FCC and ISED Test Report

Apple Inc, Model: A2843

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

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

FCC ID: BCGA2843 IC: 579C-A2843

COMMERCIAL-IN-CONFIDENCE

Document 75954422-28 Issue 01

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NAME	**JOB TITLE**	**RESPONSIBLE FOR**	**ISSUE DATE**
Matthew Russell	Senior Engineer (RF)	Authorised Signatory	23 September 2022

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
Report Generation	Hollie Marshall	23 September 2022	

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: 2020, ISED RSS-247: Issue 2 (02-2017) and ISED RSS-GEN: Issue 5 (04-2018) + A2 (02-2021) for the tests detailed in section 1.3.

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Contents

1 Report Summary 2

1.1 Report Modification Record 2
1.2 Introduction 2
1.3 Brief Summary of Results 3
1.4 Product Information 4
1.5 Deviations from the Standard 4
1.6 EUT Modification Record 4
1.7 Test Location 5

2 Test Details 6

2.1 Restricted Band Edges 6
2.2 Emission Bandwidth 10
2.3 Maximum Conducted Output Power 14
2.4 Spurious Radiated Emissions 17
2.5 Authorised Band Edges 25
2.6 Power Spectral Density 28

3 Measurement Uncertainty 31

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	23 September 2022

Table 1

1.2 Introduction

Applicant	Apple Inc
Manufacturer	Apple Inc
Model Number(s)	A2843
Serial Number(s)	CVP4VD6WJV and YWL2C4T4WY
Hardware Version(s)	REV 1.0
Software Version(s)	20J42560n
Number of Samples Tested	2
Test Specification/Issue/Date	FCC 47 CFR Part 15C: 2020 ISED RSS-247: Issue 2 (02-2017) ISED RSS-GEN: Issue 5 (04-2018) + A2 (02-2021)
Order Number	540246998
Date of Receipt of EUT	26-May-2022
Start of Test	26-May-2022
Finish of Test	11-August-2022
Name of Engineer(s)	Faisal Malyar, Taha Shafique, Daniel Cameron, Ian Hart, Mohammad Malik and Thomas Randall
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
	FCC Part 15C	RSS-247	RSS-GEN			
Configuration and Mode: Thread communication link						
-	15.203	-	-	Antenna Requirement	N/T	The device complies with the provisions of this section, as it uses permanently attached integral antennas.
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) and 15.209	3.3 and 5.5	6.13 and 8.9	Spurious Radiated Emissions	Pass	
2.5	15.247 (d)	5.5	-	Authorised Band Edges	Pass	
2.6	15.247 (e)	5.2	6.12	Power Spectral Density	Pass	

Table 2

1.4 Product Information

1.4.1 Technical Description

The equipment under test was an Apple TV Set Top Box with Bluetooth®, Thread and IEEE 802.11 a/b/g/n/ac/ax Wi-Fi capabilities in the 2.4GHz and 5GHz bands.

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: A2843, Serial Number: CVP4VD6WJV			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: A2843, Serial Number: YWL2C4T4WY			
0	As supplied by the customer	Not Applicable	Not Applicable

Table 3

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: Thread communication link		
Restricted Band Edges	Faisal Malyar and Taha Shafique	UKAS
Emission Bandwidth	Daniel Cameron	UKAS
Maximum Conducted Output Power	Daniel Cameron	UKAS
Spurious Radiated Emissions	Ian Hart, Mohammad Malik and Thomas Randall	UKAS
Authorised Band Edges	Faisal Malyar and Taha Shafique	UKAS
Power Spectral Density	Daniel Cameron	UKAS

Table 4

Office Address:

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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-247, Clause 3.3
ISED RSS-GEN, Clause 8.10

2.1.2 Equipment Under Test and Modification State

A2843, S/N: YWL2C4T4WY - Modification State 0

2.1.3 Date of Test

26-May-2022

2.1.4 Test Method

This test was performed in accordance with ANSI C63.10, clause 6.10.5 and 11.12.1.

Plots for average measurements were taken in accordance with ANSI C63.10, clause 11.12.2.5.2.

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	20.1 °C
Relative Humidity	48.8 %

2.1.6 Test Results

Thread communication link

Modulation	Tx Frequency (MHz)	Core	Band Edge Frequency (MHz)	Peak Level (dBµV/m)	Average Level (dBµV/m)
OQPSK	2405	Thread	2390.0	57.69	45.67
OQPSK	2475	Thread	2483.5	58.99	49.48

Table 5 - Restricted Band Edge Results

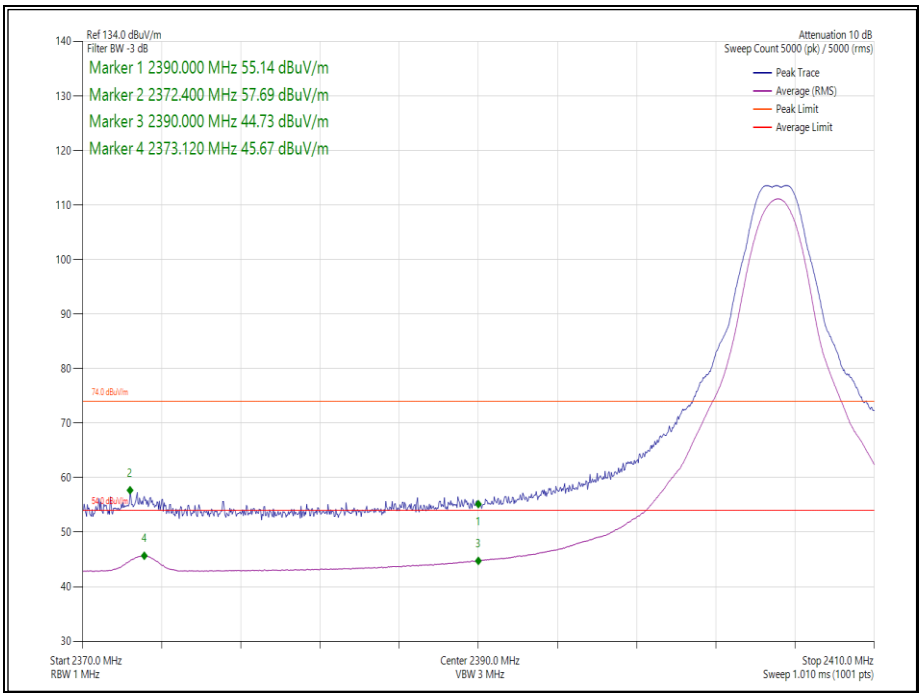

Figure 1 Thread - 2405 MHz – Band Edge Frequency 2390.0 MHz

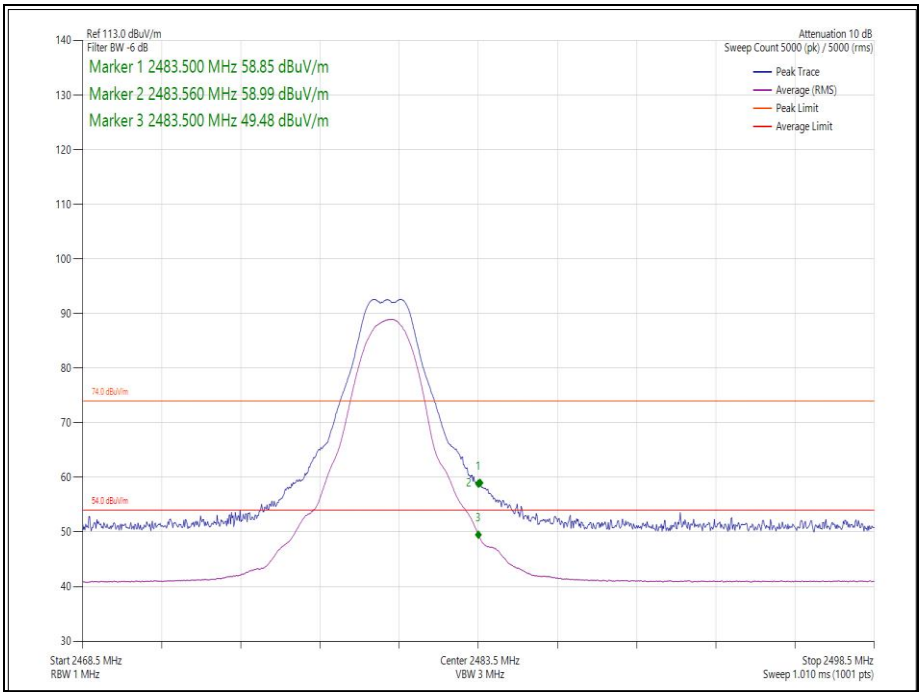

Figure 2 Thread - 2475 MHz - Band Edge Frequency 2483.5 MHz

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 RF Chamber 11.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
EMI Test Receiver	Rohde & Schwarz	ESW44	5084	12	17-May-2023
Emissions Software	TUV SUD	EmX V3.1.4	5125	-	Software
Screened Room (11)	Rainford	Rainford	5136	36	24-Nov-2024
Mast	Maturo	TAM 4.0-P	5158	-	TU
Mast and Turntable Controller	Maturo	Maturo NCD	5159	-	TU
Turntable	Maturo	TT 15WF	5160	-	TU
Antenna (DRG 1-10.5GHz)	Schwarzbeck	BBHA9120B	5215	12	28-May-2022
2m SMA Cable	Junkosha	MWX221-02000AMSAMS/A	5518	12	12-Apr-2023
8m N Type Cable	Junkosha	MWX221-08000NMSNMS/B	5522	12	24-Mar-2023
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB 40	5604	12	22-Sep-2022

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

A2843, S/N: CVP4VD6WJV - Modification State 0

2.2.3 Date of Test

11-August-2022

2.2.4 Test Method

This test was performed in accordance with ANSI C63.10, clause 11.8.1 for 6 dB BW and 6.9.3 for 99% occupied bandwidth measurements.

2.2.5 Environmental Conditions

Ambient Temperature	23.8 °C
Relative Humidity	49.2 %

2.2.6 Test Results

Thread communication link

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Limit Clause(s):	15.247 (a)(2) 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	Duty Cycle (%):	-
Data Rate:	-	DCCF (dB):	-
Antenna Configuration:	SISO	Peak Antenna Gain (dBi):	-
Active Port(s):	D (Thread)	Active Chain(s):	1

Test Frequency (MHz)	6 dB Bandwidth (MHz)				Limit (kHz)
	A	B	C	D	
2405	-	-	-	1.150	≥500.0
2440	-	-	-	1.220	≥500.0
2475	-	-	-	1.230	≥500.0

Table 9 - 6 dB Bandwidth Results

Test Frequency (MHz)	99% Bandwidth (MHz)				Limit (kHz)
	A	B	C	D	
2405	-	-	-	2.230	-
2440	-	-	-	2.250	-
2475	-	-	-	2.250	-

Table 10 - 99% Bandwidth Results

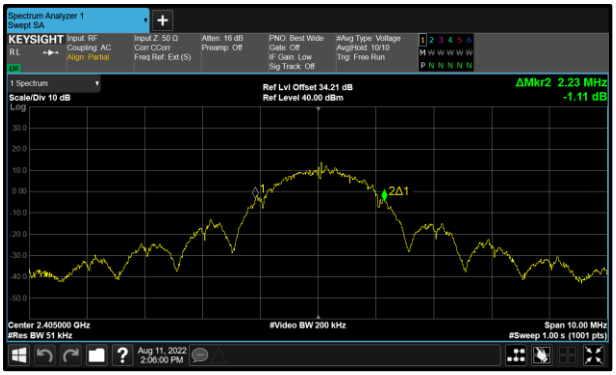

Figure 3 - Thread (D) 2405 MHz (CH11) 99% Bandwidth

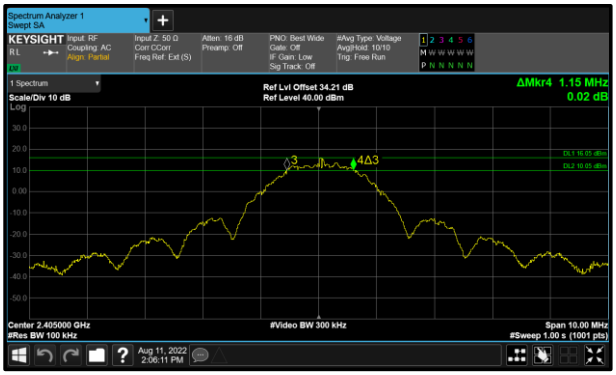

Figure 4 - Thread (D) 2405 MHz (CH11) 6 dB Bandwidth

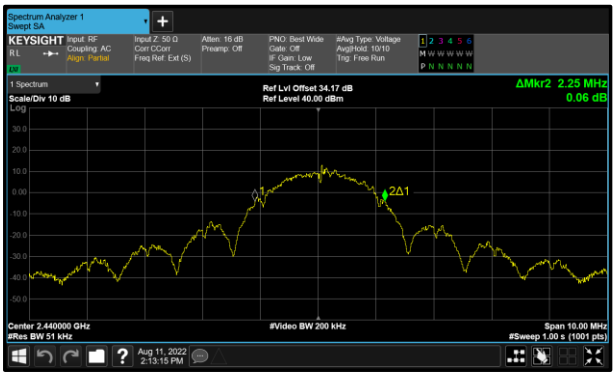

Figure 5 - Thread (D) 2440 MHz (CH18) 99% Bandwidth

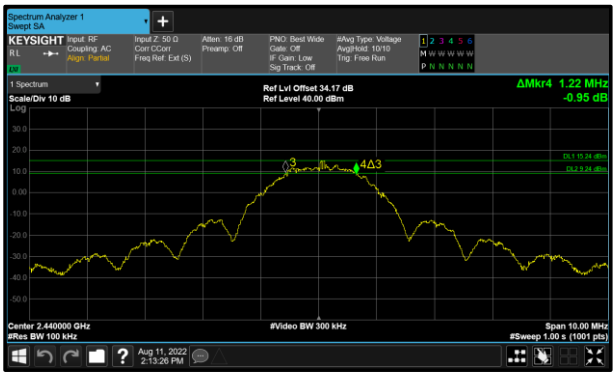

Figure 6 - Thread (D) 2440 MHz (CH18) 6 dB Bandwidth

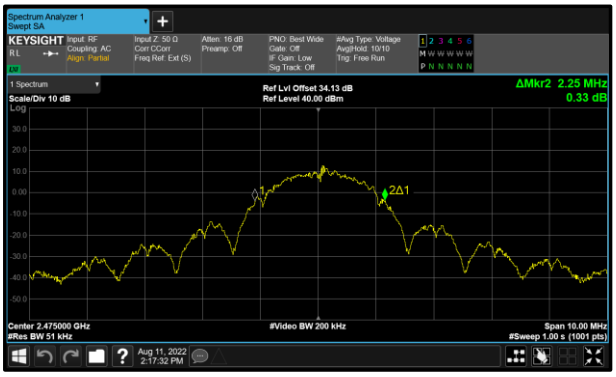

Figure 7 - Thread (D) 2475 MHz (CH25) 99% Bandwidth

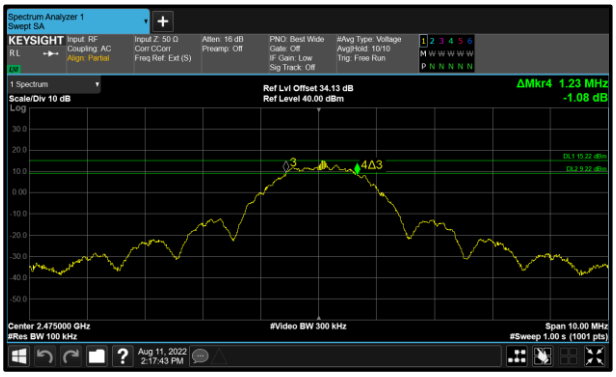

Figure 8 - Thread (D) 2475 MHz (CH25) 6 dB Bandwidth

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 Expires
Multimeter	Fluke	79 Series III	611	12	21-Dec-2022
Hygrometer	Rotronic	I-1000	3220	12	05-Nov-2022
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	01-Feb-2023
AC Programmable Power Supply	iTech	IT7324	5225	-	O/P Mon
MXA Signal Analyser	Keysight Technologies	N9020B	5528	24	21-Mar-2024
Signal Conditioning Unit	TUV SUD	SPECTRUM SCU001	5546	12	06-Apr-2023

Table 11

O/P Mon – Output Monitored using calibrated equipment

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

A2843, S/N: CVP4VD6WJV - Modification State 0

2.3.3 Date of Test

11-August-2022

2.3.4 Test Method

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

2.3.5 Environmental Conditions

Ambient Temperature	23.8 °C
Relative Humidity	49.2 %

2.3.6 Test Results

Thread communication link

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Limit Clause(s):	15.247, (b)(3) RSS-247, 5.4	Test Method(s):	C63.10 11.9.2.3.2
Additional Reference(s):	-		

DUT Configuration			
Mode:	Thread	Duty Cycle (%):	85.1
Data Rate	-	DCCF (dB):	-
Antenna Configuration:	SISO	Peak Antenna Gain (dBi):	2.02
Active Port(s):	D (Thread)	Active Chain(s):	1

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)
	A	B	C	D	∑		
2405	-	-	-	15.97	-	30.00	-14.03
2440	-	-	-	15.45	-	30.00	-14.55
2475	-	-	-	15.57	-	30.00	-14.43

Table 12 - FCC Maximum Conducted (average) 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	∑					
2405	-	-	-	15.97	-	30.00	-14.03	17.99	36.00	-18.01
2440	-	-	-	15.45	-	30.00	-14.55	17.47	36.00	-18.53
2475	-	-	-	15.57	-	30.00	-14.43	17.59	36.00	-18.41

Table 13 - ISED Maximum Conducted (average) 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 (d)

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 Expires
Multimeter	Fluke	79 Series III	611	12	21-Dec-2022
Hygrometer	Rotronic	I-1000	3220	12	05-Nov-2022
AC Programmable Power Supply	iTech	IT7324	5225	-	O/P Mon
Signal Conditioning Unit	TUV SUD	SPECTRUM SCU001	5546	12	06-Apr-2023
USB Power Sensor	Boonton	RTP5008	5822	12	06-Apr-2023

Table 14

O/P Mon – Output Monitored using calibrated equipment

2.4 Spurious Radiated Emissions

2.4.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (d) and 15.209
ISED RSS-247, Clause 3.3 and 5.5
ISED RSS-GEN, Clause 6.13 and 8.9

2.4.2 Equipment Under Test and Modification State

A2843, S/N: YWL2C4T4WY - Modification State 0

2.4.3 Date of Test

06-July-2022 to 10-July-2022

2.4.4 Test Method

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

Ports on the EUT were terminated with loads as described in ANSI C63.4 clause 6.2.4.

In the 30 MHz to 1 GHz range pre-scans were only performed on the mid channel (2440 MHz) only.

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).

Above 18 GHz, the measurement distance was reduced to 1 m. 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.

2.4.5 Test Setup Diagram

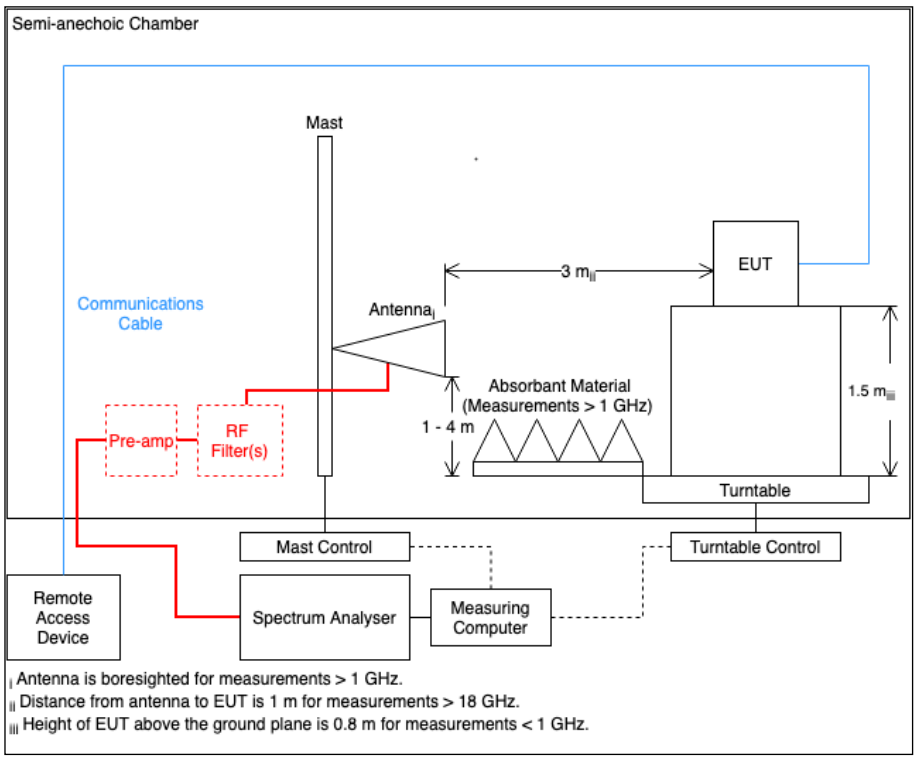

Figure 1

2.4.6 Environmental Conditions

Ambient Temperature	20.5 - 23.2 °C
Relative Humidity	48.0 - 54.5 %

2.4.7 Test Results

Thread communication link

Frequency (MHz)	Level (dBuv/m)	Limit (dBuv/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
2277.029	36.9	54.0	-17.1	RMS	194	116	Horizontal
2341.087	39.9	54.0	-14.2	RMS	209	119	Horizontal
2341.127	37.7	54.0	-16.3	RMS	174	276	Vertical

Table 15 - 2405 MHz (CH11), Thread, 1 GHz to 26 GHz

No other emissions found within 10 dB of the limit.

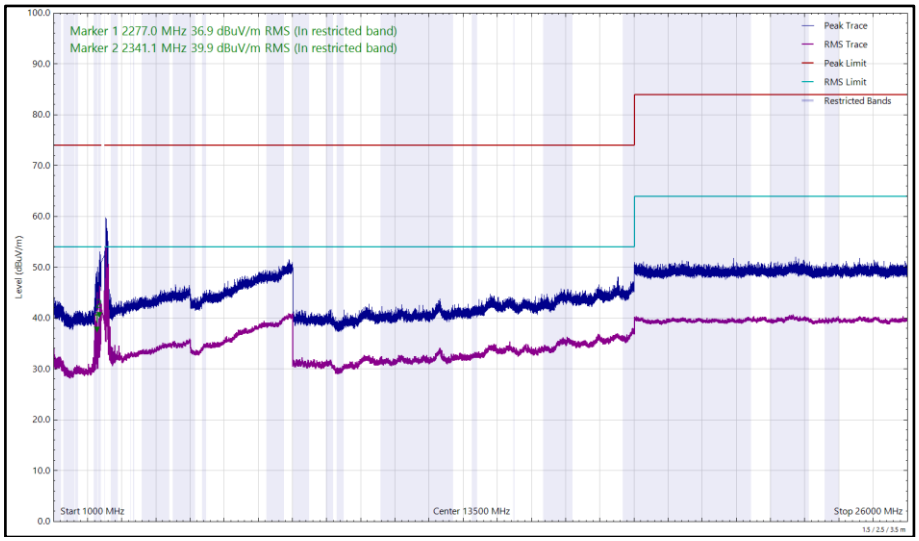

Figure 10 - 2405 MHz (CH11), Thread, 1 GHz to 26 GHz, Horizontal

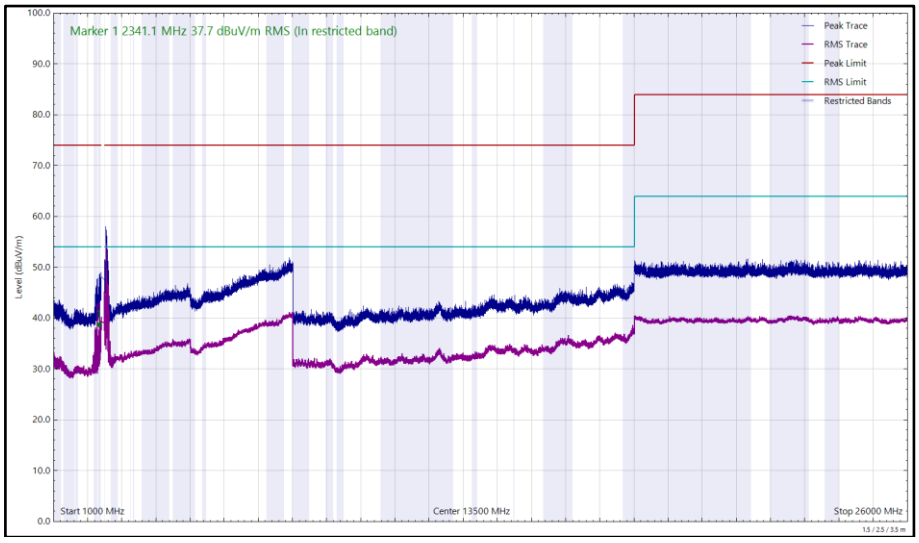

Figure 11 - 2405 MHz (CH11), Thread, 1 GHz to 26 GHz, Vertical

Frequency (MHz)	Level (dBuv/m)	Limit (dBuv/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
2311.990	37.5	54.0	-16.5	RMS	171	285	Vertical
2312.085	56.5	74.0	-17.5	Peak	202	126	Horizontal
2312.085	40.4	54.0	-13.6	RMS	202	126	Horizontal
2375.981	39.1	54.0	-14.9	RMS	170	272	Vertical
2376.197	41.6	54.0	-12.4	RMS	212	141	Horizontal

Table 16 - 2440 MHz (CH18), Thread, 30 MHz to 26 GHz

No other emissions found within 10 dB of the limit.

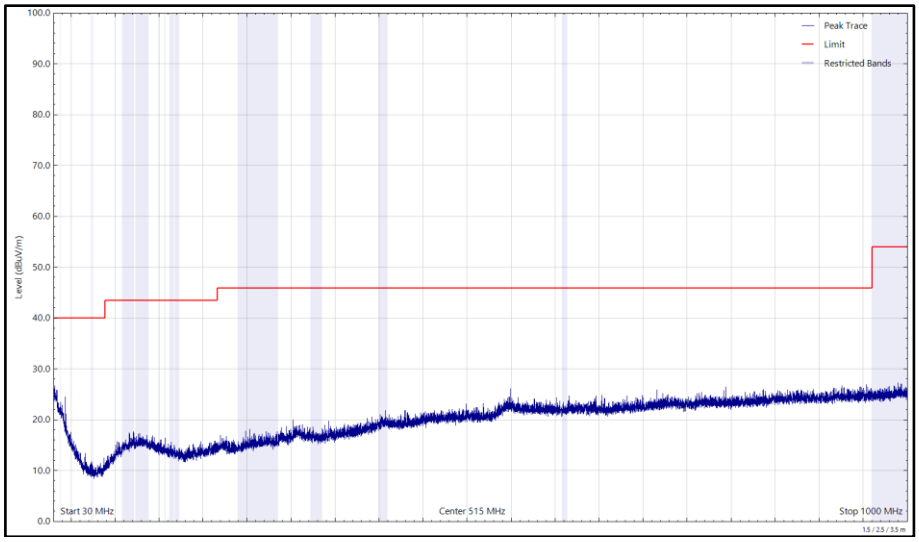

Figure 12 - 2440 MHz (CH18), Thread, 30 MHz to 1 GHz, Horizontal (Peak)

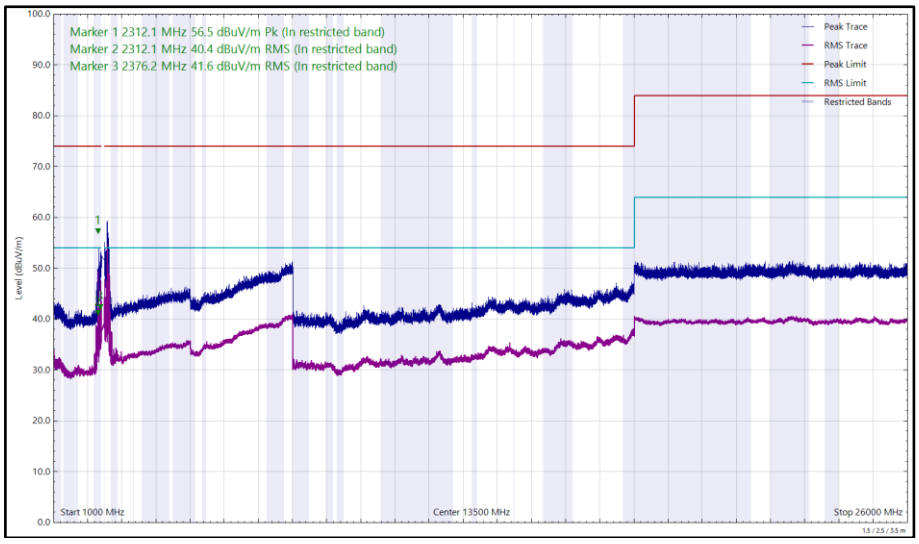

Figure 13 - 2440 MHz (CH18), Thread, 1 GHz to 26 GHz, Horizontal

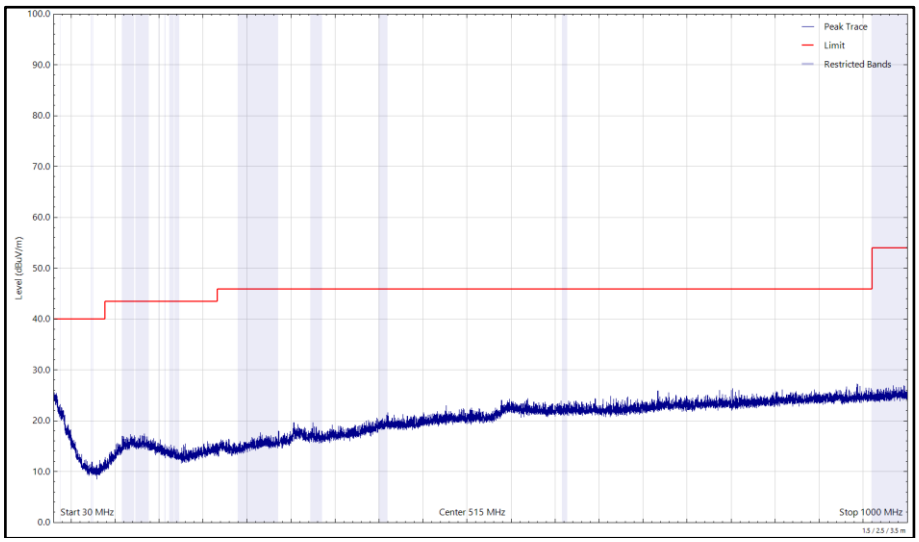

Figure 14 - 2440 MHz (CH18), Thread, 30 MHz to 1 GHz, Vertical (Peak)

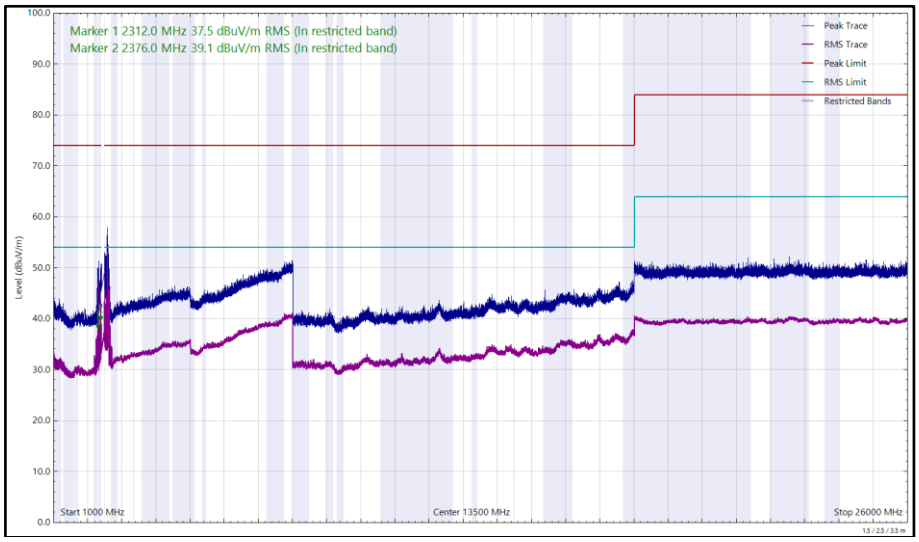

Figure 15 - 2440 MHz (CH18), Thread, 1 GHz to 26 GHz, Vertical

Frequency (MHz)	Level (dBuv/m)	Limit (dBuv/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
2346.322	57.9	74.0	-16.1	Peak	204	100	Horizontal
2346.322	40.1	54.0	-13.9	RMS	204	100	Horizontal
2347.031	38.7	54.0	-15.3	RMS	177	238	Vertical

Table 17 - 2475 MHz (CH25), Thread, 1 GHz to 26 GHz

No other emissions found within 10 dB of the limit.

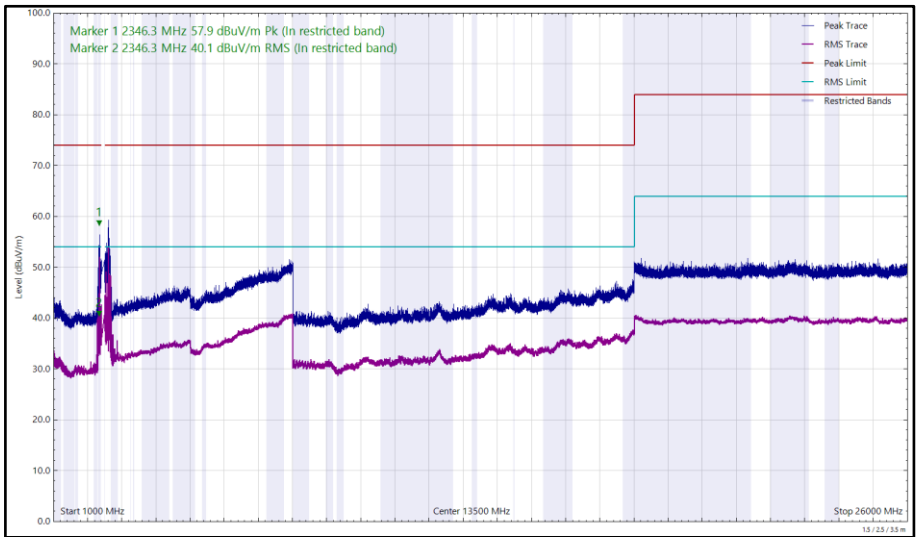

Figure 16 - 2475 MHz (CH25), Thread, 1 GHz to 26 GHz, Horizontal

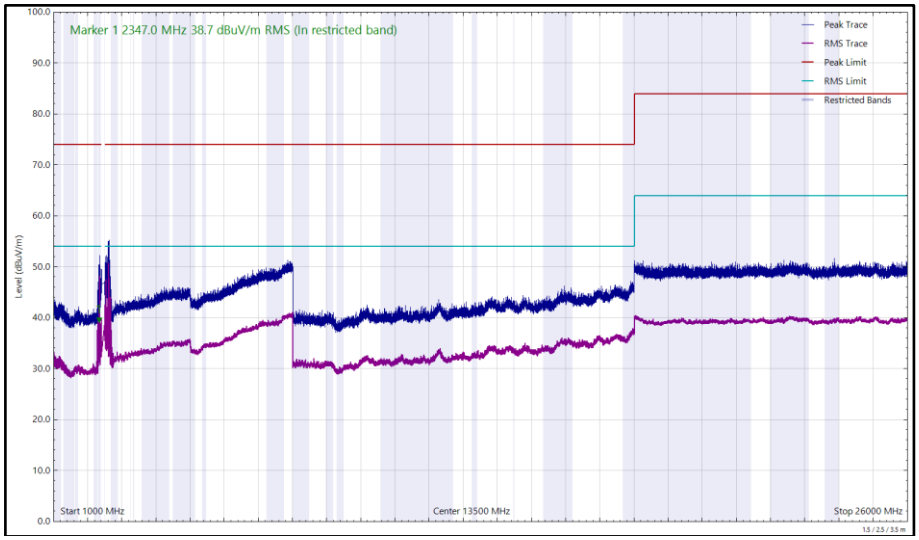

Figure 17 - 2475 MHz (CH25), Thread, 1 GHz to 26 GHz, Vertical

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)

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.

In addition, radiated emissions which fall in the restricted bands, as defined in RSS-GEN, clause 8.10, must also comply with the radiated emission limits specified in RSS-GEN clause 8.9.

2.4.8 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 Expires
Antenna (DRG, 18 GHz to 40 GHz)	Link Microtek	AM180HA-K-TU2	230	24	19-Sep-2022
Antenna with attenuator (Bilog, 30 MHz to 3 GHz)	Schaffner	CBL6143	287	24	14-Oct-2022
Screened Room (5)	Rainford	Rainford	1545	36	15-Apr-2024
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
DC Power Supply	Hewlett Packard	6269B	1909	-	TU
Cable (1-8GHzTx, Nm-Nm, 2m)	Scott Cables	9649-NMNM-2000	4604	6	09-Sep-2022
Mast Controller	Maturo Gmbh	NCD	4810	-	TU
Tilt Antenna Mast	Maturo Gmbh	TAM 4.0-P	4811	-	TU
Antenna (DRG 1-10.5GHz)	Schwarzbeck	BBHA9120B	4848	12	28-May-2023
Band Reject Filter - 2.425 GHz	Wainwright	WRCGV14-2390-2400-2450-2460-50SS	5067	12	29-Sep-2022
Band Reject Filter - 2.4585 GHz	Wainwright	WRCGV14-2423.5-2433.5-2483.5-2493.5-50SS	5069	12	11-Oct-2022
Emissions Software	TUV SUD	EmX V3.1.4	5125	-	Software
Preamplifier (30dB 1GHz to 18GHz)	Schwarzbeck	BBV 9718 C	5261	12	08-Apr-2023
Antenna (DRG Horn 7.5-18GHz)	Schwarzbeck	HWRD750	5348	12	15-Oct-2022
1m K-Type Cable	Junkosha	MWX241-01000KMSKMS/A	5512	12	14-Apr-2023
Cable (sma to sma 1m)	Junkosha	MWX221-01000AMSAMS/A	5513	12	12-Apr-2023
1m -SMA Cable	Junkosha	MWX221-01000AMSAMS/A	5514	12	12-Apr-2023
Cable (SMA to SMA, 2 m)	Junkosha	MWX221-02000AMSAMS/A	5517	12	12-Apr-2023
Cable (N-Type to N-Type, 8 m)	Junkosha	MWX221-08000NMSNMS/B	5520	12	24-March-2023
3 GHz High pass Filter	Wainwright	WHKX12-2580-3000-18000-80SS	5548	12	11-May-2023
7 GHz High pass Filter	Wainwright	WHKX12-5850-6800-18000-80SS	5549	12	19-May-2023
1200 MHz Low Pass Filter (01)	Mini-Circuits	VLF-1200+	5559	12	23-May-2023
8 - 18 GHz Amplifier	Wright Technologies	APS06-0061	5596	12	24-Aug-2022
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB 40	5604	12	23-Sep-2022

Table 18

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

A2843, S/N: YWL2C4T4WY - Modification State 0

2.5.3 Date of Test

26-May-2022

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	20.1 °C
Relative Humidity	48.8 %

2.5.6 Test Results

Thread communication link

Modulation	Tx Frequency (MHz)	Core	Band Edge Frequency (MHz)	Level (dBc)
OQPSK	2405	Thread	2400.0	-51.84

Table 19 - Authorised Band Edge Results

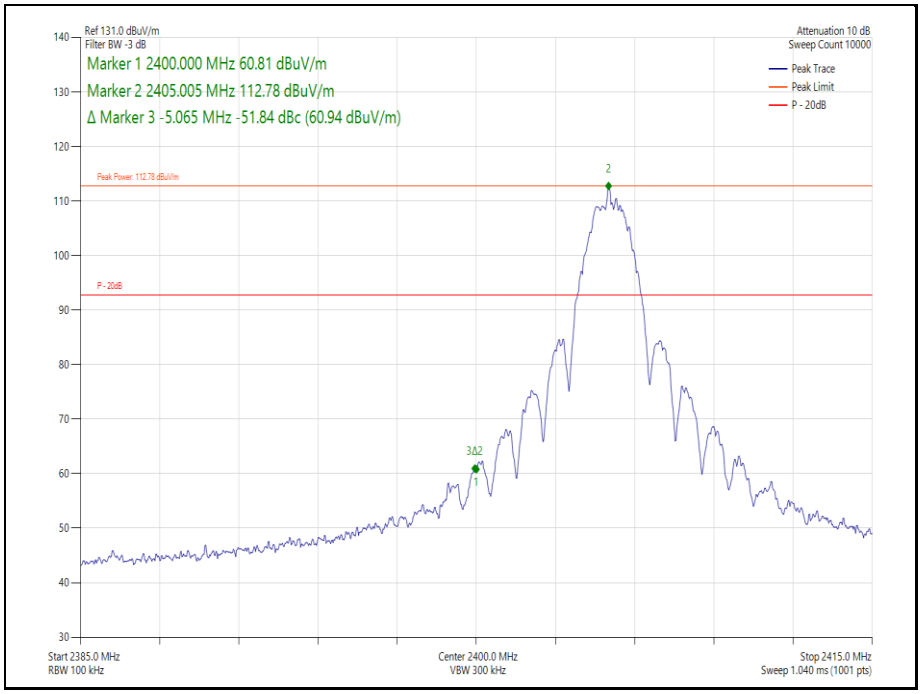

Figure 18 Thread - 2405 MHz – Band Edge Frequency 2400.0 MHz

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 Expires
EMI Test Receiver	Rohde & Schwarz	ESW44	5084	12	17-May-2023
Emissions Software	TUV SUD	EmX V3.1.4	5125	-	Software
Screened Room (11)	Rainford	Rainford	5136	36	24-Nov-2024
Mast	Maturo	TAM 4.0-P	5158	-	TU
Mast and Turntable Controller	Maturo	Maturo NCD	5159	-	TU
Turntable	Maturo	TT 15WF	5160	-	TU
Antenna (DRG 1-10.5GHz)	Schwarzbeck	BBHA9120B	5215	12	28-May-2022
2m SMA Cable	Junkosha	MWX221-02000AMSAMS/A	5518	12	12-Apr-2023
8m N Type Cable	Junkosha	MWX221-08000NMSNMS/B	5522	12	24-Mar-2023
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB 40	5604	12	22-Sep-2022

Table 20

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

A2843, S/N: CVP4VD6WJV - Modification State 0

2.6.3 Date of Test

11-August-2022

2.6.4 Test Method

This test was performed in accordance with ANSI C63.10, clause 11.10.5.

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 (Method AVGPSD-2).

2.6.5 Environmental Conditions

Ambient Temperature	23.8 °C
Relative Humidity	49.2 %

2.6.6 Test Results

Thread communication link

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Limit Clause(s):	15.247 (e) RSS-247 5.2	Test Method(s):	C63.10 11.10.5
Additional Reference(s):	-		
Note(s):	DCCF was added to the spectrum analyser reference level offset.		

DUT Configuration			
Mode:	Thread	Duty Cycle (%):	85.1
Data Rate:	-	DCCF (dB):	0.70
Antenna Configuration:	SISO	Peak Antenna Gain (dBi):	-
Active Port(s):	D (Thread)	Active Chain(s):	1

Test Frequency (MHz)	RBW (kHz)	PSD (dBm/RBW)					Limit (dBm/3 kHz)	Margin (dB)
		A	B	C	D	∑		
2405	3.0	-	-	-	1.04	-	8.00	-6.96
2440	3.0	-	-	-	0.59	-	8.00	-7.41
2475	3.0	-	-	-	0.27	-	8.00	-7.73

Table 21 - 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 Expires
Multimeter	Fluke	79 Series III	611	12	21-Dec-2022
Hygrometer	Rotronic	I-1000	3220	12	05-Nov-2022
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	01-Feb-2023
AC Programmable Power Supply	iTech	IT7324	5225	-	O/P Mon
MXA Signal Analyser	Keysight Technologies	N9020B	5528	24	21-Mar-2024
Signal Conditioning Unit	TUV SUD	SPECTRUM SCU001	5546	12	06-Apr-2023

Table 22

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
Restricted Band Edges	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 40 GHz: ± 6.3 dB
Emission Bandwidth	± 101.42 kHz
Maximum Conducted Output Power	± 1.38 dB
Spurious Radiated Emissions	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
Power Spectral Density	± 1.49 dB

Table 23

Measurement Uncertainty Decision Rule – Accuracy Method

Determination of conformity with the specification limits is based on the decision rule according to IEC Guide 115:2021, Clause 4.4.3 (Procedure 2). The measurement results are directly compared with the test limit to determine conformance with the requirements of the standard.

Risk: The uncertainty of measurement about the measured result is negligible with regard to the final pass/fail decision. The measurement result can be directly compared with the test limit to determine conformance with the requirement (compare IEC Guide 115). The level of risk to falsely accept and falsely reject items is further described in ILAC-G8.