
Project 19775-15

**Austin Devices LLC
Zilker Valve
Model ZV**

Wireless Certification Report

Prepared for:

Austin Devices LLC
5606 Shoalwood Ave.
Austin, TX 78756

By

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

15 Mar 2018

Reviewed by



Larry Finn
Chief Technical Officer

Written by



Eric Lifsey
EMC Engineer

Revision History

Revision Number	Description	Date
Final 01		15 Mar 2018

Errata:

Where mention of Zilker S or Sensor is found it actually refers to the Zilker Valve device.

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Compliance Certificate

Applicant	Device & Test Identification
Austin Devices LLC 5606 Shoalwood Ave. Austin, TX 78756 Certificate Date: 15 Mar 2018	FCC ID: 2AO4VZV Industry Canada ID: 23667-ZV Model(s): ZV Laboratory Project ID: 19775-15

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
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

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
Austin Devices LLC Model: Zilker Valve	129002	Remote wireless-controlled valve & sensor based on a 902-928 MHz radio using 16 channels

Table 1.2.2: Support Equipment		
Manufacturer / Model	Serial #	Description
N/A		

The EUT is a battery powered device that is normally attached in series with a water line. It sends status data via a wireless proprietary network and receives commands to control the water valve.

The EUT electronics are on a single circuit board which is nominally rectangular in shape and measures approximately 6.6 by 3.6 cm. The cylindrical enclosure completely encloses the board and is about 7 cm in diameter and 12 cm long.

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:

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

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 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
ANSI C63.10:2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

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 conducted means and 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	1 Mar 2018

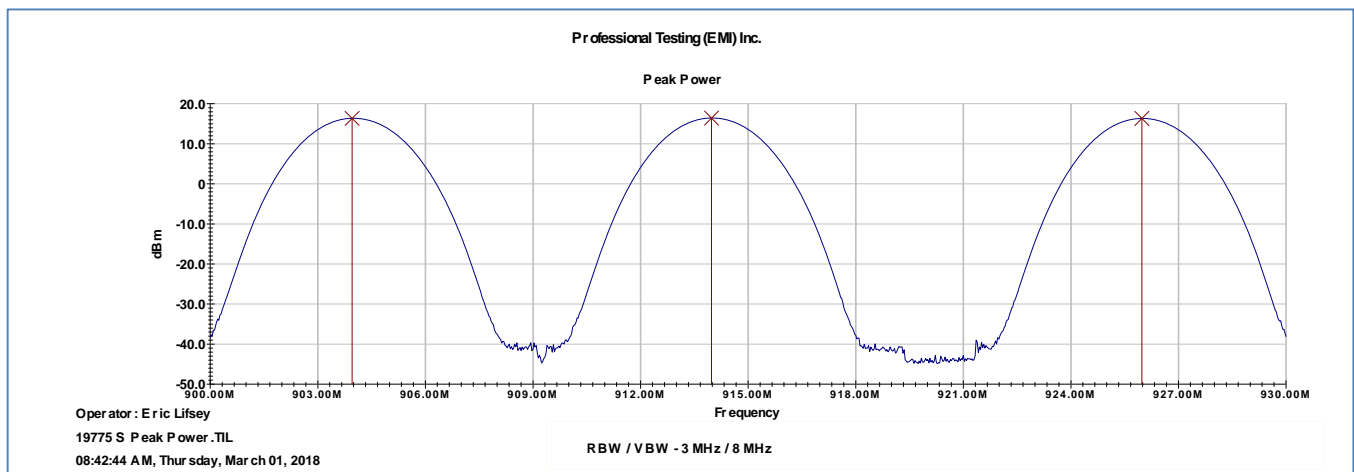
2.3 Test Results, Peak Power

The EUT was measured for conducted power by connection directly to a spectrum analyzer.

Table 2.3.1 Power, Peak, Conducted (Unmodulated)				
Frequency MHz	Measured Peak Power in dBm	Antenna Gain dBi	EIRP dBm	EIRP Peak Power Restated in mW
904	16.3	-0.1	16.2	41.7
914	16.4	-0.1	16.3	42.7
926	16.3	-0.1	16.2	41.7

Measured in 3 MHz RBW, 8 MHz VBW.

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.

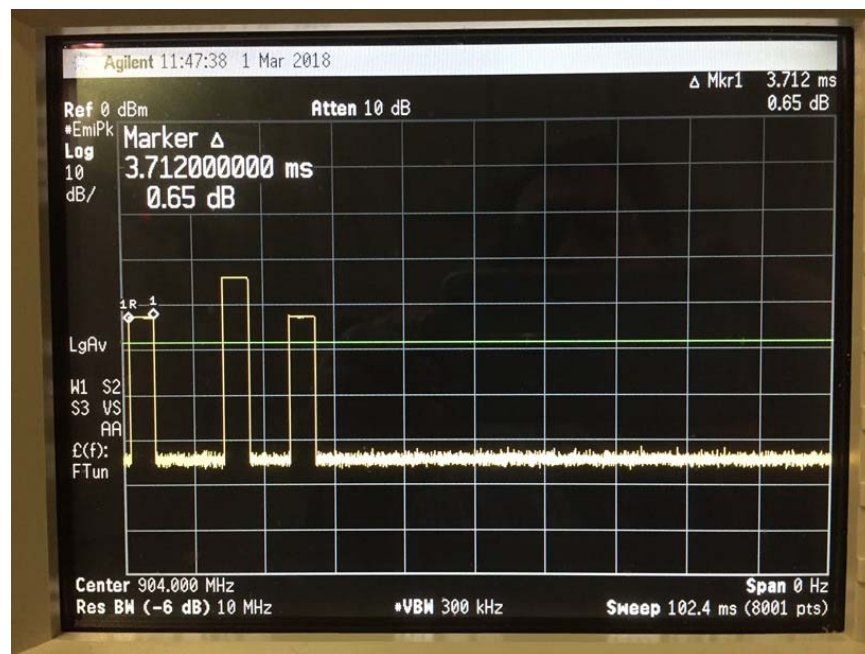
Table 2.4.1 Duty Cycle Results and Average Duty Cycle Factor Result

Total Measured On Time (msec)	Declared Time Interval (msec)	Duty Cycle Factor Calculation	Result (dB)	Duty Cycle Factor Allowed (dB)
= 7.37	6000 Allowed 100	$= 20 * \log_{10} (7.37 \text{ msec} / 100 \text{ msec})$	-22.6	-20

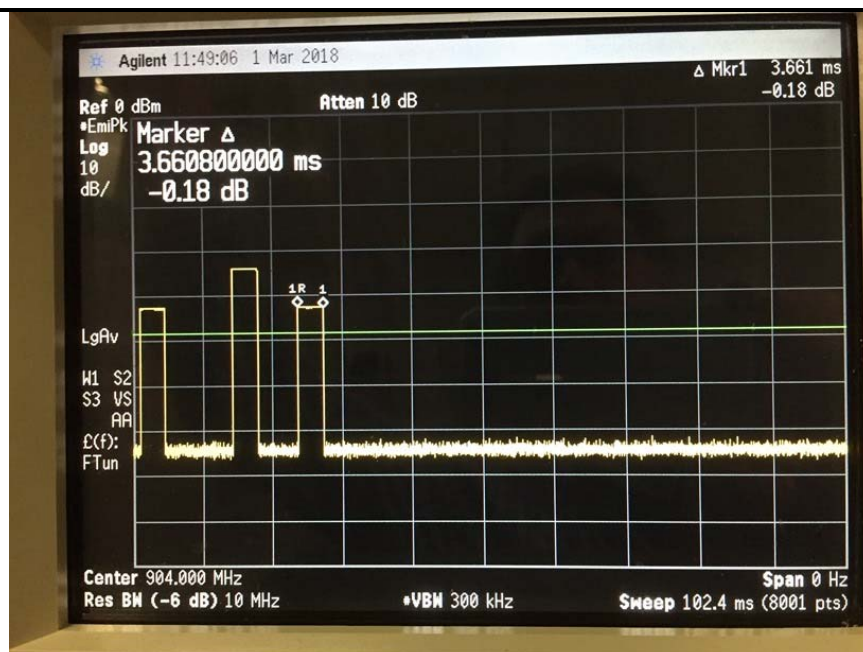
The weighted duty cycle for exposure purposes is: $10 \log (7.37 / 6000) = -29.1 \text{ dB}$

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

Plotted results appear below. It records an initial transmit event, response (from other device), and acknowledge transmit event. The total transmit time is the sum of the two transmit events. These events occur at six second intervals.



Transmit Event 1



Transmit Event 2

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.

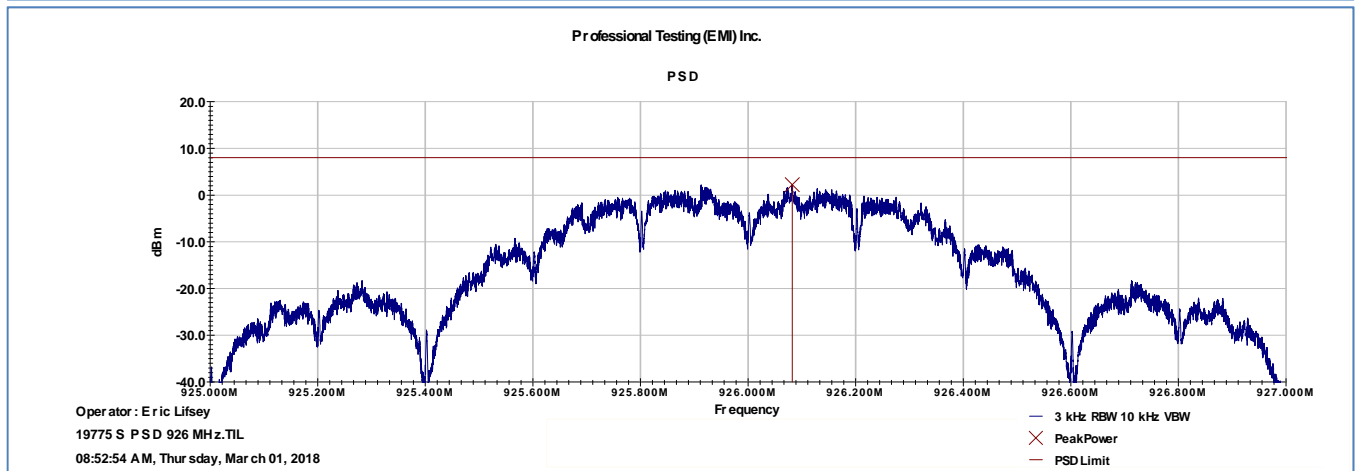
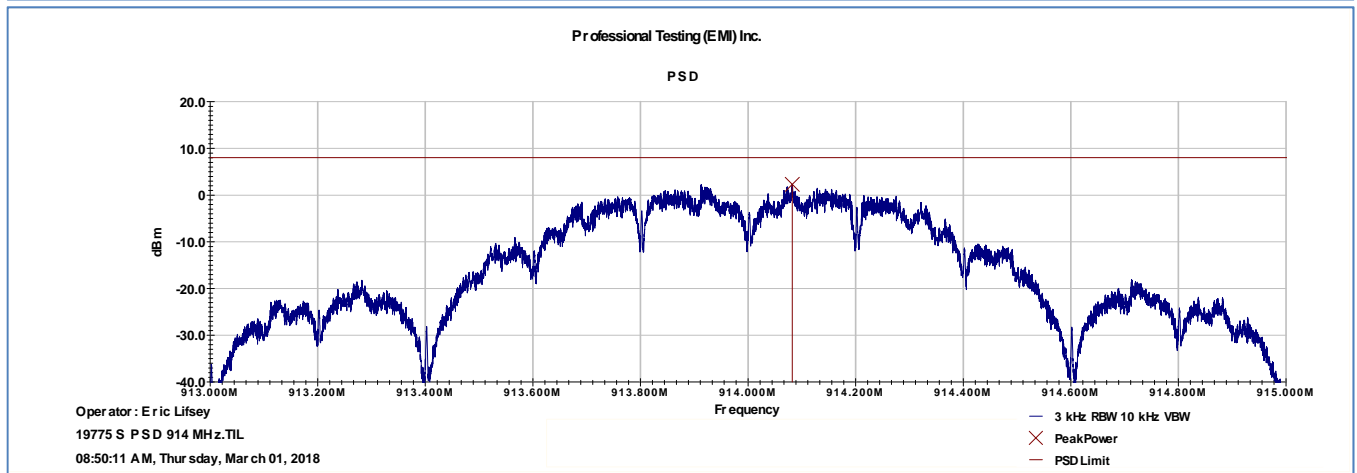
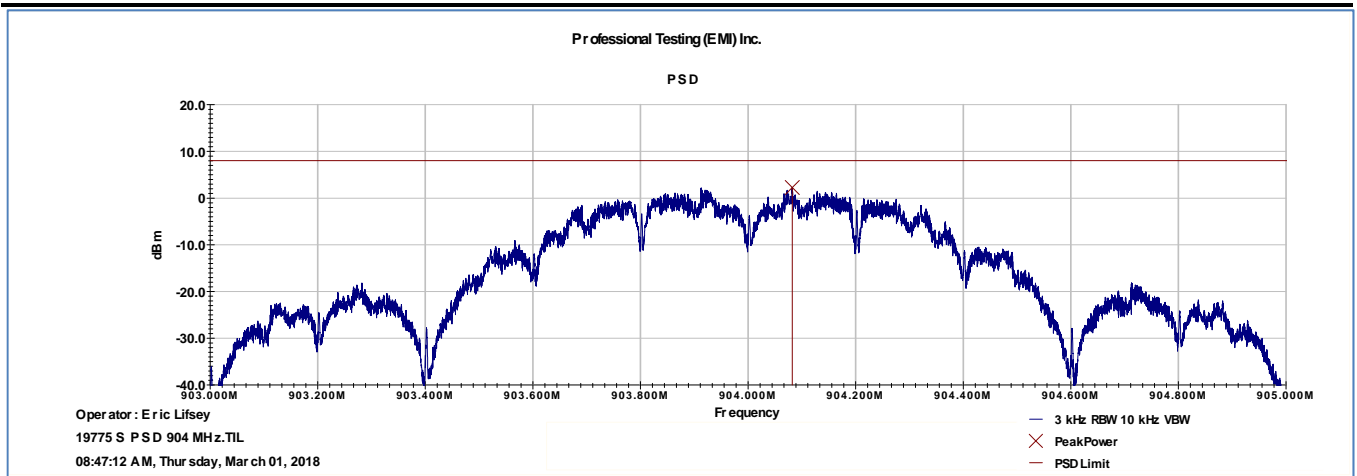
3.2 Test Criteria

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	1 Mar 2018

3.3 Test Results

Table 3.3.1 Power Spectral Density, Conducted	
Frequency MHz	Measured Peak Power dBm
904	2.3
914	2.3
926	2.2

The EUT satisfied the requirement.



4.0 Occupied Bandwidth

4.1 Test Procedure

Bandwidth is measured by conducted 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, 99%	1 Mar 2018

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.

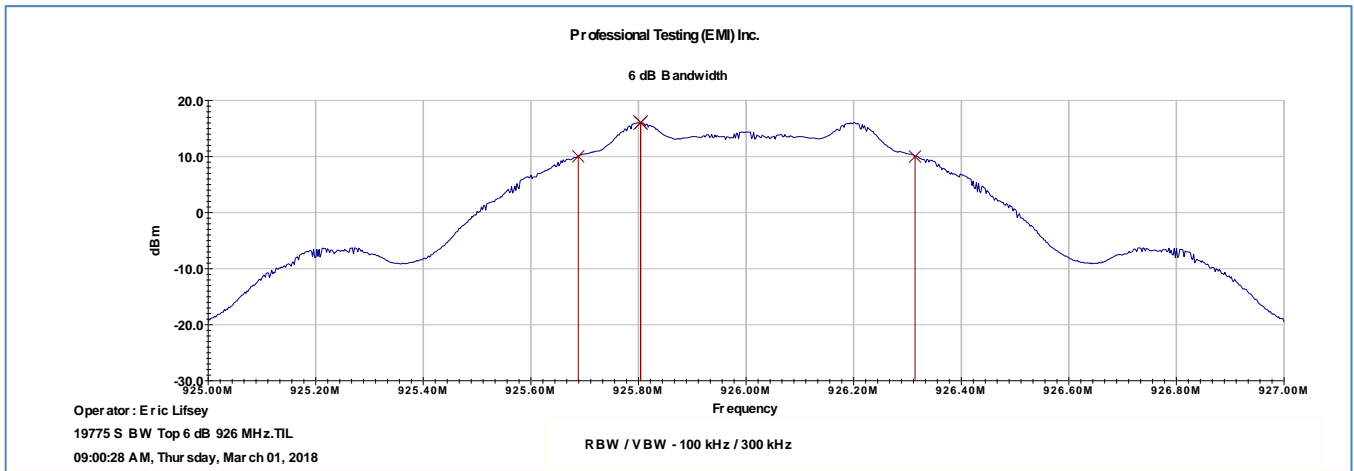
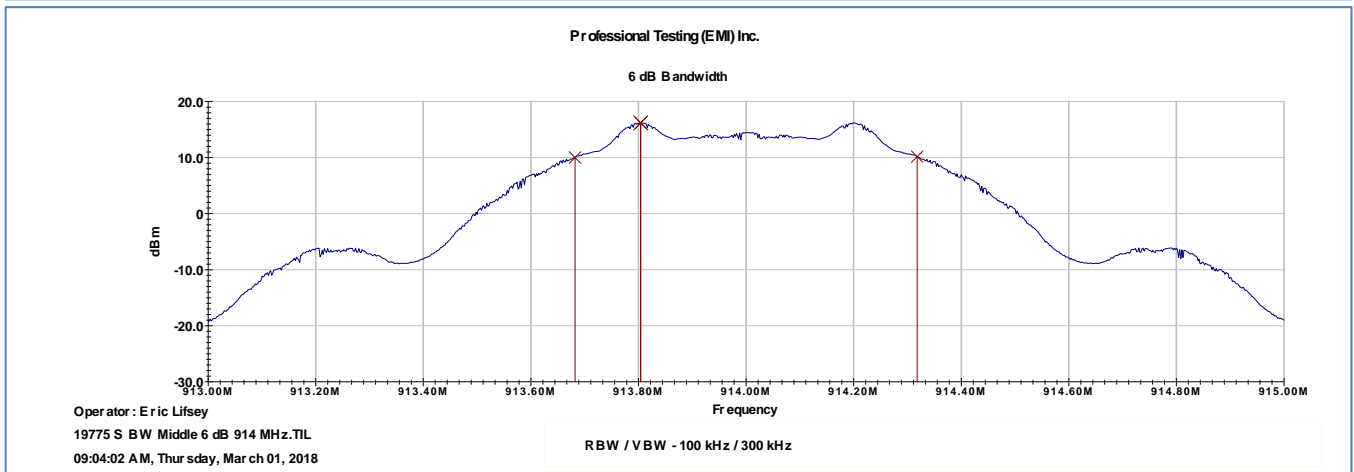
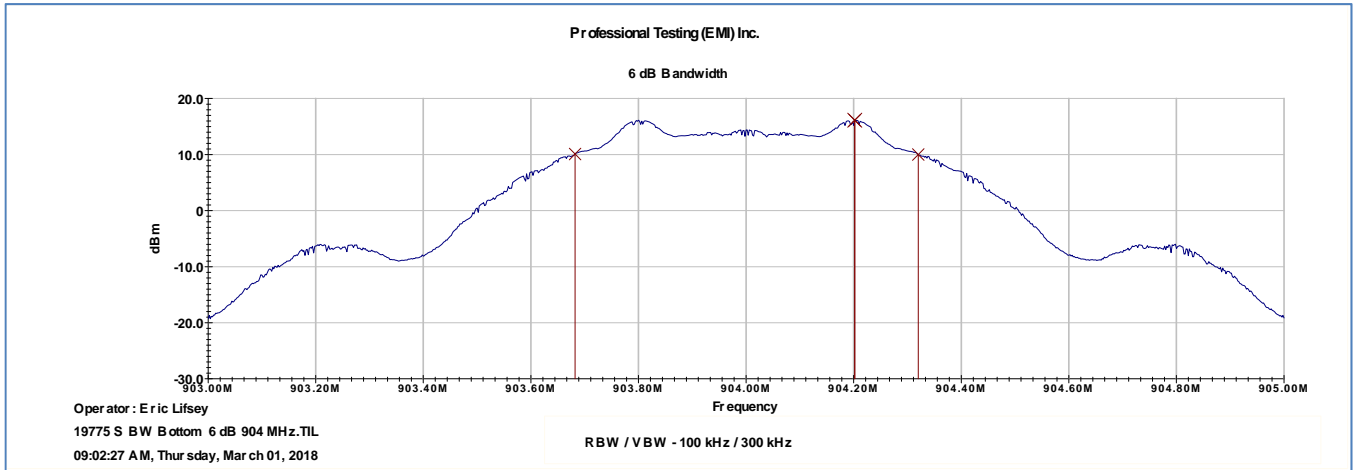
Table 4.3.1 Bandwidth 6 dB, Minimum 500 kHz in 100 kHz RBW			
Low Channel Measured BW (kHz)	Middle Channel Measured BW (kHz)	High Channel Measured BW (kHz)	Reported Minimum BW (kHz)
638	636	626	626

Table 4.3.2 Bandwidth 20 dB, Measure and Report			
Low Channel Measured BW (kHz)	Middle Channel Measured BW (kHz)	High Channel Measured BW (kHz)	Reported Maximum BW (kHz)
1036	1008	1000	1036

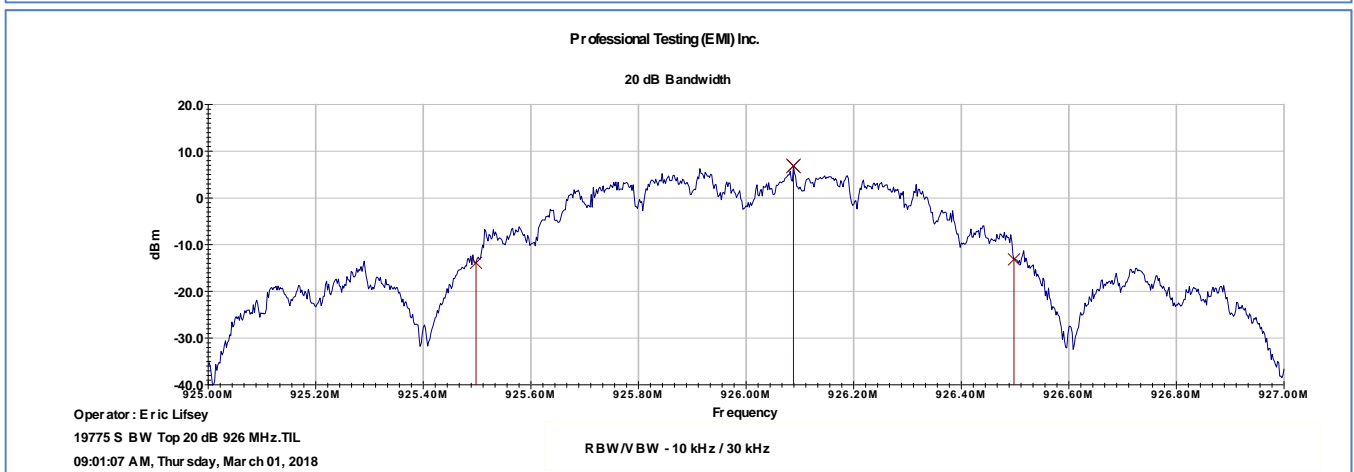
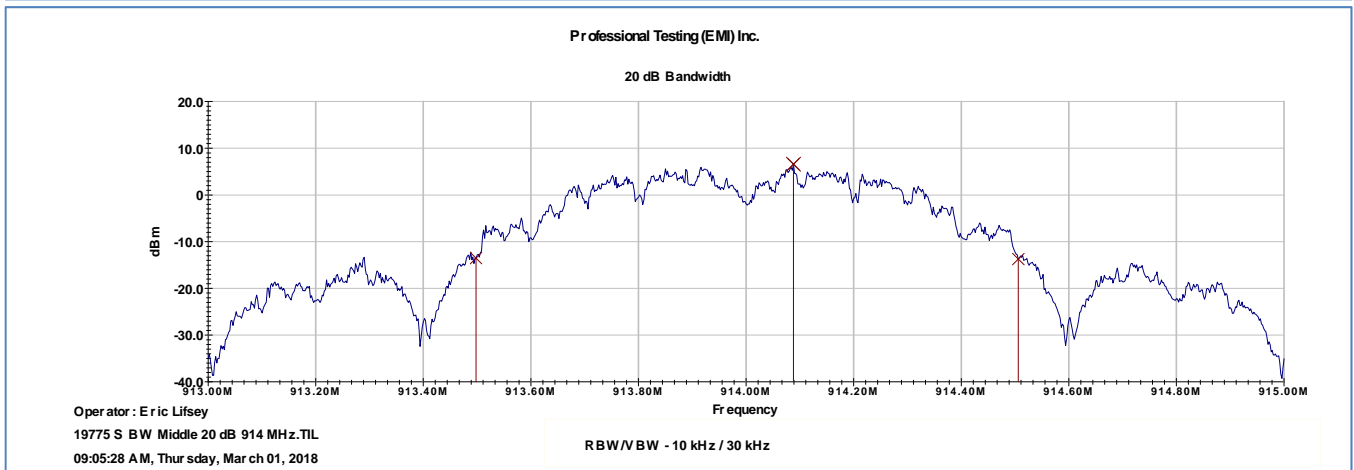
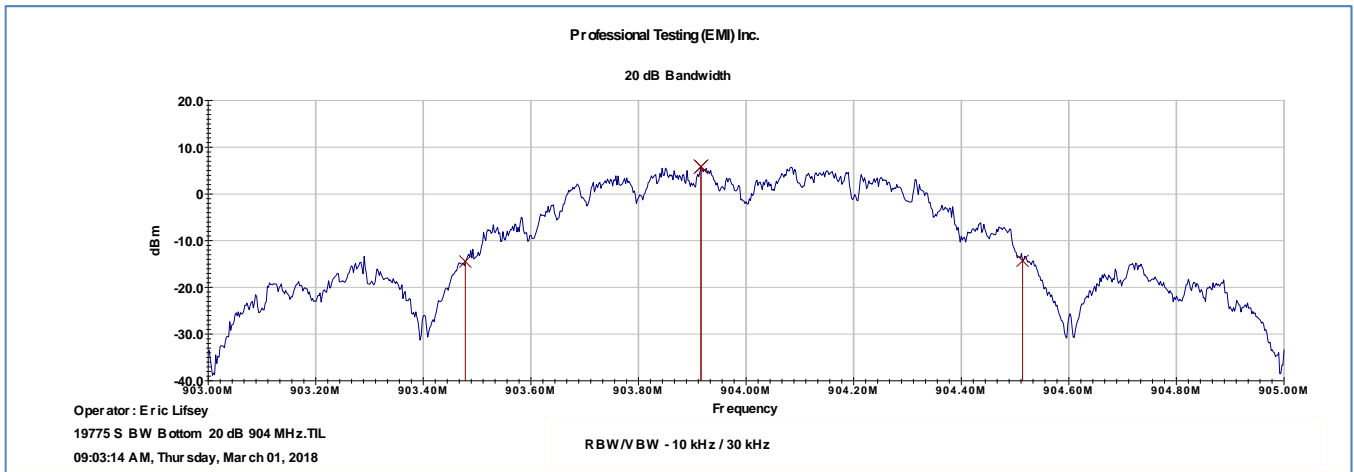
Table 4.3.3 Bandwidth 99%, Measure and Report			
Low Channel Measured BW (kHz)	Middle Channel Measured BW (kHz)	High Channel Measured BW (kHz)	Reported Maximum BW (kHz)
1024	1013	1005	1024

Plotted measurements appear on the following pages.

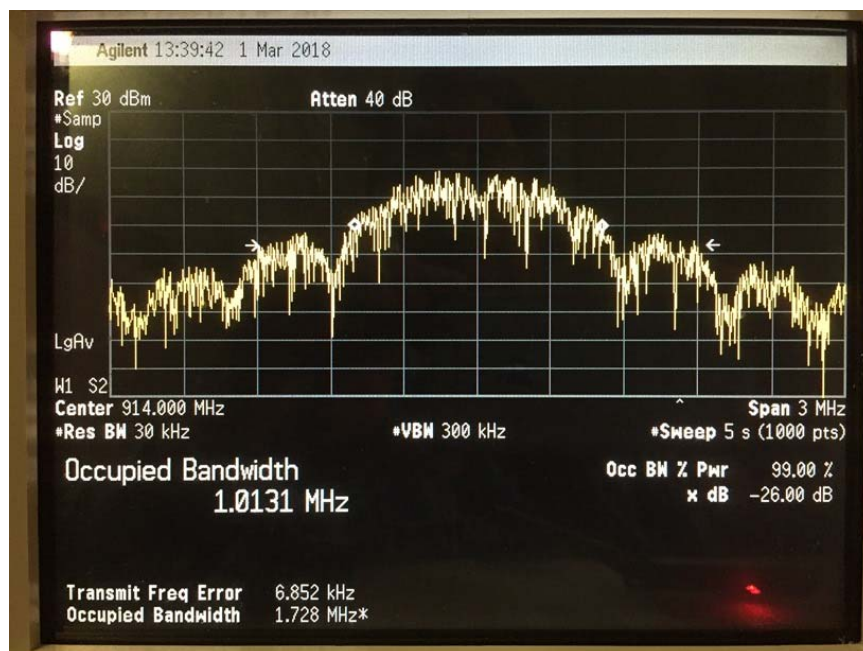
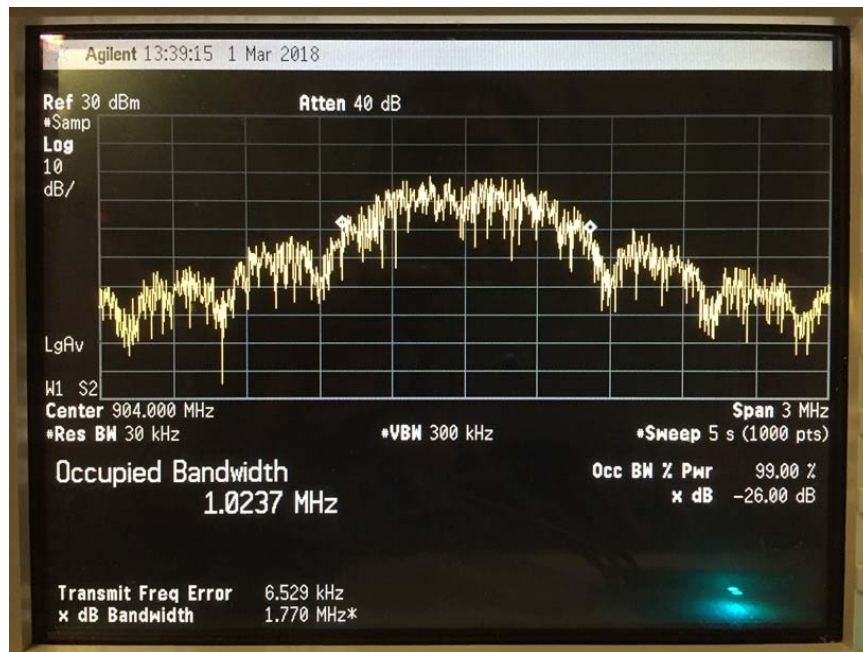
4.3.1 Bandwidth Plots, 6 dB

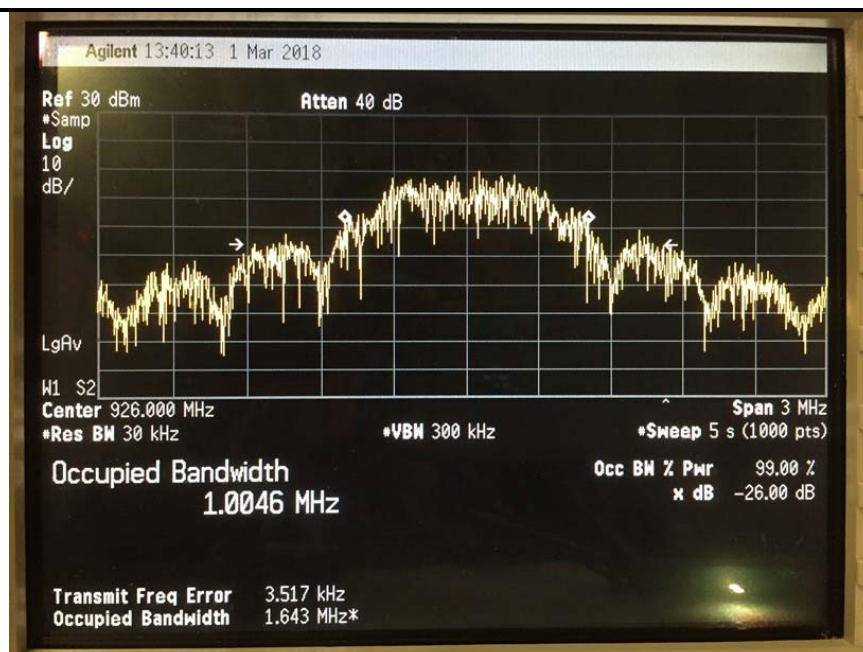


4.3.2 Bandwidth Plots, 20 dB



4.3.3 Bandwidth Plots, 99%





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 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 (if any), Conducted	1 Mar 2018

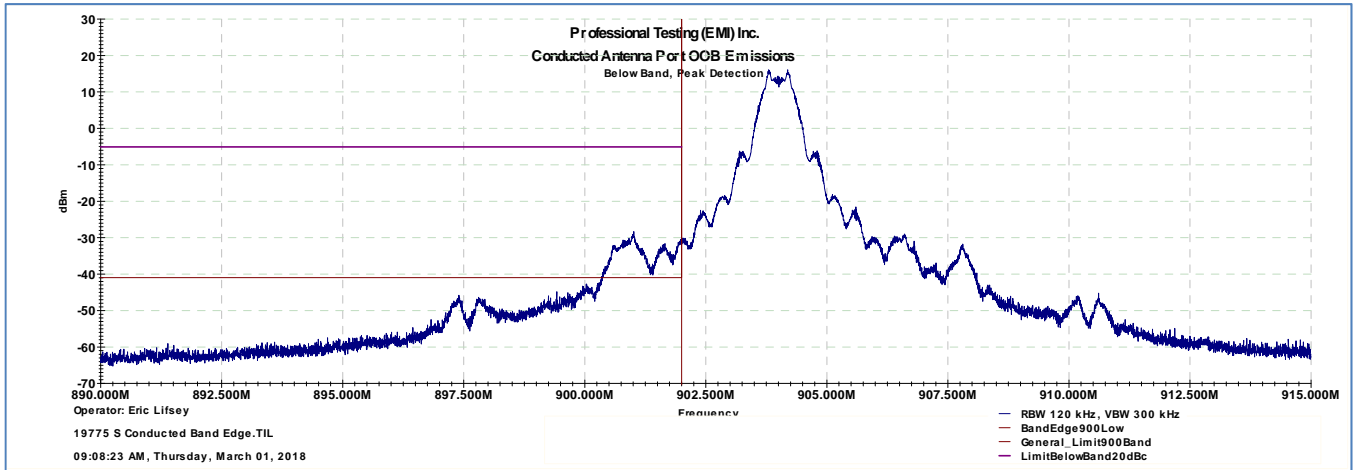
5.3 Test Results

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 for a conducted measurement.

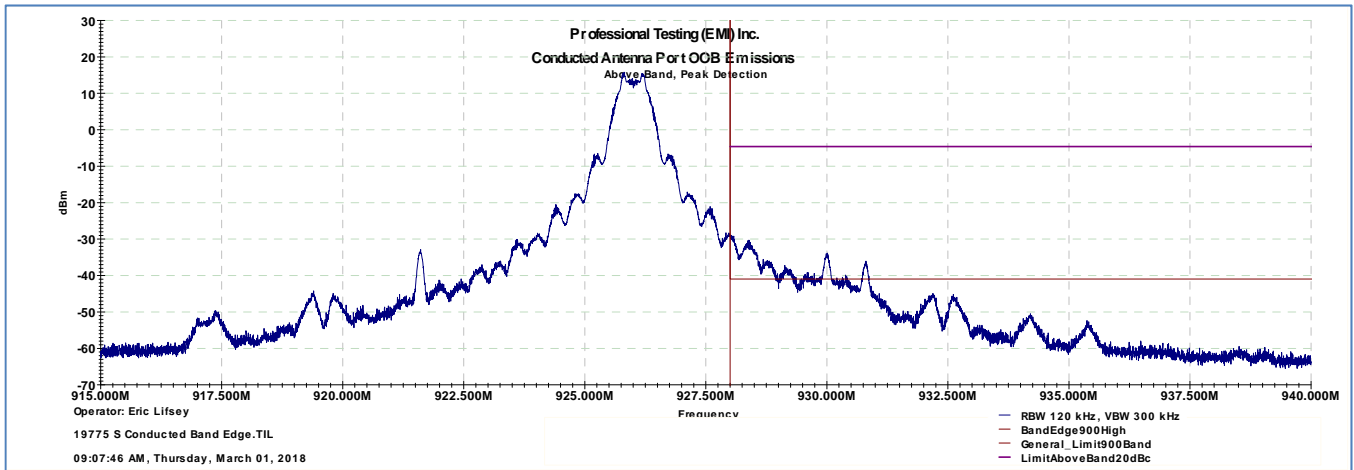
For the 900 MHz band there are no adjacent restricted bands. The emission limit is -20 dBc on both edges.

The EUT satisfied the criteria. Plotted results of peak detection appear on the following pages. If desired, the duty cycle factor of -20 dB can be applied to the measurement.

5.3.1 Low Channel Band Edge



5.3.2 High Channel Band Edge

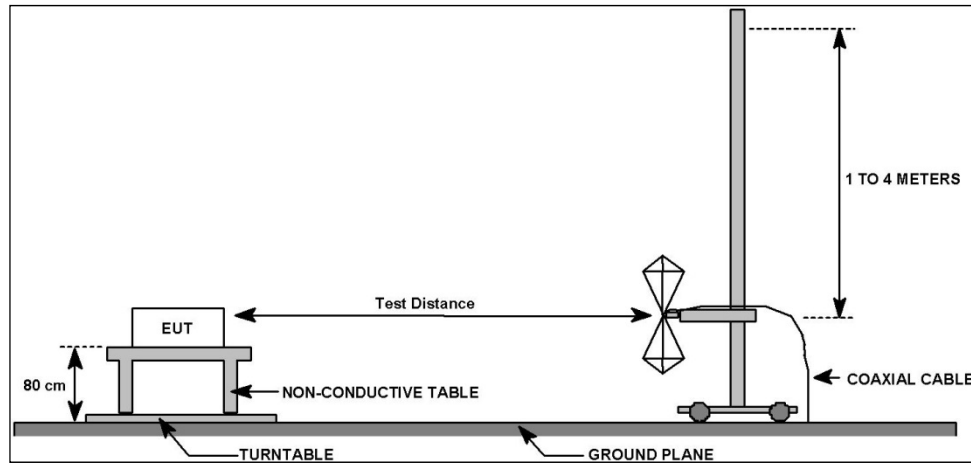


6.0 Radiated Spurious Emissions, Transmit/Receive Modes

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 using 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 Transmit & Receive Mode	28 Feb 2018

6.3 Test Results

This device was simultaneously tested with its companion device designated Bridge. Operating mode of both devices was confirmed.

Modulation was disabled for this test and the transmitters were placed into continuous transmit mode.

Above 1 GHz the duty cycle averaging factor applies -20.0 dB to the peaks recorded for the harmonics.

6.3.1 Transmit, Middle Channel Up to 1 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):		2/28/2018			EUT Serial #:		None		
Customer:		Austin Devices LLC			EUT Part #:		None		
Project Number:		19775			Test Technician:		Eric Lifsey		
Purchase Order #:		0			Supervisor:		Lisa Arndt		
Equip. Under Test:		Zilker Sensor & Bridge			Witness' Name:		None		
Radiated Emissions Test Results Data Sheet								Page: 1 of 1	
EUT Line Voltage:		3 & 5 VDC			EUT Power Frequency:		0 N/A		
Antenna Orientation:		Vertical			Frequency Range:		30MHz to 1GHz		
EUT Mode of Operation:					Transmit, Center Channel 914 MHz				
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
30.074	10	178	1.91	Quasi-peak	24.472	13.406	29.5	-16.1	Pass
56.236	10	122	4.02	Quasi-peak	27.504	8.054	29.5	-21.4	Pass
60.037	10	212	2.47	Quasi-peak	30.276	10.465	29.5	-19.0	Pass
768.409	10	299	3.55	Quasi-peak	21.56	22.253	35.6	-13.3	Pass
898.617	10	132	1.97	Quasi-peak	21.393	24.982	35.6	-10.6	Pass
977.442	10	1	1.46	Quasi-peak	21.011	26.361	43.5	-17.1	Pass
<div style="display: flex; justify-content: space-between;"> <div style="width: 60%;"> <p>Professional Testing, EMI, Inc Radiated Emissions, 10m Distance 30MHz - 1GHz Vertical Polarity Measured Emissions</p> </div> <div style="width: 35%;"> <ul style="list-style-type: none"> — Quasi-peak Limit — Ambient Scan — Pre-scan Emissions — Quasi-peak Reading — LPRF Verification Limit — Verified Low-PRFQP Reading </div> </div> <p>Operator : Eric Lifsey RE'19775'022818'Run01'Center Chan'S&B.tif Current Time -09:45:51 AM, Wednesday, February 28, 2018</p> <p>Mode: Transmit, center channel, continuous Power: 2XAA 3V battery, 5.0 VDC external</p> <p>EUT: EUT1: Sensor, EUT2: Bridge Project Number: 19775 Client: Austin Devices LLC</p>									
≤ 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):	2/28/2018	EUT Serial #:	None
Customer:	Austin Devices LLC	EUT Part #:	None
Project Number:	19775	Test Technician:	Eric Lifsey
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	Zilker Sensor & Bridge	Witness' Name:	None

Radiated Emissions Test Results Data Sheet

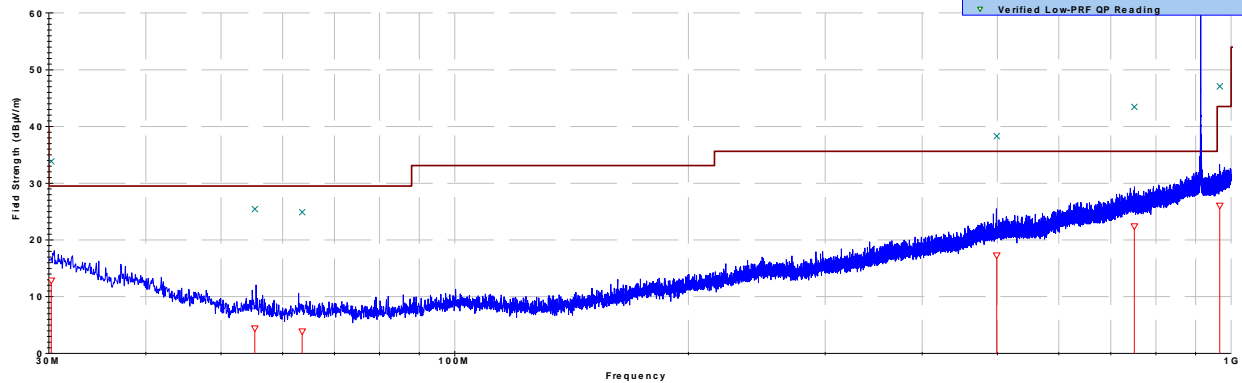
Page: 1 of 1

EUT Line Voltage:		3 & 5 VDC			EUT Power Frequency:		0 N/A		
Antenna Orientation:		Horizontal			Frequency Range:		30MHz to 1GHz		
EUT Mode of Operation:					Transmit, Center Channel 914 MHz				
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
30.221	10	128	1.33	Quasi-peak	23.974	12.847	29.5	-16.7	Pass
55.274	10	138	3.86	Quasi-peak	23.796	4.426	29.5	-25.1	Pass
63.605	10	202	3.15	Quasi-peak	23.645	3.889	29.5	-25.6	Pass
499.056	10	242	3.8	Quasi-peak	22.265	17.282	35.6	-18.3	Pass
750.627	10	189	1.2	Quasi-peak	21.694	22.419	35.6	-13.2	Pass
967.412	10	280	1.29	Quasi-peak	20.962	26.056	43.5	-17.4	Pass

Professional Testing, EMI, Inc.

Radiated Emissions, 10m Distance

30 MHz - 1 GHz Horizontal Polarity Measured Emissions



Operator: Eric Lifsey

RE:19775'022818'Run01'CenterChan'S&B.ttl

Current Time -09:56:19 AM, Wednesday, February 28, 2018

Mode: Transmit, center channel, continuous

Power: 2XAA 3V battery, 5.0 VDC external

EUT: EUT1: Sensor, EUT2: Bridge

Project Number: 19775

Client: Austin Devices LLC

≤ 1GHz Horizontal Antenna Polarity Measured Emissions

6.3.2 Transmit, Middle Channel Up to 10 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):	2/28/2018	EUT Serial #:	None
Customer:	Austin Devices LLC	EUT Part #:	None
Project Number:	19775	Test Technician:	Eric Lifsey
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	Zilker Sensor & Bridge	Witness' Name:	None

Radiated Emissions Test Results Data Sheet

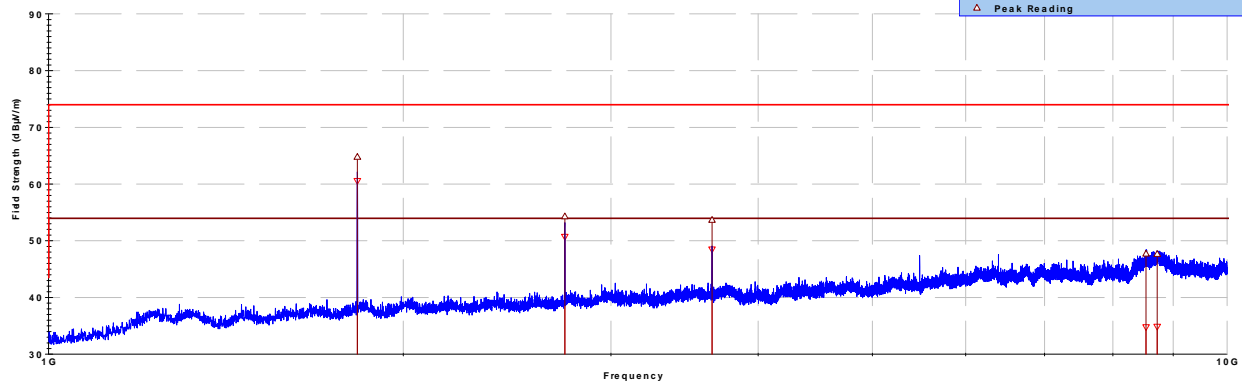
Page: 1 of 1

EUT Line Voltage:		3 & 5 VDC			EUT Power Frequency:		0 N/A		
Antenna Orientation:		Vertical			Frequency Range:		Above 1GHz		
EUT Mode of Operation:					Transmit, Center Channel 914 MHz				
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
1828.03	3	210	1.27	Peak	74.4	64.777	74.0	-9.2	Pass
2742.02	3	225	2.63	Peak	62.1	54.293	74.0	-19.7	Pass
3655.98	3	214	2.02	Peak	60.4	53.659	74.0	-20.3	Pass
8536.02	3	93	3.49	Average	27.1	34.766	54.0	-19.2	Pass
8722.79	3	266	1.83	Average	26.3	34.846	54.0	-19.1	Pass

Professional Testing, EMI, Inc.

Radiated Emissions, 3m Distance

1-10GHz Vertical Polarity Measured Emissions



EUT: EUT1: Sensor, EUT2: Bridge

Operator: Eric Lifsey

Mode: Transmit, center channel, continuous

Project Number: 19775

Current Time: 10:32:49 AM, Wednesday, February 28, 2018

Power: 2XAA 3V battery, 5.0 VDC external

Client: Austin Devices LLC

> 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):	2/28/2018	EUT Serial #:	None
Customer:	Austin Devices LLC	EUT Part #:	None
Project Number:	19775	Test Technician:	Eric Lifsey
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	Zilker Sensor & Bridge	Witness' Name:	None

Radiated Emissions Test Results Data Sheet

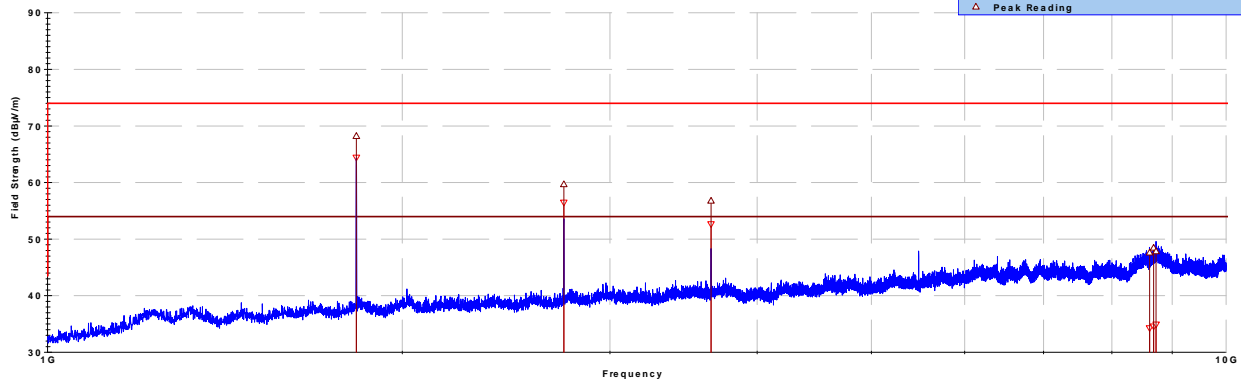
Page: 1 of 1

EUT Line Voltage:			3 & 5 VDC		EUT Power Frequency:		0 N/A		
Antenna Orientation:			Horizontal		Frequency Range:		Above 1GHz		
EUT Mode of Operation:					Transmit, Center Channel 914 MHz				
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
1828	3	327	3.47	Peak	77.8	68.197	74.0	-5.8	Pass
2742.04	3	91	2.3	Peak	67.4	59.663	74.0	-14.3	Pass
3655.92	3	60	1.94	Peak	63.5	56.767	74.0	-17.2	Pass
8611.38	3	272	1.36	Average	26.3	34.262	54.0	-19.7	Pass
8680.08	3	29	2.8	Average	26.3	34.579	54.0	-19.4	Pass
8722.31	3	85	3.58	Average	26.4	34.9	54.0	-19.1	Pass

Professional Testing, EMI, Inc.

Radiated Emissions, 3m Distance

1-10 GHz Horizontal Polarity Measured Emissions



Operator: Eric Lifsey

Mode: Transmit, center channel, continuous

EUT: EUT1: Sensor, EUT2: Bridge

Power: 2XAA 3V battery, 5.0 VDC external

Project Number: 19775

Current Time -10:32:49 AM, Wednesday, February 28, 2018

Client: Austin Devices LLC

> 1GHz Horizontal Antenna Polarity Measured Emissions

6.3.3 Transmit, Bottom Channel, up to 1 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):		2/28/2018		EUT Serial #:		None			
Customer:		Austin Devices LLC		EUT Part #:		None			
Project Number:		19775		Test Technician:		Eric Lifsey			
Purchase Order #:		0		Supervisor:		Lisa Arndt			
Equip. Under Test:		Zilker Sensor & Bridge		Witness' Name:		None			
Radiated Emissions Test Results Data Sheet								Page: 1 of 1	
EUT Line Voltage:		3 & 5 VDC		EUT Power Frequency:		0 N/A			
Antenna Orientation:		Vertical		Frequency Range:		30MHz to 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
873.339	10	29	1.56	Quasi-peak	21.453	24.817	35.6	-10.8	Pass
951.342	10	328	1.31	Quasi-peak	21.01	25.695	35.6	-9.9	Pass
<div style="display: flex; justify-content: space-between;"> <div> <p>Professional Testing, EMI, Inc Radiated Emissions, 10m Distance 30MHz - 1GHz Vertical Polarity Measured Emissions</p> </div> <div style="border: 1px solid blue; padding: 5px; font-size: small;"> <p>— Quasi-peak Limit</p> <p>— Ambient Scan</p> <p>— Pre-scan Emissions</p> <p>△ Quasi-peak Reading</p> <p>× LPRF Verification Limit</p> <p>▽ Verified Low-PRFQP Reading</p> </div> </div> <div style="display: flex; justify-content: space-between; font-size: x-small; margin-top: 10px;"> <div> <p>Operator: Eric Lifsey</p> <p>RE: 19775022818Run03Bottom Chan'S&B.til</p> <p>Current Time: 12:16:07 PM, Wednesday, February 28, 2018</p> </div> <div> <p>Mode: Transmit, bottom channel, continuous</p> <p>Power: 2XAA 3V battery, 5.0 VDC external</p> </div> <div> <p>EUT: EUT1: Sensor, EUT2: Bridge</p> <p>Project Number: 19775</p> <p>Client: Austin Devices LLC</p> </div> </div>									
≤ 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):	2/28/2018	EUT Serial #:	None
Customer:	Austin Devices LLC	EUT Part #:	None
Project Number:	19775	Test Technician:	Eric Lifsey
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	Zilker Sensor & Bridge	Witness' Name:	None

Radiated Emissions Test Results Data Sheet

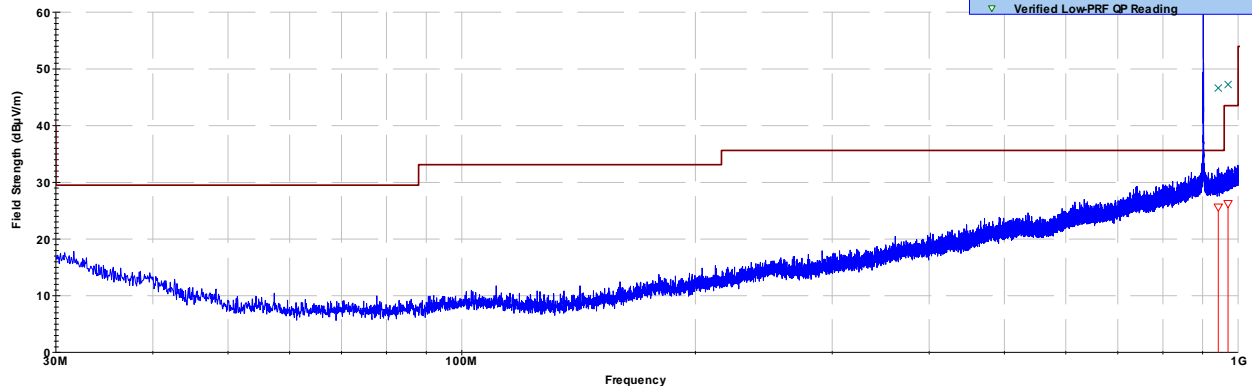
Page: 1 of 1

EUT Line Voltage:		3 & 5 VDC			EUT Power Frequency:		0 N/A		
Antenna Orientation:		Horizontal			Frequency Range:		30MHz to 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
942.983	10	203	3.69	Quasi-peak	21.141	25.618	35.6	-10.0	Pass
970.799	10	294	3.29	Quasi-peak	21.058	26.238	43.5	-17.3	Pass

Professional Testing, EMI, Inc.

Radiated Emissions, 10m Distance

30MHz - 1GHz Horizontal Polarity Measured Emissions



Operator: Eric Lifsey

RE: 19775'022818'Run03'BottomChan'S&B.ttl

Current Time -12:21:04 PM, Wednesday, February 28, 2018

Mode: Transmit, bottom channel, continuous

Power: 2XAA 3V battery, 5.0 VDC external

EUT: EUT1: Sensor, EUT2: Bridge

Project Number: 19775

Client: Austin Devices LLC

≤ 1GHz Horizontal Antenna Polarity Measured Emissions

6.3.4 Transmit, Bottom Channel, up to 10 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):	2/28/2018	EUT Serial #:	None
Customer:	Austin Devices LLC	EUT Part #:	None
Project Number:	19775	Test Technician:	Eric Lifsey
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	Zilker Sensor & Bridge	Witness' Name:	None

Radiated Emissions Test Results Data Sheet

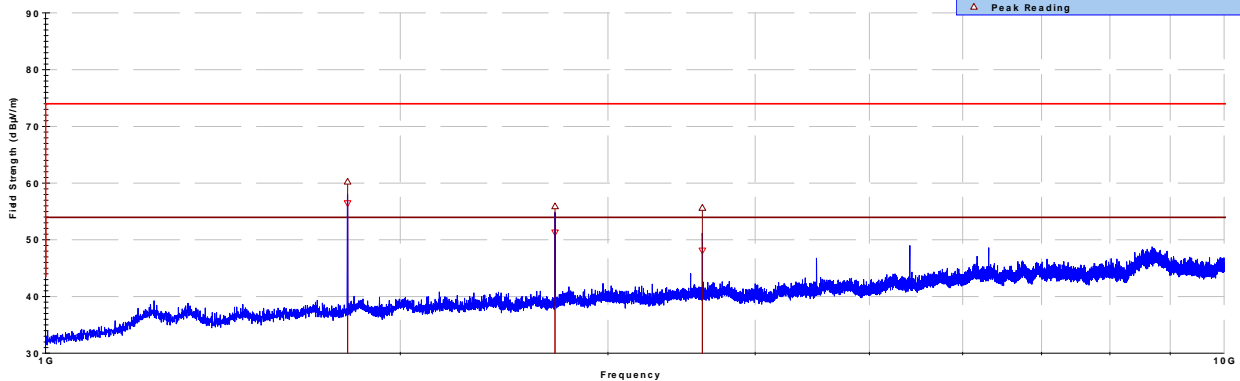
Page: 1 of 1

EUT Line Voltage:			3 & 5 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
1804.04	3	325	1.88	Peak	69.9	60.245	74.0	-13.7	Pass
2706.04	3	21	1.02	Peak	63.8	55.9	74.0	-18.1	Pass
3607.98	3	232	2.05	Peak	62.4	55.629	74.0	-18.3	Pass

Professional Testing, EMI, Inc

Radiated Emissions, 3m Distance

1-10GHz Vertical Polarity Measured Emissions



Operator: Eric Lifsey

Mode: Transmit, bottom channel, continuous

EUT: EUT1: Sensor, EUT2: Bridge

Current Time -12:58:49 PM, Wednesday, February 28, 2018

Power: 2XAA 3V battery, 5.0 VDC external

Project Number: 19775

Client: Austin Devices LLC

> 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):	2/28/2018	EUT Serial #:	None
Customer:	Austin Devices LLC	EUT Part #:	None
Project Number:	19775	Test Technician:	Eric Lifsey
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	Zilker Sensor & Bridge	Witness' Name:	None

Radiated Emissions Test Results Data Sheet

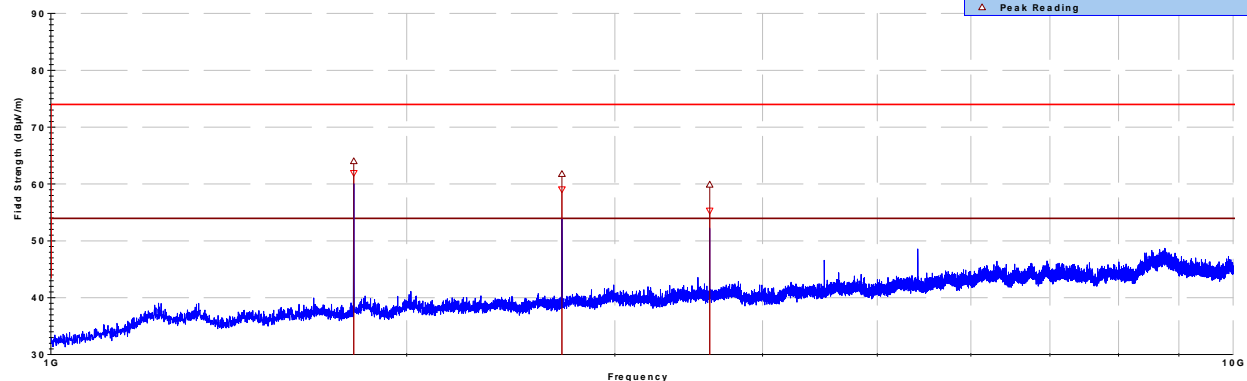
Page: 1 of 1

EUT Line Voltage:			3 & 5 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
1803.97	3	143	3.41	Peak	73.6	63.982	74.0	-10.0	Pass
2705.93	3	91	2.36	Peak	69.7	61.734	74.0	-12.2	Pass
3607.97	3	61	1.91	Peak	66.7	59.873	74.0	-14.1	Pass

Professional Testing, EMI, Inc

Radiated Emissions, 3m Distance

1-10GHz Horizontal Polarity Measured Emissions



Operator: Eric Lifsey

Mode: Transmit, bottom channel, continuous

EUT: EUT1: Sensor, EUT2: Bridge

Current Time -12:58:49 PM, Wednesday, February 28, 2018

Power: 2XAA 3V battery, 5.0 VDC external

Project Number: 19775

Client: Austin Devices LLC

> 1GHz Horizontal Antenna Polarity Measured Emissions

6.3.5 Transmit, Top Channel, up to 1 GHz

Professional Testing, EMI, Inc.

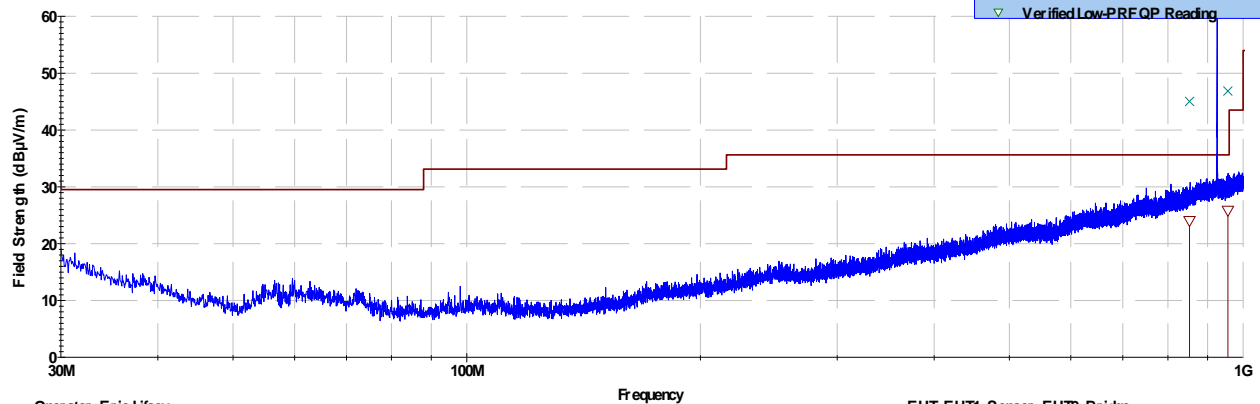
Test Method:	ANSI C63.10: 2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	2/28/2018	EUT Serial #:	None
Customer:	Austin Devices LLC	EUT Part #:	None
Project Number:	19775	Test Technician:	Eric Lifsey
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	Zilker Sensor & Bridge	Witness' Name:	None

Radiated Emissions Test Results Data Sheet

Page: 1 of 1

EUT Line Voltage:		3 & 5 VDC			EUT Power Frequency:		0 N/A		
Antenna Orientation:		Vertical			Frequency Range:		30MHz to 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
853.363	10	314	2.8	Quasi-peak	21.411	24.026	35.6	-11.6	Pass
956.055	10	195	2.19	Quasi-peak	21.027	25.832	35.6	-9.8	Pass

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



Operator : Eric Lifsey

RE:19775022818Run02TopChanS&B.til

Current Time -11:26:30 AM, Wednesday, February 28, 2018

Mode: Transmit, top channel, continuous

Power: 2XAA 3V battery, 5.0 VDC external

EUT: EUT1: Sensor, EUT2: Bridge

Project Number : 19775

Client: Austin Devices LLC

≤ 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):	2/28/2018	EUT Serial #:	None
Customer:	Austin Devices LLC	EUT Part #:	None
Project Number:	19775	Test Technician:	Eric Lifsey
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	Zilker Sensor & Bridge	Witness' Name:	None

Radiated Emissions Test Results Data Sheet

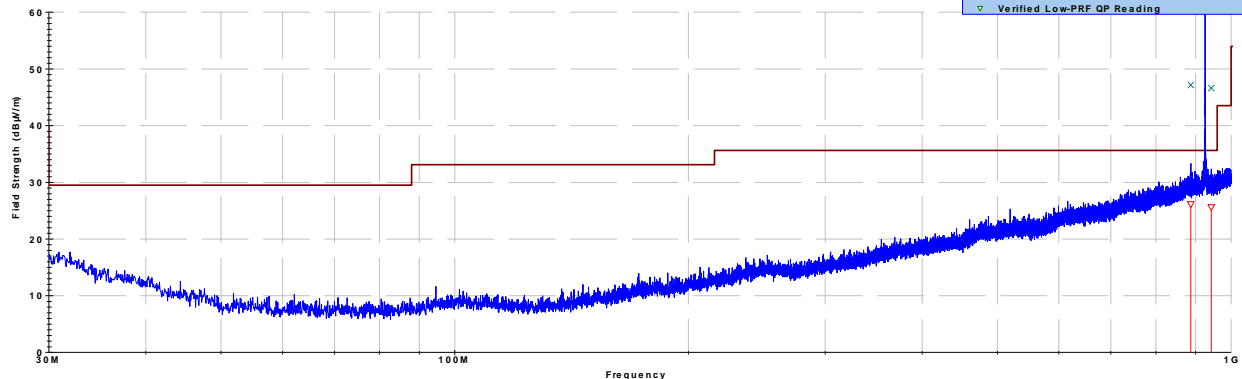
Page: 1 of 1

EUT Line Voltage:		3 & 5 VDC			EUT Power Frequency:		0 N/A		
Antenna Orientation:		Horizontal			Frequency Range:		30MHz to 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
887.561	10	16	1.2	Quasi-peak	22.625	26.15	35.6	-9.5	Pass
942.954	10	238	1.73	Quasi-peak	21.139	25.615	35.6	-10.0	Pass

Professional Testing, EMI, Inc.

Radiated Emissions, 10m Distance

30MHz - 1GHz Horizontal Polarity Measured Emissions



Operator: Eric Lifsey

RE: 19775-022818-Run02-TopChan-S&B.ttl

Current Time -11:29:35 AM, Wednesday, February 28, 2018

Mode: Transmit, top channel, continuous

Power: 2XAA 3V battery, 5.0 VDC external

EUT: EUT1: Sensor, EUT2: Bridge

Project Number: 19775

Client: Austin Devices LLC

≤ 1GHz Horizontal Antenna Polarity Measured Emissions

6.3.6 Transmit, Top Channel, up to 10 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):	2/28/2018	EUT Serial #:	None
Customer:	Austin Devices LLC	EUT Part #:	None
Project Number:	19775	Test Technician:	Eric Lifsey
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	Zilker Sensor & Bridge	Witness' Name:	None

Radiated Emissions Test Results Data Sheet

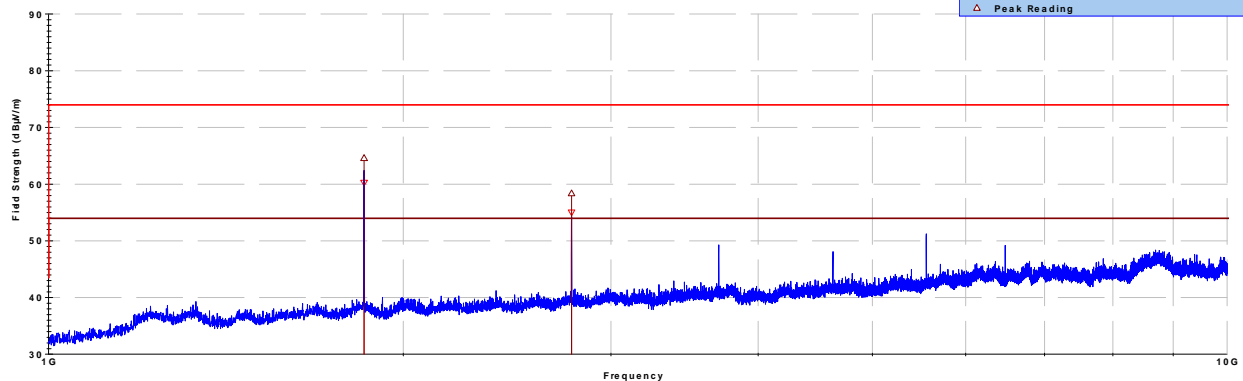
Page: 1 of 1

EUT Line Voltage:		3 & 5 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
1852.1	3	328	2.01	Peak	74.1	64.572	74.0	-9.4	Pass
2778.07	3	25	2.44	Peak	66	58.354	74.0	-15.6	Pass

Professional Testing, EMI, Inc.

Radiated Emissions, 3m Distance

1-10GHz Vertical Polarity Measured Emissions



EUT: EUT1: Sensor, EUT2: Bridge

Operator: Eric Lifsey

Mode: Transmit, top channel, continuous

Project Number: 19775

Current Time -11:51:24 AM, Wednesday, February 28, 2018

Power: 2XAA 3V battery, 5.0 VDC external

Client: Austin Devices LLC

> 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):	2/28/2018	EUT Serial #:	None
Customer:	Austin Devices LLC	EUT Part #:	None
Project Number:	19775	Test Technician:	Eric Lifsey
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	Zilker Sensor & Bridge	Witness' Name:	None

Radiated Emissions Test Results Data Sheet

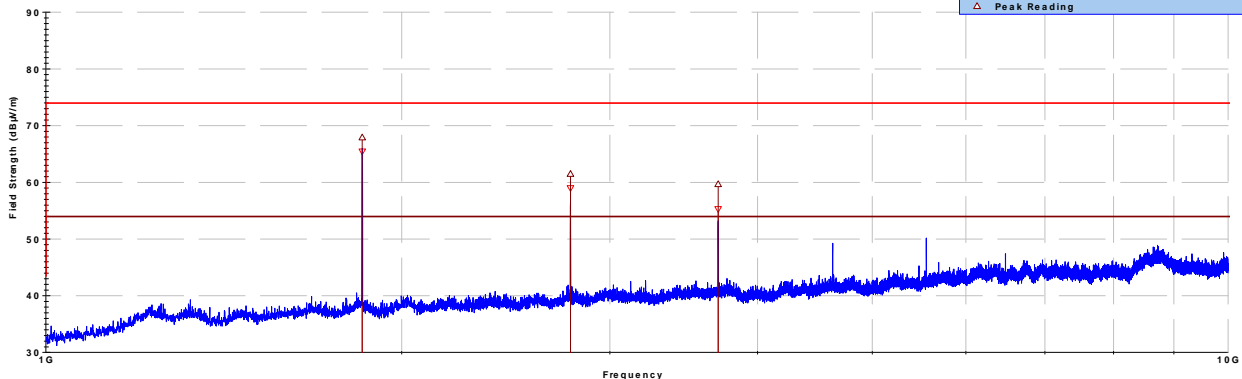
Page: 1 of 1

EUT Line Voltage:		3 & 5 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
887.561	3	16	1.2	Peak	26.236	29.761	46.1	-16.3	Pass
942.954	3	238	1.73	Peak	25.296	29.772	46.1	-16.3	Pass

Professional Testing, EMI, Inc.

Radiated Emissions, 3m Distance

1-10 GHz Horizontal Polarity Measured Emissions



Operator: Eric Lifsey

Mode: Transmit, top channel, continuous

EUT: EUT1: Sensor, EUT2: Bridge

Current Time: 11:51:24 AM, Wednesday, February 28, 2018

Power: 2XAA 3V battery, 5.0 VDC external

Project Number: 19775

Client: Austin Devices LLC

> 1GHz Horizontal Antenna Polarity Measured Emissions

6.3.7 Receive, Middle Channel, 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):		2/28/2018		EUT Serial #:		None			
Customer:		Austin Devices LLC		EUT Part #:		None			
Project Number:		19775		Test Technician:		Eric Lifsey			
Purchase Order #:		0		Supervisor:		Lisa Arndt			
Equip. Under Test:		Zilker Sensor & Bridge		Witness' Name:		None			
Radiated Emissions Test Results Data Sheet								Page: 1 of 1	
EUT Line Voltage:		3 & 5 VDC		EUT Power Frequency:		0 N/A			
Antenna Orientation:		Vertical		Frequency Range:		30MHz to 1GHz			
EUT Mode of Operation:				Receive Mode, 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
30.035	10	153	2.96	Quasi-peak	26.146	15.096	29.5	-14.4	Pass
55.745	10	115	1.48	Quasi-peak	25.756	6.345	29.5	-23.2	Pass
60.053	10	36	2.74	Quasi-peak	29.213	9.402	29.5	-20.1	Pass
73.084	10	14	1.56	Quasi-peak	26.571	6.812	29.5	-22.7	Pass
874.64	10	104	3.56	Quasi-peak	21.368	24.785	35.6	-10.8	Pass
952.184	10	213	3.78	Quasi-peak	20.968	25.674	35.6	-9.9	Pass

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

Operator: Eric Lifsey
RE'19775'022818'Run04'RXMode'S&B.ttl
Current Time -01:37:21 PM, Wednesday, February 28, 2018

Mode: Receive, middle channel
Power: 2XAA 3V battery, 5.0 VDC external

— Quasi-peak Limit
— Ambient Scan
— Pre-scan Emissions
△ Quasi-peak Reading
x LPRF Verification Limit
▽ Verified Low-PRFQP Reading

EUT: EUT1: Sensor, EUT2: Bridge
Project Number: 19775
Client: Austin Devices LLC

≤ 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):	2/28/2018	EUT Serial #:	None
Customer:	Austin Devices LLC	EUT Part #:	None
Project Number:	19775	Test Technician:	Eric Lifsey
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	Zilker Sensor & Bridge	Witness' Name:	None

Radiated Emissions Test Results Data Sheet

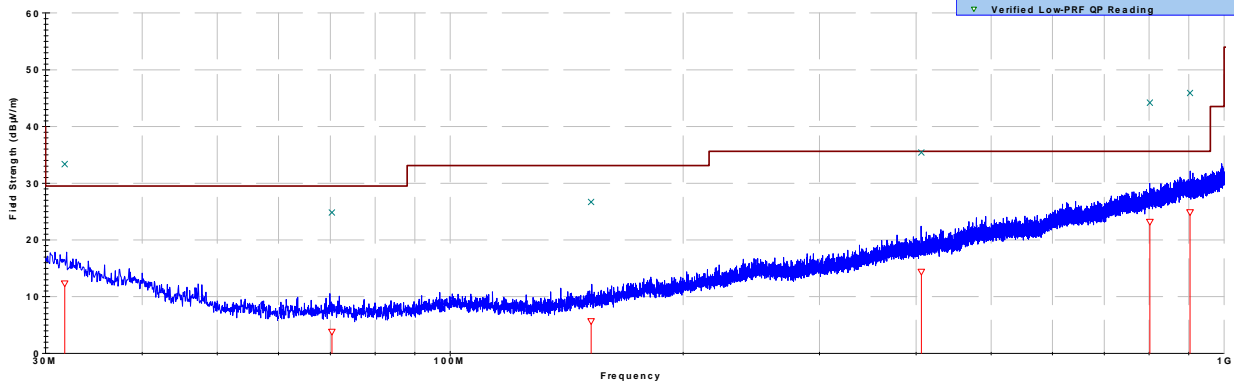
Page: 1 of 1

EUT Line Voltage:		3 & 5 VDC			EUT Power Frequency:		0 N/A		
Antenna Orientation:		Horizontal			Frequency Range:		30MHz to 1GHz		
EUT Mode of Operation:					Receive Mode, 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
31.754	10	104	3.33	Quasi-peak	24.135	12.349	29.5	-17.2	Pass
70.326	10	104	2.61	Quasi-peak	23.525	3.825	29.5	-25.7	Pass
152.052	10	117	3.9	Quasi-peak	23.016	5.676	33.1	-27.4	Pass
406.24	10	290	3.13	Quasi-peak	22.195	14.403	35.6	-21.2	Pass
801.718	10	288	3.18	Quasi-peak	21.391	23.195	35.6	-12.4	Pass
903.79	10	68	2.71	Quasi-peak	21.243	24.9	35.6	-10.7	Pass

Professional Testing, EMI, Inc.

Radiated Emissions, 10m Distance

30 MHz - 1 GHz Horizontal Polarity Measured Emissions



Operator: Eric Lifsey

RE:19775'022818'Run04'RXM04'S&B.ttl

Current Time -01:48:22 PM, Wednesday, February 28, 2018

Mode: Receive, middle channel

Power: 2XAA 3V battery, 5.0 VDC external

EUT: EUT1: Sensor, EUT2: Bridge

Project Number: 19775

Client: Austin Devices LLC

≤ 1GHz Horizontal Antenna Polarity Measured Emissions

6.3.8 Receive, Middle Channel, 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):		2/28/2018			EUT Serial #:		None		
Customer:		Austin Devices LLC			EUT Part #:		None		
Project Number:		19775			Test Technician:		Eric Lifsey		
Purchase Order #:		0			Supervisor:		Lisa Arndt		
Equip. Under Test:		Zilker Sensor & Bridge			Witness' Name:		None		
Radiated Emissions Test Results Data Sheet								Page: 1 of 1	
EUT Line Voltage:		3 & 5 VDC			EUT Power Frequency:		0 N/A		
Antenna Orientation:		Vertical			Frequency Range:		Above 1GHz		
EUT Mode of Operation:					Receive Mode, 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
1325.7	3	82	3.86	Peak	50.8	38.95	74.0	-35.0	Pass
1919.42	3	135	2.22	Peak	54.5	45.212	74.0	-28.7	Pass
3216.24	3	83	2.3	Peak	52.9	45.361	74.0	-28.6	Pass
<div style="display: flex; justify-content: space-between;"> <div style="width: 60%;"> <p>Professional Testing, EMI, Inc. Radiated Emissions, 3m Distance 1-5GHz Vertical Polarity Measured Emissions</p> <p style="text-align: center;">Frequency</p> </div> <div style="width: 35%; border: 1px solid black; padding: 5px;"> <p>— Average Limit △ Average Reading — Peak Limit — Pre-scan Emissions △ Peak Reading</p> </div> </div> <div style="display: flex; justify-content: space-between; margin-top: 10px;"> <div style="width: 30%;"> <p>Operator: Eric Lifsey Current Time -02:23:30 PM, Wednesday, February 28, 2018</p> </div> <div style="width: 40%; text-align: center;"> <p>Mode: Receive, middle channel Power: 2XAA 3V battery, 5.0 VDC external</p> </div> <div style="width: 30%; text-align: right;"> <p>EUT: EUT1: Sensor, EUT2: Bridge Project Number: 19775 Client: Austin Devices LLC</p> </div> </div>									
> 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):	2/28/2018	EUT Serial #:	None
Customer:	Austin Devices LLC	EUT Part #:	None
Project Number:	19775	Test Technician:	Eric Lifsey
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	Zilker Sensor & Bridge	Witness' Name:	None

Radiated Emissions Test Results Data Sheet

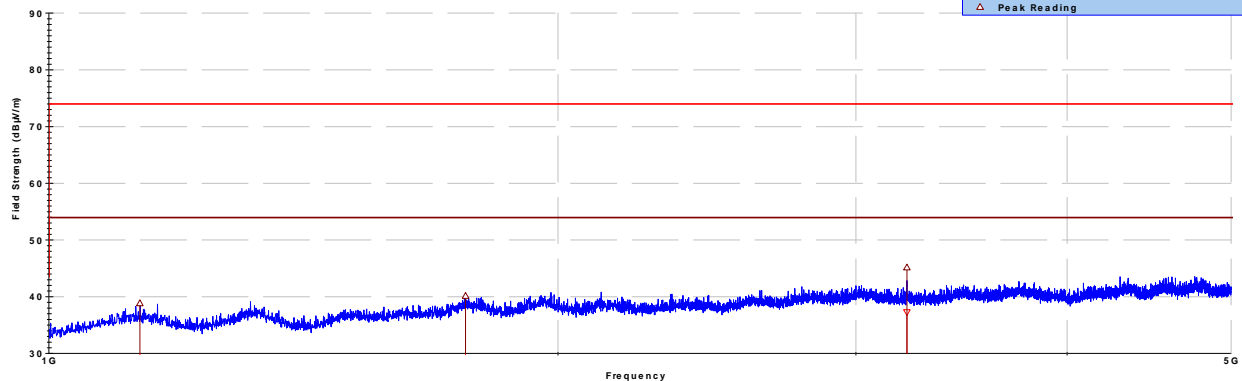
Page: 1 of 1

EUT Line Voltage: 3 & 5 VDC					EUT Power Frequency: 0 N/A				
Antenna Orientation: Horizontal					Frequency Range:		Above 1GHz		
EUT Mode of Operation:					Receive Mode, 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
1131.79	3	63	3.83	Peak	51.3	38.831	74.0	-35.1	Pass
1763.41	3	105	1.44	Peak	49.9	40.144	74.0	-33.8	Pass
3215.97	3	109	2.82	Peak	52.7	45.144	74.0	-28.8	Pass

Professional Testing, EMI, Inc

Radiated Emissions, 3m Distance

1-5GHz Horizontal Polarity Measured Emissions



Operator: Eric Lifsey

Mode: Receive, middle channel

EUT: EUT1: Sensor, EUT2: Bridge

Current Time -02:23:30 PM, Wednesday, February 28, 2018

Power: 2XAA 3V battery, 5.0 VDC external

Project Number: 19775

Client: Austin Devices LLC

> 1GHz Horizontal Antenna Polarity Measured Emissions

7.0 Mains Conducted Emission

7.1 Procedure

The EUT was placed on a non-conductive table 0.8 meters above the floor and 0.4 meters from the conductive reference plane (wall). The EUT is powered through a line impedance stabilization network (LISN) that provides a measurement tap and a termination approximating 50 Ohms in the measurement range of 150 kHz to 30 MHz. A spectrum analyzer is connected, in turn, to each mains line measurement tap and software is employed to measure the radio frequency noise generated by the EUT.

7.2 Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.207 // RSS-Gen 8.3	Mains Conducted Emission	Not Applicable

7.3 Results

This device exclusively uses AA style batteries for power and does not have a means to be powered by other means. This test does not apply.

8.0 Antenna Construction Requirements

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.

8.2 Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.203 // RSS-Gen 8.3	Antenna Construction	1 Mar 2018

8.3 Results

Table 8.3.1 Antenna Construction Details
Manufacturer: Austin Devices LLC
<ul style="list-style-type: none"> • Antenna is a soldered-in chip combined with an etched circuit antenna. • The antenna is entirely housed within the manufactured enclosure. • The temporary U.F.L connector used for conducted antenna port measurements is not present in the finished product. • Peak antenna gain is -0.1 dBi.

The antenna design satisfies the requirements.

9.0 Equipment

9.1 Radiated Emissions 30 MHz to 10 GHz

Radiated Emissions Test Equipment List					
Tile! Software Version:		4.2.A, May 23, 2010, 08:38:52 AM			
Test Profile:		2016 RE_ClassA - Boresite+Mast_LowPRF_030617.til or 2016 RE_ClassB - Boresite+Mast_LowPRF_030617.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	Spectrum Analyzer, 3 Hz - 26.5 GHz, Opt. AYZ	MY44808298	11/7/2018
1926	ETS-Lindgren	3142D	Antenna, Biconilog, 26 MHz - 6 GHz	135454	3/7/2019
C027D	PTI	None	Relay	none	N/A
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, 30 MHz - 18GHz	none	9/28/2018
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
846	SMT	41241	Filter, High Pass, 1.5 GHz	101	4/6/2018

Note – asset 846 removed for receive mode emissions.

9.2 Power, Power Spectral Density, Band Edge, and Bandwidth

Asset #	Manufacturer	Model #	Description	Calibration Due
2295	Agilent	E4440A	Spectrum Analyzer	19 Dec 2018

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.				

Conducted Emissions Spectrum Analyzer Bandwidth and Measurement Time				
Frequency Band Start (MHz)	Frequency Band Stop (MHz)	6 dB Bandwidth (kHz)	Number of Ranges Used	Measurement Time per Range
0.01	0.15	0.3	7	Five 1 second sweeps
0.15	30	9	20	Five 1 second sweeps
*Notes: 1. The settings above are specifically calculated for the HP856X series of spectrum analyzers, which have 1,000 data points per range. 2. The measurement receiver resolution bandwidth setting was 300 Hz for quasi-peak measurements from 10-150 kHz. 3. The measurement receiver resolution bandwidth setting was 9 kHz for quasi-peak measurements from 0.15-30 MHz.				

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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