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Project 19459-10

**TFW-01**  
**Wireless Methane Alarm**

**Wireless Certification Report**

**FCC 15.249, RSS-210**

Prepared for:

Ascendant Engineering Solutions  
12303 Technology  
Suite 925  
Austin, TX 78727

For applicant:

Northeast Gas Association  
20 Waterview Boulevard, 4th Floor  
Parsippany New Jersey United States 07054

By

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

17 Jan 2018

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Reviewed by



Larry Finn  
Chief Technology Officer

Written by



Eric Lifsey  
EMC Engineer

**Revision History**

<b>Revision Number</b>	<b>Description</b>	<b>Date</b>
Final 01		17 Jan 2018

Errata:

All citations of TF02-W refer to the TFW-01 being identical except for nomenclature.

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# Certificate of Compliance

FCC MRA Designation Number: US5270

NVLAP Accreditation Number: 200062-0

Applicant	Device & Test Identification
Northeast Gas Association 20 Waterview Boulevard, 4th Floor Parsippany New Jersey United States 07054 Certificate Date: 29 Dec 2017	FCC ID: 2AOLCTFW-01 Industry Canada ID: Not sought at this time. Model(s): TFW-01 Laboratory Project ID: 19459-15

The device(s) listed above were tested utilizing the following documents and found to be in compliance with the required criteria on the indicated certificate date.

47 CFR (USA), IC (Industry Canada)	
Section Reference	Parameter
15.249(a), RSS-210 Issue 9 Annex B.10	Fundamental Field Strength Limit 50 mV/m
15.209, RSS-210 Issue 9 Annex B.10	Harmonic & Spurious Emissions
15.203, RSS-Gen Issue 4	Antenna Requirements
2.1049, RSS-Gen	Bandwidth

I, the undersigned below, 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.

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. The procedures of ANSI C63.4: 2009 were used for making all radiated enclosure and mains emission measurements.

### 1.2 EUT Description

The device is a wireless methane level alarm. After connecting with the wireless network, the device remains quiet until it detects methane levels above a programmed set point. It then reports this to the network every 30 seconds. When the methane level drops below a programmed set point, the device reports this change and returns to the quiet monitoring state.

Table 1.2.1: Equipment Under Test		
Manufacturer / Model	Serial #	Description
Northeast Gas Association TFW-01	None	916 MHz transceiver; serves as wireless methane alarm.

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

### 1.3 EUT Operation

The EUT was exercised in a manner consistent with normal operations. This device is designed for fixed mounting on a wall or ceiling.

### 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-210 Issue 9	Licence-Exempt Radio Apparatus: Category I Equipment
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	15.249(a)	RSS-210 Issue 9 Annex B.10
Bandwidth	2.1049	RSS-Gen Issue 4
Spurious Emission	15.249, 15.209, 15.205	RSS-210 Issue 9 Annex B.10, RSS-Gen Issue 4
Antenna Requirement	15.203	RSS-Gen Issue 4

## 2.0 Fundamental Power

### 2.1 Test Procedure

EUT is placed on a non-conductive surface 80 cm above a reference plane and measurements of emissions are made to find maximum emission level.

### 2.2 Test Criteria

Section Reference	Parameter	Date(s)
15.249, RSS210 B.10	Radiated Output Power, 50 mV/m @ 3 m Restated as 93.98 dB $\mu$ V/m @ 3 m Restated as 83.5 dB $\mu$ V/m @ 10 m	4 Oct 2017

### 2.3 Test Results

The EUT was found to be in compliance with the applicable criteria. The measurement is radiated and includes the effects of antenna gain.

<b>Table 2.3.1 Radiated Peak Power Measurement Unmodulated; Maximum in Horizontal Polarity</b>			
Frequency MHz	Corrected Level (Measured Peak Level) dB $\mu$ V/m	Limit @ 10 meters dB $\mu$ V/m	Margin dB
916	77.2	83.5	-6.3

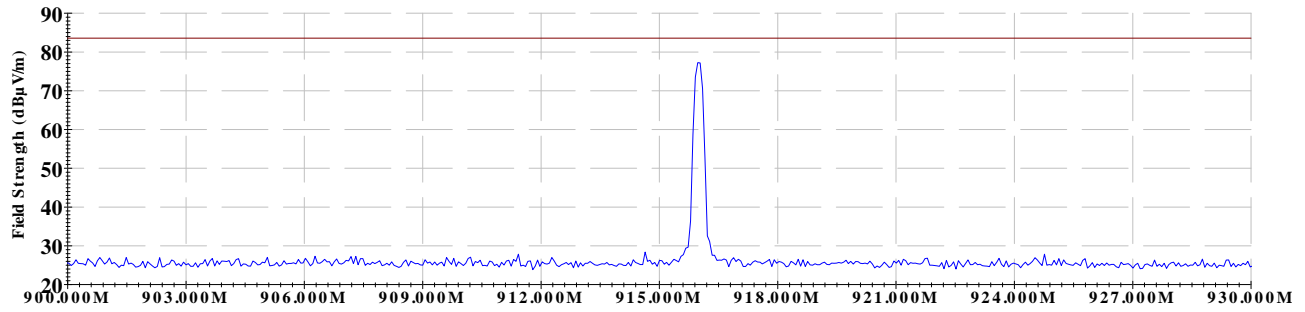
Resolution bandwidth 1 MHz. Video bandwidth 3 MHz.

Recorded measurements appear below.

# Professional Testing, EMI, Inc

## Radiated Emissions, 10m Distance

30MHz - 1GHz Vertical Polarity Measured Fundamental



Operator: Eric Lifsey

19459'RERun01'TxModeUnmod'916M000.ttl

09:31:29 AM, Wednesday, October 04, 2017

Mode: Transmit unmodulated

Power: 120 VAC 60Hz adapter

Position: Wallmount upright

Frequency

EUT: TF02-W

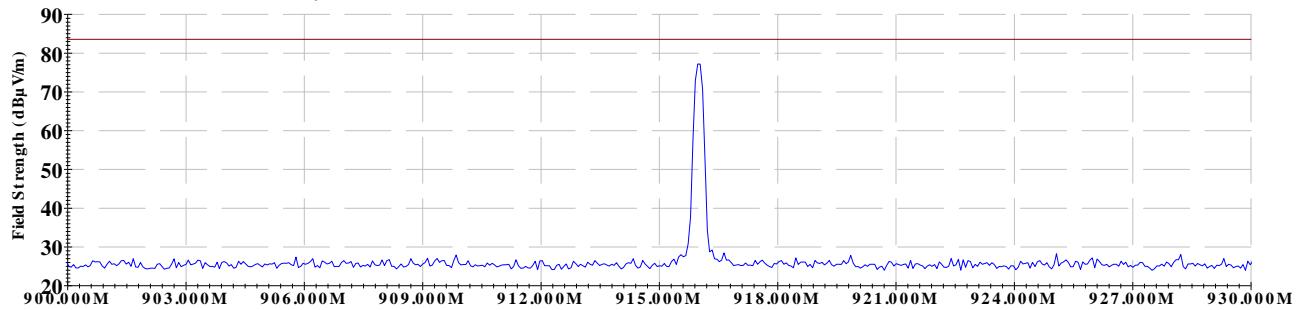
Project Number: 19459

Client: AES

# Professional Testing, EMI, Inc

## Radiated Emissions, 10m Distance

30MHz - 1GHz Horizontal Polarity Measured Fundamental



Operator: Eric Lifsey

19459'RERun01'TxModeUnmod'916M000.ttl

09:31:29 AM, Wednesday, October 04, 2017

Mode: Transmit unmodulated

Power: 120 VAC 60Hz adapter

Position: Wallmount upright

Frequency

EUT: TF02-W

Project Number: 19459

Client: AES



### 3.0 Transmitter Duty Cycle

#### 3.1 Test Procedure

EUT operation is verified by analyzing the programmed operation.

#### 3.2 Test Criteria

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.

#### 3.3 Test Results

"The unit is in the receive mode until gas is detected in excess of a predetermined level. When the level is exceeded, the unit sends a 56 bits message at 100k bytes/second which lasts 560 microseconds. This message is sent every 30 seconds. As soon as the gas level drops the messages stop."

Calculated On Time (msec)	Measured Time Interval (msec)	Duty Cycle Factor Calculation	Result (dB)	Duty Cycle Factor Allowed (dB)
0.56	30	$= 20 * \log_{10} ( 0.56 \text{ msec} / 30,000 \text{ msec} )$	-94.6	-20

The allowed duty cycle factor is applied to fundamental and harmonic signals as needed to determine average levels.

Factor for exposure calculation is result above divided by 2 for power effect:  $-94.6 / 2 = -47.3 \text{ dB}$

## 4.0 Occupied Bandwidth

### 4.1 Test Procedure

The EUT is configured for adequate signal/power and the bandwidth then is measured. A recording of the results is included.

### 4.2 Test Criteria

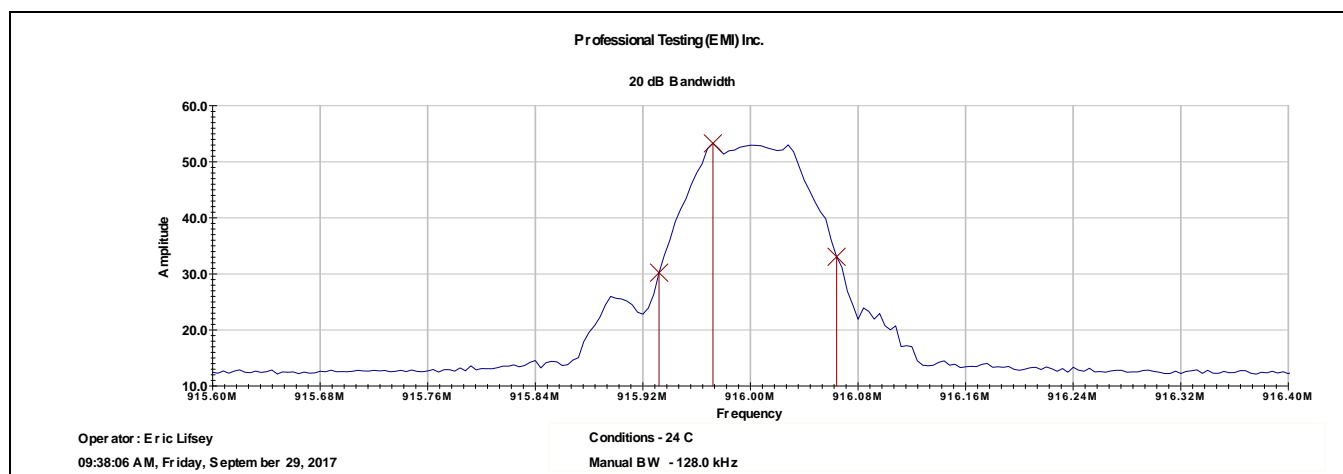
Section Reference	Parameter	Date(s)
2.1049, RSS-Gen	Bandwidth, 20 dB	29 Sep 2017

### 4.3 Test Results

EUT was found to be in compliance with applicable requirements.

Maximum BW (kHz)
128

#### 4.3.1 Bandwidth Plots

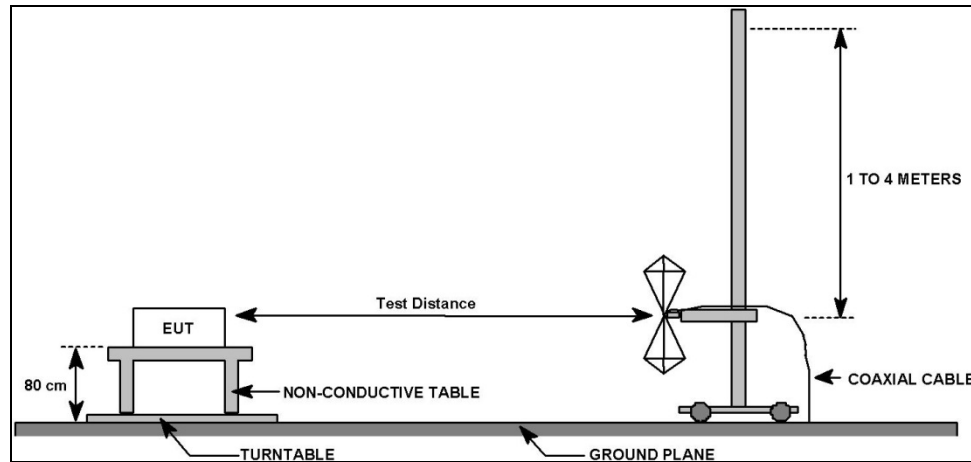


## 5.0 Radiated Spurious Emissions Transmit Mode

### 5.1 Test Procedure

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

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



### 5.2 Test Criteria

Clause Subject	Section Number	Date
Field Strength of Radiated Spurious/Harmonic Emissions	15.249, 15.209, RSS-210 B.10	4 Oct 2017

### 5.3 Test Results

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

## 5.4 Up to 1 GHz

## Professional Testing, EMI, Inc.

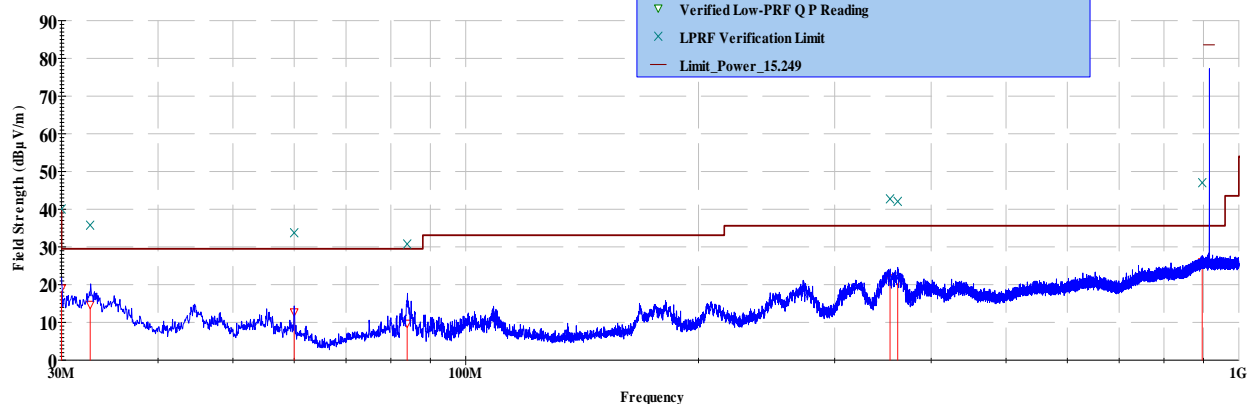
<b>Test Method:</b>	ANSI C63.10: 2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
<b>In accordance with:</b>	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
<b>Section:</b>	15.209		
<b>Test Date(s):</b>	10/4/2017	<b>EUT Serial #:</b>	None
<b>Customer:</b>	AES	<b>EUT Part #:</b>	0
<b>Project Number:</b>	19459	<b>Test Technician:</b>	Eric Lifsey
<b>Purchase Order #:</b>	0	<b>Supervisor:</b>	Lisa Arndt
<b>Equip. Under Test:</b>	TF02-W	<b>Witness' Name:</b>	Alan Rudnai

## Radiated Emissions Test Results Data Sheet

Page: 1 of 1

EUT Line Voltage:		120 VAC			EUT Power Frequency:		60 Hz		
Antenna Orientation:		Vertical			Frequency Range:		30MHz to 1GHz		
EUT Mode of Operation:					Transmit, modulated				
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
29.9973	10	333	0	Quasi-peak	31.1	19.062	39.1	-20.0	Pass
32.6692	10	308	1.54	Quasi-peak	26.7	14.74	29.5	-14.8	Pass
59.9951	10	88	1.66	Quasi-peak	31	12.75	29.5	-16.8	Pass
84.0024	10	31	2.01	Quasi-peak	29.6	9.761	29.5	-19.7	Pass
353.819	10	60	3.71	Quasi-peak	31.5	21.75	35.6	-13.9	Pass
362.01	10	143	3.97	Quasi-peak	30.5	21.043	35.6	-14.6	Pass
896.896	10	140	1.43	Quasi-peak	21.3	26.033	35.6	-9.6	Pass

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



Operator: Eric Lifsey  
19459'RERun01'TxModeUnmod'916M000.ttl  
10:06:17 AM, Wednesday, October 04, 2017

Mode: Transmit unmodulated  
Power: 120VAC 60Hz adapter  
Position: Wall mount upright

EUT: TF02-W  
Project Number: 19459  
Client: AES

≤ 1GHz Vertical Antenna Polarity Measured Emissions

## Professional Testing, EMI, Inc.

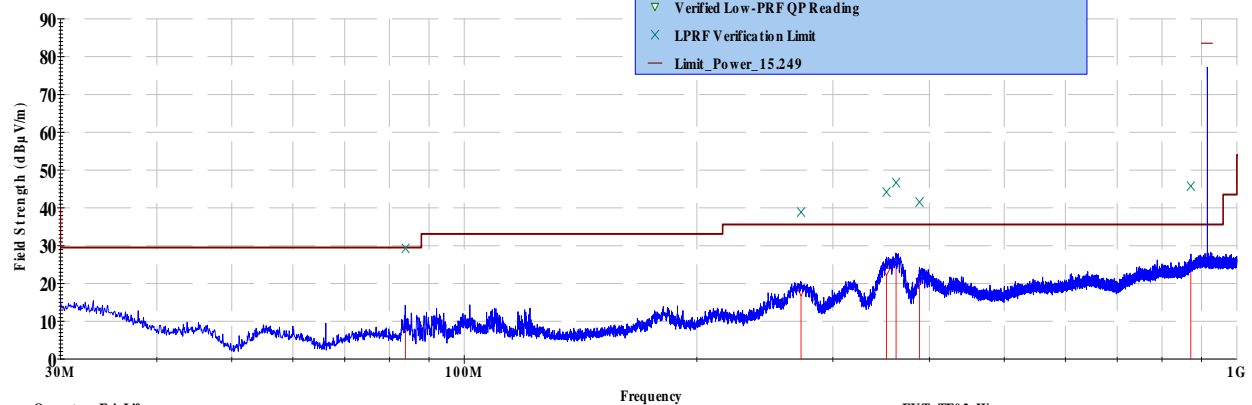
<b>Test Method:</b>	ANSI C63.10: 2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
<b>In accordance with:</b>	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
<b>Section:</b>	15.209		
<b>Test Date(s):</b>	10/4/2017	<b>EUT Serial #:</b>	None
<b>Customer:</b>	AES	<b>EUT Part #:</b>	0
<b>Project Number:</b>	19459	<b>Test Technician:</b>	Eric Lifsey
<b>Purchase Order #:</b>	0	<b>Supervisor:</b>	Lisa Arndt
<b>Equip. Under Test:</b>	TF02-W	<b>Witness' Name:</b>	Alan Rudnai

### Radiated Emissions Test Results Data Sheet

Page: 1 of 1

EUT Line Voltage:		120 VAC			EUT Power Frequency:		60 Hz		
Antenna Orientation:		Horizontal			Frequency Range:		30MHz to 1GHz		
EUT Mode of Operation:					Transmit, modulated				
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
83.9381	10	242	3.66	Quasi-peak	28.1	8.287	29.5	-21.2	Pass
272.817	10	263	2.13	Quasi-peak	28.5	17.866	35.6	-17.7	Pass
351.963	10	304	2.41	Quasi-peak	33.1	23.214	35.6	-12.4	Pass
362.173	10	281	2.55	Quasi-peak	35.1	25.693	35.6	-9.9	Pass
388.389	10	124	2.05	Quasi-peak	28.4	20.505	35.6	-15.1	Pass
871.932	10	346	1.9	Quasi-peak	21.3	24.737	35.6	-10.9	Pass

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



Operator: Eric Lifsey

19459'RERun01TxModeUnmod'916M000.tif

10:06:17 AM, Wednesday, October 04, 2017

Mode: Transmit unmodulated  
Power: 120VAC 60Hz adapter  
Position: Wallmount upright

EUT: TF02-W

Project Number: 19459

Client: AES

**≤ 1GHz Horizontal Antenna Polarity Measured Emissions**

## 5.5 Above 1 GHz

Professional Testing, EMI, Inc.			
<b>Test Method:</b>	ANSI C63.10: 2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
<b>In accordance with:</b>	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
<b>Section:</b>	15.209		
<b>Test Date(s):</b>	10/4/2017	<b>EUT Serial #:</b>	None
<b>Customer:</b>	AES	<b>EUT Part #:</b>	0
<b>Project Number:</b>	19459	<b>Test Technician:</b>	Eric Lifsey
<b>Purchase Order #:</b>	0	<b>Supervisor:</b>	Lisa Arndt
<b>Equip. Under Test:</b>	TF02-W	<b>Witness' Name:</b>	Alan Rudnai
<b>Radiated Emissions Test Results Data Sheet</b>		<b>Page:</b>	<b>1 of 1</b>
<b>EUT Line Voltage:</b>	120 VAC	<b>EUT Power Frequency:</b>	60 Hz
<b>Antenna Orientation:</b>	Vertical	<b>Frequency Range:</b>	Above 1GHz
<b>EUT Mode of Operation:</b>	Transmit, modulated		
<div style="display: flex; justify-content: space-between;"> <div style="width: 60%;"> <p><b>Professional Testing, EMI, Inc</b> Radiated Emissions, 3m Distance 1-18GHz Vertical Polarity Measured Emissions</p> <p>The graph displays field strength measurements from 1 GHz to 10 GHz. The y-axis ranges from 20 to 90 dBµV/m. A red line at approximately 75 dBµV/m represents the Average Limit Level. A red line at approximately 55 dBµV/m represents the Peak Limit Level. The measured emissions (blue line) fluctuate between 30 and 50 dBµV/m, with several sharp peaks reaching up to 60 dBµV/m. A legend in the top right corner identifies the lines: Average Limit Level (red line), Corrected Average Reading (red triangle), Peak Limit Level (red line), and Corrected Peak Reading (blue line).</p> </div> <div style="width: 35%; text-align: right;"> </div> </div> <div style="display: flex; justify-content: space-between; margin-top: 10px;"> <div style="width: 30%;"> <p>Operator: Eric Lifsey 19459'RERun01TxModeUnmod'916M000.tif 10:25:57 AM, Wednesday, October 04, 2017</p> </div> <div style="width: 30%; text-align: center;"> <p>Mode: Transmit unmodulated Power: 120VAC 60Hz adapter Position: Wall mount upright</p> </div> <div style="width: 30%; text-align: right;"> <p>EUT: TF02-W Project Number: 19459 Client: AES</p> </div> </div>			
<b>&gt; 1GHz Vertical Antenna Polarity Measured Emissions</b>			

The averaging factor of -20 dB can be applied to the peak measurements recorded above.

## Professional Testing, EMI, Inc.

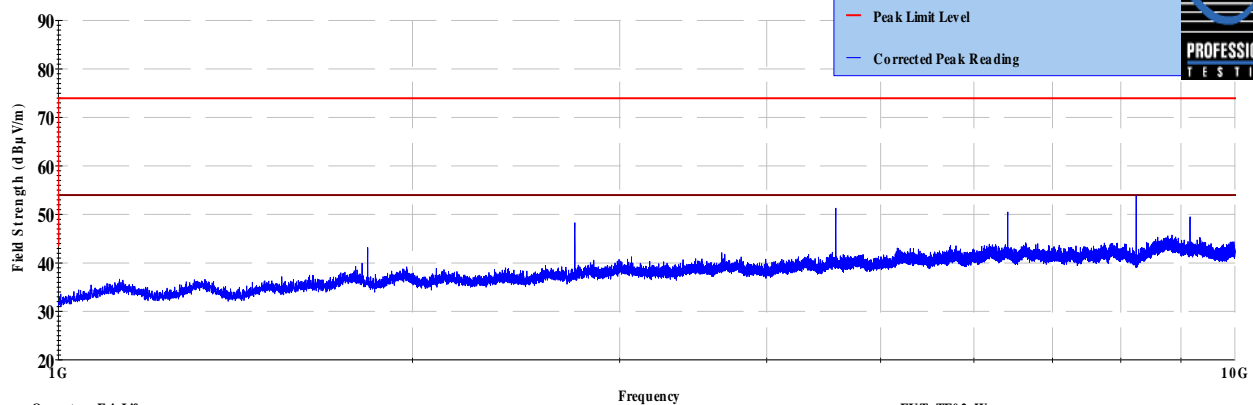
<b>Test Method:</b>	ANSI C63.10: 2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
<b>In accordance with:</b>	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
<b>Section:</b>	15.209		
<b>Test Date(s):</b>	10/4/2017	<b>EUT Serial #:</b>	None
<b>Customer:</b>	AES	<b>EUT Part #:</b>	0
<b>Project Number:</b>	19459	<b>Test Technician:</b>	Eric Lifsey
<b>Purchase Order #:</b>	0	<b>Supervisor:</b>	Lisa Arndt
<b>Equip. Under Test:</b>	TF02-W	<b>Witness' Name:</b>	Alan Rudnai

### Radiated Emissions Test Results Data Sheet

Page: 1 of 1

<b>EUT Line Voltage:</b>	120 VAC	<b>EUT Power Frequency:</b>	60 Hz
<b>Antenna Orientation:</b>	Horizontal	<b>Frequency Range:</b>	Above 1GHz
<b>EUT Mode of Operation:</b>	Transmit, modulated		

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



Operator: Eric Lifsey

19459'RERun01TxModeUnmod'916M000.ttl

10:25:56 AM, Wednesday, October 04, 2017

Mode: Transmit unmodulated  
Power: 120VAC 60Hz adapter  
Position: Wallmount upright

EUT: TF02-W

Project Number: 19459

Client: AES

### > 1GHz Horizontal Antenna Polarity Measured Emissions

The averaging factor of -20 dB can be applied to the peak measurements recorded above.

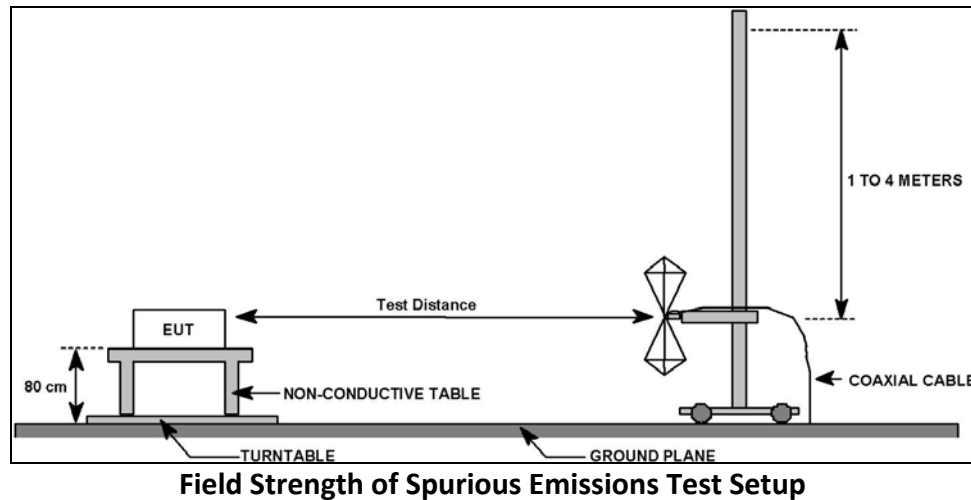
## 6.0 Radiated Spurious Emissions Receive Mode

### 6.1 Test Procedure

The EUT was placed on a non-conductive table 0.8 meters above the ground plane. The table was centered on a rotating turntable at a distance of 1 meter from the measurement antenna.

Harmonic emissions above 1 GHz peak were measured with peak detection, a resolution bandwidth of 3 MHz, and at a distance of 3 meters. If peak measurements exceeded average limits, the peak limit was applicable and duty cycle factor was then applied for average level calculation. Emissions were investigated up to the 10<sup>th</sup> harmonic of the transmitter fundamental.

Non-harmonic spurious emissions must satisfy the average limit and the peak limit (20 dB above average).



### 6.2 Test Criteria

Clause Subject	Section Number	Date
Field Strength of Radiated Spurious/Harmonic Emissions	15.249, 15.209, RSS-Gen	4 Oct 2017

### 6.3 Test Results

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



## 6.4 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):	10/4/2017	EUT Serial #:	None
Customer:	AES	EUT Part #:	0
Project Number:	19459	Test Technician:	Eric Lifsey
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	TF02-W	Witness' Name:	Alan Rudnai

#### Radiated Emissions Test Results Data Sheet

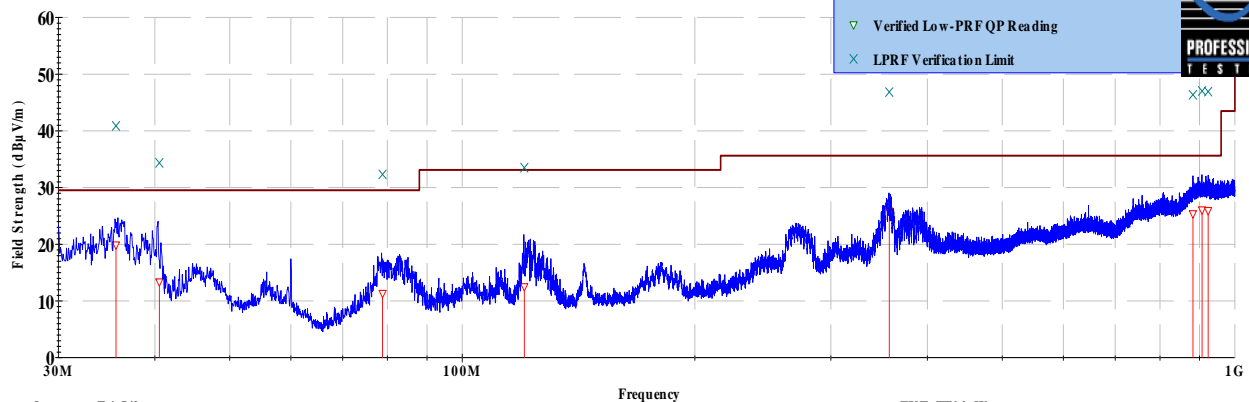
Page: 1 of 1

EUT Line Voltage:		120 VAC			EUT Power Frequency:		60 Hz		
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
35.6119	10	11	1.04	Quasi-peak	32.4	19.858	29.5	-9.6	Pass
40.5272	10	9	1.48	Quasi-peak	31.2	13.345	29.5	-16.2	Pass
78.8376	10	61	1.64	Quasi-peak	29.7	11.311	29.5	-18.2	Pass
120.273	10	330	1.44	Quasi-peak	29.9	12.504	33.1	-20.6	Pass
356.989	10	111	1.08	Quasi-peak	35.5	25.83	35.6	-9.8	Pass
882.637	10	139	3.86	Quasi-peak	21.3	25.34	35.6	-10.3	Pass
906.903	10	27	3.87	Quasi-peak	21.2	26.03	35.6	-9.6	Pass
923.551	10	101	2.45	Quasi-peak	21.1	25.921	35.6	-9.7	Pass

#### Professional Testing, EMI, Inc

##### Radiated Emissions, 10m Distance

30MHz - 1GHz Vertical Polarity Measured Emissions



Operator: Eric Lifsey

19459'RERun02'RxModel

06:25:58 PM, Wednesday, October 04, 2017

Mode: Receive

Power: 120 VAC 60 Hz

Position: Wall Mount Vertical

EUT: TF02-W

Project Number: 19459

Client: AES

#### ≤ 1GHz Vertical Antenna Polarity Measured Emissions

## Professional Testing, EMI, Inc.

<b>Test Method:</b>	ANSI C63.10: 2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
<b>In accordance with:</b>	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
<b>Section:</b>	15.209		
<b>Test Date(s):</b>	10/4/2017	<b>EUT Serial #:</b>	None
<b>Customer:</b>	AES	<b>EUT Part #:</b>	0
<b>Project Number:</b>	19459	<b>Test Technician:</b>	Eric Lifsey
<b>Purchase Order #:</b>	0	<b>Supervisor:</b>	Lisa Arndt
<b>Equip. Under Test:</b>	TF02-W	<b>Witness' Name:</b>	Alan Rudnai

### Radiated Emissions Test Results Data Sheet

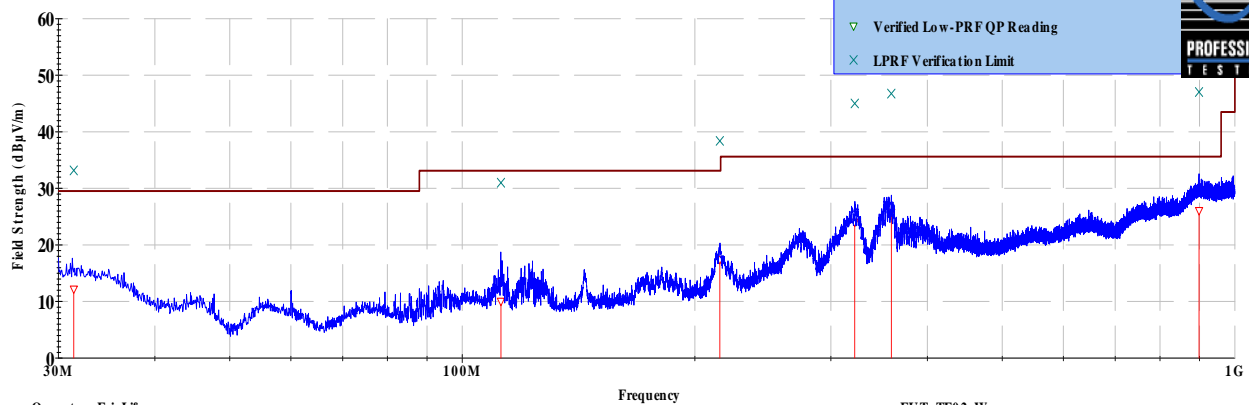
Page: 1 of 1

EUT Line Voltage:		120 VAC			EUT Power Frequency:		60 Hz		
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
31.4047	10	187	3.89	Quasi-peak	24.2	12.17	29.5	-17.3	Pass
112.2	10	52	3.7	Quasi-peak	26.8	10.001	33.1	-23.1	Pass
215.47	10	195	3.95	Quasi-peak	31.8	17.372	33.1	-15.7	Pass
322.103	10	43	2.79	Quasi-peak	33.7	24.005	35.6	-11.6	Pass
359.145	10	63	2.01	Quasi-peak	35.3	25.747	35.6	-9.9	Pass
898.856	10	73	2.36	Quasi-peak	21.2	26.036	35.6	-9.6	Pass

#### Professional Testing, EMI, Inc

##### Radiated Emissions, 10m Distance

30MHz - 1GHz Horizontal Polarity Measured Emissions



Operator: Eric Lifsey

19459'RERun02'RxModc.tif

06:25:58 PM, Wednesday, October 04, 2017

Mode: Receive

Power: 120 VAC 60 Hz

Position: Wall Mount Vertical

EUT: TF02-W

Project Number: 19459

Client: AES

**≤ 1GHz Horizontal Antenna Polarity Measured Emissions**

## 6.5 Above 1 GHz

## Professional Testing, EMI, Inc.

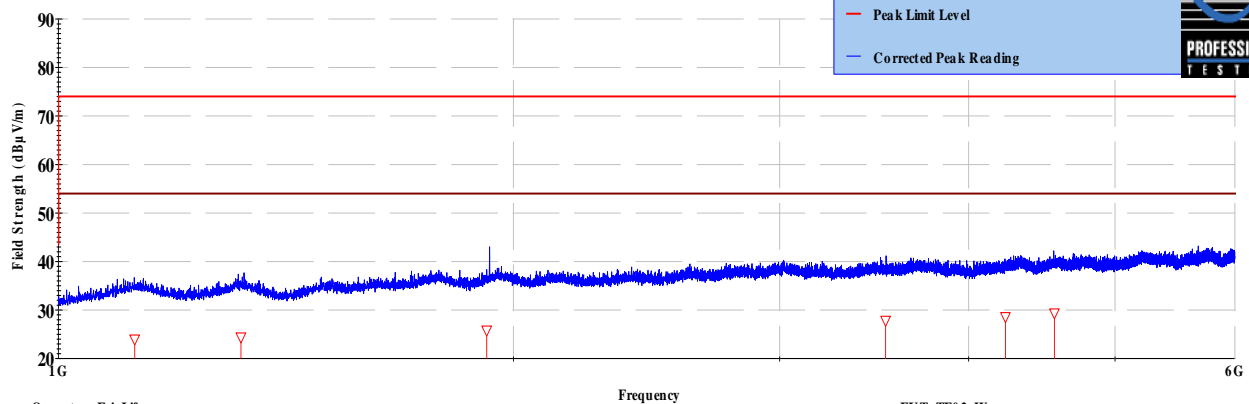
Test Method:	ANSI C63.10: 2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	10/4/2017	EUT Serial #:	None
Customer:	AES	EUT Part #:	0
Project Number:	19459	Test Technician:	Eric Lifsey
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	TF02-W	Witness' Name:	Alan Rudnai

## Radiated Emissions Test Results Data Sheet

Page: 1 of 1

EUT Line Voltage:			120 VAC		EUT Power Frequency:		60 Hz		
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
1123.17	3	216	1.31	Average	36.6	23.945	54.0	-30.0	Pass
1320.3	3	63	1.64	Average	36.3	24.39	54.0	-29.6	Pass
1919.85	3	316	2.2	Average	35.2	25.812	54.0	-28.1	Pass
3525.35	3	131	2.69	Average	34.9	27.815	54.0	-26.1	Pass
4230.78	3	121	1.61	Average	33.6	28.576	54.0	-25.4	Pass
4558.66	3	188	2.04	Average	33.8	29.332	54.0	-24.6	Pass

Professional Testing, EMI, Inc  
Radiated Emissions, 3m Distance  
1-6GHz Vertical Polarity Measured Emissions



Operator: Eric Lifsey  
19459 RERun02 RxModel  
08:11:06 AM, Thursday, October 05, 2017

Mode: Receive  
Power: 120 VAC 60 Hz  
Position: Wall Mount Vertical

EUT: TF02-W  
Project Number: 19459  
Client: AES

## &gt; 1GHz Vertical Antenna Polarity Measured Emissions

## Professional Testing, EMI, Inc.

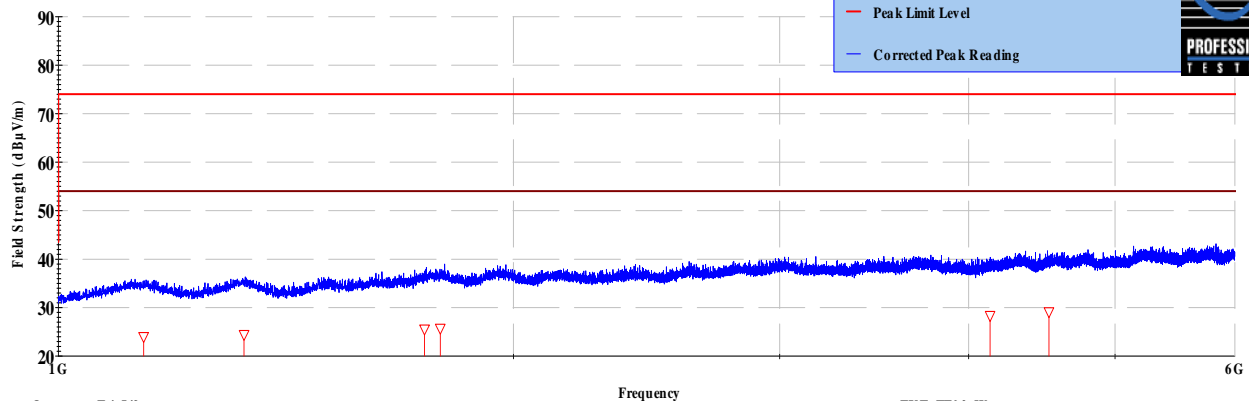
<b>Test Method:</b>	ANSI C63.10: 2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
<b>In accordance with:</b>	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
<b>Section:</b>	15.209		
<b>Test Date(s):</b>	10/4/2017	<b>EUT Serial #:</b>	None
<b>Customer:</b>	AES	<b>EUT Part #:</b>	0
<b>Project Number:</b>	19459	<b>Test Technician:</b>	Eric Lifsey
<b>Purchase Order #:</b>	0	<b>Supervisor:</b>	Lisa Arndt
<b>Equip. Under Test:</b>	TF02-W	<b>Witness' Name:</b>	Alan Rudnai

### Radiated Emissions Test Results Data Sheet

Page: 1 of 1

EUT Line Voltage:		120 VAC			EUT Power Frequency:		60 Hz		
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
1138.6	3	203	1.35	Average	36.6	23.974	54.0	-30.0	Pass
1326.9	3	335	3.89	Average	36.3	24.402	54.0	-29.6	Pass
1746.45	3	296	3.41	Average	35.5	25.534	54.0	-28.4	Pass
1788.91	3	303	3.71	Average	35.5	25.712	54.0	-28.2	Pass
4133.08	3	85	2.5	Average	34	28.318	54.0	-25.6	Pass
4520.92	3	242	2.95	Average	33.6	29.094	54.0	-24.9	Pass

**Professional Testing, EMI, Inc**  
Radiated Emissions, 3m Distance  
1-6 GHz Horizontal Polarity Measured Emissions



Operator: Eric Lifsey  
19459 RERun02 RxMod.tif  
08:11:06 AM, Thursday, October 05, 2017

Mode: Receive  
Power: 120 VAC 60 Hz  
Position: Wall Mount Vertical

EUT: TF02-W  
Project Number: 19459  
Client: AES

**> 1GHz Horizontal Antenna Polarity Measured Emissions**

## 7.0 Antenna Construction Requirements

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

### 7.1 Procedure

A direct examination of the antenna construction is performed and compared to rule criteria that prevents wireless device antennas from being modified by end users in ways that would void their authorization to use the device.

### 7.2 Criteria

Clause Subject	Section Number	Date
Antenna Construction	15.203, RSS-Gen	29 Dec 2017

### 7.3 Results

Antenna Manufacturer and Model	Specifications
Taoglas ILA.09	Description: 915 MHz ceramic loop chip antenna. Peak Gain: 0.39 dBi @ 915 MHz Estimated 0.5 dBi per datasheet charted peak gain.

- The antenna is internal only to the device.
- The antenna is a soldered-on factory made component on the transmitter circuit board.
- There is no antenna connector.

The antenna design meets the requirements of the rules.

## 8.0 Lists

### 8.1 Equipment for Spurious Radiated Emissions

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	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	TDK 10M	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, 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

## 8.2 Equipment for Bandwidth Measurement

Asset #	Manufacturer	Model #	Description	Calibration Due
2216	HP	8593E	Spectrum Analyzer	18 Jan 2018
None	PTI	None	Sense antenna	CNR

## 8.3 Measurement Bandwidths for Spurious Emissions

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
<p>*Notes:</p> <ol style="list-style-type: none"> <li>1. The settings above are specifically calculated for the E4440A series of spectrum analyzers, which have 8,000 data points per range.</li> <li>2. The measurement receiver resolution bandwidth setting was 300 Hz for quasi-peak measurements from 9-150 kHz.</li> <li>3. The measurement receiver resolution bandwidth setting was 9 kHz for quasi-peak measurements from 0.15-30 MHz.</li> <li>4. The measurement receiver resolution bandwidth setting was 120 kHz for quasi-peak measurements from 30-1000 MHz.</li> <li>5. The measurement receiver resolution bandwidth setting was 1 MHz for average measurements from 1-18 GHz.</li> </ol>				

Note that specific transmitter measurements may use different bandwidths than listed here.

## 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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