

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		

Report No. WILL0001.1 3/23

ACCREDITATIONS AND AUTHORIZATIONS



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

Report No. WILL0001.1 4/23

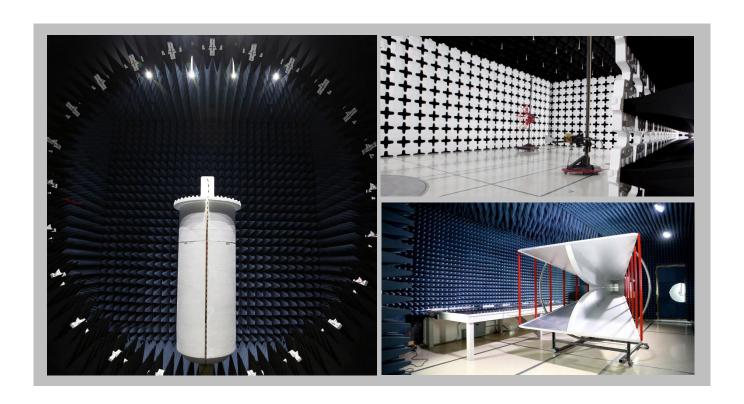
FACILITIES







California Labs OC01-17 41 Tesla Irvine, CA 92618 (949) 861-8918	Minnesota Labs MN01-10 9349 W Broadway Ave. Brooklyn Park, MN 55445 (612)-638-5136	New York Labs NY01-04 4939 Jordan Rd. Elbridge, NY 13060 (315) 554-8214	Oregon Labs EV01-12 6775 NE Evergreen Pkwy #400 Hillsboro, OR 97124 (503) 844-4066	Labs EV01-12 Labs TX01-09 6775 NE Evergreen Pkwy #400 3801 E Plano Pkwy Hillsboro, OR 97124 Plano, TX 75074			
		NV	LAP				
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	2834B-1, 2834B-3 2834E-1, 2834E-3 N/A 2834D-1, 2834D-2		2834D-1, 2834D-2	2834G-1	2834F-1		
		BS	МІ				
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		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 US019		US0157		



Report No. WILL0001.1 5/23

MEASUREMENT UNCERTAINTY



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.

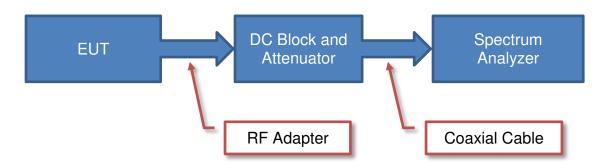
Test	+ MU	- MU
Frequency Accuracy (Hz)	0.0007%	-0.0007%
Amplitude Accuracy (dB)	1.2 dB	-1.2 dB
Conducted Power (dB)	0.3 dB	-0.3 dB
Radiated Power via Substitution (dB)	0.7 dB	-0.7 dB
Temperature (degrees C)	0.7°C	-0.7°C
Humidity (% RH)	2.5% RH	-2.5% RH
Voltage (AC)	1.0%	-1.0%
Voltage (DC)	0.7%	-0.7%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

Report No. WILL0001.1 6/23

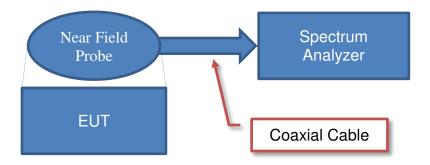
Test Setup Block Diagrams



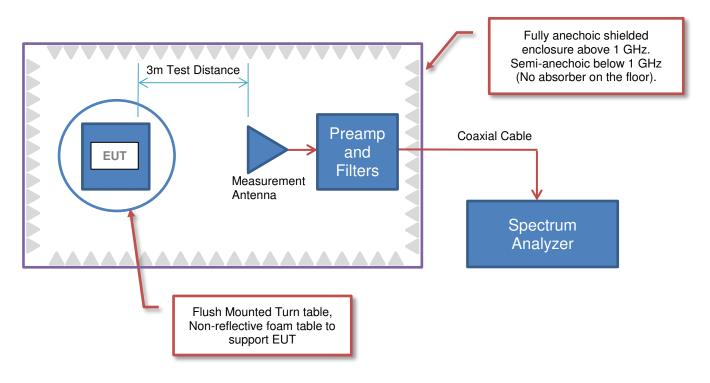
Antenna Port Conducted Measurements



Near Field Test Fixture Measurements



Spurious Radiated Emissions



Report No. WILL0001.1 7/23

PRODUCT DESCRIPTION



Client and Equipment Under Test (EUT) Information

Company Name	Williams DDM Inc
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.

Report No. WILL0001.1 8/23

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

Report No. WILL0001.1 9/23

MODIFICATIONS



Equipment Modifications

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

Report No. WILL0001.1 10/23

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
Start i requeries de wir iz	Olop i requeries	1000 Willia

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.

Report No. WILL0001.1 11/23

FIELD STRENGTH OF FUNDAMENTAL

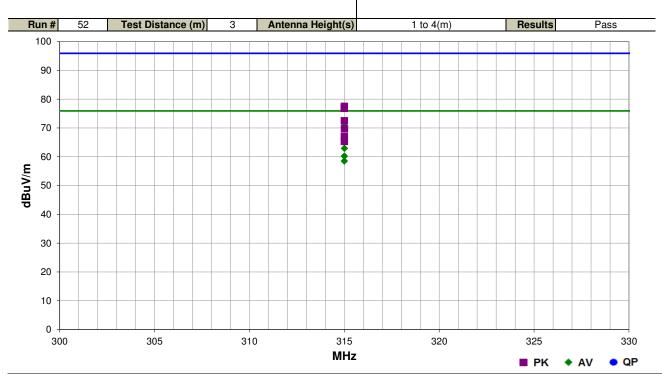


				EmiR5 2018.02.06 PSA-ESCI 2017.12.19				
Work Order:	WILL0001	Date:	27-Mar-2018	COMPANY OF THE PARTY OF THE PAR				
Project:	None	Temperature:	23.8 °C	Morty Marti				
Job Site:	TX02	Humidity:	48% RH					
Serial Number:	None	Barometric Pres.:	1019 mbar	Tested by: Marty Martin				
EUT:	STFS Sensor	•		•				
Configuration:	2							
Customer:	Williams RDM Inc.							
Attendees:	Kisoo Jung	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 Met	hod				

Test Specifications

FCC 15.231:2018

ANSI C63.10:2013



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

Report No. WILL0001.1 12/23

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
Start i requestoy See Ivii iz	otop i roquonoj	0200 1111 12

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 +...

Report No. WILL0001.1 13/23

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..

Report No. WILL0001.1 14/23

SPURIOUS RADIATED EMISSIONS



										EmiR5 20	18.02.06			PSA-ESCI 2017.12.19	<u>.</u>
Work C		WILL		-	Date:		ar-2018	m	-	710	1	11		-	
	roject: b Site:	No TX		lei	mperature: Humidity:		7 ℃ % RH	116	orly		11	la	Co	e'	
Serial Nu		No		Barome	etric Pres.:		mbar	-	Tested by:	Marty	Martir	1			_
Containtai		STFS Sens		Daroni	JULIO 1 10011	1010	mour		rootou by.	iviaity	iviaitii				_
Configur	ration: 2	2													- -
		Villiams R													_
		Kisoo Jung													_
	Power: B		a CW (Un	modulated)	at 315 MHz										-
Operating I	Mode:	ransmillin	g 0 v (0111	nodulated)	at 010 Willia										
Devia	ations:	Vone													-
Devia				. /0	10 10 1			\							=
Comm	ments:	315 MHz P	K measure	ment (3m,	10 dB exter	nal attenua	ation, no filte	er). Used -6	.8 DCCF.						
Collin	nems.														
Test Specificat	ations						Test Meth	od							1
FCC 15.231:20							ANSI C63.								=
1 00 13.231.20	710						ANOI OUS.	10.2010							
D #	57	Toct Di-	tonos (m)	3	Antonio	Hoight/a\		1 to 4(m)		Per	ulta		р-	200	-
Run #	5/	Test Dis	tance (m)	3	Antenna	Height(s)		1 (0 4(111)		Res	uits		Pa	ass	-
80															
	1 [ו וווו					ш	┸		╨	$\overline{}$	J	₩	
70	ш														
60															
60															
П	ΙП						سب	—ш			₩	Π,	ч	₩7	
= ⁵⁰													+		
m//Nngp	ШШ		ט∣ט	"	\		•								
2 40						-	*								
8 "															
30															
20													+		
10															
0 100						1000								10000	
						MHz									
											PK	◆ A	V	• QP	
			Antonic		Duty Cycle	Entered	Polarity/		Dioton					Compared	
Freq Am	nplitude	Factor	Antenna Height	Azimuth	Correction Factor	External Attenuation	Transducer Type	Detector	Distance Adjustment	Adjust		Spec. L		Compared to Spec.	
(MHz) (d	dBuV)	(dB)	(meters)	(degrees)	(dB)	(dB)			(dB)	(dBuV	/m)	(dBuV	m)	(dB)	C
630.002 6	61.7	-14.9	1.0	7.0	-6.8	10.0	Vert	AV	0.0	50.	0	55.9)	-5.9	Comments EUT Z
630.001 6	61.1	-14.9	1.0	146.0	-6.8	10.0	Vert	AV	0.0	49.	4	55.9	9	-6.5	EUT Y
	60.4 59.2	-14.9 -14.9	1.4 1.0	226.9 292.9	-6.8 -6.8	10.0 10.0	Horz Vert	AV AV	0.0 0.0	48. 47.		55.9 55.9		-7.2 -8.4	EUT X EUT X
	58.1	-14.9	1.4	280.9	-6.8	10.0	Horz	AV	0.0	46.		55.9		-9.5	EUTZ
630.004 5	57.4	-14.9	1.4	271.0	-6.8	10.0	Horz	AV	0.0	45.	7	55.9	9	-10.2	EUT Y
	58.9 57.3	-8.2 -8.2	1.1 3.6	127.0 231.9	-6.8 -6.8	0.0 0.0	Vert Horz	AV AV	0.0 0.0	43. 42.		55.9 55.9		-12.0 -13.6	EUT Z EUT X
	07.0	-0.2 -9.4	1.0	87.0	-6.8	10.0	Vert	AV	0.0	38.		55.9		-13.6	EUT Z
	44.5	∪. ¬				10.0	Vert	PK	0.0	56.		75.9		-19.1	EUT Z
945.018 4 630.002 6	61.7	-14.9	1.0	7.0											
945.018 4 630.002 6 945.003 4	61.7 42.6	-14.9 -9.4	1.0	222.0	-6.8	10.0	Horz Vert	AV PK	0.0	36.	4	55.9	9	-19.5	EUT X
945.018 4 630.002 6 945.003 4 630.001 6	61.7	-14.9			-6.8		Horz Vert Horz	AV PK PK			4 2		9	-19.5 -19.7 -20.4	EUT X EUT Y EUT X
945.018 4 630.002 6 945.003 4 630.001 6 629.992 6 629.996 5	61.7 42.6 61.1 60.4 59.2	-14.9 -9.4 -14.9 -14.9 -14.9	1.0 1.0 1.4 1.0	222.0 146.0 226.9 292.9	-6.8	10.0 10.0 10.0 10.0	Vert Horz Vert	PK PK PK	0.0 0.0 0.0 0.0	36. 56. 55. 54.	4 2 5 3	55.9 75.9 75.9 75.9	9 9 9	-19.5 -19.7 -20.4 -21.6	EUT X EUT Y EUT X EUT X
945.018 4 630.002 6 945.003 4 630.001 6 629.992 6 629.996 5 630.006 5	61.7 42.6 61.1 60.4 59.2 58.1	-14.9 -9.4 -14.9 -14.9 -14.9	1.0 1.0 1.4 1.0 1.4	222.0 146.0 226.9 292.9 280.9	-6.8	10.0 10.0 10.0 10.0 10.0	Vert Horz Vert Horz	PK PK PK PK	0.0 0.0 0.0 0.0 0.0	36. 56. 55. 54.	4 2 5 3 2	55.9 75.9 75.9 75.9 75.9	9	-19.5 -19.7 -20.4 -21.6 -22.7	EUT X EUT Y EUT X EUT X EUT Z
945.018 4 630.002 6 945.003 4 630.001 6 629.992 6 629.996 5 630.006 5	61.7 42.6 61.1 60.4 59.2	-14.9 -9.4 -14.9 -14.9 -14.9	1.0 1.0 1.4 1.0	222.0 146.0 226.9 292.9	-6.8	10.0 10.0 10.0 10.0	Vert Horz Vert	PK PK PK	0.0 0.0 0.0 0.0	36. 56. 55. 54.	4 2 5 3 2 5	55.9 75.9 75.9 75.9	9	-19.5 -19.7 -20.4 -21.6	EUT X EUT Y EUT X EUT X EUT Z EUT Z EUT Y
945.018 4 630.002 6 945.003 4 630.001 6 629.992 6 629.996 5 630.006 5 630.004 5 1259.965 5	61.7 42.6 61.1 60.4 59.2 58.1 57.4 58.9 57.3	-14.9 -9.4 -14.9 -14.9 -14.9 -14.9 -14.9 -8.2 -8.2	1.0 1.0 1.4 1.0 1.4 1.4 1.1 3.6	222.0 146.0 226.9 292.9 280.9 271.0 127.0 231.9	-6.8	10.0 10.0 10.0 10.0 10.0 10.0 0.0	Vert Horz Vert Horz Horz Vert Horz	PK PK PK PK PK PK PK	0.0 0.0 0.0 0.0 0.0 0.0 0.0	36. 56. 55. 54. 53. 52. 50. 49.	4 2 5 3 2 5 7	55.9 75.9 75.9 75.9 75.9 75.9 75.9	9	-19.5 -19.7 -20.4 -21.6 -22.7 -23.4 -25.2 -26.8	EUT X EUT Y EUT X EUT X EUT Z EUT Z EUT Z EUT Z EUT Z
945.018 4 630.002 6 945.003 4 630.001 6 629.992 6 630.006 6 630.004 5 1259.965 5 945.018	61.7 42.6 61.1 60.4 59.2 58.1 57.4 58.9	-14.9 -9.4 -14.9 -14.9 -14.9 -14.9 -14.9	1.0 1.0 1.4 1.0 1.4 1.4	222.0 146.0 226.9 292.9 280.9 271.0 127.0	-6.8	10.0 10.0 10.0 10.0 10.0 10.0 0.0	Vert Horz Vert Horz Horz Vert	PK PK PK PK PK PK	0.0 0.0 0.0 0.0 0.0 0.0 0.0	36. 56. 55. 54. 53. 52. 50.	4 2 5 3 2 5 7 1	55.9 75.9 75.9 75.9 75.9 75.9		-19.5 -19.7 -20.4 -21.6 -22.7 -23.4 -25.2	EUT X EUT Y EUT X EUT X EUT Z EUT Z EUT Y

Report No. WILL0001.1 15/23

SPURIOUS RADIATED EMISSIONS



VV		WILL	UUU4		Date:	00 14-	ır-2018			EmiR5 2018.02.06		PSA-ESCI 2017.12.19	1
	Ork Order: Project:	No		Ten	nperature:		7 °C	17/	my	- 1	last	1.	
	Job Site:	TX	02		Humidity:	50.39	% RH	110	0			he	
Seria	al Number:	No STFS Sens		Barome	tric Pres.:	1015	mbar		Tested by:	Marty Mart	in		-
Con	figuration:	2											=
		Williams RI											-
	UT Power:	Kisoo Jung Battery											_
	ting Mode:	Transmittin	g CW (Unr	nodulated)	at 315 MHz	Z							_
													_
	Deviations:	None											
		315 MHz P	K measure	ment (3m,	no external	attenuation	n, no filter).	Used -6.8 l	DCCF.				-
C	Comments:												
Tool Cross	aifi antion a						Test Meth		1				
FCC 15.23	cifications						ANSI C63.						=
1 00 10.20	01.2010						711101 000.	10.2010					
Run #	62	Test Dis	tance (m)	3	Antenna	Height(s)		1 to 4(m)		Results	Р	ass	-
80													
							$\neg \bot$				<u>,,,,,</u>	√	
70 -													
60 -													
												√	
_ 50													
w/\ng p			_							•	• •		
20 40													
8 →			•	•									
			•	• •									
30 -													
20 -													
20 - 10 -													
10 -													
10 -	00											10000	
10 -	00					MHz						10000	
10 -	00					MHz				■ PK	◆ AV	10000 • QP	
10 -	00		Antenna		Duty Cycle Correction		Polarity/ Transducer		Distance	■ PK	◆ AV	• QP	
10 - 0 - 100	Amplitude	Factor	Antenna Height	Azimuth	Correction Factor	External Attenuation	Polarity/ Transducer Type	Detector	Distance Adjustment	Adjusted	Spec. Limit	Ompared to Spec.	
10 -		Factor (dB)		Azimuth (degrees)	Correction	External	Transducer	Detector				• QP Compared to	Comments
10 - 0 + 100 Freq (MHz) 8155.950	Amplitude (dBuV)	(dB) 15.2	Height (meters)	(degrees)	Correction Factor (dB)	External Attenuation (dB)	Transducer Type	AV	Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	EUT X
10 - 0 - 100 Freq (MHz)	Amplitude (dBuV)	(dB)	Height (meters)	(degrees)	Correction Factor (dB)	External Attenuation (dB)	Transducer Type		Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	
10 - 0 + 100 Freq (MHz) 8155.950 8155.995 7617.990 7618.225	Amplitude (dBuV) 39.6 39.5 39.5 38.9	(dB) 15.2 15.2 14.4 14.4	Height (meters) 1.0 1.8 1.0 1.0	(degrees) 106.9 123.0 308.0 187.0	Correction Factor (dB) -6.8 -6.8 -6.8	External Attenuation (dB) 0.0 0.0 0.0 0.0	Horz Vert Horz Vert	AV AV AV	Adjustment (dB) 0.0 0.0 0.0 0.0 0.0	Adjusted (dBuV/m) 48.0 47.9 47.1 46.5	Spec. Limit (dBuV/m) 54.0 54.0 54.0 54.0	• QP Compared to Spec. (dB) -6.0 -6.1 -6.9 -7.5	EUT X EUT Z EUT X EUT Z
10 - 0 + 100 Freq (MHz) 8155.950 8155.995 7617.990 7618.225 1575.205	Amplitude (dBuV) 39.6 39.5 39.5 38.9 50.8	15.2 15.2 14.4 14.4 -7.2	1.0 1.8 1.0 1.0 3.6	106.9 123.0 308.0 187.0 104.0	-6.8 -6.8 -6.8 -6.8	External Attenuation (dB) 0.0 0.0 0.0 0.0 0.0 0.0	Horz Vert Horz Vert Horz Vert Horz	AV AV AV AV	Adjustment (dB) 0.0 0.0 0.0 0.0 0.0 0.0	Adjusted (dBuV/m) 48.0 47.9 47.1 46.5 36.8	Spec. Limit (dBuV/m) 54.0 54.0 54.0 54.0 54.0	• QP Compared to Spec. (dB) -6.0 -6.1 -6.9 -7.5 -17.2	EUT X EUT Z EUT X EUT Z EUT X
10 - 0 + 100 Freq (MHz) 8155.950 8155.995 7617.990 7618.225	Amplitude (dBuV) 39.6 39.5 39.5 38.9	(dB) 15.2 15.2 14.4 14.4	Height (meters) 1.0 1.8 1.0 1.0	(degrees) 106.9 123.0 308.0 187.0	Correction Factor (dB) -6.8 -6.8 -6.8	External Attenuation (dB) 0.0 0.0 0.0 0.0	Horz Vert Horz Vert	AV AV AV	Adjustment (dB) 0.0 0.0 0.0 0.0 0.0	Adjusted (dBuV/m) 48.0 47.9 47.1 46.5	Spec. Limit (dBuV/m) 54.0 54.0 54.0 54.0	• QP Compared to Spec. (dB) -6.0 -6.1 -6.9 -7.5	EUT X EUT Z EUT X EUT Z
Freq (MHz) 8155.950 8155.995 7617.990 7618.225 1575.205 2205.085 8155.950 8155.950	Amplitude (dBuV) 39.6 39.5 39.5 38.9 50.8 46.2 39.6 39.5	(dB) 15.2 15.2 14.4 14.4 -7.2 -4.4 15.2 15.2	1.0 1.8 1.0 1.0 3.6 1.0 1.0	106.9 123.0 308.0 187.0 104.0 122.0 106.9 123.0	Correction Factor (dB) -6.8 -6.8 -6.8 -6.8 -6.8	External Attenuation (dB) 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0	Horz Vert Horz Vert Horz Vert Horz Vert Horz Vert Horz Vert Vert Vert	AV AV AV AV AV PK PK	Adjustment (dB) 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0	Adjusted (dBuV/m) 48.0 47.9 47.1 46.5 36.8 35.0 54.8 54.7	Spec. Limit (dBuV/m) 54.0 54.0 54.0 54.0 54.0 54.0 74.0	• QP Compared to Spec. (dB) -6.0 -6.1 -6.9 -7.5 -17.2 -19.0 -19.2 -19.3	EUT X EUT Z EUT X EUT Z EUT X EUT Z EUT X EUT Z EUT X
Freq (MHz) 8155.950 8155.995 7617.990 7618.225 1575.205 2205.085 8155.995 2204.500	Amplitude (dBuV) 39.6 39.5 39.5 39.5 50.8 46.2 39.6 39.5 45.3	(dB) 15.2 15.2 14.4 14.4 -7.2 -4.4 15.2 15.2 -4.4	1.0 1.8 1.0 1.0 3.6 1.0 1.0 1.2 1.0 1.0	(degrees) 106.9 123.0 308.0 187.0 104.0 122.0 106.9 123.0 26.0	-6.8 -6.8 -6.8 -6.8	External Attenuation (dB) 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0	Transducer Type Horz Vert Horz Vert Horz Vert Horz Vert Horz Vert Horz Vert Horz	AV AV AV AV AV PK PK AV	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	Adjusted (dBuV/m) 48.0 47.9 47.1 46.5 36.8 35.0 54.8 54.7 34.1	Spec. Limit (dBuV/m) 54.0 54.0 54.0 54.0 54.0 74.0 74.0 54.0	• QP Compared to Spec. (dB) -6.0 -6.1 -6.9 -7.5 -17.2 -19.0 -19.2 -19.3 -19.9	EUT X EUT Z EUT X EUT Z EUT X EUT Z EUT X EUT Z EUT Z EUT X EUT Z EUT X
Freq (MHz) 8155.950 8155.950 7617.990 7618.225 1575.205 2205.085 8155.950 8155.950 8157.990	Amplitude (dBuV) 39.6 39.5 39.5 38.9 50.8 46.2 39.6 39.5 45.3 39.5	(dB) 15.2 15.2 14.4 14.4 -7.2 -4.4 15.2 15.2 -4.4 14.4	1.0 1.8 1.0 1.0 3.6 1.0 1.0 1.0 2.7	106.9 123.0 308.0 187.0 104.0 122.0 106.9 123.0 26.0 308.0	Correction Factor (dB) -6.8 -6.8 -6.8 -6.8 -6.8 -6.8	External Attenuation (dB) 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0	Transducer Type Horz Vert Horz Vert Horz Vert Horz Vert Horz Horz Horz Horz	AV AV AV AV AV PK PK AV PK	Adjustment (dB) 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0	Adjusted (dBuV/m) 48.0 47.9 47.1 46.5 36.8 35.0 54.8 54.7 34.1 53.9	Spec. Limit (dBuV/m) 54.0 54.0 54.0 54.0 54.0 74.0 74.0 74.0	• QP Compared to Spec. (dB) -6.0 -6.1 -6.9 -7.5 -17.2 -19.0 -19.2 -19.3 -19.9 -20.1	EUT X EUT Z EUT X EUT Z EUT X EUT Z EUT X EUT Z EUT X EUT X EUT X EUT X
Freq (MHz) 8155.950 8155.995 7617.990 7618.225 1575.205 2205.085 8155.995 2204.500 7617.990 1889.845	Amplitude (dBuV) 39.6 39.5 39.5 38.9 50.8 46.2 39.6 39.5 45.3 39.5 48.5	15.2 15.2 14.4 14.4 -7.2 -4.4 15.2 15.2 -4.4 14.4 -6.0	Height (meters) 1.0 1.8 1.0 3.6 1.0 1.0 3.7 1.0 3.1	106.9 123.0 308.0 187.0 104.0 122.0 106.9 123.0 26.0 308.0 307.0	Correction Factor (dB) -6.8 -6.8 -6.8 -6.8 -6.8 -6.8	External Attenuation (dB) 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0	Horz Vert Horz Vert Horz Vert Horz Vert Horz Vert Horz Horz Horz Horz Horz	AV AV AV AV AV PK PK AV PK	Adjustment (dB) 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0	Adjusted (dBuV/m) 48.0 47.9 47.1 46.5 36.8 35.0 54.8 54.7 34.1 53.9 35.7	Spec. Limit (dBuV/m) 54.0 54.0 54.0 54.0 54.0 74.0 74.0 74.0 74.0 55.9	- QP Compared to Spec. (dB) -6.0 -6.1 -6.9 -7.5 -17.2 -19.0 -19.2 -19.3 -19.9 -20.1 -20.2	EUT X EUT Z EUT X EUT Z EUT X EUT Z EUT X EUT Z EUT X EUT X EUT Z EUT X EUT Z EUT X EUT X
Freq (MHz) 8155.950 8155.950 7617.990 7618.225 1575.205 2205.085 8155.950 8155.950 8157.990	Amplitude (dBuV) 39.6 39.5 39.5 38.9 50.8 46.2 39.6 39.5 45.3 39.5	(dB) 15.2 15.2 14.4 14.4 -7.2 -4.4 15.2 15.2 -4.4 14.4	1.0 1.8 1.0 1.0 3.6 1.0 1.0 1.0 2.7	106.9 123.0 308.0 187.0 104.0 122.0 106.9 123.0 26.0 308.0	Correction Factor (dB) -6.8 -6.8 -6.8 -6.8 -6.8 -6.8	External Attenuation (dB) 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0	Transducer Type Horz Vert Horz Vert Horz Vert Horz Vert Horz Horz Horz Horz	AV AV AV AV AV PK PK AV PK	Adjustment (dB) 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0	Adjusted (dBuV/m) 48.0 47.9 47.1 46.5 36.8 35.0 54.8 54.7 34.1 53.9	Spec. Limit (dBuV/m) 54.0 54.0 54.0 54.0 54.0 74.0 74.0 74.0	• QP Compared to Spec. (dB) -6.0 -6.1 -6.9 -7.5 -17.2 -19.0 -19.2 -19.3 -19.9 -20.1	EUT X EUT Z EUT X EUT Z EUT X EUT Z EUT X EUT Z EUT X EUT X EUT X EUT X
Freq (MHz) 8155.950 8155.995 7617.990 7618.225 1575.205 2205.085 8155.995 2204.500 7617.990 1889.845 1574.780	Amplitude (dBuV) 39.6 39.5 39.5 39.5 50.8 46.2 39.6 39.5 45.3 39.5 48.3 47.3	15.2 15.2 14.4 14.4 -7.2 -4.4 15.2 15.2 -4.4 14.4 -6.0 -7.2 14.4 -6.0	1.0 1.8 1.0 1.0 3.6 1.0 1.0 1.8 2.7 1.0 3.1 3.9	106.9 123.0 308.0 187.0 104.0 122.0 106.9 123.0 26.0 308.0 307.0 175.0	Correction Factor (dB) -6.8 -6.8 -6.8 -6.8 -6.8 -6.8	External Attenuation (dB) 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0	Transducer Type Horz Vert Vert Vert Vert Vert Vert Vert Vert	AV AV AV AV AV PK PK AV PK AV	Adjustment (dB) 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0	Adjusted (dBuV/m) 48.0 47.9 47.1 46.5 36.8 35.0 54.8 54.7 34.1 53.9 35.7 33.3 53.3 53.3	Spec. Limit (dBuV/m) 54.0 54.0 54.0 54.0 54.0 54.0 74.0 74.0 55.9 54.0 74.0 55.9	- QP Compared to Spec. (dB) -6.0 -6.1 -6.9 -7.5 -17.2 -19.0 -19.2 -19.3 -19.9 -20.1 -20.2 -20.7 -23.7	EUT X EUT Z EUT X EUT X EUT X EUT X EUT X EUT X EUT Z EUT X EUT Z EUT X EUT Z EUT Z EUT Z EUT Z
Freq (MHz) 8155.950 8155.995 7617.990 7618.225 1575.205 2205.085 8155.956 2204.500 7617.990 1889.845 1574.780 7618.225 1890.045	Amplitude (dBuV) 39.6 39.5 39.5 38.9 50.8 46.2 39.6 39.5 45.3 39.5 44.3 38.9 45.0 50.8	(dB) 15.2 15.2 14.4 14.4 -7.2 -4.4 15.2 15.2 -4.4 14.4 -6.0 -7.2 14.4 -6.0 -7.2	1.0 1.8 1.0 3.6 1.0 1.0 3.6 1.0 3.1 3.9 1.0 3.1 3.9	(degrees) 106.9 123.0 308.0 187.0 104.0 122.0 106.9 123.0 26.0 308.0 307.0 175.0 187.0 172.9 104.0	Correction Factor (dB) -6.8 -6.8 -6.8 -6.8 -6.8 -6.8 -6.8	External Attenuation (dB) 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0	Transducer Type Horz Vert Horz Vert Horz Vert Horz Vert Horz Vert Vert Vert Vert Vert Vert Horz	AV AV AV AV AV PK AV PK AV PK AV PK AV	Adjustment (dB) 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0	Adjusted (dBuV/m) 48.0 47.9 47.1 46.5 36.8 35.0 54.8 54.7 34.1 53.9 35.7 33.3 53.3 32.2 43.6	Spec. Limit (dBuV/m) 54.0 54.0 54.0 54.0 54.0 54.0 74.0 74.0 74.0 74.0 74.0 75.9 54.0 74.0 74.0	- QP Compared to Spec. (dB) -6.0 -6.1 -6.9 -7.5 -17.2 -19.0 -19.3 -19.9 -20.1 -20.2 -20.7 -20.7 -23.7 -30.4	EUT X EUT Z EUT Z EUT X EUT Z EUT Z EUT Z EUT Z EUT Z
Freq (MHz) 8155.950 8155.995 7617.990 7618.225 1575.205 2205.085 8155.995 2204.500 7617.990 1889.845 1574.780 7618.225 1890.045 1575.205 2205.085	Amplitude (dBuV) 39.6 39.5 39.5 39.5 50.8 46.2 39.6 39.5 45.3 39.5 47.3 38.9 45.0 50.8 46.2	(dB) 15.2 15.2 14.4 14.4 -7.2 -4.4 15.2 15.2 4.4 14.4 -6.0 -7.2 14.4 -6.0 -7.2 -4.4	Height (meters) 1.0 1.8 1.0 3.6 1.0 1.8 2.7 1.0 3.1 3.9 1.0 1.0 3.6 1.0 1.0	(degrees) 106.9 123.0 308.0 187.0 104.0 122.0 106.9 123.0 26.0 308.0 307.0 175.0 187.0 172.9 104.0 122.0	Correction Factor (dB) -6.8 -6.8 -6.8 -6.8 -6.8 -6.8 -6.8	External Attenuation (dB) 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0	Transducer Type Horz Vert Horz Vert Horz Vert Horz Vert Horz Vert Vert Horz Vert Vert Vert Vert Vert Vert Vert Vert	AV AV AV AV AV PK PK AV PK AV PK AV PK AV	Adjustment (dB) 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0	Adjusted (dBuV/m) 48.0 47.9 47.1 46.5 36.8 35.0 54.8 54.7 34.1 53.9 35.7 33.3 32.2 43.6 41.8	Spec. Limit (dBuV/m) 54.0 54.0 54.0 54.0 54.0 54.0 74.0 74.0 74.0 74.0 75.9 74.0 74.0 74.0	- QP Compared to Spec. (dB) -6.0 -6.1 -6.9 -7.5 -17.2 -19.0 -19.2 -19.3 -19.9 -20.1 -20.2 -20.7 -23.7 -23.7 -30.4 -32.2	EUT X EUT Z EUT Z EUT Z EUT Z EUT X EUT Z
Freq (MHz) 8155.950 8155.950 8155.950 8155.950 8155.950 8155.950 8155.950 8155.995 2204.500 7617.990 1889.845 1574.780 7618.225 1890.045 1575.205 2205.085	Amplitude (dBuV) 39.6 39.5 39.5 38.9 50.8 46.2 39.6 39.5 45.3 39.5 48.5 47.3 38.9 45.0 50.8 46.2 45.3	(dB) 15.2 15.2 14.4 14.4 -7.2 -4.4 15.2 15.2 -4.4 14.4 -6.0 -7.2 14.4 -6.0 -7.2 -4.4	Height (meters) 1.0 1.8 1.0 1.0 3.6 1.0 1.8 2.7 1.0 3.1 3.9 1.0 3.6 1.0 2.7	(degrees) 106.9 123.0 308.0 187.0 104.0 122.0 106.9 123.0 26.0 308.0 307.0 175.0 187.0 172.9 104.0 122.0 26.0	Correction Factor (dB) -6.8 -6.8 -6.8 -6.8 -6.8 -6.8 -6.8	External Attenuation (dB) 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0	Transducer Type Horz Vert Horz Vert Horz Vert Horz Vert Horz Vert Vert Horz Horz Vert Horz Vert Vert Vert Vert Horz Vert Horz Vert Horz	AV AV AV AV AV PK AV	Adjustment (dB) 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0	Adjusted (dBuV/m) 48.0 47.9 47.1 46.5 36.8 35.0 54.8 54.7 34.1 53.9 35.7 33.3 32.2 43.6 41.8 40.9	Spec. Limit (dBuV/m) 54.0 54.0 54.0 54.0 54.0 54.0 74.0 74.0 74.0 55.9 74.0 75.9 74.0 74.0 74.0 74.0	- QP Compared to Spec. (dB) -6.0 -6.1 -6.9 -7.5 -17.2 -19.0 -19.2 -19.3 -19.9 -20.1 -20.2 -20.7 -23.7 -30.4 -32.2 -33.1	EUT X EUT Z EUT Z EUT X EUT Z EUT X EUT Z EUT X
Freq (MHz) 8155.950 8155.995 7617.990 7618.225 1575.205 2205.085 8155.995 2204.500 7617.990 1889.845 1574.780 7618.225 1890.045 1575.205 2205.085	Amplitude (dBuV) 39.6 39.5 39.5 39.5 50.8 46.2 39.6 39.5 45.3 39.5 47.3 38.9 45.0 50.8 46.2	(dB) 15.2 15.2 14.4 14.4 -7.2 -4.4 15.2 15.2 4.4 14.4 -6.0 -7.2 14.4 -6.0 -7.2 -4.4	Height (meters) 1.0 1.8 1.0 3.6 1.0 1.8 2.7 1.0 3.1 3.9 1.0 1.0 3.6 1.0 1.0	(degrees) 106.9 123.0 308.0 187.0 104.0 122.0 106.9 123.0 26.0 308.0 307.0 175.0 187.0 172.9 104.0 122.0	Correction Factor (dB) -6.8 -6.8 -6.8 -6.8 -6.8 -6.8 -6.8	External Attenuation (dB) 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0	Transducer Type Horz Vert Horz Vert Horz Vert Horz Vert Horz Vert Vert Horz Vert Vert Vert Vert Vert Vert Vert Vert	AV AV AV AV AV PK PK AV PK AV PK AV PK AV	Adjustment (dB) 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0	Adjusted (dBuV/m) 48.0 47.9 47.1 46.5 36.8 35.0 54.8 54.7 34.1 53.9 35.7 33.3 32.2 43.6 41.8	Spec. Limit (dBuV/m) 54.0 54.0 54.0 54.0 54.0 54.0 74.0 74.0 74.0 74.0 75.9 74.0 74.0 74.0	- QP Compared to Spec. (dB) -6.0 -6.1 -6.9 -7.5 -17.2 -19.0 -19.2 -19.3 -19.9 -20.1 -20.2 -20.7 -23.7 -23.7 -30.4 -32.2	EUT X EUT Z EUT Z EUT Z EUT Z EUT X EUT Z
Freq (MHz) 8155.950 8155.995 7617.990 7618.225 8155.952 2204.500 7617.990 1889.845 1574.780 7618.225 2204.500 7617.990 1889.845	Amplitude (dBuV) 39.6 39.5 39.5 38.9 50.8 46.2 39.6 39.5 45.3 39.5 45.3 38.9 50.8 46.2 45.3 48.5	(dB) 15.2 15.2 14.4 14.4 -7.2 -4.4 15.2 15.2 -4.4 14.4 -6.0 -7.2 14.4 -6.0 -7.2 -4.4 -6.0	Height (meters) 1.0 1.8 1.0 3.6 1.0 1.8 2.7 1.0 3.1 3.9 1.0 3.6 1.0 2.7 3.1	(degrees) 106.9 123.0 308.0 187.0 104.0 122.0 106.9 123.0 26.0 308.0 307.0 175.0 187.0 172.9 104.0 122.0 26.0 307.0	Correction Factor (dB) -6.8 -6.8 -6.8 -6.8 -6.8 -6.8 -6.8	External Attenuation (dB) 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0	Transducer Type Horz Vert Vert Vert Vert Horz	AV AV AV AV AV PK AV PK AV PK AV PK AV PK AV	Adjustment (dB) 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0	Adjusted (dBuV/m) 48.0 47.9 47.1 46.5 36.8 35.0 54.8 54.7 34.1 53.9 35.7 33.3 53.3 53.3 42.2 43.6 41.8 40.9 42.5	Spec. Limit (dBuV/m) 54.0 54.0 54.0 54.0 54.0 54.0 74.0 74.0 74.0 55.9 54.0 74.0 74.0 75.9	- QP Compared to Spec. (dB) -6.0 -6.1 -6.9 -7.5 -17.2 -19.0 -19.2 -19.3 -19.9 -20.1 -20.2 -20.7 -20.7 -23.7 -30.4 -32.2 -33.1 -33.4	EUT X EUT Z EUT Z EUT X EUT Z

Report No. WILL0001.1 16/23

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.

Report No. WILL0001.1 17/23

OCCUPIED BANDWIDTH



Work Order: WILL0001

Date: 28-Mar-18

Temperature: 23.7 °C

Humidity: 48.9% RH

Barometric Pres.: 1011 mbar

Job Site: TX02 EUT: STFS Sensor Serial Number: None
Customer: Williams RDM Inc. Attendees: Kisoo Jung
Project: None
Tested by: Marty Martin
TEST SPECIFICATIONS Power: Battery
Test Method ANSI C63.10:2013 FCC 15.231:2018 COMMENTS Connected Near Field Probe from EUT straight to Analyzer. DEVIATIONS FROM TEST STANDARD None Monty Marti Configuration # Signature **Value** 18.943 Limit Result Single Channel, 315 MHz

Report No. WILL0001.1 18/23

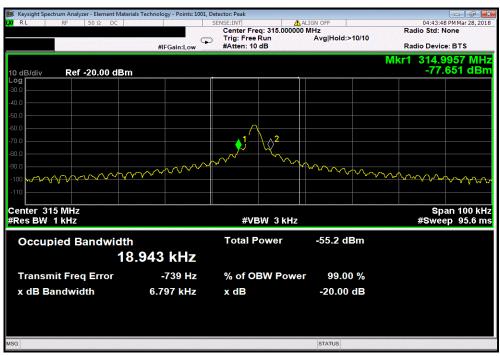
OCCUPIED BANDWIDTH

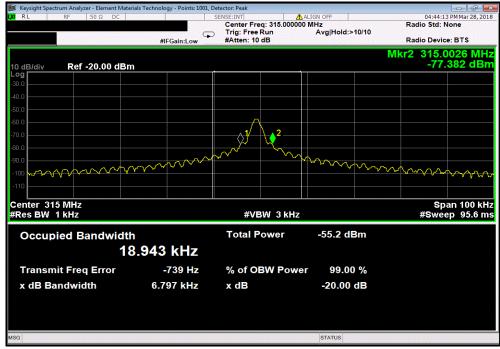


Single Channel, 315 MHz

Value Limit Result

18,943 78.75 MHz Pass





Report No. WILL0001.1 19/23

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.

Report No. WILL0001.1 20/23

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	Pow	er: 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 DEVIATIONS FROM TEST STANDARD	,						
None							
Configuration # 1 Signature	Mosty	Marti	3				
		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 N/A

Report No. WILL0001.1 21/23

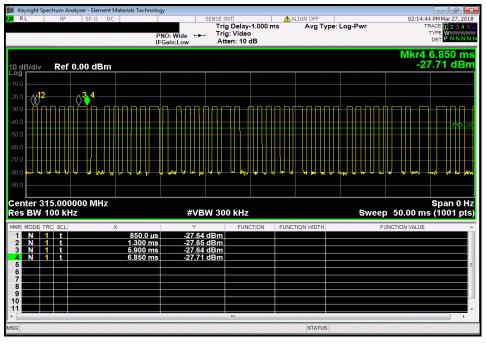


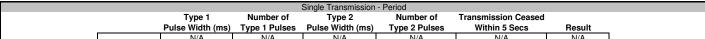
Single Transmission - Pulse Widths

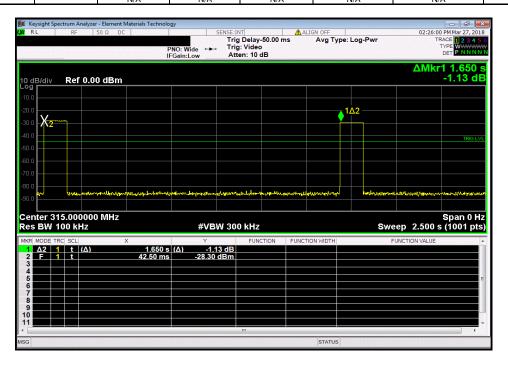
Type 1 Number of Type 2 Number of Transmission Ceased

Pulse Width (ms) Type 1 Pulses Pulse Width (ms) Type 2 Pulses Within 5 Secs Result

0.45 72 0.95 14 N/A N/A







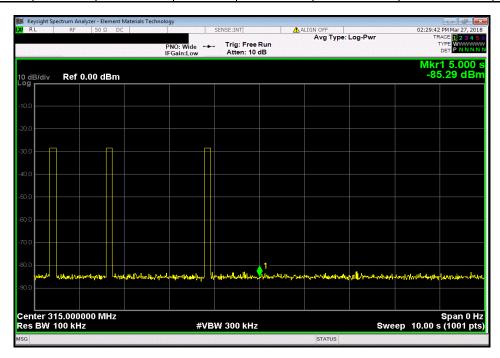
Report No. WILL0001.1 22/23

DUTY CYCLE



XMit 2017.12.13

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



Report No. WILL0001.1 23/23