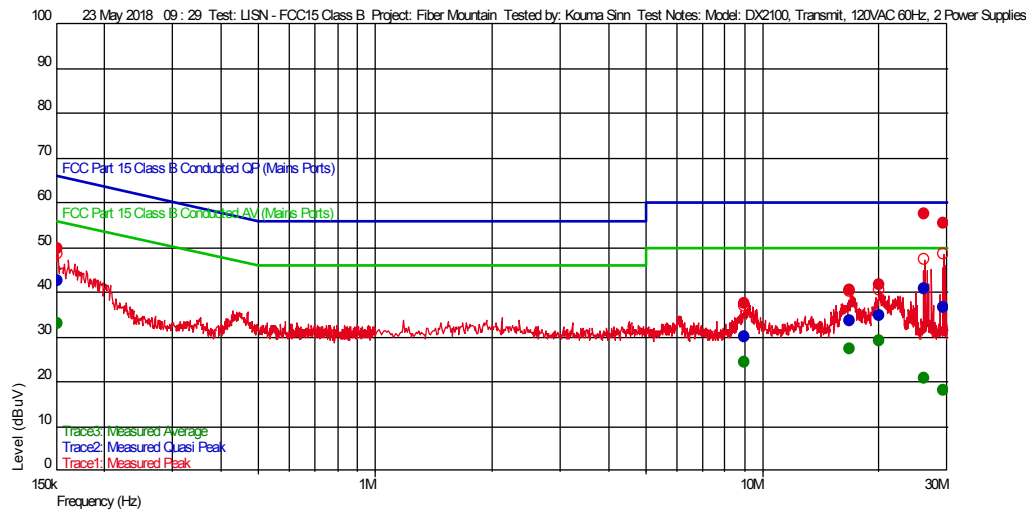
Transmit & Receive Modes, 120VAC 60Hz, 2 Power Supplies

Test Information

Test Details: User Entry
 Test: LISN - FCC15 Class B
 Project: Fiber Mountain
 Test Notes: Model: DX2100, Transmit & Receive Modes, 120VAC 60Hz, 2 Power Supplies
 Temperature: 21C
 Humidity: 57%, 1002mbar
 Tested by: Kouma Sinn
 Test Started: 23 May 2018 09:29

Additional Information

Prescan Emission Graph



- Measured Peak Value
- Measured Quasi Peak Value
- Measured Average Value
- Maximum Value of Mast and Turntable
- Swept Peak Data
- Swept Quasi Peak Data
- Swept Average Data

Emissions Test Data

Trace2: Measured Quasi Peak

Frequency(Hz)	Level(dBuV)	TF	PA+CL	Limit(dBuV)	Margin(dBuV)	RBW(Hz)	Comment	LINE
9.028 M	30.01	0.344	20.302	60.000	-29.99	9 k		L1
16.92 M	33.49	0.350	20.396	60.000	-26.51	9 k		L1
20.16 M	34.70	0.350	20.429	60.000	-25.30	9 k		L1
151.7 k	42.41	1.653	20.074	65.906	-23.49	9 k		L1
29.44 M	36.52	0.369	20.524	60.000	-23.48	9 k		L1
26.32 M	40.85	0.363	20.492	60.000	-19.15	9 k		L1

Trace3: Measured Average

Frequency(Hz)	Level(dBuV)	TF	PA+CL	Limit(dBuV)	Margin(dBuV)	RBW(Hz)	Comment	LINE
29.44 M	18.12	0.369	20.524	50.000	-31.88	9 k		L1
26.32 M	20.78	0.363	20.492	50.000	-29.22	9 k		L1
9.028 M	24.34	0.344	20.302	50.000	-25.66	9 k		L1
151.7 k	32.90	1.653	20.074	55.906	-23.00	9 k		L1
16.92 M	27.27	0.350	20.396	50.000	-22.73	9 k		L1
20.16 M	29.23	0.350	20.429	50.000	-20.77	9 k		L1

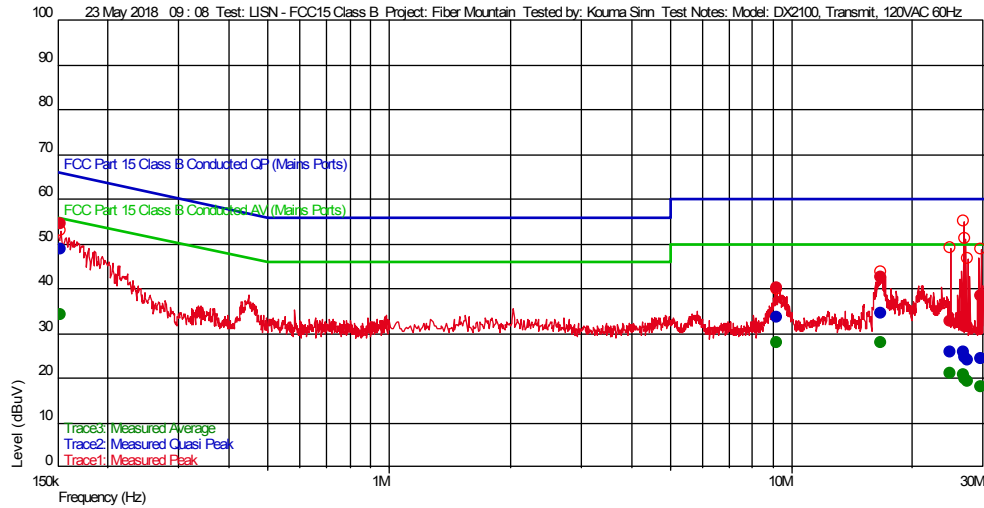
Transmit & Receive Modes, 120VAC 60Hz, 1 Power Supply

Test Information

Test Details: User Entry
 Test: LISN - FCC15 Class B
 Project: Fiber Mountain
 Test Notes: Model: DX2100, Transmit & Receive Modes 120VAC 60Hz
 Temperature: 21C
 Humidity: 57%, 1002mbar
 Tested by: Kouma Sinn
 Test Started: 23 May 2018 09:08

Additional Information

Prescan Emission Graph



- Measured Peak Value
- Measured Quasi Peak Value
- Measured Average Value
- Maximum Value of Mast and Turntable
- Swept Peak Data
- Swept Quasi Peak Data
- Swept Average Data

Emissions Test Data

Trace2: Measured Quasi Peak

Frequency(Hz)	Level(dBuV)	TF	PA+CL	Limit(dBuV)	Margin(dBuV)	RBW(Hz)	Comment	LINE
27.4 M	24.13	0.365	20.503	60.000	-35.87	9 k		L1
29.6 M	24.42	0.369	20.526	60.000	-35.58	9 k		N
27.08 M	24.55	0.364	20.500	60.000	-35.45	9 k		L1
26.76 M	25.69	0.364	20.496	60.000	-34.31	9 k		L1
24.88 M	25.90	0.360	20.477	60.000	-34.10	9 k		L1
9.244 M	33.72	0.345	20.307	60.000	-26.28	9 k		N
16.68 M	34.56	0.350	20.393	60.000	-25.44	9 k		L1
152.55 k	48.74	1.645	20.074	65.860	-17.12	9 k		L1

Trace3: Measured Average

Frequency(Hz)	Level(dBuV)	TF	PA+CL	Limit(dBuV)	Margin(dBuV)	RBW(Hz)	Comment	LINE
29.6 M	18.18	0.369	20.526	50.000	-31.82	9 k		N
27.4 M	19.26	0.365	20.503	50.000	-30.74	9 k		L1
27.08 M	19.70	0.364	20.500	50.000	-30.30	9 k		L1
26.76 M	20.72	0.364	20.496	50.000	-29.28	9 k		L1
24.88 M	21.00	0.360	20.477	50.000	-29.00	9 k		L1
9.244 M	28.03	0.345	20.307	50.000	-21.97	9 k		N
16.68 M	28.03	0.350	20.393	50.000	-21.97	9 k		L1
152.55 k	34.12	1.645	20.074	55.860	-21.74	9 k		L1

Test Personnel: Kouma Sinn *KPS*
Supervising/Reviewing Engineer:
(Where Applicable) N/A
Product Standard: FCC 47CFR Part 15.225
ISED RSS-210
Input Voltage: 120VAC 60Hz, 230VAC 50Hz
Pretest Verification w/
Ambient Signals or BB Source: Used signal generator @ -20
dBm for verification

Test Date: 05/23/2018
Limit Applied: See report section 12.3
Ambient Temperature: 21 °C
Relative Humidity: 57 %
Atmospheric Pressure: 1002 mbars

Deviations, Additions, or Exclusions: None

13 Revision History

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	06/05/2018	103382409BOX-010	KPS <i>KPS</i>	VFV <i>VFV</i>	Original Issue