

# FCC and ISED Test Report

Apple Inc  
Model: A2438

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

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

FCC ID: BCGA2438

IC: 579C-A2438



## COMMERCIAL-IN-CONFIDENCE

Document 75948887-14 Issue 01

SIGNATURE			
NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
Steve Marshall	Senior Engineer	Authorised Signatory	10 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 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	Ahmad Javid	10 February 2021	
Testing	Jaiyanth Balendrarajah	10 February 2021	
Testing	Mohammad Malik	10 February 2021	
Testing	Mohamud Mohamud	10 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 Parts 15: 2019, ISED RSS-247: Issue 2 (2017-02) 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	10 February 2021

**Table 1**

## 1.2 Introduction

Applicant	Apple Inc
Manufacturer	Apple Inc
Model Number(s)	A2438
Serial Number(s)	C02DM00Q087X
Hardware Version(s)	REV 1.0
Software Version(s)	20W430340t
Number of Samples Tested	1
Test Specification/Issue/Date	FCC 47 CFR Part 15: 2019 ISED RSS-247: Issue 2 (2017-02) ISED RSS-GEN: Issue 5 (04-2018) + A1 (03-2019)
Order Number	0540201117
Date	05-May-2020
Date of Receipt of EUT	11-December-2020
Start of Test	15-December-2020
Finish of Test	04-January-2021
Name of Engineer(s)	Ahmad Javid, Jaiyanth Balendrarajah, Mohammad Malik and Mohamud Mohamud
Related Document(s)	ANSI C63.4: 2009 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: 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	ANSI C63.10: 2013
Configuration and Mode: CoTX - 2.4 GHz WLAN, 5 GHz 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	ANSI C63.10: 2013

**Table 2**



**1.4 Product Information**

**1.4.1 Technical Description**

The Equipment Under Test (EUT) was a desktop 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: A2438, Serial Number: C02DM00Q087X			
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: SDB - 2.4 GHz WLAN and 5 GHz WLAN		
Radiated Spurious Emissions (Simultaneous Transmission)	Ahmad Javid, Jaiyanth Balendrarajah, Mohammad Malik and Mohamud Mohamud	UKAS
Configuration and Mode: CoTX - 2.4 GHz WLAN, 5 GHz WLAN and 2.4 GHz Bluetooth		
Radiated Spurious Emissions (Simultaneous Transmission)	Ahmad Javid, Jaiyanth Balendrarajah, Mohammad Malik and Mohamud Mohamud	UKAS

**Table 4**

Office Address:

Octagon House  
 Concorde Way  
 Segensworth North  
 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

A2438, S/N: C02DM00Q087X - Modification State 0

#### 2.1.3 Date of Test

15-December-2020 to 04-January-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 dB $\mu$ V/m to  $\mu$ V/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

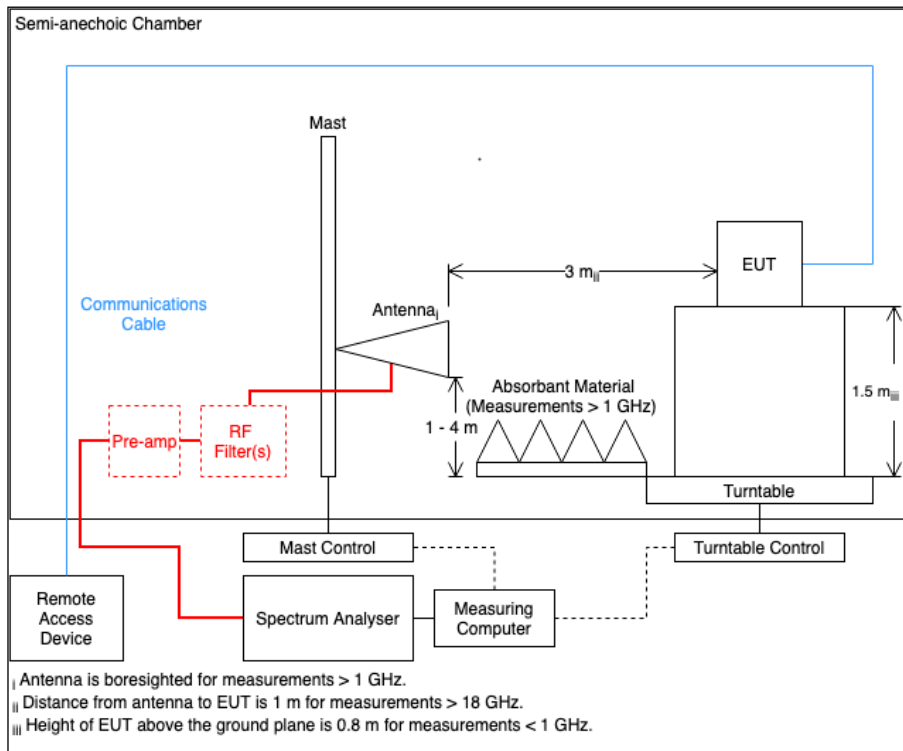


Figure 1

### 2.1.6 Environmental Conditions

Ambient Temperature	20.8 - 23.5 °C
Relative Humidity	32.8 - 51.9 %



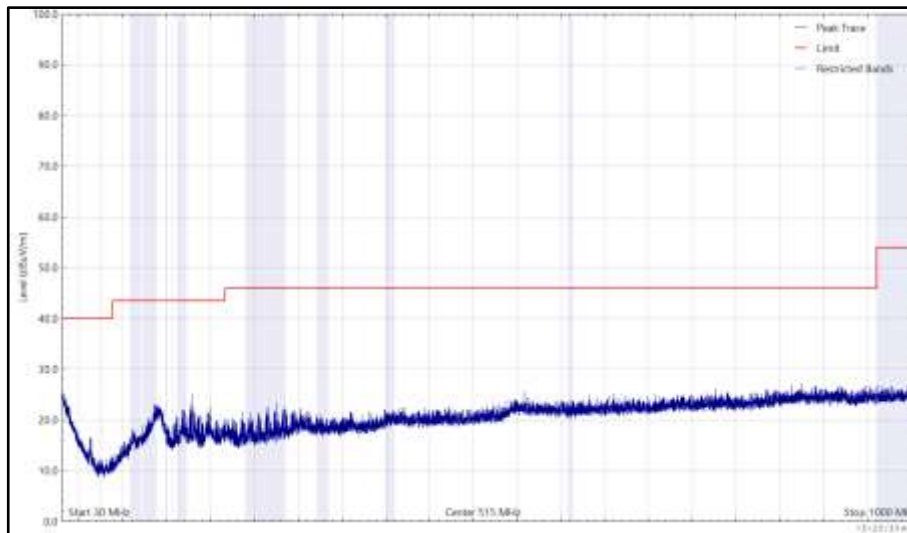
**2.1.7 Test Results**

SDB - 2.4 GHz WLAN and 5 GHz WLAN

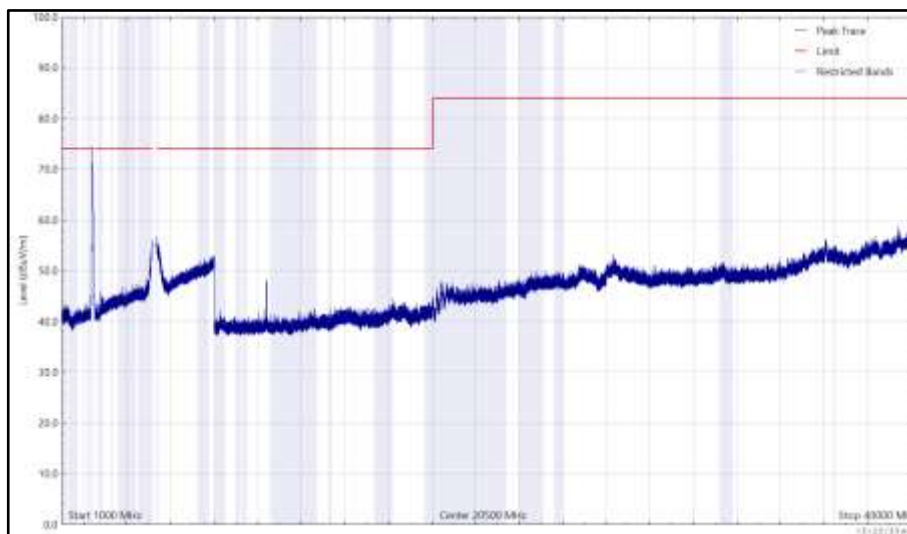
Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
2782.874	35.2	54.0	-18.8	RMS	42	106	Horizontal
4833.022	37.9	54.0	-15.7	RMS	171	204	Horizontal
4835.048	43.1	54.0	-10.5	RMS	16	191	Vertical

**Table 5 - 2417 MHz (CH2), 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 2 - 2417 MHz (CH2), 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 3 - 2417 MHz (CH2), 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 (Peak)**



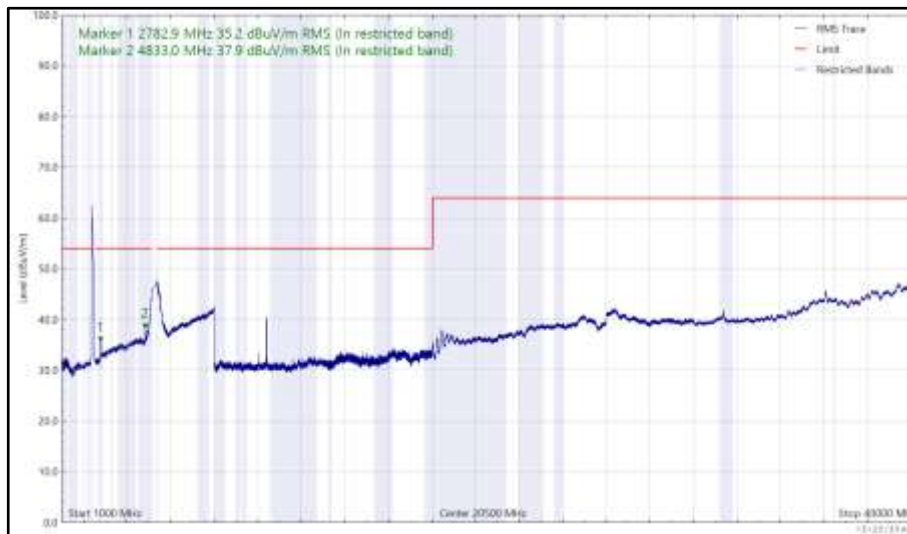


Figure 4 - 2417 MHz (CH2), HT20, CDD, Core 0 + Core 1 and U-NII-1 - 5200 MHz (CH40), HT20, CDD, Core 0 + Core 1, 1 GHz to 40 GHz, Horizontal (rms)

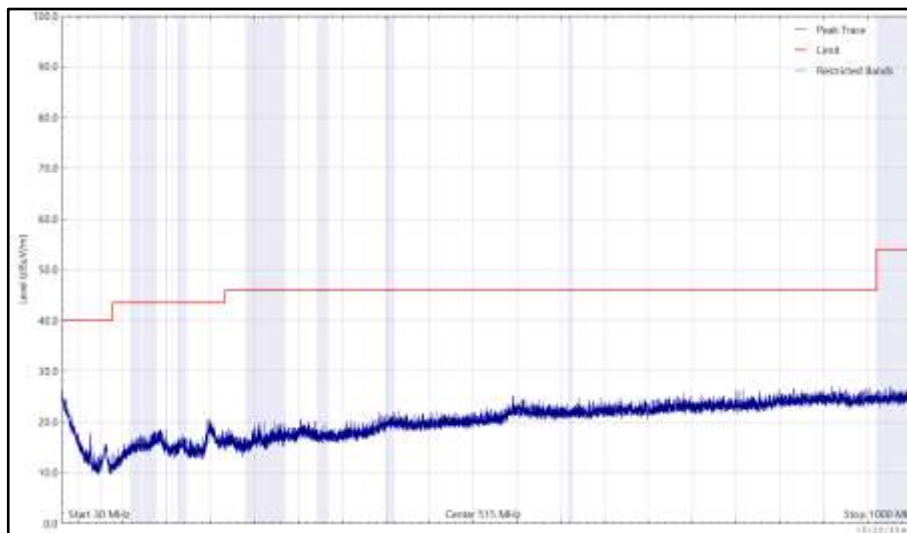


Figure 5 - 2417 MHz (CH2), HT20, CDD, Core 0 + Core 1 and U-NII-1 - 5200 MHz (CH40), HT20, CDD, Core 0 + Core 1, 30 MHz to 1 GHz, Vertical (Peak)

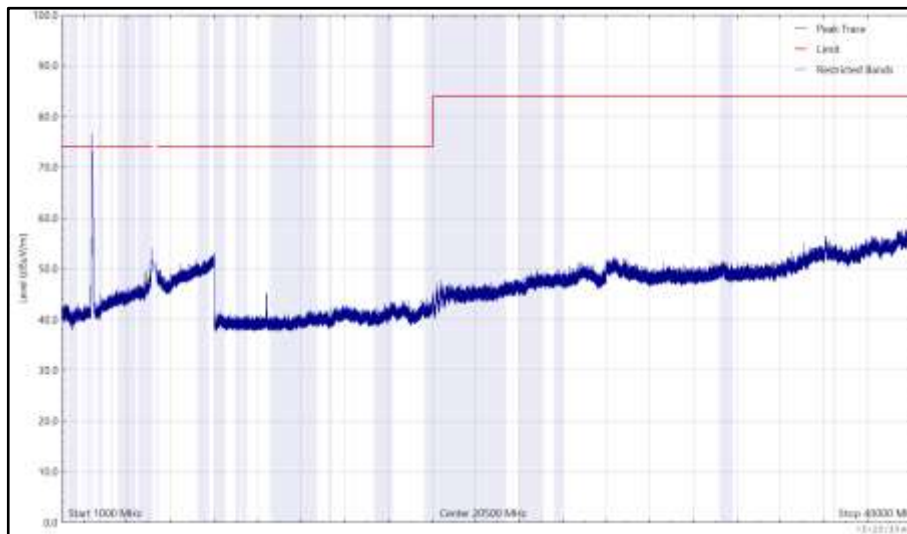


Figure 6 - 2417 MHz (CH2), HT20, CDD, Core 0 + Core 1 and U-NII-1 - 5200 MHz (CH40), HT20, CDD, Core 0 + Core 1, 1 GHz to 40 GHz, Vertical (Peak)

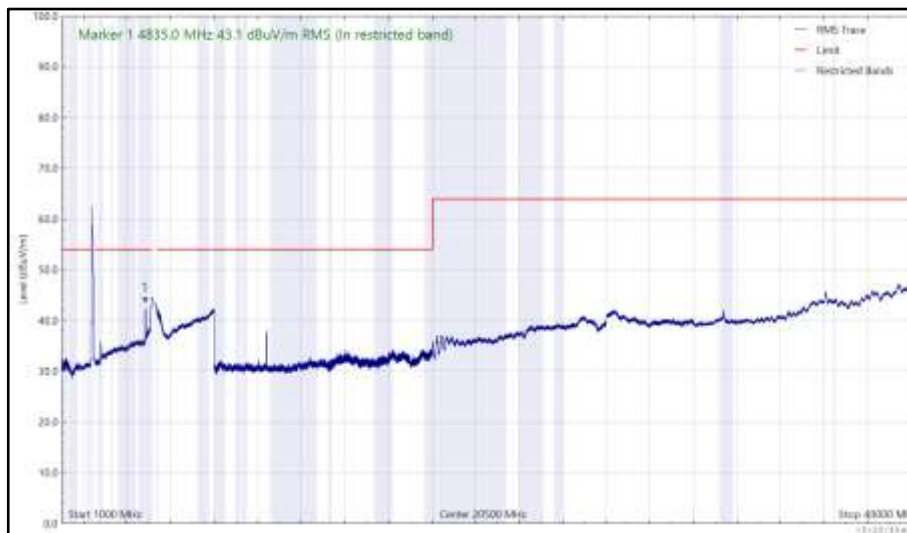


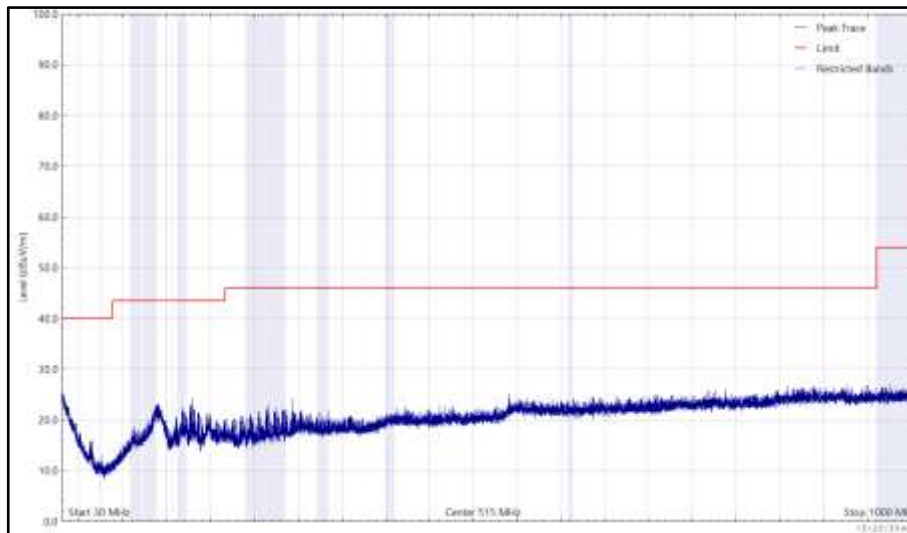
Figure 7 - 2417 MHz (CH2), HT20, CDD, Core 0 + Core 1 and U-NII-1 - 5200 MHz (CH40), HT20, CDD, Core 0 + Core 1, 1 GHz to 40 GHz, Vertical (rms)



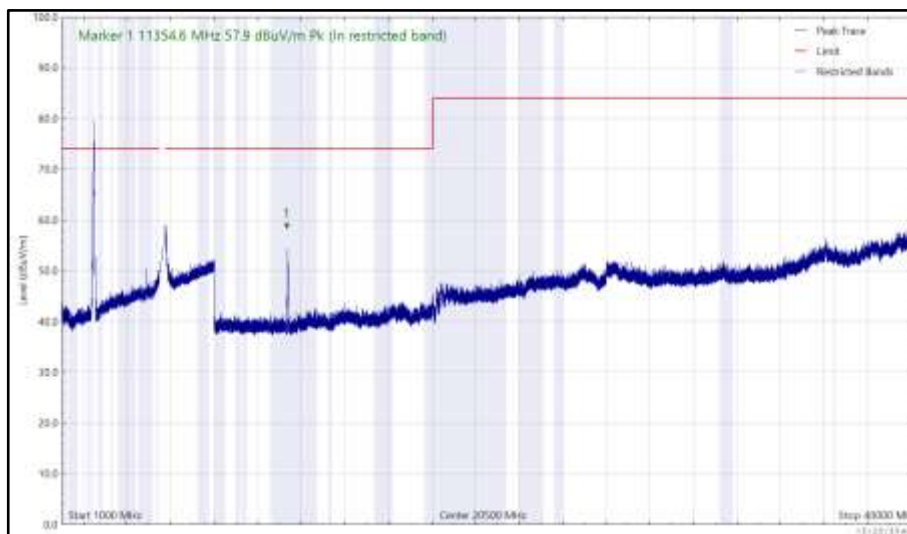
Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
4905.031	38.6	54.0	-15.0	RMS	150	100	Horizontal
4905.163	43.9	54.0	-9.7	RMS	19	110	Vertical
11354.557	57.9	74.0	-16.1	Peak	240	100	Horizontal
11361.141	46.0	54.0	-7.6	RMS	253	100	Horizontal
11361.328	42.0	54.0	-11.6	RMS	147	105	Vertical
11361.572	55.2	74.0	-18.4	Peak	156	100	Vertical

**Table 6 - 2452 MHz (CH9), 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 8 - 2452 MHz (CH9), 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 9 - 2452 MHz (CH9), 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 (Peak)**

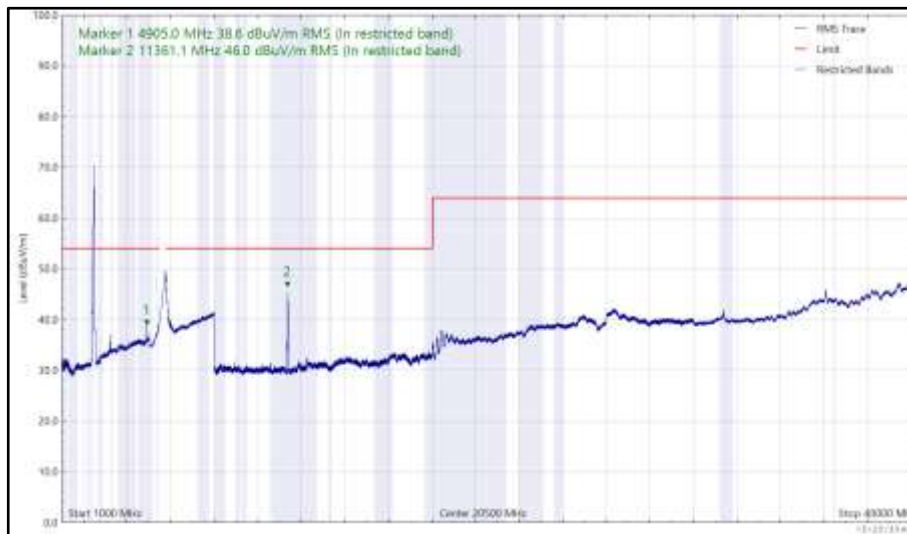


Figure 10 - 2452 MHz (CH9), HT20, CDD, Core 0 + Core 1 and U-NII-2C - 5680 MHz (CH136), HT20, CDD, Core 0 + Core 1, 1 GHz to 40 GHz, Horizontal (rms)

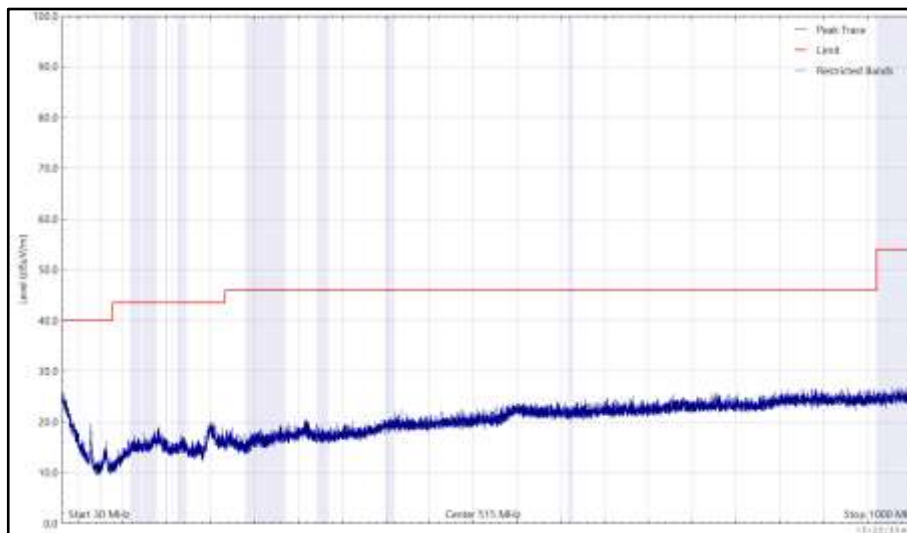


Figure 11 - 2452 MHz (CH9), HT20, CDD, Core 0 + Core 1 and U-NII-2C - 5680 MHz (CH136), HT20, CDD, Core 0 + Core 1, 30 MHz to 1 GHz, Vertical (Peak)

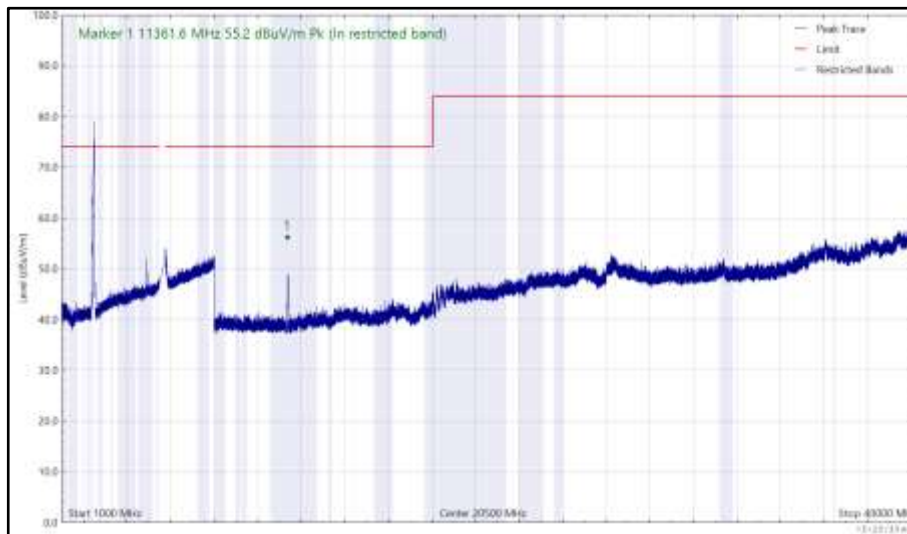


Figure 12 - 2452 MHz (CH9), HT20, CDD, Core 0 + Core 1 and U-NII-2C - 5680 MHz (CH136), HT20, CDD, Core 0 + Core 1, 1 GHz to 40 GHz, Vertical (Peak)

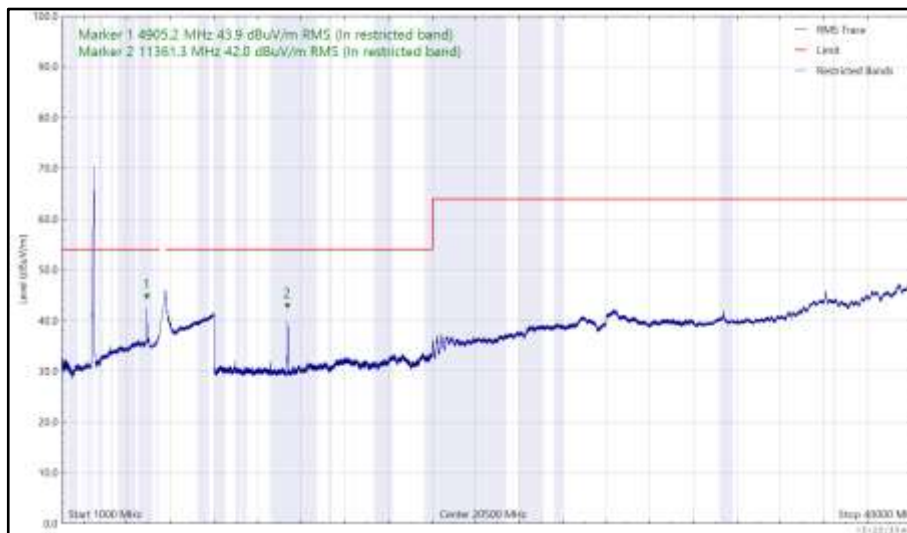


Figure 13 - 2452 MHz (CH9), HT20, CDD, Core 0 + Core 1 and U-NII-2C - 5680 MHz (CH136), HT20, CDD, Core 0 + Core 1, 1 GHz to 40 GHz, Vertical (rms)

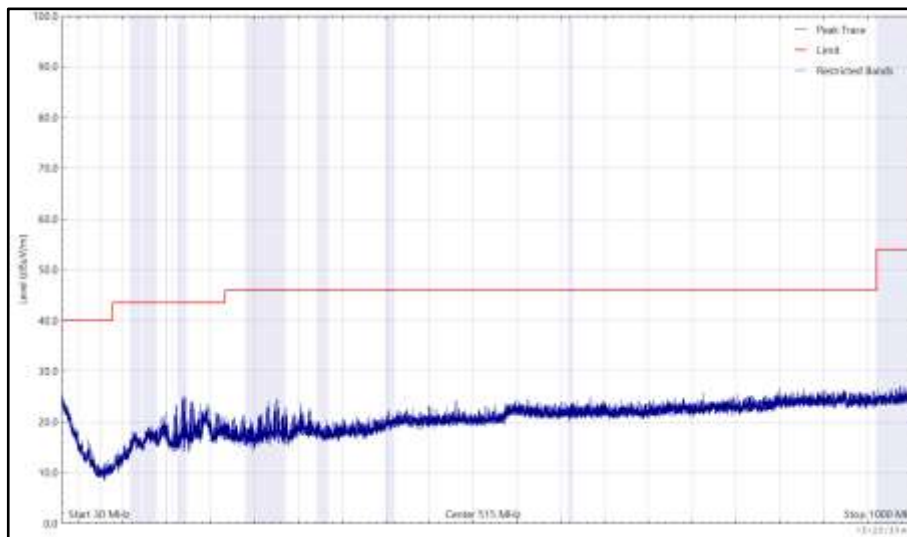


CoTX - 2.4 GHz WLAN and 5 GHz WLAN and 2.4 GHz Bluetooth

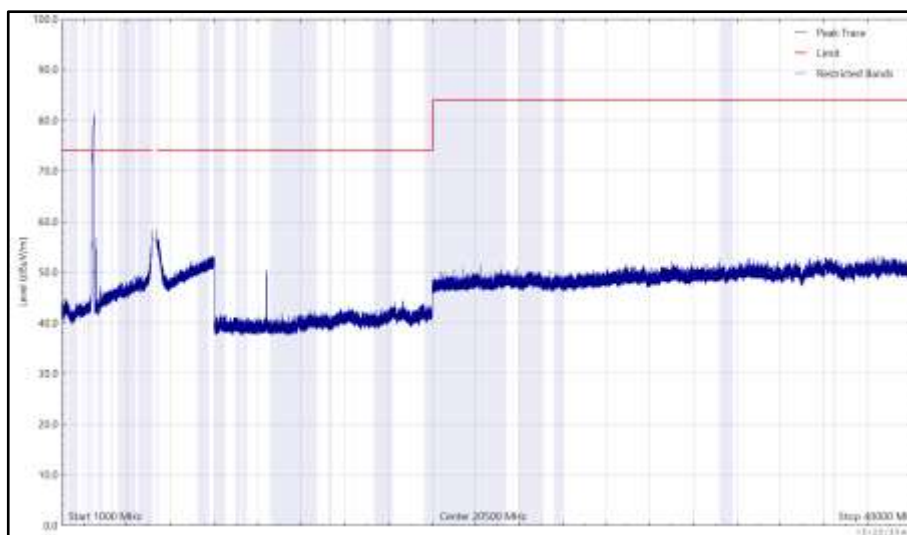
Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
4842.876	39.7	54.0	-13.9	RMS	19	169	Vertical

**Table 7 - 2417 MHz (CH2), HT20, Core 0 + Core 1 and U-NII-1 - 5200 MHz (CH40), HT20, Core 0 + Core 1 and 2480 MHz (CH78), DH5, iPA, Core 2, 1 to 40 GHz**

No other emissions found within 10 dB of the limit.



**Figure 14 - 2417 MHz (CH2), HT20, Core 0 + Core 1 and U-NII-1 - 5200 MHz (CH40), HT20, Core 0 + Core 1 and 2480 MHz (CH78), DH5, iPA, Core 2, 30 MHz to 1 GHz, Horizontal (Peak)**



**Figure 15 - 2417 MHz (CH2), HT20, Core 0 + Core 1 and U-NII-1 - 5200 MHz (CH40), HT20, Core 0 + Core 1 and 2480 MHz (CH78), DH5, iPA, Core 2, 1 GHz to 40 GHz, Horizontal (Peak)**

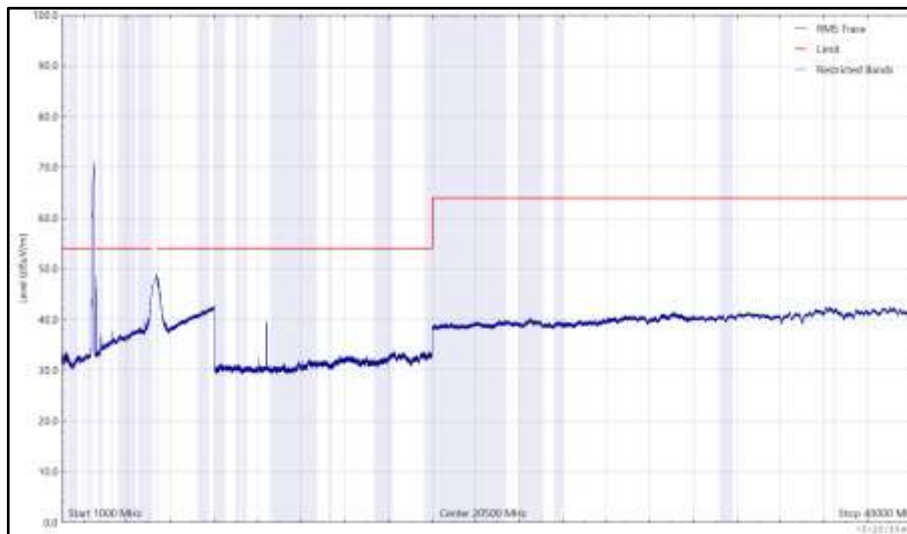


Figure 16 - 2417 MHz (CH2), HT20, Core 0 + Core 1 and U-NII-1 - 5200 MHz (CH40), HT20, Core 0 + Core 1 and 2480 MHz (CH78), DH5, iPA, Core 2, 1 GHz to 40 GHz, Horizontal (rms)

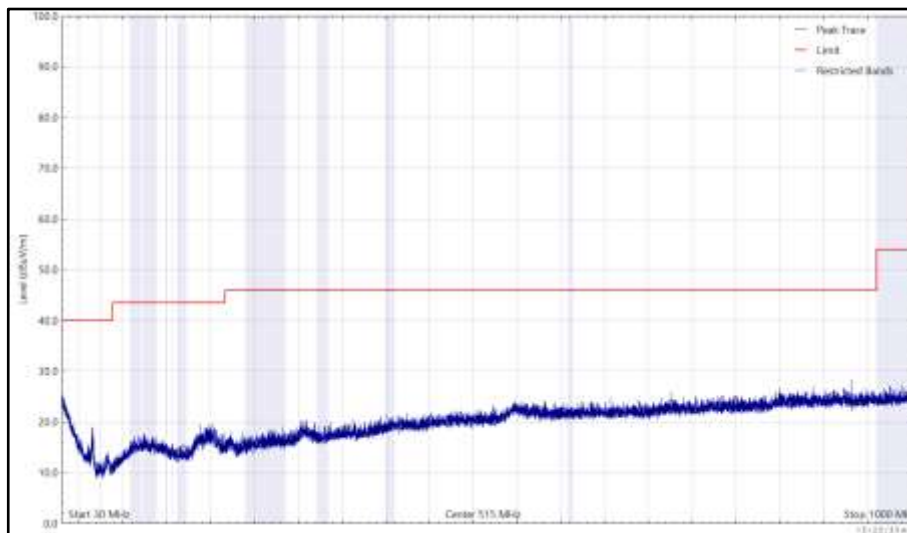


Figure 17 - 2417 MHz (CH2), HT20, Core 0 + Core 1 and U-NII-1 - 5200 MHz (CH40), HT20, Core 0 + Core 1 and 2480 MHz (CH78), DH5, iPA, Core 2, 30 MHz to 1 GHz, Vertical (Peak)

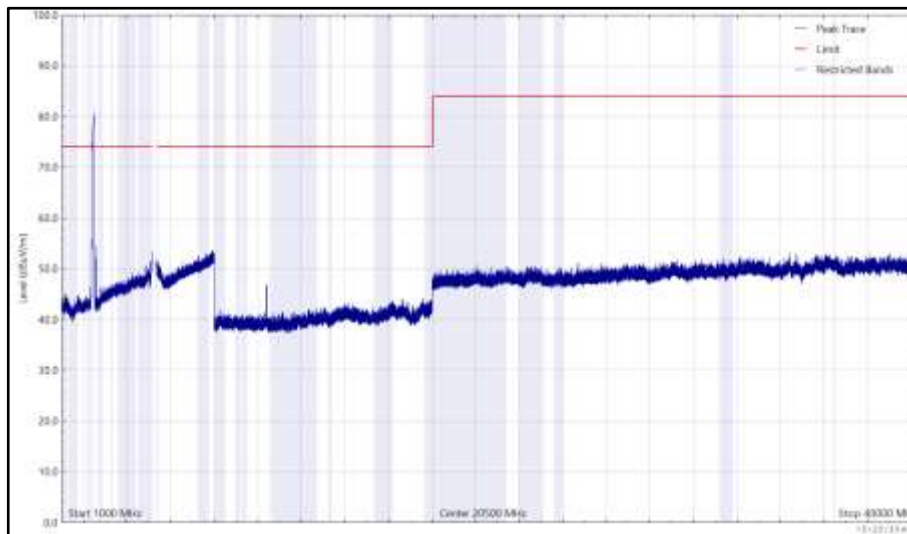


Figure 18 - 2417 MHz (CH2), HT20, Core 0 + Core 1 and U-NII-1 - 5200 MHz (CH40), HT20, Core 0 + Core 1 and 2480 MHz (CH78), DH5, iPA, Core 2, 1 GHz to 40 GHz, Vertical (Peak)

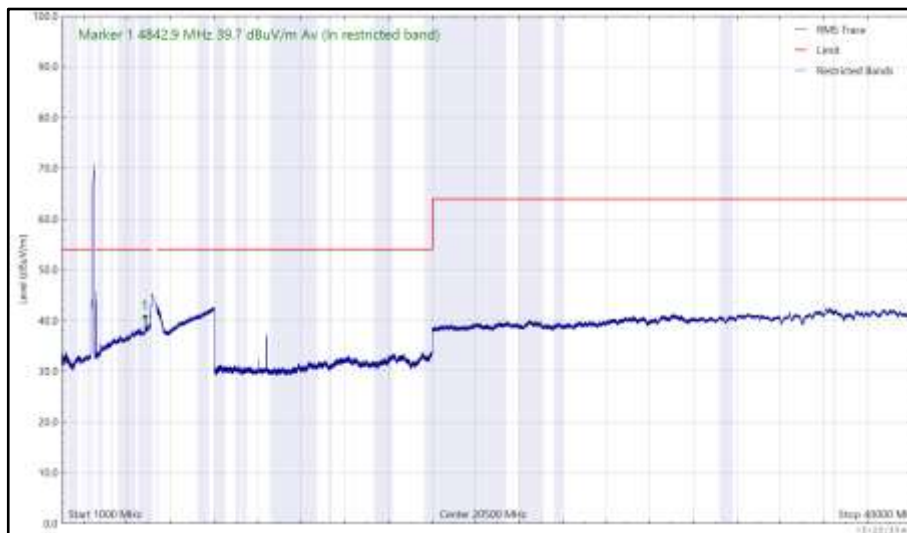


Figure 19 - 2417 MHz (CH2), HT20, Core 0 + Core 1 and U-NII-1 - 5200 MHz (CH40), HT20, Core 0 + Core 1 and 2480 MHz (CH78), DH5, iPA, Core 2, 1 GHz to 40 GHz, Vertical (rms)

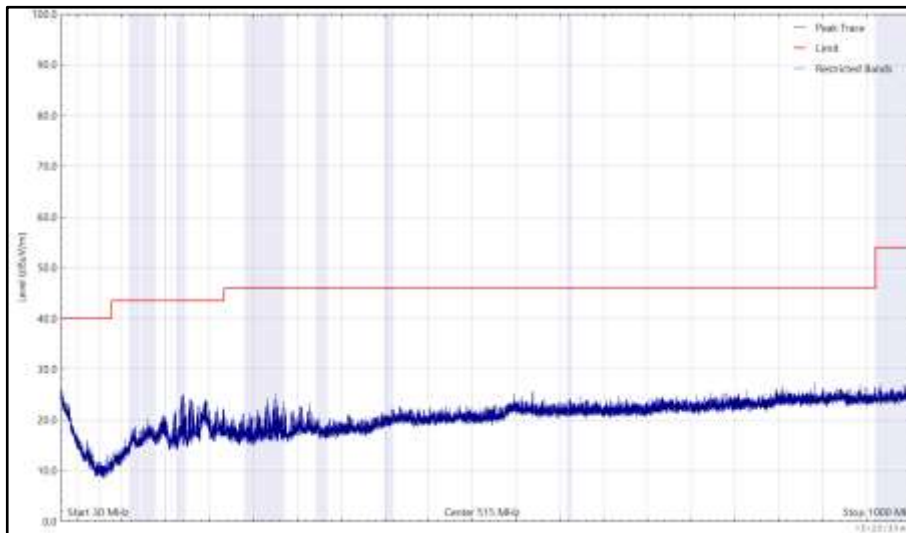




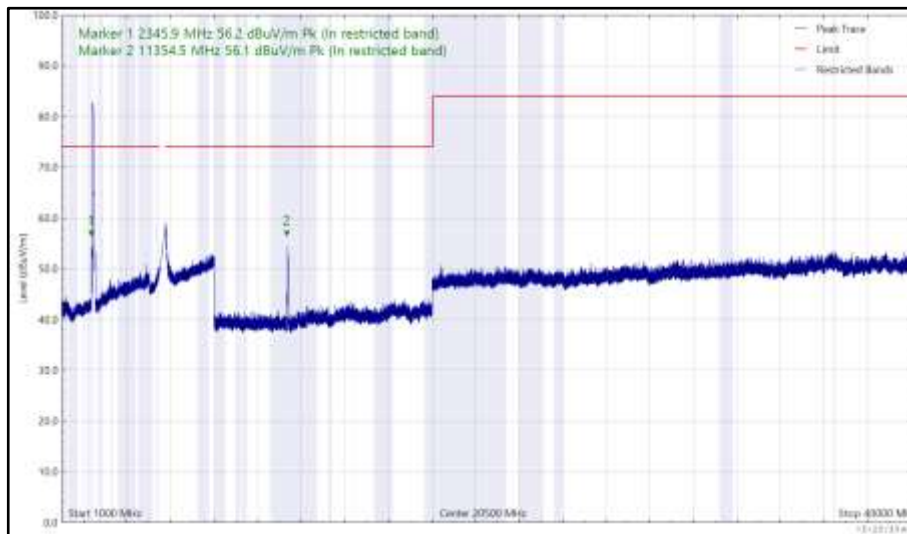
Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
2345.944	56.2	74.0	-17.9	Peak	54	169	Horizontal
2349.181	41.2	54.0	-12.4	RMS	57	196	Horizontal
2356.215	36.5	54.0	-17.1	RMS	301	148	Vertical
4902.755	37.1	54.0	-16.5	RMS	156	110	Horizontal
4907.607	40.1	54.0	-13.5	RMS	RMS	101	Vertical
11354.456	56.1	74.0	-17.9	Peak	238	100	Horizontal
11361.011	43.1	54.0	-10.6	RMS	158	106	Vertical
11361.135	44.4	54.0	-9.3	RMS	199	249	Horizontal
11361.701	55.6	74.0	-18.4	Peak	158	102	Vertical

**Table 8 - 2452 MHz (CH9), HT20, Core 0 + Core 1 and U-NII-2C - 5680 MHz (CH136), HT20, Core 0 + Core 1 and 2402 MHz (CH0), DH5, iPA, Core 2, 1 to 40 GHz**

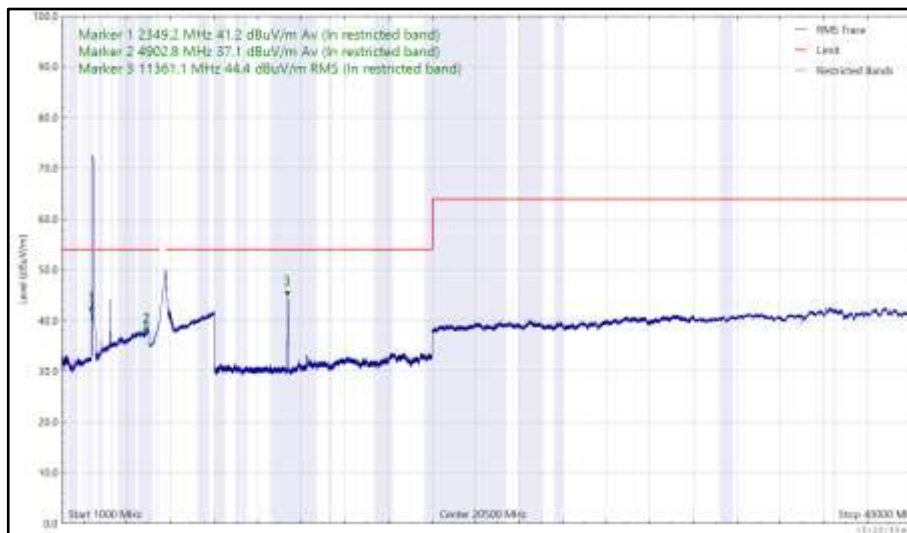
No other emissions found within 10 dB of the limit.



**Figure 20 - 2452 MHz (CH9), HT20, Core 0 + Core 1 and U-NII-2C - 5680 MHz (CH136), HT20, Core 0 + Core 1 and 2402 MHz (CH0), DH5, iPA, Core 2, 30 MHz to 1 GHz, Horizontal (Peak)**



**Figure 21 - 2452 MHz (CH9), HT20, Core 0 + Core 1 and U-NII-2C - 5680 MHz (CH136), HT20, Core 0 + Core 1 and 2402 MHz (CH0), DH5, iPA, Core 2, 1 GHz to 40 GHz, Horizontal (Peak)**



**Figure 22 - 2452 MHz (CH9), HT20, Core 0 + Core 1 and U-NII-2C - 5680 MHz (CH136), HT20, Core 0 + Core 1 and 2402 MHz (CH0), DH5, iPA, Core 2, 1 GHz to 40 GHz, Horizontal (rms)**

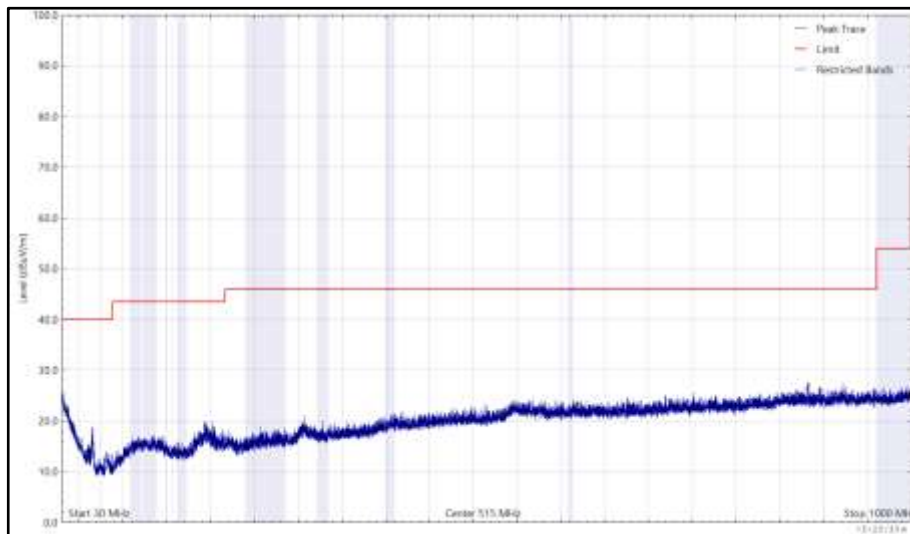


Figure 23 - 2452 MHz (CH9), HT20, Core 0 + Core 1 and U-NII-2C - 5680 MHz (CH136), HT20, Core 0 + Core 1 and 2402 MHz (CH0), DH5, iPA, Core 2, 30 MHz to 1 GHz, Vertical (Peak)

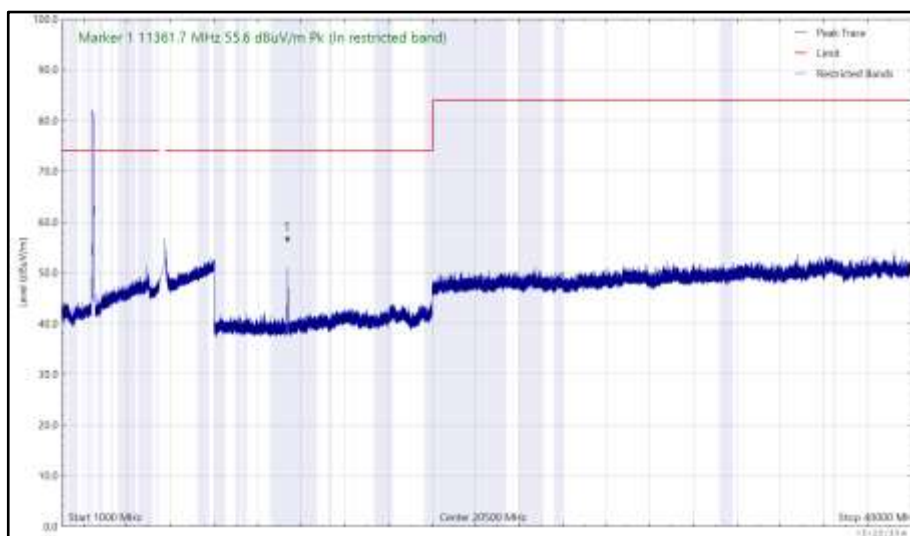
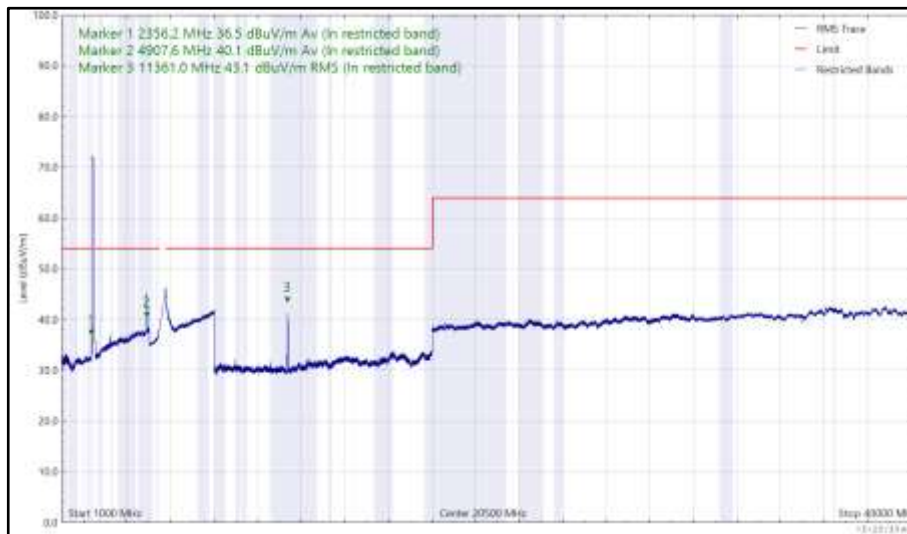


Figure 24 - 2452 MHz (CH9), HT20, Core 0 + Core 1 and U-NII-2C - 5680 MHz (CH136), HT20, Core 0 + Core 1 and 2402 MHz (CH0), DH5, iPA, Core 2, 1 GHz to 40 GHz, Vertical (Peak)



**Figure 25 - 2452 MHz (CH9), HT20, Core 0 + Core 1 and U-NII-2C - 5680 MHz (CH136), HT20, Core 0 + Core 1 and 2402 MHz (CH0), DH5, iPA, Core 2, 1 GHz to 40 GHz, Vertical (rms)**

Limit Clauses

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

Specification and Clause	Limit
FCC Part 15.247 (d)	-20 dBc
FCC Part 15.407 (b)	-27 dBm (EIRP) / 68.2 dB $\mu$ V/m at 3 m
FCC Part 15.209 (Within restricted bands listed in 15.205)	Peak: 74 dB $\mu$ V/m at 3 m Average 54 dB $\mu$ V/m at 3 m
ISED RSS-247, Clause 5.5	-20 dBc
ISED RSS-247, Clause 6.2	-27 dBm (EIRP) / 68.2 dB $\mu$ V/m at 3 m
ISED RSS-GEN, Clause 8.9 (Within restricted bands listed in clause 8.8)	Peak: 74 dB $\mu$ V/m at 3 m Average 54 dB $\mu$ V/m at 3 m

**Table 9**



### 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 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
18GHz - 40GHz Pre-Amplifier	Phase One	PSO4-0087	1534	12	18-Feb-2021
Cable 1503 2M 2.92(P)m 2.92(P)m	Rhophase	KPS-1503A-2000-KPS	4293	12	16-Nov-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
Cable (18 GHz)	Rosenberger	LU7-071-1000	5102	12	12-Oct-2021
Cable (18 GHz)	Rosenberger	LU7-071-1000	5103	12	12-Oct-2021
EmX Emissions Software	TUV SUD	V2.1.0	5125	-	Software
Screened Room (11)	Rainford	Rainford	5136	36	01-Nov-2021
Horn Antenna (1-10GHz)	Schwarzbeck	BBHA 9120 B	5215	12	10-Mar-2021
DRG Horn Antenna (7.5-18GHz)	Schwarzbeck	HWRD750	5216	12	10-Mar-2021
Pre Amp 1 - 26.5 GHz	Agilent Technologies	8449B	5445	12	06-May-2021
1m K-Type Cable	Junkosha	MWX241-01000KMSKMS/A	5512	12	03-Apr-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
3 GHz High pass Filter	Wainwright	WHKX12-2580-3000-18000-80SS	5547	12	05-May-2021
7 GHz High pass Filter	Wainwright	WHKX12-5850-6800-18000-80SS	5550	12	23-May-2021
1200 MHz Low Pass Filter (02)	Mini-Circuits	VLF-1200+	5560	12	23-May-2021
8 - 18 GHz Amplifier	Wright Technologies	APS06-0061	5595	12	25-Aug-2021

Table 10



### 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: $\pm 5.2$ dB 1 GHz to 40 GHz: $\pm 6.3$ dB

**Table 11**

#### 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.