

FCC and Industry Canada Testing of the
Wireless Measurement Ltd,
Model: STAMP Radio Module (WML-MOD-00003)
In accordance with FCC 47 CFR Part 15C,
Industry Canada RSS-247 and Industry Canada
RSS-GEN

Prepared for: Wireless Measurement Ltd
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Queen Street
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UNITED KINGDOM



FCC ID: 2AKX6-MØ3
IC: 22384-MØ3

COMMERCIAL-IN-CONFIDENCE

Date: February 2017
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RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Project Management	Steven White	22 February 2017	
Authorised Signatory	Matthew Russell	22 February 2017	

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD Product Service document control rules.

ENGINEERING STATEMENT

The measurements shown in this report were made in accordance with the procedures described on test pages. All reported testing was carried out on a sample equipment to demonstrate limited compliance with FCC 47 CFR Part 15C, Industry Canada RSS-247 and Industry Canada RSS-GEN. The sample tested was found to comply with the requirements defined in the applied rules.

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Testing	Graeme Lawler	22 February 2017	

FCC Accreditation
90987 Octagon House, Fareham Test Laboratory

Industry Canada Accreditation
IC2932B-1 Octagon House, Fareham Test Laboratory

EXECUTIVE SUMMARY

A sample of this product was tested and found to be in compliance with FCC 47 CFR Part 15C: 2015, Industry Canada RSS-247: Issue 1 and Industry Canada RSS-GEN: Issue 4.



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ACCREDITATION

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1 Report Summary

1.1 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

Issue	Description of Change	Date of Issue
1	First Issue	22 February 2017

Table 1

1.2 Introduction

Applicant	Wireless Measurement Ltd
Manufacturer	Wireless Measurement Ltd
Model Number(s)	STAMP Radio Module
Part Number(s)	WML-MOD-00003
Serial Number(s)	39590
Hardware Version(s)	1.0
Software Version(s)	1.0
Number of Samples Tested	1
Test Specification/Issue/Date	FCC 47 CFR Part 15C: 2015 Industry Canada RSS-247: Issue 1: 2015 Industry Canada RSS-GEN: Issue 4: 2014
Order Number	161202
Date	02-December-2016
Date of Receipt of EUT	15-December-2016
Start of Test	23-January-2017
Finish of Test	29-January-2017
Name of Engineer(s)	Graeme Lawler
Related Document(s)	ANSI C63.10 (2013)



1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with FCC 47 CFR Part 15C, Industry Canada RSS-247 and Industry Canada RSS-GEN is shown below.

Section	Specification Clause			Test Description	Result	Comments/Base Standard
	Part 15C	RSS-247	RSS-GEN			
Configuration: 2.4 GHz SRD						
2.1	15.247 (d) and 15.205	5.5	8.10	Spurious Radiated Emissions	Pass	ANSI C63.10
2.2	15.247 (d)	5.5	-	Authorised Band Edges	Pass	ANSI C63.10
2.3	15.205	-	8.10	Restricted Band Edges	Pass	ANSI C63.10

Table 2



1.4 Application Form

EQUIPMENT DESCRIPTION	
Model Name/Number	STAMP Radio Module - integrated antenna
Part Number	WML-MOD-00003
Hardware Version	1
Software Version	N/A
FCC ID (if applicable)	2AKX6-MØ3
Industry Canada ID (if applicable)	22384-MØ3
Technical Description (Please provide a brief description of the intended use of the equipment)	2.4Ghz radio module for use with wireless sensor products

INTENTIONAL RADIATORS									
Technology	Frequency Band (MHz)	Conducted Declared Output Power (dBm)	Antenna Gain (dBi)	Supported Bandwidth (s) (MHz)	Modulation Scheme(s)	ITU Emission Designator	Test Channels (MHz)		
							Bottom	Middle	Top
IEEE-802.15.4	2400	8	-0.5	2	O-QPSK		2405	2450	2475

UN-INTENTIONAL RADIATOR	
Highest frequency generated or used in the device or on which the device operates or tunes	2475 MHz

Power Source			
AC	Single Phase	Three Phase	Nominal Voltage
External DC	Nominal Voltage		Maximum Current
Battery	Nominal Voltage		Battery Operating End Point Voltage
	3.6 V		2.9 V
Can EUT transmit whilst being charged?		Yes <input type="checkbox"/>	No <input type="checkbox"/>

EXTREME CONDITIONS				
Maximum temperature	-40	°C	Minimum temperature	+85 °C



Ancillaries

Please list all ancillaries which will be used with the device.

ANTENNA CHARACTERISTICS

<input type="checkbox"/> Antenna connector	State impedance	Ohm
<input type="checkbox"/> Temporary antenna connector	State impedance	Ohm
<input checked="" type="checkbox"/> Integral antenna	Type	Ceramic
<input type="checkbox"/> External antenna	Type	

I hereby declare that the information supplied is correct and complete.

Name: David Wooller

Position held: Design Engineer Date: 16/02/2017

1.5 Product Information

1.5.1 Technical Description

Radio module to build into radio sensor measurement systems.

1.5.2 EUT configuration

The device was powered via its own 3.6V internal battery throughout testing.

1.6 Deviations from the Standard

No deviations from the applicable test standard were made during testing.

1.7 EUT Modification Record

The table below details modifications made to the EUT during the test programme.
The modifications incorporated during each test are recorded on the appropriate test pages.

Modification State	Description of Modification still fitted to EUT	Modification Fitted By	Date Modification Fitted
Serial Number: 39590			
0	As supplied by the customer	Not Applicable	Not Applicable

Table 3

1.8 Test Location

TÜV SÜD Product Service conducted the following tests at our Fareham Test Laboratory.

Test Name	Name of Engineer(s)	Accreditation
Configuration: 2.4 GHz SRD		
Spurious Radiated Emissions	Graeme Lawler	UKAS
Authorised Band Edges	Graeme Lawler	UKAS
Restricted Band Edges	Graeme Lawler	UKAS

Table 4

Office Address:

Octagon House
Concorde Way
Segensworth North
Fareham
Hampshire
PO15 5RL
United Kingdom

2 Test Details

2.1 Spurious Radiated Emissions

2.1.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (d) and 15.205
Industry Canada RSS-247, Clause 5.5
Industry Canada RSS-GEN, Clause 8.10

2.1.2 Equipment Under Test and Modification State

STAMP Radio Module (WML-MOD-00003), S/N: 39590 - Modification State 0

2.1.3 Date of Test

23-January-2017 to 29-January-2017

2.1.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 6.3, 6.5 and 6.6.

Plots for average measurements were taken in accordance with ANSI C63.10, clause 4.1.4.2.3

Final average measurements were taken in accordance with ANSI C63.10, clause 4.1.4.2.2

2.1.5 Environmental Conditions

Ambient Temperature 19.3 °C
Relative Humidity 34.0 %

2.1.6 Test Results

2.4 GHz SRD

2405.0 MHz

Frequency (MHz)	QP Level (dB μ V/m)	QP Limit (dB μ V/m)	QP Margin (dB μ V/m)	Angle(Deg)	Height(m)	Polarity
30.146	30.8	40.0	-9.2	0	1.00	Vertical
30.334	30.5	40.0	-9.5	0	1.00	Vertical
30.727	30.2	40.0	-9.8	0	1.00	Vertical
866.417	33.7	46.0	-12.3	0	1.00	Vertical
894.890	33.9	46.0	-12.1	0	1.00	Vertical
960.000	34.2	46.0	-11.8	0	1.00	Vertical

Table 5 - 30 MHz to 1 GHz Emissions Results

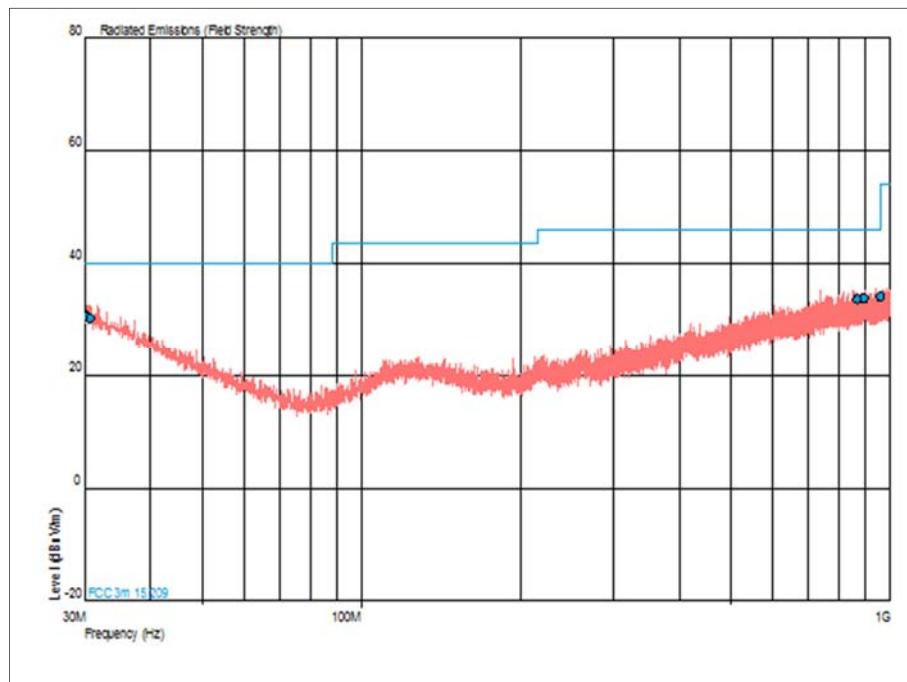


Figure 1 - 30 MHz to 1 GHz - Polarity Horizontal and Vertical

Frequency (MHz)	Result (μ V/m)		Limit (μ V/m)		Margin (μ V/m)	
	Peak	Average	Peak	Average	Peak	Average
4810.984	668.34	310.46	5000	500	433.66	189.54

Table 6 - 1 GHz to 25 GHz Emissions Results

No other emissions were detected within 10 dB of the limit.

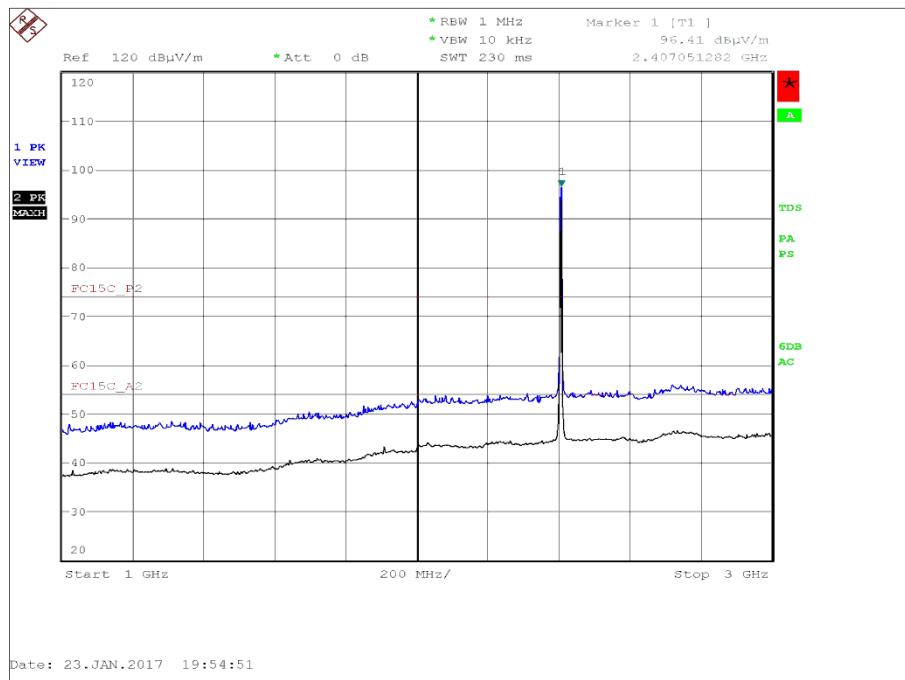


Figure 2 - 1 GHz to 3 GHz - Polarity: Horizontal and Vertical

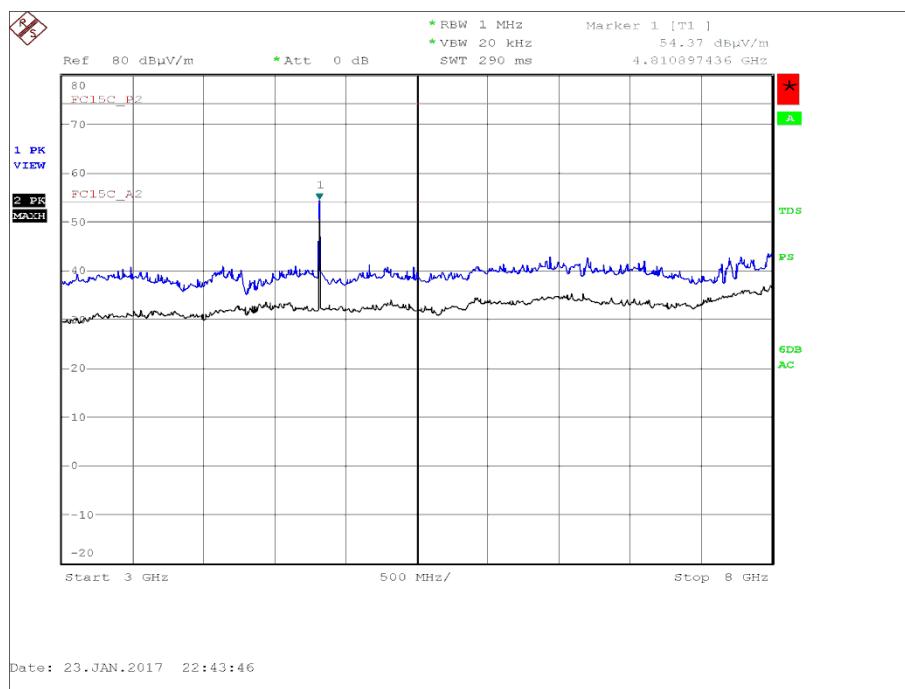


Figure 3 - 3 GHz to 8 GHz - Polarity: Horizontal and Vertical

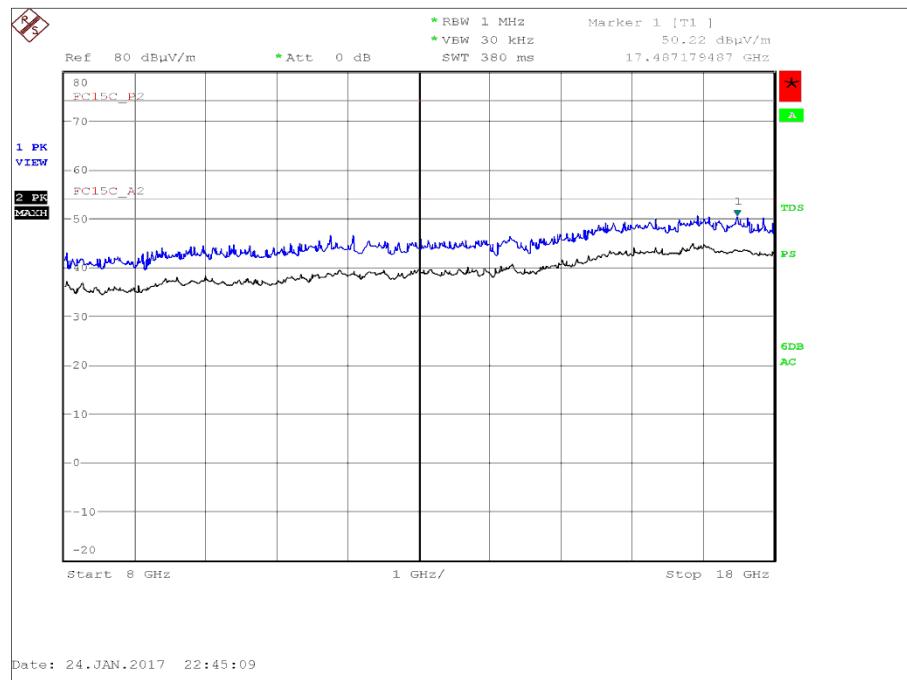


Figure 4 - 8 GHz to 18 GHz - Polarity: Horizontal and Vertical

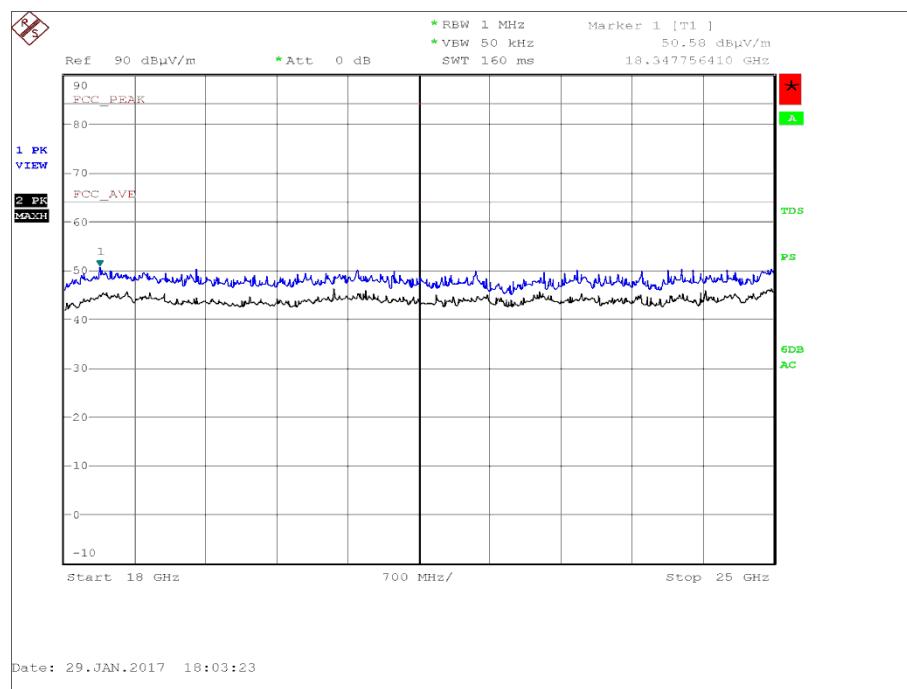


Figure 5 - 18 GHz to 25 GHz - Polarity: Horizontal and Vertical

2440 MHz

Frequency (MHz)	QP Level (dB μ V/m)	QP Limit (dB μ V/m)	QP Margin (dB μ V/m)	Angle(Deg)	Height(m)	Polarity
30.384	30.5	40.0	-9.5	0	1.00	Vertical
32.463	29.4	40.0	-10.6	0	1.00	Vertical
35.026	28.0	40.0	-12.0	0	1.00	Vertical
859.841	33.2	46.0	-12.8	0	1.00	Vertical
909.715	33.8	46.0	-12.2	0	1.00	Vertical
960.000	34.1	46.0	-11.9	0	1.00	Vertical

Table 7 - 30 MHz to 1 GHz Emissions Results

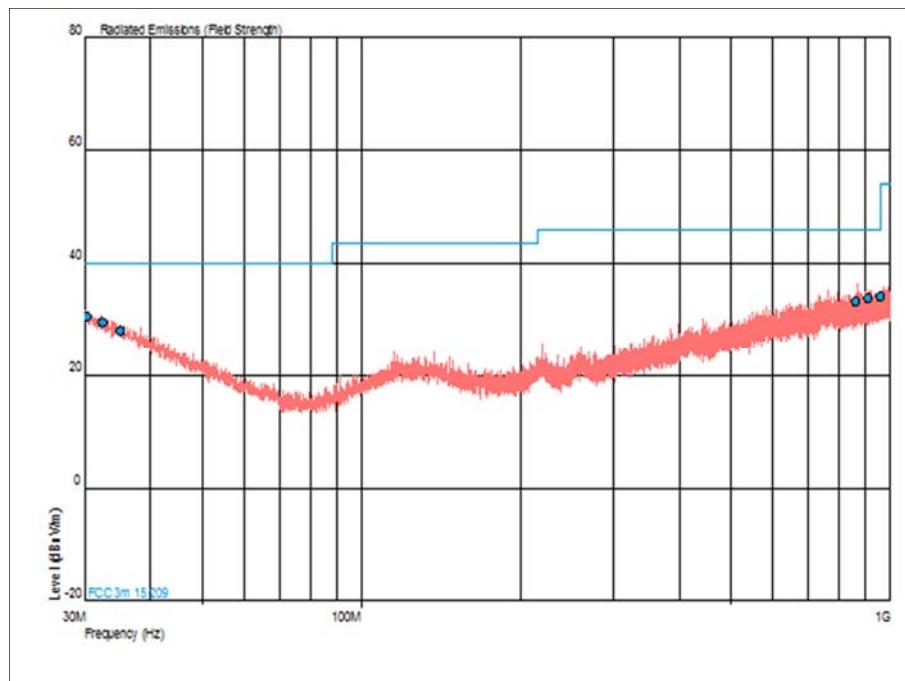


Figure 6 - 30 MHz to 1 GHz - Polarity Horizontal and Vertical

Frequency (MHz)	Result (μ V/m)		Limit (μ V/m)		Margin (μ V/m)	
	Peak	Average	Peak	Average	Peak	Average
4.879000	592.92	264.85	5000	500	4407.08	235.15

Table 8 - 1 GHz to 25 GHz Emissions Results

No other emissions were detected within 10 dB of the limit.

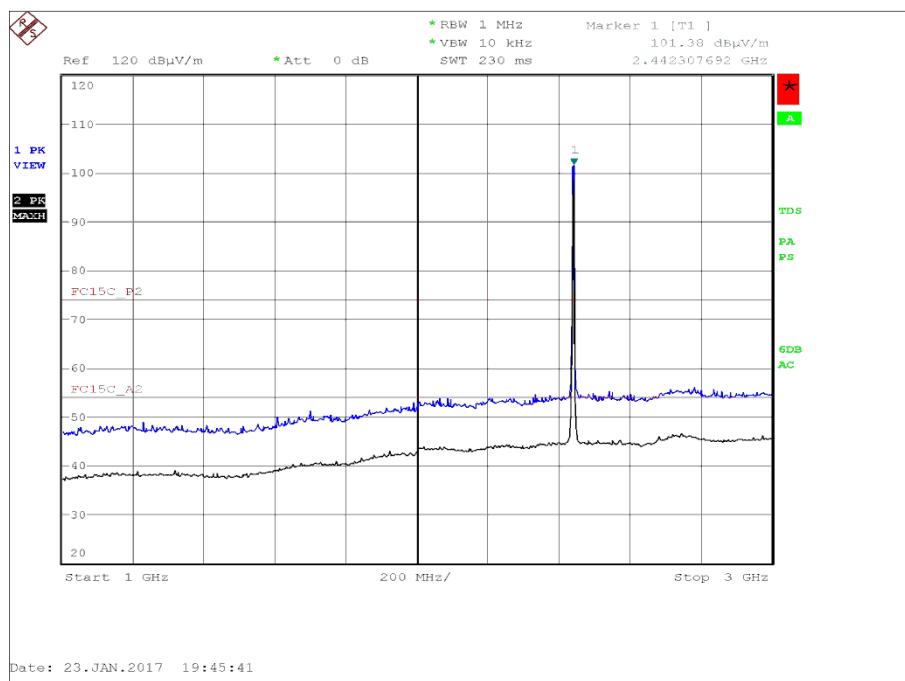


Figure 7 - 1 GHz to 3 GHz - Polarity: Horizontal and Vertical

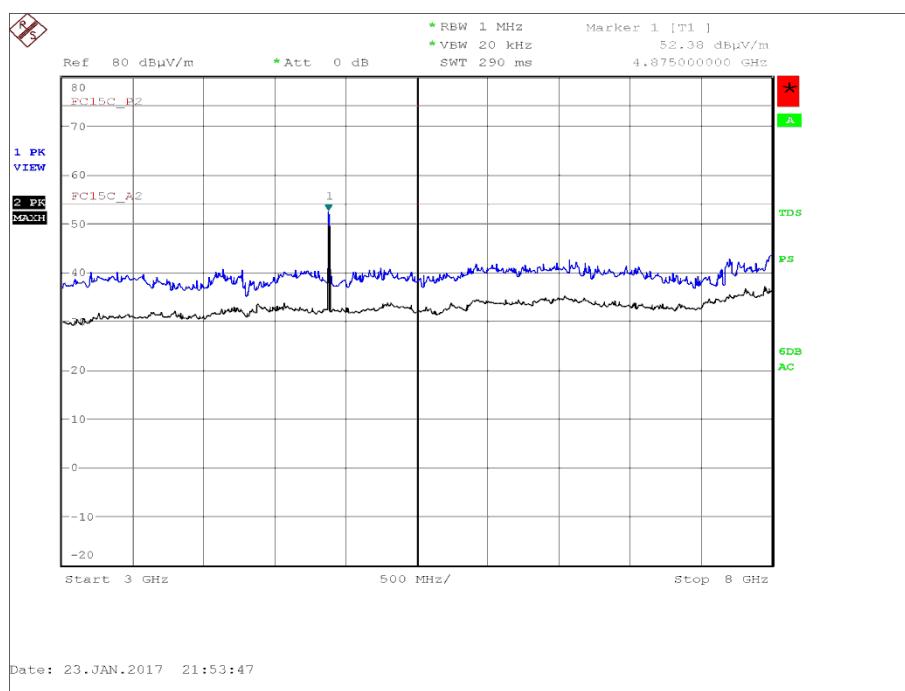


Figure 8 - 3 GHz to 8 GHz - Polarity: Horizontal and Vertical

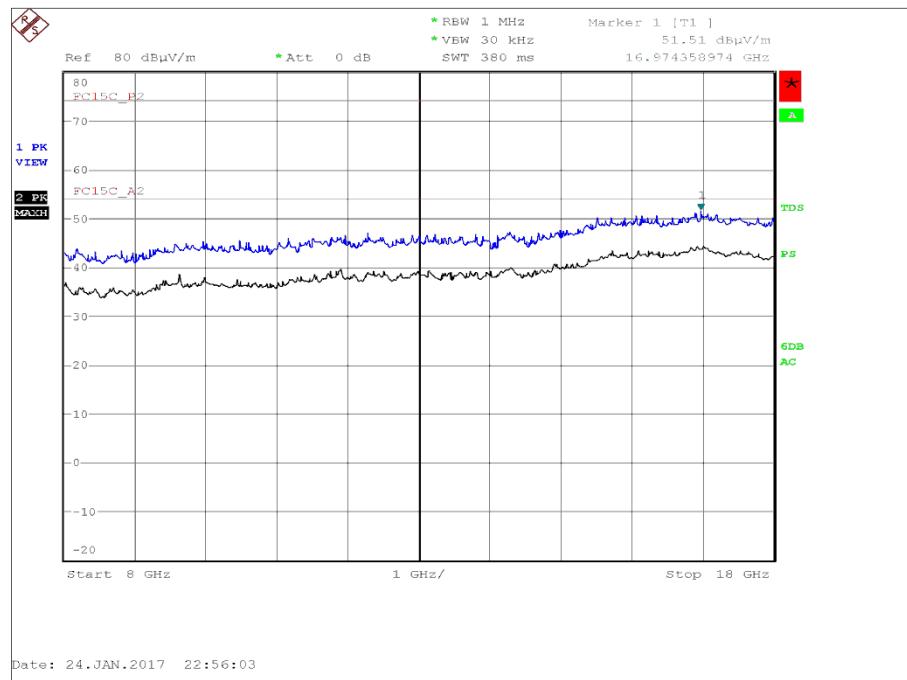


Figure 9 - 8 GHz to 18 GHz - Polarity: Horizontal and Vertical

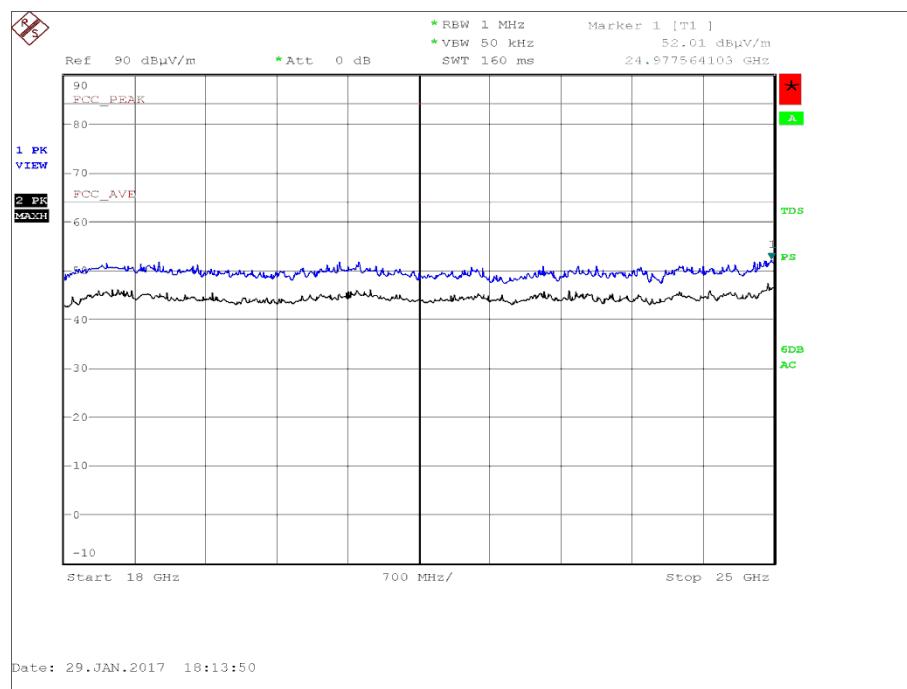


Figure 10 - 18 GHz to 25 GHz - Polarity: Horizontal and Vertical

2475.0 MHz

Frequency (MHz)	QP Level (dB μ V/m)	QP Limit (dB μ V/m)	QP Margin (dB μ V/m)	Angle(Deg)	Height(m)	Polarity
30.290	30.5	40.0	-9.5	0	1.00	Vertical
31.244	30.4	40.0	-9.6	0	1.00	Vertical
32.608	29.3	40.0	-10.7	0	1.00	Vertical
861.766	33.3	46.0	-12.7	0	1.00	Vertical
914.932	33.8	46.0	-12.2	0	1.00	Vertical
960.000	34.2	46.0	-11.8	0	1.00	Vertical

Table 9 - 30 MHz to 1 GHz Emissions Results

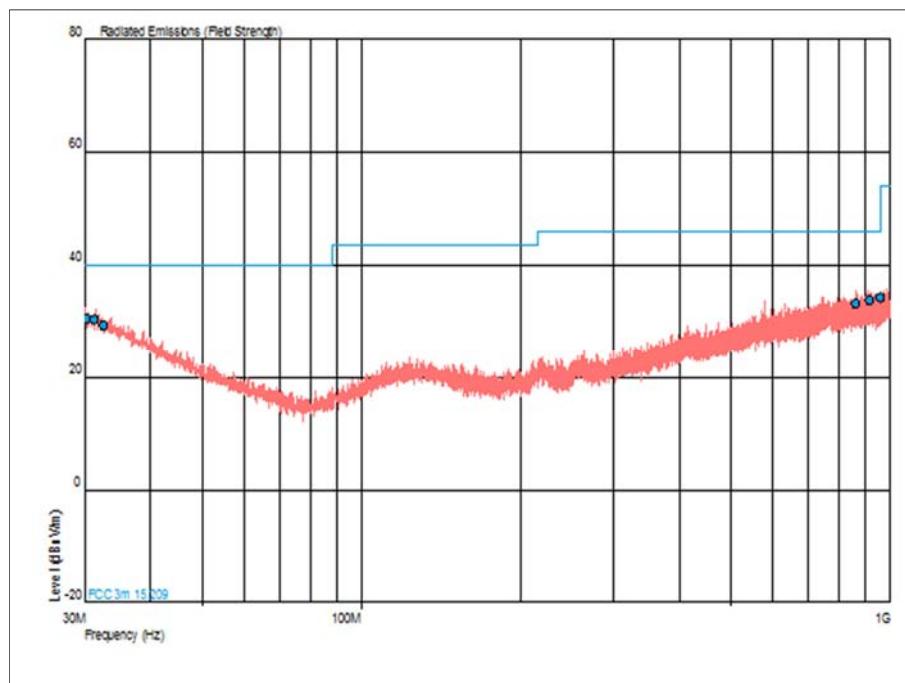


Figure 11 - 30 MHz to 1 GHz - Polarity Horizontal and Vertical

Frequency (MHz)	Result (μ V/m)		Limit (μ V/m)		Margin (μ V/m)	
	Peak	Average	Peak	Average	Peak	Average
4.950888	806.31	371.11	5000	500	4193.69	128.89

Table 10 - 1 GHz to 25 GHz Emissions Results

No other emissions were detected within 10 dB of the limit.

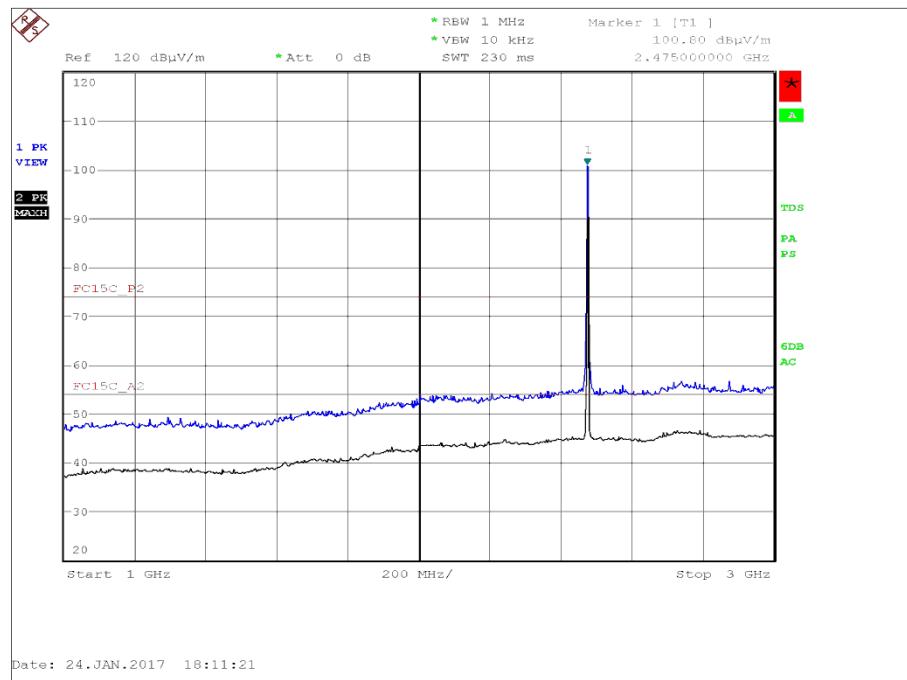


Figure 12 - 1 GHz to 3 GHz - Polarity: Horizontal and Vertical

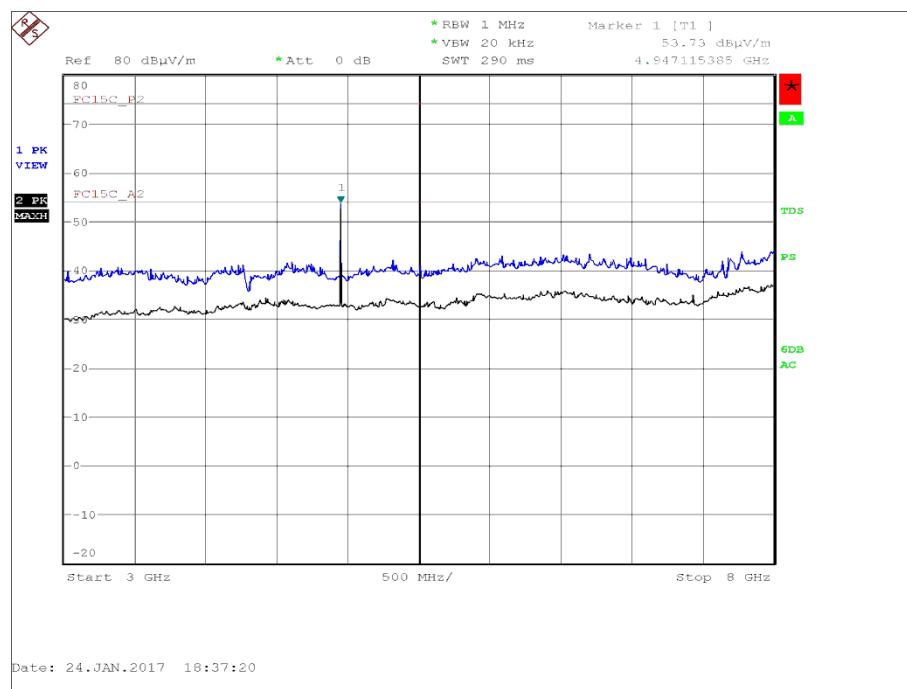


Figure 13 - 3 GHz to 8 GHz - Polarity: Horizontal and Vertical

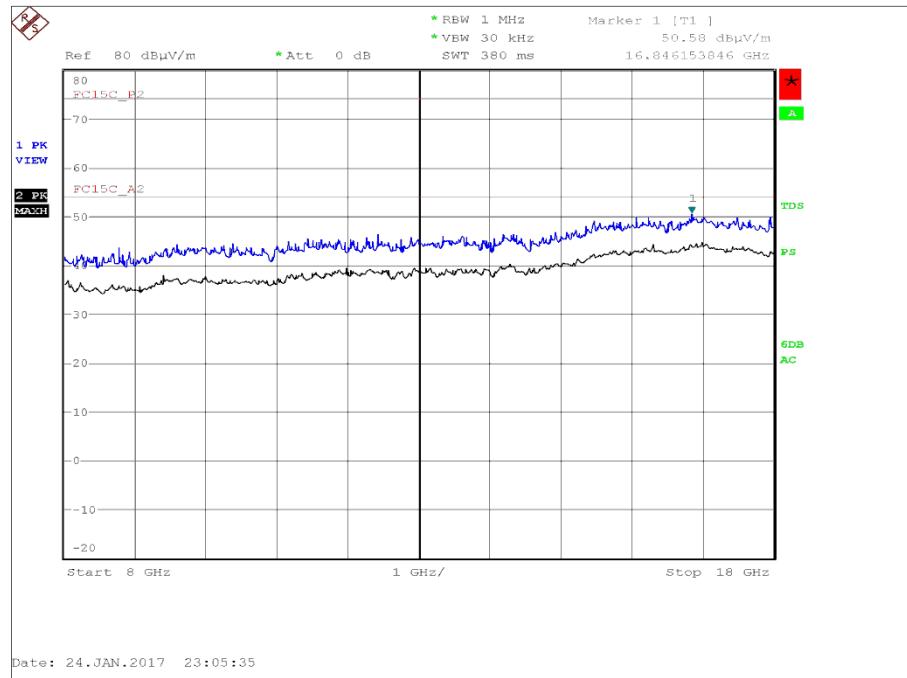


Figure 14 - 8 GHz to 18 GHz - Polarity: Horizontal and Vertical

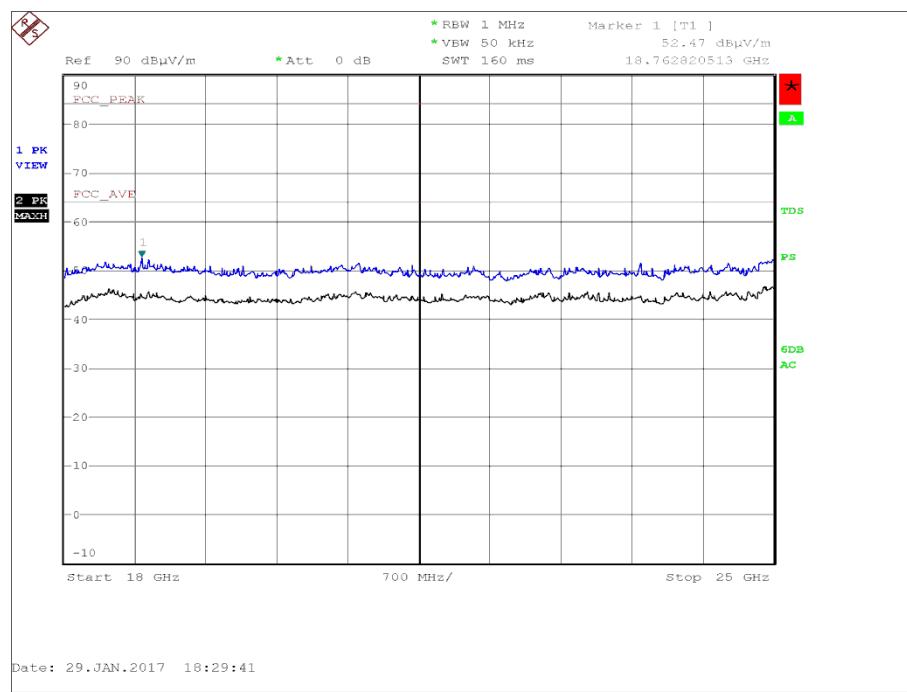


Figure 15 - 18 GHz to 25 GHz - Polarity: Horizontal and Vertical



FCC 47 CFR Part 15, Limit Clause 15.247 (d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in 15.209(a)

Industry Canada RSS-247, Limit Clause 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

2.1.7 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 5.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Screened Room (5)	Rainford	Rainford	1545	36	20-Dec-2017
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Hygrometer	Rotronic	HYGROPALM 1	2338	12	21-Sep-2017
Cable (N-N, 8m)	Rhophase	NPS-2302-8000-NPS	3248	-	O/P Mon
Signal Generator: 10MHz to 20GHz	Rohde & Schwarz	SMR20	3475	12	26-Feb-2017
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	12-Nov-2017
Tilt Antenna Mast	maturo GmbH	TAM 4.0-P	3916	-	TU
Mast Controller	maturo GmbH	NCD	3917	-	TU
1GHz to 8GHz Low Noise Amplifier	Wright Technologies	APS04-0085	4365	12	17-Oct-2017
Suspended Substrate Highpass Filter	Advance Power Components	11SH10-3000/X18000-O/O	4412	12	23-Mar-2017
Cable (Yellow, Rx, Km-Km 2m)	Scott Cables	KPS-1501-2000-KPS	4527	-	O/P Mon
Cable (Rx, SMAm-SMAm 0.5m)	Scott Cables	SLSLL18-SMSM-00.50M	4528	6	3-Feb-2017
Double Ridged Waveguide Horn Antenna	ETS-Lindgren	3117	4722	12	27-Feb-2017

Table 11

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment

2.2 Authorised Band Edges

2.2.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (d)
Industry Canada RSS-247, Clause 5.5

2.2.2 Equipment Under Test and Modification State

STAMP Radio Module (WML-MOD-00003), S/N: 39590 - Modification State 0

2.2.3 Date of Test

23-January-2017 to 24-January-2017

2.2.4 Test Method

Testing was performed in accordance with ANSI C63.10, Clause 11.13. and 6.10.4

Environmental Conditions
Ambient Temperature 19.1 °C
Relative Humidity 31.0 %

2.2.5 Test Results

2.4 GHz SRD

Frequency (MHz)	Measured Frequency (MHz)	Peak Level (dB μ V/m)
2405.0	2400.0	53.93
2475.0	2483.5	52.14

Table 12

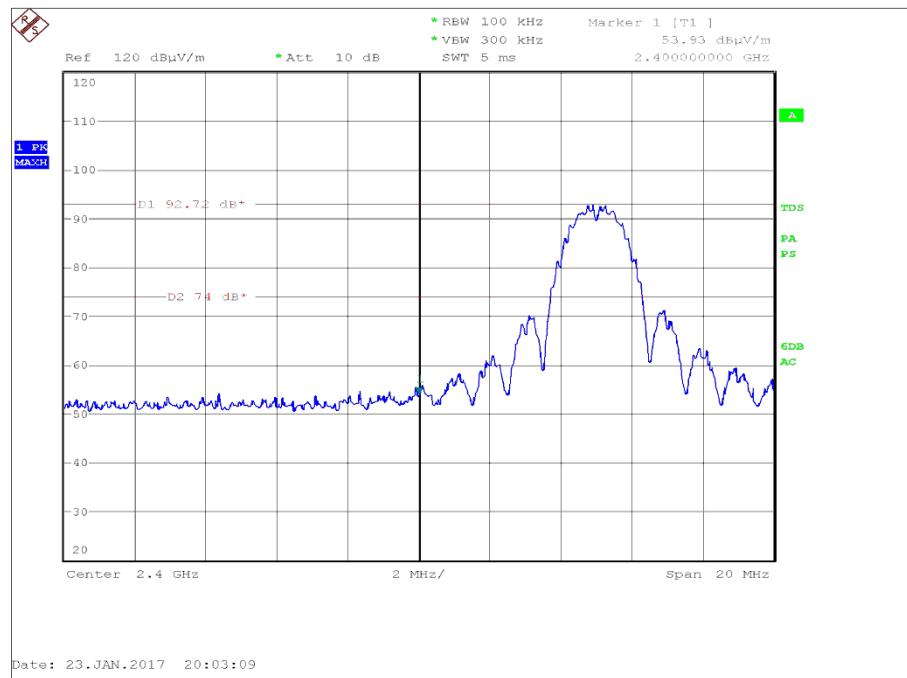


Figure 16 - 2405.0 MHz, Measured Frequency 2400 MHz

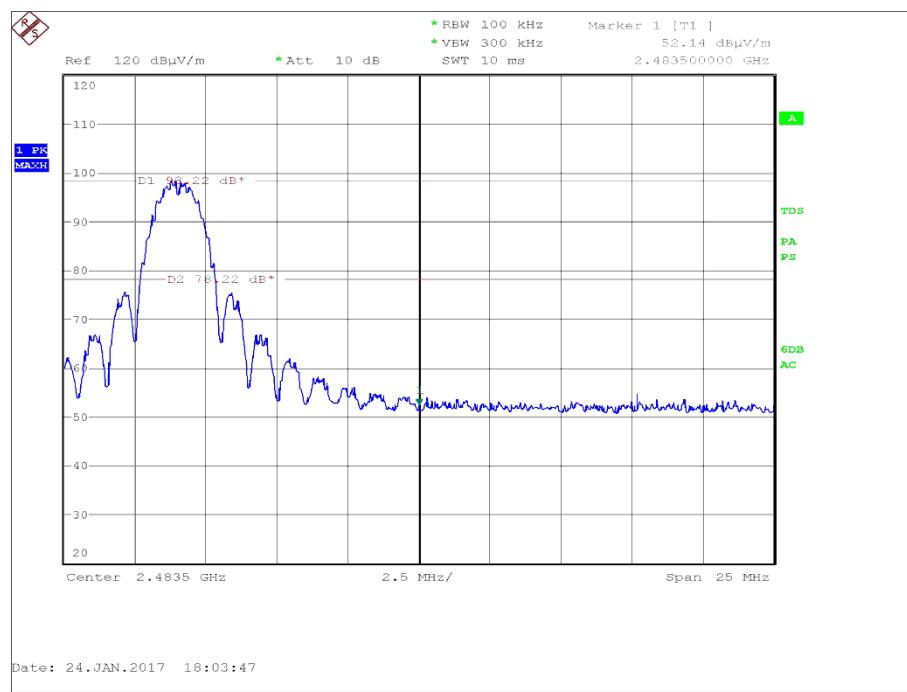


Figure 17 - 2475.0 MHz, Measured Frequency 2483.5 MHz

FCC 47 CFR Part 15, Limit Clause 15.247 (d)

20 dB below the fundamental measured in a 100 kHz bandwidth using a peak detector. If the transmitter complies with the conducted power limits, based on the use of RMS averaging over a time interval, the attenuation required shall be 30 dB below the fundamental instead of 20 dB.

Industry Canada RSS-247, Limit Clause 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

2.2.6 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 5.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Screened Room (5)	Rainford	Rainford	1545	36	20-Dec-2017
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Hygrometer	Rotronic	HYGROPALM 1	2338	12	21-Sep-2017
Cable (N-N, 8m)	Rhophase	NPS-2302-8000-NPS	3248	-	O/P Mon
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	12-Nov-2017
Tilt Antenna Mast	maturo GmbH	TAM 4.0-P	3916	-	TU
Mast Controller	maturo GmbH	NCD	3917	-	TU
Cable (Yellow, Rx, Km-Km 2m)	Scott Cables	KPS-1501-2000-KPS	4527	-	O/P Mon
Double Ridged Waveguide Horn Antenna	ETS-Lindgren	3117	4722	12	27-Feb-2017

Table 13

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment

2.3 Restricted Band Edges

2.3.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.205
Industry Canada RSS-GEN, 8.10

2.3.2 Equipment Under Test and Modification State

STAMP Radio Module (WML-MOD-00003), S/N: 39590 - Modification State 0

2.3.3 Date of Test

23-January-2017 to 24-January-2017

2.3.4 Test Method

Testing was performed in accordance with ANSI C63.10, Clause 11.13. and 6.10.5

Plots for average measurements were taken in accordance with ANSI C63.10, Clause 4.1.4.2.3.

Final average measurements were taken in accordance with ANSI C63.10, Clause 4.1.4.2.2.

2.3.5 Environmental Conditions

Ambient Temperature 24.1 °C

Relative Humidity 31.0 %

2.3.6 Test Results

2.4 GHz SRD

Frequency (MHz)	Measured Frequency (MHz)	Peak Level (dB μ V/m)	Average Level (dB μ V/m)
2405.0	2390.0	63.32	46.37
2475.0	2483.5	64.33	48.29

Table 14

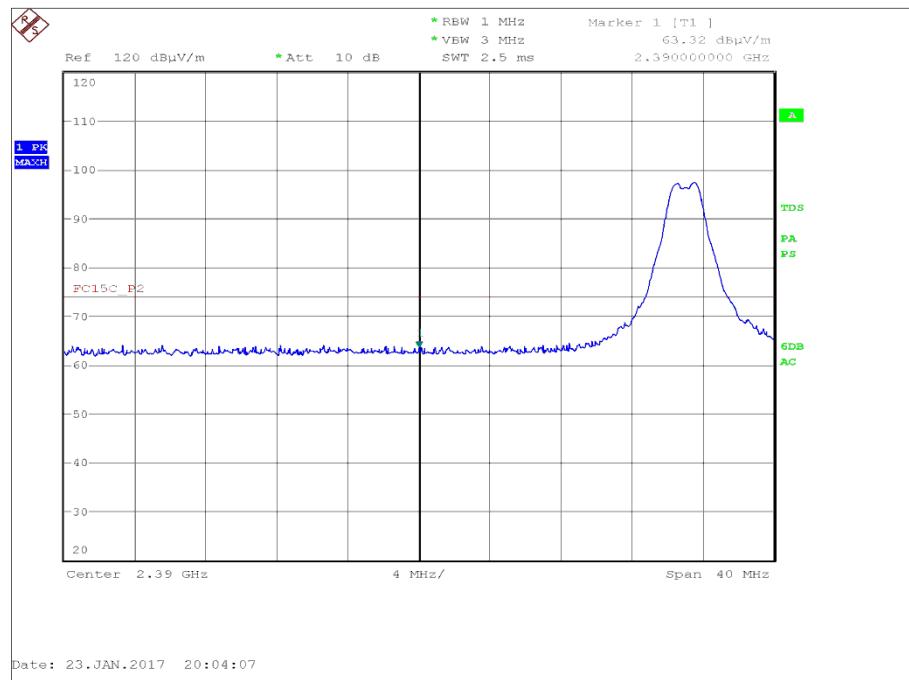


Figure 18 - 2405.0 MHz, Measured Frequency 2390.0 MHz, Peak

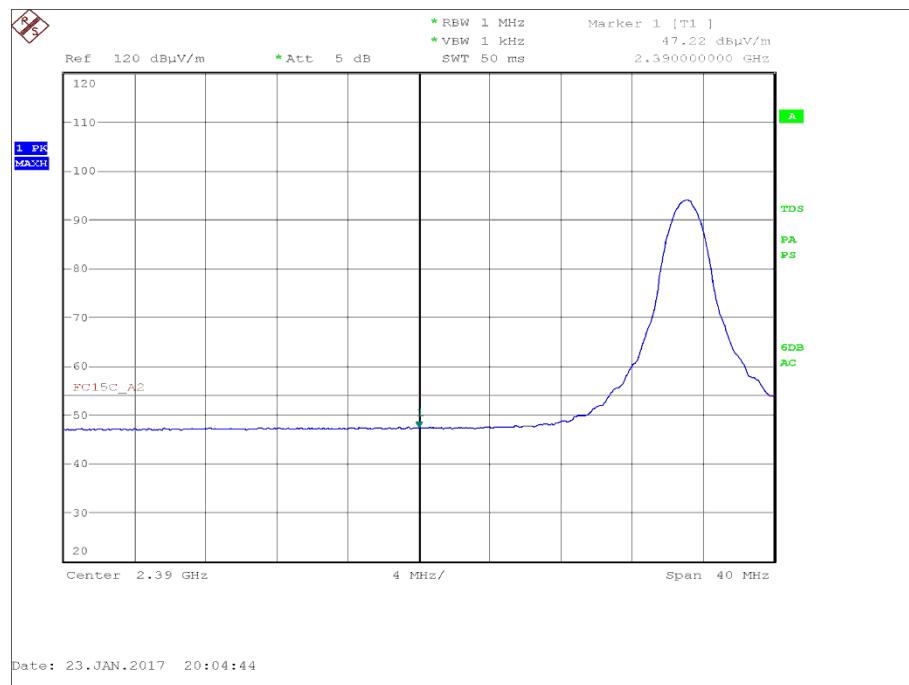


Figure 19 - 2405.0 MHz, Measured Frequency 2390.0 MHz, Average

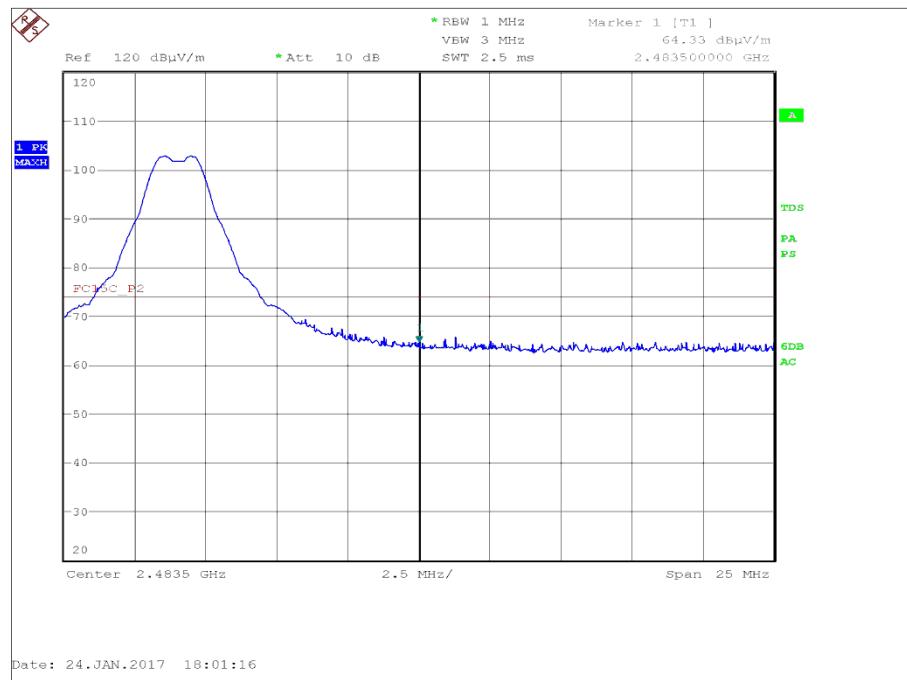


Figure 20 - 2475.0 MHz, Measured Frequency 2483.5 MHz, Peak

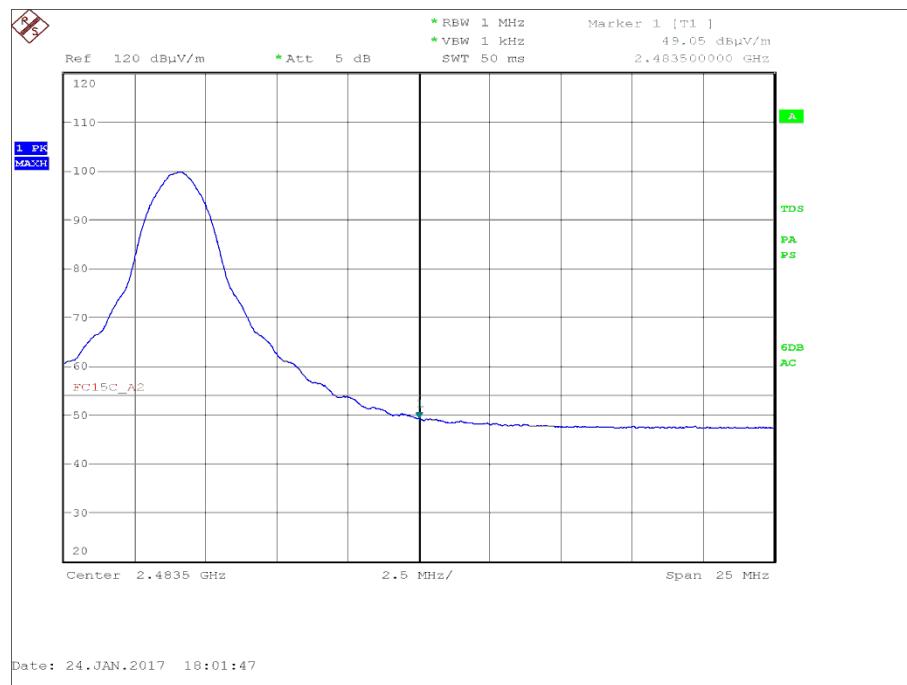


Figure 21 - 2475.0 MHz, Measured Frequency 2483.5 MHz, Average

FCC 47 CFR Part 15, Limit Clause 15.205

	Peak (dB μ V/m)	Average (dB μ V/m)
Restricted Bands of Operation	74	54

Table 15

Industry Canada RSS-GEN, Limit Clause 8.9

Frequency (MHz)	Field Strength (μ V/m at 3 metres)
30-88	100
88-216	150
216-960	200
Above 960*	500

Table 16

*Unless otherwise specified, for all frequencies greater than 1 GHz, the radiated emission limits for licence-exempt radio apparatus stated in applicable RSSs (including RSS-GEN) are based on measurements using a linear average detector function having a minimum resolution bandwidth of 1 MHz. If an average limit is specified for the EUT, then the peak emission shall also be measured with instrumentation properly adjusted for such factors as pulse desensitisation to ensure the peak emission is less than 20 dB above the average limit.

2.3.7 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 5.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Screened Room (5)	Rainford	Rainford	1545	36	20-Dec-2017
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Hygrometer	Rotronic	HYGROPALM 1	2338	12	21-Sep-2017
Cable (N-N, 8m)	Rhophase	NPS-2302-8000-NPS	3248	-	O/P Mon
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	12-Nov-2017
Tilt Antenna Mast	maturo GmbH	TAM 4.0-P	3916	-	TU
Mast Controller	maturo GmbH	NCD	3917	-	TU
Cable (Yellow, Rx, Km-Km 2m)	Scott Cables	KPS-1501-2000-KPS	4527	-	O/P Mon
Double Ridged Waveguide Horn Antenna	ETS-Lindgren	3117	4722	12	27-Feb-2017

Table 17

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment

3 Measurement Uncertainty

For a 95% confidence level, the measurement uncertainties for defined systems are:

Test Name	Measurement Uncertainty
Spurious Radiated Emissions	30 MHz to 1 GHz: ± 5.1 dB 1 GHz to 40 GHz: ± 6.3 dB
Authorised Band Edges	Radiated: 30 MHz to 1 GHz: ± 5.1 dB Radiated: 1 GHz to 40 GHz: ± 6.3 dB
Restricted Band Edges	30 MHz to 1 GHz: ± 5.1 dB 1 GHz to 40 GHz: ± 6.3 dB

Table 18