
Project 19044-15

**Vendwatch
T313**

Wireless Certification Report

Prepared for:

Alfonso Barragan
Vendwatch
111 W. Anderson Lane, Suite E360
Austin, TX 78753

By

Professional Testing (EMI), Inc.
1601 North A.W. Grimes Blvd., Suite B
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12 Jul 2017

Reviewed by

A handwritten signature in black ink, appearing to read 'Larry Finn'.

Larry Finn
Chief Technical Officer

Written by

A handwritten signature in black ink, appearing to read 'Eric Lifsey'.

Eric Lifsey
EMC Engineer

Revision History

Revision Number	Description	Date
02	Draft for review.	7 Jul 2017
01	Final.	12 Jul 2017

DRAFT NOTES

Need dimensions.

Corrections:

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Compliance Certificate

Applicant	Device & Test Identification
Vendwatch 111 W. Anderson Lane, Suite E360 Austin, TX 78753 Certificate Date: 12 Jul 2017	FCC ID: 2ALVO-T313 Industry Canada ID: N/A Model(s): T313 Laboratory Project ID: 19044-15

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

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

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

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

Eric Lifsey
EMC Engineer

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

Representative of Applicant

1.0 Introduction

1.1 Scope

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

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

1.2 EUT Description

Table 1.2.1: Equipment Under Test		
Manufacturer / Model	Serial #	Description
Vendwatch Model: T313	none	2400-2483.5 MHz FHSS transceiver; using Bluetooth Low Energy radio protocols.

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

The EUT provides remote control and monitoring of vending machines.

The EUT electronics are on a single circuit board which measures approximately 10 cm x 10 cm x 1.6 cm. It is provided inside a plastic RF-transparent enclosure. The EUT is field-installed into vending machines. It includes a pre-certified cellular modem radio module for remote communications. The radio section that is the subject of this report is for local short-range access by service technicians.

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 also be hopping per the Bluetooth Low Energy 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 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

2.0 Fundamental Power

2.1 Test Procedure

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

2.2 Test Criteria

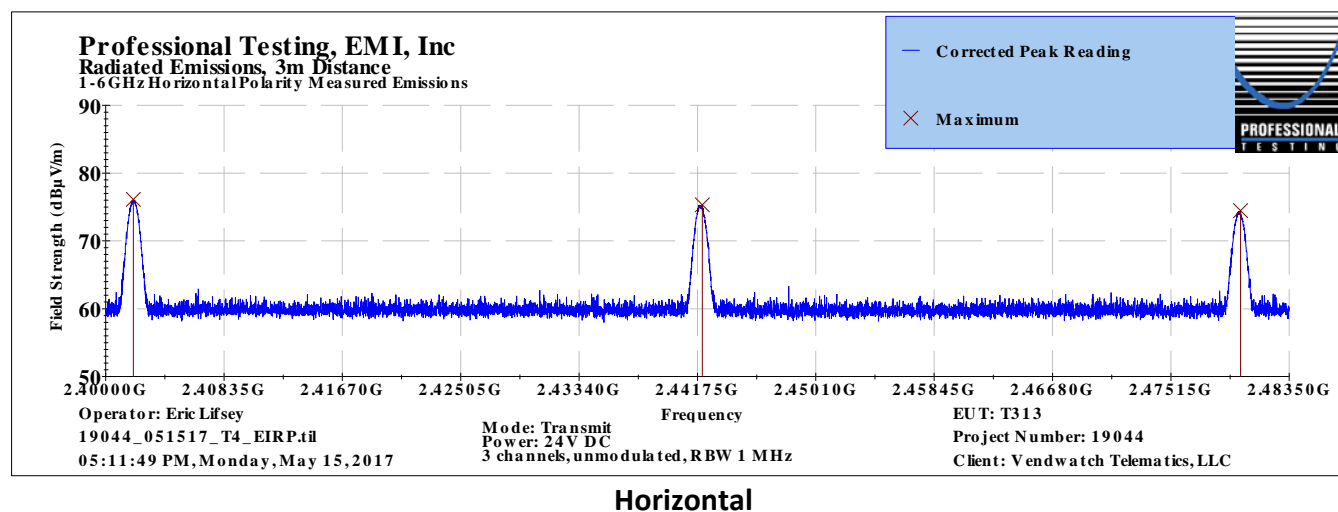
47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date
15.247(a)(3) // RSS-247 5.2	Fundamental Power Conducted Limits 1 W Limit Restated as Field: 125.23 dB μ V/m @ 3 m	15 May 2017

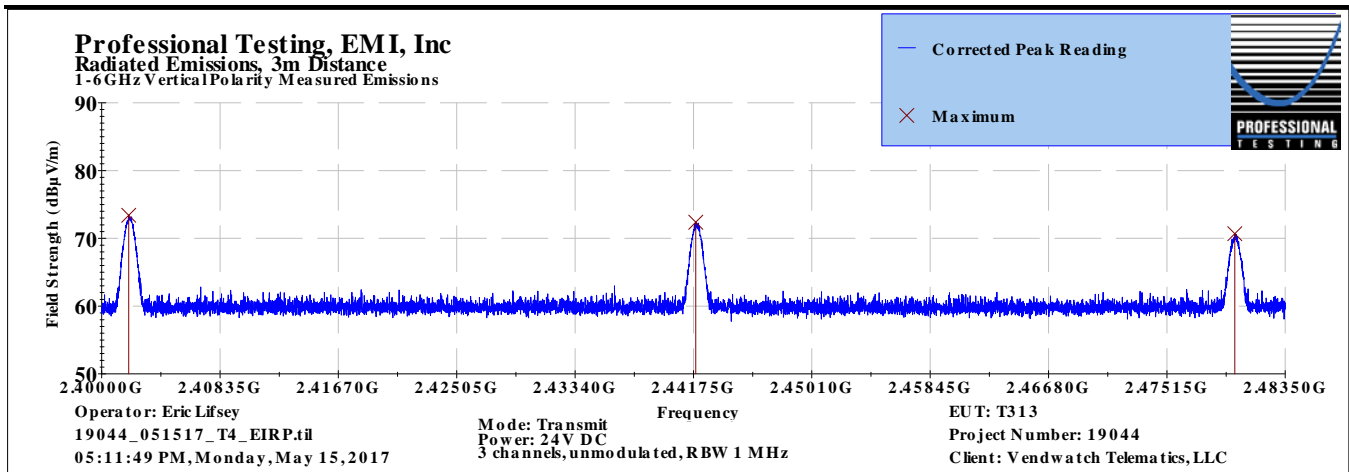
2.3 Test Results, Peak Power

Table 2.3.1 Power, Peak, Radiated				
Frequency MHz	Measured Peak Power dB μ V/m @ 3 m Horizontal Polarity	Measured Peak Power dB μ V/m @ 3 m Vertical Polarity	Maximum Measured Peak Power Restated as EIRP dBm	Maximum Measured Peak Power Restated as EIRP μ W
2402	76.1	73.4	-19.3	11.8
2440	75.3	72.4	-19.9	10.2
2480	74.5	70.7	-20.7	8.5

Measured in 1 MHz RBW, 3 MHz VBW.

The EUT was satisfied the requirements.





Vertical

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.

Due to the very low power used this measurement was not required.

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	16 May 2017

4.3 Test Results

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

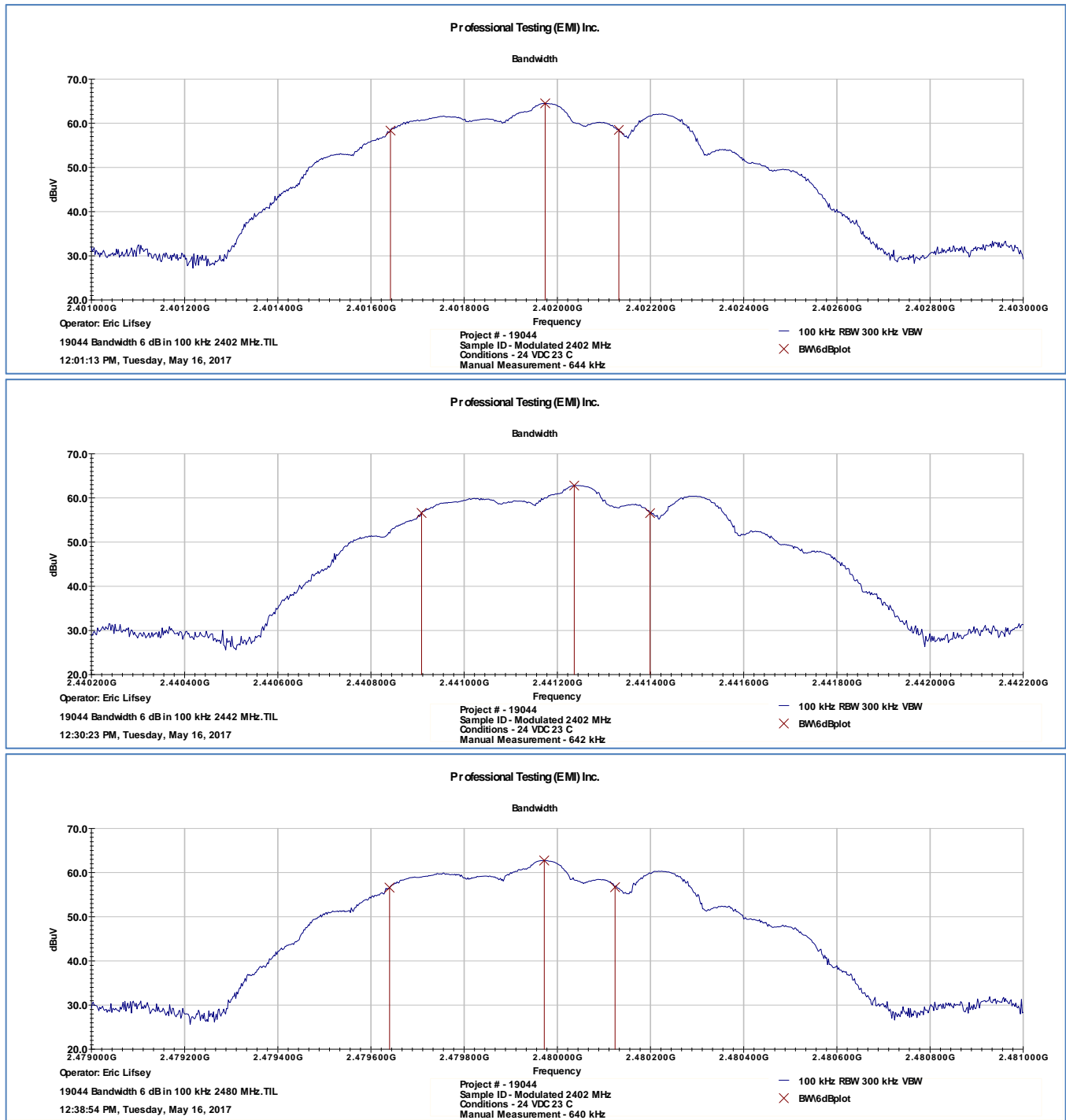
The EUT was found to be in compliance with applicable requirements.

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)
644	642	640	640

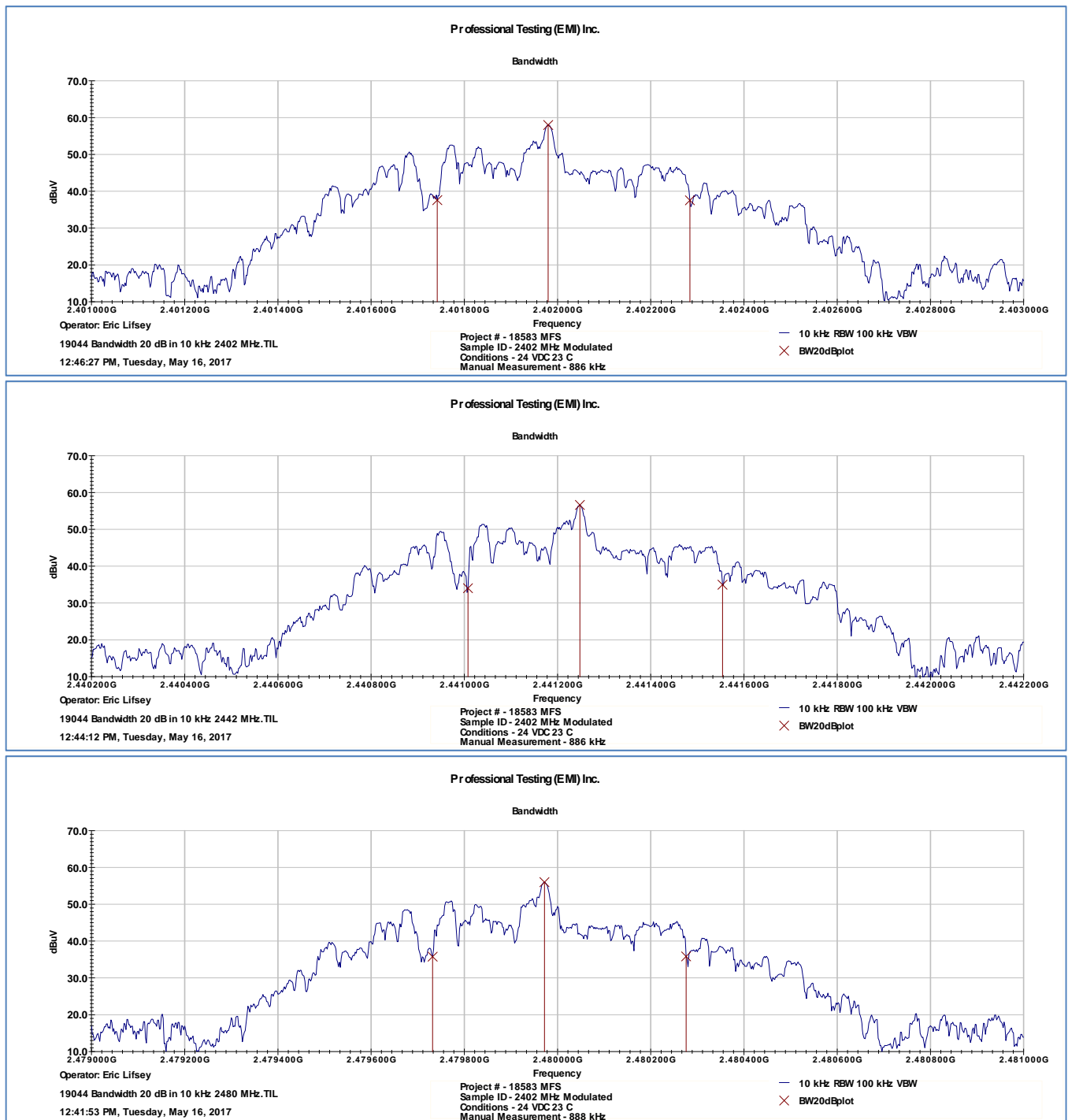
Table 5.3.2 Bandwidth 20 dB, Measure and Report			
Low Channel Measured BW (kHz)	Mid Channel Measured BW (kHz)	High Channel Measured BW (kHz)	Reported Maximum BW (kHz)
886	886	888	888

Plotted measurements appear on the following pages.

4.3.1 Bandwidth Plots, 6 dB



4.3.2 Bandwidth Plots, 20 dB



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	16 May 2017

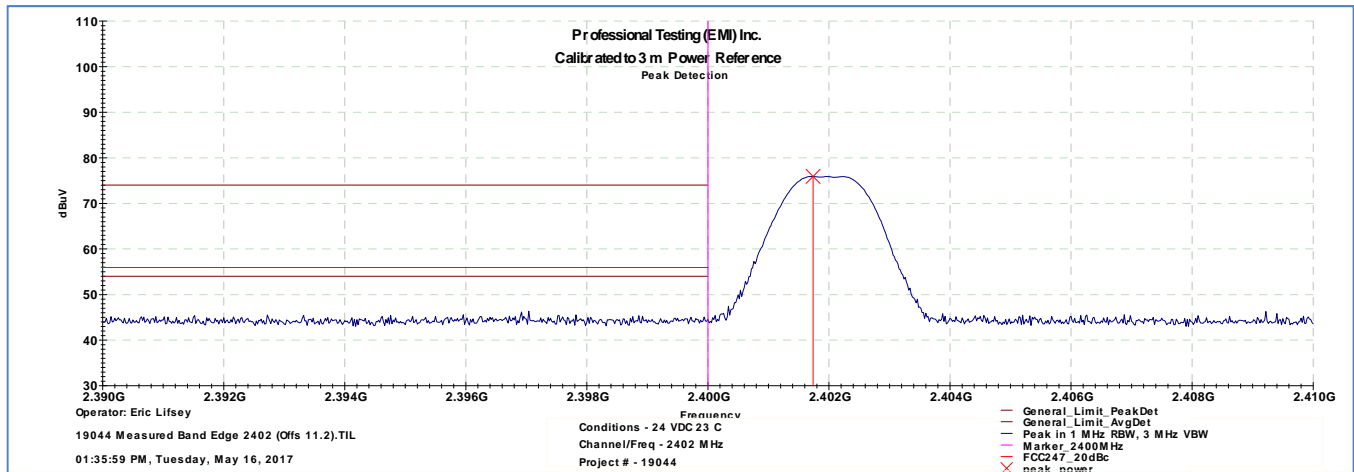
5.3 Test Results

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 relative measurement referenced and calibrated to the maximum power.

Applicable Duty Cycle Factor for Averaging Peak Emissions: 0.0 dB

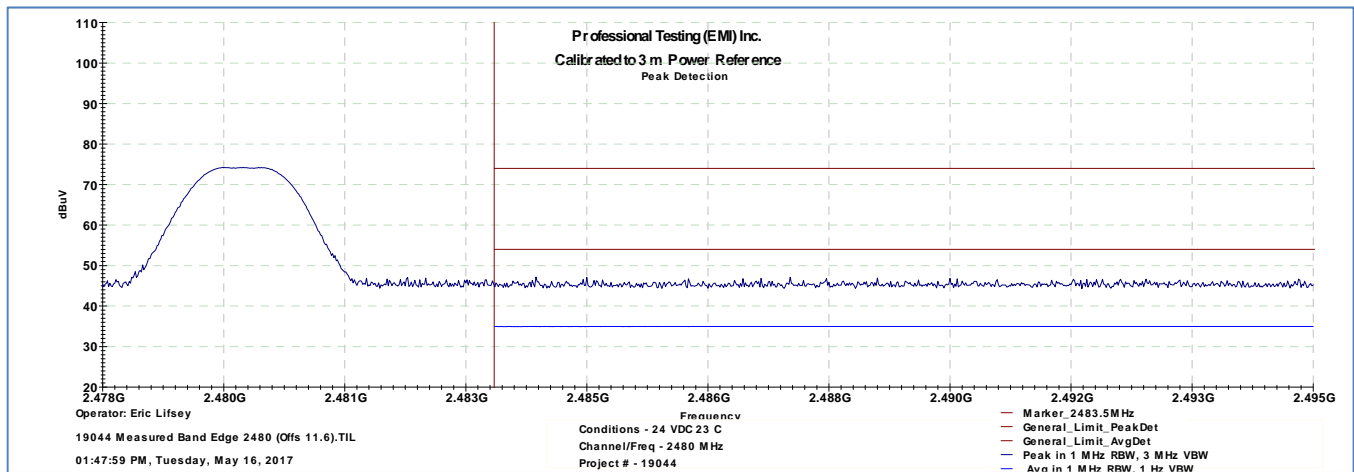
The EUT satisfied the criteria. Plotted results appear on the following pages.

5.3.1 Low Channel Band Edge



Peak detection in 100 kHz RBW is employed and the DTS limit -20dBc is shown.0

5.3.2 High Channel Band Edge



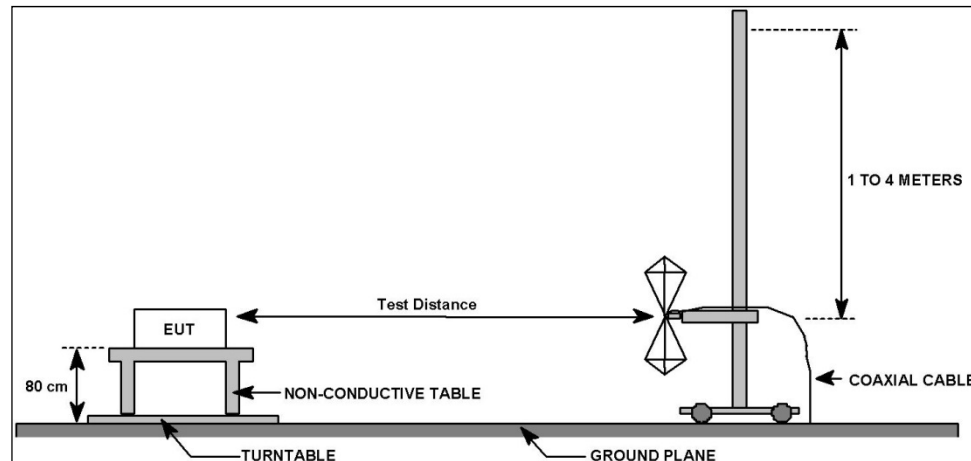
Peak detection and video average is employed in 1 MHz RBW.
The general emission limits for average and peak levels are shown.
The applicable duty cycle factor is 0.0 dB.

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	15 May 2017

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.

6.3.1 Up to 1 GHz

Professional Testing, EMI, Inc.

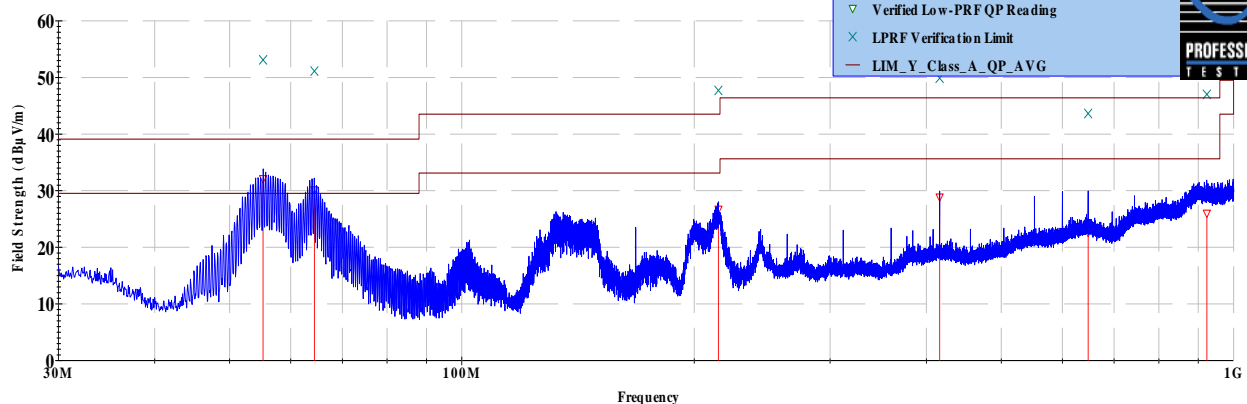
Test Method:	ANSI C63.4: 2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	5/15/2017	EUT Serial #:	None
Customer:	Vendwatch Telematics, LLC	EUT Part #:	None
Project Number:	19044	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	T313	Witness' Name:	Bryan Olinger

Radiated Emissions Test Results Data Sheet

Page: 1 of 1

EUT Line Voltage:			24 VDC		EUT Power Frequency:		0 N/A		
Antenna Orientation:			Vertical		Frequency Range:		30MHz to 1GHz		
EUT Mode of Operation:					Receive				
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
55.2734	10	72	2.45	Quasi-peak	49.8	32.105	39.1	-7.0	Pass
64.3999	10	136	2.26	Quasi-peak	51.1	30.127	39.1	-9.0	Pass
214.999	10	81	1.57	Quasi-peak	41.1	26.709	43.5	-16.8	Pass
415.98	10	290	3.66	Quasi-peak	35.5	28.85	46.4	-17.6	Pass
647.956	10	231	2.3	Quasi-peak	24.4	22.629	46.4	-23.8	Pass
923.216	10	36	3.99	Quasi-peak	21.2	26.001	46.4	-20.4	Pass

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



≤ 1GHz Vertical Antenna Polarity Measured Emissions

Professional Testing, EMI, Inc.

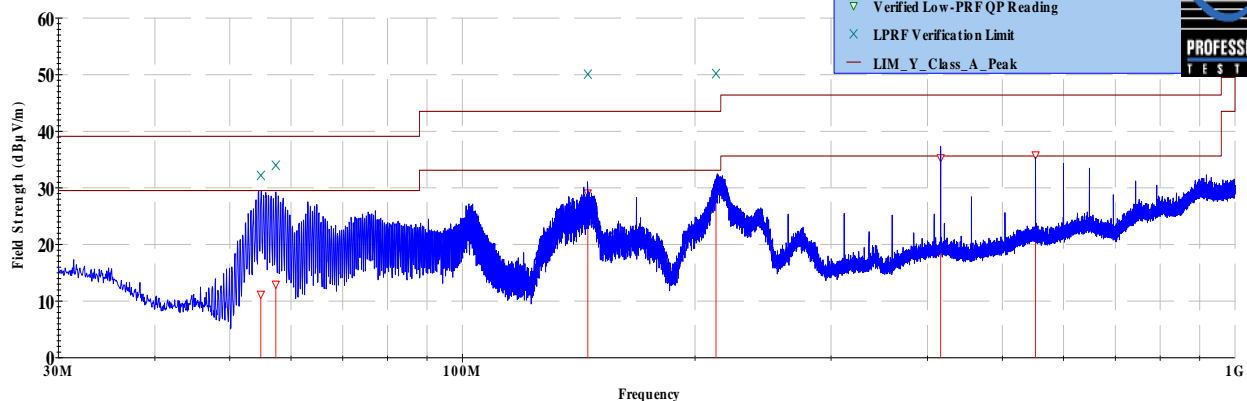
Test Method:	ANSI C63.4: 2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	5/15/2017	EUT Serial #:	None
Customer:	Vendwatch Telematics, LLC	EUT Part #:	None
Project Number:	19044	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	T313	Witness' Name:	Bryan Olinger

Radiated Emissions Test Results Data Sheet

Page: 1 of 1

EUT Line Voltage:		24 VDC			EUT Power Frequency:		0 N/A		
Antenna Orientation:		Horizontal			Frequency Range:		30MHz to 1GHz		
EUT Mode of Operation:									
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
54.8542	10	344	1.1	Quasi-peak	29	11.19	39.1	-27.9	Pass
57.3351	10	335	1.48	Quasi-peak	30.9	12.969	39.1	-26.1	Pass
145.327	10	159	3.31	Quasi-peak	45.9	29.085	43.5	-14.4	Pass
212.903	10	93	3.45	Quasi-peak	43.6	29.188	43.5	-14.3	Pass
416.012	10	40	1.35	Quasi-peak	42	35.298	46.4	-11.1	Pass
551.997	10	108	1.26	Quasi-peak	39.6	35.8	46.4	-10.6	Pass

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



Operator: Eric Lifsey

19044\051417\RET4\Run07\RXmode\DCSupply\Telit Enabled\Class A\24VDC\Z11
03:34:18 PM, Monday, May 15, 2017
Telit module enabled.

EUT: T313

Project Number: 19044

Client: Vendwatch Telematics, LLC

≤ 1GHz Horizontal Antenna Polarity Measured Emissions

6.3.2 Up to 13 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):	5/15/2017				EUT Serial #:	None			
Customer:	Vendwatch Telematics, LLC				EUT Part #:	None			
Project Number:	19044				Test Technician:	Eric Lifsey			
Purchase Order #:	NA				Supervisor:	Lisa Arndt			
Equip. Under Test:	T313				Witness' Name:	Bryan Olinger			
Radiated Emissions Test Results Data Sheet						Page: 1 of 1			
EUT Line Voltage:		24 VDC			EUT Power Frequency:		0 N/A		
Antenna Orientation:		Vertical			Frequency Range:		Above 1GHz		
EUT Mode of Operation:					Receive				
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
1080.09	3	144	1.3	Average	46.5	33.535	54.0	-20.4	Pass
1512.03	3	63	1.22	Average	49.8	37.775	54.0	-16.2	Pass
1655.75	3	287	1.26	Average	46.9	36.1	54.0	-17.9	Pass
8799.47	3	194	2.62	Average	26.9	34.308	54.0	-19.6	Pass
11589.4	3	198	3.42	Average	27.3	37.96	54.0	-16.0	Pass
11947.7	3	31	1.34	Average	27.5	37.766	54.0	-16.2	Pass
<div style="display: flex; justify-content: space-between;"> <div style="width: 60%;"> <p>Professional Testing, EMI, Inc Radiated Emissions, 3m Distance 1-18GHz Vertical Polarity Measured Emissions</p> <p>Operator: Eric Lifsey 19044\051417\RET4\Run06A\RXmode\DCSupply\Telit Enabled\Power: 24VDC 01:59:04 PM, Monday, May 15, 2017</p> </div> <div style="width: 35%; text-align: right;"> <p>EUT: T313 Project Number: 19044 Client: Vendwatch Telematics, 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):	5/15/2017	EUT Serial #:	None
Customer:	Vendwatch Telematics, LLC	EUT Part #:	None
Project Number:	19044	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	T313	Witness' Name:	Bryan Olinger

Radiated Emissions Test Results Data Sheet

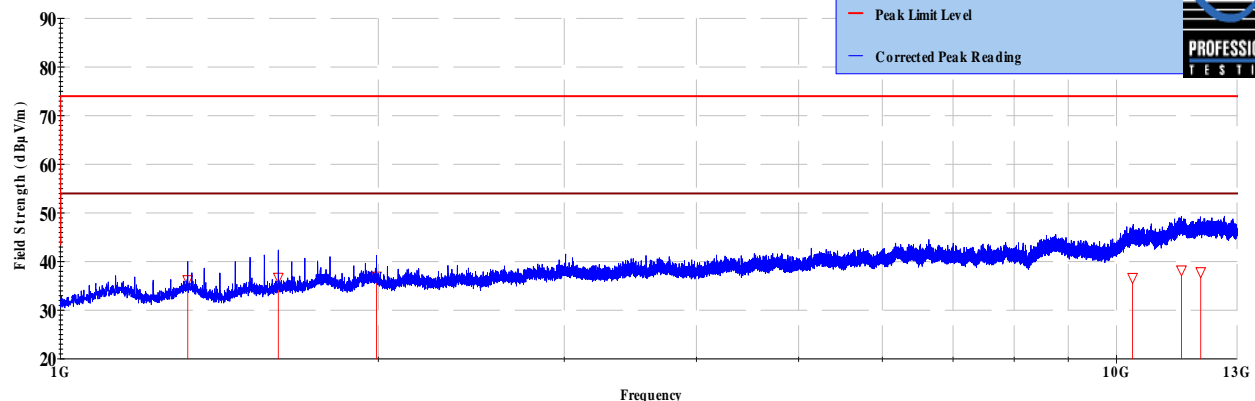
Page: 1 of 1

EUT Line Voltage:		24 VDC			EUT Power Frequency:		0 N/A		
Antenna Orientation:		Horizontal			Frequency Range:		Above 1GHz		
EUT Mode of Operation:					Receive				
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
1319.91	3	170	3.22	Average	48.1	36.196	54.0	-17.8	Pass
1608.13	3	52	1.08	Average	47.9	36.709	54.0	-17.2	Pass
1991.96	3	61	1.82	Average	46.2	36.937	54.0	-17.0	Pass
10356.1	3	264	3.24	Average	26.7	36.664	54.0	-17.3	Pass
11518.5	3	172	3.04	Average	27.3	38.245	54.0	-15.7	Pass
12013.5	3	338	1.18	Average	27.4	37.863	54.0	-16.1	Pass

Professional Testing, EMI, Inc

Radiated Emissions, 3m Distance

1-18GHz Horizontal Polarity Measured Emissions



Operator: Eric Lifsey

19044 051417 RET4 Run06A RXmodeDCSupply Telit Enabled Pass 1-18GHz TA All
01:59:04 PM, Monday, May 15, 2017
Telit module enabled.

EUT: T313

Project Number: 19044

Client: Vendwatch Telematics, LLC

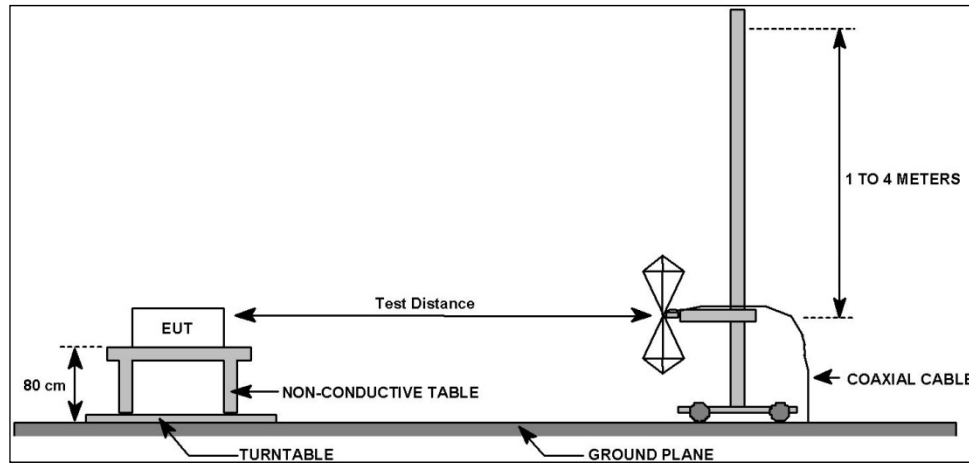
> 1GHz Horizontal Antenna Polarity Measured Emissions

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	

7.3 Test Results

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

The duty cycle averaging factor applies -0.0 dB to the peaks recorded for the harmonics.

7.3.1 Up to 1 GHz (Unintentional emissions to Class A.)

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):	5/15/2017	EUT Serial #:	None
Customer:	Vendwatch Telematics, LLC	EUT Part #:	None
Project Number:	19044	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	T313	Witness' Name:	Bryan Olinger
Radiated Emissions Test Results Data Sheet		Page:	1 of 1
EUT Line Voltage:	24 VDC	EUT Power Frequency:	0 N/A
Antenna Orientation:	Vertical	Frequency Range:	30MHz to 1GHz
EUT Mode of Operation:		Transmit, 3 Channels	
<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> <p>Field Strength (dBuV/m)</p> <p>Frequency</p> </div> <div style="width: 35%;"> <p>Operator: Eric Lifsey 19044\051617\RET4\Run09\TXmode\ClkA.tif 04:26:04 PM, Monday, May 15, 2017</p> <p>Mode: Transmit Power: 24VDC Telit module enabled.</p> <p>EUT: T313 Project Number: 19044 Client: Vendwatch Telematics, LLC</p> </div> </div>			
≤ 1GHz Vertical Antenna Polarity Measured Emissions			

Professional Testing, EMI, Inc.

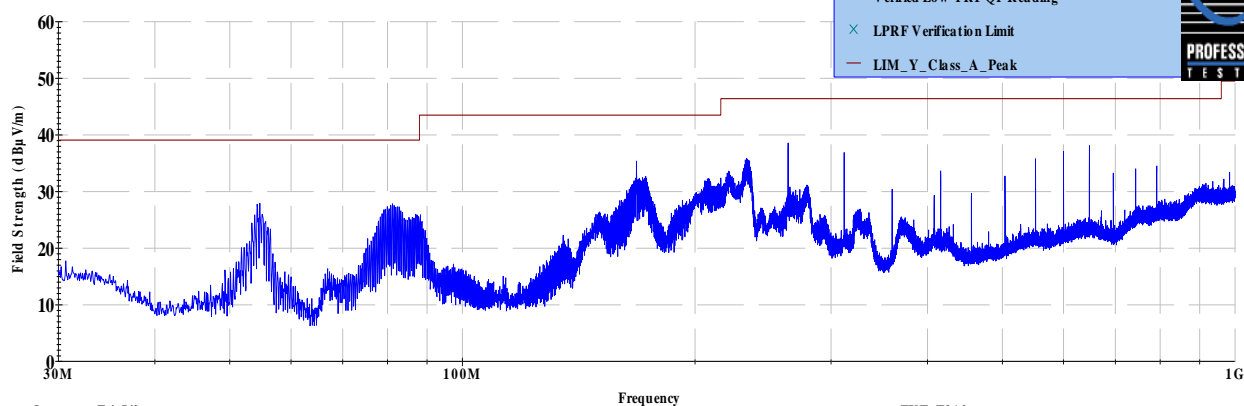
Test Method:	ANSI C63.4: 2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	5/15/2017	EUT Serial #:	None
Customer:	Vendwatch Telematics, LLC	EUT Part #:	None
Project Number:	19044	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	T313	Witness' Name:	Bryan Olinger

Radiated Emissions Test Results Data Sheet

Page: 1 of 1

EUT Line Voltage:	24 VDC	EUT Power Frequency:	0 N/A
Antenna Orientation:	Horizontal	Frequency Range:	30MHz to 1GHz
EUT Mode of Operation:	Transmit, 3 Channels		

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



Operator: Eric Lifsey

19044\051617\RET4\Run09\TXmode\clsA.tif

04:26:04 PM, Monday, May 15, 2017

Mode: Transmit
Power: 24VDC
Telit module enabled.

EUT: T313

Project Number: 19044

Client: Vendwatch Telematics, LLC

≤ 1GHz Horizontal Antenna Polarity Measured Emissions

7.3.2 Up to 18 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):	5/15/2017	EUT Serial #:	None
Customer:	Vendwatch Telematics, LLC	EUT Part #:	None
Project Number:	19044	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	T313	Witness' Name:	Bryan Olinger
Radiated Emissions Test Results Data Sheet		Page:	1 of 1
EUT Line Voltage:	24 VDC	EUT Power Frequency:	0 N/A
Antenna Orientation:	Vertical	Frequency Range:	Above 1GHz
EUT Mode of Operation:		Transmit, 3 Channels	
<div style="display: flex; justify-content: space-between;"> <div style="width: 60%;"> <p>Professional Testing, EMI, Inc Radiated Emissions, 3m Distance 1-18GHz Vertical Polarity Measured Emissions</p> <p>Operator: Eric Lifsey 19044\051417\RET4\Run08\TXmodel.t 04:48:39 PM, Monday, May 15, 2017</p> <p>Mode: Transmit Power: 24VDC Telit module enabled.</p> </div> <div style="width: 35%; text-align: right;"> <p>EUT: T313 Project Number: 19044 Client: Vendwatch Telematics, LLC</p> </div> </div>			
> 1GHz Vertical Antenna Polarity Measured Emissions			

Professional Testing, EMI, Inc.

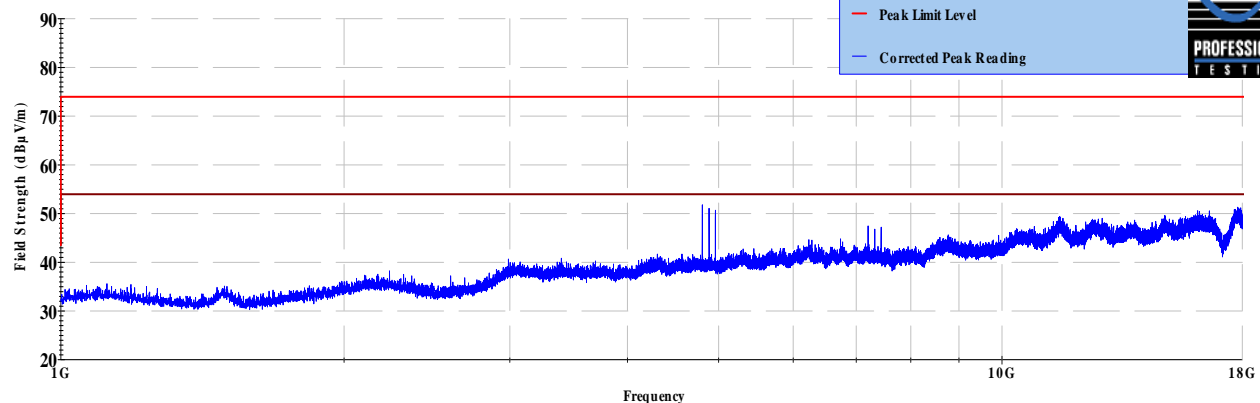
Test Method:	ANSI C63.10: 2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	5/15/2017	EUT Serial #:	None
Customer:	Vendwatch Telematics, LLC	EUT Part #:	None
Project Number:	19044	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	T313	Witness' Name:	Bryan Olinger

Radiated Emissions Test Results Data Sheet

Page: 1 of 1

EUT Line Voltage:	24 VDC	EUT Power Frequency:	0 N/A
Antenna Orientation:	Horizontal	Frequency Range:	Above 1GHz
EUT Mode of Operation:	Transmit, 3 Channels		

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



Operator: Eric Lifsey
19044\051417\RET4Run08\TXmode.tif
04:48:36 PM, Monday, May 15, 2017

Mode: Transmit
Power: 24VDC
Telit module enabled.

EUT: T313
Project Number: 19044
Client: Vendwatch Telematics, LLC

> 1GHz Horizontal Antenna Polarity Measured Emissions

7.3.3 Up 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):	5/16/2017	EUT Serial #:	None
Customer:	Vendwatch Telematics, LLC	EUT Part #:	None
Project Number:	19044	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	T313	Witness' Name:	Bryan Olinger
Radiated Emissions Test Results Data Sheet		Page:	1 of 1
EUT Line Voltage:	24 VDC	EUT Power Frequency:	0 N/A
Antenna Orientation:	Vertical	Frequency Range:	Above 1GHz
EUT Mode of Operation:		Transmit, 3 Channels	
<div style="display: flex; justify-content: space-between;"> <div style="width: 60%;"> <p>Professional Testing, EMI, Inc Radiated Emissions, Measured at 1m and Scaled to 3m Distance 18-26.5 GHz Vertical Polarity Measured Emissions</p> <p>The graph displays field strength in dBµV/m on the y-axis (ranging from 30 to 90) against frequency in GHz on the x-axis (ranging from 18.000G to 25.000G). Two horizontal red lines represent the Average Limit Level at approximately 75 dBµV/m and the Peak Limit Level at approximately 55 dBµV/m. A blue line with markers represents the corrected average reading, which remains consistently below the average limit level, fluctuating between approximately 35 and 45 dBµV/m. A legend in the top right corner identifies the lines: Average Limit Level (red line), Corrected Average Reading (blue line with triangles), Peak Limit Level (red line), and Corrected Peak Reading (blue line with squares). A 'PROFESSIONAL TESTING' logo is also present.</p> </div> <div style="width: 35%; text-align: right;"> <p>Operator: Eric Lifsey 19044'051617'RET4'Run09'TXmode.tif 09:24:52 AM, Tuesday, May 16, 2017</p> <p>Mode: Transmit Power: 24VDC Telit module enabled.</p> <p>EUT: T313 Project Number: 19044 Client: Vendwatch Telematics, LLC</p> </div> </div>			
> 1GHz Vertical Antenna Polarity Measured Emissions			

Professional Testing, EMI, Inc.

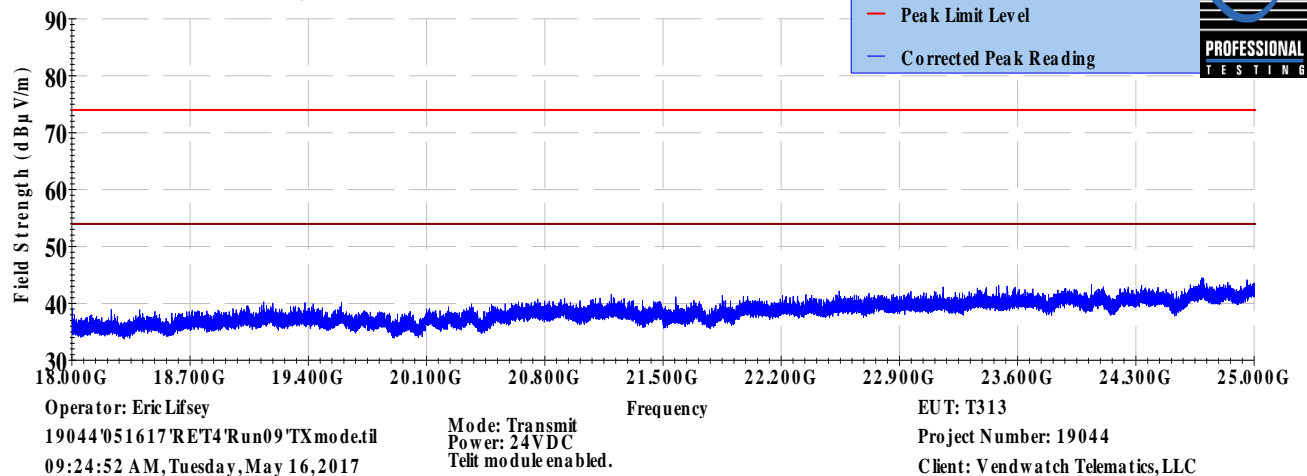
Test Method:	ANSI C63.10: 2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	5/16/2017	EUT Serial #:	None
Customer:	Vendwatch Telematics, LLC	EUT Part #:	None
Project Number:	19044	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	T313	Witness' Name:	Bryan Olinger

Radiated Emissions Test Results Data Sheet

Page: 1 of 1

EUT Line Voltage:	24 VDC	EUT Power Frequency:	0 N/A
Antenna Orientation:	Horizontal	Frequency Range:	Above 1GHz
EUT Mode of Operation:	Transmit, 3 Channels		

Professional Testing, EMI, Inc
Radiated Emissions, Measured at 1m and Scaled to 3m Distance
18-26.5 GHz Horizontal Polarity Measured Emissions



> 1GHz Horizontal Antenna Polarity Measured Emissions

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	7 Jul 2017

8.3 Results

Table 8.3.1 Antenna Construction Details

Manufacturer: Vendwatch



- Antenna is an etched shortened linear-loaded inverted F type.
- There is no antenna connector.
- Peak gain is 0.0 dBi.

The antenna design above satisfies the requirements of the rules.

9.0 Equipment

9.1 Radiated Emissions 30 MHz to 25 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	N/A	TDK 10M Chamber, NSA < 1 GHz	DAC-012915-005	7/10/2017
1890	HP	8447F	Preamp/Amp, 9kHz-1300MHz, 28/25dB	3313A05298	2/1/2018
1937	Agilent	E4440A	Spectrum Analyzer, 3 Hz - 26.5 GHz, Opt. AYZ	MY44808298	11/15/2017
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	N/A	TDK 10M Chamber, VSWR > 1 GHz	DAC-012915-005	6/23/2019
2004	Miteq	AFS44-00101800-2S-10P-44	Amplifier, 40dB, .1-18GHz	0	1/11/2018
C030	none	none	Cable Coax, N-N, 30m	none	10/1/2017
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
1542	A.H. Systems	SAS-572	Antenna, Horn 18-26.5GHz, 20dB gain	225	11/20/2018
2295	Keysight	E4440A-AYZ	PSA Spectrum Analyzer	MY46186204	9/30/2017
1973	Agilent	83017A	Amplifier, Microwave 0.5-26.5 GHz	MY39500497	11/17/2018

9.2 Bandwidth and Band Edge

Asset #	Manufacturer	Model #	Description	Calibration Due
2295	Agilent	E4440A	Spectrum Analyzer	30 Sep 2017
None	ETS	5211	Shielded Test Enclosure	CNR
None	PTI	None	2 GHz Sleeve Dipole Sense Antenna	CNR
C241	Pasternack	RG type	Coaxial Cable	CNR

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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