
Project 19070-15

**FieldComm Group
WirelessHART Access Point**

Wireless Certification Report

Prepared for:

FieldComm Group
9430 Research Blvd
Suite 1-120
Austin, TX 78759
USA

By

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

16 Mar 2018

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
Final 01		16 Mar 2018

Errata:

None.

Table of Contents

Revision History.....	2
Compliance Certificate.....	5
1.0 Introduction.....	6
1.1 Scope.....	6
1.2 EUT Description	6
1.3 EUT Operation.....	6
1.4 Modifications to Equipment.....	6
1.5 Test Site	6
1.6 Radiated Measurements	7
1.7 Applicable Documents and Clauses.....	7
2.0 Fundamental Power	8
2.1 Test Procedure	8
2.2 Test Criteria	8
2.3 Test Results, Peak Power	8
2.4 Test Results, Duty Cycle.....	9
3.0 Power Spectral Density.....	10
3.1 Test Procedure	10
3.2 Test Criteria	10
3.3 Test Results.....	10
4.0 Occupied Bandwidth.....	11
4.1 Test Procedure	11
4.2 Test Criteria	11
4.3 Test Results.....	11
4.3.1 Bandwidth Plots, 6 dB.....	12
4.3.2 Bandwidth Plots, 20 dB.....	13
5.0 Band Edge.....	14
5.1 Test Procedure	14
5.2 Test Criteria	14
5.3 Test Results.....	14
5.3.1 Low Channel Band Edge.....	15
5.3.2 High Channel Band Edge	15
6.0 Radiated Spurious Emissions, Receive Mode.....	16
6.1 Test Procedure	16
6.2 Test Criteria	16
6.3 Test Results.....	16
6.3.1 Up to 1 GHz	17
6.3.2 Up to 13 GHz	19
7.0 Radiated Spurious Emissions, Transmit Mode	21
7.1 Test Procedure	21
7.2 Test Criteria	21
7.3 Test Results.....	21
7.3.1 Center Channel Up to 1 GHz.....	22
7.3.2 Three Channels Up to 18 GHz	24
7.3.3 Three Channels Up to 25 GHz	26
8.0 Antenna Construction Requirements	28
8.1 Procedure	28
8.2 Criteria	28
8.3 Results.....	28
9.0 Equipment.....	29
9.1 Radiated Emissions 30 MHz to 25 GHz	29
9.2 Power, Bandwidth, Duty Cycle, Band Edge, Conducted Spurious.....	30
10.0 Measurement Bandwidths.....	31
Appendix: Policy, Rationale, and Evaluation of EMC Measurement Uncertainty	32
End of Report	33

NOTICE: (1) This Report must not be used to claim product endorsement, by NVLAP, NIST, the FCC or any other Agency. This report also does not warrant certification by NVLAP or NIST. (2) This report shall not be reproduced except in full, without the written approval of Professional Testing (EMI), Inc. (3) The significance of this report is dependent on the representative character of the test sample submitted for evaluation and the results apply only in reference to the sample tested. The manufacturer must continuously implement the changes shown herein to attain and maintain the required degree of compliance.



Compliance Certificate

FCC MRA Designation Number: US5270
 NVLAP Accreditation Number: 200062-0

Applicant	Device & Test Identification
FieldComm Group 9430 Research Blvd Suite 1-120 Austin, TX 78759 USA Certificate Date: 16 Mar 2018	FCC ID: 2AOZ6-TOOL091R2 Industry Canada ID: 23615-TOOL091R2 Model(s): WirelessHART Access Point Laboratory Project ID: 19070-15

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 5	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
FieldComm Group Model: Access Point	AP#1, AP#2, AP#3	2400-2483.5 MHz DTS transceiver; serves as access point demonstrator kit.

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

This device is a wireless access point for the WirelessHART protocol. It connects by USB cable to a host computer for power, data and control.

The EUT electronics are on a single circuit board. The board is housed in an extruded metal case and features a RP-SMA connector and included antenna.

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

Table 1.6 1 Measurement Corrections	
Parameter	From Sums Of
Radiated Field Strength	Raw Measured Level + Antenna Factor + Cable Losses – Amplifier Gain
Conducted Antenna Port	Raw Measured Level + Attenuator Factor + Cable Losses
Conducted Mains Port	Raw Measured Level + LISN Factor + Cable/Filter/Limiter Losses

Additionally, measurement distance extrapolation factors (such as $1/d$ above 30 MHz) 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	15.247, 15.203	RSS-Gen 8.3

2.0 Fundamental Power

2.1 Test Procedure

Peak power is measured using conducted means and without modulation.

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 dBμV/m @ 3 m	12 Jun 2017

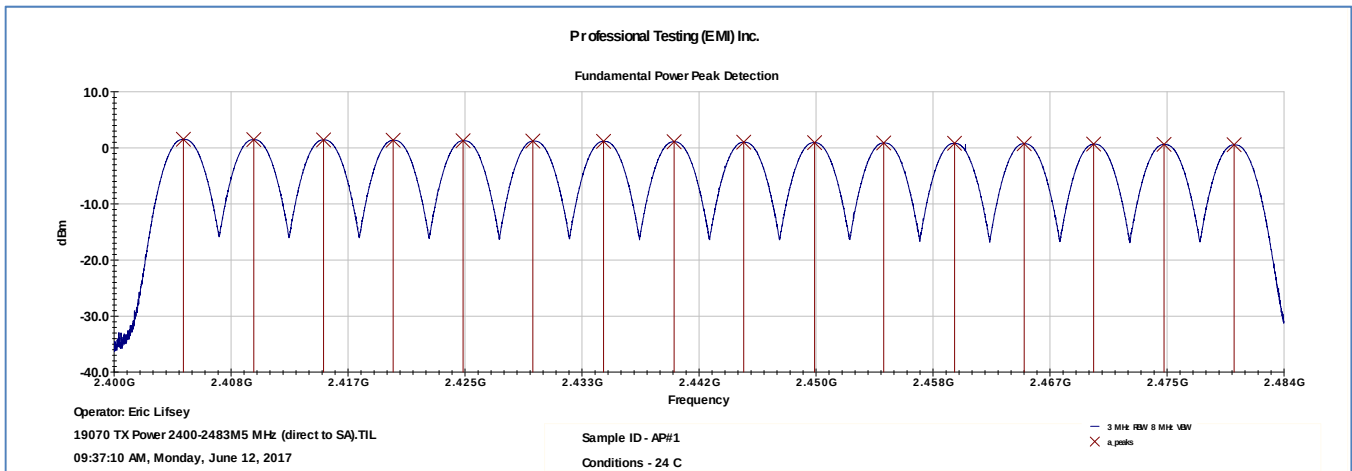
2.3 Test Results, Peak Power

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

Table 2.3.1 Power, Peak, Conducted		
Frequency MHz	Measured Peak Power in dBm	Measured Peak Power in mW
2405	1.5	1.4
2440	1.1	1.3
2480	0.5	1.1

Measured in 3 MHz RBW, 8 MHz VBW.

The EUT was 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.

The EUT power output is low and there were no transmitter spurious measurements needing the averaging factor. 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 full bandwidth fundamental peak power measured below the limit for this test. 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	12 Jun 2017

4.3 Test Results

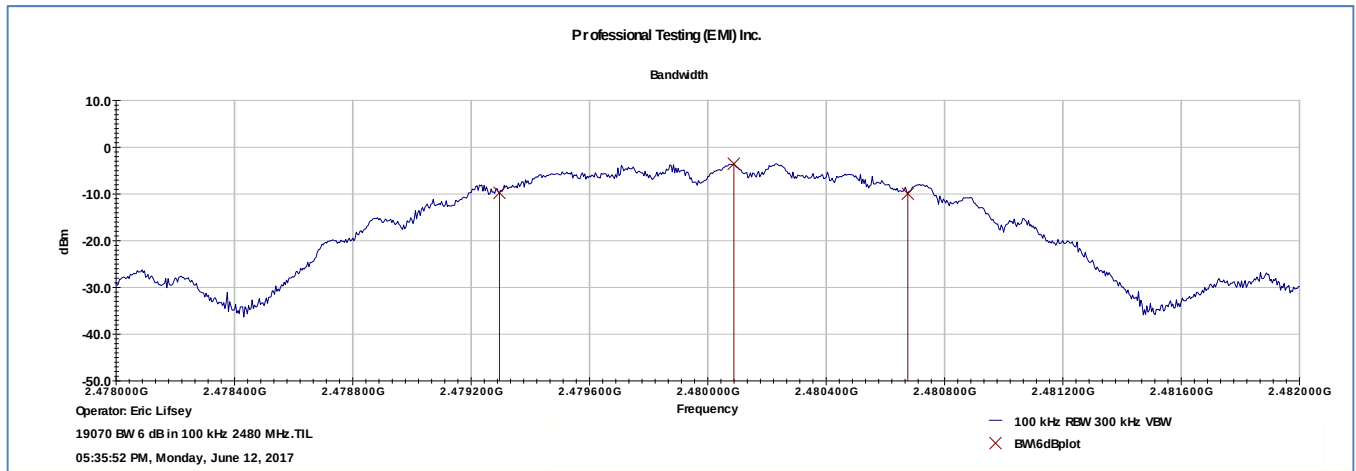
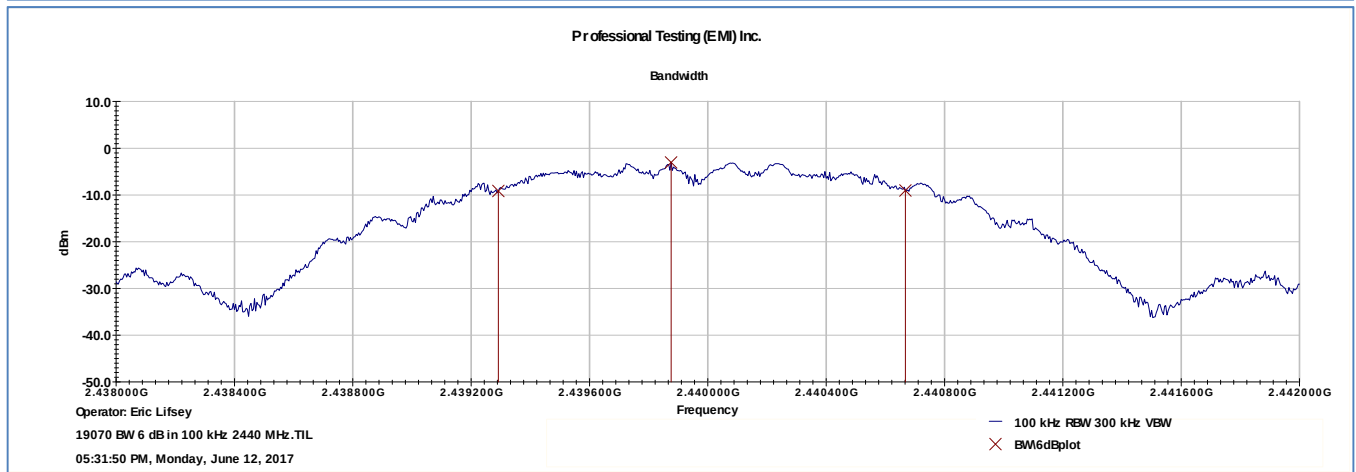
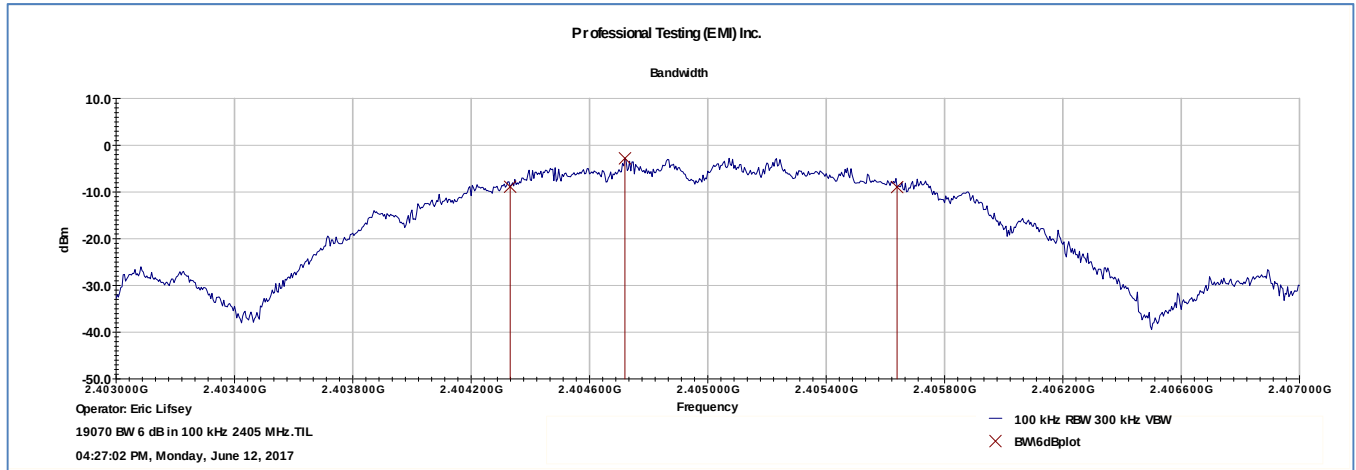
The bandwidth measurement is used to verify DTS characteristics and/or for general reporting for agency application.

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

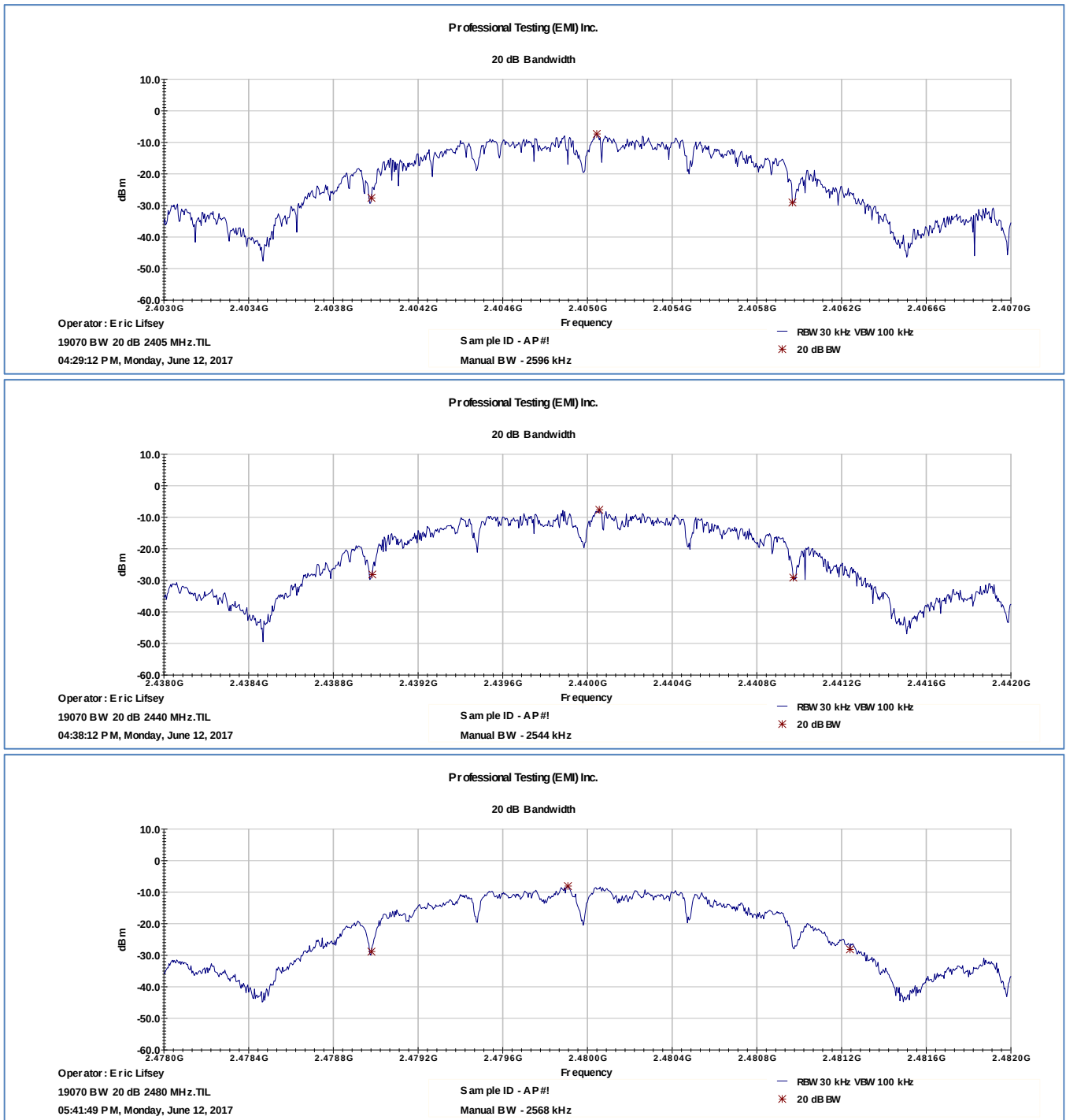
Table 4.3.1			
Bandwidth 6 dB, Minimum 500 kHz in 100 kHz RBW			
Low Channel Measured BW (kHz)	Mid Channel Measured BW (kHz)	High Channel Measured BW (kHz)	Reported Minimum BW (kHz)
1308	1376	1380	1308
Bandwidth 20 dB, Measure and Report			
Low Channel Measured BW (kHz)	Mid Channel Measured BW (kHz)	High Channel Measured BW (kHz)	Reported Maximum BW (kHz)
2596	2544	2568	2596

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	13 Jun 2017

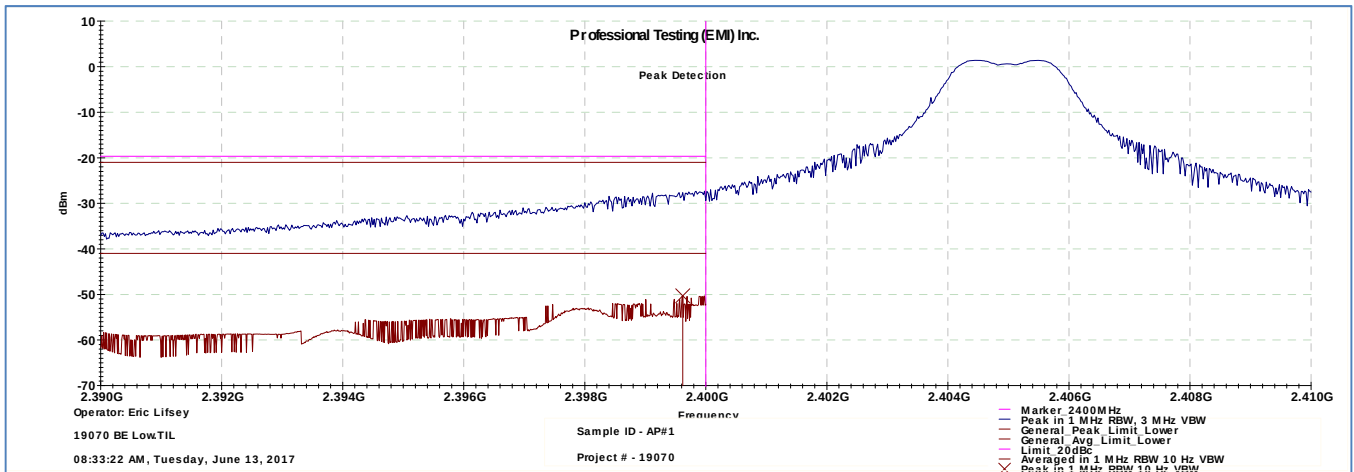
5.3 Test Results

Measurements included fundamental and more than 2 standard bandwidths (standard bandwidth 1 MHz) beyond the band edges to provide a clear view of the fundamental and the declining emission levels.

Average levels were measured outside the band using 10 Hz video bandwidth.

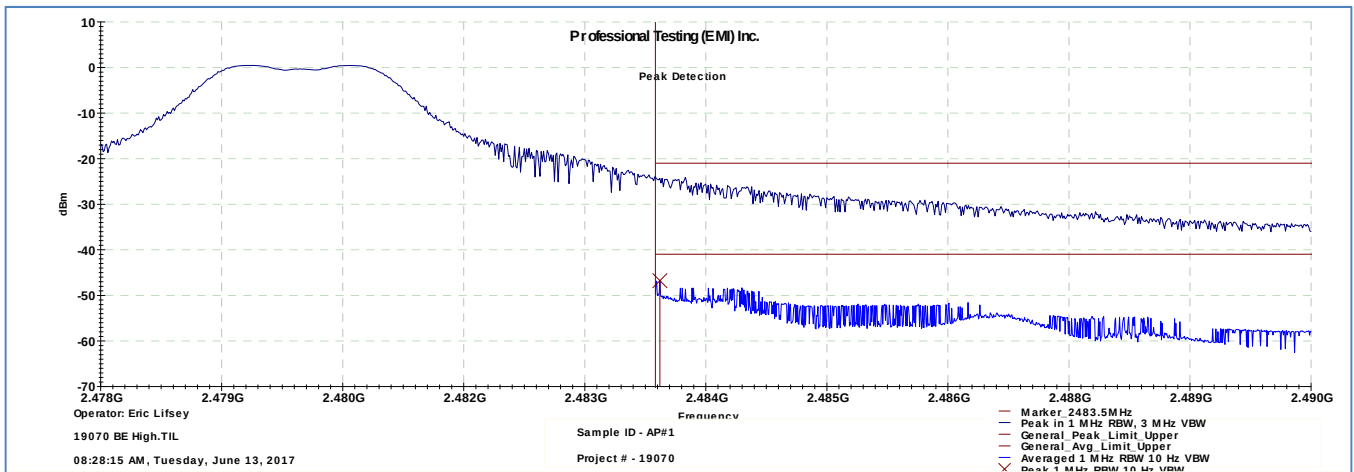
The EUT satisfied the criteria. Plotted results appear on the following pages.

5.3.1 Low Channel Band Edge



The 15.247 (-20 dBc) and general emission limits are shown.

5.3.2 High Channel Band Edge



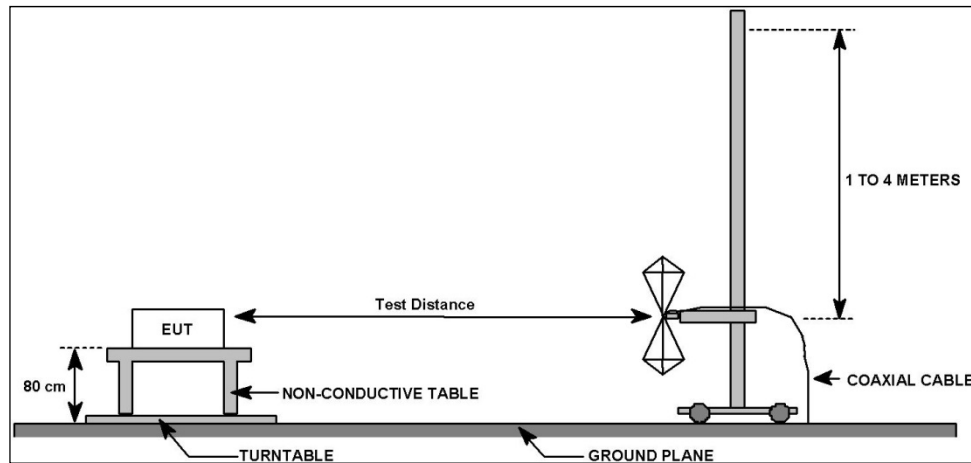
The general emission limit is shown.

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	13 Jun 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.

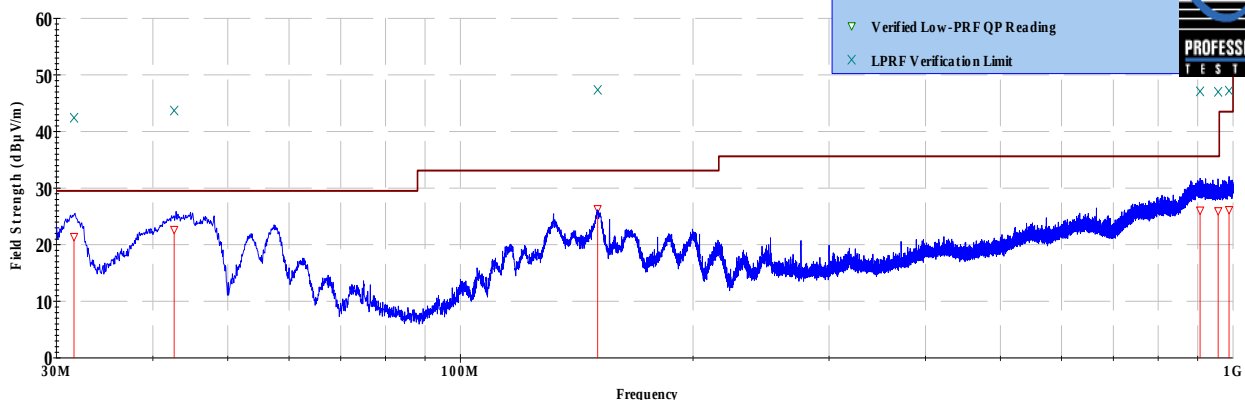
Test Method:	ANSI C63.4: 2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	6/13/2017	EUT Serial #:	AP#2
Customer:	FieldComm Group	EUT Part #:	0
Project Number:	19070	Test Technician:	Spencer Flint
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	WirelessHART	Witness' Name:	None

Radiated Emissions Test Results Data Sheet

Page: 1 of 1

EUT Line Voltage:		5 VDC			EUT Power Frequency:		N/A N/A		
Antenna Orientation:		Vertical			Frequency Range:		30MHz to 1GHz		
EUT Mode of Operation:					Receive Mode				
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
31.6174	10	241	2.29	Quasi-peak	33.4	21.428	29.5	-8.1	Pass
42.6152	10	65	1.18	Quasi-peak	39.8	22.69	29.5	-6.8	Pass
150.555	10	336	1.26	Quasi-peak	42.9	26.351	33.1	-6.7	Pass
906.803	10	169	3	Quasi-peak	21.3	26.099	35.6	-9.5	Pass
957.059	10	112	3.78	Quasi-peak	21	26.006	35.6	-9.6	Pass
988.435	10	311	2.1	Quasi-peak	21	26.199	43.5	-17.3	Pass

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



Operator: Spencer Flint

19070_REC_2016 RE_ClassB- BoreSite+ Mast_LowPRF_041417-8-13-17
EUT Model: 5VDC / USB Powered
EUT AP#2

EUT: WirelessHART

Project Number: 19070

Client: FieldComm Group

≤ 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):	6/13/2017	EUT Serial #:	AP#2
Customer:	FieldComm Group	EUT Part #:	0
Project Number:	19070	Test Technician:	Spencer Flint
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	WirelessHART	Witness' Name:	None

Radiated Emissions Test Results Data Sheet

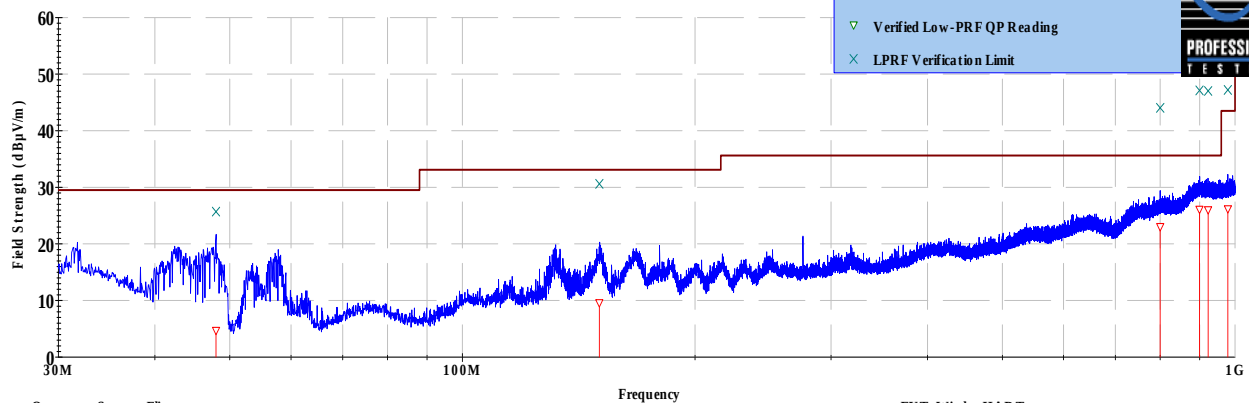
Page: 1 of 1

EUT Line Voltage:		5 VDC			EUT Power Frequency:		N/A N/A		
Antenna Orientation:		Horizontal			Frequency Range:		30MHz to 1GHz		
EUT Mode of Operation:					Receive Mode				
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
47.9945	10	336	1.4	Quasi-peak	24.4	4.694	29.5	-24.8	Pass
150.396	10	276	1.25	Quasi-peak	26.1	9.595	33.1	-23.5	Pass
800.443	10	237	1.72	Quasi-peak	21.4	23.047	35.6	-12.6	Pass
899.839	10	256	1.2	Quasi-peak	21.3	26.122	35.6	-9.5	Pass
923.335	10	24	3.86	Quasi-peak	21.2	26.03	35.6	-9.6	Pass
979.328	10	226	2.2	Quasi-peak	21	26.208	43.5	-17.3	Pass

Professional Testing, EMI, Inc

Radiated Emissions, 10m Distance

30MHz - 1GHz Horizontal Polarity Measured Emissions



Operator: Spencer Flint

19070_REC_2016 RE_ClassB- BoreSite+ Mast_LowPRF_041417_8.mw
EUT Mode: Receive Mode
EUT Power: 5VDC / USB Powered
EUT AP#2

EUT: WirelessHART

Project Number: 19070

Client: FieldComm Group

≤ 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):		6/13/2017			EUT Serial #:		AP#2		
Customer:		FieldComm Group			EUT Part #:		0		
Project Number:		19070			Test Technician:		Spencer Flint		
Purchase Order #:		0			Supervisor:		Lisa Arndt		
Equip. Under Test:		WirelessHART			Witness' Name:		None		
Radiated Emissions Test Results Data Sheet									
Page: 1 of 1									
EUT Line Voltage:		5 VDC			EUT Power Frequency:		N/A N/A		
Antenna Orientation:		Vertical			Frequency Range:		Above 1GHz		
EUT Mode of Operation:					Receive Mode				
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
1044.38	3	167	3.55	Average	34.9	21.725	54.0	-32.2	Pass
3004.49	3	287	1.45	Average	34.9	27.823	54.0	-26.1	Pass
3495	3	61	1.73	Average	35.2	28.123	54.0	-25.8	Pass
5205.92	3	28	2.06	Average	33.3	30.434	54.0	-23.5	Pass
5782.6	3	290	3.22	Average	32	30.728	54.0	-23.2	Pass
5998.46	3	22	3.78	Average	31.7	30.667	54.0	-23.3	Pass
6649.84	3	268	3.77	Average	30.5	32.168	54.0	-21.8	Pass
8768.62	3	159	1.9	Average	27.1	34.522	54.0	-19.4	Pass
10725.5	3	184	2.3	Average	27.1	36.597	54.0	-17.4	Pass
15111.2	3	73	2.03	Average	28.2	39.834	54.0	-14.1	Pass
15639.3	3	108	1.73	Average	27.6	41.036	54.0	-12.9	Pass
17967.4	3	69	1.15	Average	26.5	42.505	54.0	-11.5	Pass

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

Operator: Spencer Flint
19070_REC_2016 RE_ClassB - Boresite+Mast_LowPRF_041417
12:24:49 PM, Tuesday, June 13, 2017

— Average Limit Level
▽ Corrected Average Reading
— Peak Limit Level
— Corrected Peak Reading

PROFESSIONAL TESTING

EUT Mode: Receive Mode
EUT Power: 5VDC / USB Powered
EUT AP#2

EUT: WirelessHART
Project Number: 19070
Client: FieldComm Group

> 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):		6/13/2017		EUT Serial #:		AP#2			
Customer:		FieldComm Group		EUT Part #:		0			
Project Number:		19070		Test Technician:		Spencer Flint			
Purchase Order #:		0		Supervisor:		Lisa Arndt			
Equip. Under Test:		WirelessHART		Witness' Name:		None			
Radiated Emissions Test Results Data Sheet								Page: 1 of 1	
EUT Line Voltage:		5 VDC		EUT Power Frequency:		N/A N/A			
Antenna Orientation:		Horizontal		Frequency Range:		Above 1GHz			
EUT Mode of Operation:					Receive Mode				
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
1957.95	3	293	2.15	Average	35.5	26.156	54.0	-27.8	Pass
3074.11	3	46	3.76	Average	34.9	27.608	54.0	-26.3	Pass
4322.28	3	9	3.03	Average	33.8	28.891	54.0	-25.1	Pass
4831.2	3	14	1.46	Average	33.2	29.188	54.0	-24.8	Pass
5248.87	3	284	2.02	Average	33	30.423	54.0	-23.5	Pass
5397.75	3	220	2.53	Average	32.6	29.936	54.0	-24.0	Pass
8797.55	3	215	3.14	Average	27	34.345	54.0	-19.6	Pass
10553.2	3	264	1.43	Average	26.7	36.57	54.0	-17.4	Pass
11528.7	3	294	1.36	Average	27.4	38.309	54.0	-15.6	Pass
13347.7	3	248	3.35	Average	28.9	39.688	54.0	-14.3	Pass
16017.9	3	24	1.31	Average	27.4	41.595	54.0	-12.4	Pass
17750.9	3	64	3.38	Average	26.6	42.411	54.0	-11.5	Pass

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

Operator: Spencer Flint
19070_REC_2016 RE_ClassB - Boresite+ Mast_LowPRF_041417.F01
12:24:49 PM, Tuesday, June 13, 2017

— Average Limit Level
▽ Corrected Average Reading
— Peak Limit Level
— Corrected Peak Reading

EUT Mode: Receive Mode
EUT Power: 5VDC / USB Powered
EUT AP#2

EUT: WirelessHART

Project Number: 19070

Client: FieldComm Group

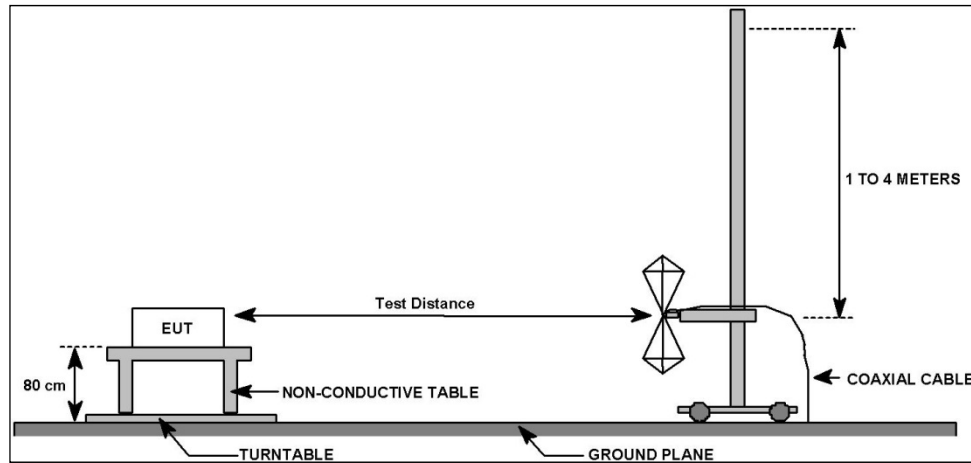
> 1GHz Horizontal Antenna Polarity Measured Emissions

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	13 Jun 2017

7.3 Test Results

This device was tested as 3 samples with each occupying the required test frequencies.

7.3.1 Center Channel Up to 1 GHz

Professional Testing, EMI, Inc.

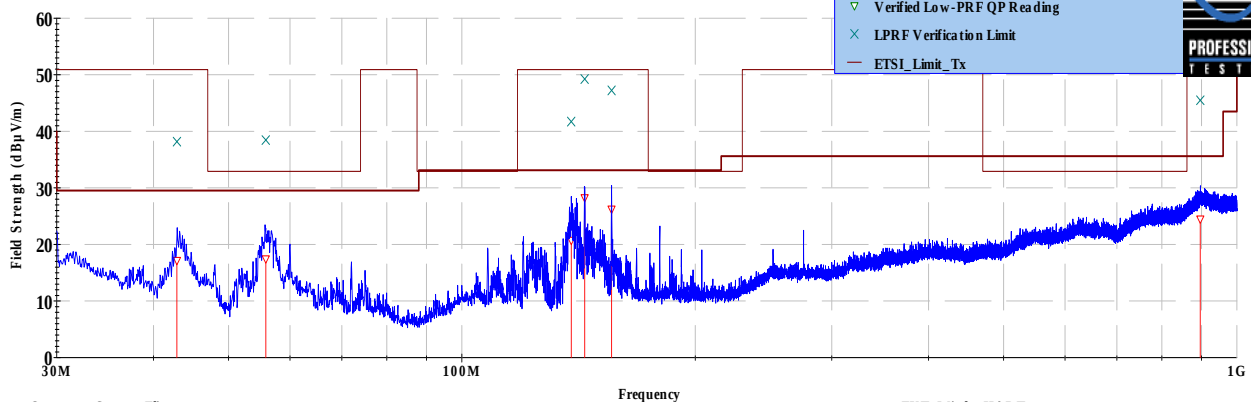
Test Method:	ANSI C63.10-2013 American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	6/13/2017	EUT Serial #:	AP#1,AP#2,AP#3
Customer:	FieldComm Group	EUT Part #:	0
Project Number:	19070	Test Technician:	Spencer Flint
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	WirelessHART	Witness' Name:	None

Radiated Emissions Test Results Data Sheet

Page: 1 of 1

EUT Line Voltage:			5	VDC		EUT Power Frequency:			N/A	N/A
Antenna Orientation:			Vertical			Frequency Range:		30MHz to 1GHz		
EUT Mode of Operation:					Transmitting (Mid Channel - 2440 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	
42.8805	10	263	1.54	Quasi-peak	34.1	17.167	29.5	-12.3	Pass	
55.831	10	34	1.47	Quasi-peak	35.3	17.432	29.5	-12.1	Pass	
138.363	10	296	1.23	Quasi-peak	37.8	20.716	33.1	-12.4	Pass	
143.976	10	330	1.28	Quasi-peak	44.7	28.235	33.1	-4.9	Pass	
155.972	10	246	1.3	Quasi-peak	41.6	26.226	33.1	-6.9	Pass	
897.106	10	183	3.08	Quasi-peak	21.4	24.478	35.6	-11.1	Pass	

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



Operator: Spencer Flint

19070_FCC_2016_RE_2440M_30M-26G_Mid Ch_Run1.tif

03:10:20 PM, Tuesday, June 13, 2017

EUT Mode: Transmitting CW
EUT Power: 5VDC USB Powered
1 EUT MHz, 3 EUTs GHz (B,M,T Channels)

EUT: WirelessHART

Project Number: 19070-15

Client: FieldComm Group

≤ 1GHz Vertical Antenna Polarity Measured Emissions

Professional Testing, EMI, Inc.

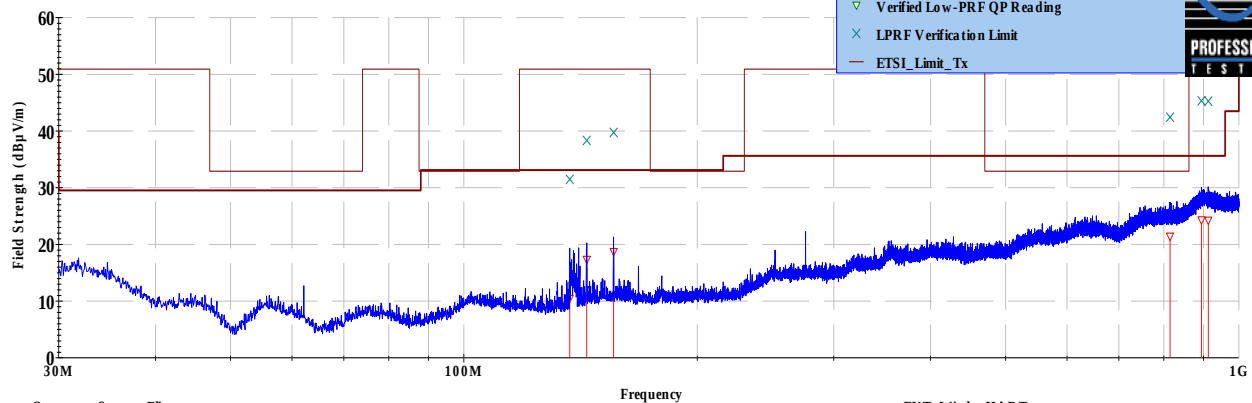
Test Method:	ANSI C63.10-2013 American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	6/13/2017	EUT Serial #:	AP#1,AP#2,AP#3
Customer:	FieldComm Group	EUT Part #:	0
Project Number:	19070	Test Technician:	Spencer Flint
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	WirelessHART	Witness' Name:	None

Radiated Emissions Test Results Data Sheet

Page: 1 of 1

EUT Line Voltage:		5	VDC		EUT Power Frequency:		N/A	N/A	
Antenna Orientation:		Horizontal			Frequency Range:		30MHz to 1GHz		
EUT Mode of Operation:					Transmitting (Mid Channel - 2440 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
136.925	10	98	2.84	Quasi-peak	27.6	10.461	33.1	-22.6	Pass
144.031	10	235	3.86	Quasi-peak	33.7	17.33	33.1	-15.8	Pass
156.031	10	81	3.56	Quasi-peak	34.1	18.733	33.1	-14.4	Pass
814.989	10	179	3.58	Quasi-peak	21.5	21.436	35.6	-14.2	Pass
894.896	10	215	1.03	Quasi-peak	21.3	24.331	35.6	-11.3	Pass
913.04	10	88	3.66	Quasi-peak	21.2	24.258	35.6	-11.3	Pass

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



Operator: Spencer Flint

19070_FCC_2016 RE_2440M_30M-26G_Mid Ch_Run1.ttl
03:10:20 PM, Tuesday, June 13, 2017

EUT Mode: Transmitting CW
EUT Power: 5VDC USB Powered
1 EUT MHz, 3 EUTs GHz (BM, TC Channels)

EUT: WirelessHART

Project Number: 19070-15
Client: FieldComm Group

≤ 1GHz Horizontal Antenna Polarity Measured Emissions

7.3.2 Three Channels 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):		6/13/2017		EUT Serial #:		AP#1,AP#2,AP#3			
Customer:		FieldComm Group		EUT Part #:		0			
Project Number:		19070		Test Technician:		Spencer Flint			
Purchase Order #:		0		Supervisor:		Lisa Arndt			
Equip. Under Test:		WirelessHART		Witness' Name:		None			
Radiated Emissions Test Results Data Sheet									
EUT Line Voltage:		5 VDC		EUT Power Frequency:		N/A N/A			
Antenna Orientation:		Vertical		Frequency Range:		Above 1GHz			
EUT Mode of Operation:				Transmitting (3 Channels - 2405,2440,2480 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
3064.11	3	224	2.83	Average	35.6	29.035	54.0	-24.9	Pass
4711.7	3	3	1.55	Average	33.6	29.811	54.0	-24.1	Pass
4809.88	3	219	1.29	Average	53.5	49.826	54.0	-4.1	Pass
4879.94	3	10	1.21	Average	47.4	43.88	54.0	-10.1	Pass
4960.19	3	317	1.64	Average	40	36.83	54.0	-17.1	Pass
5846.27	3	161	1.64	Average	32.1	30.77	54.0	-23.2	Pass
7319.69	3	50	1.64	Average	41.1	44.382	54.0	-9.6	Pass
8518.49	3	326	2.17	Average	27.5	34.379	54.0	-19.6	Pass
11514.4	3	159	1.41	Average	27.6	38.667	54.0	-15.3	Pass
16282.1	3	15	3.18	Average	27.4	41.808	54.0	-12.1	Pass
17696.4	3	26	2.92	Average	27	42.99	54.0	-11.0	Pass
17858.1	3	224	1.9	Average	26.8	42.962	54.0	-11.0	Pass

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

Operator: Spencer Flint
19070_FCC_2016 RE_2440M_30M-26G_Mid Ch_Run1.ttl
05:30:25 PM, Tuesday, June 13, 2017

EUT Mode: Transmitting CW
EUT Power: 5VDC USB Powered
1 EUT MHz, 3 EUTs GHz (B,M,T Channels)

EUT: WirelessHART
Project Number: 19070-15
Client: FieldComm Group

— Average Limit Level
△ Corrected Average Reading
— Peak Limit Level
— Corrected Peak Reading
— ETSI_Limit_Tx

PROFESSIONAL TESTING

> 1GHz Vertical Antenna Polarity Measured Emissions

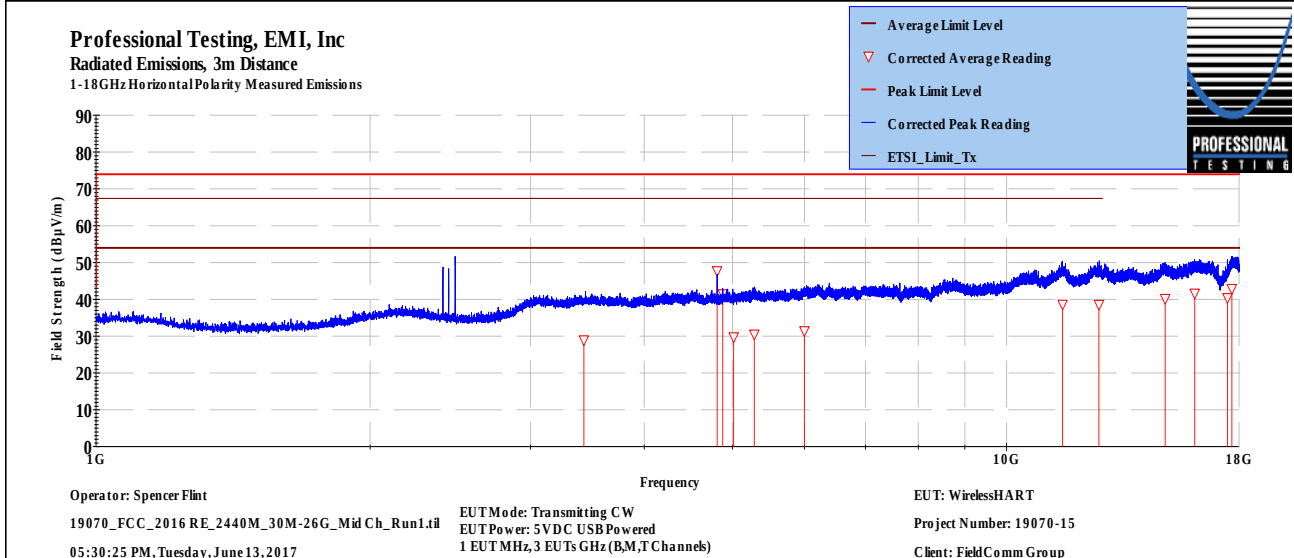
Professional Testing, EMI, Inc.

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):	6/13/2017	EUT Serial #:	AP#1,AP#2,AP#3
Customer:	FieldComm Group	EUT Part #:	0
Project Number:	19070	Test Technician:	Spencer Flint
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	WirelessHART	Witness' Name:	None

Radiated Emissions Test Results Data Sheet

Page: 1 of 1

EUT Line Voltage:		5	VDC		EUT Power Frequency:		N/A	N/A	
Antenna Orientation:		Horizontal			Frequency Range:		Above 1GHz		
EUT Mode of Operation:					Transmitting (3 Channels - 2405,2440,2480 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
3434.61	3	170	1.44	Average	35	28.982	54.0	-25.0	Pass
4809.91	3	264	2.4	Average	51.4	47.727	54.0	-6.2	Pass
4880.04	3	270	1.44	Average	45	41.494	54.0	-12.5	Pass
5015.31	3	86	1.53	Average	32.8	29.774	54.0	-24.2	Pass
5284.78	3	63	2.32	Average	33	30.501	54.0	-23.5	Pass
5998.15	3	105	3.76	Average	31.9	31.439	54.0	-22.5	Pass
11522.1	3	58	3.65	Average	27.6	38.632	54.0	-15.3	Pass
12632.5	3	206	1.21	Average	27.9	38.601	54.0	-15.4	Pass
14935.2	3	294	2.04	Average	28.4	40.228	54.0	-13.7	Pass
16092	3	68	1.04	Average	27.1	41.635	54.0	-12.3	Pass
17482	3	90	2.84	Average	26.8	40.401	54.0	-13.6	Pass
17679.1	3	197	2.32	Average	27.1	42.884	54.0	-11.1	Pass



> 1GHz Horizontal Antenna Polarity Measured Emissions

7.3.3 Three Channels 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):		6/13/2017		EUT Serial #:		AP#1,AP#2,AP#3			
Customer:		FieldComm Group		EUT Part #:		0			
Project Number:		19070		Test Technician:		Spencer Flint			
Purchase Order #:		0		Supervisor:		Lisa Arndt			
Equip. Under Test:		WirelessHART		Witness' Name:		None			
Radiated Emissions Test Results Data Sheet								Page: 1 of 1	
EUT Line Voltage:		5 VDC		EUT Power Frequency:		N/A N/A			
Antenna Orientation:		Vertical		Frequency Range:		Above 1GHz			
EUT Mode of Operation:				Transmitting (3 Channels - 2405,2440,2480 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
20732.5	3	84	1	Average	33.2	27.548	54.0	-26.4	Pass
22487.4	3	206	1	Average	32.5	27.334	54.0	-26.6	Pass
22681.8	3	110	1	Average	33.3	28.159	54.0	-25.8	Pass
23411.7	3	186	1	Average	33.5	28.729	54.0	-25.2	Pass
23776.3	3	186	1	Average	33.3	29.026	54.0	-24.9	Pass
23942.4	3	196	1	Average	33.3	29.177	54.0	-24.8	Pass
Professional Testing, EMI, Inc Radiated Emissions, Measured at 1m and Scaled to 3m Distance 18-26.5 GHz Vertical Polarity Measured Emissions The graph displays field strength in dBμV/m on the y-axis (ranging from 20 to 90) against frequency in GHz on the x-axis (ranging from 18.0 to 26.5). A blue line represents the corrected average reading, which fluctuates between approximately 30 and 45 dBμV/m. A red line represents the average limit level at 54.0 dBμV/m. Another red line represents the peak limit level at approximately 75 dBμV/m. Several red triangles indicate specific measurement points. — Average Limit Level ▽ Corrected Average Reading — Peak Limit Level — Corrected Peak Reading PROFESSIONAL TESTING Operator: Spencer Flint 19070_FCC_2016 RE_2440M_30M-26G_3 Chan_Run1.tif 09:40:38 AM, Wednesday, June 14, 2017 EUT Mode: Transmitting CW EUT Power: 5VDC USB Powered 1 EUT MHz, 3 EUTs GHz (BM,T Channels) EUT: WirelessHART Project Number: 19070-15 Client: FieldComm Group									
> 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):	6/13/2017	EUT Serial #:	AP#1,AP#2,AP#3
Customer:	FieldComm Group	EUT Part #:	0
Project Number:	19070	Test Technician:	Spencer Flint
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	WirelessHART	Witness' Name:	None

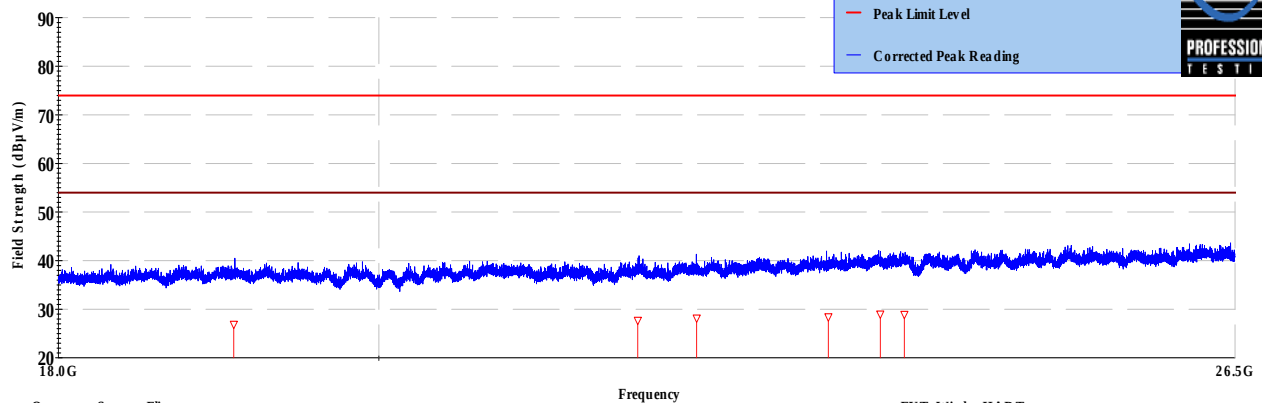
Radiated Emissions Test Results Data Sheet

Page: 1 of 1

EUT Line Voltage:		5	VDC		EUT Power Frequency:		N/A	N/A	
Antenna Orientation:		Horizontal			Frequency Range:		Above 1GHz		
EUT Mode of Operation:					Transmitting (3 Channels - 2405,2440,2480 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
19068.5	3	77	1	Average	32.7	26.872	54.0	-27.1	Pass
21776.8	3	30	1	Average	33.4	27.697	54.0	-26.3	Pass
22202.5	3	88	1	Average	33.4	28.153	54.0	-25.8	Pass
23184.4	3	63	1	Average	33.5	28.406	54.0	-25.6	Pass
23584	3	192	1	Average	33.5	28.983	54.0	-25.0	Pass
23770.8	3	277	1	Average	33.2	28.909	54.0	-25.0	Pass

Professional Testing, EMI, Inc

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



Operator: Spencer Flint

19070_FCC_2016 RE_2440M_30M-26G_3 Chan_Run1.ttl

09:40:38 AM, Wednesday, June 14, 2017

EUT Mode: Transmitting CW
EUT Power: 5VDC USB Powered
1 EUT MHz, 3 EUTs GHz (B,M,T Channels)

EUT: WirelessHART

Project Number: 19070-15

Client: FieldComm Group

> 1GHz Horizontal Antenna Polarity Measured Emissions

8.0 Antenna Construction Requirements

8.1 Procedure

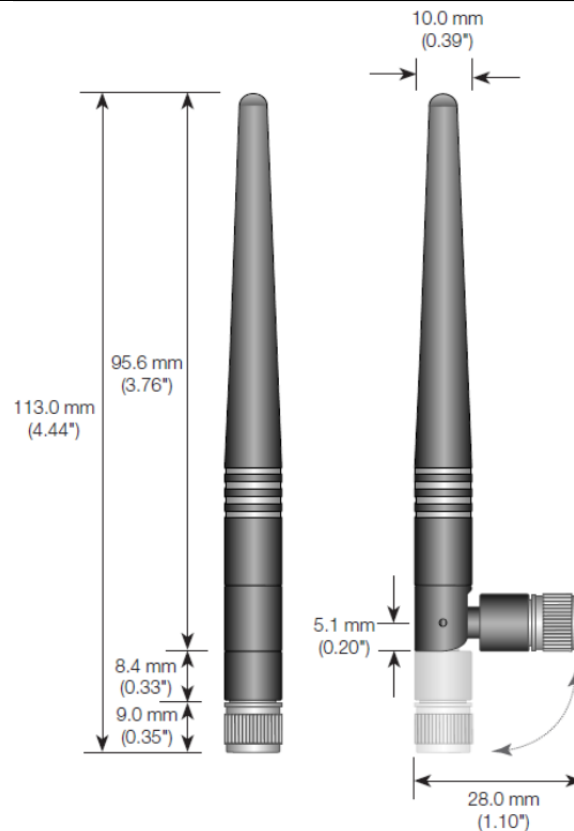
A direct examination of the antenna construction is performed and compared to rule criteria that prevent wireless device antennas from being modified by end users.

8.2 Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.203, 15.247 // RSS-Gen 8.3	Antenna Construction	21 Dec 2017

8.3 Results

Table 8.3.1 Antenna Construction Details



Manufacturer: Linx
 Model/PN: ANT-2.4-CW-RCT-RP
 Gain 2.2 dBi peak gain
 RP-SMA style connector.

The antenna system 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
2172	ETS-Lindgren	3142C	Antenna, Biconilog, 26 MHz-3GHz	49383	11/27/2018
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	6/19/2017
2004	Miteq	AFS44-00101800-2S-10P-44	Amplifier, 40dB, .1-18GHz	0	1/11/2018
C030	none	none	Cable Coax, N-N, 30m	none	10/1/2017
1325	EMCO	1050	Controller, Antenna Mast	9003-1461	N/A
819	EMCO	3115	Antenna, Horn, DRG, 1-18GHz	113	8/4/2018

9.2 Power, Bandwidth, Duty Cycle, Band Edge, Conducted Spurious

Asset #	Manufacturer	Model #	Description	Calibration Due
2295	Agilent	E4440A	Spectrum Analyzer	30 Sep 2017
1831	HP	6622A	Power Supply	CIU
0472	Tektronix	THS730A	DMM/Scope	15 Nov 2017

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.				

Applies to the general emission measurements. Other transmitter measurements use specific bandwidths not listed above.

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

(This page intentionally left blank.)