FCC and ISED Test Report

SureFlap Ltd
Pet Drinking Station, Model: iCWS

In accordance with FCC 47 CFR Part 15C, ISED RSS-247 and ISED RSS-GEN (2.4 GHz 802.15.4)

Add value.
Inspire trust.

Prepared for: SureFlap Ltd
Ground floor, Building 2020
Cambourne Business Park,
Cambourne,
Cambridgeshire,
CB23 6DW
United Kingdom

FCC ID: XO9-ICWS001 IC: 8906A-ICWS001

COMMERCIAL-IN-CONFIDENCE

Document 75950067-08 Issue 01

SIGNATURE			
NAME	**JOB TITLE**	**RESPONSIBLE FOR**	**ISSUE DATE**
Steve Marshall	Senior Engineer	Authorised Signatory	20 January 2021

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD 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, ISED RSS-247 and ISED RSS-GEN. The sample tested was found to comply with the requirements defined in the applied rules.

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Testing	Nandhini Mathivanan	20 January 2021	
Testing	Graeme Lawler	20 January 2021	

FCC Accreditation
90987 Octagon House, Fareham Test Laboratory

ISED Accreditation
12669A Octagon House, Fareham Test Laboratory

EXECUTIVE SUMMARY

A sample of this product was tested and found to be compliant with FCC 47 CFR Part 15C: 2019, ISED RSS-247: Issue 2 (02-2017) and ISED RSS-GEN: Issue 5 (04-2018) + A1 (03-2019) for the tests detailed in section 1.3.

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Contents

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	20-January-2021

Table 1

1.2 Introduction

Applicant	SureFlap Ltd
Manufacturer	SureFlap Ltd
Model Number(s)	iCWS
Serial Number(s)	Unit B - P001-0000329 Unit C - P001-0000813
Hardware Version(s)	V2 as defined by 10850-DA-02 Poseidon General Assembly
Software Version(s)	Firmware 01742_FF
Number of Samples Tested	2
Test Specification/Issue/Date	FCC 47 CFR Part 15C: 2019 ISED RSS-247: Issue 2 (02-2017) ISED RSS-GEN: Issue 5 (04-2018) + A1 (03-2019)
Order Number Date	3957 21-September-2020
Date of Receipt of EUT	01-December-2020
Start of Test	01-December-2020
Finish of Test	16-December-2020
Name of Engineer(s)	Nandhini Mathivanan and 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, ISED RSS-247 and ISED RSS-GEN is shown below.

Section	Specification Clause			Test Description	Result	Comments/Base Standard
	Part 15C	RSS-247	RSS-GEN			
Configuration and Mode: 2.4 GHz (802.15.4)						
-	15.203	-	-	Antenna Requirement	N/T	The EUT has an integral antenna so therefore the requirement is met.
2.1	15.205	3.3	8.10	Restricted Band Edges	Pass	
2.2	15.247 (a)(2)	5.2	6.7	Emission Bandwidth	Pass	
2.3	15.247 (b)	5.4	6.12	Maximum Conducted Output Power	Pass	
2.4	15.247 (d)	5.5	-	Authorised Band Edges	Pass	
2.5	15.247 (d) and 15.205	5.5	6.13	Spurious Radiated Emissions	Pass	
2.6	15.247 (e)	5.2	6.12	Power Spectral Density	Pass	

Table 2

1.4 Application Form

Equipment Description

Technical Description: *(Please provide a brief description of the intended use of the equipment including the technologies the product supports)*	The iCWS is a pet drinking station designed to provide the user with a measurement of how much their pet is drinking. The unit includes load cells to weight the water as it is drunk and an RFID antenna to identify the animal drinking. The units also includes a 2.4 GHz link (802.15.4) for communication to the user App via a Sure Petcare Hub.
Manufacturer:	SureFlap Ltd.
Model:	iCWS
Part Number:	iCWSWT
Hardware Version:	V2 as defined by 10850-DA-02 Poseidon General Assembly
Software Version:	Firmware 01742_FF (but special version for TUV SUD testing)
FCC ID of the product under test – see guidance here	XO9-ICWS001
IC ID of the product under test – see guidance here	8906A-ICWS001

Intentional Radiators

Technology	802.15.4	RFiD				
Frequency Range (MHz to MHz)	2.45 GHz	126 kHz – 133 kHz				
Conducted Declared Output Power (dBm)	4.5 dBm	N/A				
Antenna Gain (dBi)	+3 dBm	N/A				
Supported Bandwidth(s) (MHz) (e.g 1 MHz, 20 MHz, 40 MHz)	2.5 MHz	N/A				
Modulation Scheme(s) (e.g GFSK, QPSK etc)	O-QPSK	AM				
ITU Emission Designator (see guidance here)	2M50G1D					
Bottom Frequency (MHz)	2.425	0.126				
Middle Frequency (MHz)	2.450	0.133				
Top Frequency (MHz)	2.480	0.133				

Un-intentional Radiators

Highest frequency generated or used in the device or on which the device operates or tunes	2.4 GHz
Lowest frequency generated or used in the device or on which the device operates or tunes	32.768 kHz
Class A Digital Device (Use in commercial, industrial or business environment) ☐ Class B Digital Device (Use in residential environment only) ☒	

AC Power Source

AC supply frequency:		Hz
Voltage		V
Max current:		A
Single Phase ☐ Three Phase ☐		

DC Power Source

Nominal voltage:		V
Extreme upper voltage:		V
Extreme lower voltage:		V
Max current:		A

Battery Power Source

Voltage:	6	V
End-point voltage:	4.5	V *(Point at which the battery will terminate)*
Alkaline ☒ Leclanche ☐ Lithium ☐ Nickel Cadmium ☐ Lead Acid* ☐ **(Vehicle regulated)*		
Other ☐ Please detail:		

Charging

Can the EUT transmit whilst being charged	Yes ☐ No ☐

Temperature

Minimum temperature:	0	°C
Maximum temperature:	35	°C

Antenna Characteristics

Antenna connector ☐			State impedance		Ohm
Temporary antenna connector ☐			State impedance		Ohm
Integral antenna ☒	Type:		Gain		dBi
External antenna ☐	Type:		Gain		dBi
For external antenna only: Standard Antenna Jack ☐ If yes, describe how user is prohibited from changing antenna (if not professional installed): Equipment is only ever professionally installed ☐ Non-standard Antenna Jack ☐					

Ancillaries (if applicable)

Manufacturer:		Part Number:	
Model:		Country of Origin:	

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

Name: Dr David Hallas
Position held: Managing Director

Date: 05-01-2021

1.5 Product Information

1.5.1 Technical Description

The iCWS is a pet drinking station designed to provide the user with a measurement of how much their pet is drinking. The unit includes load cells to weight the water as it is drunk and an RFID antenna to identify the animal drinking. The units also includes a 2.4 GHz link (802.15.4) for communication to the user App via a Sure Petcare Hub.

1.5.2 Test modes

The equipment under test was provided with special firmware to transmit a continuous signal on either bottom, middle or top channel, with modulation at the maximum supported power for the channel under test.

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
Model: iCWS, Serial Number: Unit B - P001-0000329			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: iCWS, Serial Number: Unit C - P001-0000813			
0	As supplied by the customer	Not Applicable	Not Applicable
1	Power on top channel reduced by 2dB	Client	16-December-2020

Table 3

1.8 Test Location

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

Test Name	Name of Engineer(s)	Accreditation
Configuration and Mode: 2.4 GHz (802.15.4)		
Restricted Band Edges	Graeme Lawler	UKAS
Emission Bandwidth	Nandhini Mathivanan	UKAS
Maximum Conducted Output Power	Nandhini Mathivanan	UKAS
Authorised Band Edges	Graeme Lawler	UKAS
Spurious Radiated Emissions	Graeme Lawler	UKAS
Power Spectral Density	Nandhini Mathivanan	UKAS

Table 4

Office Address:

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

2 Test Details

2.1 Restricted Band Edges

2.1.1 Specification Reference

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

2.1.2 Equipment Under Test and Modification State

iCWS, S/N: Unit C - P001-0000813 - Modification State 0
iCWS, S/N: Unit C - P001-0000813 - Modification State 1

2.1.3 Date of Test

07-December-2020 to 16-December-2020

2.1.4 Test Method

This test was performed in accordance with ANSI C63.10, clause 6.10.5.

Plots for average measurements were taken in accordance with ANSI C63.10, clause 4.1.4.2.5. These are shown for information purposes and were used to determine the worst-case measurement point. Final average measurements were then taken in accordance with ANSI C63.10, clause 4.1.4.2.2 to obtain the measurement result recorded in the test results tables. The following conversion can be applied to convert from dBµV/m to µV/m:
10^(Field Strength in dBµV/m/20).

2.1.5 Environmental Conditions

Ambient Temperature	21.1 - 21.8 °C
Relative Humidity	31.3 - 40.9 %

2.1.6 Test Results

2.4 GHz (802.15.4)

Mode	Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBµV/m)	Average Level (dBµV/m)
Static	2425	2390	51.73	39.96
Static	2480	2483.5	60.82	52.64

Table 5 - Restricted Band Edge Results

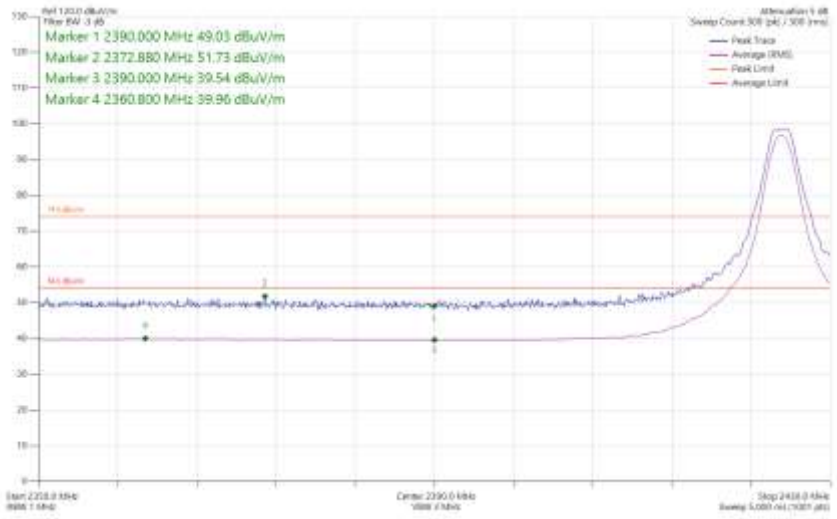

Figure 1 – 2425 MHz – Band Edge Frequency: 2390 MHz

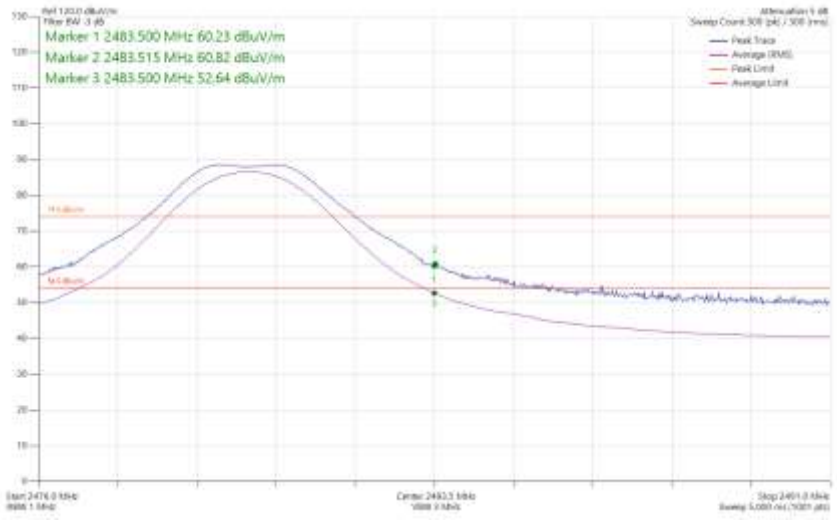

Figure 2 – 2480 MHz – Band Edge Frequency: 2483.5 MHz

FCC 47 CFR Part 15, Limit Clause 15.209

Frequency (MHz)	Field Strength (μV/m at 3 m)
30 to 88	100
88 to 216	150
216 to 960	200
Above 960	500

Table 6

ISED RSS-GEN, Limit Clause 8.9

Frequency (MHz)	Field Strength (μV/m at 3 m)
30 to 88	100
88 to 216	150
216 to 960	200
Above 960*	500

Table 7

*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 desensitization to ensure the peak emission is less than 20 dB above the average limit.

2.1.7 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 12.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	03-Jan-2021
EmX Emissions Software	TUV SUD	V2.0.1	5125	-	Software
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5428	12	15-Oct-2021
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB-40	5481	12	18-Mar-2021
8m N Type Cable	Junkosha	MWX221-08000NMSNMS/B	5519	12	24-Mar-2021
Broadband Horn Antenna (1-10 GHz)	Schwarzbeck	BBHA 9120 B	5611	12	22-Sep-2021
Turntable & Mast Controller	Maturo Gmbh	NCD/498/2799.01	5612	-	TU
Tilt Antenna Mast TAM 4.0-P	Maturo Gmbh	TAM 4.0-P	5613	-	TU
3m Semi Anechoic Chamber	MVG	EMC-3	5621	36	11-Aug-2023

Table 8

TU - Traceability Unscheduled

2.2 Emission Bandwidth

2.2.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (a)(2)
ISED RSS-247, Clause 5.2
ISED RSS-GEN, Clause 6.7

2.2.2 Equipment Under Test and Modification State

iCWS, S/N: Unit B - P001-0000329 - Modification State 0

2.2.3 Date of Test

01-December-2020

2.2.4 Test Method

This test was performed in accordance with ANSI C63.10, clause 11.8.1.

2.2.5 Environmental Conditions

Ambient Temperature	23.2 °C
Relative Humidity	28.1 %

2.2.6 Test Results

2.4 GHz (802.15.4)

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Specification Clause(s):	15.247(2) RSS-247 5.2 a)	Test Method(s):	Ansi C63.10 6.9.3 Ansi C63.10 11.8.1
Additional Reference(s):	-		

Table 9

DUT Configuration			
Mode:	Thread 802.15.4	Duty Cycle (%):	-
Antenna Configuration:	SISO	DCCF (dB):	-
Active Ports(s):	A (PORT 0)	Antenna Gain (dBi):	-

Table 10

Test Frequency (MHz)	6 dB Bandwidth (MHz)					Limit (kHz)
	A	B	C	D	Minimum	
2425	1.568	-	-	-	1.568	≥500.0
2450	1.568	-	-	-	1.568	≥500.0
2480	1.592	-	-	-	1.592	≥500.0

Table 11 - 6 dB Bandwidth Results

Test Frequency (MHz)	99% Bandwidth (MHz)					
	A	B	C	D	Minimum	
2425	2.288	-	-	-	2.288	
2450	2.312	-	-	-	2.312	
2480	2.352	-	-	-	2.352	

Table 12 - 99% Bandwidth Results

Figure 3 - 2425 MHz - 99% Bandwidth

Figure 4 - 2425 MHz - 6 dB Bandwidth

Figure 5 - 2450 MHz - 99% Bandwidth

Figure 6 - 2450 MHz - 6 dB Bandwidth

Figure 7 - 2480 MHz - 99% Bandwidth

Figure 8 - 2480 MHz - 6 dB Bandwidth

FCC 47 CFR Part 15, Limit Clause 15.247(a)(2) and ISED RSS-247, Clause 5.2(a)

The minimum 6 dB Bandwidth shall be at least 500 kHz.

2.2.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	17-May-2021
Hygrometer	Rotronic	A1	2760	12	02-Jan-2021
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	17-May-2021
MXA Signal Analyser	Keysight Technologies	N9020B	5528	24	04-Mar-2022
Signal Commissioning Unit	TUV SUD	SCU001	5546	12	15-Apr-2021

Table 13

2.3 Maximum Conducted Output Power

2.3.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (b)
ISED RSS-247, Clause 5.4
ISED RSS-GEN, Clause 6.12

2.3.2 Equipment Under Test and Modification State

iCWS, S/N: Unit B - P001-0000329 - Modification State 0

2.3.3 Date of Test

01-December-2020

2.3.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 11.9.1.3.

2.3.5 Environmental Conditions

Ambient Temperature	23.2 °C
Relative Humidity	28.1 %

2.3.6 Test Results

2.4 GHz (802.15.4)

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Specification Clause(s):	15.247 (b)(3) RSS-247 5.4 d)	Test Method(s):	Ansi C63.10 11.9.1.3
Additional Reference(s):	-		

Table 14

DUT Configuration			
Mode:	Thread 802.15.4	Duty Cycle (%):	100.0
Antenna Configuration:	SISO	DCCF (dB):	-
Active Ports(s):	A (PORT 0)	Antenna Gain (dBi):	3.00

Table 15

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)
	A	B	C	D	∑		
2425	3.42	-	-	-	-	30.00	-26.58
2450	3.37	-	-	-	-	30.00	-26.63
2480	-5.16	-	-	-	-	30.00	-35.16

Table 16 - FCC Maximum Conducted (peak) Output Power Results

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)	EIRP (dBm)	EIRP Limit (dBm)	EIRP Margin (dB)
	A	B	C	D	∑					
2425	3.42	-	-	-	-	30.00	-26.58	6.42	36.00	-29.58
2450	3.37	-	-	-	-	30.00	-26.63	6.37	36.00	-29.63
2480	-5.16	-	-	-	-	30.00	-35.16	-2.16	36.00	-38.16

Table 17 - ISED Maximum Conducted (peak) Output Power Results

FCC 47 CFR Part 15, Limit Clause 15.247 (b)(3)

For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt.

ISED RSS-247, Limit Clause 5.4 (b)

For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1 W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e) of the specification.

2.3.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Hygrometer	Rotronic	A1	2760	12	02-Jan-2021
USB Power Sensor	Boonton	RTP5006	5184	12	09-Jan-2021
Signal Commissioning Unit	TUV SUD	SCU001	5546	12	15-Apr-2021

Table 18

2.4 Authorised Band Edges

2.4.1 Specification Reference

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

2.4.2 Equipment Under Test and Modification State

iCWS, S/N: Unit C - P001-0000813 - Modification State 0

2.4.3 Date of Test

07-December-2020

2.4.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 6.10.4.

2.4.5 Environmental Conditions

Ambient Temperature	21.1 °C
Relative Humidity	31.3 %

2.4.6 Test Results

2.4 GHz (802.15.4)

Mode	Frequency (MHz)	Band Edge Frequency (MHz)	Level (dBc)
Static	2425	2400	-53.46

Table 19 - Authorised Band Edge Results

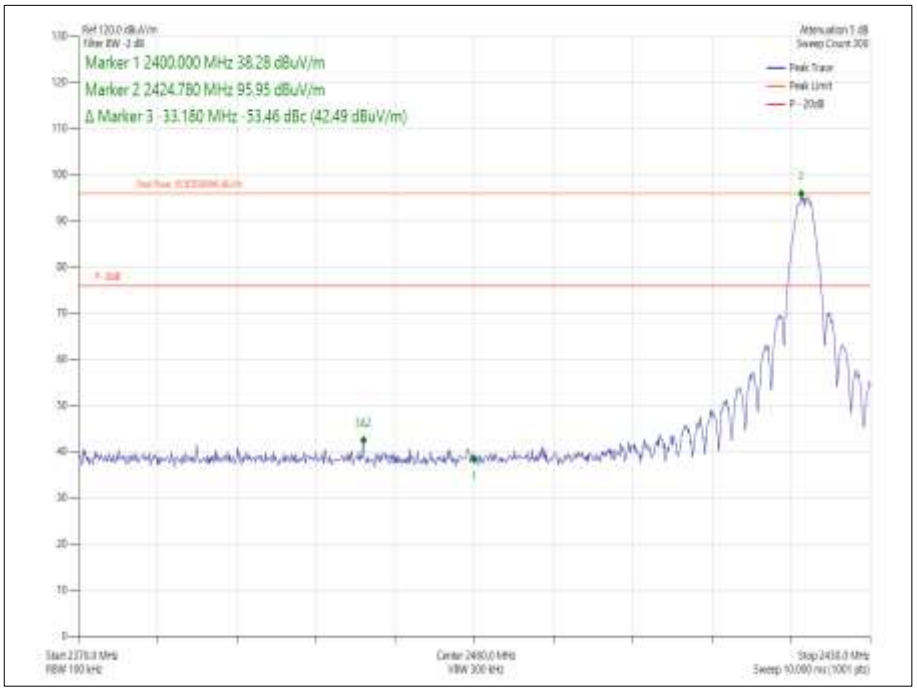

Figure 9 – 2425 MHz - Measured Frequency 2400 MHz

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.

ISED 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.

2.4.7 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 12.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	03-Jan-2021
EmX Emissions Software	TUV SUD	V2.0.1	5125	-	Software
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5428	12	15-Oct-2021
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB-40	5481	12	18-Mar-2021
8m N Type Cable	Junkosha	MWX221-08000NMSNMS/B	5519	12	24-Mar-2021
Broadband Horn Antenna (1-10 GHz)	Schwarzbeck	BBHA 9120 B	5611	12	22-Sep-2021
Turntable & Mast Controller	Maturo Gmbh	NCD/498/2799.01	5612	-	TU
Tilt Antenna Mast TAM 4.0-P	Maturo Gmbh	TAM 4.0-P	5613	-	TU
3m Semi Anechoic Chamber	MVG	EMC-3	5621	36	11-Aug-2023

Table 20

TU - Traceability Unscheduled

2.5 Spurious Radiated Emissions

2.5.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (d) and 15.205
ISED RSS-247, Clause 5.5
ISED RSS-GEN, Clause 6.13

2.5.2 Equipment Under Test and Modification State

iCWS, S/N: Unit C - P001-0000813 - Modification State 0

2.5.3 Date of Test

07-December-2020 to 16-December-2020

2.5.4 Test Method

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

The EUT was placed on the non-conducting platform in a manner typical of a normal installation.

For frequencies > 1 GHz, plots for average measurements were taken in accordance with ANSI C63.10, clause 4.1.4.2.5 to characterize the EUT. Where emissions were detected, final average measurements were taken in accordance with ANSI C63.10, clause 4.1.4.2.2.

The plots shown are the characterisation of the EUT. The limits on the plots represent the most stringent case for restricted bands, (74/54 dBuV/m) when compared to 20 dBc outside restricted bands. The limits shown have been used as a threshold to determine where further measurements are necessary. Where results are within 10 dB of the limits shown on the plots, further investigation was carried out and reported in results tables.

The following conversion can be applied to convert from dBµV/m to µV/m:

10^(Field Strength in dBµV/m/20).

At a measurement distance of 1 meter the limit line was increased by 20*LOG(3/1) = 9.54 dB. Where formal measurements have been necessary, the results have been presented in the emissions table.

2.5.5 Example Test Setup Diagram

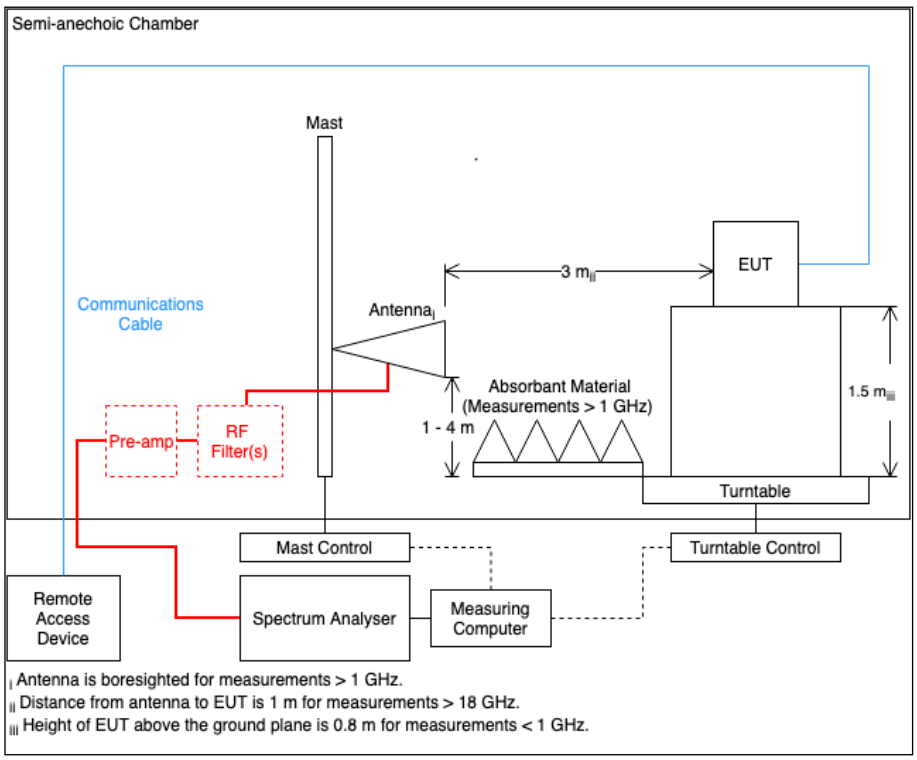

Figure 10

2.5.6 Environmental Conditions

Ambient Temperature	21.1 - 21.8 °C
Relative Humidity	31.3 - 40.9 %

2.5.7 Test Results

2.4 GHz (802.15.4)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation	Orientation
*								

Table 21 - 2425 MHz, 30 MHz to 1 GHz - Emission Results

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

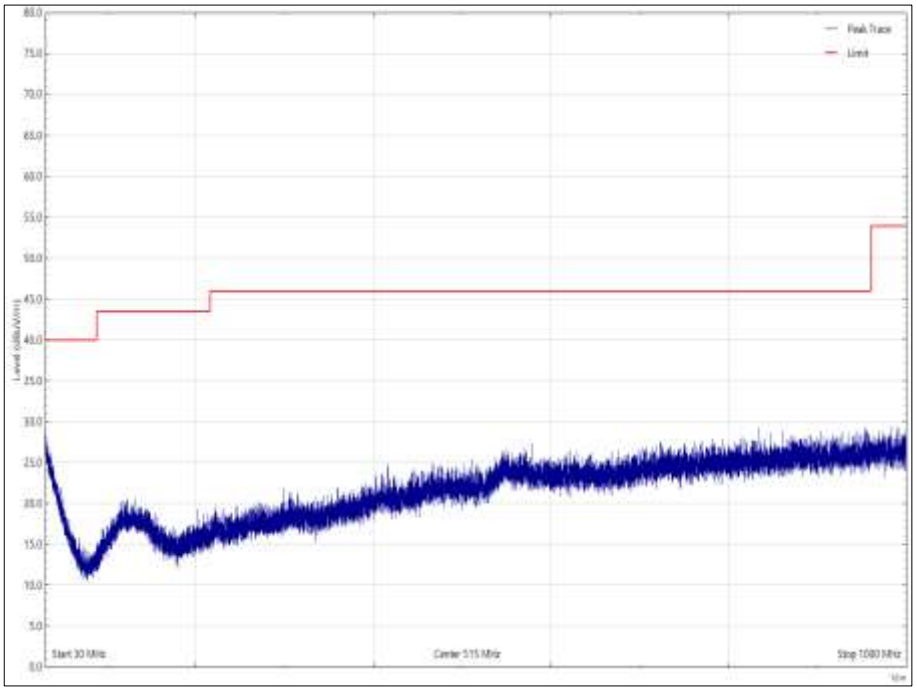

Figure 11 - 2425 MHz, 30 MHz to 1 GHz, Vertical, X Orientation

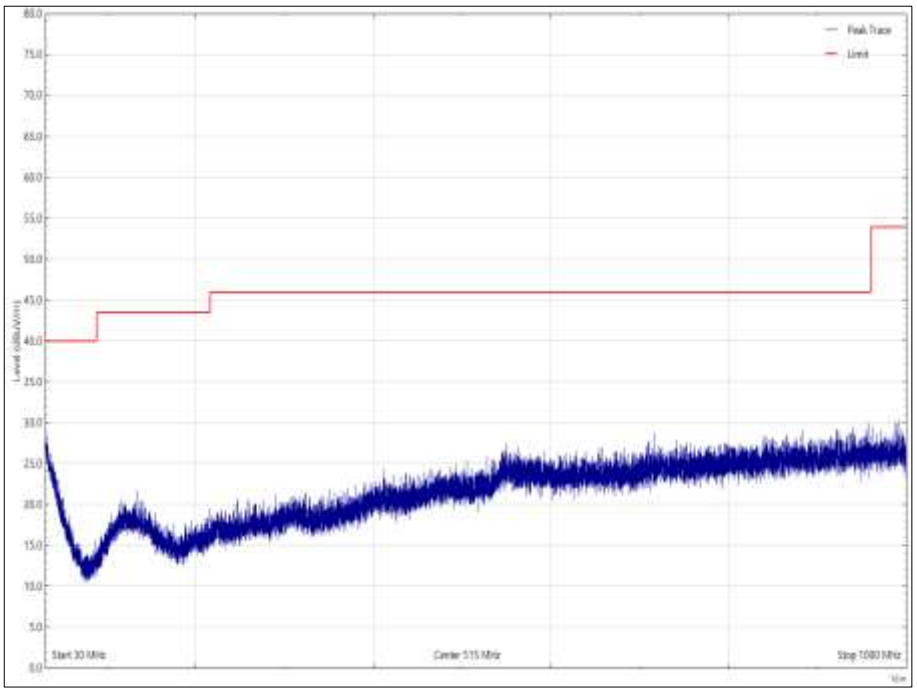

Figure 12 - 2425 MHz, 30 MHz to 1 GHz, Horizontal, X Orientation

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation	Orientation
*								

Table 22 - 2425 MHz, 1 GHz to 25 GHz Emissions Results

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

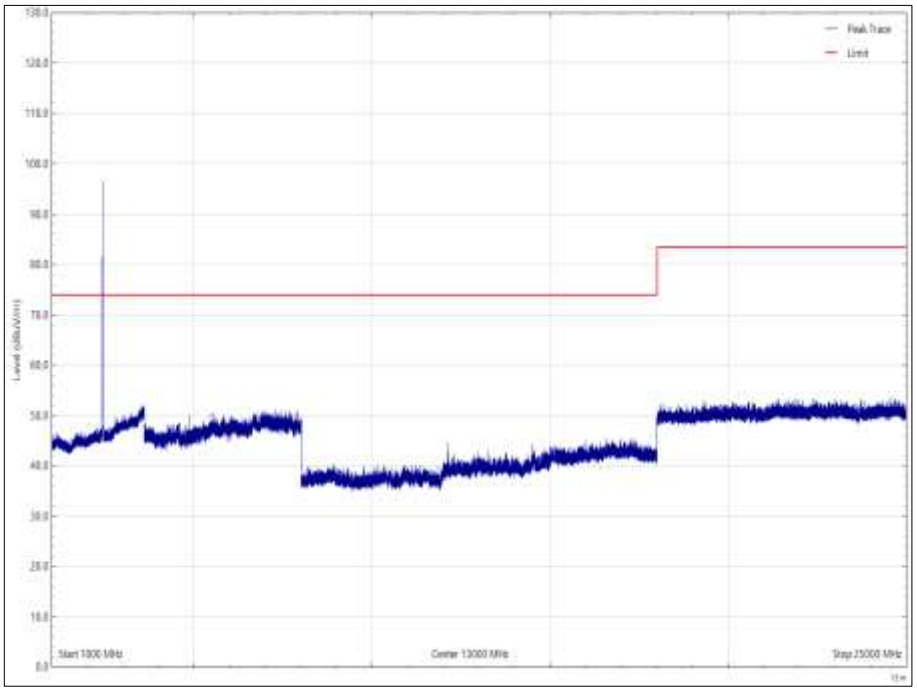

Figure 13 - 2425 MHz, 1 GHz to 25 GHz, Vertical, X Orientation: - Peak

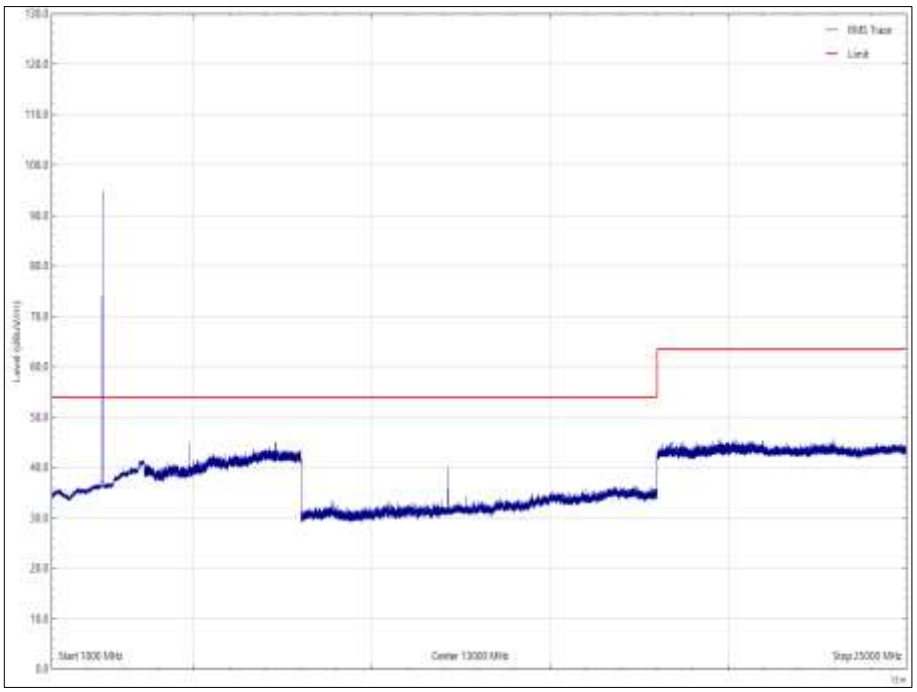

Figure 14 - 2425 MHz, 1 GHz to 25 GHz, Vertical, X Orientation: - Average

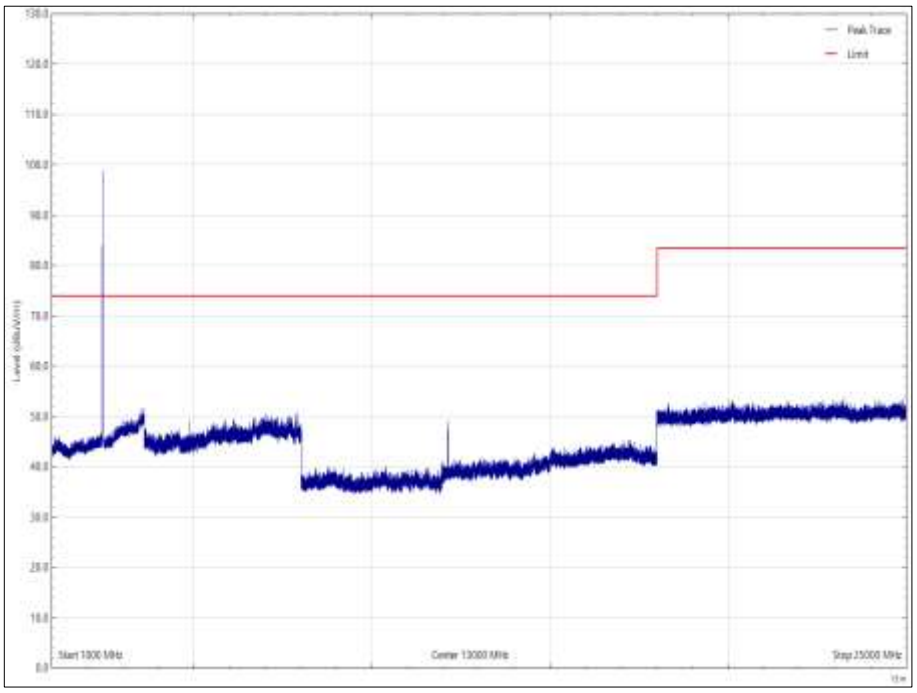

Figure 15 - 2425 MHz, 1 GHz to 25 GHz, Horizontal, X Orientation: - Peak

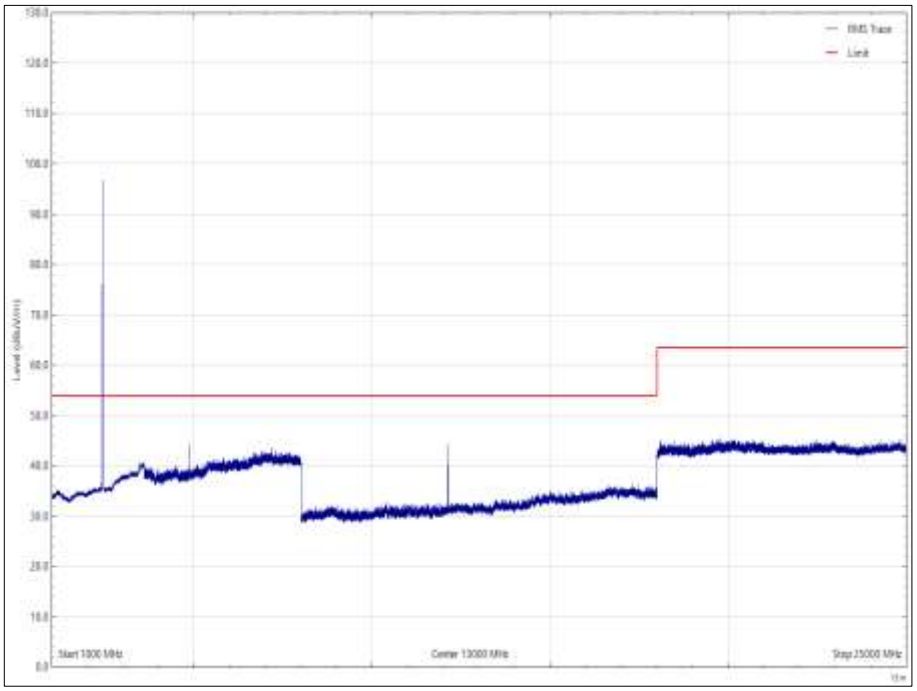

Figure 16 - 2425 MHz, 1 GHz to 25 GHz, Horizontal, X Orientation: - Average

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation	Orientation
*								

Table 23 - 2450 MHz, 30 MHz to 1 GHz - Emission Results

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

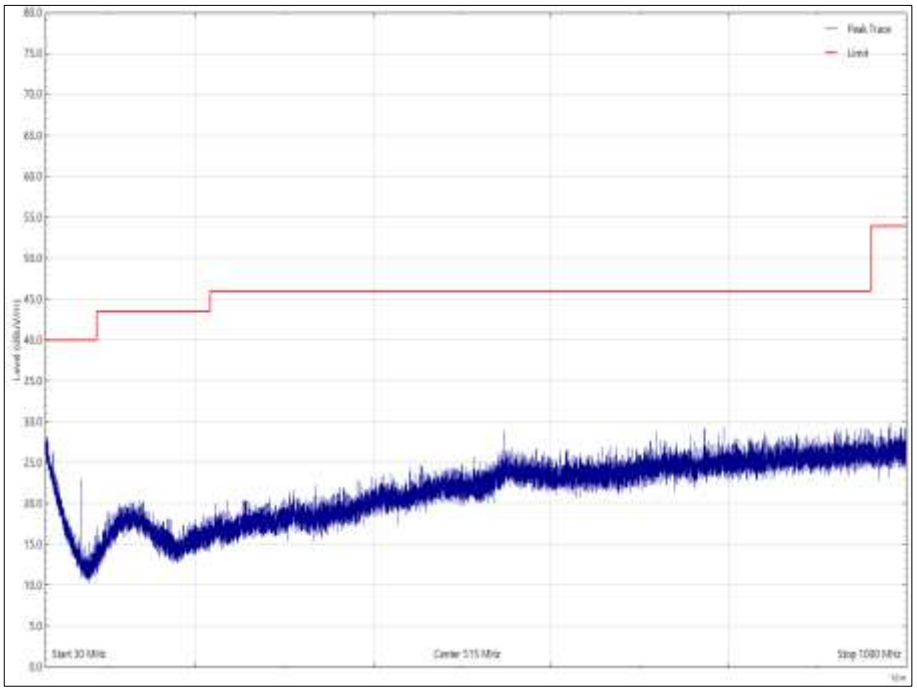

Figure 17 - 2450 MHz, 30 MHz to 1 GHz, Vertical, X Orientation

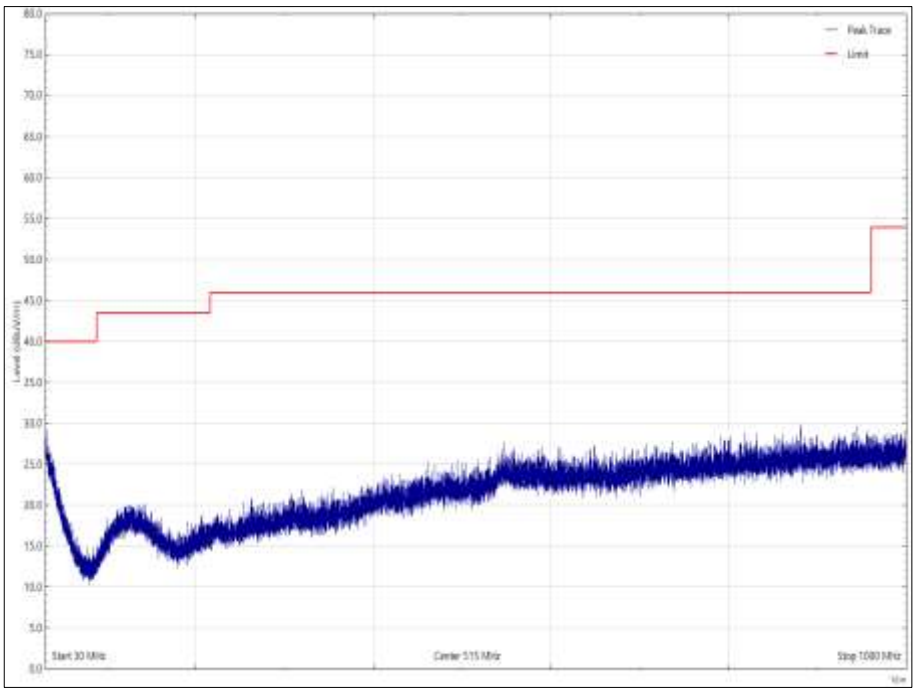

Figure 18 - 2450 MHz, 30 MHz to 1 GHz, Horizontal, X Orientation

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation	Orientation
*								

Table 24 - 2450 MHz - 1 GHz to 25 GHz Emissions Results

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

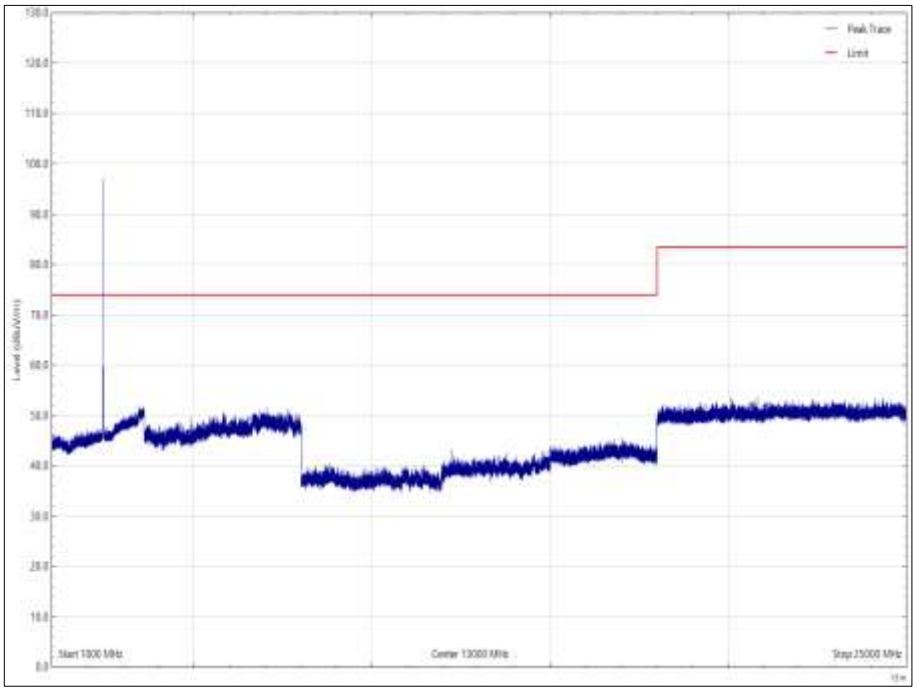

Figure 19 - 2450 MHz - 1 GHz to 25 GHz, Vertical, X Orientation, Peak

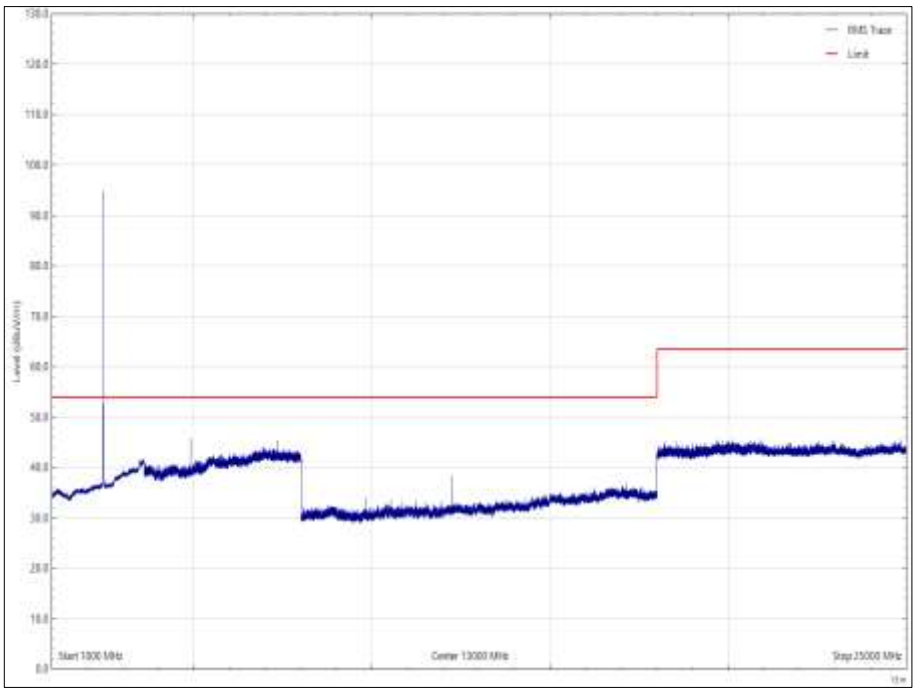

Figure 20 - 2450 MHz - 1 GHz to 25 GHz, Vertical, X Orientation, Average

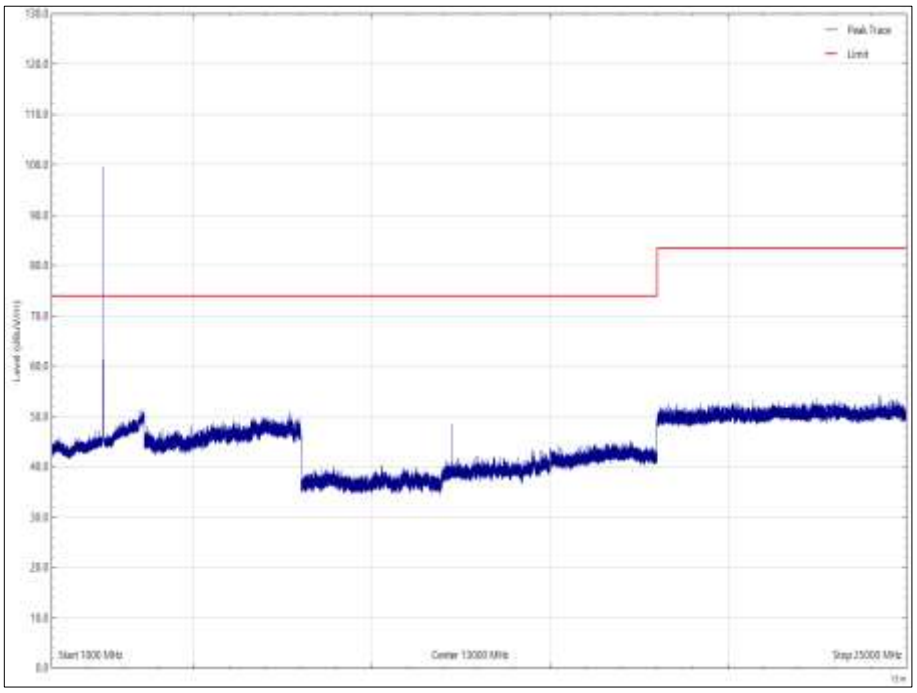

Figure 21 - 2450 MHz - 1 GHz to 25 GHz, Horizontal, X Orientation, Peak

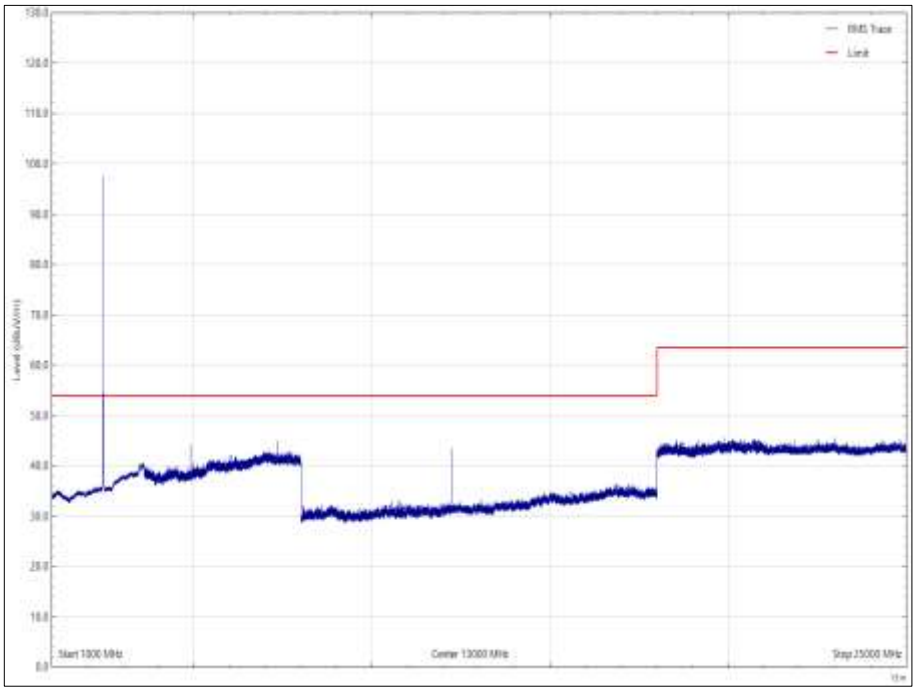

Figure 22 - 2450 MHz - 1 GHz to 25 GHz, Horizontal, X Orientation, Average

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation	Orientation
*								

Table 25 - 2480 MHz, 30 MHz to 1 GHz - Emission Results

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

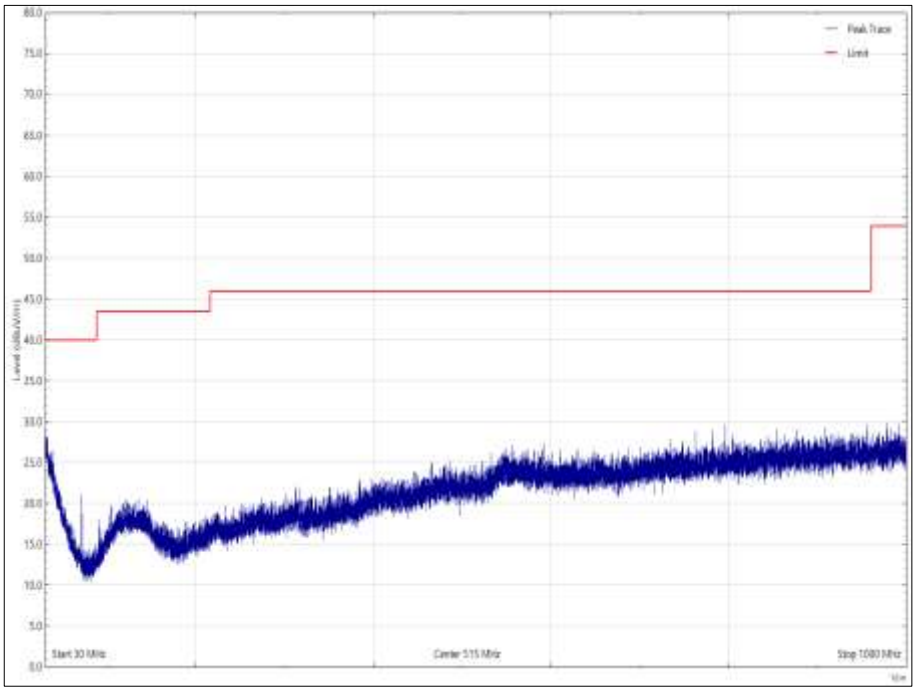

Figure 23 - 2480 MHz, 30 MHz to 1 GHz, Vertical, X Orientation

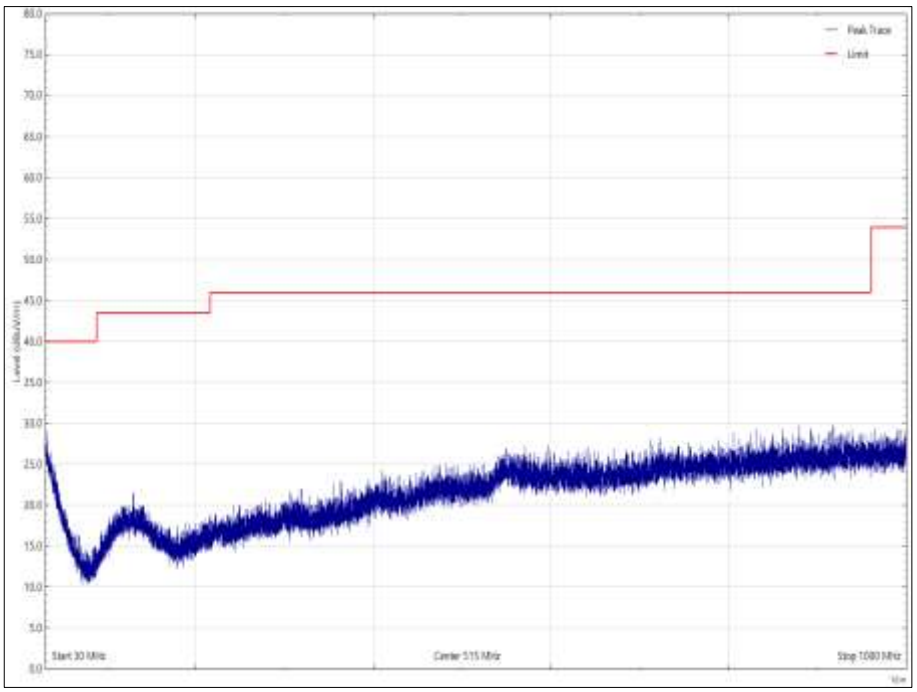

Figure 24 - 2480 MHz, 30 MHz to 1 GHz, Horizontal, X Orientation

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation	Orientation
*								

Table 26 - 2480 MHz - 1 GHz to 25 GHz Emissions Results

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

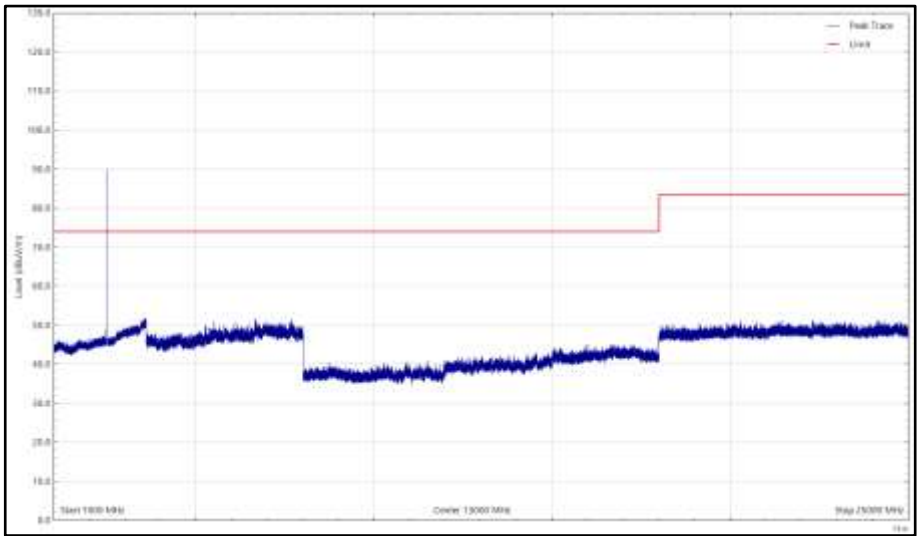

Figure 25 - 2480 MHz - 1 GHz to 25 GHz, Vertical, X Orientation, Peak

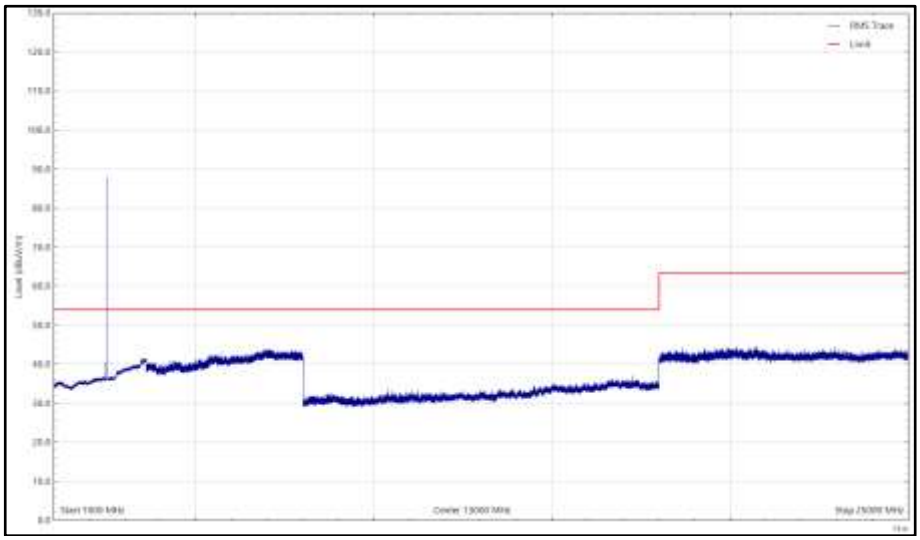

Figure 26 - 2480 MHz - 1 GHz to 25 GHz, Vertical, X Orientation, Average

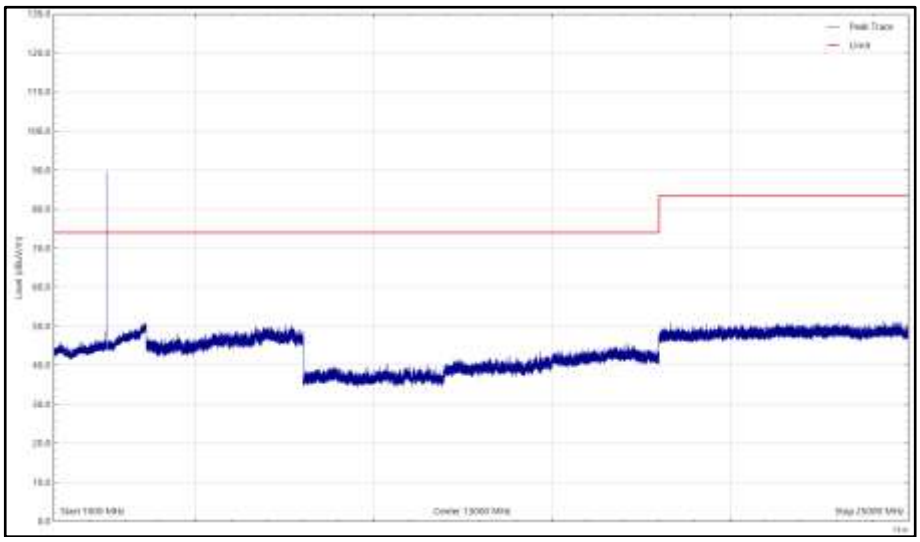

Figure 27 - 2480 MHz - 1 GHz to 25 GHz, Horizontal, X Orientation, Peak

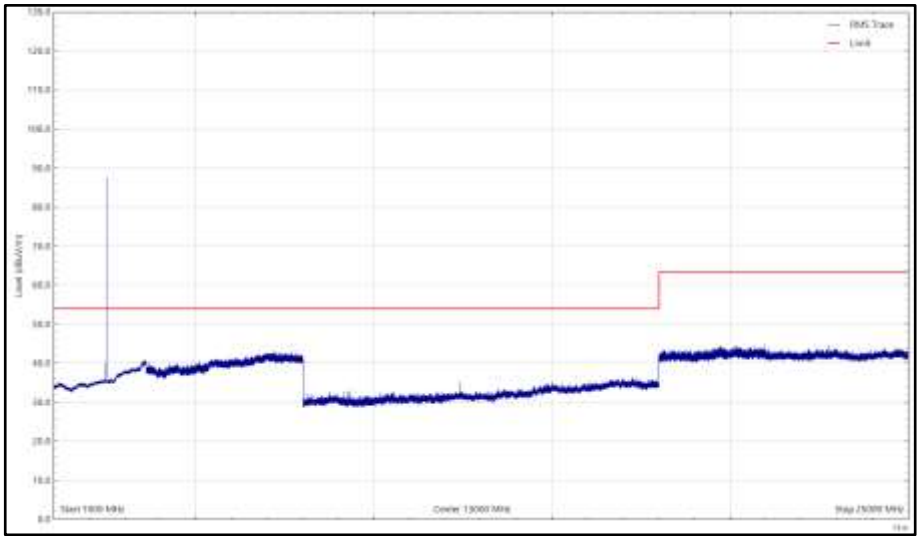

Figure 28 - 2480 MHz - 1 GHz to 25 GHz, Horizontal, X Orientation, Average

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)

ISED 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.

2.5.8 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 12.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Antenna 18-40GHz (Double Ridge Guide)	Link Microtek Ltd	AM180HA-K-TU2	230	24	27-Jul-2022
Antenna with permanent attenuator (Bilog)	Schaffner	CBL6143	287	24	14-Oct-2022
Pre-Amplifier	Phase One	PS04-0086	1533	12	04-Feb-2021
18GHz - 40GHz Pre-Amplifier	Phase One	PSO4-0087	1534	12	18-Feb-2021
Comb Generator	Schaffner	RSG1000	3034	-	TU
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	03-Jan-2021
EmX Emissions Software	TUV SUD	V2.0.1	5125	-	Software
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5428	12	15-Oct-2021
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB-40	5481	12	18-Mar-2021
8m N Type Cable	Junkosha	MWX221-08000NMSNMS/B	5519	12	24-Mar-2021
DRG Horn Antenna (7.5-18GHz)	Schwarzbeck	HWRD750	5610	12	22-Sep-2021
Broadband Horn Antenna (1-10 GHz)	Schwarzbeck	BBHA 9120 B	5611	12	22-Sep-2021
Turntable & Mast Controller	Maturo Gmbh	NCD/498/2799.01	5612	-	TU
Tilt Antenna Mast TAM 4.0-P	Maturo Gmbh	TAM 4.0-P	5613	-	TU
3m Semi Anechoic Chamber	MVG	EMC-3	5621	36	11-Aug-2023

Table 27

TU - Traceability Unscheduled

2.6 Power Spectral Density

2.6.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (e)
ISED RSS-247, Clause 5.2
ISED RSS-GEN, Clause 6.12

2.6.2 Equipment Under Test and Modification State

iCWS, S/N: Unit B - P001-0000329 - Modification State 0

2.6.3 Date of Test

01-December-2020

2.6.4 Test Method

This test was performed in accordance with ANSI C63.10, clause 11.10.2.

2.6.5 Environmental Conditions

Ambient Temperature	23.2 °C
Relative Humidity	28.1 %

2.6.6 Test Results

2.4 GHz (802.15.4)

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Specification Clause(s):	15.247 (e) RSS-247 5.2 a)	Test Method(s):	Ansi C63.10 11.10.2
Additional Reference(s):	-		

Table 28

DUT Configuration			
Mode:	Thread 802.15.4	Duty Cycle (%):	100.0
Antenna Configuration:	SISO	DCCF (dB):	0.00
Active Ports(s):	A (PORT 0)	Antenna Gain (dBi):	-

Table 29

Test Frequency (MHz)	RBW (kHz)	PSD (dBm/RBW)					Limit (dBm/3 kHz)	Margin (dB)
		A	B	C	D	∑		
2425	3.0	-9.49	-	-	-	-	8.00	-17.49
2450	3.0	-9.06	-	-	-	-	8.00	-17.06
2480	3.0	-18.27	-	-	-	-	8.00	-26.27

Table 30 - Maximum Power Spectral Density Results

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

The power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

ISED RSS-247, Limit Clause 5.2(b)

The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission

2.6.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	17-May-2021
Multimeter	Iso-tech	IDM101	2424	12	12-Dec-2020
Hygrometer	Rotronic	A1	2760	12	02-Jan-2021
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	17-May-2021
AC Programmable Power Supply	iTech	IT7324	5225	-	O/P Mon
MXA Signal Analyser	Keysight Technologies	N9020B	5528	24	04-Mar-2022
Signal Commissioning Unit	TUV SUD	SCU001	5546	12	15-Apr-2021

Table 31

O/P Mon – Output Monitored using calibrated equipment

3 Photographs

3.1 Test Setup Photographs

Figure 29 – 30 MHz to 1 GHz

Figure 30 – 1 GHz to 18 GHz

Figure 31 – 18 GHz to 25 GHz

4 Measurement Uncertainty

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

Test Name	Measurement Uncertainty
Restricted Band Edges	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 40 GHz: ± 6.3 dB
Emission Bandwidth	± 71.713 kHz
Maximum Conducted Output Power	± 3.2 dB
Authorised Band Edges	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 40 GHz: ± 6.3 dB
Spurious Radiated Emissions	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 40 GHz: ± 6.3 dB
Power Spectral Density	± 3.2 dB

Table 32

Measurement Uncertainty Decision Rule

Determination of conformity with the specification limits is based on the decision rule according to IEC Guide 115: 2007, clause 4.4.3 and 4.5.1.