Williams RDM Inc.

STFS Sensor

FCC 15.231:2018

Low Power 315 MHz Periodic Transmitter

Report # WILL0001.1

NVLAP LAB CODE: 201049-0

CERTIFICATE OF TEST

Last Date of Test: March 28, 2018
Williams RDM Inc.
Model: STFS Sensor

Radio Equipment Testing

Standards

Specification	Method
FCC 15.231:2018	ANSI C63.10:2013

Results

Method Clause	Test Description	Applied	Results	Comments
6.2	Powerline Conducted Emissions	No	N/A	Not required for a battery powered EUT.
6.5, 6.6	Field Strength of Fundamental	Yes	Pass	
6.5, 6.6	Spurious Radiated Emissions	Yes	Pass	
6.9.2	Occupied Bandwidth	Yes	Pass	
7.5	Duty Cycle	Yes	Pass	

Deviations From Test Standards

None

Approved By:

Jeremiah Darden, Operations Manager

Product compliance is the responsibility of the client; therefore, the tests and equipment modes of operation represented in this report were agreed upon by the client, prior to testing. The results of this test pertain only to the sample(s) tested. The specific description is noted in each of the individual sections of the test report supporting this certificate of test. This report reflects only those tests from the referenced standards shown in the certificate of test. It does not include inspection or verification of labels, identification, marking or user information.

REVISION HISTORY

Revision Number	Description	Date	Page Number
00	None		

ACCREDITATIONS AND AUTHORIZATIONS

2018.2.20

United States

FCC - Designated by the FCC as a Telecommunications Certification Body (TCB). Certification chambers, Open Area Test Sites, and conducted measurement facilities are listed with the FCC.

A2LA - Accredited by A2LA to ISO / IEC 17065 as a product certifier. This allows Element to certify transmitters to FCC and IC specifications.

NVLAP - Each laboratory is accredited by NVLAP to ISO 17025

Canada

ISED - Recognized by Innovation, Science and Economic Development Canada as a Certification Body (CB). Certification chambers and Open Area Test Sites are filed with ISED.

European Union

European Commission – Within Element, we have a EU Notified Body validated for the EMCD and RED Directives.

Australia/New Zealand

ACMA - Recognized by ACMA as a CAB for the acceptance of test data.

Korea

MSIT / RRA - Recognized by KCC's RRA as a CAB for the acceptance of test data.

Japan

VCCI - Associate Member of the VCCI. Conducted and radiated measurement facilities are registered.

Taiwan

BSMI – Recognized by BSMI as a CAB for the acceptance of test data.

NCC - Recognized by NCC as a CAB for the acceptance of test data.

Singapore

IDA – Recognized by IDA as a CAB for the acceptance of test data.

Israel

MOC – Recognized by MOC as a CAB for the acceptance of test data.

Hong Kong

OFCA – Recognized by OFCA as a CAB for the acceptance of test data.

Vietnam

MIC – Recognized by MIC as a CAB for the acceptance of test data.

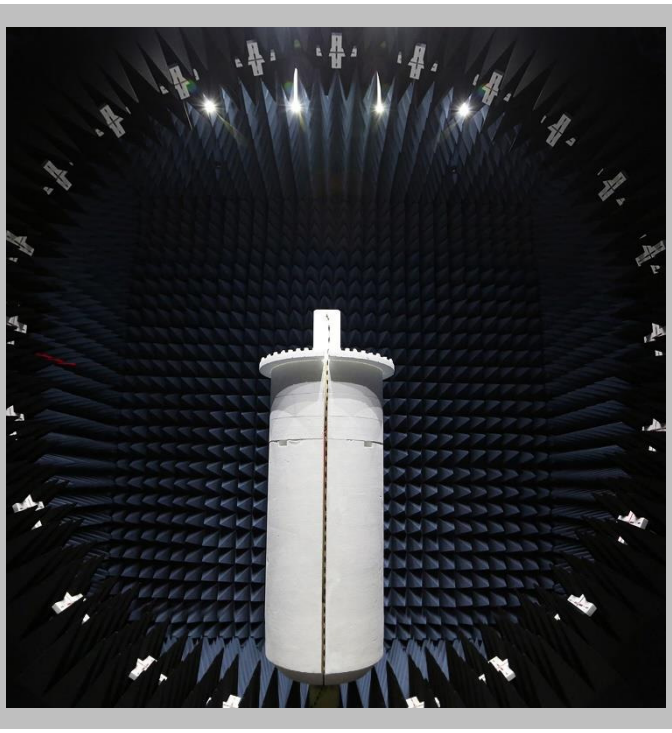
SCOPE

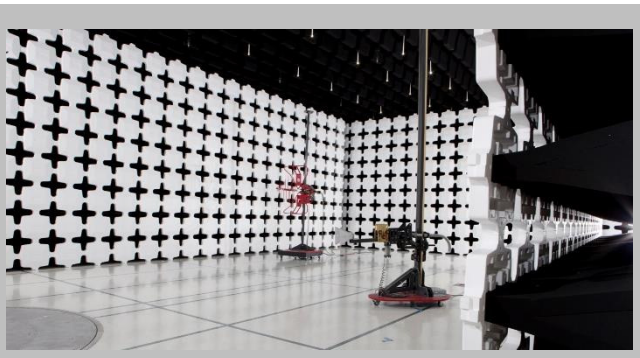
For details on the Scopes of our Accreditations, please visit:
http://portlandcustomer.element.com/ts/scope/scope.htm
http://gsi.nist.gov/global/docs/cabs/designations.html

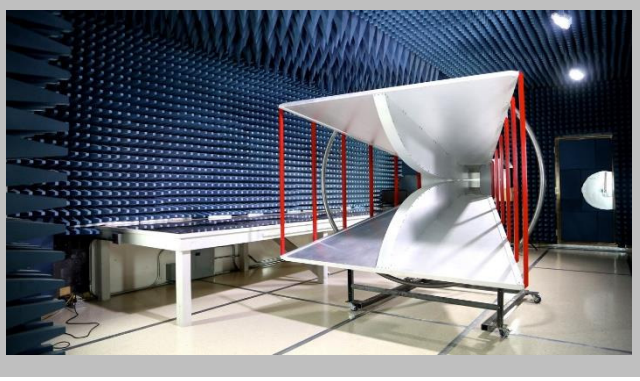
FACILITIES

2017.9.15

California	Minnesota	New York	Oregon	Texas	Washington
Labs OC01-17 41 Tesla Irvine, CA 92618 (949) 861-8918	Labs MN01-10 9349 W Broadway Ave. Brooklyn Park, MN 55445 (612)-638-5136	Labs NY01-04 4939 Jordan Rd. Elbridge, NY 13060 (315) 554-8214	Labs EV01-12 6775 NE Evergreen Pkwy #400 Hillsboro, OR 97124 (503) 844-4066	Labs TX01-09 3801 E Plano Pkwy Plano, TX 75074 (469) 304-5255	Labs NC01-05 19201 120th Ave NE Bothell, WA 98011 (425)984-6600
NVLAP					
NVLAP Lab Code: 200676-0	NVLAP Lab Code: 200881-0	NVLAP Lab Code: 200761-0	NVLAP Lab Code: 200630-0	NVLAP Lab Code:201049-0	NVLAP Lab Code: 200629-0
Innovation, Science and Economic Development Canada					
2834B-1, 2834B-3	2834E-1, 2834E-3	N/A	2834D-1, 2834D-*2*	2834G-1	2834F-1
BSMI					
SL2-IN-E-1154R	SL2-IN-E-1152R	N/A	SL2-IN-E-1017	SL2-IN-E-1158R	SL2-IN-E-1153R
VCCI					
A-0029	A-0109	N/A	A-0108	A-0201	A-0110
Recognized Phase I CAB for ACMA, BSMI, IDA, KCC/RRA, MIC, MOC, NCC, OFCA					
US0158	US0175	N/A	US0017	US0191	US0157







MEASUREMENT UNCERTAINTY

TMU.2015.07.10

Measurement Uncertainty

When a measurement is made, the result will be different from the true or theoretically correct value. The difference is the result of tolerances in the measurement system that cannot be completely eliminated. To the extent that technology allows us, it has been our aim to minimize this error. Measurement uncertainty is a statistical expression of measurement error qualified by a probability distribution.

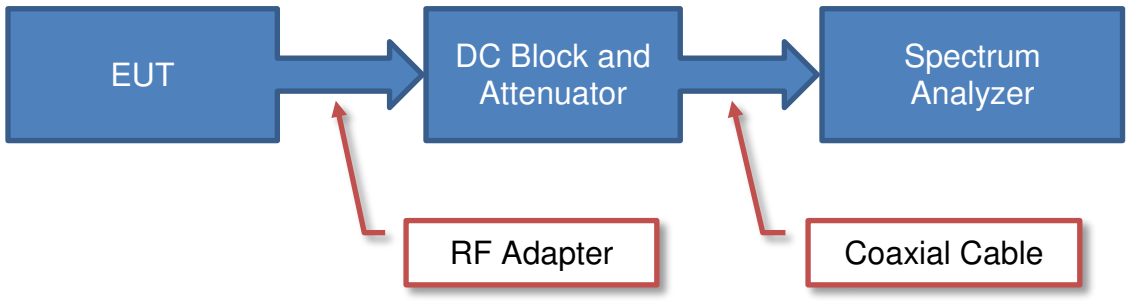
A measurement uncertainty estimation has been performed for each test per our internal quality document QM205.4.6. The estimation is used to compare the measured result with its "true" or theoretically correct value. The expanded measurement uncertainty (K=2) can be found included as part of the applicable test description page. Our measurement data meets or exceeds the measurement uncertainty requirements of the applicable specification; therefore, the test data can be compared directly to the specification limit to determine compliance. The calculations for estimating measurement uncertainty are based upon ETSI TR 100 028 (or CISPR 16-4-2 as applicable), and are available upon request.

The following table represents the Measurement Uncertainty (MU) budgets for each of the tests that may be contained in this report.

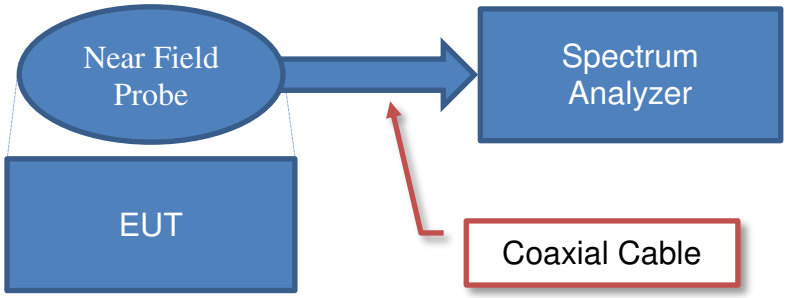
Test	+ MU	- MU
Frequency Accuracy (Hz)	0.0007%	-0.0007%
Amplitude Accuracy (dB)	1.2 dB	-1.2 dB
Conducted Power (dB)	0.3 dB	-0.3 dB
Radiated Power via Substitution (dB)	0.7 dB	-0.7 dB
Temperature (degrees C)	0.7°C	-0.7°C
Humidity (% RH)	2.5% RH	-2.5% RH
Voltage (AC)	1.0%	-1.0%
Voltage (DC)	0.7%	-0.7%
Field Strength (dB)	4.9 dB	-4.9 dB
AC Powerline Conducted Emissions (dB)	2.4 dB	-2.4 dB

Test Setup Block Diagrams

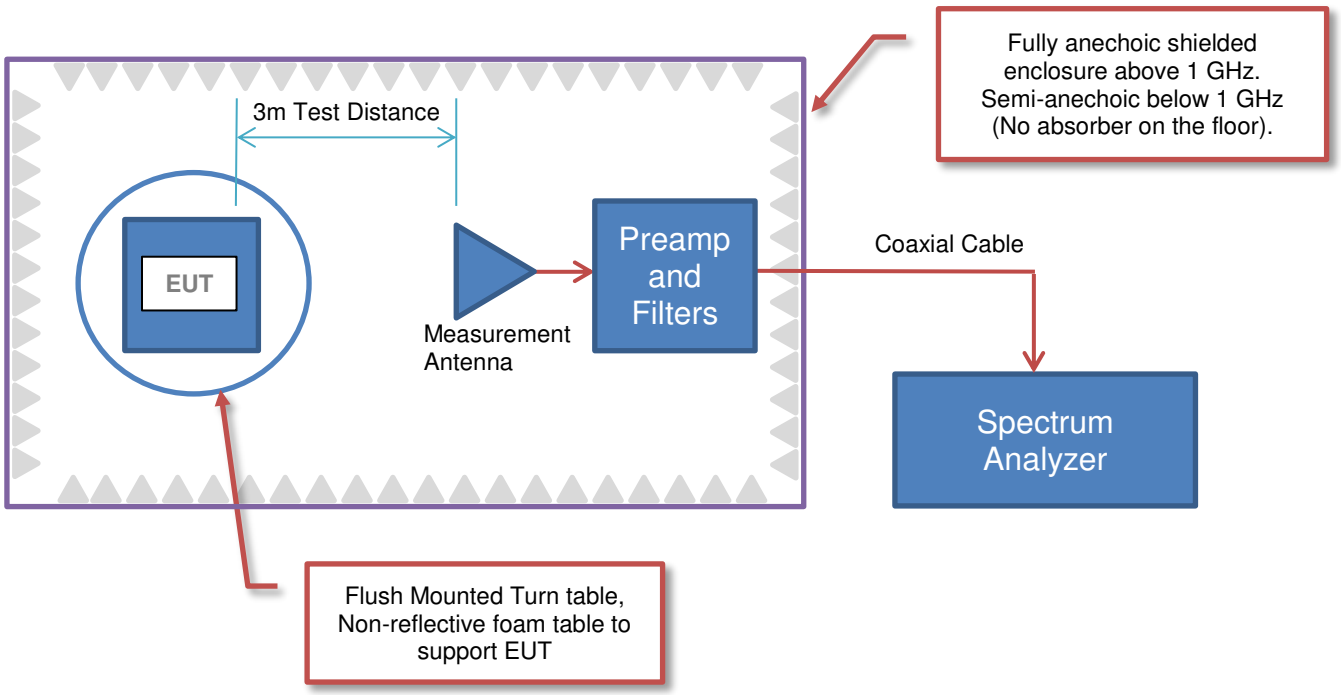
Antenna Port Conducted Measurements



Near Field Test Fixture Measurements



Spurious Radiated Emissions



PRODUCT DESCRIPTION

2017-1-25

Client and Equipment Under Test (EUT) Information

Company Name:	Williams RDM Inc.
Address:	200 Greenleaf St
City, State, Zip:	Fort Worth, TX 76107
Test Requested By:	Chris Stimek
Model:	STFS Sensor
First Date of Test:	March 27, 2018
Last Date of Test:	March 28, 2018
Receipt Date of Samples:	February 12, 2018
Equipment Design Stage:	Production
Equipment Condition:	No Damage
Purchase Authorization:	Verified

Information Provided by the Party Requesting the Test

Functional Description of the EUT:
The StoveTop FireStop (STFS) sensor product is a small cylindrical unit that magnetically mounts above a residential stove, to either the bottom of a vent hood or microwave oven, and is used to detect and prevent cooking fires. When a fire is detected on the stove the unit deploys a fire suppressing powder, sounds an audible alert and sends a wireless message to a stove shutoff unit which shuts off the stove by either disconnecting power or shutting off the gas. Additionally, in order to prevent cooking fires the STFS sensor unit will sound and alert and send a wireless message to shut off the stove if the sensor determines that the conditions are right for a cooking fire to start. Lastly, the STFS sensor unit automatically transmits a heartbeat message to the shutoff unit a few times a day as well as when the user presses the self-test button. These messages are used to facilitate automatic and manual testing of the system. The STFS sensor unit transmits at 315MHz and each message consists of a series of 3 identical messages for redundancy separated by a random back off. During an alarm condition the unit transmits stove shutoff messages repeatedly using the random back off delay to prevent collision with messages from other STFS sensor units if present.

Testing Objective:
To demonstrate compliance of the periodic radio to FCC 15.231(b) requirements.

CONFIGURATIONS

Configuration WILL0001- 1

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Stovetop Firestop Sensor (Normal/Pulsed)	Williams RDM Inc.	681-3-11	300195800009

Configuration WILL0001- 2

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Stovetop Firestop Sensor (CW)	Williams RDM Inc.	681-3-11	300195800008

MODIFICATIONS

2017-1-25

Equipment Modifications

Item	Date	Test	Modification	Note	Disposition of EUT
1	3/27/2018	Spurious Radiated Emissions	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
2	3/27/2018	Occupied Bandwidth	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
3	3/28/2018	Duty Cycle	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
4	3/28/2018	Field Strength of Fundamental	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	Scheduled testing was completed.

FIELD STRENGTH OF FUNDAMENTAL

PSA-ESCI 2017.12.19

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data. The test data represents the configuration / operating mode/ model that produced the highest emission levels as compared to the specification limit.

MODES OF OPERATION

Transmitting CW (Unmodulated) at 315 MHz

POWER SETTINGS INVESTIGATED

Battery

CONFIGURATIONS INVESTIGATED

WILL0001 - 2

FREQUENCY RANGE INVESTIGATED

Start Frequency	30 MHz	Stop Frequency	1000 MHz

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Interval
Amplifier - Pre-Amplifier	Miteq	AM-1551	PAH	10-Oct-2017	12 mo
Antenna - Biconilog	ETS Lindgren	3143B	AYF	13-Apr-2016	24 mo
Cable	Northwest EMC	RE 9kHz - 1GHz	TXB	10-Oct-2017	12 mo
Analyzer - Spectrum Analyzer	Agilent	N9010A	AFL	15-Mar-2018	12 mo

TEST DESCRIPTION

The antennas to be used with the EUT were tested. The EUT was configured for continuous un-modulated CW operation at its single transmit frequency. The field strength of the transmit frequency was maximized by rotating the EUT, adjusting the measurement antenna height and polarization, and manipulating the EUT in 3 orthogonal planes (per ANSI C63.10:2013).

To derive average emission measurements, a duty cycle correction factor was utilized:

Duty Cycle = On time/100 milliseconds (or the period, whichever is less)

Where “On time” = N1L1 +N2L2 +….

Where N1 is the number of type 1 pulses, L1 is length of type 1 pulses, N2 is the number of type 2 pulses, L2 is the length of type 2 pulses, etc.

Therefore, Duty Cycle = (N1L1 +N2L2 +…)/100mS or T, whichever is less. (Where T is the period of the pulse train.)

The measured values for the EUT’s pulse train are as follows:

Period = 100 ms
Pulsewidth of Type 1 Pulse = 0.45 ms
Pulsewidth of Type 2 Pulse = 0.95 ms
Number of Type 1 Pulses = 72
Number of Type 2 Pulses = 14

Duty Cycle = 20 log [((72)(0.45) + (14)(0.95))]/100 = -6.8 dB

The duty cycle correction factor of –6.8 dB was added to the peak readings to mathematically derive the average levels. Peak measurements were made with a resolution bandwidth of 100 kHz and a video bandwidth of 300 kHz.

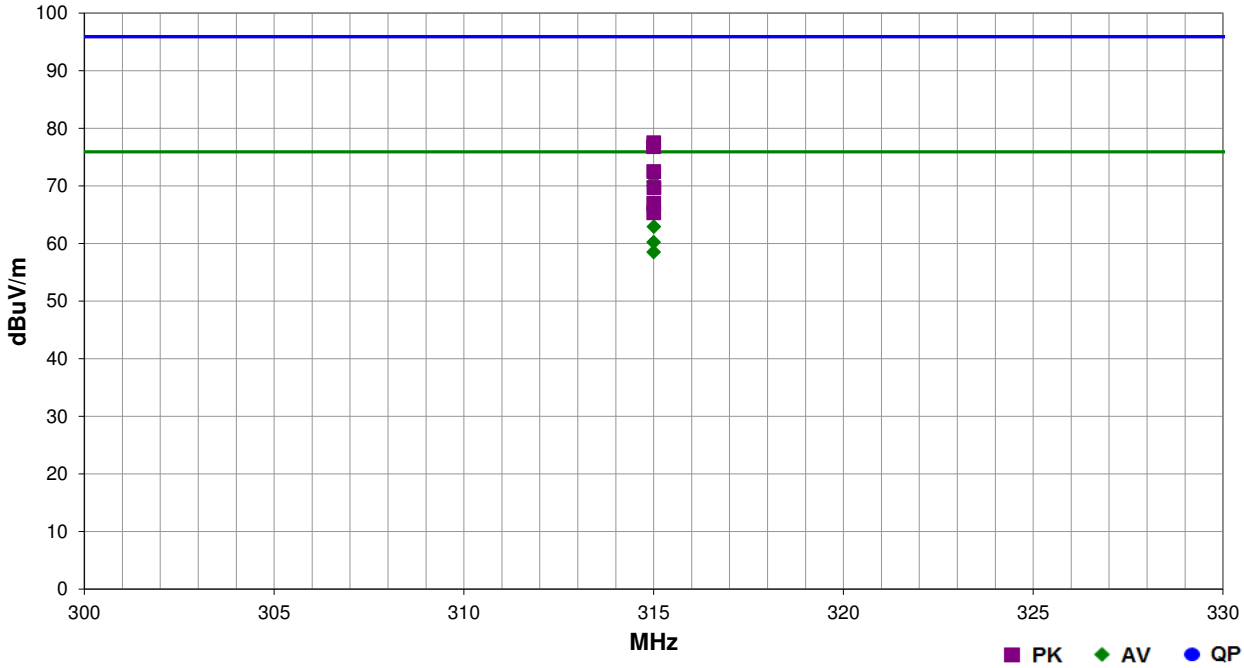
FIELD STRENGTH OF FUNDAMENTAL

EmiR5 2018.02.06 PSA-ESCI 2017.12.19

Work Order:	WILL0001	**Date:**	27-Mar-2018		
Project:	None	**Temperature:**	23.8 °C		
Job Site:	TX02	**Humidity:**	48% RH		
Serial Number:	None	**Barometric Pres.:**	1019 mbar	**Tested by:**	Marty Martin
EUT:	STFS Sensor				
Configuration:	2				
Customer:	Williams RDM Inc.				
Attendees:	Kisoo Jung				
EUT Power:	Battery				
Operating Mode:	Transmitting CW (Unmodulated) at 315 MHz				
Deviations:	None				
Comments:	315 MHz PK measurement (3m, no external attenuation, no filter, no preamp). CW2 unit. For Field Strength of Fundamental eval.				

Test Specifications	**Test Method**
FCC 15.231:2018	ANSI C63.10:2013

Run #	52	**Test Distance (m)**	3	**Antenna Height(s)**	1 to 4(m)	**Results**	Pass



Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Duty Cycle Correction Factor (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
315.001	58.2	19.3	1.0	93.9	-6.8	0.0	Horz	AV	0.0	70.7	75.9	-5.2	EUT X
314.997	57.5	19.3	1.0	60.0	-6.8	0.0	Horz	AV	0.0	70.0	75.9	-5.9	EUT Y
314.999	53.2	19.3	1.8	111.0	-6.8	0.0	Vert	AV	0.0	65.7	75.9	-10.2	EUT Z
315.004	50.4	19.3	1.0	279.9	-6.8	0.0	Horz	AV	0.0	62.9	75.9	-13.0	EUT Z
315.002	47.7	19.3	1.3	331.0	-6.8	0.0	Vert	AV	0.0	60.2	75.9	-15.7	EUT Y
315.002	46.0	19.3	3.3	175.0	-6.8	0.0	Vert	AV	0.0	58.5	75.9	-17.4	EUT X
315.001	58.2	19.3	1.0	93.9		0.0	Horz	PK	0.0	77.5	95.9	-18.4	EUT X
314.997	57.5	19.3	1.0	60.0		0.0	Horz	PK	0.0	76.8	95.9	-19.1	EUT Y
314.999	53.2	19.3	1.8	111.0		0.0	Vert	PK	0.0	72.5	95.9	-23.4	EUT Z
315.004	50.4	19.3	1.0	279.9		0.0	Horz	PK	0.0	69.7	95.9	-26.2	EUT Z
315.002	47.7	19.3	1.3	331.0		0.0	Vert	PK	0.0	67.0	95.9	-28.9	EUT Y
315.002	46.0	19.3	3.3	175.0		0.0	Vert	PK	0.0	65.3	95.9	-30.6	EUT X

SPURIOUS RADIATED EMISSIONS

PSA-ESCI 2017.12.19

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data. The test data represents the configuration / operating mode/ model that produced the highest emission levels as compared to the specification limit.

MODES OF OPERATION

Transmitting CW (Unmodulated) at 315 MHz

POWER SETTINGS INVESTIGATED

Battery

CONFIGURATIONS INVESTIGATED

WILL0001 - 2

FREQUENCY RANGE INVESTIGATED

Start Frequency	30 MHz	Stop Frequency	8200 MHz

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Interval
Cable	Northwest EMC	RE 9kHz - 1GHz	TXB	10-Oct-2017	12 mo
Amplifier - Pre-Amplifier	Miteq	AM-1551	PAH	10-Oct-2017	12 mo
Antenna - Biconilog	ETS Lindgren	3143B	AYF	13-Apr-2016	24 mo
Antenna - Double Ridge	ETS Lindgren	3115	AJN	15-Sep-2016	24 mo
Amplifier - Pre-Amplifier	Miteq	AMF-3D-00100800-32-13P	PAJ	31-May-2017	12 mo
Analyzer - Spectrum Analyzer	Agilent	N9010A	AFL	15-Mar-2018	12 mo
Cable	Northwest EMC	1-8.2 GHz	TXC	31-May-2017	12 mo
Attenuator, 10db 'SMA'	Weinschel Corp	4H-10	AWA	16-Mar-2018	12 mo

TEST DESCRIPTION

The highest gain antenna of each type to be used with the EUT was tested. The EUT was configured for the required transmit frequency in each operational band and the modes as showed in the data sheets.

For each configuration, the spectrum was scanned throughout the specified range as part of the exploratory investigation of the emissions. These “pre-scans” are not included in the report. Final measurements on individual emissions were then made and included in this test report.

The individual emissions from the EUT were maximized by rotating the EUT on a turntable, adjusting the position of the EUT and EUT antenna in three orthogonal axis, and adjusting the measurement antenna height and polarization (per ANSI C63.10). A preamp and high pass filter (and notch filter) were used for this test in order to provide sufficient measurement sensitivity.

Measurements were made with the required detectors and annotated on the data for each individual point using the following annotation:

QP = Quasi-Peak Detector
PK = Peak Detector
AV = RMS Detector

To derive average emission measurements, a duty cycle correction factor was utilized:

Duty Cycle = On time/100 milliseconds (or the period, whichever is less)

Where “On time” = N1L1 +N2L2 +….

Where N1 is the number of type 1 pulses, L1 is length of type 1 pulses, N2 is the number of type 2 pulses, L2 is the length of type 2 pulses, etc.

Therefore, Duty Cycle = (N1L1 +N2L2 +…)/100mS or T, whichever is less. Where T is the period of the pulse train.

The measured values for the EUT’s pulse train are as follows:

Period = 100 ms
Pulsewidth of Type 1 Pulse = 0.45 ms
Pulsewidth of Type 2 Pulse = 0.95 ms
Number of Type 1 Pulses = 72
Number of Type 2 Pulses = 14

Duty Cycle = 20 log [((72)(0.45) + (14)(0.95))]/100 = -6.8 dB

The duty cycle correction factor of –6.8 dB was added to the peak readings to mathematically derive the average levels. Peak measurements were made with a resolution bandwidth of 100 kHz and a video bandwidth of 300 kHz..

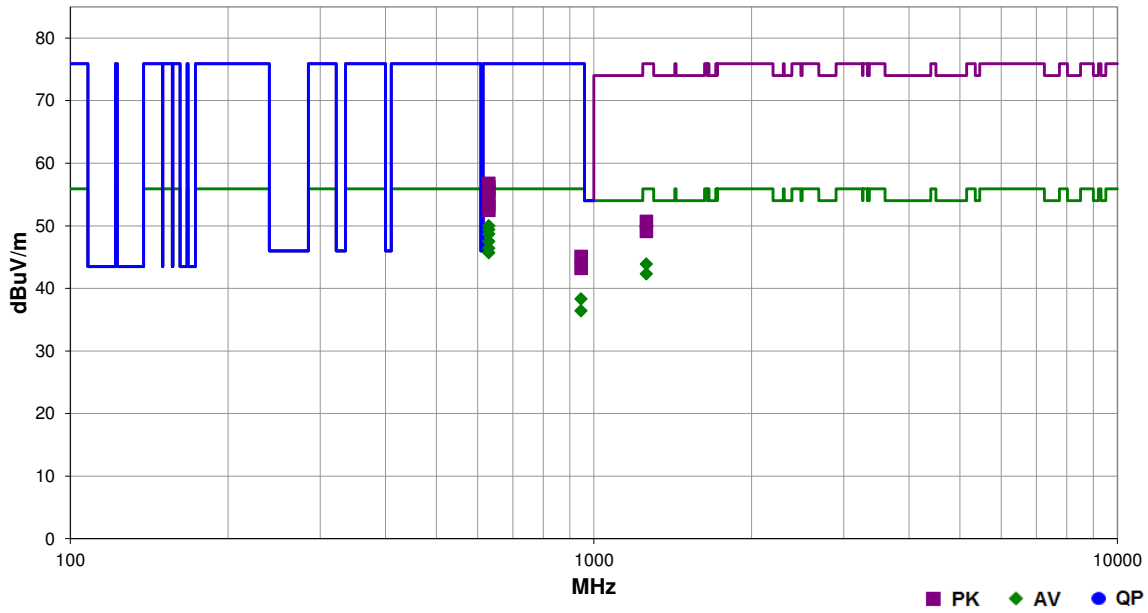
SPURIOUS RADIATED EMISSIONS

EmiR5 2018.02.06 PSA-ESCI 2017.12.19

Work Order:	WILL0001	**Date:**	28-Mar-2018		
Project:	None	**Temperature:**	23.7 °C		
Job Site:	TX02	**Humidity:**	50.3% RH		
Serial Number:	None	**Barometric Pres.:**	1015 mbar	**Tested by:**	Marty Martin
EUT:	STFS Sensor				
Configuration:	2				
Customer:	Williams RDM Inc.				
Attendees:	Kisoo Jung				
EUT Power:	Battery				
Operating Mode:	Transmitting CW (Unmodulated) at 315 MHz				
Deviations:	None				
Comments:	315 MHz PK measurement (3m, 10 dB external attenuation, no filter). Used -6.8 DCCF.				

Test Specifications	**Test Method**
FCC 15.231:2018	ANSI C63.10:2013

Run #	57	**Test Distance (m)**	3	**Antenna Height(s)**	1 to 4(m)	**Results**	Pass



Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Duty Cycle Correction Factor (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
630.002	61.7	-14.9	1.0	7.0	-6.8	10.0	Vert	AV	0.0	50.0	55.9	-5.9	EUT Z
630.001	61.1	-14.9	1.0	146.0	-6.8	10.0	Vert	AV	0.0	49.4	55.9	-6.5	EUT Y
629.992	60.4	-14.9	1.4	226.9	-6.8	10.0	Horz	AV	0.0	48.7	55.9	-7.2	EUT X
629.996	59.2	-14.9	1.0	292.9	-6.8	10.0	Vert	AV	0.0	47.5	55.9	-8.4	EUT X
630.006	58.1	-14.9	1.4	280.9	-6.8	10.0	Horz	AV	0.0	46.4	55.9	-9.5	EUT Z
630.004	57.4	-14.9	1.4	271.0	-6.8	10.0	Horz	AV	0.0	45.7	55.9	-10.2	EUT Y
1260.005	58.9	-8.2	1.1	127.0	-6.8	0.0	Vert	AV	0.0	43.9	55.9	-12.0	EUT Z
1259.965	57.3	-8.2	3.6	231.9	-6.8	0.0	Horz	AV	0.0	42.3	55.9	-13.6	EUT X
945.018	44.5	-9.4	1.0	87.0	-6.8	10.0	Vert	AV	0.0	38.3	55.9	-17.6	EUT Z
630.002	61.7	-14.9	1.0	7.0		10.0	Vert	PK	0.0	56.8	75.9	-19.1	EUT Z
945.003	42.6	-9.4	1.0	222.0	-6.8	10.0	Horz	AV	0.0	36.4	55.9	-19.5	EUT X
630.001	61.1	-14.9	1.0	146.0		10.0	Vert	PK	0.0	56.2	75.9	-19.7	EUT Y
629.992	60.4	-14.9	1.4	226.9		10.0	Horz	PK	0.0	55.5	75.9	-20.4	EUT X
629.996	59.2	-14.9	1.0	292.9		10.0	Vert	PK	0.0	54.3	75.9	-21.6	EUT X
630.006	58.1	-14.9	1.4	280.9		10.0	Horz	PK	0.0	53.2	75.9	-22.7	EUT Z
630.004	57.4	-14.9	1.4	271.0		10.0	Horz	PK	0.0	52.5	75.9	-23.4	EUT Y
1260.005	58.9	-8.2	1.1	127.0		0.0	Vert	PK	0.0	50.7	75.9	-25.2	EUT Z
1259.965	57.3	-8.2	3.6	231.9		0.0	Horz	PK	0.0	49.1	75.9	-26.8	EUT X
945.018	44.5	-9.4	1.0	87.0		10.0	Vert	PK	0.0	45.1	75.9	-30.8	EUT Z
945.003	42.6	-9.4	1.0	222.0		10.0	Horz	PK	0.0	43.2	75.9	-32.7	EUT X

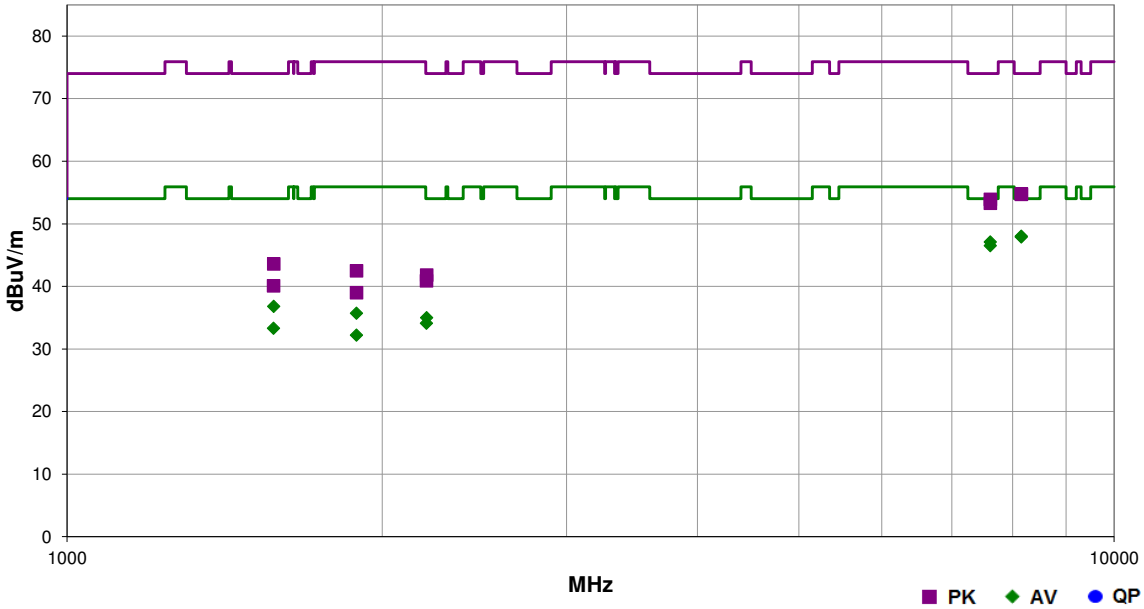
SPURIOUS RADIATED EMISSIONS

EmiR5 2018.02.06 PSA-ESCI 2017.12.19

Work Order:	WILL0001	**Date:**	28-Mar-2018		
Project:	None	**Temperature:**	23.7 °C		
Job Site:	TX02	**Humidity:**	50.3% RH		
Serial Number:	None	**Barometric Pres.:**	1015 mbar	**Tested by:**	Marty Martin
EUT:	STFS Sensor				
Configuration:	2				
Customer:	Williams RDM Inc.				
Attendees:	Kisoo Jung				
EUT Power:	Battery				
Operating Mode:	Transmitting CW (Unmodulated) at 315 MHz				
Deviations:	None				
Comments:	315 MHz PK measurement (3m, no external attenuation, no filter). Used -6.8 DCCF.				

Test Specifications	**Test Method**
FCC 15.231:2018	ANSI C63.10:2013

Run #	62	**Test Distance (m)**	3	**Antenna Height(s)**	1 to 4(m)	**Results**	Pass



Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Duty Cycle Correction Factor (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
8155.950	39.6	15.2	1.0	106.9	-6.8	0.0	Horz	AV	0.0	48.0	54.0	-6.0	EUT X
8155.995	39.5	15.2	1.8	123.0	-6.8	0.0	Vert	AV	0.0	47.9	54.0	-6.1	EUT Z
7617.990	39.5	14.4	1.0	308.0	-6.8	0.0	Horz	AV	0.0	47.1	54.0	-6.9	EUT X
7618.225	38.9	14.4	1.0	187.0	-6.8	0.0	Vert	AV	0.0	46.5	54.0	-7.5	EUT Z
1575.205	50.8	-7.2	3.6	104.0	-6.8	0.0	Horz	AV	0.0	36.8	54.0	-17.2	EUT X
2205.085	46.2	-4.4	1.0	122.0	-6.8	0.0	Vert	AV	0.0	35.0	54.0	-19.0	EUT Z
8155.950	39.6	15.2	1.0	106.9		0.0	Horz	PK	0.0	54.8	74.0	-19.2	EUT X
8155.995	39.5	15.2	1.8	123.0		0.0	Vert	PK	0.0	54.7	74.0	-19.3	EUT Z
2204.500	45.3	-4.4	2.7	26.0	-6.8	0.0	Horz	AV	0.0	34.1	54.0	-19.9	EUT X
7617.990	39.5	14.4	1.0	308.0		0.0	Horz	PK	0.0	53.9	74.0	-20.1	EUT X
1889.845	48.5	-6.0	3.1	307.0	-6.8	0.0	Horz	AV	0.0	35.7	55.9	-20.2	EUT X
1574.780	47.3	-7.2	3.9	175.0	-6.8	0.0	Vert	AV	0.0	33.3	54.0	-20.7	EUT Z
7618.225	38.9	14.4	1.0	187.0		0.0	Vert	PK	0.0	53.3	74.0	-20.7	EUT Z
1890.045	45.0	-6.0	1.0	172.9	-6.8	0.0	Vert	AV	0.0	32.2	55.9	-23.7	EUT Z
1575.205	50.8	-7.2	3.6	104.0		0.0	Horz	PK	0.0	43.6	74.0	-30.4	EUT X
2205.085	46.2	-4.4	1.0	122.0		0.0	Vert	PK	0.0	41.8	74.0	-32.2	EUT Z
2204.500	45.3	-4.4	2.7	26.0		0.0	Horz	PK	0.0	40.9	74.0	-33.1	EUT X
1889.845	48.5	-6.0	3.1	307.0		0.0	Horz	PK	0.0	42.5	75.9	-33.4	EUT X
1574.780	47.3	-7.2	3.9	175.0		0.0	Vert	PK	0.0	40.1	74.0	-33.9	EUT Z
1890.045	45.0	-6.0	1.0	172.9		0.0	Vert	PK	0.0	39.0	75.9	-36.9	EUT Z

OCCUPIED BANDWIDTH

XMit 2017.12.13

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Probe - Near Field Set	ETS Lindgren	7405	IPS	NCR	NCR
Analyzer - Spectrum Analyzer	Agilent	N9010A	AFL	15-Mar-18	15-Mar-19

TEST DESCRIPTION

A near-field probe was placed near the transmitter. A low-loss coaxial cable was used to connect the near-field probe to the spectrum analyzer. The EUT was transmitting at its maximum data rate.

The 20 dB occupied bandwidth is required to be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz.

OCCUPIED BANDWIDTH

XMit 2017.12.13

EUT:	**STFS Sensor**			**Work Order:**	**WILL0001**
Serial Number:	**None**			**Date:**	**28-Mar-18**
Customer:	**Williams RDM Inc.**			**Temperature:**	**23.7 °C**
Attendees:	**Kisoo Jung**			**Humidity:**	**48.9% RH**
Project:	**None**			**Barometric Pres.:**	**1011 mbar**
Tested by:	**Marty Martin**	**Power:**	**Battery**	**Job Site:**	**TX02**

TEST SPECIFICATIONS	**Test Method**
FCC 15.231:2018	ANSI C63.10:2013

COMMENTS

Connected Near Field Probe from EUT straight to Analyzer.

DEVIATIONS FROM TEST STANDARD

None

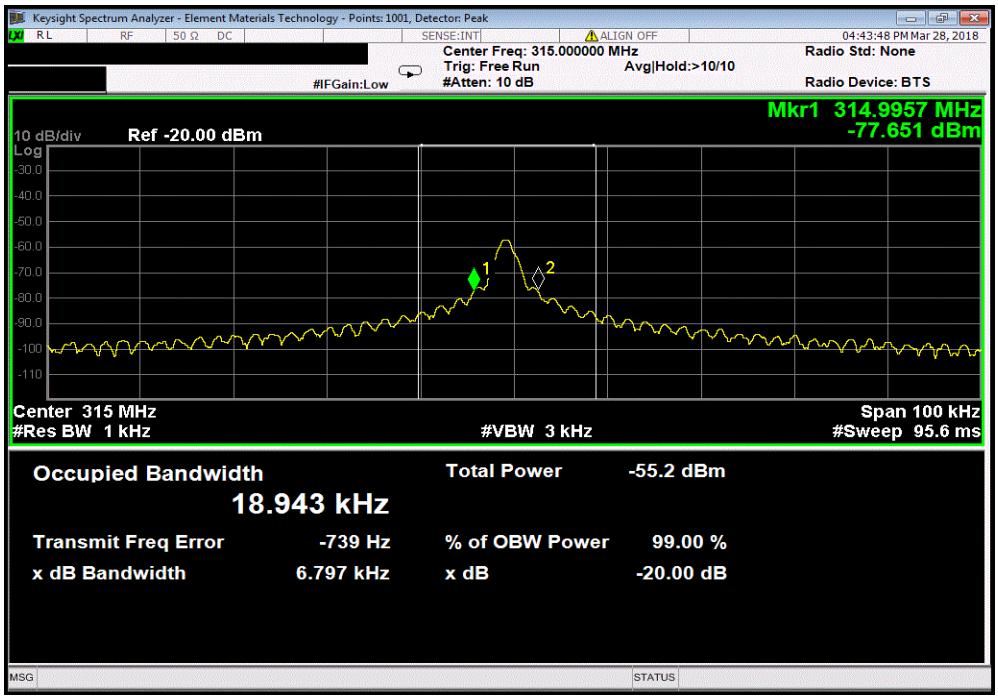
Configuration #	**1**	*Signature* Marty Martin

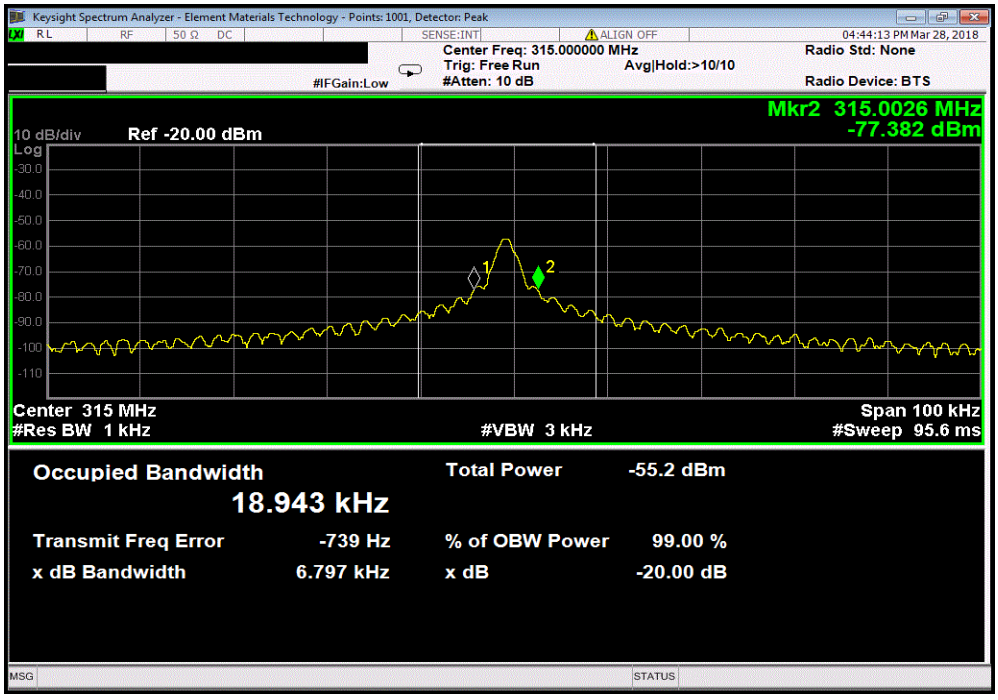
	Value	**Limit**	**Result**
Single Channel, 315 MHz	18.943	78.75 MHz	Pass

OCCUPIED BANDWIDTH

XMit 2017.12.13

Single Channel, 315 MHz						
				Value	Limit	Result
				18.943	78.75 MHz	Pass





DUTY CYCLE

XMit 2017.12.13

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Probe - Near Field Set	ETS Lindgren	7405	IPS	NCR	NCR
Analyzer - Spectrum Analyzer	Agilent	N9010A	AFL	15-Mar-18	15-Mar-19

TEST DESCRIPTION

A near-field probe was placed near the transmitter. A low-loss coaxial cable was used to connect the near-field probe to the spectrum analyzer. For software controlled or pre-programmed devices, the manufacturer shall declare the duty cycle class or classes for the equipment under test. For manually operated or event dependant devices, with or without software controlled functions, the manufacturer shall declare whether the device once triggered, follows a pre-programmed cycle, or whether the transmission is constant until the trigger is released or manually reset. The manufacturer shall also give a description of the application for the device and include a typical usage pattern. The typical usage pattern as declared by the manufacturer shall be used to determine the duty cycle and hence the duty class.

Where an acknowledgement is required, the additional transmitter on-time shall be included and declared by the manufacturer.

To derive average emission measurements, a duty cycle correction factor was utilized:

Duty Cycle = On time/100 milliseconds (or the period, whichever is less)

Where “On time” = N1L1 +N2L2 +….

Where N1 is the number of type 1 pulses, L1 is length of type 1 pulses, N2 is the number of type 2 pulses, L2 is the length of type 2 pulses, etc.

Therefore, Duty Cycle = (N1L1 +N2L2 +…)/100mS or T, whichever is less. (Where T is the period of the pulse train.)

The measured values for the EUT’s pulse train are as follows:

Period = 100 ms
Pulsewidth of Type 1 Pulse = 0.45 ms
Pulsewidth of Type 2 Pulse = 0.95 ms
Number of Type 1 Pulses = 72
Number of Type 2 Pulses = 14

Duty Cycle = 20 log [((72)(0.45) + (14)(0.95))]/100 = -6.8 dB

The duty cycle correction factor of –6.8 dB was added to the peak readings to mathematically derive the average levels. Peak measurements were made with a resolution bandwidth of 100kHz and a video bandwidth of 300kHz.

DUTY CYCLE

XMit 2017.12.13

EUT:	STFS Sensor			**Work Order:**	WILL0001
Serial Number:	None			**Date:**	27-Mar-18
Customer:	Williams RDM Inc.			**Temperature:**	23.6 °C
Attendees:	Kisoo Jung			**Humidity:**	47.4% RH
Project:	None			**Barometric Pres.:**	1019 mbar
Tested by:	Marty Martin	**Power:**	Battery	**Job Site:**	TX02

TEST SPECIFICATIONS	Test Method
FCC 15.231:2018	ANSI C63.10:2013

COMMENTS

315 MHz PK measurement (3m, no external attenuation, no filter, no preamp).

DEVIATIONS FROM TEST STANDARD

None

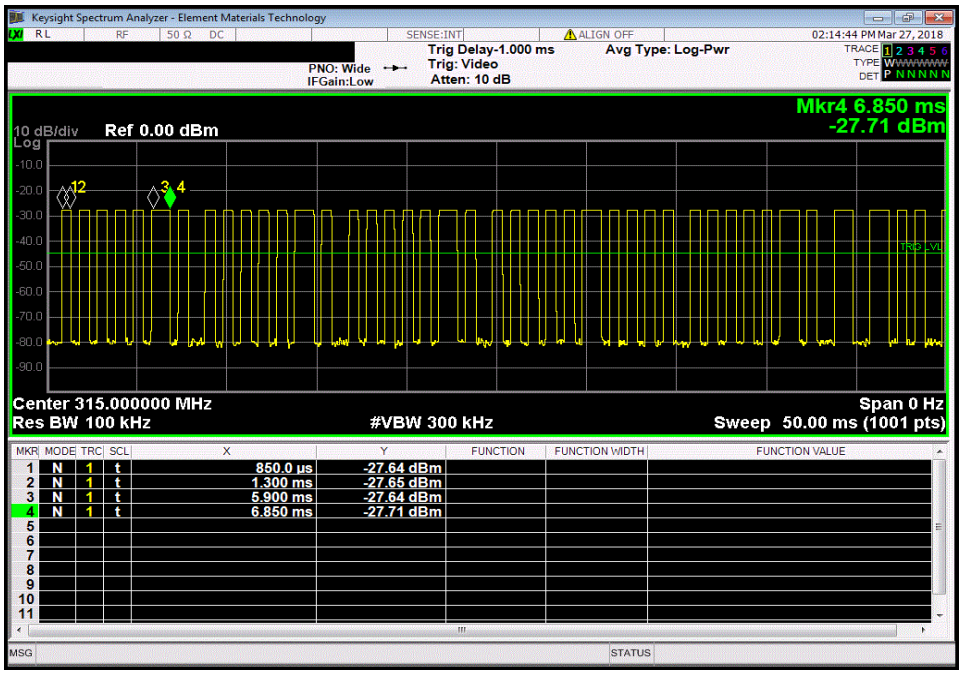
Configuration #	1	Signature

	Type 1 Pulse Width (ms)	Number of Type 1 Pulses	Type 2 Pulse Width (ms)	Number of Type 2 Pulses	Transmission Ceased Within 5 Secs	Result
Single Transmission - Pulse Widths	0.45	72	0.95	14	N/A	N/A
Single Transmission - Period	N/A	N/A	N/A	N/A	N/A	N/A
All Transmissions	N/A	N/A	N/A	N/A	Yes	N/A

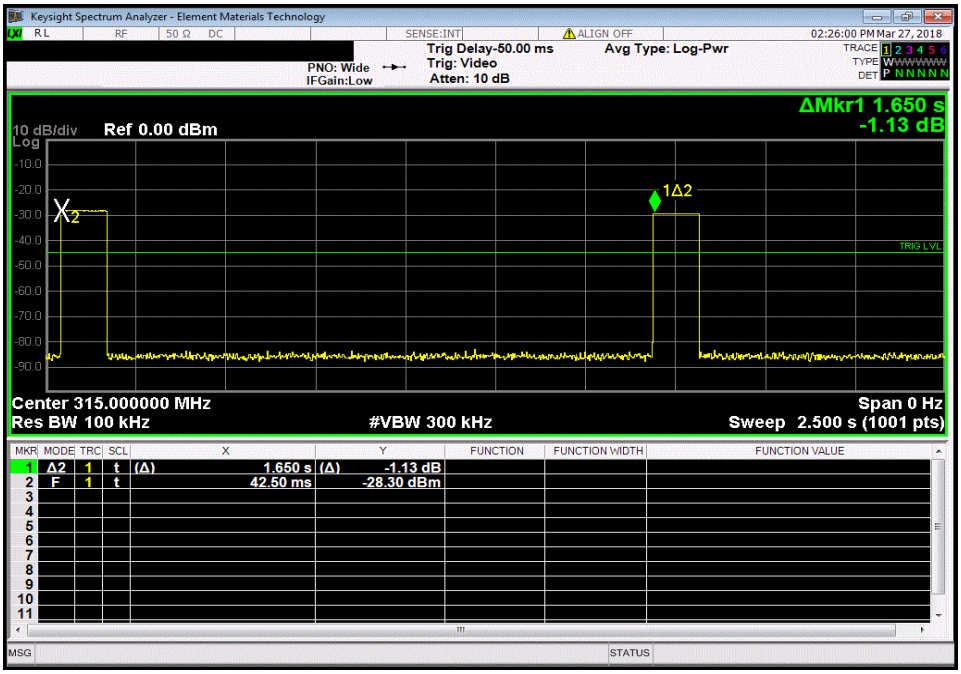
DUTY CYCLE

XMit 2017.12.13

Single Transmission - Pulse Widths						
	Type 1 Pulse Width (ms)	Number of Type 1 Pulses	Type 2 Pulse Width (ms)	Number of Type 2 Pulses	Transmission Ceased Within 5 Secs	Result
	0.45	72	0.95	14	N/A	N/A



Single Transmission - Period						
	Type 1 Pulse Width (ms)	Number of Type 1 Pulses	Type 2 Pulse Width (ms)	Number of Type 2 Pulses	Transmission Ceased Within 5 Secs	Result
	N/A	N/A	N/A	N/A	N/A	N/A



DUTY CYCLE

XMit 2017.12.13

All Transmissions						
	Type 1 Pulse Width (ms)	Number of Type 1 Pulses	Type 2 Pulse Width (ms)	Number of Type 2 Pulses	Transmission Ceased Within 5 Secs	Result
	N/A	N/A	N/A	N/A	Yes	N/A