



# Compliance Testing, LLC

Previously Flom Test Lab

EMI, EMC, RF Testing Experts Since 1963

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## Test Report

Prepared for: Nudge systems

Model: Pleco sensor, PW2S

Description: Water Usage measurement Device

Serial Number: NA

FCC ID: 2ATURPW2S

IC ID: 25251-PW2S

To

FCC Part 15.231

&

RSS 210

Date of Issue: July 3, 2019

On the behalf of the applicant:

Nudge systems  
230 Oak CT.  
Menlo Park, CA 94025

Attention of:

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Project No: p1940005

Poona Saber  
Project Test Engineer

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All results contained herein relate only to the sample tested.



## Test Report Revision History

Revision	Date	Revised By	Reason for Revision
1.0	July 3, 2019	Poona Saber	Original Document
2.0	March 12 <sup>th</sup> , 2020	Poona Saber	Added average measurement methods on page 9 Revised average numbers and pulse period on page 10 Added model number on page one and page 6
3.0	March 23,2020	Poona Saber	Revised duty cycle factor, power level and average measurements of fundamental and spurious emissions



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**ILAC / A2LA**

Compliance Testing, LLC, has been accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to the joint ISO-ILAC-IAF Communiqué dated January 2009).

The tests results contained within this test report all fall within our scope of accreditation, unless noted below.

Please refer to <http://www.compliancetesting.com/labscope.html> for current scope of accreditation.

Testing Certificate Number: **2152.01**



**FCC Site Reg. #349717**

**IC Site Reg. #2044A-2**

**Non-accredited tests contained in this report:**

**N/A**

**The applicant has been cautioned as to the following**

**15.21: Information to User**

The user's manual or instruction manual for an intentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

**15.27(a): Special Accessories**

Equipment marketed to a consumer must be capable of complying with the necessary regulations in the configuration in which the equipment is marketed. Where special accessories, such as shielded cables and/or special connectors are required to enable an unintentional or intentional radiator to comply with the emission limits in this part, the equipment must be marketed with, i.e. shipped and sold with, those special accessories. However, in lieu of shipping or packaging the special accessories with the unintentional or intentional radiator the responsible part may employ other methods of ensuring that the special accessories are provided to the consumer, without an additional charge.

Information detailing any alternative method used to supply the special accessories for a grant of equipment authorization or retained in the verification records, as appropriate. The party responsible for the equipment, as detailed in § 2.909 of this chapter, shall ensure that these special accessories are provided with the equipment. The instruction manual for such devices shall include appropriate instructions on the first page of text concerned with the installation of the device that these special accessories must be used with the device. It is the responsibility of the user to use the needed special accessories supplied with the equipment.

**Standard Test Conditions Engineering Practices**

Except as noted herein, the following conditions and procedures were observed during the testing:

In accordance with ANSI C63.10-2009 and unless otherwise indicated in the specific measurement results, the ambient temperature of the actual EUT was maintained within the range of 10° to 40°C (50° to 104°F) unless the particular equipment requirements specified testing over a different temperature range. Also, unless otherwise indicated, the humidity levels were in the range of 10% to 90% relative humidity.

Measurement results, unless otherwise noted, are worst-case measurements.

Environmental Conditions		
Temperature (°C)	Humidity (%)	Pressure (Mbar)
24-25.3	24.1-32.2	956-962

**EUT Description**

**Model:** Pleco Sensor, PW2S

**Description:** Water Usage measurement Device

**Serial Number:** NA

**Highest Clock Frequency:** sensor -16 MHz

**Additional Information:**

EUT consists of display unit (DU) and Sensor unit (SU) which will be paired together with a 433.92 MHz radio module and the operation and transmit power of the sensor unit is controlled by display unit which is served as the main user interface. Sensor unit is attached within the water meter pit and is connected to an external antenna with a battery enclosure that contains 4 lithium batteries and would be activated when all the batteries are on.

The maximum antenna gain of the sensor unit is 1.1 dBi for a ¼ wave antenna.

**EUT Operation during Tests**

Sensor unit unit transmits a pulse of 32 ms long every 10 seconds and the measurements below are made with the power setting of 16 dBm by Display unit.



**Accessories:**

Qty	Description	Manufacturer	Model	S/N
None				

**Cables:**

Qty	Description	Length (M)	Shielding Y/N	Shielded Hood Y/N	Termination
None					

**Modifications:**

None				
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## Test Results Summary

Specification	Test Name	Pass, Fail, N/A	Comments
15.231 (e) RSS 210 A.1.1, A.1.4	Fundamental Field Strength	Pass	
15.231(e) A.1.4	Out of Band Spurious Emissions	Pass	
15.231(c), RSS-210	99% Occupied Bandwidth	Pass	



## Field Strength of Fundamental and Spurious emissions

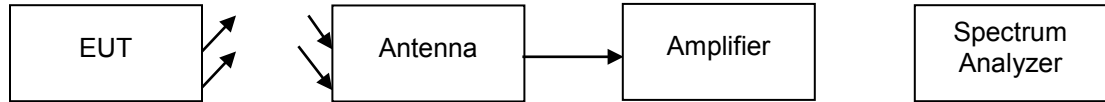
**Engineer:** Poona Saber

**Test Date:** 1/30/20

### Test Procedure

The EUT was tested in a semi-anechoic chamber at a distance of 3 meters from the receiving antenna. A spectrum analyzer was used to verify that the EUT met the requirements for Fundamental Field Strength.

### Test Setup



### Spectrum Analyzer Settings

Detector Settings	RBW	VBW	Span
Average	120 kHz	300 kHz	As Necessary

### Sample Calculations:

Measurement level is the raw data in dBuV without any correction factors added to it. Correction factors including Antenna, pre amp and cable insertion loss is added to this raw data as below in order to represent the electric field strength of dBuV/m and compared to limit per table at part 15.231 (b)

Electric field (dBuV/m) = Measured level (dBuV) + ACF + Cable Loss – Amplifier Gain

### Average measurement:

Per Ansi C63.10 when the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 s (100 ms).

The average field strength may be found by measuring the peak pulse amplitude (in log equivalent units) and determining the duty cycle correction factor (in dB) associated with the pulse modulation as shown below:

$$\delta(\text{dB}) = 20\log(\Delta)$$

where

$\delta$  is the duty cycle correction factor (dB)

$\Delta$  is the duty cycle (dimensionless)

This correction factor may then be subtracted from the peak pulse amplitude (in dB) to find the average emission. This correction may be applied to all emissions that demonstrate the same pulse timing characteristics as the fundamental emission

Please refer to plots below for pulse duration and duty cycle and tables below on applying the duty cycle factor to peak emissions measurement.

Duty cycle:

$$\Delta = 38/100 = 0.38$$

Duty Cycle factor:

$$\delta(\text{dB}) = 20\log(\Delta) = -8.4$$



**Limits per 15.231 (e)**

Average		
Fundamental Frequency (MHz)	Field Strength of Fundamental (dBuV/m)	Field Strength of Spurious Emissions (dBuV/m)
433.9	72.8	52.8

Peak		
Fundamental Frequency (MHz)	Field Strength of Fundamental (dBuV/m)	Field Strength of Spurious Emissions (dBuV/m)
433.9	92.8	72.8

**Test Results**

**Fundamental Field Strength**

Peak						
Tuned Frequency (MHz)	Peak Measured Level (dBuV)	Antenna Correction Factor (dB)	Cable Loss (dB)	Amplifier Gain (dB)	Peak Measurement (dBuV/m)	Result (dBuV/m)
433.9	77.05	21	1.95	27.23	72.77	Pass

Average						
Tuned Frequency (MHz)	Peak Measured Level (dBuV/m)	Pulse duration (ms)	Pulse Period (s)	Duty Cycle factor	Average Filed strength (dBuV/m)	Result (dBuV/m)
433.9	72.77	38.5	10.15	-8.4	64.37	Pass

**Spurious Field Strength**

Peak						
Tuned Frequency (MHz)	Peak Measured Level (dBuV)	Antenna Correction Factor (dB)	Cable Loss (dB)	Amplifier Gain (dB)	Peak Measurement (dBuV/m)	Result (dBuV/m)
867.81	54.65	27.4	2.6	27.3	57.35	Pass

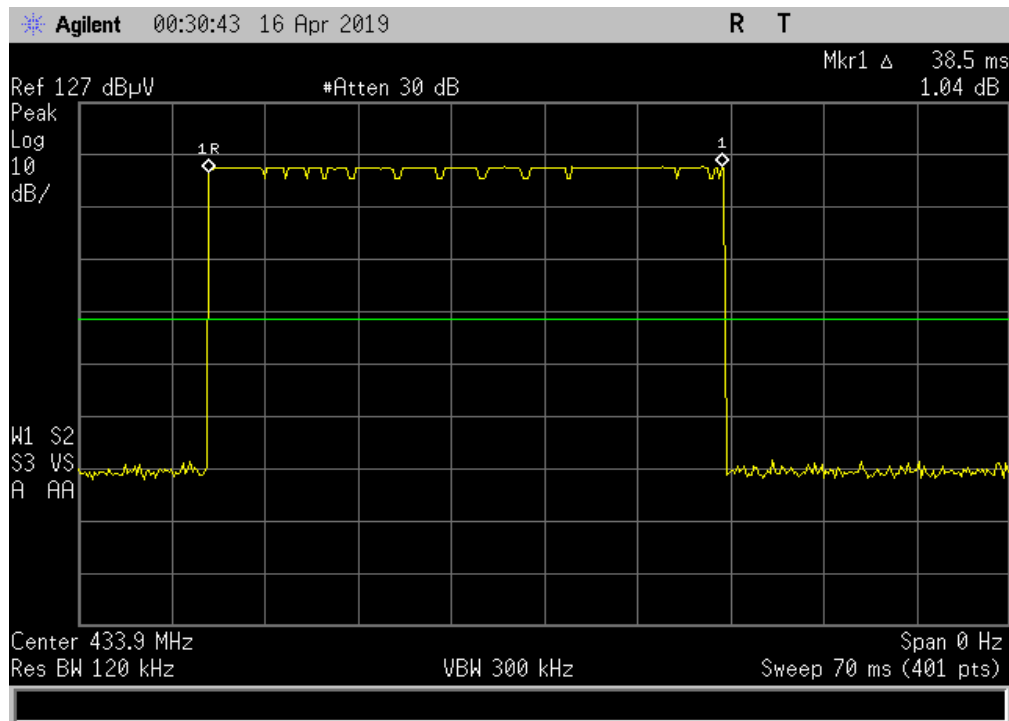
Average						
Tuned Frequency (MHz)	Peak Measured Level (dBuV/m)	Pulse duration (ms)	Pulse Period (s)	Duty Cycle factor	Average Filed strength (dBuV/m)	Result (dBuV/m)
433.9	57.35	38.5	10.15	-8.4	48.95	Pass

**Note:** There is no emissions in restricted band of 15.205 Observed per plots below

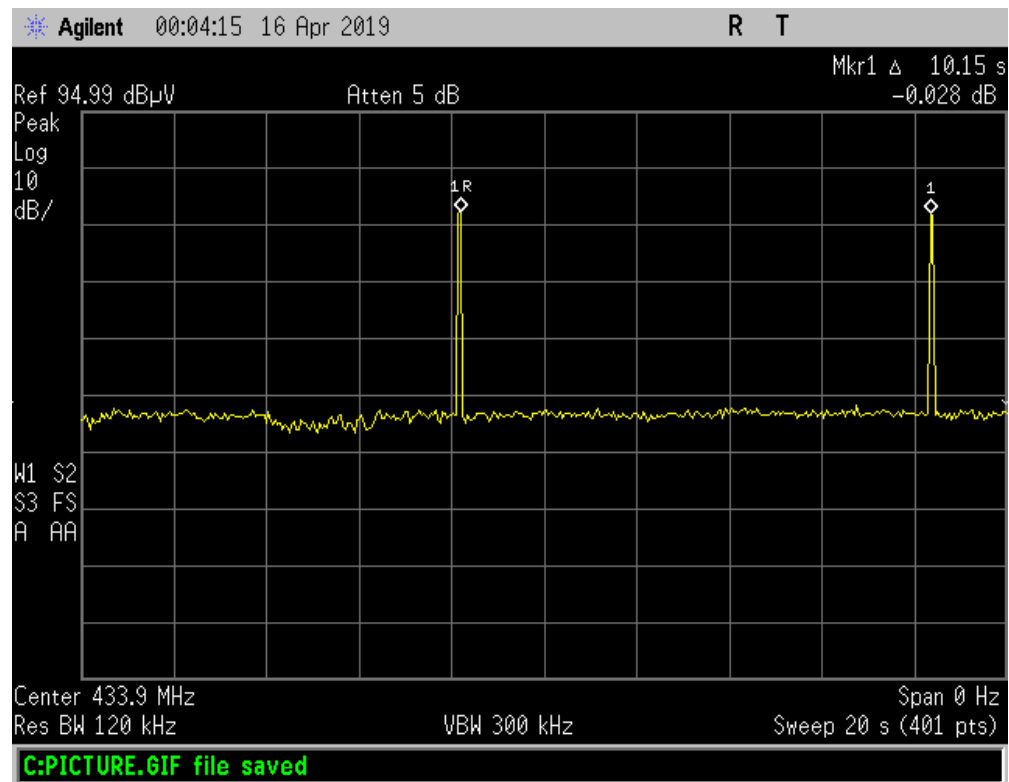


## Test Plots

### Duration of transmission

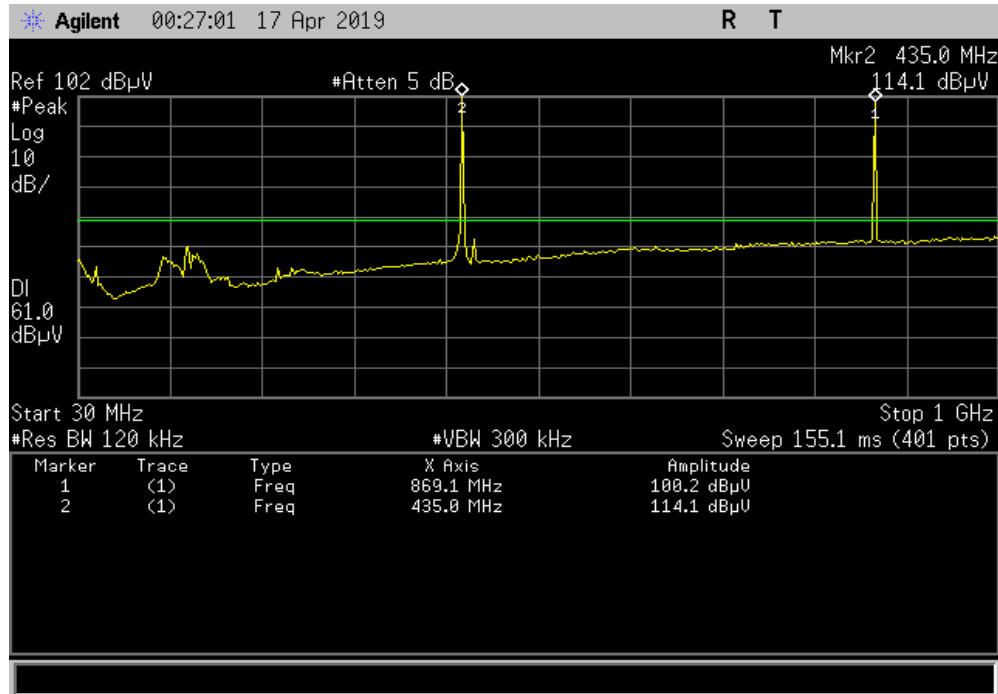


### Period of transmission





### 30 MHz- 1 GHz

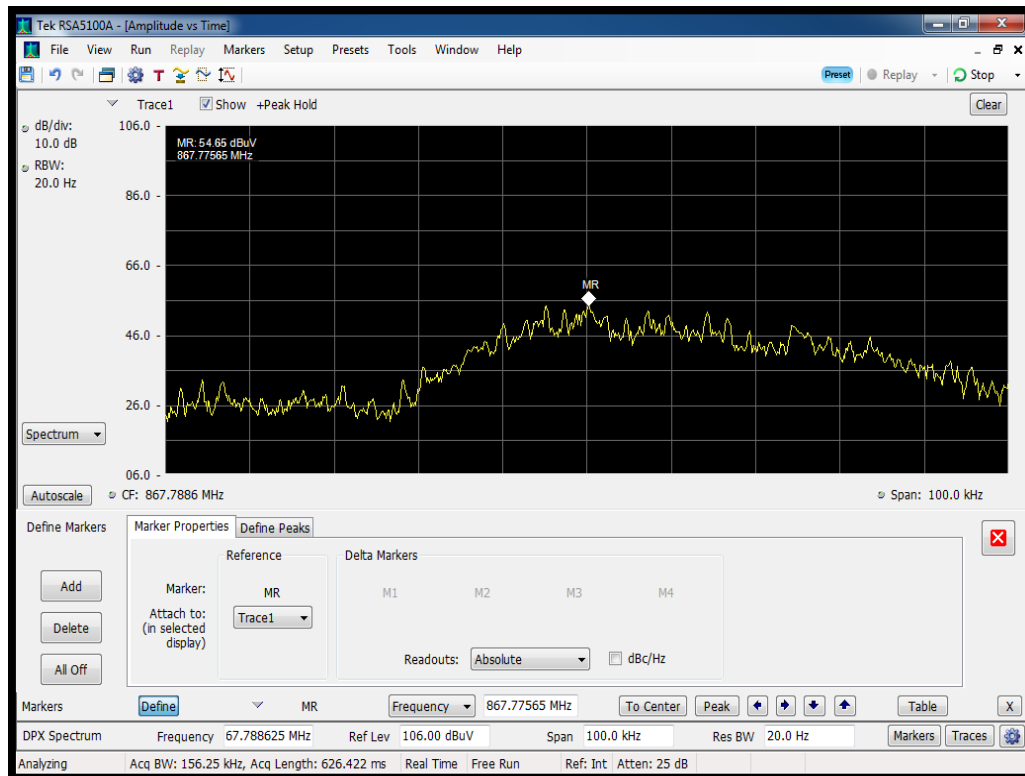


### Fundamental peak measurement at 433.9 MHz

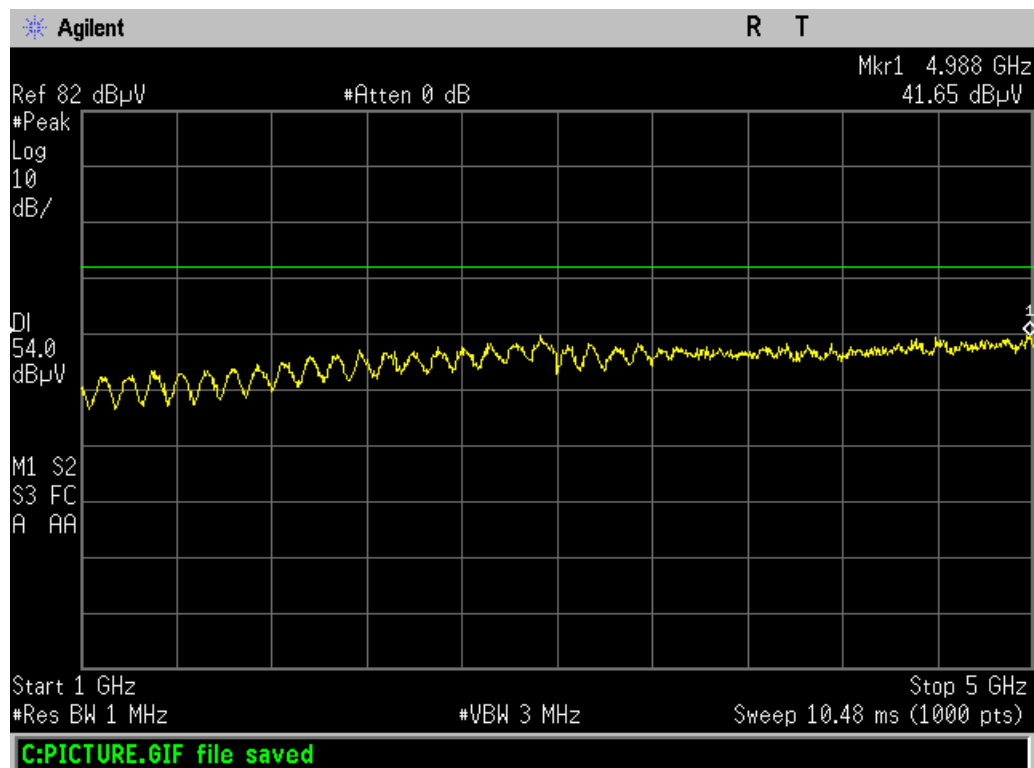




## spurious peak measurement at 867.7 MHz



## 1-5 GHz





## 99% Occupied Bandwidth

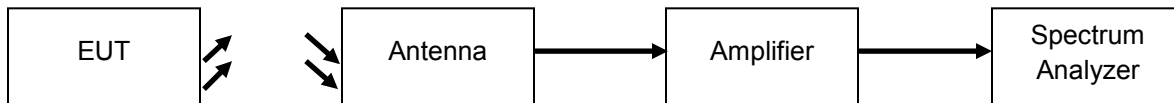
Engineer: Poona Saber

Test Date: 5/18/19

### Test Procedure

The EUT was tested in a semi-anechoic chamber at a distance of 3 meter from the receiving antenna. The Span was set wide enough to capture the entire transmit spectrum and the resolution bandwidth was set to at least 1% of the span. The analyzer was set to max hold while the 99% bandwidth was measured.

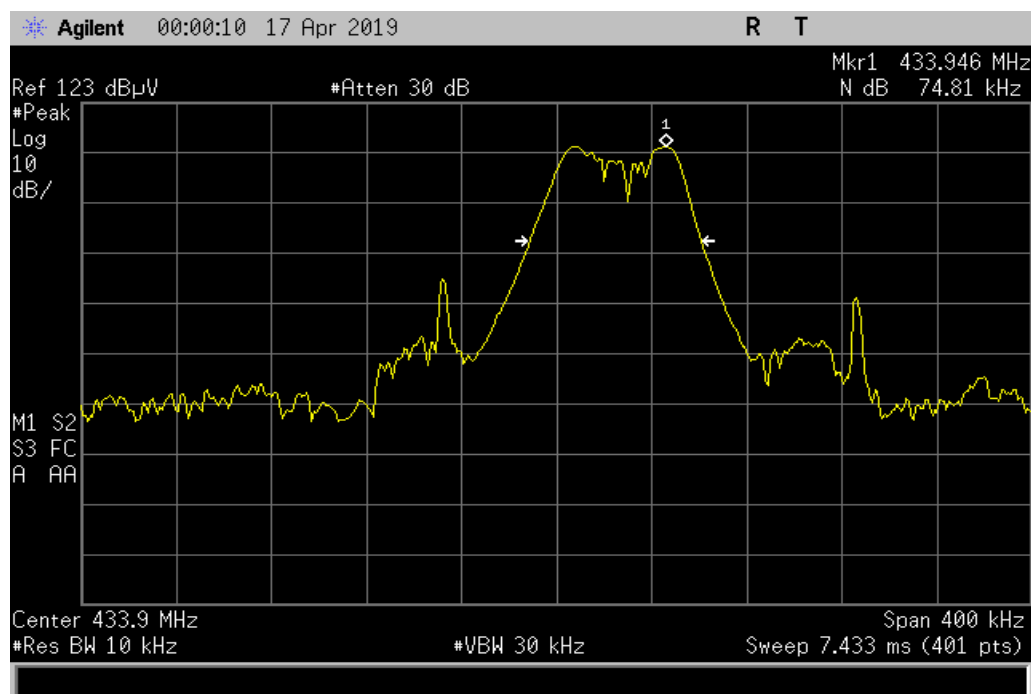
### Test Setup



### Occupied Bandwidth Summary

Frequency (MHz)	Recorded Measurement (kHz)	Result
433.9	74.81	Pass

### 99% Bandwidth





## Test Equipment Utilized

Description	Manufacturer	Model #	CT Asset #	Last Cal Date	Cal Due Date
Bi-Log Antenna	Chase	CBL6111C	i00267	3/8/18	3/8/20
Horn Antenna, Amplified	ARA	DRG-118/A	i00271	6/16/18	6/16/20
EMI Analyzer	Agilent	E7405A	i00379	1/16/19	1/16/20
RSA signal analyzer	Tektronix	RSA5126A	i00424	7/17/19	7/17/20
Preamplifier for 1-18GHz horn antenna	Miteq	AFS44 00101 400 23-10P-44	i00509	N/A	N/A

In addition to the above listed equipment standard RF connectors and cables were utilized in the testing of the described equipment. Prior to testing these components were tested to verify proper operation.

END OF TEST REPORT