FCC and ISED Test Report

Apple Inc
Model: A2438

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

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

FCC ID: BCGA2438 IC: 579C-A2438

COMMERCIAL-IN-CONFIDENCE

Document 75948887-11 Issue 01

SIGNATURE			
NAME	**JOB TITLE**	**RESPONSIBLE FOR**	**ISSUE DATE**
Phil Harrison	Senior Engineer	Authorised Signatory	11 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	Mohamud Mohamud	11 February 2021	
Testing	Aasim Butt	11 February 2021	
Testing	Ahmad Javid	11 February 2021	
Testing	Mohammad Malik	11 February 2021	
Testing	George Porter	11 February 2021	
Testing	Jaiyanth Balendrarajah	11 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	11 February 2021

Table 1

1.2 Introduction

Applicant	Apple Inc
Manufacturer	Apple Inc
Model Number(s)	A2438
Serial Number(s)	C02DM00V087Y and C02DM00Q087X
Hardware Version(s)	REV 1.0
Software Version(s)	20W430340t
Number of Samples Tested	2
Test Specification/Issue/Date	FCC 47 CFR Part 15C: 2019 ISED RSS-247: Issue 2 (02-2017) ISED RSS-GEN: Issue 5 (04-2018) + A1 (03-2019)
Order Number Date	0540201117 05-May-2020
Date of Receipt of EUT	02-October-2020
Start of Test	02-October-2020
Finish of Test	13-January-2021
Name of Engineer(s)	Mohamud Mohamud, George Porter, Aasim Butt, Jaiyanth Balendrarajah, Ahmad Javid, Mohammad Malik
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, ISED RSS-247 and ISED RSS-GEN is shown below.

Section	Specification Clause			Test Description	Result	Comments/Base Standard
	Part 15C	RSS-247	RSS-GEN			
Configuration and Mode: 2.4 GHz WLAN						
-	15.203	-	-	Antenna Requirement	N/T	The device complies with the provisions of this section, as it uses a permanently attached integral antenna.
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	15.247 (d)	5.5	-	Authorised Band Edges	Pass	
2.5	15.205	-	8.10	Restricted Band Edges	Pass	
2.6	15.247 (d) and 15.205	3.3	6.13	Spurious Radiated Emissions	Pass	

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.

1.4.2 Test Modes

The 2.4 GHz 802.11 radio supports SISO and 2x2 MIMO. 802.11b and 802.11g only supports SISO operation. 802.11n and 802.11ax are supported for both SISO and 2x2 MIMO at 20 MHz channel bandwidths only. 802.11ax supports Single User (SU) and Multi-User MIMO (MU-MIMO) modes. MU-MIMO modes support Resource Unit (RU) sizes of 26/52/106/242 subcarriers.

The EUT uses different output powers per core dependent on how many cores are used. It uses the same conducted power across all cores in any given mode, but due to the different antenna gains the radiated power per core differs.

After preliminary investigations were performed, the EUT was therefore tested in the following worst-case modes:

- SISO Modes (Core 1):
  - 802.11b 1 Mbps
  - 802.11g 6 Mbps
  - 802.11n HT20 MCS7
  - 802.11ax HE20 MCS7x1 SU & MU

- 2x2 MIMO Modes (Core 0 + Core 1):
  - 802.11n HT20 MCS7 - CDD
  - 802.11ax HE20 MCS7x1 SU & MU - CDD

For 802.11ax modes, only SU modes (highest power) are reported for Output Power. For Bandwidth tests, only SU modes (widest BW) and MU-MIMO with 26 subcarriers (narrowest) are reported. For Power Spectral Density (PSD), RU sizes of 26 to 106 subcarriers are reported.

1.4.3 Test Set-up

For conducted tests the EUT antennas were disconnected and replaced with U.FL to SMA test cables to enable conducted testing on each core. The loss of these test cables were known and compensated for in any conducted measurements.

For all tests, the EUT was put into a continuous transmit test mode with the chipset manufacturer's test commands via a script running in the EUTs terminal application. The EUT then transmitted the required type of packeted 802.11 data frames of fixed length, containing the standard headers and with pseudo-random data content, ensuring the measured signals were representative and contained all the symbols at the highest power control level.

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

1.4.4 Antenna Gain Table (2.4GHz WLAN)

Antenna Port	Frequency Range (MHz)	Peak Gain (dBi)	Conducted Cable Loss (dB)
Core 0	2400 - 2480	0.70	1.90
Core 1	2400 - 2480	2.50	1.90

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: A2438, Serial Number: C02DM00V087Y			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: A2438, Serial Number: C02DM00Q087X			
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 WLAN		
Maximum Conducted Output Power	George Porter	UKAS
Power Spectral Density	George Porter	UKAS
Emission Bandwidth	George Porter	UKAS
Authorised Band Edges	Mohamud Mohamud, Aasim Butt, Ahmad Javid and Mohammad Malik	UKAS
Restricted Band Edges	Mohamud Mohamud, Aasim Butt, Ahmad Javid and Mohammad Malik	UKAS
Spurious Radiated Emissions	Mohamud Mohamud, George Porter, Aasim Butt, Jaiyanth Balendrarajah, Ahmad Javid, 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

A2438, S/N: C02DM00V087Y - Modification State 0

2.1.3 Date of Test

18-December-2020 to 13-January-2021

2.1.4 Test Method

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

The output power was verified as being the same from each transmit core, but the antenna gains were not identical, therefore the modes reported for SISO operation are those giving the highest EIRP and/or lowest conducted limit based on the antenna giving highest directional gain.

MIMO output port summing was performed in accordance with KDB 662911 D01. Directional Gain was calculated in accordance with clause F)2)f)(ii) using the calculations from F)2)f)(i) with worst-case individual gain and an array gain of zero.

2.1.5 Environmental Conditions

Ambient Temperature	20.9 - 26.4 °C
Relative Humidity	22.4 - 50.1 %

2.1.6 Test Results

2.4 GHz WLAN

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
Antenna Directional Gain (dBi)	2.50	2.50	2.50
15.247 Conducted Power Limit (dBm)	30.00	30.00	30.00
RSS-247 Conducted Power Limit (dBm)	30.00	30.00	30.00
Conducted Power (dBm)	18.67	21.83	11.79
RSS-247 EIRP Limit (dBm)	36.00	36.00	36.00
EIRP Power (dBm)	21.17	24.33	14.29

Table 6 - 802.11b / 1 Mbps / SISO / Core 1

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
Antenna Directional Gain (dBi)	2.50	2.50	2.50
15.247 Conducted Power Limit (dBm)	30.00	30.00	30.00
RSS-247 Conducted Power Limit (dBm)	30.00	30.00	30.00
Conducted Power (dBm)	14.36	21.87	2.83
RSS-247 EIRP Limit (dBm)	36.00	36.00	36.00
EIRP Power (dBm)	16.86	24.37	5.33

Table 7 - 802.11g / 6 Mbps / SISO / Core 1

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
Antenna Directional Gain (dBi)	2.50	2.50	2.50
15.247 Conducted Power Limit (dBm)	30.00	30.00	30.00
RSS-247 Conducted Power Limit (dBm)	30.00	30.00	30.00
Conducted Power (dBm)	14.35	21.76	2.58
RSS-247 EIRP Limit (dBm)	36.00	36.00	36.00
EIRP Power (dBm)	16.85	24.26	5.08

Table 8 - 802.11n / HT20 MCS7 / SISO / Core 1

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
Conducted Power Core 0 (dBm)	14.37	21.75	2.47
Conducted Power Core 1 (dBm)	14.44	21.86	2.12
Antenna Directional Gain (dBi)	2.50	2.50	2.50
15.247 Conducted Power Limit (dBm)	30.00	30.00	30.00
RSS-247 Conducted Power Limit (dBm)	30.00	30.00	30.00
Total Conducted Power (dBm)	17.42	24.82	5.31
RSS-247 EIRP Limit (dBm)	36.00	36.00	36.00
EIRP Power (dBm)	19.92	27.32	7.81

Table 9 - 802.11n / HT20 MCS7 / MIMO CDD / Cores 0+1

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
Antenna Directional Gain (dBi)	2.50	2.50	2.50
15.247 Conducted Power Limit (dBm)	30.00	30.00	30.00
RSS-247 Conducted Power Limit (dBm)	30.00	30.00	30.00
Conducted Power (dBm)	14.15	21.78	2.69
RSS-247 EIRP Limit (dBm)	36.00	36.00	36.00
EIRP Power (dBm)	16.65	24.28	5.19

Table 10 - 802.11ax / HE20 MCS7x1 / SU / SISO / Core 1

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
Conducted Power Core 0 (dBm)	14.18	21.68	2.39
Conducted Power Core 1 (dBm)	14.49	21.65	2.28
Antenna Directional Gain (dBi)	2.50	2.50	2.50
15.247 Conducted Power Limit (dBm)	30.00	30.00	30.00
RSS-247 Conducted Power Limit (dBm)	30.00	30.00	30.00
Total Conducted Power (dBm)	17.35	24.68	5.35
RSS-247 EIRP Limit (dBm)	36.00	36.00	36.00
EIRP Power (dBm)	19.85	27.18	7.85

Table 11 - 802.11ax / HE20 MCS7x1 / SU / MIMO CDD / Cores 0+1

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.

2.1.7 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
1800-6000 MHz Power Splitter	Mini-Circuits	ZN2PD-63-S+	4055	-	O/P Mon
1 Metre SMA Cable	Rhophase	3PS-1801A-1000-3PS	4099	12	22-Jun-2021
USB Power Sensor	Boonton	RTP5006	5186	12	02-Dec-2021
AC Programmable Power Supply	iTech	IT7324	5227	-	O/P Mon
USB Power Sensor	Boonton	RTP5006	5280	12	27-Apr-2021
Cable 2.92m	Junkosha	MWX241/B	5411	12	22-Jun-2021
3.5 mm 1m Cable	Junkosha	MWX221-01000DMS	5417	12	22-Jun-2021
3.5 mm 1m Cable	Junkosha	MWX221-01000DMS	5418	12	22-Jun-2021
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5430	12	22-Jun-2021
10dB/5W Attenuator	Aaren	AT40A-404-D18-10	5486	12	14-Apr-2021
Attenuator 5W 10dB DC-18GHz	Aaren	AT40A-4041-D18-10	5487	12	14-Apr-2021
Attenuator 2W 10dB DC-10GHz	Telegartner	J01156A0031	5575	-	O/P Mon
Attenuator 2W 10dB DC-10GHz	Telegartner	J01156A0031	5579	-	O/P Mon
Attenuator 2W 10dB DC-10GHz	Telegartner	J01156A0031	5580	-	O/P Mon
Attenuator 2W 10dB DC-10GHz	Telegartner	J01156A0031	5581	-	O/P Mon
2-Way Power Divider (2-8 GHz)	Aaren	AT30A-TE0208-2-AF	5685	12	18-Dec-2021
2-Way Power Divider (2-8 GHz)	Aaren	AT30A-TE0208-2-AF	5687	12	18-Dec-2021

Table 12

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

A2438, S/N: C02DM00V087Y - Modification State 0

2.2.3 Date of Test

18-December-2020 to 13-January-2021

2.2.4 Test Method

This test was performed in accordance with ANSI C63.10, clause 11.10.3 (AVGPSD-1) and 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 (Method AVGPSD-2). Where the duty cycle was ≥ 98 % the spectrum analyser was set to trace (power) averaging and no duty cycle correction made (Method AVGPSD-1).

The output power was verified as being the same from each transmit core, but the antenna gains were not identical, therefore the modes reported for SISO operation are those giving the highest EIRP and/or lowest conducted limit based on the antenna giving highest directional gain.

MIMO output port summing was performed in accordance with KDB 662911 D01. The Directional Gain was calculated in accordance with the equation given in clause F)2)f)(ii) summed for a single spatial stream.

2.2.5 Environmental Conditions

Ambient Temperature	20.9 - 26.3 °C
Relative Humidity	22.4 - 50.1 %

2.2.6 Test Results

2.4 GHz WLAN

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
Raw Conducted PSD (dBm/30kHz)	-3.86	0.23	-10.90
Duty Cycle Correction (dB)	N/A SA-1	N/A SA-1	N/A SA-1
15.247 Conducted PSD Limit (dBm/3kHz)	8.00	8.00	8.00
RSS-247 Conducted PSD Limit (dBm/3kHz)	8.00	8.00	8.00
Conducted PSD Result (dBm/30kHz)	-3.86	0.23	-10.90

Table 13 - 802.11b / 1 Mbps / SISO / Core 1

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
Raw Conducted PSD (dBm/30kHz)	-9.25	-0.74	-20.92
Duty Cycle Correction (dB)	N/A SA-1	N/A SA-1	N/A SA-1
15.247 Conducted PSD Limit (dBm/3kHz)	8.00	8.00	8.00
RSS-247 Conducted PSD Limit (dBm/3kHz)	8.00	8.00	8.00
Conducted PSD Result (dBm/30kHz)	-9.25	-0.74	-20.92

Table 14 - 802.11g / 6 Mbps / SISO / Core 1

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
Raw Conducted PSD (dBm/30kHz)	-9.59	-1.06	-21.03
Duty Cycle Correction (dB)	0.36	0.36	0.37
15.247 Conducted PSD Limit (dBm/3kHz)	8.00	8.00	8.00
RSS-247 Conducted PSD Limit (dBm/3kHz)	8.00	8.00	8.00
Conducted PSD Result (dBm/30kHz)	-9.23	-0.70	-20.66

Table 15 - 802.11n / HT20 MCS7 / SISO / Core 1

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
Conducted PSD Core 0 (dBm/30kHz)	-10.32	-1.02	-22.15
Conducted PSD Core 1 (dBm/30kHz)	-9.31	-0.71	-21.26
Duty Cycle Correction (dB)	0.36	0.36	0.37
15.247 Conducted PSD Limit (dBm/3kHz)	8.00	8.00	8.00
RSS-247 Conducted PSD Limit (dBm/3kHz)	8.00	8.00	8.00
Conducted PSD Result (dBm/30kHz)	-6.41	2.51	-18.30

Table 16 - 802.11n / HT20 MCS7 / MIMO CDD / Cores 0+1

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
Raw Conducted PSD (dBm/30kHz)	-10.54	-1.70	-21.71
Duty Cycle Correction (dB)	0.41	0.41	0.42
15.247 Conducted PSD Limit (dBm/3kHz)	8.00	8.00	8.00
RSS-247 Conducted PSD Limit (dBm/3kHz)	8.00	8.00	8.00
Conducted PSD Result (dBm/30kHz)	-10.12	-1.29	-21.29

Table 17 - 802.11ax / HE20 MCS7x1 / SU / SISO / Core 1

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
Raw Conducted PSD (dBm/30kHz)	-4.81	-4.24	-15.92
Duty Cycle Correction (dB)	0.38	0.37	0.38
15.247 Conducted PSD Limit (dBm/3kHz)	8.00	8.00	8.00
RSS-247 Conducted PSD Limit (dBm/3kHz)	8.00	8.00	8.00
Conducted PSD Result (dBm/30kHz)	-4.43	-3.86	-15.54

Table 18 - 802.11ax / HE20 MCS7x1 / RU 26-0 / SISO / Core 1

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
Raw Conducted PSD (dBm/30kHz)	-5.26	-3.76	-15.26
Duty Cycle Correction (dB)	0.38	0.37	0.38
15.247 Conducted PSD Limit (dBm/3kHz)	8.00	8.00	8.00
RSS-247 Conducted PSD Limit (dBm/3kHz)	8.00	8.00	8.00
Conducted PSD Result (dBm/30kHz)	-4.88	-3.39	-14.88

Table 19 - 802.11ax / HE20 MCS7x1 / RU 26-8 / SISO / Core 1

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
Raw Conducted PSD (dBm/30kHz)	-3.73	-3.36	-16.22
Duty Cycle Correction (dB)	0.40	0.40	0.40
15.247 Conducted PSD Limit (dBm/3kHz)	8.00	8.00	8.00
RSS-247 Conducted PSD Limit (dBm/3kHz)	8.00	8.00	8.00
Conducted PSD Result (dBm/30kHz)	-3.34	-2.96	-15.81

Table 20 - 802.11ax / HE20 MCS7x1 / RU 52-37 / SISO / Core 1

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
Raw Conducted PSD (dBm/30kHz)	-4.34	-3.40	-16.14
Duty Cycle Correction (dB)	0.40	0.40	0.40
15.247 Conducted PSD Limit (dBm/3kHz)	8.00	8.00	8.00
RSS-247 Conducted PSD Limit (dBm/3kHz)	8.00	8.00	8.00
Conducted PSD Result (dBm/30kHz)	-3.94	-3.00	-15.74

Table 21 - 802.11ax / HE20 MCS7x1 / RU 52-40 / SISO / Core 1

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
Raw Conducted PSD (dBm/30kHz)	-5.75	-2.94	-18.49
Duty Cycle Correction (dB)	0.21	0.21	0.21
15.247 Conducted PSD Limit (dBm/3kHz)	8.00	8.00	8.00
RSS-247 Conducted PSD Limit (dBm/3kHz)	8.00	8.00	8.00
Conducted PSD Result (dBm/30kHz)	-5.54	-2.74	-18.27

Table 22 - 802.11ax / HE20 MCS7x1 / RU 106-53 / SISO / Core 1

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
Raw Conducted PSD (dBm/30kHz)	-5.32	-2.92	-17.97
Duty Cycle Correction (dB)	0.21	0.21	0.21
15.247 Conducted PSD Limit (dBm/3kHz)	8.00	8.00	8.00
RSS-247 Conducted PSD Limit (dBm/3kHz)	8.00	8.00	8.00
Conducted PSD Result (dBm/30kHz)	-5.11	-2.71	-17.76

Table 23 - 802.11ax / HE20 MCS7x1 / RU 106-54 / SISO / Core 1

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
Conducted PSD Core 0 (dBm/30kHz)	-10.89	-1.67	-22.78
Conducted PSD Core 1 (dBm/30kHz)	-9.67	-1.76	-22.46
Duty Cycle Correction (dB)	0.41	0.41	0.42
15.247 Conducted PSD Limit (dBm/3kHz)	8.00	8.00	8.00
RSS-247 Conducted PSD Limit (dBm/3kHz)	8.00	8.00	8.00
Conducted PSD Result (dBm/30kHz)	-6.81	1.70	-19.19

Table 24 - 802.11ax / HE20 MCS7x1 / SU / MIMO CDD / Cores 0+1

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
Conducted PSD Core 0 (dBm/30kHz)	-5.28	-4.11	-16.30
Conducted PSD Core 1 (dBm/30kHz)	-5.08	-4.12	-15.84
Duty Cycle Correction (dB)	0.38	0.37	0.38
15.247 Conducted PSD Limit (dBm/3kHz)	8.00	8.00	8.00
RSS-247 Conducted PSD Limit (dBm/3kHz)	8.00	8.00	8.00
Conducted PSD Result (dBm/30kHz)	-1.79	-0.73	-12.67

Table 25 - 802.11ax / HE20 MCS7x1 / RU 26-0 / MIMO CDD / Cores 0+1

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
Conducted PSD Core 0 (dBm/30kHz)	-5.41	-3.99	-16.19
Conducted PSD Core 1 (dBm/30kHz)	-5.14	-4.16	-15.82
Duty Cycle Correction (dB)	0.38	0.37	0.38
15.247 Conducted PSD Limit (dBm/3kHz)	8.00	8.00	8.00
RSS-247 Conducted PSD Limit (dBm/3kHz)	8.00	8.00	8.00
Conducted PSD Result (dBm/30kHz)	-1.89	-0.69	-12.61

Table 26 - 802.11ax / HE20 MCS7x1 / RU 26-8 / MIMO CDD / Cores 0+1

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
Conducted PSD Core 0 (dBm/30kHz)	-4.32	-2.87	-16.84
Conducted PSD Core 1 (dBm/30kHz)	-4.20	-3.33	-16.58
Duty Cycle Correction (dB)	0.40	0.40	0.40
15.247 Conducted PSD Limit (dBm/3kHz)	8.00	8.00	8.00
RSS-247 Conducted PSD Limit (dBm/3kHz)	8.00	8.00	8.00
Conducted PSD Result (dBm/30kHz)	-0.86	0.31	-13.29

Table 27 - 802.11ax / HE20 MCS7x1 / RU 52-37 / MIMO CDD / Cores 0+1

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
Conducted PSD Core 0 (dBm/30kHz)	-4.90	-3.38	-16.68
Conducted PSD Core 1 (dBm/30kHz)	-4.27	-3.52	-16.20
Duty Cycle Correction (dB)	0.40	0.40	0.40
15.247 Conducted PSD Limit (dBm/3kHz)	8.00	8.00	8.00
RSS-247 Conducted PSD Limit (dBm/3kHz)	8.00	8.00	8.00
Conducted PSD Result (dBm/30kHz)	-1.16	-0.04	-13.02

Table 28 - 802.11ax / HE20 MCS7x1 / RU 52-40 / MIMO CDD / Cores 0+1

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
Conducted PSD Core 0 (dBm/30kHz)	-8.84	-2.98	-19.05
Conducted PSD Core 1 (dBm/30kHz)	-8.32	-3.15	-18.32
Duty Cycle Correction (dB)	0.21	0.21	0.21
15.247 Conducted PSD Limit (dBm/3kHz)	8.00	8.00	8.00
RSS-247 Conducted PSD Limit (dBm/3kHz)	8.00	8.00	8.00
Conducted PSD Result (dBm/30kHz)	-5.35	0.16	-15.44

Table 29 - 802.11ax / HE20 MCS7x1 / RU 106-53 / MIMO CDD / Cores 0+1

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
Conducted PSD Core 0 (dBm/30kHz)	-8.55	-2.68	-18.68
Conducted PSD Core 1 (dBm/30kHz)	-8.01	-2.89	-17.86
Duty Cycle Correction (dB)	0.21	0.21	0.21
15.247 Conducted PSD Limit (dBm/3kHz)	8.00	8.00	8.00
RSS-247 Conducted PSD Limit (dBm/3kHz)	8.00	8.00	8.00
Conducted PSD Result (dBm/30kHz)	-5.05	0.43	-15.03

Table 30 - 802.11ax / HE20 MCS7x1 / RU 106-54 / MIMO CDD / Cores 0+1

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	17-May-2021
Multimeter	Iso-tech	IDM101	2421	12	30-Oct-2021
Hygrometer	Rotronic	I-1000	3220	12	16-Oct-2021
1800-6000 MHz Power Splitter	Mini-Circuits	ZN2PD-63-S+	4055	-	O/P Mon
1 Metre SMA Cable	Rhophase	3PS-1801A-1000-3PS	4099	12	22-Jun-2021
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	17-May-2021
AC Programmable Power Supply	iTech	IT7324	5227	-	O/P Mon
Cable 2.92m	Junkosha	MWX241/B	5411	12	22-Jun-2021
3.5 mm 1m Cable	Junkosha	MWX221-01000DMS	5417	12	22-Jun-2021
3.5 mm 1m Cable	Junkosha	MWX221-01000DMS	5418	12	22-Jun-2021
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5430	12	22-Jun-2021
Signal Analyzer	Keysight Technologies	PXA N9030B	5432	12	08-Dec-2021
10dB/5W Attenuator	Aaren	AT40A-404-D18-10	5486	12	14-Apr-2021
Attenuator 5W 10dB DC-18GHz	Aaren	AT40A-4041-D18-10	5487	12	14-Apr-2021
MXA Signal Analyser	Keysight Technologies	N9020B	5529	24	04-Mar-2022
Attenuator 2W 10dB DC-10GHz	Telegartner	J01156A0031	5575	-	O/P Mon
Attenuator 2W 10dB DC-10GHz	Telegartner	J01156A0031	5579	-	O/P Mon
Attenuator 2W 10dB DC-10GHz	Telegartner	J01156A0031	5580	-	O/P Mon
Attenuator 2W 10dB DC-10GHz	Telegartner	J01156A0031	5581	-	O/P Mon
2-Way Power Divider (2-8 GHz)	Aaren	AT30A-TE0208-2-AF	5685	12	18-Dec-2021
2-Way Power Divider (2-8 GHz)	Aaren	AT30A-TE0208-2-AF	5687	12	18-Dec-2021

Table 31

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

A2438, S/N: C02DM00V087Y - Modification State 0

2.3.3 Date of Test

18-December-2020 to 13-January-2021

2.3.4 Test Method

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

For modes of operation using multiple cores, measurements were made on each core but only the worst case results are reported. Worst case was considered as the narrowest results for 6 dB bandwidth and the widest result for 99 % occupied bandwidth.

2.3.5 Environmental Conditions

Ambient Temperature	20.9 - 26.3 °C
Relative Humidity	22.4 - 50.1 %

2.3.6 Test Results

2.4 GHz WLAN

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
6 dB Bandwidth (MHz)	8.640	8.160	8.160
99% Bandwidth (MHz)	12.969	13.010	12.826

Table 32 - 802.11b / 1 Mbps / SISO / Core 1

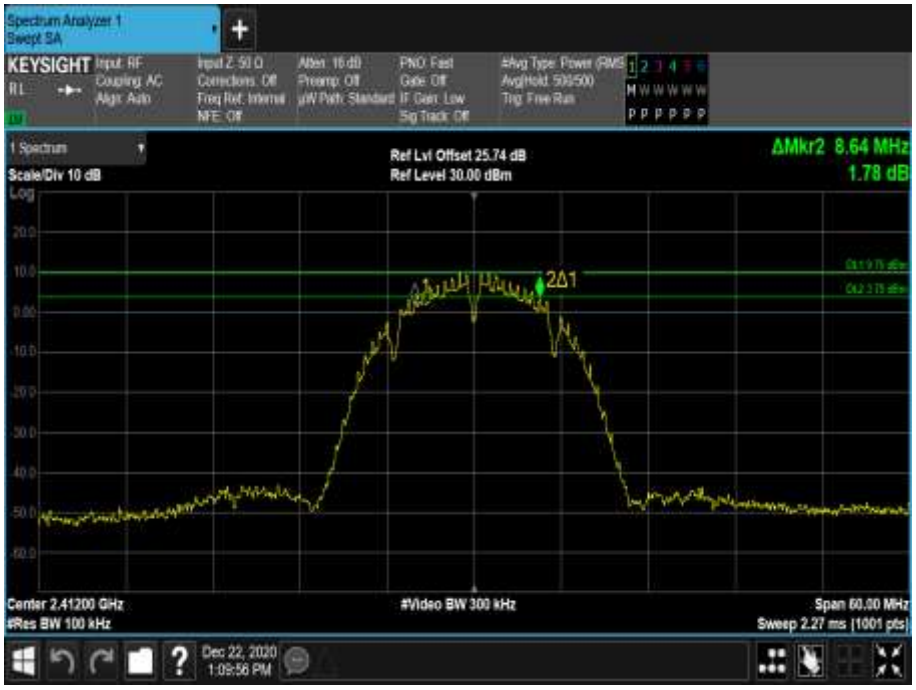

Figure 1 - 2412 MHz - 6 dB DTS Bandwidth

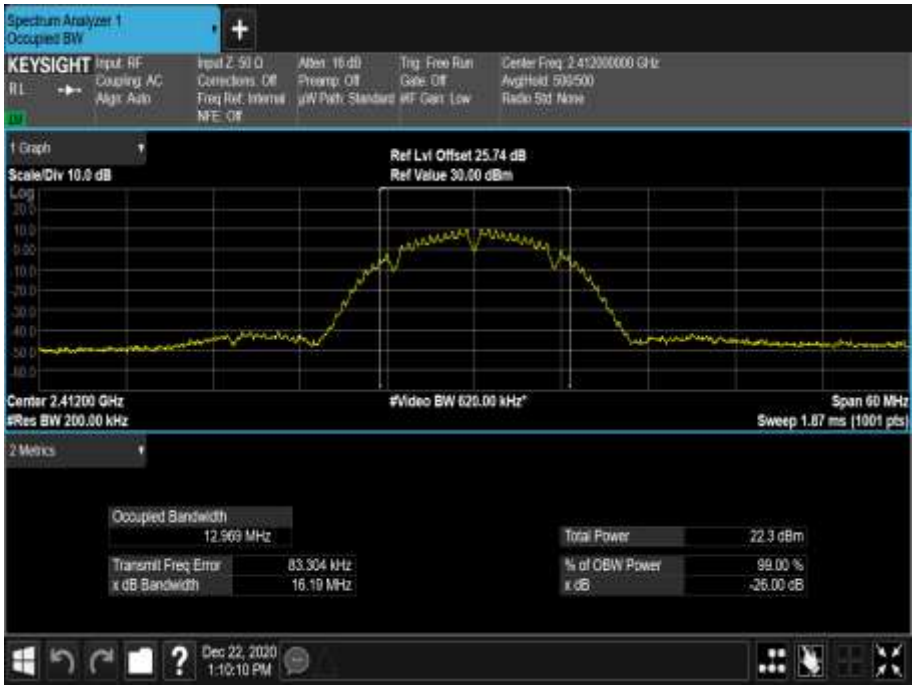

Figure 2 - 2412 MHz - 99% Occupied Bandwidth

Figure 3 - 2437 MHz - 6 dB DTS Bandwidth

Figure 4 - 2437 MHz - 99% Occupied Bandwidth

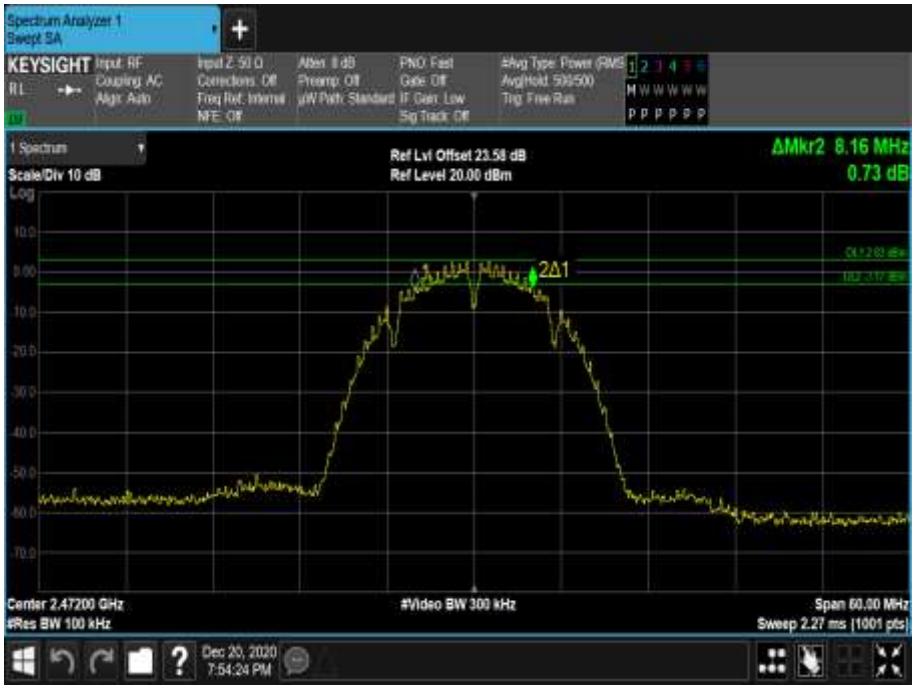

Figure 5 - 2472 MHz - 6 dB DTS Bandwidth

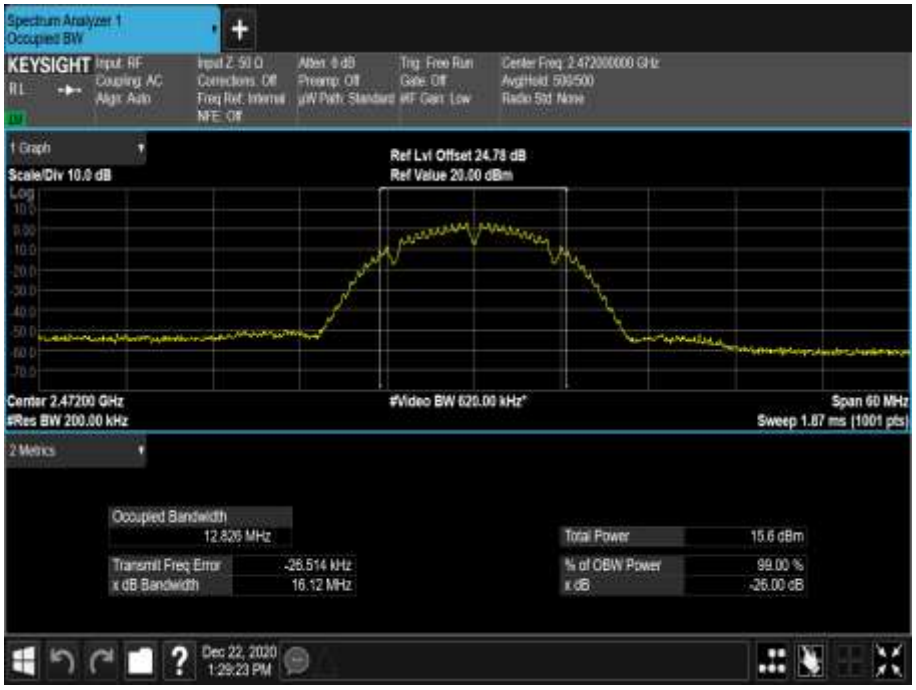

Figure 6 - 2472 MHz - 99% Occupied Bandwidth

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
6 dB Bandwidth (MHz)	15.300	15.180	15.240
99% Bandwidth (MHz)	16.349	16.360	16.296

Table 33 - 802.11g / 6 Mbps / SISO / Core 1

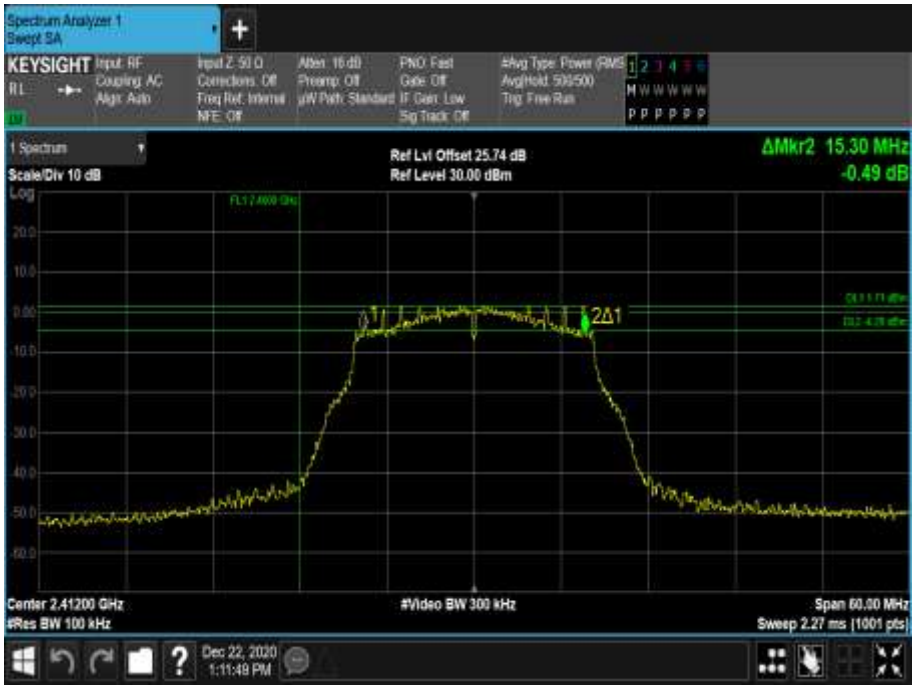

Figure 7 - 2412 MHz - 6 dB DTS Bandwidth

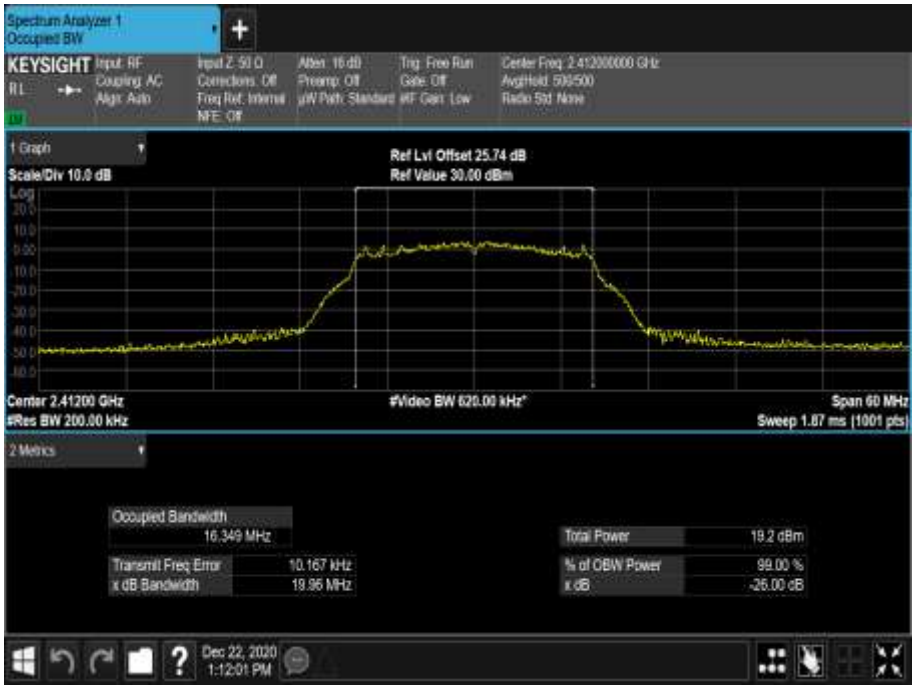

Figure 8 - 2412 MHz - 99% Occupied Bandwidth

Figure 9 - 2437 MHz - 6 dB DTS Bandwidth

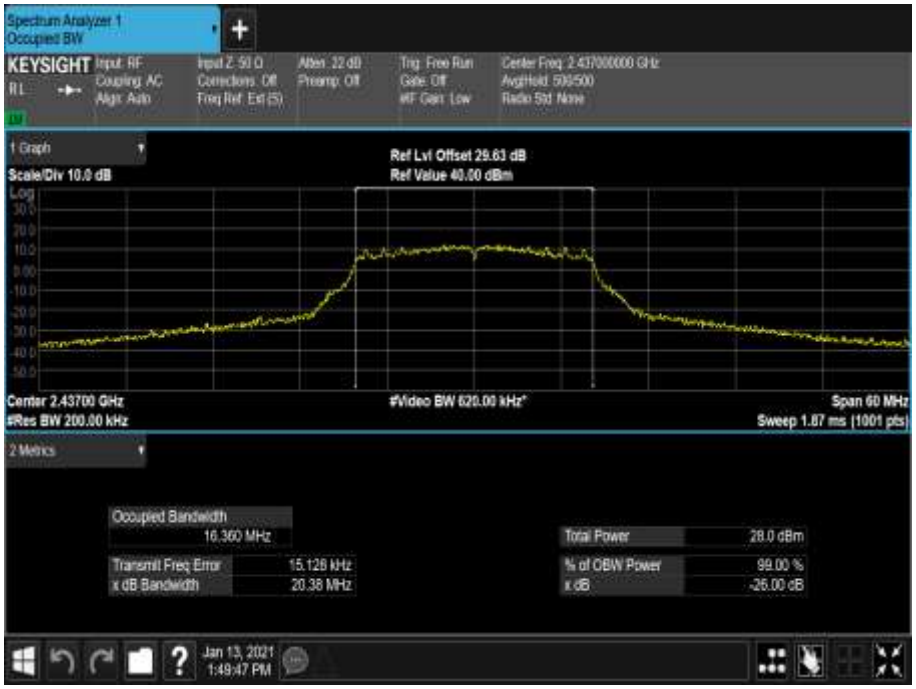

Figure 10 - 2437 MHz - 99% Occupied Bandwidth

Figure 11 - 2472 MHz - 6 dB DTS Bandwidth

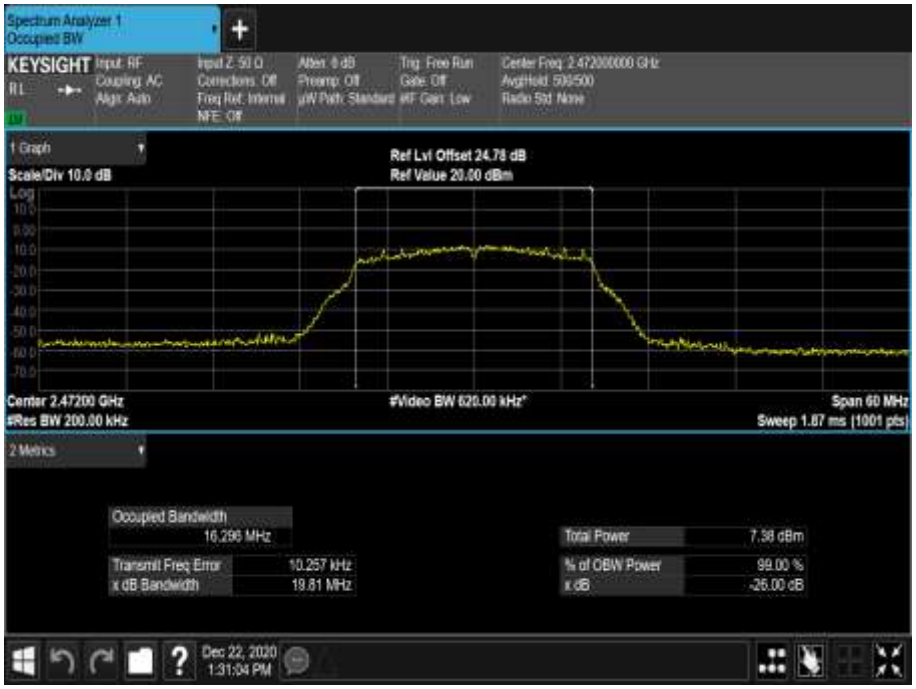

Figure 12 - 2472 MHz - 99% Occupied Bandwidth

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
6 dB Bandwidth (MHz)	17.820	17.700	17.580
99% Bandwidth (MHz)	17.696	17.732	17.629

Table 34 - 802.11n / HT20 MCS7 / SISO / Core 1

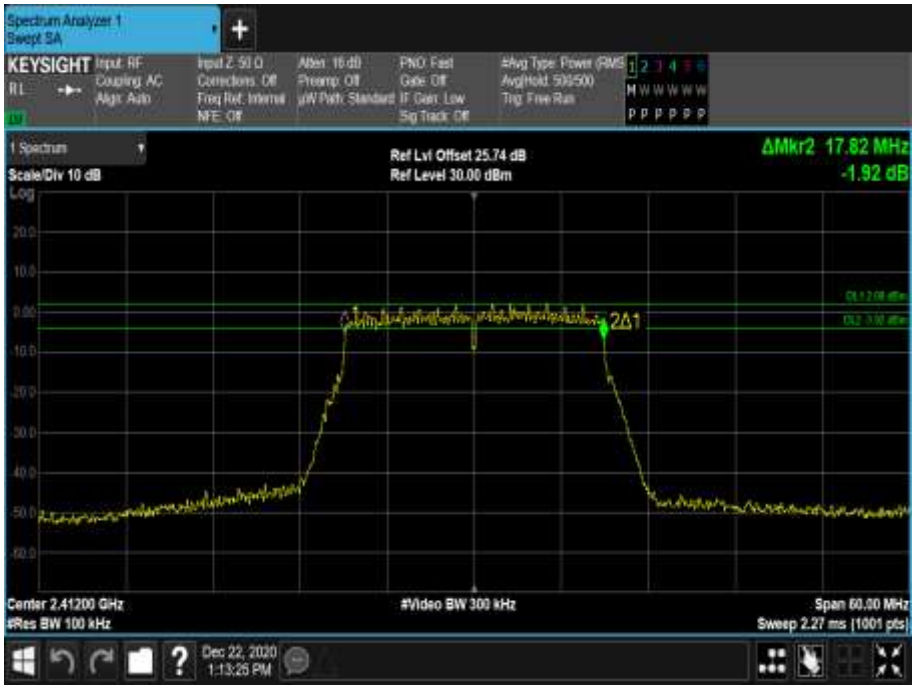

Figure 13 - 2412 MHz - 6 dB DTS Bandwidth

Figure 14 - 2412 MHz - 99% Occupied Bandwidth

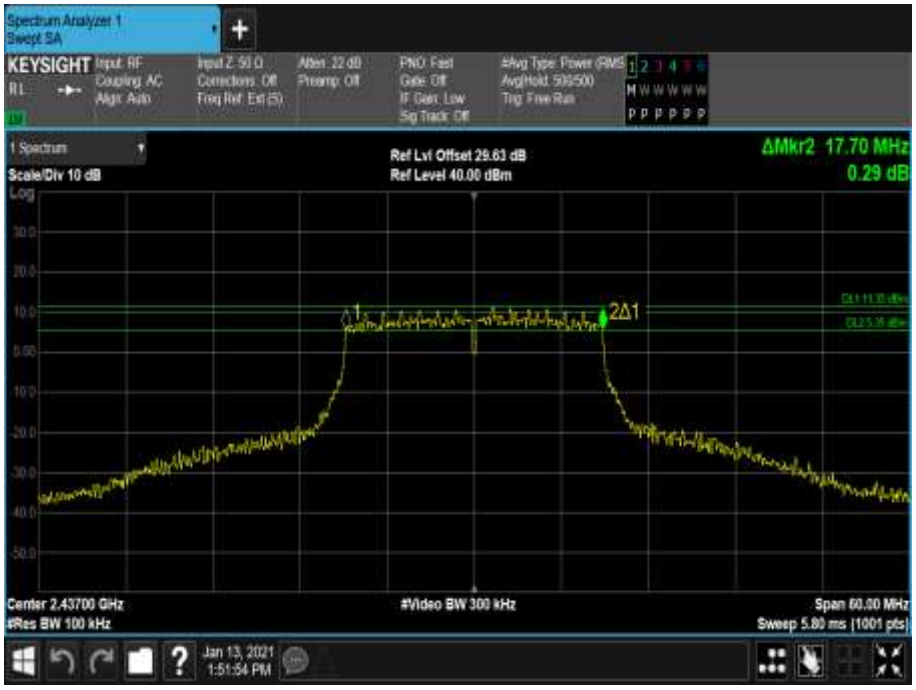

Figure 15 - 2437 MHz - 6 dB DTS Bandwidth

Figure 16 - 2437 MHz - 99% Occupied Bandwidth

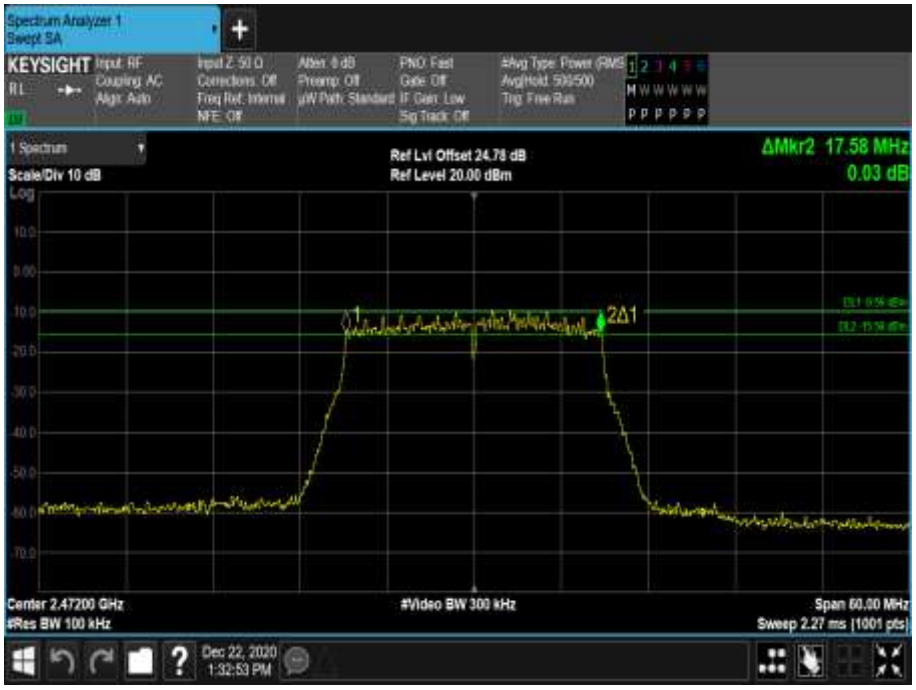

Figure 17 - 2472 MHz - 6 dB DTS Bandwidth

Figure 18 - 2472 MHz - 99% Occupied Bandwidth

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
6 dB Bandwidth (MHz)	17.760	17.760	17.580
99% Bandwidth (MHz)	17.721	17.730	17.646

Table 35 - 802.11n / HT20 MCS7 / MIMO CDD / Cores 0+1

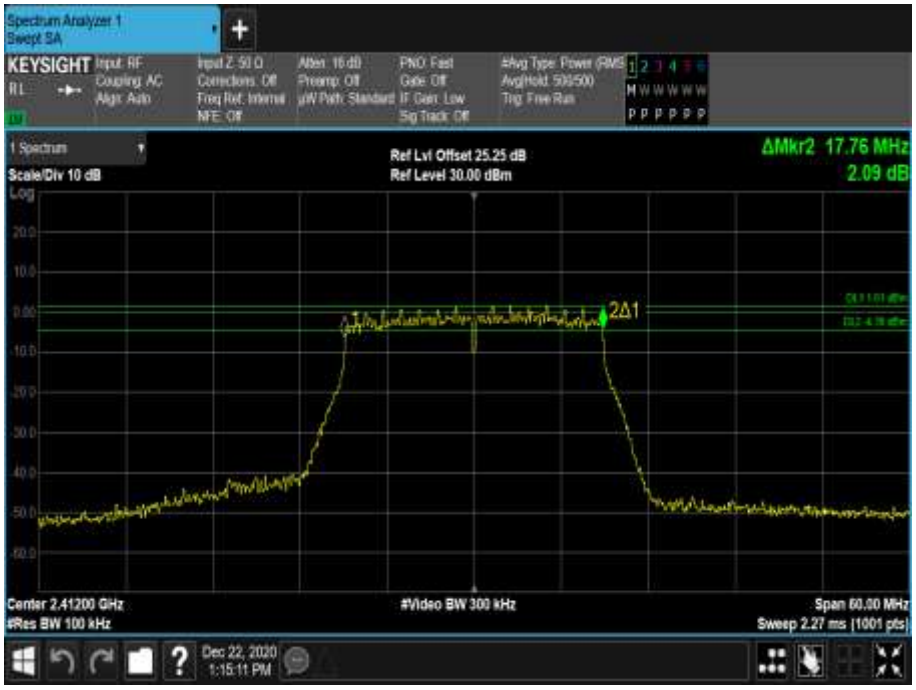

Figure 19 - 2412 MHz - 6 dB DTS Bandwidth

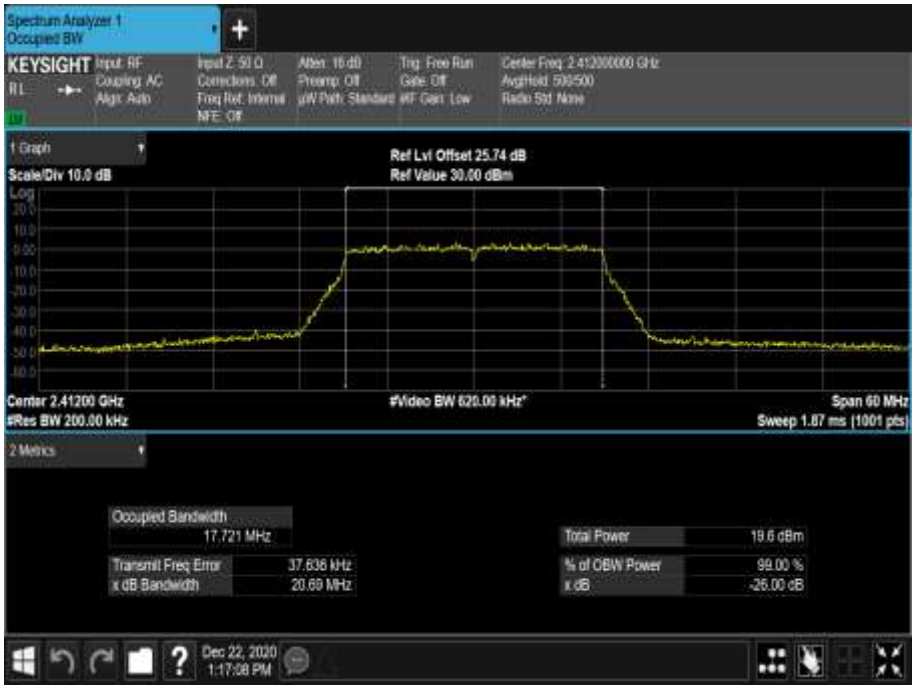

Figure 20 - 2412 MHz - 99% Occupied Bandwidth

Figure 21 - 2437 MHz - 6 dB DTS Bandwidth

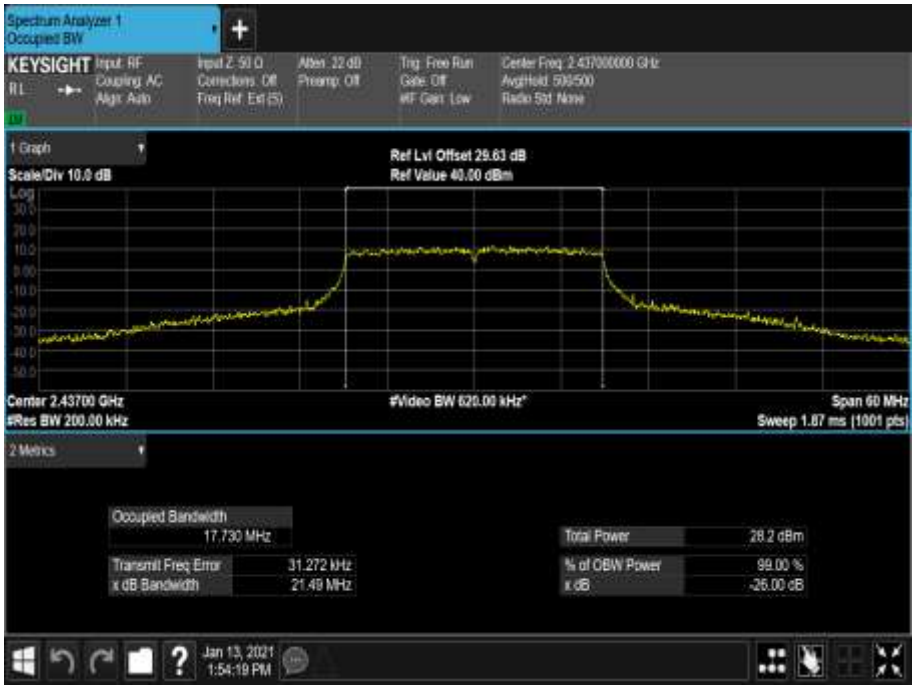

Figure 22 - 2437 MHz - 99% Occupied Bandwidth

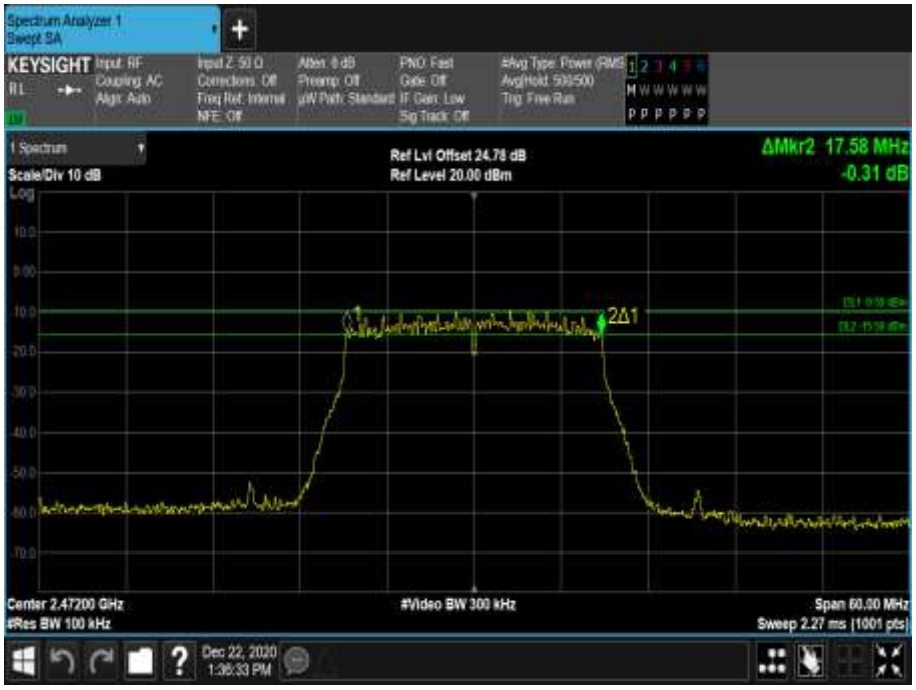

Figure 23 - 2472 MHz - 6 dB DTS Bandwidth

Figure 24 - 2472 MHz - 99% Occupied Bandwidth

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
6 dB Bandwidth (MHz)	18.840	18.840	18.900
99% Bandwidth (MHz)	18.910	18.942	18.878

Table 36 - 802.11ax / HE20 MCS7x1 / SU / SISO / Core 1

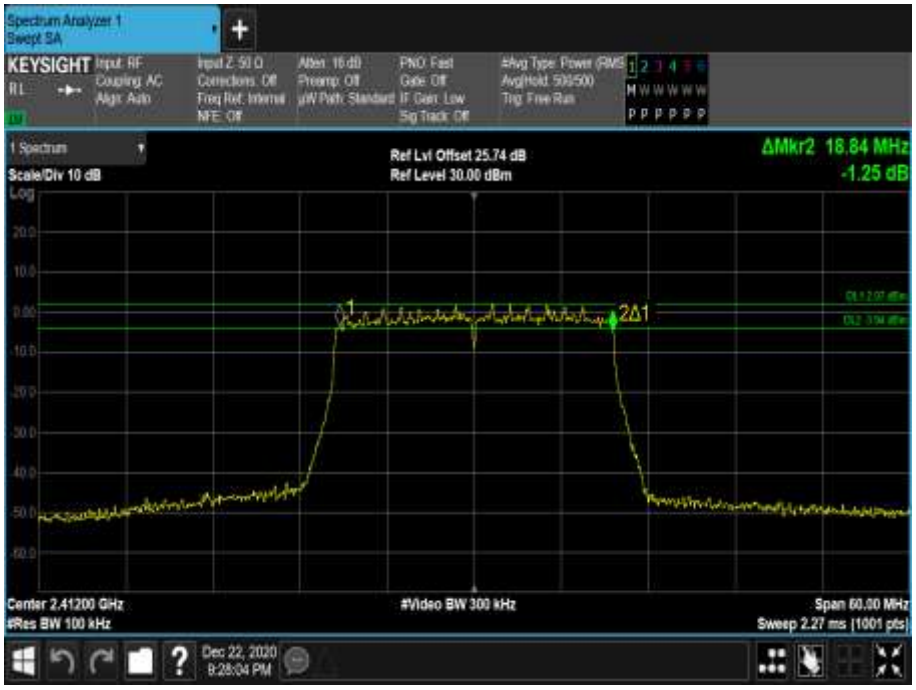

Figure 25 - 2412 MHz - 6 dB DTS Bandwidth

Figure 26 - 2412 MHz - 99% Occupied Bandwidth

Figure 27 - 2437 MHz - 6 dB DTS Bandwidth

Figure 28 - 2437 MHz - 99% Occupied Bandwidth

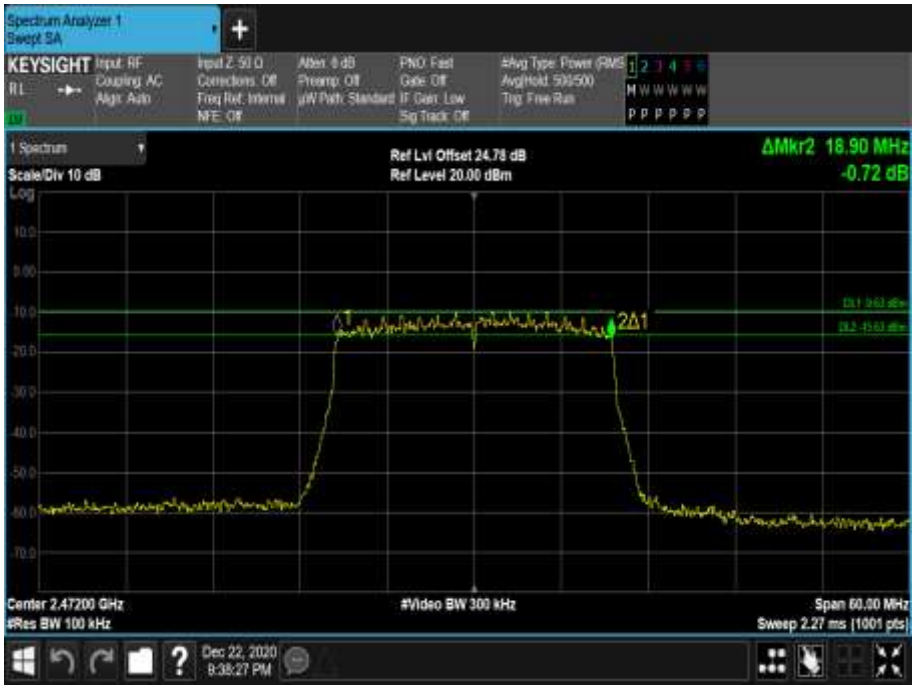

Figure 29 - 2472 MHz - 6 dB DTS Bandwidth

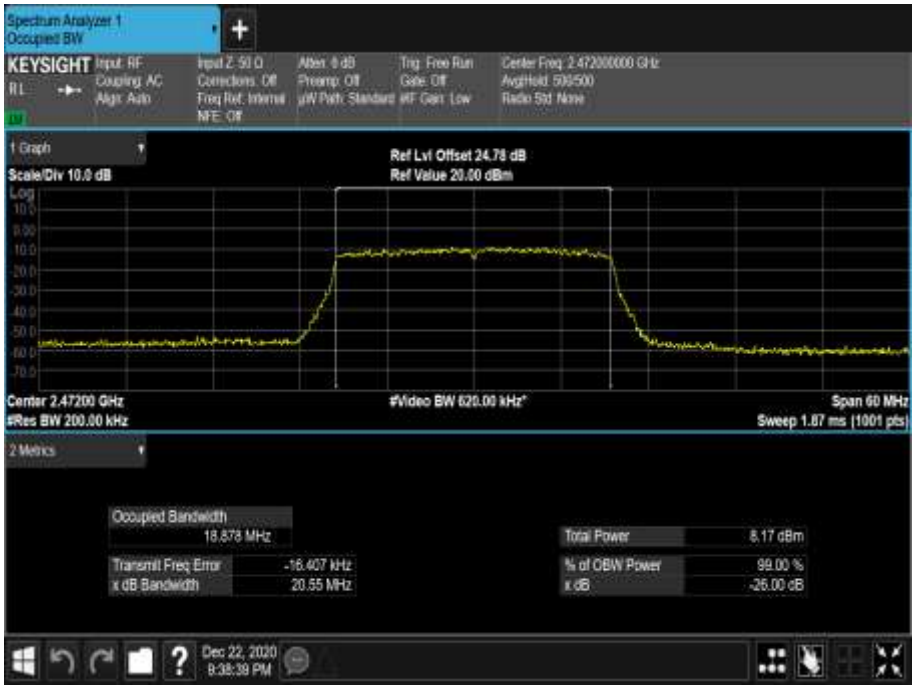

Figure 30 - 2472 MHz - 99% Occupied Bandwidth

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
6 dB Bandwidth (MHz)	2.160	2.160	14.700
99% Bandwidth (MHz)	18.307	18.232	18.211

Table 37 - 802.11ax / HE20 MCS7x1 / RU 26-0 / SISO / Core 1

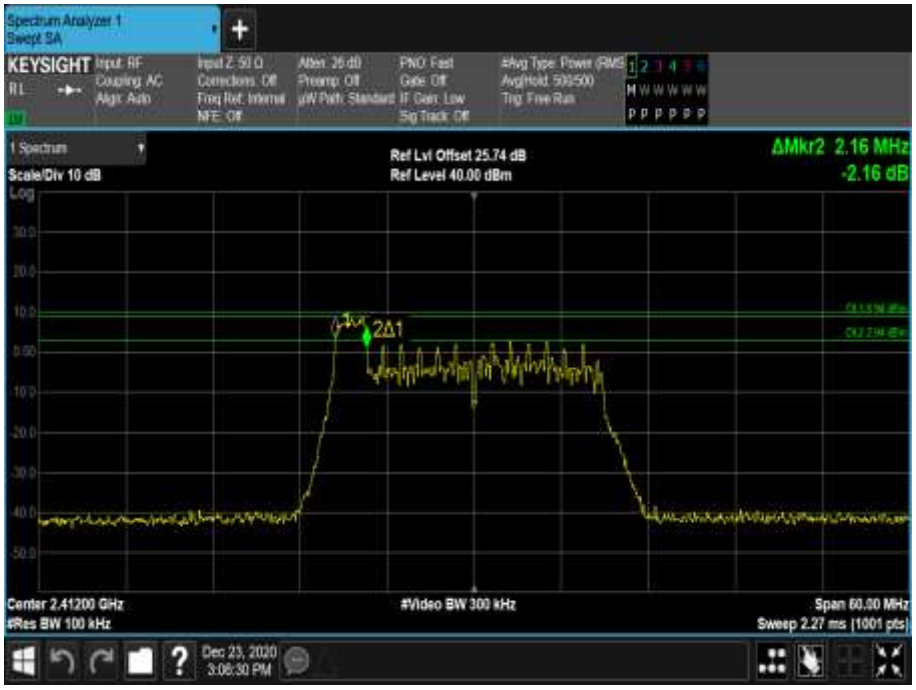

Figure 31 - 2412 MHz - 6 dB DTS Bandwidth

Figure 32 - 2412 MHz - 99% Occupied Bandwidth

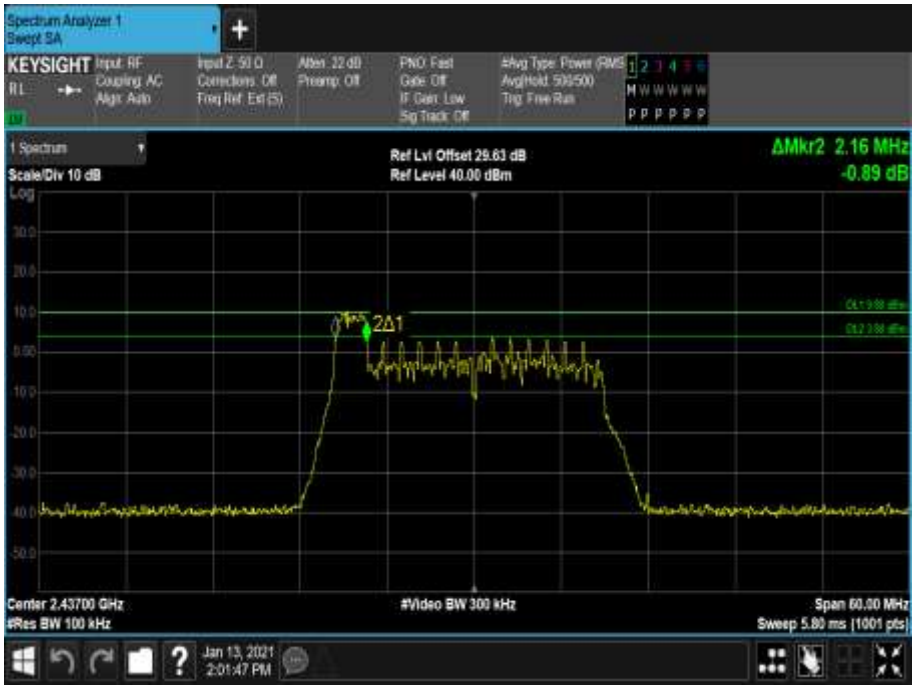

Figure 33 - 2437 MHz - 6 dB DTS Bandwidth

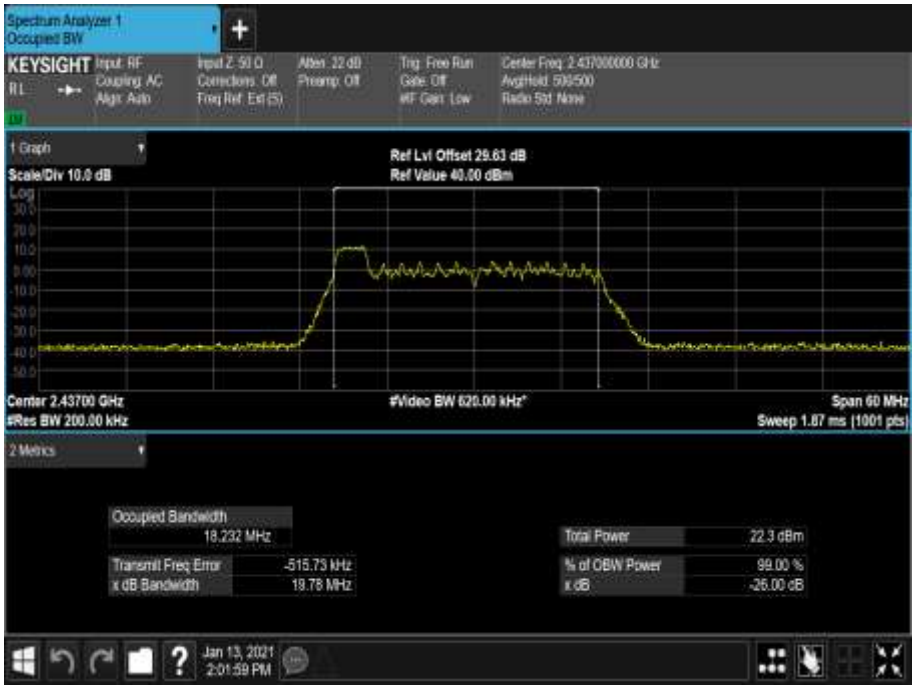

Figure 34 - 2437 MHz - 99% Occupied Bandwidth

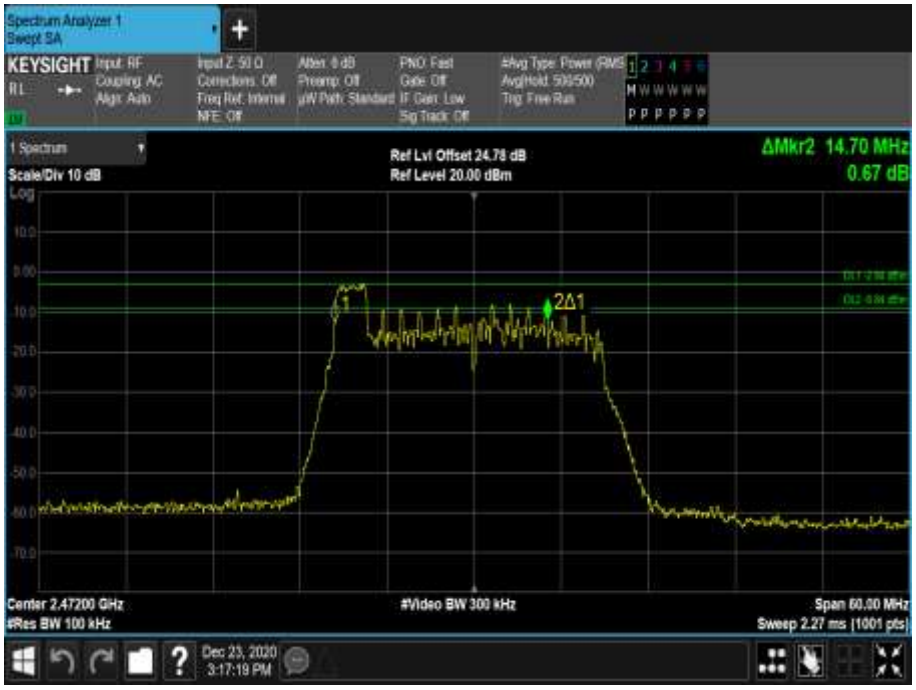

Figure 35 - 2472 MHz - 6 dB DTS Bandwidth

Figure 36 - 2472 MHz - 99% Occupied Bandwidth

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
6 dB Bandwidth (MHz)	2.160	2.160	2.160
99% Bandwidth (MHz)	18.372	18.373	18.384

Table 38 - 802.11ax / HE20 MCS7x1 / RU 26-8 / SISO / Core 1

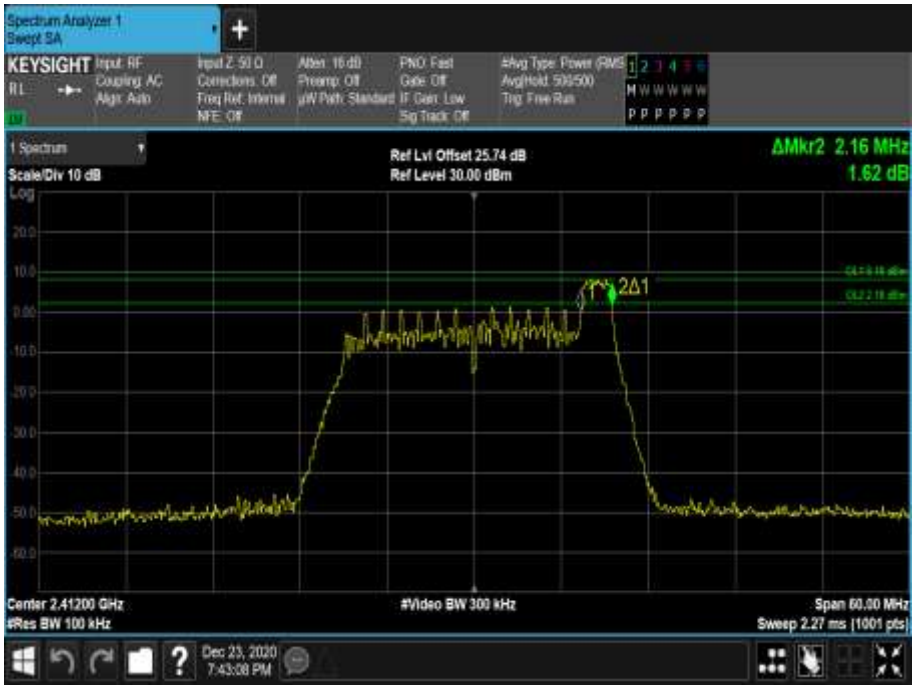

Figure 37 - 2412 MHz - 6 dB DTS Bandwidth

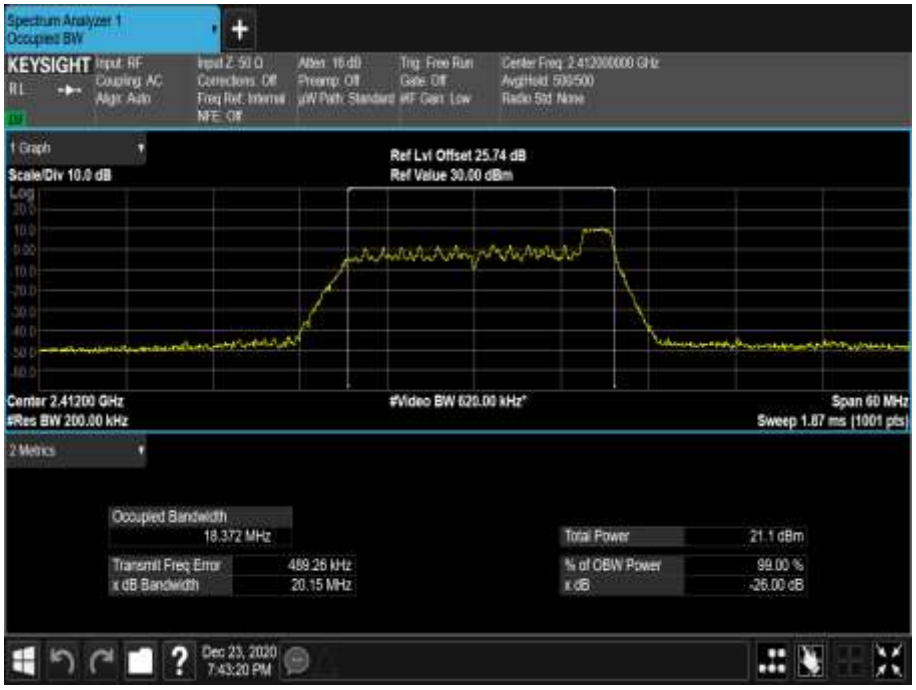

Figure 38 - 2412 MHz - 99% Occupied Bandwidth

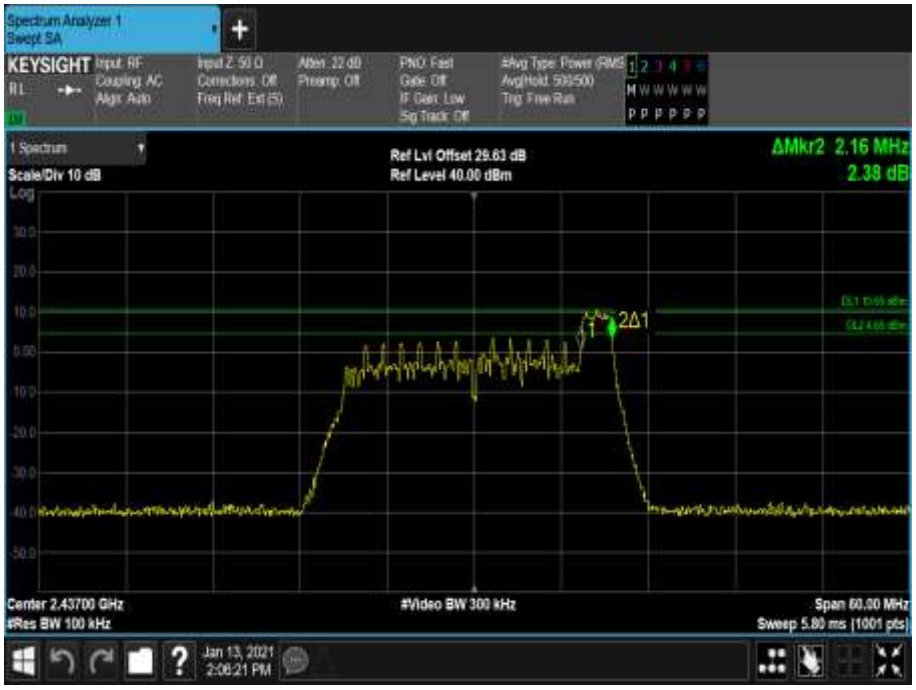

Figure 39 - 2437 MHz - 6 dB DTS Bandwidth

Figure 40 - 2437 MHz - 99% Occupied Bandwidth

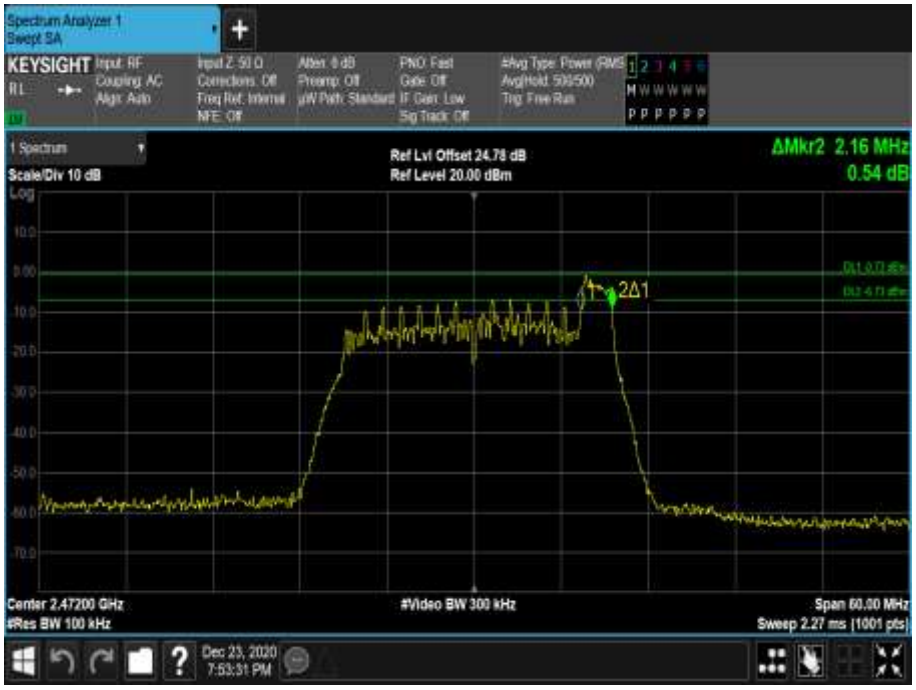

Figure 41 - 2472 MHz - 6 dB DTS Bandwidth

Figure 42 - 2472 MHz - 99% Occupied Bandwidth

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
6 dB Bandwidth (MHz)	18.960	18.720	18.900
99% Bandwidth (MHz)	18.942	18.987	18.886

Table 39 - 802.11ax / HE20 MCS7x1 / SU / MIMO CDD / Cores 0+1

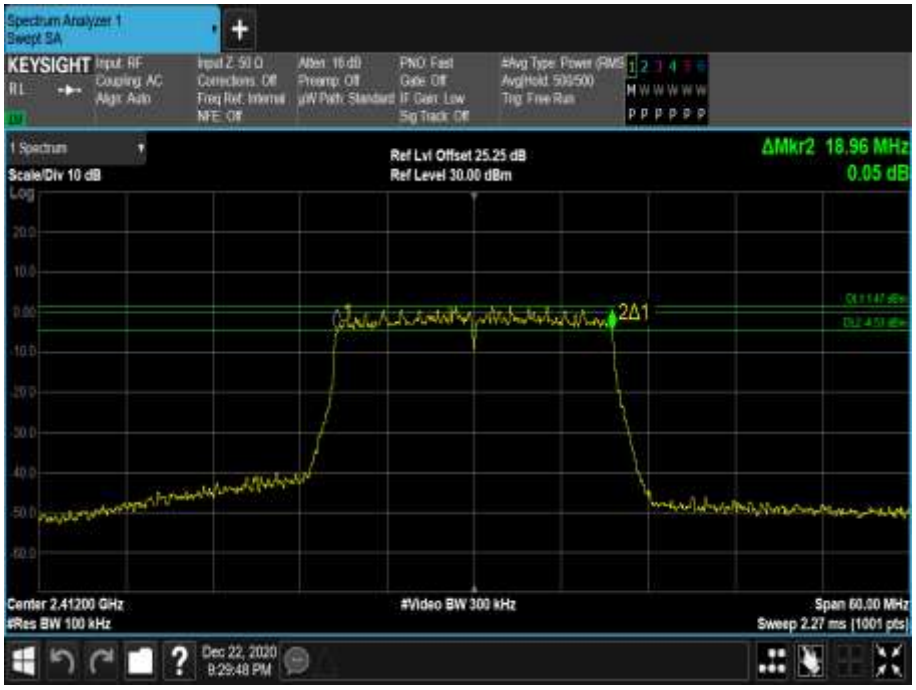

Figure 43 - 2412 MHz - 6 dB DTS Bandwidth

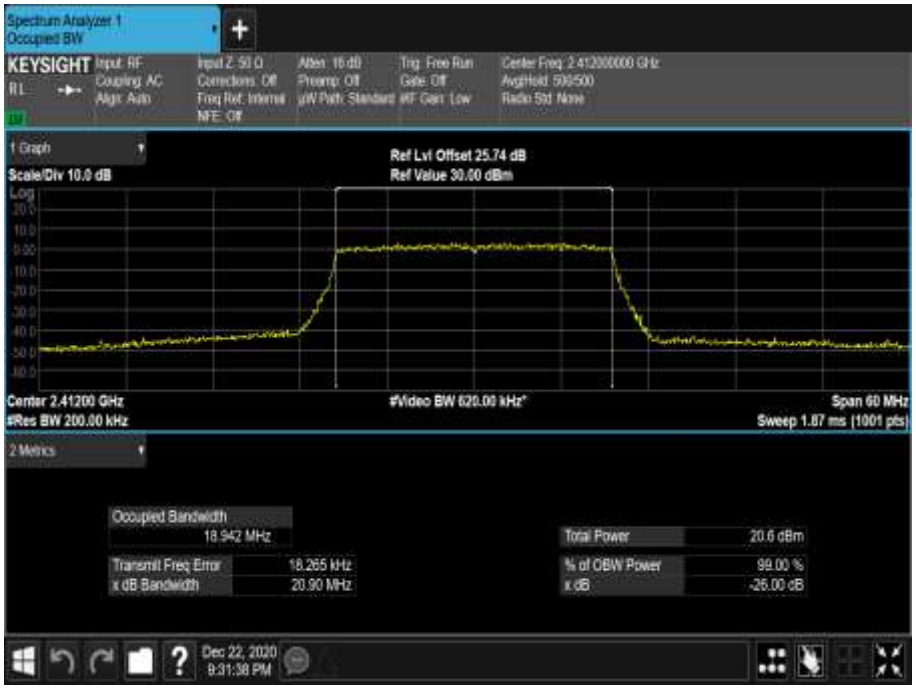

Figure 44 - 2412 MHz - 99% Occupied Bandwidth

Figure 45 - 2437 MHz - 6 dB DTS Bandwidth

Figure 46 - 2437 MHz - 99% Occupied Bandwidth

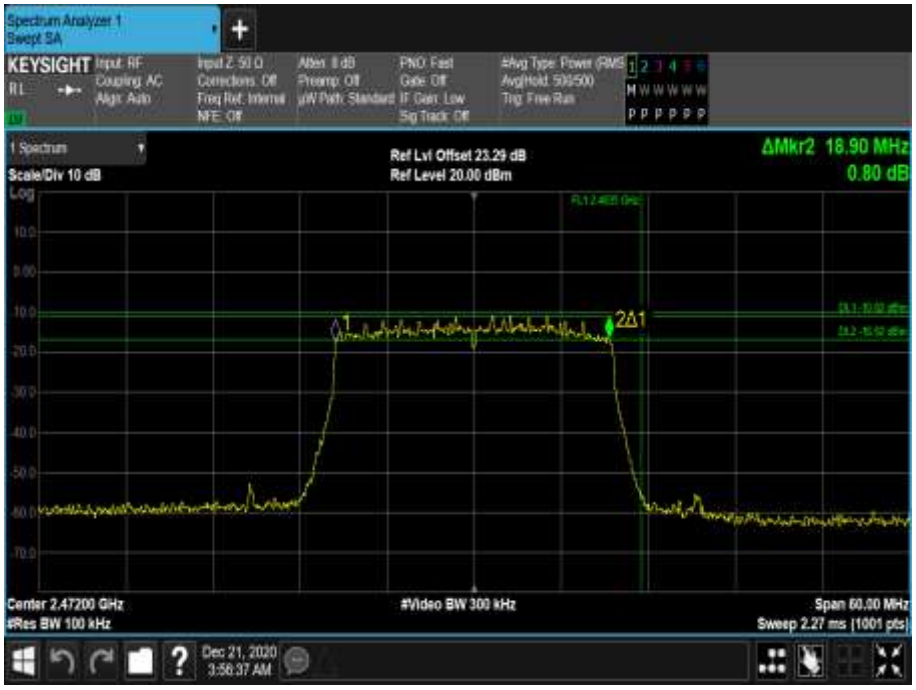

Figure 47 - 2472 MHz - 6 dB DTS Bandwidth

Figure 48 - 2472 MHz - 99% Occupied Bandwidth

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
6 dB Bandwidth (MHz)	2.160	10.920	2.160
99% Bandwidth (MHz)	18.291	18.213	18.179

Table 40 - 802.11ax / HE20 MCS7x1 / RU 26-0 / MIMO CDD / Cores 0+1

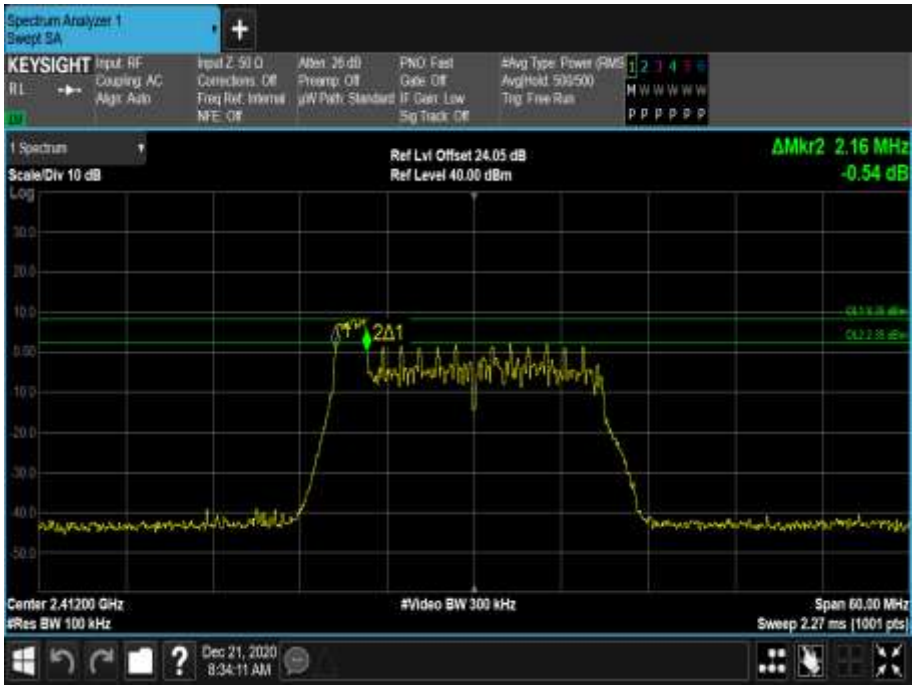

Figure 49 - 2412 MHz - 6 dB DTS Bandwidth

Figure 50 - 2412 MHz - 99% Occupied Bandwidth

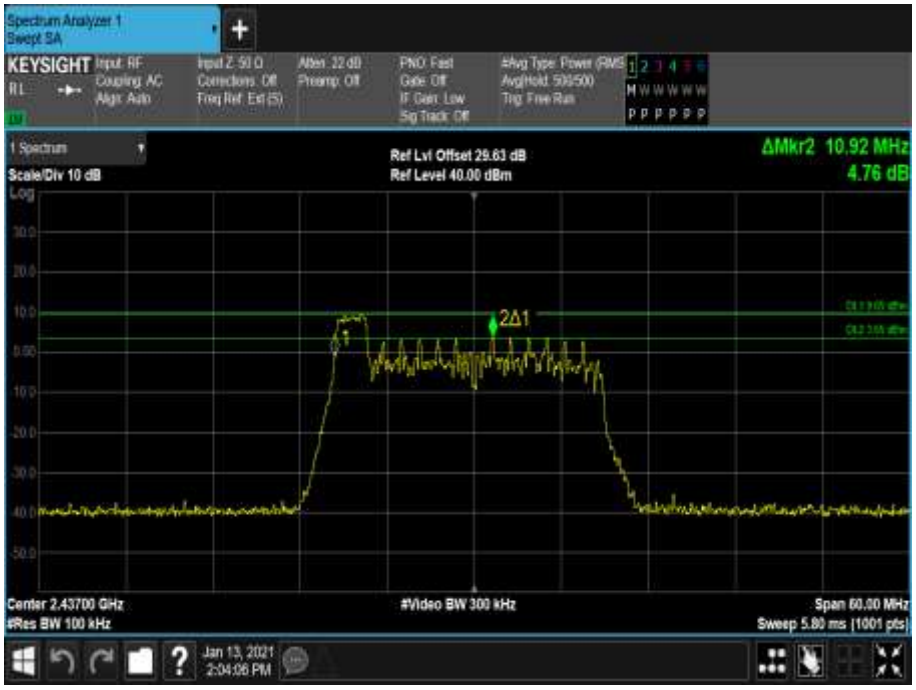

Figure 51 - 2437 MHz - 6 dB DTS Bandwidth

Figure 52 - 2437 MHz - 99% Occupied Bandwidth

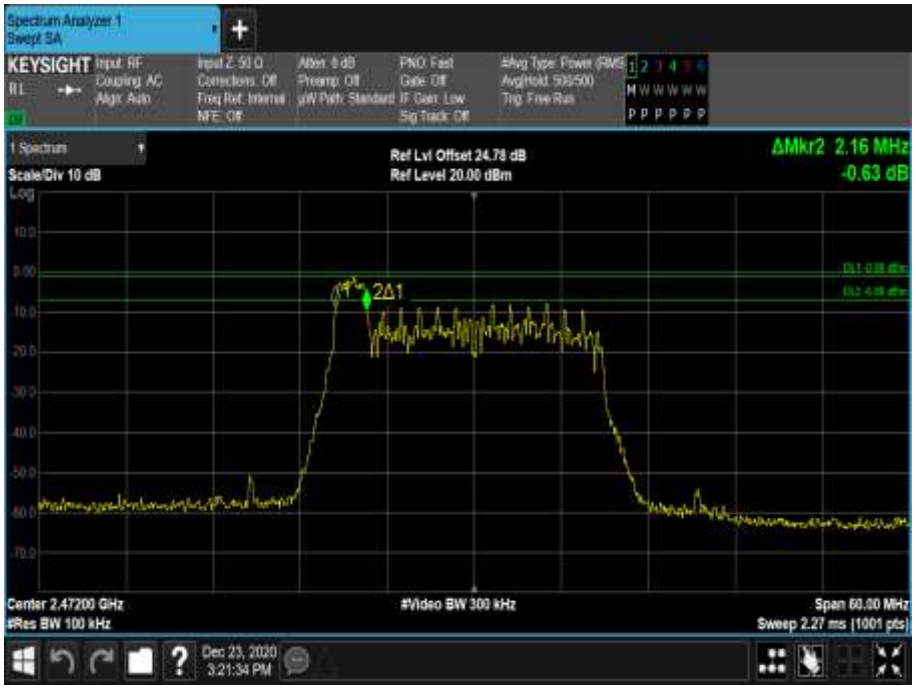

Figure 53 - 2472 MHz - 6 dB DTS Bandwidth

Figure 54 - 2472 MHz - 99% Occupied Bandwidth

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
6 dB Bandwidth (MHz)	2.160	2.160	10.860
99% Bandwidth (MHz)	18.380	18.400	18.406

Table 41 - 802.11ax / HE20 MCS7x1 / RU 26-8 / MIMO CDD / Cores 0+1

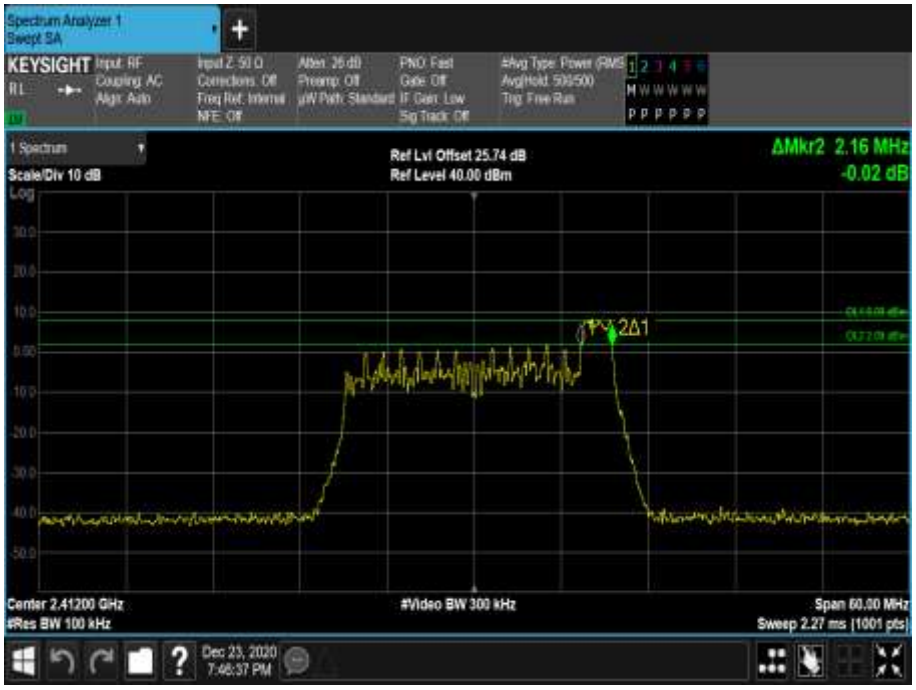

Figure 55 - 2412 MHz - 6 dB DTS Bandwidth

Figure 56 - 2412 MHz - 99% Occupied Bandwidth

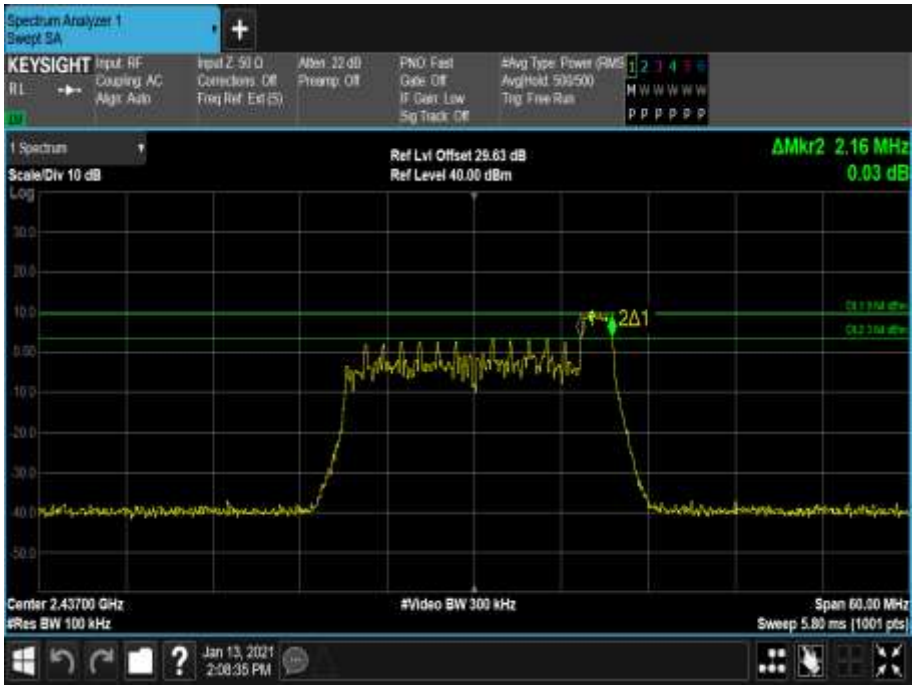

Figure 57 - 2437 MHz - 6 dB DTS Bandwidth

Figure 58 - 2437 MHz - 99% Occupied Bandwidth

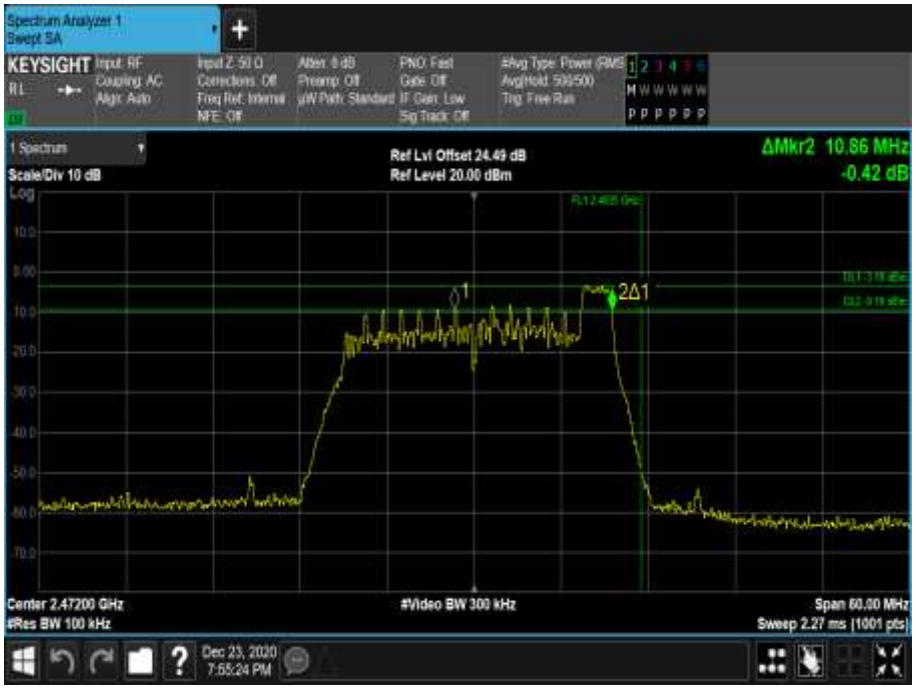

Figure 59 - 2472 MHz - 6 dB DTS Bandwidth

Figure 60 - 2472 MHz - 99% Occupied Bandwidth

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

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
1800-6000 MHz Power Splitter	Mini-Circuits	ZN2PD-63-S+	4055	-	O/P Mon
1 Metre SMA Cable	Rhophase	3PS-1801A-1000-3PS	4099	12	22-Jun-2021
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	17-May-2021
AC Programmable Power Supply	iTech	IT7324	5227	-	O/P Mon
Cable 2.92m	Junkosha	MWX241/B	5411	12	22-Jun-2021
3.5 mm 1m Cable	Junkosha	MWX221-01000DMS	5417	12	22-Jun-2021
3.5 mm 1m Cable	Junkosha	MWX221-01000DMS	5418	12	22-Jun-2021
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5430	12	22-Jun-2021
Signal Analyzer	Keysight Technologies	PXA N9030B	5432	12	08-Dec-2021
10dB/5W Attenuator	Aaren	AT40A-404-D18-10	5486	12	14-Apr-2021
Attenuator 5W 10dB DC-18GHz	Aaren	AT40A-4041-D18-10	5487	12	14-Apr-2021
MXA Signal Analyser	Keysight Technologies	N9020B	5529	24	04-Mar-2022
Attenuator 2W 10dB DC-10GHz	Telegartner	J01156A0031	5575	-	O/P Mon
Attenuator 2W 10dB DC-10GHz	Telegartner	J01156A0031	5579	-	O/P Mon
Attenuator 2W 10dB DC-10GHz	Telegartner	J01156A0031	5580	-	O/P Mon
Attenuator 2W 10dB DC-10GHz	Telegartner	J01156A0031	5581	-	O/P Mon
2-Way Power Divider (2-8 GHz)	Aaren	AT30A-TE0208-2-AF	5685	12	18-Dec-2021
2-Way Power Divider (2-8 GHz)	Aaren	AT30A-TE0208-2-AF	5687	12	18-Dec-2021

Table 42

O/P Mon – Output Monitored using calibrated equipment

2.4 Authorised Band Edges

2.4.1 Specification Reference

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

2.4.2 Equipment Under Test and Modification State

A2438, S/N: C02DM00Q087X - Modification State 0

2.4.3 Date of Test

02-October-2020 to 07-January-2021

2.4.4 Test Method

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

Authorised band edge measurements were performed with the device operating in SISO and MIMO configurations across the various modes supported by the device.

Since compliance with the power limits in section 2.1 was shown by RMS averaging across all symbols in the signaling alphabet, a 30 dBc limit rather than 20 dBc limit was applied in accordance with FCC 47 CFR Part 15.247(d) and RSS-247 clause 5.5.

The measurements displayed within this report, have in some cases been limited to those modes which have been shown to be worst case. Further measurements are held on file by TÜV SÜD and are available if required.

2.4.5 Environmental Conditions

Ambient Temperature	18.8 - 25.5 °C
Relative Humidity	25.5 - 46.9 %

2.4.6 Test Results

2.4 GHz WLAN

Mode	Data Rate /MCS	Resource size	Resource Index	TX Frequency (MHz)	Band Edge Frequency (MHz)	Level (dBc)
802.11b, Core 0	1 Mbps	-	-	2412	2400	-52.19
802.11g, Core 0	6 Mbps	-	-	2412	2400	-42.50
802.11n HT20, Core 0	MCS7	-	-	2412	2400	-42.38
802.11ax HE20, Core 0	MCS7x1	SU	-	2412	2400	-42.86
802.11ax HE20, Core 0	MCS7x1	26	0	2412	2400	-42.25

Table 43 - SISO Authorised Band Edge Results

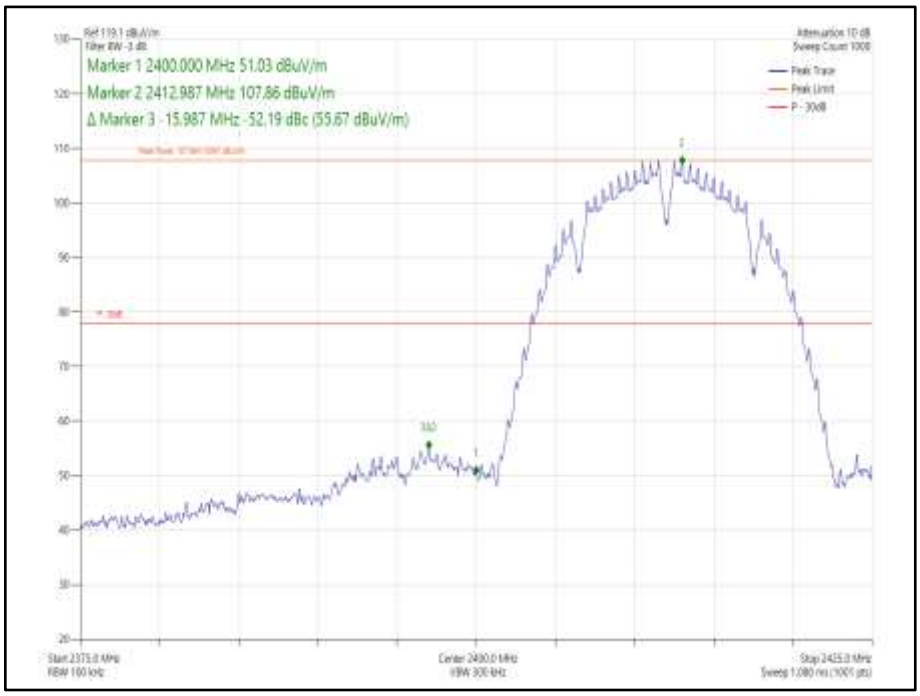

Figure 61 - 802.11b, Core 0 - 2412 MHz
Band Edge Frequency 2400 MHz

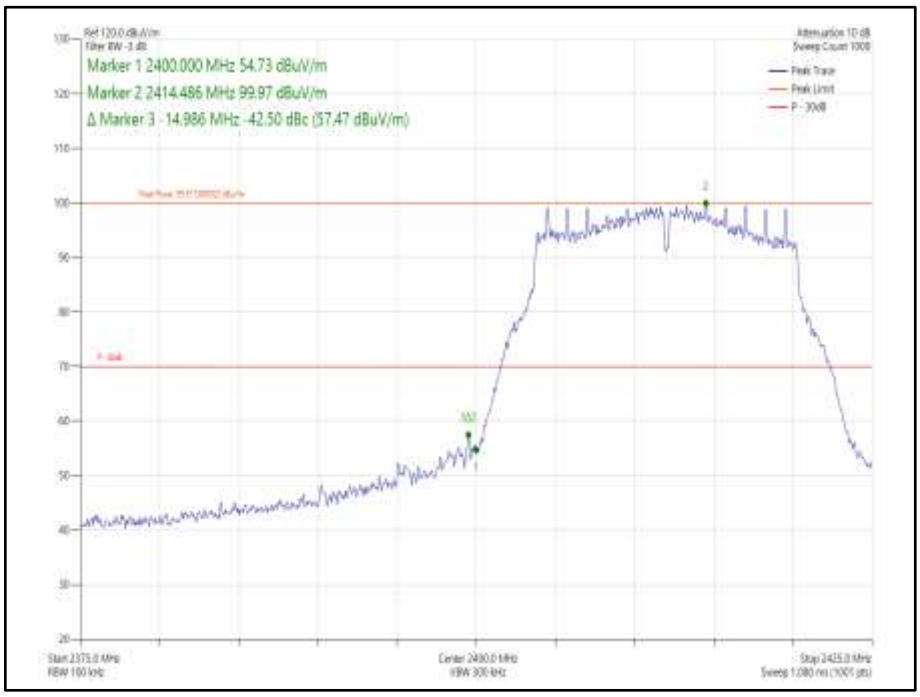

Figure 62 - 802.11g, Core 0 - 2412 MHz
Band Edge Frequency 2400 MHz

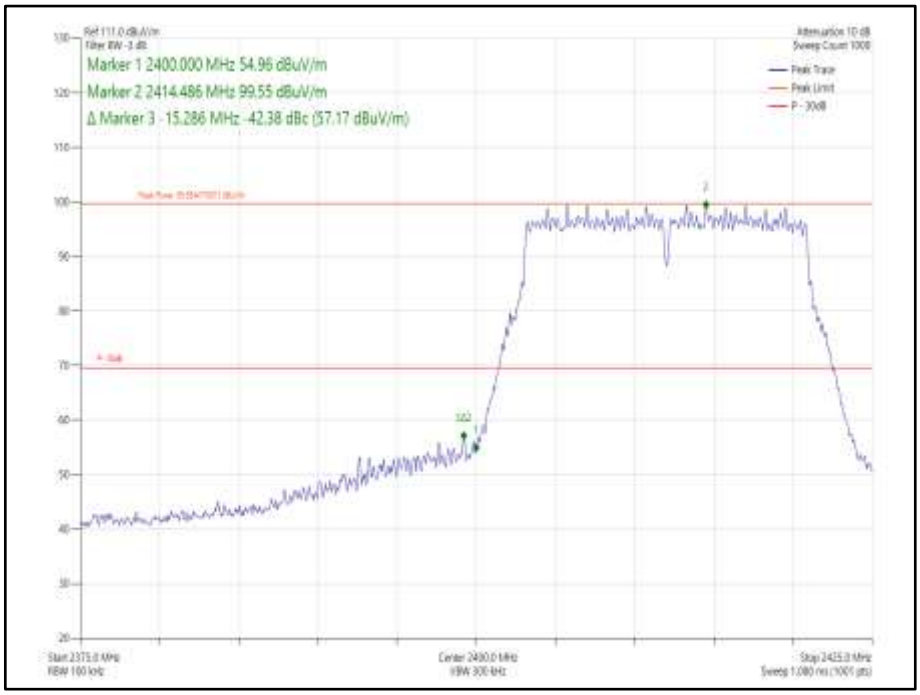

Figure 63 - 802.11n HT20, Core 0 - 2412 MHz
Band Edge Frequency 2400 MHz

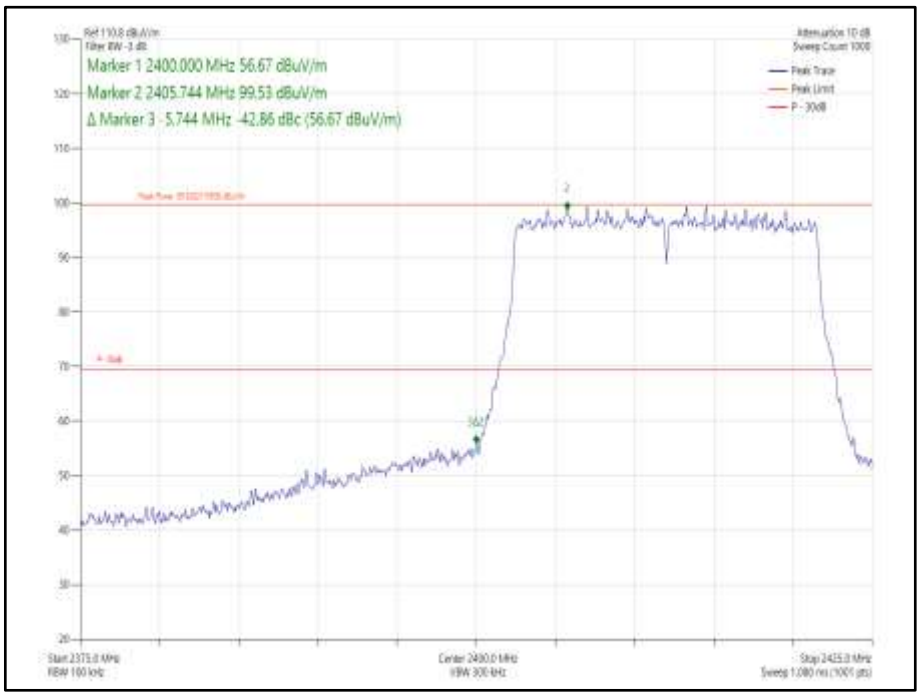

Figure 64 - 802.11ax HE20, Core 0, SU - 2412 MHz
Band Edge Frequency 2400 MHz

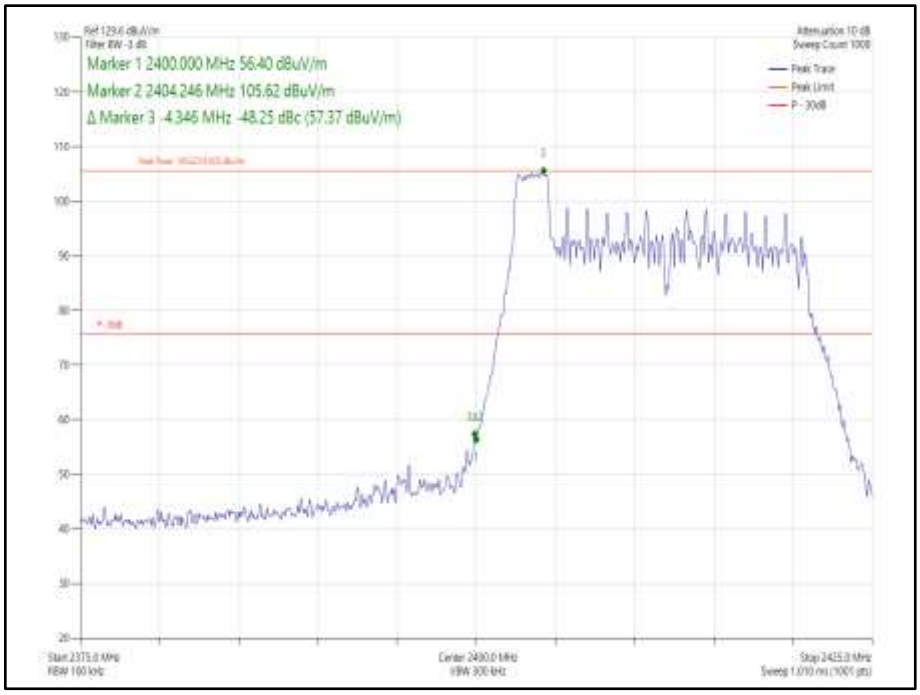

Figure 65 - 802.11ax HE20, Core 0, 26-0 - 2412 MHz
Band Edge Frequency 2400 MHz

Mode	Data Rate /MCS	Resource size	Resource Index	TX Frequency (MHz)	Band Edge Frequency (MHz)	Level (dBc)
802.11b, Core 1	1 Mbps	-	-	2412	2400	-55.24
802.11g, Core 1	6 Mbps	-	-	2412	2400	-46.79
802.11n HT20, Core 1	MCS7	-	-	2412	2400	-46.37
802.11ax HE20, Core 1	MCS7x1	SU	-	2412	2400	-47.03
802.11ax HE20, Core 1	MCS7x1	26	0	2412	2400	-51.62

Table 44 - SISO Authorised Band Edge Results

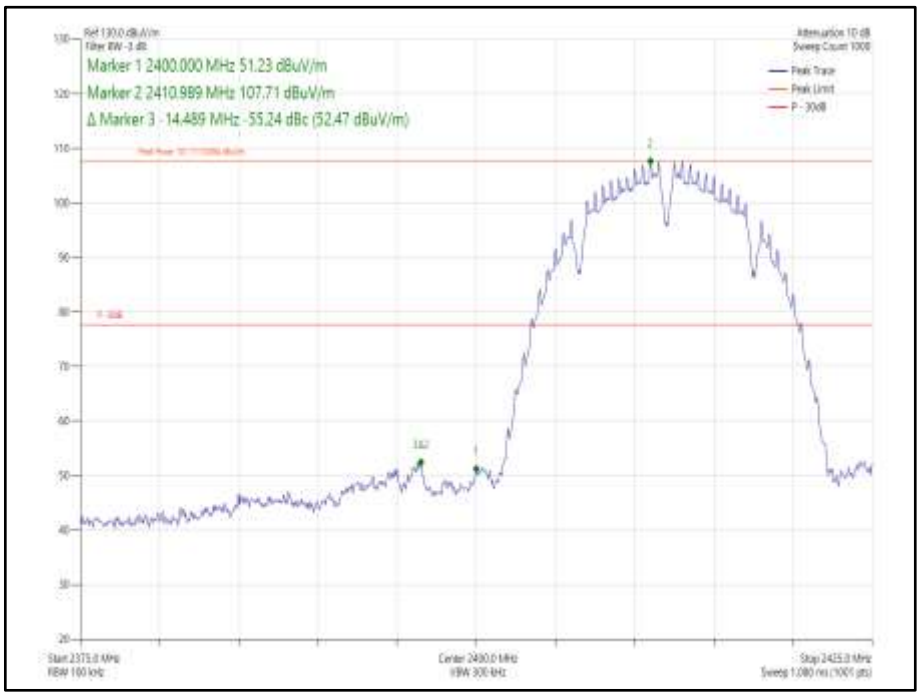

Figure 66 - 802.11b, Core 1 - 2412 MHz
Band Edge Frequency 2400 MHz

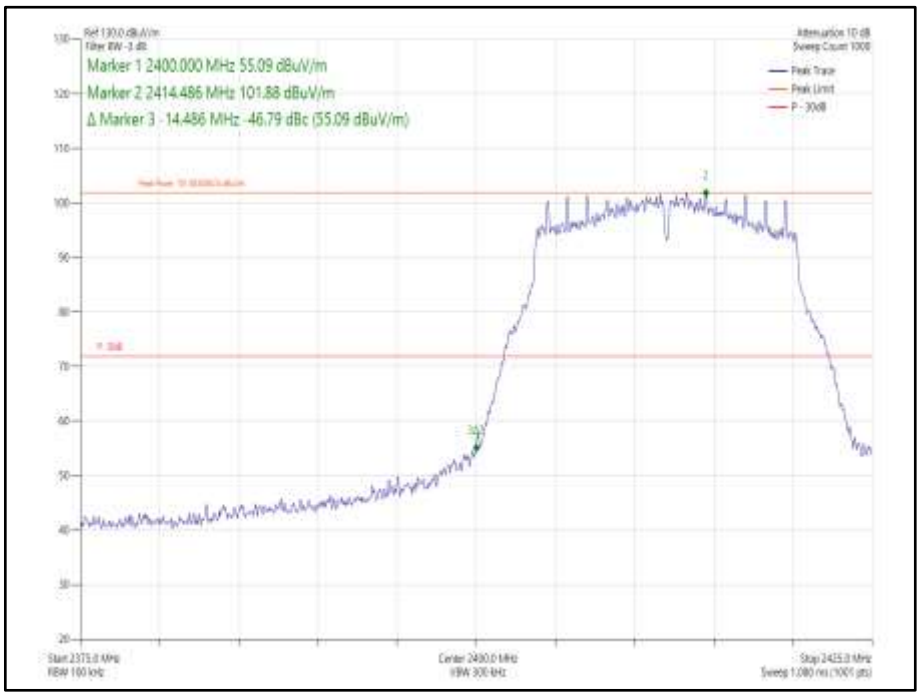

Figure 67 - 802.11g, Core 1 - 2412 MHz
Band Edge Frequency 2400 MHz

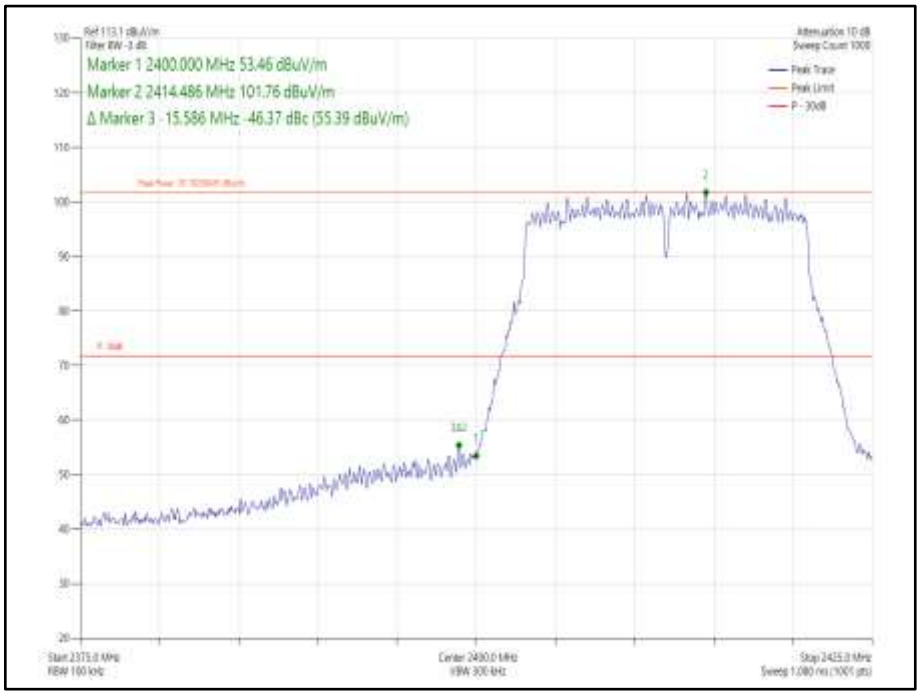

Figure 68 - 802.11n HT20, Core 1 - 2412 MHz
Band Edge Frequency 2400 MHz

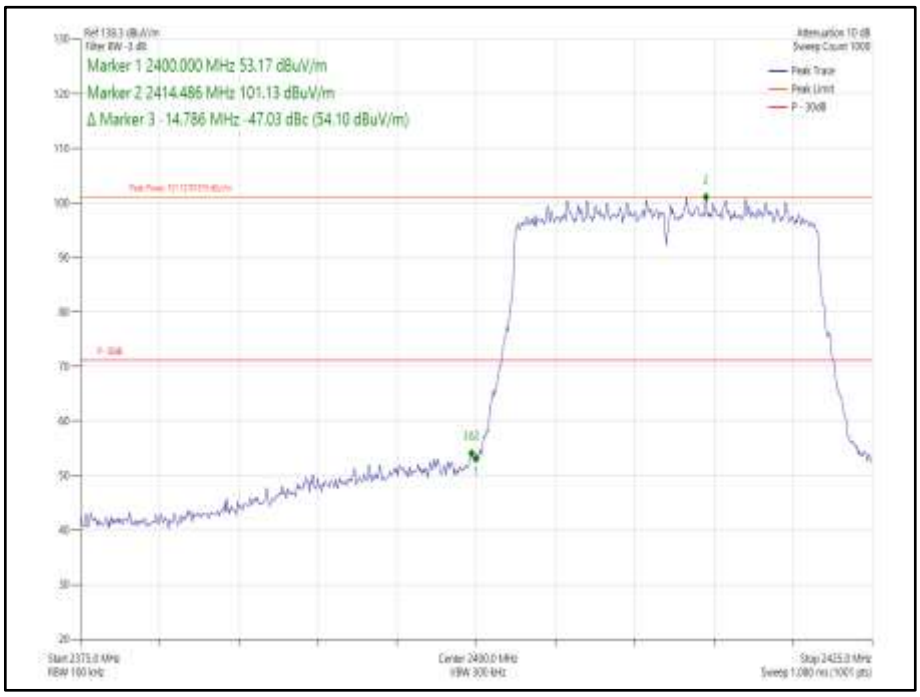

Figure 69 - 802.11ax HE20, Core 1, SU - 2412 MHz
Band Edge Frequency 2400 MHz

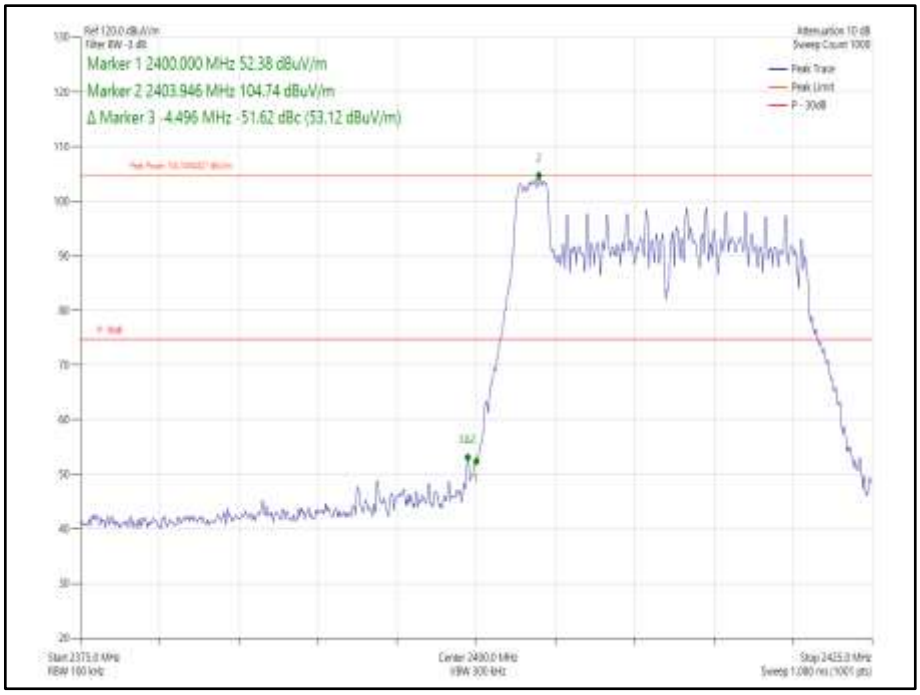

Figure 70 - 802.11ax HE20, Core 1, 26-0 - 2412 MHz
Band Edge Frequency 2400 MHz

Mode	Data Rate /MCS	Resource size	Resource Index	TX Frequency (MHz)	Band Edge Frequency (MHz)	Level (dBc)
802.11n HT20, Cores 0-1	MCS7	-	-	2412	2400	-46.72
802.11ax HE20, Cores 0-1	MCS7x1	SU	-	2412	2400	-47.36
802.11ax HE20, Cores 0-1	MCS7x1	26	0	2412	2400	-53.14

Table 45 - MIMO Authorised Band Edge Results

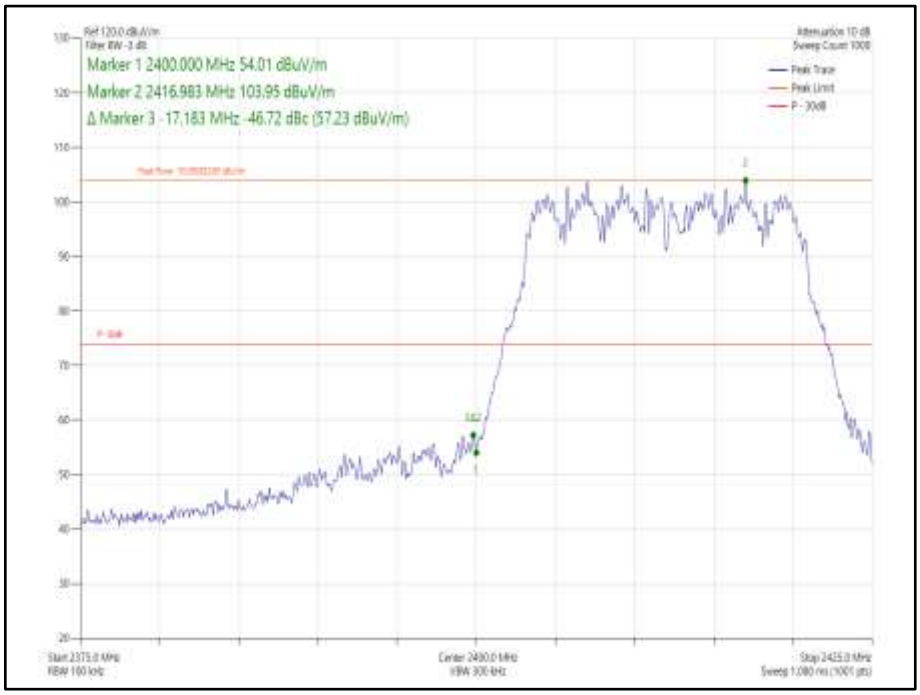

Figure 71 - 802.11n HT20, Cores 0-1 - 2412 MHz
Band Edge Frequency 2400 MHz

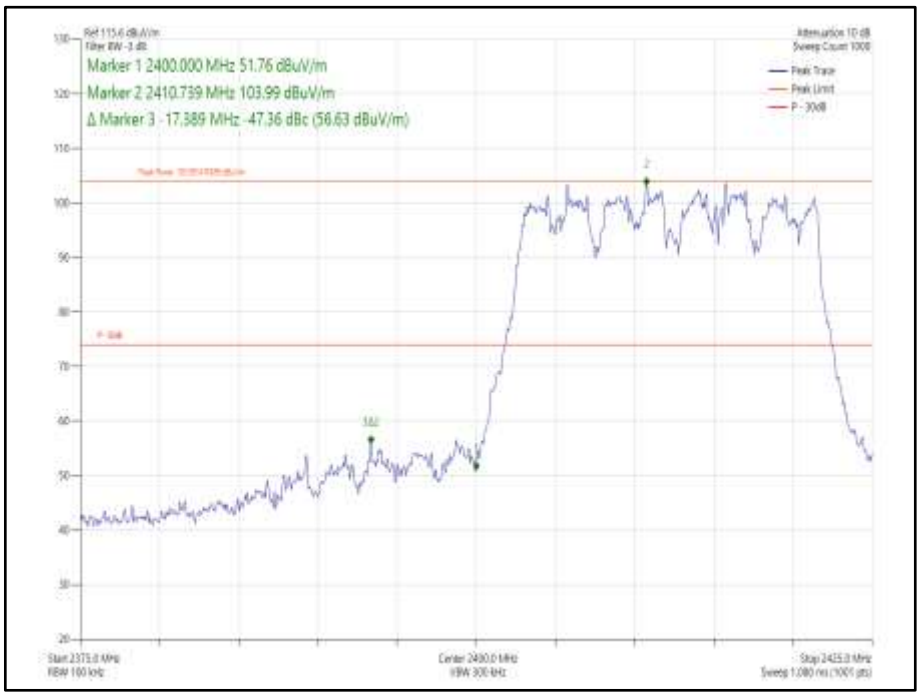

Figure 72 - 802.11ax HE20, Cores 0-1, SU - 2412 MHz
Band Edge Frequency 2400 MHz

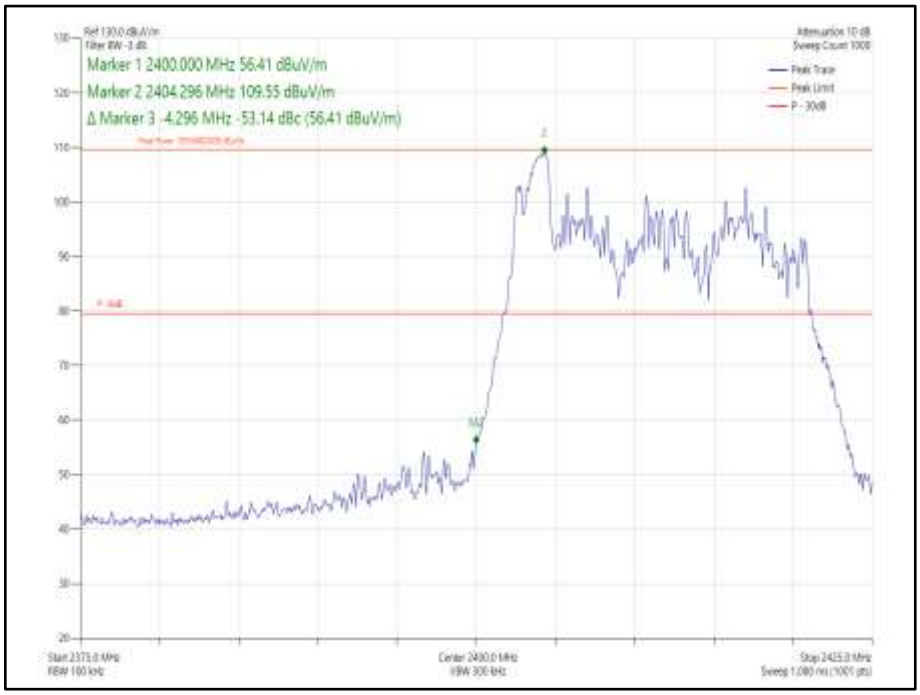

Figure 73 - 802.11ax HE20, Cores 0-1, 26-0 - 2412 MHz
Band Edge Frequency 2400 MHz

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

20 dB below the fundamental measured in a 100 kHz bandwidth using a peak detector. If the transmitter complies with the conducted power limits, based on the use of RMS averaging over a time interval, the attenuation required shall be 30 dB below the fundamental instead of 20 dB.

ISED RSS-247, Limit Clause 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

2.4.7 Test Location and Test Equipment Used

This test was carried out in RF Chamber 11.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
EMI Test Receiver	Rohde & Schwarz	ESW44	5084	12	04-Feb-2021
EmX Emissions Software	TUV SUD	V2.1.0	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 46

TU - Traceability Unscheduled

2.5 Restricted Band Edges

2.5.1 Specification Reference

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

2.5.2 Equipment Under Test and Modification State

A2438, S/N: C02DM00Q087X - Modification State 0

2.5.3 Date of Test

09-November-2020 to 10-January-2021

2.5.4 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 4.1.4.2.5. These are shown for information purposes and were used to determine the worst-case measurement point. Final average measurements were then taken in accordance with ANSI C63.10, clause 4.1.4.2.2 to obtain the measurement result recorded in the test results tables.

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

10^(Field Strength in dBµV/m/20).

Restricted band edge measurements were performed, with the device operating in SISO and MIMO configurations, across the various modes supported by the device.

The measurements displayed within this report, have been limited to those modes which have been shown to be worst case.

Further measurements are held on file by TÜV SÜD and are available if required.

2.5.5 Environmental Conditions

Ambient Temperature	18.8 - 25.5 °C
Relative Humidity	35.0 - 46.9 %

2.5.6 Test Results

2.4 GHz WLAN

Mode	Data Rate /MCS	Resource Size	Resource Index	TX Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBµV/m)	Average Level (dBµV/m)
802.11b, Core 1	1 Mbps	-	-	2412	2390.0	56.82	46.60
802.11b, Core 1	1 Mbps	-	-	2462	2483.5	55.74	45.10
802.11b, Core 1	1 Mbps	-	-	2467	2483.5	57.31	46.97
802.11b, Core 1	1 Mbps	-	-	2472	2483.5	54.13	43.80
802.11g, Core 1	6 Mbps	-	-	2412	2390.0	56.69	45.68
802.11g, Core 1	6 Mbps	-	-	2462	2483.5	55.40	44.03
802.11g, Core 1	6 Mbps	-	-	2467	2483.5	58.44	44.53
802.11g, Core 1	6 Mbps	-	-	2472	2483.5	55.64	43.52
802.11n HT20, Core 1	MCS7	-	-	2412	2390.0	63.95	48.06
802.11n HT20, Core 1	MCS7	-	-	2462	2483.5	56.59	45.12
802.11n HT20, Core 1	MCS7	-	-	2467	2483.5	55.63	45.22
802.11n HT20, Core 1	MCS7	-	-	2472	2483.5	56.19	43.87
802.11ax HE20, Core 1	MCS7x1	SU	-	2412	2400	65.85	49.03
802.11ax HE20, Core 1	MCS7x1	26	0	2412	2400	56.25	44.25
802.11ax HE20, Core 1	MCS7x1	SU	-	2462	2483.5	58.75	45.79
802.11ax HE20, Core 1	MCS7x1	26	8	2462	2483.5	65.70	46.67
802.11ax HE20, Core 1	MCS7x1	SU	-	2467	2483.5	55.69	45.39
802.11ax HE20, Core 1	MCS7x1	26	8	2467	2483.5	55.44	44.34
802.11ax HE20, Core 1	MCS7x1	SU	-	2472	2483.5	57.21	43.25
802.11ax HE20, Core 1	MCS7x1	26	8	2472	2483.5	64.10	46.11

Table 47 - SISO Restricted Band Edge Results

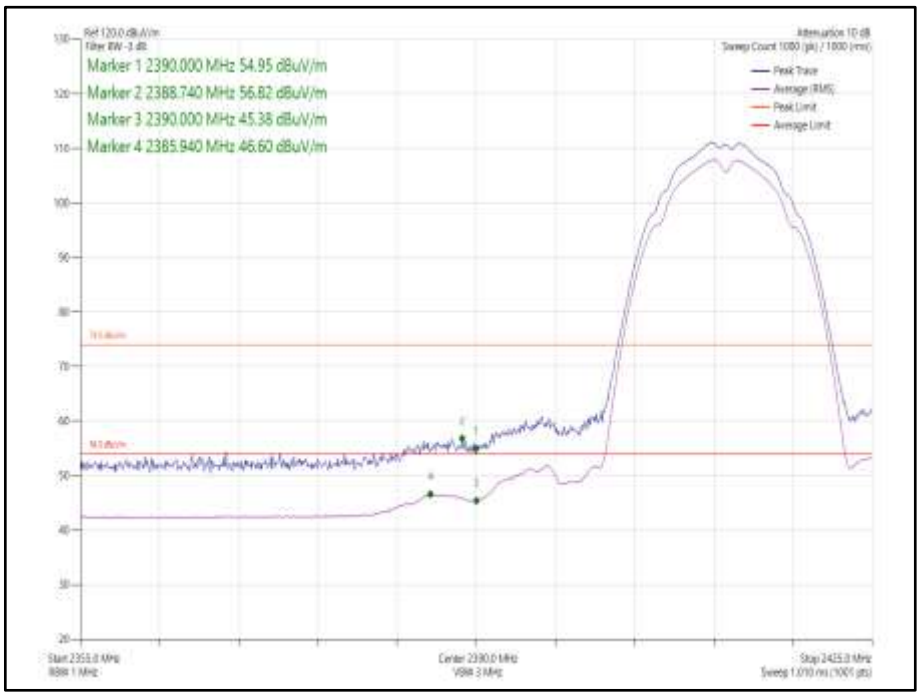

Figure 74 - 802.11b, Core 1 - 2412 MHz, Band Edge Frequency 2390.0 MHz

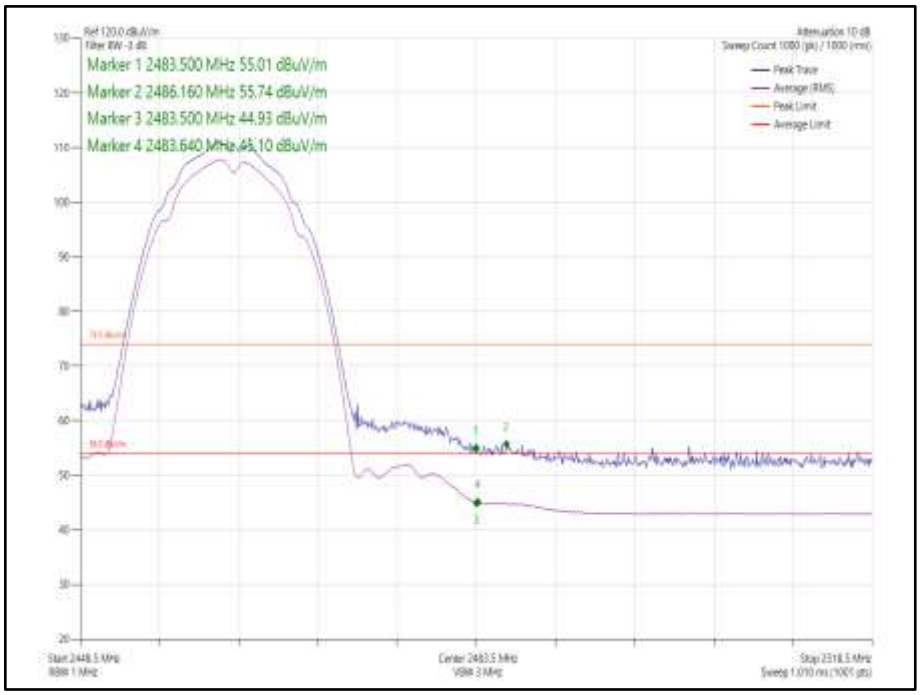

Figure 75 - 802.11b, Core 1 - 2462 MHz, Band Edge Frequency 2483.5 MHz

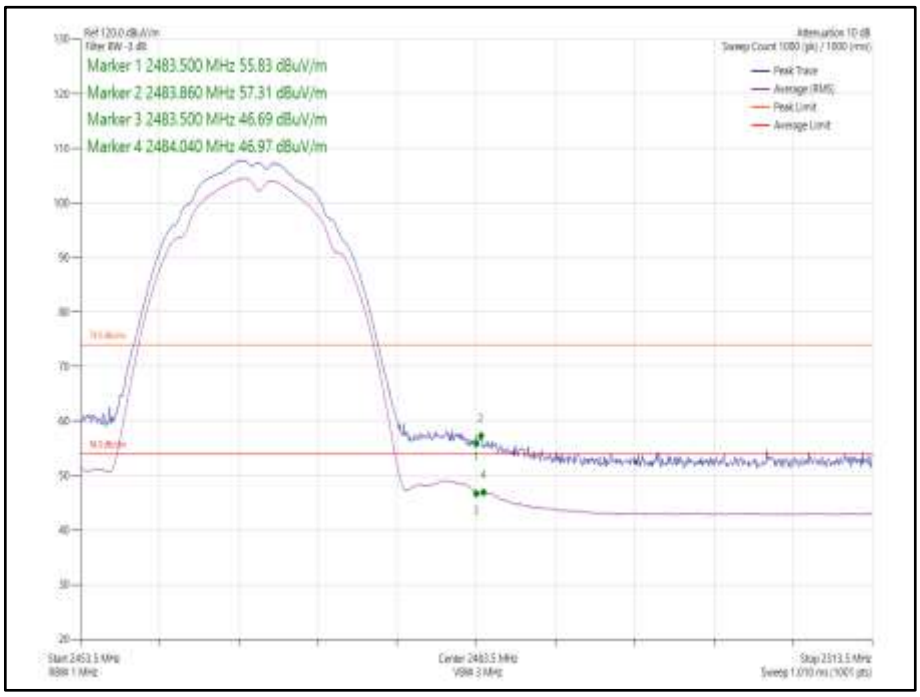

Figure 76 - 802.11b, Core 1 - 2467 MHz, Band Edge Frequency 2483.5 MHz

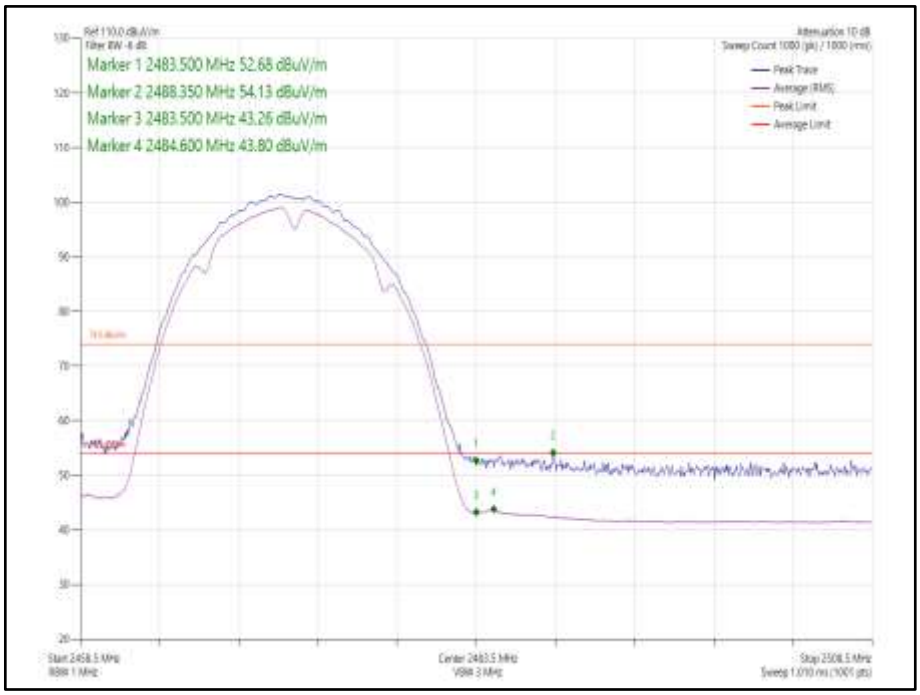

Figure 77 - 802.11b, Core 1 - 2472 MHz, Band Edge Frequency 2483.5 MHz

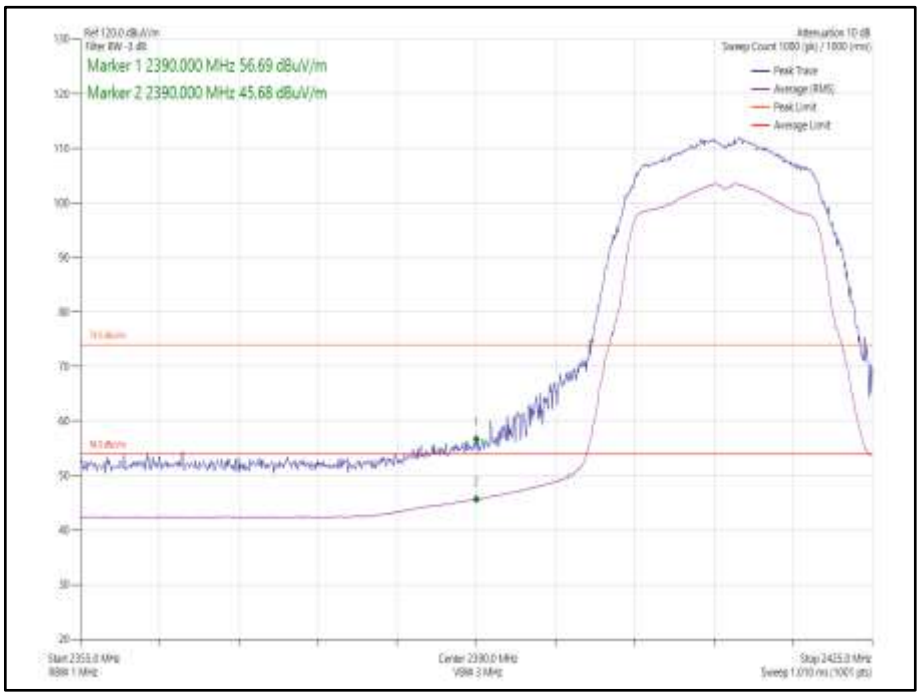

Figure 78 - 802.11g, Core 1 - 2412 MHz, Band Edge Frequency 2390.0 MHz

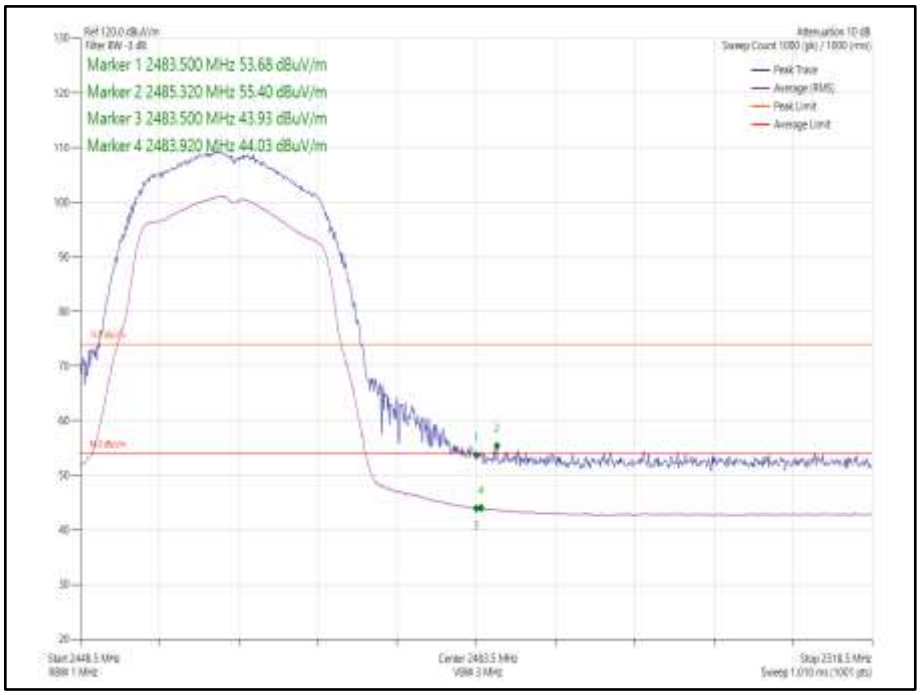

Figure 79 - 802.11g, Core 1 - 2462 MHz, Band Edge Frequency 2483.5 MHz

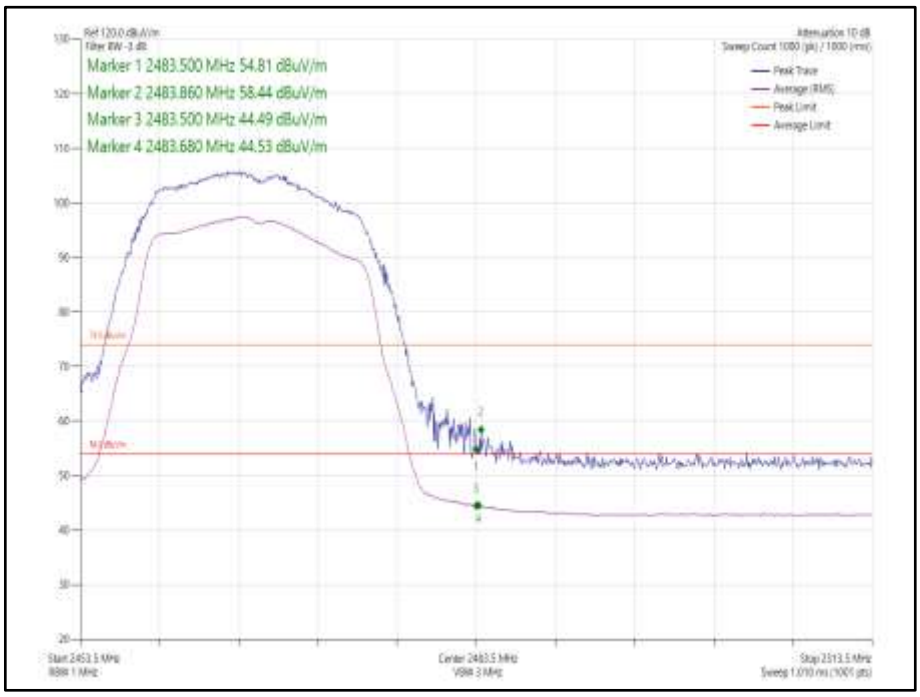

Figure 80 - 802.11g, Core 1 - 2467 MHz, Band Edge Frequency 2483.5 MHz

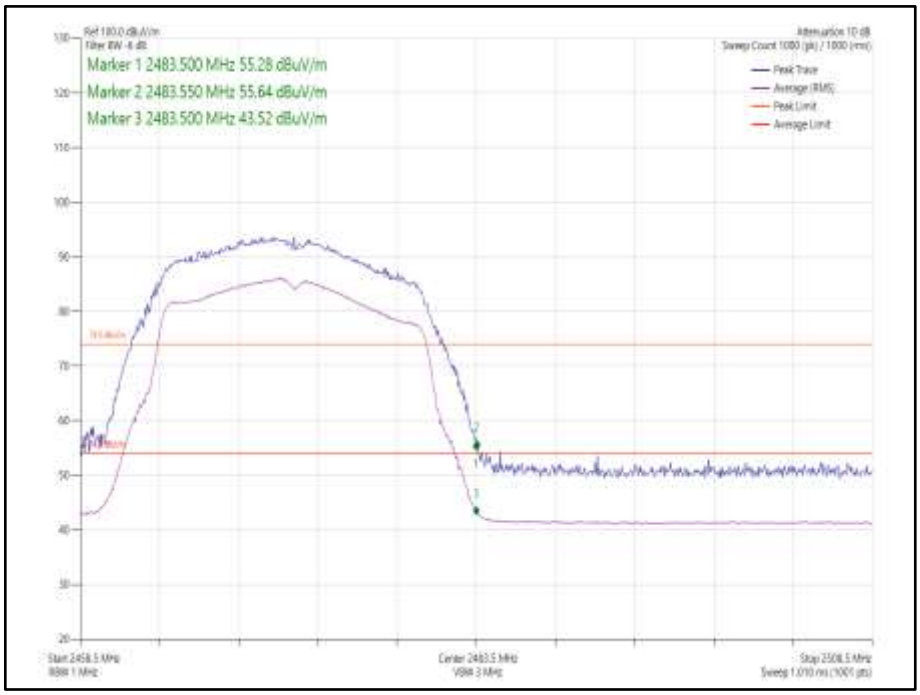

Figure 81 - 802.11g, Core 1 - 2472 MHz, Band Edge Frequency 2483.5 MHz

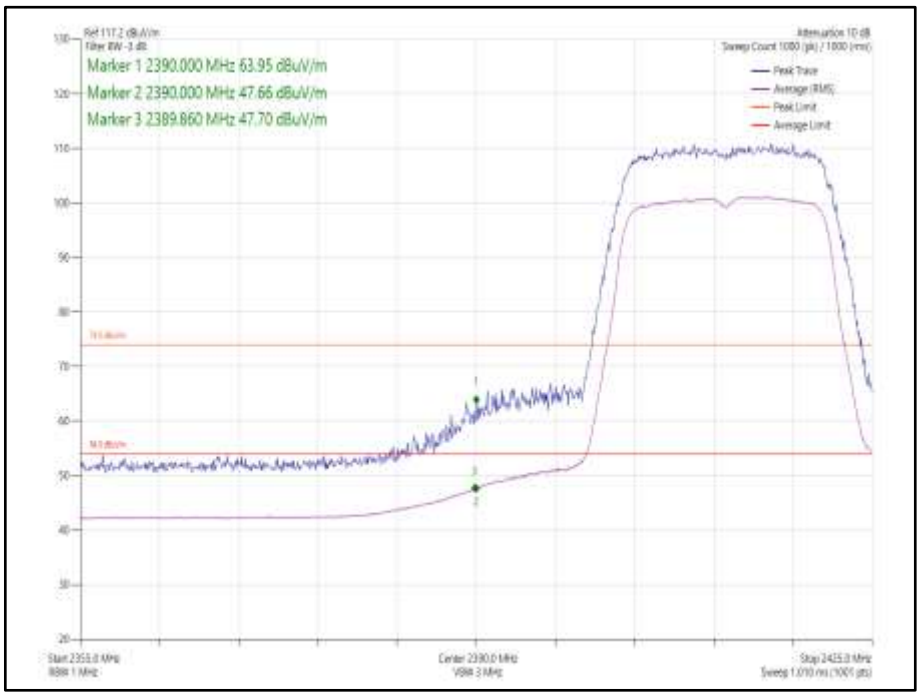

Figure 82 - 802.11n, HT20, Core 1 - 2412 MHz, Band Edge Frequency 2390 MHz

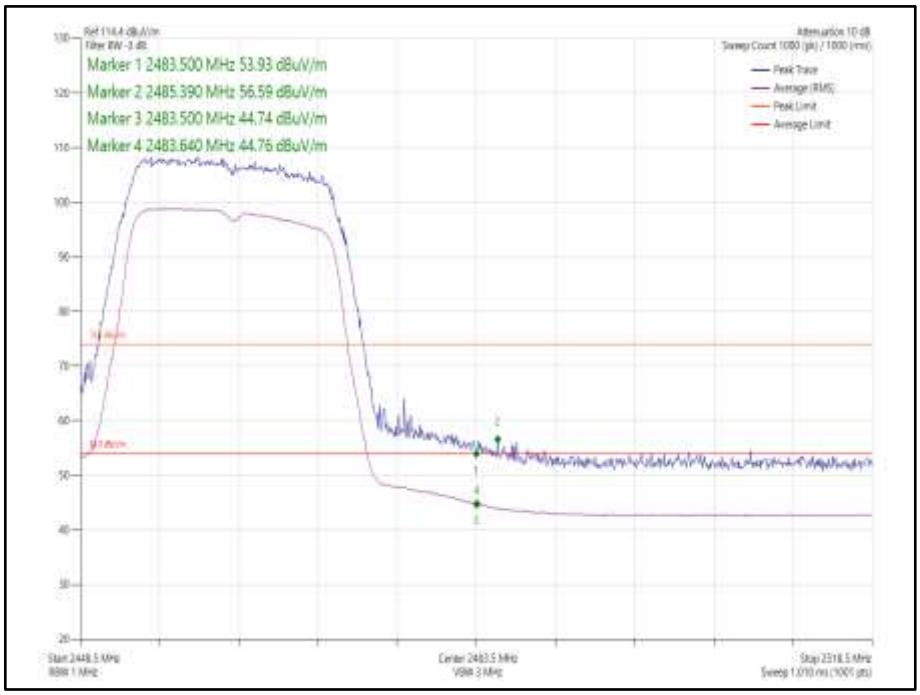

Figure 83 - 802.11n HT20, Core 1 - 2462 MHz, Band Edge Frequency 2483.5 MHz

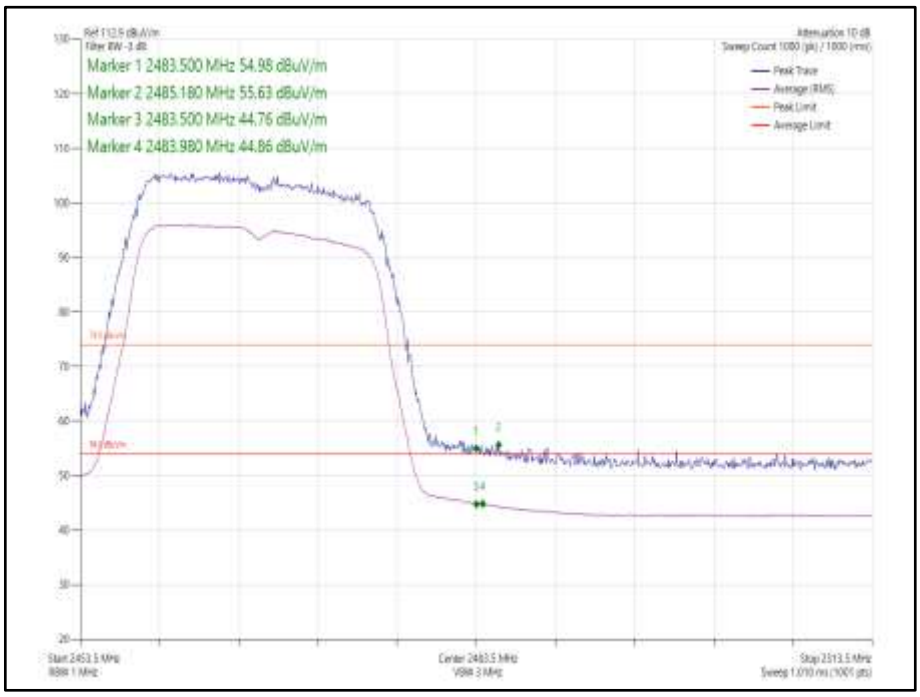

Figure 84 - 802.11n HT20, Core 1 - 2467 MHz, Band Edge Frequency 2483.5 MHz

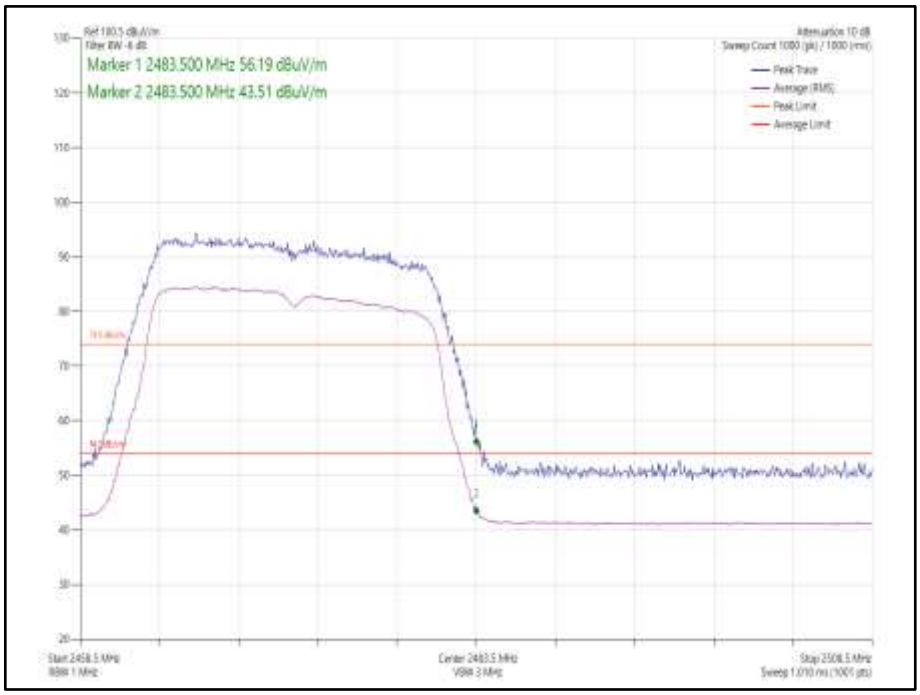

Figure 85 - 802.11n HT20, Core 1 - 2472 MHz, Band Edge Frequency 2483.5 MHz

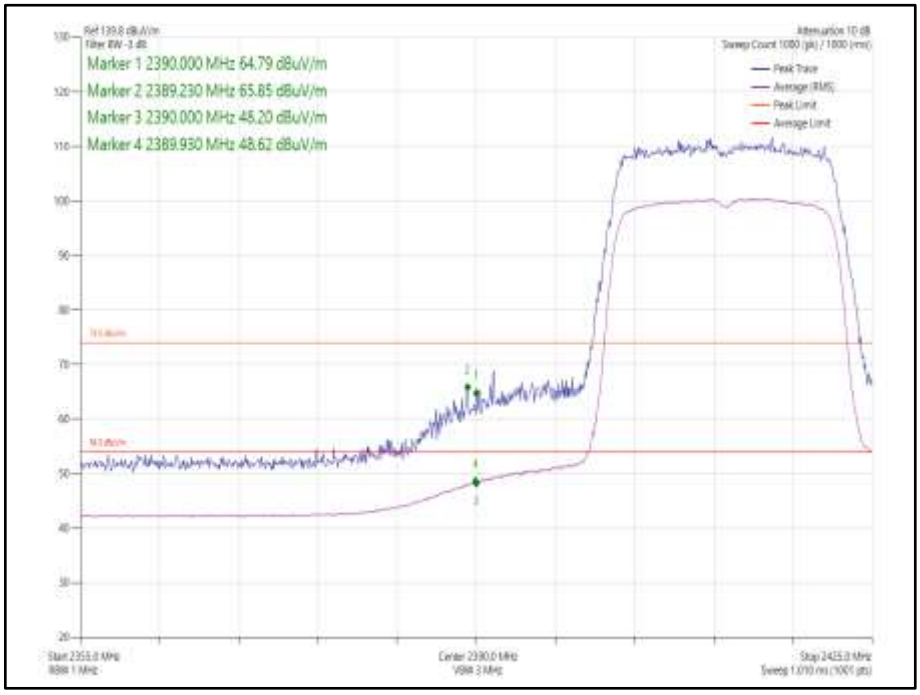

Figure 86 - 802.11ax HE20, Core 1, SU - 2412 MHz, Band Edge Frequency 2390 MHz

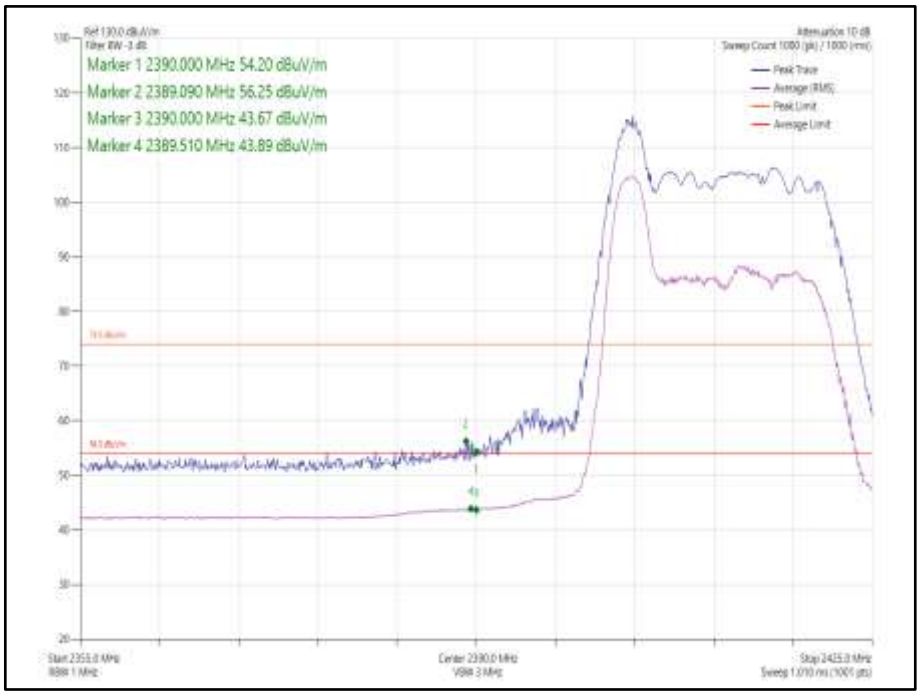

Figure 87 - 802.11ax HE20, Core 1, 26-0 - 2412 MHz, Band Edge Frequency 2390 MHz

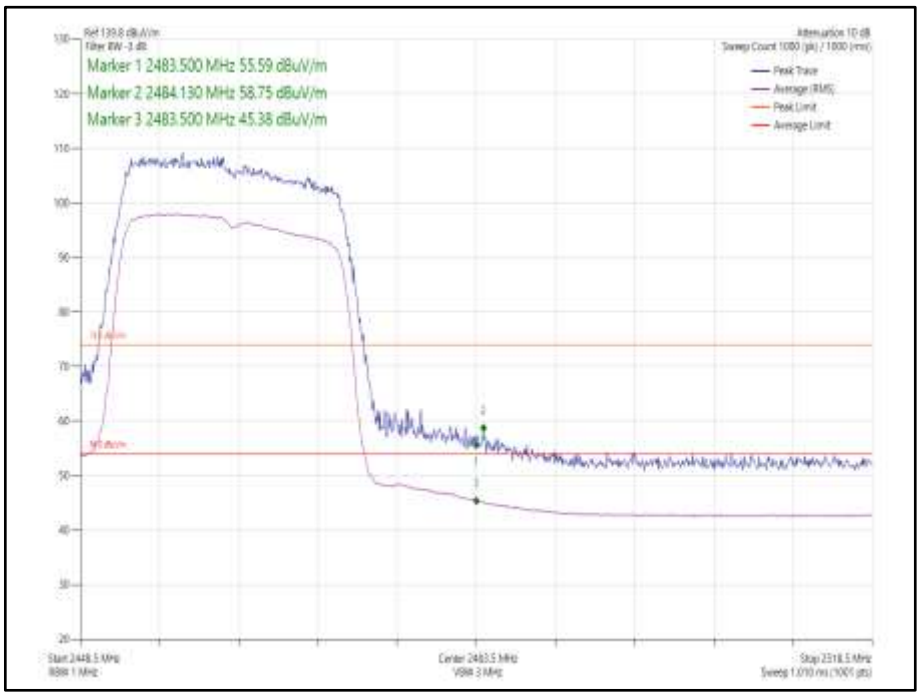

Figure 88 - 802.11ax HE20, Core 1, SU - 2462 MHz, Band Edge Frequency 2483.5 MHz

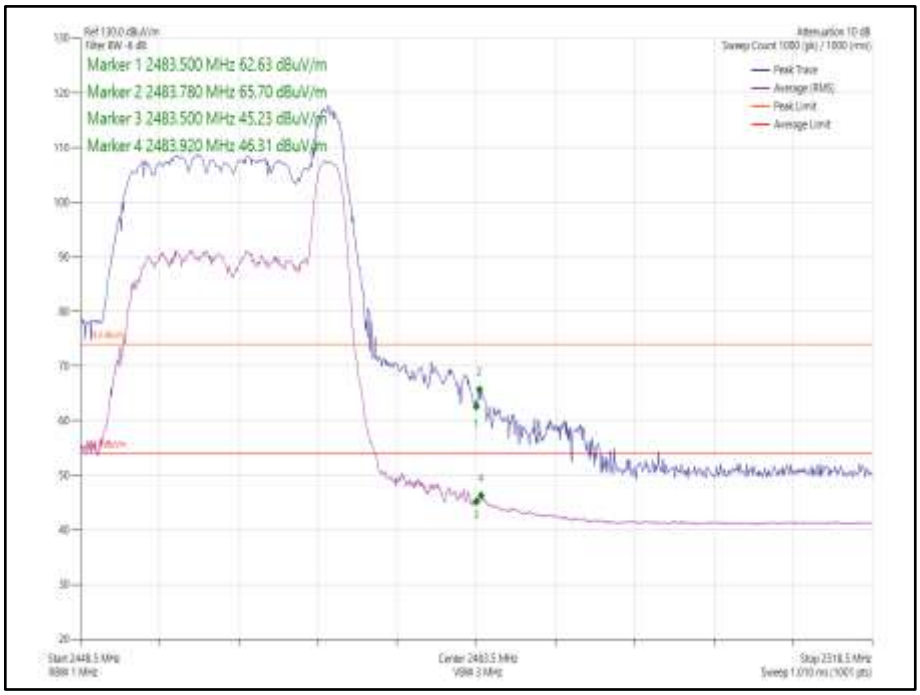

Figure 89 - 802.11ax HE20, Core 1, 26-8 - 2462 MHz, Band Edge Frequency 2483.5 MHz

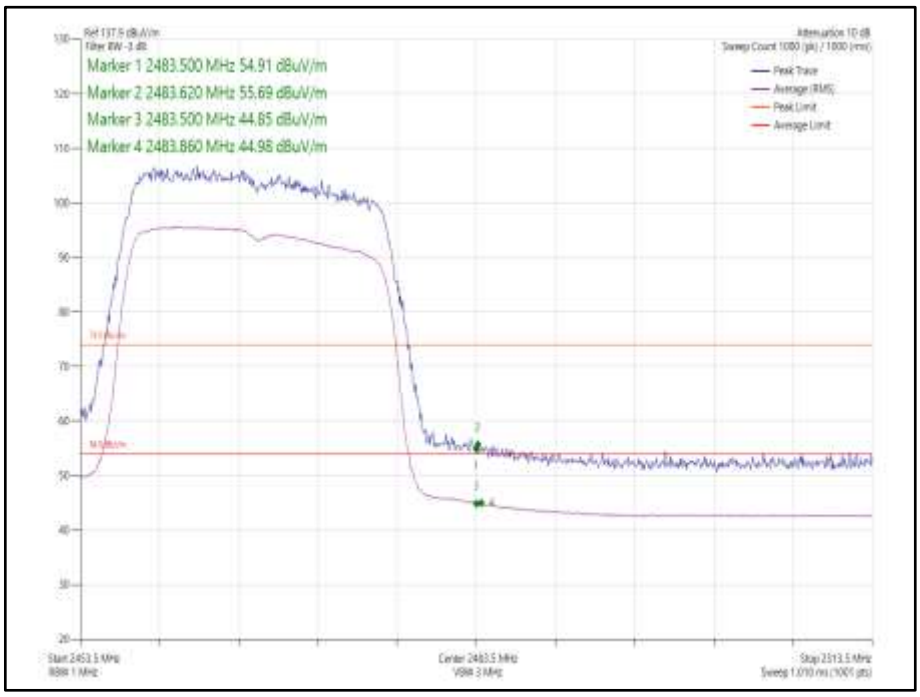

Figure 90 - 802.11ax HE20, Core 1, SU - 2467 MHz, Band Edge Frequency 2483.5 MHz

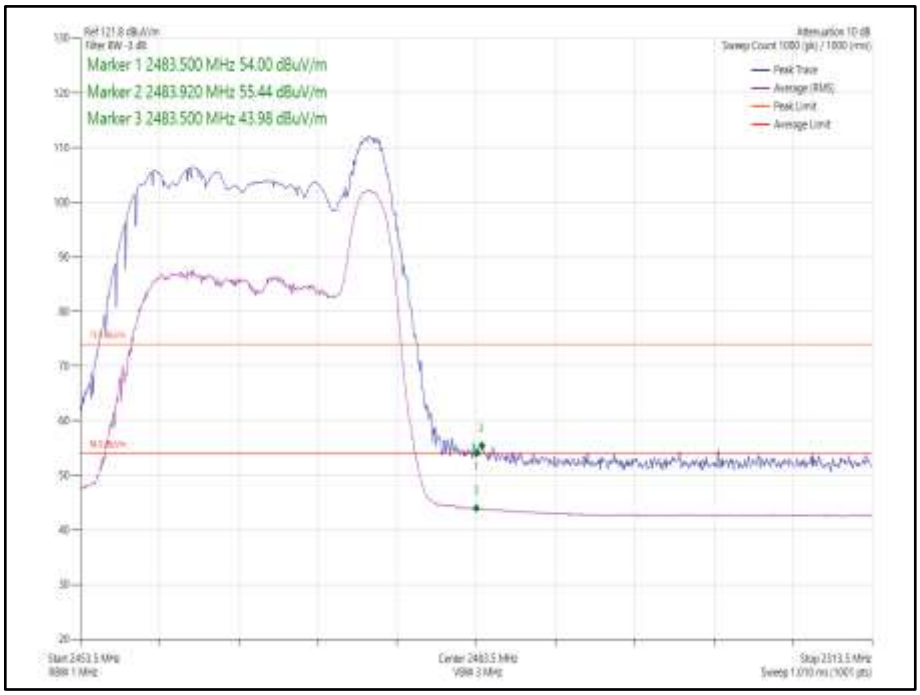

Figure 91 - 802.11ax HE20, Core 1, 26-8 - 2467 MHz, Band Edge Frequency 2483.5 MHz

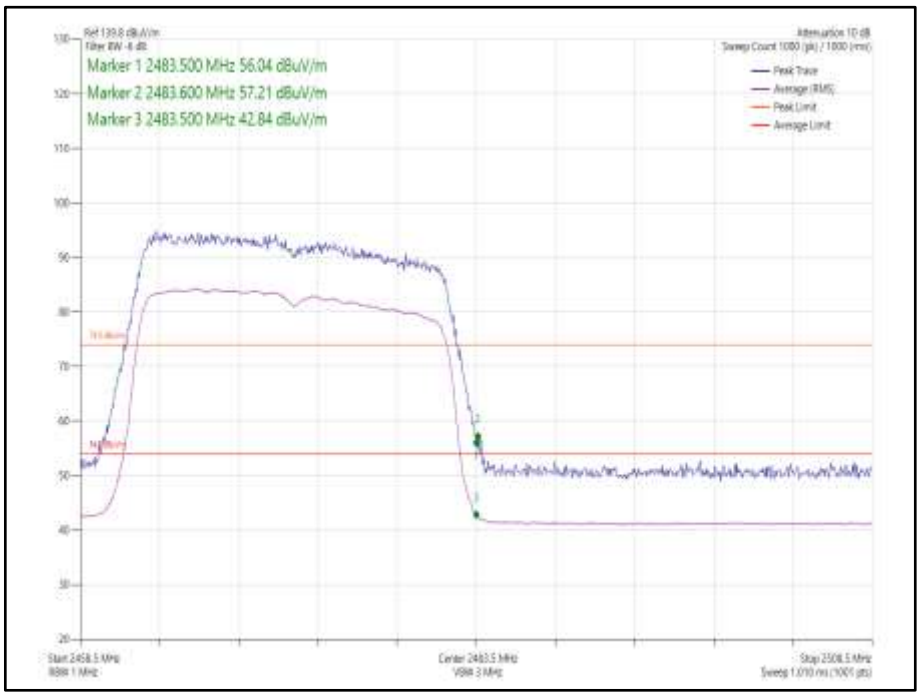

Figure 92 - 802.11ax HE20, Core 1, SU - 2472 MHz, Band Edge Frequency 2483.5 MHz

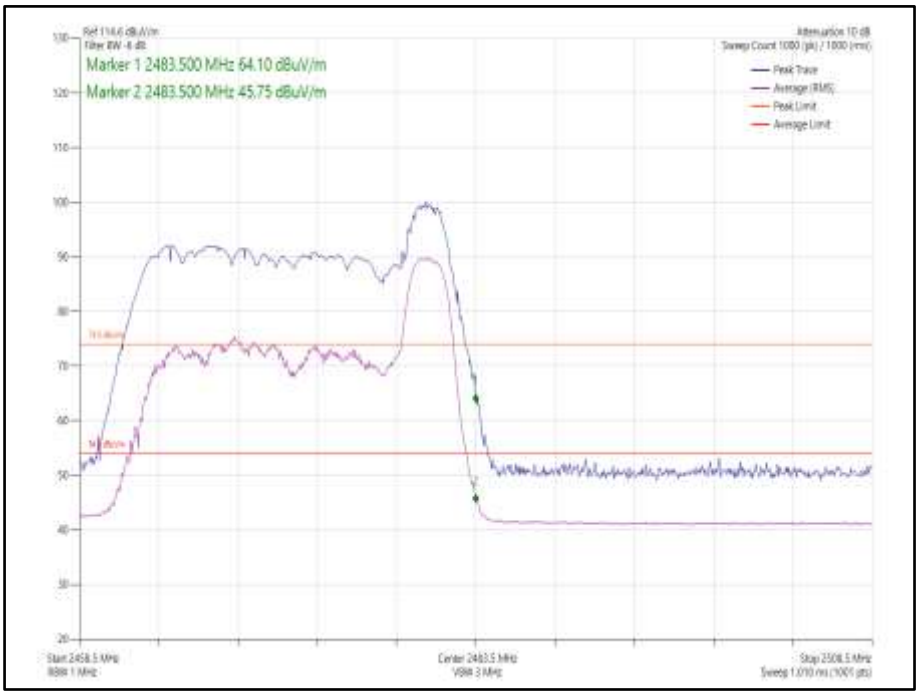

Figure 93 - 802.11ax HE20, Core 1, 26-8 - 2472 MHz, Band Edge Frequency 2483.5 MHz

Mode	Data Rate/ MCS	Resource Size	Resource Index	TX Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBµV/m)	Average Level (dBµV/m)
802.11n HT20, Core 0-1	MCS7	-	-	2412	2390.0	64.94	48.12
802.11n HT20, Core 0-1	MCS7	-	-	2462	2483.5	60.11	48.14
802.11n HT20, Core 0-1	MCS7	-	-	2467	2483.5	60.10	47.45
802.11n HT20, Core 0-1	MCS7	-	-	2472	2483.5	62.16	47.81
802.11ax HE20, Core 0-1	MCS7x1	SU	-	2412	2400	66.08	50.05
802.11ax HE20, Core 0-1	MCS7x1	26	0	2412	2400	57.16	45.17
802.11ax HE20, Core 0-1	MCS7x1	SU	-	2462	2483.5	61.30	47.40
802.11ax HE20, Core 0-1	MCS7x1	26	8	2462	2483.5	64.34	46.20
802.11ax HE20, Core 0-1	MCS7x1	SU	-	2467	2483.5	59.77	47.92
802.11ax HE20, Core 0-1	MCS7x1	26	8	2467	2483.5	61.52	48.02
802.11ax HE20, Core 0-1	MCS7x1	SU	-	2472	2483.5	63.11	45.39
802.11ax HE20, Core 0-1	MCS7x1	26	8	2472	2483.5	69.36	51.41

Table 48 – MIMO Restricted Band Edge Results

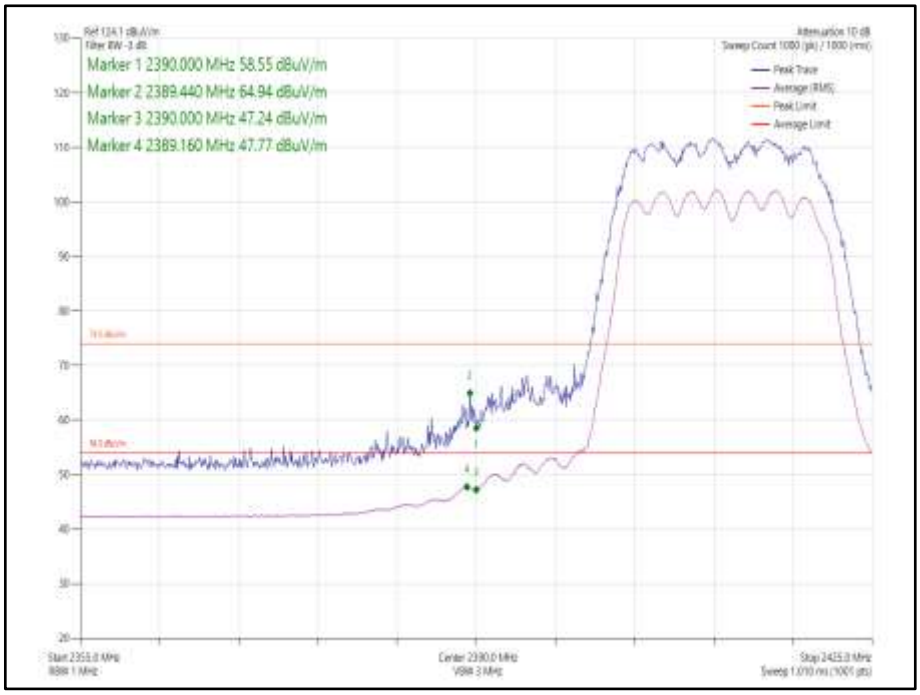

Figure 94 - 802.11n HT20, Core 0-1 - 2412 MHz, Band Edge Frequency 2390 MHz

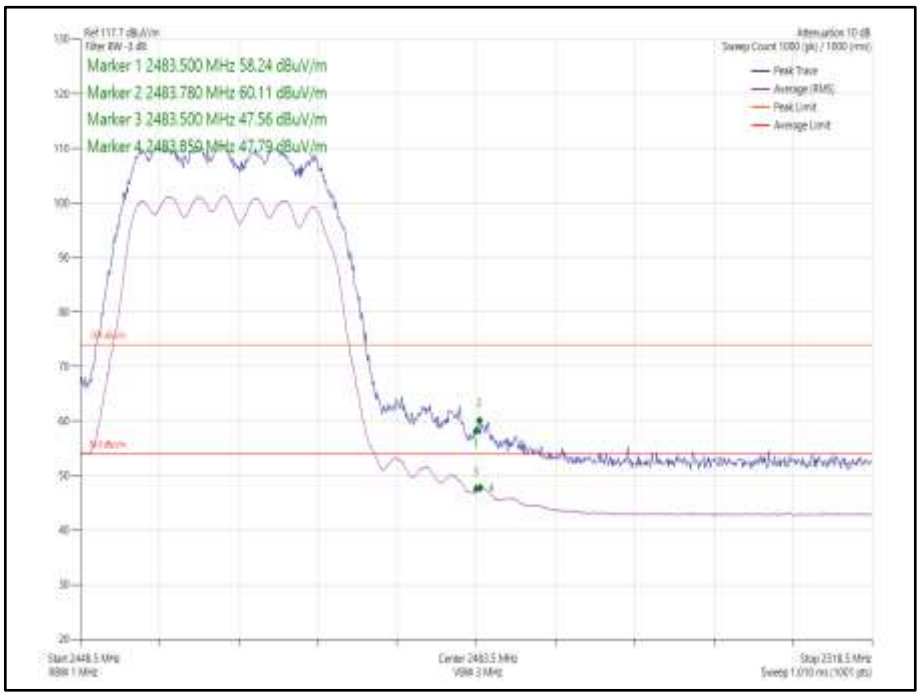

Figure 95 - 802.11n HT20, Core 0-1 - 2462 MHz, Band Edge Frequency 2483.5 MHz

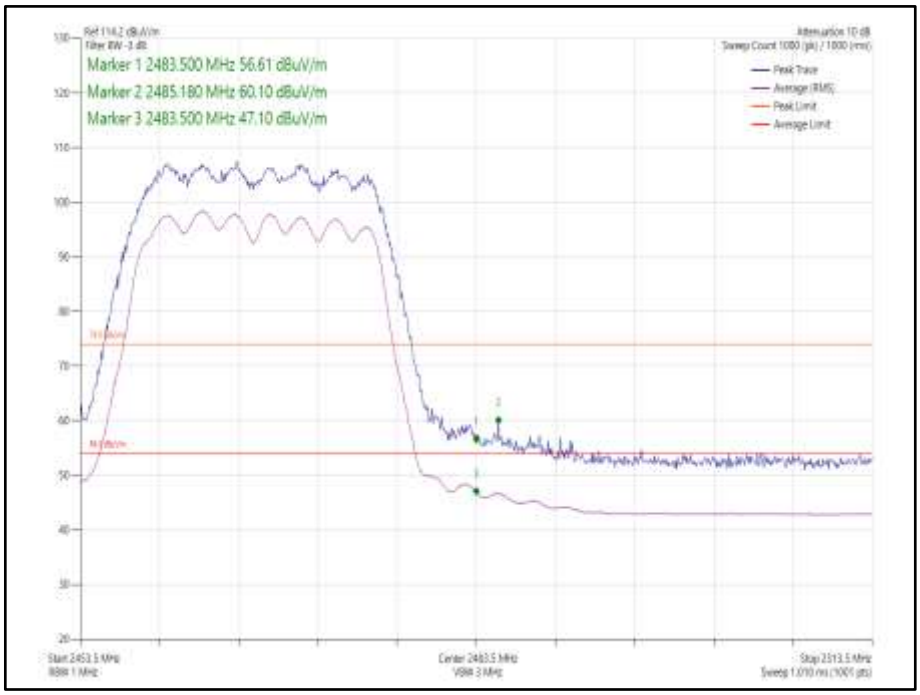

Figure 96 - 802.11n HT20, Core 0-1 - 2467 MHz, Band Edge Frequency 2483.5 MHz

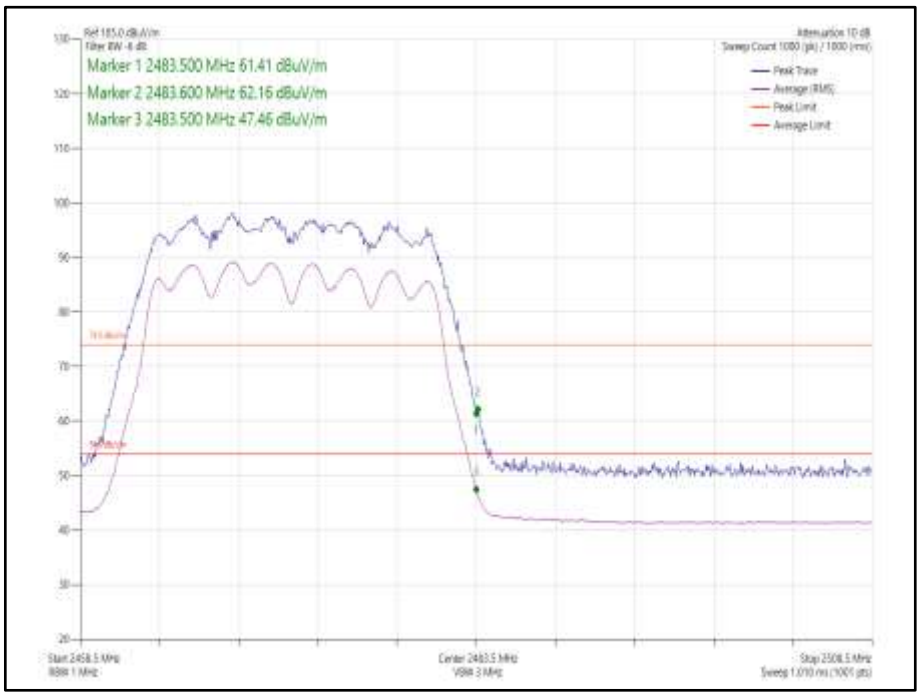

Figure 97 - 802.11n HT20, Core 0-1 - 2472 MHz, Band Edge Frequency 2483.5 MHz

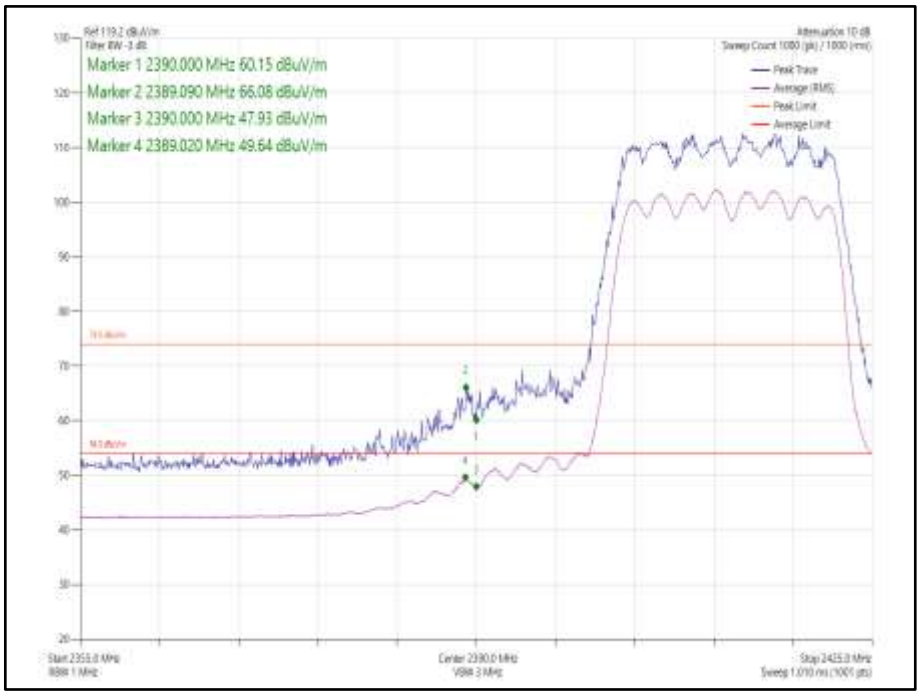

Figure 98 - 802.11ax HE20, Core 0-1, SU - 2412 MHz, Band Edge Frequency 2390 MHz

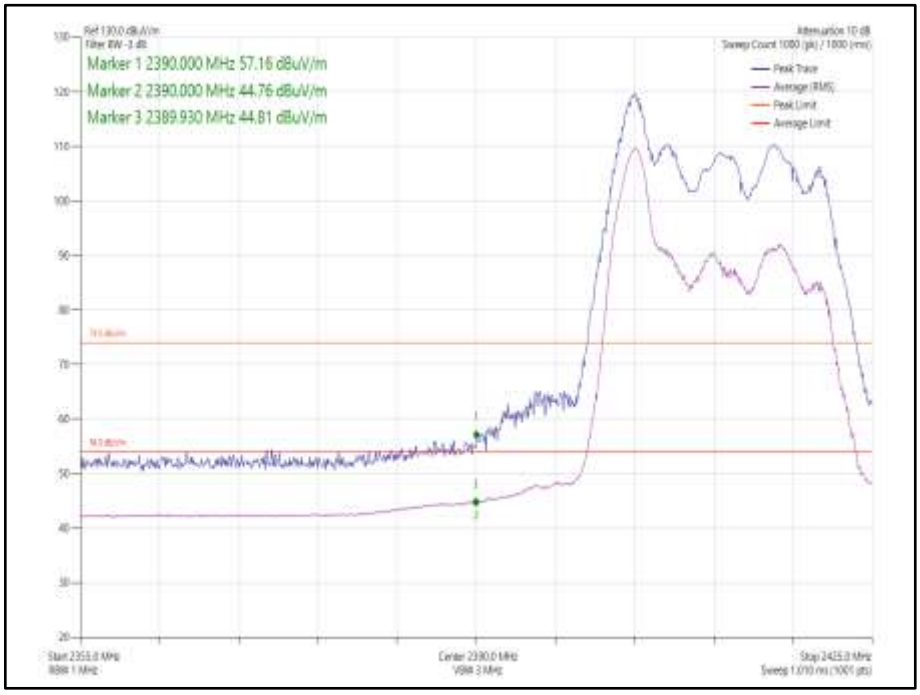

Figure 99 - 802.11ax HE20, Core 0-1, 26-0 - 2412 MHz, Band Edge Frequency 2390 MHz

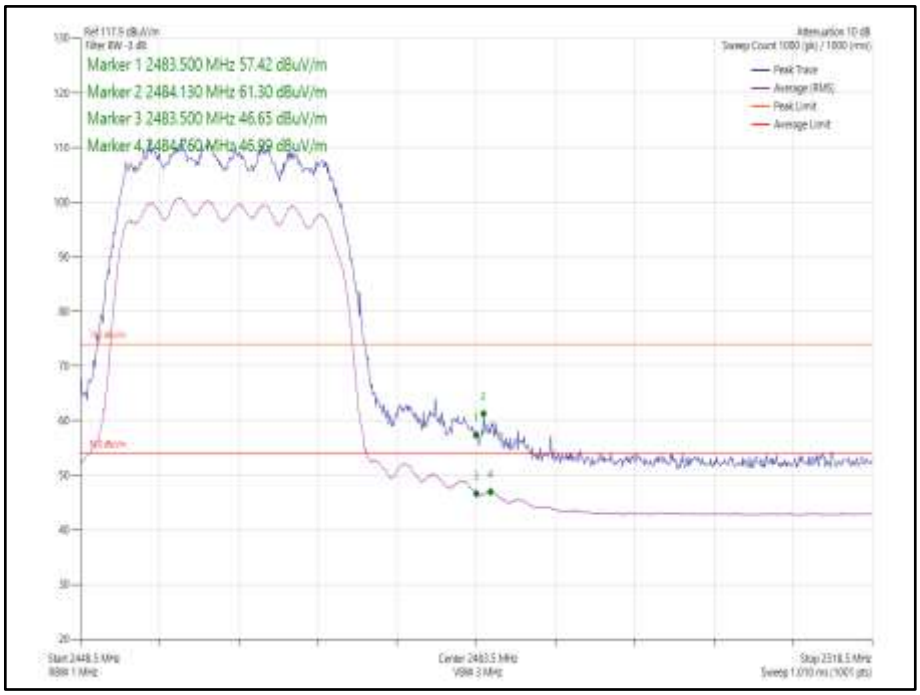

Figure 100 - 802.11ax HE20, Core 0-1, SU - 2462 MHz, Band Edge Frequency 2483.5 MHz

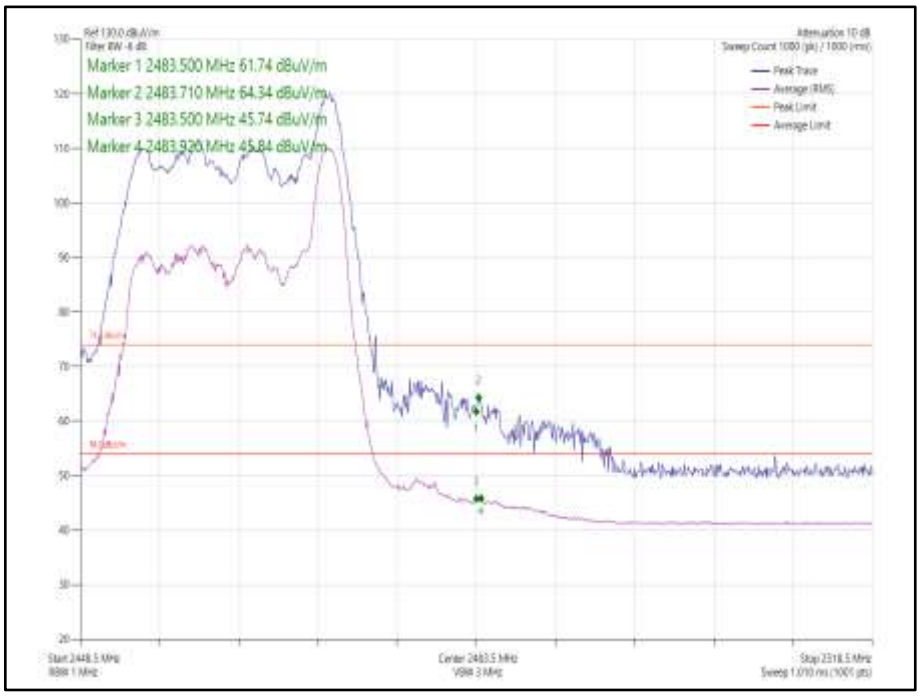

Figure 101 - 802.11ax HE20, Core 0-1, 26-8 - 2462 MHz, Band Edge Frequency 2483.5 MHz

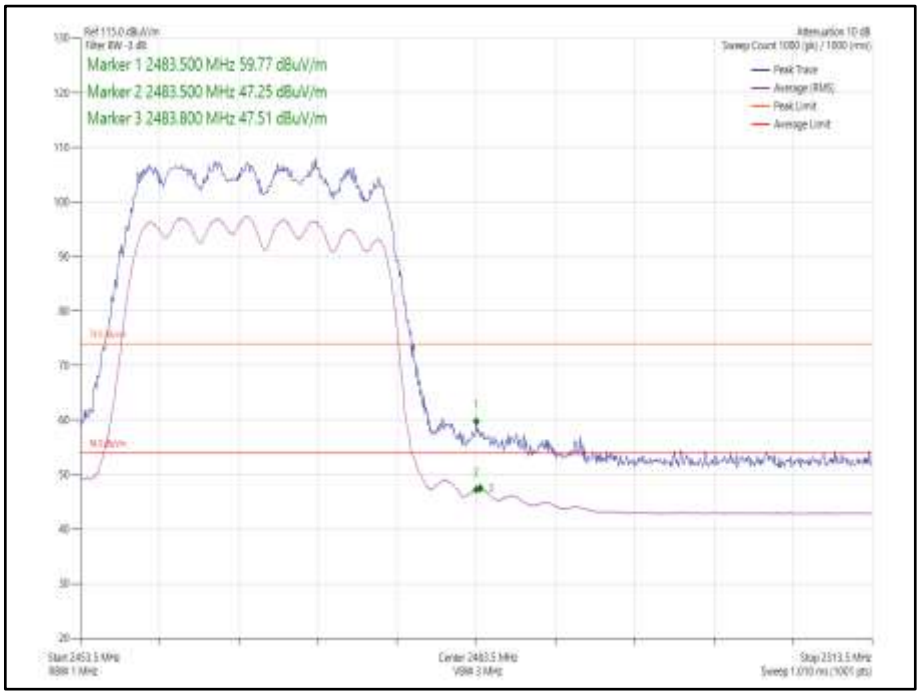

Figure 102 - 802.11ax HE20, Core 0-1, SU - 2467 MHz, Band Edge Frequency 2483.5 MHz

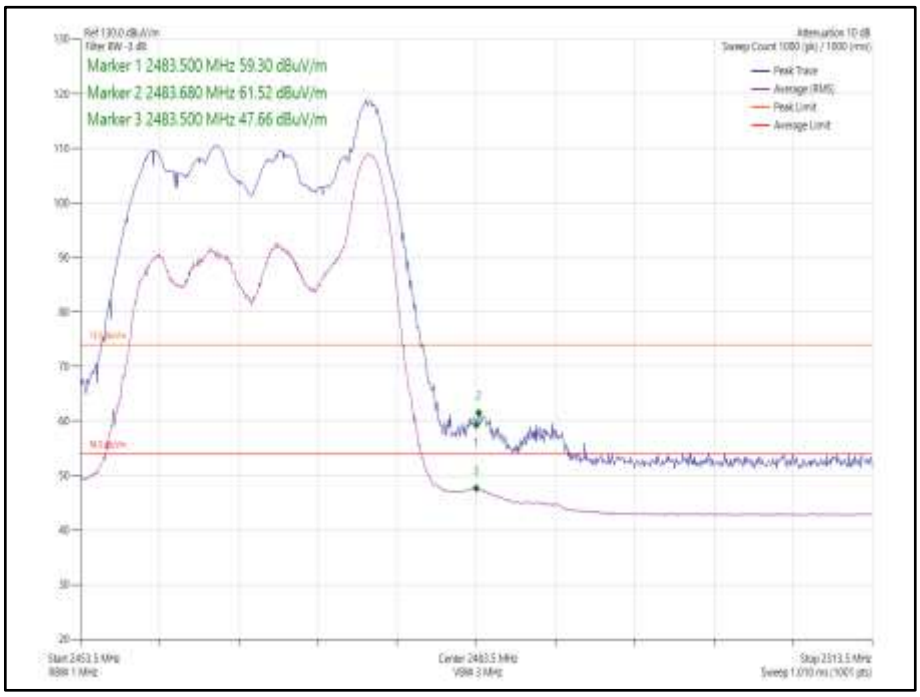

Figure 103 - 802.11ax HE20, Core 0-1, 26-8 - 2467 MHz, Band Edge Frequency 2483.5 MHz

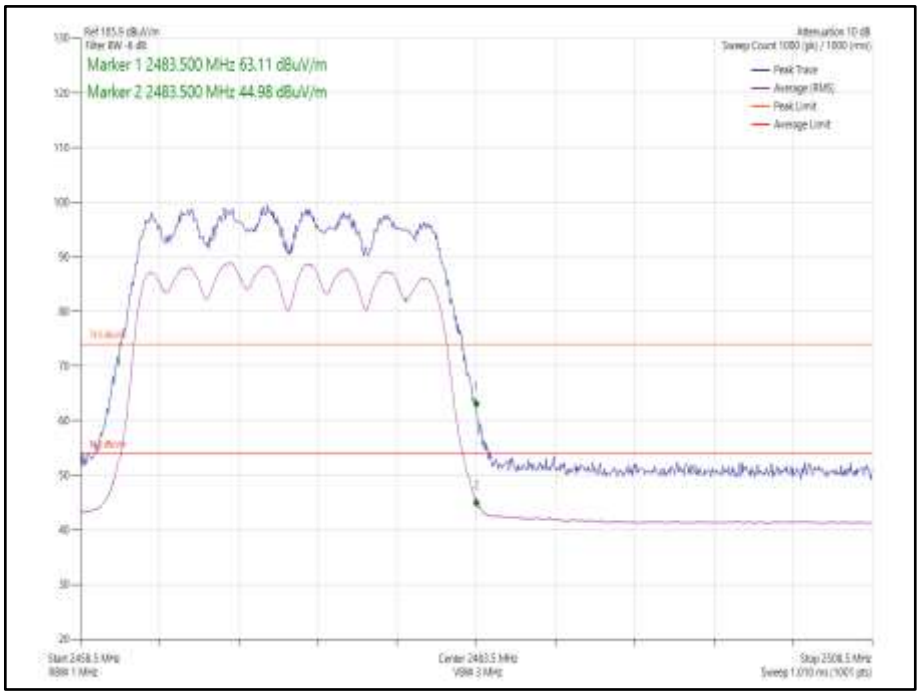

Figure 104 - 802.11ax HE20, Core 0-1, SU - 2472 MHz, Band Edge Frequency 2483.5 MHz

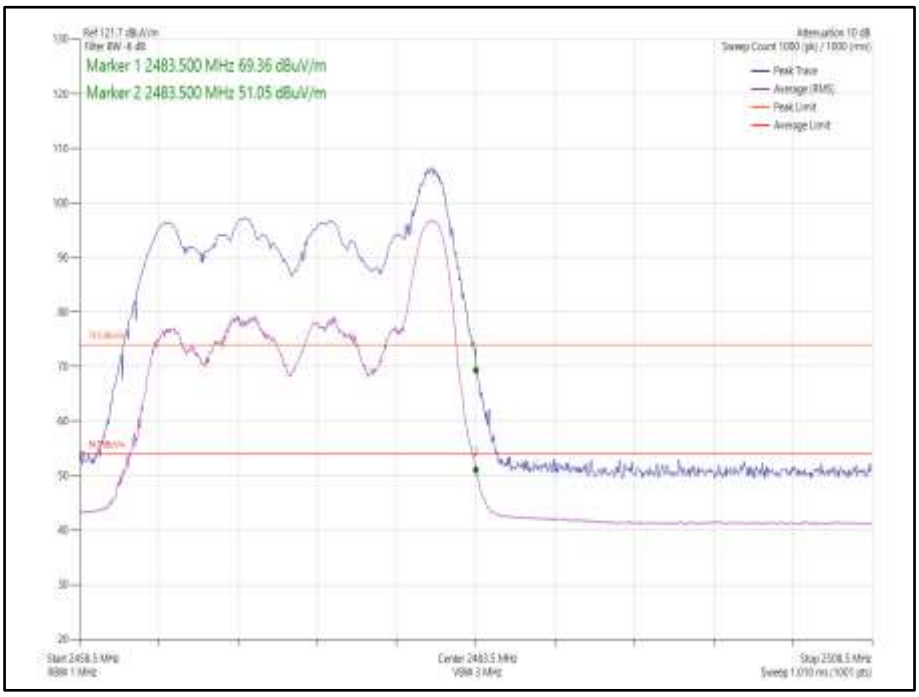

Figure 105 - 802.11ax HE20, Core 0-1, 26-8 - 2472 MHz, Band Edge Frequency 2483.5 MHz

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 49

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 50

*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.

2.5.7 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
EMI Test Receiver	Rohde & Schwarz	ESW44	5084	12	04-Feb-2021
EmX Emissions Software	TUV SUD	V2.1.0	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 51

TU - Traceability Unscheduled

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 3.3
ISED RSS-GEN, Clause 6.13

2.6.2 Equipment Under Test and Modification State

A2438, S/N: C02DM00Q087X - Modification State 0

2.6.3 Date of Test

09-December-2020 to 18-December-2020

2.6.4 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. One port of each type was loaded.

For frequencies > 1 GHz, plots for average measurements were taken in accordance with ANSI C63.10, clause 11.12.2.5.2.

Where duty cycle corrections were required for average results, these are included in the result tables but are not shown on the plots.

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 30 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.

Note the edges of the fundamental may be visible and in some cases appear to exceed the limit in these pre-scans. These band edge emissions were not measured in this section and are investigated fully in sections 2.3 and 2.4.

The following conversion can be applied to convert from dBµV/m to µV/m:
10^(Field Strength in dBµV/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*LOG(3/1) = 9.54 dB.

Where formal measurements have been necessary, the results have been presented in the emissions table.

In the 30 MHz to 1 GHz range pre-scans were only performed on the main radio mid channel (2437 MHz).

2.6.5 Example Test Setup Diagram

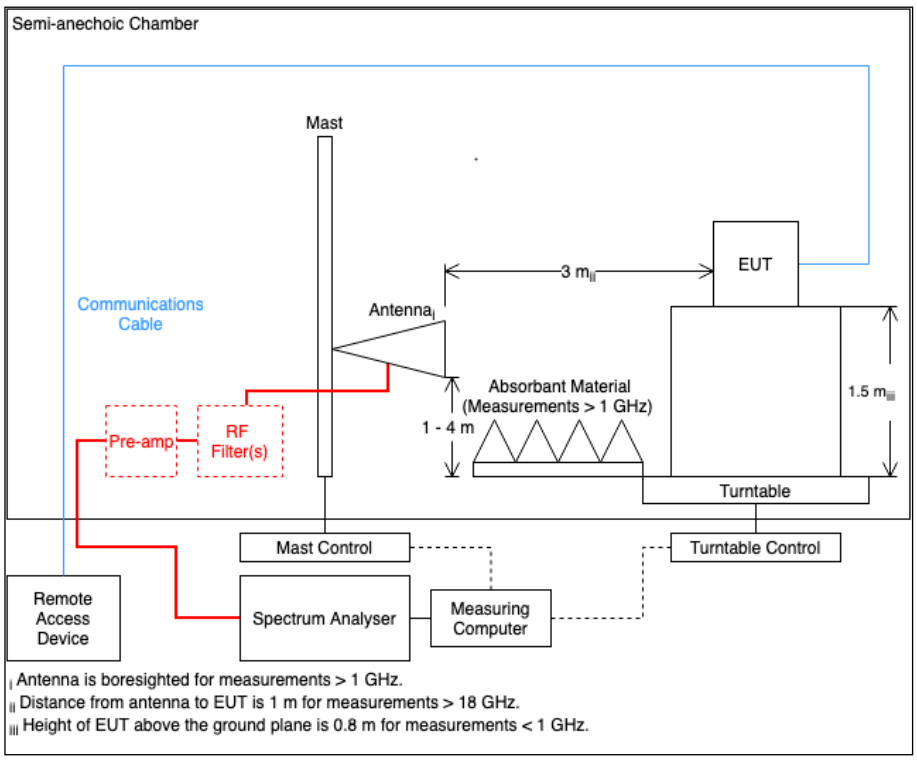

Figure 106

2.6.6 Environmental Conditions

Ambient Temperature	20.5 - 22.2 °C
Relative Humidity	36.3 - 45.5 %

2.6.7 Test Results

2.4 GHz WLAN

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

Table 52 - 2412 MHz (CH1), HT20, CDD, Core 0 + Core 1, 1 GHz to 26 GHz

*No emissions found within 10 dB of the limit.

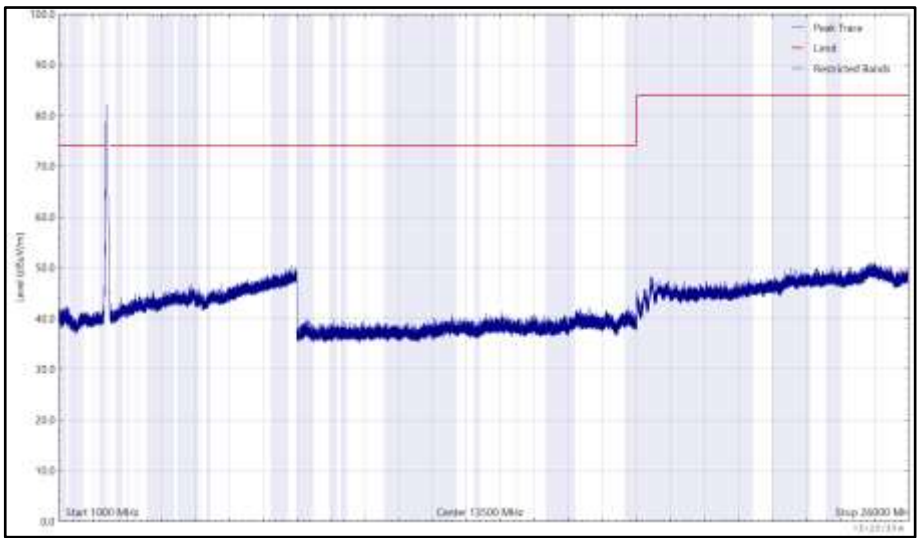

Figure 107 - 2412 MHz (CH1), HT20, CDD, Core 0 + Core 1, 1 GHz to 26 GHz, Horizontal (Peak)

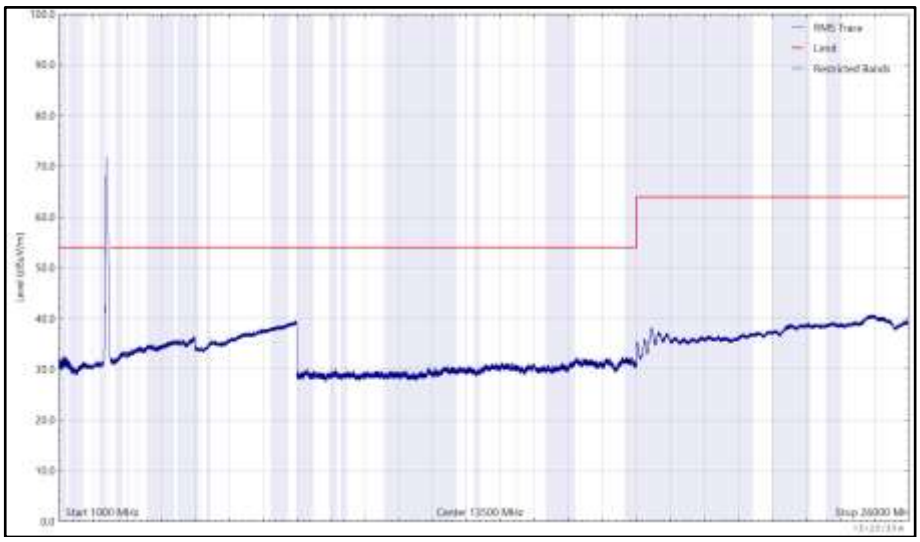

Figure 108 - 2412 MHz (CH1), HT20, CDD, Core 0 + Core 1, 1 GHz to 26 GHz, Horizontal (RMS)

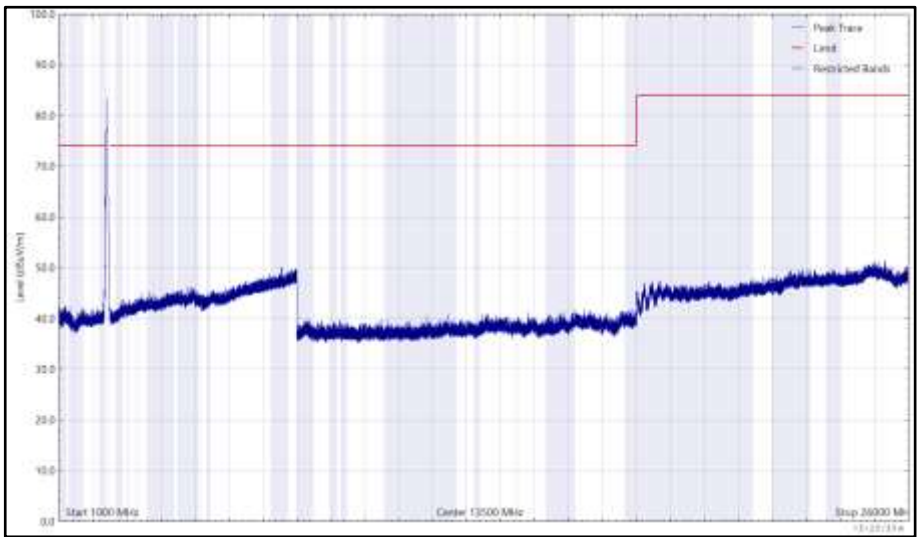

Figure 109 - 2412 MHz (CH1), HT20, CDD, Core 0 + Core 1, 1 GHz to 26 GHz, Vertical (Peak)

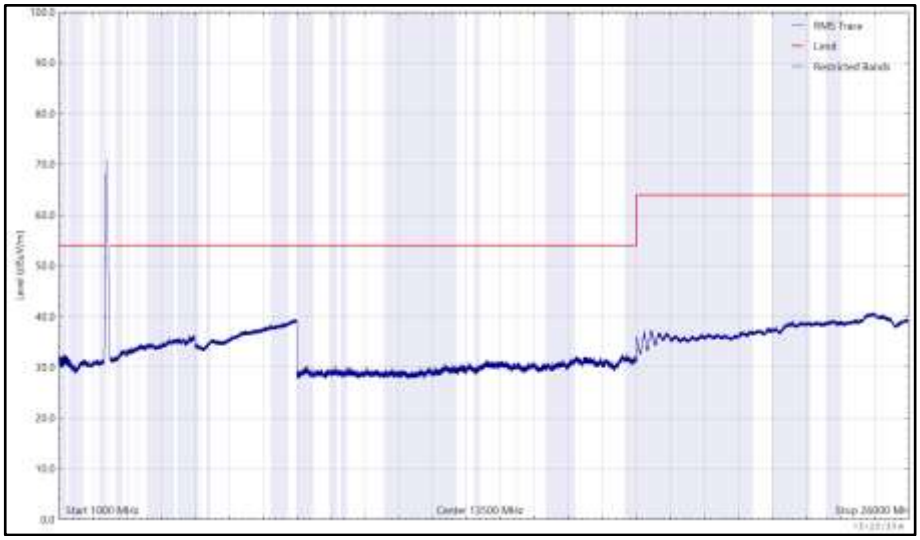

Figure 110 - 2412 MHz (CH1), HT20, CDD, Core 0 + Core 1, 1 GHz to 26 GHz, Vertical (RMS)

Frequency (MHz)	Level (dBuv/m)	Limit (dBuv/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
4875.455	36.6	54.0	-17.4	RMS	20	259	Vertical

Table 53 - 2437 MHz (CH6), HT20, CDD, Core 0 + Core 1, 30 MHz to 26 GHz

No other emissions found within 10 dB of the limit.

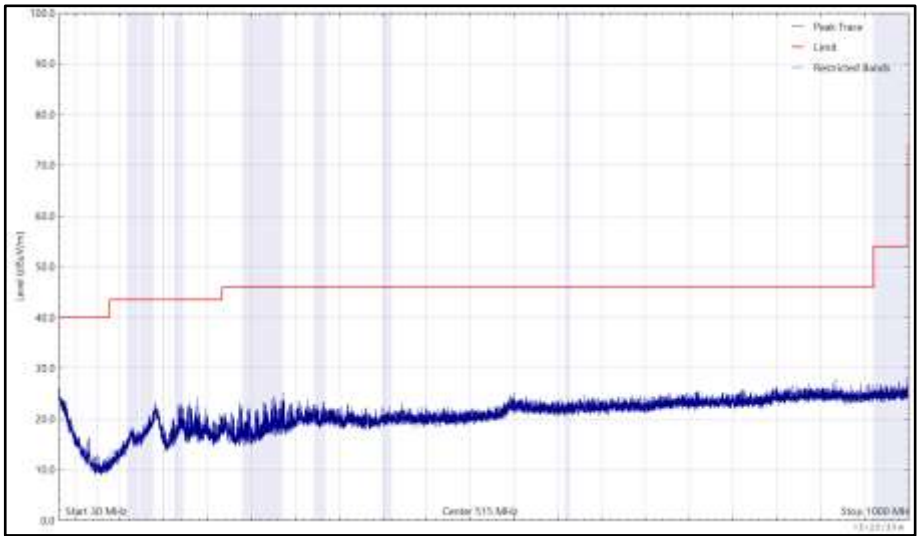

Figure 111 - 2437 MHz (CH6), HT20, CDD, Core 0 + Core 1, 30 MHz to 1 GHz, Horizontal (Peak)

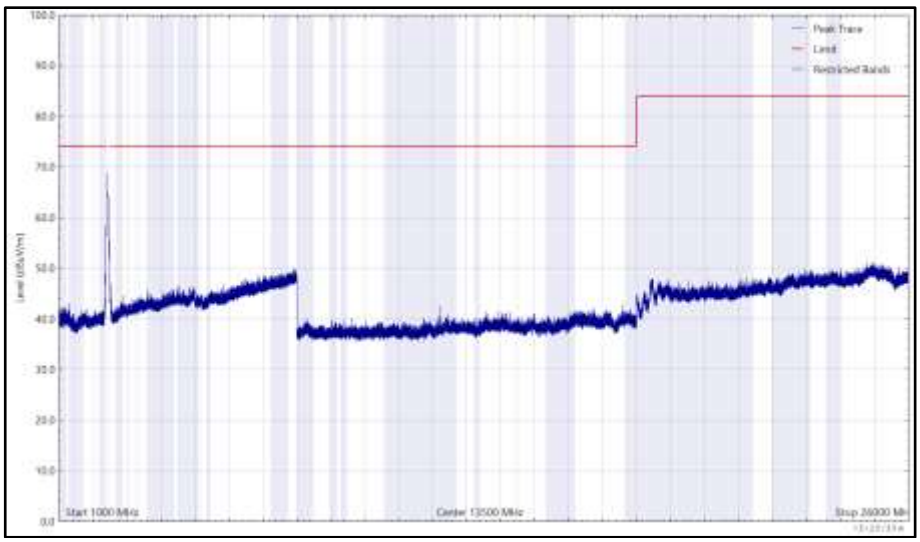

Figure 112 - 2437 MHz (CH6), HT20, CDD, Core 0 + Core 1, 1 GHz to 26 GHz, Horizontal (Peak)

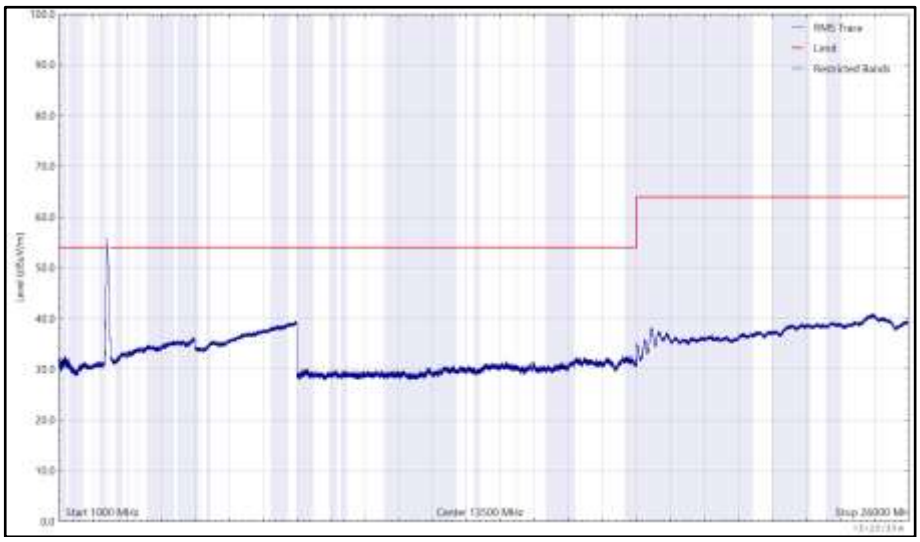

Figure 113 - 2437 MHz (CH6), HT20, CDD, Core 0 + Core 1, 1 GHz to 26 GHz, Horizontal (RMS)

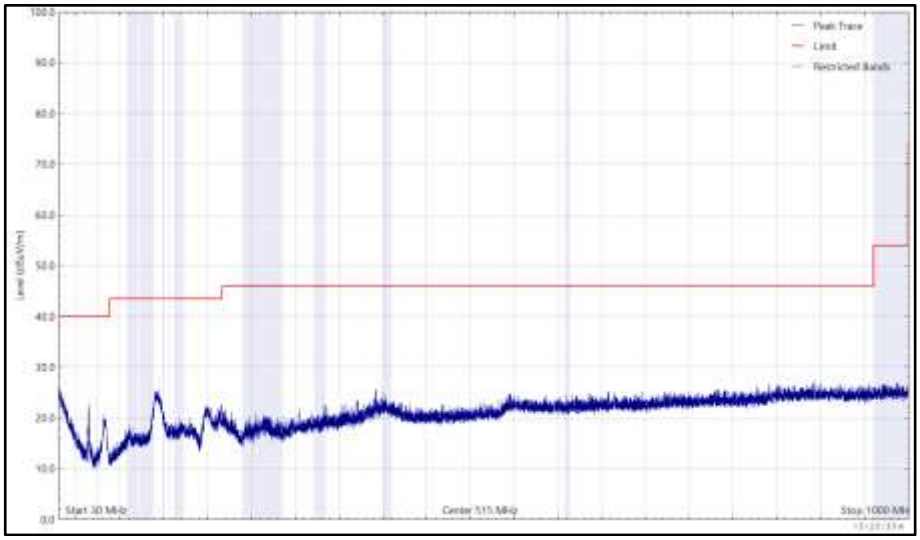

Figure 114 - 2437 MHz (CH6), HT20, CDD, Core 0 + Core 1, 30 MHz to 1 GHz, Vertical (Peak)

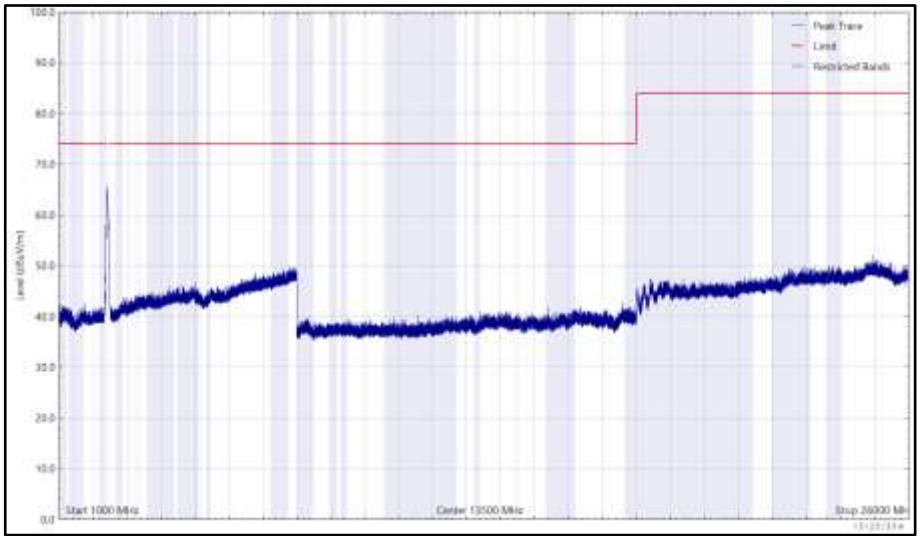

Figure 115 - 2437 MHz (CH6), HT20, CDD, Core 0 + Core 1, 1 GHz to 26 GHz, Vertical (Peak)

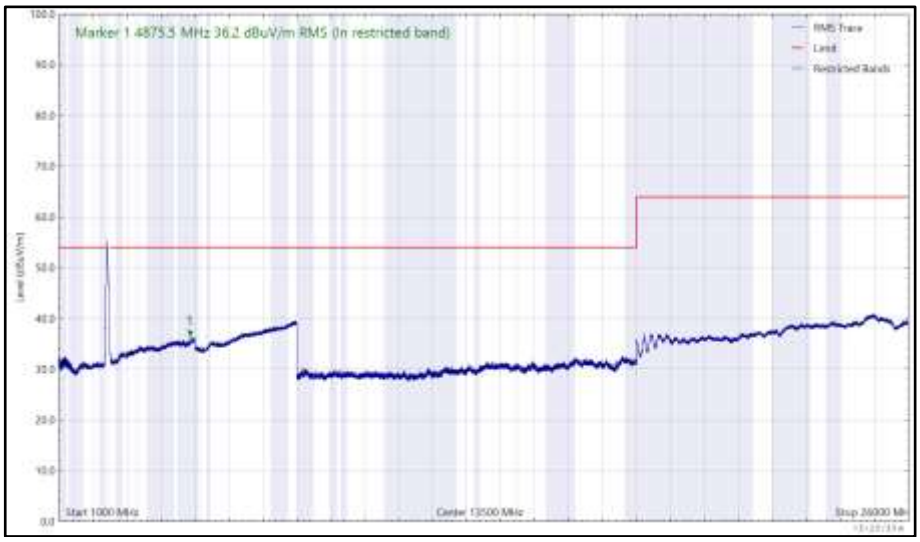

Figure 116 - 2437 MHz (CH6), HT20, CDD, Core 0 + Core 1, 1 GHz to 26 GHz, Vertical (RMS)

Frequency (MHz)	Level (dBuv/m)	Limit (dBuv/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
4945.420	37.8	54.0	-16.2	RMS	13	103	Vertical

Table 54 - 2472 MHz (CH13), HT20, CDD, Core 0 + Core 1, 1 GHz to 26 GHz

No other emissions found within 10 dB of the limit.

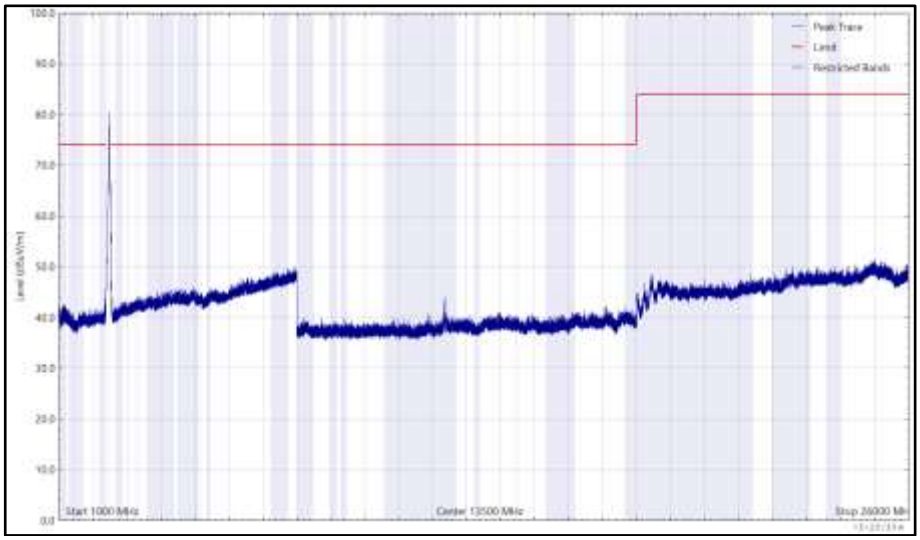

Figure 117 - 2472 MHz (CH13), HT20, CDD, Core 0 + Core 1, 1 GHz to 26 GHz, Horizontal (Peak)

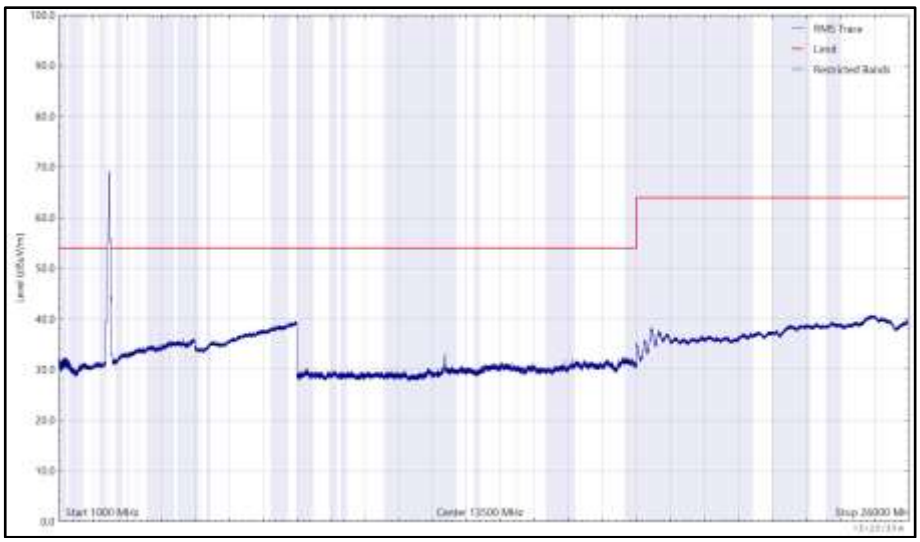

Figure 118 - 2472 MHz (CH13), HT20, CDD, Core 0 + Core 1, 1 GHz to 26 GHz, Horizontal (RMS)

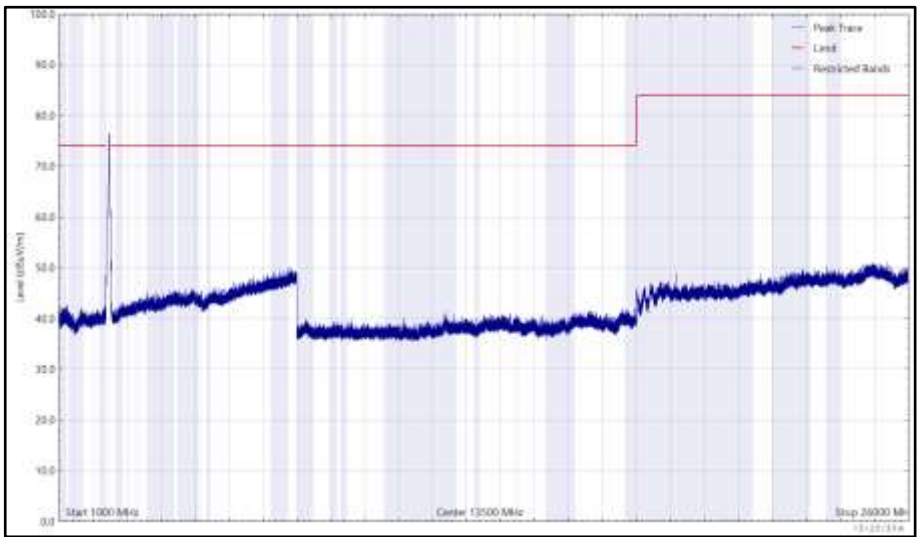

Figure 119 - 2472 MHz (CH13), HT20, CDD, Core 0 + Core 1, 1 GHz to 26 GHz, Vertical (Peak)

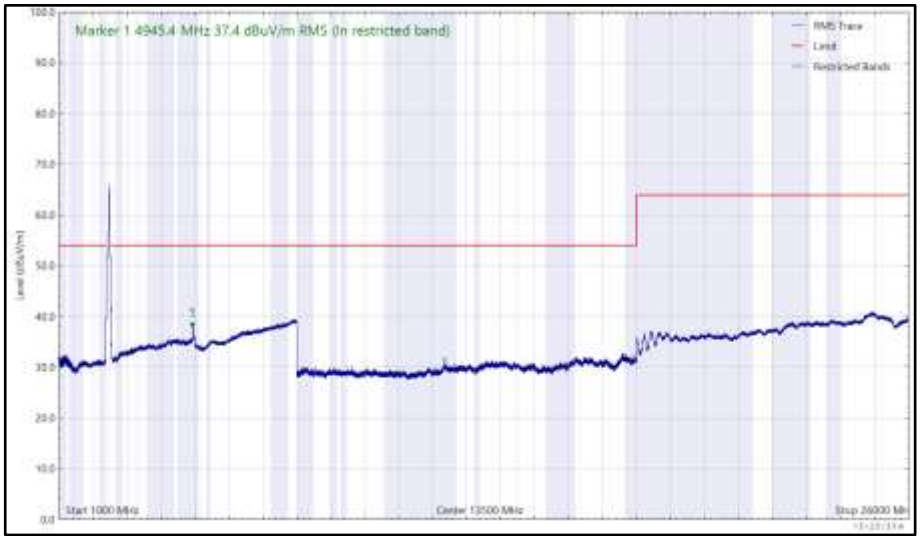

Figure 120 - 2472 MHz (CH13), HT20, CDD, Core 0 + Core 1, 1 GHz to 26 GHz, Vertical (RMS)

Frequency (MHz)	Level (dBuv/m)	Limit (dBuv/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
3505.213	32.8	54.0	-21.2	RMS	348	109	Vertical

Table 55 - 2412 MHz (CH1), 802.11g, Core 0, 1 GHz to 26 GHz

No other emissions found within 10 dB of the limit.

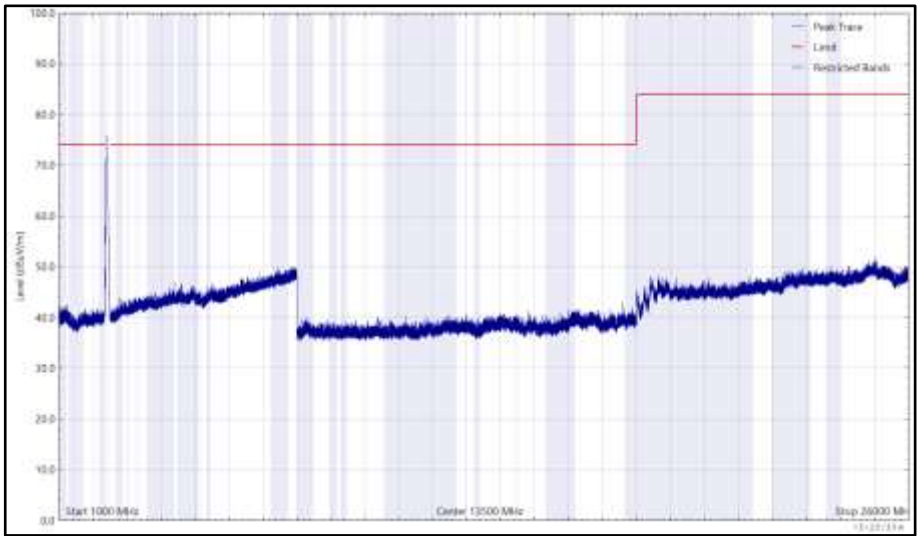

Figure 121 - 2412 MHz (CH1), 802.11g, Core 0, 1 GHz to 26 GHz, Horizontal (Peak)

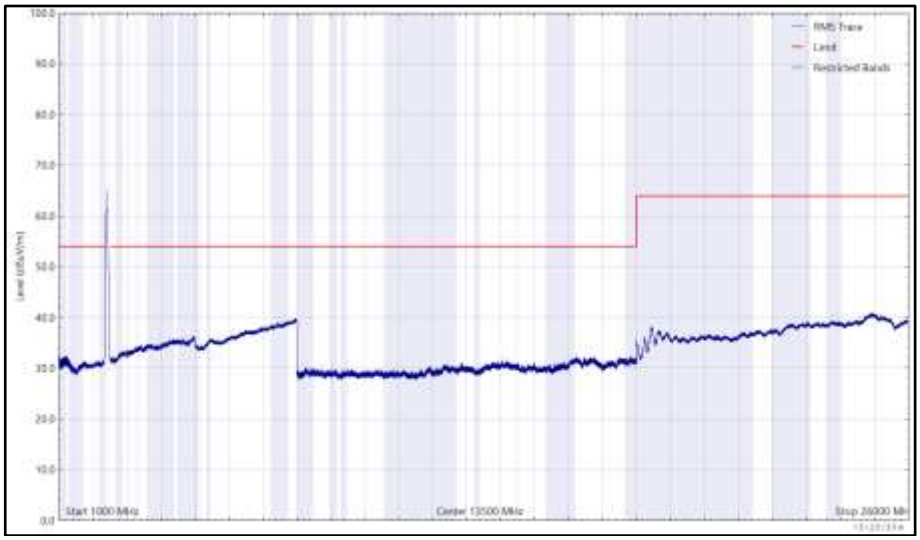

Figure 122 - 2412 MHz (CH1), 802.11g, Core 0, 1 GHz to 26 GHz, Horizontal (RMS)

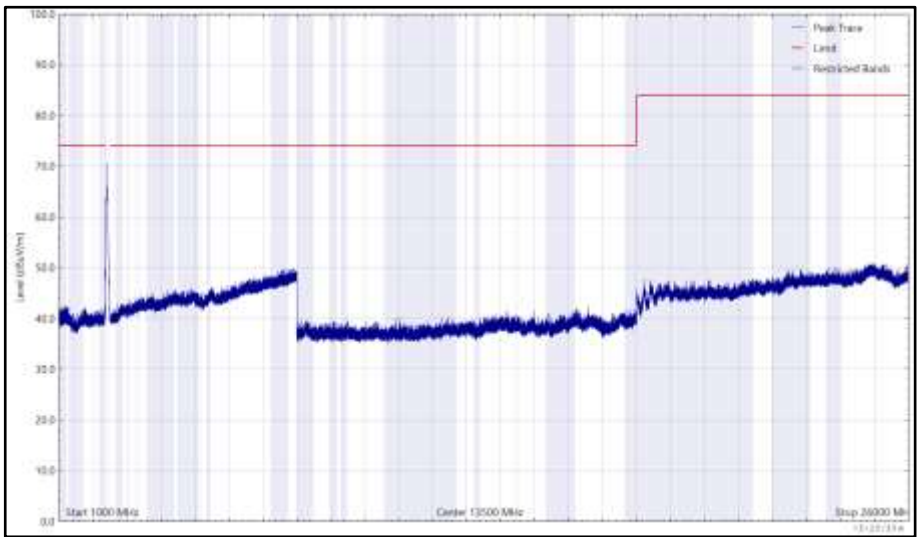

Figure 123 - 2412 MHz (CH1), 802.11g, Core 0, 1 GHz to 26 GHz, Vertical (Peak)

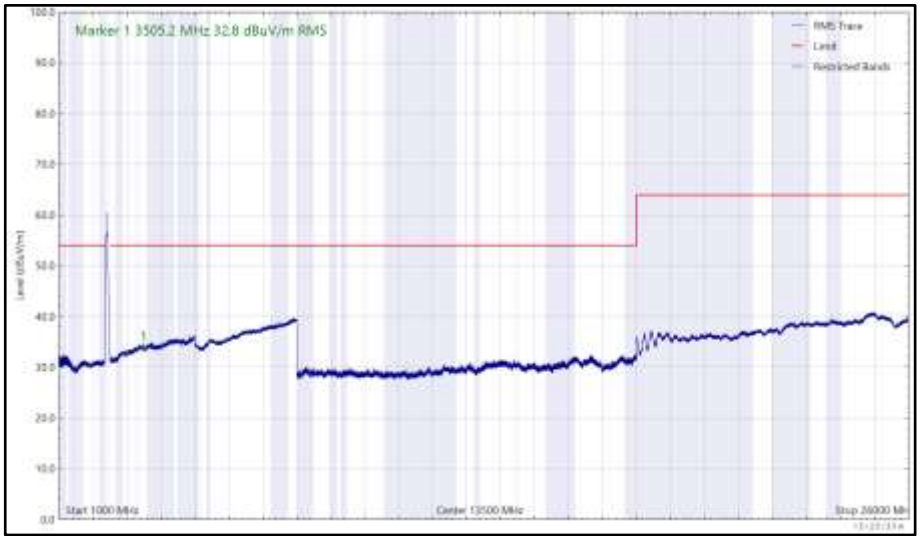

Figure 124 - 2412 MHz (CH1), 802.11g, Core 0, 1 GHz to 26 GHz, Vertical (RMS)

Frequency (MHz)	Level (dBuv/m)	Limit (dBuv/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
4875.171	36.6	54.0	-17.4	RMS	5	110	Vertical

Table 56 - 2437 MHz (CH6), 802.11g, Core 0, 30 MHz to 26 GHz

No other emissions found within 10 dB of the limit.

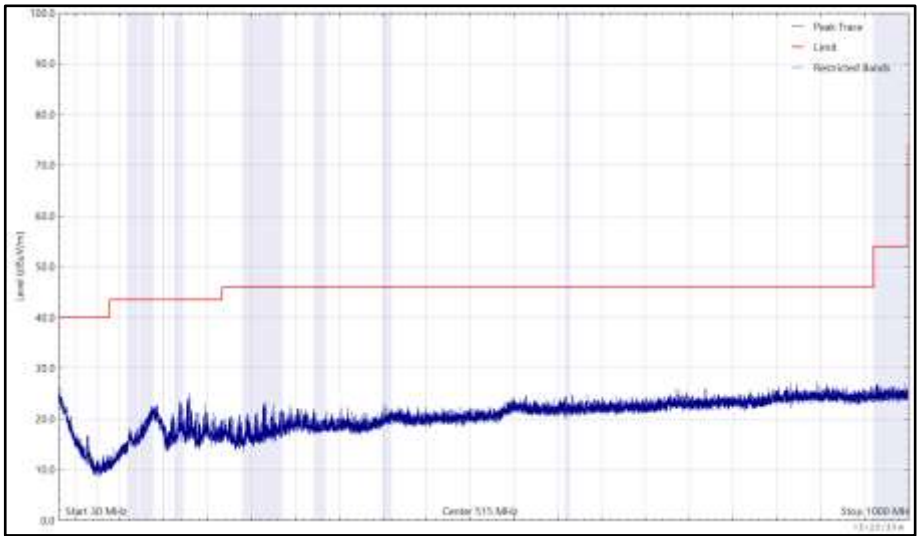

Figure 125 - 2437 MHz (CH6), 802.11g, Core 0, 30 MHz to 1 GHz, Horizontal (Peak)

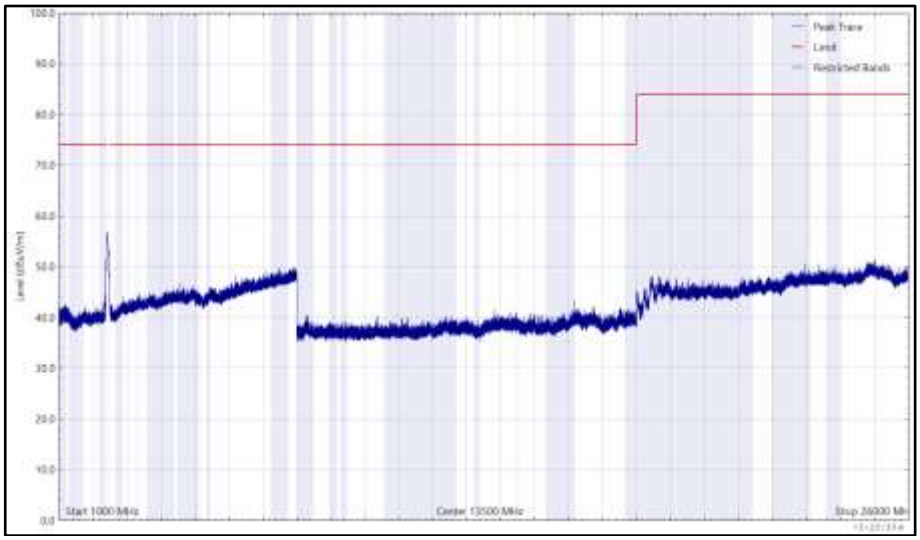

Figure 126 - 2437 MHz (CH6), 802.11g, Core 0, 1 GHz to 26 GHz, Horizontal (Peak)

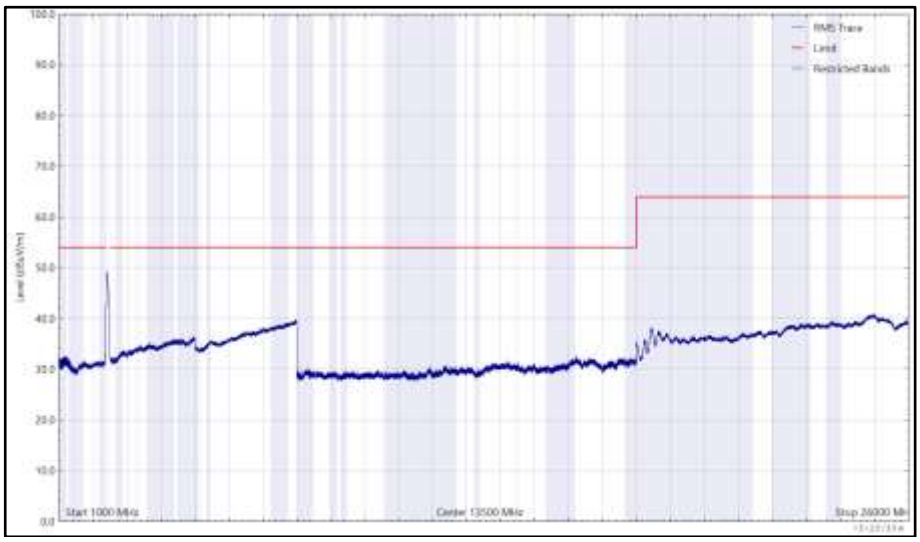

Figure 127 - 2437 MHz (CH6), 802.11g, Core 0, 1 GHz to 26 GHz, Horizontal (RMS)

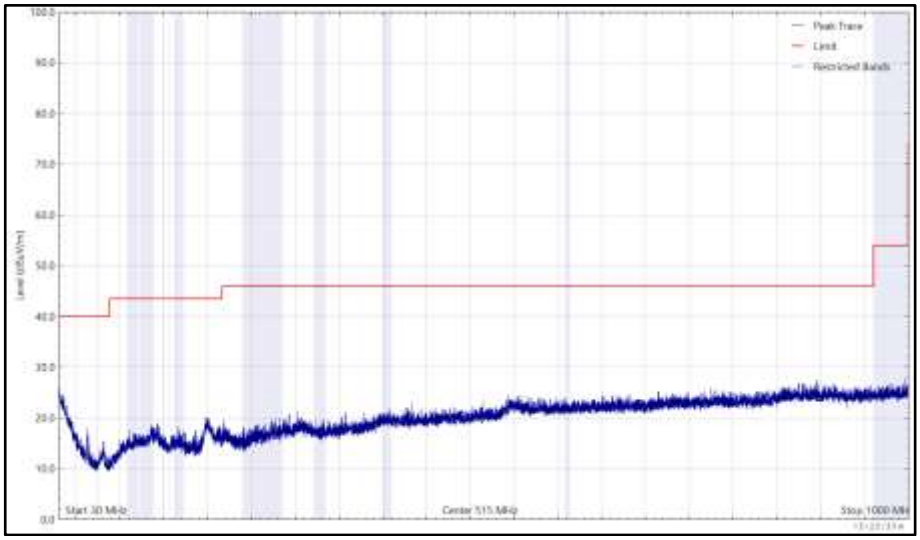

Figure 128 - 2437 MHz (CH6), 802.11g, Core 0, 30 MHz to 1 GHz, Vertical (Peak)

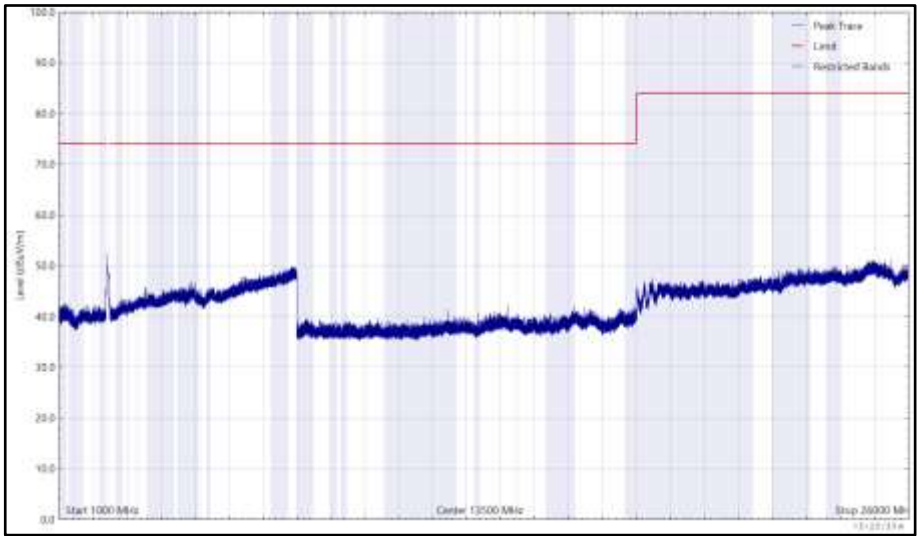

Figure 129 - 2437 MHz (CH6), 802.11g, Core 0, 1 GHz to 26 GHz, Vertical (Peak)

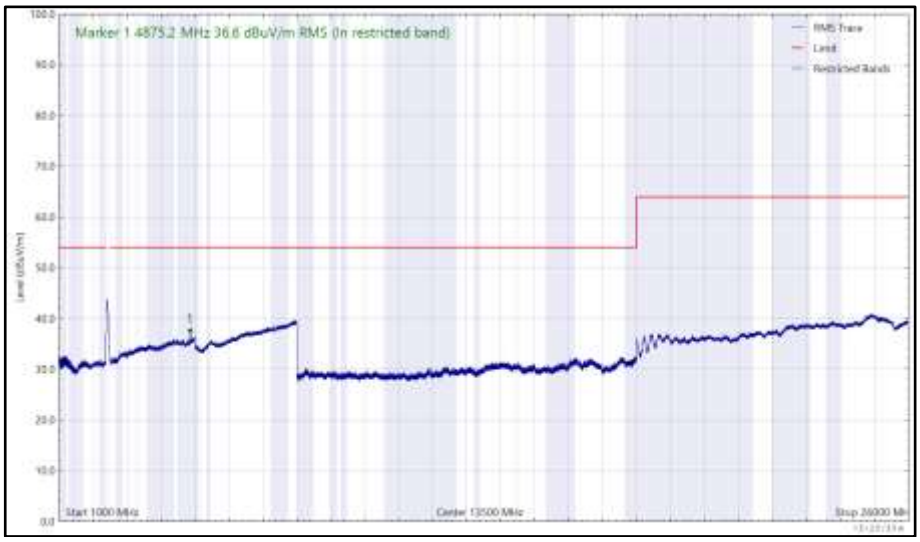

Figure 130 - 2437 MHz (CH6), 802.11g, Core 0, 1 GHz to 26 GHz, Vertical (RMS)

Frequency (MHz)	Level (dBuv/m)	Limit (dBuv/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
4943.913	38.6	54.0	-15.4	RMS	15	190	Vertical

Table 57 - 2472 MHz (CH13), 802.11g, Core 0, 1 GHz to 26 GHz

No other emissions found within 10 dB of the limit.

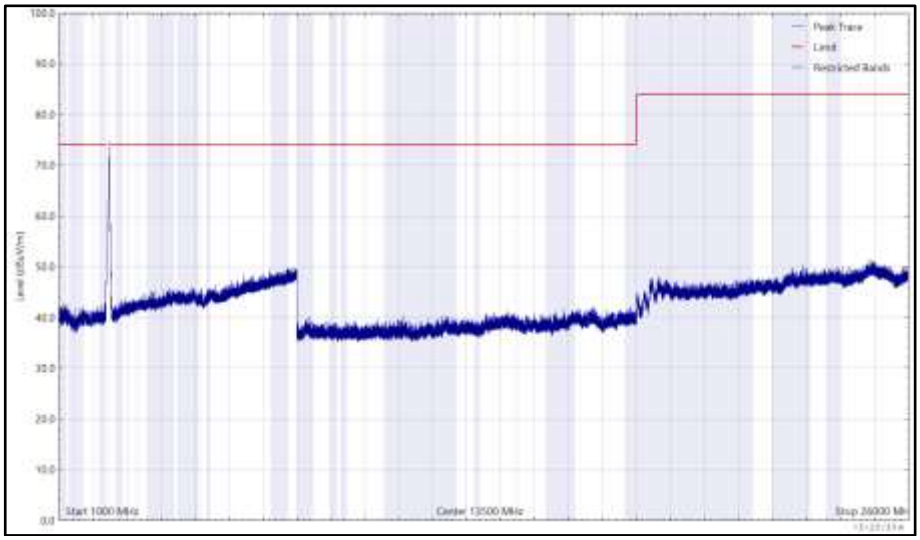

Figure 131 - 2472 MHz (CH13), 802.11g, Core 0, 1 GHz to 26 GHz, Horizontal (Peak)

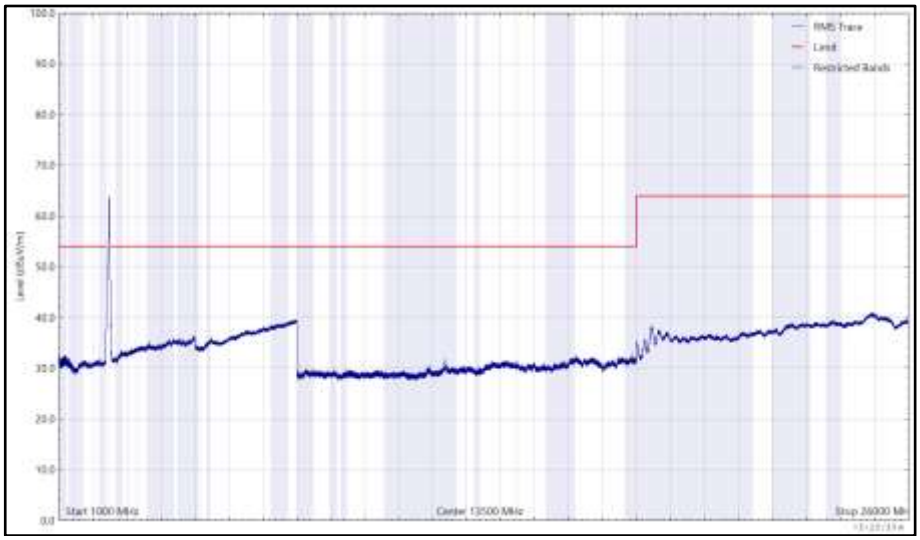

Figure 132 - 2472 MHz (CH13), 802.11g, Core 0, 1 GHz to 26 GHz, Horizontal (RMS)

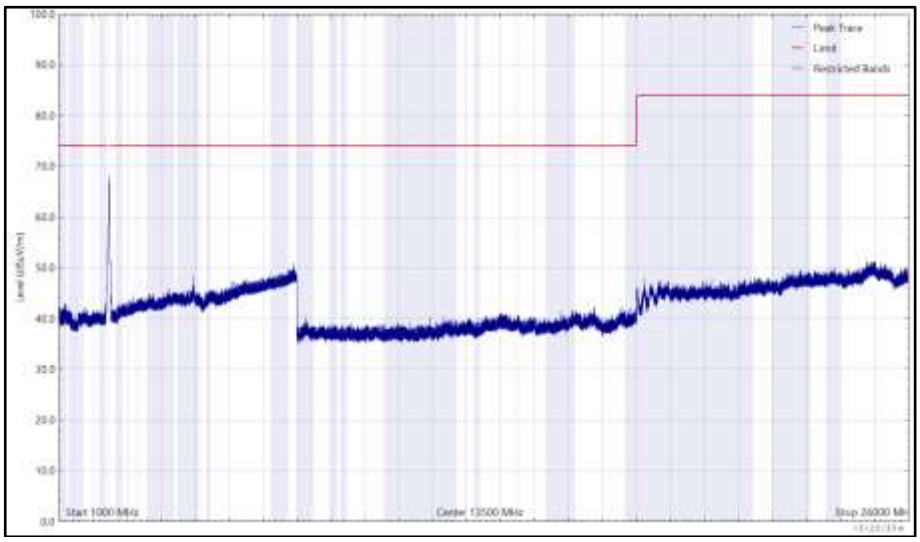

Figure 133 - 2472 MHz (CH13), 802.11g, Core 0, 1 GHz to 26 GHz, Vertical (Peak)

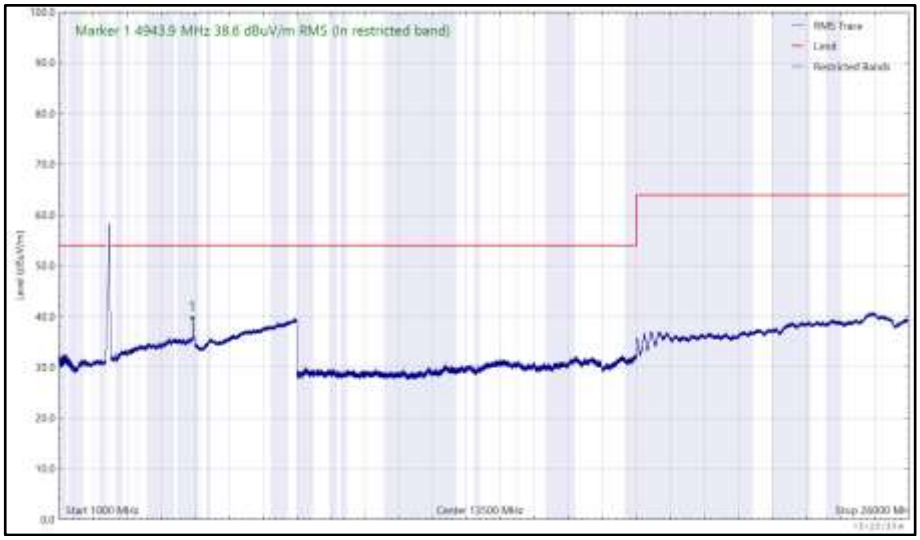

Figure 134 - 2472 MHz (CH13), 802.11g, Core 0, 1 GHz to 26 GHz, Vertical (RMS)

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

Table 58 - 2412 MHz (CH1), 802.11g, Core 1, 1 GHz to 26 GHz

*No emissions found within 10 dB of the limit.

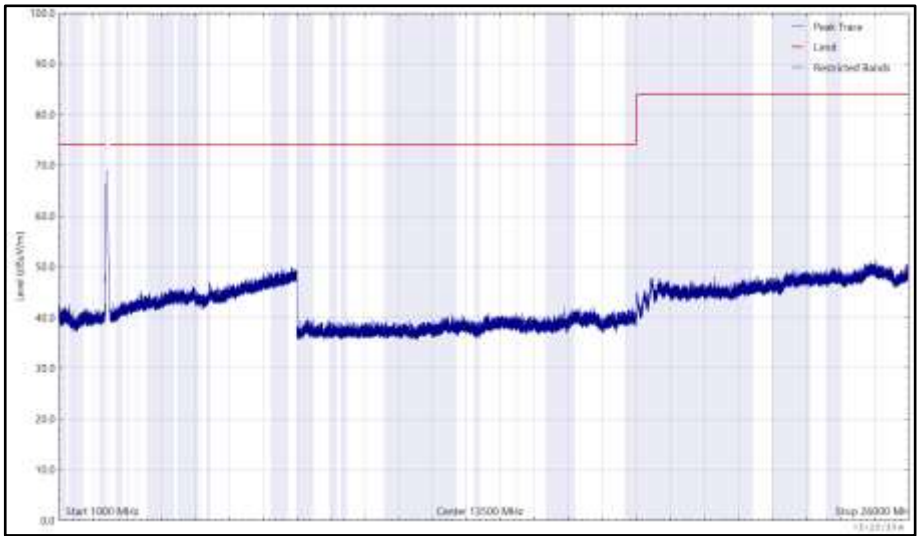

Figure 135 - 2412 MHz (CH1), 802.11g, Core 1, 1 GHz to 26 GHz, Horizontal (Peak)

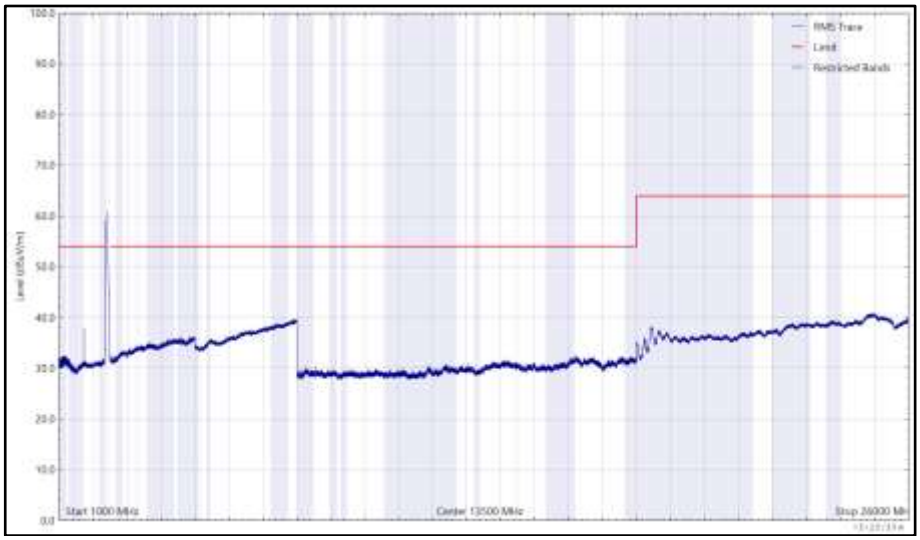

Figure 136 - 2412 MHz (CH1), 802.11g, Core 1, 1 GHz to 26 GHz, Horizontal (RMS)

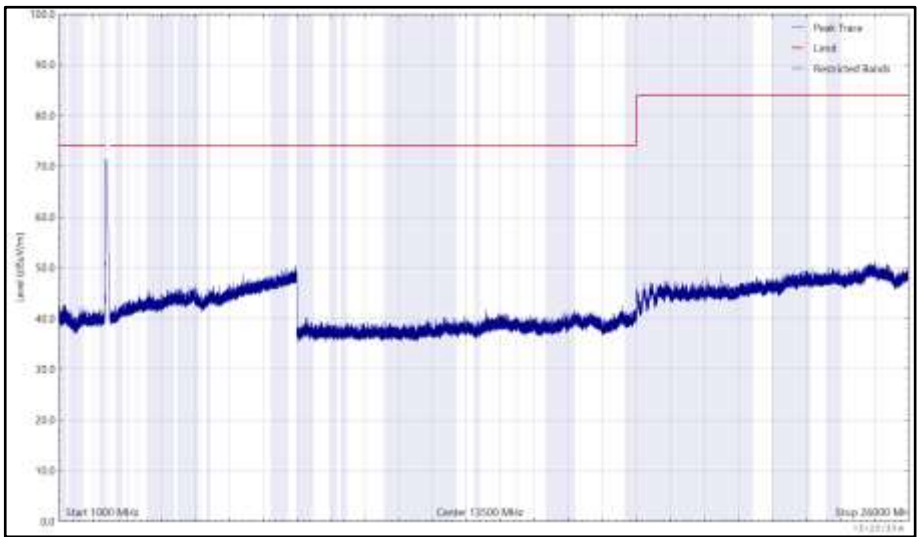

Figure 137 - 2412 MHz (CH1), 802.11g, Core 1, 1 GHz to 26 GHz, Vertical (Peak)

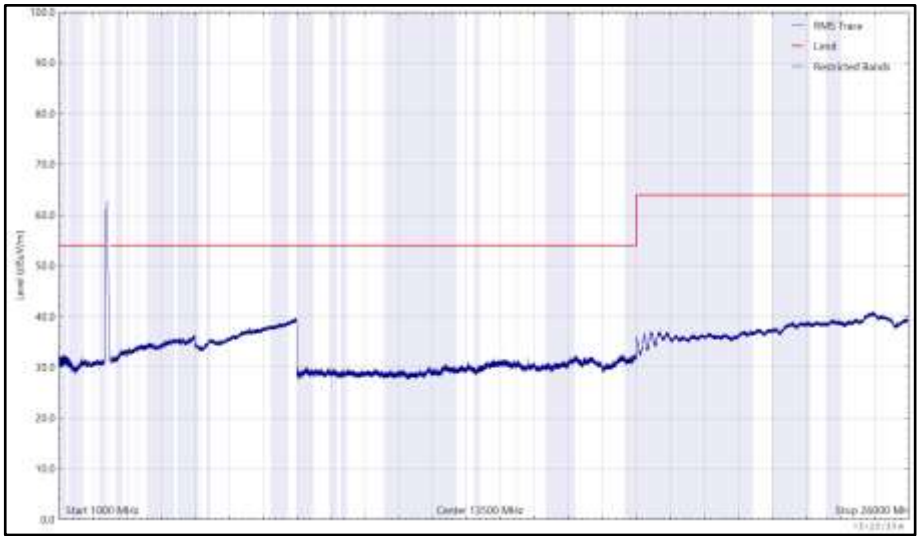

Figure 138 - 2412 MHz (CH1), 802.11g, Core 1, 1 GHz to 26 GHz, Vertical (RMS)

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

Table 59 - 2437 MHz (CH6), 802.11g, Core 1, 30 MHz to 26 GHz

*No emissions found within 10 dB of the limit.

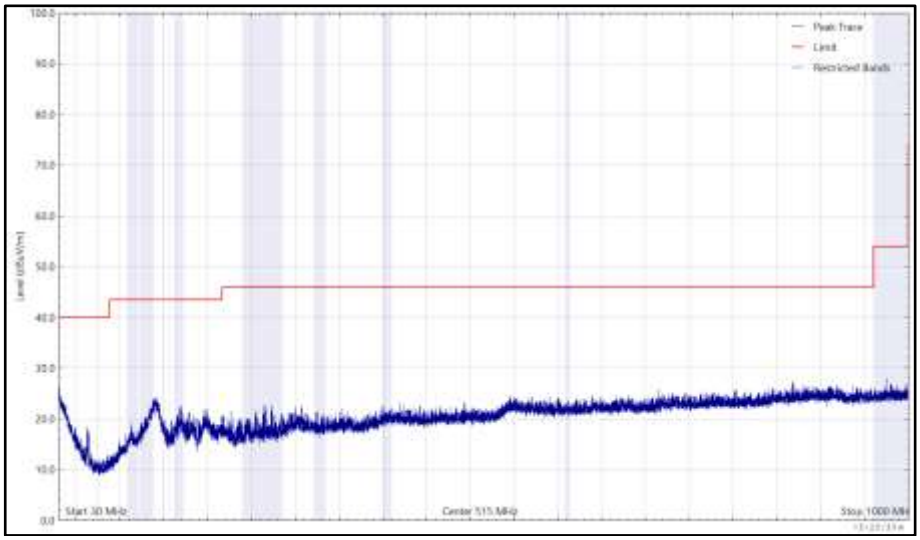

Figure 139 - 2437 MHz (CH6), 802.11g, Core 1, 30 MHz to 1 GHz, Horizontal (Peak)

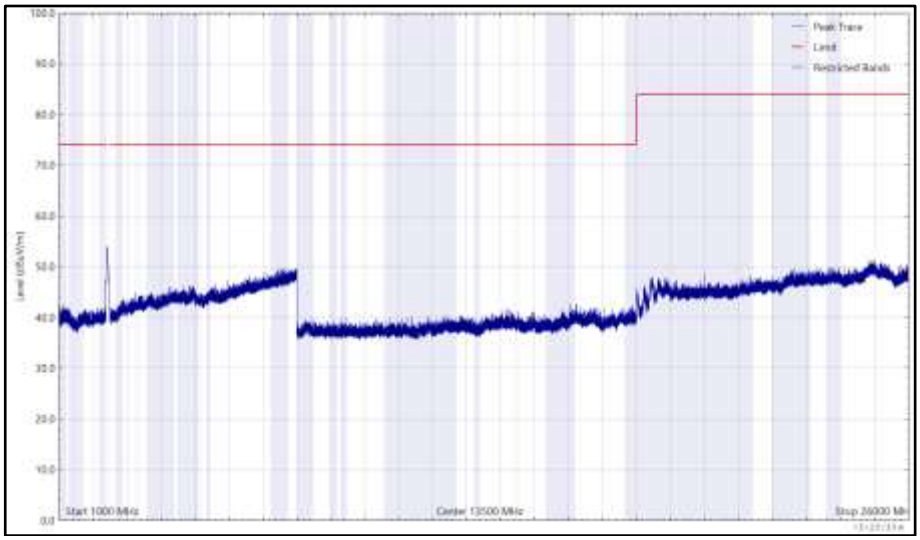

Figure 140 - 2437 MHz (CH6), 802.11g, Core 1, 1 GHz to 26 GHz, Horizontal (Peak)

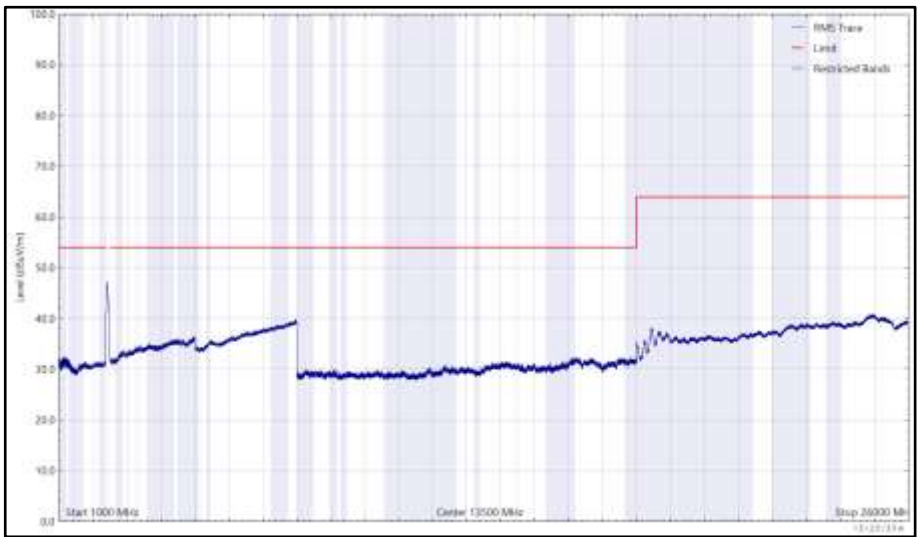

Figure 141 - 2437 MHz (CH6), 802.11g, Core 1, 1 GHz to 26 GHz, Horizontal (RMS)

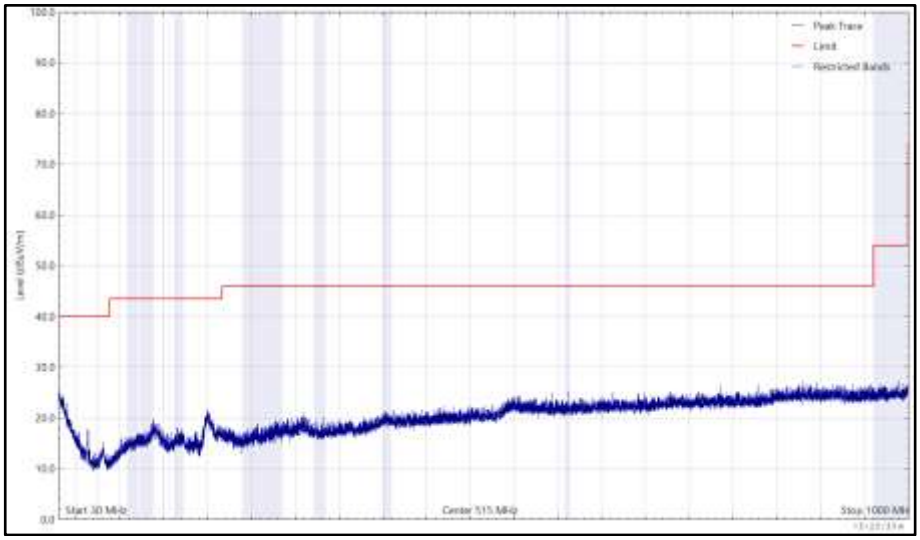

Figure 142 - 2437 MHz (CH6), 802.11g, Core 1, 30 MHz to 1 GHz, Vertical (Peak)

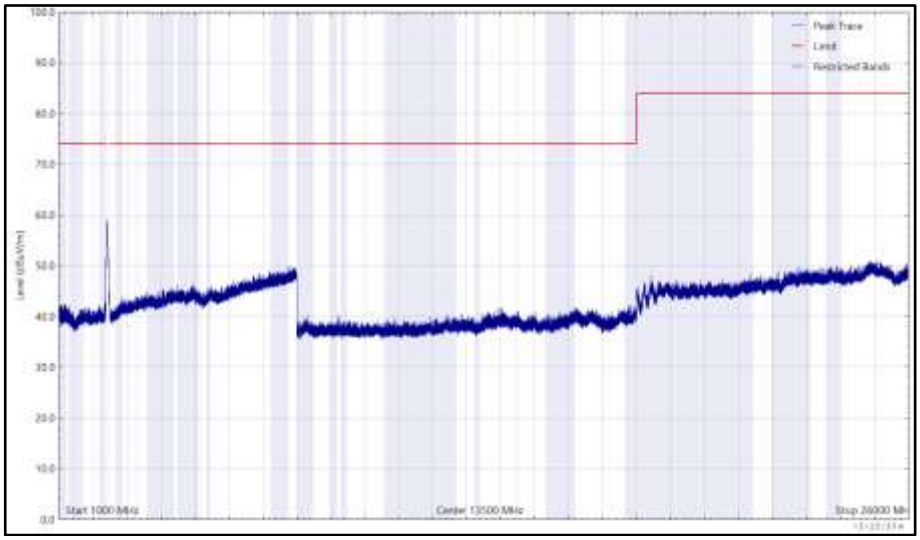

Figure 143 - 2437 MHz (CH6), 802.11g, Core 1, 1 GHz to 26 GHz, Vertical (Peak)

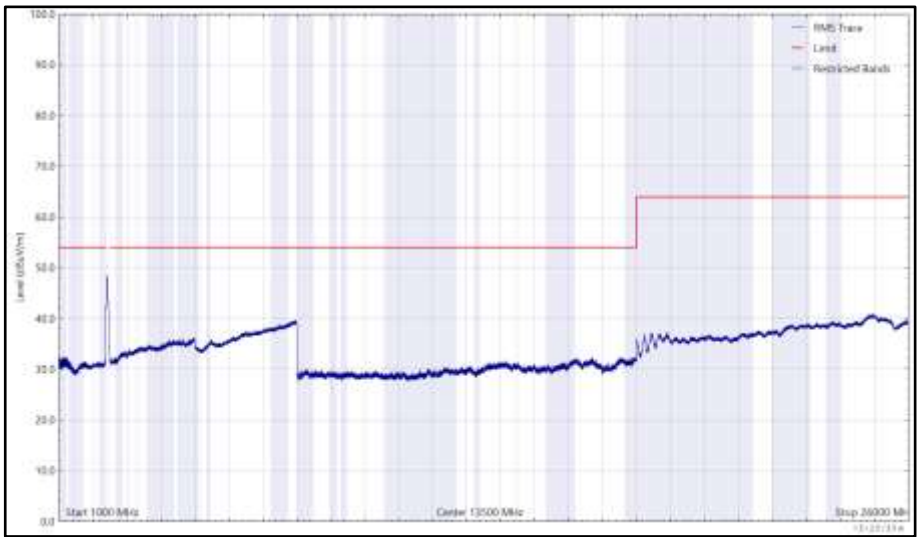

Figure 144 - 2437 MHz (CH6), 802.11g, Core 1, 1 GHz to 26 GHz, Vertical (RMS)

Frequency (MHz)	Level (dBuv/m)	Limit (dBuv/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
1733.949	42.0	74.0	-32.0	Peak	351	185	Horizontal

Table 60 - 2472 MHz (CH13), 802.11g, Core 1, 1 GHz to 26 GHz

No other emissions found within 10 dB of the limit.

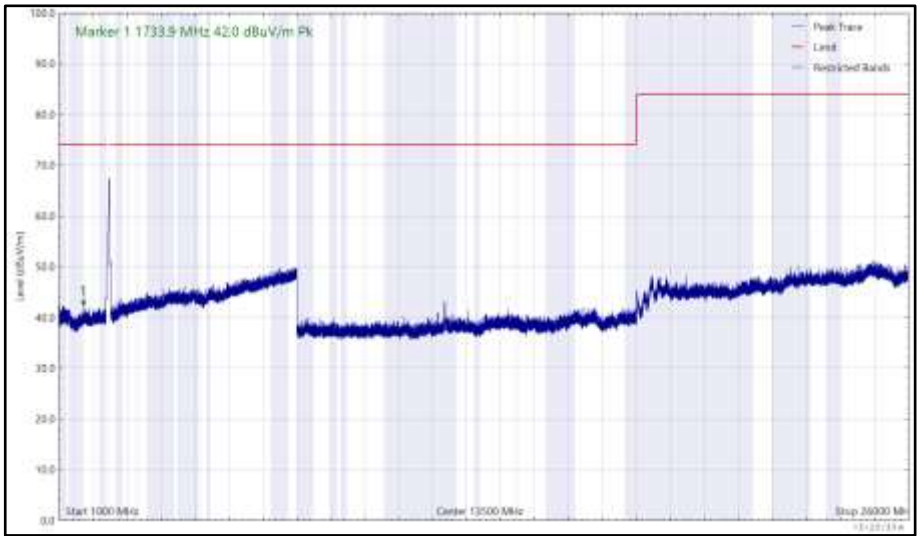

Figure 145 - 2472 MHz (CH13), 802.11g, Core 1, 1 GHz to 26 GHz, Horizontal (Peak)

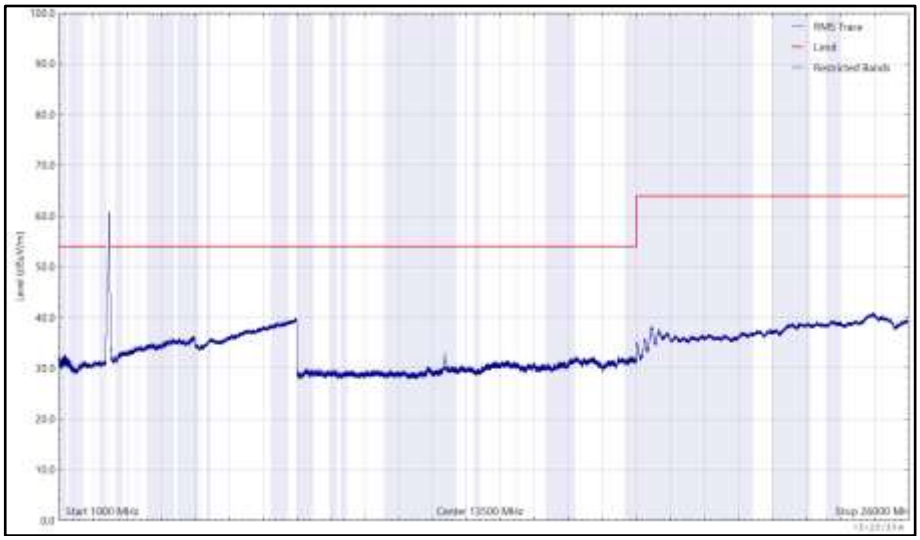

Figure 146 - 2472 MHz (CH13), 802.11g, Core 1, 1 GHz to 26 GHz, Horizontal (RMS)

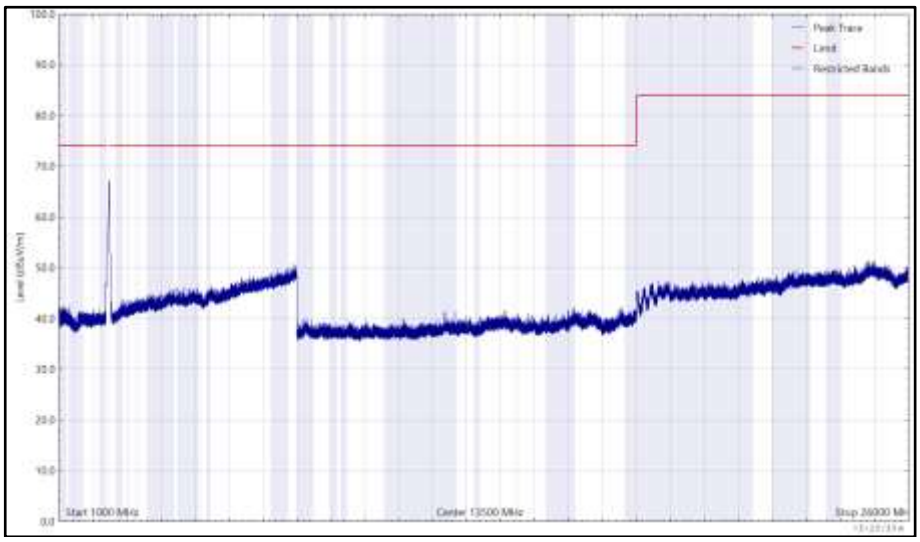

Figure 147 - 2472 MHz (CH13), 802.11g, Core 1, 1 GHz to 26 GHz, Vertical (Peak)

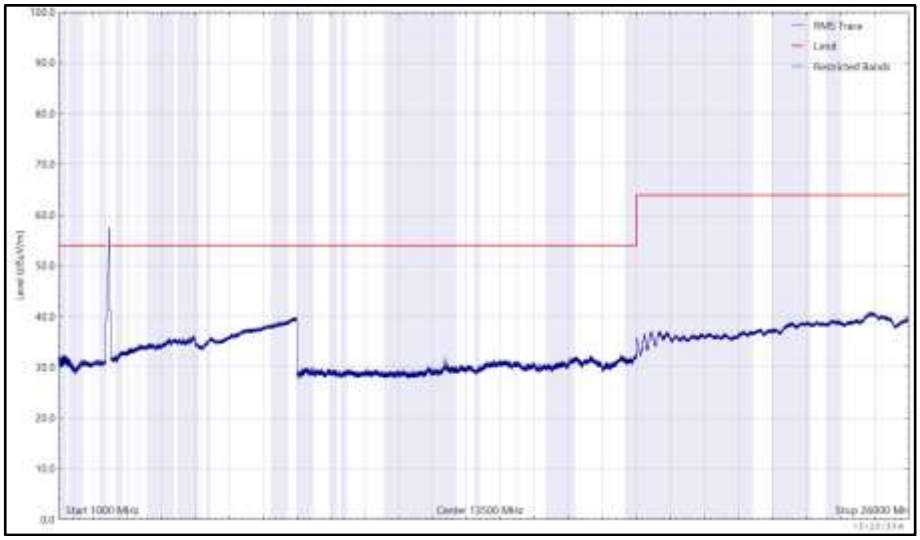

Figure 148 - 2472 MHz (CH13), 802.11g, Core 1, 1 GHz to 26 GHz, Vertical (RMS)

Frequency (MHz)	Level (dBuv/m)	Limit (dBuv/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
4824.020	42.1	54.0	-11.9	RMS	11	186	Vertical

Table 61 - 2412 MHz (CH1), 802.11b, Core 0, 1 GHz to 26 GHz

No other emissions found within 10 dB of the limit.

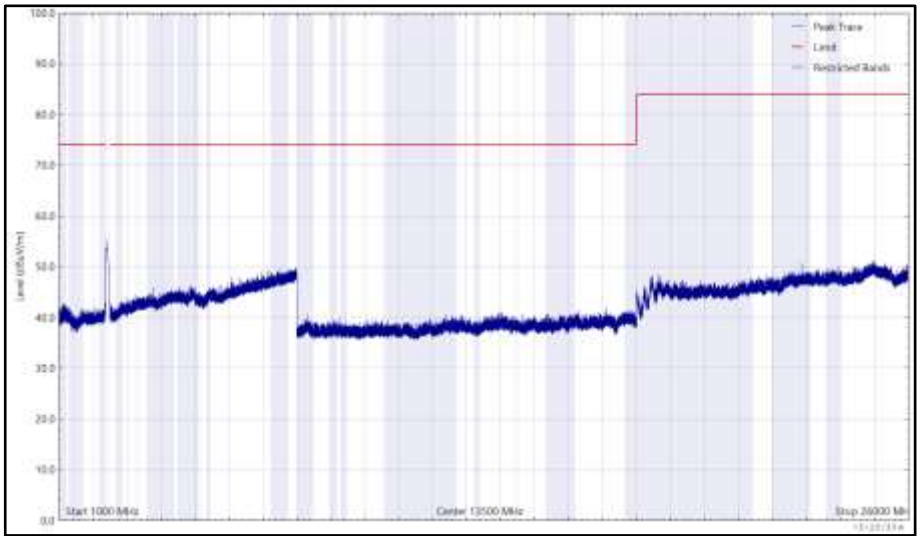

Figure 149 - 2412 MHz (CH1), 802.11b, Core 0, 1 GHz to 26 GHz, Horizontal (Peak)

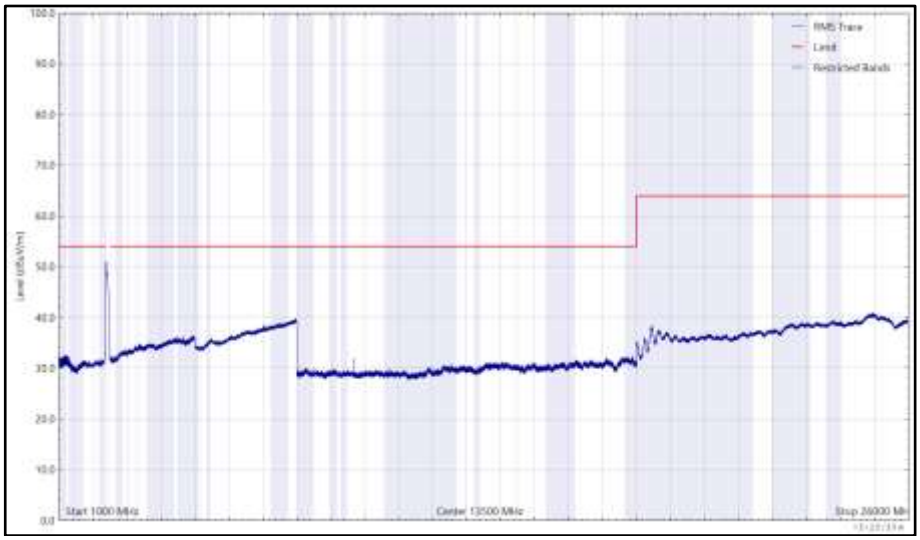

Figure 150 - 2412 MHz (CH1), 802.11b, Core 0, 1 GHz to 26 GHz, Horizontal (RMS)

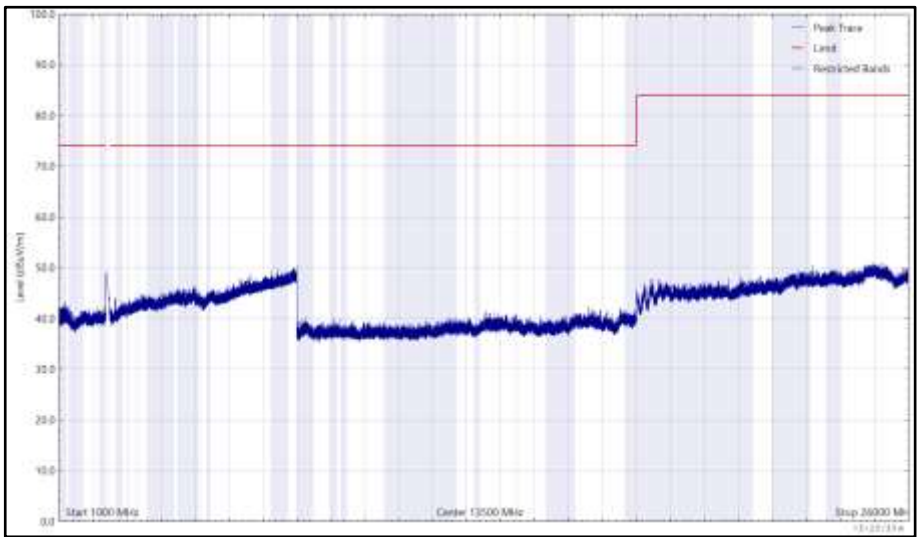

Figure 151 - 2412 MHz (CH1), 802.11b, Core 0, 1 GHz to 26 GHz, Vertical (Peak)

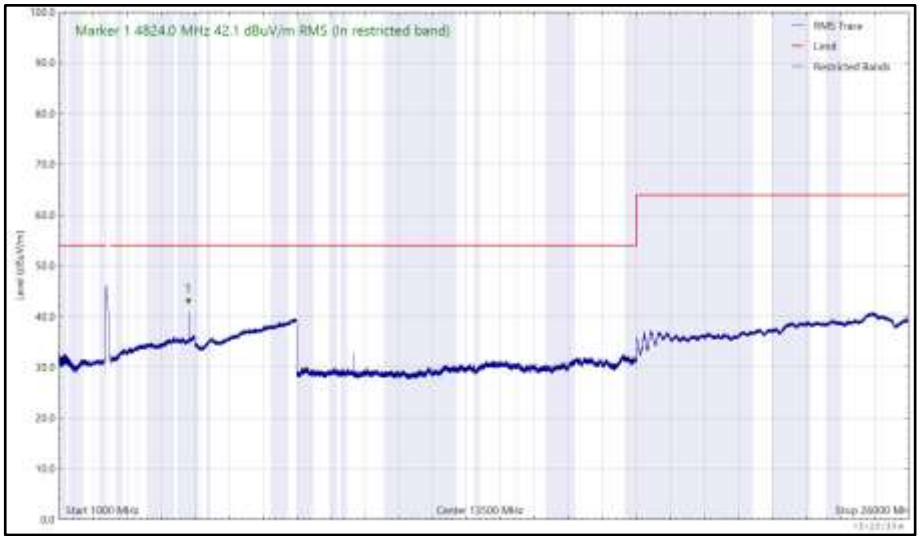

Figure 152 - 2412 MHz (CH1), 802.11b, Core 0, 1 GHz to 26 GHz, Vertical (RMS)

Frequency (MHz)	Level (dBuv/m)	Limit (dBuv/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
4874.000	45.1	54.0	-8.9	RMS	17	170	Vertical

Table 62 - 2437 MHz (CH6), 802.11b, Core 0, 30 MHz to 26 GHz

No other emissions found within 10 dB of the limit.

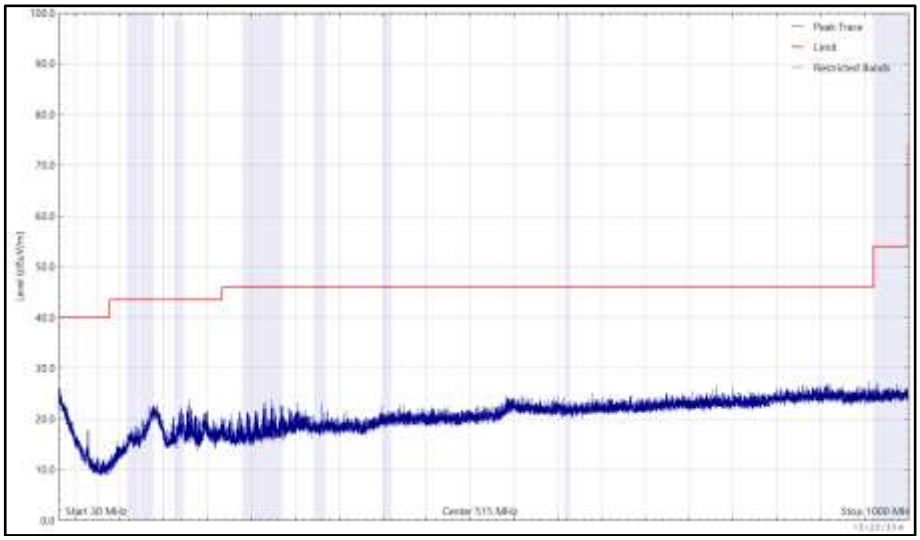

Figure 153 - 2437 MHz (CH6), 802.11b, Core 0, 30 MHz to 1 GHz, Horizontal (Peak)

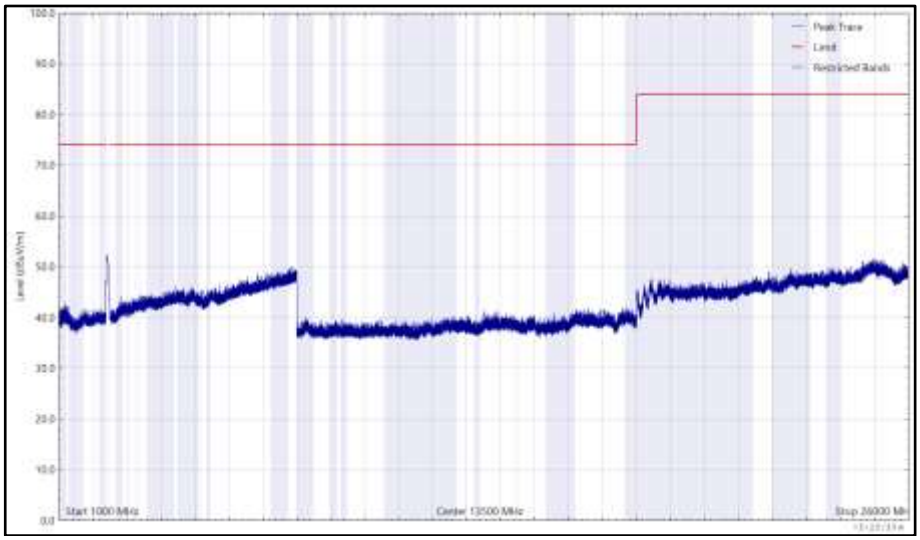

Figure 154 - 2437 MHz (CH6), 802.11b, Core 0, 1 GHz to 26 GHz, Horizontal (Peak)

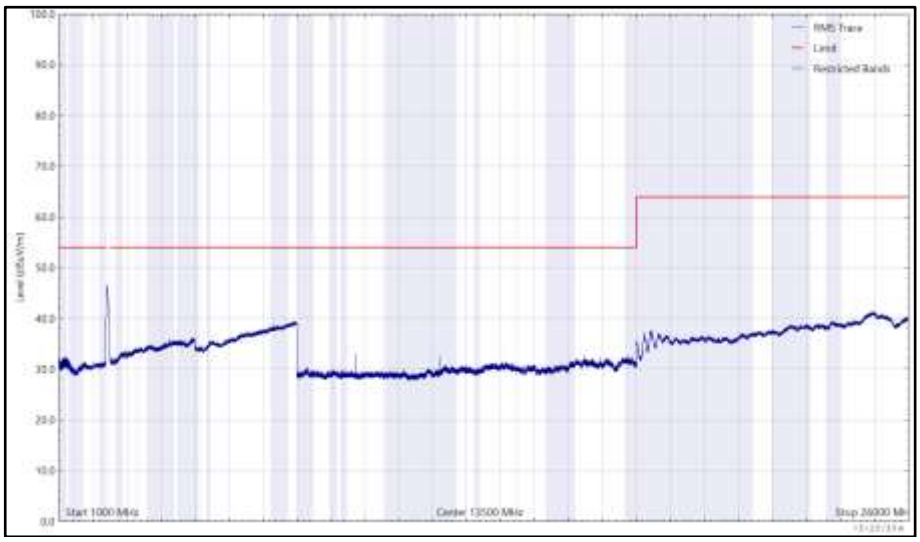

Figure 155 - 2437 MHz (CH6), 802.11b, Core 0, 1 GHz to 26 GHz, Horizontal (RMS)

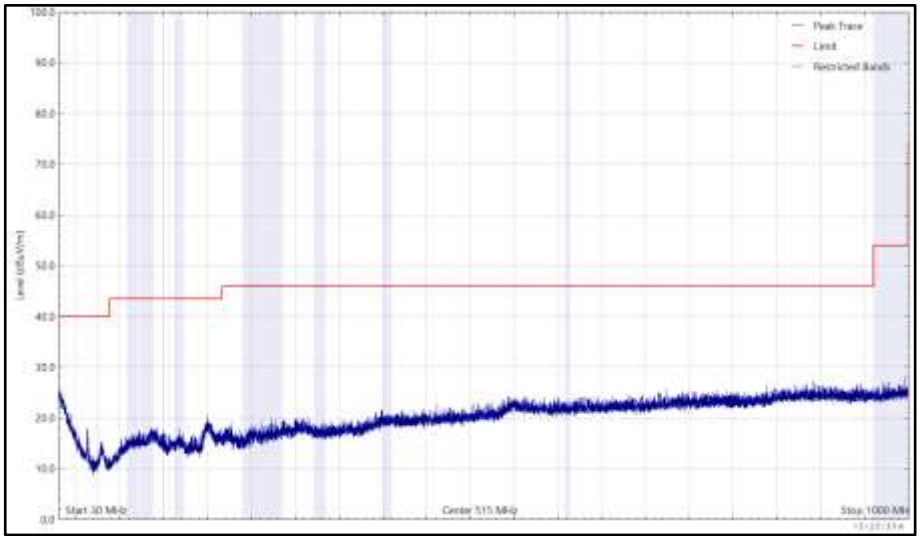

Figure 156 - 2437 MHz (CH6), 802.11b, Core 0, 30 MHz to 1 GHz, Vertical (Peak)

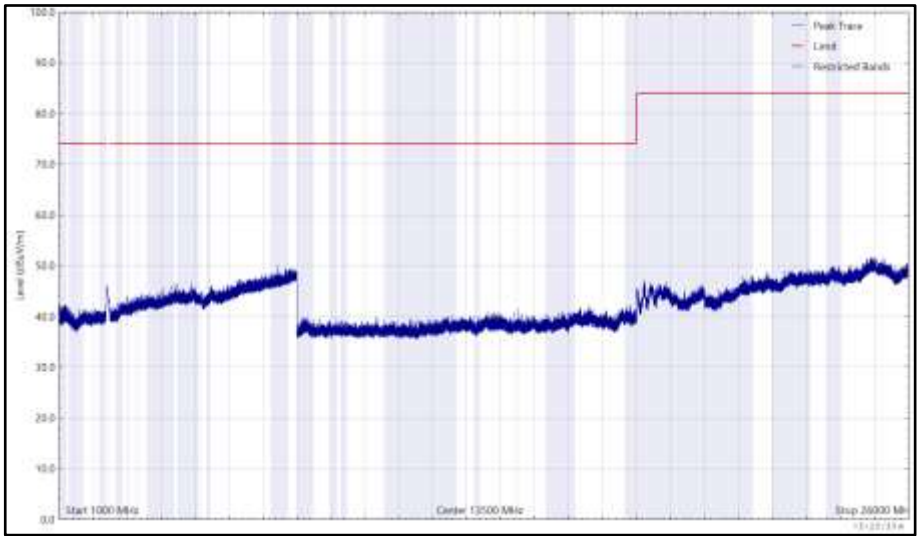

Figure 157 - 2437 MHz (CH6), 802.11b, Core 0, 1 GHz to 26 GHz, Vertical (Peak)

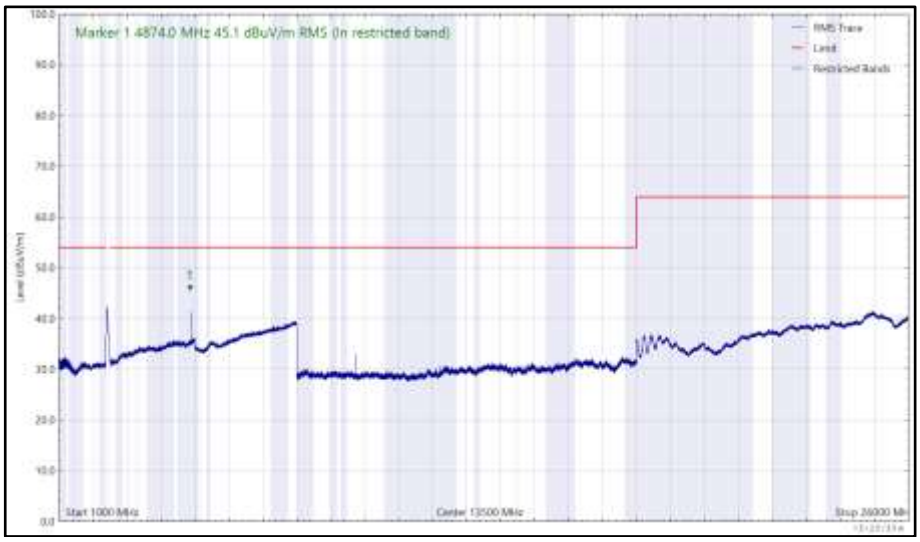

Figure 158 - 2437 MHz (CH6), 802.11b, Core 0, 1 GHz to 26 GHz, Vertical (RMS)

Frequency (MHz)	Level (dBuv/m)	Limit (dBuv/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
4943.964	39.8	54.0	-14.2	RMS	39	283	Horizontal
4944.009	46.8	54.0	-7.2	RMS	9	185	Vertical
12360.916	33.1	54.0	-20.9	RMS	352	223	Horizontal

Table 63 - 2472 MHz (CH13), 802.11b, Core 0, 1 GHz to 26 GHz

No other emissions found within 10 dB of the limit.

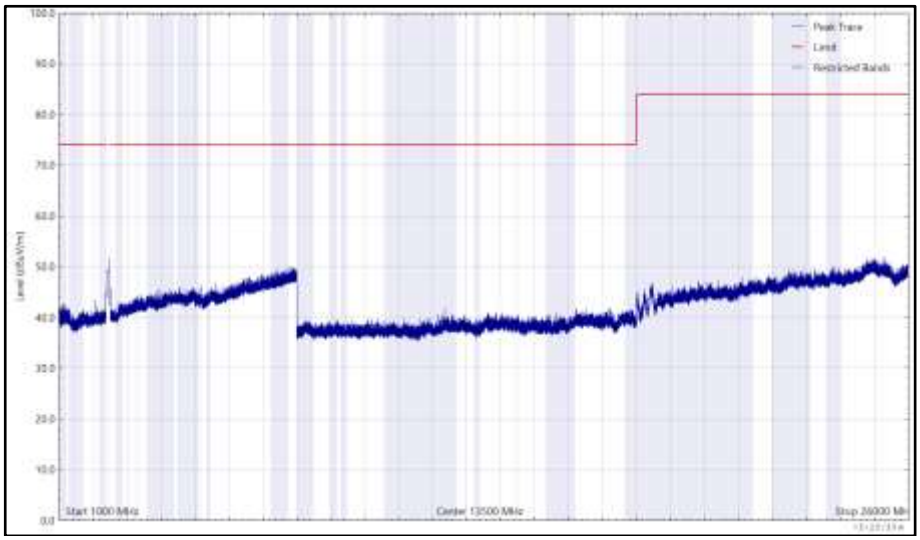

Figure 159 - 2472 MHz (CH13), 802.11b, Core 0, 1 GHz to 26 GHz, Horizontal (Peak)

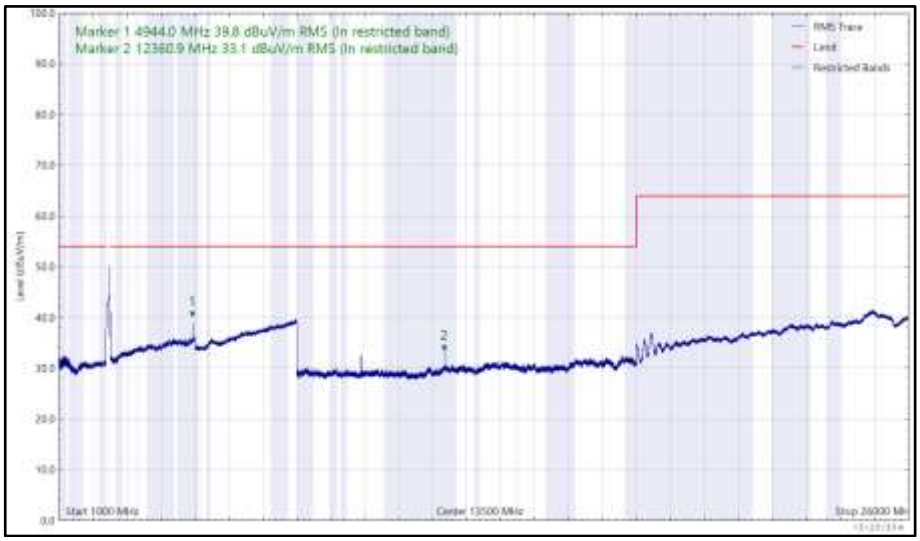

Figure 160 - 2472 MHz (CH13), 802.11b, Core 0, 1 GHz to 26 GHz, Horizontal (RMS)

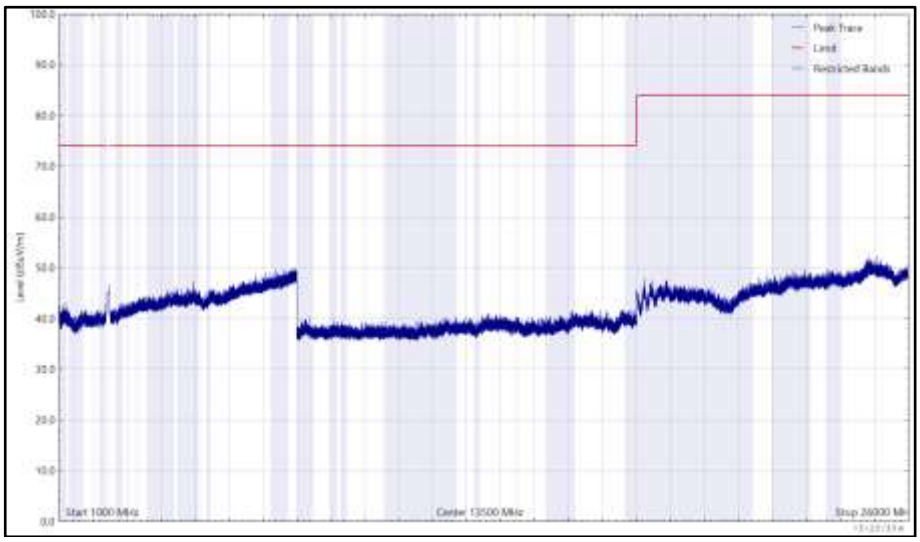

Figure 161 - 2472 MHz (CH13), 802.11b, Core 0, 1 GHz to 26 GHz, Vertical (Peak)

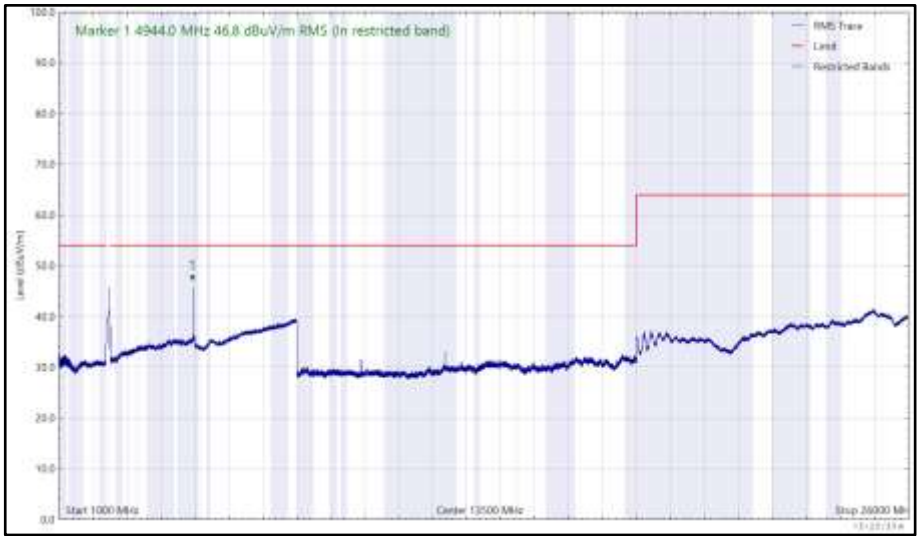

Figure 162 - 2472 MHz (CH13), 802.11b, Core 0, 1 GHz to 26 GHz, Vertical (RMS)

Frequency (MHz)	Level (dBuv/m)	Limit (dBuv/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
4824.007	38.5	54.0	-15.5	RMS	200	100	Horizontal

Table 64 - 2412 MHz (CH1), 802.11b, Core 1, 1 GHz to 26 GHz

No other emissions found within 10 dB of the limit.

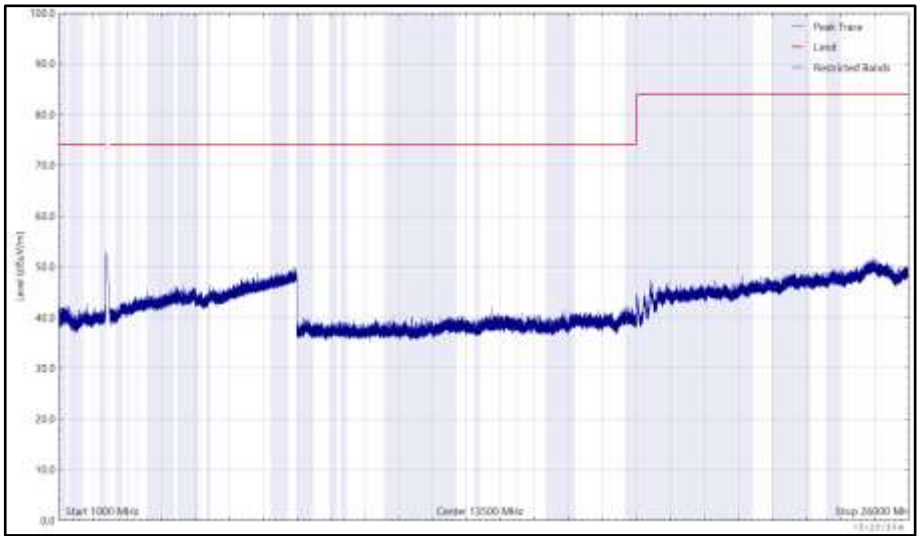

Figure 163 - 2412 MHz (CH1), 802.11b, Core 1, 1 GHz to 26 GHz, Horizontal (Peak)

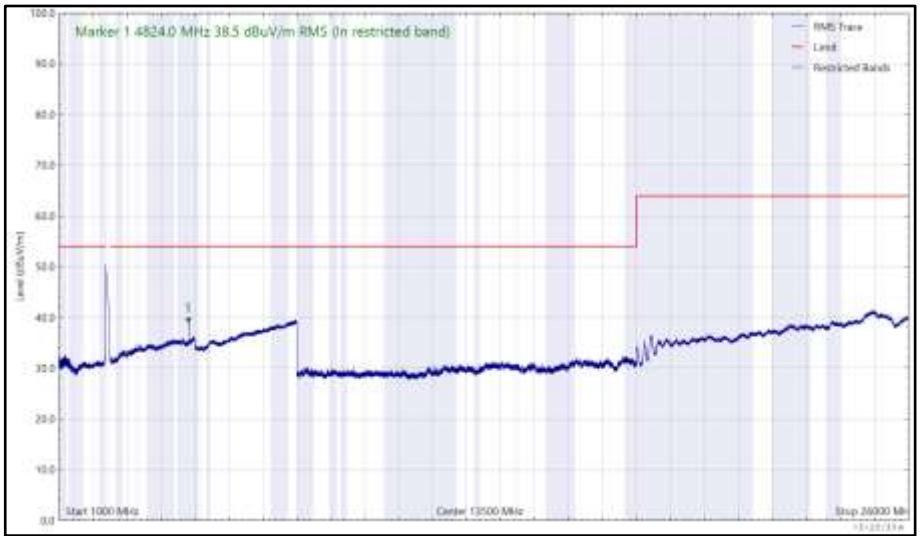

Figure 164 - 2412 MHz (CH1), 802.11b, Core 1, 1 GHz to 26 GHz, Horizontal (RMS)

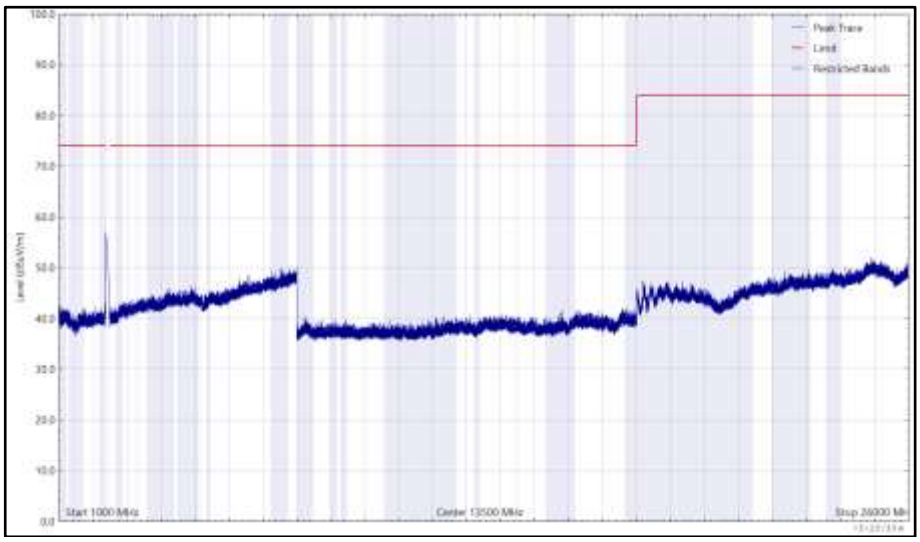

Figure 165 - 2412 MHz (CH1), 802.11b, Core 1, 1 GHz to 26 GHz, Vertical (Peak)

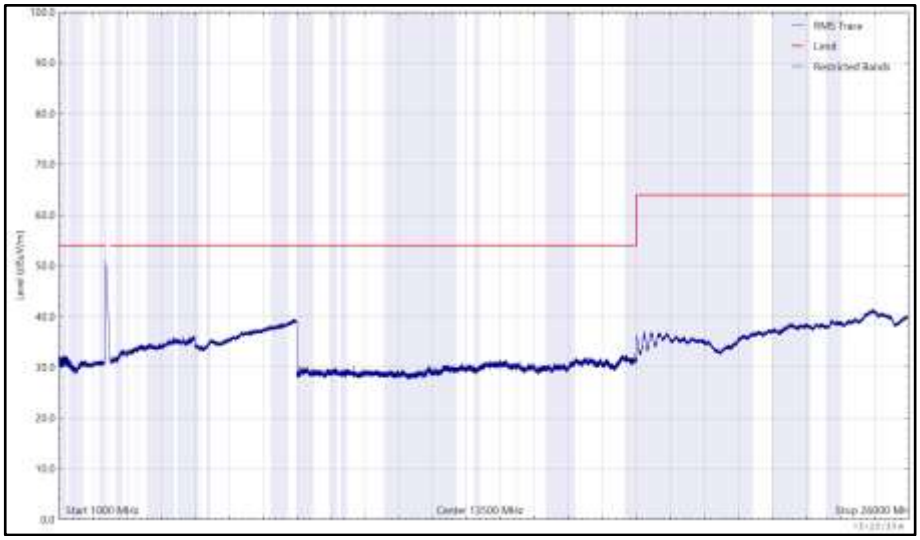

Figure 166 - 2412 MHz (CH1), 802.11b, Core 1, 1 GHz to 26 GHz, Vertical (RMS)

Frequency (MHz)	Level (dBuv/m)	Limit (dBuv/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
4874.615	34.4	54.0	-19.6	RMS	54	110	Horizontal

Table 65 - 2437 MHz (CH6), 802.11b, Core 1, 30 MHz to 26 GHz

No other emissions found within 10 dB of the limit.

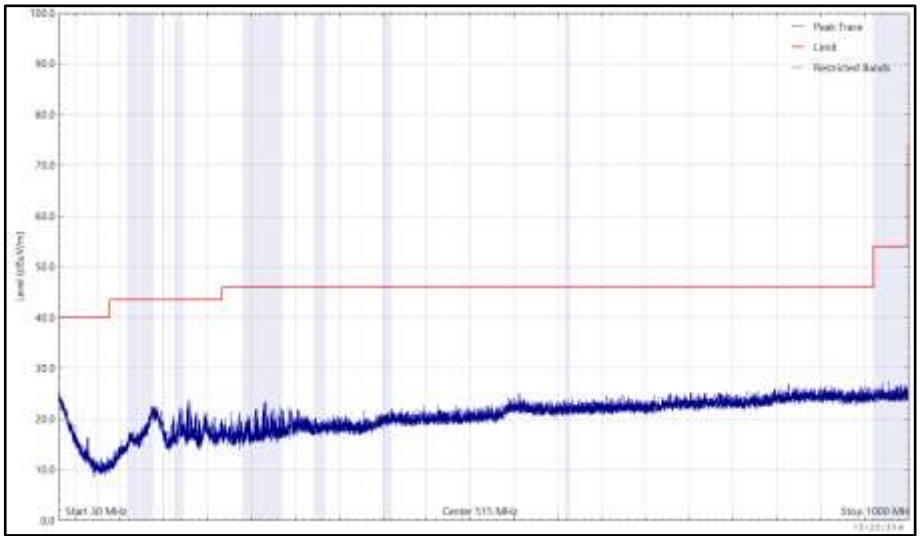

Figure 167 - 2437 MHz (CH6), 802.11b, Core 1, 30 MHz to 1 GHz, Horizontal (Peak)

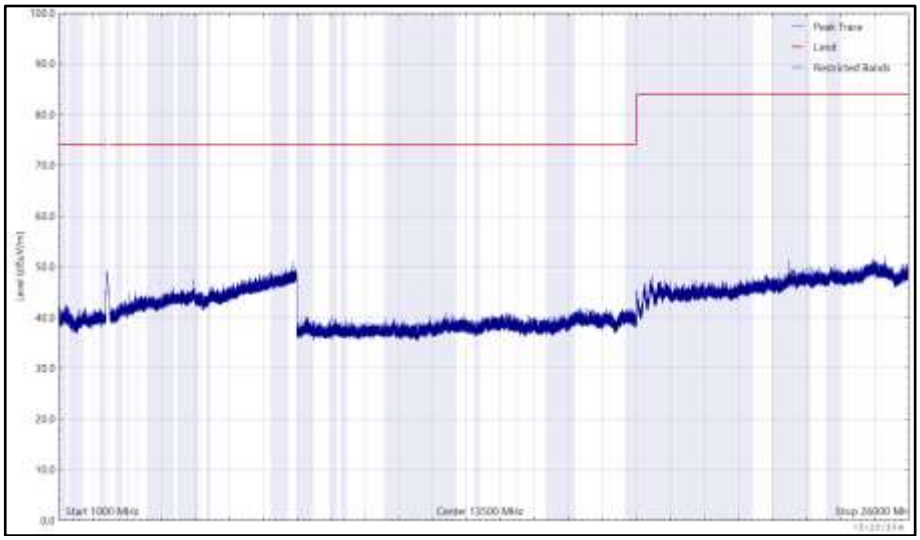

Figure 168 - 2437 MHz (CH6), 802.11b, Core 1, 1 GHz to 26 GHz, Horizontal (Peak)

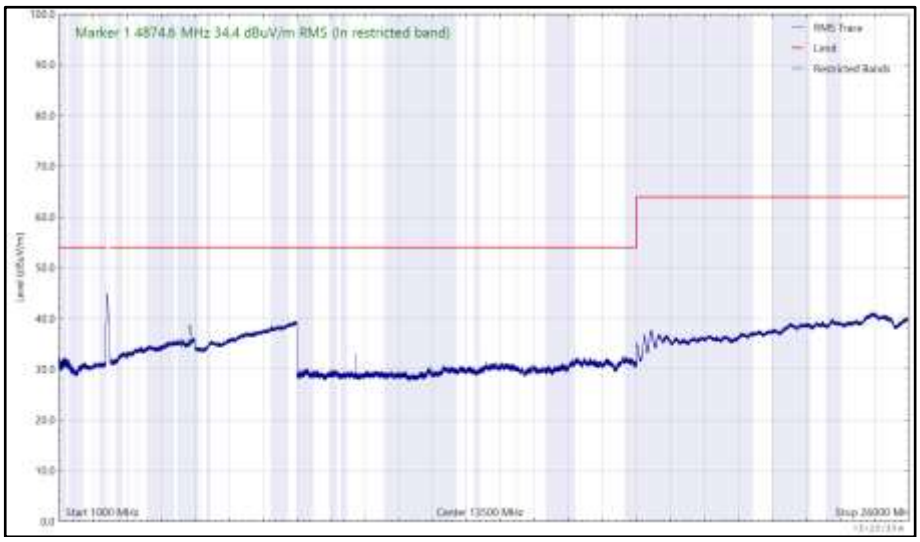

Figure 169 - 2437 MHz (CH6), 802.11b, Core 1, 1 GHz to 26 GHz, Horizontal (RMS)

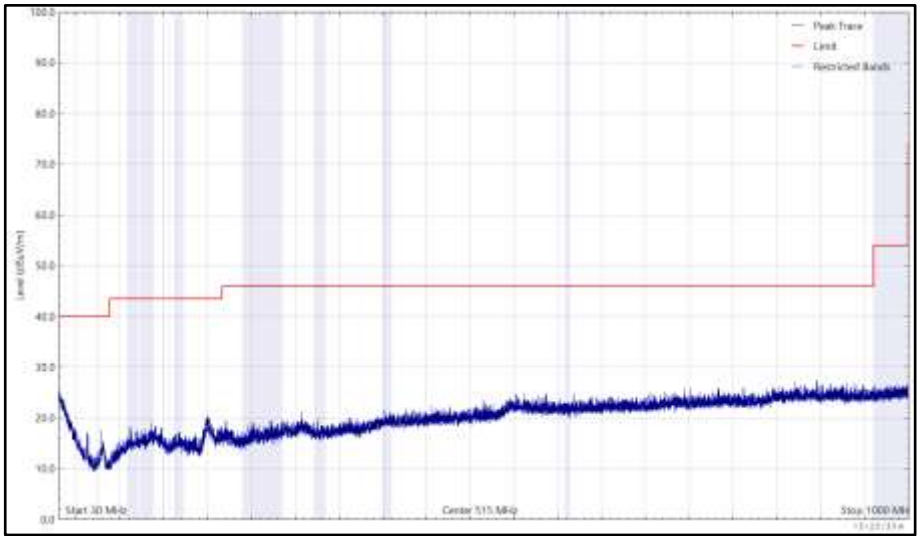

Figure 170 - 2437 MHz (CH6), 802.11b, Core 1, 30 MHz to 1 GHz, Vertical (Peak)

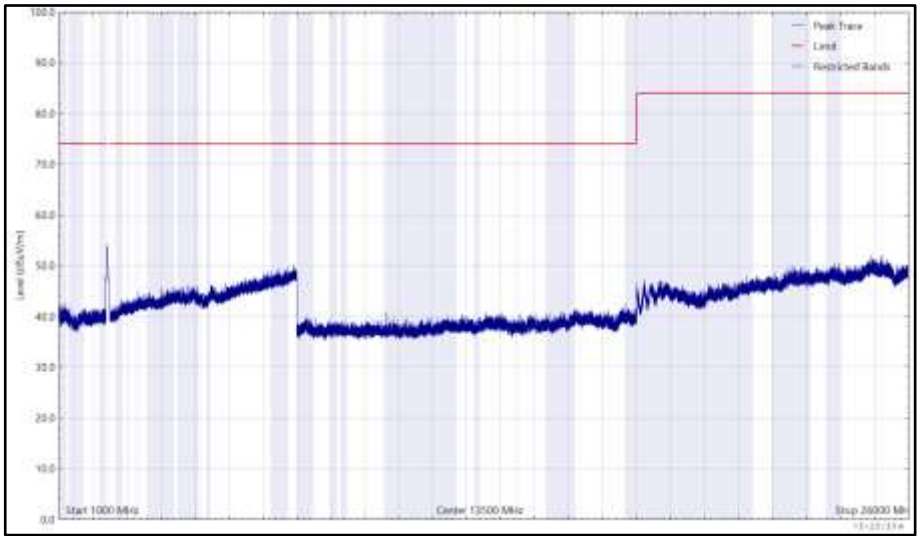

Figure 171 - 2437 MHz (CH6), 802.11b, Core 1, 1 GHz to 26 GHz, Vertical (Peak)

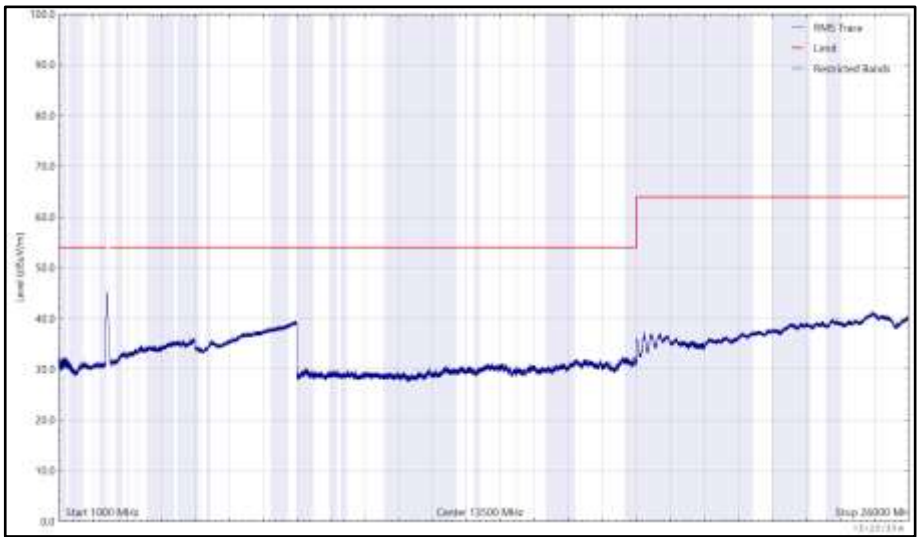

Figure 172 - 2437 MHz (CH6), 802.11b, Core 1, 1 GHz to 26 GHz, Vertical (RMS)

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

Table 66 - 2472 MHz (CH13), 802.11b, Core 1, 1 GHz to 26 GHz

*No emissions found within 10 dB of the limit.

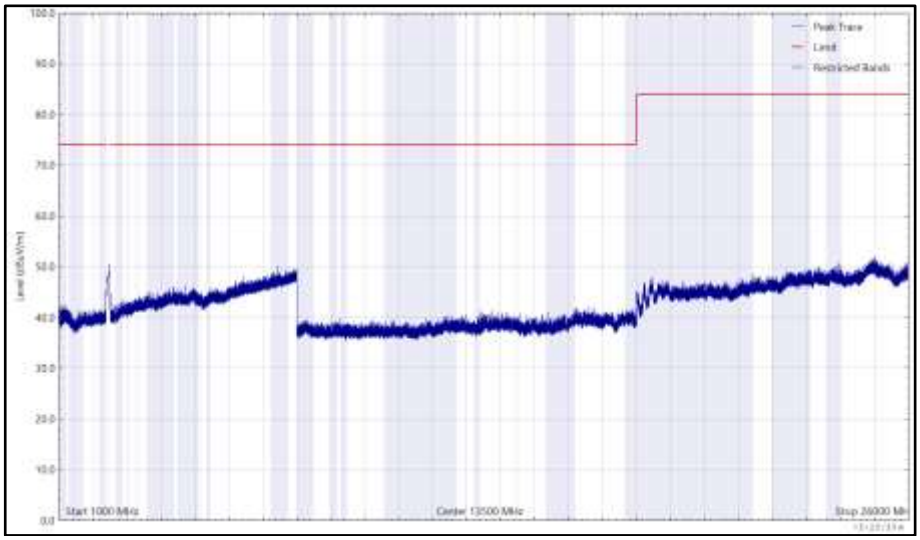

Figure 173 - 2472 MHz (CH13), 802.11b, Core 1, 1 GHz to 26 GHz, Horizontal (Peak)

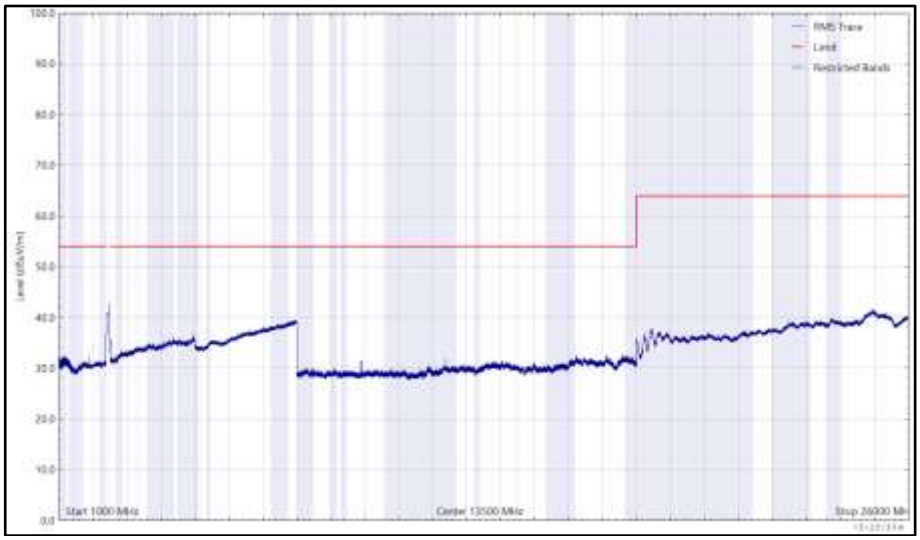

Figure 174 - 2472 MHz (CH13), 802.11b, Core 1, 1 GHz to 26 GHz, Horizontal (RMS)

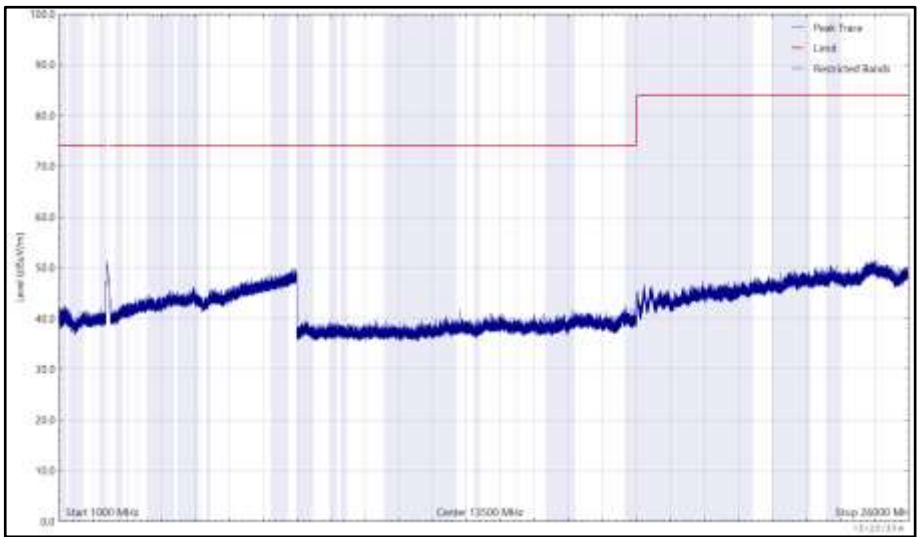

Figure 175 - 2472 MHz (CH13), 802.11b, Core 1, 1 GHz to 26 GHz, Vertical (Peak)

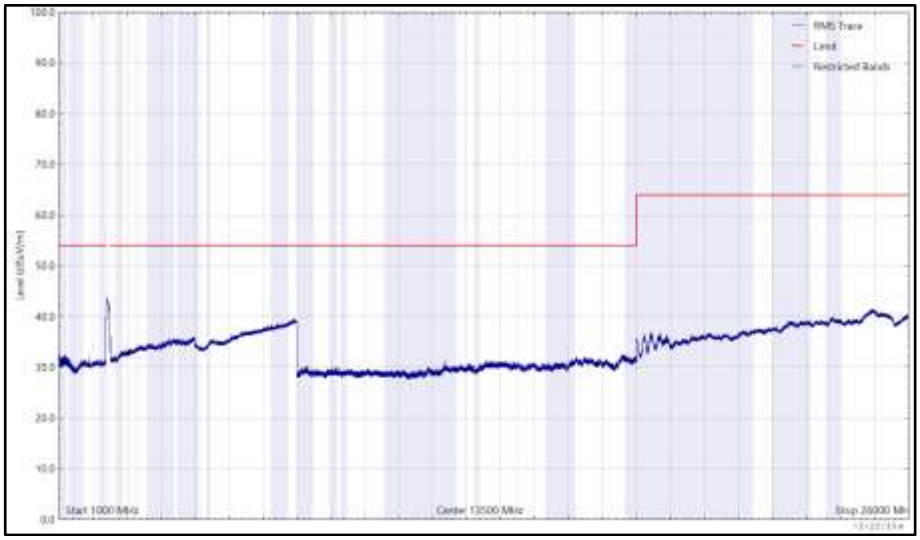

Figure 176 - 2472 MHz (CH13), 802.11b, Core 1, 1 GHz to 26 GHz, Vertical (RMS)

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

Table 67 - 2412 MHz (CH1), HE20, RU26-0, Core 0 + Core 1, 1 GHz to 26 GHz

*No emissions found within 10 dB of the limit.

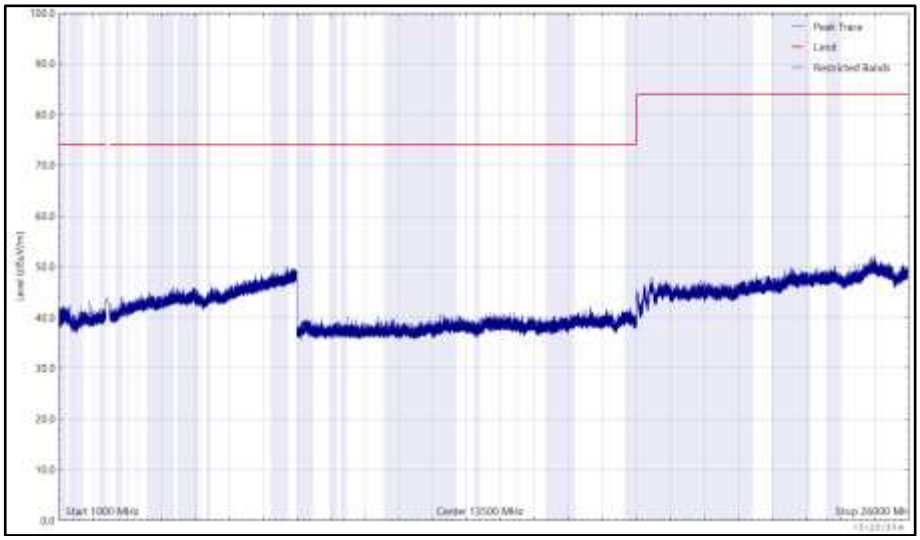

Figure 177 - 2412 MHz (CH1), HE20, RU26-0, Core 0 + Core 1, 1 GHz to 26 GHz, Horizontal (Peak)

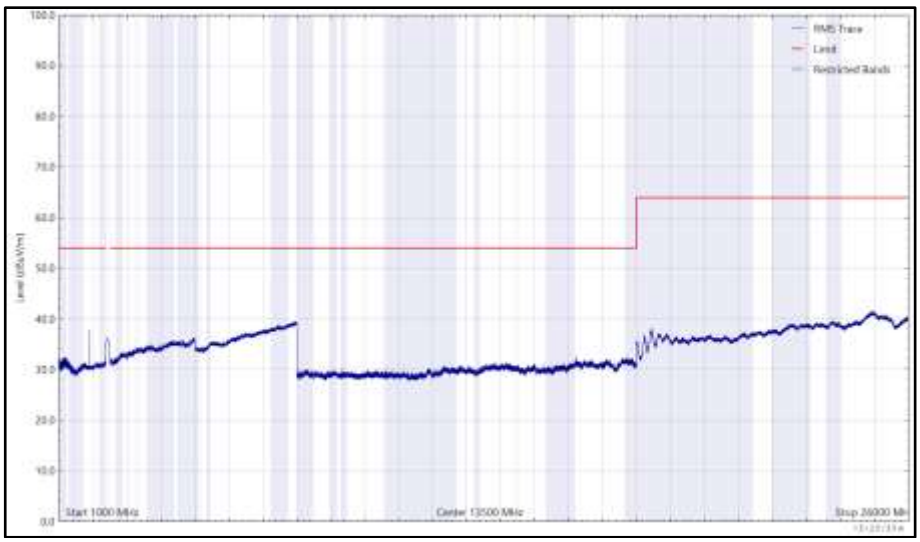

Figure 178 - 2412 MHz (CH1), HE20, RU26-0, Core 0 + Core 1, 1 GHz to 26 GHz, Horizontal (RMS)

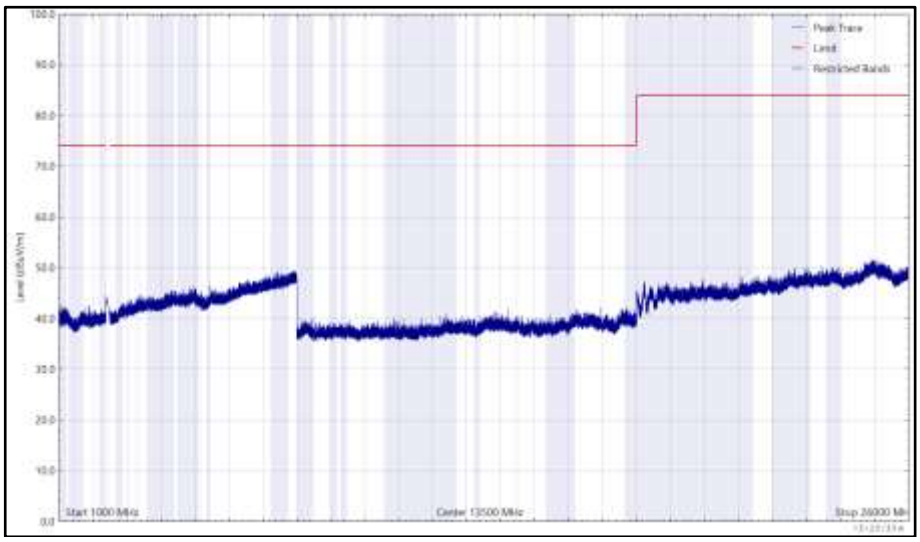

Figure 179 - 2412 MHz (CH1), HE20, RU26-0, Core 0 + Core 1, 1 GHz to 26 GHz, Vertical (Peak)

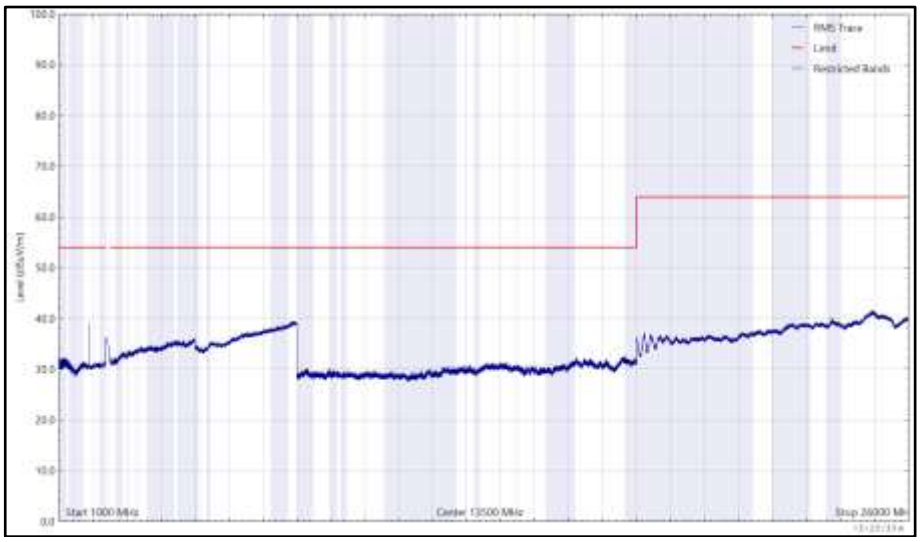

Figure 180 - 2412 MHz (CH1), HE20, RU26-0, Core 0 + Core 1, 1 GHz to 26 GHz, Vertical (RMS)

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

Table 68 - 2437 MHz (CH6), HE20, RU26-0, Core 0 + Core 1, 30 MHz to 26 GHz

*No emissions found within 10 dB of the limit.

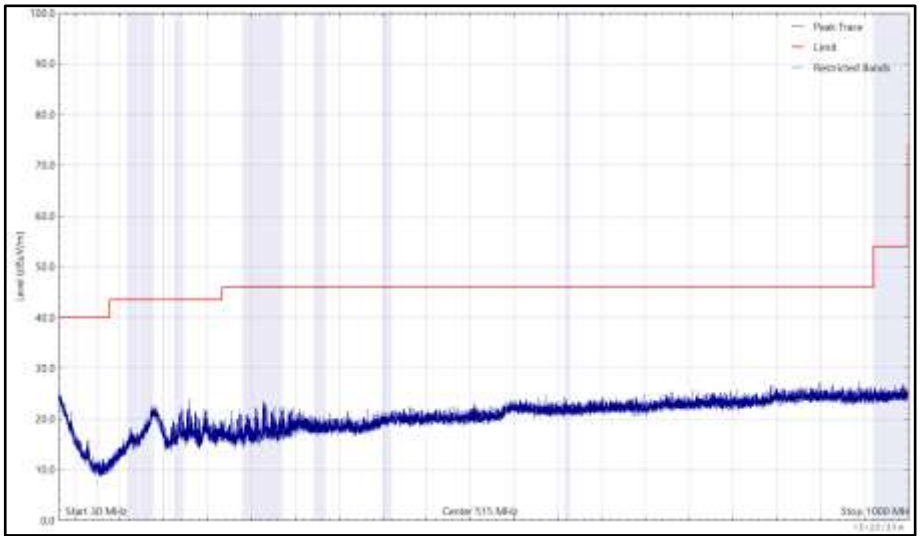

Figure 181 - 2437 MHz (CH6), HE20, RU26-0, Core 0 + Core 1, 30 MHz to 1 GHz, Horizontal (Peak)

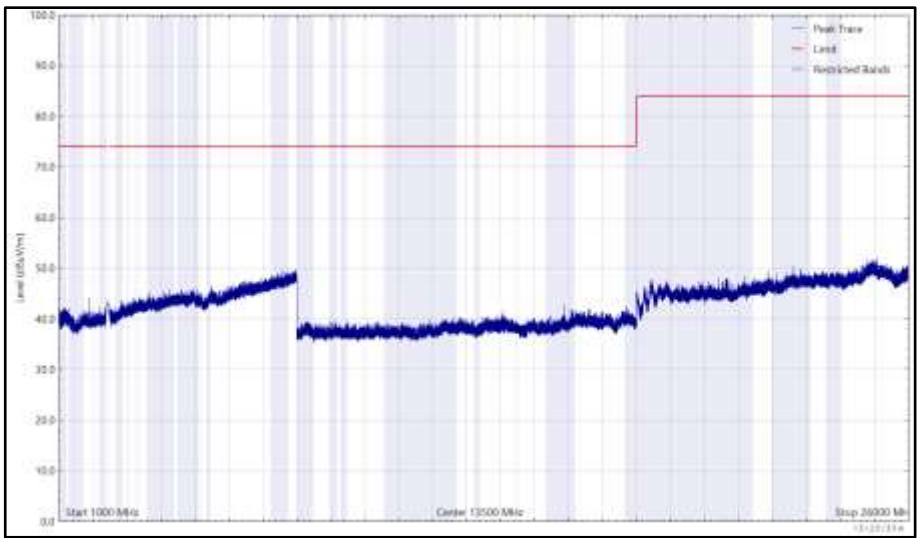

Figure 182 - 2437 MHz (CH6), HE20, RU26-0, Core 0 + Core 1, 1 GHz to 26 GHz, Horizontal (Peak)

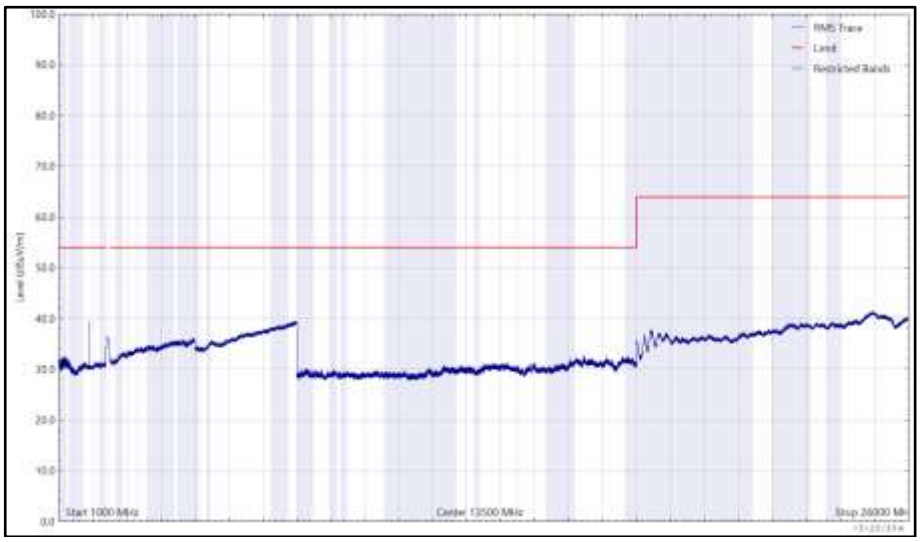

Figure 183 - 2437 MHz (CH6), HE20, RU26-0, Core 0 + Core 1, 1 GHz to 26 GHz, Horizontal (RMS)

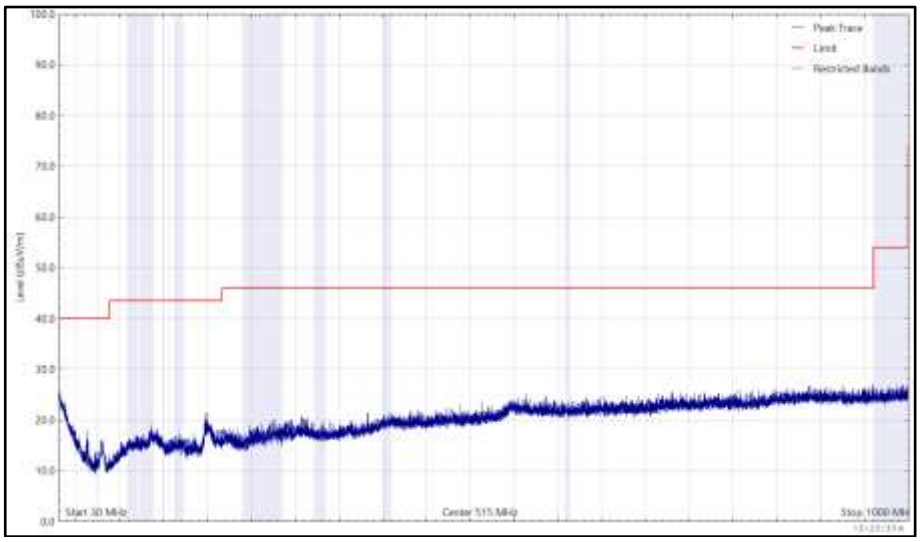

Figure 184 - 2437 MHz (CH6), HE20, RU26-0, Core 0 + Core 1, 30 MHz to 1 GHz, Vertical (Peak)

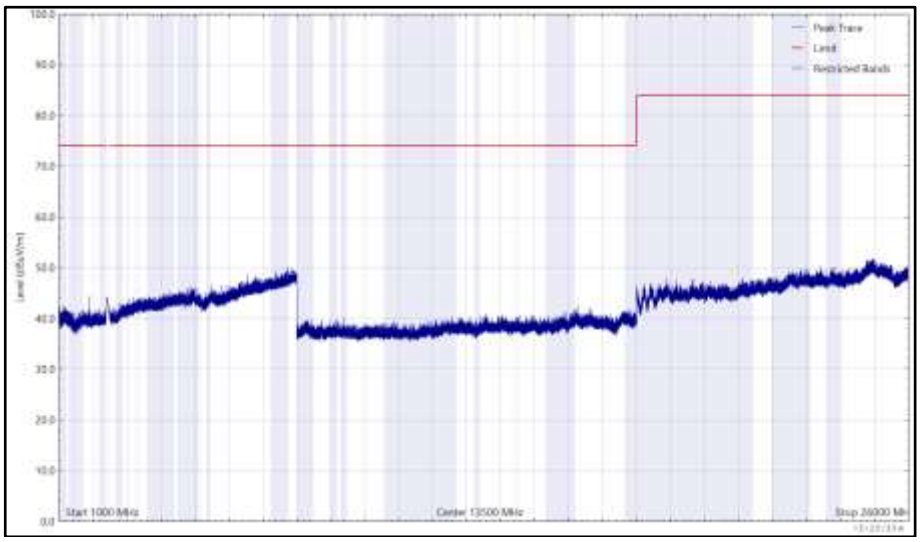

Figure 185 - 2437 MHz (CH6), HE20, RU26-0, Core 0 + Core 1, 1 GHz to 26 GHz, Vertical (Peak)

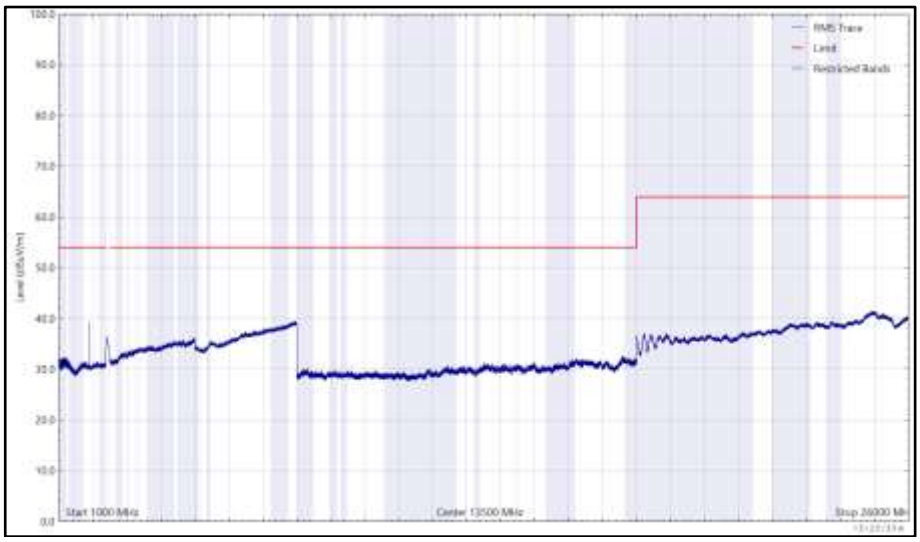

Figure 186 - 2437 MHz (CH6), HE20, RU26-0, Core 0 + Core 1, 1 GHz to 26 GHz, Vertical (RMS)

Frequency (MHz)	Level (dBuv/m)	Limit (dBuv/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
4871.425	34.7	54.0	-19.3	RMS	5	110	Horizontal

Table 69 - 2472 MHz (CH13), HE20, RU26-0, Core 0 + Core 1, 1 GHz to 26 GHz

No other emissions found within 10 dB of the limit.

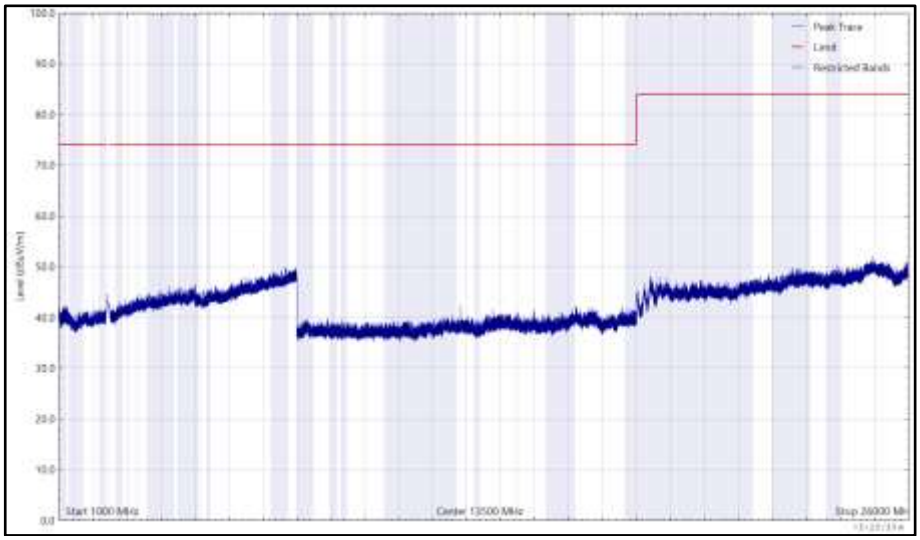

Figure 187 - 2472 MHz (CH13), HE20, RU26-0, Core 0 + Core 1, 1 GHz to 26 GHz, Horizontal (Peak)

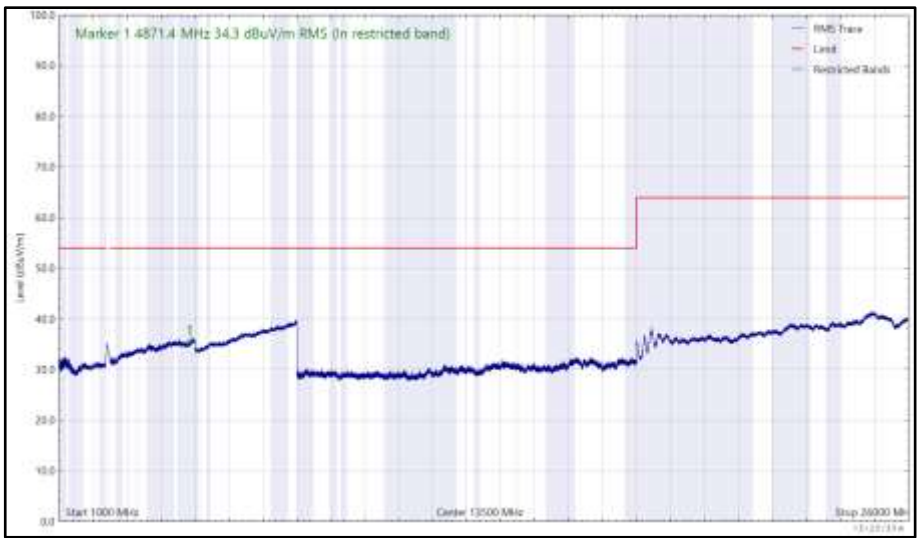

Figure 188 - 2472 MHz (CH13), HE20, RU26-0, Core 0 + Core 1, 1 GHz to 26 GHz, Horizontal (RMS)

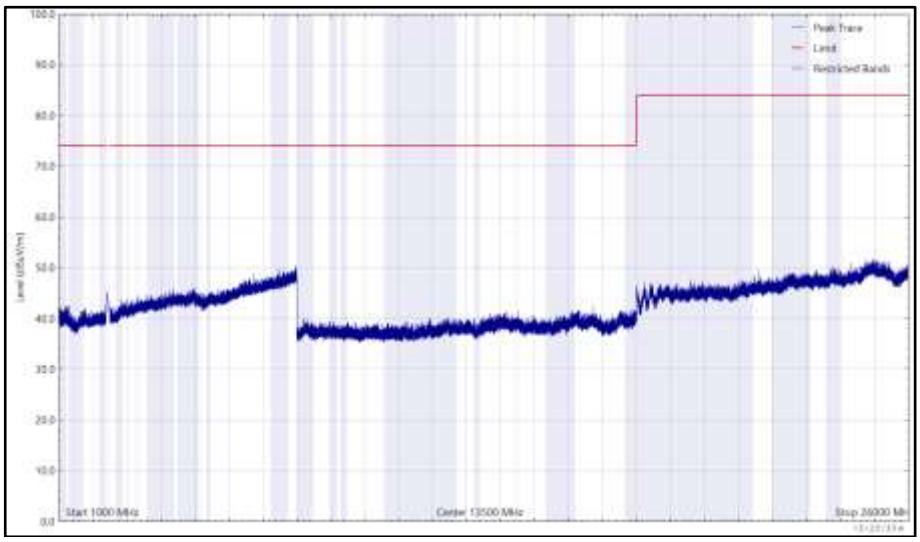

Figure 189 - 2472 MHz (CH13), HE20, RU26-0, Core 0 + Core 1, 1 GHz to 26 GHz, Vertical (Peak)

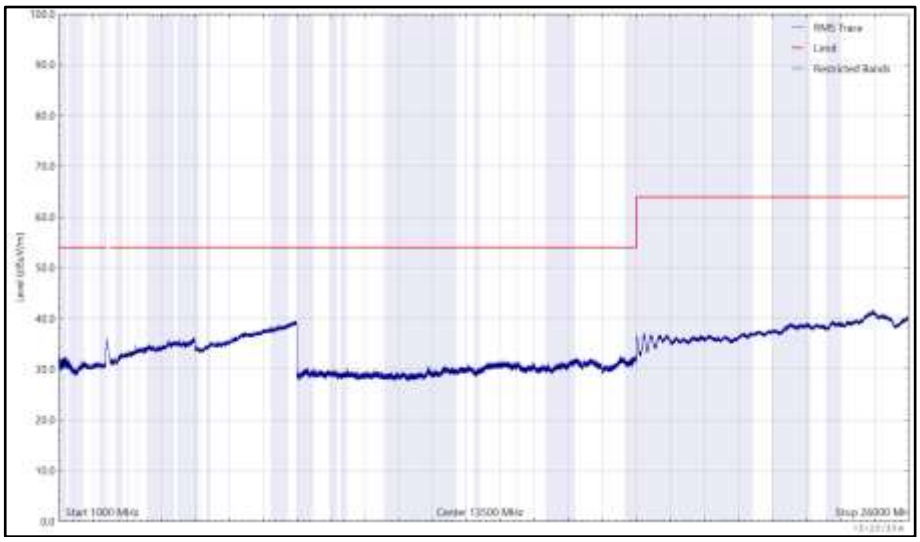

Figure 190 - 2472 MHz (CH13), HE20, RU26-0, Core 0 + Core 1, 1 GHz to 26 GHz, Vertical (RMS)

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 11.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
EMI Test Receiver	Rohde & Schwarz	ESW44	5084	12	04-Feb-2021
EmX Emissions Software	TUV SUD	V2.1.0	5125	-	Software
Mast	Maturo	TAM 4.0-P	5158	-	TU
Mast and Turntable Controller	Maturo	Maturo NCD	5159	-	TU
Turntable	Maturo	TT 15WF	5160	-	TU
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
Antenna with permanent attenuator (Bilog)	Chase	CBL6143	2904	24	30-Sep-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
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)	Rosenberger	LU7-071-1000	5104	12	10-Dec-2021
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
Horn Antenna (15-40GHz)	Schwarzbeck	BBHA 9170	5217	12	14-Oct-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
2m K Type Cable	Junkosha	MWX241-02000KMSKMS/A	5524	12	03-Apr-2021
3 GHz High pass Filter	Wainwright	WHKX12-2580-3000-18000-80SS	5547	12	05-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
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB-40	5475	12	17-Mar-2021

Table 70

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	± 279.049 kHz
Authorised Band Edges	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 40 GHz: ± 6.3 dB
Restricted 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 71

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.