FCC and ISED Test Report

Renishaw PLC

RMP24-Micro, Model: RMP24MICQE

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

Prepared for: Renishaw Plc
New Mills
Wotton-Under-Edge
GL12 8JR, United Kingdom

FCC ID: KQGRMP24MICQE IC: 3928A-RMP24Micro

COMMERCIAL-IN-CONFIDENCE

Document 75960006-04 Issue 01

SIGNATURE			
			
NAME	**JOB TITLE**	**RESPONSIBLE FOR**	**ISSUE DATE**
Steve Marshall	Senior Engineer	Authorised Signatory	23 February 2024

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	Ahmad Javid	23 February 2024	
	Thomas Biddlecombe	23 February 2024	

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

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Contents

1 Report Summary

1.1 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

Issue	Description of Change	Date of Issue
1	First Issue	23-February-2024

Table 1

1.2 Introduction

Applicant	Renishaw Plc
Manufacturer	Renishaw Plc
Model Number(s)	RMP24MICQE
Serial Number(s)	5RGC00 and 5RGC15
Hardware Version(s)	Production
Software Version(s)	Production
Number of Samples Tested	2
Test Specification/Issue/Date	FCC 47 CFR Part 15C: 2021 ISED RSS-247: Issue 3 (08-2023) ISED RSS-GEN: Issue 5 (04-2018) + A2 (02-2021)
Order Number	PU03663331
Date	06-December-2023
Date of Receipt of EUT	05-January-2024
Start of Test	09-January-2024
Finish of Test	26-January-2024
Name of Engineer(s)	Ahmad Javid and Thomas Biddlecombe
Related Document(s)	ANSI C63.10 (2020) ANSI C63.10 (2013) KDB 996369 D04 Module Integration Guide v02

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 Transceiver - 2 Mbps (DTS)						
-	15.203	-	-	Antenna Requirement	N/T	The EUT meets the requirements of 15.203 as it uses permanently attached integral antennas
2.1	15.205	3.3	8.10	Restricted Band Edges	Pass	ANSI C63.10 (2020) ANSI C63.10 (2013)
2.2	15.247 (a)(2)	5.2	6.7	Emission Bandwidth	Pass	ANSI C63.10 (2020) ANSI C63.10 (2013)
2.3	15.247 (b)	5.4	6.12	Maximum Conducted Output Power	Pass	ANSI C63.10 (2020) ANSI C63.10 (2013)
2.4	15.247 (d)	5.5	-	Authorised Band Edges	Pass	ANSI C63.10 (2020) ANSI C63.10 (2013)
2.5	15.209 & 15.247 (d)	3.3 & 5.5	6.13 & 8.9	Spurious Radiated Emissions	Pass	ANSI C63.10 (2020) ANSI C63.10 (2013) ANSI C63.4 (2014)
2.6	15.247 (e)	5.2	6.12	Power Spectral Density	Pass	ANSI C63.10 (2020) ANSI C63.10 (2013)

Configuration and Mode: 2.4 GHz Transceiver - 1 Mbps (FHSS)						
	15.203	-	-	Antenna Requirement	N/T	The EUT meets the requirements of 15.203 as it uses permanently attached integral antennas
2.1	15.205	3.3	8.10	Restricted Band Edges	Pass	ANSI C63.10 (2020) ANSI C63.10 (2013)
2.3	15.247 (b)	5.4	6.12	Maximum Conducted Output Power	Pass	ANSI C63.10 (2020) ANSI C63.10 (2013)
2.4	15.247 (d)	5.5	-	Authorised Band Edges	Pass	ANSI C63.10 (2020) ANSI C63.10 (2013)
2.5	15.209 & 15.247 (d)	3.3 & 5.5	6.13 & 8.9	Spurious Radiated Emissions	Pass	ANSI C63.10 (2020) ANSI C63.10 (2013) ANSI C63.4 (2014)
2.6	15.247 (a)(1)	5.1	-	Frequency Hopping Systems - Average Time of Occupancy	Pass	ANSI C63.10 (2020) ANSI C63.10 (2013)
2.7	15.247 (a)(1)	5.1	-	Frequency Hopping Systems - Channel Separation	Pass	ANSI C63.10 (2020) ANSI C63.10 (2013)
2.8	15.247 (a)(1)	5.1	-	Frequency Hopping Systems - Number of Hopping Channels	Pass	ANSI C63.10 (2020) ANSI C63.10 (2013)
2.9	15.247 (a)(1)	5.1	6.7	Frequency Hopping Systems - 20 dB Bandwidth	Pass	ANSI C63.10 (2020) ANSI C63.10 (2013)

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)*	The RMP24-micro enables automated workpiece inspection and job set-up on small multi-tasking machines and machine centres. It uses 2.4GHz FHSS GFSK to communicate with an appropriate interface (RMI-QE).		
Manufacturer:	Renishaw PLC		
Model:	RMP24MICQE		
Part Number:	As Tested		
Hardware Version:	Production		
Software Version:	Production		
FCC ID of the product under test – see guidance here		KQGRMP24MICQE	
IC ID of the product under test – see guidance here		3928A-RMP24Micro	
Device Category	Mobile ☐	Portable ☐	Fixed ☐
Equipment is fitted with an Audio Low Pass Filter		Yes ☐	No ☒

Table 3

Intentional Radiators

Technology	Renishaw Proprietary (Mode 1)	Renishaw Proprietary (Mode 2)
Frequency Range (MHz to MHz)	2400MHz to 2483.5MHz	2400MHz to 2483.5MHz
Conducted Declared Output Power (dBm)	0dBm	4dBm
Antenna Gain (dBi)	-14.43 dBi	-14.43 dBi
Supported Bandwidth(s) (MHz) (e.g. 1 MHz, 20 MHz, 40 MHz)	1MHz	2MHz
Modulation Scheme(s) (e.g. GFSK, QPSK etc)	GFSK	GFSK
ITU Emission Designator (see guidance here) (not mandatory for Part 15 devices)	N/A	N/A
Bottom Frequency (MHz)	2403MHz	2404MHz
Middle Frequency (MHz)	2442MHz	2442MHz
Top Frequency (MHz)	2481MHz	2480MHz

Table 4

Un-intentional Radiators

Highest frequency generated or used in the device or on which the device operates or tunes	
Lowest frequency generated or used in the device or on which the device operates or tunes	
Class A Digital Device (Use in commercial, industrial or business environment) ☐ Class B Digital Device (Use in residential environment only) ☐	

Table 5

AC Power Source

AC supply frequency:		Hz
Voltage		V
Max current:		A
Single Phase ☐ Three Phase ☐		

Table 6

DC Power Source

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

Table 7

Battery Power Source

Voltage:	6.0	V
End-point voltage:	4.0	V *(Point at which the battery will terminate)*
Alkaline ☐ Leclanche ☐ Lithium ☐ Nickel Cadmium ☐ Lead Acid* ☐ **(Vehicle regulated)*		
Other ☒ Lithium Manganese Dioxide Please detail:	2 x CR1632	

Table 8

Charging

Can the EUT transmit whilst being charged	Yes ☐ No ☐

Table 9

Temperature

Minimum temperature:	5	°C
Maximum temperature:	55	°C

Table 10

Cable Loss

Adapter Cable Loss (Conducted sample)	0.4 (estimate)	dB

Table 11

Antenna Characteristics

Antenna connector ☐			State impedance		Ohm
Temporary antenna connector ☒			State impedance	50	Ohm
Integral antenna ☒	Type:	PCB Slot	Gain	-14.43	dBi
External antenna ☐	Type:		Gain		dBi
For external antenna only: Standard Antenna Jack ☐ If yes, describe how user is prohibited from changing antenna (if not professional installed): Equipment is only ever professionally installed ☐ Non-standard Antenna Jack ☐ 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.					

Table 12

Ancillaries (if applicable)

Manufacturer:		Part Number:	
Model:		Country of Origin:	

Table 13

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

Name: John Styles
Position held: MPD Electronics Design Manager
Date: 20.02.24

1.5 Product Information

1.5.1 Technical Description

The RMP24-micro enables automated workpiece inspection and job set-up on small multi-tasking machines and machine centres. It uses 2.4GHz FHSS GFSK to communicate with an appropriate interface (RMI-QE).

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: RMP24MICQE, Serial Number: 5RGC15			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: RMP24MICQE, Serial Number: 5RGC00			
0	As supplied by the customer	Not Applicable	Not Applicable

Table 14

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 Transceiver - 2 Mbps (DTS)		
Restricted Band Edges	Ahmad Javid	UKAS
Emission Bandwidth	Thomas Biddlecombe	UKAS
Maximum Conducted Output Power	Thomas Biddlecombe	UKAS
Authorised Band Edges	Ahmad Javid	UKAS
Spurious Radiated Emissions	Ahmad Javid	UKAS
Power Spectral Density	Thomas Biddlecombe	UKAS
Configuration and Mode: 2.4 GHz Transceiver - 1 Mbps (FHSS)		
Restricted Band Edges	Ahmad Javid	UKAS
Frequency Hopping Systems - Average Time of Occupancy	Thomas Biddlecombe	UKAS
Frequency Hopping Systems - Channel Separation	Thomas Biddlecombe	UKAS
Frequency Hopping Systems - Number of Hopping Channels	Thomas Biddlecombe	UKAS
Frequency Hopping Systems - 20 dB Bandwidth	Thomas Biddlecombe	UKAS
Maximum Conducted Output Power	Thomas Biddlecombe	UKAS
Authorised Band Edges	Ahmad Javid	UKAS
Spurious Radiated Emissions	Ahmad Javid	UKAS

Table 15

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

RMP24MICQE, S/N: 5RGC15 - Modification State 0

2.1.3 Date of Test

21-January-2024

2.1.4 Test Method

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

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

The following conversion can be applied to convert from dBµV/m to µV/m:
10^(Field Strength in dBµV/m/20).

2.1.5 Environmental Conditions

Ambient Temperature	20.1 °C
Relative Humidity	42.3 %

2.1.6 Test Results

2.4 GHz Transceiver - 2 Mbps (DTS)

Mode	Data Rate/MCS	Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBµV/m)	Average Level (dBµV/m)
DTS	2 Mbps	2404	2390	54.62	43.18
DTS	2 Mbps	2480	2483.5	54.83	43.30

Table 16

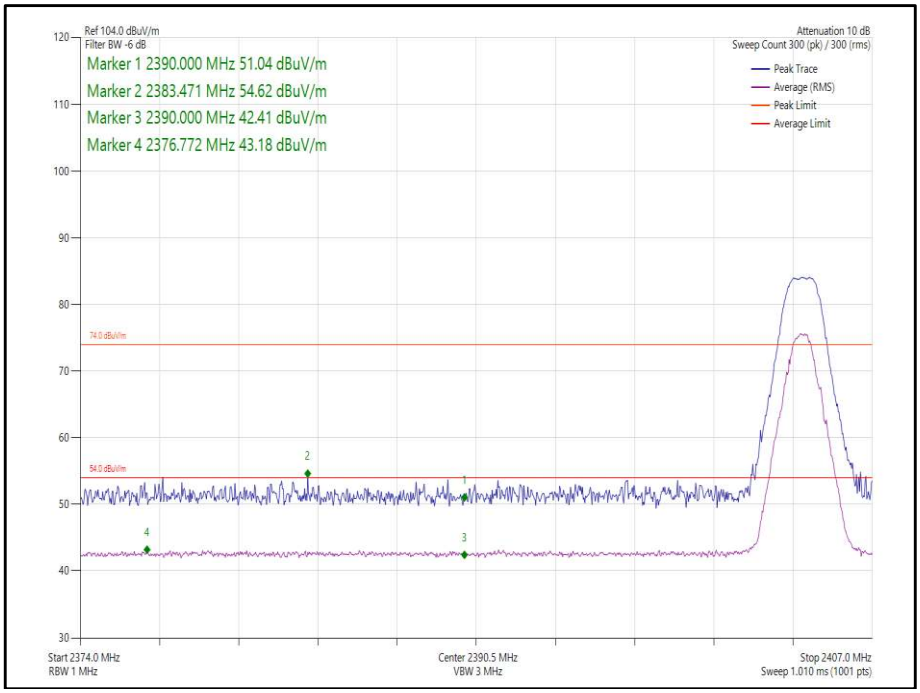

Figure 1 - DTS, 2404 MHz, Band Edge Frequency 2390 MHz

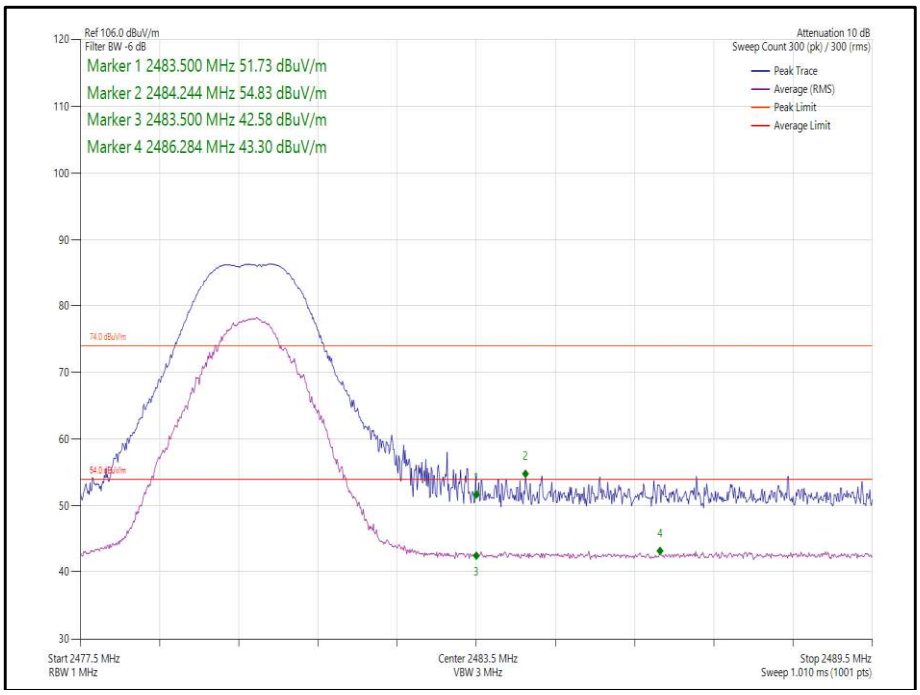

Figure 2 - DTS, 2480 MHz, Band Edge Frequency 2483.5 MHz

2.4 GHz Transceiver - 1 Mbps (FHSS)

Mode	Data Rate/MCS	Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBµV/m)	Average Level (dBµV/m)
FHSS	1 Mbps	2403	2390	53.91	43.02
FHSS	1 Mbps	2481	2483.5	53.48	43.30

Table 17

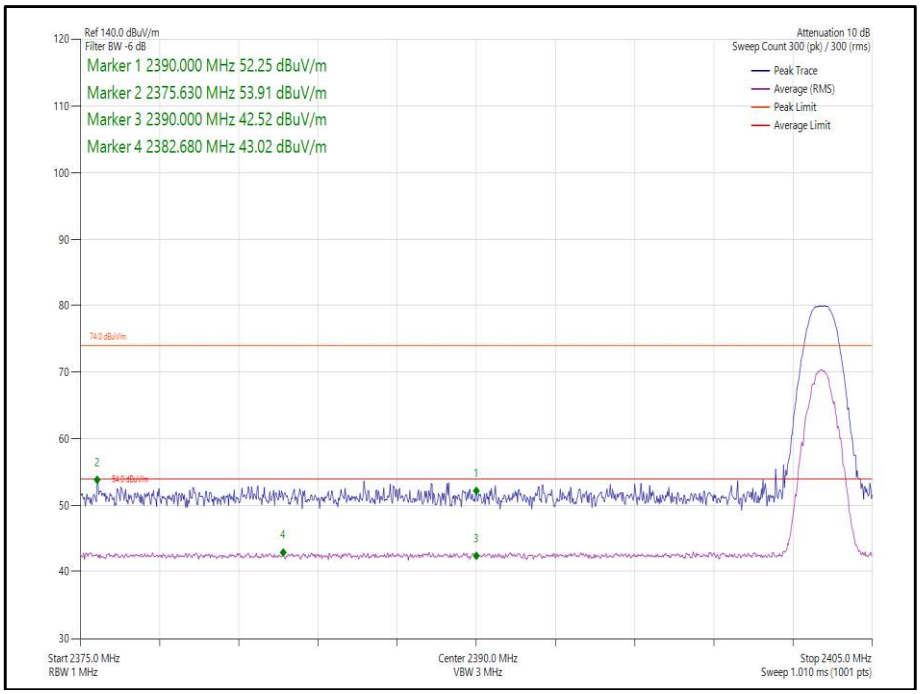

Figure 3 - FHSS, 2403 MHz, Band Edge Frequency 2390 MHz

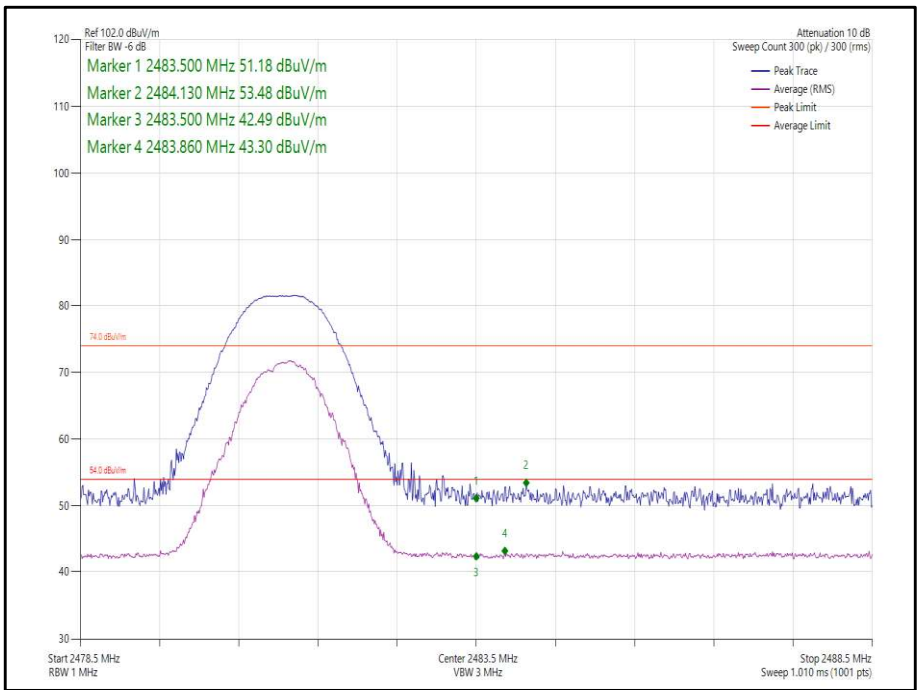

Figure 4 - FHSS, 2481 MHz, Band Edge Frequency 2483.5 MHz

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 18

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 16

*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	15-Apr-2024
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Hygropalm Temperature and Humidity Meter	Rotronic	HP21	4410	12	08-Aug-2024
Mast Controller	Maturo Gmbh	NCD	4810	-	TU
Tilt Antenna Mast	Maturo Gmbh	TAM 4.0-P	4811	-	TU
Antenna (DRG 1-10.5GHz)	Schwarzbeck	BBHA9120B	4848	12	09-Jul-2024
Emissions Software	TUV SUD	EmX V3.1.12	5125	-	Software
Cable (SMA to SMA, 2 m)	Junkosha	MWX221-02000AMSAMS/A	5517	12	21-May-2024
Cable (N-Type to N-Type, 8 m)	Junkosha	MWX221-08000NMSNMS/B	5521	12	05-Jun-2024
EMI Test Receiver	Rohde & Schwarz	ESW44	5527	12	15-Jun-2024

Table 20

TU - Traceability Unscheduled

2.2 Emission Bandwidth

2.2.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (a)(2),
ISED RSS-247, Clause 5.2
ISED RSS-GEN, Clause 6.7

2.2.2 Equipment Under Test and Modification State

RMP24MICQE, S/N: 5RGC00 - Modification State 0

2.2.3 Date of Test

09-January-2024

2.2.4 Test Method

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

2.2.5 Environmental Conditions

Ambient Temperature	22.4 °C
Relative Humidity	21.2 %

2.2.6 Test Results

2.4 GHz Transceiver - 2 Mbps (DTS)

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Limit Clause(s):	15.247 (a)(2) RSS-247 5.2 a)	Test Method(s):	C63.10 6.9.3 C63.10 11.8.1
Additional Reference(s):	-		

DUT Configuration			
Mode:	2 MBit/s DTS GFSK	Duty Cycle (%):	-
Antenna Configuration:	SISO	DCCF (dB):	-
Active Port(s):	-	Peak Antenna Gain (dBi):	-

Test Frequency (MHz)	6 dB Bandwidth (MHz)				Limit (kHz)
	A	B	C	D	
2404	0.608	-	-	-	≥500.0
2442	0.656	-	-	-	≥500.0
2480	0.512	-	-	-	≥500.0

Table 21 - 6 dB Bandwidth Results

Test Frequency (MHz)	99% Bandwidth (MHz)				Limit (kHz)
	A	B	C	D	
2404	1.888	-	-	-	-
2442	1.896	-	-	-	-
2480	1.936	-	-	-	-

Table 22 - 99% Bandwidth Results

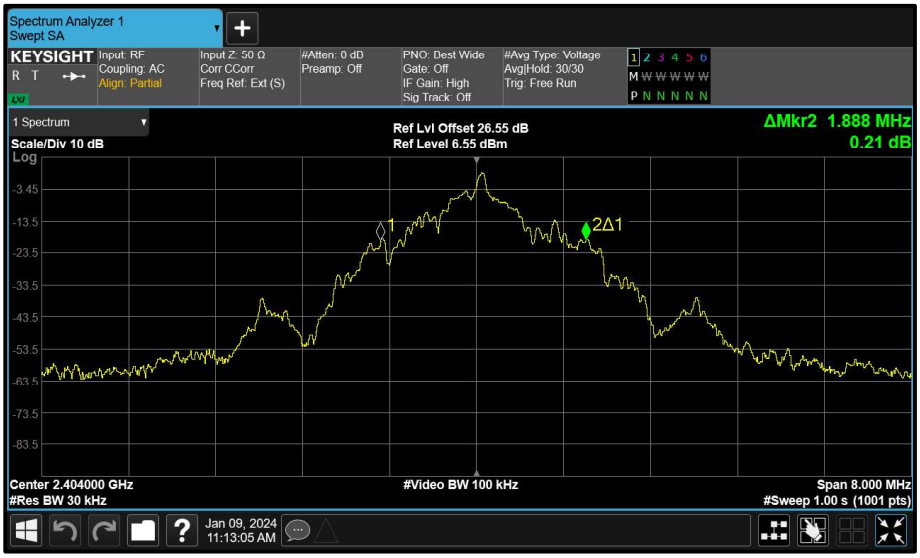

Figure 5 - 2404 MHz 99% Bandwidth

Figure 6 - 2404 MHz 6 dB Bandwidth

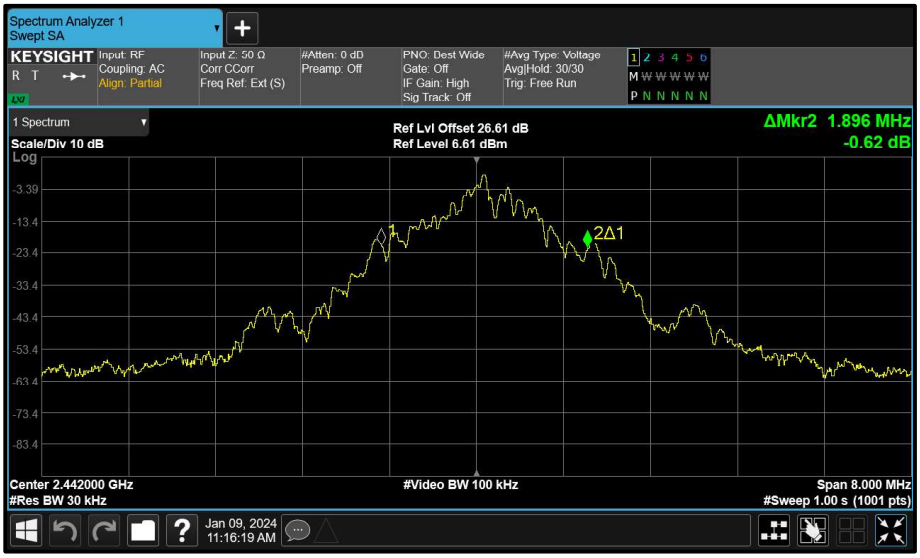

Figure 7 - 2442 MHz 99% Bandwidth

Figure 8 - 2442 MHz 6 dB Bandwidth

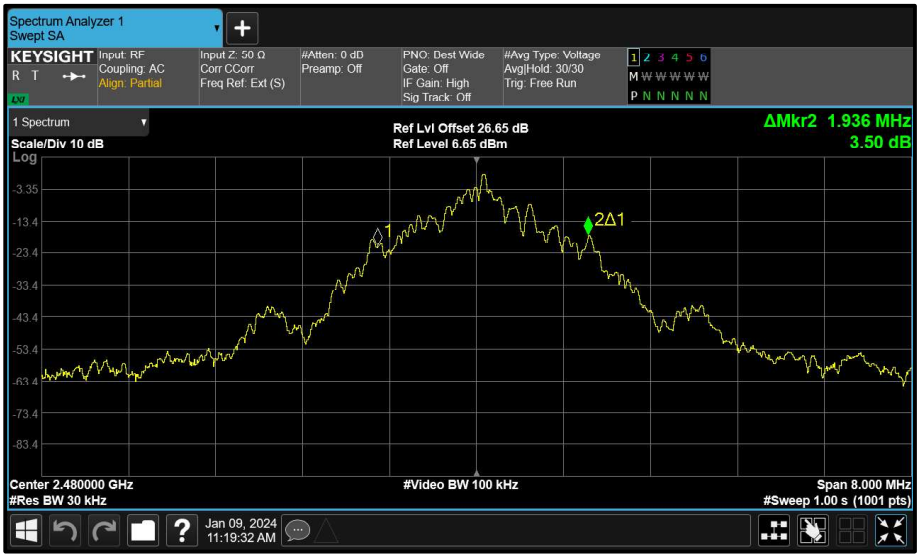

Figure 9 - 2480 MHz 99% Bandwidth

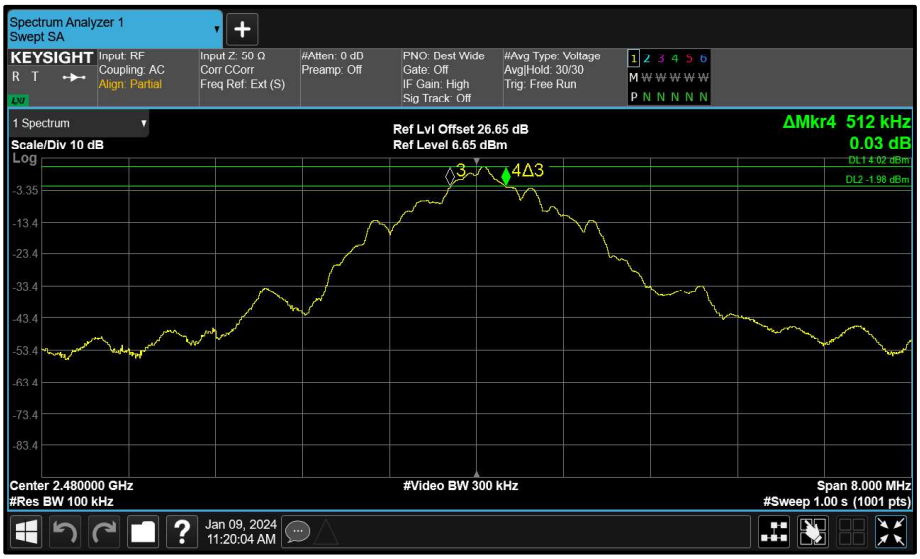

Figure 10 - 2480 MHz 6 dB Bandwidth

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

The minimum 6 dB Bandwidth shall be at least 500 kHz.

2.2.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
Hygrometer	Rotronic	I-1000	3220	12	28-Nov-2024
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	08-Feb-2024
MXA Signal Analyser	Keysight Technologies	N9020B	5528	24	18-Sep-2025
Signal Conditioning Unit	TUV SUD	SPECTRUM_SCU001	6350	-	26-Jul-2024
SCU Cable Assembly SCU	TUV SUD	SPECTRUM_SCU_CA	6638	12	26-Jul-2024

Table 23

2.3 Maximum Conducted Output Power

2.3.1 Specification Reference

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

2.3.2 Equipment Under Test and Modification State

RMP24MICQE, S/N: 5RGC00 - Modification State 0

2.3.3 Date of Test

09-January-2024

2.3.4 Test Method

2.4 GHz Transceiver - 2 Mbps (DTS)
The test was performed in accordance with ANSI C63.10 clause 11.9.2.3.2 Method AVGPM-G

2.4 GHz Transceiver - 1 Mbps (FHSS)
The test was performed in accordance with ANSI C63.10 clause 7.8.5 using a power meter.

2.3.5 Environmental Conditions

Ambient Temperature	22.4 °C
Relative Humidity	21.2 %

2.3.6 Test Results

2.4 GHz Transceiver - 2 Mbps (DTS)

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:	2 MBit/s DTS GFSK	Duty Cycle (%):	19.3
Antenna Configuration:	SISO	DCCF (dB):	-
Active Port(s):	-	Peak Antenna Gain (dBi):	-14.43

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)
	A	B	C	D	∑		
2404	4.08	-	-	-	-	30.00	-25.92
2442	3.90	-	-	-	-	30.00	-26.10
2480	3.79	-	-	-	-	30.00	-26.21

Table 24 - 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	∑					
2404	4.08	-	-	-	-	30.00	-25.92	-10.35	36.00	-46.35
2442	3.90	-	-	-	-	30.00	-26.10	-10.53	36.00	-46.53
2480	3.79	-	-	-	-	30.00	-26.21	-10.64	36.00	-46.64

Table 25 - ISED Maximum Conducted (average) Output Power Results

2.4 GHz Transceiver - 1 Mbps (FHSS)

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Limit Clause(s):	15.247 (b)(1) RSS-247 5.4 b)	Test Method(s):	C63.10 7.8.5
Additional Reference(s):	-		

DUT Configuration			
Mode:	1 MBit/s FHSS GFSK	Duty Cycle (%):	10.5
Antenna Configuration:	SISO	DCCF (dB):	-
Active Port(s):	-	Peak Antenna Gain (dBi):	-14.43

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)
	A	B	C	D	∑		
2403	1.07	-	-	-	-	30.00	-28.93
2442	0.94	-	-	-	-	30.00	-29.06
2481	0.83	-	-	-	-	30.00	-29.17

Table 26 - FCC Maximum Conducted (peak) 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	∑					
2403	1.07	-	-	-	-	30.00	-28.93	-13.36	36.00	-49.36
2442	0.94	-	-	-	-	30.00	-29.06	-13.49	36.00	-49.49
2481	0.83	-	-	-	-	30.00	-29.17	-13.60	36.00	-49.60

Table 27 - ISED Maximum Conducted (peak) 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.

FCC 47 CFR Part 15, Limit Clause 15.247 (b)(1)

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

ISED RSS-247, Limit Clause 5.4 (b)

For FHSS operating in the band 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W if the hopset uses 75 or more hopping channel; the maximum peak conducted output power shall not exceed 0.125 W if the hopset uses less than 75 hopping channel. The e.i.r.p. shall not exceed 4 W except as provided in section 5.4(e) of the specification.

2.3.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
Hygrometer	Rotronic	I-1000	3220	12	28-Nov-2024
USB Power Sensor	Boonton	RTP5008	5833	12	12-Jul-2024
Signal Conditioning Unit	TUV SUD	SPECTRUM_SCU001	6350	-	26-Jul-2024
SCU Cable Assembly SCU	TUV SUD	SPECTRUM_SCU_CA	6638	12	26-Jul-2024

Table 28

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

RMP24MICQE, S/N: 5RGC15 - Modification State 0

2.4.3 Date of Test

21-January-2024

2.4.4 Test Method

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

2.4.5 Environmental Conditions

Ambient Temperature	20.1 °C
Relative Humidity	42.3 %

2.4.6 Test Results

2.4 GHz Transceiver - 2 Mbps (DTS)

Mode	Data Rate/MCS	Frequency (MHz)	Band Edge Frequency (MHz)	Level (dBc)
DTS	2 Mbps	2404	2400	-40.81
DTS	2 Mbps	2480	2483.5	-42.33

Table 29

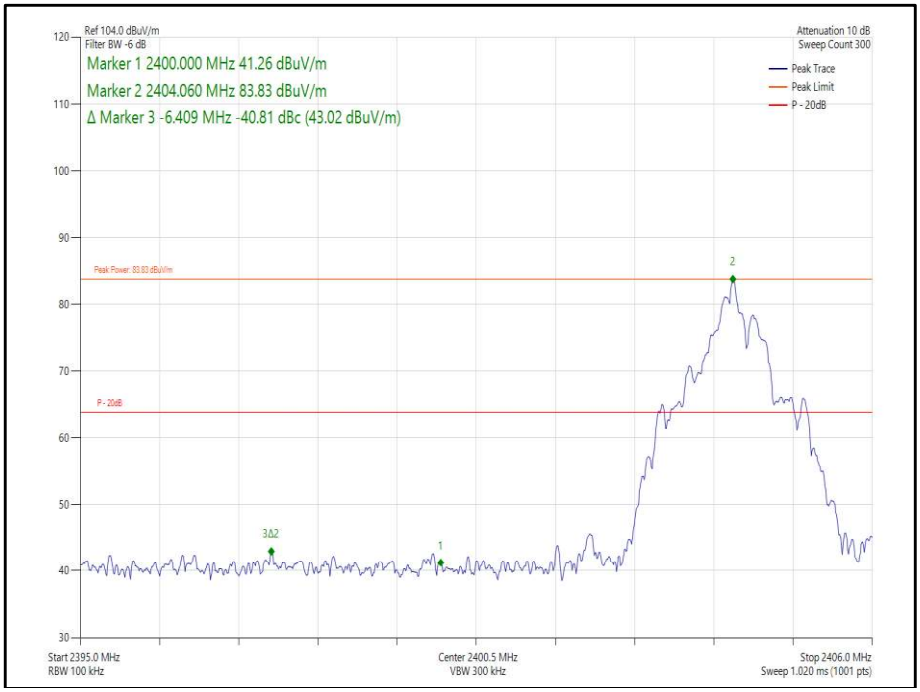

Figure 11 - DTS, 2404 MHz, Band Edge Frequency 2400 MHz

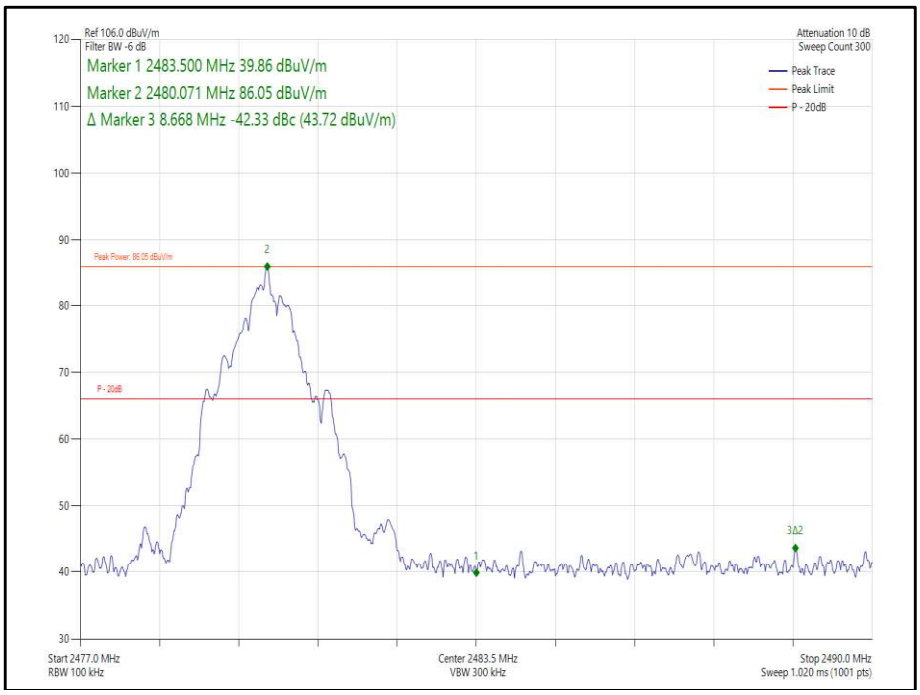

Figure 12 - DTS, 2480 MHz, Band Edge Frequency 2483.5 MHz

2.4 GHz Transceiver - 1 Mbps (FHSS)

Mode	Data Rate/MCS	Frequency (MHz)	Band Edge Frequency (MHz)	Level (dBc)
FHSS	1 Mbps	2403	2400	-36.65
FHSS	1 Mbps	HOPPING	2400	-35.41
FHSS	1 Mbps	2481	2483.5	-38.23
FHSS	1 Mbps	HOPPING	2483.5	-34.36

Table 30

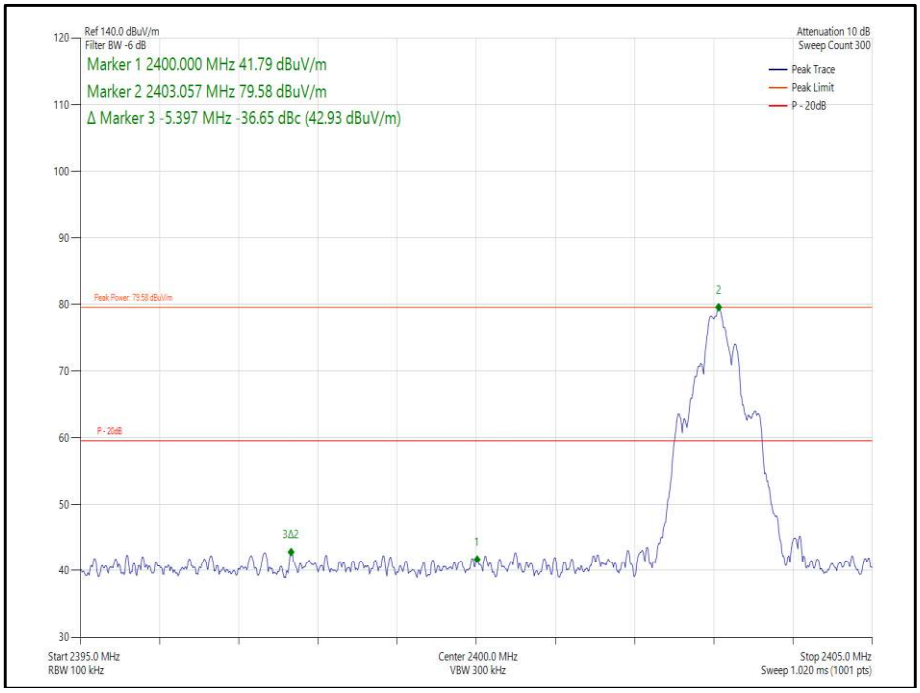

Figure 13 - FHSS, 2403 MHz, Band Edge Frequency 2400 MHz

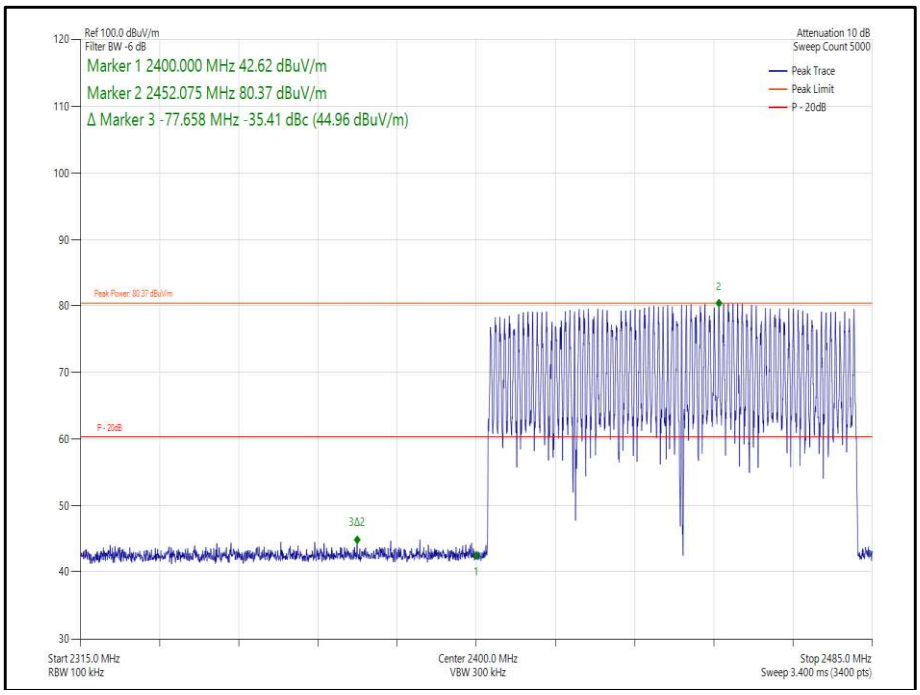

Figure 14 - FHSS, HOPPING, Band Edge Frequency 2400 MHz

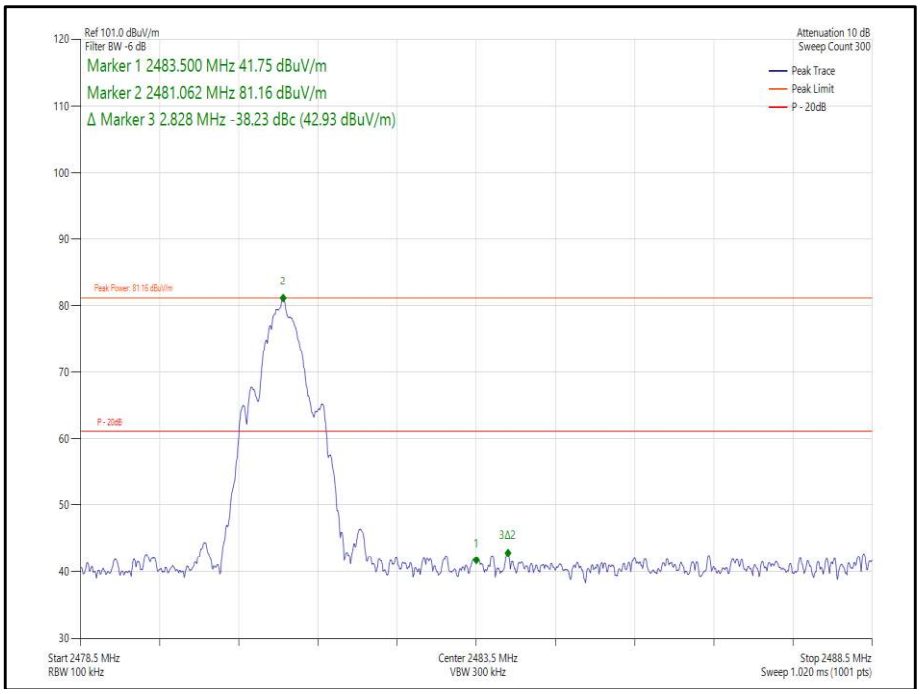

Figure 15 - FHSS, 2481 MHz, Band Edge Frequency 2483.5 MHz

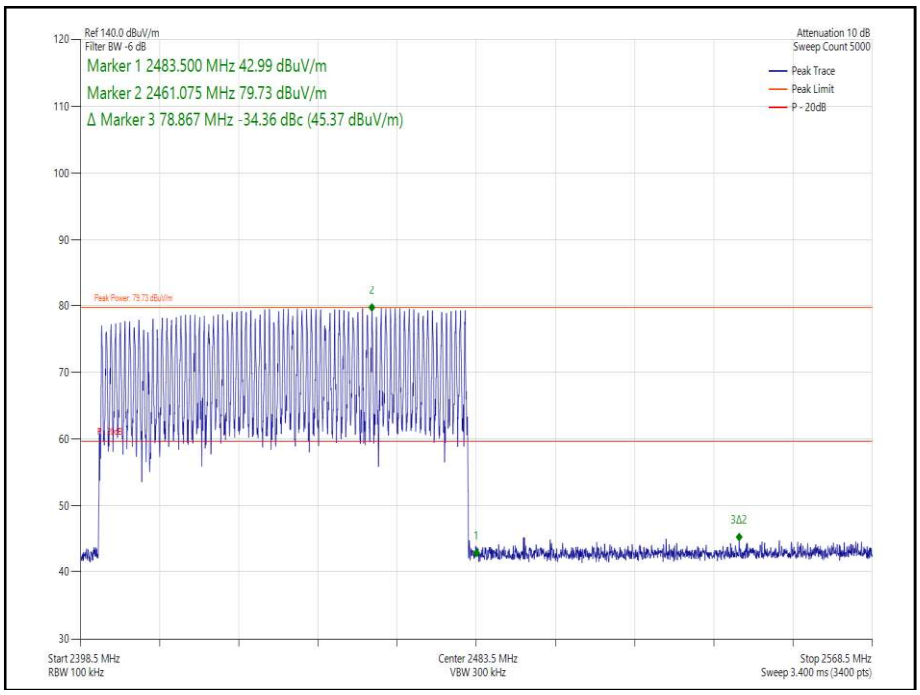

Figure 16 - FHSS, HOPPING, Band Edge Frequency 2483.5 MHz

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.

2.4.7 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	15-Apr-2024
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Hygropalm Temperature and Humidity Meter	Rotronic	HP21	4410	12	08-Aug-2024
Mast Controller	Maturo Gmbh	NCD	4810	-	TU
Tilt Antenna Mast	Maturo Gmbh	TAM 4.0-P	4811	-	TU
Antenna (DRG 1-10.5GHz)	Schwarzbeck	BBHA9120B	4848	12	09-Jul-2024
Emissions Software	TUV SUD	EmX V3.1.12	5125	-	Software
Cable (SMA to SMA, 2 m)	Junkosha	MWX221-02000AMSAMS/A	5517	12	21-May-2024
Cable (N-Type to N-Type, 8 m)	Junkosha	MWX221-08000NMSNMS/B	5521	12	05-Jun-2024
EMI Test Receiver	Rohde & Schwarz	ESW44	5527	12	15-Jun-2024

Table 31

TU - Traceability Unscheduled

2.5 Spurious Radiated Emissions

2.5.1 Specification Reference

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

2.5.2 Equipment Under Test and Modification State

RMP24MICQE, S/N: 5RGC15 - Modification State 0

2.5.3 Date of Test

17-January-2024 to 26-January-2024

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

The following conversion can be applied to convert from dBµV/m to µV/m:
10^(Field Strength in dBµV/m/20).
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.
Above 18 GHz, the measurement distance was reduced to 1 m. The limit line was increased by 20*LOG(3/1) = 9.54 dB.

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.

2.5.5 Example Test Setup Diagram

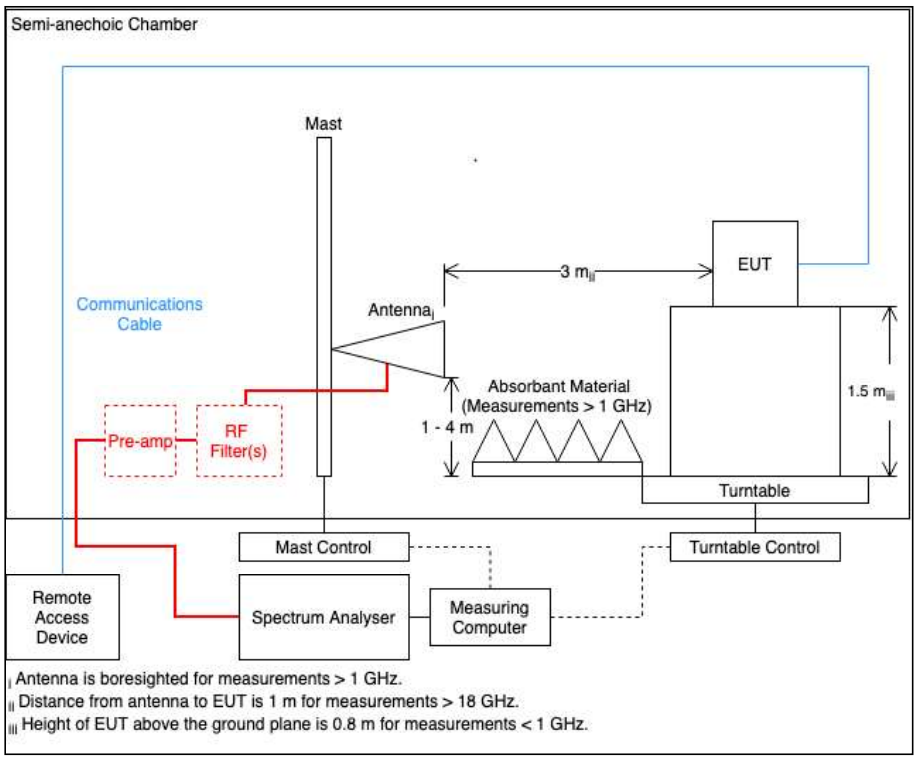

Figure 16

2.5.6 Environmental Conditions

Ambient Temperature	20.1 - 21.3 °C
Relative Humidity	45.3 – 46.8 %

2.5.7 Test Results

2.4 GHz Transceiver - 2 Mbps (DTS)

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

Table 32 - DTS_Bot_2Mbps_X, 2404 MHz, 30 MHz to 25 GHz

*No emissions found within 10 dB of the limit.

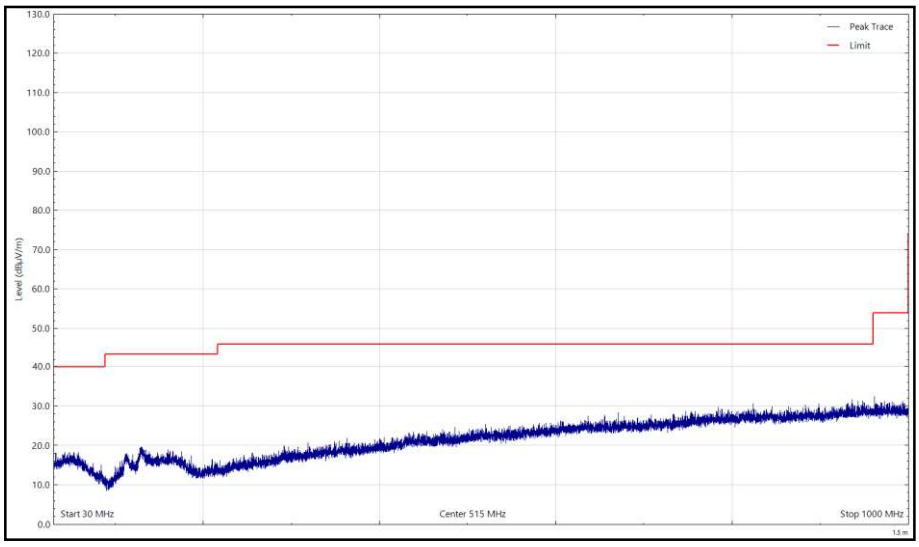

Figure 14 - DTS_Bot_2Mbps_X, 2404 MHz, 30 MHz to 1 GHz, Horizontal (Peak)

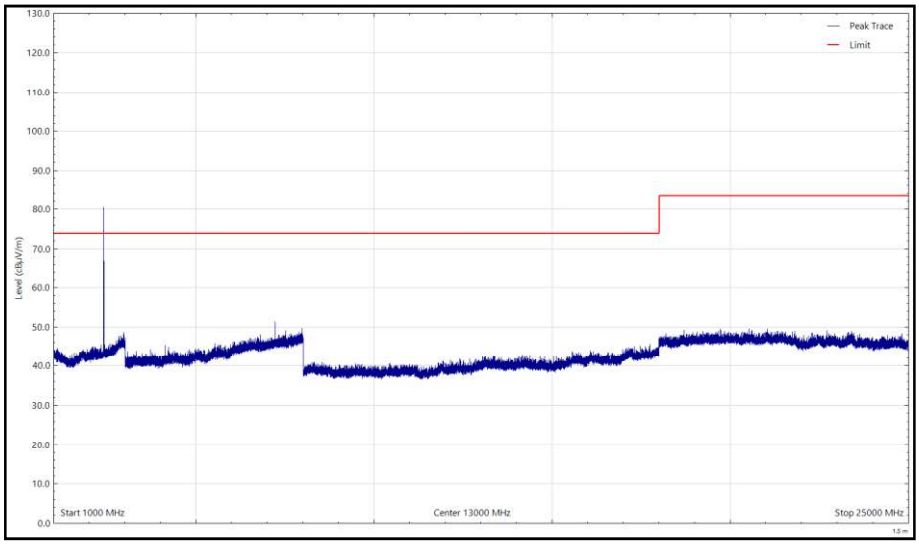

Figure 15 - DTS_Bot_2Mbps_X, 2404 MHz, 1 GHz to 25 GHz, Horizontal (Peak)

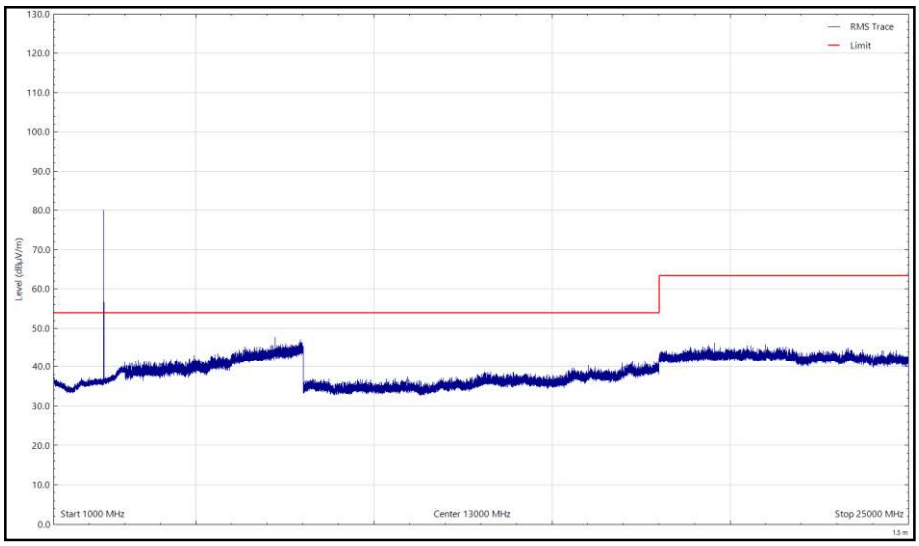

Figure 16 - DTS_Bot_2Mbps_X, 2404 MHz, 1 GHz to 25 GHz, Horizontal (rms)

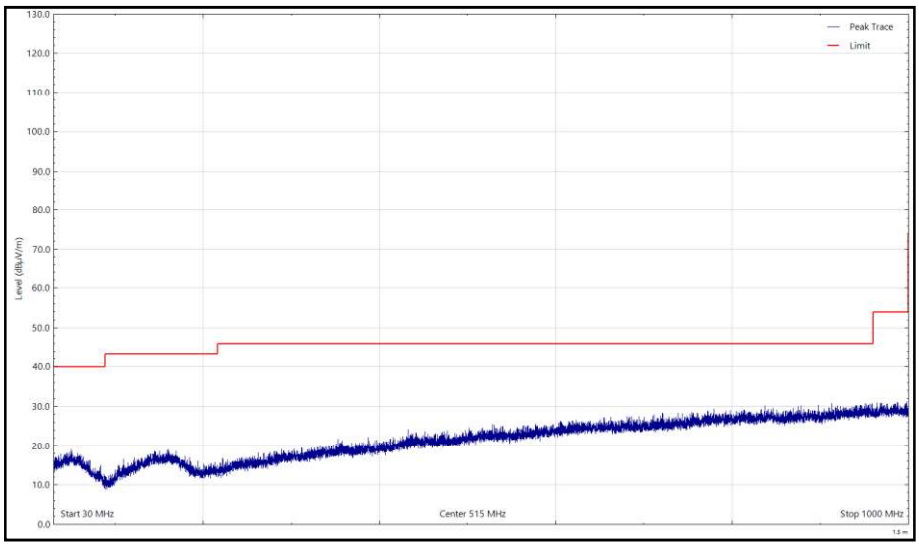

Figure 17 - DTS_Bot_2Mbps_X, 2404 MHz, 30 MHz to 1 GHz, Vertical (Peak)

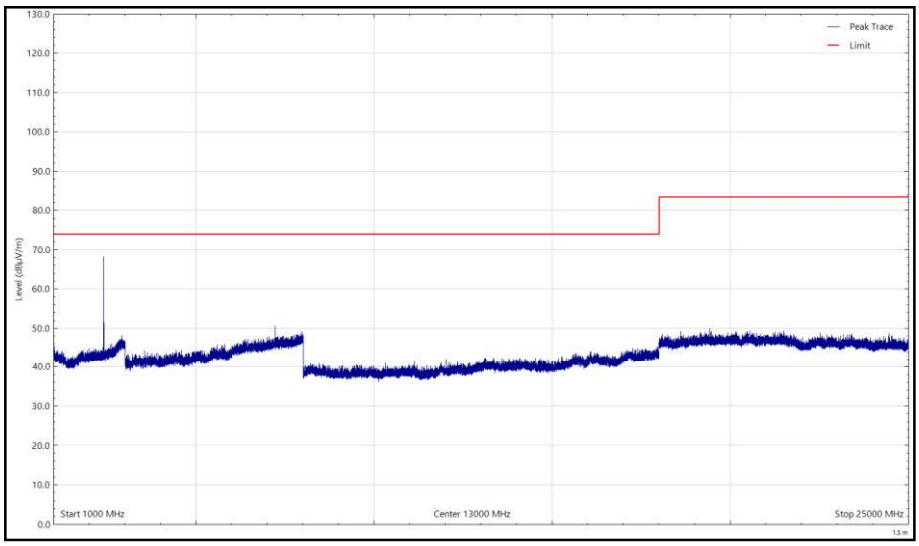

Figure 18 - DTS_Bot_2Mbps_X, 2404 MHz, 1 GHz to 25 GHz, Vertical (Peak)

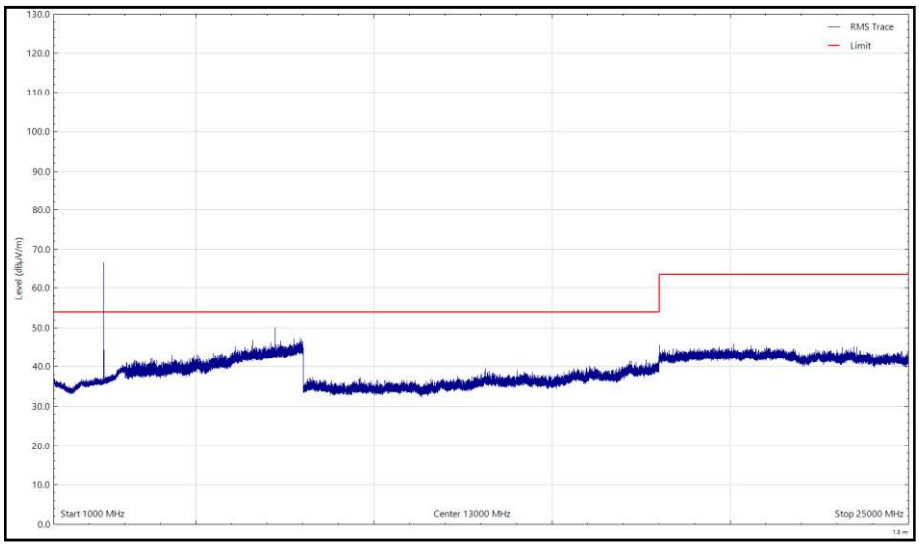

Figure 19 - DTS_Bot_2Mbps_X, 2404 MHz, 1 GHz to 25 GHz, Vertical (rms)

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

Table 33 - DTS_Mid_2Mbps_X, 2442 MHz, 30 MHz to 25 GHz

*No emissions found within 10 dB of the limit.

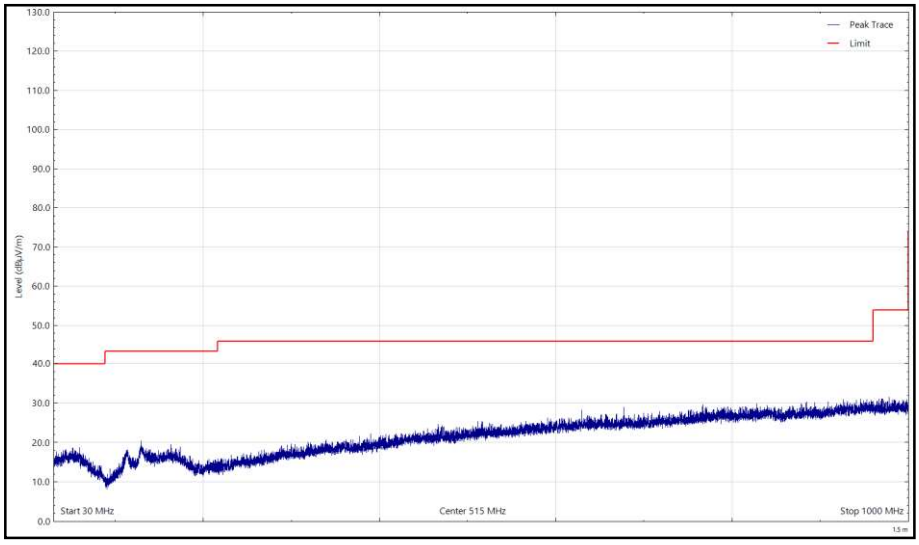

Figure 20 - DTS_Mid_2Mbps_X, 2442 MHz, 30 MHz to 1 GHz, Horizontal (Peak)

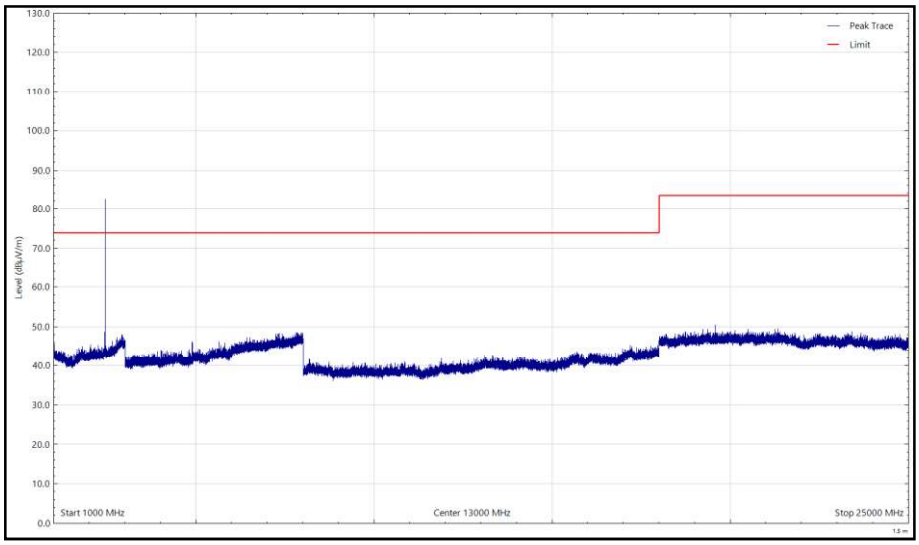

Figure 21 - DTS_Mid_2Mbps_X, 2442 MHz, 1 GHz to 25 GHz, Horizontal (Peak)

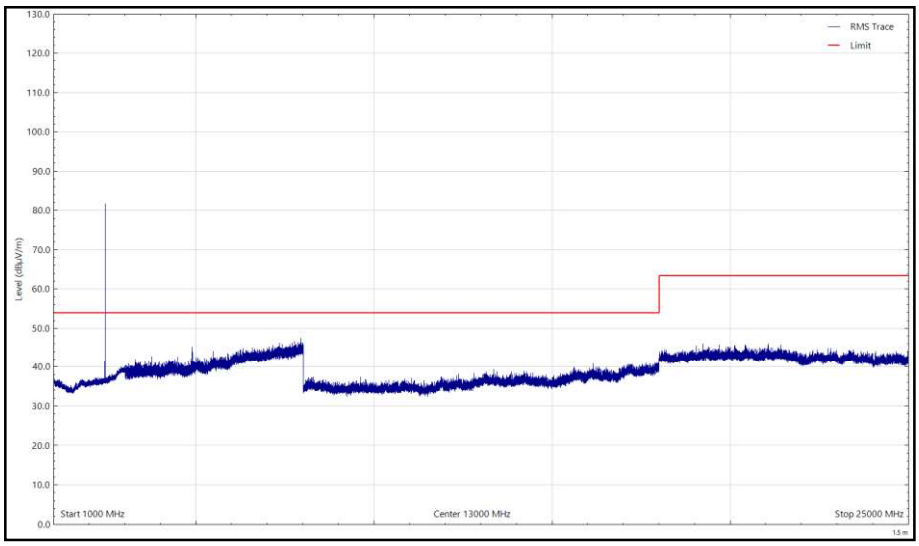

Figure 22 - DTS_Mid_2Mbps_X, 2442 MHz, 1 GHz to 25 GHz, Horizontal (rms)

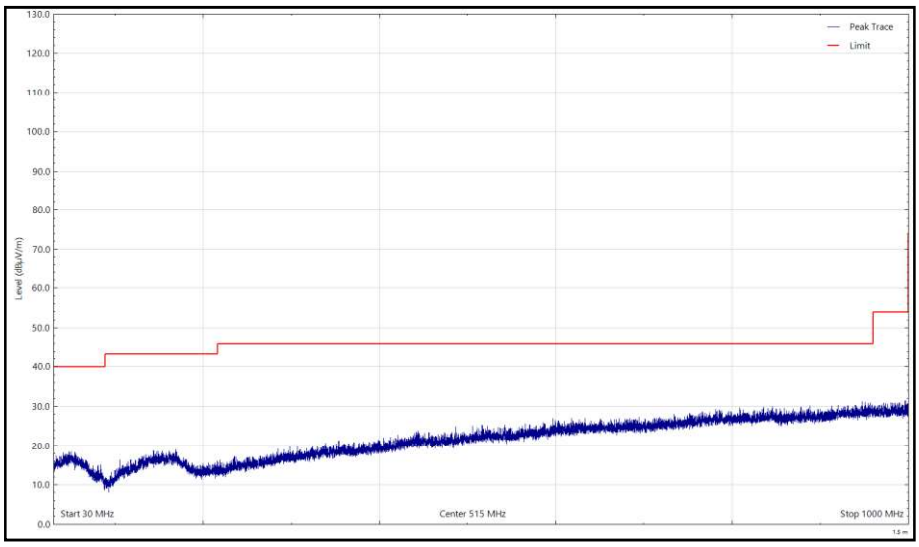

Figure 23 - DTS_Mid_2Mbps_X, 2442 MHz, 30 MHz to 1 GHz, Vertical (Peak)

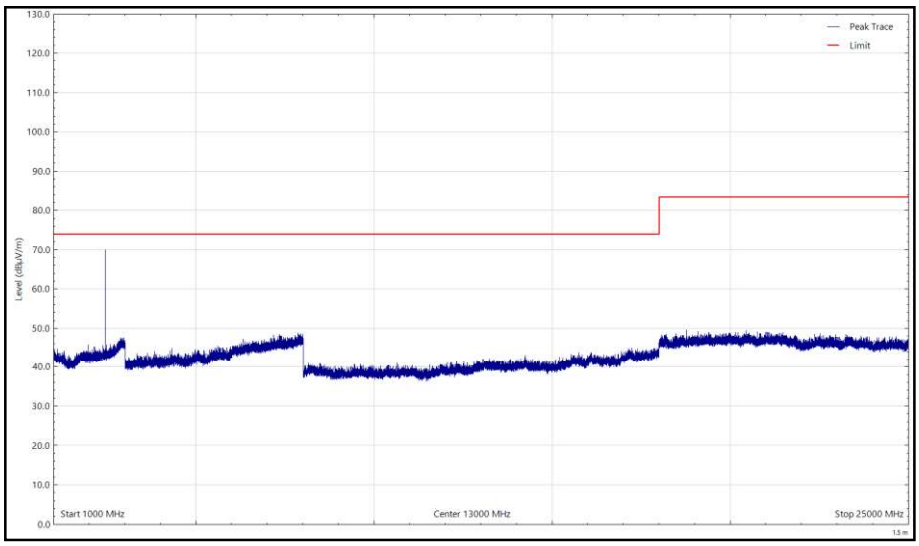

Figure 24 - DTS_Mid_2Mbps_X, 2442 MHz, 1 GHz to 25 GHz, Vertical (Peak)

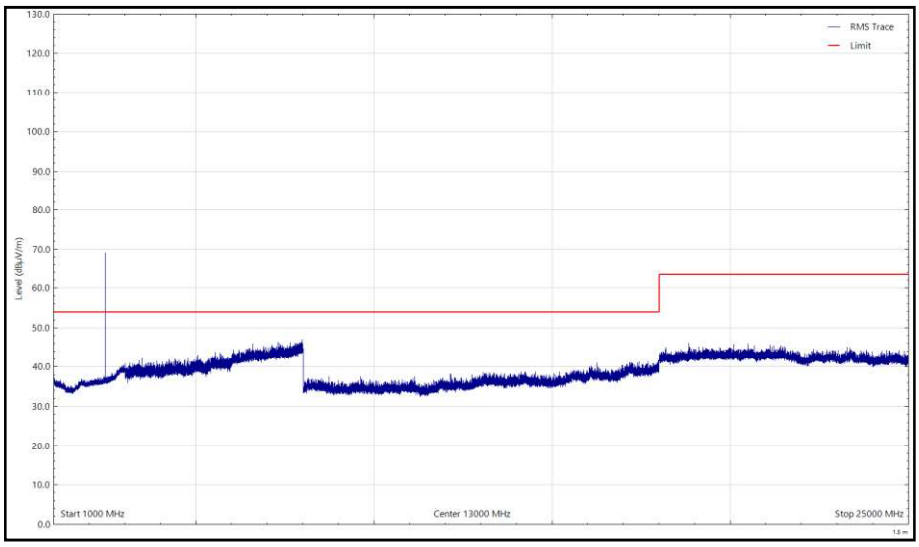

Figure 25 - DTS_Mid_2Mbps_X, 2442 MHz, 1 GHz to 25 GHz, Vertical (rms)

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

Table 34 - DTS_Top_2Mbps_X, 2480 MHz, 30 MHz to 25 GHz

*No emissions found within 10 dB of the limit.

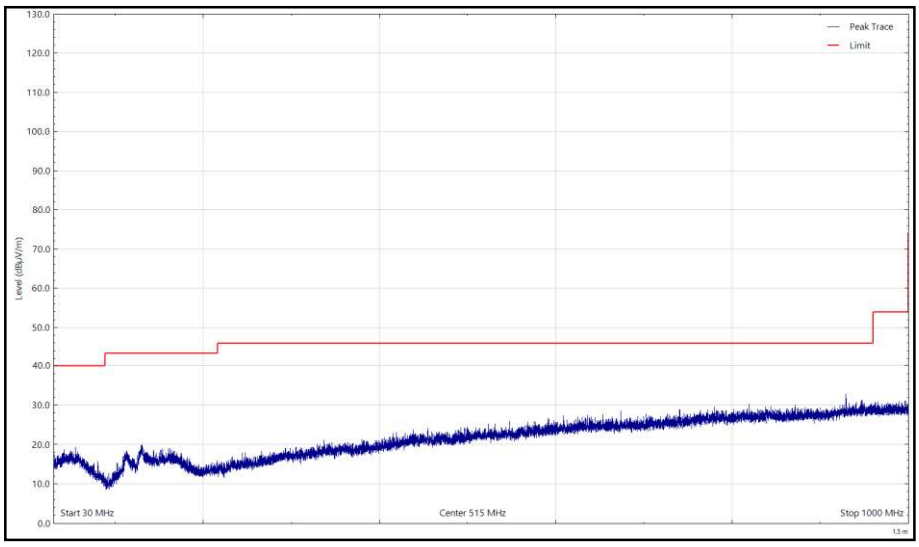

Figure 26 - DTS_Top_2Mbps_X, 2480 MHz, 30 MHz to 1 GHz, Horizontal (Peak)

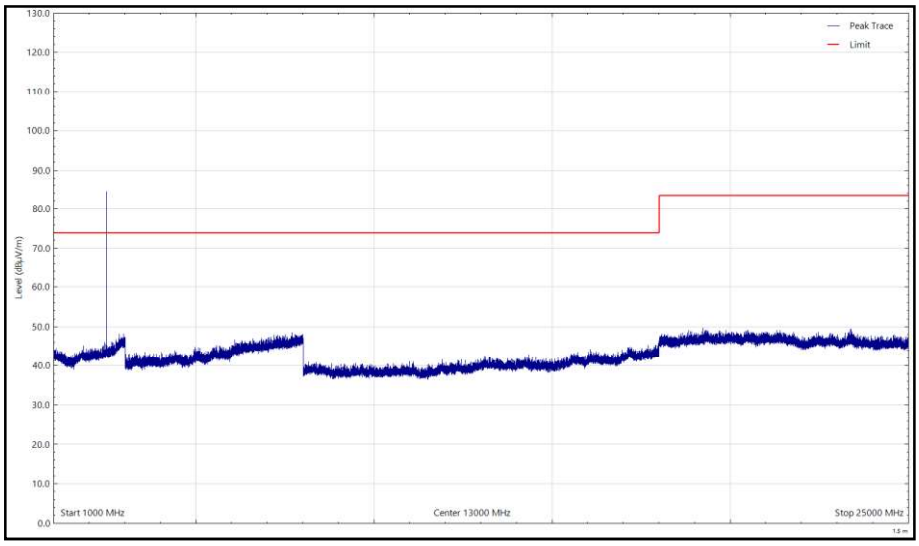

Figure 27 - DTS_Top_2Mbps_X, 2480 MHz, 1 GHz to 25 GHz, Horizontal (Peak)

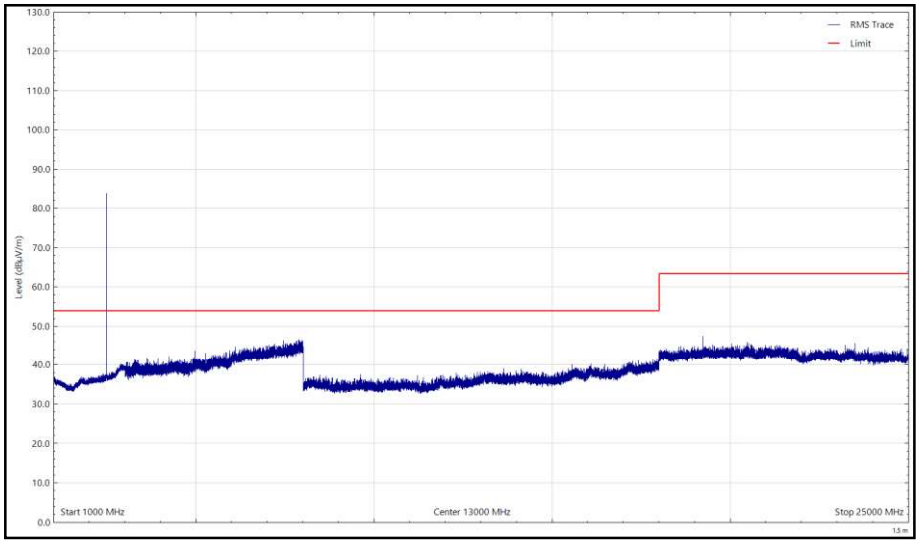

Figure 28 - DTS_Top_2Mbps_X, 2480 MHz, 1 GHz to 25 GHz, Horizontal (rms)

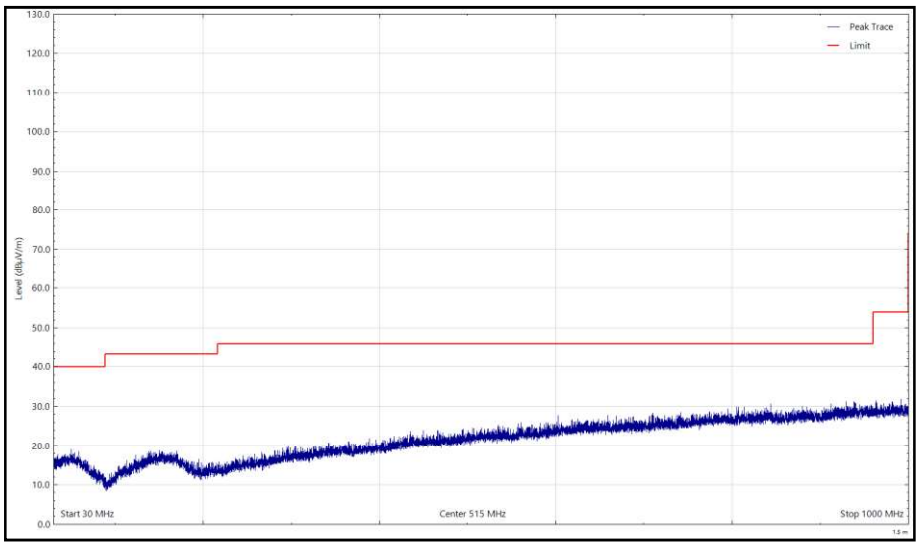

Figure 29 - DTS_Top_2Mbps_X, 2480 MHz, 30 MHz to 1 GHz, Vertical (Peak)

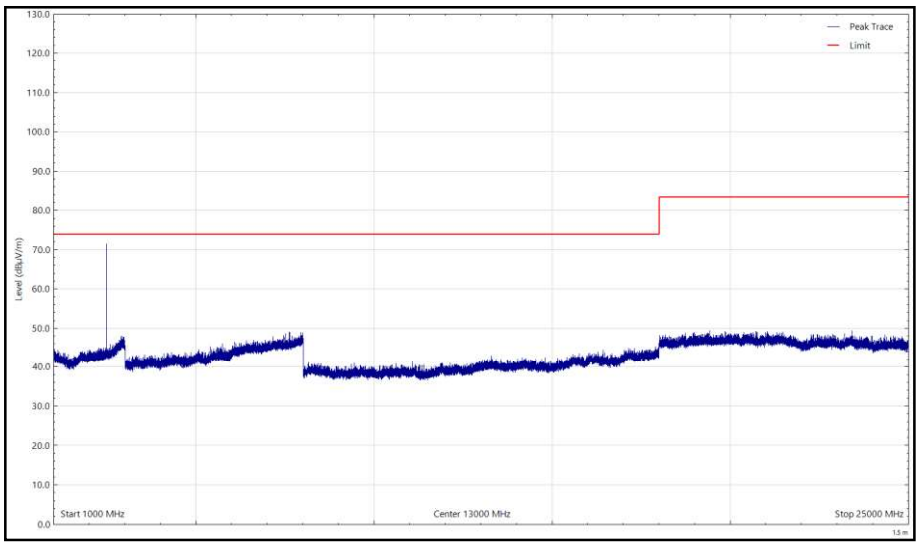

Figure 30 - DTS_Top_2Mbps_X, 2480 MHz, 1 GHz to 25 GHz, Vertical (Peak)

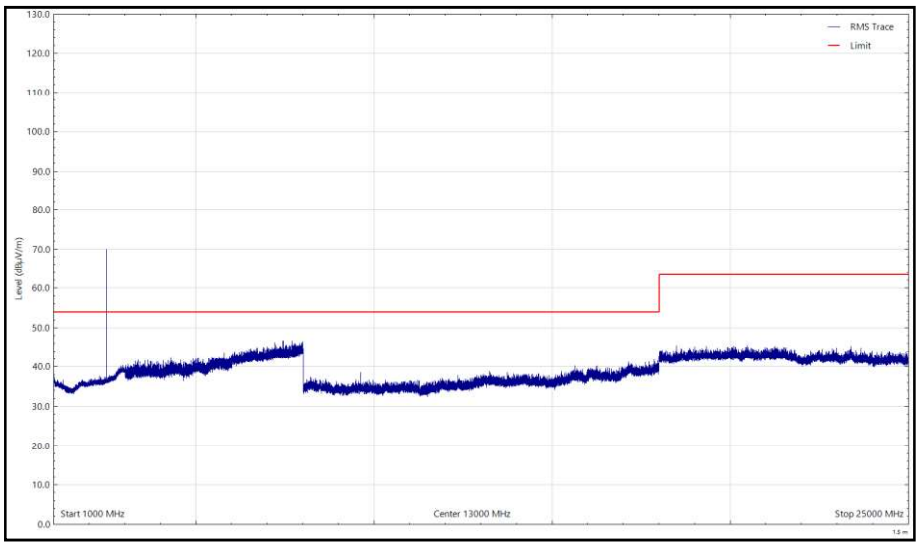

Figure 31 - DTS_Top_2Mbps_X, 2480 MHz, 1 GHz to 25 GHz, Vertical (rms)

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

Table 35 - DTS_Bot_2Mbps_Y, 2404 MHz, 30 MHz to 25 GHz

*No emissions found within 10 dB of the limit.

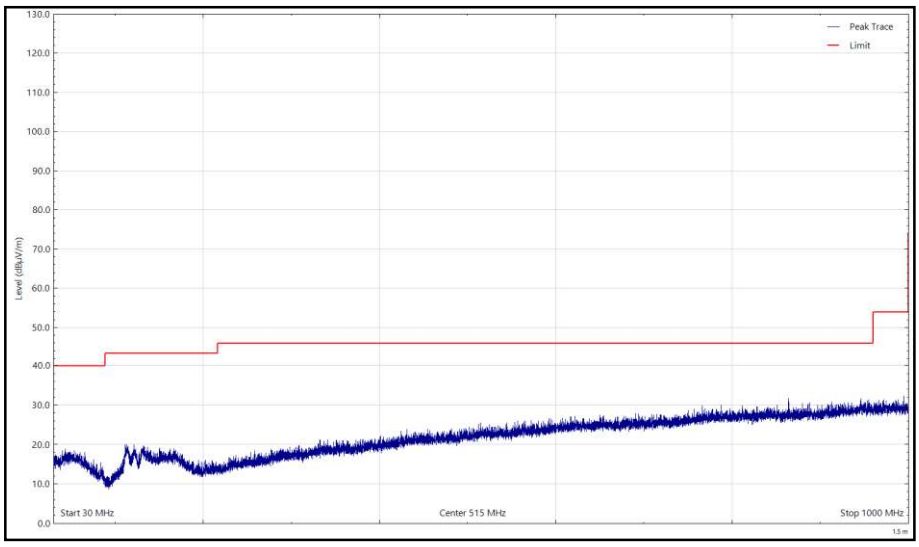

Figure 32 - DTS_Bot_2Mbps_Y, 2404 MHz, 30 MHz to 1 GHz, Horizontal (Peak)

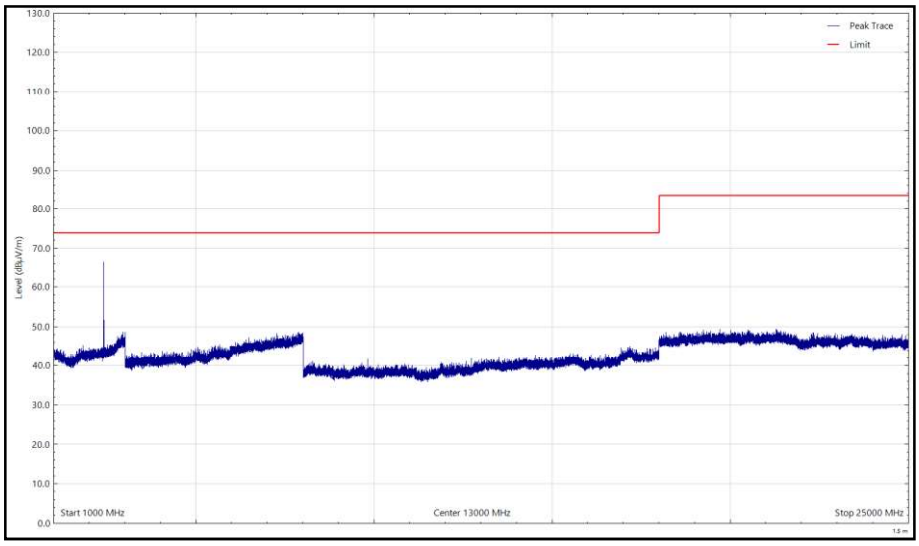

Figure 33 - DTS_Bot_2Mbps_Y, 2404 MHz, 1 GHz to 25 GHz, Horizontal (Peak)

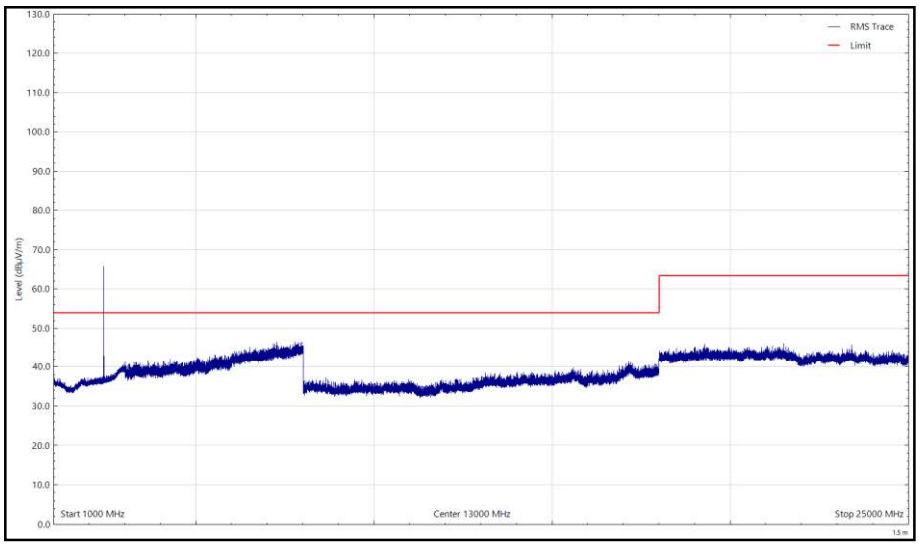

Figure 34 - DTS_Bot_2Mbps_Y, 2404 MHz, 1 GHz to 25 GHz, Horizontal (rms)

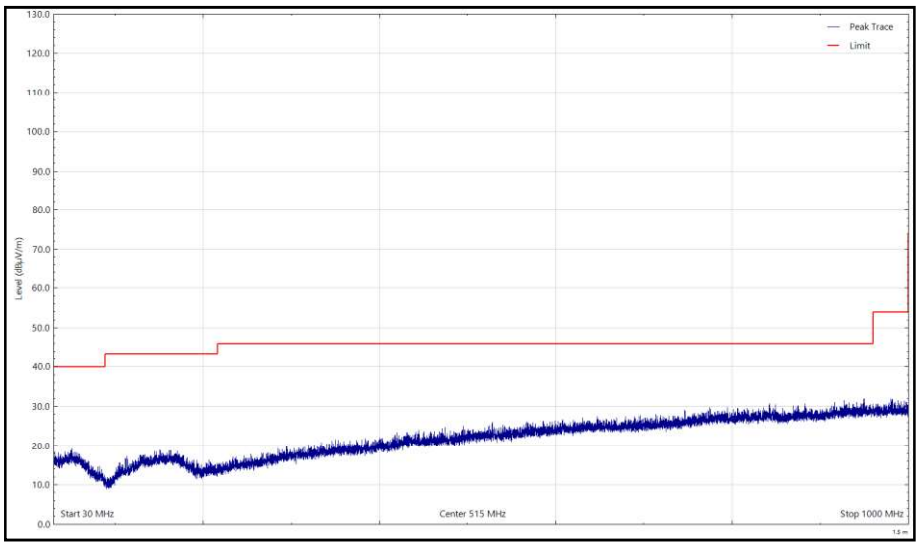

Figure 35 - DTS_Bot_2Mbps_Y, 2404 MHz, 30 MHz to 1 GHz, Vertical (Peak)

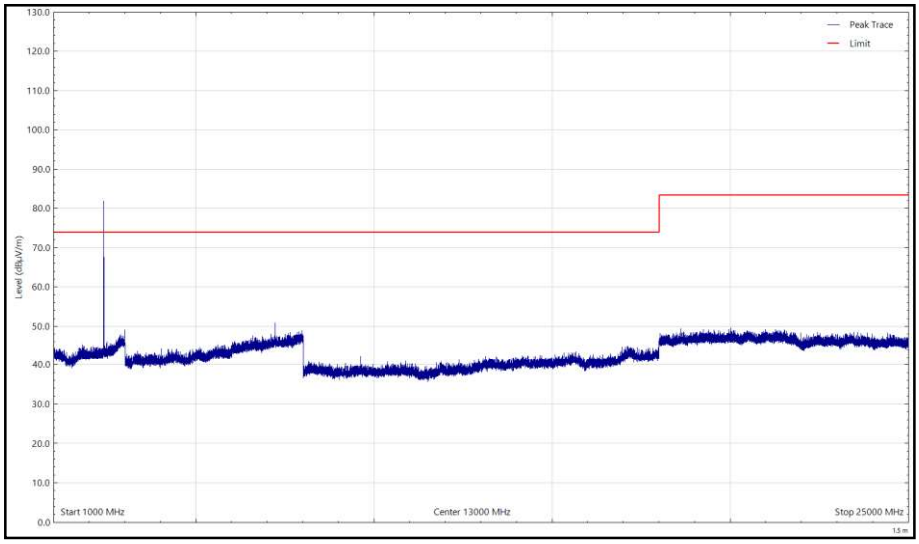

Figure 36 - DTS_Bot_2Mbps_Y, 2404 MHz, 1 GHz to 25 GHz, Vertical (Peak)

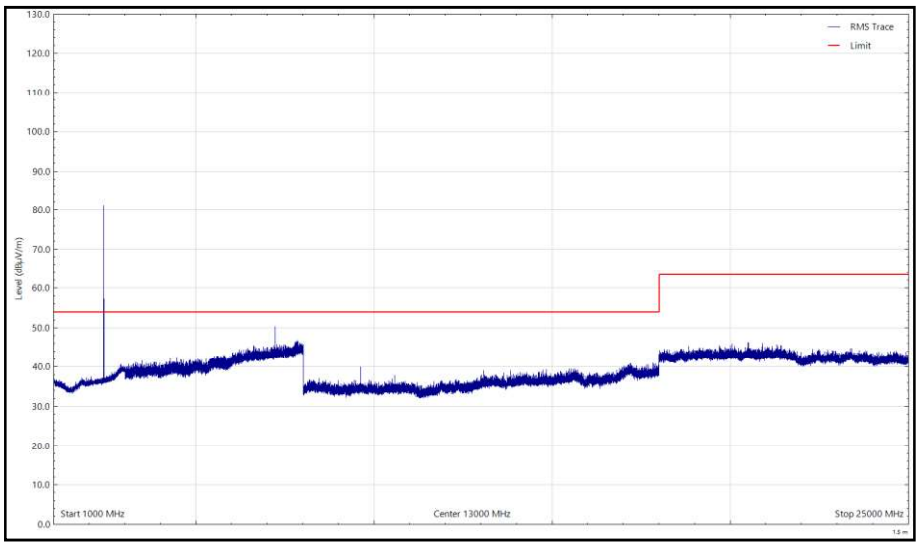

Figure 37 - DTS_Bot_2Mbps_Y, 2404 MHz, 1 GHz to 25 GHz, Vertical (rms)

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

Table 36 - DTS_Mid_2Mbps_Y, 2442 MHz, 30 MHz to 25 GHz

*No emissions found within 10 dB of the limit.

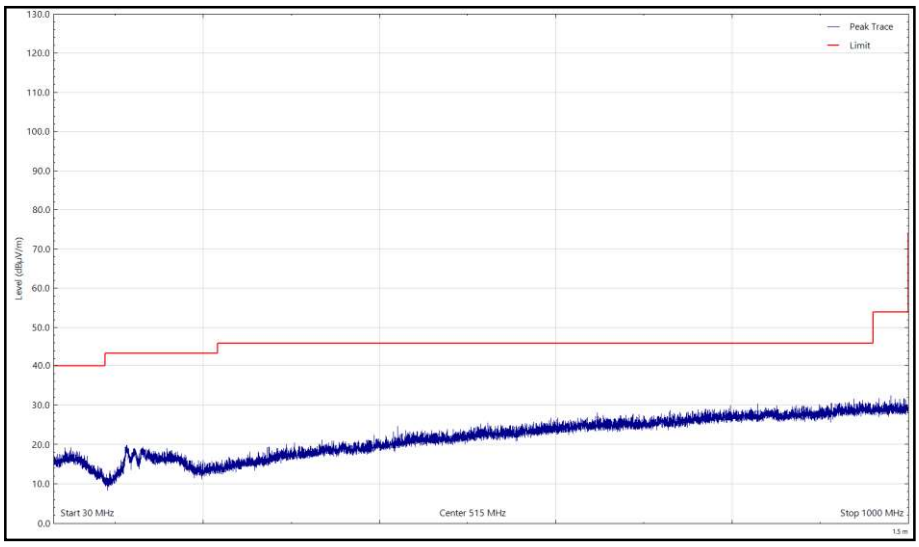

Figure 38 - DTS_Mid_2Mbps_Y, 2442 MHz, 30 MHz to 1 GHz, Horizontal (Peak)

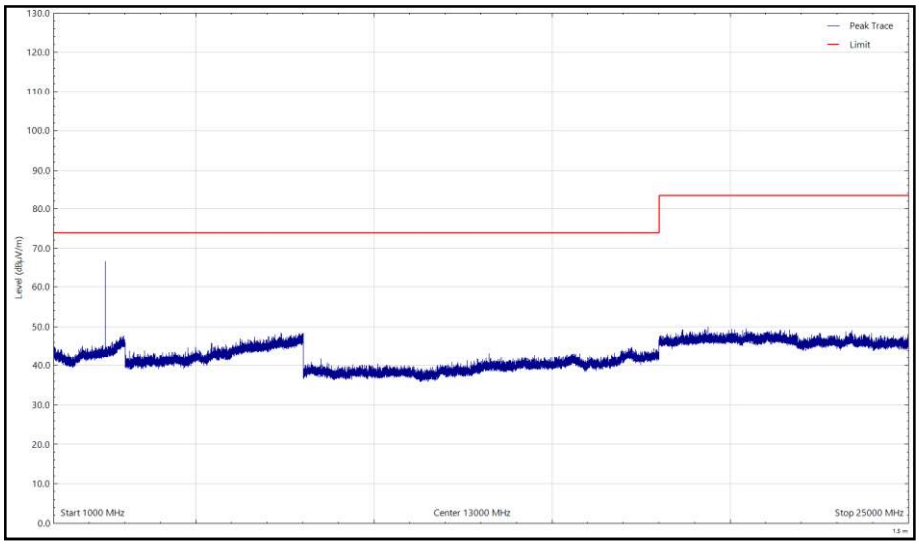

Figure 39 - DTS_Mid_2Mbps_Y, 2442 MHz, 1 GHz to 25 GHz, Horizontal (Peak)

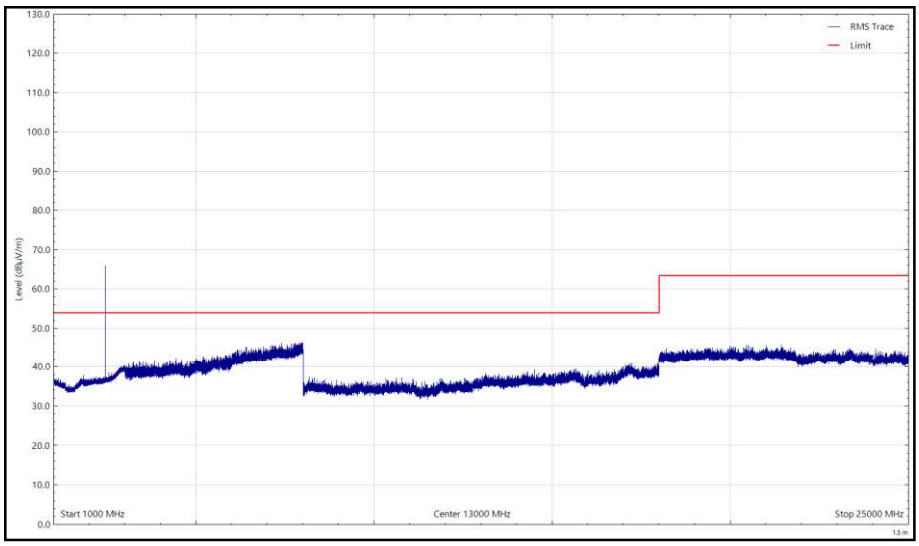

Figure 40 - DTS_Mid_2Mbps_Y, 2442 MHz, 1 GHz to 25 GHz, Horizontal (rms)

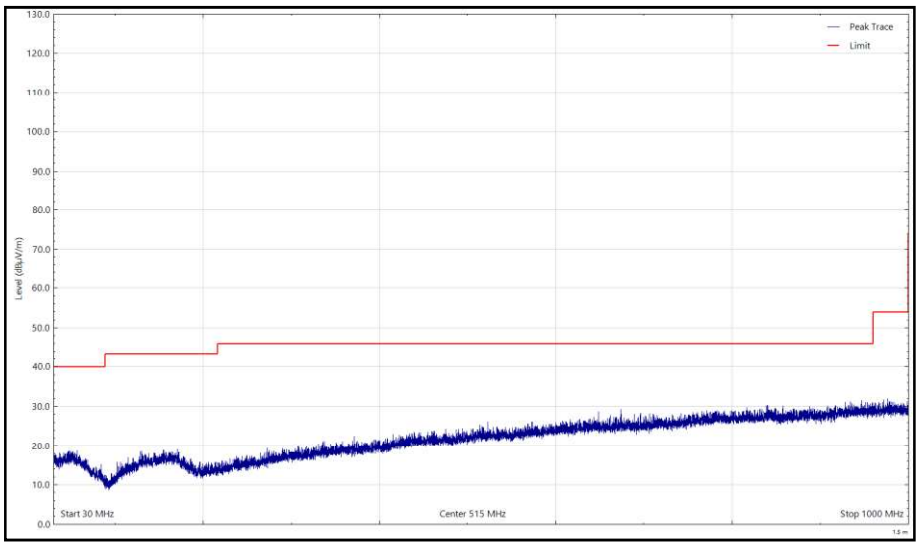

Figure 41 - DTS_Mid_2Mbps_Y, 2442 MHz, 30 MHz to 1 GHz, Vertical (Peak)

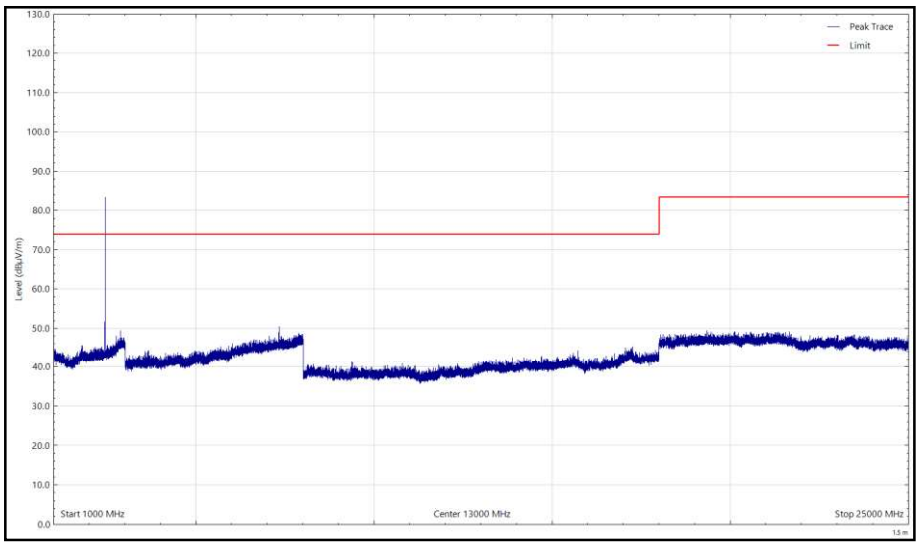

Figure 42 - DTS_Mid_2Mbps_Y, 2442 MHz, 1 GHz to 25 GHz, Vertical (Peak)

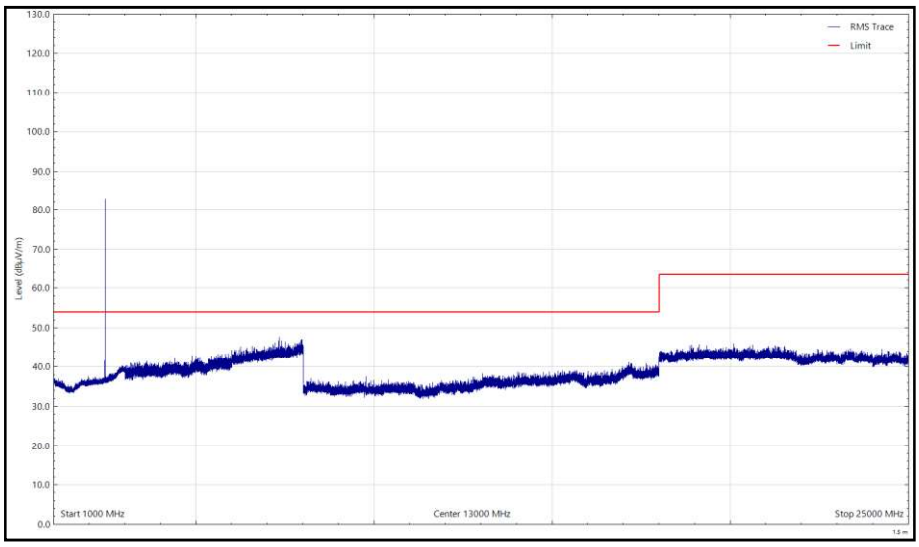

Figure 43 - DTS_Mid_2Mbps_Y, 2442 MHz, 1 GHz to 25 GHz, Vertical (rms)

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

Table 37 - DTS_Top_2Mbps_Y, 2480 MHz, 30 MHz to 25 GHz

*No emissions found within 10 dB of the limit.

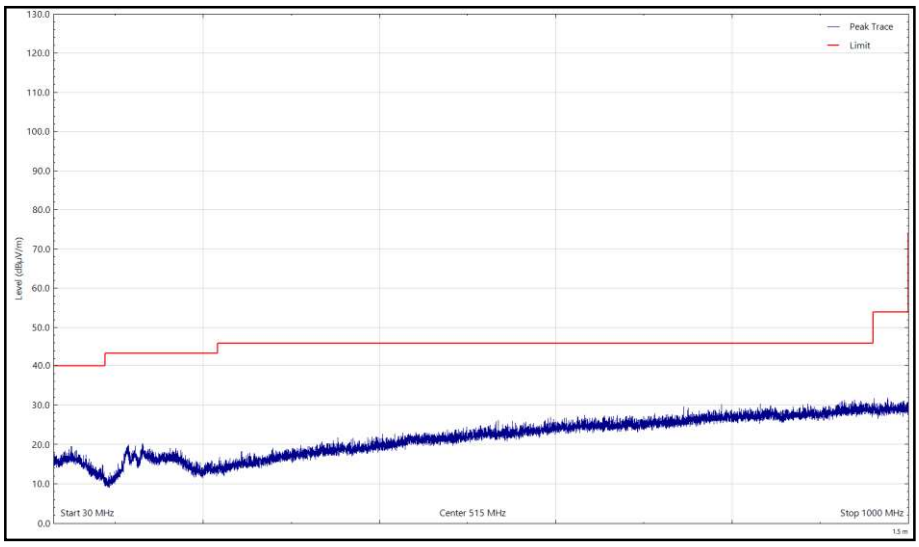

Figure 44 - DTS_Top_2Mbps_Y, 2480 MHz, 30 MHz to 1 GHz, Horizontal (Peak)

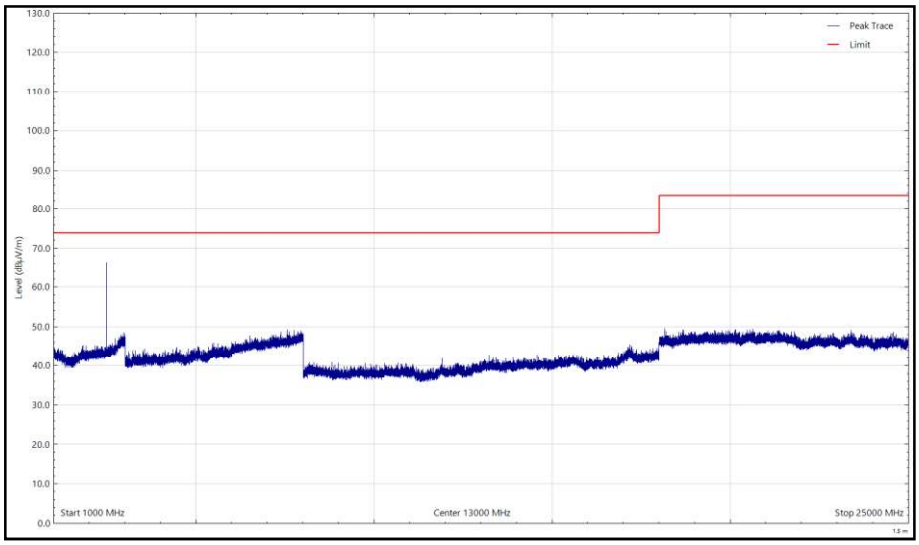

Figure 45 - DTS_Top_2Mbps_Y, 2480 MHz, 1 GHz to 25 GHz, Horizontal (Peak)

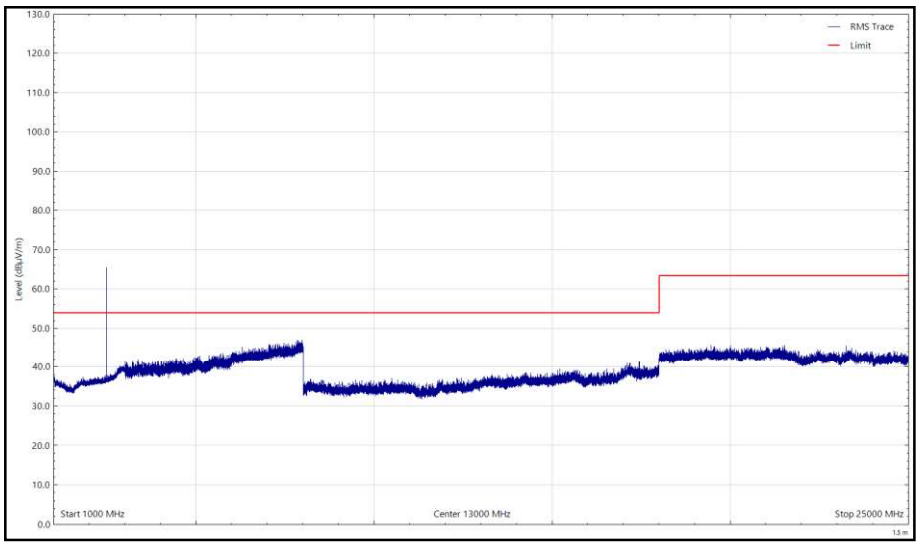

Figure 46 - DTS_Top_2Mbps_Y, 2480 MHz, 1 GHz to 25 GHz, Horizontal (rms)

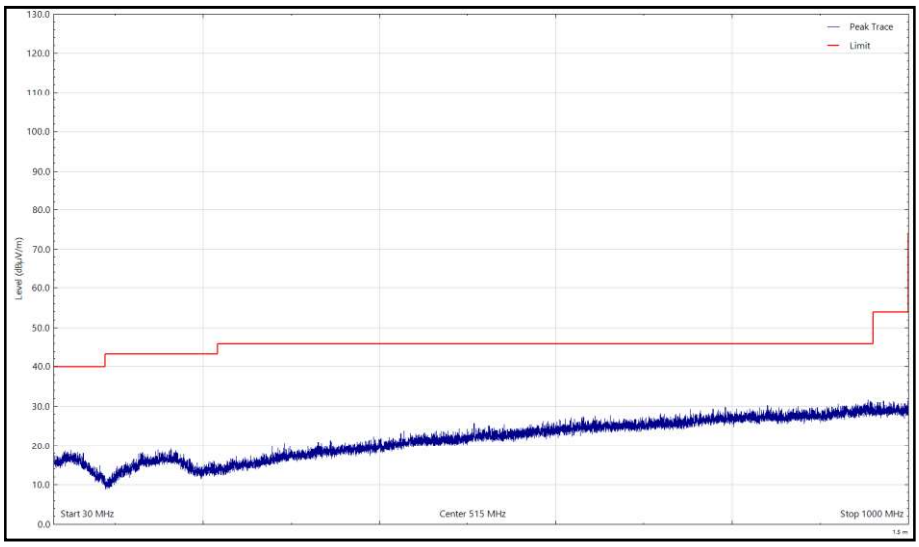

Figure 47 - DTS_Top_2Mbps_Y, 2480 MHz, 30 MHz to 1 GHz, Vertical (Peak)

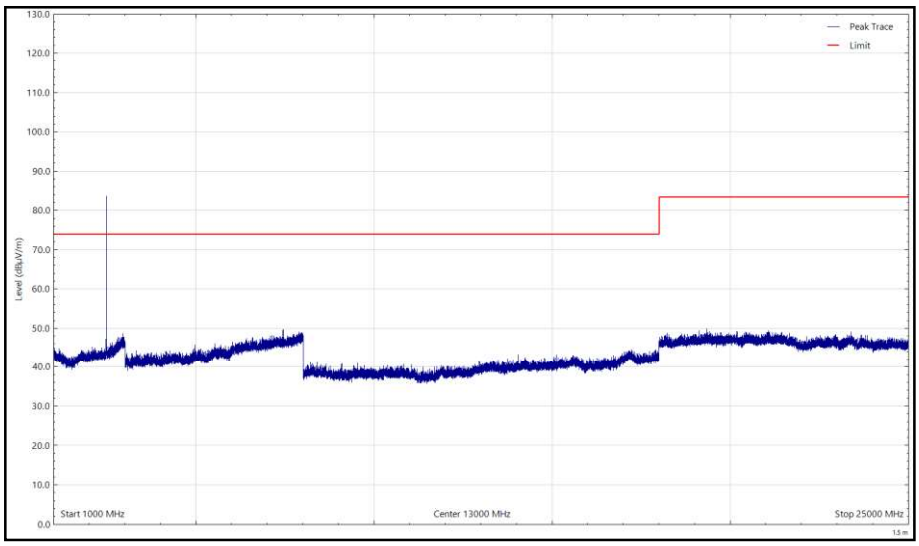

Figure 48 - DTS_Top_2Mbps_Y, 2480 MHz, 1 GHz to 25 GHz, Vertical (Peak)

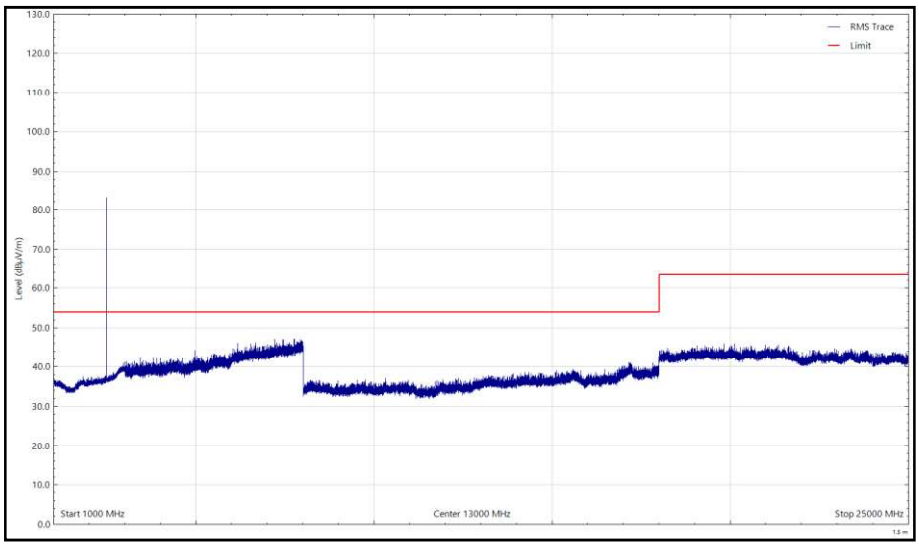

Figure 49 - DTS_Top_2Mbps_Y, 2480 MHz, 1 GHz to 25 GHz, Vertical (rms)

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

Table 38 - DTS_Bot_2Mbps_Z, 2404 MHz, 30 MHz to 25 GHz

*No emissions found within 10 dB of the limit.

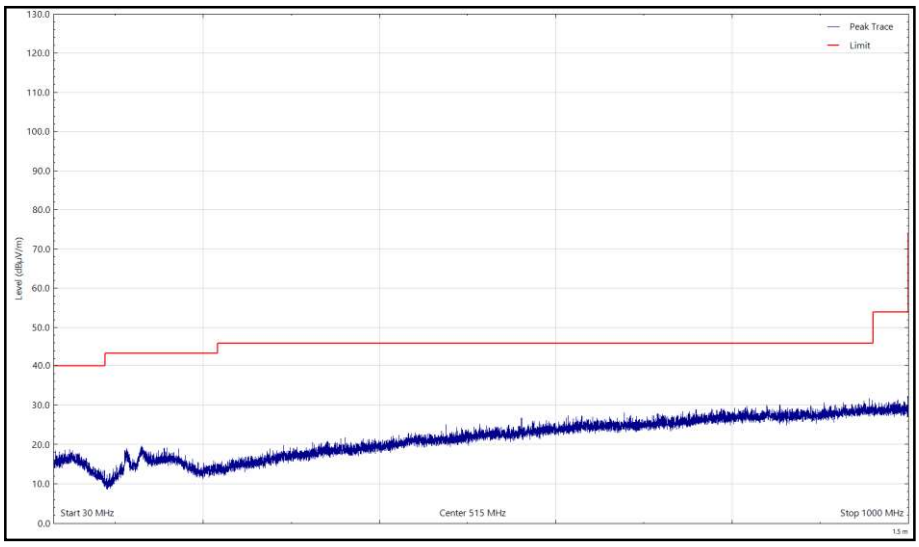

Figure 50 - DTS_Bot_2Mbps_Z, 2404 MHz, 30 MHz to 1 GHz, Horizontal (Peak)

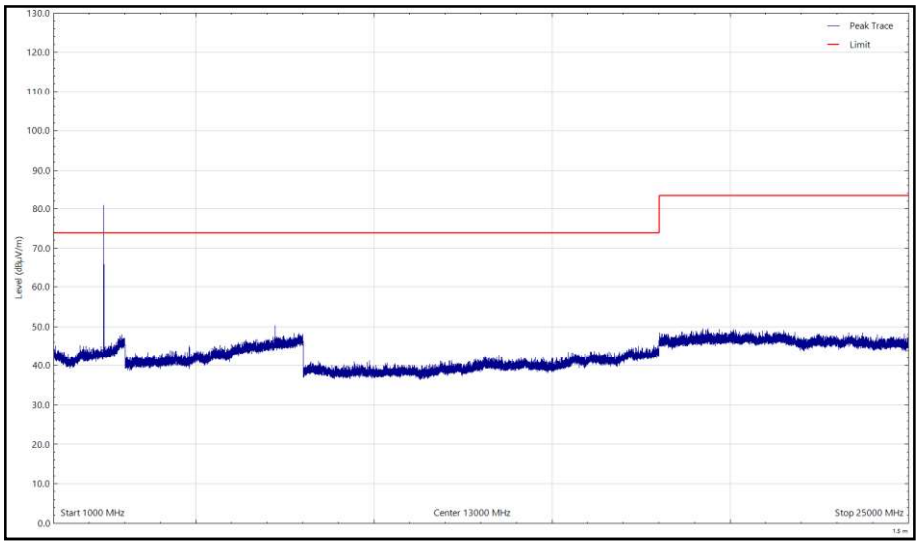

Figure 51 - DTS_Bot_2Mbps_Z, 2404 MHz, 1 GHz to 25 GHz, Horizontal (Peak)

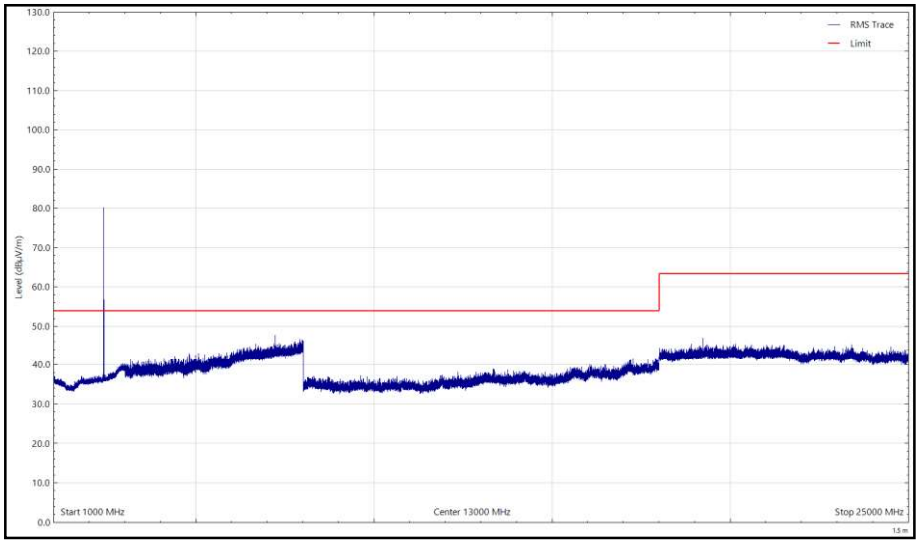

Figure 52 - DTS_Bot_2Mbps_Z, 2404 MHz, 1 GHz to 25 GHz, Horizontal (rms)

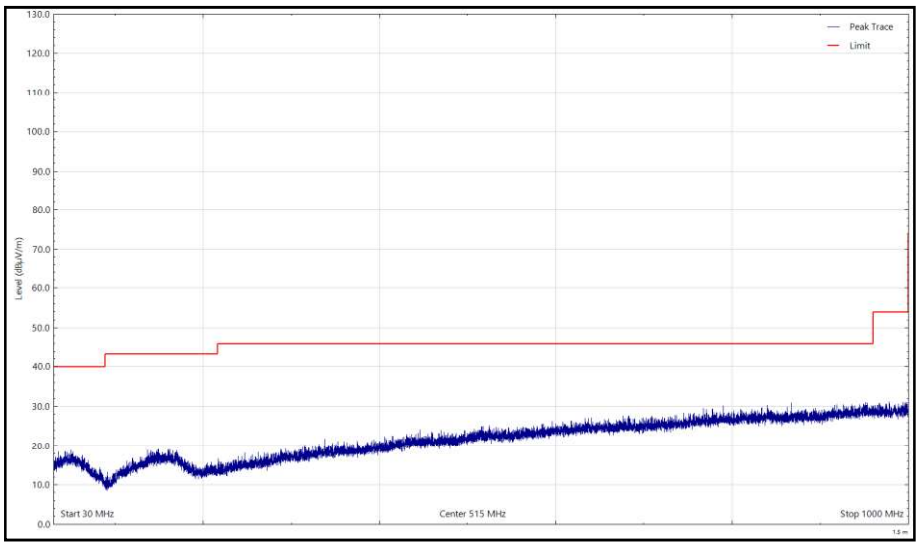

Figure 53 - DTS_Bot_2Mbps_Z, 2404 MHz, 30 MHz to 1 GHz, Vertical (Peak)