
Project 17712-15

**Triax Technologies
SIM-P**

Wireless Certification Report

Prepared for:

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By

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4 May 2016

Reviewed by



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Written by



Eric Lifsey
EMC Engineer

Revision History

Revision Number	Description	Date
00	Draft for client and internal review.	1 Mar 2016
01	Final; revised with IC CN.	4 May 2016

Corrections:

None.

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Compliance Certificate

Applicant	Device & Test Identification
Triax Technologies (Justin Morgenthau) 66 Fort Point Street Norwalk, CT 06855 Certificate Date: 1 May 2016	FCC ID: 2AGHISIM-P Industry Canada ID: 21358-SIM-P Model(s): SIM-P Laboratory Project ID: 17712-15

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	15.107, 15.207	Conducted emission limits.
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 1	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
Triax Technologies SIM-P	221*	2400-2483.5 MHz FHSS transceiver; using Bluetooth Low Energy radio protocols.

*This was the normal firmware sample. Additional non-serial numbered samples were programmed to operate on fixed frequencies as needed for various tests.

Table 1.2.2: Support Equipment		
Manufacturer / Model	Serial #	Description
none		none

The EUT designed as a remote sensor of impact forces experienced by participants in contact sports.

The EUT measures approximately 33 mm x 13 mm x 9 mm. It includes a permanently embedded rechargeable battery. It plugs into a small adapter that connects the flush charging pins to a typical USB power source to charge. It uses about 25 mA of current when in operation.

1.3 EUT Operation

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

The EUT was tested as a DTS device as its bandwidth satisfies the DTS minimum bandwidth requirements. In the final application it will be also hopping per the Bluetooth protocol.

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:

$$\text{Raw Measured Level} + \text{Antenna Factor} + \text{Cable Losses} - \text{Amplifier Gain} = \text{Corrected Level}$$

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

$$\text{Raw Measured Level} + \text{Attenuator Factor} + \text{Cable Losses} = \text{Corrected Level}$$

Conducted mains levels are determined as follows:

$$\text{Raw Measured Level} + \text{LISN Factor} + \text{Cable/Filter/Limiter Losses} = \text{Corrected Level}$$

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
RSS-247 Issue 1	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
ANSI C63.4 2009	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low Voltage Electrical and Electronic Equipment

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)(1), 2.1049, KDB 558074 D01	RSS-Gen 4.6
Spurious Emission	15.247, 15.209, 15.205	RSS-247 5.5, RSS-GEN 4.9, 4.10
Band Edge	15.247, 15.205	RSS-247 5.5, RSS-Gen 4.9
Antenna Requirement	15.203	RSS-Gen 8.3
Conducted Emissions, Mains	15.207	RSS-Gen 8.8

2.0 Fundamental Power

2.1 Test Procedure

Peak power is measured using radiated means with 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(a)(3) // RSS-247 5.2	Fundamental Power Conducted Limits 1 W Limit Restated as Field: 125.23 dB μ V/m @ 3 m	3 Feb 2016

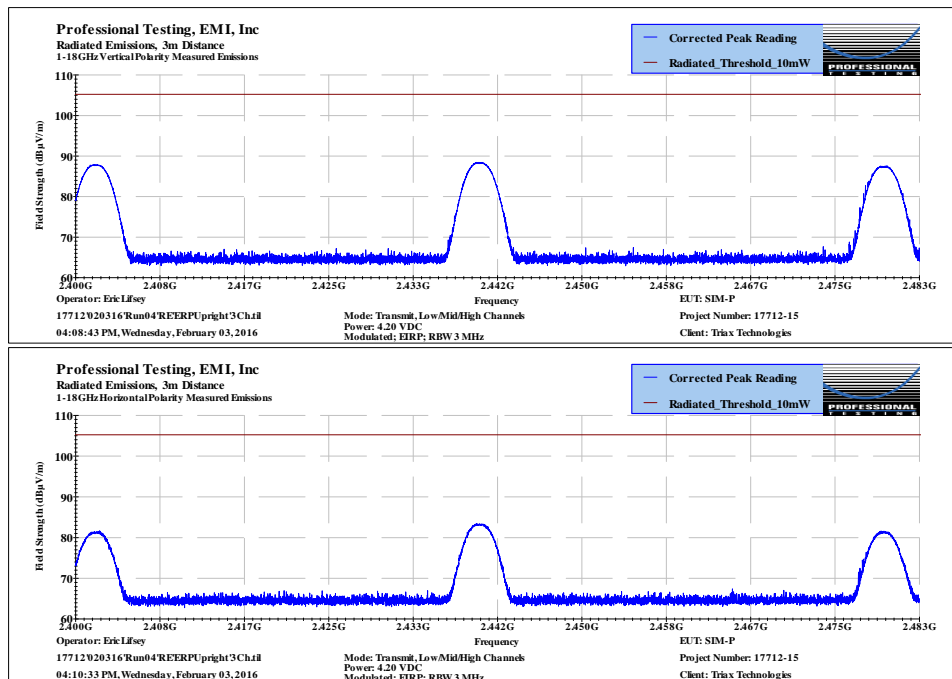
2.3 Test Results, Peak Power

The EUT was measured for radiated power in three orthogonal orientations; the maximum orientation is reported below.

Frequency MHz	Measured Peak Power dB μ V/m @ 3 m Vertical Polarity	Maximum Measured Peak Power Restated as EIRP in dBm	Maximum Measured Peak Power Restated as EIRP in mW
2402	87.8	-7.43	0.181
2440	88.4	-6.83	0.208
2480	87.6	-7.63	0.173

Measured in 3 MHz RBW, 3 MHz VBW.

The EUT was satisfied the requirements. Plotted measurements appear below.



2.4 Test Results, Duty Cycle

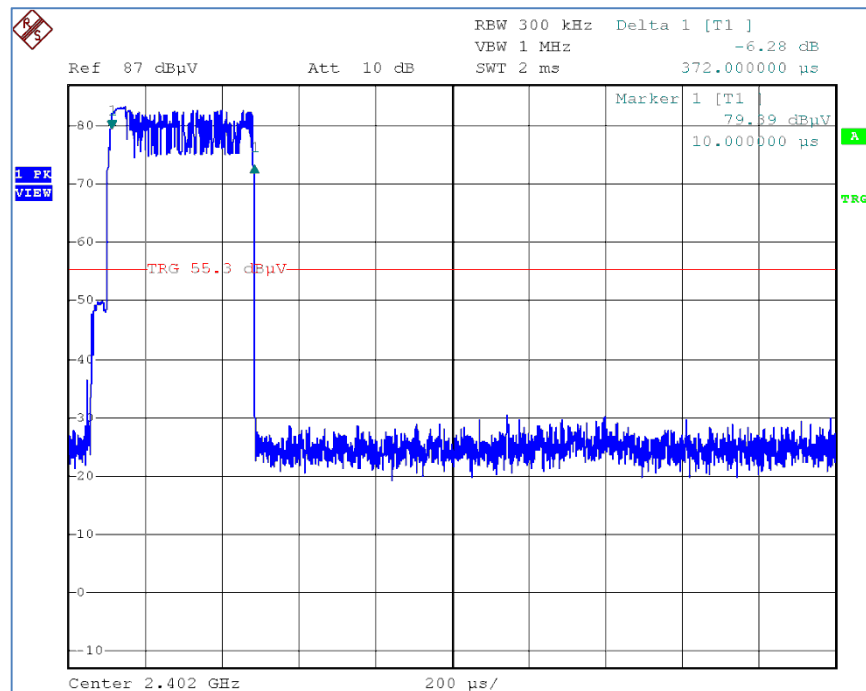
Measurement is based on intervals not to exceed 100 msec. Maximum transmitter on time is divided by the lesser of 100 msec or the actual measured minimum transmitter interval time. The result is converted to dB and applied as needed to peak measurements of transmitter artifacts to determine average power.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

The EUT was placed ~3 cm from the sense antenna and provoked to transmit by tapping it on the surface beneath it to simulate impacts. The EUT communicated with a personal device (iPod) that was located about 1 meter away. The signal was verified as being from the EUT and measurements were taken.

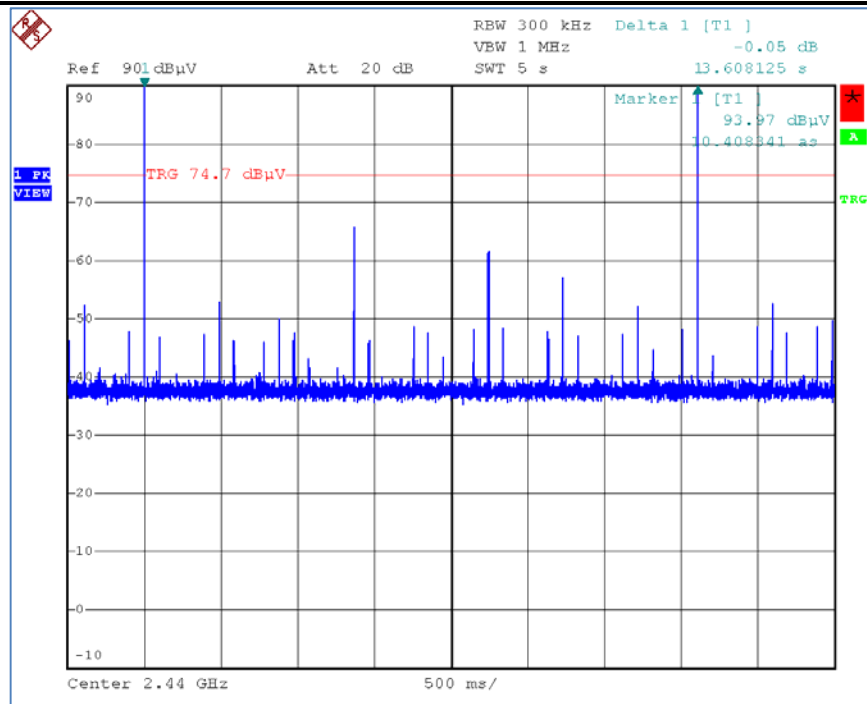
Table 2.5.1 Duty Cycle Results and Average Duty Cycle Factor Result				
Measured On Time (msec)	Measured Time Interval (msec)	Duty Cycle Factor Calculation	Result (dB)	Duty Cycle Factor Allowed (dB)
0.372	13,600	$= 20 * \text{Log}_{10} (0.372 \text{ msec} / 100 \text{ msec})$	-48.6	-20.0

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

Plotted results appear below.



Transmit On Time



Transmit Period

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 dB μ V/m at 3 m	NA

3.3 Test Results

The fundamental peak power measured below the limit for this test and at a greater resolution bandwidth; the EUT satisfies the criteria without additional measurement.

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)
14.247(a)(2), 2.1049, KDB 558074 D01 // RSS-Gen 4.6	Bandwidth, 6 dB, 20 dB	3 Feb 2016

4.3 Test Results

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

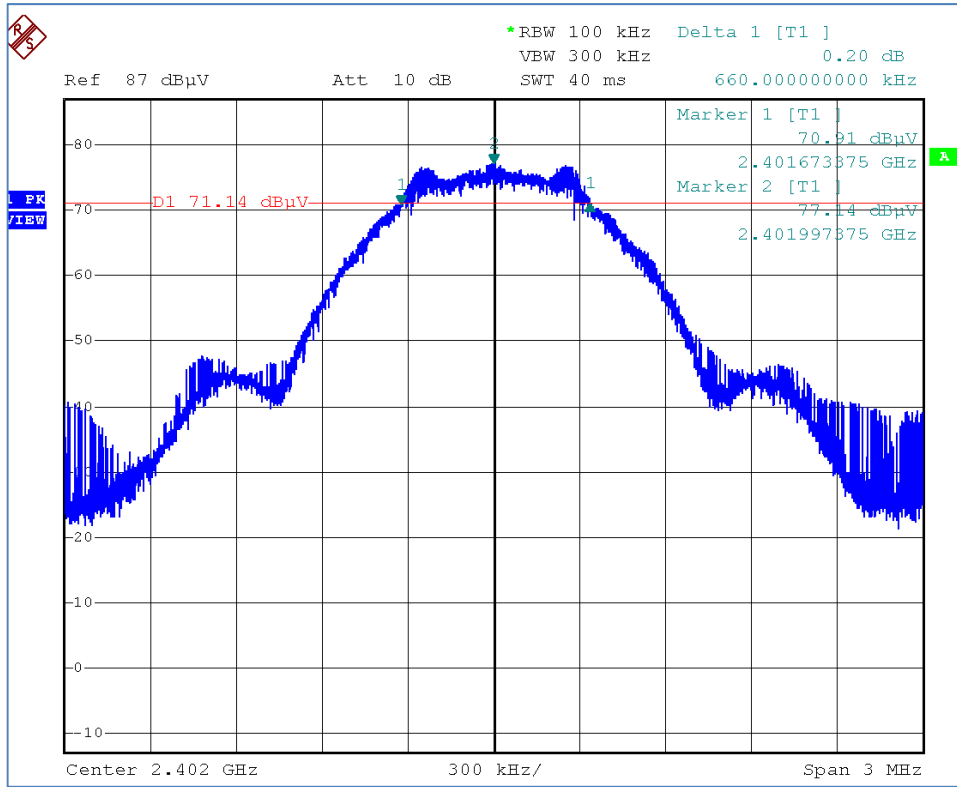
The EUT was found to be in compliance with applicable requirements.

Table 5.3.1 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)
660	666	666	660

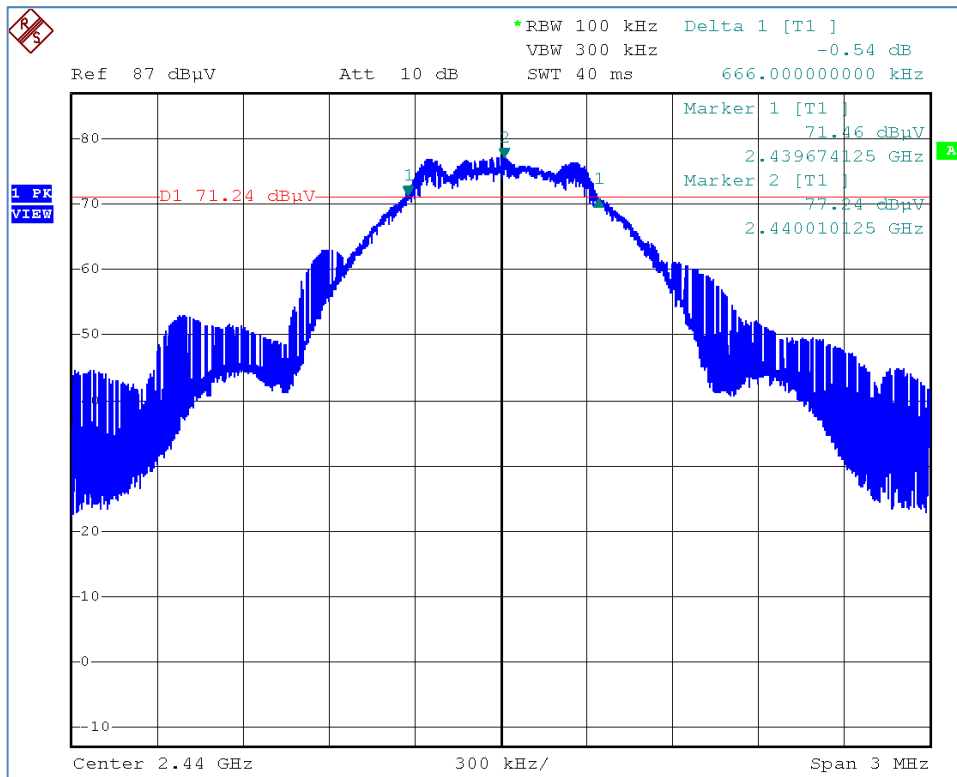
Table 5.3.2 Bandwidth 20 dB, Measure and Report			
Low Channel Measured BW (kHz)	Mid Channel Measured BW (kHz)	High Channel Measured BW (kHz)	Reported Maximum BW (kHz)
1098	1218	1254	1254

Plotted measurements appear on the following pages.

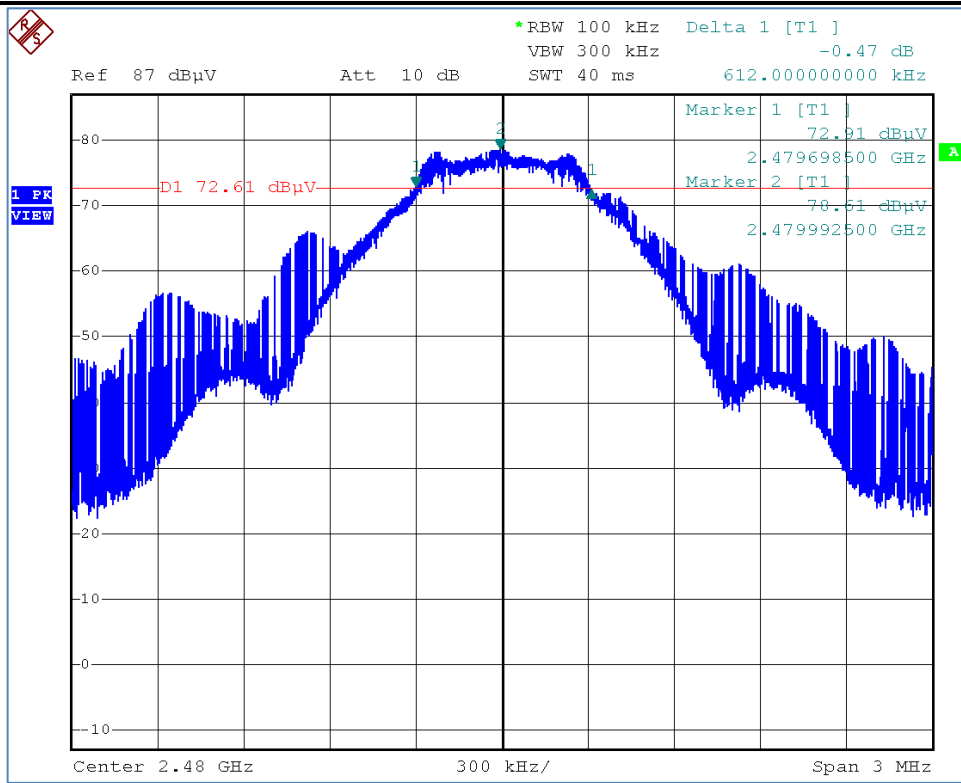
4.3.1 Bandwidth Plots, 6 dB



6 dB, Low Channel

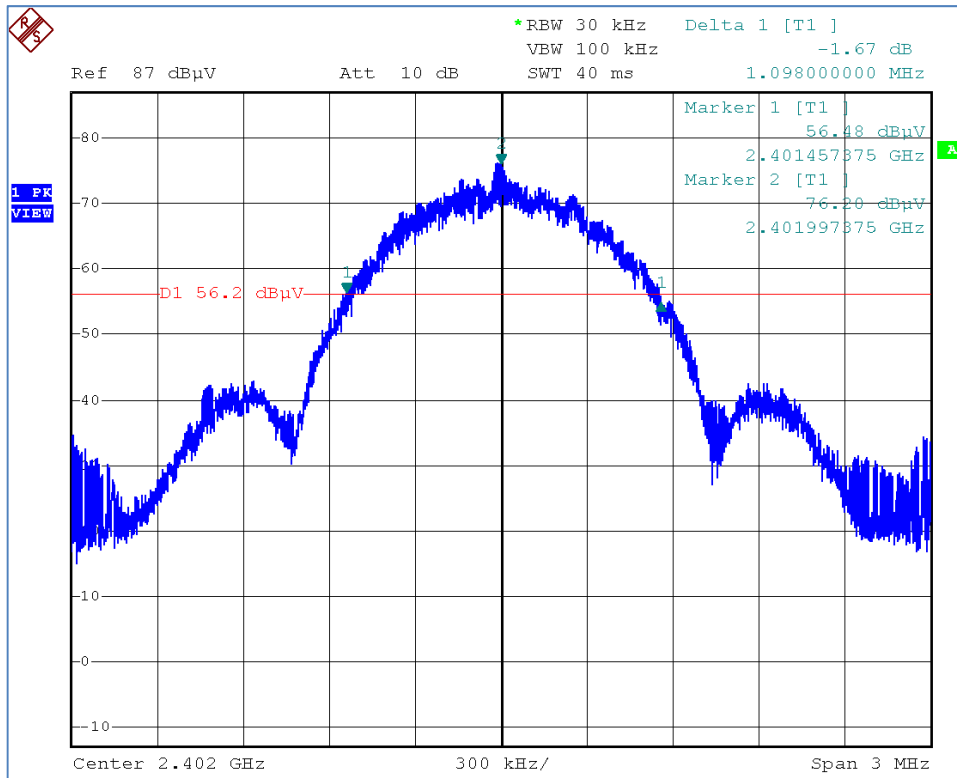


6 dB, Middle Channel

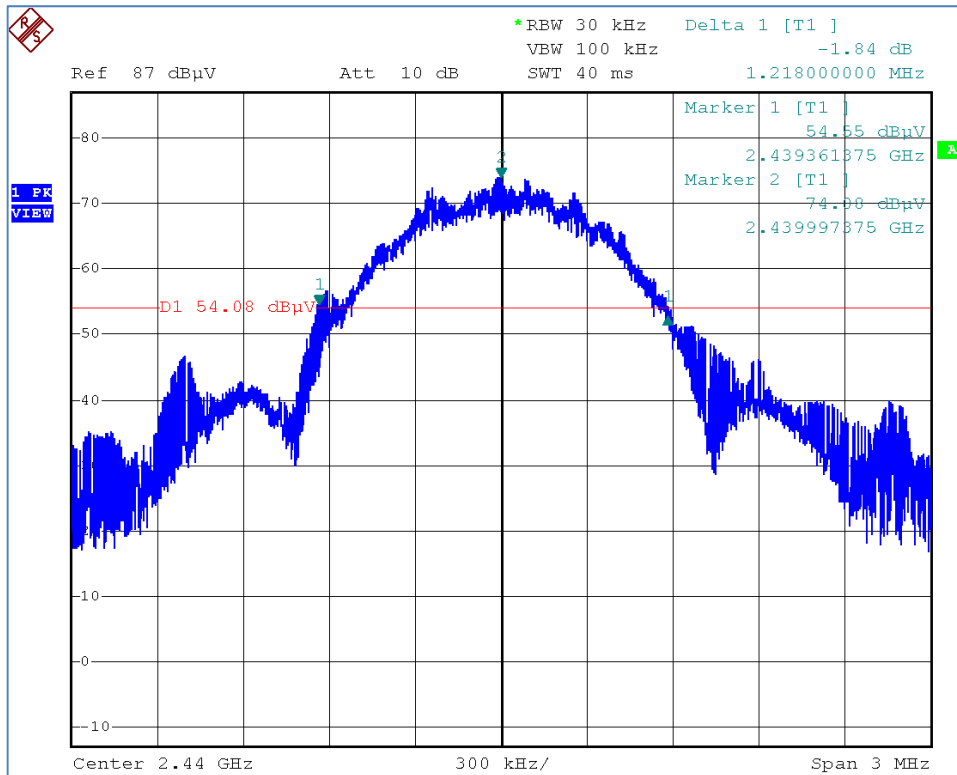


6 dB, High Channel

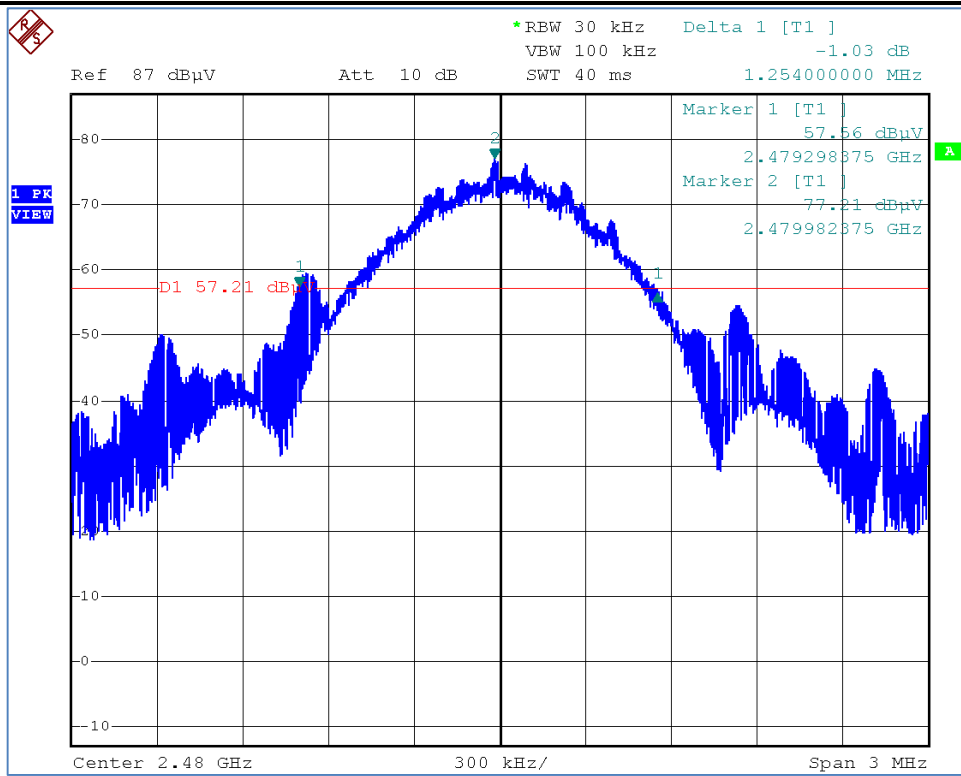
4.3.2 Bandwidth Plots, 20 dB



20 dB, Low Channel



20 dB, Middle Channel



20 dB, High Channel

5.0 Band Edge

5.1 Test Procedure

EUT is placed into normal transmit operation on the nearest band edge channel. The spectrum analyzer is approximately centered on the band edge frequency with span sufficient to include the peak of the adjacent fundamental signal. Measurement includes at least two standard bandwidths from the respective band edge. If required, the band-edge marker-delta method of C63.4 is utilized.

5.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.247, 15.205 // RSS-247 5.5, RSS-Gen 4.9	Unwanted Emissions Adjacent to Authorized Band, Radiated	4 Feb 2016

5.3 Test Results

Measurements included more than 2 standard bandwidths (standard bandwidth 1 MHz) from the band edges to provide a clear view of the fundamental and the declining emission levels. Peak detection with max-hold was employed.

Peak detection of emissions at both band edges were below the general emission limits for average limit levels. Also, the duty cycle averaging factor applies -20.0 dB to the peaks recorded.

The EUT satisfied the criteria. Plotted results appears on the following pages.

5.3.1 Low Channel Band Edge

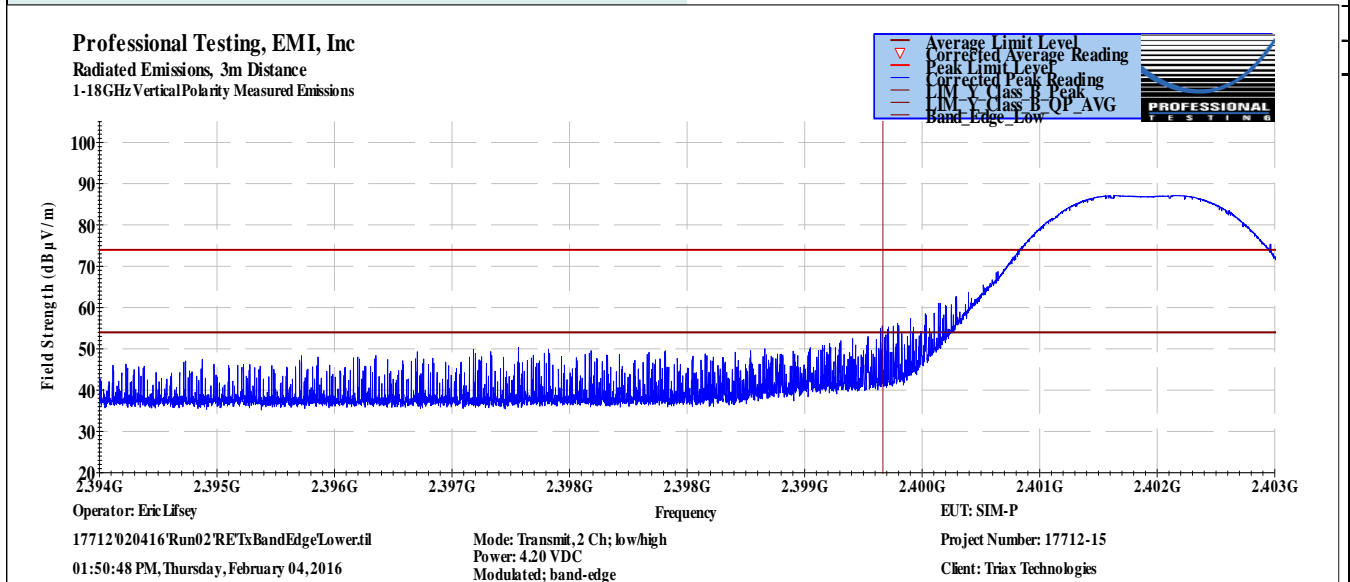
Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.10-2013 American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	2/4/2016	EUT Serial #:	none
Customer:	Triax Technologies	EUT Part #:	none
Project Number:	17712-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	SIM-P	Witness' Name:	None

Radiated Emissions Test Results Data Sheet			Page:	1	of	1
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EUT Line Voltage:	4.2	VDC	EUT Power Frequency:	0	N/A
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Antenna Orientation:	Vertical	Frequency Range:	Above 1GHz
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Band Edge; Low; EUT Mode of Operation:	Transmit; Low Channel
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> 1GHz Vertical Antenna Polarity Measured Emissions

5.3.2 High Channel Band Edge

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):	2/4/2016	EUT Serial #:	none
Customer:	Triax Technologies	EUT Part #:	none
Project Number:	17712-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	SIM-P	Witness' Name:	None

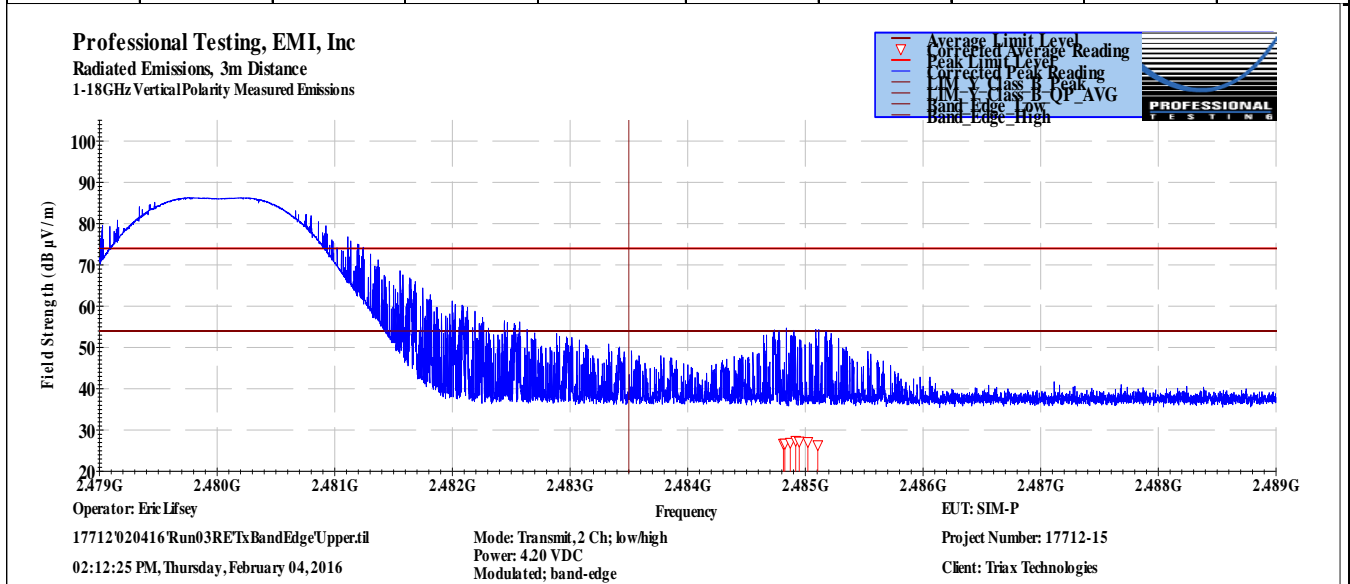
Radiated Emissions Test Results Data Sheet Page: 1 of 1

EUT Line Voltage:	4.2 VDC	EUT Power Frequency:	0 N/A
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Antenna Orientation:	Vertical	Frequency Range:	Above 1GHz
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Band Edge; High; 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
2484.81	3	188	1	Average	35.1	26.719	54.0	-27.2	Pass
2484.83	3	181	1	Average	35.1	26.743	54.0	-27.2	Pass
2484.87	3	54	1	Average	35.3	26.973	54.0	-27.0	Pass
2484.92	3	137	1	Average	35.8	27.444	54.0	-26.5	Pass
2484.95	3	334	1	Average	35.6	27.27	54.0	-26.7	Pass
2485.02	3	220	1	Average	35.6	27.185	54.0	-26.8	Pass
2485.11	3	29	1	Average	34.8	26.4	54.0	-27.6	Pass
2484.92	3	137	1	Peak	44.2	35.817	74.0	-38.1	Pass
2484.95	3	334	1	Peak	43.6	35.238	74.0	-38.7	Pass
2485.02	3	220	1	Peak	44.2	35.801	74.0	-38.2	Pass



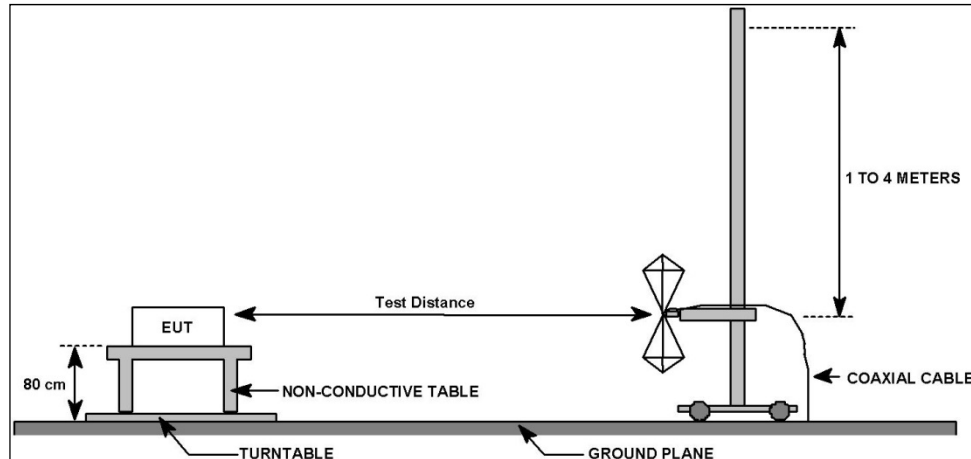
> 1GHz Vertical Antenna Polarity Measured Emissions

6.0 Radiated Spurious Emissions, Receive Mode

6.1 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.



6.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.247, 15.209 // RSS-247 5.5, RSS-Gen 4.9 & 4.10	Field Strength of Radiated Spurious/Harmonic Emissions Receive Mode	4 Feb 2016

6.3 Test Results

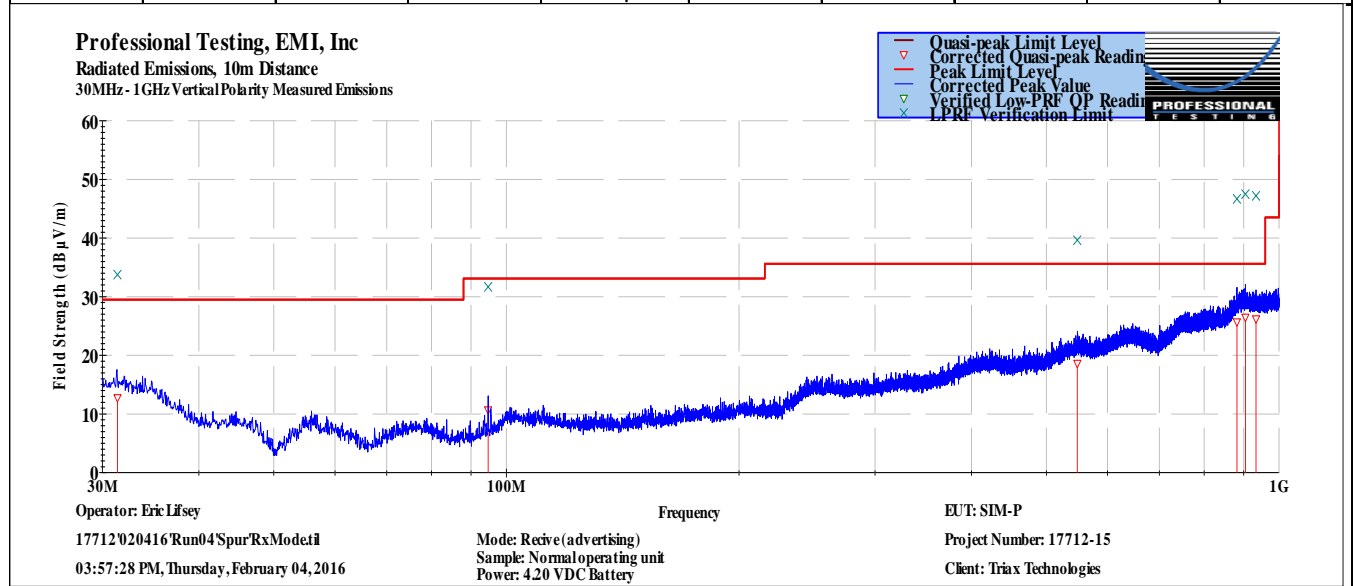
The EUT was tuned to the middle channel and placed in receive mode.

The EUT satisfied the criteria. Recorded data is presented below.

Table 6.3.1: Radiated Spurious Emissions, Receive Mode, Below 1 GHz, Vertical Polarity

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):	2/4/2016	EUT Serial #:	none
Customer:	Triax Technologies	EUT Part #:	none
Project Number:	17712-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	SIM-P	Witness' Name:	None

Radiated Emissions Test Results Data Sheet							Page: 1 of 1		
EUT Line Voltage:	4.2	VDC	EUT Power Frequency:	0	N/A				
Antenna Orientation:	Vertical		Frequency Range:	30MHz to 1GHz					
EUT Mode of Operation:				Receive Mode (Advertising)					
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
31.3805	10	129	2.8	Quasi-peak	24.2	12.743	29.5	-16.8	Pass
94.7165	10	2	1.4	Quasi-peak	29.5	10.666	33.1	-22.4	Pass
548.33	10	93	2.38	Quasi-peak	22	18.616	35.6	-17.0	Pass
882.389	10	294	3.98	Quasi-peak	21.3	25.68	35.6	-9.9	Pass
904.85	10	213	1.54	Quasi-peak	21.3	26.474	35.6	-9.1	Pass
934.04	10	174	2.26	Quasi-peak	21.2	26.184	35.6	-9.4	Pass

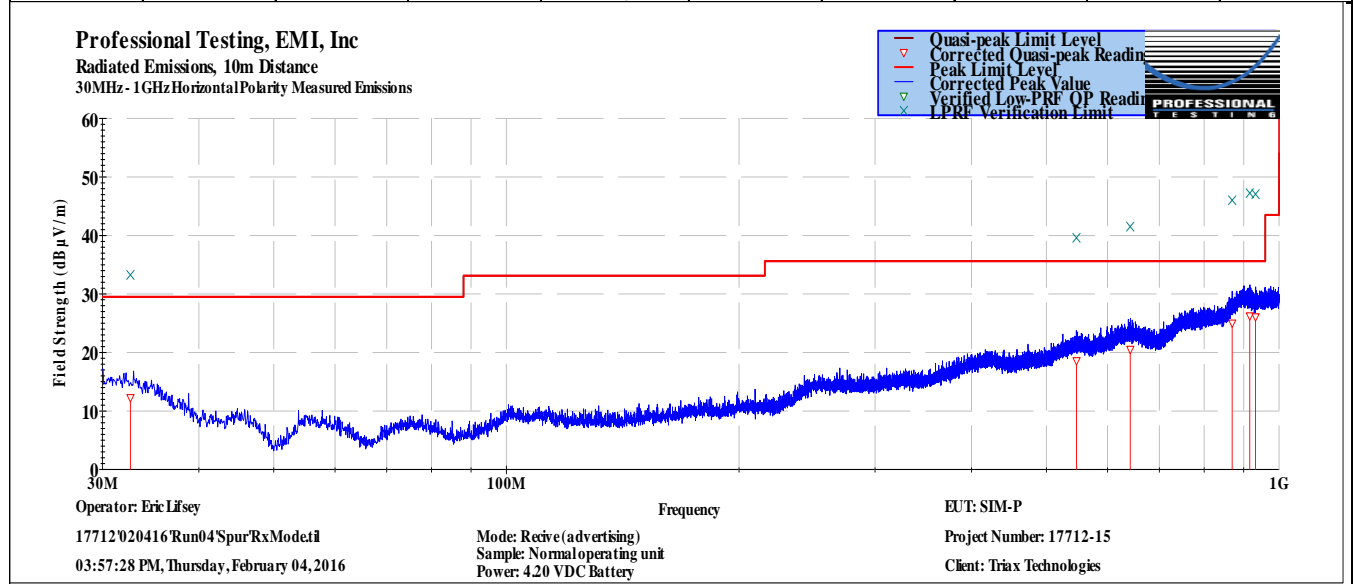


≤ 1GHz Vertical Antenna Polarity Measured Emissions

Table 6.3.2: Radiated Spurious Emissions, Receive Mode, Below 1 GHz, Horizontal Polarity

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):	2/4/2016	EUT Serial #:	none
Customer:	Triax Technologies	EUT Part #:	none
Project Number:	17712-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	SIM-P	Witness' Name:	None

Radiated Emissions Test Results Data Sheet							Page: 1 of 1		
EUT Line Voltage:	4.2	VDC	EUT Power Frequency:	0	N/A				
Antenna Orientation:	Horizontal			Frequency Range:	30MHz to 1GHz				
EUT Mode of Operation:				Receive Mode (Advertising)					
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
32.6168	10	110	2.24	Quasi-peak	23.7	12.241	29.5	-17.3	Pass
546.914	10	328	1.09	Quasi-peak	22.1	18.586	35.6	-17.0	Pass
642.127	10	239	3.18	Quasi-peak	21.9	20.498	35.6	-15.1	Pass
870.025	10	233	2.24	Quasi-peak	21.4	25.003	35.6	-10.6	Pass
916.844	10	312	1.05	Quasi-peak	21.2	26.233	35.6	-9.4	Pass
932.765	10	19	2.1	Quasi-peak	21	26.063	35.6	-9.5	Pass



≤ 1GHz Horizontal Antenna Polarity Measured Emissions

Table 6.3.3: Radiated Spurious Emissions, Receive Mode, Above 1 GHz, Vertical Polarity

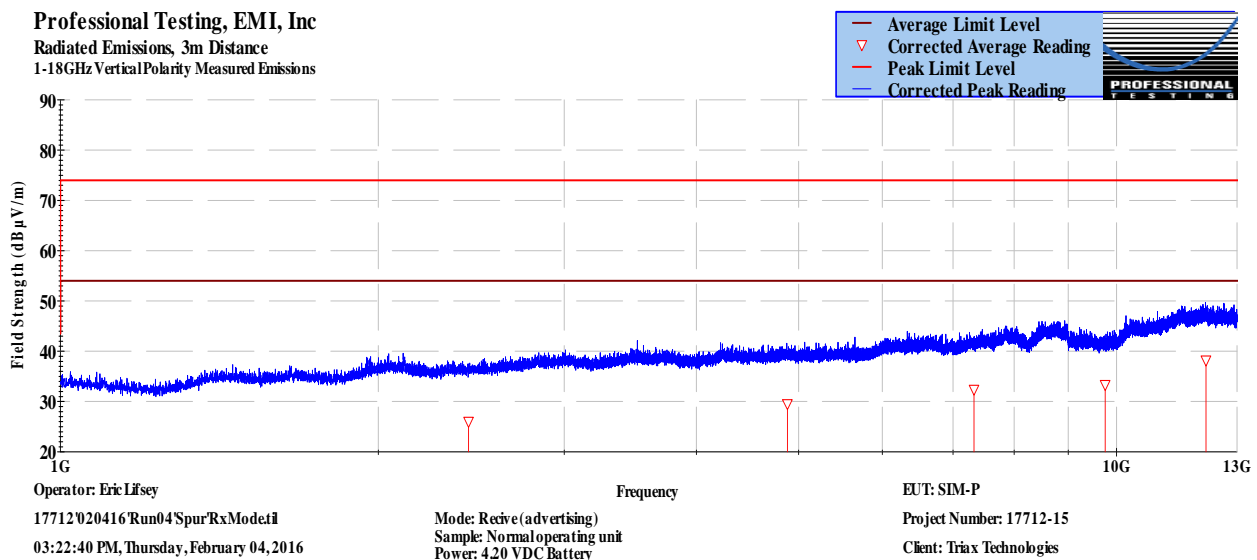
Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.10-2013 American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	2/4/2016	EUT Serial #:	none
Customer:	Triax Technologies	EUT Part #:	none
Project Number:	17712-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	SIM-P	Witness' Name:	None

Radiated Emissions Test Results Data Sheet

Page: 1 of 1

EUT Line Voltage:	4.2	VDC	EUT Power Frequency:	0	N/A				
Antenna Orientation:	Vertical		Frequency Range:	Above 1GHz					
EUT Mode of Operation:			Receive Mode (Advertising)						
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
2434.77	3	331	1	Peak	44.5	35.971	74.0	-38.0	Pass
4878.53	3	255	1	Peak	43.3	39.48	74.0	-34.5	Pass
7327.91	3	346	1	Peak	37.4	40.855	74.0	-33.1	Pass
9752.84	3	32	1	Peak	35.4	42.313	74.0	-31.6	Pass
12150	3	23	1	Peak	36.1	46.426	74.0	-27.5	Pass
2434.77	3	331	1	Average	34.5	26.011	54.0	-27.9	Pass
4878.53	3	255	1	Average	33.3	29.51	54.0	-24.4	Pass
7327.91	3	346	1	Average	28.9	32.405	54.0	-21.6	Pass
9752.84	3	32	1	Average	26.5	33.337	54.0	-20.6	Pass
12150	3	23	1	Average	27.9	38.206	54.0	-15.8	Pass

Professional Testing, EMI, Inc
Radiated Emissions, 3m Distance
1-18GHz Vertical Polarity Measured Emissions



Operator: Eric Lifsey

17712\020416\Run04\Spur\RxModel1
03:22:40 PM, Thursday, February 04, 2016

Mode: Recv (advertising)
Sample: Normal operating unit
Power: 4.20 VDC Battery

EUT: SIM-P

Project Number: 17712-15
Client: Triax Technologies

> 1GHz Vertical Antenna Polarity Measured Emissions

Table 6.3.4: Radiated Spurious Emissions, Receive Mode, Above 1 GHz, Horizontal Polarity

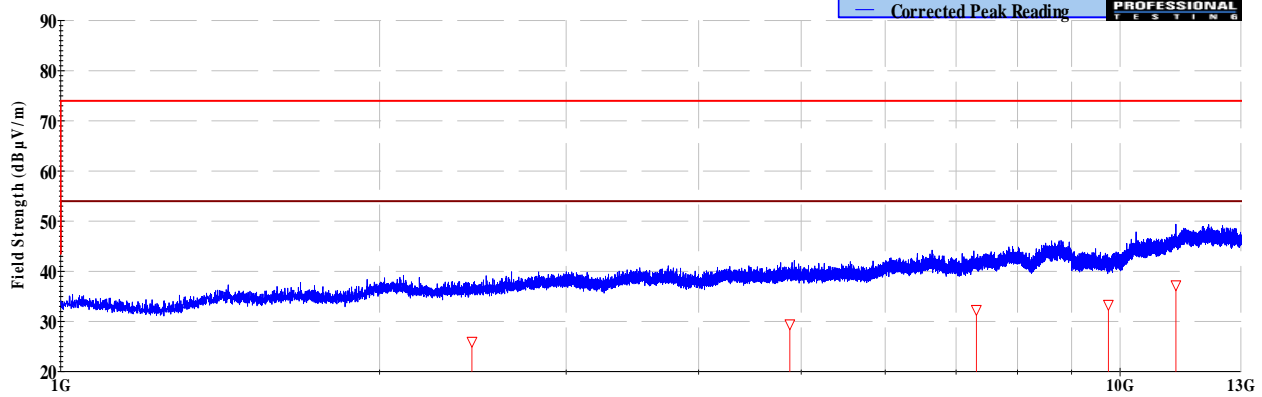
Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.10-2013 American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	2/4/2016	EUT Serial #:	none
Customer:	Triax Technologies	EUT Part #:	none
Project Number:	17712-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	SIM-P	Witness' Name:	None

Radiated Emissions Test Results Data Sheet

Page: 1 of 1

EUT Line Voltage:	4.2	VDC	EUT Power Frequency:	0	N/A				
Antenna Orientation:	Horizontal		Frequency Range:	Above 1GHz					
EUT Mode of Operation:			Receive Mode (Advertising)						
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
2444.36	3	320	1	Peak	44.3	35.784	74.0	-38.2	Pass
4877.72	3	254	1	Peak	41.4	37.637	74.0	-36.3	Pass
7315.97	3	221	1	Peak	38.4	41.804	74.0	-32.2	Pass
9747.08	3	201	1	Peak	35.3	42.159	74.0	-31.8	Pass
11290	3	307	1	Peak	37.2	47.127	74.0	-26.8	Pass
2444.36	3	320	1	Average	34.5	26.015	54.0	-27.9	Pass
4877.72	3	254	1	Average	33.3	29.475	54.0	-24.5	Pass
7315.97	3	221	1	Average	28.9	32.337	54.0	-21.6	Pass
9747.08	3	201	1	Average	26.5	33.372	54.0	-20.6	Pass
11290	3	307	1	Average	27.3	37.265	54.0	-16.7	Pass

Professional Testing, EMI, Inc
Radiated Emissions, 3m Distance
1-18GHz Horizontal Polarity Measured Emissions



Operator: Eric Lifsey
17712020416 Run04 SpurRxModetfl
03:22:40 PM, Thursday, February 04, 2016

Mode: Recive (advertising)
Sample: Normal operating unit
Power: 4.20 VDC Battery

EUT: SIM-P
Project Number: 17712-15
Client: Triax Technologies

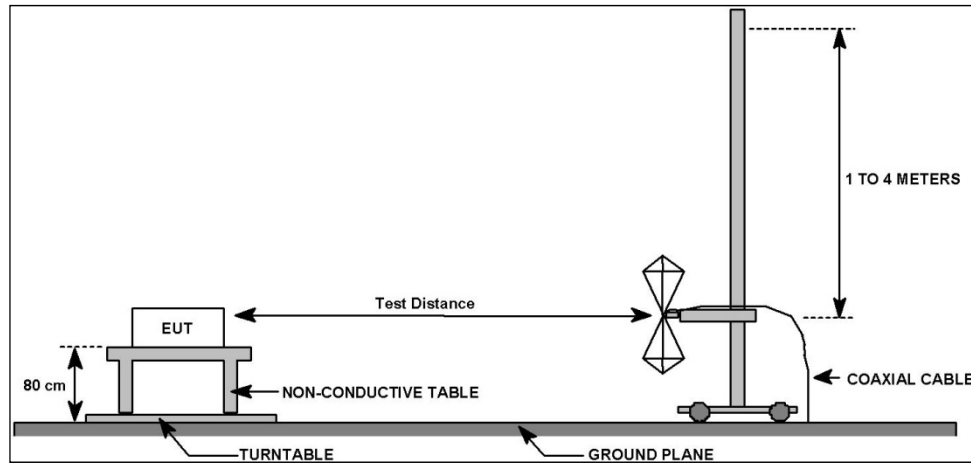
> 1GHz Horizontal Antenna Polarity Measured Emissions

7.0 Radiated Spurious Emissions, Transmit Mode

7.1 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 using 1 MHz resolution bandwidth. A diagram showing the test setup appears below.



7.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.247, 15.209 // RSS-247 5.5, RSS-Gen 4.9 & 4.10	Field Strength of Radiated Spurious/Harmonic Emissions Transmit Mode	4 Feb 2016

7.3 Test Results

Three EUTs were employed to cover the three test channels of bottom, middle, and top channel.

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

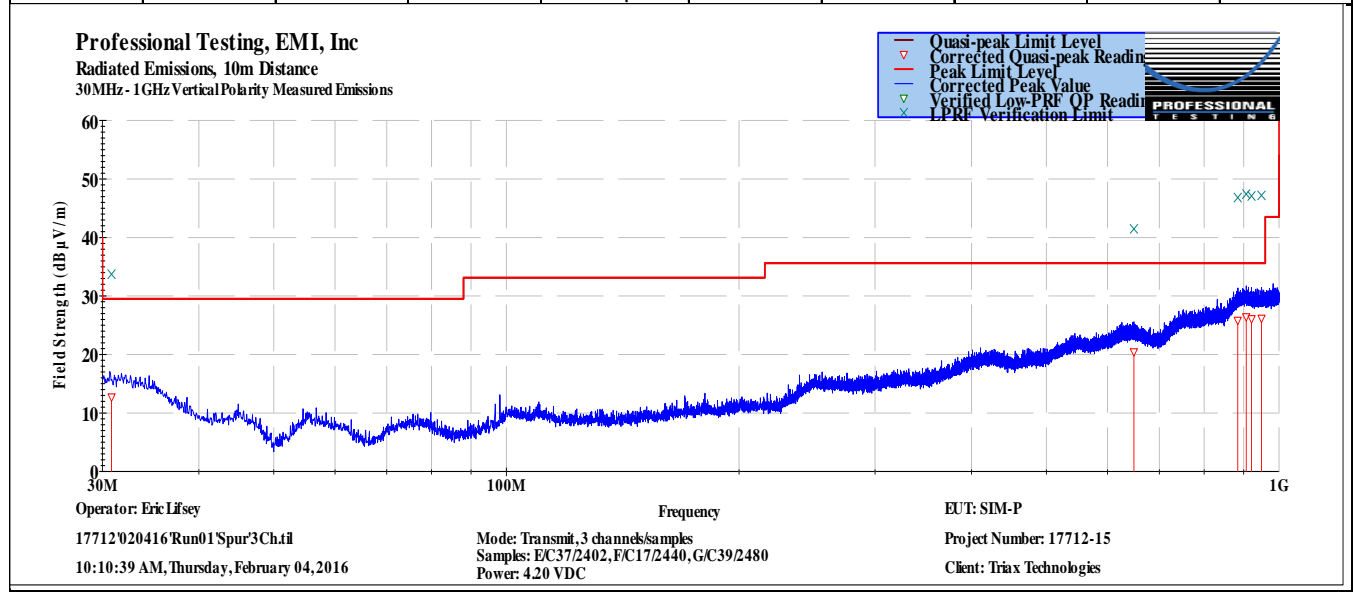
The duty cycle averaging factor applies -20.0 dB to the peaks recorded for the harmonics.

All measurements used peak detection.

Table 7.3.1: TX Mode, Below 1 GHz, Vertical Polarity

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):	2/4/2016	EUT Serial #:	none
Customer:	Triax Technologies	EUT Part #:	none
Project Number:	17712-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	SIM-P	Witness' Name:	None

Radiated Emissions Test Results Data Sheet								Page:	1	of	1
EUT Line Voltage:	4.2	VDC	EUT Power Frequency:	0	N/A						
Antenna Orientation:	Vertical			Frequency Range:	30MHz to 1GHz						
EUT Mode of Operation:				Transmit Mode, Modulated, 3 Channels/EUTs							
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		
30.8241	10	35	3.06	Quasi-peak	24.2	12.7	29.5	-16.8	Pass		
648.938	10	162	1.47	Quasi-peak	21.8	20.448	35.6	-15.2	Pass		
884.565	10	37	2.79	Quasi-peak	21.3	25.812	35.6	-9.8	Pass		
906.976	10	81	3.26	Quasi-peak	21.3	26.425	35.6	-9.2	Pass		
921.557	10	145	1.29	Quasi-peak	21.1	26.076	35.6	-9.5	Pass		
949.336	10	25	2.12	Quasi-peak	21	26.177	35.6	-9.4	Pass		



≤ 1GHz Vertical Antenna Polarity Measured Emissions

Table 7.3.2: TX Mode, Below 1 GHz, Horizontal Polarity

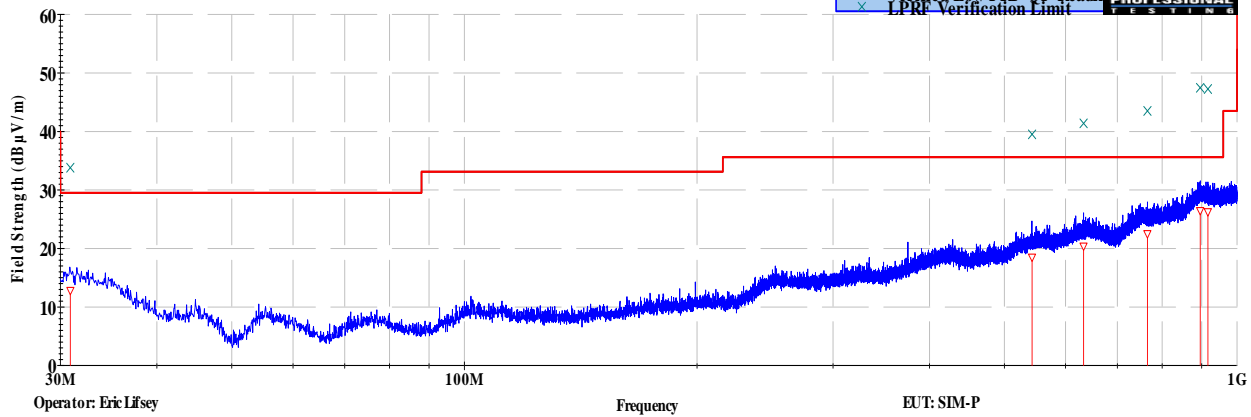
Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.10-2013 American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	2/4/2016	EUT Serial #:	none
Customer:	Triax Technologies	EUT Part #:	none
Project Number:	17712-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	SIM-P	Witness' Name:	None

Radiated Emissions Test Results Data Sheet

Page: 1 of 1

EUT Line Voltage:	4.2	VDC	EUT Power Frequency:	0	N/A				
Antenna Orientation:	Horizontal		Frequency Range:	30MHz to 1GHz					
EUT Mode of Operation:			Transmit Mode, Modulated, 3 Channels/EUTs						
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
30.9033	10	207	3.7	Quasi-peak	24.2	12.787	29.5	-16.7	Pass
543.007	10	252	1.32	Quasi-peak	22.1	18.493	35.6	-17.1	Pass
633.169	10	299	1.3	Quasi-peak	22	20.368	35.6	-15.2	Pass
765.838	10	299	3.49	Quasi-peak	21.5	22.502	35.6	-13.1	Pass
896.133	10	80	1.3	Quasi-peak	21.4	26.46	35.6	-9.1	Pass
916.981	10	264	3.94	Quasi-peak	21.2	26.25	35.6	-9.4	Pass

Professional Testing, EMI, Inc
 Radiated Emissions, 10m Distance
 30MHz - 1GHz Horizontal Polarity Measured Emissions



Operator: Eric Lifsey

17712\020416\Run01\Spur3Ch.ttl

10:10:39 AM, Thursday, February 04, 2016

Frequency

Mode: Transmit, 3 channels/samples

Samples: EC372402, FC172440, GC392480

Power: 4.20 VDC

EUT: SIM-P

Project Number: 17712-15

Client: Triax Technologies

≤ 1GHz Horizontal Antenna Polarity Measured Emissions

Table 7.3.3: TX Mode, Above 1 GHz, Vertical Polarity

Professional Testing, EMI, Inc.

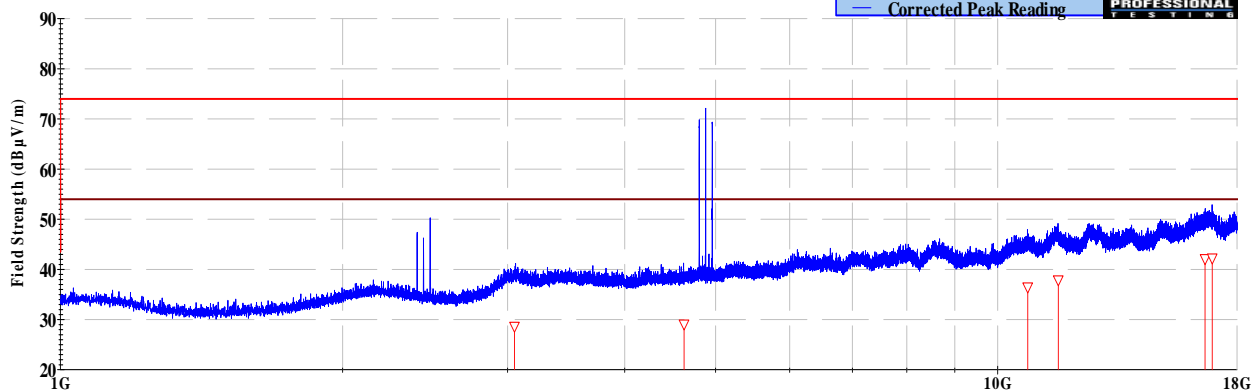
Test Method:	ANSI C63.10-2013 American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	2/4/2016	EUT Serial #:	none
Customer:	Triax Technologies	EUT Part #:	none
Project Number:	17712-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	SIM-P	Witness' Name:	None

Radiated Emissions Test Results Data Sheet

Page: 1 of 1

EUT Line Voltage:	4.2	VDC	EUT Power Frequency:	0	N/A				
Antenna Orientation:	Vertical		Frequency Range:	Above 1GHz					
EUT Mode of Operation:			Transmit Mode, Modulated, 3 Channels/EUTs						
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
3051.68	3	311	1	Peak	44.5	37.956	74.0	-36.0	Pass
4627.82	3	211	1	Peak	43.5	39.362	74.0	-34.6	Pass
10766.8	3	23	1	Peak	36.5	45.793	74.0	-28.2	Pass
11604.1	3	145	1	Peak	36.5	46.974	74.0	-27.0	Pass
16648.1	3	206	1	Peak	36.2	50.856	74.0	-23.1	Pass
16936.9	3	254	1	Peak	37.8	52.432	74.0	-21.5	Pass
3051.68	3	311	1	Average	35.1	28.611	54.0	-25.3	Pass
4627.82	3	211	1	Average	33.2	29.056	54.0	-24.9	Pass
10766.8	3	23	1	Average	27.2	36.45	54.0	-17.5	Pass
11604.1	3	145	1	Average	27.4	37.869	54.0	-16.1	Pass
16648.1	3	206	1	Average	27.4	42.093	54.0	-11.9	Pass
16936.9	3	254	1	Average	27.6	42.215	54.0	-11.7	Pass

Professional Testing, EMI, Inc
 Radiated Emissions, 3m Distance
 1-18GHz Vertical Polarity Measured Emissions



Operator: Erik Lifsey

17712\020416\Run01\Spur3Ch.tif

11:26:13 AM, Thursday, February 04, 2016

Frequency

Mode: Transmit, 3 channels/samples
 Samples: EC37/2402, FC17/2440, GC39/2480
 Power: 4.20 VDC

EUT: SIM-P

Project Number: 17712-15

Client: Triax Technologies

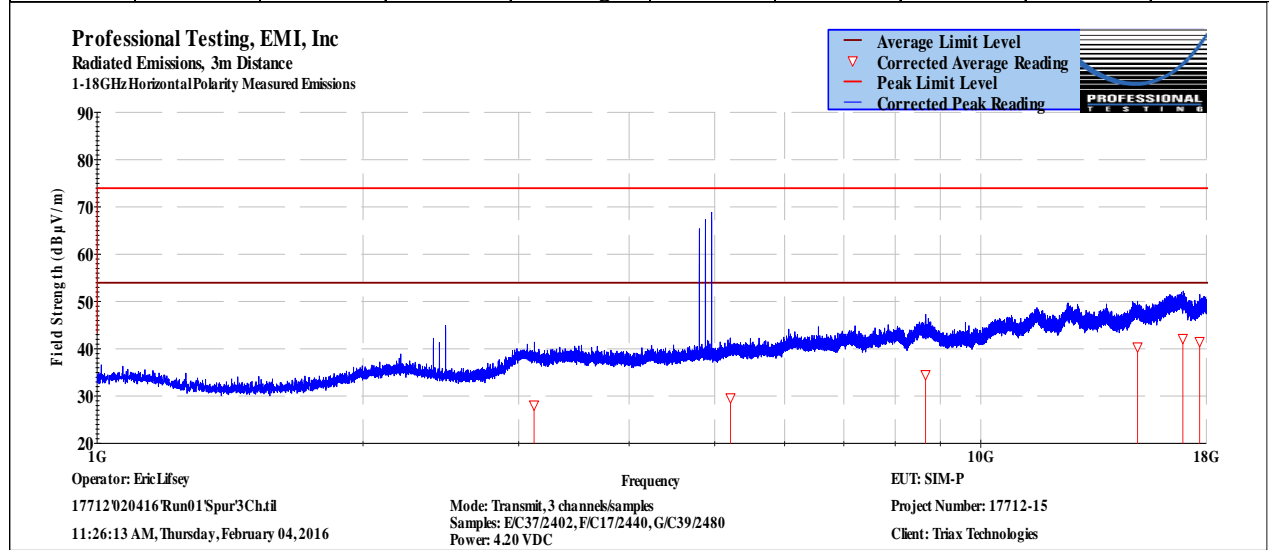
1 to 18 GHz Vertical Antenna Polarity Measured Emissions

Table 7.3.4: TX Mode, Above 1 GHz, Horizontal Polarity

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):	2/4/2016	EUT Serial #:	none
Customer:	Triax Technologies	EUT Part #:	none
Project Number:	17712-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	SIM-P	Witness' Name:	None

Radiated Emissions Test Results Data Sheet Page: 1 of 1

EUT Line Voltage:	4.2	VDC	EUT Power Frequency:	0	N/A				
Antenna Orientation:	Horizontal		Frequency Range:	Above 1GHz					
EUT Mode of Operation:			Transmit Mode, Modulated, 3 Channels/EUTs						
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
3122.7	3	255	1	Peak	44.1	37.376	74.0	-36.6	Pass
5208.92	3	250	1	Peak	41.9	38.861	74.0	-35.1	Pass
8659.97	3	172	1	Peak	35.6	42.95	74.0	-31.0	Pass
15046	3	212	1	Peak	36.8	48.767	74.0	-25.2	Pass
16929	3	30	1	Peak	36.1	50.766	74.0	-23.2	Pass
17686.5	3	38	1	Peak	35.4	49.88	74.0	-24.1	Pass
3122.7	3	255	1	Average	34.8	28.1	54.0	-25.9	Pass
5208.92	3	250	1	Average	32.6	29.616	54.0	-24.3	Pass
8659.97	3	172	1	Average	27.2	34.541	54.0	-19.4	Pass
15046	3	212	1	Average	28.4	40.37	54.0	-13.6	Pass
16929	3	30	1	Average	27.6	42.206	54.0	-11.8	Pass
17686.5	3	38	1	Average	27.1	41.546	54.0	-12.4	Pass

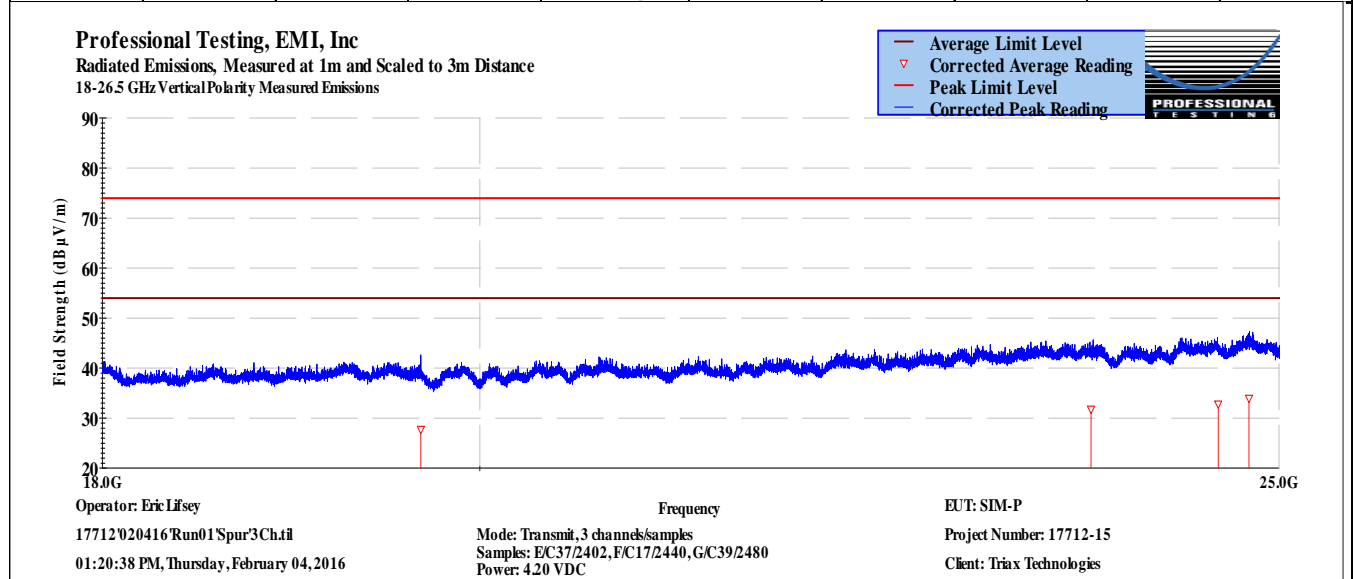


1 to 18 GHz Horizontal Antenna Polarity Measured Emissions

Table 7.3.5: TX Mode, 18-25 GHz, Vertical Polarity

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):	2/4/2016	EUT Serial #:	none
Customer:	Triax Technologies	EUT Part #:	none
Project Number:	17712-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	SIM-P	Witness' Name:	None

Radiated Emissions Test Results Data Sheet							Page: 1 of 1		
EUT Line Voltage:	4.2	VDC	EUT Power Frequency:	0	N/A				
Antenna Orientation:	Vertical			Frequency Range:	Above 1GHz				
EUT Mode of Operation:				Transmit Mode, Modulated, 3 Channels/EUTs					
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
19673.6	3	332	1	Average	32.3	27.76	54.0	-26.2	Pass
23721.6	3	281	1	Average	33.4	31.762	54.0	-22.2	Pass
24579.4	3	158	1	Average	33.4	32.8	54.0	-21.2	Pass
24791.5	3	157	1	Average	33.6	33.942	54.0	-20.0	Pass

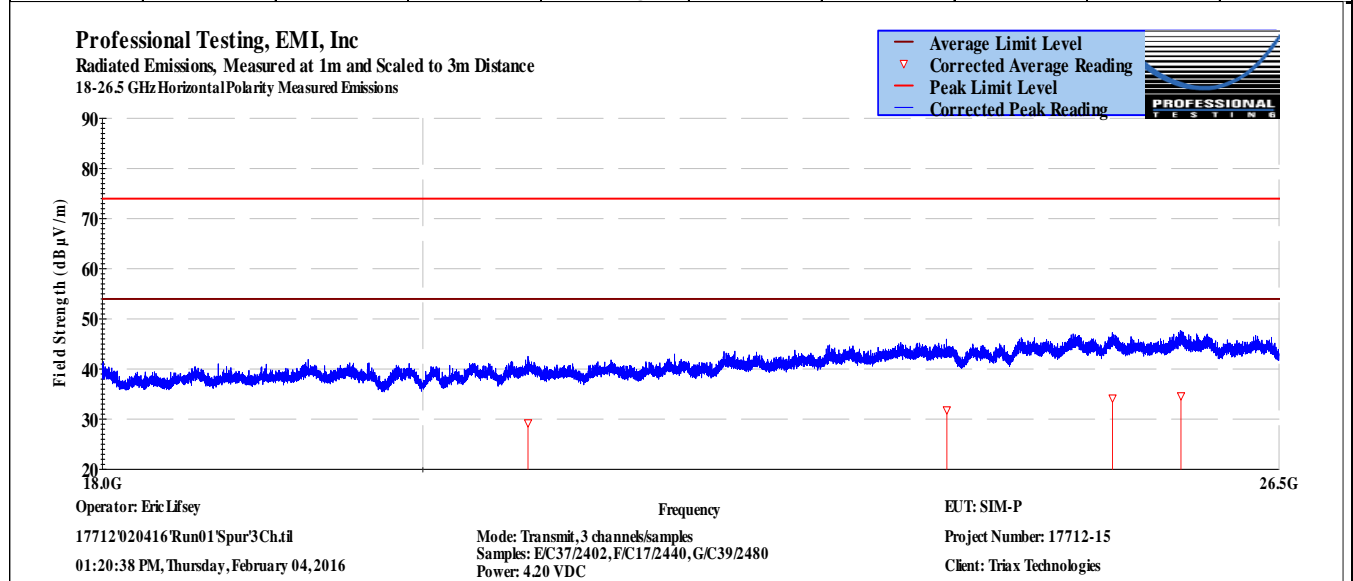


> 18 GHz Vertical Antenna Polarity Measured Emissions

Table 7.3.6: TX Mode, 18-25 GHz, Horizontal Polarity

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):	2/4/2016	EUT Serial #:	none
Customer:	Triax Technologies	EUT Part #:	none
Project Number:	17712-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	SIM-P	Witness' Name:	None

Radiated Emissions Test Results Data Sheet							Page: 1 of 1		
EUT Line Voltage:	4.2	VDC	EUT Power Frequency:	0	N/A				
Antenna Orientation:	Horizontal			Frequency Range:	Above 1GHz				
EUT Mode of Operation:				Transmit Mode, Modulated, 3 Channels/EUTs					
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
20703.3	3	259	1	Average	33.1	29.251	54.0	-24.7	Pass
23759.3	3	29	1	Average	33.5	31.865	54.0	-22.1	Pass
25089.2	3	90	1	Average	33.9	34.216	54.0	-19.7	Pass
25659.9	3	66	1	Average	34.2	34.663	54.0	-19.3	Pass



> 18 GHz Horizontal Antenna Polarity Measured Emissions

8.0 Antenna Construction Requirements

The design was investigated for meeting the antenna construction requirements of the applicable rules.

8.1 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 in ways that would void their authorization to use the device.

8.2 Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.203 // RSS-Gen 8.3	Antenna Construction	1 Mar 2016

8.3 Results

Table 8.3.1 Antenna Construction Details	
Antenna Manufacturer and Model	Specifications
Manufacturer:	
Part Number:	

- Antenna is chip style component.
- There is no external antenna connector.
- The antenna is not accessible.

The antenna design above satisfies the requirements of the rules.

9.0 Equipment

9.1 Radiated Emissions 30 MHz to 25 GHz

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):		2/4/2016		EUT Serial #: none	
Customer:		Triax Technologies		EUT Part #: none	
Project Number:		17712-15		Test Technician: Eric Lifsey	
Purchase Order #:		NA		Supervisor: Lisa Arndt	
Equip. Under Test:		SIM-P		Witness' Name: None	
Radiated Emissions Test Equipment List					
Tile! Software Version:		4.2.A, May 23, 2010, 08:38:52 AM			
Test Profile:		2015 Rad Emissions_ClassA - LowPRF_072715.til or 2015 Rad Emissions_ClassB - LowPRF_072715.til			
Asset #	Manufacturer	Model	Equipment Nomenclature	Serial Number	Calibration Due Date
1937	Agilent	E4440A	Spectrum Analyzer, 3 Hz - 26.5 GHz, Opt. AYZ	MY44808298	12/15/2016
1926	ETS-Lindgren	3142D	Antenna, Biconilog, 26 MHz - 6 GHz	135454	1/25/2017
C027D	none	RG214	Cable Coax, N-N, 25m	none	10/1/2016
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	N/A	TDK 10M Chamber, VSWR > 1 GHz	DAC-012915-005	3/14/2017
2004	Miteq	AFS44-00101800-2S-10P-44	Amplifier, 40dB, .1-18GHz	0	1/11/2018
C030	none	none	Cable Coax, N-N, 30m	none	10/1/2016
1325	EMCO	1050	Controller, Antenna Mast	9003-1461	N/A
1780	ETS-Lindgren	3117	Antenna, Double Ridged Guide Horn, 1 - 18 GHz	110313	2/25/2017
1542	A.H. Systems	SAS-572	Antenna, Horn 18-26.5GHz, 20dB gain	225	N/A
1973	Agilent	83017A	Amplifier, Microwave 0.5-26.5 GHz	MY39500497	2/2/2018

9.2 Bandwidth and Duty Cycle

Asset #	Manufacturer	Model #	Description	Calibration Due
ALN-077	Rohde & Schwarz	FSP-30	Spectrum Analyzer	16 Dec 2016

10.0 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

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