

FCC and ISED Test Report

Disruptive Technologies Research AS

Model: Sensor RF module 2AA (US)

In accordance with FCC 47 CFR Part 15C, ISED
RSS-247 and ISED RSS-GEN
(Short Range Device)

Prepared for: Disruptive Technologies Research AS
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1366 Lysaker
Norway

FCC ID: 2ATFX-102540

IC ID: 25087-102540



COMMERCIAL-IN-CONFIDENCE

Document 75954104-06 Issue 01

SIGNATURE

NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
Steve Marshall	Senior engineer	Authorised Signatory	14 June 2022

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	Thomas Biddlecombe	14 June 2022	
Testing	Graeme Lawler	14 June 2022	

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: 2020, ISED RSS-247: Issue 2 (02-2017) and ISED RSS-GEN: Issue 5 (04-2018) + A2 (02-2021) for the tests detailed in section 1.3.



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1 Report Summary

1.1 Report Modification Record

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

Issue	Description of Change	Date of Issue
1	First Issue	14-June-2022

Table 1

1.2 Introduction

Applicant	Disruptive Technologies Research AS
Manufacturer	Disruptive Technologies Research AS
Model Number(s)	Sensor RF module 2AA (US)
Serial Number(s)	US 2
Hardware Version(s)	0
Software Version(s)	1.2.28
Number of Samples Tested	1
Test Specification/Issue/Date	FCC 47 CFR Part 15C: 2020 ISED RSS-247: Issue 2 (02-2017) ISED RSS-GEN: Issue 5 (04-2018) + A2 (02-2021)
Order Number	DK-12
Date	14-December-2021
Date of Receipt of EUT	17-February-2022
Start of Test	14-March-2022
Finish of Test	29-April-2022
Name of Engineer(s)	Thomas Biddlecombe and Graeme Lawler
Related Document(s)	ANSI C63.10 (2013)



1.3 Brief Summary of Results

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

Section	Specification Clause			Test Description	Result	Comments/Base Standard
	FCC Part 15C	RSS-247	RSS-GEN			
Configuration and Mode: Radio chip/PCB combination – Single (Standard) Mode						
2.1	15.247 (a)(2)	5.2	6.7	Emission Bandwidth	Pass	
2.2	15.247 (b)	5.4	6.12	Maximum Conducted Output Power	Pass	
2.3	15.247 (d) and 15.209	3.3 and 5.5	6.13 and 8.9	Spurious Radiated Emissions	Pass	
2.4	15.247 (d)	5.5	-	Authorised Band Edges	Pass	
2.5	15.247 (e)	5.2	6.12	Power Spectral Density	Pass	

Table 2



1.4 Application Form

Equipment Description

Technical Description: <i>(Please provide a brief description of the intended use of the equipment including the technologies the product supports)</i>	The "Sensor RF module 2AA (US)" is a platform for connecting various sensors to the RF network of Disruptive Technologies. The module reads values from a connected sensor and converts the data into the right format for transmission on air using the proprietary SDS protocol.	
Manufacturer:	Zollner Elektronik AG, Manfred-Zollner-Str. 1, 93499 Zandt, Germany	
Model:	RF module 2AA (US)	
Part Number:	102540	
Hardware Version:	0	
Software Version:	1.2.28	
FCC ID of the product under test – see guidance here	2ATFX-102540	
IC ID of the product under test – see guidance here	25087-102540	

Table 3

Intentional Radiators

Technology						
Frequency Range (MHz to MHz)	903.250 to 926.750					
Conducted Declared Output Power (dBm)	12					
Antenna Gain (dBi)	-1					
Supported Bandwidth(s) (MHz) (e.g. 1 MHz, 20 MHz, 40 MHz)	536 kHz					
Modulation Scheme(s) (e.g. GFSK, QPSK etc)	GFSK					
ITU Emission Designator (see guidance here) (not mandatory for Part 15 devices)						
Bottom Frequency (MHz)	903.250					
Middle Frequency (MHz)	915.000					
Top Frequency (MHz)	926.750					

Table 4



Un-intentional Radiators

Highest frequency generated or used in the device or on which the device operates or tunes	926.750 MHz
Lowest frequency generated or used in the device or on which the device operates or tunes	903.250 MHz
Class A Digital Device (Use in commercial, industrial or business environment) X	
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:	3	V
End-point voltage:	2.3	V (Point at which the battery will terminate)
Alkaline X Leclanche ☐ Lithium ☐ Nickel Cadmium ☐ Lead Acid* ☐ *(Vehicle regulated)		
Other ☐	Please detail:	

Table 8

Charging

Can the EUT transmit whilst being charged	Yes ☐ No X
---	--

Table 9

Temperature

Minimum temperature:	0	°C
Maximum temperature:	50	°C

Table 10



Cable Loss

Adapter Cable Loss (Conducted sample)	0	dB
--	---	----

Table 11

Antenna Characteristics

Antenna connector ☐			State impedance		Ohm
Temporary antenna connector X			State impedance	50	Ohm
Integral antenna X	Type:	Helix PCB antenna	Gain	-1	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 ☐					

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: Øystein Moldsvor
Position held: VP Engineering
Date: 18 May 2022



1.5 Product Information

1.5.1 Technical Description

The “Sensor RF module 2AA (US)” is a platform for connecting various sensors to the RF network of Disruptive Technologies. The module reads values from a connected sensor and converts the data into the right format for transmission on air using the proprietary SDS protocol.

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: Sensor RF module 2AA (US), Serial Number: US 2			
0	As supplied by the customer	Not Applicable	Not Applicable

Table 14

1.8 Test Location

TÜV SÜD conducted the following tests at our Fareham Test Laboratory.

Test Name	Name of Engineer(s)	Accreditation
Configuration and Mode: Radio chip/PCB combination – Single (Standard) Mode		
Emission Bandwidth	Thomas Biddlecombe	UKAS
Maximum Conducted Output Power	Thomas Biddlecombe	UKAS
Spurious Radiated Emissions	Graeme Lawler	UKAS
Authorised Band Edges	Graeme Lawler	UKAS
Power Spectral Density	Thomas Biddlecombe	UKAS

Table 15

Office Address:

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



2 Test Details

2.1 Emission Bandwidth

2.1.1 Specification Reference

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

2.1.2 Equipment Under Test and Modification State

Sensor RF module 2AA (US), S/N: US 2 - Modification State 0

2.1.3 Date of Test

15-April-2022 to 29-April-2022

2.1.4 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.

2.1.5 Environmental Conditions

Ambient Temperature	22.8 - 24.5 °C
Relative Humidity	29.5 - 36.4 %



2.1.6 Test Results

Radio chip/PCB combination – Single (Standard) Mode

Frequency (MHz)	99 % Occupied Bandwidth (kHz)	6 dB Bandwidth (kHz)
903.250	723.88	548.1
915	738.89	550.2
926.750	759.14	544.0

Table 16



Figure 1 - 903.250 MHz



Figure 2 - 915 MHz



Figure 3 - 926.750 MHz

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

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



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 Expires
Hygrometer	Rotronic	I-1000	3220	12	05-Nov-2022
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	30-Jun-2022
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	08-Mar-2023
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5423	12	23-Jun-2022
Attenuator 5W 30dB DC-18GHz	Aaren	AT40A-4041-D18-30	5504	12	14-Apr-2022

Table 17



2.2 Maximum Conducted Output Power

2.2.1 Specification Reference

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

2.2.2 Equipment Under Test and Modification State

Sensor RF module 2AA (US), S/N: US 2 - Modification State 0

2.2.3 Date of Test

15-April-2022 to 29-April-2022

2.2.4 Test Method

The test was performed in accordance with ANSI C63.10 clause 11.9.1.1

2.2.5 Environmental Conditions

Ambient Temperature	22.8 - 24.5 °C
Relative Humidity	29.5 - 36.4 %



2.2.6 Test Results

Radio chip/PCB combination – Single (Standard) Mode

Frequency (MHz)	Maximum Output Power	
	dBm	mW
903.250	11.912	15.531
915	11.876	15.403
926.750	11.942	15.639

Table 18

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	3220	12	05-Nov-2022
P-Series Power Meter	Agilent Technologies	N1911A	3980	12	08-Nov-2022
50 MHz-18 GHz Wideband Power Sensor	Agilent Technologies	N1921A	3982	12	08-Nov-2022
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	30-Jun-2022
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5423	12	23-Jun-2022

Table 19



2.3 Spurious Radiated Emissions

2.3.1 Specification Reference

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

2.3.2 Equipment Under Test and Modification State

Sensor RF module 2AA (US), S/N: US 2 - Modification State 0

2.3.3 Date of Test

14-March-2022 to 20-March-2022

2.3.4 Test Method

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

For frequencies greater than 1 GHz, average plots were taken in accordance with ANSI C63.10 clause 4.1.4.2.5 with a max hold trace to characterize the trace. Where emissions were detected, final average measurements were taken in accordance with ANSI C63.10 clause 7.5. A peak measurement was performed. A duty cycle correction factor is then subtracted from the peak value to determine the average.

The Duty Cycle Correction Factor is determined by the expression $\text{Duty (dB)} = 20\log(\text{On Time} / (\text{On Time} + \text{Off Time}))$

Declared On time = 1 mS. Off Time = 99 mS

Duty Cycle Correction Factor = $20\log(1.00/(1.00 + 99.00)) = 20.00 \text{ dB}$

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 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 dBuV/m to uV/m:

$10^{(\text{Field Strength in dBuV/m}/20)}$.

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

2.3.5 Example Test Setup Diagram

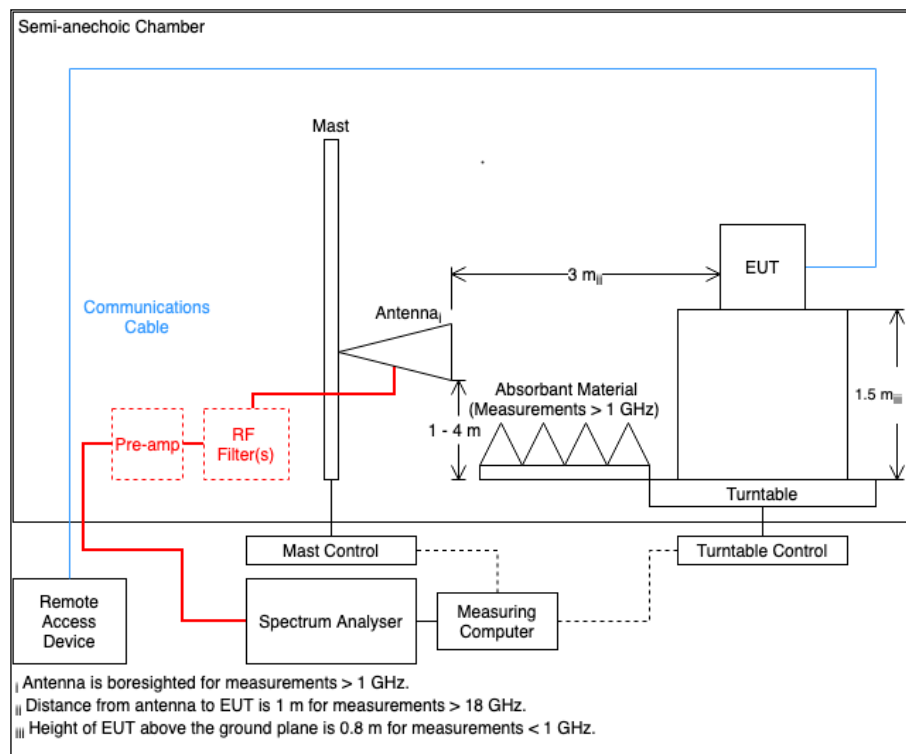


Figure 4

2.3.6 Environmental Conditions

Ambient Temperature	19.7 - 21.1 °C
Relative Humidity	27.8 - 39.8 %



2.3.7 Test Results

Radio chip/PCB combination - Single (Standard) Mode

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

Table 20 - DTS - X Orientation, 915 MHz, 30 MHz to 10 GHz

*No emissions found within 10 dB of the limit.

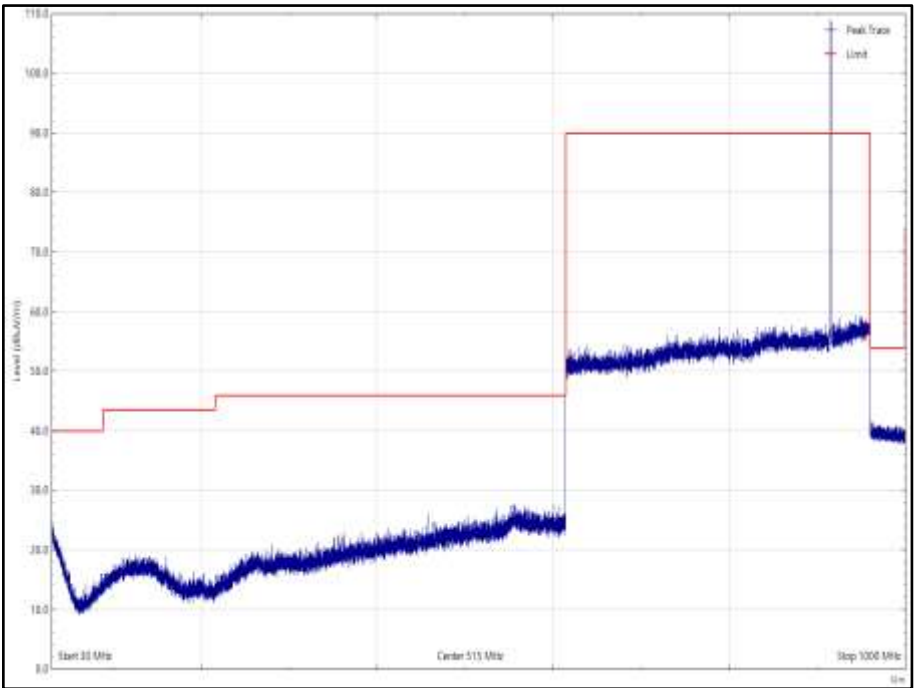


Figure 5 - DTS - X Orientation, 915 MHz, 30 MHz to 1 GHz, Horizontal (Peak)

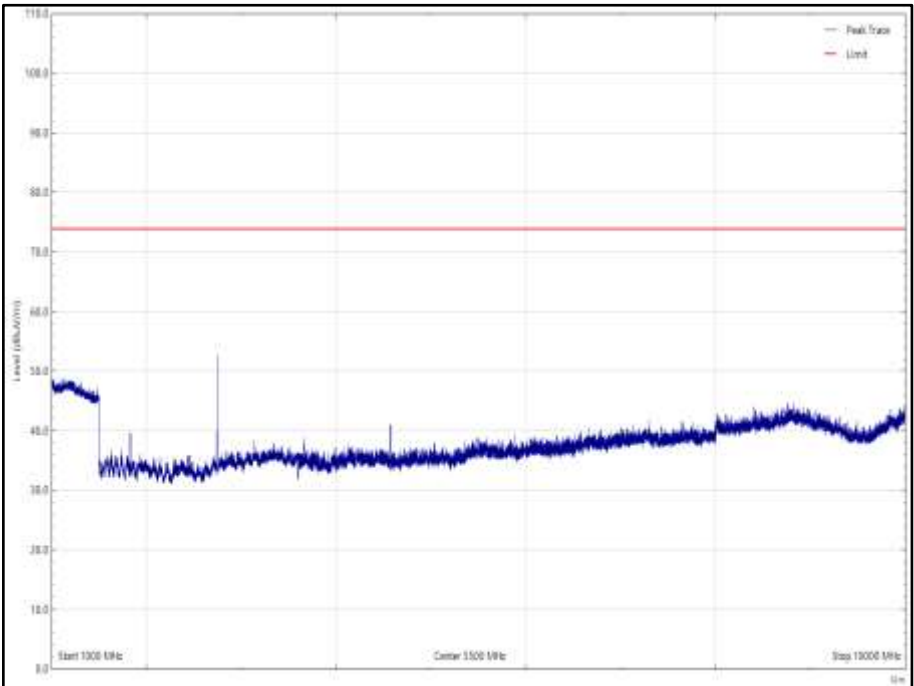


Figure 6 - DTS - X Orientation, 915 MHz, 1 GHz to 10 GHz, Horizontal (Peak)

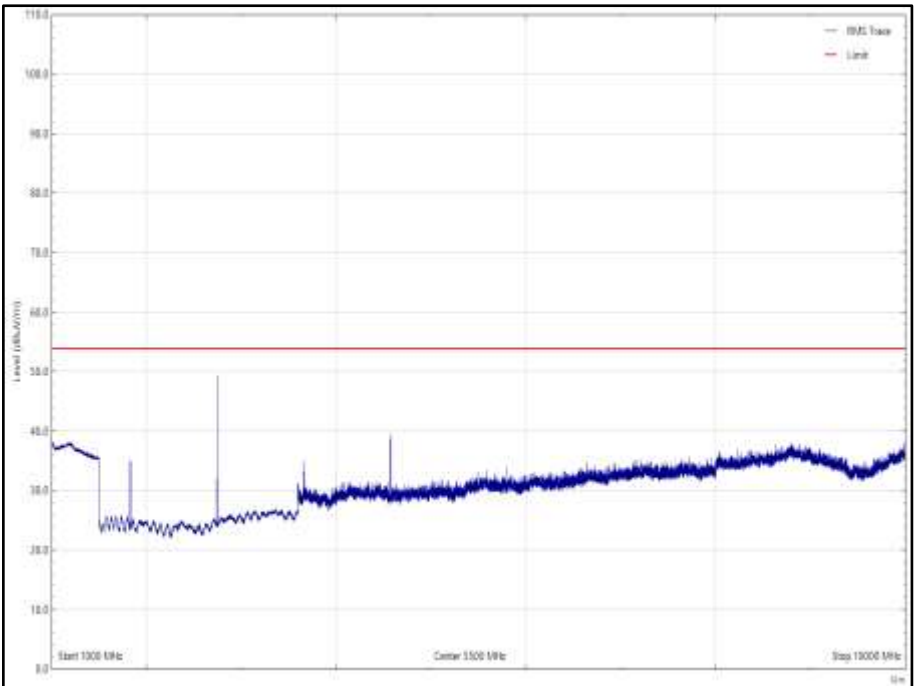


Figure 7 - DTS - X Orientation, 915 MHz, 1 GHz to 10 GHz, Horizontal (rms)

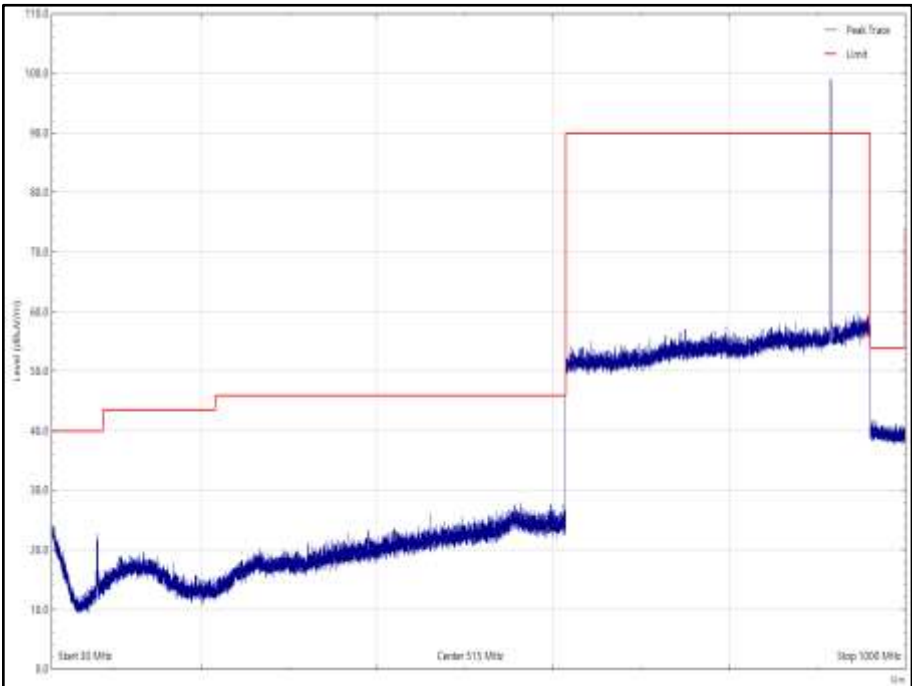


Figure 8 - DTS - X Orientation, 915 MHz, 30 MHz to 1 GHz, Vertical (Peak)

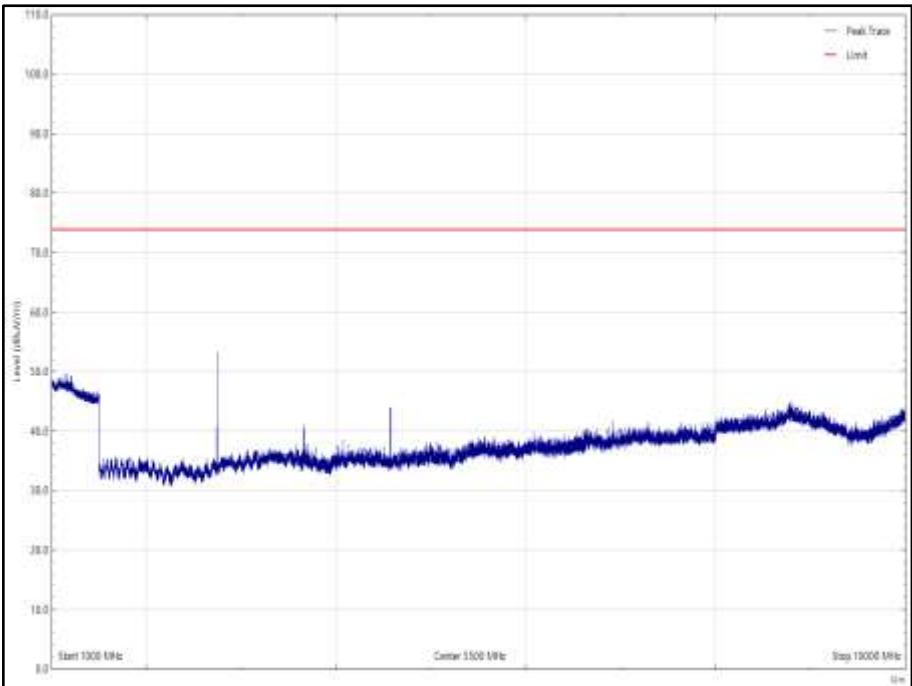


Figure 9 - DTS - X Orientation, 915 MHz, 1 GHz to 10 GHz, Vertical (Peak)

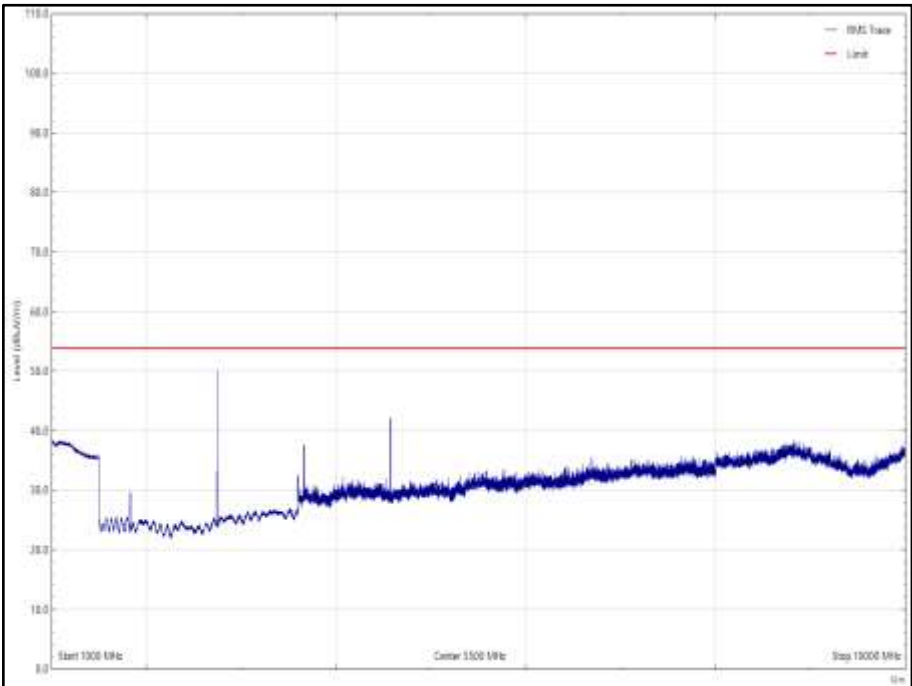


Figure 10 - DTS - X Orientation, 915 MHz, 1 GHz to 10 GHz, Vertical (rms)

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

Table 21 - DTS - X Orientation, 903.25 MHz, 30 MHz to 10 GHz

*No emissions found within 10 dB of the limit.

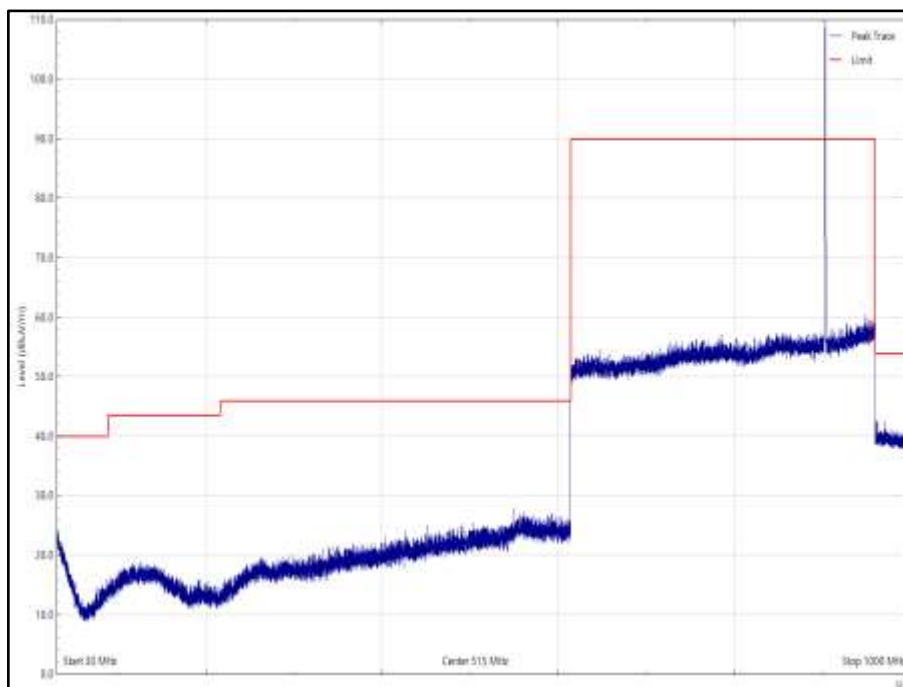


Figure 11 - DTS - X Orientation, 903.25 MHz, 30 MHz to 1 GHz, Horizontal (Peak)

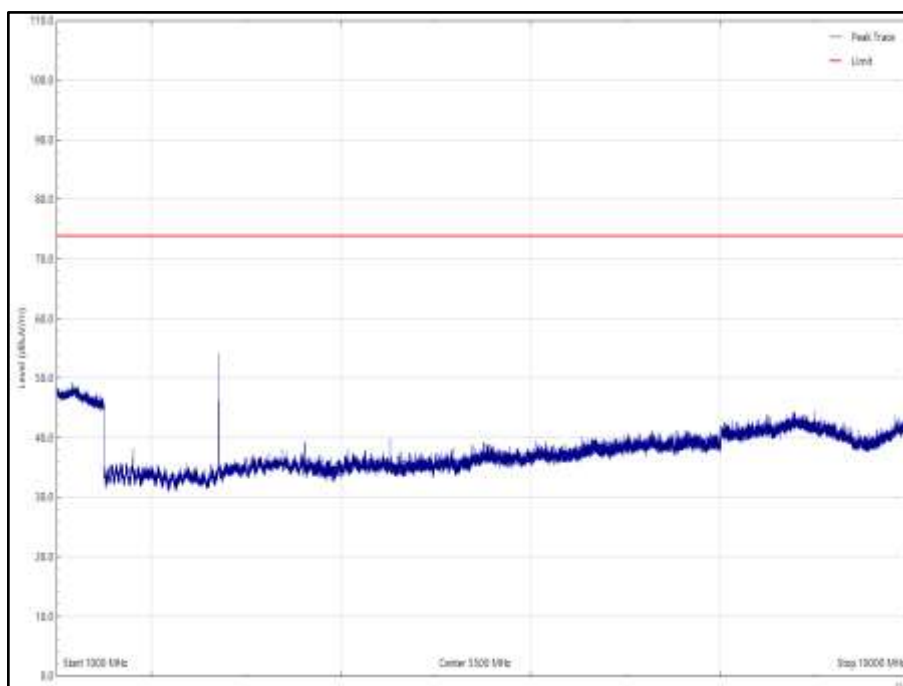


Figure 12 - DTS - X Orientation, 903.25 MHz, 1 GHz to 10 GHz, Horizontal (Peak)

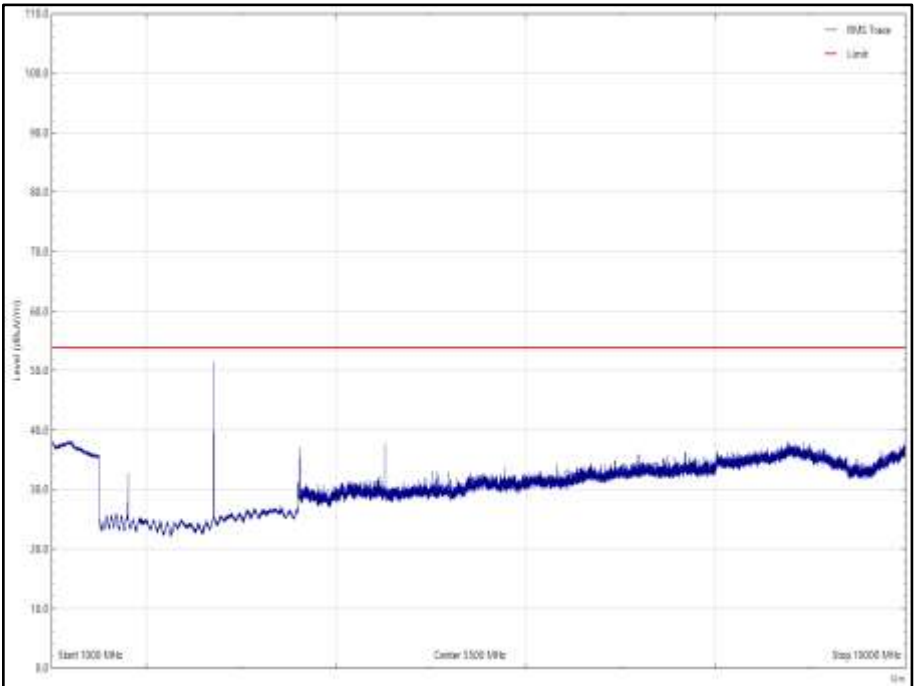


Figure 13 - DTS - X Orientation, 903.25 MHz, 1 GHz to 10 GHz, Horizontal (rms)

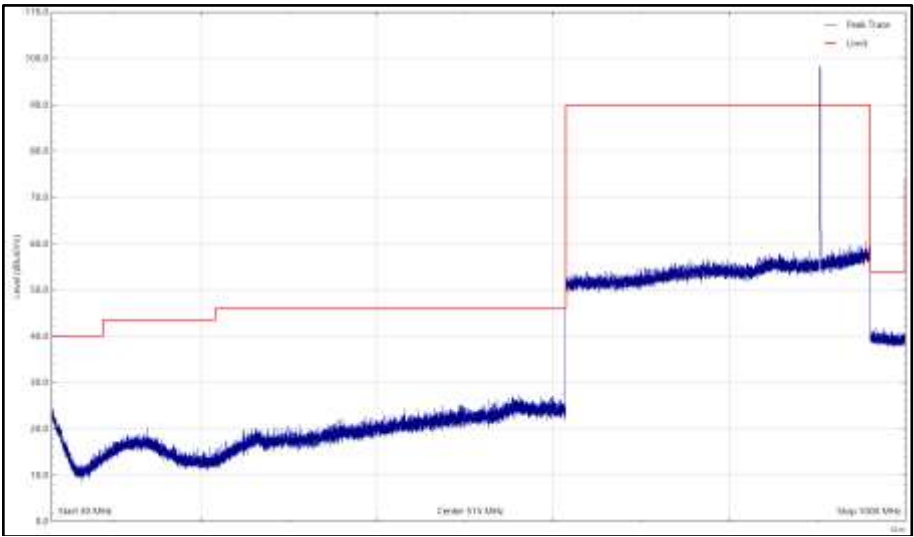


Figure 14 - DTS - X Orientation, 903.25 MHz, 30 MHz to 1 GHz, Vertical (Peak)

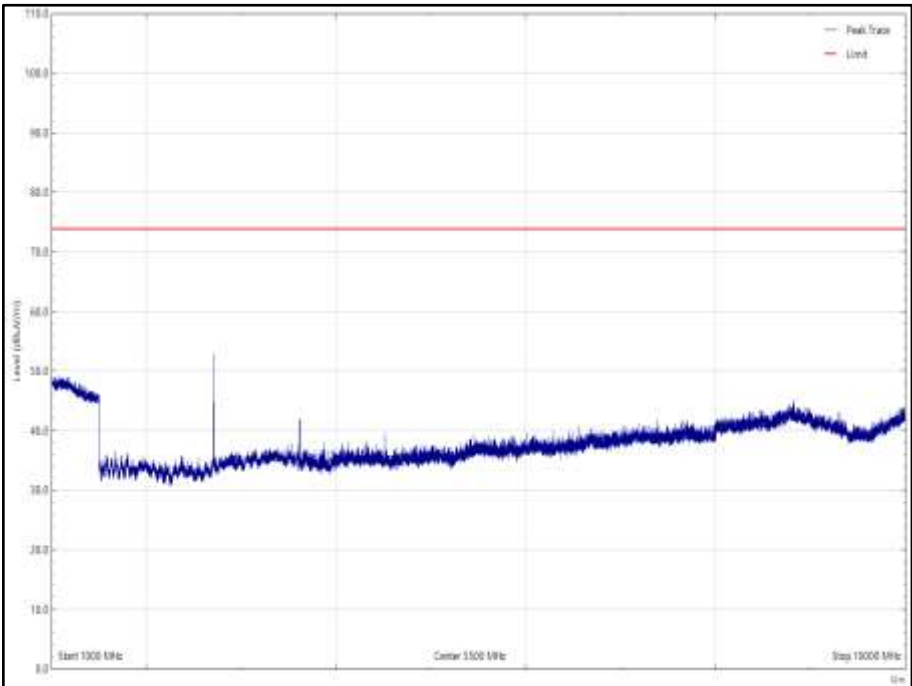


Figure 15 - DTS - X Orientation, 903.25 MHz, 1 GHz to 10 GHz, Vertical (Peak)

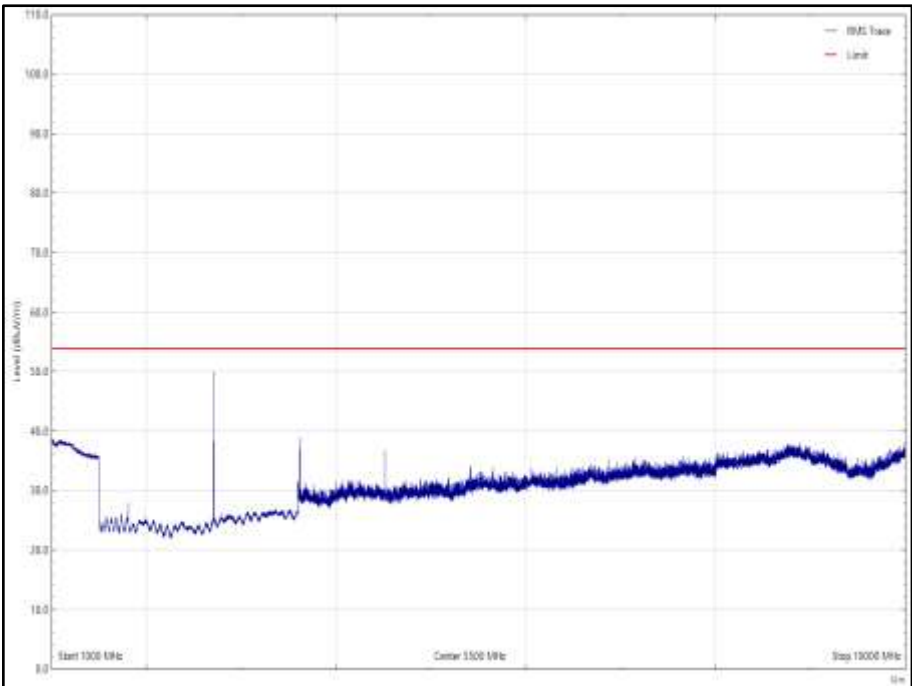


Figure 16 - DTS - X Orientation, 903.25 MHz, 1 GHz to 10 GHz, Vertical (rms)

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

Table 22 - DTS - X Orientation, 926.75MHz, 30 MHz to 10 GHz

*No emissions found within 10 dB of the limit.

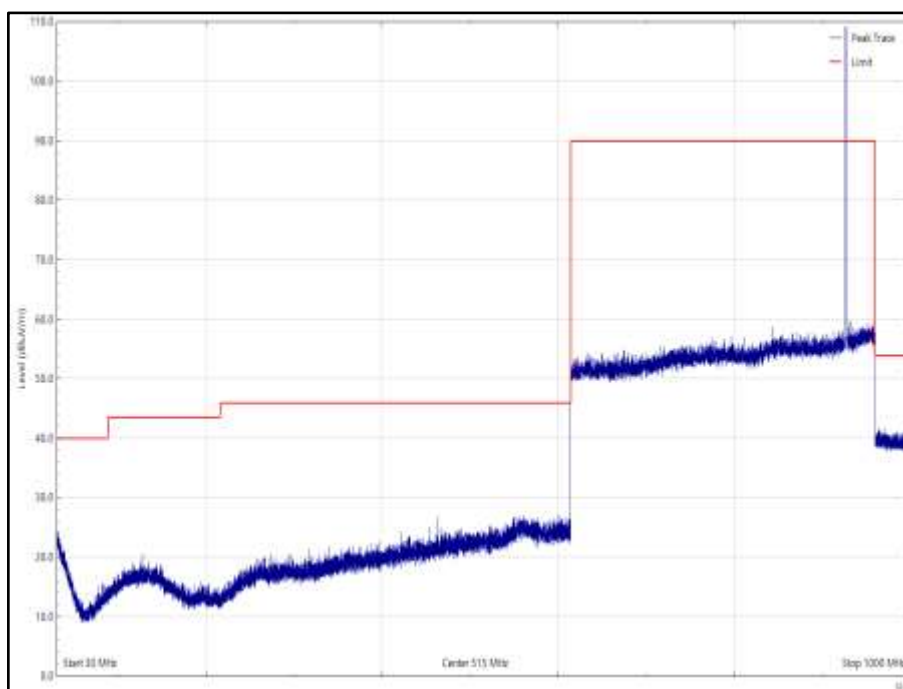


Figure 17 - DTS - X Orientation, 926.75 MHz, 30 MHz to 1 GHz, Horizontal (Peak)

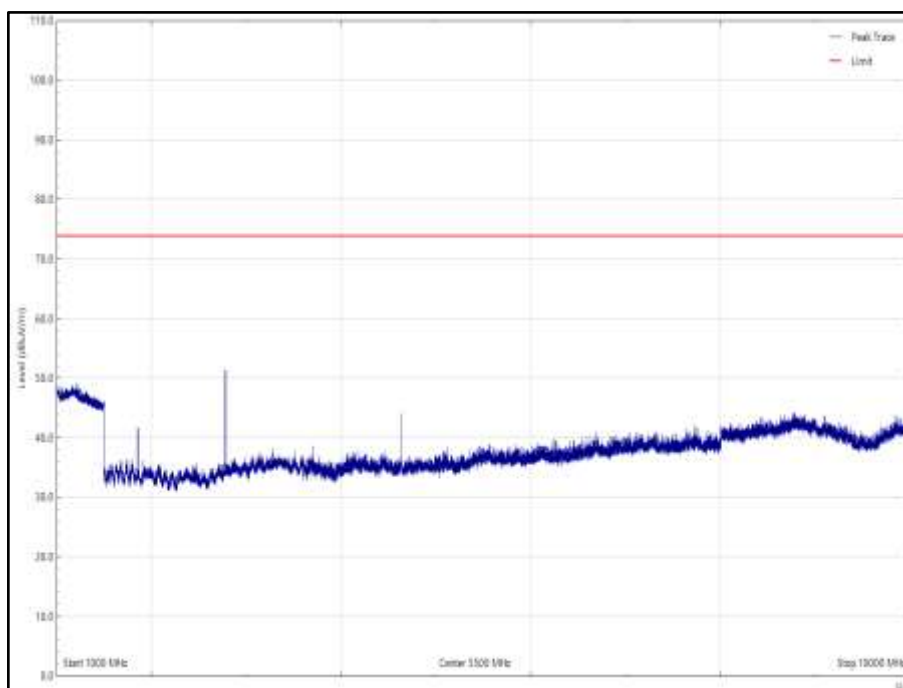


Figure 18 - DTS - X Orientation, 926.75 MHz, 1 GHz to 10 GHz, Horizontal (Peak)

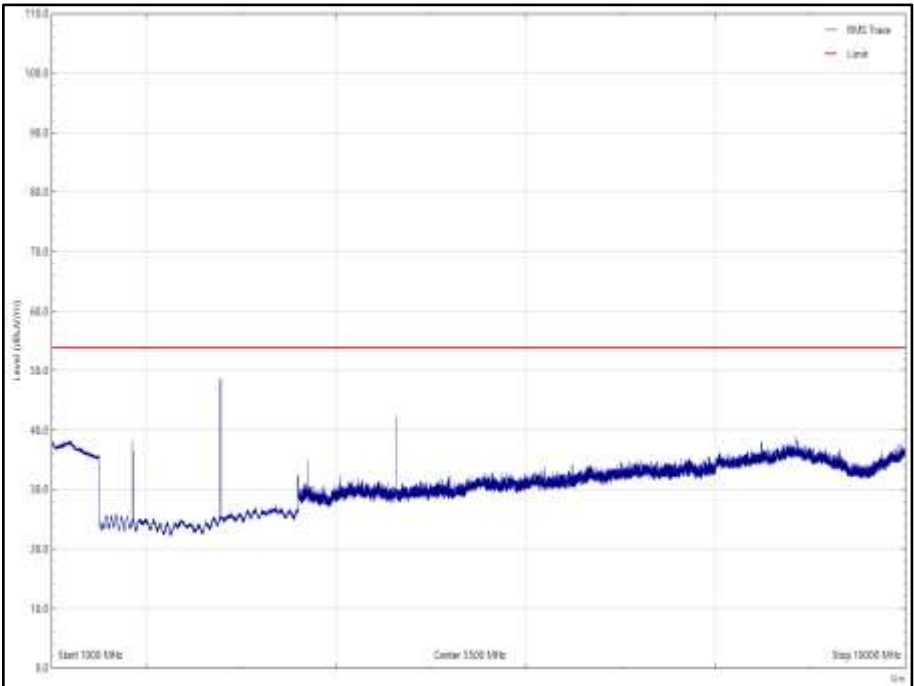


Figure 19 - DTS - X Orientation, 926.75 MHz, 1 GHz to 10 GHz, Horizontal (rms)

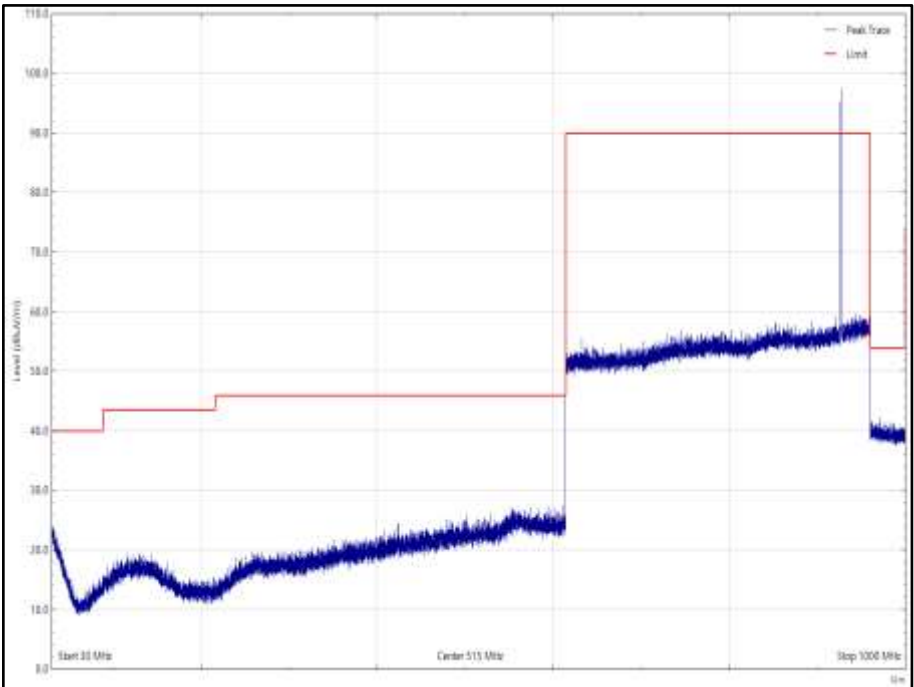


Figure 20 - DTS - X Orientation, 926.75 MHz, 30 MHz to 1 GHz, Vertical (Peak)

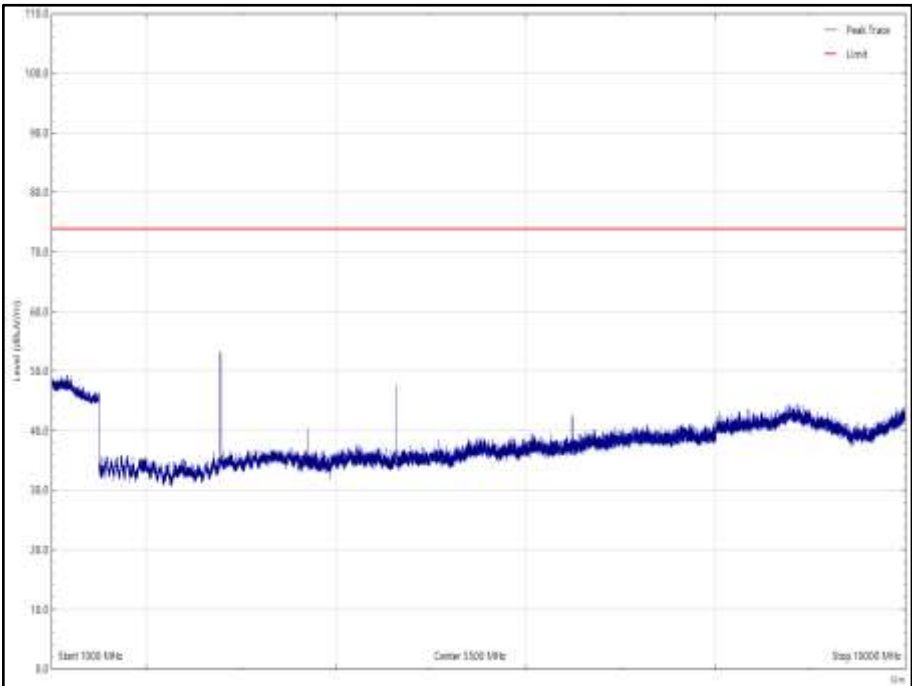


Figure 21 - DTS - X Orientation, 926.75 MHz, 1 GHz to 10 GHz, Vertical (Peak)

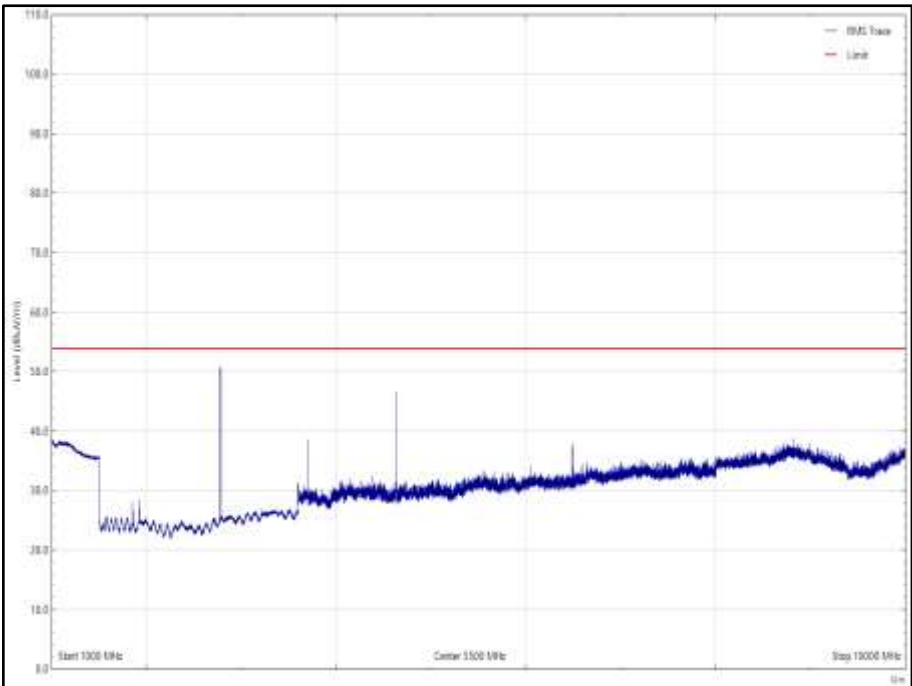


Figure 22 - DTS - X Orientation, 926.75 MHz, 1 GHz to 10 GHz, Vertical (rms)



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

Table 23 - DTS - Y Orientation, 915 MHz, 30 MHz to 10 GHz

*No emissions found within 10 dB of the limit.

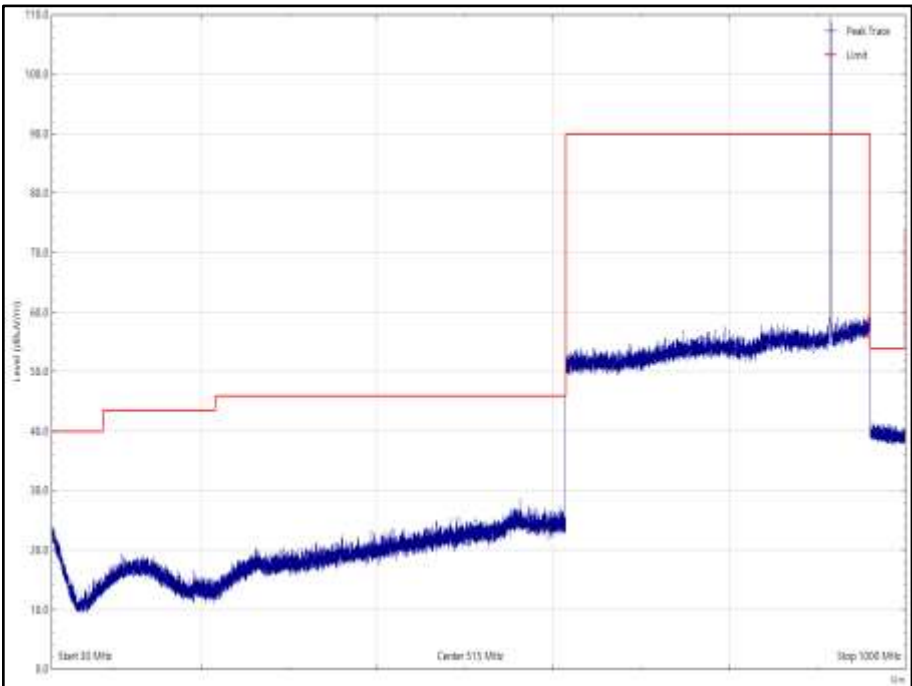


Figure 23 - DTS - Y Orientation, 915 MHz, 30 MHz to 1 GHz, Horizontal (Peak)

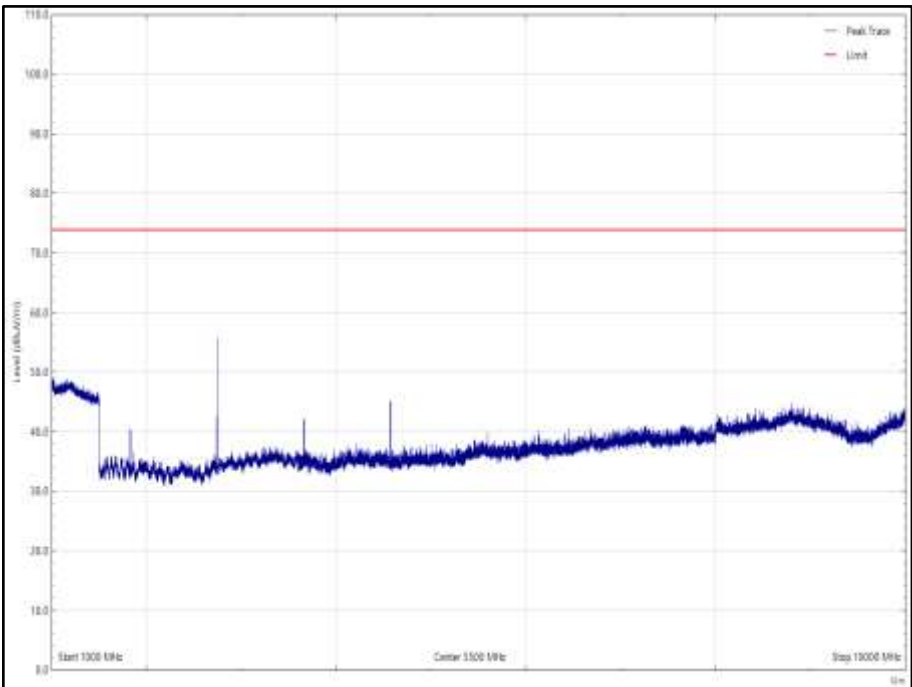


Figure 24 - DTS - Y Orientation, 915 MHz, 1 GHz to 10 GHz, Horizontal (Peak)

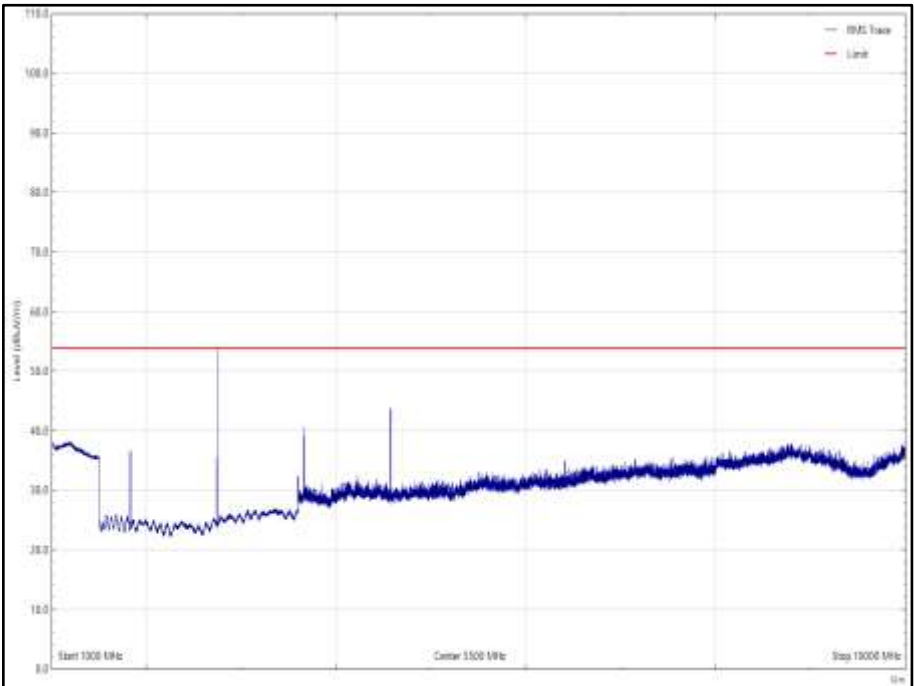


Figure 25 - DTS - Y Orientation, 915 MHz, 1 GHz to 10 GHz, Horizontal (rms)

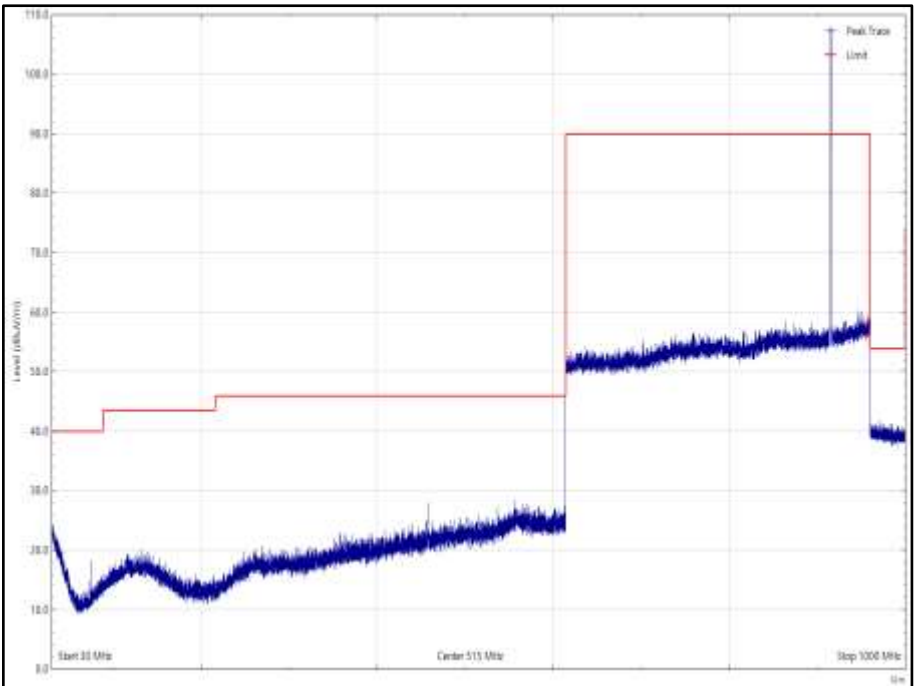


Figure 26 - DTS - Y Orientation, 915 MHz, 30 MHz to 1 GHz, Vertical (Peak)

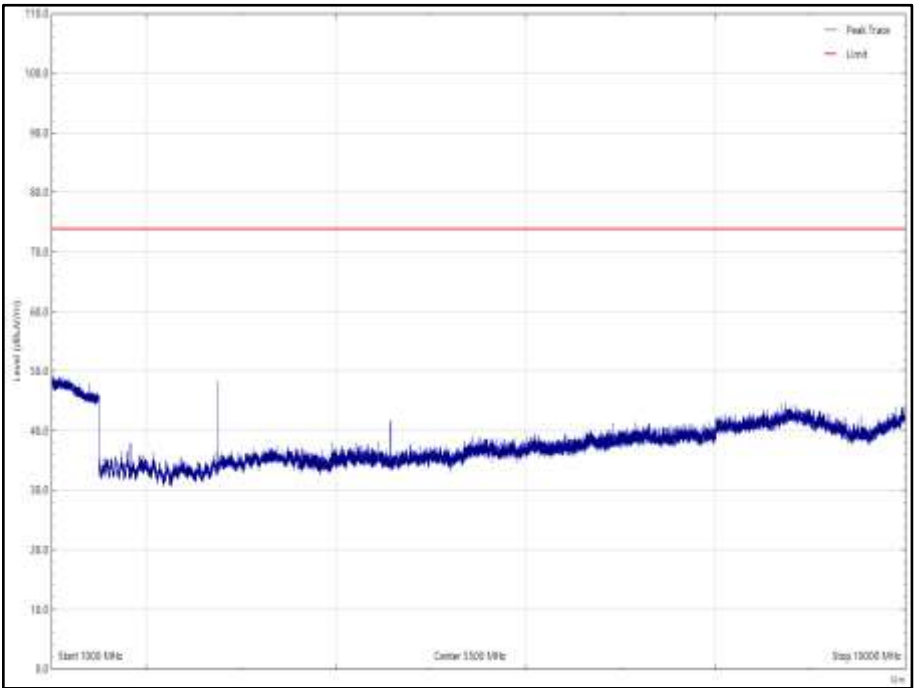


Figure 27 - DTS - Y Orientation, 915 MHz, 1 GHz to 10 GHz, Vertical (Peak)

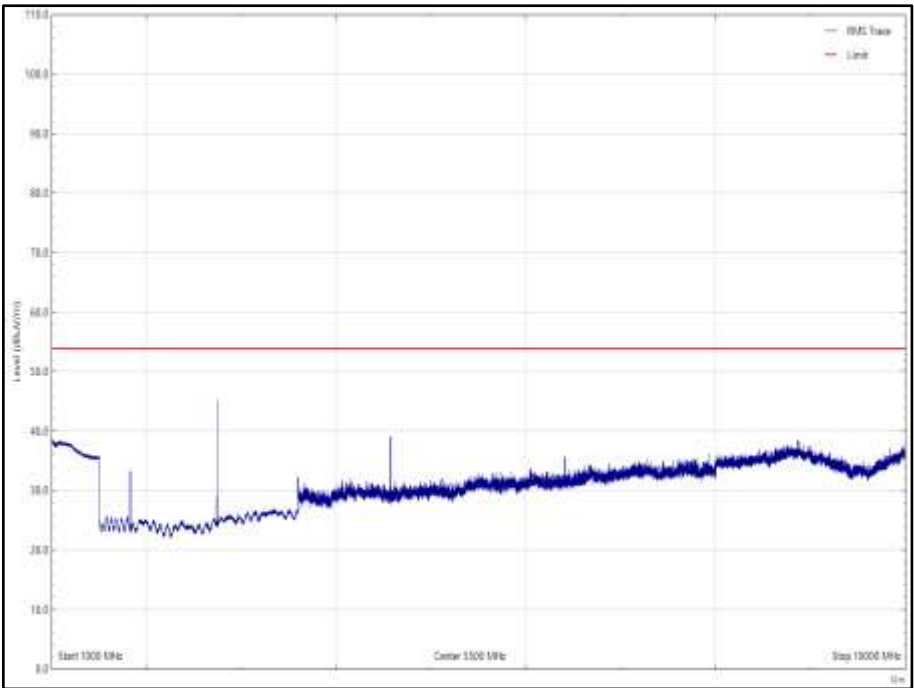


Figure 28 - DTS - Y Orientation, 915 MHz, 1 GHz to 10 GHz, Vertical (rms)



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

Table 24 - DTS - Y Orientation, 903.25 MHz, 30 MHz to 10 GHz

*No emissions found within 10 dB of the limit.

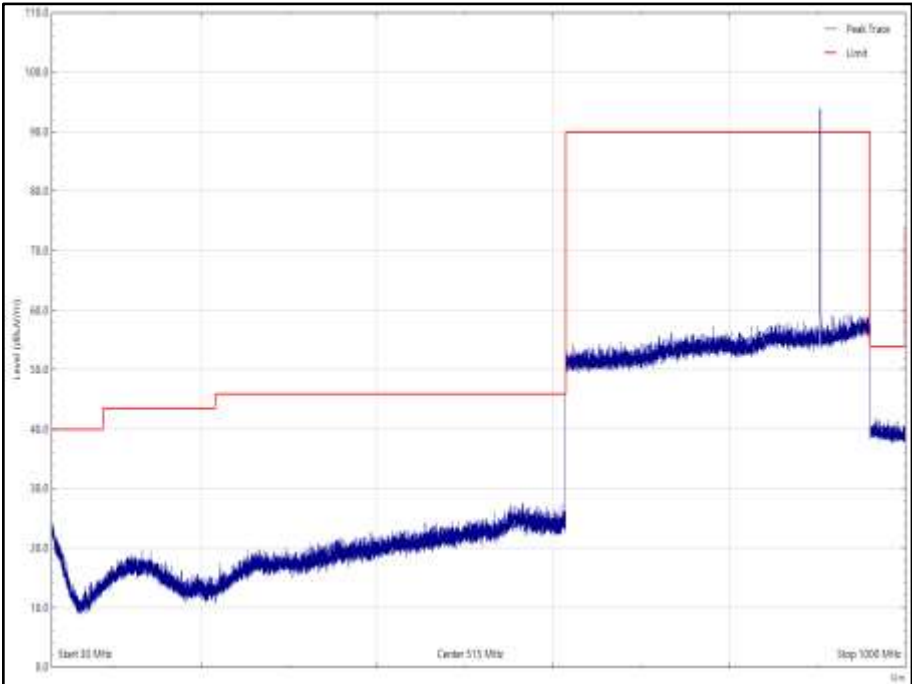


Figure 29 - DTS - Y Orientation, 903.25 MHz, 30 MHz to 1 GHz, Horizontal (Peak)

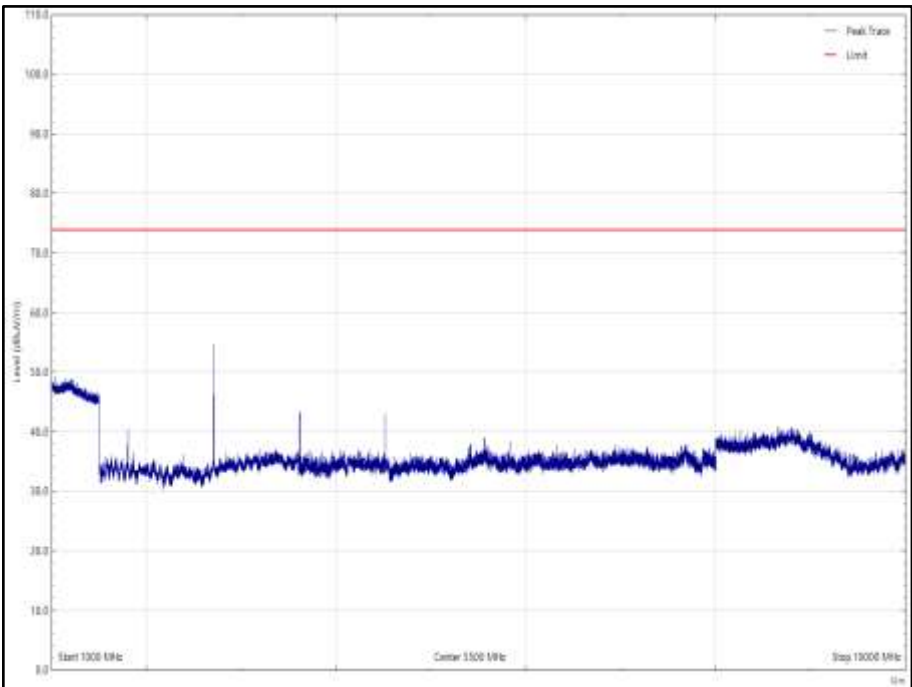


Figure 30 - DTS - Y Orientation, 903.25 MHz, 1 GHz to 10 GHz, Horizontal (Peak)

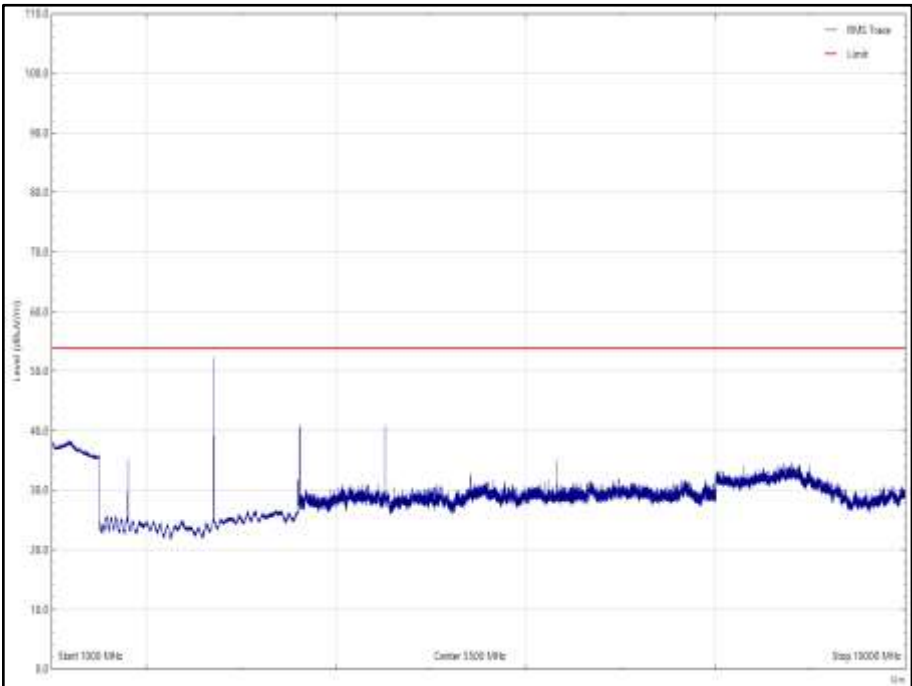


Figure 31 - DTS - Y Orientation, 903.25 MHz, 1 GHz to 10 GHz, Horizontal (rms)

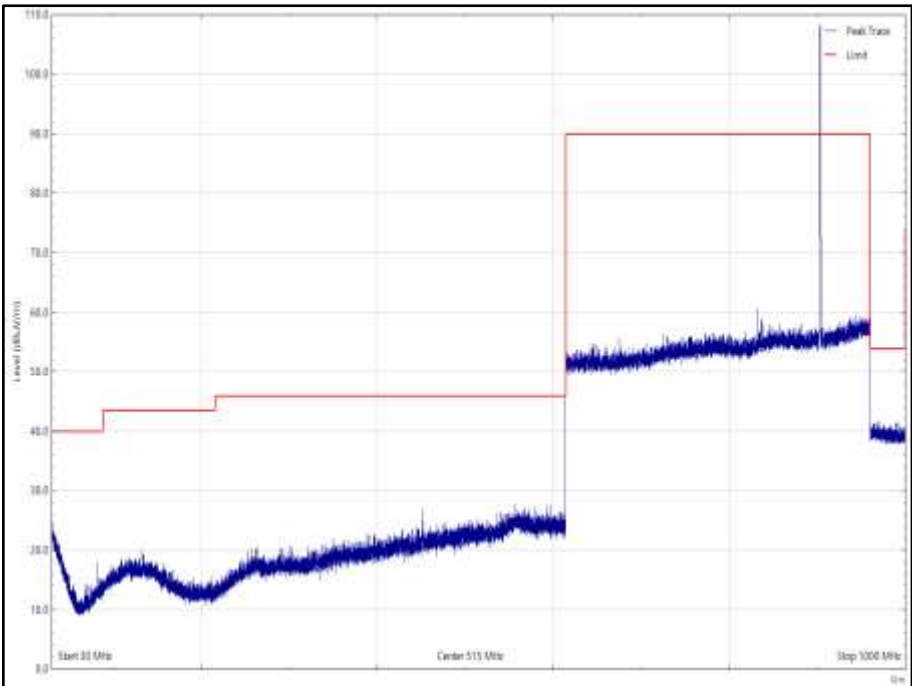


Figure 32 - DTS - Y Orientation, 903.25 MHz, 30 MHz to 1 GHz, Vertical (Peak)

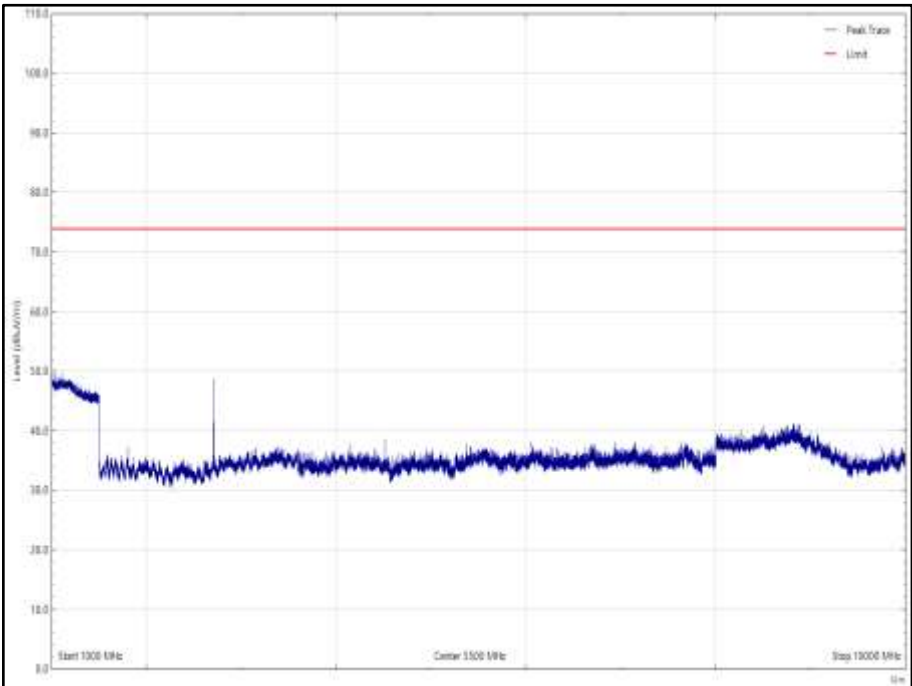


Figure 33 - DTS - Y Orientation, 903.25 MHz, 1 GHz to 10 GHz, Vertical (Peak)

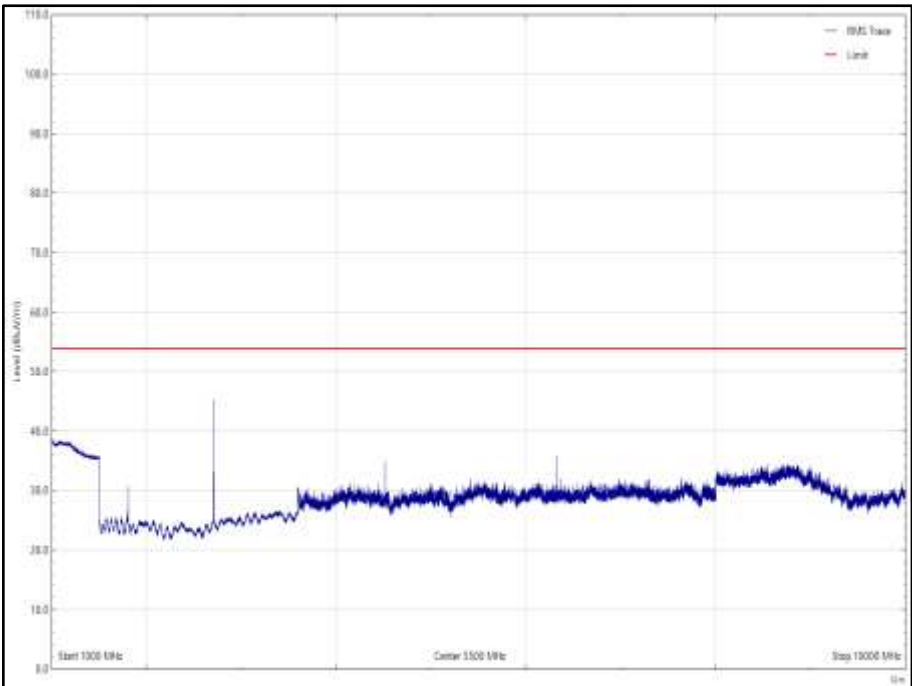


Figure 34 - DTS - Y Orientation, 903.25 MHz, 1 GHz to 10 GHz, Vertical (rms)

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

Table 25 - DTS - Y Orientation, 926.75 MHz, 30 MHz to 10 GHz

*No emissions found within 10 dB of the limit.

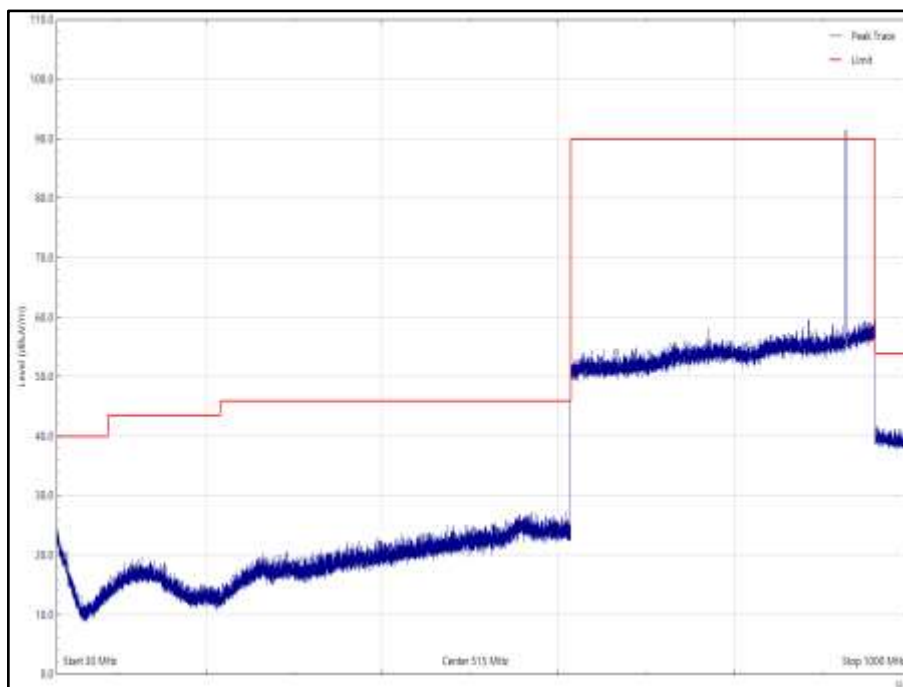


Figure 35 - DTS - Y Orientation, 926.75 MHz, 30 MHz to 1 GHz, Horizontal (Peak)

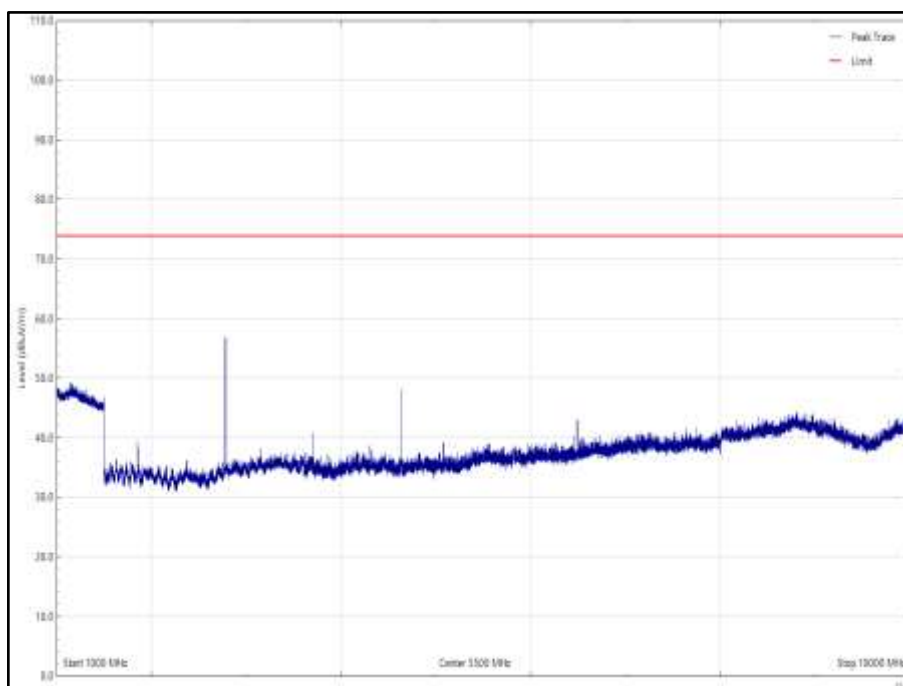


Figure 36 - DTS - Y Orientation, 926.75 MHz, 1 GHz to 10 GHz, Horizontal (Peak)

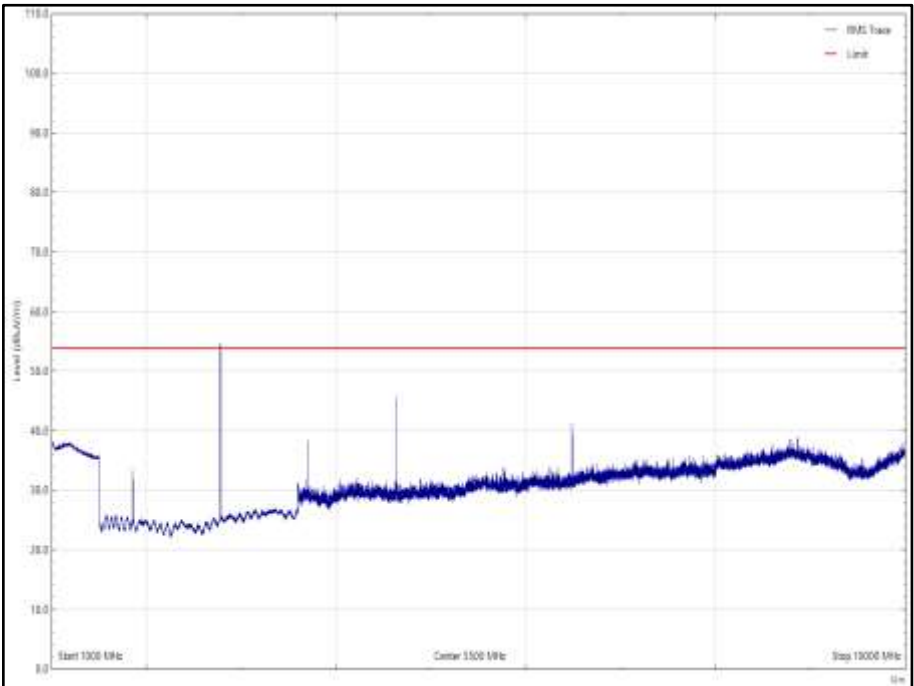


Figure 37 - DTS - Y Orientation, 926.75 MHz, 1 GHz to 10 GHz, Horizontal (rms)

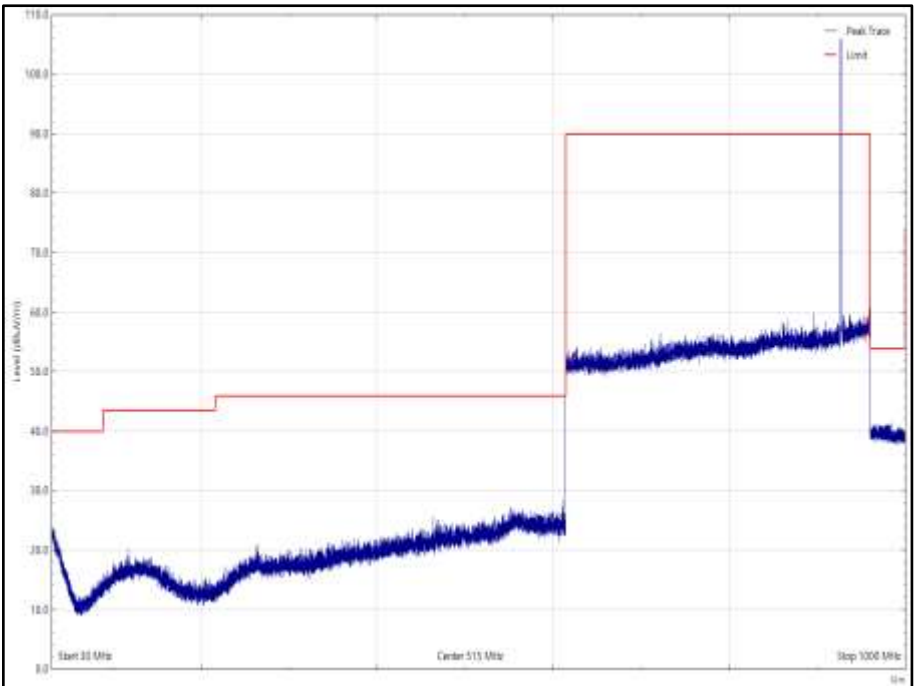


Figure 38 - DTS - Y Orientation, 926.75 MHz, 30 MHz to 1 GHz, Vertical (Peak)

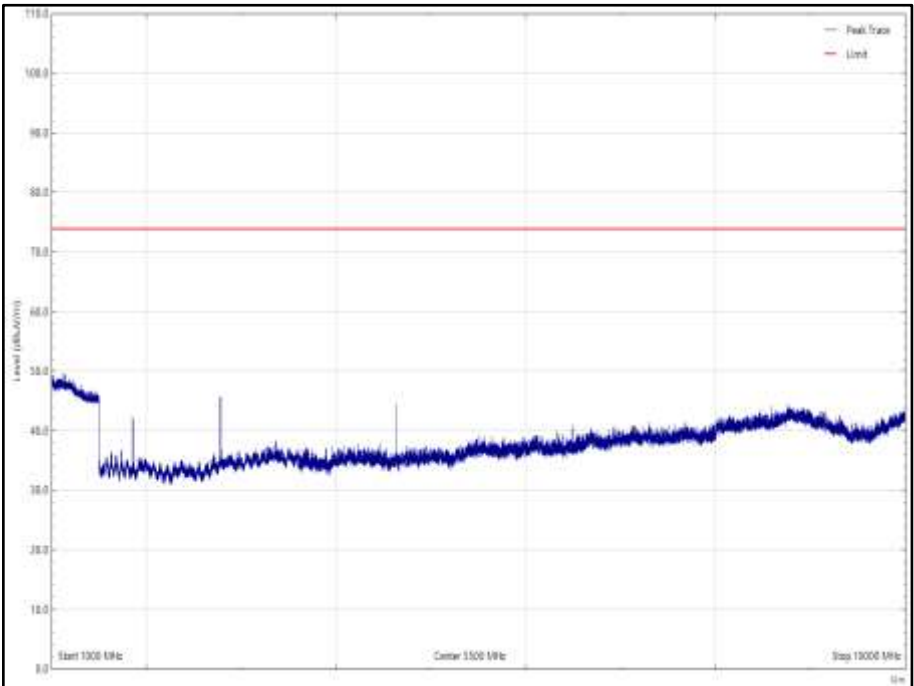


Figure 39 - DTS - Y Orientation, 926.75 MHz, 1 GHz to 10 GHz, Vertical (Peak)

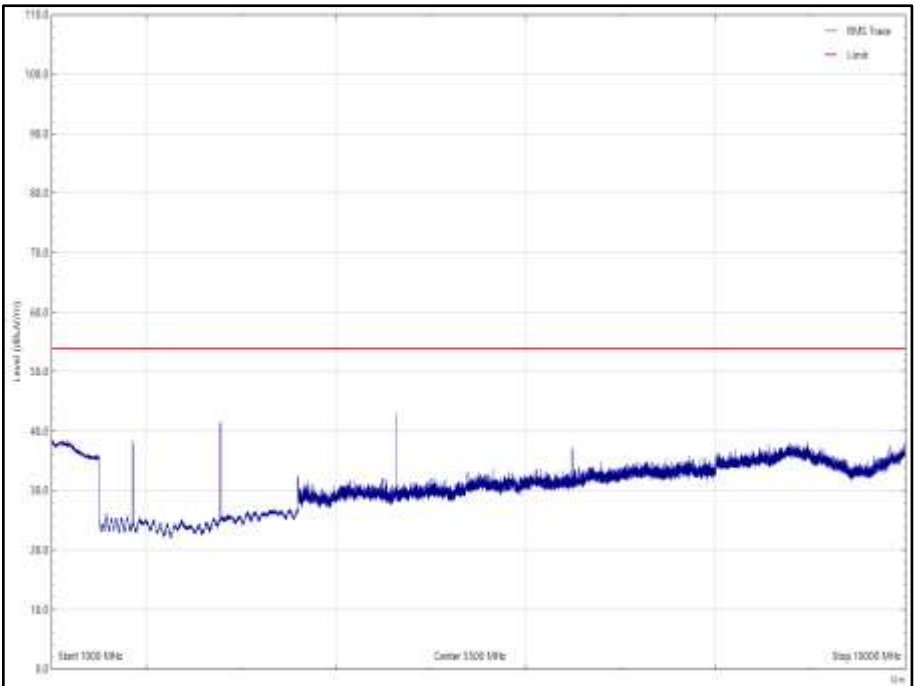


Figure 40 - DTS - Y Orientation, 926.75 MHz, 1 GHz to 10 GHz, Vertical (rms)

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

Table 26 - DTS - Z Orientation, 915 MHz, 30 MHz to 10 GHz

*No emissions found within 10 dB of the limit.

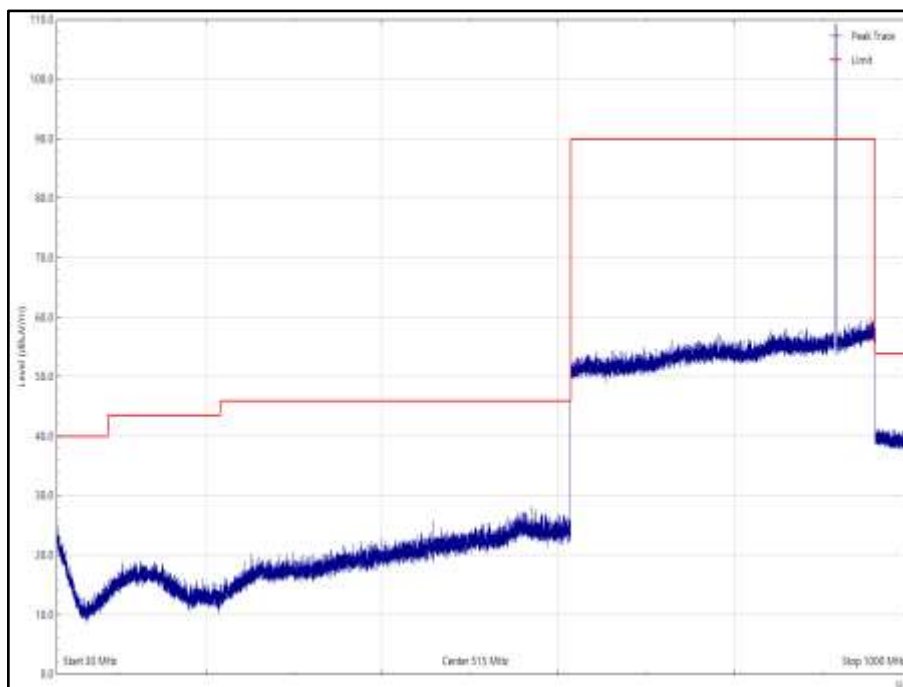


Figure 41 - DTS - Z Orientation, 915 MHz, 30 MHz to 1 GHz, Horizontal (Peak)

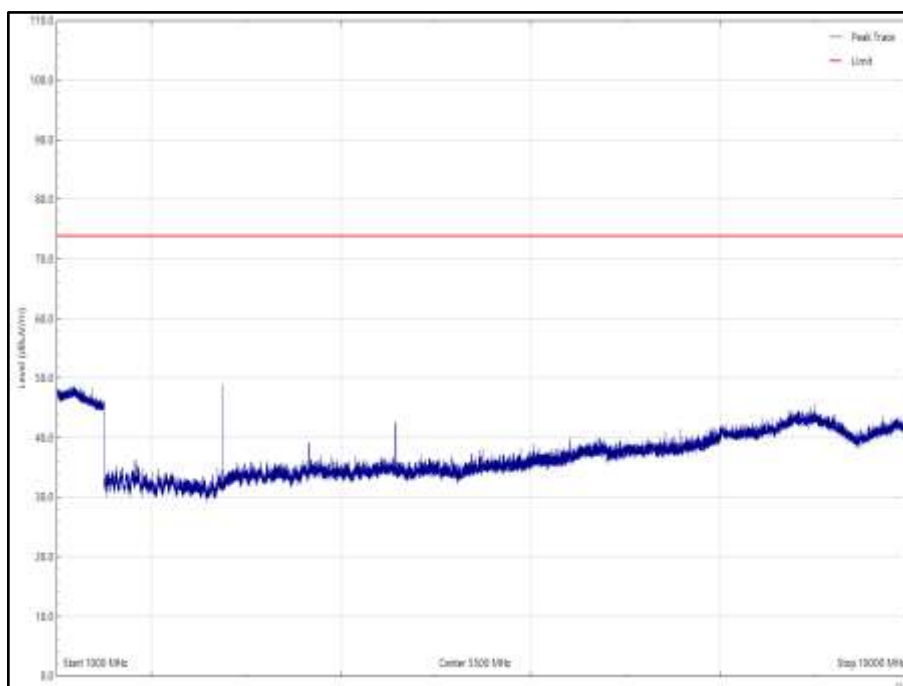


Figure 42 - DTS - Z Orientation, 915 MHz, 1 GHz to 10 GHz, Horizontal (Peak)

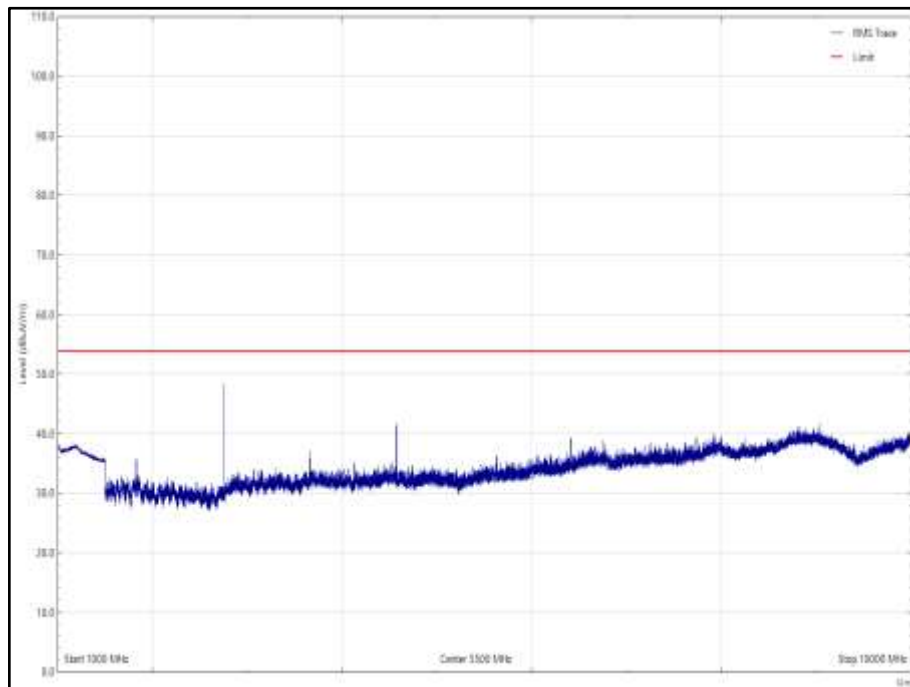


Figure 43 - DTS - Z Orientation, 915 MHz, 1 GHz to 10 GHz, Horizontal (rms)

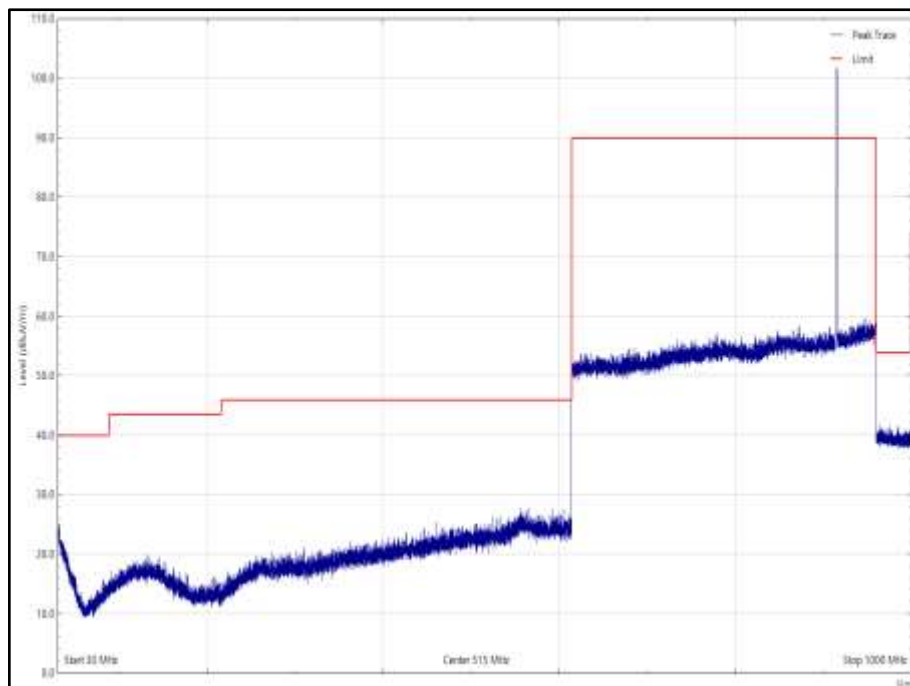


Figure 44 - DTS - Z Orientation, 915 MHz, 30 MHz to 1 GHz, Vertical (Peak)

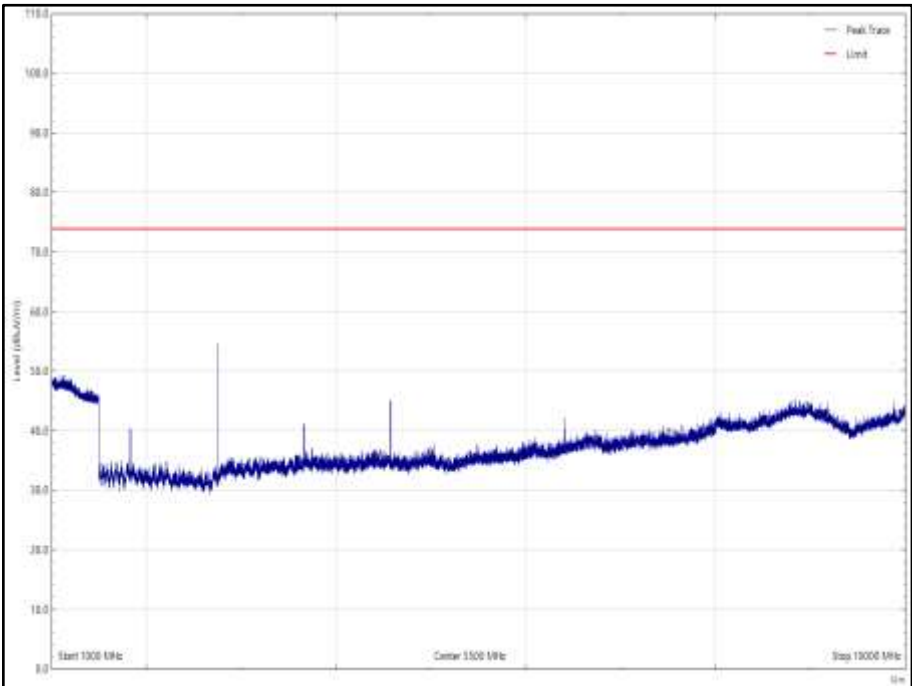


Figure 45 - DTS - Z Orientation, 915 MHz, 1 GHz to 10 GHz, Vertical (Peak)

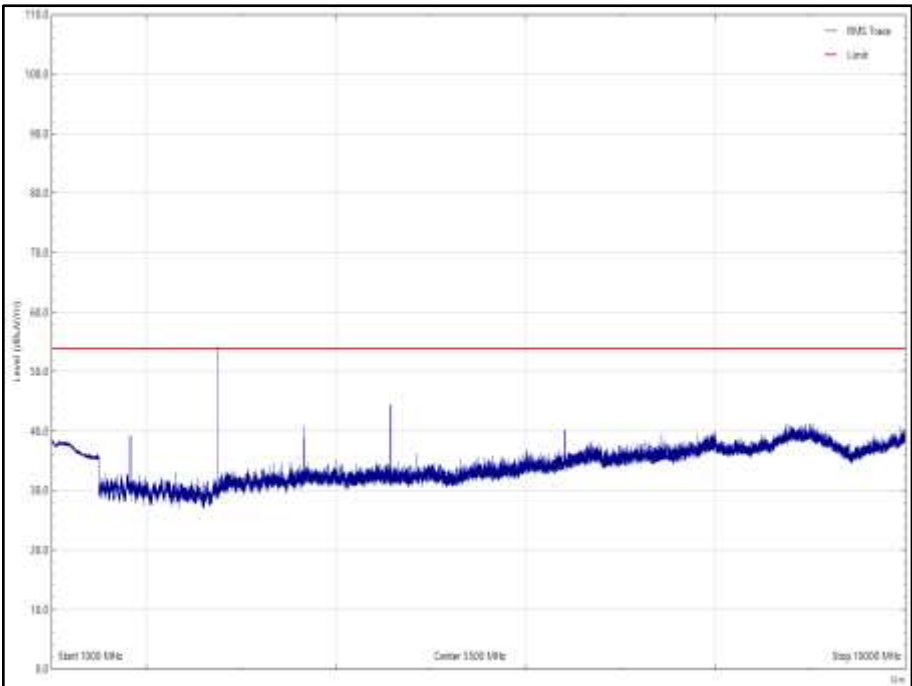


Figure 46 - DTS - Z Orientation, 915 MHz, 1 GHz to 10 GHz, Vertical (rms)

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

Table 27 - DTS - Z Orientation, 903.25 MHz, 30 MHz to 10 GHz

*No emissions found within 10 dB of the limit.

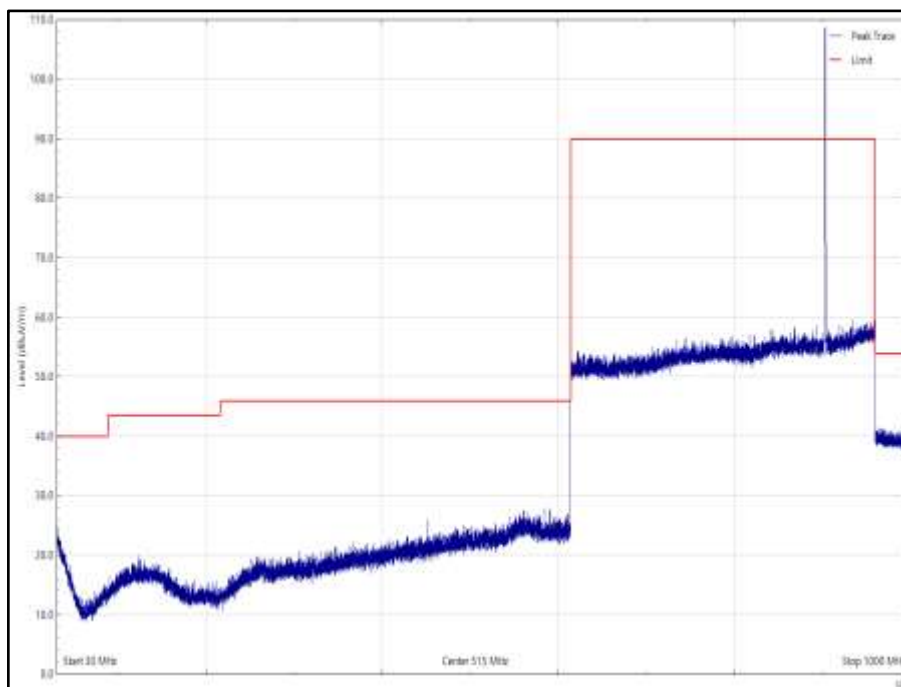


Figure 47 - DTS - Z Orientation, 903.25 MHz, 30 MHz to 1 GHz, Horizontal (Peak)

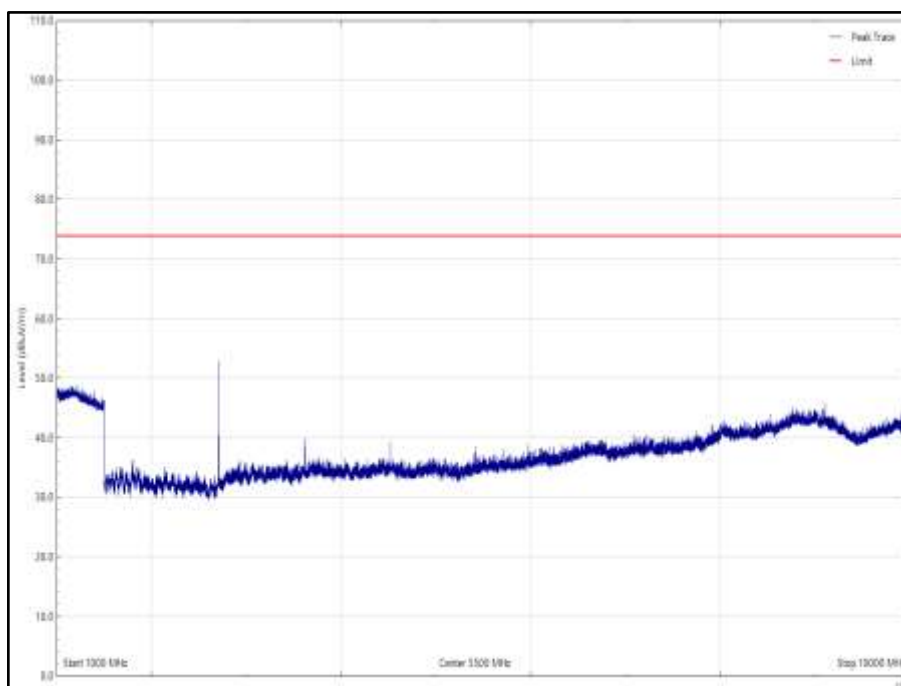


Figure 48 - DTS - Z Orientation, 903.25 MHz, 1 GHz to 10 GHz, Horizontal (Peak)

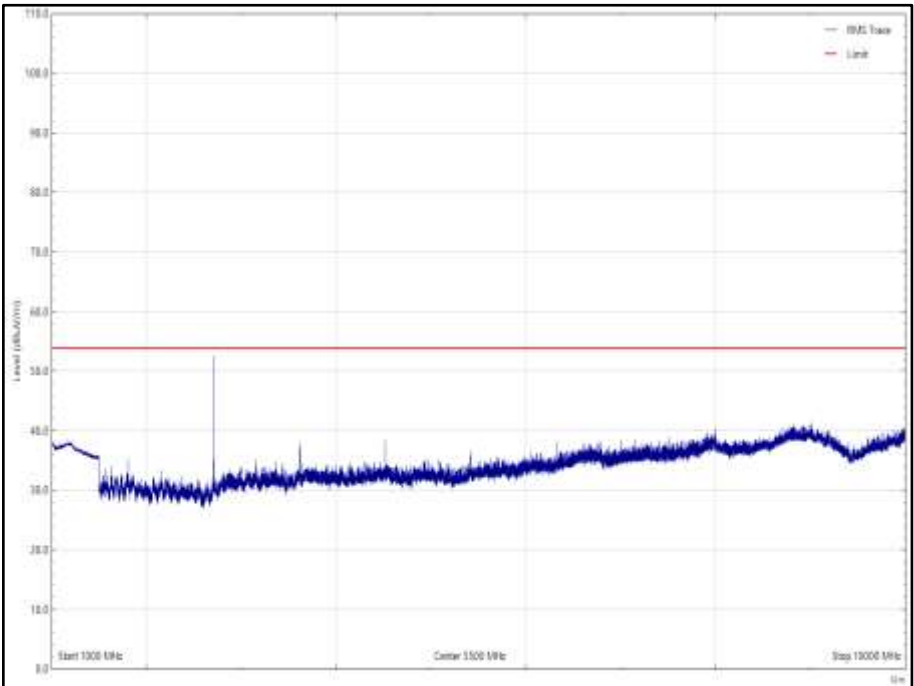


Figure 49 - DTS - Z Orientation, 903.25 MHz, 1 GHz to 10 GHz, Horizontal (rms)

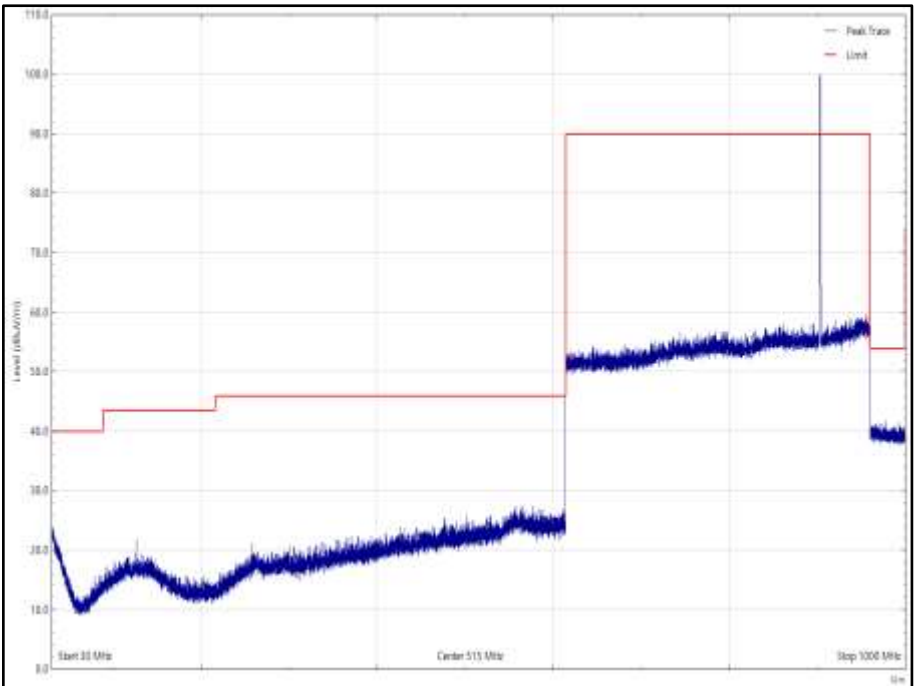


Figure 50 - DTS - Z Orientation, 903.25 MHz, 30 MHz to 1 GHz, Vertical (Peak)

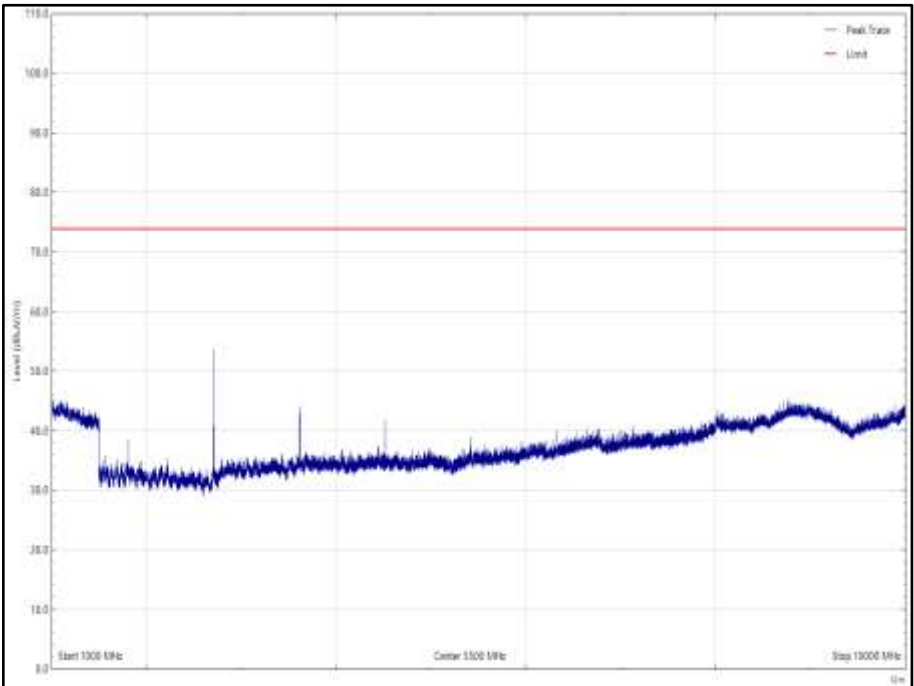


Figure 51 - DTS - Z Orientation, 903.25 MHz, 1 GHz to 10 GHz, Vertical (Peak)

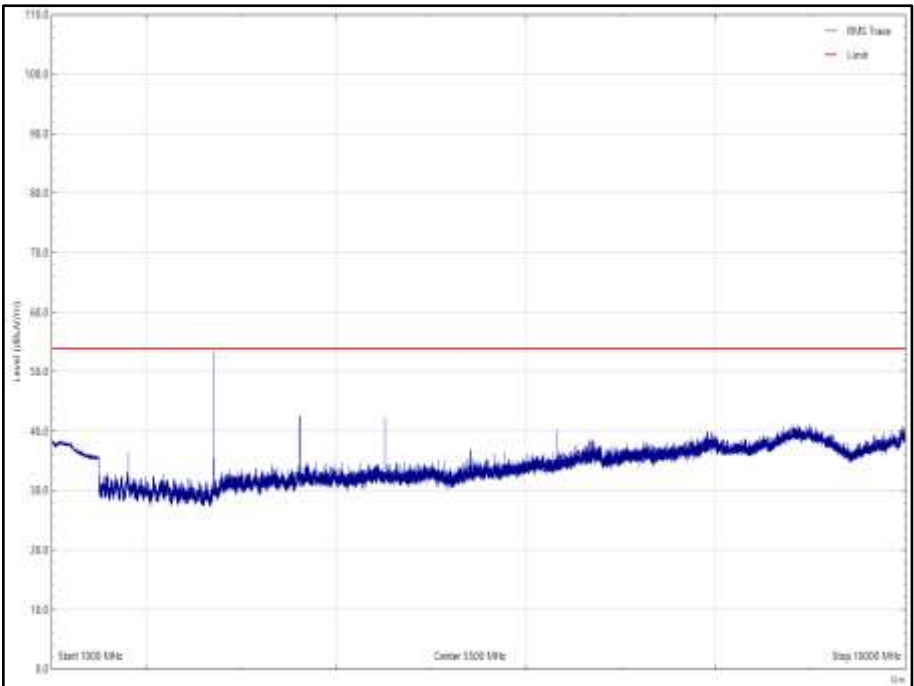


Figure 52 - DTS - Z Orientation, 903.25 MHz, 1 GHz to 10 GHz, Vertical (rms)

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

Table 28 - DTS - Z Orientation, 926.75 MHz, 30 MHz to 10 GHz

*No emissions found within 10 dB of the limit.

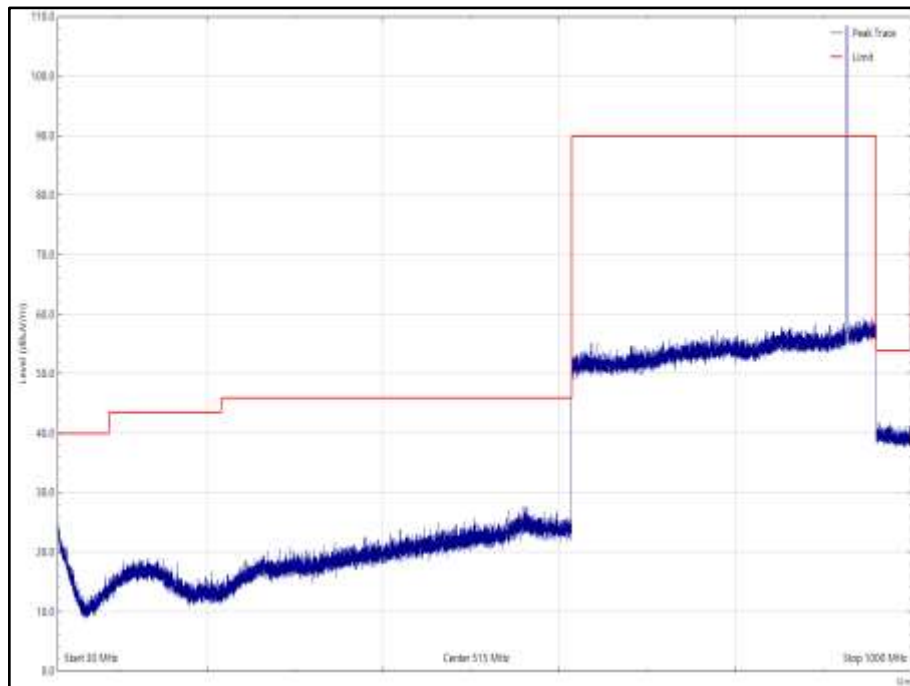


Figure 53 - DTS - Z Orientation, 926.75 MHz, 30 MHz to 1 GHz, Horizontal (Peak)

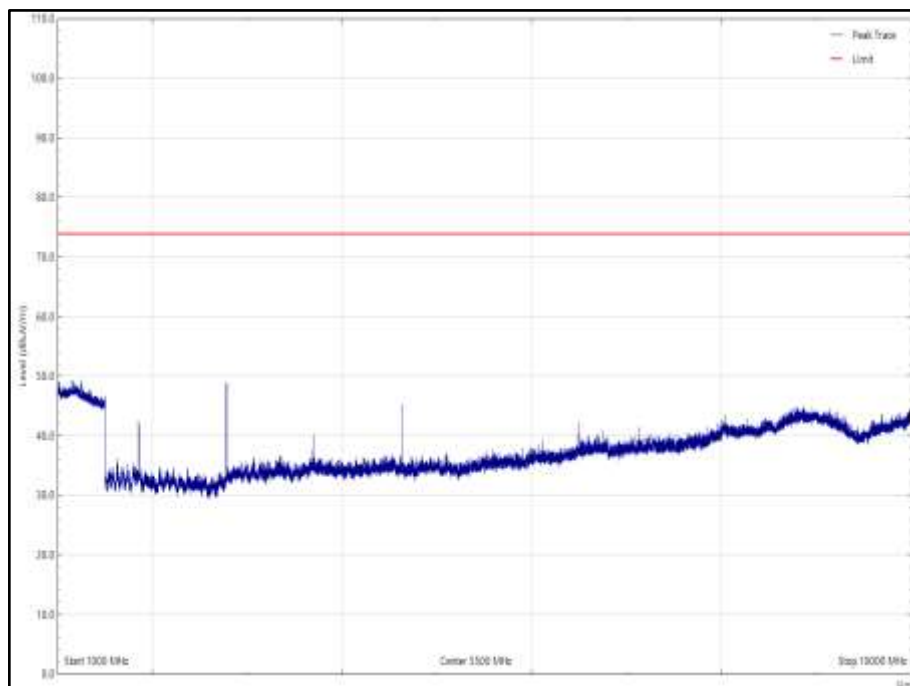


Figure 54 - DTS - Z Orientation, 926.75 MHz, 1 GHz to 10 GHz, Horizontal (Peak)

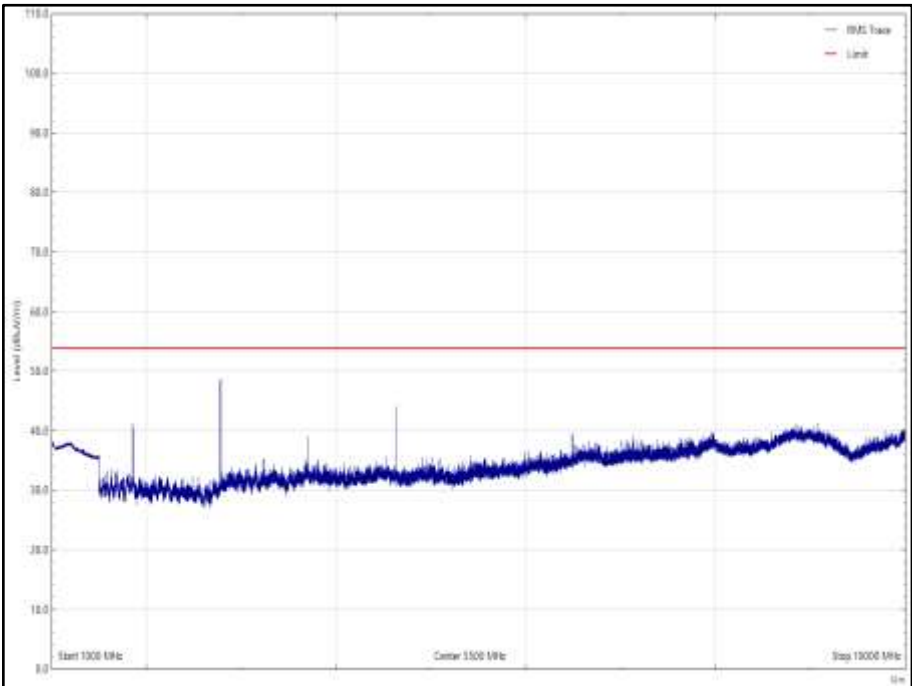


Figure 55 - DTS - Z Orientation, 926.75 MHz, 1 GHz to 10 GHz, Horizontal (rms)

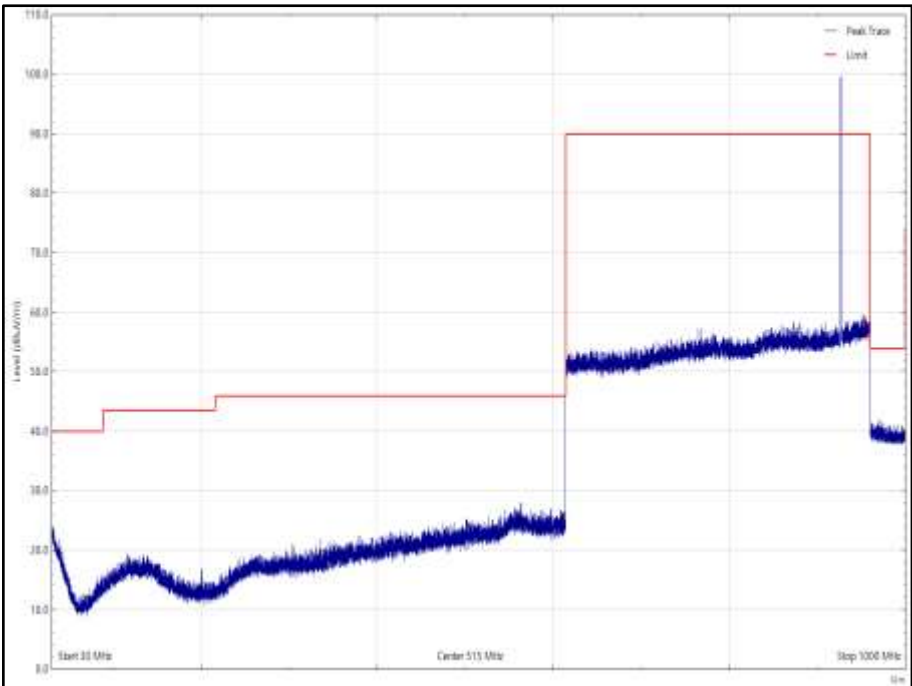


Figure 56 - DTS - Z Orientation, 926.75 MHz, 30 MHz to 1 GHz, Vertical (Peak)

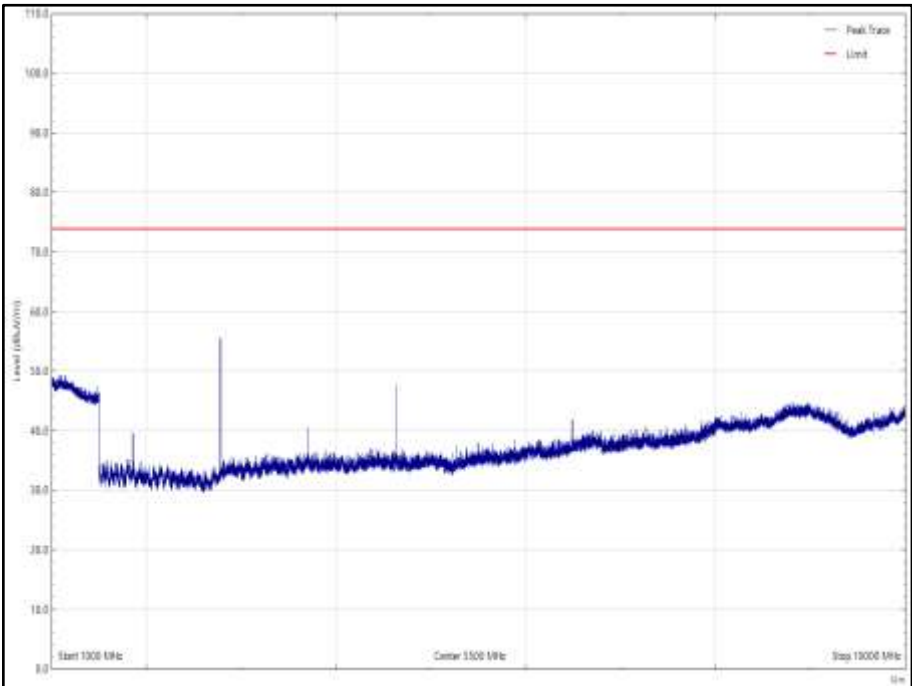


Figure 57 - DTS - Z Orientation, 926.75 MHz, 1 GHz to 10 GHz, Vertical (Peak)

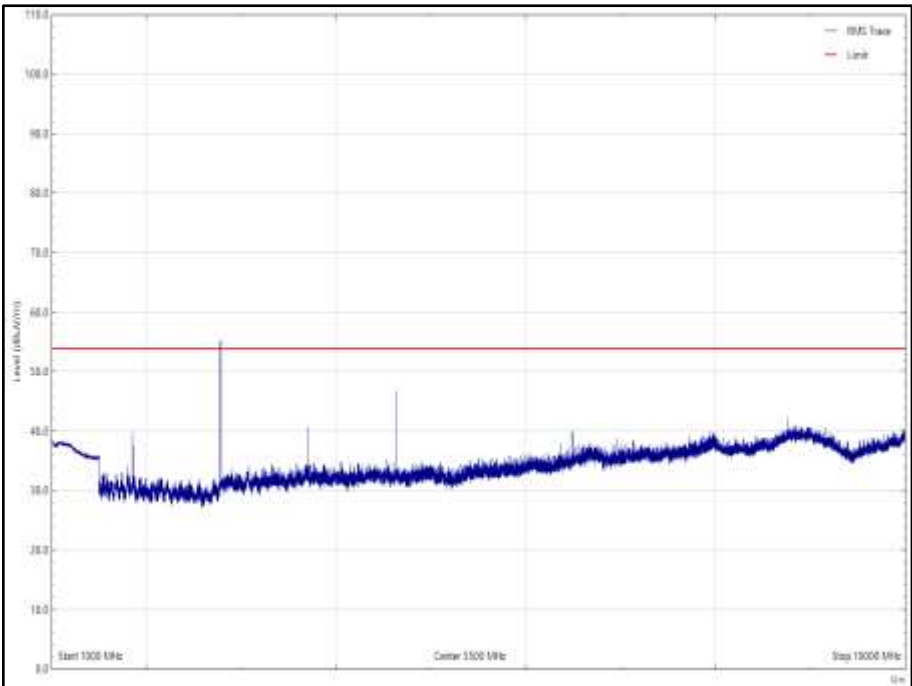


Figure 58 - DTS - Z Orientation, 926.75 MHz, 1 GHz to 10 GHz, Vertical (rms)



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.

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.



2.3.8 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 12.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
Comb Generator	Schaffner	RSG1000	3034	-	TU
Test Receiver	Rohde & Schwarz	ESU40	3506	12	18-Mar-2022
Cable (SMA to SMA, 2 m)	Rhophase	3PS-1801A-2000-3PS	4113	12	27-Jan-2023
High Pass filter	Wainwright	WHKX12-1290-1500-18000-80SS	4961	12	25-Mar-2022
Cable (N-Type to N-Type, 1 m)	Rosenberger	LU7-036-1000	5031	12	23-Jul-2022
Emissions Software	TUV SUD	EmX V2.1.12	5125	-	Software
Pre-Amplifier (1 GHz to 18 GHz)	Schwarzbeck	BBV 9718 C	5350	12	22-Sep-2022
Cable (N-Type to N-Type, 8 m)	Teledyne	PR90-088-8MTR	5450	6	08-Mar-2022
Cable (N-Type to N-Type, 8 m)	Teledyne	PR90-088-8MTR	5450	6	01-Apr-2022
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB-40	5481	12	31-Mar-2022
Antenna (DRG, 1 GHz to 10 GHz)	Schwarzbeck	BBHA 9120 B	5611	12	15-Oct-2022
Turntable & Mast Controller	Maturo Gmbh	NCD/498/2799.01	5612	-	TU
Tilt Antenna Mast	Maturo Gmbh	TAM 4.0-P	5613	-	TU
Turntable	Maturo Gmbh	Turntable 1.5 SI-2t	5614	-	TU
Antenna (Bi-Log, 30 MHz to 1 GHz)	Teseq	CBL6111D	5615	24	16-Oct-2022
Screened Room (12)	MVG	EMC-3	5621	36	11-Aug-2023
EMI Test Receiver	Rohde & Schwarz	ESW44	5912	12	17-Feb-2023

Table 29

TU - Traceability Unscheduled



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

Sensor RF module 2AA (US), S/N: US 2 - Modification State 0

2.4.3 Date of Test

15-March-2022

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	20.9 °C
Relative Humidity	37.9 %

2.4.6 Test Results

Radio chip/PCB combination – Single (Standard) Mode

Mode	Frequency (MHz)	Band Edge Frequency (MHz)	Level (dBc)
Standard	903.25	902.0	-56.44

Table 30 - Band Edge Results

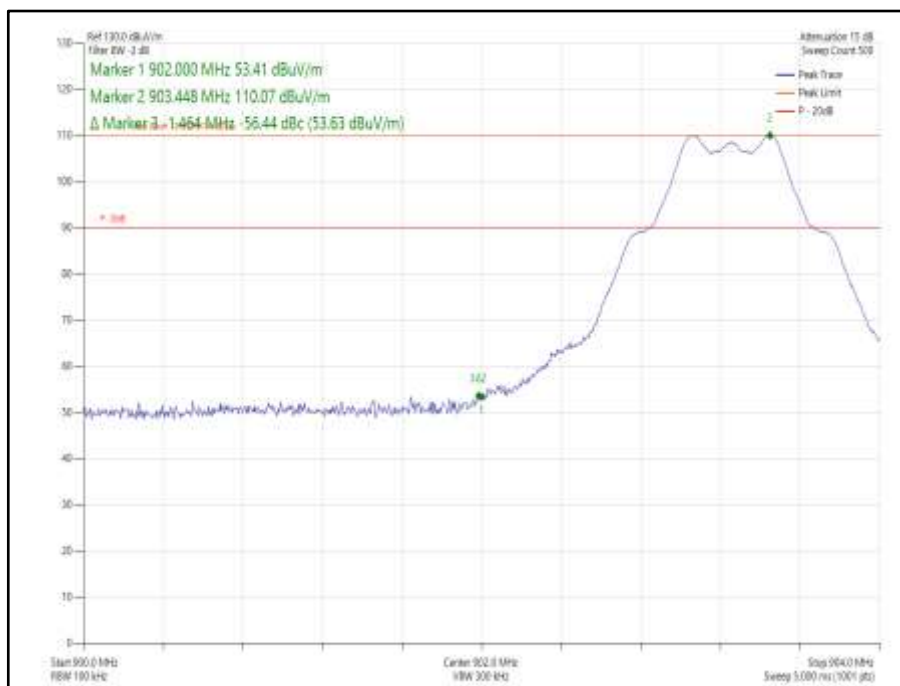


Figure 59 - DTS, 903.25MHz, Band Edge Frequency 902 MHz

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 12.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
Comb Generator	Schaffner	RSG1000	3034	-	TU
Test Receiver	Rohde & Schwarz	ESU40	3506	12	18-Mar-2022
Cable (SMA to SMA, 2 m)	Rhophase	3PS-1801A-2000-3PS	4113	12	27-Jan-2023
Emissions Software	TUV SUD	EmX V2.1.12	5125	-	Software
Cable (N-Type to N-Type, 8 m)	Teledyne	PR90-088-8MTR	5450	6	01-Apr-2022
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB-40	5481	12	31-Mar-2022
Turntable & Mast Controller	Maturo Gmbh	NCD/498/2799.01	5612	-	TU
Tilt Antenna Mast	Maturo Gmbh	TAM 4.0-P	5613	-	TU
Turntable	Maturo Gmbh	Turntable 1.5 SI-2t	5614	-	TU
Antenna (Bi-Log, 30 MHz to 1 GHz)	Teseq	CBL6111D	5615	24	16-Oct-2022
Screened Room (12)	MVG	EMC-3	5621	36	11-Aug-2023

Table 31

TU - Traceability Unscheduled



2.5 Power Spectral Density

2.5.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (e)
ISED RSS-247, Clause 5.2
ISED RSS-GEN, Clause 6.12

2.5.2 Equipment Under Test and Modification State

Sensor RF module 2AA (US), S/N: US 2 - Modification State 0

2.5.3 Date of Test

16-April-2022

2.5.4 Test Method

This test was performed in accordance with ANSI C63.10, clause 11.10.2

2.5.5 Environmental Conditions

Ambient Temperature	24.5 °C
Relative Humidity	35.4 %



2.5.6 Test Results

Radio chip/PCB combination – Single (Standard) Mode

Frequency (MHz)	Power Spectral Density (dBm)	Measurement Bandwidth (kHz)
903.250	10.830	496.9
915	7.769	497.8
926.750	3.982	500.3

Table 32



Figure 60 – 903.250 MHz



Figure 61 – 915 MHz



Figure 62 – 926.750 MHz



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

2.5.7 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	05-Nov-2022
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	30-Jun-2022
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	08-Mar-2023
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5423	12	23-Jun-2022

Table 33

3 Photographs

3.1 Test Setup Photographs



Figure 63 - Test Setup - 30 MHz to 1 GHz - X Orientation



Figure 64 - Test Setup - 30 MHz to 1 GHz - Y Orientation

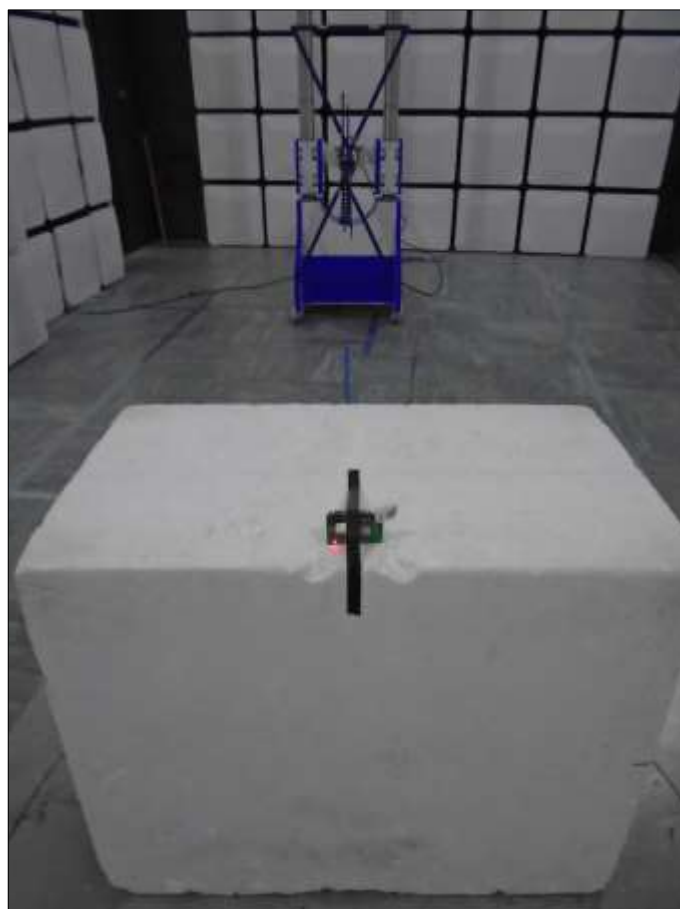


Figure 65 - Test Setup - 30 MHz to 1 GHz - Z Orientation



Figure 66 - Test Setup - 1 GHz to 10 GHz - X Orientation



Figure 67 - Test Setup - 1 GHz to 10 GHz - Y Orientation



Figure 68 - Test Setup - 1 GHz to 10 GHz - Z Orientation



4 Measurement Uncertainty

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

Test Name	Measurement Uncertainty
Emission Bandwidth	± 9.185 kHz
Maximum Conducted Output Power	± 3.2 dB
Spurious Radiated Emissions	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 40 GHz: ± 6.3 dB
Authorised Band Edges	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 40 GHz: ± 6.3 dB
Power Spectral Density	± 3.2 dB

Table 34

Measurement Uncertainty Decision Rule – Accuracy Method

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. (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.