Project 20634-15

Pinnacle Peak Holding Corporation
dba Setcom Corporation

MS900MAX

Wireless Certification Report
FCC 15.247 & RSS-247

Prepared for:

Setcom Corporation
3019 Alvin Devane Blvd.
Suite 560
Austin, Texas 78741

By

Professional Testing (EMI), Inc.
1601 North A.W. Grimes Blvd., Suite B
Round Rock, Texas 78665

11 Apr 2019

Reviewed by

Larry Finn
Chief Technical Officer

Written by

Eric Lifsey
EMC Engineer

Revision History

Revision Number	Description	Date
Final01	Model number finalized.	25 Oct 2019

Errata:

None.

Table of Contents

Compliance Certificate

Applicant	Device & Test Identification
Pinnacle Peak Holding Corporation dba Setcom Corporation 3019 Alvin Devane Blvd. Suite 560 Austin, Texas 78741 Certificate Date: 8 May 2019	FCC ID: TLV-MS900MAX Industry Canada ID: 6143A-MS900MAX Model(s): MS900MAX Laboratory Project ID: 20634-15

The device named above was tested utilizing the following documents and found to be in compliance with the required criteria:

Requirement	Reference	Detail
FCC 47 CFR Part 15 C	15.247	Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.
FCC 47 CFR Part 15 C	15.209	Radiated emission limits; general requirements.
FCC 47 CFR Part 15 C	15.205	Restricted Bands of Operation
KDB 558074 D01	DR01	DTS Measurement Guidance v03r02
KDB 412172	D01	Guidelines for Determining the ERP and EIRP of an RF Transmitting System
OET Bulletin 65*	Edition 97-01, and Supplement C, Ed. 01-01	Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields
RSS-247	Issue 2	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
RSS-Gen	Issue 4	General Requirements and Information for the Certification of Radio Apparatus
RSS-102	Issue 4	Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)

*MPE is reported separately from this document. **Corresponding RSS references are listed in the body of the report.

I, Eric Lifsey, for Professional Testing (EMI), Inc., being familiar with the above requirements and test procedures have reviewed the test setup, measured data, and this report. I believe them to be true and accurate.

Eric Lifsey
EMC Engineer

This report has been reviewed and accepted by the Applicant**.** The undersigned is responsible for ensuring that this device will continue to comply with the requirements listed above.

_____
Representative of Applicant

1.0 Introduction

1.1 Scope

This report describes the extent to which the equipment under test (EUT) conformed to the intentional radiator requirements of the United States and Canada.

Professional Testing (EMI), Inc., (PTI) follows the guidelines of National Institute of Standards and Technology (NIST) for all uncertainty calculations, estimates, and expressions thereof for electromagnetic compatibility testing.

1.2 EUT Description

Table 1.2.1: Equipment Under Test

Manufacturer / Model	Serial #	Description
Setcom Model: MS900MAX	none	902 to 928 MHz DTS transceiver; using OFDM with proprietary protocols.

Table 1.2.2: Support Equipment

Manufacturer / Model	Serial #	Description
None		

The EUT is a DC powered base station that provides hands-free real time wireless voice communication for a team of individuals that are equipped with the companion headset product.

The EUT connects by a cable to the user's headset. It gets power from an external power supply, typically that of a vehicle for which it is intended for installation.

1.3 EUT Operation

The EUT was exercised in a manner consistent with normal operations.

1.4 Modifications to Equipment

No modifications were made to the EUT during the performance of the test program.

1.5 Test Site

Measurements were made at the PTI semi-anechoic facility designated Site 45 (FCC 459644, IC 3036B-1) in Austin, Texas. The site is registered with the FCC under Section 2.948 and Industry Canada per RSS-GEN, and is subsequently confirmed by laboratory accreditation (NVLAP). The test site is located at 11400 Burnet Road, Austin, Texas 78758, while the main office is located at 1601 North A.W. Grimes Boulevard, Suite B, Round Rock, Texas, 78665.

1.6 Radiated Measurements

Radiated levels are determined as follows:

Raw Measured Field Level + Antenna Factor + Cable Losses – Amplifier Gain = Corrected Level

Conducted RF levels, when applicable, are determined as follows:

Raw Measured Level + Attenuator Factor + Cable Losses = Corrected Level

Conducted mains levels, when applicable, are determined as follows:

Raw Measured Level + LISN Factor + Cable/Filter/Limiter Losses = Corrected Level

Additionally, measurement distance extrapolation factors are applied and documented where used.

1.7 Applicable Documents and Clauses

Table 1.7.1: Applicable Documents	
Document	**Title**
47 CFR	Part 15 – Radio Frequency Devices Subpart C - Intentional Radiators, Subpart B – Unintentional Radiators
ANSI C63.10:2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless 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
RSS-247 Issue 2	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
RSS-Gen Issue 4	General Requirements and Information for the Certification of Radio Apparatus

Table 1.7.2: Applicable Clauses		
Parameter	**FCC Part 15 Rule Paragraphs**	**IC RSS References**
Transmitter Characteristics	15.247	RSS-247 5.2 (DTS) & 5.4, RSS-Gen
Bandwidth	15.247(a)(2), 2.1049, KDB 558074 D01	RSS-247 6.2.4.1, RSS-Gen 6.6
Spurious Emission	15.247(d), 15.209, 15.205	RSS-247 5.5, RSS-GEN 6.13 & 8.10
Band Edge	15.247, 15.205	RSS-247 5.5, RSS-Gen 4.9
Antenna Requirement	15.247, 15.203	RSS-Gen 8.3

2.0 Fundamental Power

2.1 Test Procedure

Peak power is measured using conducted means and without modulation. The transmitter hopping sequence is disabled to operate on a single channel for the measurement.

2.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date
15.247(b)(3) // RSS-247 5.4(b)	Fundamental Power Conducted Limits 1 W Limit Restated as Field: 125.23 dBµV/m @ 3 m	14 Feb 2019

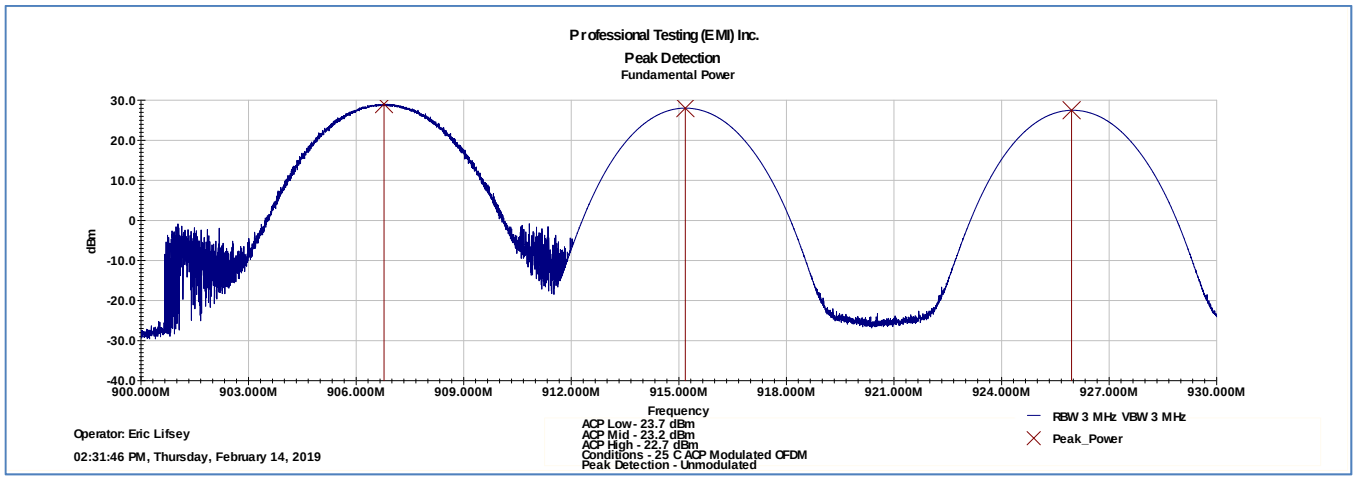
2.3 Test Results, Peak Power

Table 2.3.1 Power, Peak, Conducted, Unmodulated

Frequency MHz	Measured Peak Power At Antenna Port dBm*	Antenna Gain dBi	Power Restated as EIRP dBm	Maximum Measured Peak Power Restated as EIRP mW
903	29.0	1.2	30.2	1047
915	28.0	1.2	29.2	831
926	27.5	1.2	28.7	741

*Measured in 3 MHz RBW, 3 MHz VBW. **Measured in 1.2 MHz ACP band.

The EUT satisfied the requirements.



2.4 Test Results, Duty Cycle

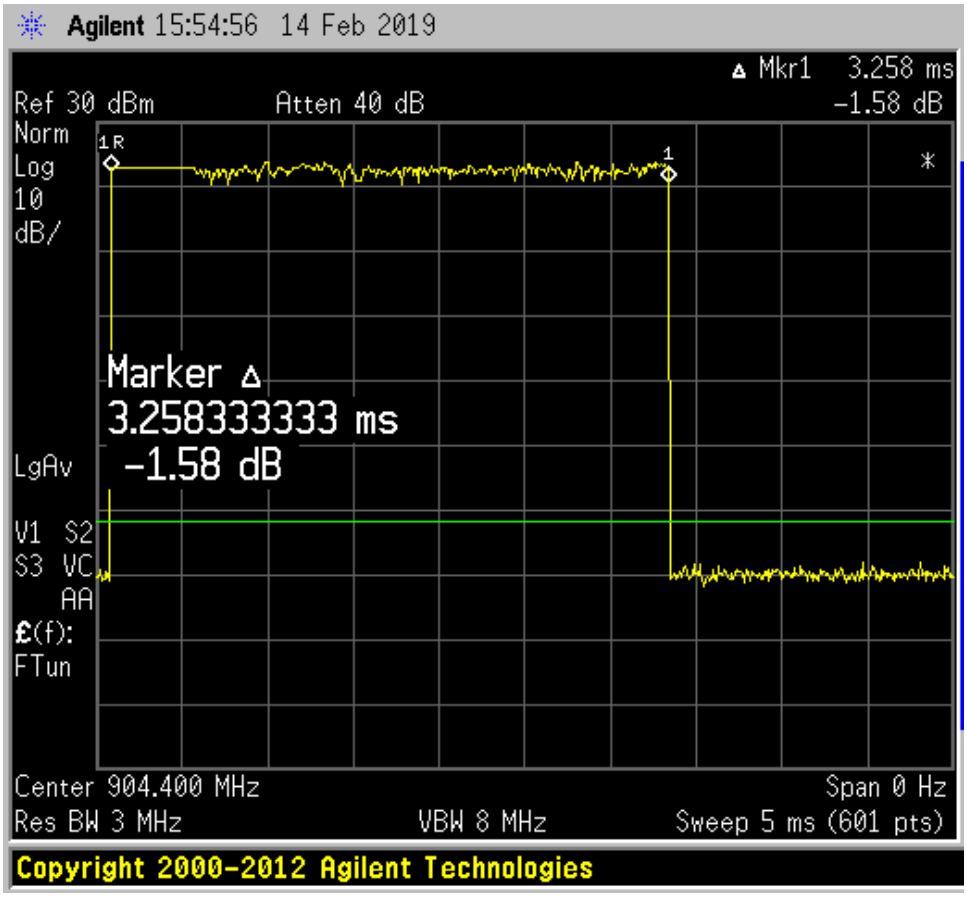
Measurement is based on intervals not to exceed 100 msec. Maximum transmitter on time is divided by the lesser of 100 msec or the actual measured minimum transmitter interval time. The result is converted to dB and applied as needed to peak measurements of transmitter artifacts to determine average power. This is not a pass/fail measurement.

Table 2.4.1 Duty Cycle Results and Average Duty Cycle Factor Result

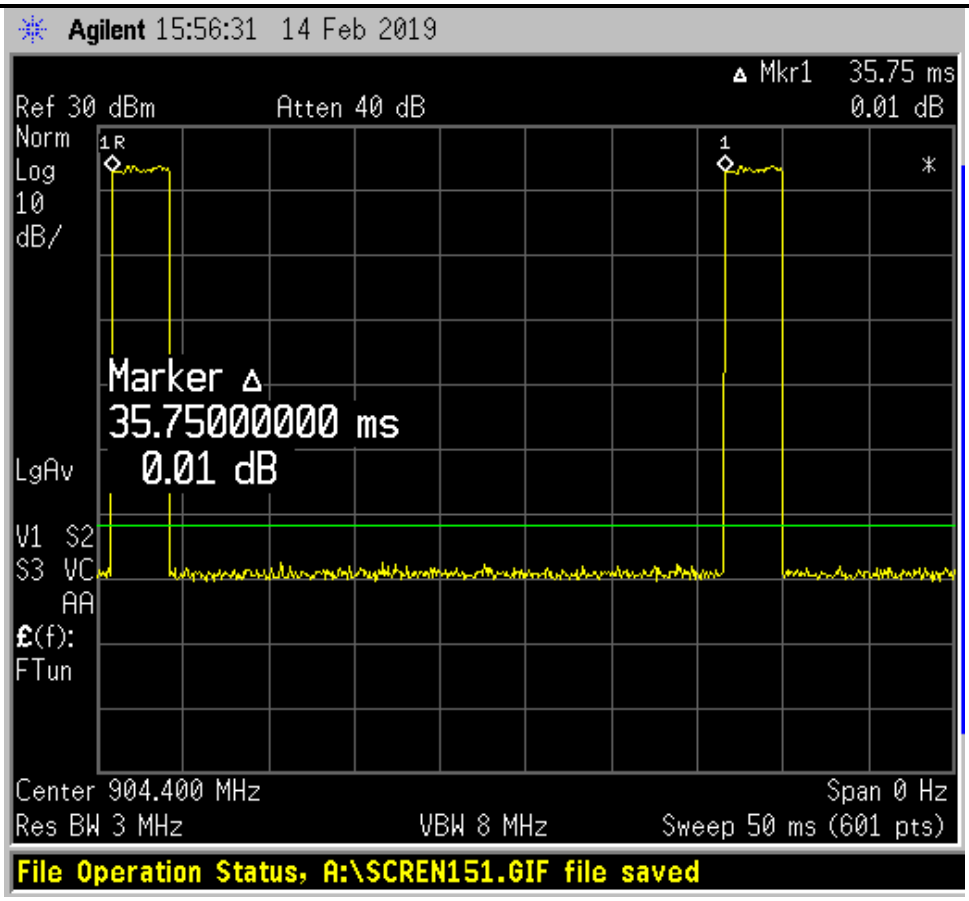
Total Measured On Time (msec)	Measured Time Interval (msec)	Duty Cycle Factor Calculation	Result (dB)	Duty Cycle Factor Allowed (dB)
3.258	35.75	= 20 * Log_{10} (3.258 msec / 35.75 msec)	-21.3	-20

For exposure consideration, the factor is -21.3 / 2 = -10.65 dB

The allowed duty cycle factor is applied to peak measured harmonic signals to find average levels.



Transmit Time



Transmit Interval

3.0 Power Spectral Density

3.1 Test Procedure

A spectrum analyzer is either connected directly to the EUT or used by radiated means to measure the fundamental emission. It is adjusted to measure the power spectral density in the specified resolution bandwidth.

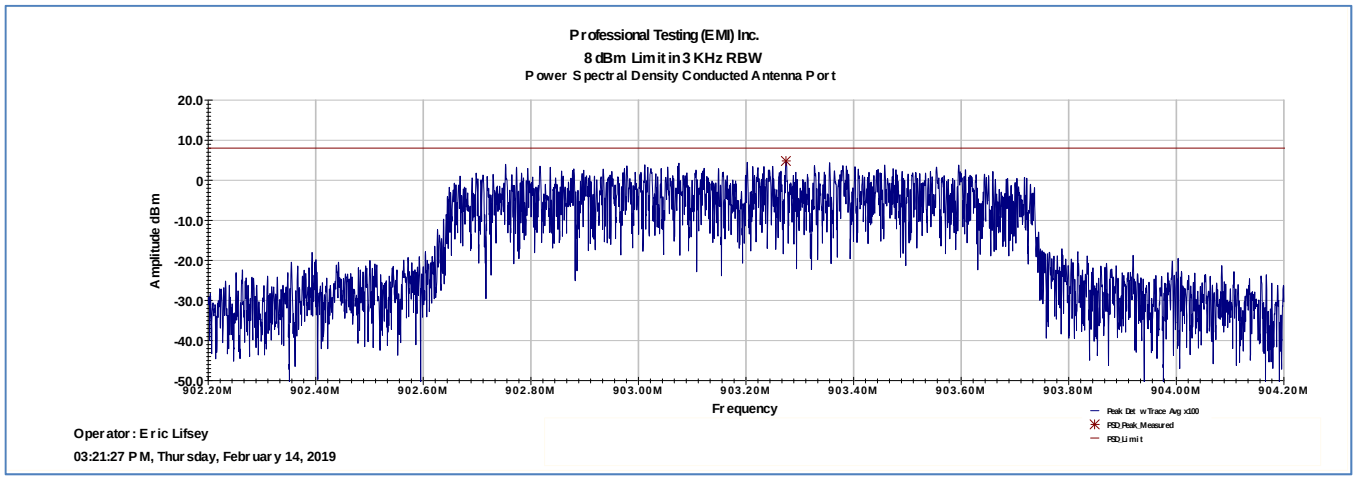
3.2 Test Criteria

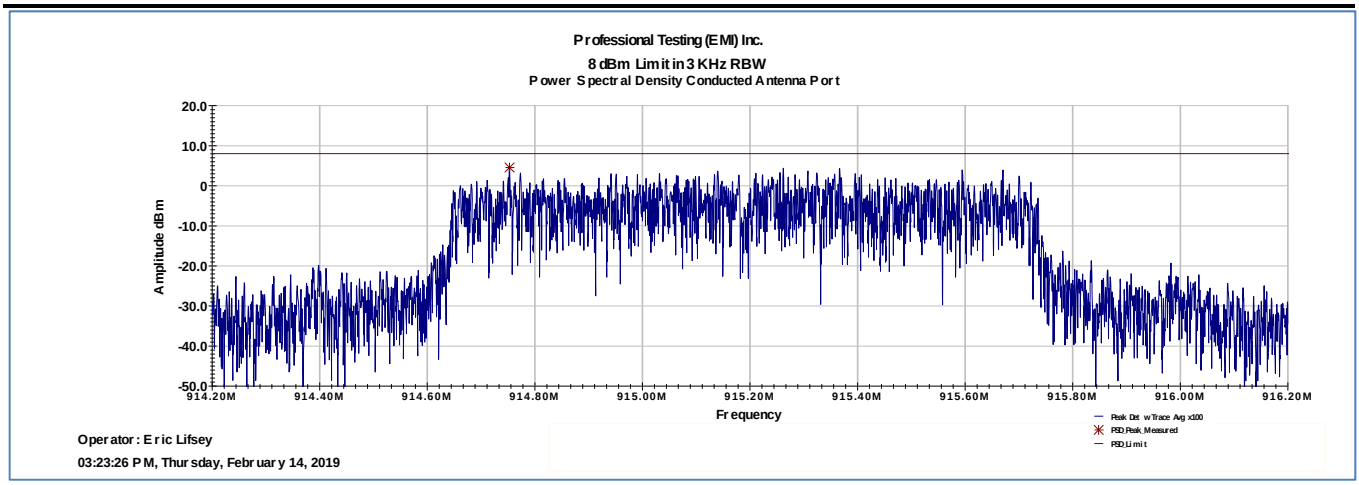
47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date
15.247(e) // RSS-247, 5.2	Power Spectral Density, Conducted Limit: 8 dBm / 3 kHz Restated as field strength limit: 103.23 dBµV/m at 3 m	14 Feb 2019

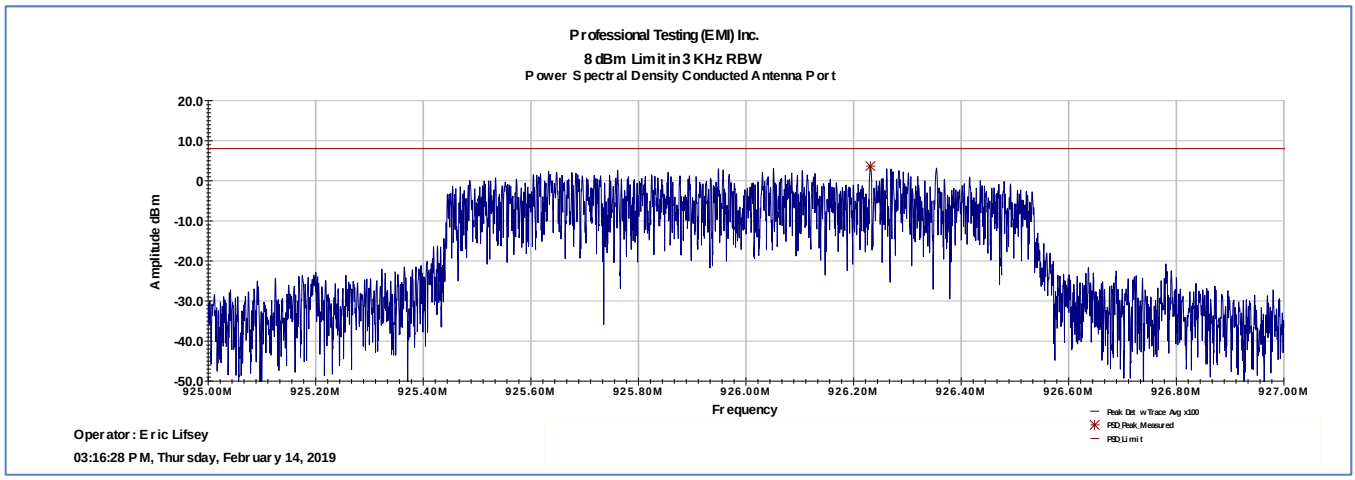
3.3 Test Results

Table 3.3.1 Power Spectral Density, Conducted	
Frequency MHz	**Maximum Measured PSD dBm**
903	4.8
915	4.6
926	3.6

The EUT satisfied the requirements.




Professional Testing (EMI) Inc.
8 dBm Limit in 3 KHz RBW
Power Spectral Density Conducted Antenna Port
Amplitude dBm
20.0
10.0
0
-10.0
-20.0
-30.0
-40.0
-50.0
914.20M
914.40M
914.60M
914.80M
915.00M
915.20M
915.40M
915.60M
915.80M
916.00M
916.20M
Frequency
Peak Det w Trace Avg x100
PSD Peak Measured
PSD Limit
Operator : Eric Lifsey
03:23:26 PM, Thursday, February 14, 2019


Professional Testing (EMI) Inc.
8 dBm Limit in 3 KHz RBW
Power Spectral Density Conducted Antenna Port
Amplitude dBm
20.0
10.0
0
-10.0
-20.0
-30.0
-40.0
-50.0
925.00M
925.20M
925.40M
925.60M
925.80M
926.00M
926.20M
926.40M
926.60M
926.80M
927.00M
Frequency
Peak Det w Trace Avg x100
PSD Peak Measured
PSD Limit
Operator : Eric Lifsey
03:16:28 PM, Thursday, February 14, 2019

4.0 Occupied Bandwidth

4.1 Test Procedure

Bandwidth is measured by radiated means. A recording of the results is included.

4.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.247(a)(2), 2.1049, KDB 558074 D01 // RSS-Gen 6.6	Bandwidth, 6 dB, 20 dB, 99%	14 Feb 2019

4.3 Test Results

The bandwidth measurement is used to verify DTS characteristics and/or for general reporting for agency application.

The EUT satisfied the requirements.

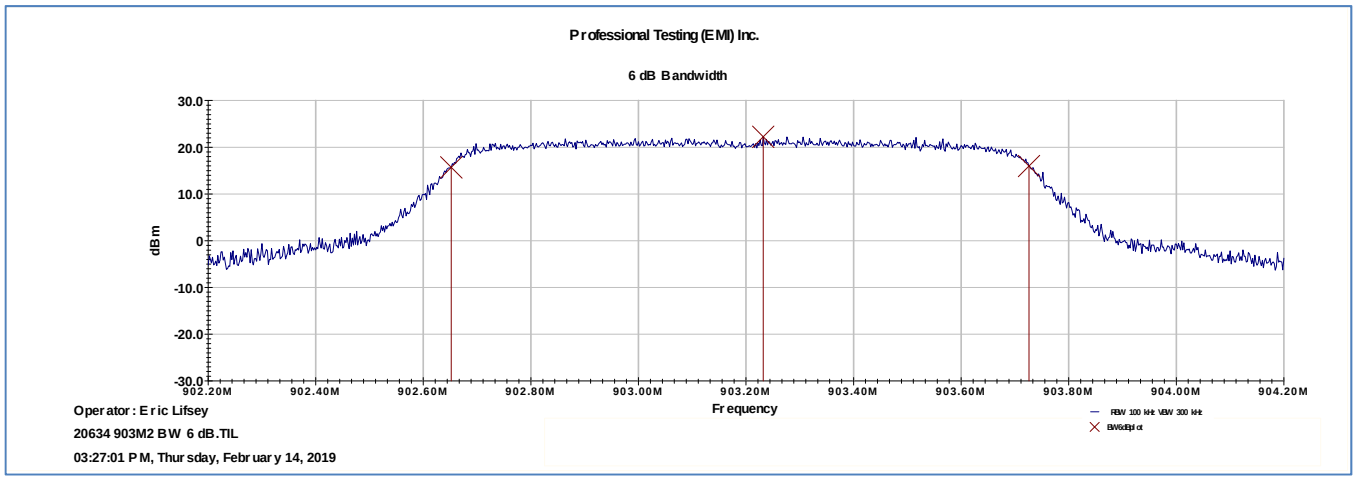
Table 4.3.1 Bandwidth 6 dB, Minimum 500 kHz in 100 kHz RBW			
Low Channel Measured BW (kHz)	Mid Channel Measured BW (kHz)	High Channel Measured BW (kHz)	**Reported Minimum BW (kHz)**
1074	1036	1072	**1036**

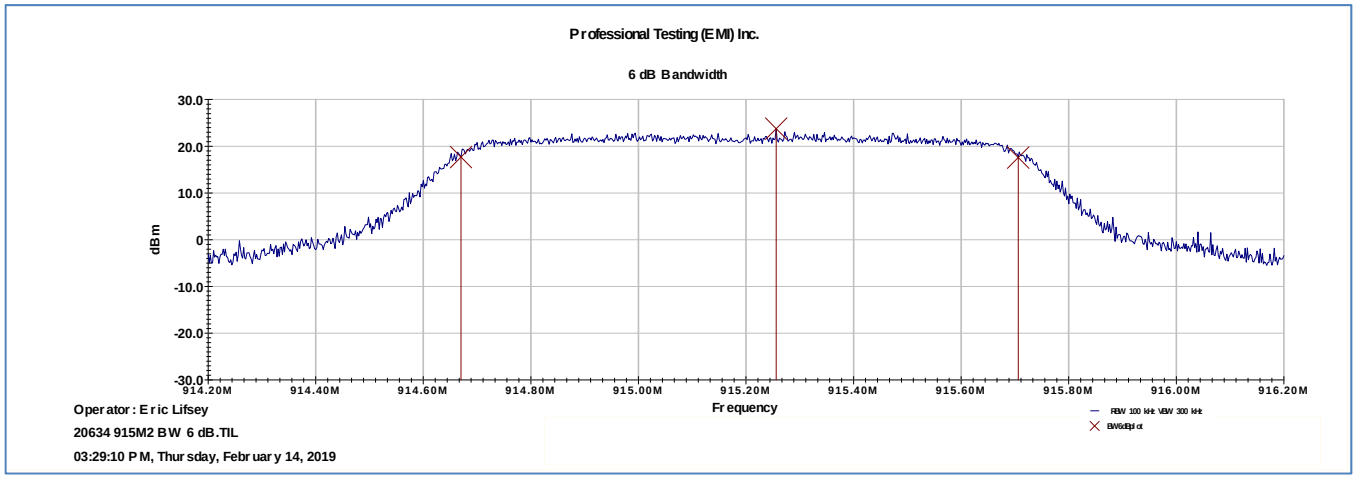
Table 4.3.2 Bandwidth 20 dB, Measure and Report			
Low Channel Measured BW (kHz)	Mid Channel Measured BW (kHz)	High Channel Measured BW (kHz)	**Reported Maximum BW (kHz)**
1202	1192	1192	**1202**

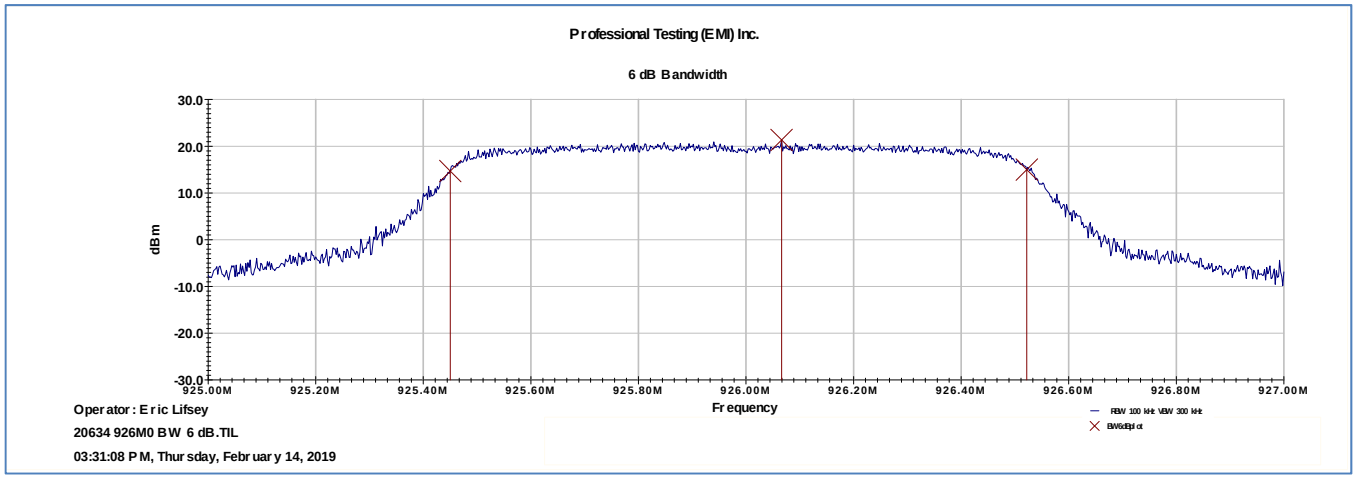
Table 4.3.3 Bandwidth 99%, Measure and Report			
Low Channel Measured BW (kHz)	Mid Channel Measured BW (kHz)	High Channel Measured BW (kHz)	**Reported Maximum BW (kHz)**
1106	1125	1111	**1125**

Plotted measurements appear on the following pages.

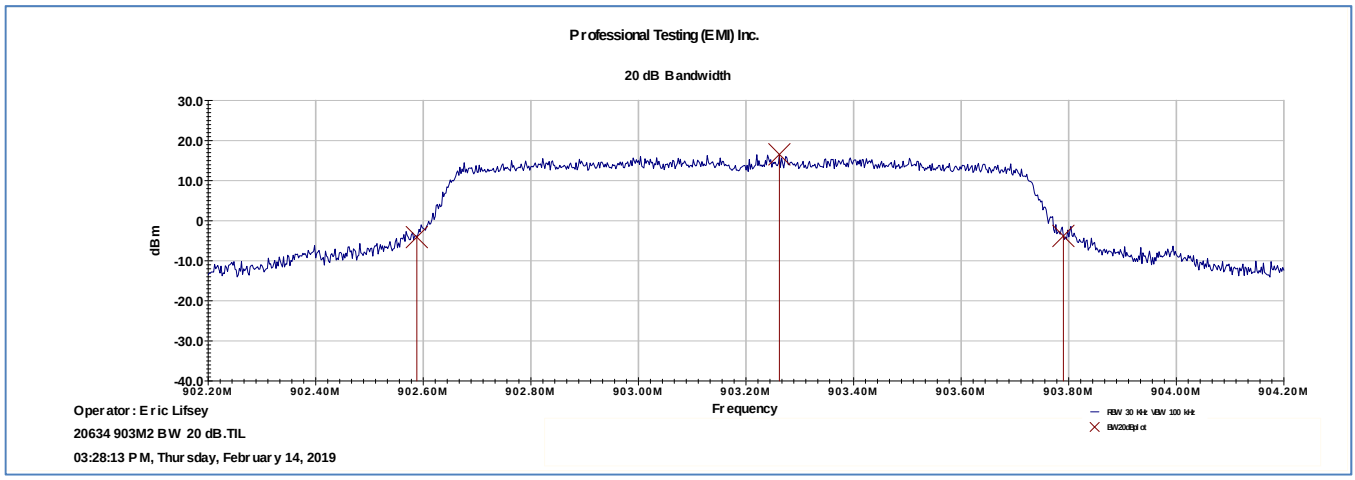
4.3.1 Bandwidth Plots, 6 dB

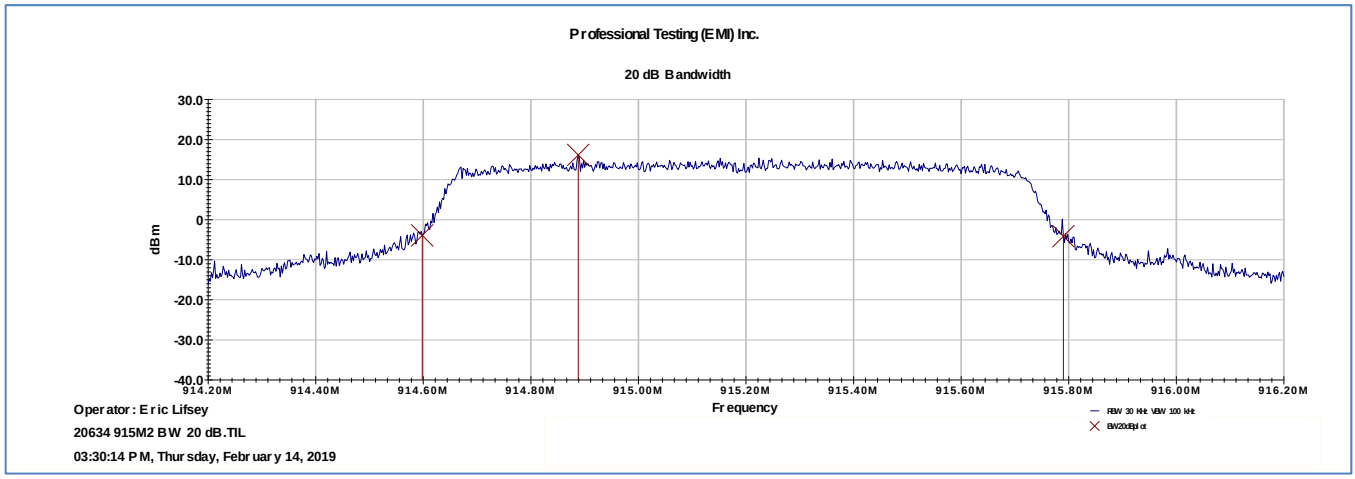


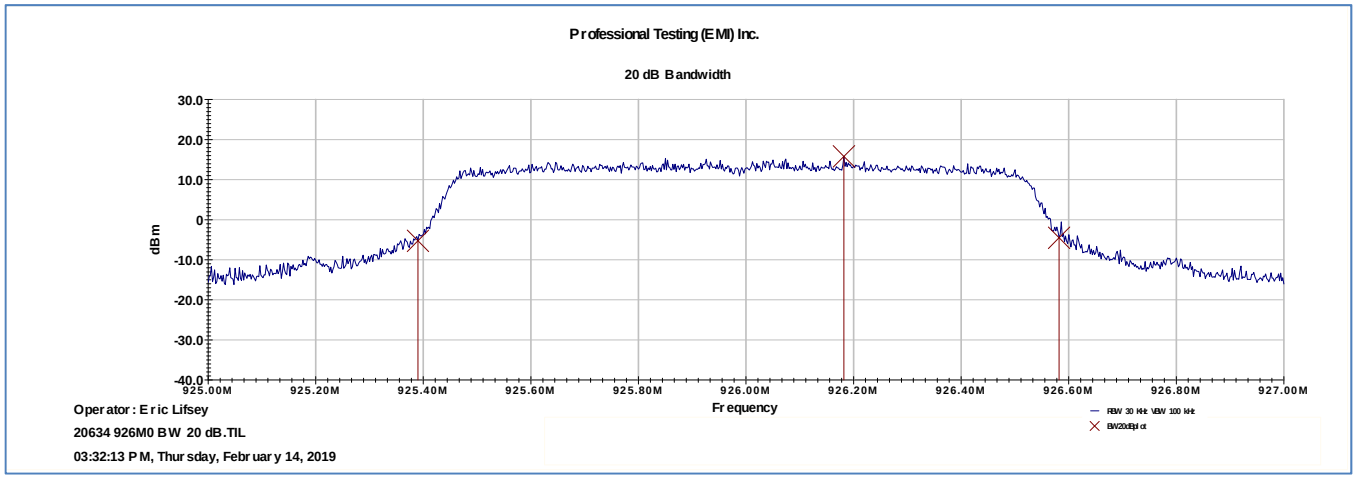




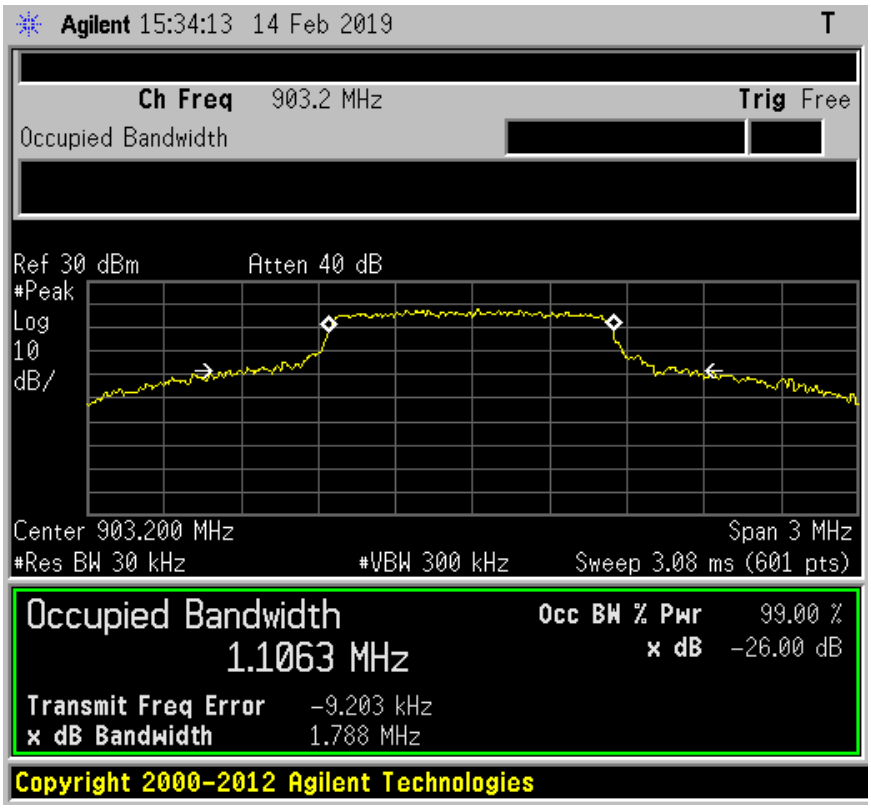
4.3.2 Bandwidth Plots, 20 dB

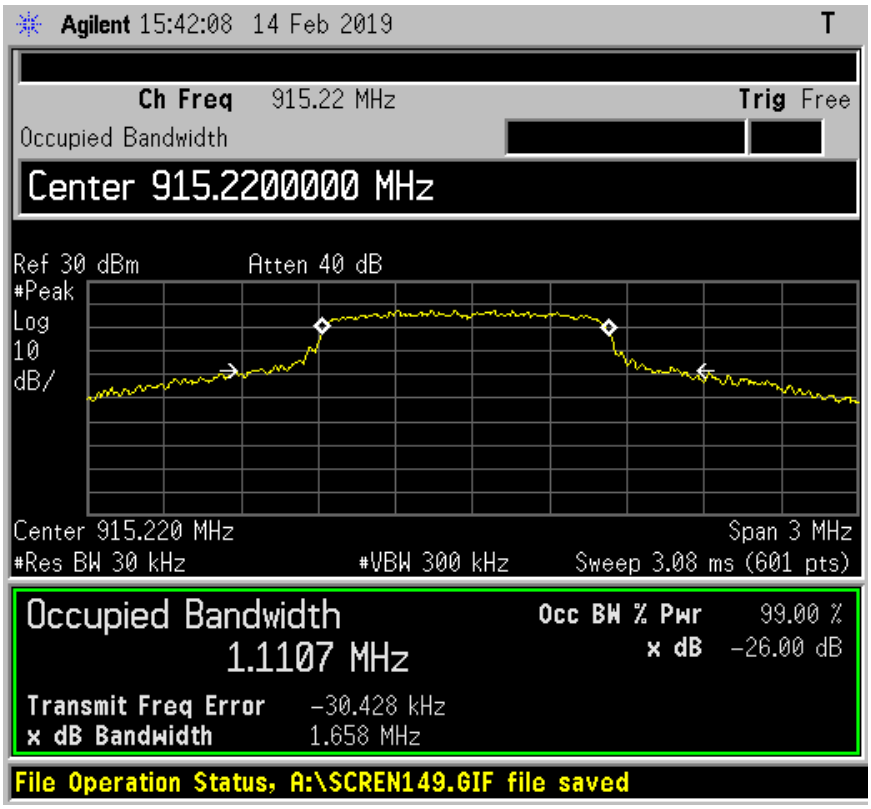


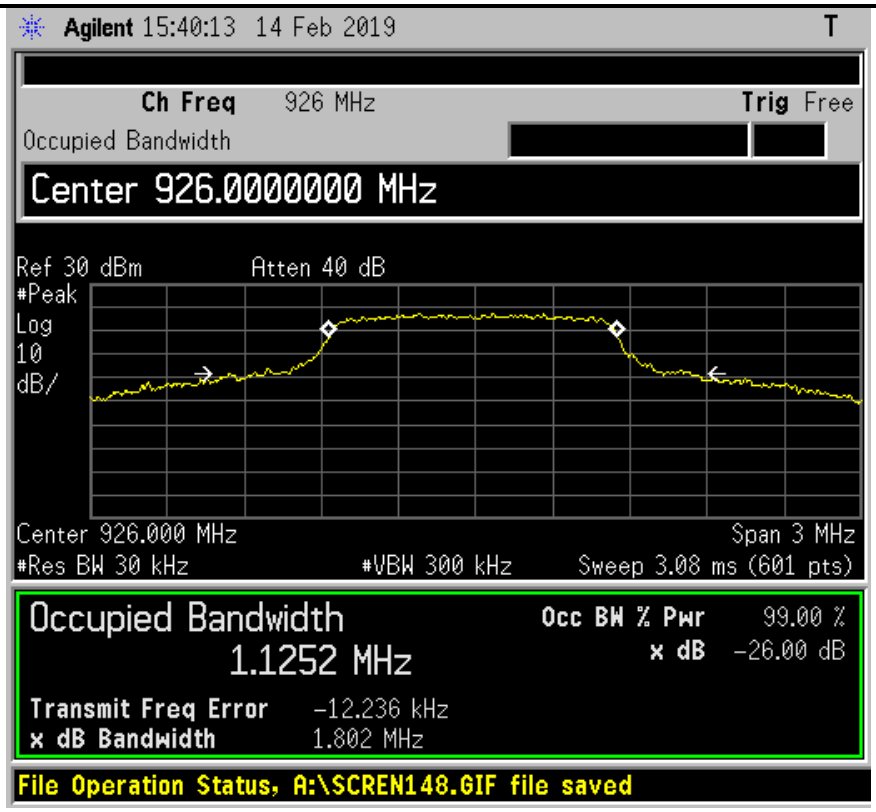




4.3.3 Bandwidth Plots, 99%





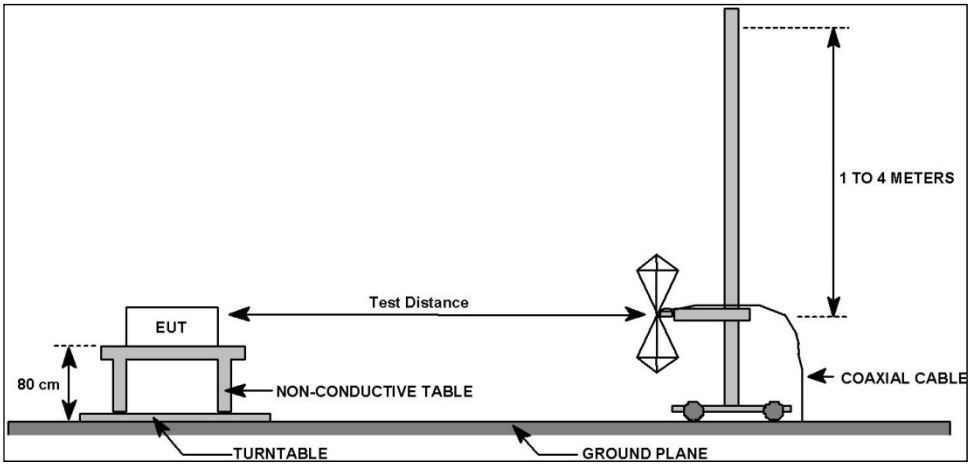

Agilent 15:40:13 14 Feb 2019
T
Ch Freq 926 MHz
Trig Free
Occupied Bandwidth
Center 926.0000000 MHz
Ref 30 dBm
Atten 40 dB
#Peak
Log
10
dB/
Center 926.000 MHz
Span 3 MHz
#Res BW 30 kHz
#VBW 300 kHz
Sweep 3.08 ms (601 pts)
Occupied Bandwidth
1.1252 MHz
Occ BW % Pwr 99.00 %
x dB -26.00 dB
Transmit Freq Error -12.236 kHz
x dB Bandwidth 1.802 MHz
File Operation Status, A:\SCREN148.GIF file saved

5.0 Radiated Spurious Emissions, Receive Mode

5.1 Test Procedure

The EUT was placed on a non-conductive table 0.8 meters above the ground plane. The EUT was centered on a rotating turntable. Measurements below 1 GHz were taken at a test distance of 10 meters from the measurement antenna. Above 1 GHz the measurement distance was 3 meters.

Spurious emissions below 1 GHz were measured with quasi-peak detection with a resolution bandwidth of 120 kHz. Above 1 GHz peak measurements were taken and average measured where appropriate and 1 MHz resolution bandwidth. A diagram showing the test setup appears below.



5.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.247(d), 15.209, 15.205 // RSS-247 5.5, RSS-Gen 6.13 & 8.10	Field Strength of Radiated Spurious/Harmonic Emissions Receive Mode	14 Feb 2019

5.3 Test Results

The EUT was tuned to the middle channel and placed in receive mode.

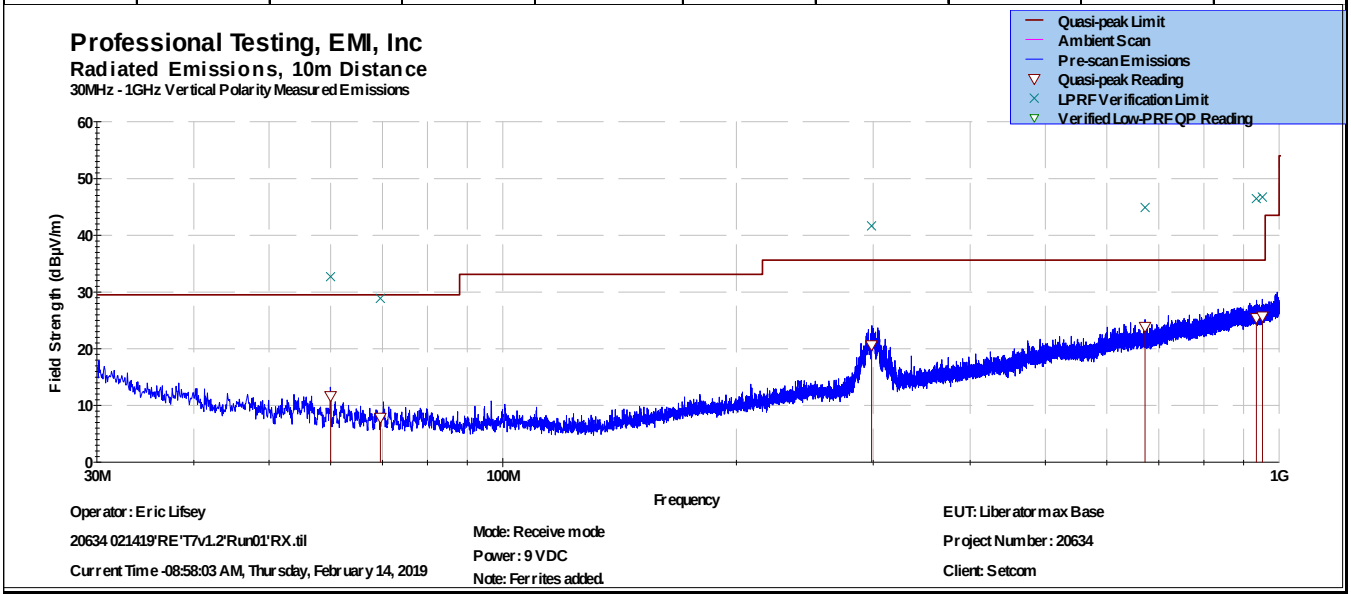
The EUT satisfied the criteria.

5.3.1 Up to 1 GHz

Professional Testing, EMI, Inc.			
Test Method:	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		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	2/14/2019	EUT Serial #:	None
Customer:	Setcom (TenX)	EUT Part #:	None
Project Number:	20634	Test Technician:	Eric Lifsey
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	LiberatorMax Base	Witness' Name:	Jason Gossiaux

Radiated Emissions Test Results Data Sheet		Page: 1 of 1	
EUT Line Voltage:	9 VDC	EUT Power Frequency:	0 N/A
Antenna Orientation:	Vertical	Frequency Range:	30MHz to 1GHz
EUT Mode of Operation:		Receive Mode Mid Chan	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
60.003	10	251	3.52	Quasi-peak	31.505	11.694	29.5	-17.8	Pass
69.555	10	9	1.74	Quasi-peak	27.549	7.864	29.5	-21.6	Pass
298.561	10	300	1.18	Quasi-peak	31.356	20.649	35.6	-15.0	Pass
672.024	10	224	2.24	Quasi-peak	25.251	23.892	35.6	-11.7	Pass
934.852	10	80	3.42	Quasi-peak	21.174	25.446	35.6	-10.2	Pass
952.040	10	274	4	Quasi-peak	21.031	25.734	35.6	-9.9	Pass



≤ 1GHz Vertical Antenna Polarity Measured Emissions

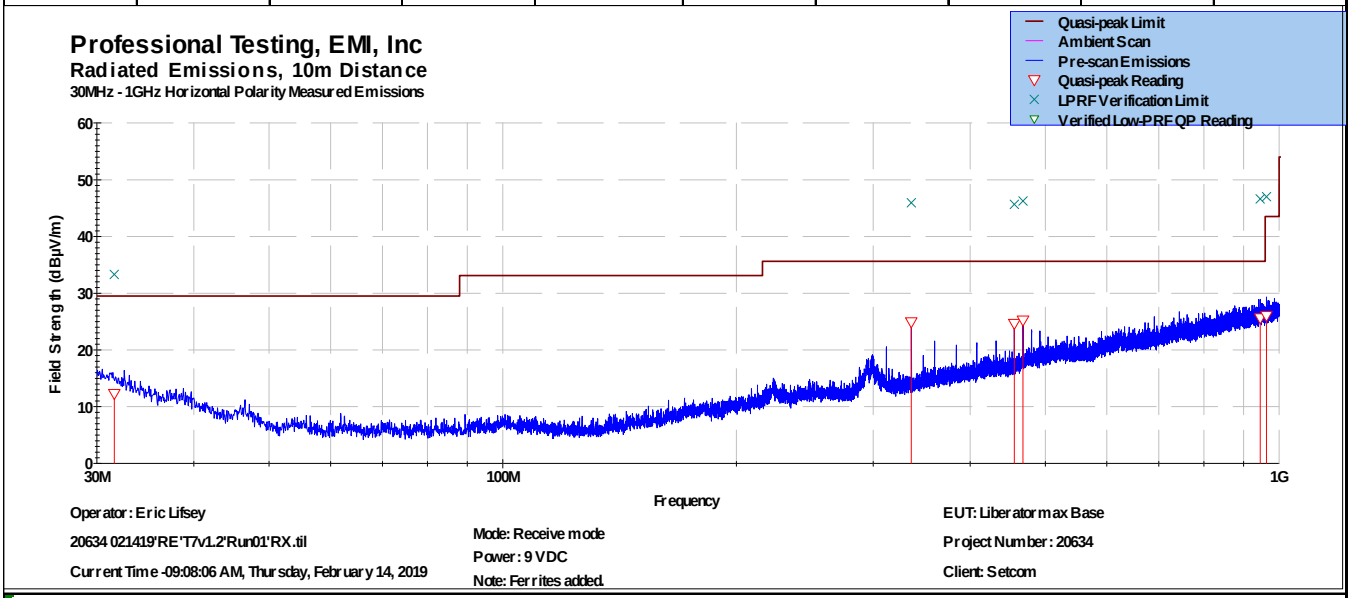
Professional Testing, EMI, Inc.

Test Method:	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		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	2/14/2019	**EUT Serial #:**	None
Customer:	Setcom (TenX)	**EUT Part #:**	None
Project Number:	20634	**Test Technician:**	Eric Lifsey
Purchase Order #:	0	**Supervisor:**	Lisa Arndt
Equip. Under Test:	LiberatorMax Base	**Witness' Name:**	Jason Gossiaux

Radiated Emissions Test Results Data Sheet — **Page: 1 of 1**

EUT Line Voltage:	9 VDC	**EUT Power Frequency:**	0 N/A
Antenna Orientation:	Horizontal	**Frequency Range:**	30MHz to 1GHz
EUT Mode of Operation:		Receive Mode Mid Chan	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
31.586	10	145	2.36	Quasi-peak	23.998	12.284	29.5	-17.2	Pass
336.004	10	73	1.71	Quasi-peak	34.626	24.923	35.6	-10.7	Pass
455.999	10	44	1.37	Quasi-peak	31.249	24.645	35.6	-11.0	Pass
468.000	10	298	1.17	Quasi-peak	31.184	25.228	35.6	-10.4	Pass
945.603	10	85	1.14	Quasi-peak	21.074	25.617	35.6	-10.0	Pass
963.407	10	146	1.13	Quasi-peak	21.017	26.009	43.5	-17.5	Pass



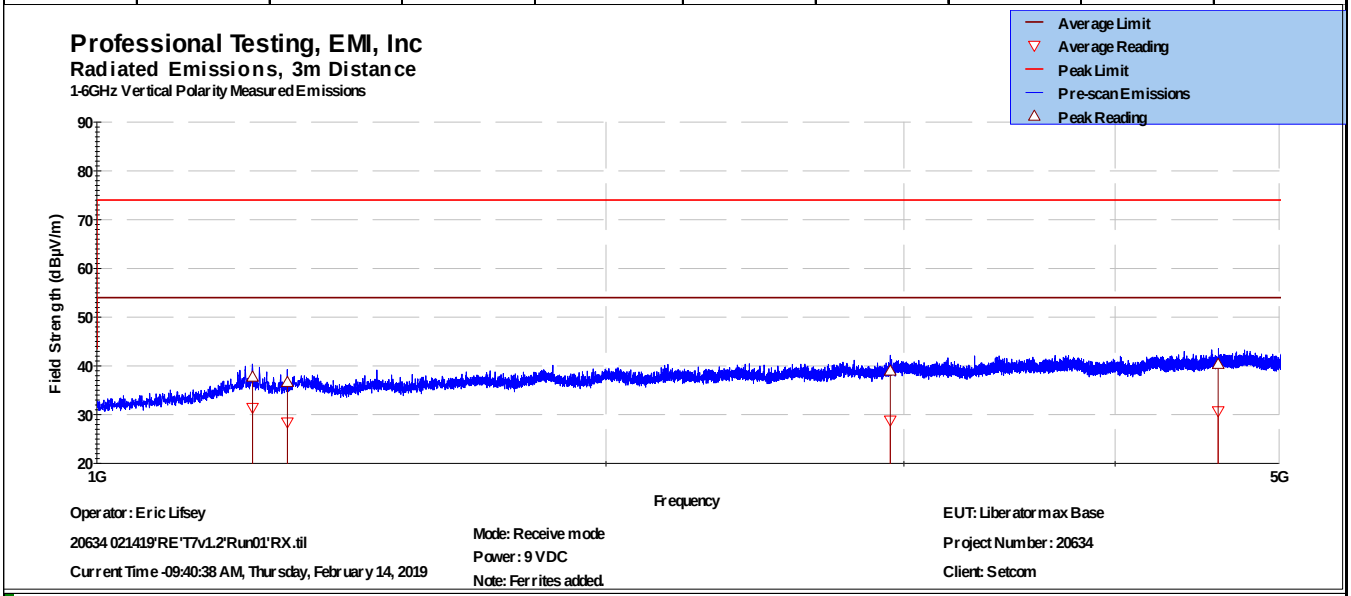
≤ 1GHz Horizontal Antenna Polarity Measured Emissions

5.3.2 Up to 5 GHz

Professional Testing, EMI, Inc.			
Test Method:	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		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	2/14/2019	EUT Serial #:	None
Customer:	Setcom (TenX)	EUT Part #:	None
Project Number:	20634	Test Technician:	Eric Lifsey
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	LiberatorMax Base	Witness' Name:	Jason Gossiaux

Radiated Emissions Test Results Data Sheet		Page: 1 of 1	
EUT Line Voltage:	9 VDC	EUT Power Frequency:	0 N/A
Antenna Orientation:	Vertical	Frequency Range:	Above 1GHz
EUT Mode of Operation:		Receive Mode Mid Chan	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
1235.99	3	103	1.39	Average	43.3	31.444	54.0	-22.5	Pass
1296	3	233	1.93	Average	40.2	28.443	54.0	-25.5	Pass
2944.92	3	112	3.6	Average	35.9	28.848	54.0	-25.1	Pass
4602.9	3	205	2.74	Average	35	30.736	54.0	-23.2	Pass



> 1GHz Vertical Antenna Polarity Measured Emissions

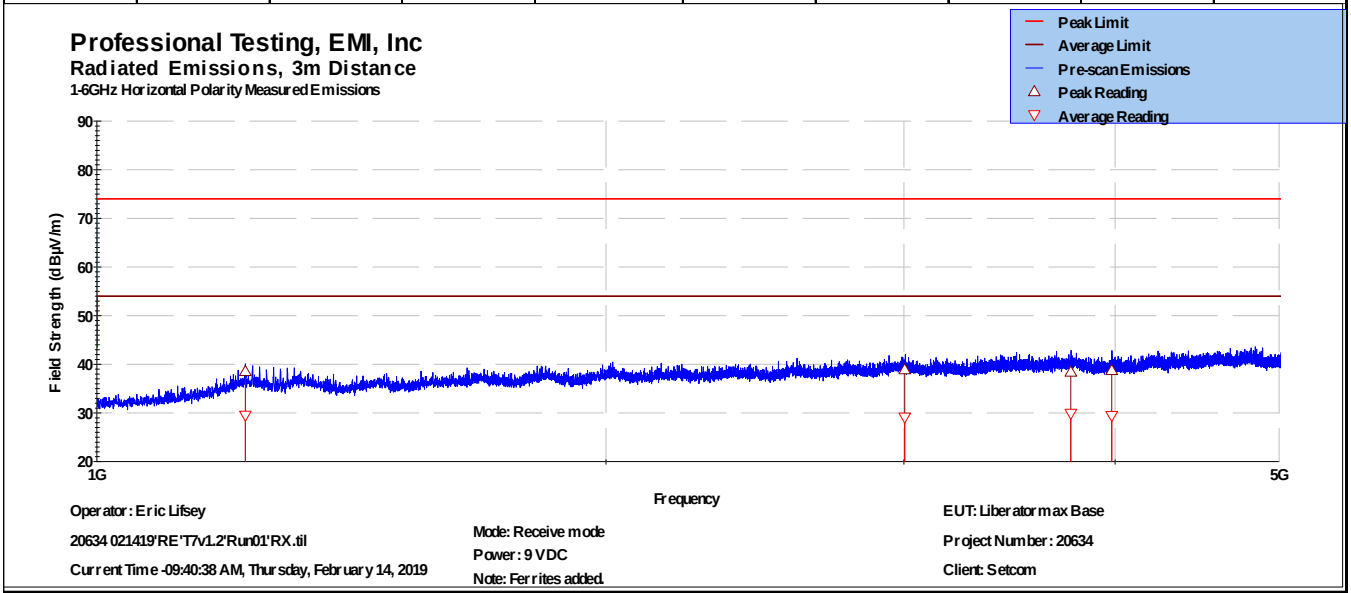
Professional Testing, EMI, Inc.

Test Method:	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		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	2/14/2019	**EUT Serial #:**	None
Customer:	Setcom (TenX)	**EUT Part #:**	None
Project Number:	20634	**Test Technician:**	Eric Lifsey
Purchase Order #:	0	**Supervisor:**	Lisa Arndt
Equip. Under Test:	LiberatorMax Base	**Witness' Name:**	Jason Gossiaux

Radiated Emissions Test Results Data Sheet — **Page: 1 of 1**

EUT Line Voltage:	9 VDC	**EUT Power Frequency:**	0 N/A
Antenna Orientation:	Horizontal	**Frequency Range:**	Above 1GHz
EUT Mode of Operation:		Receive Mode Mid Chan	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
1224.04	3	271	2.35	Average	41.3	29.463	54.0	-24.5	Pass
3003.57	3	31	1.8	Average	36	29.07	54.0	-24.9	Pass
3765.99	3	300	2.2	Average	36.4	29.873	54.0	-24.1	Pass
3981.01	3	133	1.82	Average	35.6	29.428	54.0	-24.5	Pass

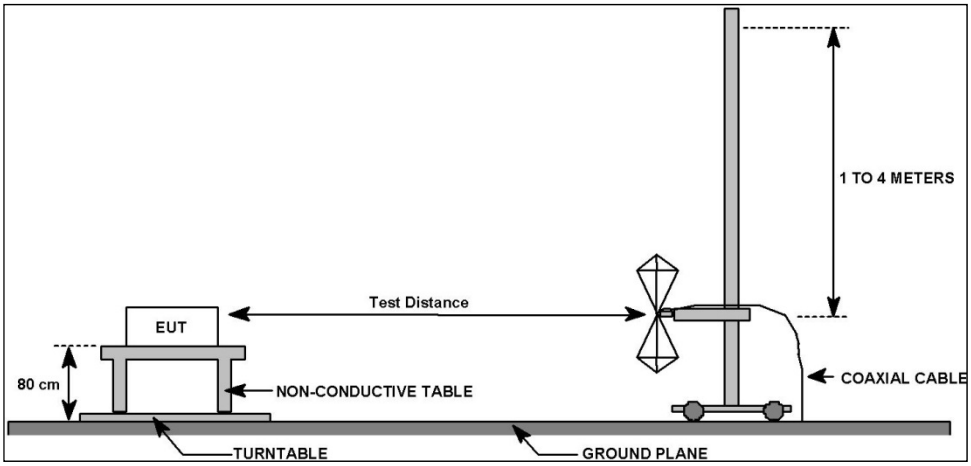


> 1GHz Horizontal Antenna Polarity Measured Emissions

6.0 Radiated Spurious Emissions, Transmit Mode

6.1 Test Procedure

Radiated emissions are measured with the EUT transmitting on the required frequencies.



6.1.1 Test Distance and Detection Method		
30 MHz to 1 GHz	**1 GHz to 18 GHz**	**18 GHz to 25 GHz**
10 m	3 m	1 m
Quasi-peak	Peak & Average	Peak & Average

6.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.247(d), 15.205 // RSS-247 5.5, RSS-Gen 6.13 & 8.10	Field Strength of Radiated Spurious/Harmonic Emissions Transmit Mode	14 Feb 2019

6.3 Test Results

Modulation was enabled for this test and the transmitter was placed into continuous transmit mode.

Lowest fundamental power measured 30.2 dBm; subtracting 20 dBc yields limit for unrestricted bands of 10.2 dBm. For field strength at 3 meters (> 1 GHz) the limit calculates to 105.4 dBµV/m. Note that the general emission limits were satisfied.

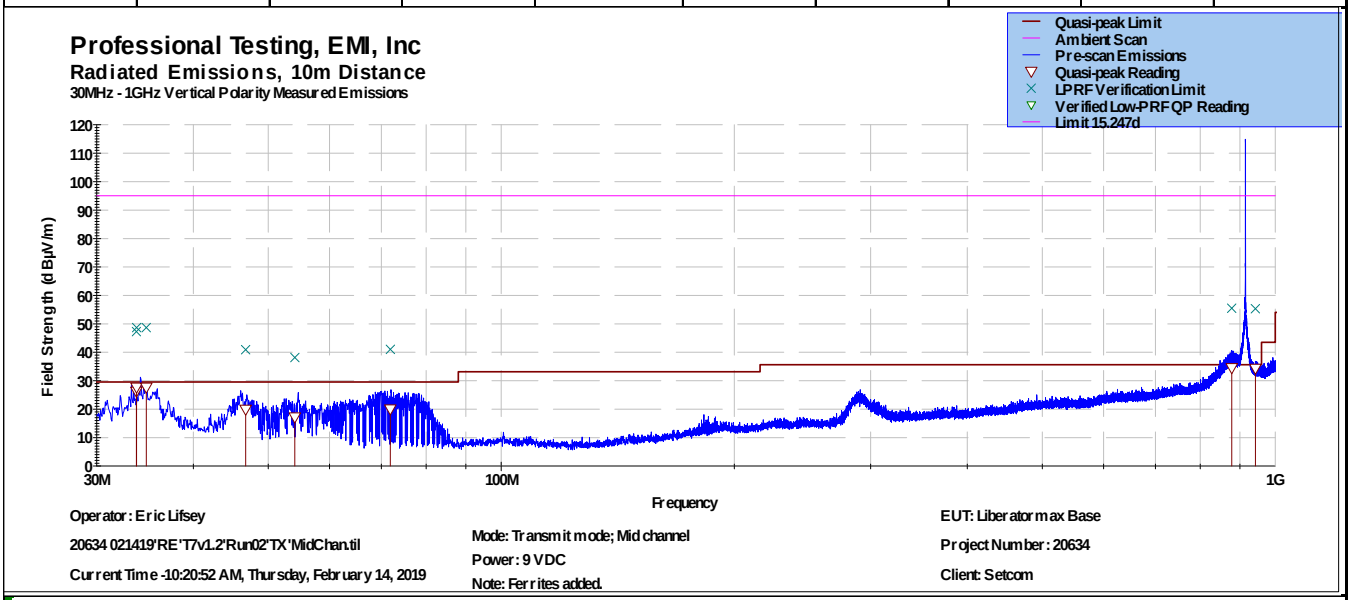
The duty cycle averaging factor applies -20.0 dB to the peaks recorded for the harmonics.

6.3.1 Up to 1 GHz, Middle Channel

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.10: 2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	2/14/2019	EUT Serial #:	None
Customer:	Setcom (TenX)	EUT Part #:	None
Project Number:	20634	Test Technician:	Eric Lifsey
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	LiberatorMax Base	Witness' Name:	Jason Gossiaux

Radiated Emissions Test Results Data Sheet		Page: 1 of 1	
EUT Line Voltage:	9 VDC	EUT Power Frequency:	0 N/A
Antenna Orientation:	Vertical	Frequency Range:	30MHz to 1GHz
EUT Mode of Operation:		Transmit Middle Channel	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
33.775	10	67	1.79	Quasi-peak	38.899	26.253	29.5	-3.2	Pass
33.792	10	79	2.03	Quasi-peak	40.302	27.649	29.5	-1.9	Pass
33.775	10	67	1.79	Quasi-peak	38.899	26.253	29.5	-3.2	Pass
34.782	10	14	1.54	Quasi-peak	40.715	27.644	29.5	-1.9	Pass
46.735	10	147	1.29	Quasi-peak	37.557	19.85	29.5	-9.7	Pass
54.121	10	117	3.55	Quasi-peak	36.415	17.149	29.5	-12.4	Pass
71.901	10	81	2.39	Quasi-peak	39.752	20.016	29.5	-9.5	Pass
878.482	10	63	3.54	Quasi-peak	31.014	34.471	35.6	-1.1	Pass
942.632	10	106	3.14	Quasi-peak	29.815	34.283	35.6	-1.3	Pass



≤ 1GHz Vertical Antenna Polarity Measured Emissions

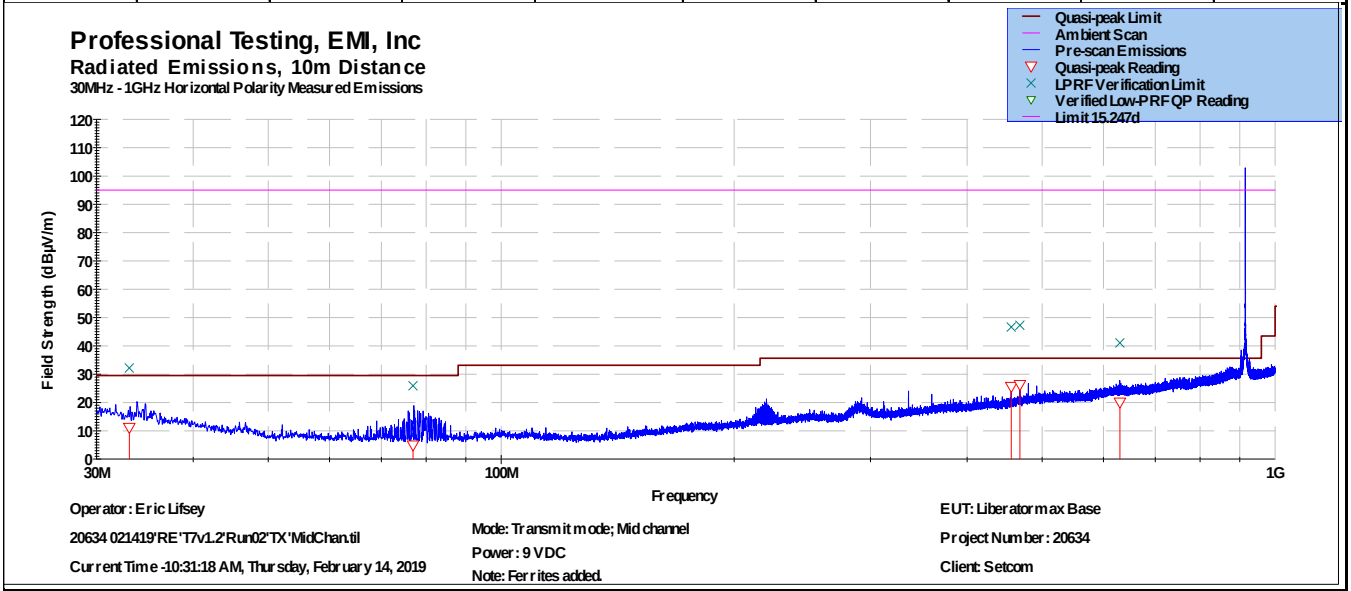
Professional Testing, EMI, Inc.

Test Method:	ANSI C63.10: 2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	2/14/2019	**EUT Serial #:**	None
Customer:	Setcom (TenX)	**EUT Part #:**	None
Project Number:	20634	**Test Technician:**	Eric Lifsey
Purchase Order #:	0	**Supervisor:**	Lisa Arndt
Equip. Under Test:	LiberatorMax Base	**Witness' Name:**	Jason Gossiaux

Radiated Emissions Test Results Data Sheet — **Page: 1 of 1**

EUT Line Voltage:	9 VDC	**EUT Power Frequency:**	0 N/A
Antenna Orientation:	Horizontal	**Frequency Range:**	30MHz to 1GHz
EUT Mode of Operation:		Transmit Middle Channel	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
33.067	10	62	3.21	Quasi-peak	23.477	11.14	29.5	-18.4	Pass
76.907	10	70	3.89	Quasi-peak	24.797	4.917	29.5	-24.6	Pass
456.003	10	238	2.88	Quasi-peak	32.196	25.592	35.6	-10.0	Pass
467.999	10	227	2.92	Quasi-peak	32.206	26.25	35.6	-9.4	Pass
630.143	10	220	1.37	Quasi-peak	21.967	20.058	35.6	-15.5	Pass



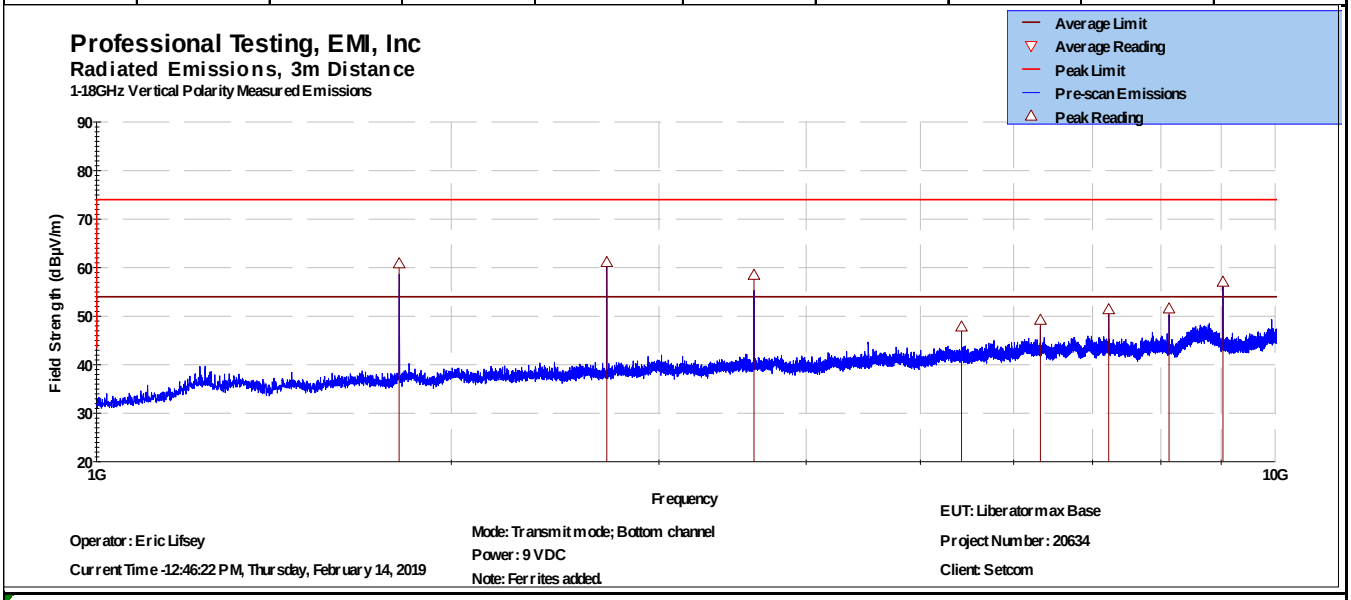
≤ 1GHz Horizontal Antenna Polarity Measured Emissions

6.3.2 1 to 10 GHz, Bottom Channel

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.10: 2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	2/14/2019	EUT Serial #:	None
Customer:	Setcom (TenX)	EUT Part #:	None
Project Number:	20634	Test Technician:	Eric Lifsey
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	LiberatorMax Base	Witness' Name:	Jason Gossiaux

Radiated Emissions Test Results Data Sheet			Page: 1 of 1
EUT Line Voltage:	9 VDC	EUT Power Frequency:	0 N/A
Antenna Orientation:	Vertical	Frequency Range:	Above 1GHz
EUT Mode of Operation:		Transmit Bottom Channel	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
1806.4	3	57	2.57	Peak	70.5	60.812	74.0	-13.1	Pass
2709.58	3	270	2.21	Peak	69	61.085	74.0	-12.9	Pass
3612.78	3	328	3.88	Peak	65.2	58.461	74.0	-15.5	Pass
5419.14	3	349	3.38	Peak	50.2	47.816	74.0	-26.1	Pass
6322.35	3	108	3.36	Peak	48.2	49.186	74.0	-24.8	Pass
7225.58	3	125	3.23	Peak	48	51.358	74.0	-22.6	Pass
8128.71	3	122	3.52	Peak	45.9	51.547	74.0	-22.4	Pass
9031.91	3	113	1.95	Peak	49.3	57.027	74.0	-16.9	Pass



> 1GHz Vertical Antenna Polarity Measured Emissions

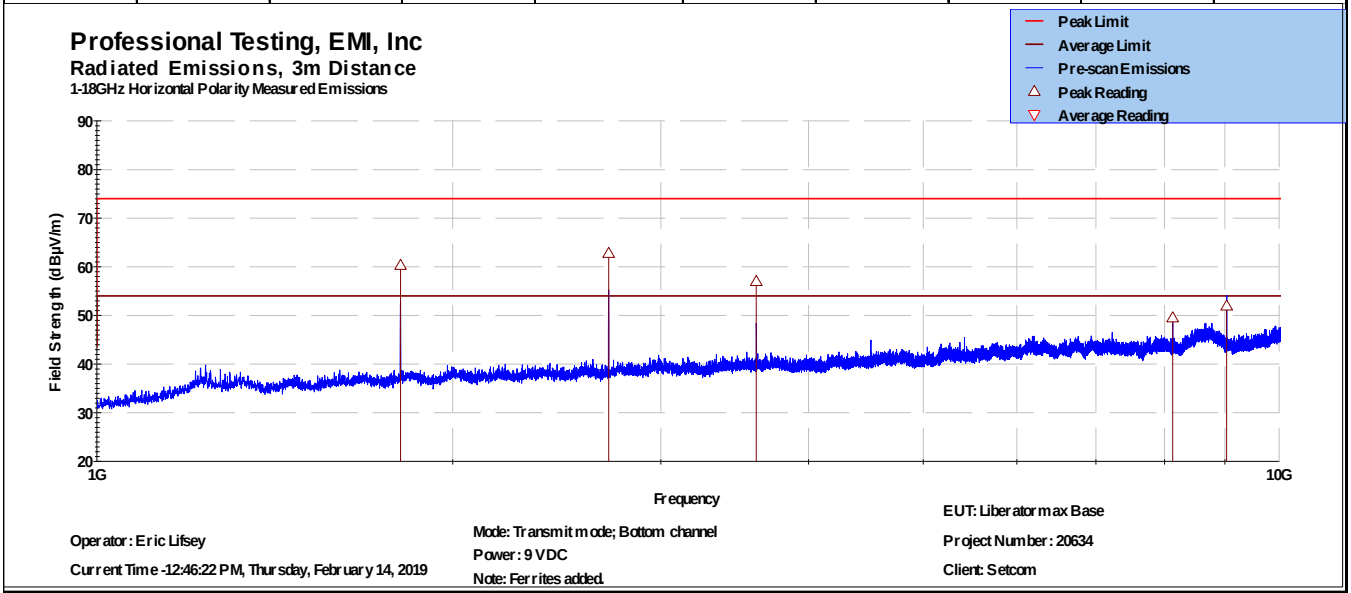
Professional Testing, EMI, Inc.

Test Method:	ANSI C63.10: 2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	2/14/2019	**EUT Serial #:**	None
Customer:	Setcom (TenX)	**EUT Part #:**	None
Project Number:	20634	**Test Technician:**	Eric Lifsey
Purchase Order #:	0	**Supervisor:**	Lisa Arndt
Equip. Under Test:	LiberatorMax Base	**Witness' Name:**	Jason Gossiaux

Radiated Emissions Test Results Data Sheet — **Page: 1 of 1**

EUT Line Voltage:	9 VDC	**EUT Power Frequency:**	0 N/A
Antenna Orientation:	Horizontal	**Frequency Range:**	Above 1GHz
EUT Mode of Operation:		Transmit Bottom Channel	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
1806.48	3	146	3.14	Peak	70	60.324	74.0	-13.6	Pass
2709.5	3	54	3.01	Peak	70.7	62.78	74.0	-11.2	Pass
3612.7	3	358	2.04	Peak	63.8	57.002	74.0	-17.0	Pass
8128.64	3	30	2.08	Peak	43.9	49.547	74.0	-24.4	Pass
9031.63	3	98	3.49	Peak	44.2	51.976	74.0	-22.0	Pass



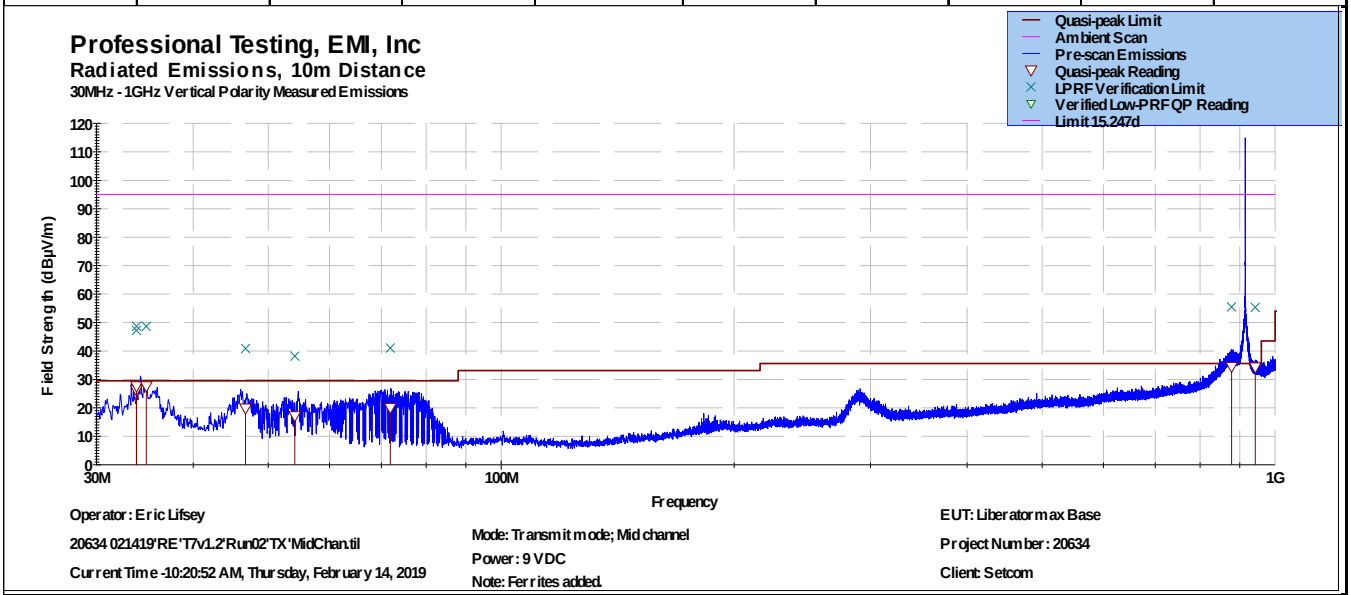
> 1GHz Horizontal Antenna Polarity Measured Emissions

6.3.3 Up to 1 GHz, Middle Channel

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.10: 2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	2/14/2019	EUT Serial #:	None
Customer:	Setcom (TenX)	EUT Part #:	None
Project Number:	20634	Test Technician:	Eric Lifsey
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	LiberatorMax Base	Witness' Name:	Jason Gossiaux

Radiated Emissions Test Results Data Sheet			Page: 1 of 1
EUT Line Voltage:	9 VDC	EUT Power Frequency:	0 N/A
Antenna Orientation:	Vertical	Frequency Range:	30MHz to 1GHz
EUT Mode of Operation:		Transmit Middle Channel	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
33.775	10	67	1.79	Quasi-peak	38.899	26.253	29.5	-3.2	Pass
33.792	10	79	2.03	Quasi-peak	40.302	27.649	29.5	-1.9	Pass
33.775	10	67	1.79	Quasi-peak	38.899	26.253	29.5	-3.2	Pass
34.782	10	14	1.54	Quasi-peak	40.715	27.644	29.5	-1.9	Pass
46.735	10	147	1.29	Quasi-peak	37.557	19.85	29.5	-9.7	Pass
54.121	10	117	3.55	Quasi-peak	36.415	17.149	29.5	-12.4	Pass
71.901	10	81	2.39	Quasi-peak	39.752	20.016	29.5	-9.5	Pass
878.482	10	63	3.54	Quasi-peak	31.014	34.471	35.6	-1.1	Pass
942.632	10	106	3.14	Quasi-peak	29.815	34.283	35.6	-1.3	Pass



≤ 1GHz Vertical Antenna Polarity Measured Emissions

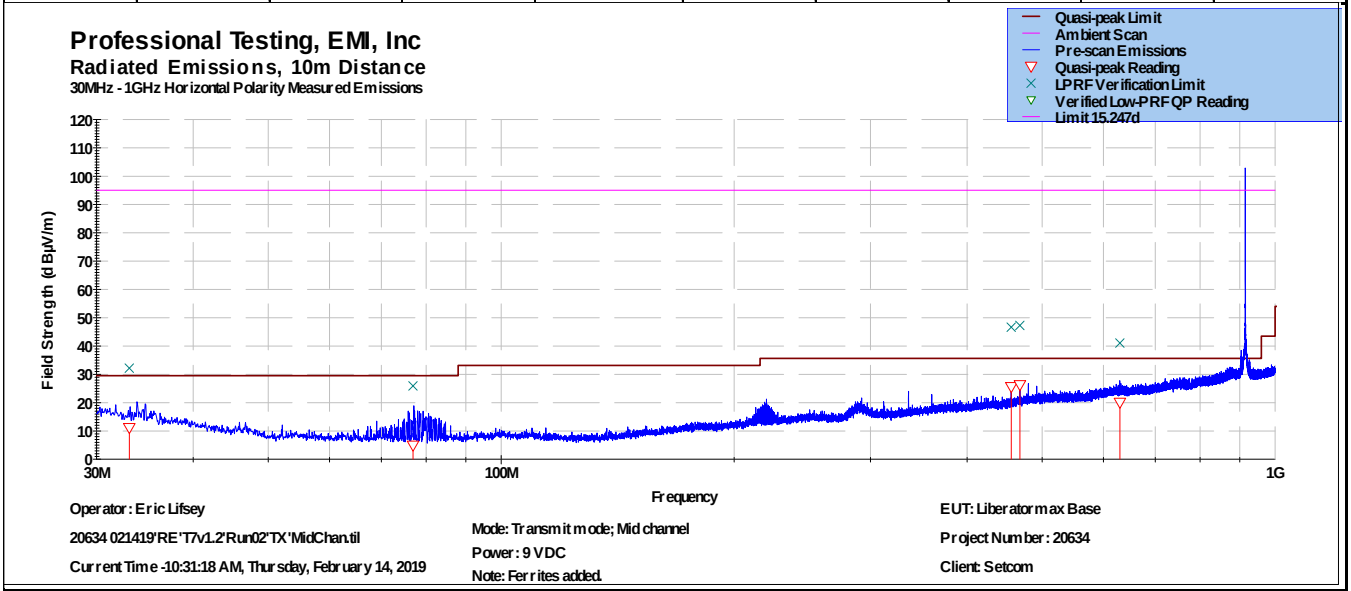
Professional Testing, EMI, Inc.

Test Method:	ANSI C63.10: 2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	2/14/2019	**EUT Serial #:**	None
Customer:	Setcom (TenX)	**EUT Part #:**	None
Project Number:	20634	**Test Technician:**	Eric Lifsey
Purchase Order #:	0	**Supervisor:**	Lisa Arndt
Equip. Under Test:	LiberatorMax Base	**Witness' Name:**	Jason Gossiaux

Radiated Emissions Test Results Data Sheet — **Page: 1 of 1**

EUT Line Voltage:	9 VDC	**EUT Power Frequency:**	0 N/A
Antenna Orientation:	Horizontal	**Frequency Range:**	30MHz to 1GHz
EUT Mode of Operation:		Transmit Middle Channel	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
33.067	10	62	3.21	Quasi-peak	23.477	11.14	29.5	-18.4	Pass
76.907	10	70	3.89	Quasi-peak	24.797	4.917	29.5	-24.6	Pass
456.003	10	238	2.88	Quasi-peak	32.196	25.592	35.6	-10.0	Pass
467.999	10	227	2.92	Quasi-peak	32.206	26.25	35.6	-9.4	Pass
630.143	10	220	1.37	Quasi-peak	21.967	20.058	35.6	-15.5	Pass



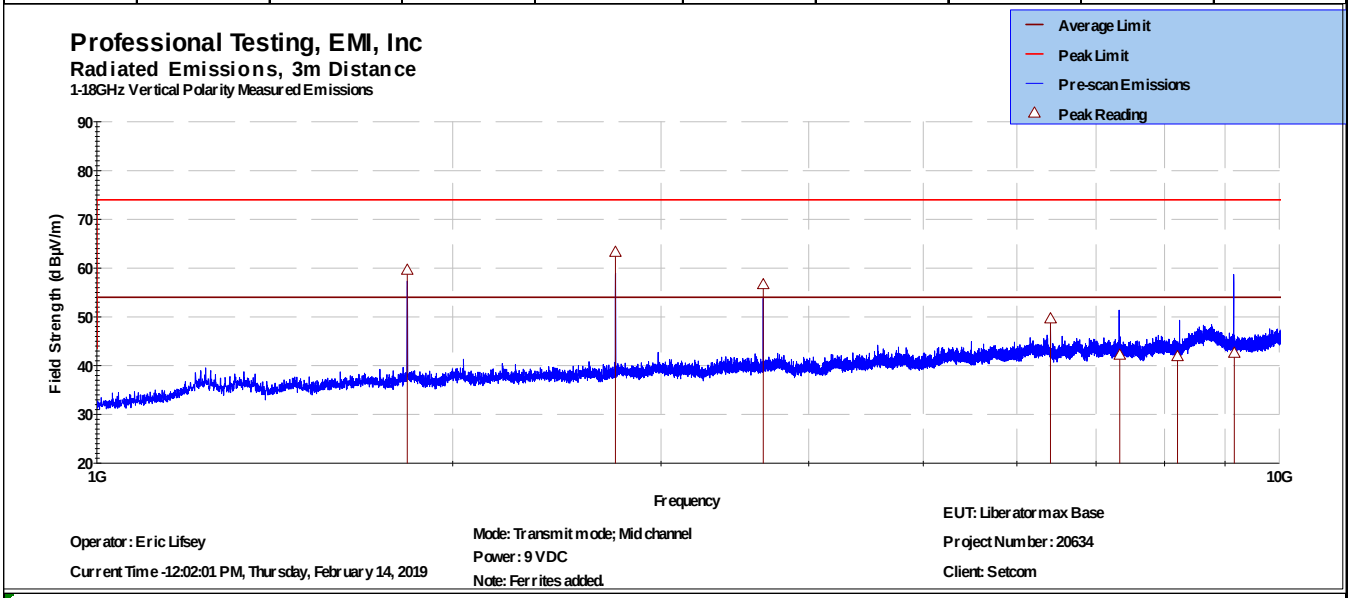
≤ 1GHz Horizontal Antenna Polarity Measured Emissions

6.3.4 Up to 10 GHz, Middle Channel

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.10: 2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	2/14/2019	EUT Serial #:	None
Customer:	Setcom (TenX)	EUT Part #:	None
Project Number:	20634	Test Technician:	Eric Lifsey
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	LiberatorMax Base	Witness' Name:	Jason Gossiaux

Radiated Emissions Test Results Data Sheet			Page: 1 of 1
EUT Line Voltage:	9 VDC	EUT Power Frequency:	0 N/A
Antenna Orientation:	Vertical	Frequency Range:	Above 1GHz
EUT Mode of Operation:		Transmit Middle Channel	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
1830.36	3	56	1.98	Peak	69.2	59.608	74.0	-14.3	Pass
2745.58	3	351	1.94	Peak	71.1	63.297	74.0	-10.7	Pass
3660.8	3	148	1.93	Peak	63.4	56.652	74.0	-17.3	Pass
6406.32	3	143	1.48	Peak	48.6	49.625	74.0	-24.3	Pass
7330.91	3	153	1.46	Peak	38.5	42.188	74.0	-31.8	Pass
8204.86	3	340	1.16	Peak	36.3	41.88	74.0	-32.1	Pass
9163.36	3	239	1.14	Peak	34.1	42.589	74.0	-31.4	Pass



> 1GHz Vertical Antenna Polarity Measured Emissions

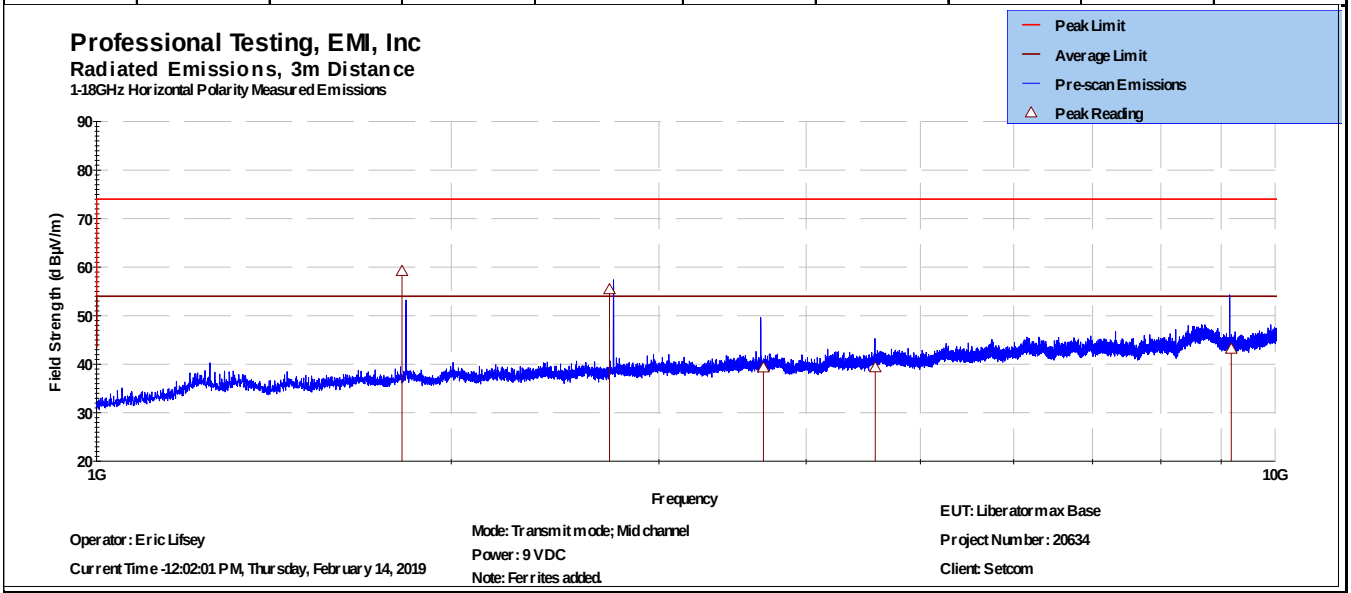
Professional Testing, EMI, Inc.

Test Method:	ANSI C63.10: 2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	2/14/2019	**EUT Serial #:**	None
Customer:	Setcom (TenX)	**EUT Part #:**	None
Project Number:	20634	**Test Technician:**	Eric Lifsey
Purchase Order #:	0	**Supervisor:**	Lisa Arndt
Equip. Under Test:	LiberatorMax Base	**Witness' Name:**	Jason Gossiaux

Radiated Emissions Test Results Data Sheet — **Page: 1 of 1**

EUT Line Voltage:	9 VDC	**EUT Power Frequency:**	0 N/A
Antenna Orientation:	Horizontal	**Frequency Range:**	Above 1GHz
EUT Mode of Operation:		Transmit Middle Channel	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
1816.04	3	130	3.25	Peak	68.8	59.153	74.0	-14.8	Pass
2724.11	3	185	3.2	Peak	63.2	55.389	74.0	-18.6	Pass
3679.91	3	281	1.09	Peak	46	39.278	74.0	-34.7	Pass
4578.45	3	115	3.39	Peak	43.6	39.282	74.0	-34.7	Pass
9179.91	3	352	3.71	Peak	34.6	43.126	74.0	-30.8	Pass



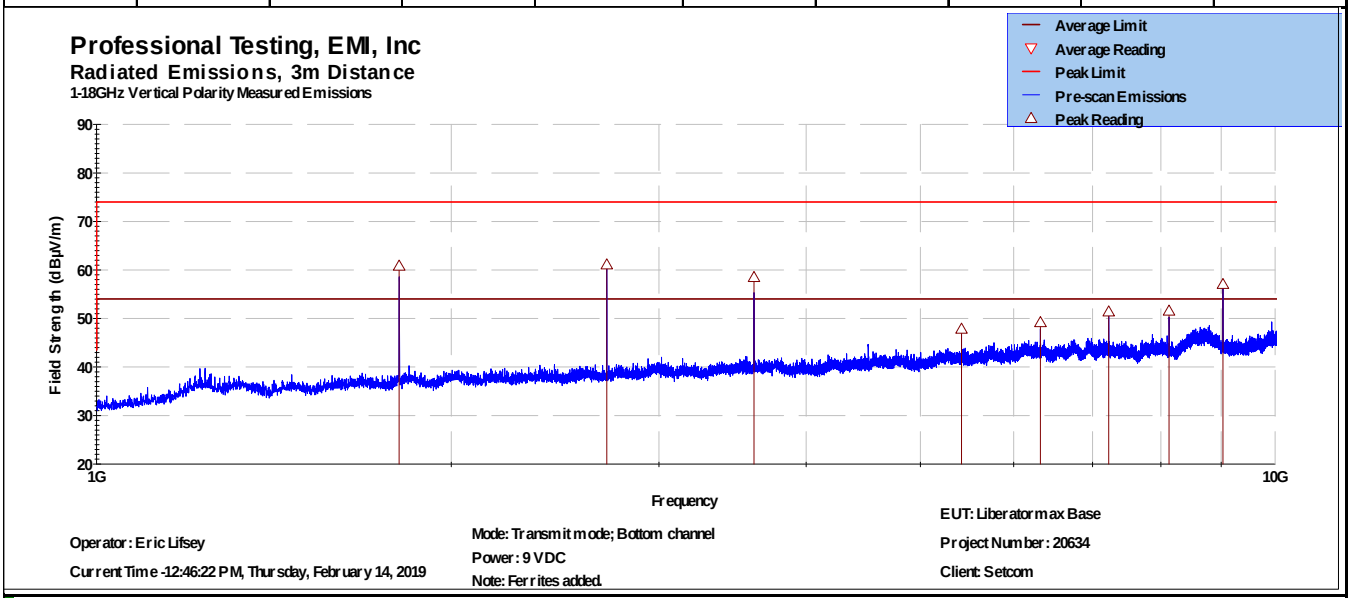
> 1GHz Horizontal Antenna Polarity Measured Emissions

6.3.5 Up to 10 GHz, Bottom Channel

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.10: 2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	2/14/2019	EUT Serial #:	None
Customer:	Setcom (TenX)	EUT Part #:	None
Project Number:	20634	Test Technician:	Eric Lifsey
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	LiberatorMax Base	Witness' Name:	Jason Gossiaux

Radiated Emissions Test Results Data Sheet		Page: 1 of 1	
EUT Line Voltage:	9 VDC	EUT Power Frequency:	0 N/A
Antenna Orientation:	Vertical	Frequency Range:	Above 1GHz
EUT Mode of Operation:		Transmit Bottom Channel	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
1806.4	3	57	2.57	Peak	70.5	60.812	74.0	-13.1	Pass
2709.58	3	270	2.21	Peak	69	61.085	74.0	-12.9	Pass
3612.78	3	328	3.88	Peak	65.2	58.461	74.0	-15.5	Pass
5419.14	3	349	3.38	Peak	50.2	47.816	74.0	-26.1	Pass
6322.35	3	108	3.36	Peak	48.2	49.186	74.0	-24.8	Pass
7225.58	3	125	3.23	Peak	48	51.358	74.0	-22.6	Pass
8128.71	3	122	3.52	Peak	45.9	51.547	74.0	-22.4	Pass
9031.91	3	113	1.95	Peak	49.3	57.027	74.0	-16.9	Pass



> 1GHz Vertical Antenna Polarity Measured Emissions

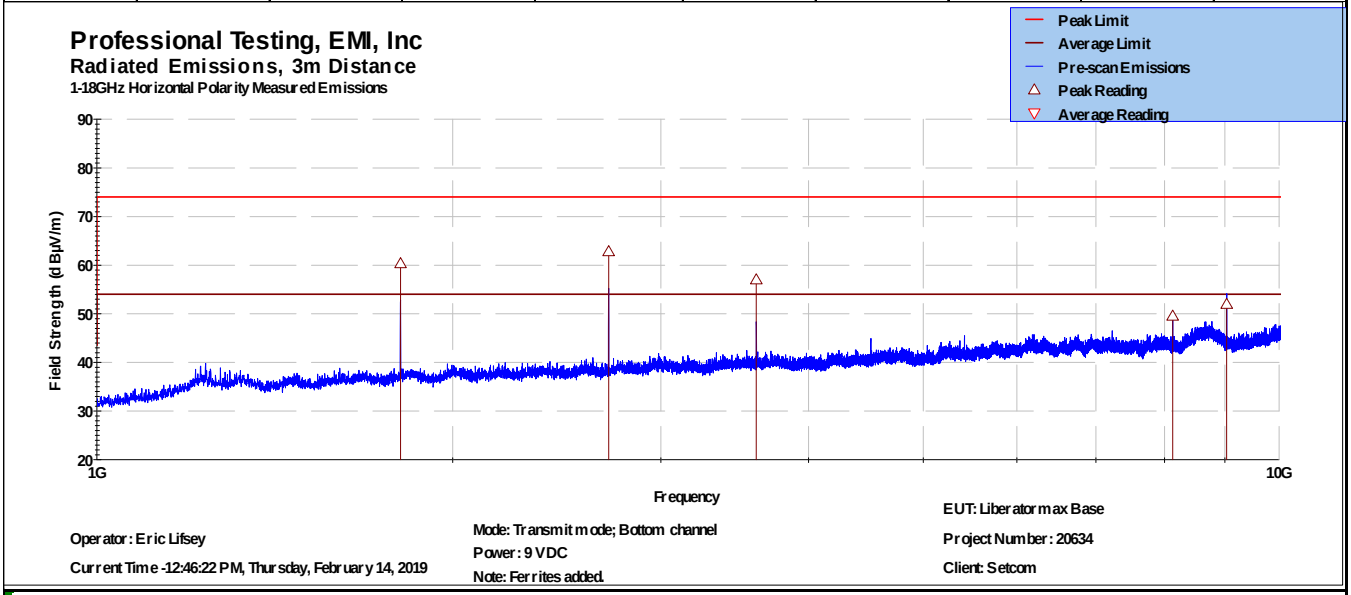
Professional Testing, EMI, Inc.

Test Method:	ANSI C63.10: 2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	2/14/2019	**EUT Serial #:**	None
Customer:	Setcom (TenX)	**EUT Part #:**	None
Project Number:	20634	**Test Technician:**	Eric Lifsey
Purchase Order #:	0	**Supervisor:**	Lisa Arndt
Equip. Under Test:	LiberatorMax Base	**Witness' Name:**	Jason Gossiaux

Radiated Emissions Test Results Data Sheet — **Page: 1 of 1**

EUT Line Voltage:	9 VDC	**EUT Power Frequency:**	0 N/A
Antenna Orientation:	Horizontal	**Frequency Range:**	Above 1GHz
EUT Mode of Operation:		Transmit Bottom Channel	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
1806.48	3	146	3.14	Peak	70	60.324	74.0	-13.6	Pass
2709.5	3	54	3.01	Peak	70.7	62.78	74.0	-11.2	Pass
3612.7	3	358	2.04	Peak	63.8	57.002	74.0	-17.0	Pass
8128.64	3	30	2.08	Peak	43.9	49.547	74.0	-24.4	Pass
9031.63	3	98	3.49	Peak	44.2	51.976	74.0	-22.0	Pass



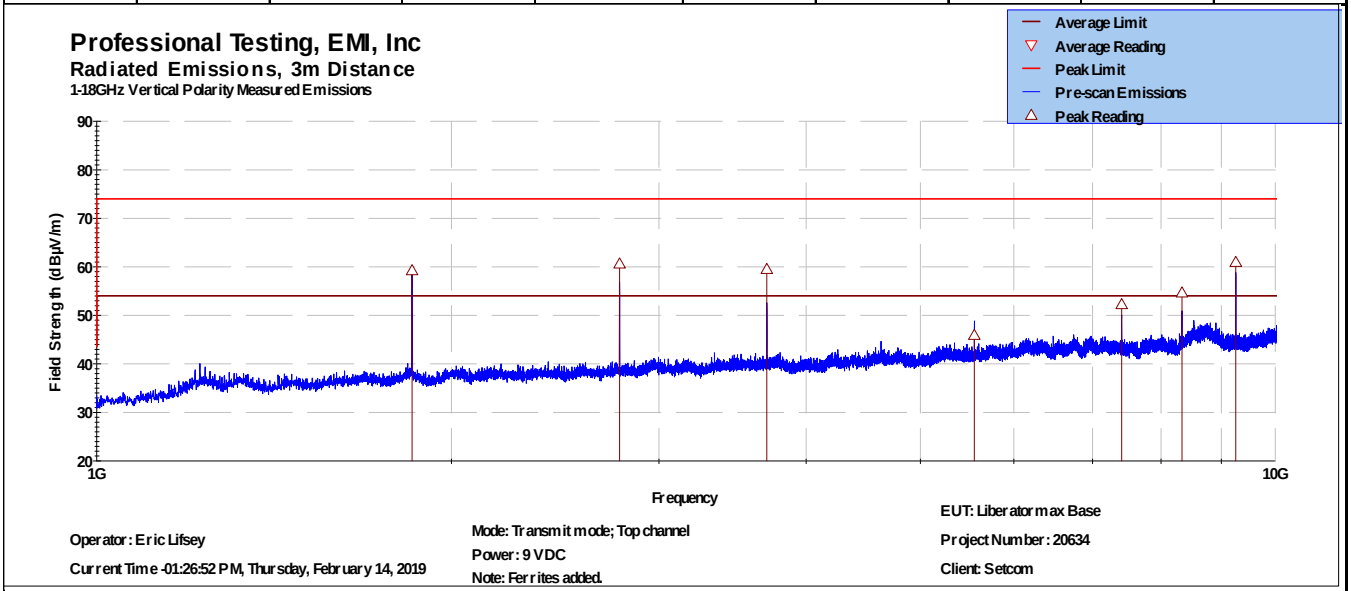
> 1GHz Horizontal Antenna Polarity Measured Emissions

6.3.6 Up to 10 GHz, Top Channel

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.10: 2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	2/14/2019	EUT Serial #:	None
Customer:	Setcom (TenX)	EUT Part #:	None
Project Number:	20634	Test Technician:	Eric Lifsey
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	LiberatorMax Base	Witness' Name:	Jason Gossiaux

Radiated Emissions Test Results Data Sheet			Page: 1 of 1
EUT Line Voltage:	9 VDC	EUT Power Frequency:	0 N/A
Antenna Orientation:	Vertical	Frequency Range:	Above 1GHz
EUT Mode of Operation:		Transmit Top Channel	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
1851.99	3	56	1.85	Peak	68.8	59.217	74.0	-14.7	Pass
2777.99	3	2	2.5	Peak	68.3	60.6	74.0	-13.4	Pass
3703.97	3	351	3.76	Peak	66.2	59.478	74.0	-14.5	Pass
5555.91	3	349	3.97	Peak	48	45.89	74.0	-28.1	Pass
7407.93	3	96	1.13	Peak	48.2	52.227	74.0	-21.7	Pass
8333.9	3	106	1.14	Peak	48.4	54.636	74.0	-19.3	Pass
9259.9	3	164	1.12	Peak	52	60.94	74.0	-13.0	Pass



> 1GHz Vertical Antenna Polarity Measured Emissions

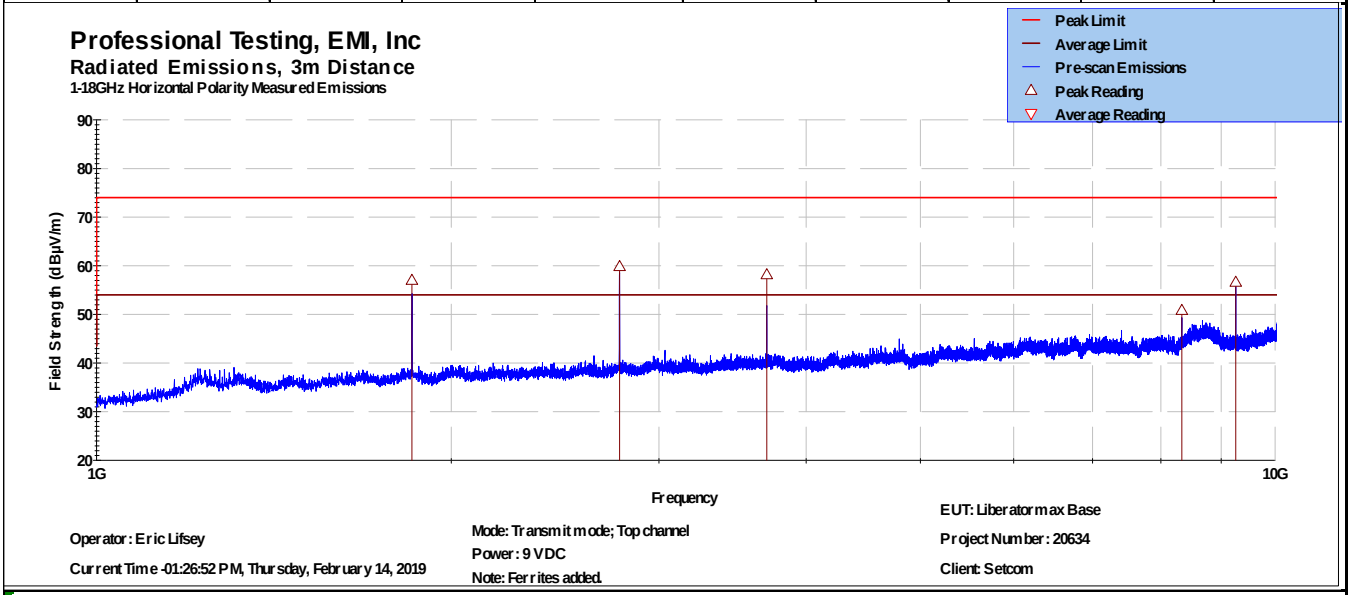
Professional Testing, EMI, Inc.

Test Method:	ANSI C63.10: 2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	2/14/2019	**EUT Serial #:**	None
Customer:	Setcom (TenX)	**EUT Part #:**	None
Project Number:	20634	**Test Technician:**	Eric Lifsey
Purchase Order #:	0	**Supervisor:**	Lisa Arndt
Equip. Under Test:	LiberatorMax Base	**Witness' Name:**	Jason Gossiaux

Radiated Emissions Test Results Data Sheet — **Page: 1 of 1**

EUT Line Voltage:	9 VDC	**EUT Power Frequency:**	0 N/A
Antenna Orientation:	Horizontal	**Frequency Range:**	Above 1GHz
EUT Mode of Operation:		Transmit Top Channel	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
1851.97	3	177	3.8	Peak	66.6	57.039	74.0	-16.9	Pass
2778.06	3	193	2.33	Peak	67.6	59.875	74.0	-14.1	Pass
3703.81	3	9	2.12	Peak	64.9	58.209	74.0	-15.7	Pass
8333.84	3	50	3.59	Peak	44.6	50.854	74.0	-23.1	Pass
9260.02	3	83	1.29	Peak	47.7	56.645	74.0	-17.3	Pass



> 1GHz Horizontal Antenna Polarity Measured Emissions

7.0 Antenna Construction Requirements

7.1 Procedure

A direct examination of the antenna construction is performed and compared to rule criteria that prevent wireless device antennas from being modified by end users.

7.2 Criteria

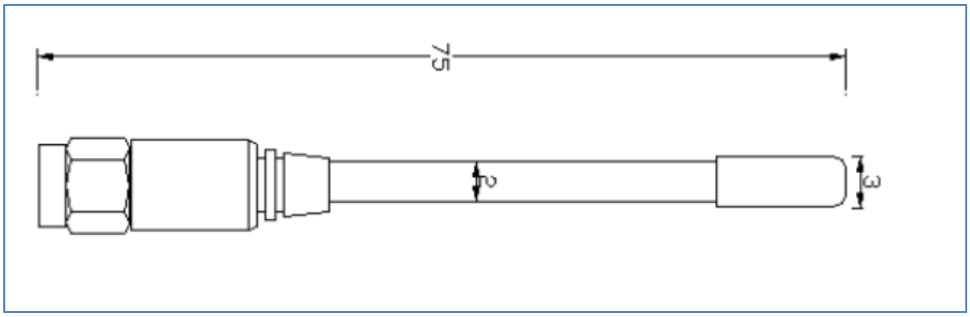
47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.203 // RSS-Gen 8.3	Antenna Construction	14 Feb 2019

7.3 Results

Table 7.3.1 Antenna Construction Details

Manufacturer: Antenna Factor by Linx

Model: ANT-916-CW-HWR-RPS



Units: mm

- Antenna is center-fed half-wave.
- The connector is a reverse-polarized center pin SMA type.
- Peak gain is 1.2 dBi.

The antenna design above satisfies the requirements of the rules.

8.0 Equipment

8.1 Radiated Emissions, Transmit & Receive Mode

Radiated Emissions Test Equipment List					
Tile! Software Version:			**Version: 7.1.2.17 (Jan 08, 2016 - 02:12:48 PM) or 4.1.A.0, April 14, 2009, 11:01:00PM**		
Test Profile:			**2018_Radiated Emissions_TILE7_v1EL.til**		
Asset #	**Manufacturer**	**Model**	**Equipment Nomenclature**	**Serial Number**	**Calibration Due Date**
1509A	Braden	TDK 10M	TDK 10M Chamber, NSA < 1 GHz	DAC-012915-005	7/10/2019
1890	HP	8447F-H64	Preamp/Amp, 9kHz-1300MHz, 28/25dB	3313A05298	1/10/2020
1937	Agilent	E4440A - AYZ	PSA , 3 Hz - 26.5 GHz, Opt. AYZ	MY44808298	11/8/2019
1926	ETS-Lindgren	3142D	Antenna, Biconilog, 26 MHz - 6 GHz	135454	3/7/2019
C027	none	RG214	Cable Coax, N-N, 25m, 30MHz - 1GHz	none	9/21/2019
1327	EMCO	1050	Controller, Antenna Mast	none	N/A
0942	EMCO	11968D	Turntable, 4ft.	9510-1835	N/A
1969	HP	11713A	Attenuator/Switch Driver	3748A04113	N/A
1509B	Braden	TDK 10M	TDK 10M Chamber,sVSWR > 1 GHz	DAC-012915-005	11/16/2019
2004	Miteq	AFS44-00101800-2S-10P-44	Amplifier, 40dB, .1-18GHz	0	1/10/2020
C030	none	none	Cable Coax, N-N, 30m, 1 - 18GHz	none	9/21/2019
1325	EMCO	1050	Controller, Antenna Mast	9003-1461	N/A
1780	ETS-Lindgren	3117	Antenna, Double Ridged Guide Horn, 1 - 18 GHz	110313	3/15/2019

8.2 Conducted Antenna Port Measurements of Power, PSD, Bandwidth, and Timings

Asset #	Manufacturer	Model #	Description	Calibration Due
2295	Agilent	E4440A	Spectrum Analyzer	6 Nov 2019

9.0 Measurement Bandwidths

Radiated Emissions Spectrum Analyzer Bandwidth and Measurement Time - Peak Scan				
Frequency Band Start (MHz)	**Frequency Band Stop (MHz)**	**6 dB Bandwidth (kHz)**	**Number of Ranges Used**	**Measurement Time per Range**
0.009	0.15	0.3	2	Multiple Sweeps
0.15	30	9	6	Multiple Sweeps
30	1000	120	2	Multiple 800 mS Sweeps
1000	6000	1000	2	Multiple Sweeps
6000	18000	1000	2	Multiple Sweeps
18000	26500	1000	2	Multiple Sweeps

*Notes:
1. The settings above are specifically calculated for the E4440A series of spectrum analyzers, which have 8,000 data points per range.
2. The measurement receiver resolution bandwidth setting was 300 Hz for quasi-peak measurements from 9-150 kHz.
3. The measurement receiver resolution bandwidth setting was 9 kHz for quasi-peak measurements from 0.15-30 MHz.
4. The measurement receiver resolution bandwidth setting was 120 kHz for quasi-peak measurements from 30-1000 MHz.
5. The measurement receiver resolution bandwidth setting was 1 MHz for average measurements from 1-18 GHz.

Appendix: Policy, Rationale, and Evaluation of EMC Measurement Uncertainty

All uncertainty calculations, estimates and expressions thereof shall be in accordance with NIST policy. Since PTI operates in accordance with NIST (NVLAP) Handbook 150-11: 2007, all instrumentation having an effect on the accuracy or validity of tests shall be periodically calibrated or verified traceable to national standards by a competent calibration laboratory. The certificates of calibration or verification on this instrumentation shall include estimates of uncertainty as required by NIST Handbook 150-11.

1. Rationale and Summary of Expanded Uncertainty.

Each piece of instrumentation at PTI that is used in making measurements for determining conformance to a standard (or limit), shall be assessed to evaluate its contribution to the overall uncertainty of the measurement in which it is used. The assessment of each item will be based on either a type A evaluation or a type B evaluation. Most of the evaluations will be type B, since they will be based on the manufacturer's statements or specifications of the calibration tolerances, or uncertainty will be stated along with a brief rationale for the type of evaluation and the resulting stated uncertainties.

The individual uncertainties included in the combined standard uncertainty for a specific test result will depend on the configuration in which the item of instrumentation is used. The combination will always be based on the law of propagation of uncertainty. Any systematic effects will be accommodated by including their uncertainties, in the calculation of the combined standard uncertainty; except that if the direction and amount of the systematic effect cannot be determined and separated from its uncertainty, the whole effect will be treated as uncertainty and combined along with the other elements of the test setup.

Type A evaluations of standard uncertainty will usually be based on calculating the standard deviation of the mean of a series of independent observations, but may be based on a least-squares curve fit or the analysis of variance for unusual situations. Type B evaluations of standard uncertainty will usually be based on manufacturer's specifications, data provided in calibration reports, and experience. The type of probability distribution used (normal, rectangular, a priori, or u-shaped) will be stated for each Type B evaluation.

In the evaluation of the uncertainty of each type of measurement, the uncertainty caused by the operator will be estimated. One notable operator contribution to measurement uncertainty is the manipulation of cables to maximize the measured values of radiated emissions. The operator contribution to measurement uncertainty is evaluated by having several operators independently repeat the same test. This results in a Type A evaluation of operator-contributed measurement uncertainty.

A summary of the expanded uncertainties of PTI measurements is shown as Table 1. These are the worst-case uncertainties considering all operative influence factors.

Table 1: Summary of Measurement Uncertainties for Site 45

Type of Measurement	Frequency Range	Meas. Dist.	Expanded Uncertainty U, dB (k=2)
Mains Conducted Emissions	150 kHz to 30 MHz	N/A	2.9
Telecom Conducted Emissions	150 kHz to 30 MHz	N/A	2.8
Radiated Emissions	30 to 1,000 MHz	10 m	4.8
	1 to 18 GHz	3 m	5.7

End of Report