

FCC and ISED Test Report

Apple Inc
Model: A2485

In accordance with FCC 47 CFR Part 15
ISED RSS-247 and ISED RSS-GEN (2.4 GHz
Bluetooth, 2.4 GHz WLAN and 5 GHz WLAN)

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

FCC ID: BCGA2485

IC: 579C-A2485



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Document 75952054-14 Issue 01

SIGNATURE

NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
Steve Marshall	Senior Engineer	Authorised Signatory	17 September 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 Parts 15, 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	Faisal Malyar	17 September 2021	
Testing	Liang Tian	17 September 2021	
Testing	Ahmad Javid	17 September 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 15: 2020, ISED RSS-247: Issue 2 (2017-02) and ISED RSS-GEN: Issue 5 (04-2018) + A2 (02-2021) 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 September 2021

Table 1

1.2 Introduction

Applicant	Apple Inc
Manufacturer	Apple Inc
Model Number(s)	A2485
Serial Number(s)	HV9QMW620K
Hardware Version(s)	REV1.0
Software Version(s)	21A102280u
Number of Samples Tested	1
Test Specification/Issue/Date	FCC 47 CFR Part 15: 2020 ISED RSS-247: Issue 2 (2017-02) ISED RSS-GEN: Issue 5 (04-2018) + A2 (02-2021)
Order Number	0540211248
Date	22-April-2021
Date of Receipt of EUT	31-March-2021
Start of Test	25-July-2021
Finish of Test	21-August-2021
Name of Engineer(s)	Faisal Malyar, Liang Tian and Ahmad Javid
Related Document(s)	ANSI C63.26: 2015 ANSI C63.10: 2013



1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with FCC 47 CFR Parts 15, ISED RSS-247 and ISED RSS-GEN is shown below

Section	Specification Clause			Test Description	Result	Comments/Base Standard
	FCC Part 15	RSS-247	RSS-GEN			
Configuration and Mode: CoTx - 2.4 GHz WLAN, 5GHz WLAN and 2.4 GHz Bluetooth						
2.1	15.247 (d), 15.407 (b) and 15.209	5.5 and 6.2	8.9 and 8.10	Radiated Spurious Emissions (Simultaneous Transmission)	Pass	
Configuration and Mode: SDB - 2.4 GHz WLAN and 5 GHz WLAN						
2.1	15.247 (d), 15.407 (b) and 15.209	5.5 and 6.2	8.9 and 8.10	Radiated Spurious Emissions (Simultaneous Transmission)	Pass	

Table 2



1.4 Product Information

1.4.1 Technical Description

The Equipment under test (EUT) was a laptop computer with Bluetooth, Bluetooth Low Energy and 802.11 a/b/g/n/ac/ax capabilities in the 2.4 GHz and 5 GHz 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: A2485, Serial Number: HV9QMW620K			
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: CoTX - 2.4 GHz WLAN, 5 GHz WLAN and 2.4 GHz Bluetooth		
Radiated Spurious Emissions (Simultaneous Transmission)	Faisal Malyar, and Liang Tian	UKAS
Configuration and Mode: SDB - 2.4 GHz WLAN and 5 GHz WLAN		
Radiated Spurious Emissions (Simultaneous Transmission)	Ahmad Javid	UKAS

Table 4

Office Address:

TÜV SÜD
Octagon House
Concorde Way
Fareham
Hampshire
PO15 5RL
United Kingdom



2 Test Details

2.1 Radiated Spurious Emissions (Simultaneous Transmission)

2.1.1 Specification Reference

FCC 47 CFR Parts 15, Clause 15.247 (d), 15.407 (b) and 15.209
ISED RSS 247, Clause 5.5 and 6.2
ISED RSS GEN, Clause 8.9 and 8.10

2.1.2 Equipment Under Test and Modification State

A2485, S/N: HV9QMW620K - Modification State 0

2.1.3 Date of Test

25-July-2021 to 21-August-2021

2.1.4 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.

Ports on the EUT were terminated with loads as described in ANSI C63.4 clause 6.2.4 for each type of port on the EUT.

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, 11.11, 11.12, 12.7.2 or 12.7.3 depending on the nature of the emission measured.

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 non-restricted band limits. 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:
 $10^{(\text{Field Strength in dB}\mu\text{V/m}/20)}$

To determine the emission characteristic of the EUT above 18 GHz, the test antenna was swept over all faces of the EUT whilst observing a spectral display. The frequency of any emissions of interest was noted for formal measurement at the correct measurement distance of 1m. This procedure was repeated for all relevant transmit operating channels.

At a measurement distance of 1 meter the limit line was increased by $20 \cdot \text{LOG}(3/1) = 9.54$ dB.

2.1.5 Example Test Setup Diagram

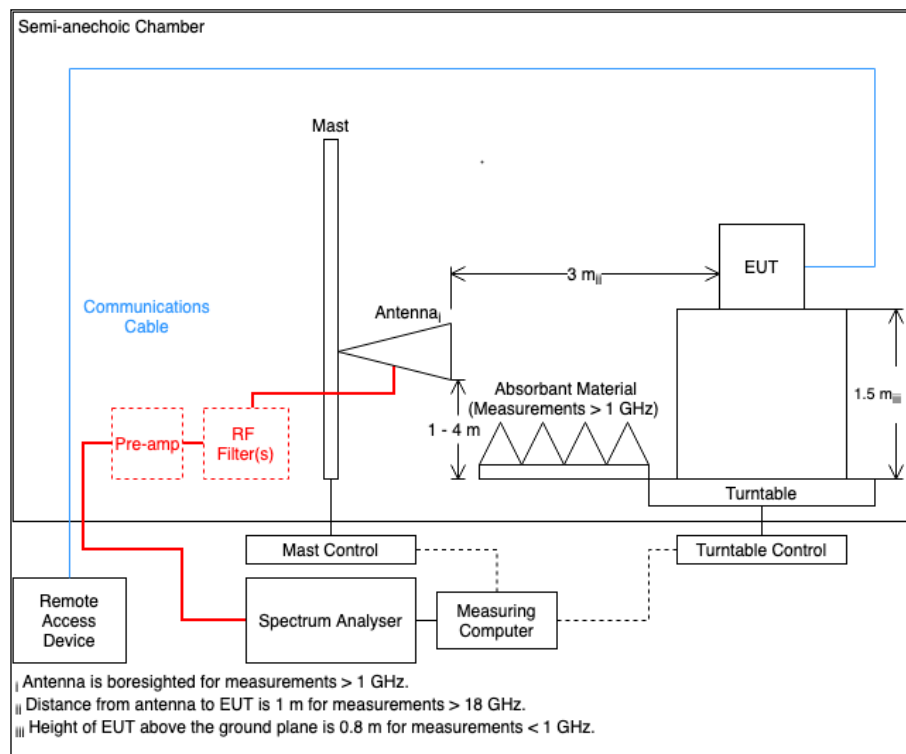


Figure 1

2.1.6 Environmental Conditions

Ambient Temperature	21.1 - 22.8 °C
Relative Humidity	47.2 - 67.7 %

2.1.7 Test Results

CoTX - 2.4 GHz WLAN and 5 GHz WLAN and 2.4 GHz Bluetooth

Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
15983.983	35.2	54.0	-18.8	RMS	87	354	Horizontal
15984.102	34.0	54.0	-20.1	RMS	79	281	Vertical

Table 5 - 2412 MHz (CH1), HT20, CDD, Core 0 + Core 1 and U-NII-1 - 5200 MHz (CH40), HT20, CDD, Core 0 + Core 1 and 2402 MHz (CH0), DH5, iPA, Core 2, 30 MHz to 40 GHz

No other emissions found within 10 dB of the limit.

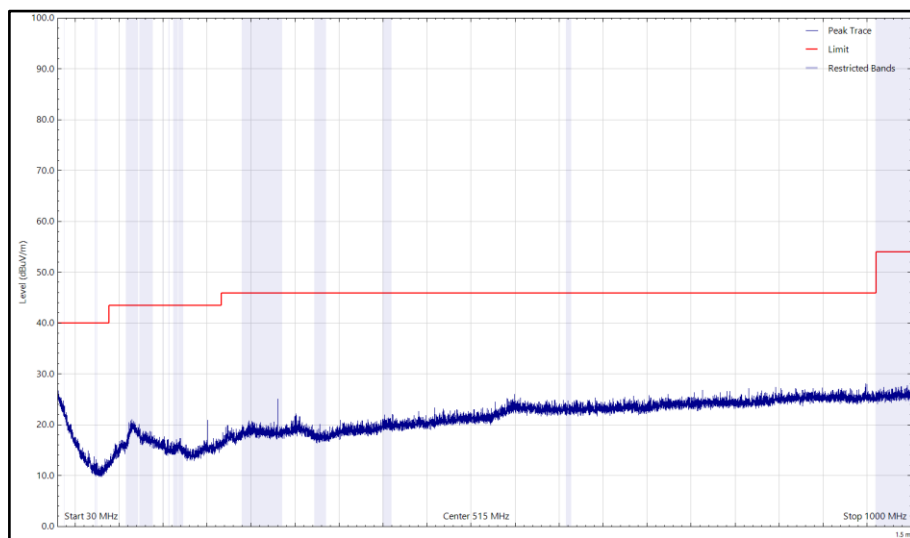


Figure 2 - 2412 MHz (CH1), HT20, CDD, Core 0 + Core 1 and U-NII-1 - 5200 MHz (CH40), HT20, CDD, Core 0 + Core 1 and 2402 MHz (CH0), DH5, iPA, Core 2, 30 MHz to 1 GHz, Horizontal (Peak)

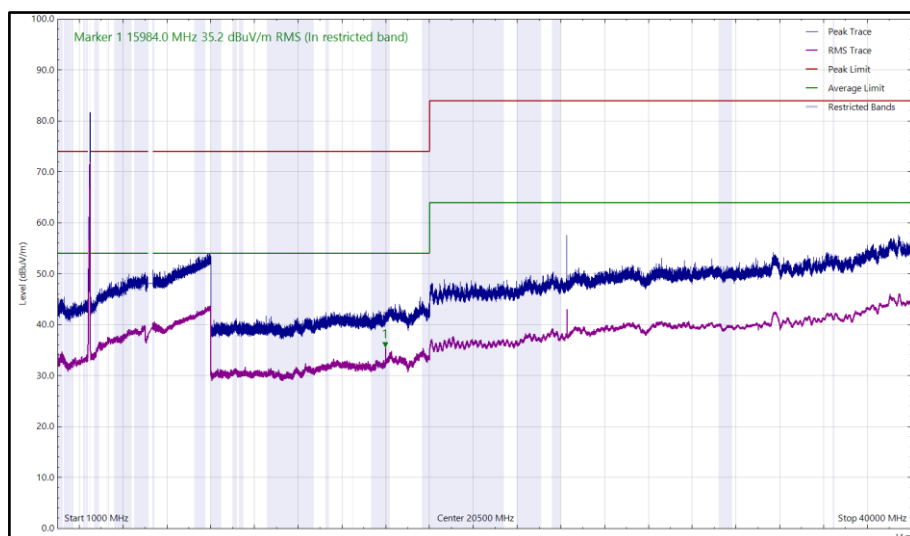


Figure 3 - 2412 MHz (CH1), HT20, CDD, Core 0 + Core 1 and U-NII-1 - 5200 MHz (CH40), HT20, CDD, Core 0 + Core 1 and 2402 MHz (CH0), DH5, iPA, Core 2, 1 GHz to 40 GHz, Horizontal

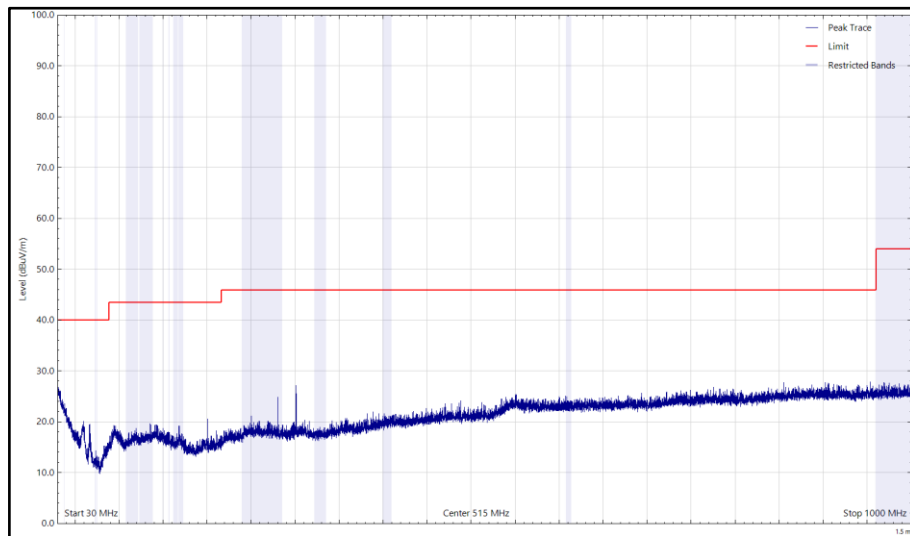


Figure 4 - 2412 MHz (CH1), HT20, CDD, Core 0 + Core 1 and U-NII-1 - 5200 MHz (CH40), HT20, CDD, Core 0 + Core 1 and 2402 MHz (CH0), DH5, iPA, Core 2, 30 MHz to 1 GHz, Vertical (Peak)

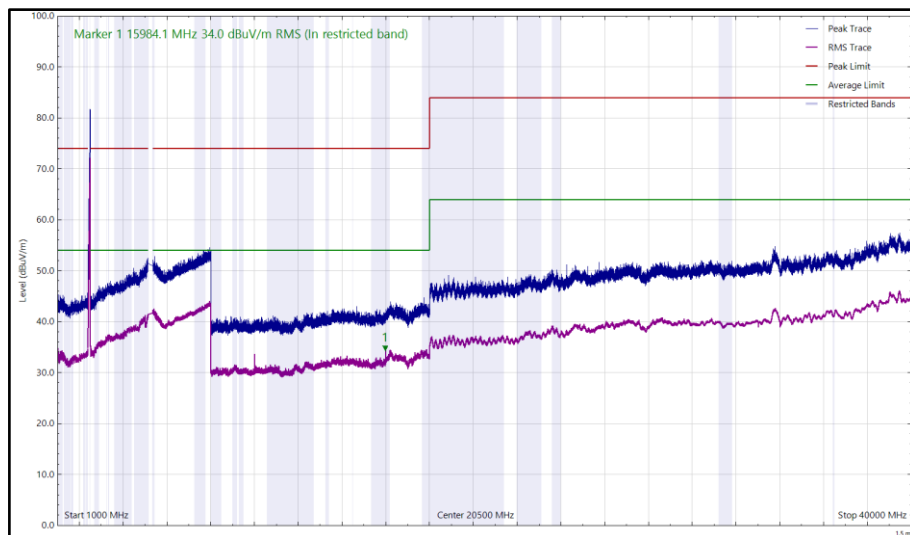


Figure 5 - 2412 MHz (CH1), HT20, CDD, Core 0 + Core 1 and U-NII-1 - 5200 MHz (CH40), HT20, CDD, Core 0 + Core 1 and 2402 MHz (CH0), DH5, iPA, Core 2, 1 GHz to 40 GHz, Vertical

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

Table 6 - 2472 MHz (CH13), HT20, CDD, Core 0 + Core 1 and U-NII-2C - 5680 MHz (CH136), HT20, CDD, Core 0 + Core 1 and 2480 MHz (CH78), DH5, iPA, Core 2, 30 MHz to 40 GHz

*No emissions found within 6 dB of the limit.

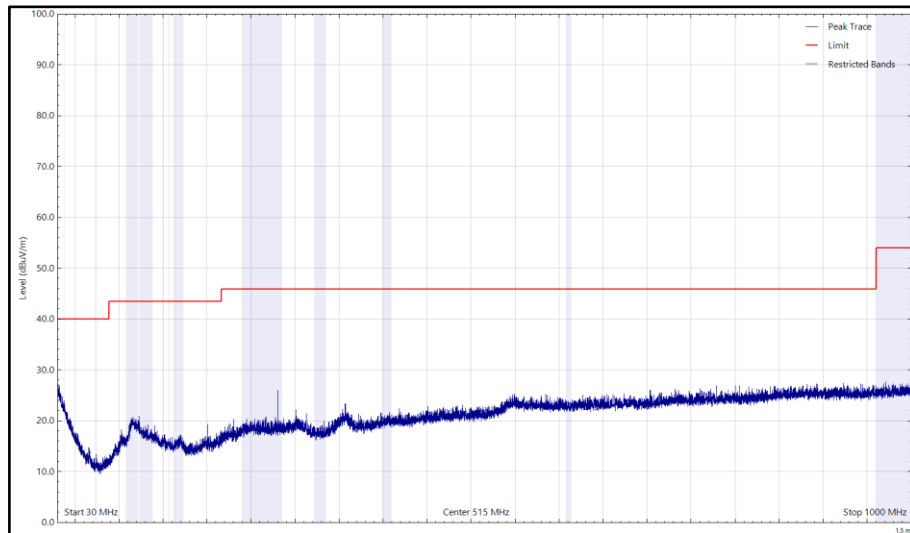


Figure 6 - 2472 MHz (CH13), HT20, CDD, Core 0 + Core 1 and U-NII-2C - 5680 MHz (CH136), HT20, CDD, Core 0 + Core 1 and 2480 MHz (CH78), DH5, iPA, Core 2, 30 MHz to 1 GHz, Horizontal (Peak)

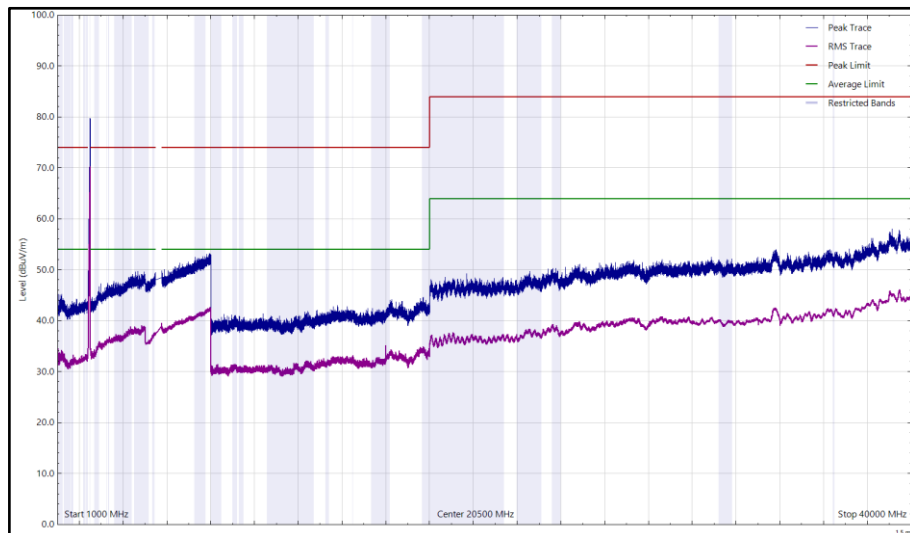


Figure 7 - 2472 MHz (CH13), HT20, CDD, Core 0 + Core 1 and U-NII-2C - 5680 MHz (CH136), HT20, CDD, Core 0 + Core 1 and 2480 MHz (CH78), DH5, iPA, Core 2, 1 GHz to 40 GHz, Horizontal

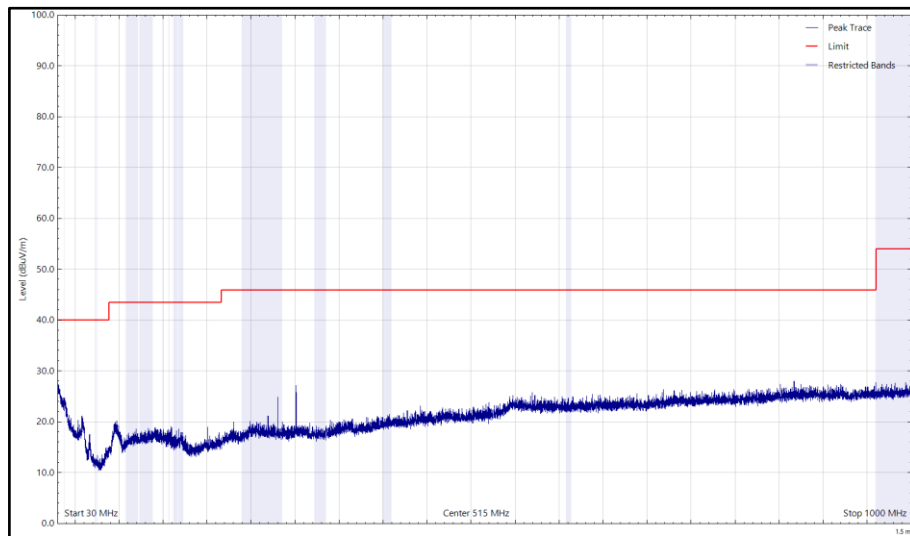


Figure 8 - 2472 MHz (CH13), HT20, CDD, Core 0 + Core 1 and U-NII-2C - 5680 MHz (CH136), HT20, CDD, Core 0 + Core 1 and 2480 MHz (CH78), DH5, iPA, Core 2, 30 MHz to 1 GHz, Vertical (Peak)

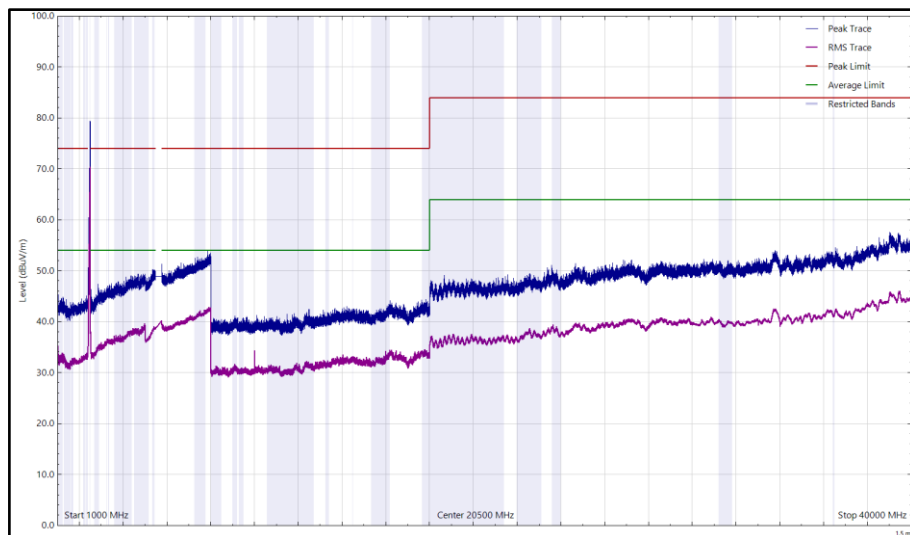


Figure 9 - 2472 MHz (CH13), HT20, CDD, Core 0 + Core 1 and U-NII-2C - 5680 MHz (CH136), HT20, CDD, Core 0 + Core 1 and 2480 MHz (CH78), DH5, iPA, Core 2, 1 GHz to 40 GHz, Vertical

SDB - 2.4 GHz WLAN and 5 GHz WLAN

Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
2787.516	38.3	54.0	-15.7	RMS	354	313	Vertical
4824.351	41.6	54.0	-12.4	RMS	360	352	Vertical

Table 7 – 2412 MHz (CH1), HT20, CDD, Core 0 + Core 1 and U-NII-1 – 5200 MHz (CH40), HT20, CDD, Core 0 + Core 1, 30 MHz to 40 GHz

No other emissions found within 10 dB of the limit.

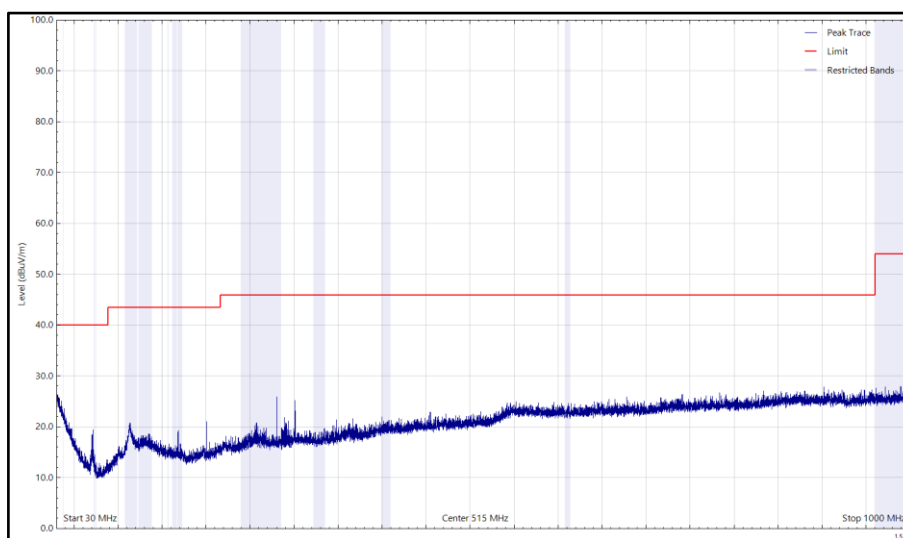


Figure 10 – 2412 MHz (CH1), HT20, CDD, Core 0 + Core 1 and U-NII-1 – 5200 MHz (CH40), HT20, CDD, Core 0 + Core 1, 30 MHz to 1 GHz, Horizontal (Peak)

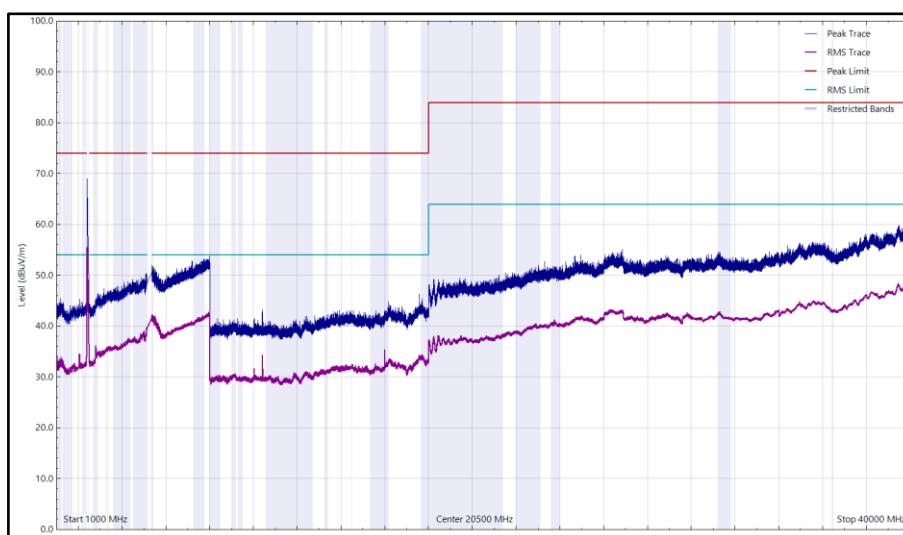


Figure 11 – 2412 MHz (CH1), HT20, CDD, Core 0 + Core 1 and U-NII-1 – 5200 MHz (CH40), HT20, CDD, Core 0 + Core 1, 1 GHz to 40 GHz, Horizontal

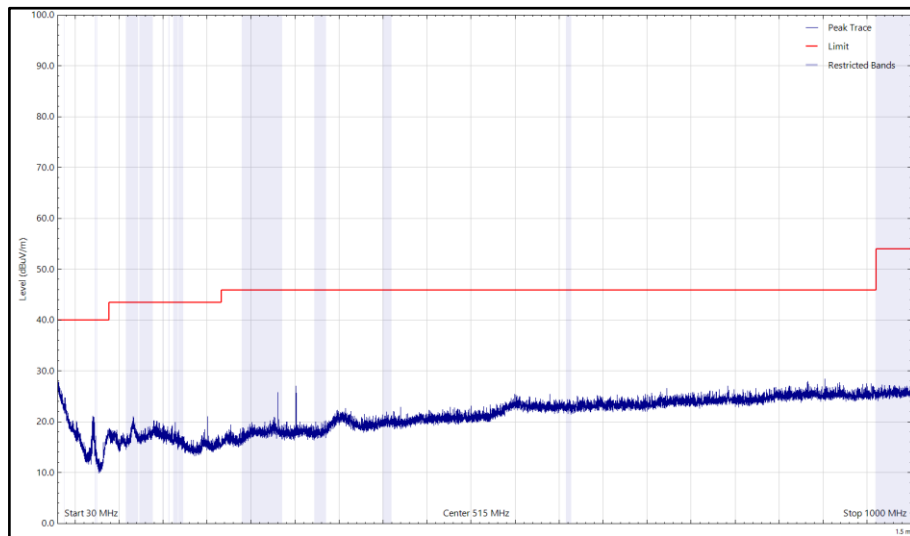


Figure 12 – 2412 MHz (CH1), HT20, CDD, Core 0 + Core 1 and U-NII-1 – 5200 MHz (CH40), HT20, CDD, Core 0 + Core 1, 30 MHz to 1 GHz, Vertical (Peak)

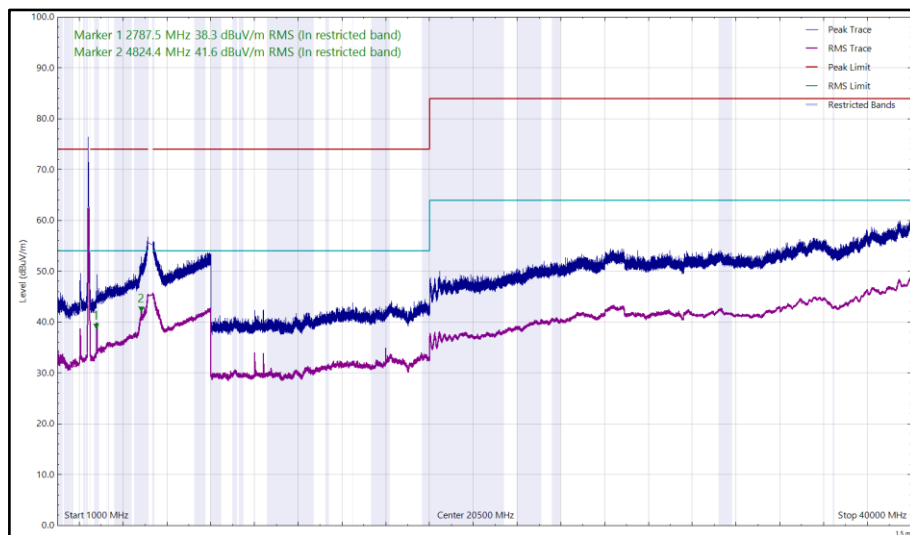


Figure 13 – 2412 MHz (CH1), HT20, CDD, Core 0 + Core 1 and U-NII-1 – 5200 MHz (CH40), HT20, CDD, Core 0 + Core 1, 1 GHz to 40 GHz, Vertical

Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
4942.119	54.2	74.0	-19.8	Peak	0	299	Vertical
4944.483	41.7	54.0	-12.3	RMS	360	254	Vertical
15984.189	35.5	54.0	-18.5	RMS	86	333	Horizontal

Table 8 – 2472 MHz (CH13), HT20, CDD, Core 0 + Core 1 and U-NII-2C – 5680 MHz (CH136), HT20, CDD, Core 0 + Core 1, 30 MHz to 40 GHz

No other emissions found within 10 dB of the limit.

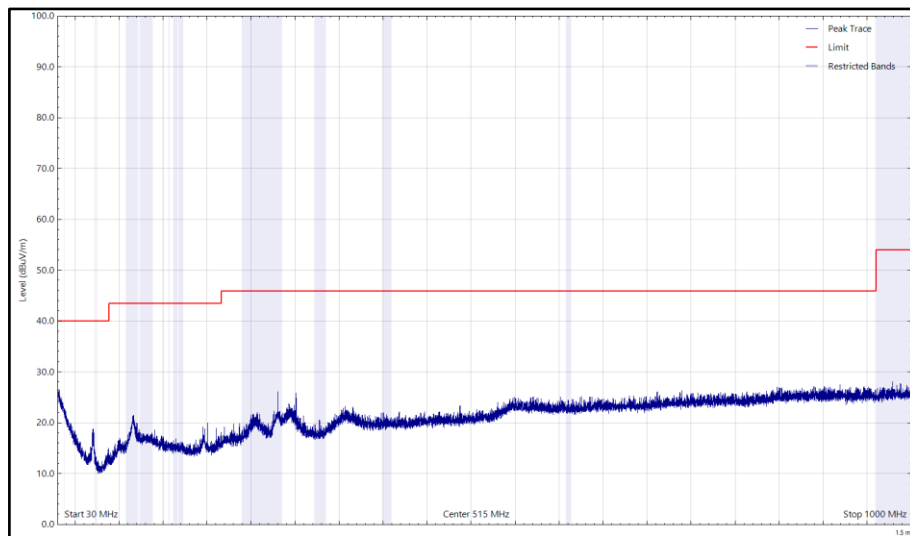


Figure 14 - 2472 MHz (CH13), HT20, CDD, Core 0 + Core 1 and U-NII-2C – 5680 MHz (CH136), HT20, CDD, Core 0 + Core 1, 30 MHz to 1 GHz, Horizontal (Peak)

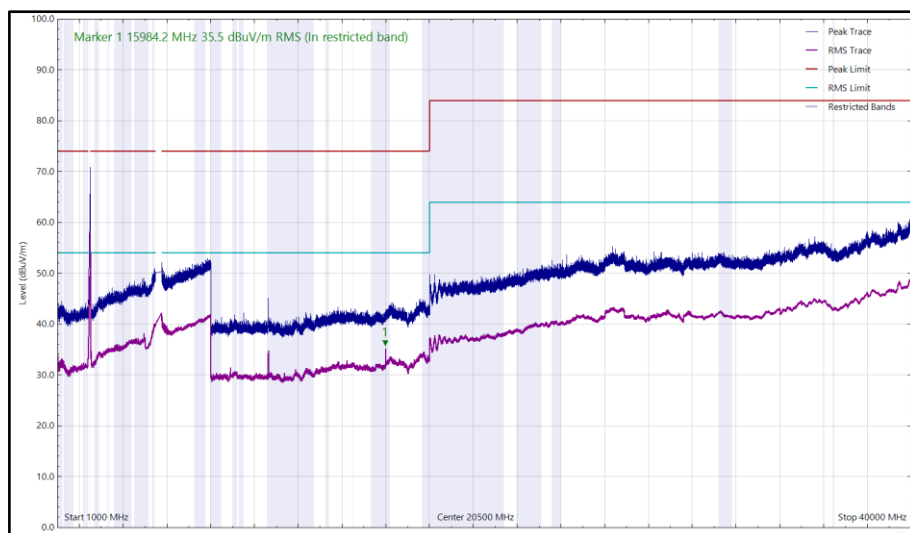


Figure 15 - 2472 MHz (CH13), HT20, CDD, Core 0 + Core 1 and U-NII-2C – 5680 MHz (CH136), HT20, CDD, Core 0 + Core 1, 1 GHz to 40 GHz, Horizontal

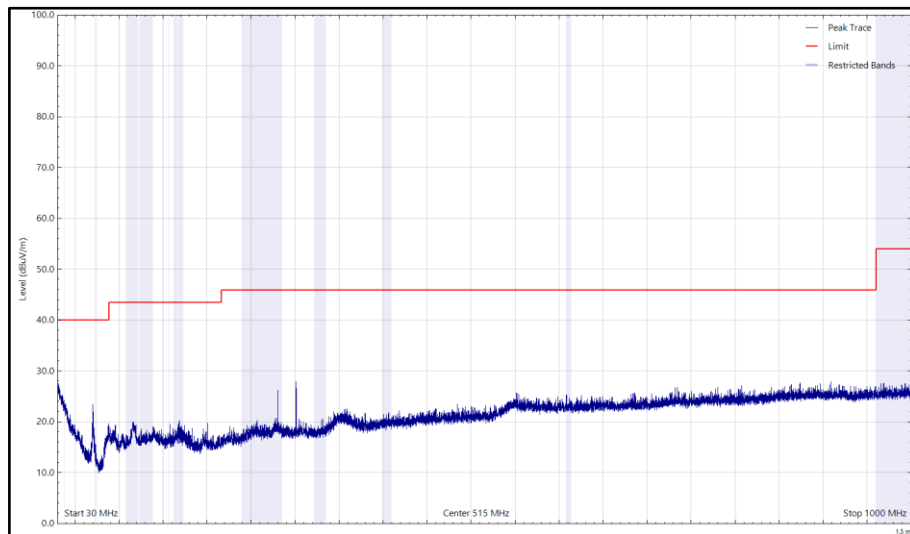


Figure 16 - 2472 MHz (CH13), HT20, CDD, Core 0 + Core 1 and U-NII-2C – 5680 MHz (CH136), HT20, CDD, Core 0 + Core 1, 30 MHz to 1 GHz, Vertical (Peak)

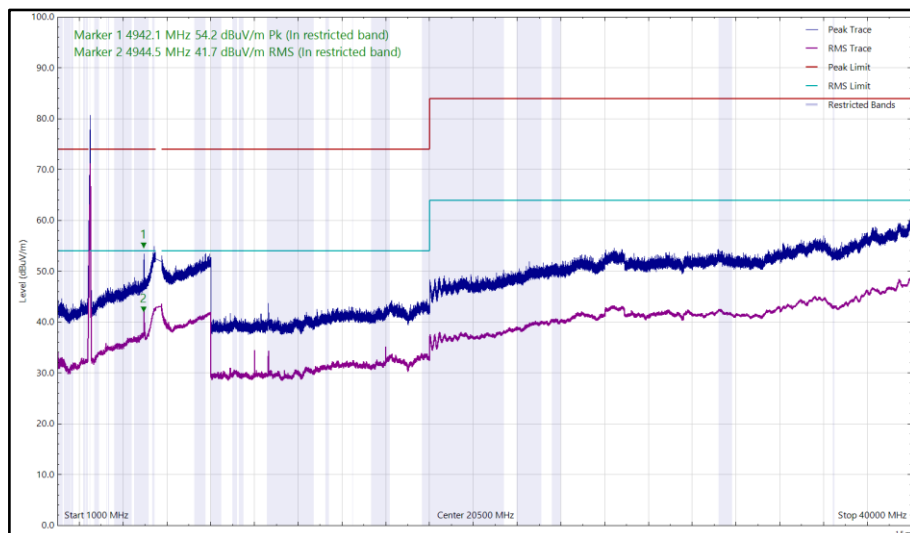


Figure 17 - 2472 MHz (CH13), HT20, CDD, Core 0 + Core 1 and U-NII-2C – 5680 MHz (CH136), HT20, CDD, Core 0 + Core 1, 1 GHz to 40 GHz, Vertical



The least stringent limit from the applicable rule parts was used to determine compliance for Radiated Emissions testing of multiple transmission sources.

FCC 47 CFR Parts 15.205, 15.247(d) and 15.407(b)

Clause	Limit
15.205	Within restricted bands of operation as listed in 15.209: 30-88 MHz: 40 dBµV/m 88-216 MHz: 43.52 dBµV/m 216-960 MHz: 46.02 dBµV/m Above 960 MHz: 53.98 dBµV/m
15.247(d)	Outside of restricted bands of operation as listed in 15.209: -20 dBc

Table 9 – FCC Emissions Limits

ISED RSS-247 Clause 5.5 and 6.2 and ISED RSS-GEN Clause 8.9

Clause	Limit
RSS-GEN Clause 8.9	Within restricted bands of operation as listed in RSS-GEN clause 8.10: 30-88 MHz: 40 dBµV/m 88-216 MHz: 43.52 dBµV/m 216-960 MHz: 46.02 dBµV/m Above 960 MHz: 53.98 dBµV/m
RSS-247 Clause 5.5	Outside of restricted bands of operation as listed in RSS-GEN clause 8.10: -20 dBc

Table 10 – ISED Emissions Limits



2.1.8 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
Programmable Power Supply	Iso-tech	IPS 2010	2437	-	O/P Mon
Antenna with permanent attenuator (Bilog)	Chase	CBL6143	2904	24	30-Sep-2021
True RMS Multimeter	Fluke	179	4007	12	29-Oct-2021
4dB Attenuator	Pasternack	PE7047-4	4935	24	30-Sep-2021
Band Reject Filter - 2.425 GHz	Wainwright	WRCGV14-2390-2400-2450-2460-50SS	5066	12	12-Oct-2021
Band Reject Filter - 2.4585 GHz	Wainwright	WRCGV14-2423.5-2433.5-2483.5-2493.5-50SS	5068	12	12-Oct-2021
Band Reject Filter - 5.22 GHz	Wainwright	WRCJV12-5120-5150-5290-5320-50SS	5072	12	02-Oct-2021
Band Reject Filter - 5.690 GHz	Wainwright	WRCJV8-5635-5670-5710-5745-50SS	5080	12	02-Oct-2021
EMI Test Receiver	Rohde & Schwarz	ESW44	5084	12	08-Mar-2022
Cable (18 GHz)	Rosenberger	LU7-071-1000	5102	12	12-Oct-2021
Cable (18 GHz)	Rosenberger	LU7-071-1000	5103	12	12-Oct-2021
Cable (18 GHz)		LU7-071-1000	5104	12	10-Dec-2021
EmX Emissions Software	TUV SUD	V2.1.11 V.V2.1.11	5125	-	Software
Screened Room (11)	Rainford	Rainford	5136	36	01-Nov-2021
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	01-Apr-2022
DRG Horn Antenna (7.5-18GHz)	Schwarzbeck	HWRD750	5216	12	01-Apr-2022
Horn Antenna (15-40GHz)	Schwarzbeck	BBHA 9170	5217	12	14-Oct-2021
Preamplifier (30dB 18-40GHz)	Schwarzbeck	BBV 9721	5218	12	14-Oct-2021
Pre Amp 1 - 26.5 GHz	Agilent Technologies	8449B	5445	12	06-May-2022
2m SMA Cable	Junkosha	MWX221-02000AMSAMS/A	5518	12	09-Apr-2022



8m N Type Cable	Junkosha	MWX221-08000NMSNMS/B	5522	12	24-Mar-2022
2m K Type Cable	Junkosha	MWX241-02000KMSKMS/A	5524	12	24-Mar-2022
3 GHz High pass Filter	Wainwright	WHKX12-2580-3000-18000-80SS	5547	12	07-May-2022
7 GHz High pass Filter	Wainwright	WHKX12-5850-6800-18000-80SS	5550	12	20-May-2022
1200 MHz Low Pass Filter (02)	Mini-Circuits	VLF-1200+	5560	12	24-May-2022
8 - 18 GHz Amplifier	Wright Technologies	APS06-0061	5595	12	25-Aug-2021
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB 40	5604	12	08-Sep-2021

Table 11

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment



3 Measurement Uncertainty

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

Test Name	Measurement Uncertainty
Radiated Spurious Emissions (Simultaneous Transmission)	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 40 GHz: ± 6.3 dB

Table 12

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.