

FCC and ISED Test Report

Apple Inc
Model: A2169

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

Prepared for: Apple Inc
One Apple Park Way, Cupertino, California,
95014, USA

FCC ID: BCGA2169

IC: 579C-A2169

COMMERCIAL-IN-CONFIDENCE

Document 75946858-16 Issue 02



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NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
Phil Harrison	Senior Engineer	Authorised Signatory	18 February 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	George Porter	18 February 2021	
Testing	Mohammad Malik	18 February 2021	
Testing	Ainsley Jenkins	18 February 2021	
Testing	Liang Tian	18 February 2021	
Testing	Connor Lee	18 February 2021	
Testing	Aasim Butt	18 February 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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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	17 February 2021
2	Updated test Equipment Lists	18 February 2021

Table 1

1.2 Introduction

Applicant	Apple Inc
Manufacturer	Apple Inc
Model Number(s)	A2169
Serial Number(s)	C07CM0EKQ4TG and C07CL0AMQ4TG
Hardware Version(s)	REV1.0
Software Version(s)	18J42710o
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	0540188556
Date	07-April-2020
Date of Receipt of EUT	01-June-2020 and 08-July-2020
Start of Test	20-June-2020
Finish of Test	10-February-2021
Name of Engineer(s)	George Porter, Mohammad Malik, Ainsley Jenkins, Liang Tian, Connor Lee & Aasim Butt
Related Document(s)	ANSI C63.10 (2013) KDB 662911 D01 v02r01



1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with FCC 47 CFR Part 15C, ISSED RSS-247 and ISSED 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 Thread - DTS						
2.1	15.247 (b)	5.4	6.12	Maximum Conducted Output Power	Pass	
2.2	15.247 (e)	5.2	6.12	Power Spectral Density	Pass	
2.3	15.247 (a)(2)	5.2	6.7	Emission Bandwidth	Pass	
2.4	15.205	-	8.10	Restricted Band Edges	Pass	
2.5	15.247 (d)	5.5	-	Authorised Band Edges	Pass	
2.6	15.247 (d) and 15.205	5.5	6.13	Spurious Radiated Emissions	Pass	

Table 2



1.4 Product Information

1.4.1 Technical Description

The Equipment under test (EUT) was an Apple TV Set Top Box with Bluetooth, Bluetooth Low Energy, Thread and 802.11 a/b/g/n/ac/ax capabilities in the 2.4 GHz and 5 GHz bands.

1.4.2 Test Setup

For conducted tests, a conducted test point was provided by the manufacturer via a UFL connector and cable. The loss of these test cables was known and compensated for in any conducted measurements.

Thread employs SISO operation from a dedicated core.

For all tests, the EUT was put into a continuous transmit test mode with the manufacturer's test commands via a script running in the EUTs terminal application. The EUT then transmitted the required type of modulation/packet type on a static channel.

All testing was performed with the EUT powered via a 120 V AC, 60 Hz source.

1.4.3 Antenna Gain Table (2.4 GHz Thread)

Antenna Port	Frequency Range (MHz)	Peak Gain (dBi)	Conducted Cable Loss (dB)
Thread	2400 to 2480	2.87	0.50

Table 3

1.5 Deviations from the Standard

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

1.6 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: A2169, Serial Number: C07CL0AMQ4TG			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: A2169, Serial Number: C07CM0EKQ4TG			
0	As supplied by the customer	Not Applicable	Not Applicable

Table 4



1.7 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 Thread - DTS		
Maximum Conducted Output Power	George Porter	UKAS
Power Spectral Density	George Porter	UKAS
Emission Bandwidth	George Porter	UKAS
Restricted Band Edges	Ainsley Jenkins, Liang Tian, Connor Lee and Aasim Butt	UKAS
Authorised Band Edges	Ainsley Jenkins, Liang Tian, Connor Lee and Aasim Butt	UKAS
Spurious Radiated Emissions	Mohammad Malik	UKAS

Table 5

Office Address:

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



2 Test Details

2.1 Maximum Conducted Output Power

2.1.1 Specification Reference

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

2.1.2 Equipment Under Test and Modification State

A2169, S/N: C07CM0EKQ4TG - Modification State 0

2.1.3 Date of Test

10-February-2021

2.1.4 Test Method

The test was performed in accordance with ANSI C63.10 clause 11.9.1.3 Method PKPM1 and clause 11.9.2.3.2 Method AVGPM-G.

2.1.5 Environmental Conditions

Ambient Temperature	21.2 °C
Relative Humidity	18.6 %



2.1.6 Test Results

2.4 GHz Thread - DTS

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

DUT Configuration			
Mode:	Thread (Thread)	Duty Cycle (%):	85.3
Antenna Configuration:	SISO	DCCF (dB):	-
Active Ports(s):	D (Thread)	Antenna Gain (dBi):	2.87

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)
	A	B	C	D	Σ		
2405	-	-	-	15.96	-	30.00	-14.04
2440	-	-	-	17.12	-	30.00	-12.88
2475	-	-	-	17.27	-	30.00	-12.73

Table 6 - 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	Σ					
2405	-	-	-	15.96	-	30.00	-14.04	18.83	36.00	-17.17
2440	-	-	-	17.12	-	30.00	-12.88	19.99	36.00	-16.01
2475	-	-	-	17.27	-	30.00	-12.73	20.14	36.00	-15.86

Table 7 - 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.



2.1.7 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
Multimeter	Iso-tech	IDM101	2421	12	30-Oct-2021
Hygrometer	Rotronic	I-1000	3220	12	16-Oct-2021
AC Programmable Power Supply	iTech	IT7324	5225	-	O/P Mon
USB Power Sensor	BOONTON	RTP5006	5279	12	27-Apr-2021
Signal Commissioning Unit	TUV SUD	SCU001	5546	12	15-Apr-2021

Table 8

O/P Mon – Output Monitored using calibrated equipment



2.2 Power Spectral Density

2.2.1 Specification Reference

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

2.2.2 Equipment Under Test and Modification State

A2169, S/N: C07CM0EKQ4TG - Modification State 0

2.2.3 Date of Test

10-February-2021

2.2.4 Test Method

This test was performed in accordance with ANSI C63.10, clause 11.10.5 (AVGPSD-2).

Where the EUT duty cycle was < 98 % and repeatable within 2%, the spectrum analyser was set to trace (power) averaging and a duty cycle correction was added as calculated in the result tables below.

2.2.5 Environmental Conditions

Ambient Temperature	21.2 °C
Relative Humidity	18.6 %



2.2.6 Test Results

2.4 GHz Thread - DTS

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

DUT Configuration			
Mode:	Thread (Thread)	Duty Cycle (%):	85.3
Antenna Configuration:	SISO	DCCF (dB):	0.69
Active Ports(s):	D (Thread)	Antenna Gain (dBi):	-

Test Frequency (MHz)	RBW (kHz)	PSD (dBm/RBW)					Limit (dBm/3 kHz)	Margin (dB)
		A	B	C	D	Σ		
2405	3.0	-	-	-	3.71	-	8.00	-4.29
2440	3.0	-	-	-	4.62	-	8.00	-3.38
2475	3.0	-	-	-	5.13	-	8.00	-2.87

Table 9 - 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



2.2.7 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	07-May-2021
Multimeter	Iso-tech	IDM101	2421	12	30-Oct-2021
Hygrometer	Rotronic	I-1000	3220	12	16-Oct-2021
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	07-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 10

O/P Mon – Output Monitored using calibrated equipment



2.3 Emission Bandwidth

2.3.1 Specification Reference

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

2.3.2 Equipment Under Test and Modification State

A2169, S/N: C07CM0EKQ4TG - Modification State 0

2.3.3 Date of Test

10-February-2021

2.3.4 Test Method

This test was performed in accordance with ANSI C63.10, clause 11.8.2.

2.3.5 Environmental Conditions

Ambient Temperature 21.2 °C
Relative Humidity 18.6 %

2.3.6 Test Results

2.4 GHz Thread - DTS

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

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

Test Frequency (MHz)	6 dB Bandwidth (MHz)					Limit (kHz)
	A	B	C	D	Minimum	
2405	-	-	-	1.220	1.220	≥500.0
2440	-	-	-	1.220	1.220	≥500.0
2475	-	-	-	1.240	1.240	≥500.0

Table 11 - 6 dB Bandwidth Results

Test Frequency (MHz)	99% Bandwidth (MHz)					Limit (kHz)
	A	B	C	D	Minimum	
2405	-	-	-	2.250	2.250	-
2440	-	-	-	2.250	2.250	-
2475	-	-	-	2.250	2.250	-



Table 12 - 99% Bandwidth Results



Figure 1 - 99% Bandwidth



Figure 2 - 6 dB Bandwidth



Figure 3 - 99% Bandwidth



Figure 4 - 6 dB Bandwidth



Figure 5 - 99% Bandwidth



Figure 6 - 6 dB Bandwidth

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

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



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
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	17-May-2021
Multimeter	Iso-tech	IDM101	2421	12	30-Oct-2021
Hygrometer	Rotronic	I-1000	3220	12	16-Oct-2021
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	07-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 13

O/P Mon – Output Monitored using calibrated equipment



2.4 Restricted Band Edges

2.4.1 Specification Reference

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

2.4.2 Equipment Under Test and Modification State

A2169, S/N: C07CL0AMQ4TG - Modification State 0

2.4.3 Date of Test

20-June-2020 to 27-October-2020

2.4.4 Test Method

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

The following conversion can be applied to convert from dBμV/m to μV/m:
 $10^{(\text{Field Strength in dB}\mu\text{V/m}/20)}$

2.4.5 Environmental Conditions

Ambient Temperature 20.7 - 23.8 °C
Relative Humidity 44.8 - 53.7 °C

2.4.6 Test Results

2.4 GHz Thread - DTS

Mode	Modulation	Packet Type	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBμV/m)	Average Level (dBμV/m)
Static	OQPSK	Thread	2405	2390.0	58.83	41.68
Static	OQPSK	Thread	2475	2483.5	58.12	45.49

Table 14 - Restricted Band Edge Results

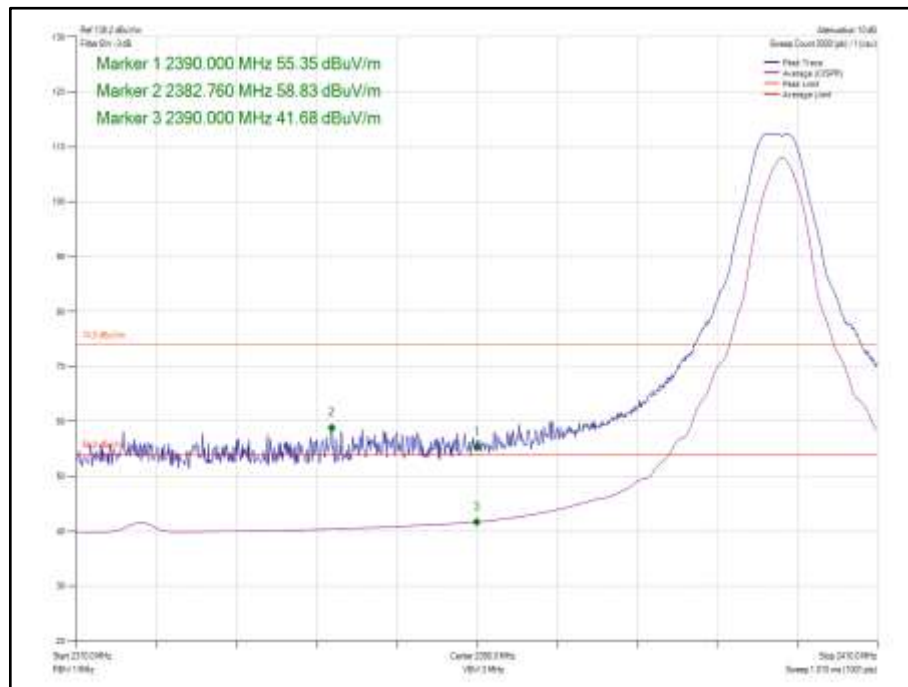


Figure 7 - Static – Thread - 2405 MHz - Band Edge Frequency 2390.0 MHz

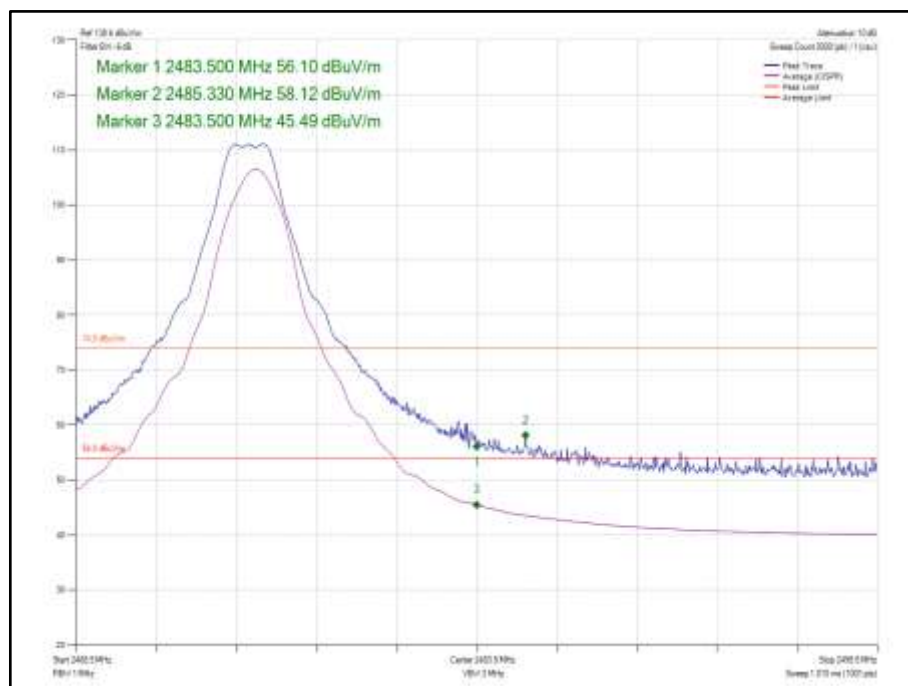


Figure 8 - Static – Thread- 2475 MHz - Band Edge Frequency 2483.5 MHz



FCC 47 CFR Part 15, Limit Clause 15.209

Frequency (MHz)	Field Strength ($\mu\text{V}/\text{m}$ at 3 m)
30 to 88	100
88 to 216	150
216 to 960	200
Above 960	500

Table 15

ISED RSS-GEN, Limit Clause 8.9

Frequency (MHz)	Field Strength ($\mu\text{V}/\text{m}$ at 3 m)
30 to 88	100
88 to 216	150
216 to 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 desensitization to ensure the peak emission is less than 20 dB above the average limit.



2.4.7 Test Location and Test Equipment Used

This test was carried out in RF Chamber 11.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Multimeter	Iso-tech	IDM101	2424	12	12-Dec-2020
EMI Test Receiver	Rohde & Schwarz	ESW44	5084	12	28-Nov-2020
EmX Emissions Software	TUV SUD	V2.0.1	5125	-	Software
Screened Room (11)	Rainford	Rainford	5136	36	01-Nov-2021
Mast	Maturo	TAM 4.0-P	5158	-	TU
Mast and Turntable Controller	Maturo	Maturo NCD	5159	-	TU
Turntable	Maturo	TT 15WF	5160	-	TU
Horn Antenna (1-10GHz)	Schwarzbeck	BBHA 9120 B	5215	12	10-Mar-2021
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB-40	5475	12	17-Mar-2021
2m SMA Cable	Junkosha	MWX221-02000AMSAMS/A	5518	12	01-Apr-2021
8m N Type Cable	Junkosha	MWX221-08000NMSNMS/B	5522	12	24-Mar-2021

Table 17

TU - Traceability Unscheduled

2.5 Authorised Band Edges

2.5.1 Specification Reference

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

2.5.2 Equipment Under Test and Modification State

A2169, S/N: C07CL0AMQ4TG - Modification State 0

2.5.3 Date of Test

20-June-2020 to 27-October-2020

2.5.4 Test Method

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

2.5.5 Environmental Conditions

Ambient Temperature 20.7 - 23.8 °C
Relative Humidity 44.8 - 53.7 °C

2.5.6 Test Results

2.4 GHz Thread - DTS

Mode	Modulation	Packet Type	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Level (dBc)
Static	OQPSK	Thread	2405	2400.0	-49.81

Table 18 - Authorised Band Edge Results

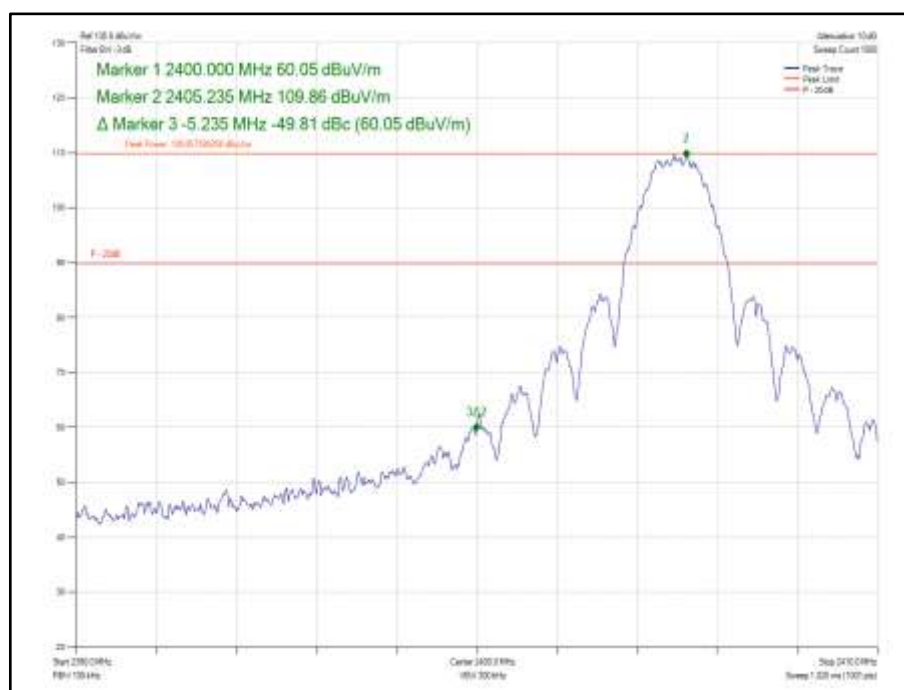


Figure 9 - Static – Thread - 2405 MHz - Band Edge Frequency 2400.0 MHz



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.

2.5.7 Test Location and Test Equipment Used

This test was carried out in RF Chamber 11.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Multimeter	Iso-tech	IDM101	2424	12	12-Dec-2020
EMI Test Receiver	Rohde & Schwarz	ESW44	5084	12	28-Nov-2020
EmX Emissions Software	TUV SUD	V2.0.1	5125	-	Software
Screened Room (11)	Rainford	Rainford	5136	36	01-Nov-2021
Mast	Maturo	TAM 4.0-P	5158	-	TU
Mast and Turntable Controller	Maturo	Maturo NCD	5159	-	TU
Turntable	Maturo	TT 15WF	5160	-	TU
Horn Antenna (1-10GHz)	Schwarzbeck	BBHA 9120 B	5215	12	10-Mar-2021
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB-40	5475	12	17-Mar-2021
2m SMA Cable	Junkosha	MWX221-02000AMSAMS/A	5518	12	01-Apr-2021
8m N Type Cable	Junkosha	MWX221-08000NMSNMS/B	5522	12	24-Mar-2021

Table 19

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment

2.6 Spurious Radiated Emissions

2.6.1 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

2.6.2 Equipment Under Test and Modification State

A2169, S/N: C07CL0AMQ4TG - Modification State 0

2.6.3 Date of Test

02-November-2020 to 03-November-2020

2.6.4 Test Method

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

The plots shown are the characterization of the EUT. The limits on the plots represent the most stringent case for restricted bands, (54/74 dBuV/m @ 3m and 64/84 dBuV/m @ 1m) when compared to 20 dBc (Peak) and 30 dBc (Average) 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:
 $10^{(\text{Field Strength in dB}\mu\text{V/m} / 20)}$.

Above 18 GHz, the measurement distance was reduced to 1 m. The limit line was increased by $20 \cdot \text{LOG}(3/1) = 9.54 \text{ dB}$.

2.6.5 Example Test Setup Diagram

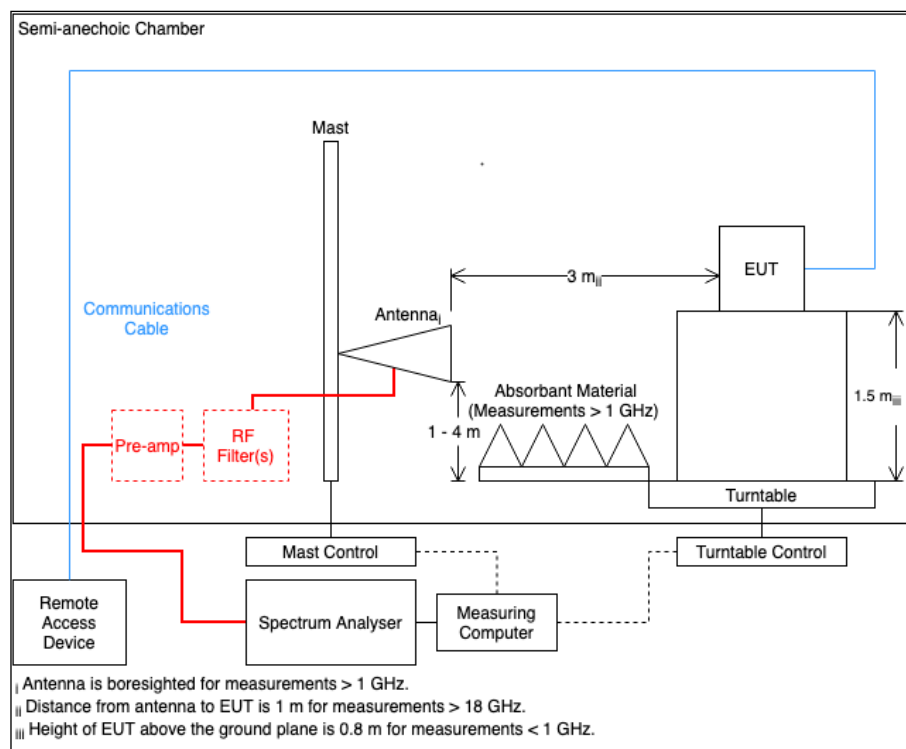


Figure 10

2.6.6 Environmental Conditions

Ambient Temperature 22.1 °C
Relative Humidity 55.8 %

2.6.7 Test Results

2.4 GHz Thread - DTS

Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
135.936	24.1	43.5	-19.4	Q-Peak	151	100	Vertical
2372.969	38.3	54.0	-15.7	RMS	340	359	Vertical
2373.135	37.3	54.0	-16.7	RMS	56	148	Horizontal
19243.845	45.0	54.0	-9.1	RMS	162	100	Horizontal
19243.940	47.6	54.0	-6.4	RMS	161	100	Vertical

Table 20 - 2405 MHz (CH11), Thread, 30 MHz to 26 GHz

No other emissions found within 6 dB of the limit.

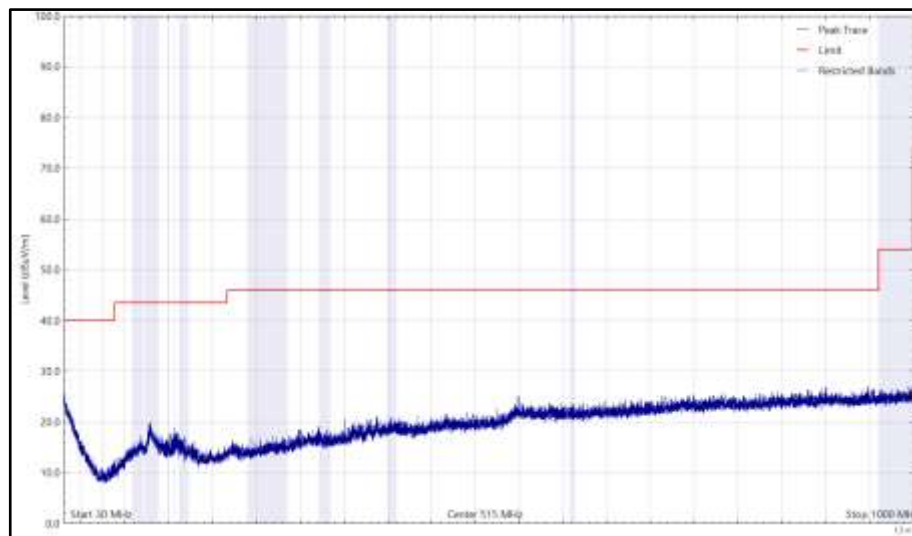


Figure 11- 2405 MHz (CH11), Thread, 30 MHz to 1 GHz, Horizontal (Peak)

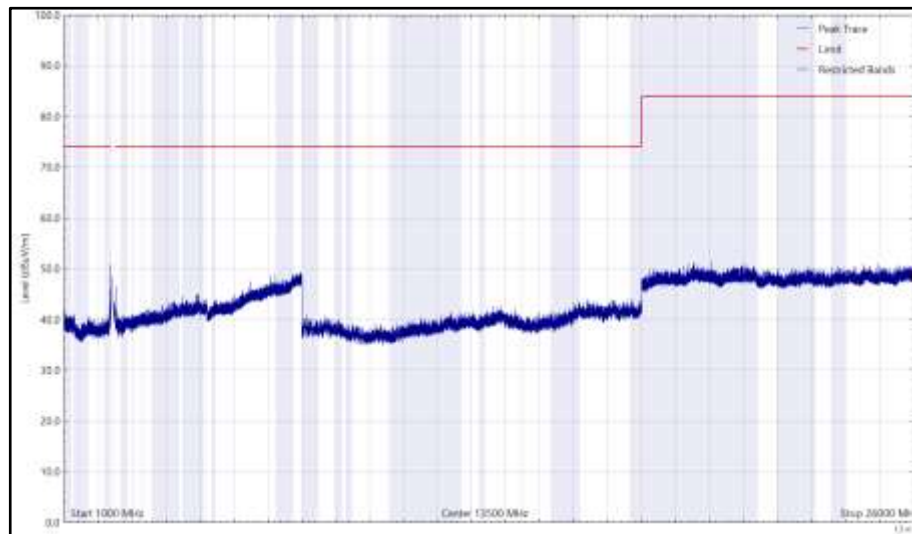


Figure 12- 2405 MHz (CH11), Thread, 1 GHz to 26 GHz, Horizontal (Peak)

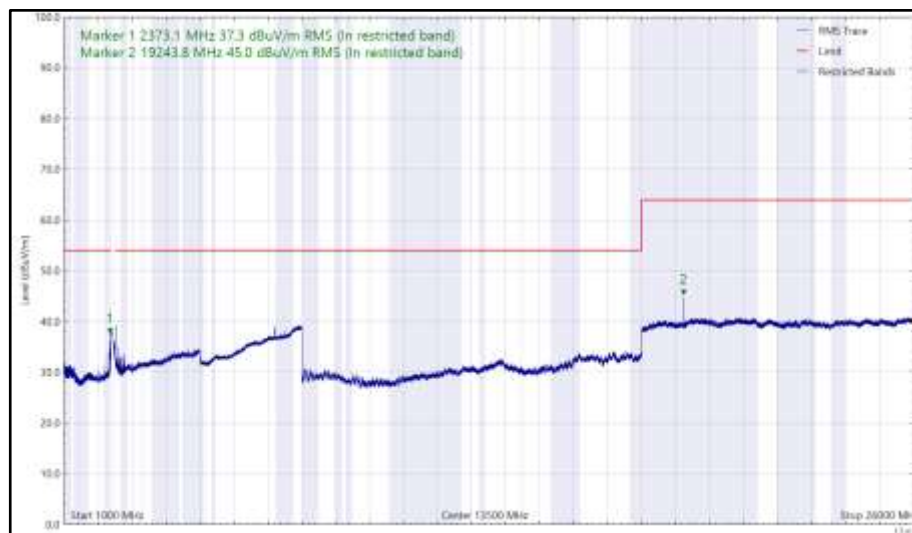


Figure 13- 2405 MHz (CH11), Thread, 1 GHz to 26 GHz, Horizontal (rms)



Figure 14- 2405 MHz (CH11), Thread, 30 MHz to 1 GHz, Vertical (Peak)

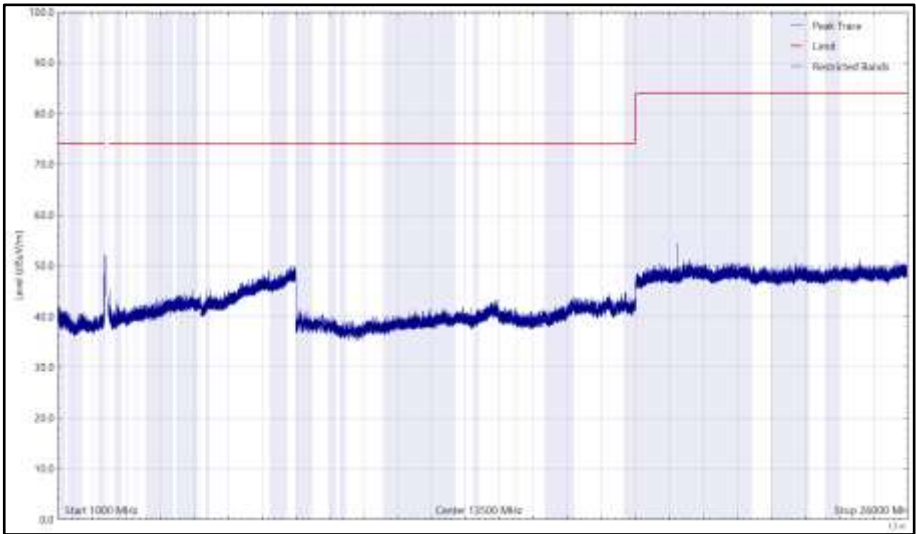


Figure 15- 2405 MHz (CH11), Thread, 1 GHz to 26 GHz, Vertical (Peak)

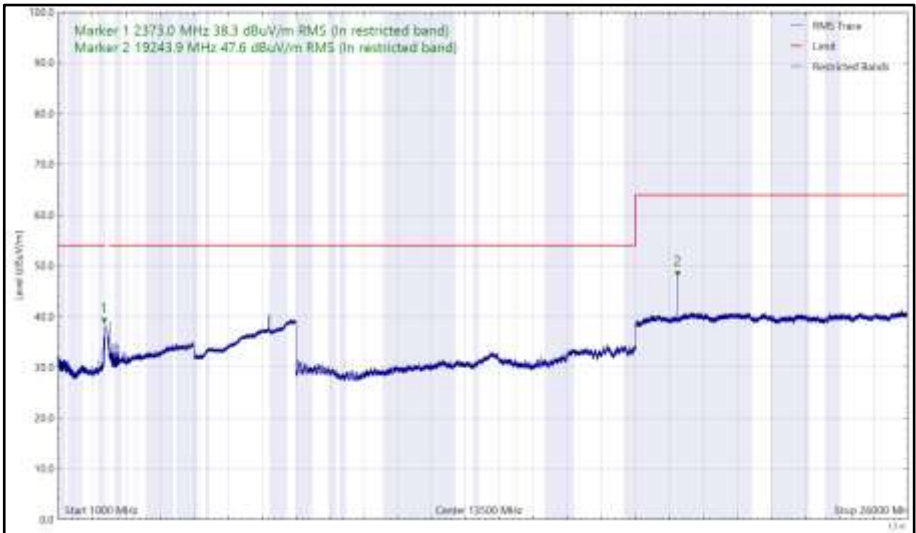


Figure 16 - 2405 MHz (CH11), Thread, 1 GHz to 26 GHz, Vertical (rms)

Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
136.415	23.8	43.5	-19.7	Q-Peak	150	100	Vertical
2376.007	36.5	54.0	-17.5	RMS	341	364	Vertical
2376.052	35.2	54.0	-18.8	RMS	59	100	Horizontal
2696.178	34.6	54.0	-19.4	RMS	326	169	Vertical
7321.306	41.3	54.0	-12.7	RMS	349	388	Horizontal
7321.356	41.6	54.0	-12.4	RMS	271	110	Vertical
19523.865	41.9	54.0	-12.1	RMS	213	100	Horizontal
19523.950	44.1	54.0	-9.9	RMS	159	100	Vertical

Table 21 - 2440 MHz (CH18), Thread, 30 MHz to 26 GHz

No other emissions found within 6 dB of the limit.

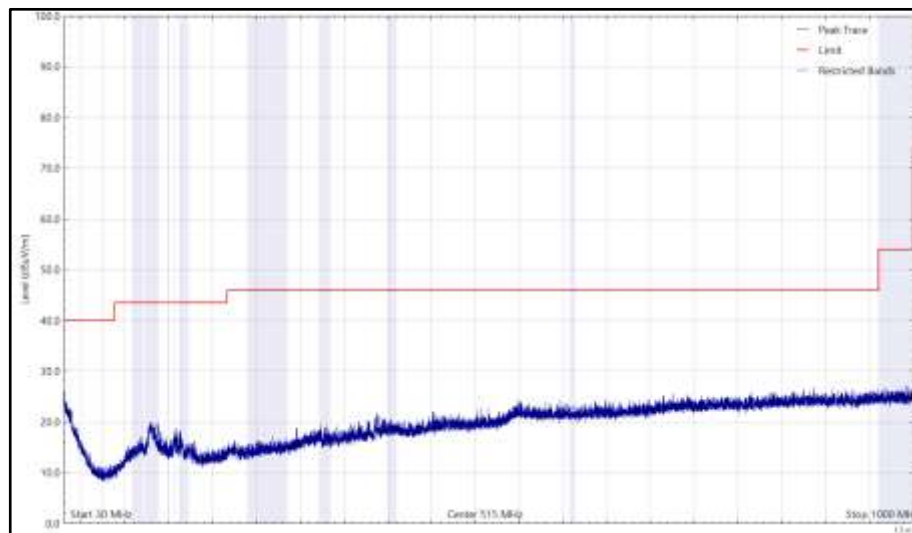


Figure 17- 2440 MHz (CH18), Thread, 30 MHz to 1 GHz, Horizontal (Peak)

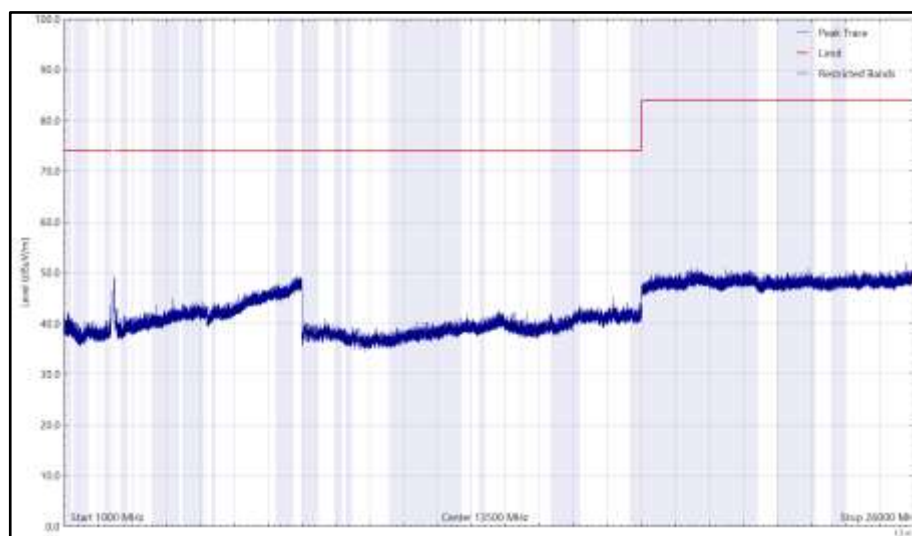


Figure 18- 2440 MHz (CH18), Thread, 1 GHz to 26 GHz, Horizontal (Peak)

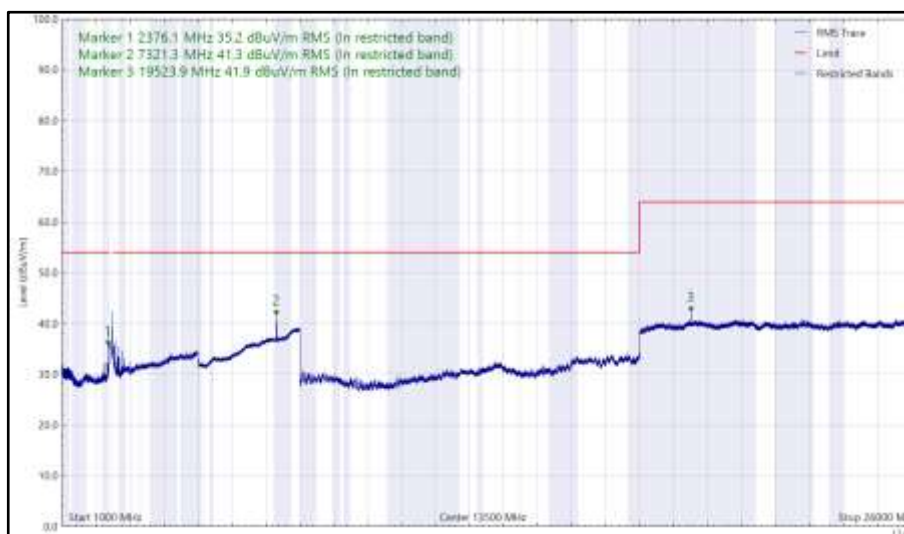


Figure 19- 2440 MHz (CH18), Thread, 1 GHz to 26 GHz, Horizontal (rms)

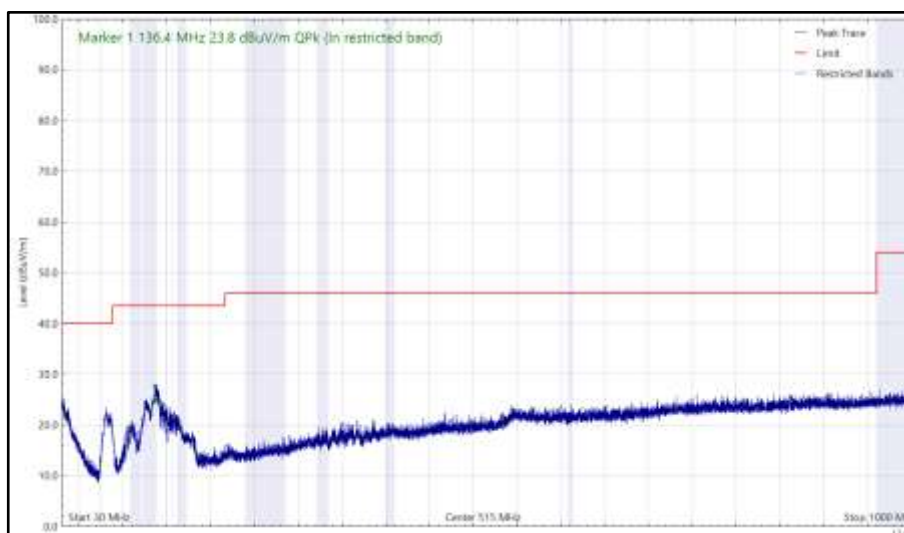


Figure 20- 2440 MHz (CH18), Thread, 30 MHz to 1 GHz, Vertical (Peak)

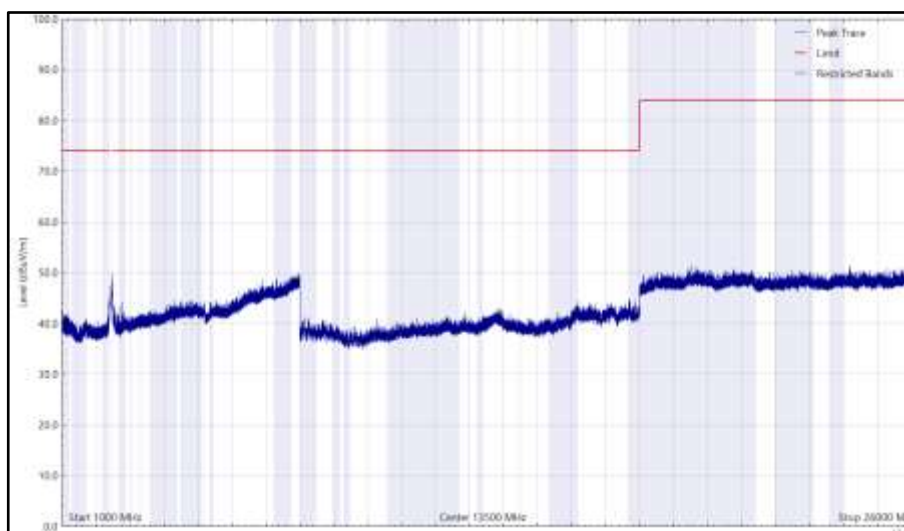


Figure 21- 2440 MHz (CH18), Thread, 1 GHz to 26 GHz, Vertical (Peak)

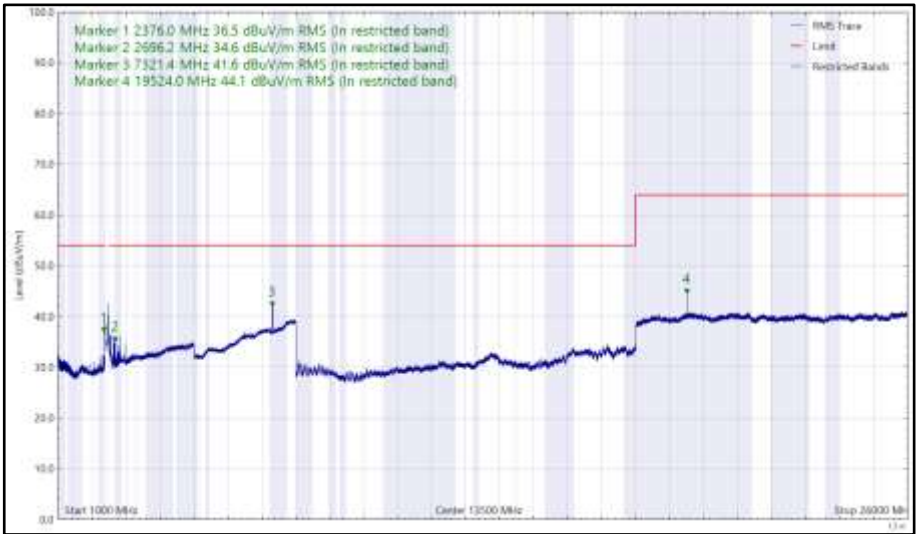


Figure 22- 2440 MHz (CH18), Thread, 1 GHz to 26 GHz, Vertical (rms)

Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
134.672	23.6	43.5	-19.9	Q-Peak	151	107	Vertical
2347.206	34.2	54.0	-19.8	RMS	142	104	Vertical
7426.286	39.6	54.0	-14.5	RMS	280	321	Horizontal
7426.444	38.9	54.0	-15.1	RMS	0	219	Vertical
19803.790	42.5	54.0	-11.5	RMS	212	100	Horizontal
19803.805	42.7	54.0	-11.3	RMS	162	100	Vertical

Table 22 - 2475 MHz (CH25), Thread, 30 MHz to 26 GHz

No other emissions found within 6 dB of the limit.

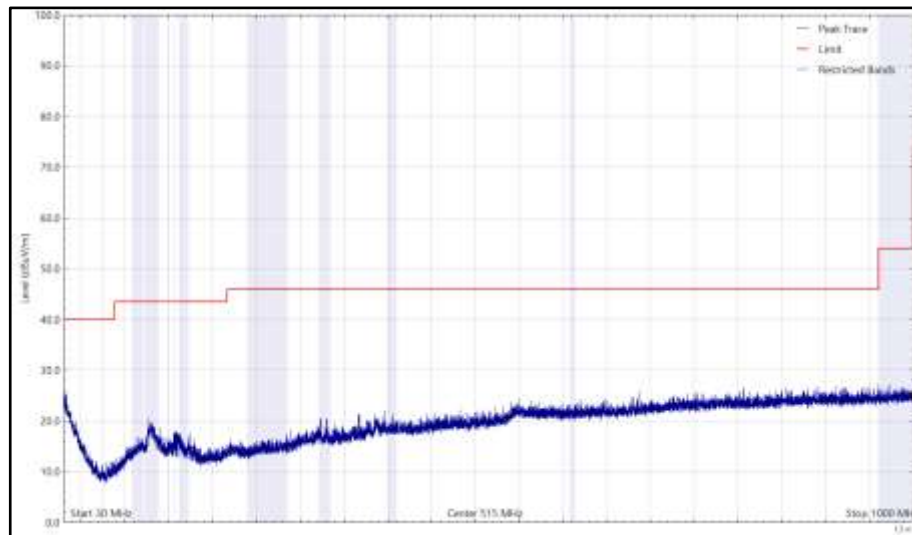


Figure 23- 2475 MHz (CH25), Thread, 30 MHz to 1 GHz, Horizontal (Peak)

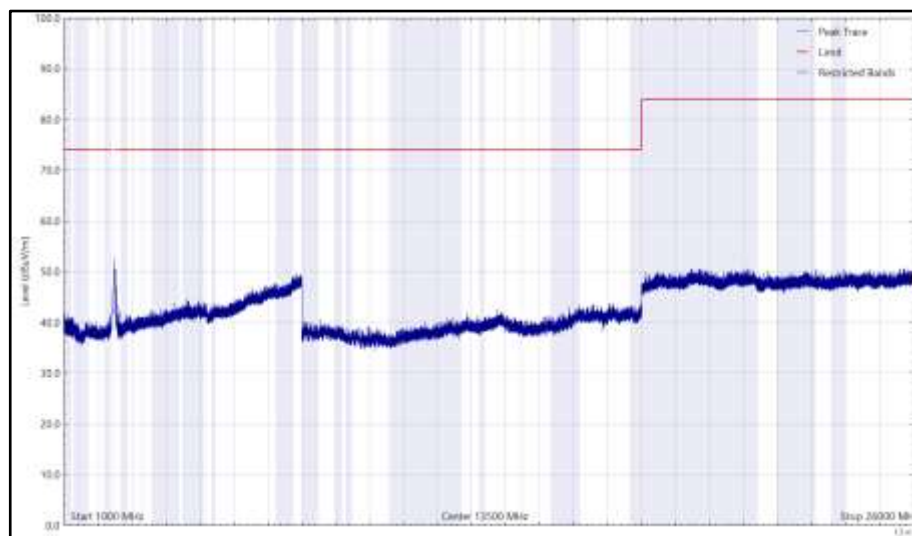


Figure 24- 2475 MHz (CH25), Thread, 1 GHz to 26 GHz, Horizontal (Peak)

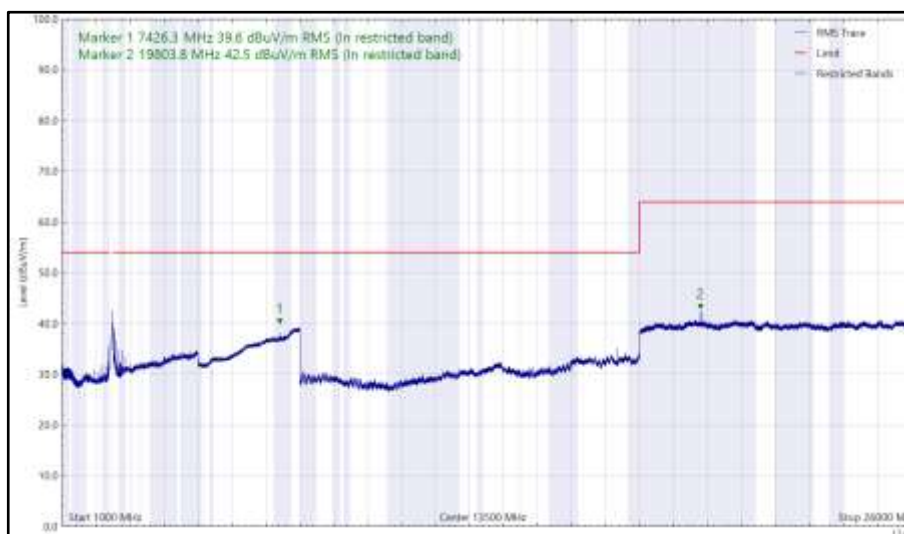


Figure 25- 2475 MHz (CH25), Thread, 1 GHz to 26 GHz, Horizontal (rms)



Figure 26- 2475 MHz (CH25), Thread, 30 MHz to 1 GHz, Vertical (Peak)

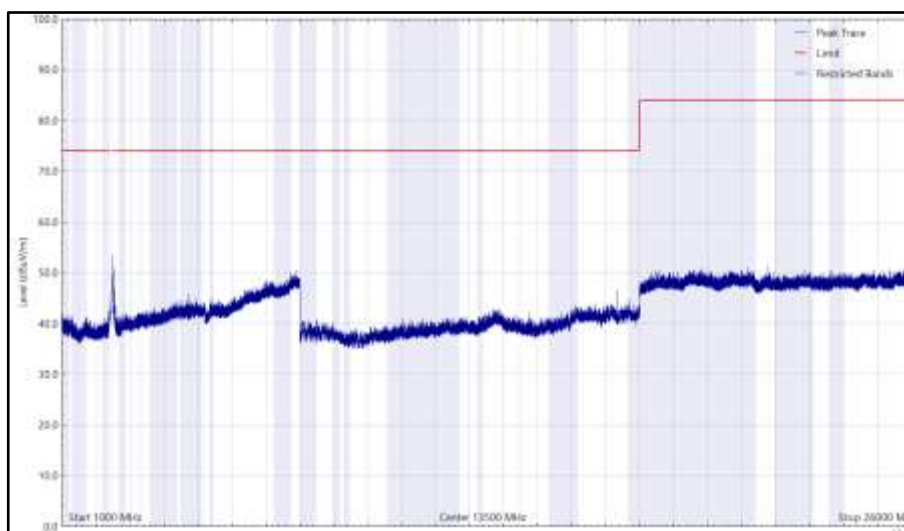


Figure 27 - 2475 MHz (CH25), Thread, 1 GHz to 26 GHz, Vertical (Peak)

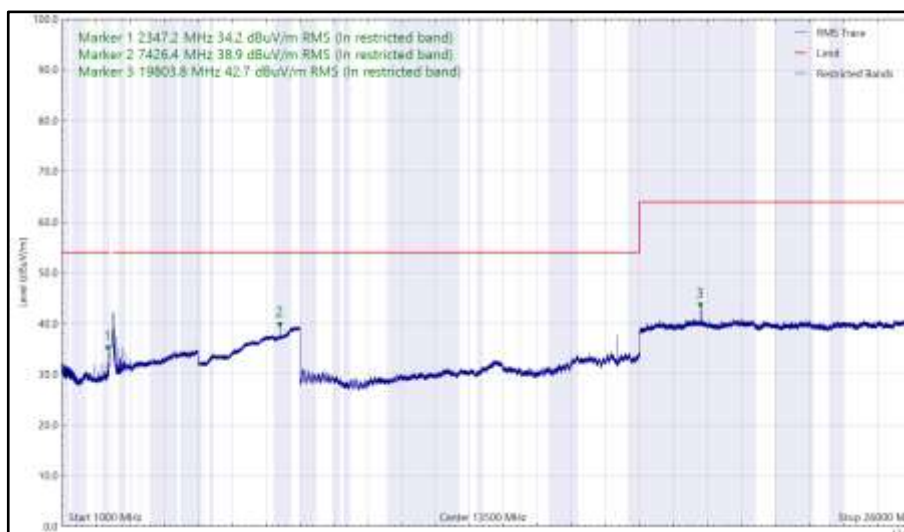


Figure 28 - 2475 MHz (CH25), Thread, 1 GHz to 26 GHz, Vertical (rms)

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.



2.6.8 Test Location and Test Equipment Used

This test was carried out in RF Chamber 5.

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
18GHz - 40GHz Pre-Amplifier	Phase One	PSO4-0087	1534	12	18-Feb-2021
Screened Room (5)	Rainford	Rainford	1545	36	23-Jan-2021
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Antenna with permanent attenuator (Bilog)	Chase	CBL6143	2904	24	30-Sep-2021
Mast Controller	Maturo GmbH	NCD	4810	-	TU
Double Ridge Broadband Horn Antenna	Schwarzbeck	BBHA 9120 B	4848	12	10-Mar-2021
Band Reject Filter - 2.425 GHz	Wainwright	WRCGV14-2390-2400-2450-2460-50SS	5067	12	02-Oct-2021
Band Reject Filter - 2.4585 GHz	Wainwright	WRCGV14-2423.5-2433.5-2483.5-2493.5-50SS	5069	12	12-Oct-2021
Cable (18 GHz)	Rosenberger	LU7-071-1000	5103	12	12-Oct-2021
DRG Horn Antenna (7.5-18GHz)	Schwarzbeck	HWRD750	5216	12	10-Mar-2021
Horn Antenna (15-40GHz)	Schwarzbeck	BBHA 9170	5217	12	14-Oct-2021
Preamplifier (30dB 1GHz to 18GHz)	Schwarzbeck	BBV 9718 C	5261	12	07-Apr-2021
Hygropalm Hygrometer	Rotronic	HP21	5264	12	15-Jul-2021
1m -K-Type Cable	Junkosha	MWX241-01000KMSKMS/A	5511	12	03-Apr-2021
1m -SMA Cable	Junkosha	MWX221-01000AMSAMS/A	5513	12	01-Apr-2021
1m -SMA Cable	Junkosha	MWX221-01000AMSAMS/A	5514	12	01-Apr-2021
2m SMA Cable	Junkosha	MWX221-02000AMSAMS/A	5517	12	01-Apr-2021
8m N-Type Cable	Junkosha	MWX221-08000NMSNMS/B	5520	12	24-Mar-2021
2 m K Type Cable	Junkosha	MWX241-02000KMSKMS/A	5523	12	03-Apr-2021
EMI Test Receiver	Rohde & Schwarz	ESW44	5527	12	06-Feb-2021
3 GHz High pass Filter	Wainwright	WHKX12-2580-3000-18000-80SS	5549	12	05-May-2021
1200 MHz Low Pass Filter (01)	Mini-Circuits	VLF-1200+	5559	12	23-May-2021
8 - 18 GHz Amplifier	Wright Technologies	APS06-0061	5596	12	25-Aug-2021

Table 23

TU - Traceability Unscheduled



3 Measurement Uncertainty

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

Test Name	Measurement Uncertainty
Maximum Conducted Output Power	± 3.2 dB
Power Spectral Density	± 3.2 dB
Emission Bandwidth	± 42.867 kHz
Restricted Band Edges	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 40 GHz: ± 6.3 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

Table 24

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.