FCC Test Report

MiX Telematics International (Pty) Ltd
Telematics Unit, Model: MiX 46MC-4G-B

In accordance with FCC 47 CFR Part 15B

Prepared for: MiX Telematics Europe Ltd
Cherry Orchard North
Kembrey Business Park
Swindon
Wiltshire
SN2 8UH
United Kingdom

Add value.
Inspire trust.

FCC ID: 2AFMS-4XMCXG

COMMERCIAL-IN-CONFIDENCE

Document 75948420-04 Issue 01

SIGNATURE			
NAME	**JOB TITLE**	**RESPONSIBLE FOR**	**ISSUE DATE**
Andy Lawson	Senior Engineer	Authorised Signatory	14 May 2020

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 15B. The sample tested was found to comply with the requirements defined in the applied rules.

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Testing	Graeme Lawler	14 May 2020	

FCC Accreditation
90987 Octagon House, Fareham Test Laboratory

EXECUTIVE SUMMARY
A sample of this product was tested and found to be compliant with FCC 47 CFR Part 15B: 2019 for the tests detailed in section 1.3.

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	14 May 2020

Table 1

1.2 Introduction

Applicant	MiX Telematics Europe Ltd
Manufacturer	MiX Telematics International (Pty) Ltd
Model Number(s)	MiX 46MC-4G-B
Manufacturer Declared Variant(s)	MiX 46MC-4G
Serial Number(s)	53000102
Hardware Version(s)	1
Software Version(s)	4.8
Number of Samples Tested	1
Test Specification/Issue/Date	FCC 47 CFR Part 15B: 2019
Order Number Date	P0093369 20-February-2020
Date of Receipt of EUT	02-March-2020
Start of Test	04-March-2020
Finish of Test	04-March-2020
Name of Engineer(s)	Graeme Lawler
Related Document(s)	ANSI C63.4: 2014

1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with FCC 47 CFR Part 15B are shown below.

Section	Specification Clause	Test Description	Result	Comments/Base Standard
Configuration and Mode: DC Powered - Idle				
2.1	15.109	Radiated Disturbance	Pass	ANSI C63.4: 2014

Table 2

1.4 Declaration of Build Status

Equipment Description

Technical Description: *(Please provide a brief description of the intended use of the equipment)*	The MiX 46MC-4G is a fleet product that incorporates the latest market trends. It consists mainly of an on-board computer, an LTE CAT M1 modem with 2G fall-back, a GNSS, an accelerometer, Low Energy Bluetooth, I/O, 2 x CAN, 2 x RS232, 4 x positive drives and 434 / 915 MHz short range transceiver.
Manufacturer:	MiX Telematics International (Pty) Ltd.
Model:	MiX 46MC-4G; MiX 46MC-4G-B
Part Number:	440FT0194; 440FT0195
Hardware Version:	1
Software Version:	4.8
FCC ID (if applicable)	2AFMS-4XMCXG
IC (if applicable)	

Intentional Radiators

Technology	LTE Band 12	LTE Band 13	LTE Band 5	LTE Band 4	LTE Band 3	LTE Band 2	SRD915	SRD2400
Frequency Band (MHz)	699-716	777-787	824-849	1710-1755	1710-1785	1880-1910	902-928	2400-2480
Conducted Declared Output Power (dBm)	23	23	23	23	23	23	20	7
Antenna Gain (dBi)	0.76	1.39	0.21	1.46	1.46	2.07	0	1.4
Supported Bandwidth(s) (MHz)	1.4	1.4	1.4	1.4	1.4	1.4	0.025	1
Modulation Scheme(s)	QPSK/ 16-QAM	QPSK/ 16-QAM	QPSK/ 16-QAM	QPSK/ 16-QAM	QPSK/ 16-QAM	QPSK/ 16-QAM	2FSK	GFSK
ITU Emission Designator	1M40W7D	1M40W7D	1M40W7D	1M40W7D	1M40W7D	1M40W7D	38K4F7D	1M00G7D
Bottom Frequency (MHz)	699	777	824	1710	1710	1850	902	2402
Middle Frequency (MHz)	707.5	782	836.5	1747.5	1747.5	1880	915	2440
Top Frequency (MHz)	716	787	849	1755	1785	1910	928	2480

Un-intentional Radiators

Highest frequency generated or used in the device or on which the device operates or tunes	2480 MHz
Lowest frequency generated or used in the device or on which the device operates or tunes	699 MHz
Class A Digital Device (Use in commercial, industrial or business environment) ☐ Class B Digital Device (Use in residential environment only) ☒	

AC Power Source

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

DC Power Source

Nominal voltage:	12 V DC	V
Extreme upper voltage:	32	V
Extreme lower voltage:	10.5	V
Max current:	2 A typical; 4.5 A absolute max (7.5 A Fused)	A

Battery Power Source

Voltage:	3.2	V
End-point voltage:	3.2	V *(Point at which the battery will terminate)*
Alkaline ☐ Leclanche ☒ Lithium ☐ Nickel Cadmium ☐ Lead Acid* ☐ **(Vehicle regulated)*		
Other ☐ Please detail:		

Charging

Can the EUT transmit whilst being charged	Yes ☒ No ☐

Temperature

Minimum temperature:	-20	°C
Maximum temperature:	60	°C

Antenna Characteristics

Antenna connector ☒			State impedance	50	Ohm
Temporary antenna connector ☐			State impedance		Ohm
Integral antenna ☒	Type:	LTE BLE SRD915 GNSS	Gain	3 1.4 0 4	dBi
External antenna ☒	Type:	GNSS	Gain	4	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 ☐

Ancillaries (if applicable)

Manufacturer:	MiX Telematics	Part Number:	440FT0033
Model:	Main Harness MP10	Country of Origin:	South Africa
Manufacturer:	MiX Telematics	Part Number:	440FT0032
Model:	Code Plug Harness with Socket CP4	Country of Origin:	South Africa
Manufacturer:	MiX Telematics	Part Number:	440FT0931
Model:	Serial Harness SR1	Country of Origin:	South Africa
Manufacturer:	RF Design	Part Number:	440FT0933
Model:	External GNSS Antenna PA2	Country of Origin:	South Africa

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

Name: Ben van der Merwe
Position held: Senior RF Engineer
Date: 3 March 2020

1.5 Manufacturer's Declared Variant(s)

The following product variants (with part numbers) are available:

Part ID	Official Name	Description
440FT0194	MiX 46MC-4G	MiX 4000 LTE with 2G fall back (Model 46MC-4G) Electronic Unit; with Magix 434MHz and 915MHz support.
440FT0195	MiX 46MC-4G-B	MiX 4000 LTE with 2G fall back (Model 46MC-4G-B) Electronic Unit with Battery (plugged in) with Magix 434MHz and 915MHz support.

The variants MiX 46MC-4G and MiX 46MC-4G-B, present the same electrical, physical and electro mechanics characteristics, the same PCB (440AWZ124), layout and components.

The only difference between them is that the model MiX 46MC-4G-B has an internal backup battery, allowing the device to work after the disconnection of the vehicle´s battery.

1.6 Product Information

1.6.1 Technical Description

The Equipment under Test (EUT) was a MiX 46MC-4G-B.

The primary function of the EUT is a fleet product that incorporates the latest market trends. It consists mainly of an on-board computer, an LTE CAT M1 modem with 2G fall-back, a GNSS, an accelerometer, Low Energy Bluetooth, I/O, 2 x CAN, 2 x RS232, 4 x positive drives and 434 / 915 MHz short range transceiver.

The EUT does not have any additional functionality.

1.6.2 EUT Port/Cable Identification

Port	Max Cable Length specified	Usage	Type	Screened
Configuration and Mode: DC Powered, Idle				
DC Input Line Ve+	1m	Power	12 V DC	No
DC Input Line Ve-	1m	Power	12 V DC	No
DC Input Port	1m	Power	12 V DC	No

Table 3

1.6.3 Test Configuration

Configuration	Description
DC Powered	The EUT was powered from a 12 V DC power supply.

Table 4

1.6.4 Modes of Operation

Mode	Description
Idle	All transmitters were configured to idle. GPS was set to receive.

Table 5

1.7 Deviations from the Standard

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

1.8 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: MiX 46MC-4G-B, Serial Number: 53000102			
0	As supplied by the customer	Not Applicable	Not Applicable

Table 6

1.9 Test Location

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

Test Name	Name of Engineer(s)	Accreditation
Configuration and Mode: DC Powered - Idle		
Radiated Disturbance	Graeme Lawler	UKAS

Table 7

Office Address:

Octagon House
Concorde Way
Segensworth North
Fareham, Hampshire
PO15 5RL
United Kingdom

2 Test Details

2.1 Radiated Disturbance

2.1.1 Specification Reference

FCC 47 CFR Part 15B, Clause 15.109

2.1.2 Equipment Under Test and Modification State

MiX 46MC-4G-B, S/N: 53000102 - Modification State 0

2.1.3 Date of Test

04-March-2020

2.1.4 Test Method

The EUT was set up in a semi-anechoic chamber on a remotely controlled turntable and placed on a non-conductive table 0.8m above a reference ground plane.

For an EUT which could reasonable 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.

A pre-scan of the EUT emissions profile was made at a 3 m distance while varying the antenna-to-EUT azimuth and polarisation using a peak detector.

Using a list of the highest emissions detected during the pre-scan along with their bearing and associated antenna polarisation, the EUT was finally measured using a Quasi-Peak, Peak or CISPR Average detector as appropriate.

The readings were maximised by adjusting the antenna height, polarisation and turntable azimuth, in accordance with the specification.

2.1.5 Example Calculation

Below 1 GHz:

Quasi-Peak level (dBµV/m) = Receiver level (dBµV) + Correction Factor (dB/m)
Margin (dB) = Quasi-Peak level (dBµV/m) - Limit (dBµV/m)

Above 1 GHz:

CISPR Average level (dBµV/m) = Receiver level (dBµV) + Correction Factor (dB/m)
Margin (dB) = CISPR Average level (dBµV/m) - Limit (dBµV/m)

Peak level (dBµV/m) = Receiver level (dBµV) + Correction Factor (dB/m)
Margin (dB) = Peak level (dBµV/m) - Limit (dBµV/m)

2.1.6 Example Test Setup Diagram

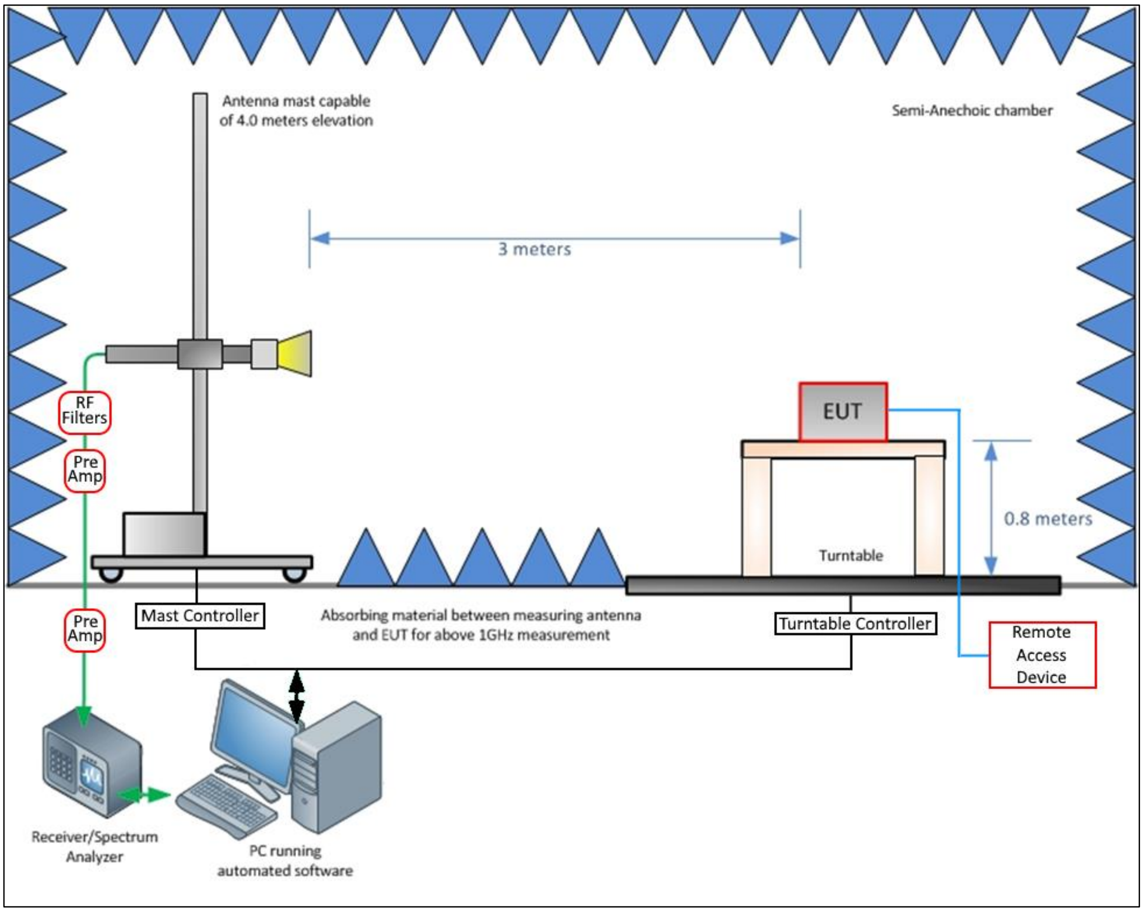

Figure 1 - Radiated Disturbance Example Test Setup

2.1.7 Environmental Conditions

Ambient Temperature 20.1 °C
Relative Humidity 33.0 %

2.1.8 Specification Limits

Required Specification Limits, Field Strength - Class B Test Limit at a 3 m Measurement Distance		
Frequency Range (MHz)	Test Limit (µV/m)	Test Limit (dBµV/m)
30 to 88	100	40.0
88 to 216	150	43.5
216 to 960	200	46.0
Above 960	500	54.0
Supplementary information: Note 1. A Quasi-peak detector is to be used for measurements below 1 GHz Note 2. A CISPR Average detector is to be used for measurements above 1 GHz Note 3. The Peak test limit above 1 GHz is 20 dB higher than the CISPR Average test limit.		

Table 8

2.1.9 Test Results

Results for Configuration and Mode: DC Powered - Idle.

This test was performed to the requirements of the Class B limits.

Performance assessment of the EUT made during this test: Pass.

Detailed results are shown below.

Highest frequency generated or used within the EUT: 2.480 GHz
Which necessitates an upper frequency test limit of: 13.000 GHz

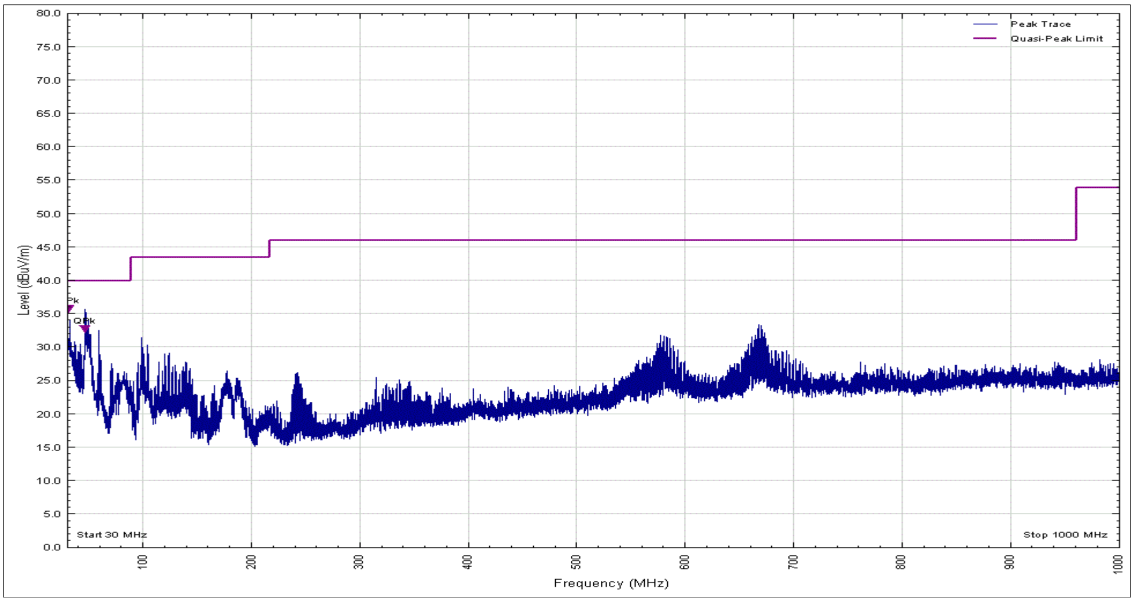

Figure 2 - 30 MHz to 1 GHz, Quasi-Peak, Vertical – X Orientation

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation	Orientation
31.823	34.88	40.00	5.12	Q-Peak	2	400	Vertical	X
46.126	31.81	40.00	8.19	Q-Peak	295	100	Vertical	X
60.466	21.34	40.00	18.66	Q-Peak	245	107	Vertical	X

Table 9

No other final measurements were made as all other peak emissions seen above the measurement system noise floor during the pre-scan were greater than 10 dB below the test limit.

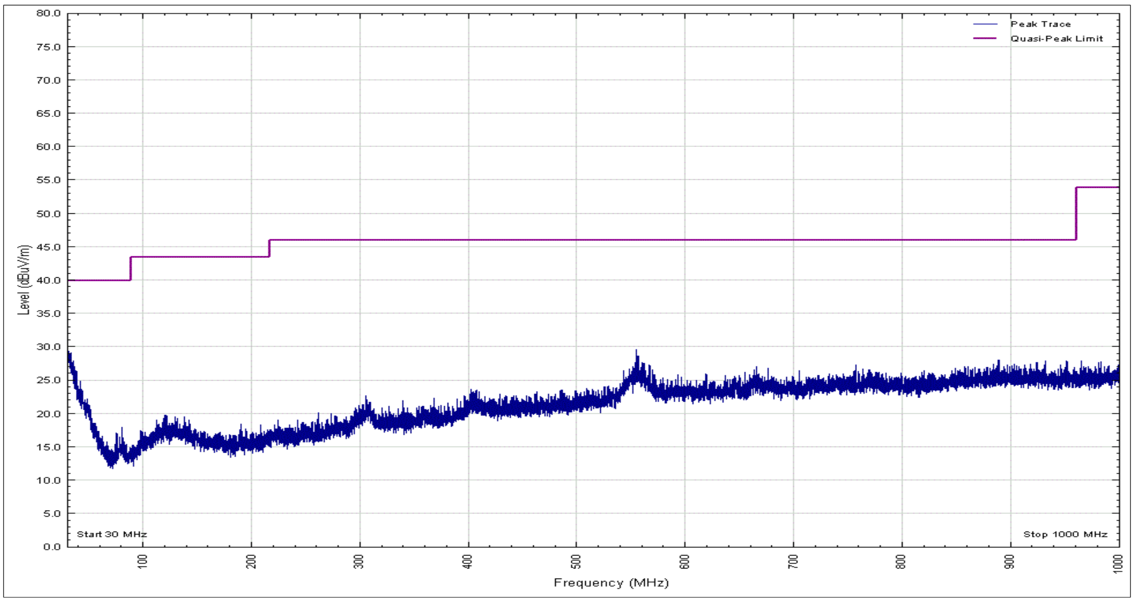

Figure 3 - 30 MHz to 1 GHz, Quasi-Peak, Horizontal – X Orientation

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

Table 10

*No final measurements were made as all peak emissions seen above the measurement system noise floor during the pre-scan were greater than 10 dB below the test limit.

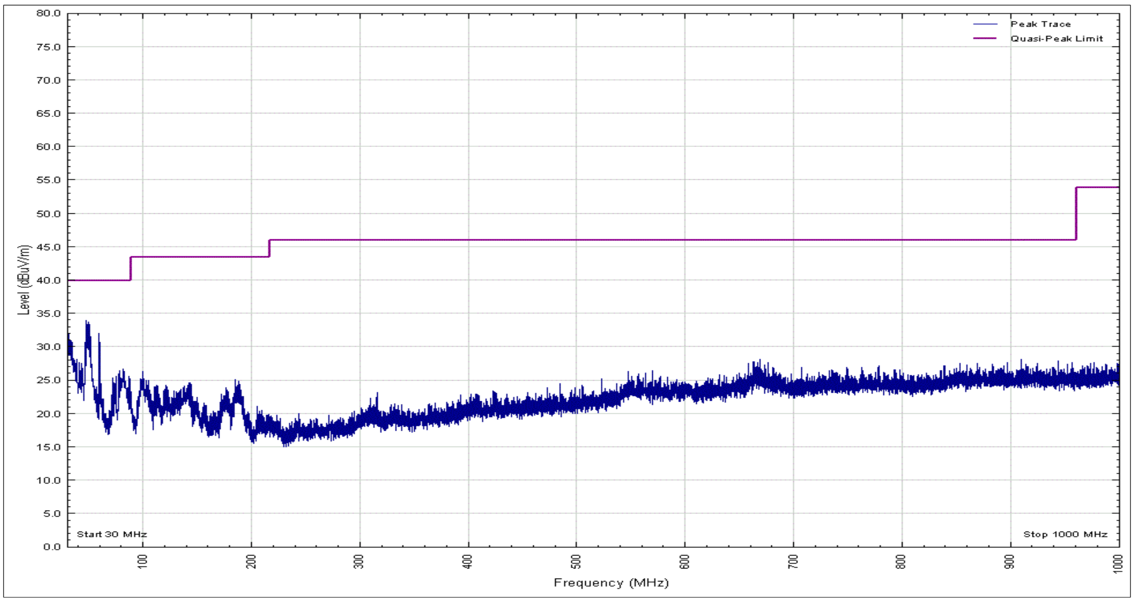

Figure 4 - 30 MHz to 1 GHz, Quasi-Peak, Vertical – Y Orientation

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation	Orientation
30.213	28.71	40.00	11.29	Q-Peak	343	400	Vertical	Y
46.954	27.22	40.00	12.78	Q-Peak	220	100	Vertical	Y
59.288	22.88	40.00	17.12	Q-Peak	258	100	Vertical	Y

Table 11

No other final measurements were made as all other peak emissions seen above the measurement system noise floor during the pre-scan were greater than 10 dB below the test limit.

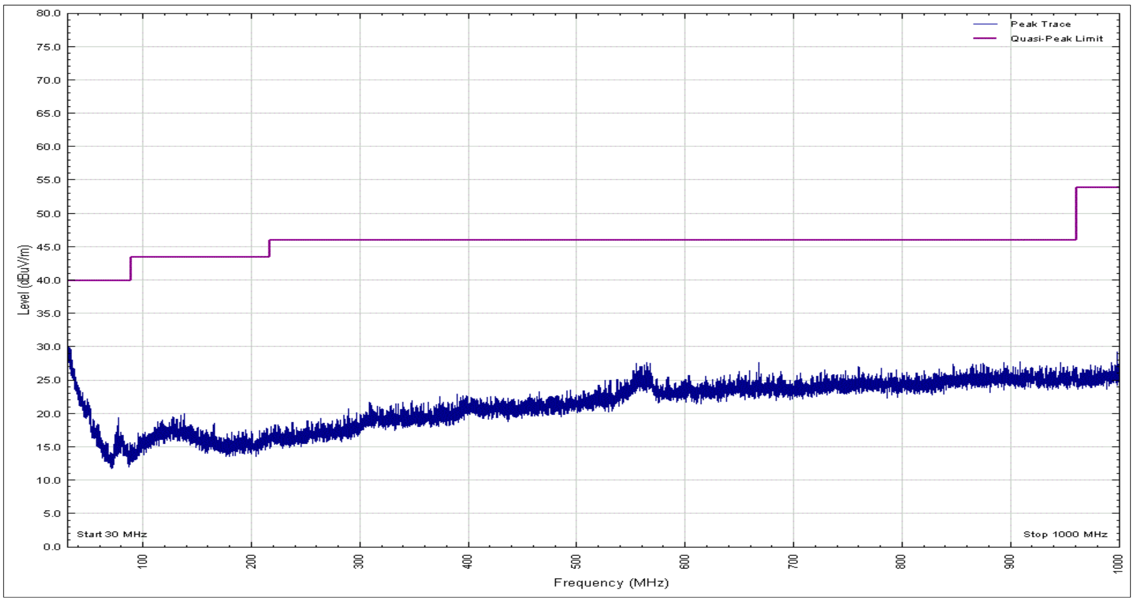

Figure 5 - 30 MHz to 1 GHz, Quasi-Peak, Horizontal – Y Orientation

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

Table 12

*No final measurements were made as all peak emissions seen above the measurement system noise floor during the pre-scan were greater than 10 dB below the test limit.

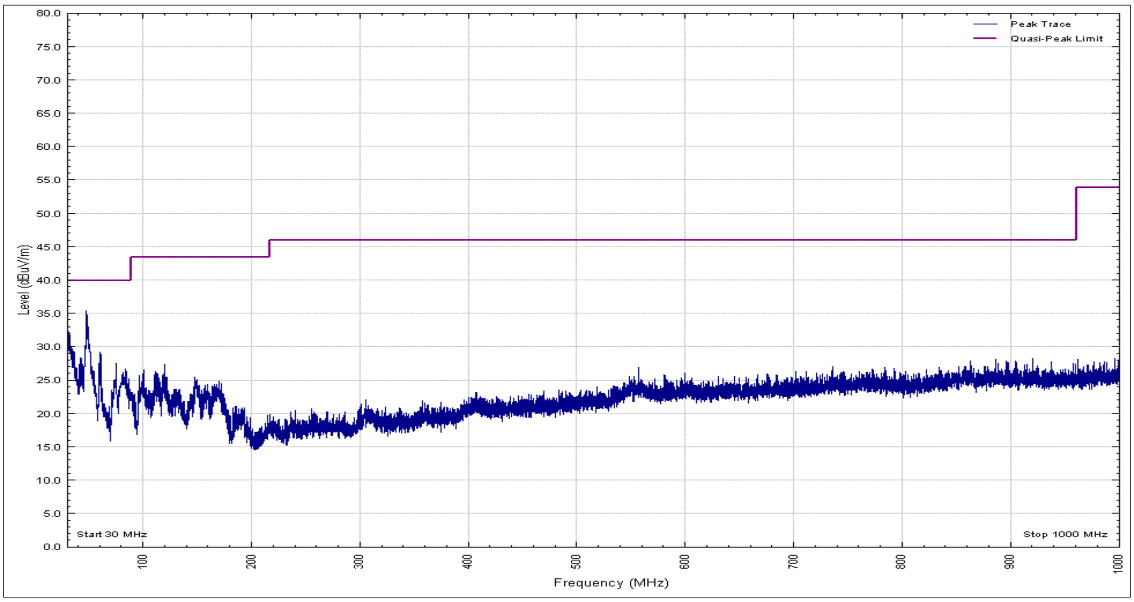

Figure 6 - 30 MHz to 1 GHz, Quasi-Peak, Vertical – Z Orientation

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation	Orientation
30.597	28.30	40.00	11.70	Q-Peak	123	273	Vertical	Z
48.233	29.97	40.00	10.03	Q-Peak	99	104	Vertical	Z

Table 13

No other final measurements were made as all other peak emissions seen above the measurement system noise floor during the pre-scan were greater than 10 dB below the test limit.

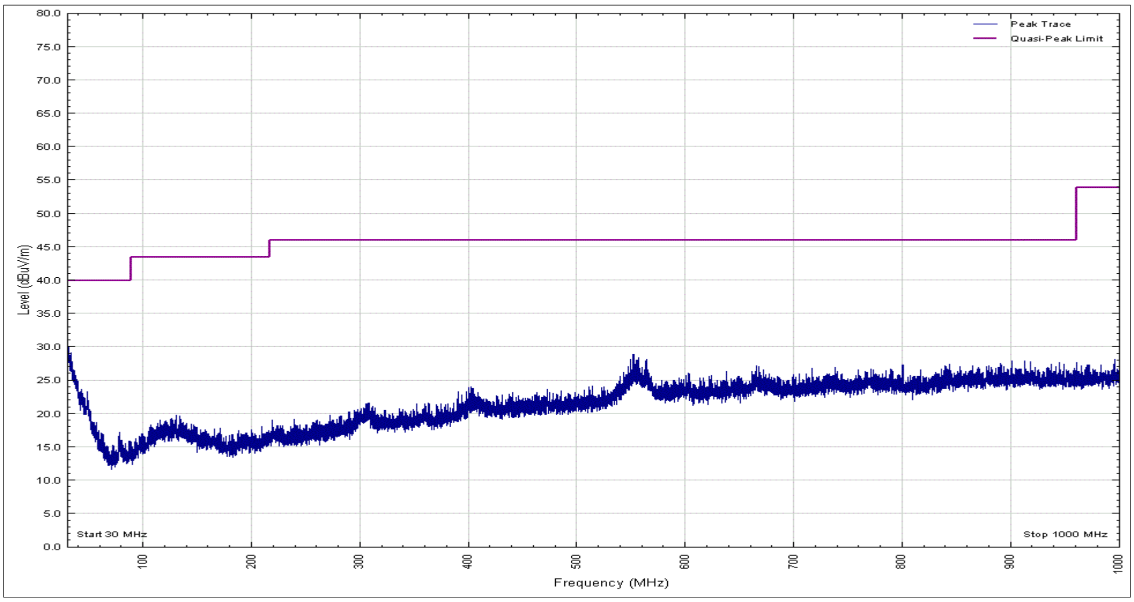

Figure 7 - 30 MHz to 1 GHz, Quasi-Peak, Horizontal – Z Orientation

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

Table 14

*No final measurements were made as all peak emissions seen above the measurement system noise floor during the pre-scan were greater than 10 dB below the test limit.

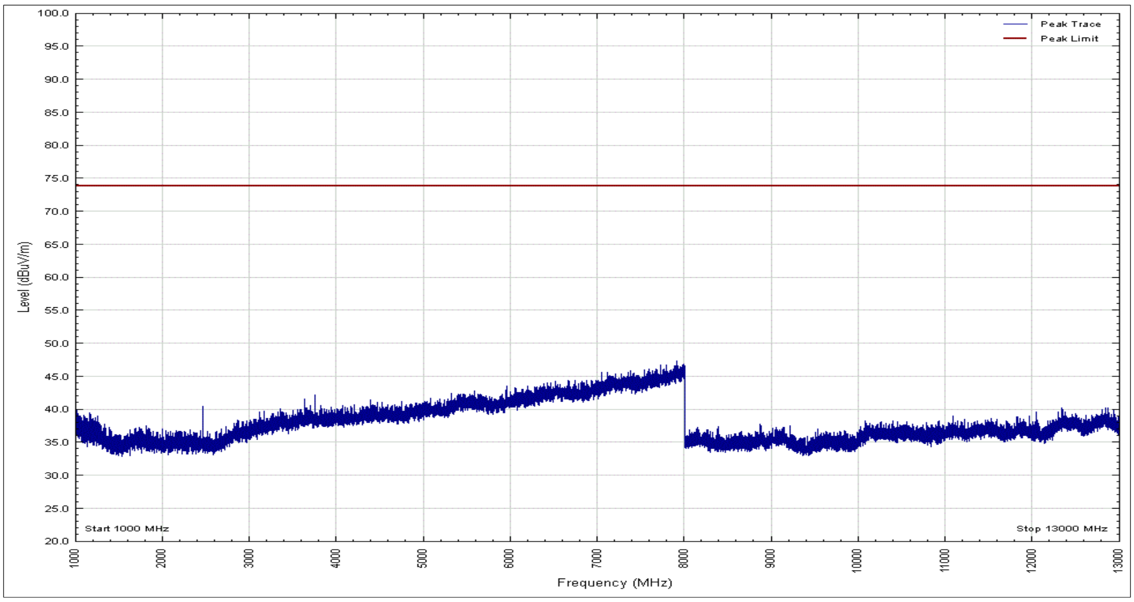

Figure 8 - 1 GHz to 13 GHz, Peak, Vertical – X Orientation

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

Table 15

*No final measurements were made as all peak emissions seen above the measurement system noise floor during the pre-scan were greater than 10 dB below the test limit.

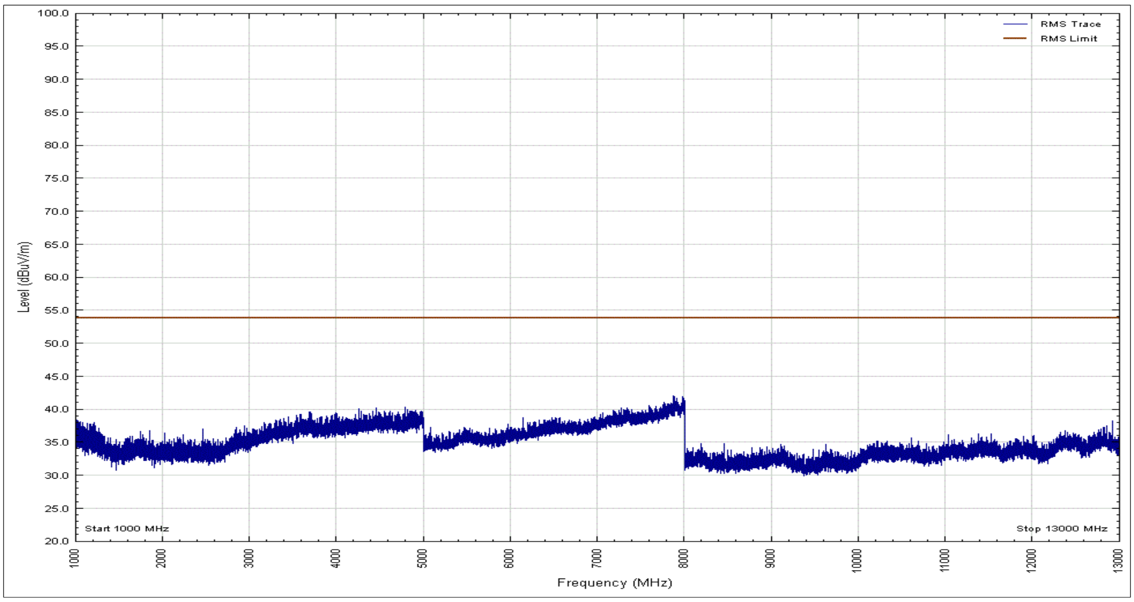

Figure 9 - 1 GHz to 13 GHz, CISPR Average, Vertical – X Orientation

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

Table 16

*No final measurements were made as all peak emissions seen above the measurement system noise floor during the pre-scan were greater than 10 dB below the test limit.

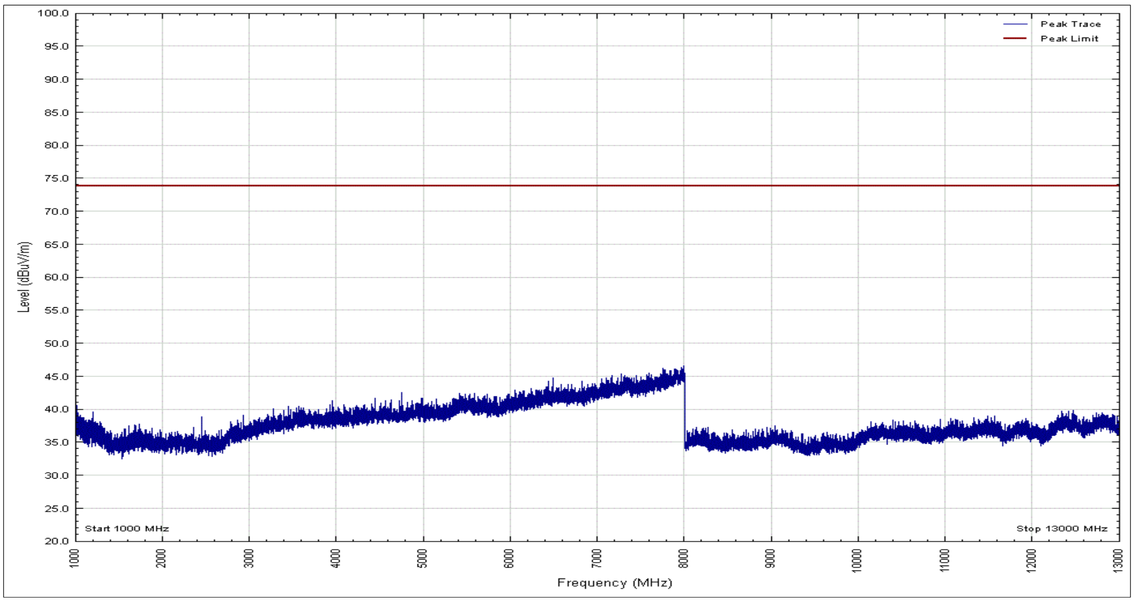

Figure 10 - 1 GHz to 13 GHz, Peak, Horizontal – X Orientation

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

Table 17

*No final measurements were made as all peak emissions seen above the measurement system noise floor during the pre-scan were greater than 10 dB below the test limit.

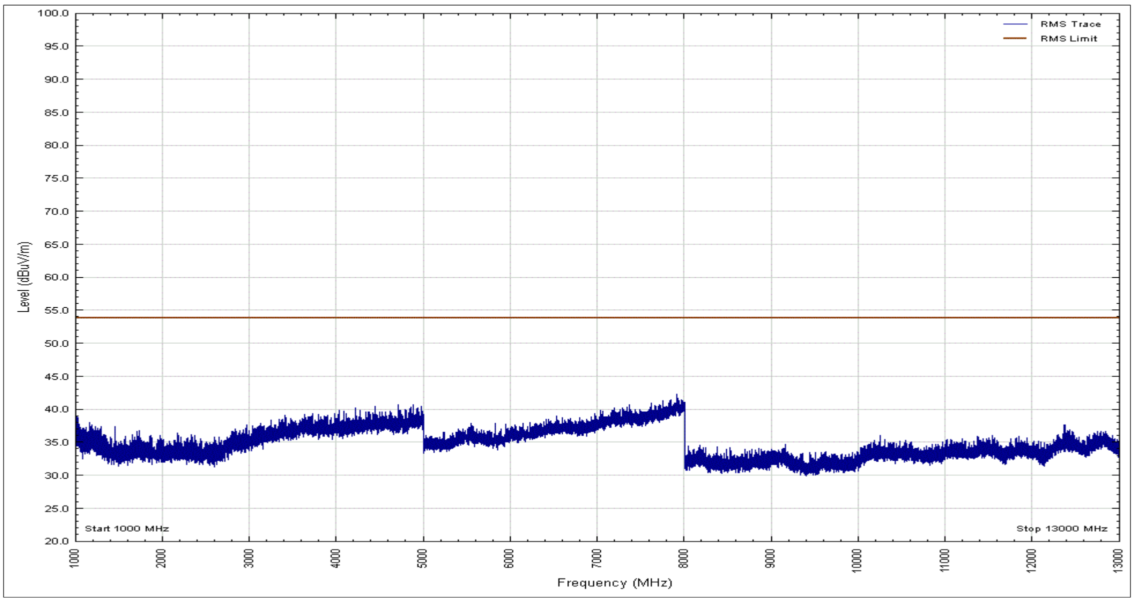

Figure 11 - 1 GHz to 13 GHz, CISPR Average, Horizontal – X Orientation

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

Table 18

*No final measurements were made as all peak emissions seen above the measurement system noise floor during the pre-scan were greater than 10 dB below the test limit.

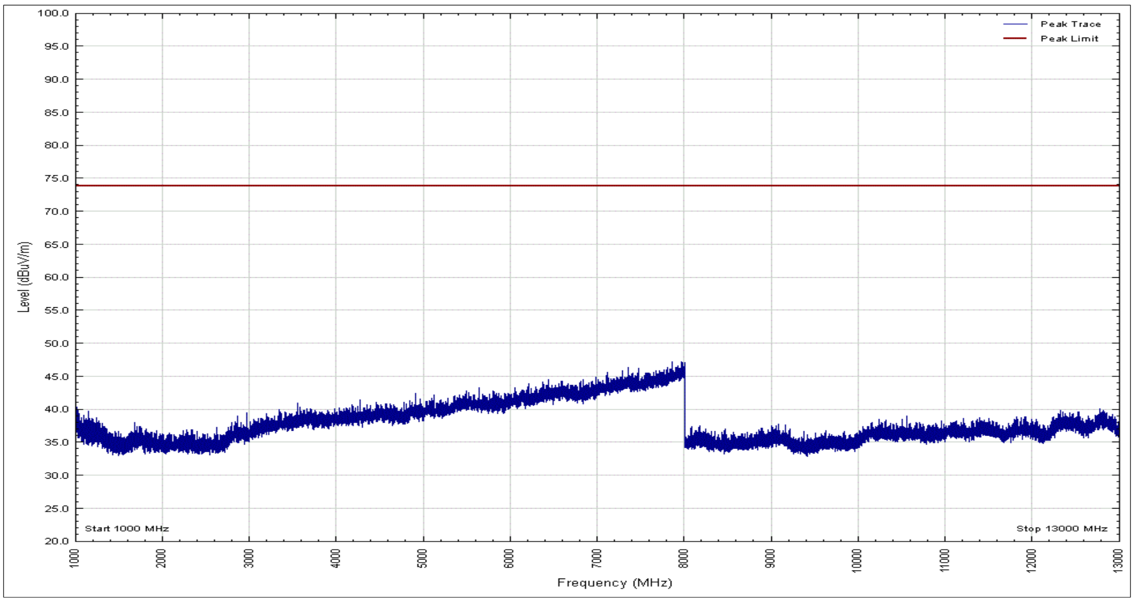

Figure 12 - 1 GHz to 13 GHz, Peak, Vertical – Y Orientation

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

Table 19

*No final measurements were made as all peak emissions seen above the measurement system noise floor during the pre-scan were greater than 10 dB below the test limit.

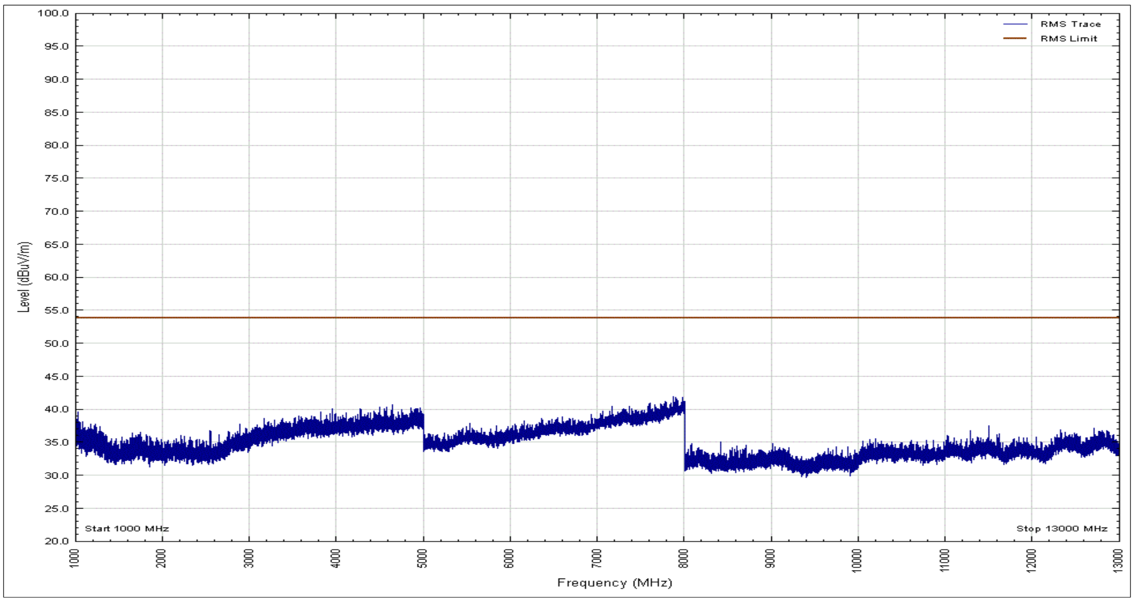

Figure 13 - 1 GHz to 13 GHz, CISPR Average, Vertical – Y Orientation

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

Table 20

*No final measurements were made as all peak emissions seen above the measurement system noise floor during the pre-scan were greater than 10 dB below the test limit.

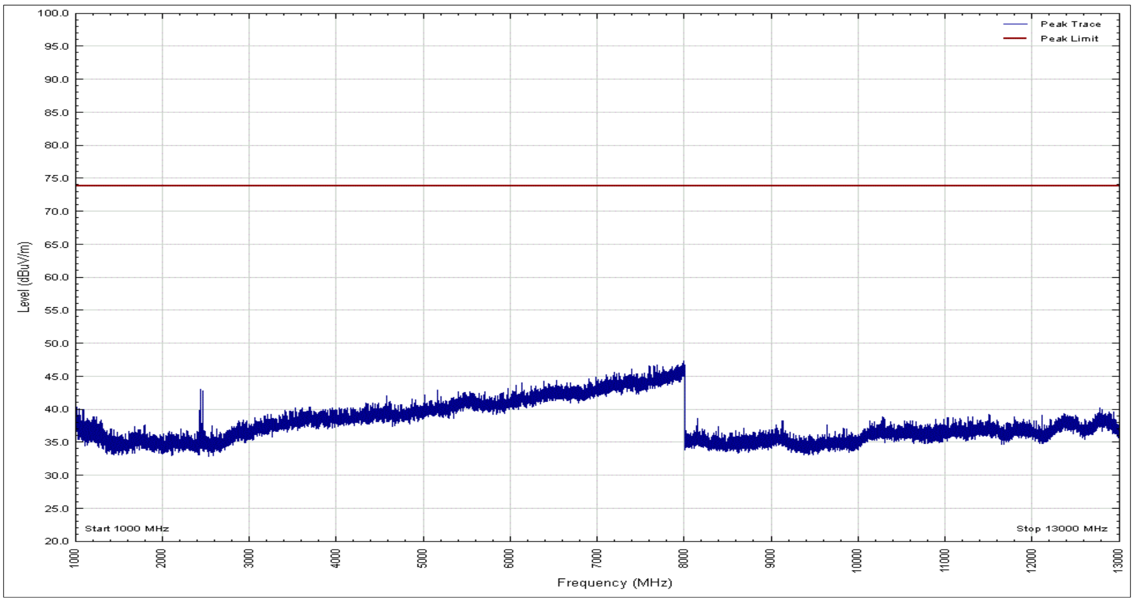

Figure 14 - 1 GHz to 13 GHz, Peak, Horizontal – Y Orientation

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

Table 21

*No final measurements were made as all peak emissions seen above the measurement system noise floor during the pre-scan were greater than 10 dB below the test limit.

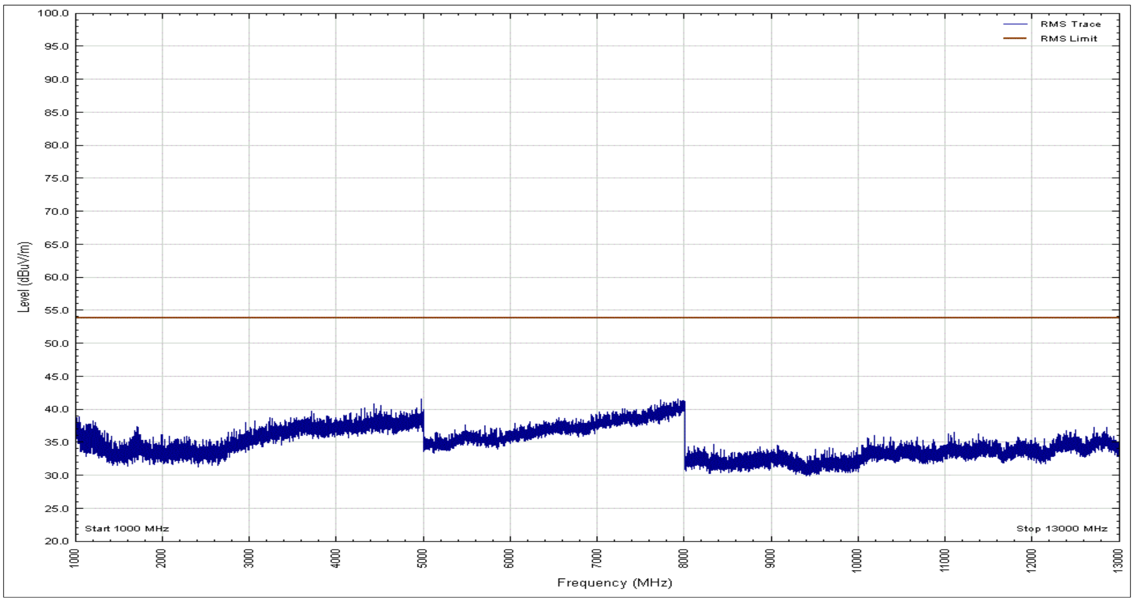

Figure 15 - 1 GHz to 13 GHz, CISPR Average, Horizontal – Y Orientation

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

Table 22

*No final measurements were made as all peak emissions seen above the measurement system noise floor during the pre-scan were greater than 10 dB below the test limit.

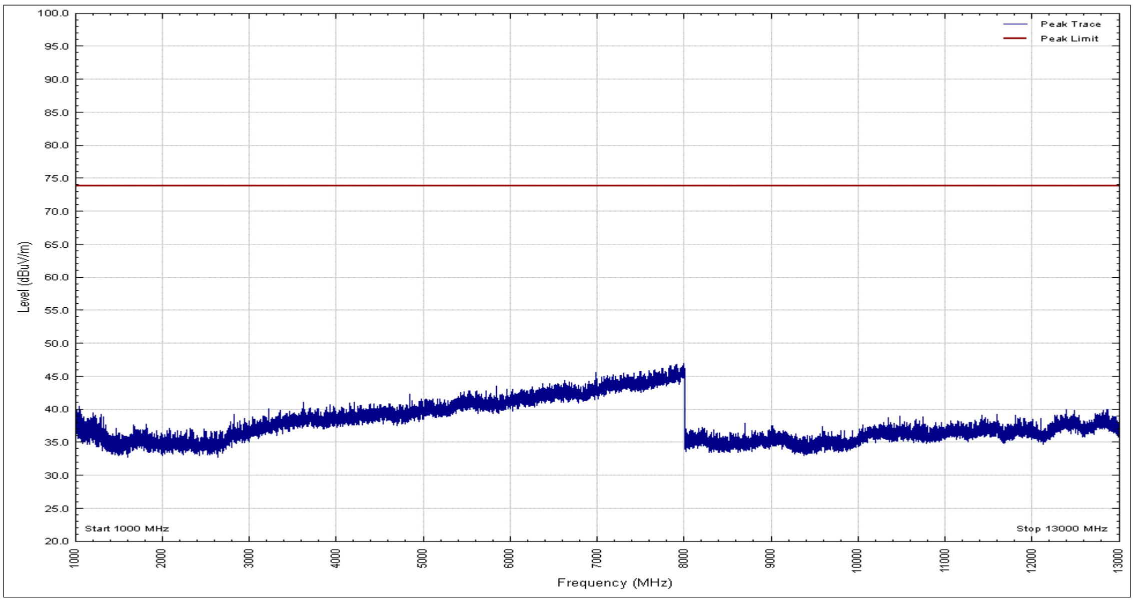

Figure 16 - 1 GHz to 13 GHz, Peak, Vertical – Z Orientation

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

Table 23

*No final measurements were made as all peak emissions seen above the measurement system noise floor during the pre-scan were greater than 10 dB below the test limit.

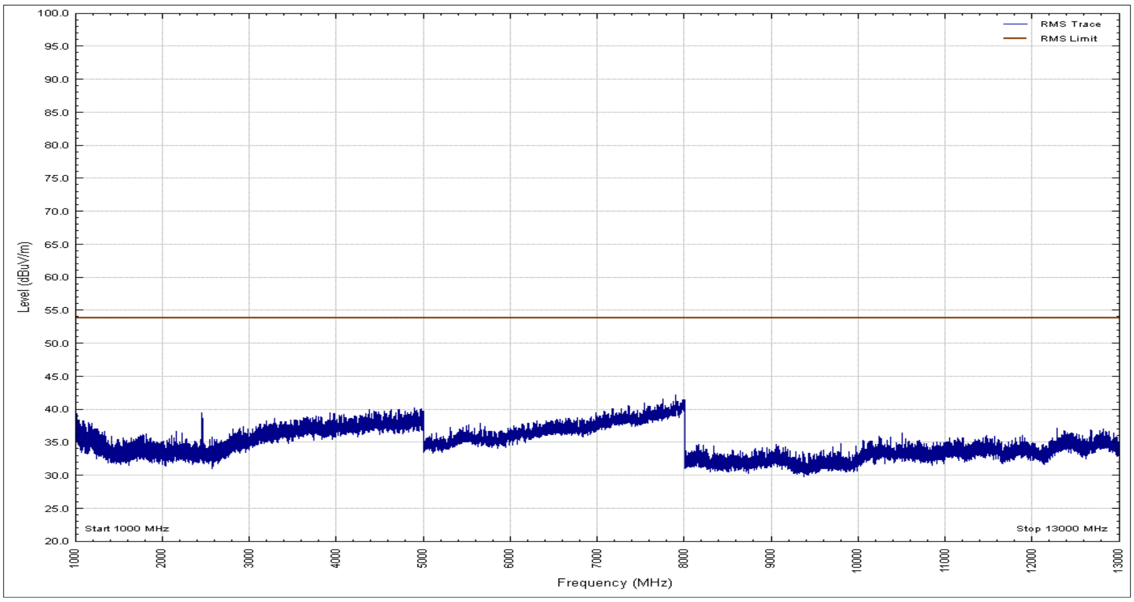

Figure 17 - 1 GHz to 13 GHz, CISPR Average, Vertical – Z Orientation

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

Table 24

*No final measurements were made as all peak emissions seen above the measurement system noise floor during the pre-scan were greater than 10 dB below the test limit.

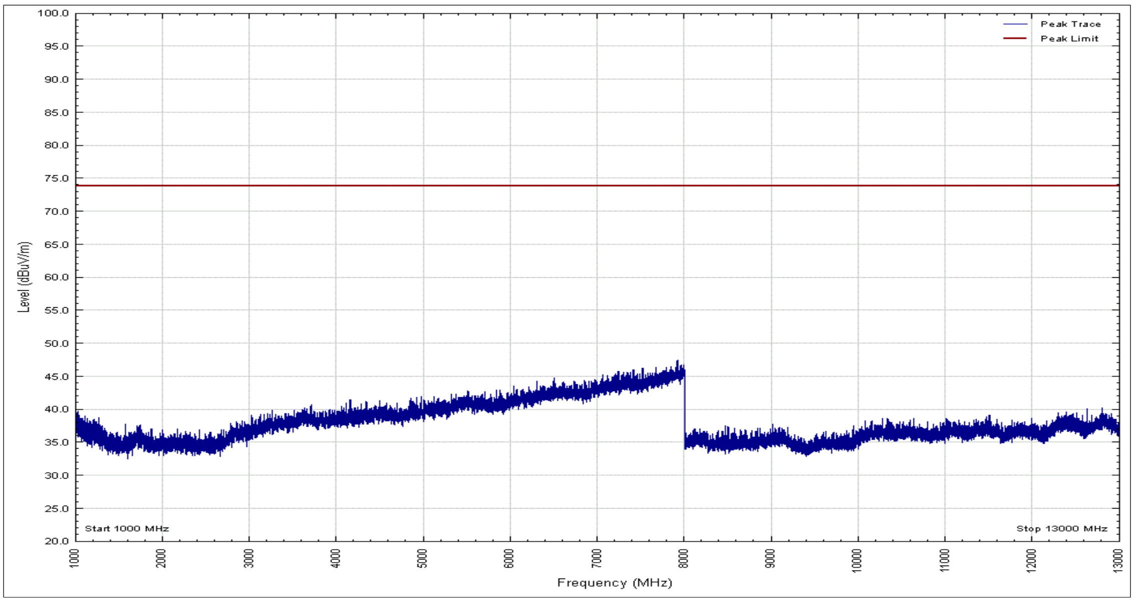

Figure 18 - 1 GHz to 13 GHz, Peak, Horizontal – Z Orientation

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

Table 25

*No final measurements were made as all peak emissions seen above the measurement system noise floor during the pre-scan were greater than 10 dB below the test limit.

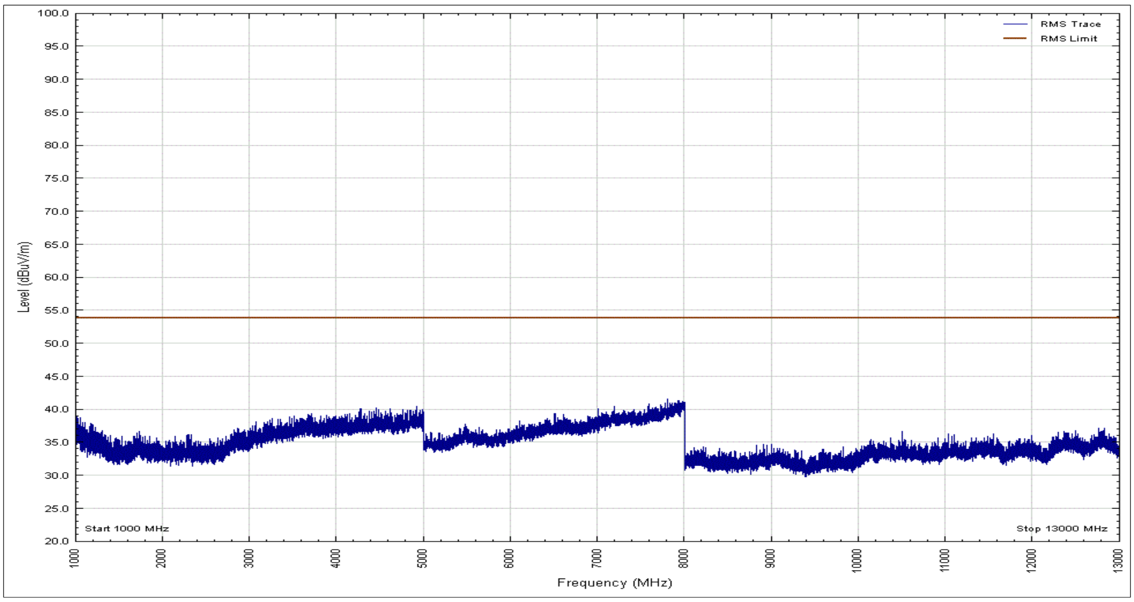

Figure 19 - 1 GHz to 13 GHz, CISPR Average, Horizontal – Z Orientation

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

Table 26

*No final measurements were made as all peak emissions seen above the measurement system noise floor during the pre-scan were greater than 10 dB below the test limit.

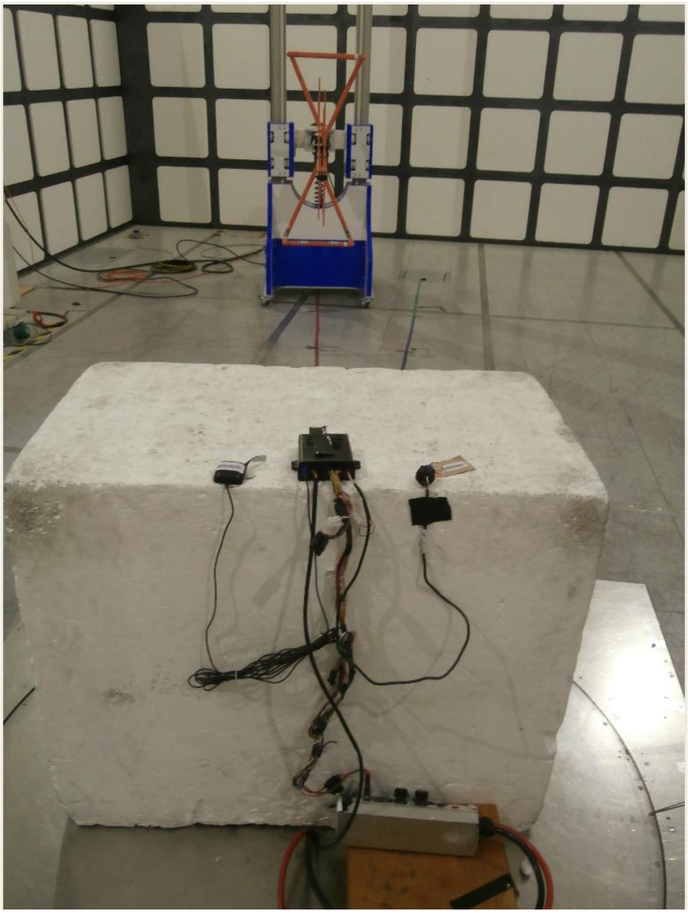

Figure 20 - Test Setup - 30 MHz to 1 GHz – X Orientation

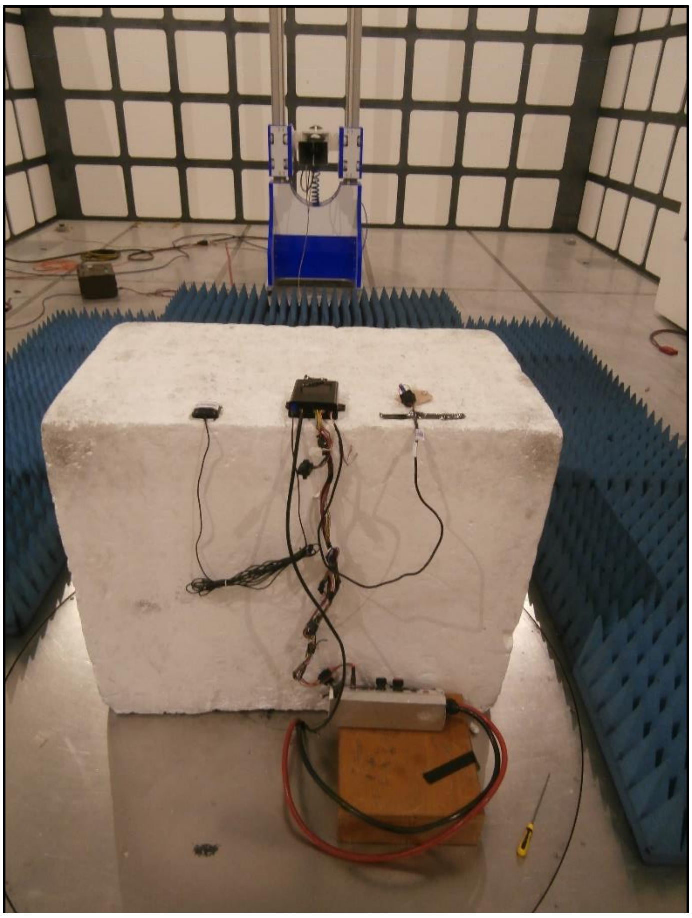

Figure 21 - Test Setup - 1 GHz to 13 GHz – X Orientation

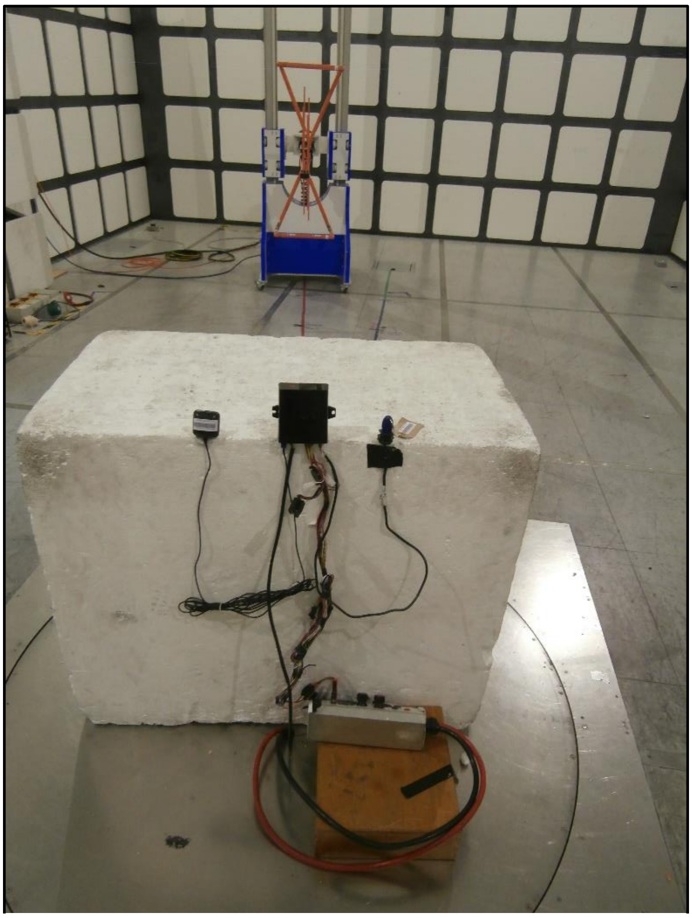

Figure 22 - Test Setup - 30 MHz to 1 GHz – Y Orientation

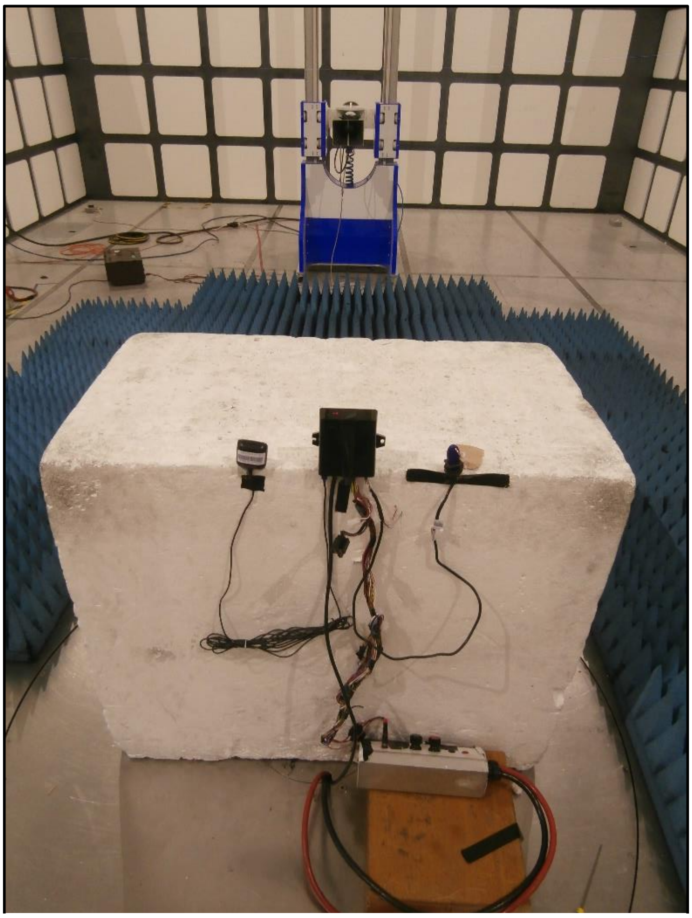

Figure 23 - Test Setup - 1 GHz to 13 GHz – Y Orientation

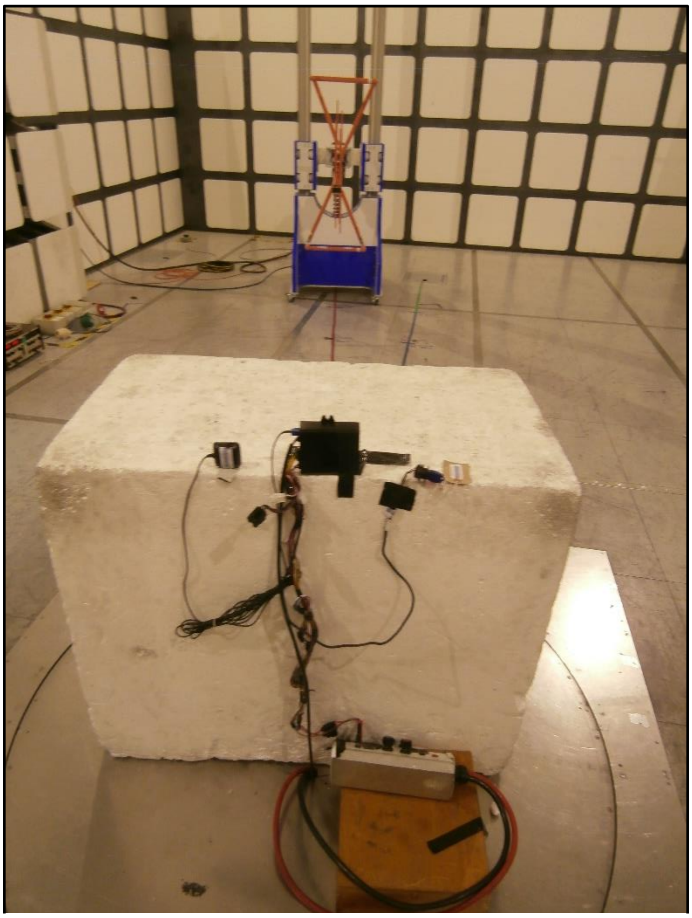

Figure 224 - Test Setup - 30 MHz to 1 GHz – Z Orientation

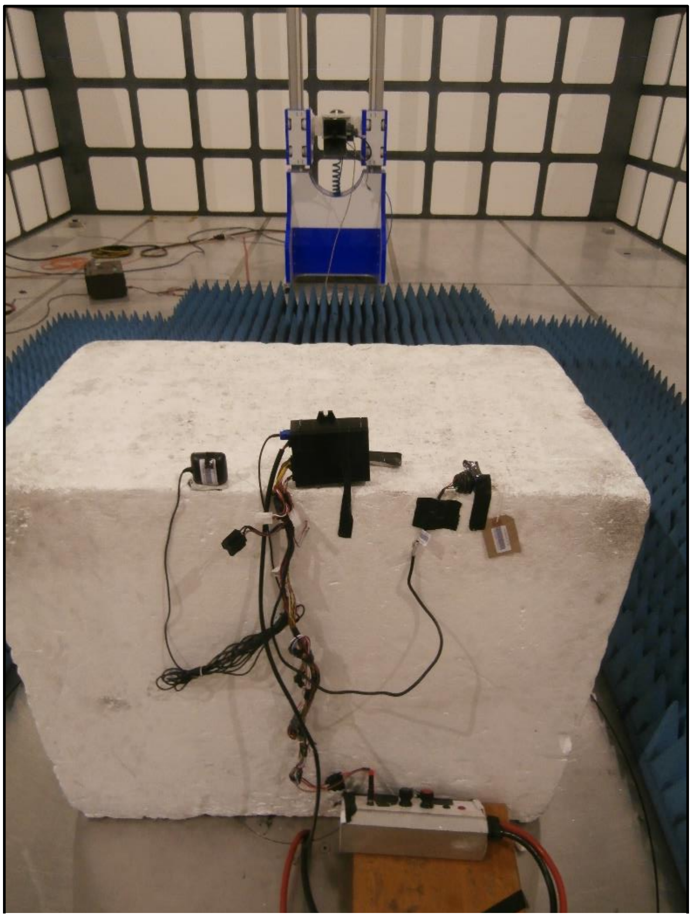

Figure 235 - Test Setup - 1 GHz to 13 GHz – Z Orientation

2.1.10 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 Due
Screened Room (5)	Rainford	Rainford	1545	36	23-Jan-2021
EmX Emissions Software	TUV SUD	EmX	5125	-	Software
EMI Test Receiver	Rohde & Schwarz	ESW44	5382	12	08-Oct-2020
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Mast Controller	Maturo Gmbh	NCD	4810	-	TU
Tilt Antenna Mast	Maturo Gmbh	TAM 4.0-P	4811	-	TU
4dB Attenuator	Pasternack	PE7047-4	4935	24	30-Sep-2021
Antenna with permanent attenuator (Bilog)	Chase	CBL6143	2904	24	30-Sep-2021
Preamplifier (30dB 1GHz to 18GHz)	Schwarzbeck	BBV 9718 C	5350	12	21-Aug-2020
Double Ridge Broadband Horn Antenna	Schwarzbeck	BBHA 9120 B	4848	12	11-Mar-2020
Antenna (DRG Horn 7.5-18GHz)	Schwarzbeck	HWRD750	5348	12	04-Sep-2020
Cable (Yellow, Rx, Km-Km 2m)	Scott Cables	KPS-1501-2000-KPS	4527	6	09-Jun-2020
Hygrometer	Rotronic	HP21	4989	12	02-May-2020
8 Meter Cable	Teledyne	PR90-088-8MTR	5212	12	30-Aug-2020
DC Power Supply	Hewlett Packard	6269B	1909	-	TU
Multimeter	Iso-tech	IDM101	2417	12	11-Nov-2020
Comb Generator	Schaffner	RSG1000	3034	-	TU

Table 27

TU - Traceability Unscheduled

3 Incident Reports

No incidents reports were raised.

4 Measurement Uncertainty

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

Test Name	Measurement Uncertainty
Radiated Disturbance	30 MHz to 1 GHz, Bilog Antenna, ±5.2 dB 1 GHz to 40 GHz, Horn Antenna, ±6.3 dB

Table 28

Worst case error for both Time and Frequency measurement 12 parts in 10^6.

Measurement Uncertainty Decision Rule

Determination of conformity with the specification limits is based on the decision rule according to IEC Guide 115: 2007, clause 4.4.3 and 4.5.1.