

# FCC and ISED Test Report

Manufacturer: 3Shape TRIOS A/S

Model: L1P-2



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

Prepared for: 3Shape TRIOS A/S  
Holmens Kanal 7  
DK-1060 Copenhagen, Denmark

FCC ID: 2A4DE-3S001      IC: 28188-3S001

## COMMERCIAL-IN-CONFIDENCE

Document 75961963-05 Issue 03

SIGNATURE			
NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
Steve Marshall	Senior Engineer	Authorised Signatory	14 March 2025

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 and ISED RSS-247 and ISED RSS-GEN. The sample tested was found to comply with the requirements defined in the applied rules.

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Testing	Ahmad Javid	14 March 2025	
Testing	Thomas Biddlecombe	14 March 2025	

FCC Accreditation  
492497/UK2010 Octagon House, Fareham Test Laboratory      ISED Accreditation  
12669A/UK0003 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 2023, ISED RSS-247 Issue 3 (2023-08) and ISED RSS-GEN: Issue 5 (2018-04) + A2 (2021-02) for the tests detailed in section 1.3.

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TÜV SÜD Group Company

Phone: +44 (0) 1489 558100  
Fax: +44 (0) 1489 558101  
[www.tuvsud.com/en](http://www.tuvsud.com/en)

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



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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	14 February 2025
2	Changed Antenna Gain details in App form	05 March 2025
3	Admin change to remove KDB 484596	14 March 2025

**Table 1**

### 1.2 Introduction

Applicant	3Shape TRIOS A/S
Manufacturer	3Shape TRIOS A/S
Model Number(s)	L1P-2
Serial Number(s)	1LD2428L01001X and 1LD2428L01002X
Hardware Version(s)	10037061-01 Build 4 RC1
Software Version(s)	Radio module driver: 11.39.0.18
Number of Samples Tested	2
Test Specification/Issue/Date	FCC 47 CFR Part 15C, 2023 ISED RSS-247, Issue 3 (2023-08) ISED RSS-GEN: Issue 5 (2018-04) + A2 (2021-02)
Order Number	Potto_26_16072024
Date	09-July-2024
Date of Receipt of EUT	07-October-2024
Start of Test	10-January-2025
Finish of Test	11-January-2025
Name of Engineer(s)	Ahmad Javid & Thomas Biddlecombe
Related Document(s)	ANSI C63.10 (2020) 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 and 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						
2.1	15.205	3.3	8.10	Restricted Band Edges	Pass	ANSI C63.10 (2020)
2.2	15.247 (b)	5.4	6.12	Maximum Conducted Output Power	Pass	ANSI C63.10 (2020) KDB 662911 D01 v02r01
2.3	15.247 (d)	5.5	N/A	Authorised Band Edges	Pass	ANSI C63.10 (2020)
2.4	15.247 (d) & 15.209	3.3 & 5.5	6.13 & 8.9	Spurious Radiated Emissions	Pass	ANSI C63.10 (2020)

**Table 2**



## 1.4 Application Form

### Equipment Description

Technical Description: (Please provide a brief description of the intended use of the equipment including the technologies the product supports)	L1P-2 is an Intra Oral Dental Scanner system with Wi-Fi and Bluetooth.		
Manufacturer:	3Shape TRIOS A/S		
Model:	L1P-2		
Part Number:	10037061-01		
Hardware Version:	Build 4 RC1		
Software Version:	Radio module driver: 11.39.0.18		
FCC ID of the product under test – <a href="#">see guidance here</a>	2A4DE-3S001		
IC ID of the product under test – <a href="#">see guidance here</a>	28188-3S001		
Device Category	Mobile <input type="checkbox"/>	Portable <input checked="" type="checkbox"/>	Fixed <input type="checkbox"/>
Equipment is fitted with an Audio Low Pass Filter	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	

### Intentional Radiators

Technology	Bluetooth (BR+EDR)	Bluetooth Low Energy	2.4 GHz WiFi	5 GHz WiFi		
Frequency Range (MHz to MHz)	2400-2483.5	2400-2483.5	2400-2483.5	5150-5350, 5470-5850		
Conducted Declared Output Power (dBm)	10	7	18	18		
Antenna Gain (dBi)	Ant.2: -4.72	Ant.2: -4.72	Ant.1: -3.08 Ant.2: -4.72	Ant.1: 2.84 Ant.2: 3.11		
Supported Bandwidth(s) (MHz) (e.g. 1 MHz, 20 MHz, 40 MHz)	1	1, 2	20, 40	20, 40, 80		
Modulation Scheme(s) (e.g. GFSK, QPSK etc)	GFSK, π/4 DQPSK, 8-DPSK	GFSK	DSSS, OFDM	OFDM		
ITU Emission Designator ( <a href="#">see guidance here</a> ) (not mandatory for Part 15 devices)	N/A	N/A	N/A	N/A		
Bottom Frequency (MHz)	2402	2402	2412	5180		
Middle Frequency (MHz)	2441	2440	2437	5500		
Top Frequency (MHz)	2480	2480	2462	5825		



### Un-intentional Radiators

Highest frequency generated or used in the device or on which the device operates or tunes	<input type="checkbox"/> 5850 (ST60-SIPT – 802.11 ac/a/b/g/n + Bluetooth 5.1 module)
Lowest frequency generated or used in the device or on which the device operates or tunes	<input type="checkbox"/> 32.768 kHz (Oscillator mainboard)
Class A Digital Device (Use in commercial, industrial or business environment) <input type="checkbox"/>	
Class B Digital Device (Use in residential environment only) <input checked="" type="checkbox"/>	

### AC Power Source

AC supply frequency:	-	Hz
Voltage	-	V
Max current:	-	A
Single Phase <input type="checkbox"/> Three Phase <input type="checkbox"/>		

### DC Power Source

Nominal voltage:	-	V
Extreme upper voltage:	-	V
Extreme lower voltage:	-	V
Max current:	-	A

### Battery Power Source

Voltage:	3.6	V
End-point voltage:	2.5	V (Point at which the battery will terminate)
Alkaline <input type="checkbox"/> Leclanche <input type="checkbox"/> Lithium <input checked="" type="checkbox"/> Nickel Cadmium <input type="checkbox"/> Lead Acid* <input type="checkbox"/> * (Vehicle regulated)		
Other <input type="checkbox"/>	Please detail:	

### Charging

Can the EUT transmit whilst being charged	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
-------------------------------------------	---------------------------------------------------------------------

### Temperature

Minimum temperature:	15	°C
Maximum temperature:	26	°C



### Cable Loss

Adapter Cable Loss (Conducted sample)	0.5	dB
------------------------------------------	-----	----

### Antenna Characteristics

Antenna connector <input type="checkbox"/>			State impedance		Ohm
Temporary antenna connector <input checked="" type="checkbox"/> SMA VIA IPEX MHF4L(HSC)			State impedance	50	Ohm
Integral antenna <input checked="" type="checkbox"/>	Type:	Flexible Monopole	Gain	Ant.1: -3.08 Ant.2: -4.72	dBi
External antenna <input type="checkbox"/>	Type:		Gain		dBi
For external antenna only: Standard Antenna Jack <input type="checkbox"/> If yes, describe how user is prohibited from changing antenna (if not professional installed): Equipment is only ever professionally installed <input type="checkbox"/> Non-standard Antenna Jack <input type="checkbox"/> All part 15 applications will need to show how the antenna gain was derived either from a manufacturer data sheet or a measurement. Where the gain of the antenna is inherently accounted for as a result of the measurement, such as field strength measurements on a part 15.249 or 15.231 device, so the gain does not necessarily need to be verified. However, enough information regarding the construction of the antenna shall be provided. Such information maybe photographs, length of wire antenna etc.					

### Ancillaries (if applicable)

Manufacturer:		Part Number:	
Model:		Country of Origin:	

I hereby declare that the information supplied is correct and complete.

Name: David Busk  
Position held: Approval Specialist  
Date: 27 January 2025



## 1.5 Product Information

### 1.5.1 Technical Description

Handheld intraoral scanner (IOS) system capable of obtaining 2D and 3D digital images of the topographical characteristics of teeth.

### 1.5.2 Additional Information

Testing was requested by the manufacturer in support of a C2PC where the antenna type and gain has been modified by the manufacturer. A test plan was determined as follows:

Maximum Conducted Output Power  
Restricted & Authorized Band Edge  
Radiated Spurious Emissions

The above tests were limited to the worst-case modes from the original filing which were identified as:

802.11b SISO Antenna Port 1, 1 Mbps  
802.11g SISO Antenna Port 1, 6 Mbps  
802.11n SISO HT20 Antenna Port 1, MCS0

## 1.6 Deviations from the Standard

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

## 1.7 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: L1P-2, Serial Number: 1LD2428L01002X			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: L1P-2, Serial Number: 1LD2428L01001X			
0	As supplied by the customer	Not Applicable	Not Applicable

**Table 3**



## 1.8 Test Location

TÜV SÜD conducted the following tests at our Octagon House Test Laboratory.

Test Name	Name of Engineer(s)	Accreditation
Configuration and Mode: 2.4 GHz WLAN		
Restricted Band Edges	Ahmad Javid	UKAS
Maximum Conducted Output Power	Thomas Biddlecombe	UKAS
Authorised Band Edges	Ahmad Javid	UKAS
Spurious Radiated Emissions	Ahmad Javid	UKAS

**Table 4**

Office Address:

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



## 2 Test Details

### 2.1 Restricted Band Edges

#### 2.1.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.205  
ISED RSS-247, Clause 3.3  
ISED RSS-GEN, Clause 8.10

#### 2.1.2 Equipment Under Test and Modification State

L1P-2, S/N: 1LD2428L01001X - Modification State 0

#### 2.1.3 Date of Test

10-January-2025

#### 2.1.4 Test Method

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

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

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

The unit was powered by a rechargeable battery supplied by the customer and was fully charged prior to testing.

#### 2.1.5 Environmental Conditions

Ambient Temperature	19.8 °C
Relative Humidity	34.9 %

## 2.1.6 Test Results

### 2.4 GHz WLAN

Mode	Data Rate/MCS	Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dB $\mu$ V/m)	Average Level (dB $\mu$ V/m)
802.11b	1Mbps	2412	2390	53.14	43.52
802.11b	1Mbps	2462	2483.5	52.50	42.64
802.11g	6Mbps	2412	2390	54.35	42.86
802.11g	6Mbps	2462	2483.5	53.39	42.77
802.11n	MCS0	2412	2390	53.30	42.71
802.11n	MCS0	2462	2483.5	54.03	43.34

Table 5

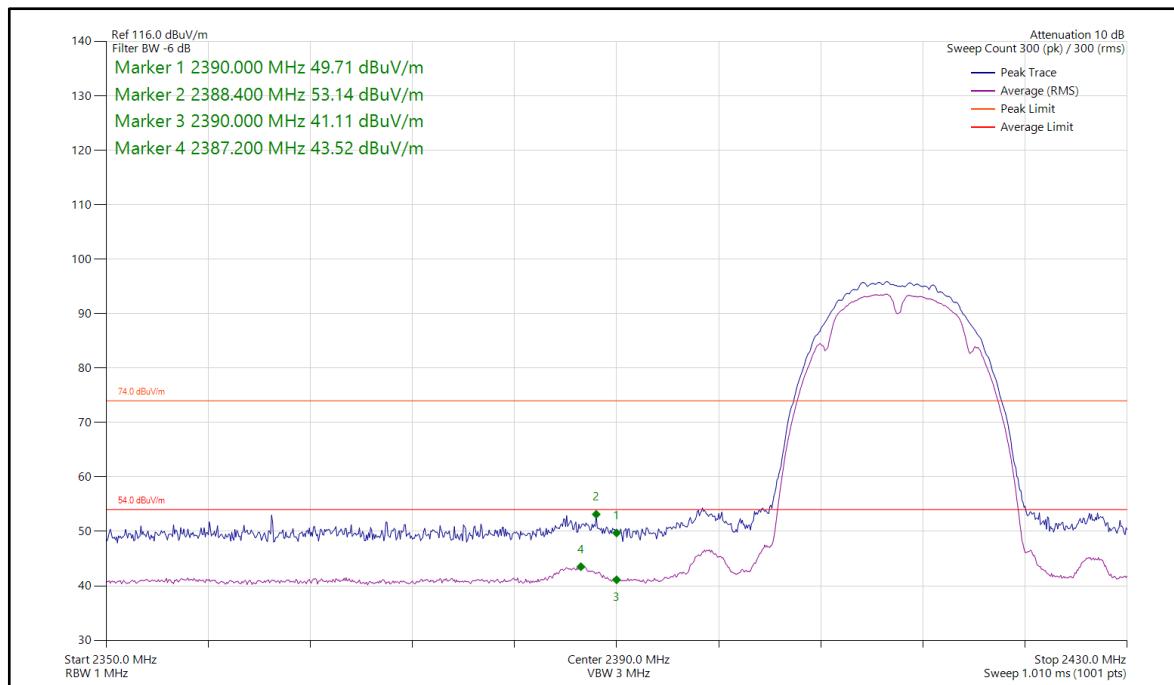


Figure 1 - CH1\_802.11b, 2412 MHz, Band Edge Frequency 2390 MHz

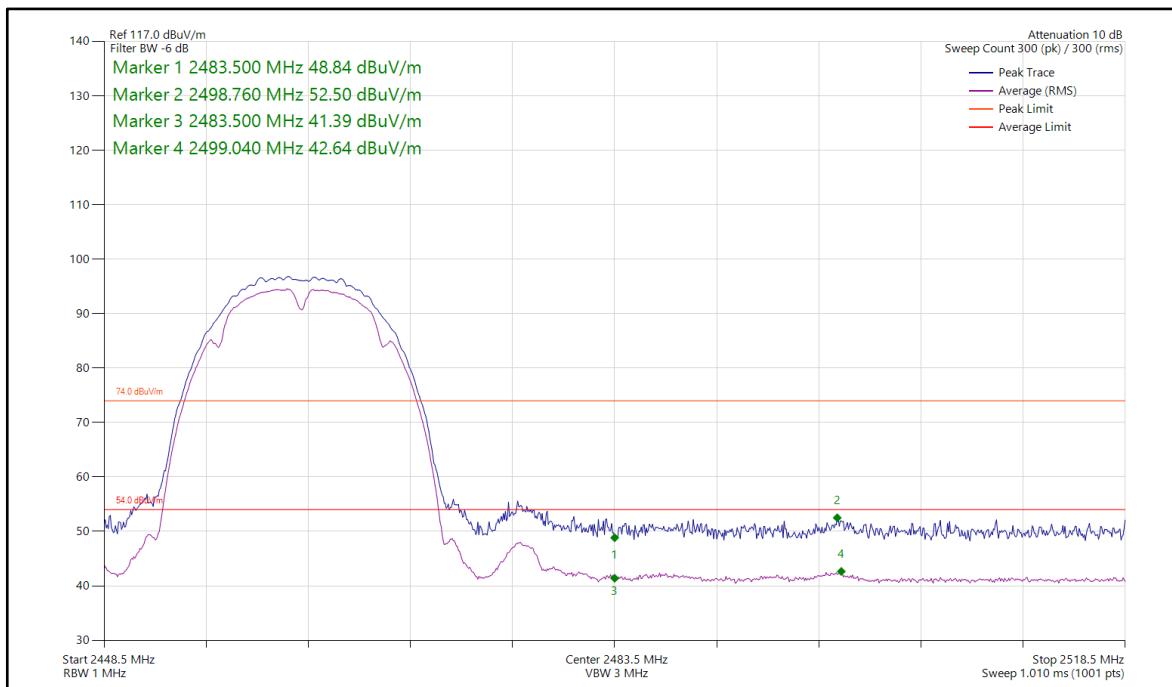


Figure 2 - CH11\_802.11b, 2462 MHz, Band Edge Frequency 2483.5 MHz

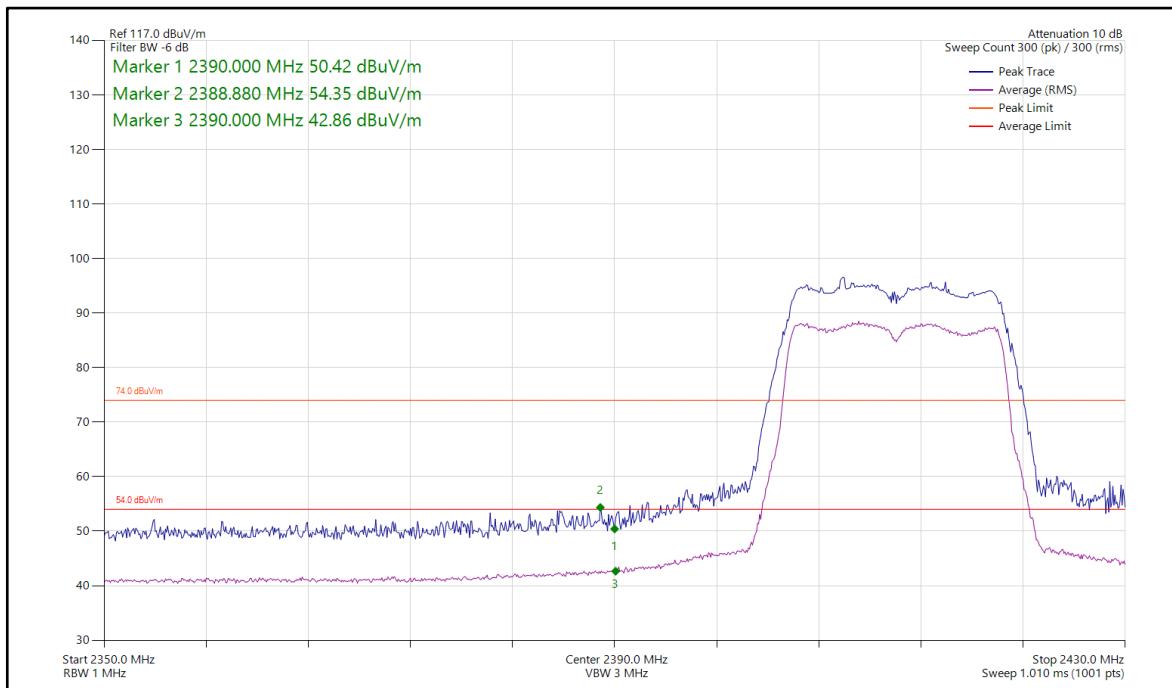


Figure 3 - CH1\_802.11g, 2412 MHz, Band Edge Frequency 2390 MHz

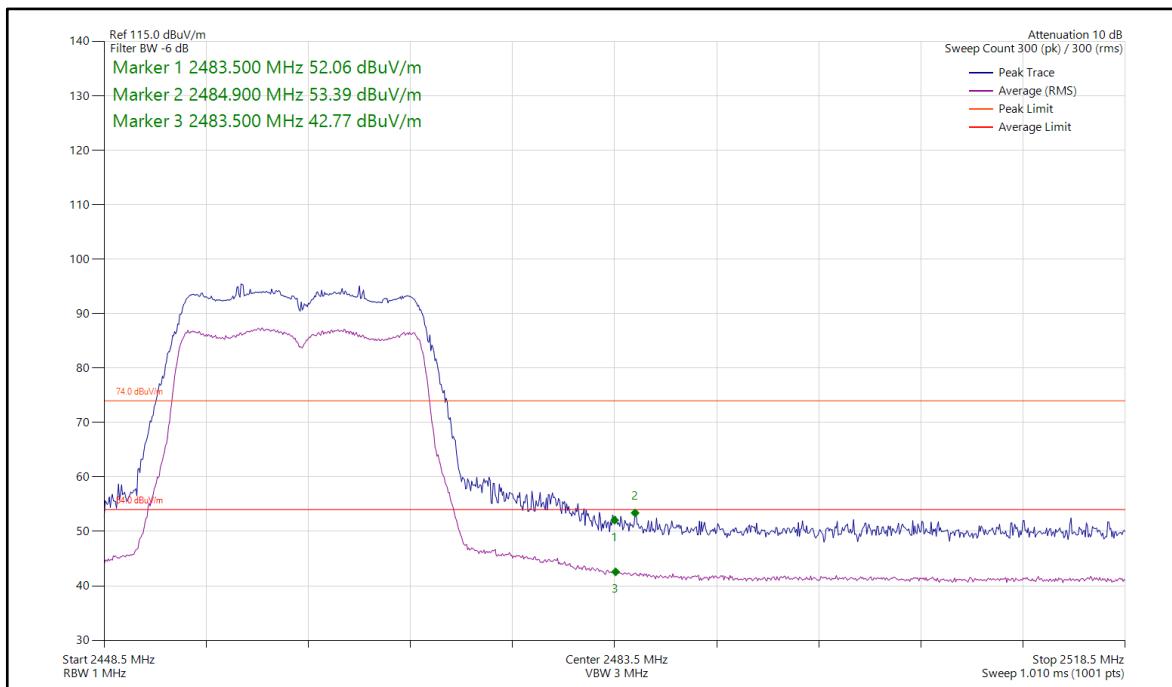


Figure 4 - CH11\_802.11g, 2462 MHz, Band Edge Frequency 2483.5 MHz

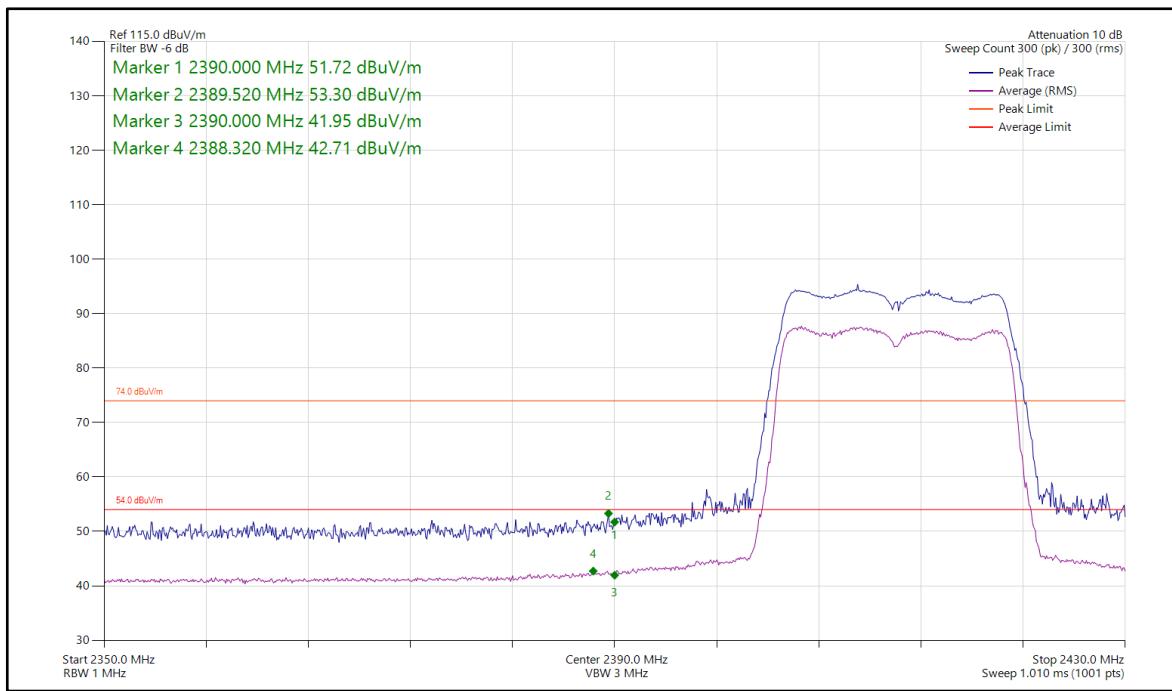


Figure 5 - CH1\_HT20, 2412 MHz, Band Edge Frequency 2390 MHz

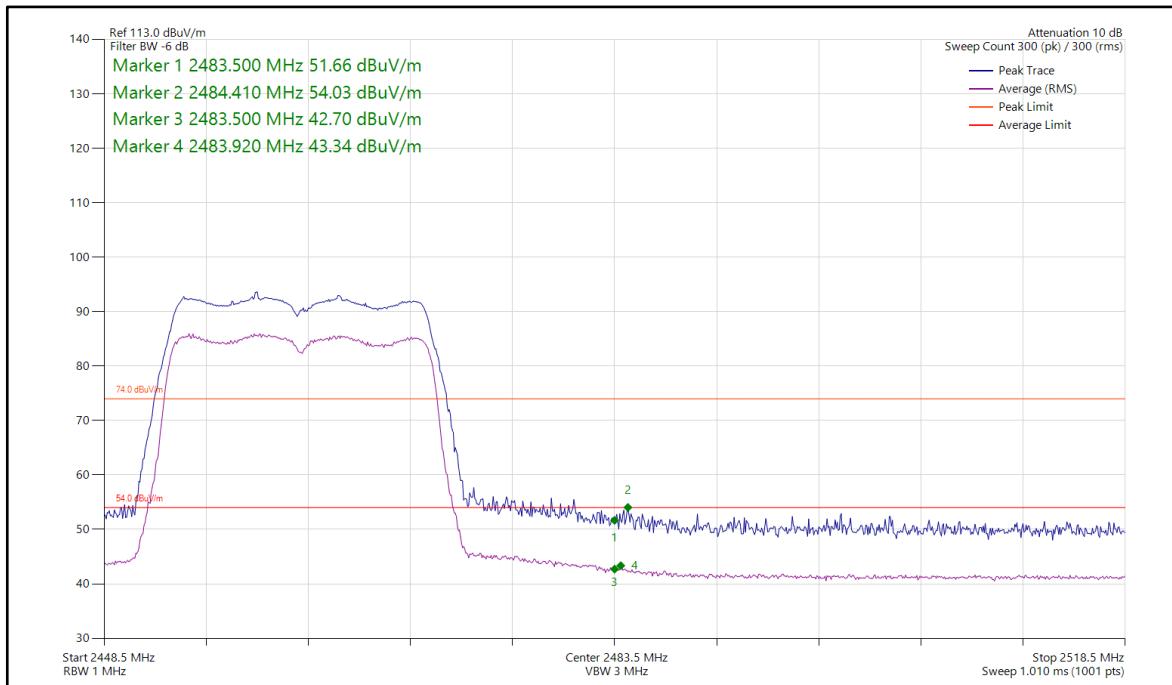


Figure 6 - CH11-HT20, 2462 MHz, Band Edge Frequency 2483.5 MHz



FCC 47 CFR Part 15, Limit Clause 15.209

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

**Table 6**

ISED RSS-GEN, Limit Clause 8.9

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

**Table 7**

\*Unless otherwise specified, for all frequencies greater than 1 GHz, the radiated emission limits for licence-exempt radio apparatus stated in applicable RSSs (including RSS-Gen) are based on measurements using a linear average detector function having a minimum resolution bandwidth of 1 MHz. If an average limit is specified for the EUT, then the peak emission shall also be measured with instrumentation properly adjusted for such factors as pulse desensitization to ensure the peak emission is less than 20 dB above the average limit.



### 2.1.7 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 5.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
3m Semi-Anechoic Chamber	Rainford	RF Chamber 5	1545	36	23-Apr-2027
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Hygrometer	Rotronic	Hygropalm 0	3028	12	12-Aug-2025
Mast Controller	Maturo GmbH	NCD	4810	-	TU
Tilt Antenna Mast	Maturo GmbH	TAM 4.0-P	4811	-	TU
Antenna (DRG, 1 GHz to 10.5 GHz)	Schwarzbeck	BBHA9120B	4848	12	14-Jul-2025
Cable (SMA to SMA, 2 m)	Junkosha	MWX221-02000AMSAMS/A	5517	12	23-May-2025
EMI Test Receiver	Rohde & Schwarz	ESW44	5527	12	26-Jul-2025
Cable (N to N 8m)	Junkosha	MWX221-08000NMSNMS/B	6330	12	17-Feb-2025

**Table 8**

TU - Traceability Unscheduled



## **2.2 Maximum Conducted Output Power**

### **2.2.1 Specification Reference**

FCC 47 CFR Part 15C, Clause 15.247 (b)(3)  
ISED RSS-247, Clause 5.4 d.  
ISED RSS-GEN, Clause 6.12

### **2.2.2 Equipment Under Test and Modification State**

L1P-2, S/N: 1LD2428L01002X - Modification State 0

### **2.2.3 Date of Test**

10-January-2025

### **2.2.4 Test Method**

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

MIMO output port summing was performed in accordance with KDB 662911 D01 v02r01.

The unit was powered by a rechargeable battery supplied by the customer and was fully charged prior to testing.

### **2.2.5 Environmental Conditions**

Ambient Temperature	20.2 °C
Relative Humidity	25.5 %



## 2.2.6 Test Results

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

DUT Configuration			
Mode:	802.11b	Duty Cycle (%):	100.0
Data Rate:	1 Mbps	DCCF (dB):	-
Antenna Configuration:	SISO	Peak Antenna Gain (dBi):	-3.08
Active Port(s):	A (Main)	Active Chain(s):	0

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)
	A	B	C	D	$\Sigma$		
2412	16.28	-	-	-	16.28	30.00	-13.72
2437	18.30	-	-	-	18.30	30.00	-11.70
2462	17.49	-	-	-	17.49	30.00	-12.51

**Table 9 - FCC Maximum Conducted (average) Output Power Results**

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)	EIRP (dBm)	EIRP Limit (dBm)	EIRP Margin (dB)
	A	B	C	D	$\Sigma$					
2412	16.28	-	-	-	16.28	30.00	-13.72	13.20	36.00	-22.80
2437	18.30	-	-	-	18.30	30.00	-11.70	15.22	36.00	-20.78
2462	17.49	-	-	-	17.49	30.00	-12.51	14.41	36.00	-21.59

**Table 10 - ISED Maximum Conducted (average) Output Power Results**



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

DUT Configuration			
Mode:	802.11g	Duty Cycle (%):	100.0
Data Rate:	6 Mbps	DCCF (dB):	-
Antenna Configuration:	SISO	Peak Antenna Gain (dBi):	-3.08
Active Port(s):	A (Main)	Active Chain(s):	0

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)
	A	B	C	D	$\Sigma$		
2412	14.25	-	-	-	14.25	30.00	-15.75
2437	18.21	-	-	-	18.21	30.00	-11.79
2462	14.44	-	-	-	14.44	30.00	-15.56

**Table 11 - FCC Maximum Conducted (average) Output Power Results**

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)	EIRP (dBm)	EIRP Limit (dBm)	EIRP Margin (dB)
	A	B	C	D	$\Sigma$					
2412	14.25	-	-	-	14.25	30.00	-15.75	11.17	36.00	-24.83
2437	18.21	-	-	-	18.21	30.00	-11.79	15.13	36.00	-20.87
2462	14.44	-	-	-	14.44	30.00	-15.56	11.36	36.00	-24.64

**Table 12 - ISED Maximum Conducted (average) Output Power Results**



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

DUT Configuration			
Mode:	802.11n HT20	Duty Cycle (%):	100.0
Modulation Coding Scheme:	MCS0	DCCF (dB):	-
Antenna Configuration:	SISO	Peak Antenna Gain (dBi):	-3.08
Active Port(s):	A (Main)	Active Chain(s):	0

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)
	A	B	C	D	$\Sigma$		
2412	13.46	-	-	-	13.46	30.00	-16.54
2437	18.40	-	-	-	18.40	30.00	-11.60
2462	12.67	-	-	-	12.67	30.00	-17.33

**Table 13 - FCC Maximum Conducted (average) Output Power Results**

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)	EIRP (dBm)	EIRP Limit (dBm)	EIRP Margin (dB)
	A	B	C	D	$\Sigma$					
2412	13.46	-	-	-	13.46	30.00	-16.54	10.38	36.00	-25.62
2437	18.40	-	-	-	18.40	30.00	-11.60	15.32	36.00	-20.68
2462	12.67	-	-	-	12.67	30.00	-17.33	9.59	36.00	-26.41

**Table 14 - ISED Maximum Conducted (average) Output Power Results**



Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Limit Clause(s):	15.247 (b)(3) RSS-247 5.4 d)	Test Method(s):	C63.10 11.9.2.3.2
Additional Reference(s):	662911 D01 v02r01 F)2)d)(ii), 662911 D01 v02r01 E)1)		

DUT Configuration			
Mode:	802.11n HT20	Duty Cycle (%):	100.0
Modulation Coding Scheme:	MCS8	DCCF (dB):	-
Antenna Configuration:	MIMO SDM	Peak Antenna Gain (dBi):	-3.82
Active Port(s):	A+B (Main + Aux)	Active Chain(s):	0+1

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)
	A	B	C	D	$\Sigma$		
2412	13.38	12.60	-	-	16.01	30.00	-13.99
2437	18.26	17.41	-	-	20.87	30.00	-9.13
2462	12.54	11.76	-	-	15.18	30.00	-14.82

**Table 15 - FCC Maximum Conducted (average) Output Power Results**

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)	EIRP (dBm)	EIRP Limit (dBm)	EIRP Margin (dB)
	A	B	C	D	$\Sigma$					
2412	13.38	12.60	-	-	16.01	30.00	-13.99	12.19	36.00	-23.81
2437	18.26	17.41	-	-	20.87	30.00	-9.13	17.04	36.00	-18.96
2462	12.54	11.76	-	-	15.18	30.00	-14.82	11.36	36.00	-24.64

**Table 16 - ISED Maximum Conducted (average) Output Power Results**



FCC 47 CFR Part 15, Limit Clause 15.247 (b)(3)

For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt.

ISED RSS-247, Limit Clause 5.4 (d)

For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1 W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e) of the specification.

#### 2.2.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
Hygrometer	Rotronic	I-1000	2891	12	02-Dec-2025
USB Power Sensor	Boonton	RTP5008	5833	12	26-Jul-2025
USB Power Sensor	Boonton	RTP5008	5834	12	26-Jul-2025
Signal Conditioning Unit	TUV SUD	SPECTRUM_SCU0_01	6350	12	02-Aug-2025
SCU Cable Assembly	TUV SUD	SPECTRUM_SCU_CA	6638	12	02-Aug-2025
SCU Cable Assembly	TUV SUD	SPECTRUM_SCU_CA	6639	12	02-Aug-2025

**Table 17**



## **2.3 Authorised Band Edges**

### **2.3.1 Specification Reference**

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

### **2.3.2 Equipment Under Test and Modification State**

L1P-2, S/N: 1LD2428L01001X - Modification State 0

### **2.3.3 Date of Test**

10-January-2025

### **2.3.4 Test Method**

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

The unit was powered by a rechargeable battery supplied by the customer and was fully charged prior to testing.

### **2.3.5 Environmental Conditions**

Ambient Temperature	19.8 °C
Relative Humidity	34.9 %



### 2.3.6 Test Results

#### 2.4 GHz WLAN - PCB Trace Antenna

Mode	Data Rate/MCS	Frequency (MHz)	Band Edge Frequency (MHz)	Level (dBc)
802.11b	1Mbps	2412	2400	-44.55
802.11b	1Mbps	2462	2483.5	-48.16
802.11g	6Mbps	2412	2400	-39.99
802.11g	6Mbps	2462	2483.5	-42.27
802.11n	MCS0	2412	2400	-41.29
802.11n	MCS0	2462	2483.5	-41.09

Table 18

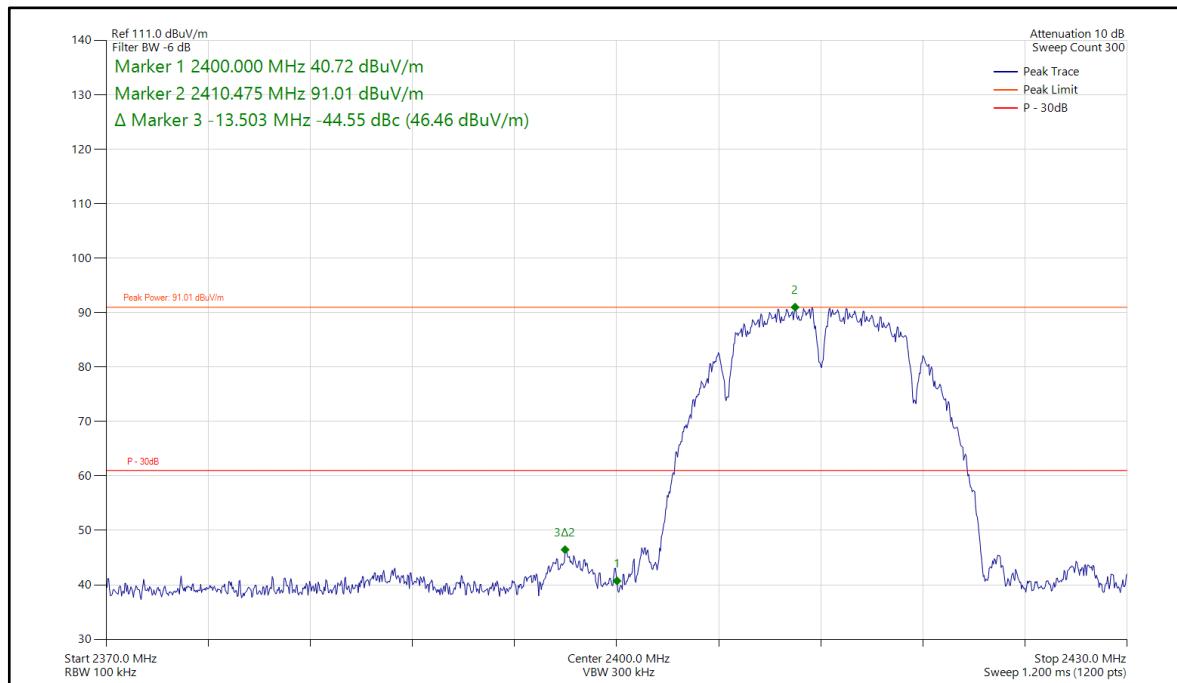


Figure 7 - CH1\_802.11b, 2412 MHz, Band Edge Frequency 2390 MHz

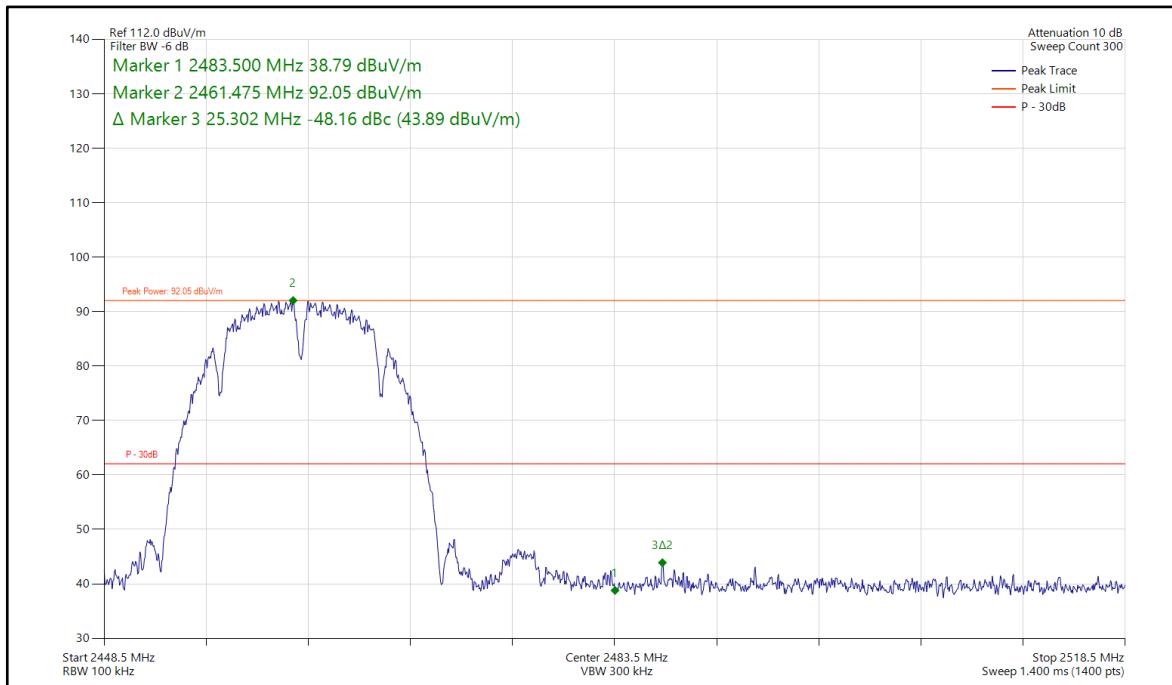


Figure 8 - CH11\_802.11b, 2462 MHz, Band Edge Frequency 2483.5 MHz

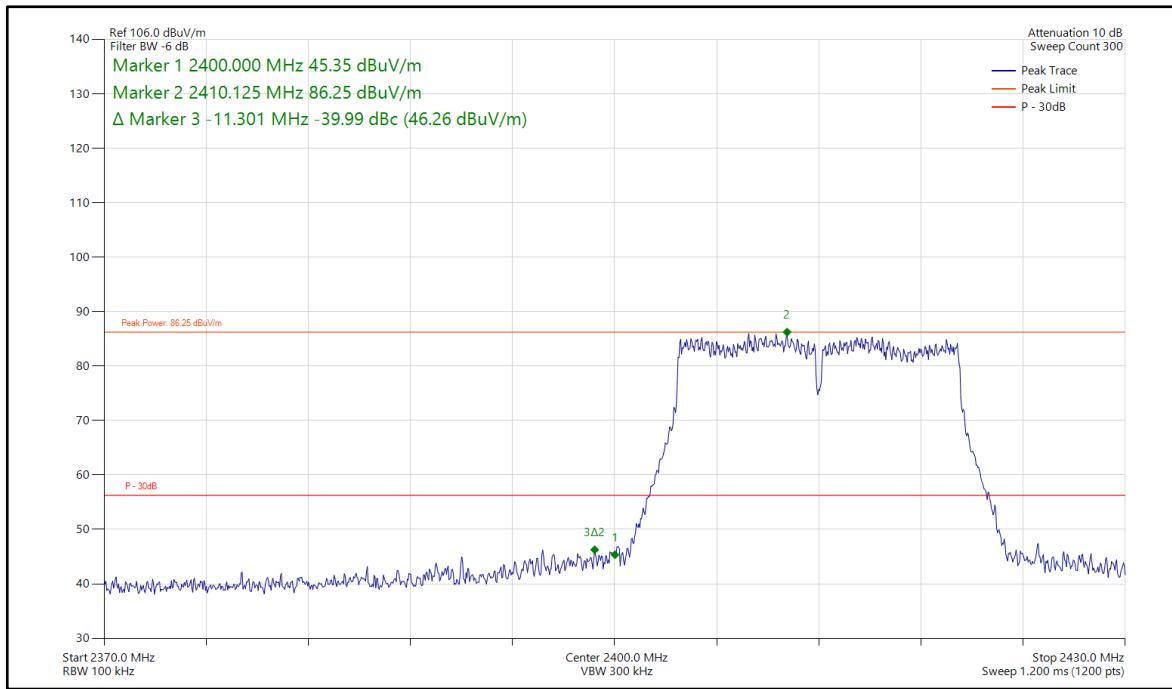


Figure 9 - CH1\_802.11g, 2412 MHz, Band Edge Frequency 2390 MHz

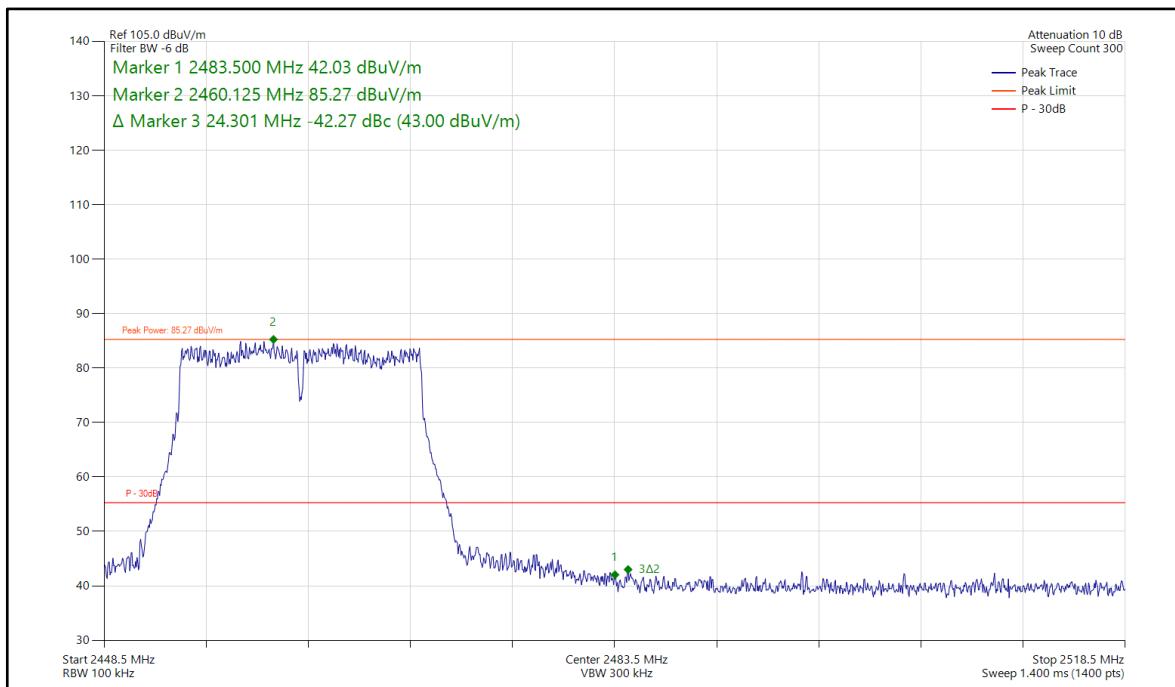


Figure 10 - CH11\_802.11g, 2462 MHz, Band Edge Frequency 2483.5 MHz

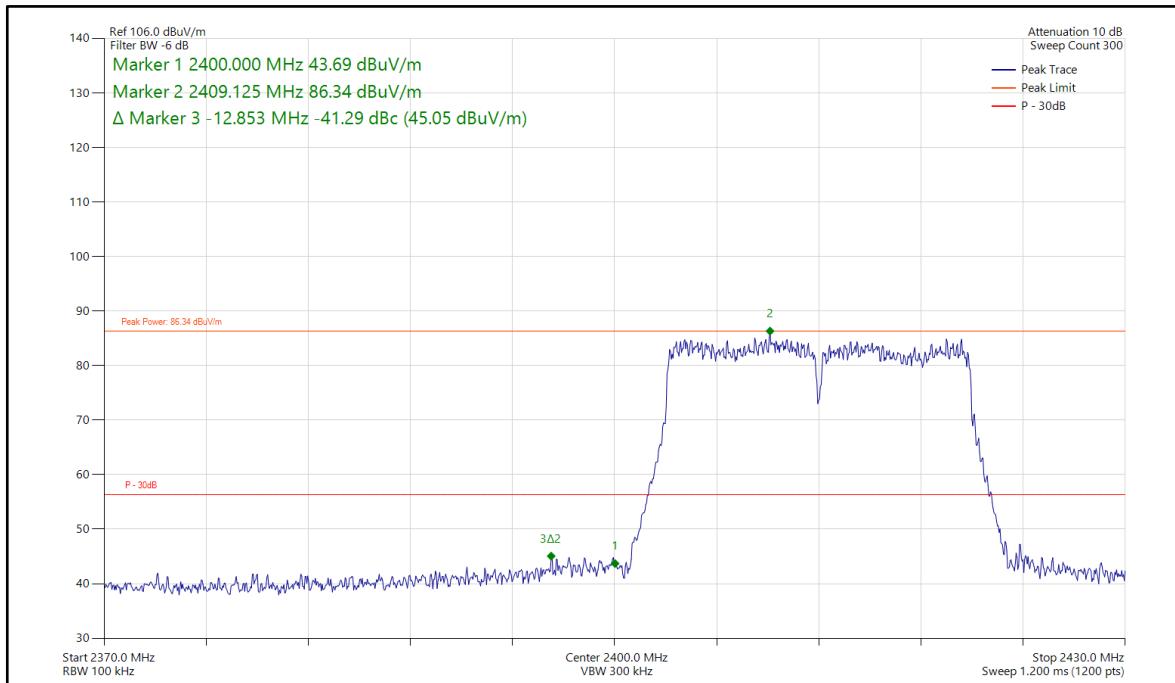
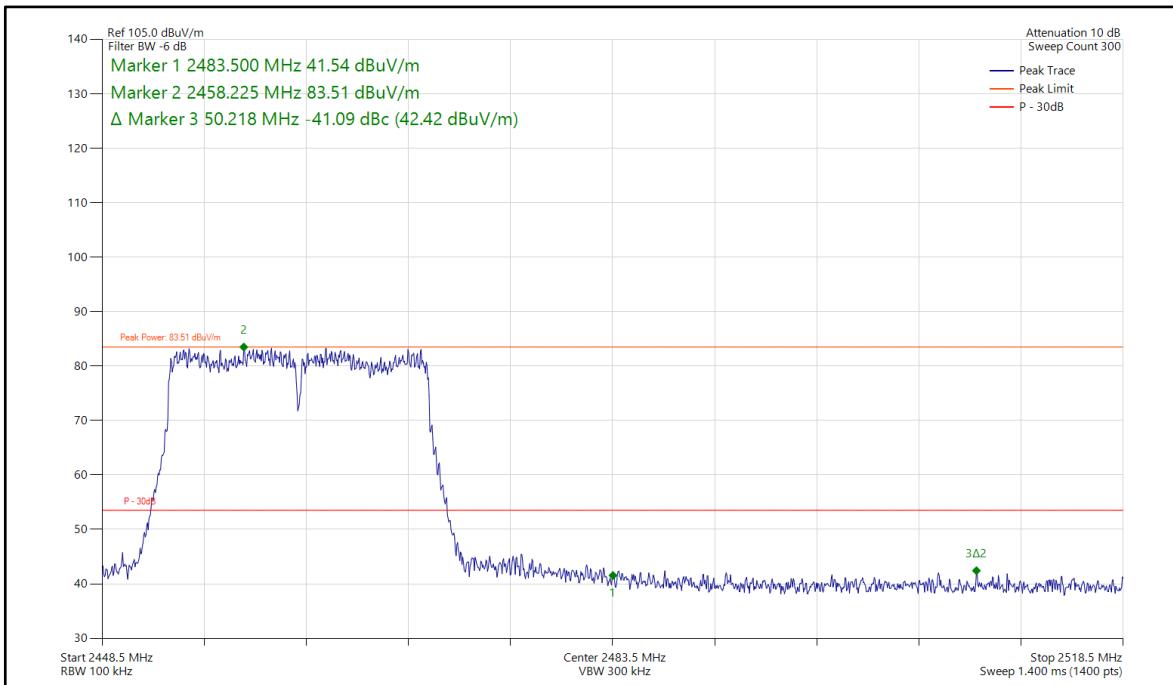


Figure 11 - CH1\_HT20, 2412 MHz, Band Edge Frequency 2390 MHz



**Figure 12 - CH11-HT20, 2462 MHz, Band Edge Frequency 2483.5 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.



### 2.3.7 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 5.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
3m Semi-Anechoic Chamber	Rainford	RF Chamber 5	1545	36	23-Apr-2027
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Hygrometer	Rotronic	Hygropalm 0	3028	12	12-Aug-2025
Mast Controller	Maturo GmbH	NCD	4810	-	TU
Antenna (DRG, 1 GHz to 10.5 GHz)	Schwarzbeck	BBHA9120B	4848	12	14-Jul-2025
Emissions Software	TUV SUD	EmX V3.4.2	5125	-	Software
Cable (SMA to SMA, 2 m)	Junkosha	MWX221-02000AMSAMS/A	5517	12	23-May-2025
EMI Test Receiver	Rohde & Schwarz	ESW44	5527	12	26-Jul-2025
Cable (N to N 8m)	Junkosha	MWX221-08000NMSNMS/B	6330	12	17-Feb-2025

**Table 19**

TU - Traceability Unscheduled



## 2.4 Spurious Radiated Emissions

### 2.4.1 Specification Reference

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

### 2.4.2 Equipment Under Test and Modification State

L1P-2, S/N: 1LD2428L01001X - Modification State 0

### 2.4.3 Date of Test

10-January-2025 to 11-January-2025

### 2.4.4 Test Method

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

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

The EUT was placed on the non-conducting platform in a manner typical of a normal installation. As the EUT was considered mobile/portable and therefore reasonable to be used in multiple planes, pre-scans were performed with the EUT orientated in X, Y and Z planes with reference to the ground plane.

The plots shown are the characterisation of the EUT. The limits on the plots represent the most stringent case for restricted bands, (74/54 dB $\mu$ V/m) when compared to 20 dBc outside restricted bands. The limits shown have been used as a threshold to determine where further measurements are necessary. Where results are within 10 dB of the limits shown on the plots, further investigation was carried out and reported in results tables.

The following conversion can be applied to convert from dB $\mu$ V/m to  $\mu$ V/m:

$10^{(Field\ Strength\ in\ dB\mu V/m/20)}$ .

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

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

The unit was powered by a rechargeable battery supplied by the customer and was fully charged prior to testing.

#### 2.4.5 Test Setup Diagram

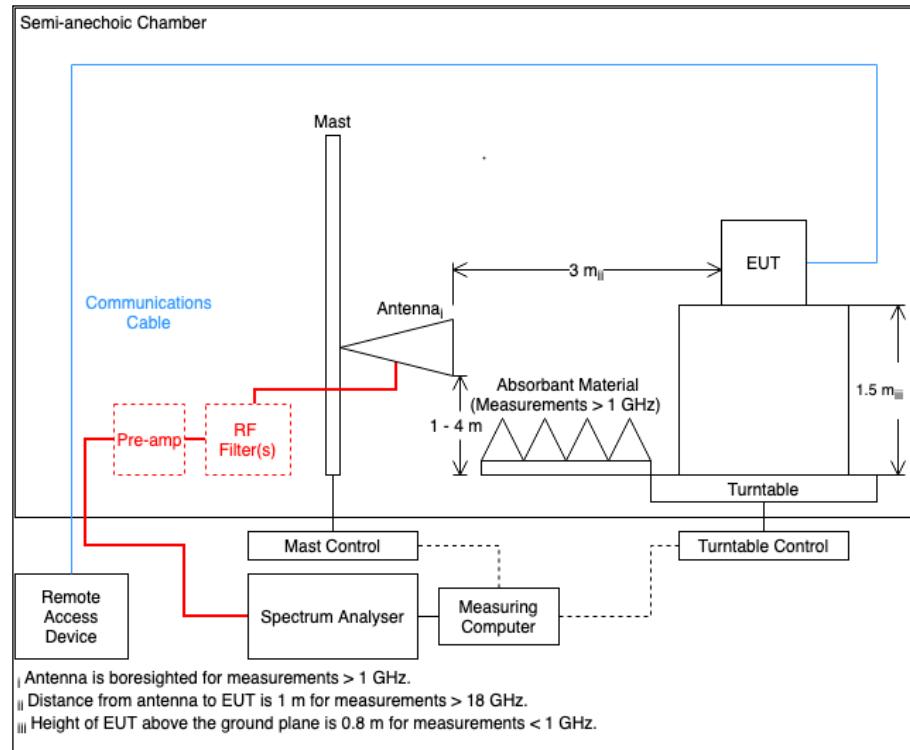


Figure 13

#### 2.4.6 Environmental Conditions

Ambient Temperature 19.8 - 21.2 °C  
Relative Humidity 34.9 - 43.8 %



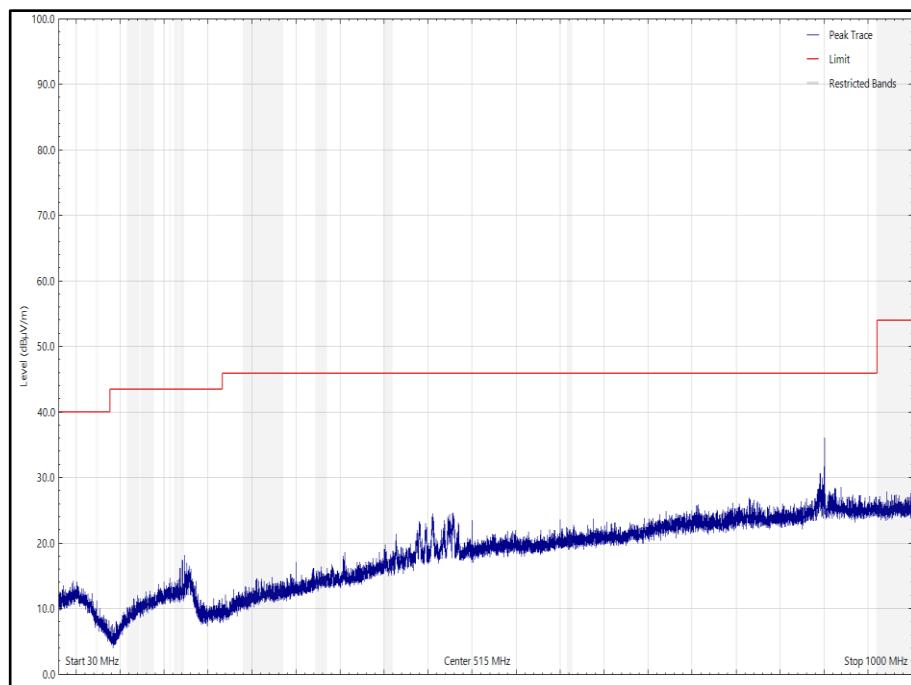
## 2.4.7 Test Results

### 2.4 GHz WLAN

Frequency (MHz)	Level	Limit	Margin (dB)	Detector	Unit	Angle (°)	Height (cm)	Polarisation
*								

**Table 20 - CH1\_802.11b\_1Mbps\_X, 2412 MHz, 30 MHz to 26 GHz**

\*No emissions found within 10 dB of the limit.



**Figure 14 - CH1\_802.11b\_1Mbps\_X, 2412 MHz, 30 MHz to 1 GHz, Horizontal (Peak)**

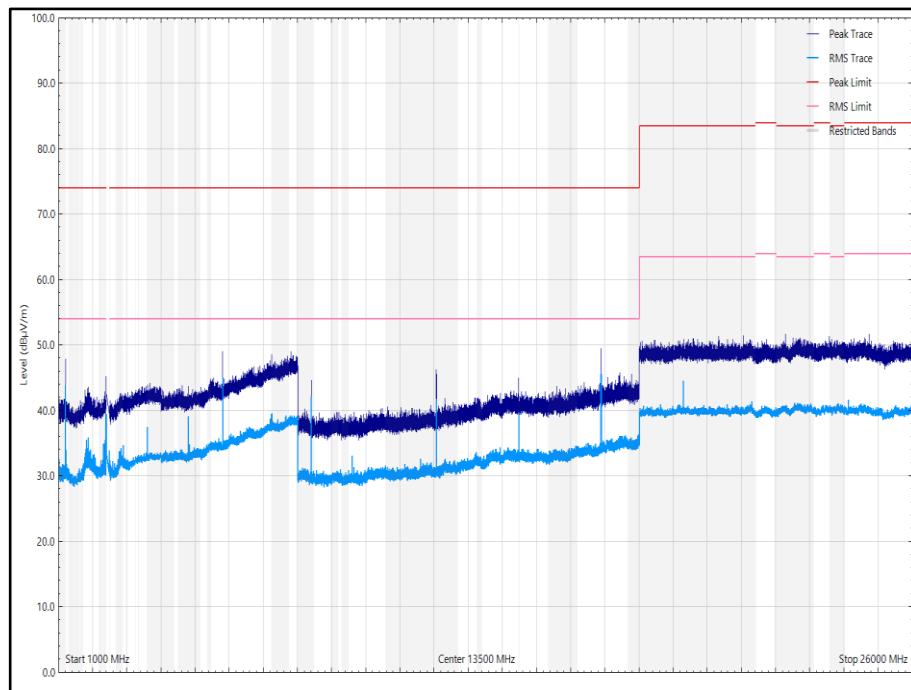


Figure 15 - CH1\_802.11b\_1Mbps\_X, 2412 MHz, 1 GHz to 26 GHz, Horizontal

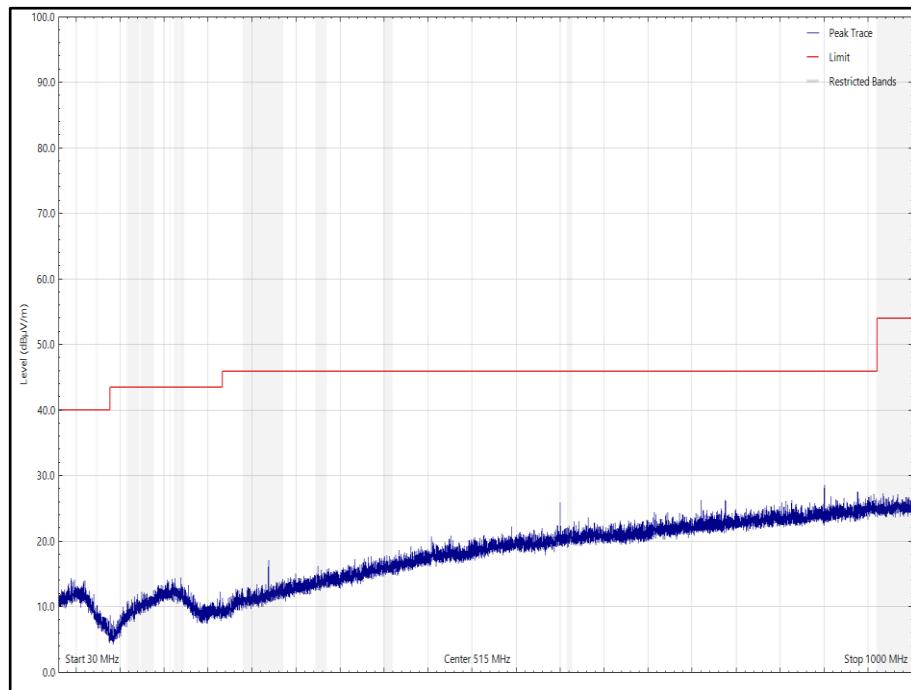
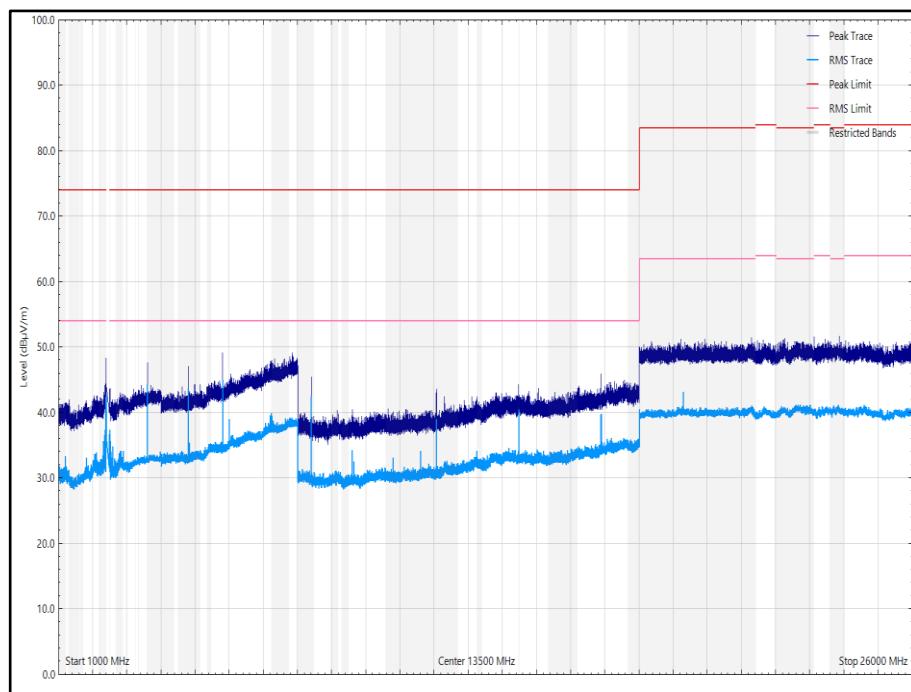


Figure 16 - CH1\_802.11b\_1Mbps\_X, 2412 MHz, 30 MHz to 1 GHz, Vertical (Peak)



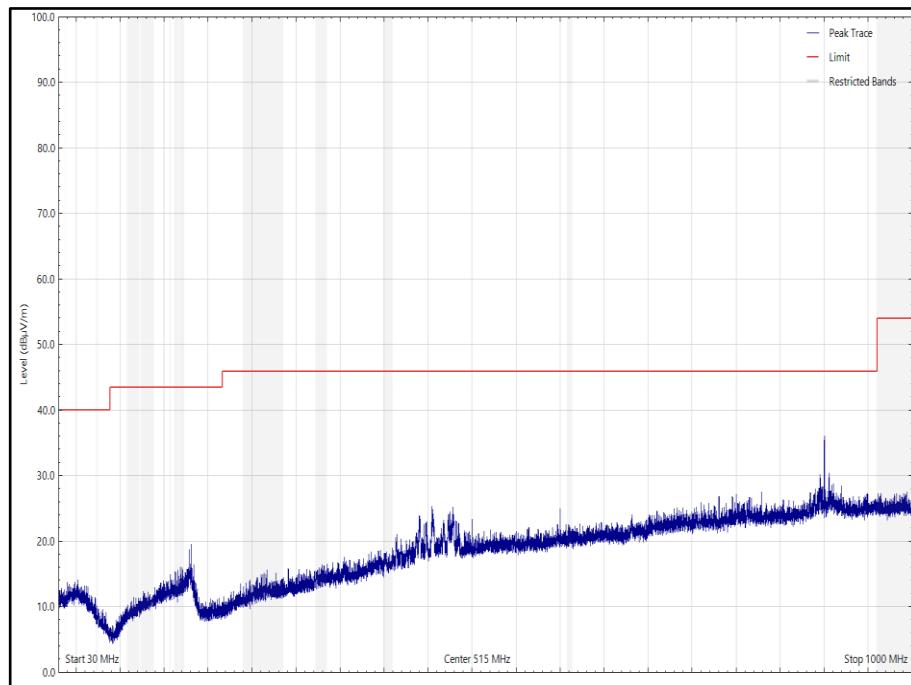
**Figure 17 - CH1\_802.11b\_1Mbps\_X, 2412 MHz, 1 GHz to 26 GHz, Vertical**



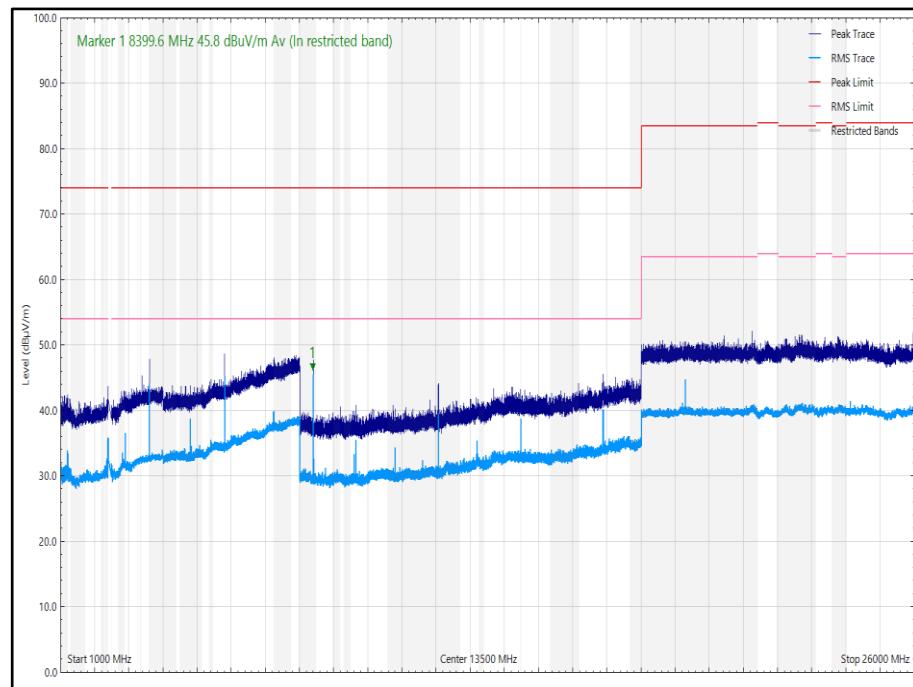
Frequency (MHz)	Level	Limit	Margin (dB)	Detector	Unit	Angle (°)	Height (cm)	Polarisation
8399.600	45.83	54.00	-8.17	CISPR Avg	dBuv/m	5	150	Horizontal

**Table 21 - CH1\_802.11b\_1Mbps\_Y, 2412 MHz, 30 MHz to 26 GHz**

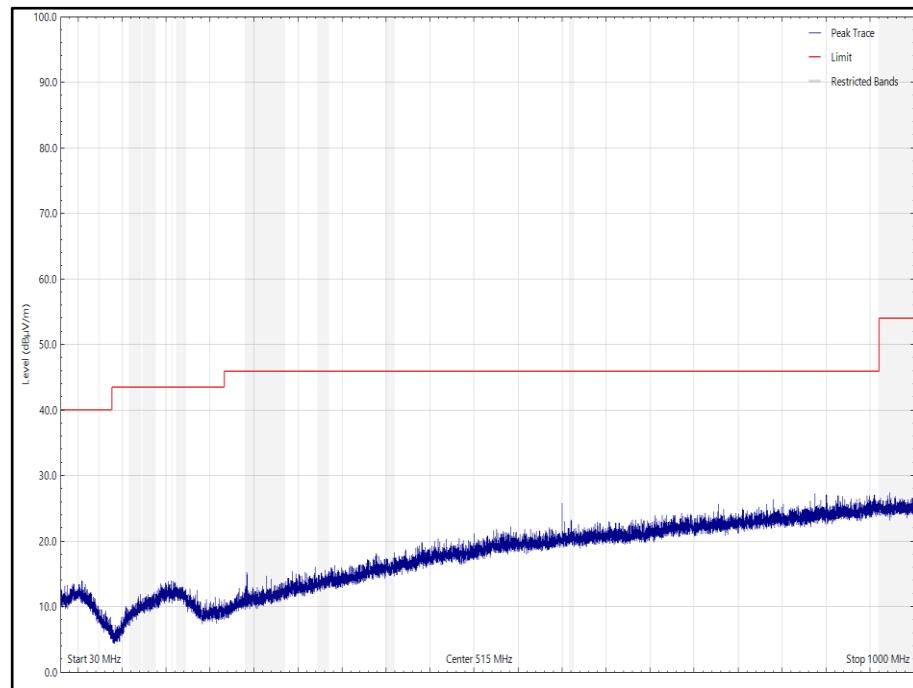
No other emissions found within 10 dB of the limit.



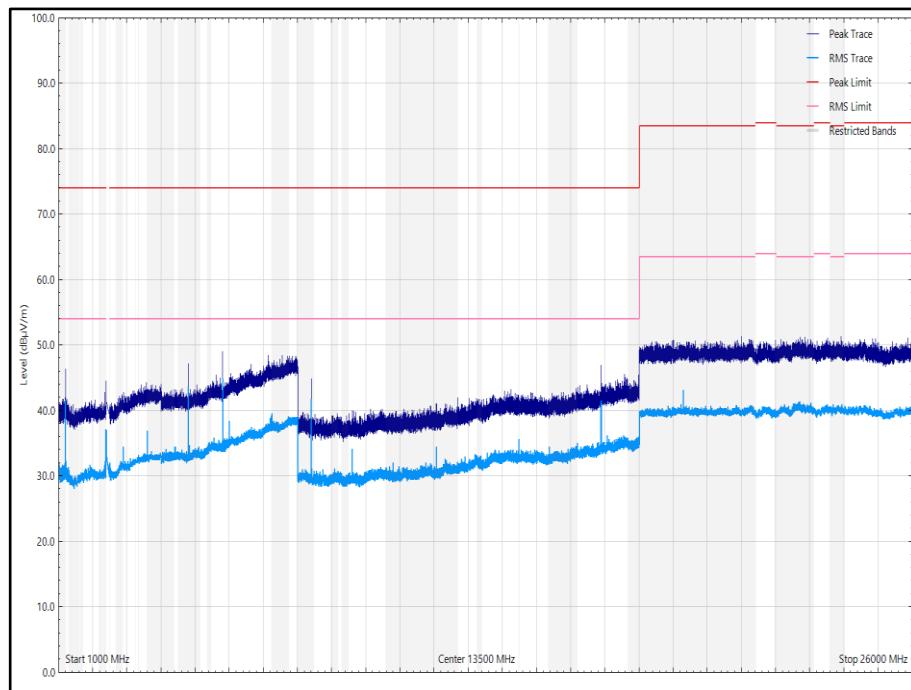
**Figure 18 - CH1\_802.11b\_1Mbps\_Y, 2412 MHz, 30 MHz to 1 GHz, Horizontal (Peak)**



**Figure 19 - CH1\_802.11b\_1Mbps\_Y, 2412 MHz, 1 GHz to 26 GHz, Horizontal**



**Figure 20 - CH1\_802.11b\_1Mbps\_Y, 2412 MHz, 30 MHz to 1 GHz, Vertical (Peak)**



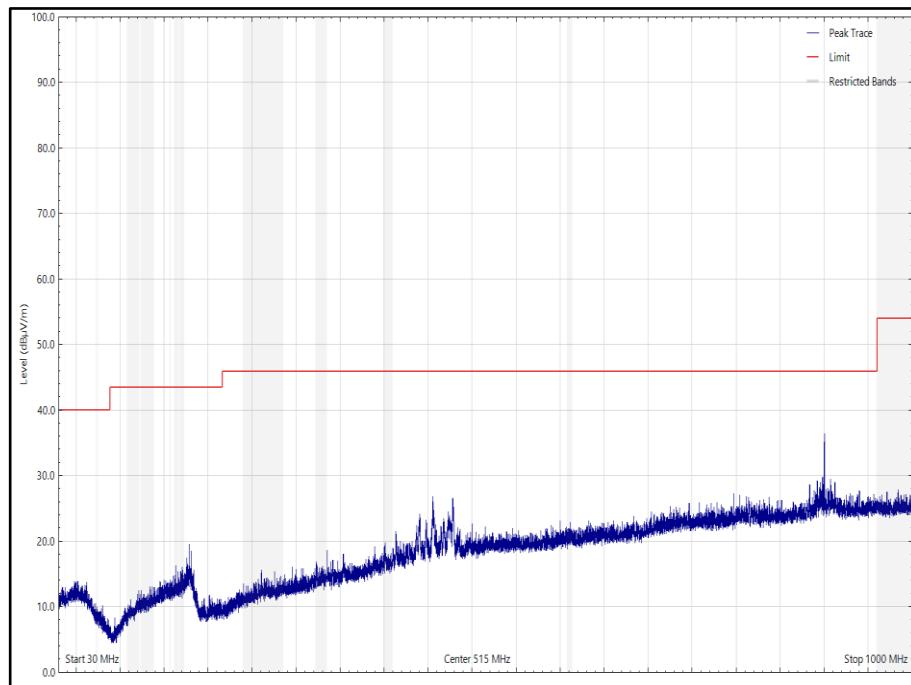
**Figure 21 - CH1\_802.11b\_1Mbps\_Y, 2412 MHz, 1 GHz to 26 GHz, Vertical**



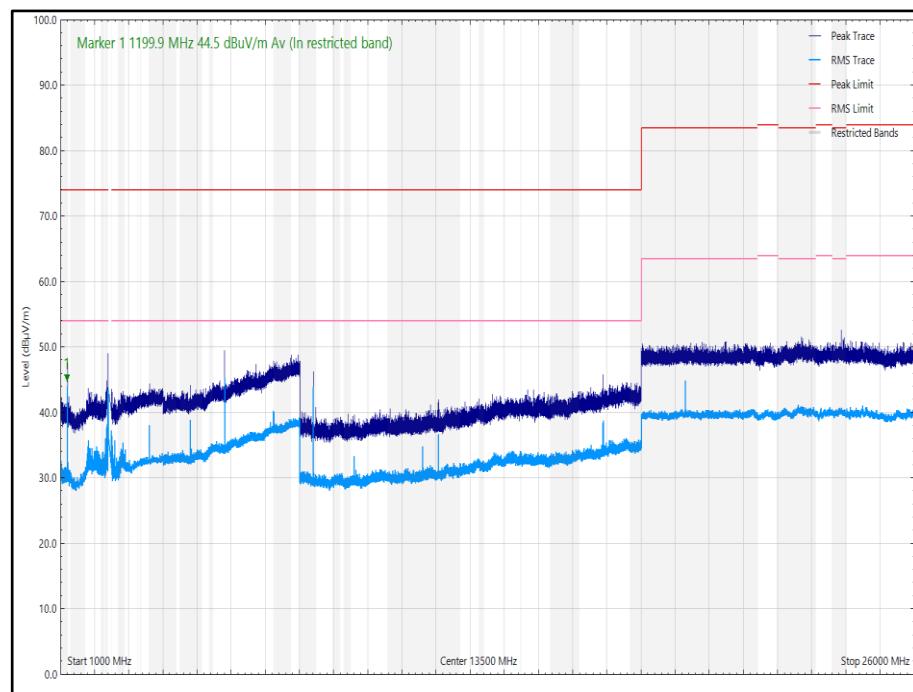
Frequency (MHz)	Level	Limit	Margin (dB)	Detector	Unit	Angle (°)	Height (cm)	Polarisation
1199.885	44.49	54.00	-9.51	CISPR Avg	dBuv/m	14	150	Horizontal

**Table 22 - CH1\_802.11b\_1Mbps\_Z, 2412 MHz, 30 MHz to 26 GHz**

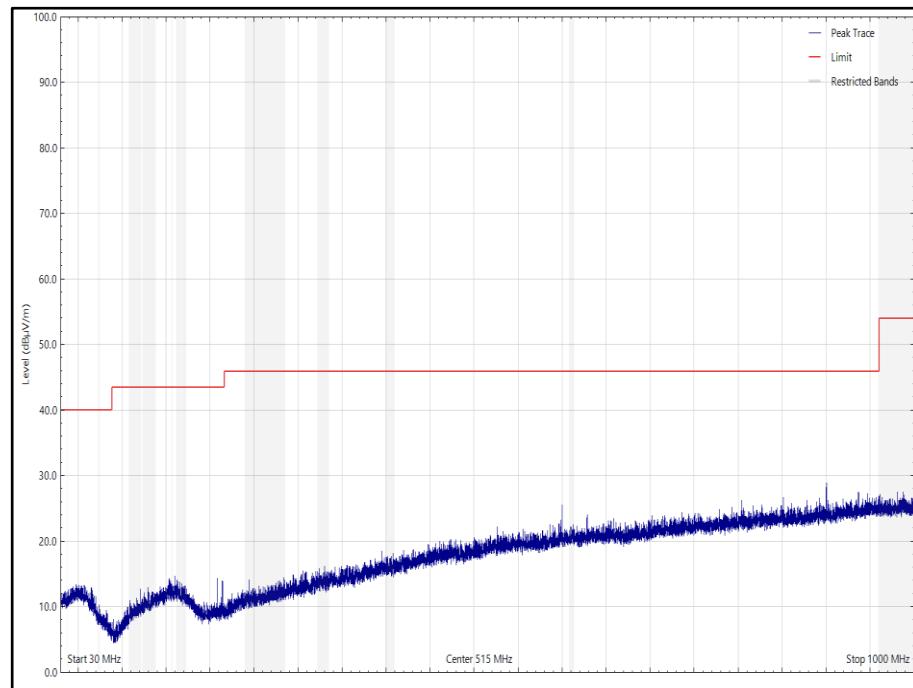
No other emissions found within 10 dB of the limit.



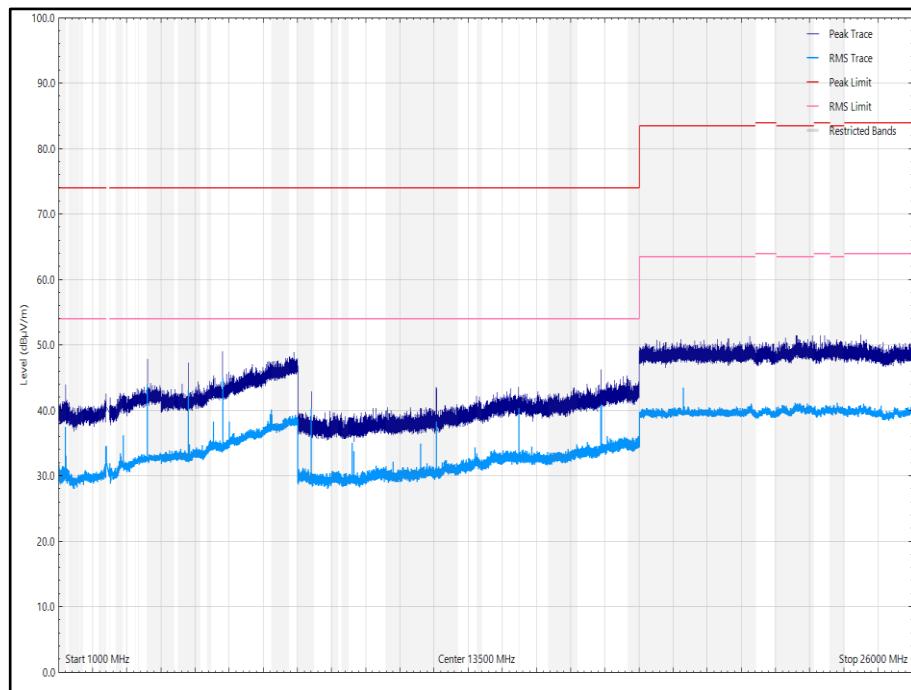
**Figure 22 - CH1\_802.11b\_1Mbps\_Z, 2412 MHz, 30 MHz to 1 GHz, Horizontal (Peak)**



**Figure 23 - CH1\_802.11b\_1Mbps\_Z, 2412 MHz, 1 GHz to 26 GHz, Horizontal**



**Figure 24 - CH1\_802.11b\_1Mbps\_Z, 2412 MHz, 30 MHz to 1 GHz, Vertical (Peak)**



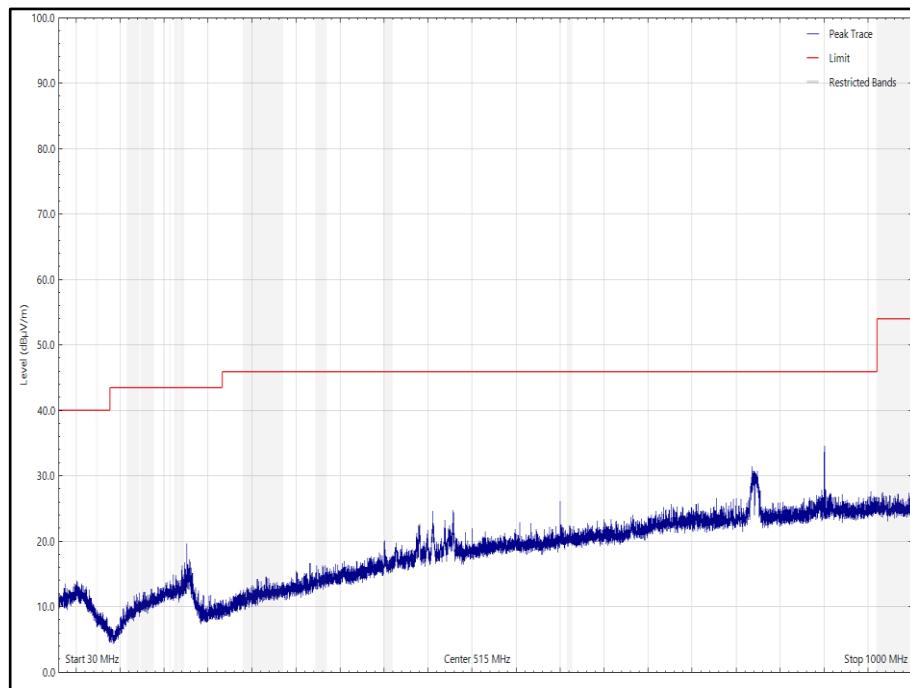
**Figure 25 - CH1\_802.11b\_1Mbps\_Z, 2412 MHz, 1 GHz to 26 GHz, Vertical**



Frequency (MHz)	Level	Limit	Margin (dB)	Detector	Unit	Angle (°)	Height (cm)	Polarisation
*								

**Table 23 - CH11\_802.11b\_1Mbps\_X, 2462 MHz, 30 MHz to 26 GHz**

\*No emissions found within 10 dB of the limit.



**Figure 26 - CH11\_802.11b\_1Mbps\_X, 2462 MHz, 30 MHz to 1 GHz, Horizontal (Peak)**

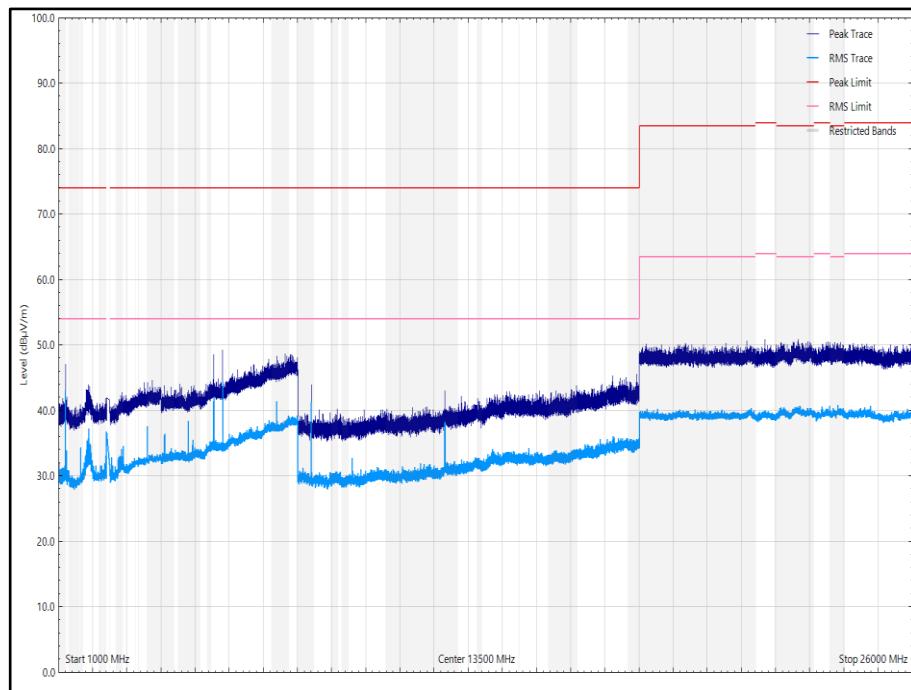


Figure 27 - CH11\_802.11b\_1Mbps\_X, 2462 MHz, 1 GHz to 26 GHz, Horizontal

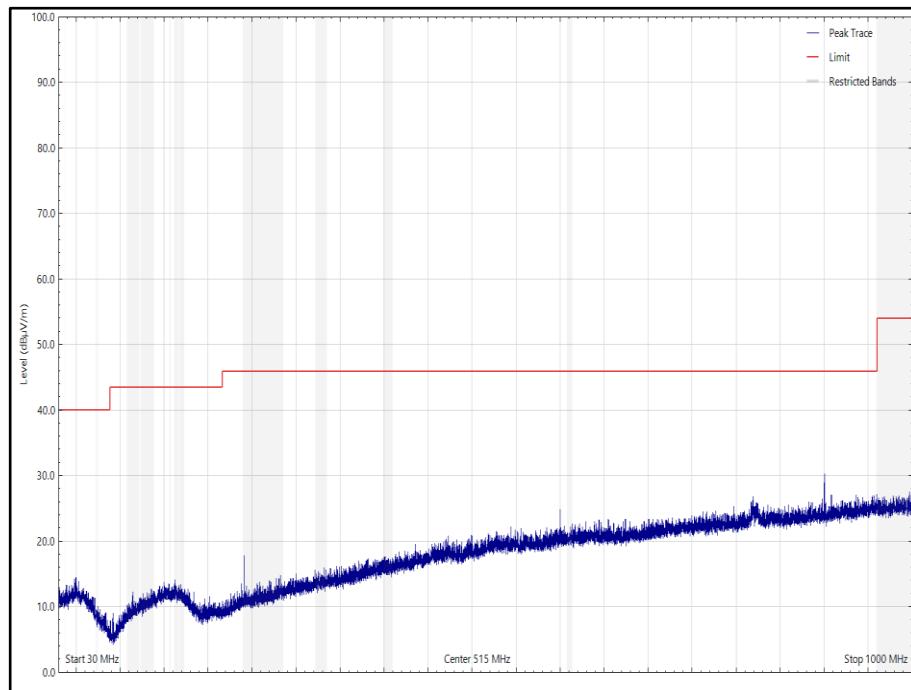


Figure 28 - CH11\_802.11b\_1Mbps\_X, 2462 MHz, 30 MHz to 1 GHz, Vertical (Peak)

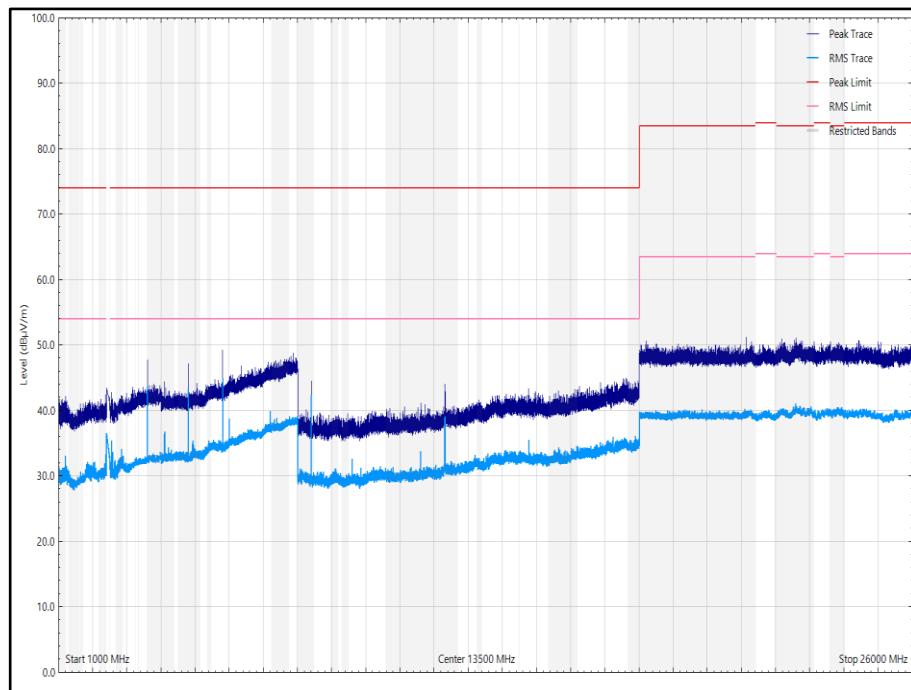


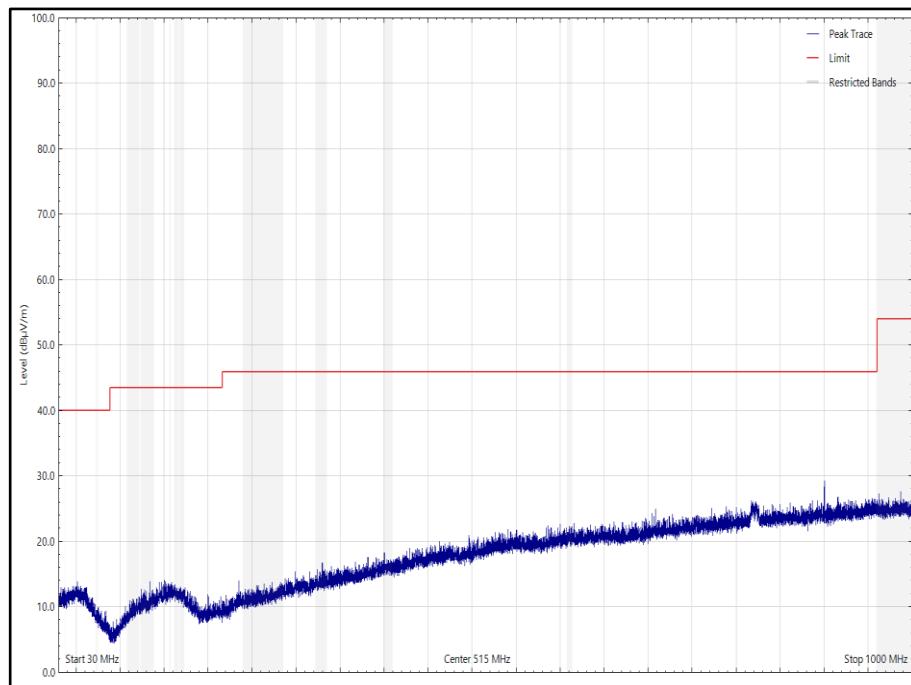
Figure 29 - CH11\_802.11b\_1Mbps\_X, 2462 MHz, 1 GHz to 26 GHz, Vertical



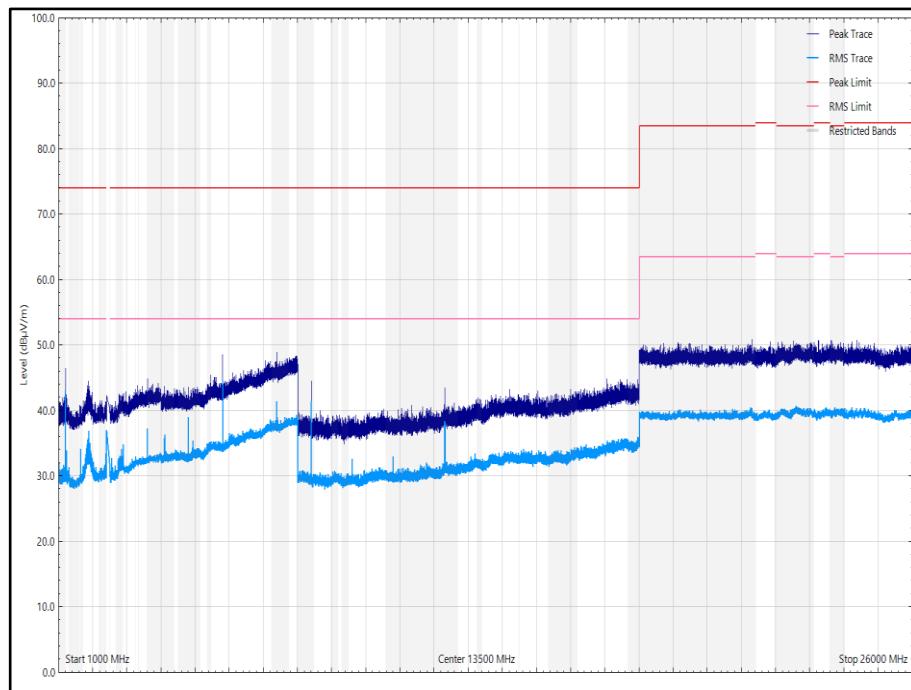
Frequency (MHz)	Level	Limit	Margin (dB)	Detector	Unit	Angle (°)	Height (cm)	Polarisation
*								

**Table 24 - CH11\_802.11b\_1Mbps\_Y, 2462 MHz, 30 MHz to 26 GHz**

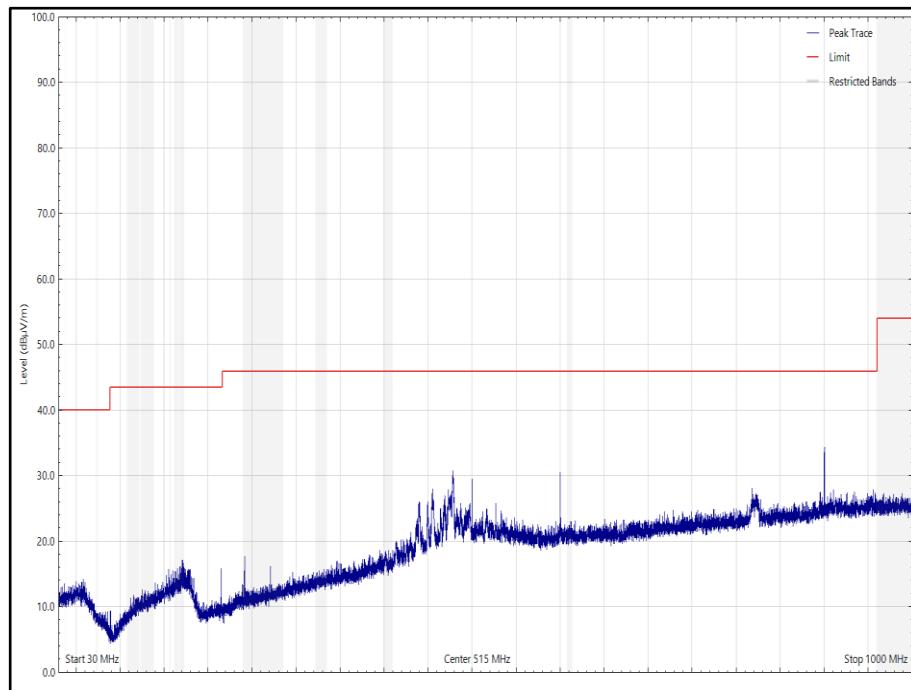
\*No emissions found within 10 dB of the limit.



**Figure 30 - CH11\_802.11b\_1Mbps\_Y, 2462 MHz, 30 MHz to 1 GHz, Horizontal (Peak)**



**Figure 31 - CH11\_802.11b\_1Mbps\_Y, 2462 MHz, 1 GHz to 26 GHz, Horizontal**



**Figure 32 - CH11\_802.11b\_1Mbps\_Y, 2462 MHz, 30 MHz to 1 GHz, Vertical (Peak)**

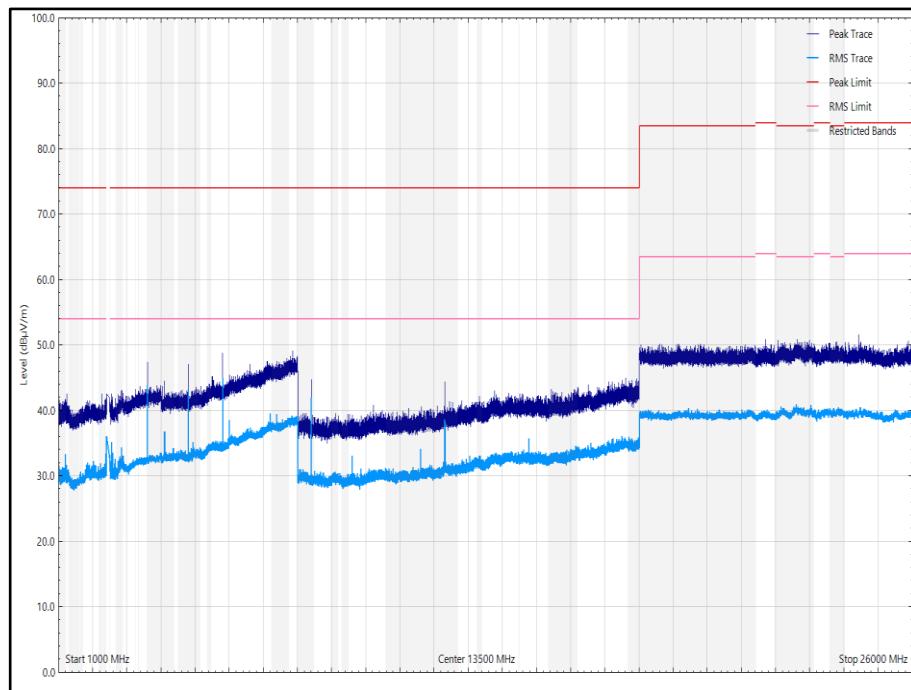


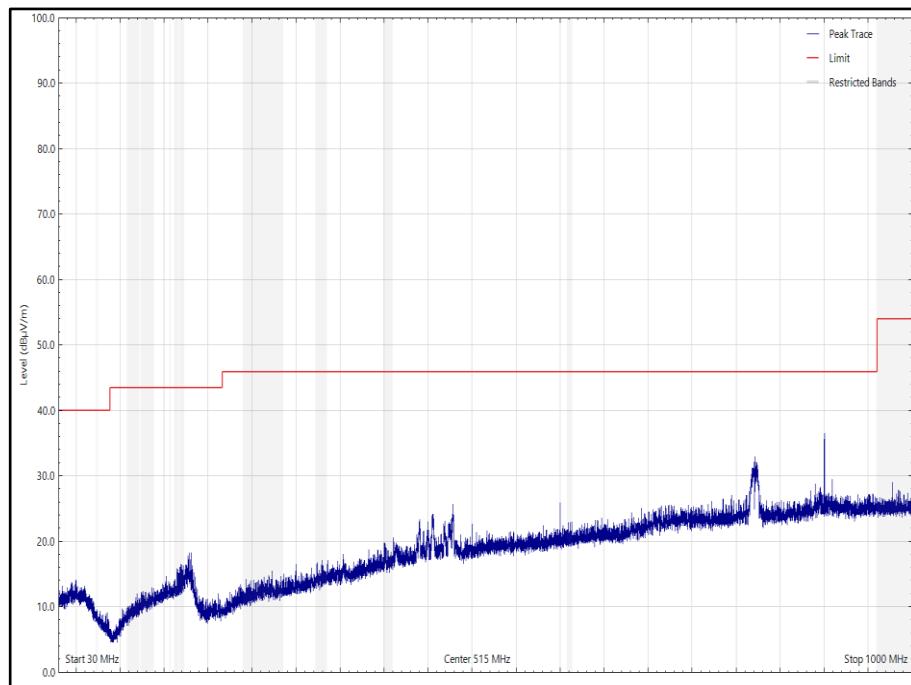
Figure 33 - CH11\_802.11b\_1Mbps\_Y, 2462 MHz, 1 GHz to 26 GHz, Vertical



Frequency (MHz)	Level	Limit	Margin (dB)	Detector	Unit	Angle (°)	Height (cm)	Polarisation
*								

**Table 25 - CH11\_802.11b\_1Mbps\_Z, 2462 MHz, 30 MHz to 26 GHz**

\*No emissions found within 10 dB of the limit.



**Figure 34 - CH11\_802.11b\_1Mbps\_Z, 2462 MHz, 30 MHz to 1 GHz, Horizontal (Peak)**

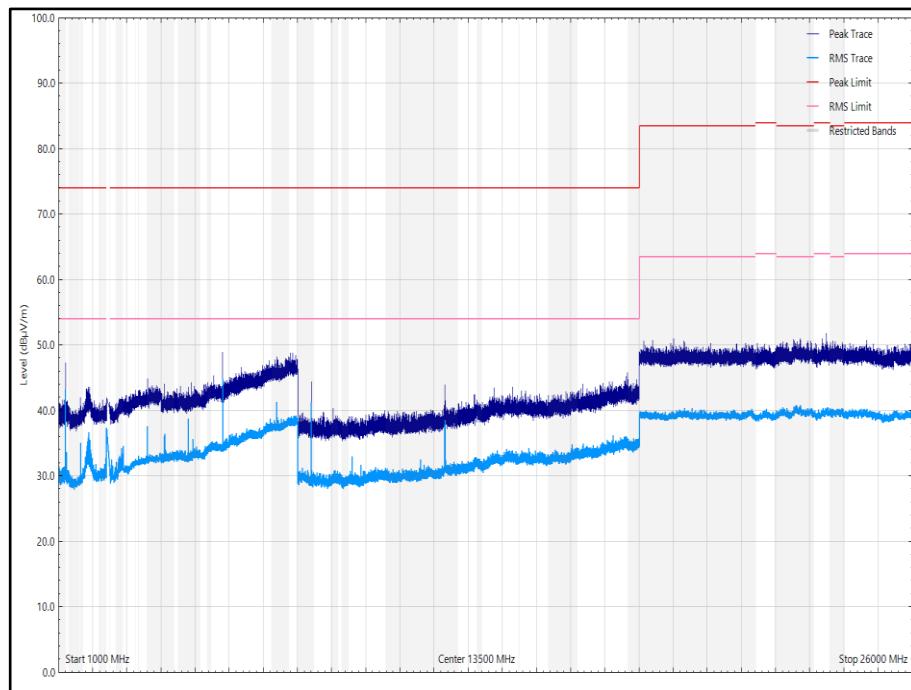


Figure 35 - CH11\_802.11b\_1Mbps\_Z, 2462 MHz, 1 GHz to 26 GHz, Horizontal

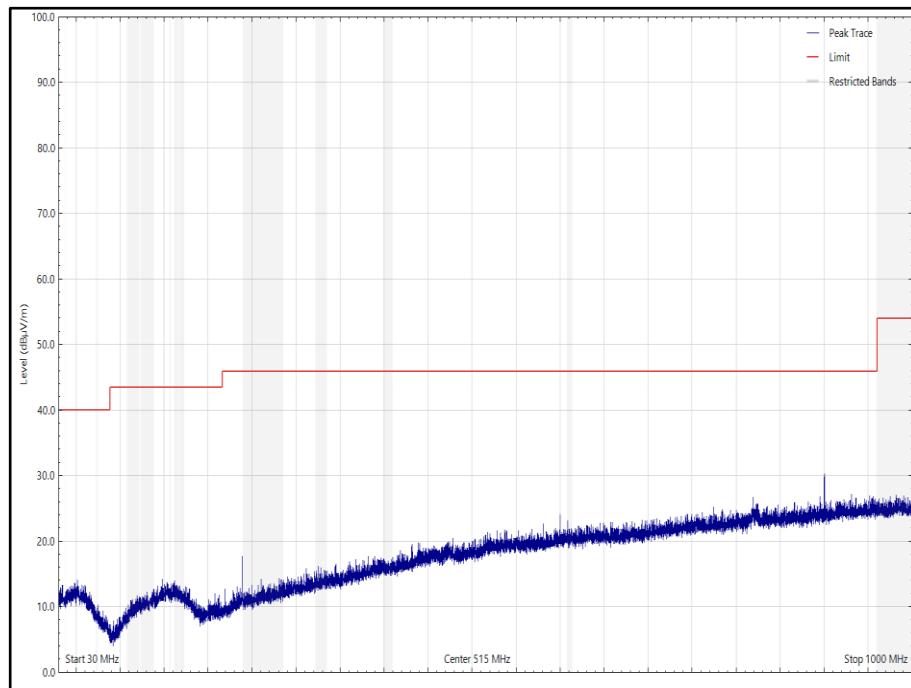


Figure 36 - CH11\_802.11b\_1Mbps\_Z, 2462 MHz, 30 MHz to 1 GHz, Vertical (Peak)

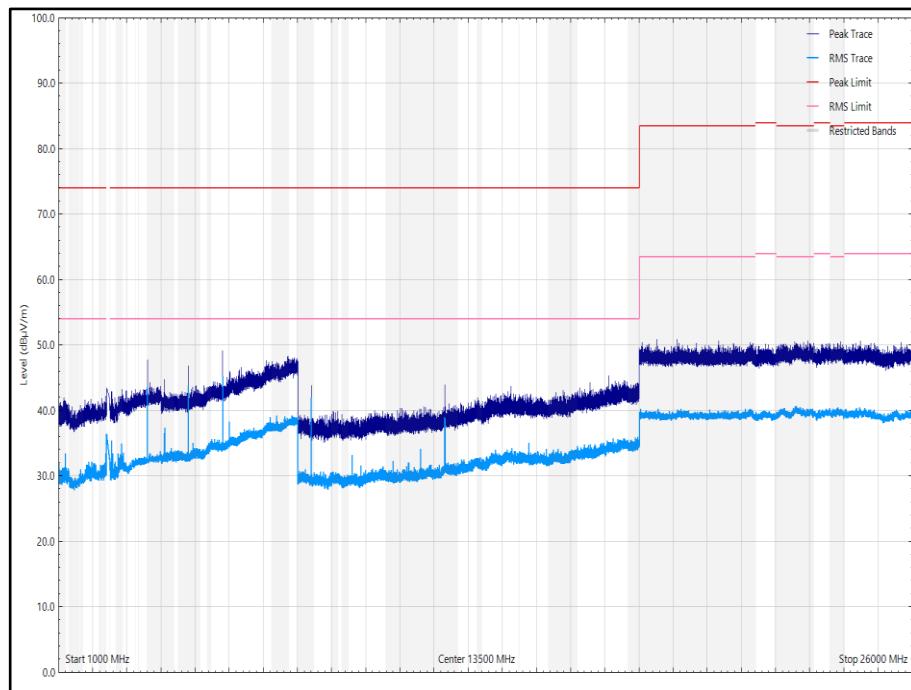


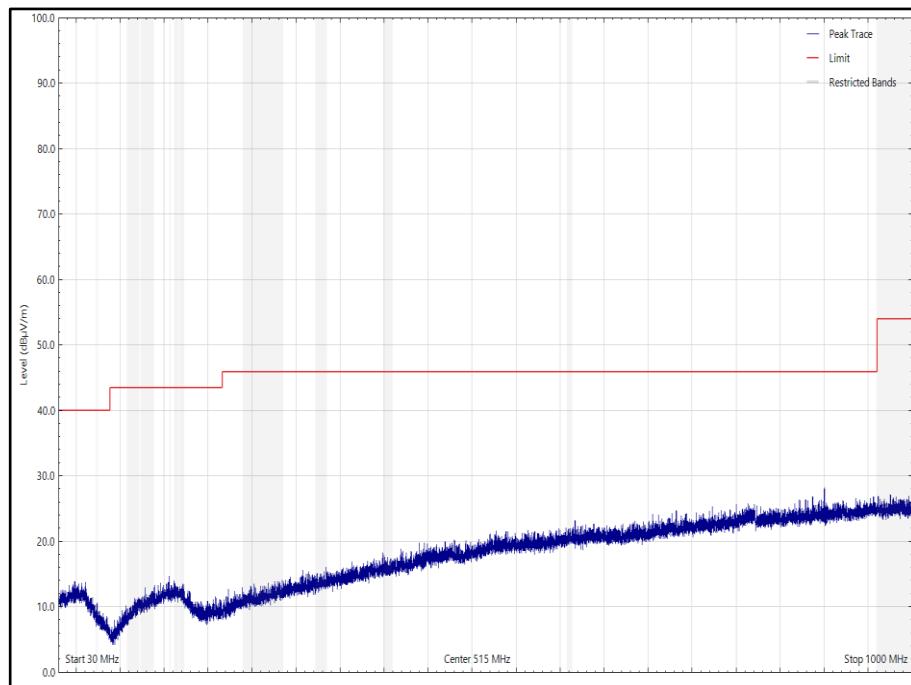
Figure 37 - CH11\_802.11b\_1Mbps\_Z, 2462 MHz, 1 GHz to 26 GHz, Vertical



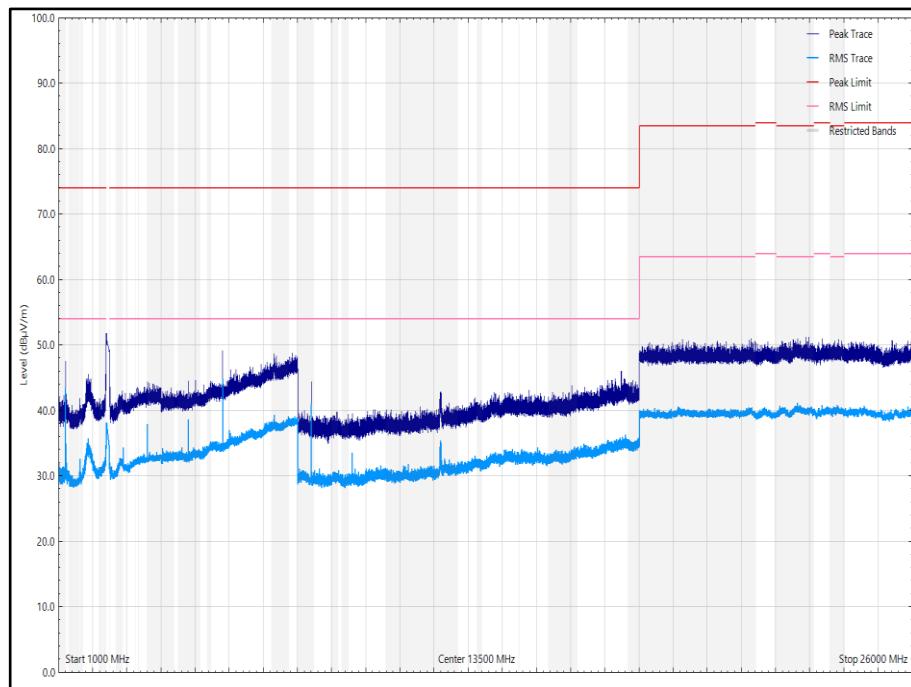
Frequency (MHz)	Level	Limit	Margin (dB)	Detector	Unit	Angle (°)	Height (cm)	Polarisation
*								

**Table 26 - CH6\_HT20\_MCS0\_X, 2437 MHz, 30 MHz to 26 GHz**

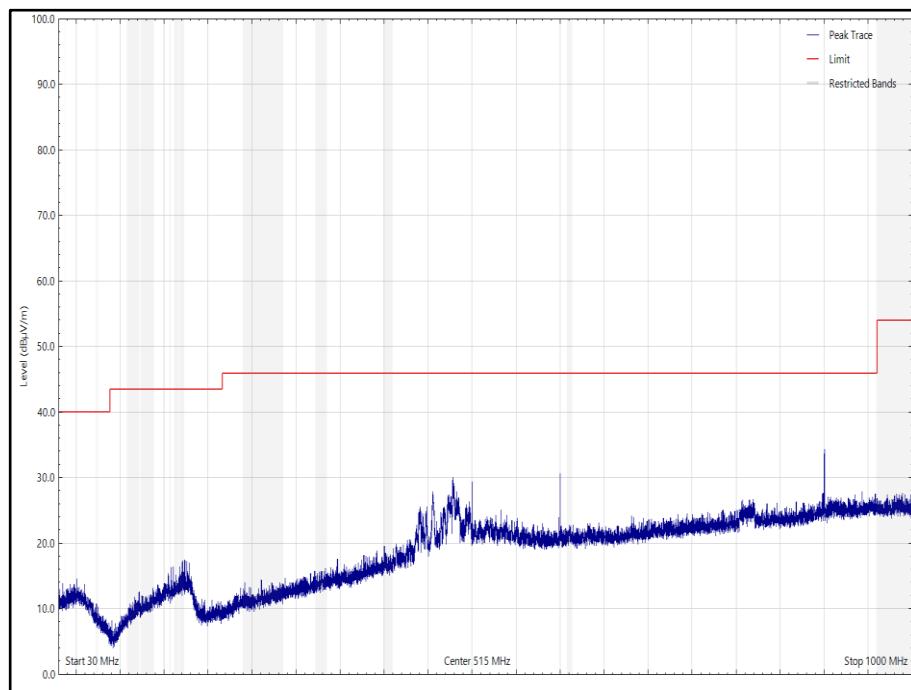
\*No emissions found within 10 dB of the limit.



**Figure 38 - CH6\_HT20\_MCS0\_X, 2437 MHz, 30 MHz to 1 GHz, Horizontal (Peak)**



**Figure 39 - CH6-HT20\_MCS0\_X, 2437 MHz, 1 GHz to 26 GHz, Horizontal**



**Figure 40 - CH6-HT20\_MCS0\_X, 2437 MHz, 30 MHz to 1 GHz, Vertical (Peak)**

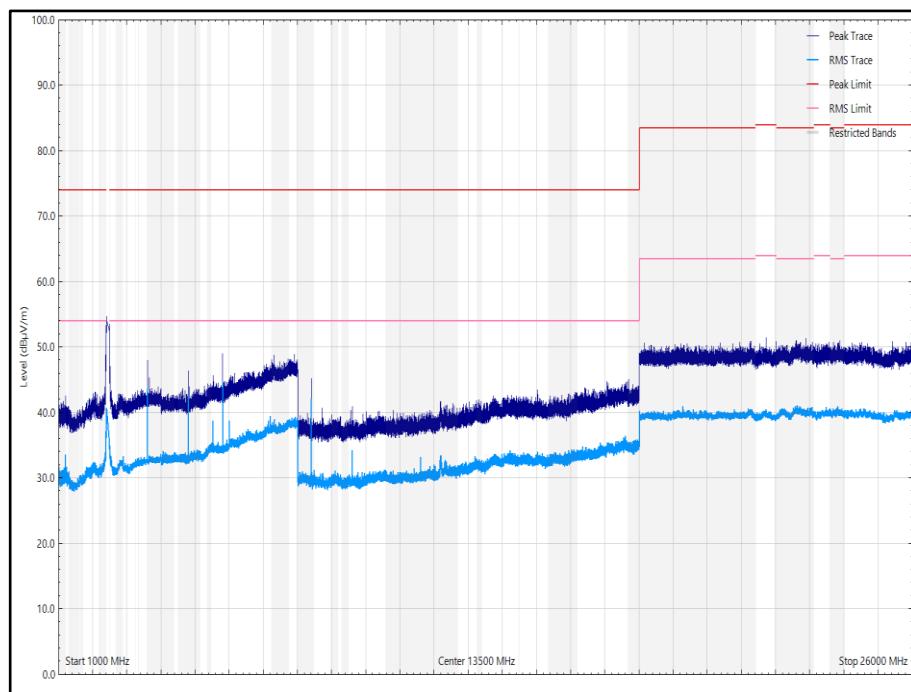
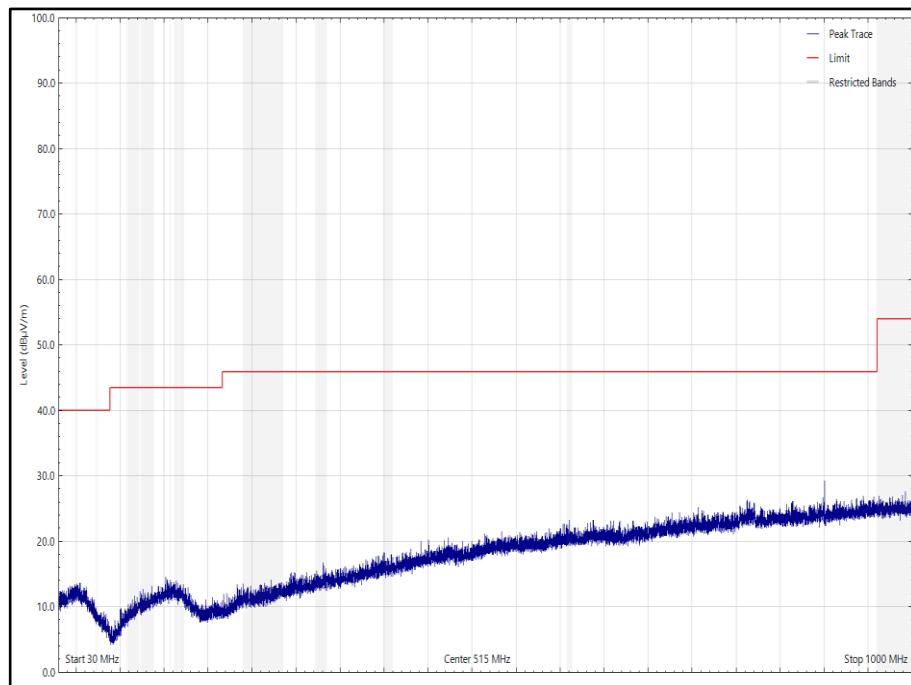


Figure 41 - CH6-HT20-MCS0-X, 2437 MHz, 1 GHz to 26 GHz, Vertical

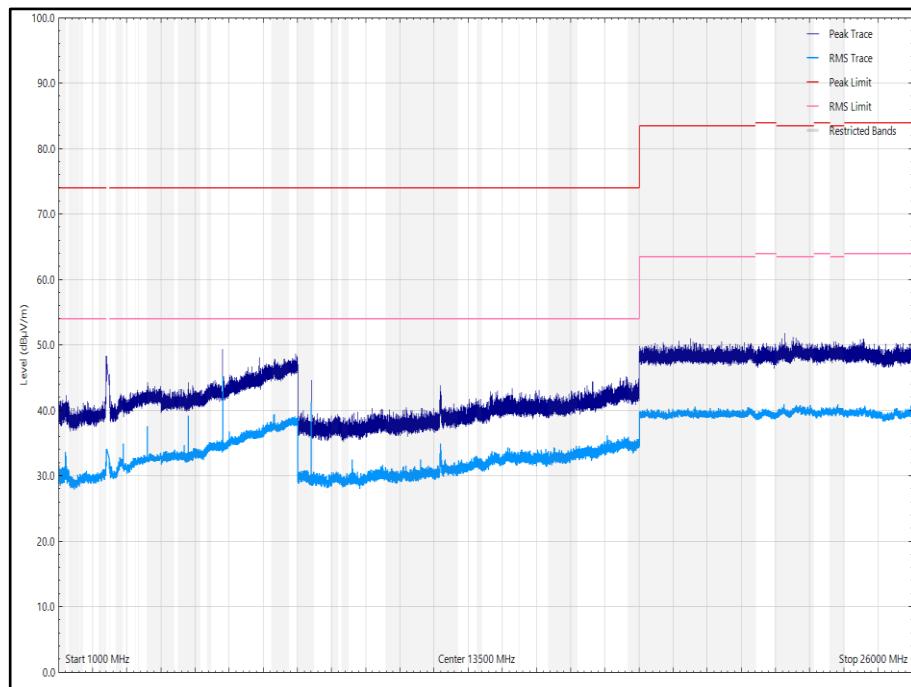
Frequency (MHz)	Level	Limit	Margin (dB)	Detector	Unit	Angle (°)	Height (cm)	Polarisation
*								

**Table 27 - CH6\_HT20\_MCS0\_Y, 2437 MHz, 30 MHz to 26 GHz**

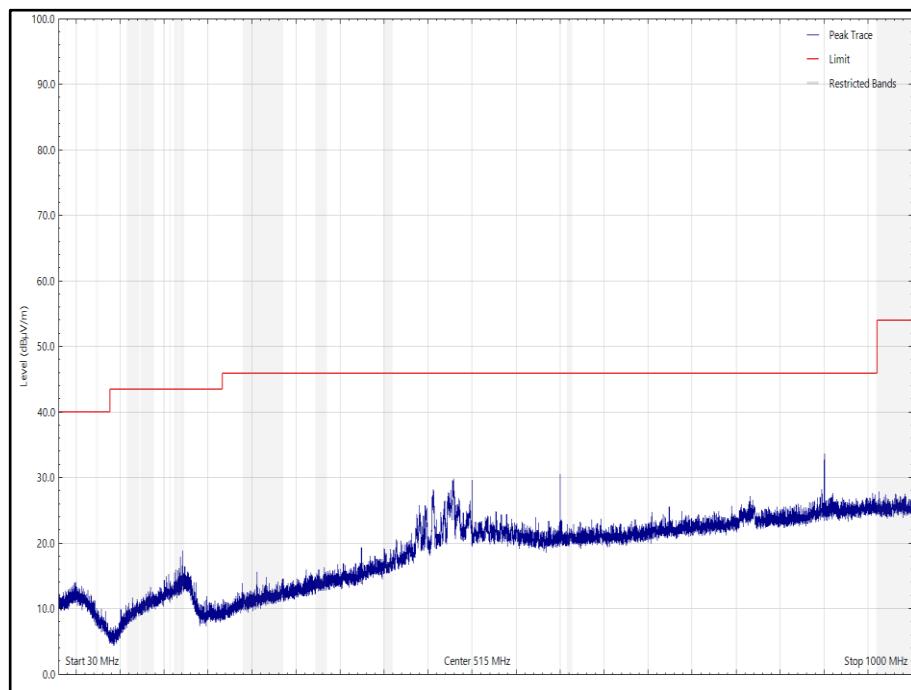
\*No emissions found within 10 dB of the limit.



**Figure 42 - CH6\_HT20\_MCS0\_Y, 2437 MHz, 30 MHz to 1 GHz, Horizontal (Peak)**



**Figure 43 - CH6-HT20\_MCS0\_Y, 2437 MHz, 1 GHz to 26 GHz, Horizontal**



**Figure 44 - CH6-HT20\_MCS0\_Y, 2437 MHz, 30 MHz to 1 GHz, Vertical (Peak)**

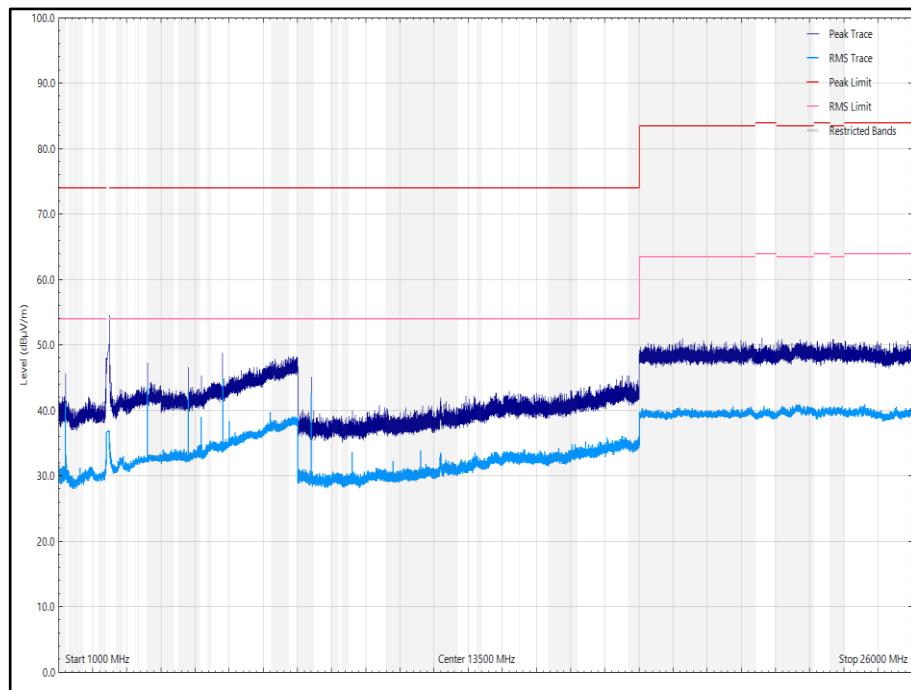


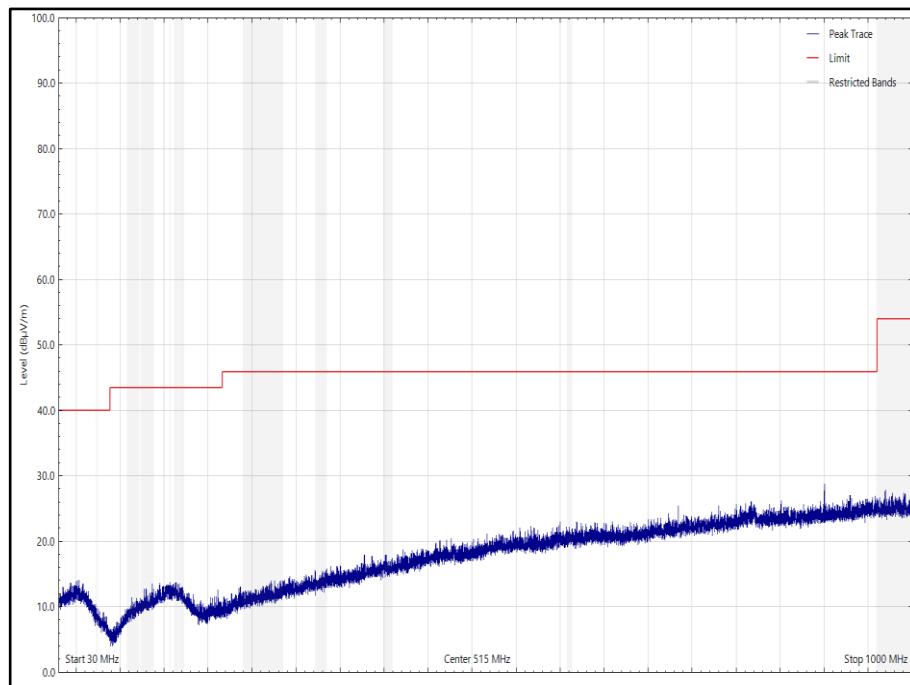
Figure 45 - CH6-HT20\_MCS0\_Y, 2437 MHz, 1 GHz to 26 GHz, Vertical



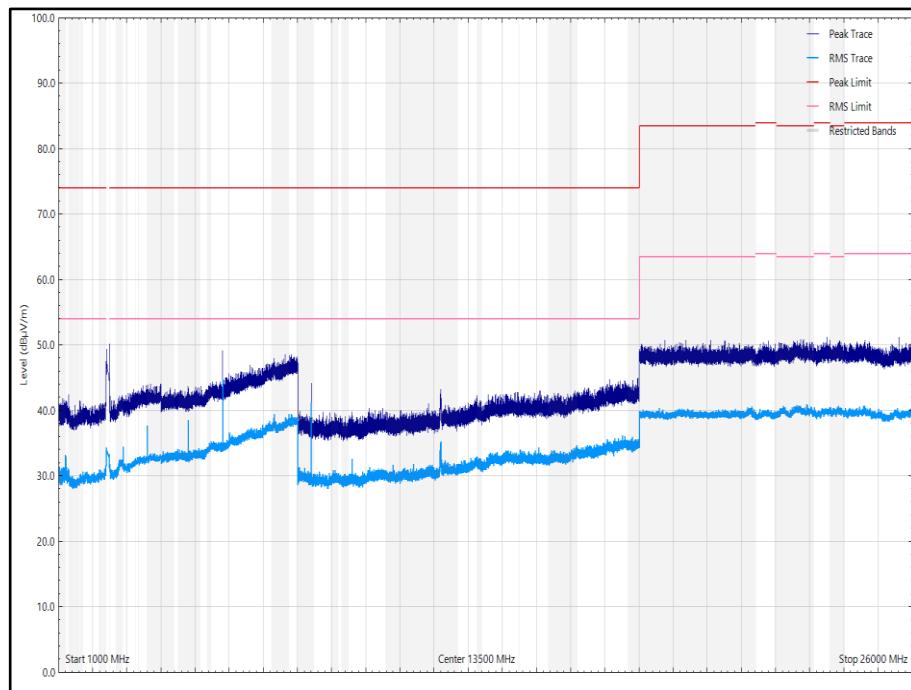
Frequency (MHz)	Level	Limit	Margin (dB)	Detector	Unit	Angle (°)	Height (cm)	Polarisation
*								

**Table 28 - CH6-HT20\_MCS0\_Z, 2437 MHz, 30 MHz to 26 GHz**

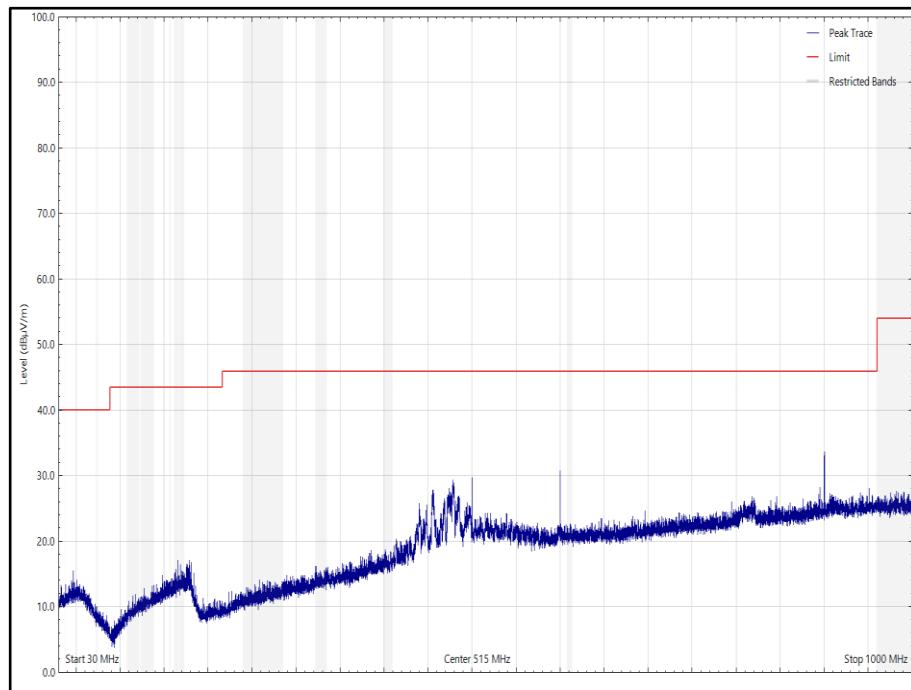
\*No emissions found within 10 dB of the limit.



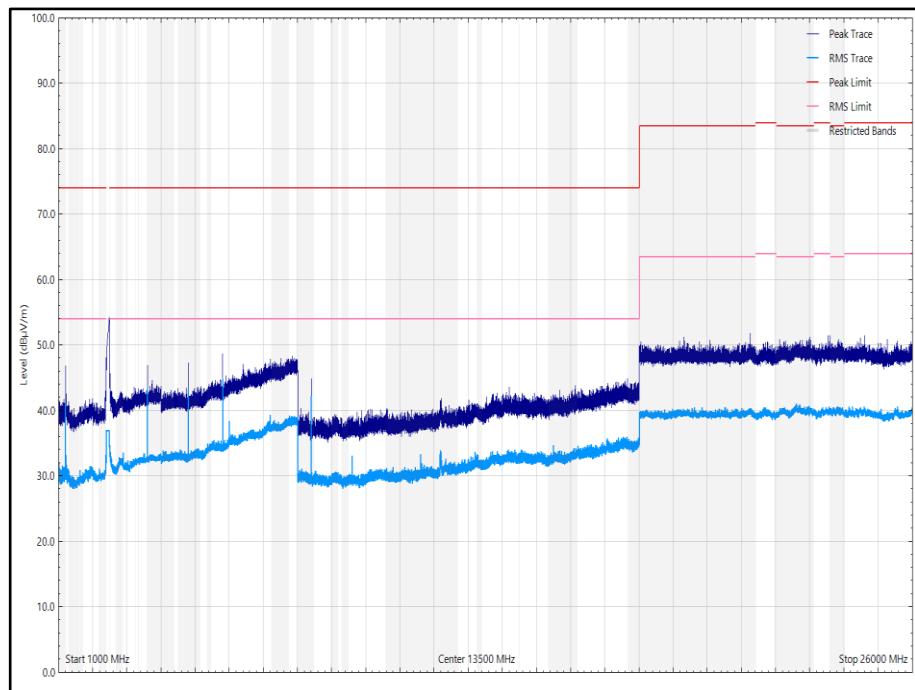
**Figure 46 - CH6-HT20\_MCS0\_Z, 2437 MHz, 30 MHz to 1 GHz, Horizontal (Peak)**



**Figure 47 - CH6-HT20\_MCS0\_Z, 2437 MHz, 1 GHz to 26 GHz, Horizontal**



**Figure 48 - CH6-HT20\_MCS0\_Z, 2437 MHz, 30 MHz to 1 GHz, Vertical (Peak)**



**Figure 49 - CH6-HT20-MCS0-Z, 2437 MHz, 1 GHz to 26 GHz, Vertical**



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

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in 15.209(a)

ISED RSS-247, Limit Clause 5.5

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

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



#### 2.4.8 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 5.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
Antenna (DRG, 18 GHz to 40 GHz)	Link Microtek Ltd	AM180HA-K-TU2	230	24	08-Oct-2026
Pre-Amplifier (18 GHz to 40 GHz)	Phase One	PSO4-0087	1534	12	16-Aug-2025
3m Semi-Anechoic Chamber	Rainford	RF Chamber 5	1545	36	23-Apr-2027
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Hygrometer	Rotronic	Hygropalm 0	3028	12	12-Aug-2025
High Pass Filter (4GHz)	K&L Microwave	11SH10-4000/X18000-0/0	4599	12	15-Oct-2025
Mast Controller	Maturo GmbH	NCD	4810	-	TU
Tilt Antenna Mast	Maturo GmbH	TAM 4.0-P	4811	-	TU
Antenna (DRG, 1 GHz to 10.5 GHz)	Schwarzbeck	BBHA9120B	4848	12	14-Jul-2025
Band Reject Filter - 2.425 GHz	Wainwright	WRCGV14-2390-2400-2450-2460-50SS	5066	12	22-Feb-2025
Band Reject Filter - 2.4585 GHz	Wainwright	WRCGV14-2423.5-2433.5-2483.5-2493.5-50SS	5068	12	06-Nov-2025
Emissions Software	TUV SUD	EmX V3.4.2	5125	-	Software
Antenna (DRG, 7.5 GHz to 18 GHz)	Schwarzbeck	HWRD750	5216	12	14-Jul-2025
Pre-Amplifier (1 GHz to 26.5 GHz)	Agilent Technologies	8449B	5445	12	23-May-2025
Cable (K-Type to K-Type, 1 m)	Junkosha	MWX241-01000KMSKMS/A	5512	12	23-May-2025
Cable (SMA to SMA, 2 m)	Junkosha	MWX221-02000AMSAMS/A	5517	12	23-May-2025
EMI Test Receiver	Rohde & Schwarz	ESW44	5527	12	26-Jul-2025
3 GHz High pass Filter	Wainwright	WHKX12-2580-3000-18000-80SS	5548	12	15-Aug-2025
7 GHz High pass Filter	Wainwright	WHKX12-5850-6800-18000-80SS	5550	12	30-May-2025
Pre-Amplifier (8 GHz to 18 GHz)	Wright Technologies	APS06-0061	5596	12	28-Oct-2025
Cable (K-Type to K-Type, 2 m)	Junkosha	MWX241-02000KMSKMS/B	5934	12	20-Jun-2025
Cable (N to N 8m)	Junkosha	MWX221-08000NMSNMS/B	6330	12	17-Feb-2025
Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9168	6635	24	13-Jun-2025

**Table 29**

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

### 3 Photographs

#### 3.1 Test Setup Photographs



Figure 50 – Test Setup 30 MHz to 1 GHz

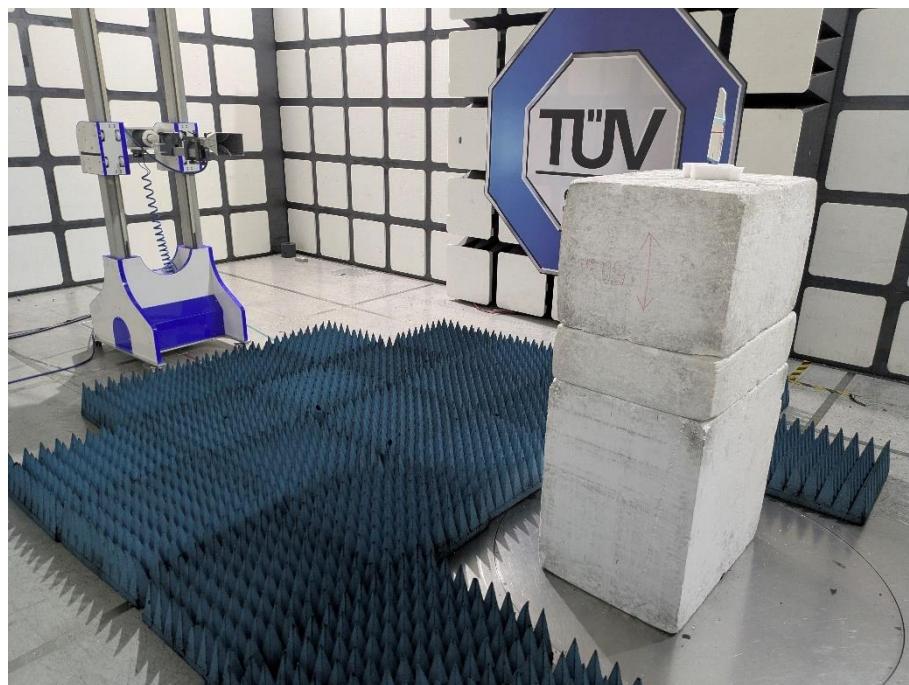
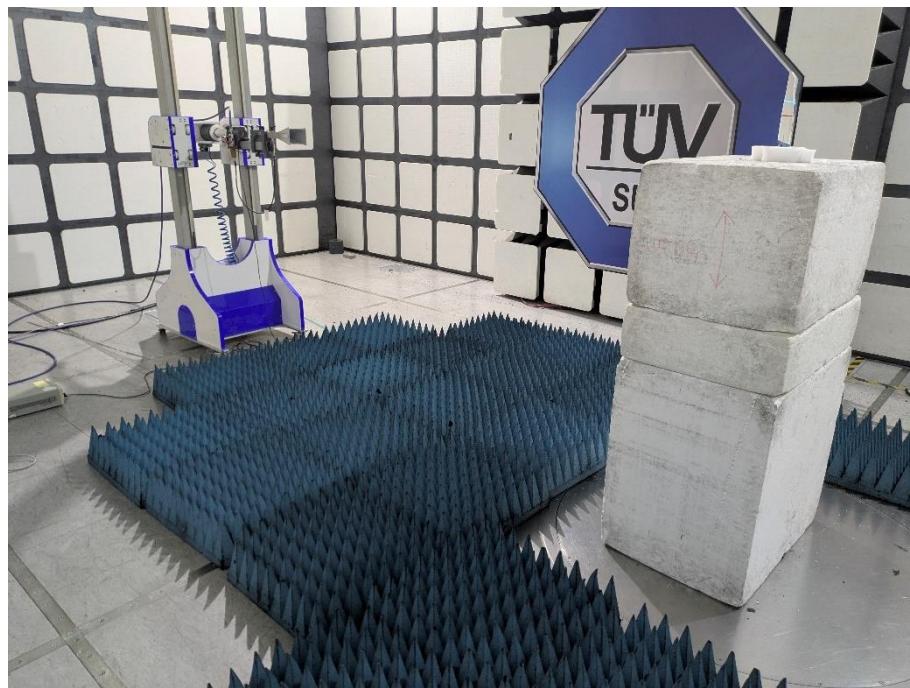
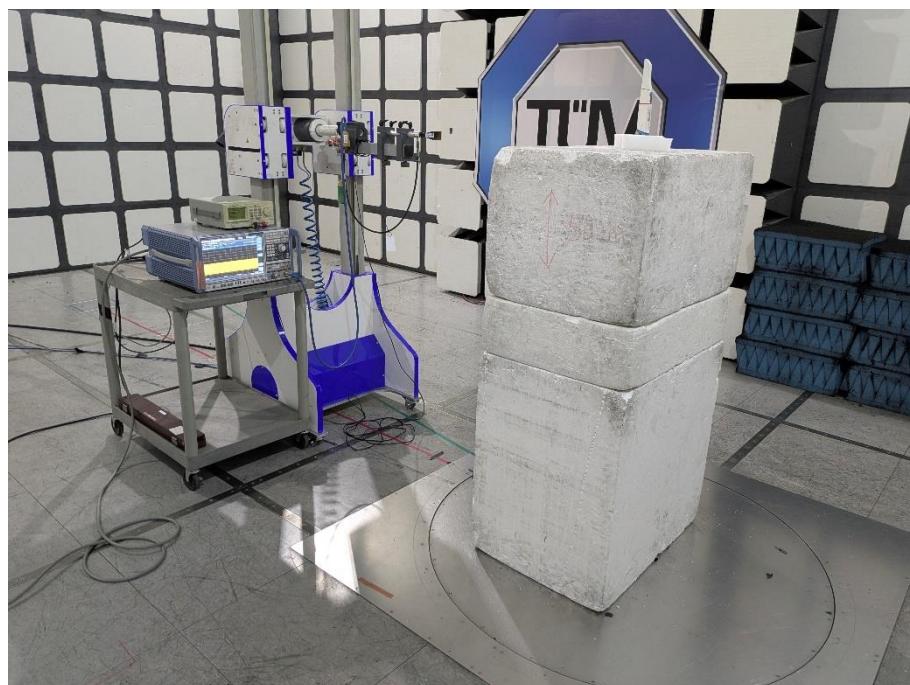


Figure 51 – Test Setup 1GHz to 8 GHz



**Figure 52 – Test Setup 8 GHz to 18 GHz**



**Figure 53 – Test Setup 18 GHz to 26 GHz**

## 4 Measurement Uncertainty

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

Test Name	Measurement Uncertainty
Restricted Band Edges	30 MHz to 1 GHz: $\pm 5.2$ dB 1 GHz to 40 GHz: $\pm 6.3$ dB
Maximum Conducted Output Power	$\pm 1.38$ dB
Authorised Band Edges	30 MHz to 1 GHz: $\pm 5.2$ dB 1 GHz to 40 GHz: $\pm 6.3$ dB
Spurious Radiated Emissions	30 MHz to 1 GHz: $\pm 5.2$ dB 1 GHz to 40 GHz: $\pm 6.3$ dB

**Table 30**

### Measurement Uncertainty Decision Rule – Accuracy Method

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

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