FCC Test Report

MiX Telematics International (Pty) Ltd
Telematics Unit, Model: MiX 44MC-3G-B

In accordance with FCC 47 CFR Parts 15 and 22 and 24 (Simultaneous Transmission)

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

FCC ID: 2AFMS-44MC3G

COMMERCIAL-IN-CONFIDENCE

Document 75947039-04 Issue 01

SIGNATURE			
NAME	**JOB TITLE**	**RESPONSIBLE FOR**	**ISSUE DATE**
Simon Bennett	Innovations Manager	Authorised Signatory	16 December 2019

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 Parts 15 and 22 and 24 (Simultaneous Transmission). The sample tested was found to comply with the requirements defined in the applied rules.

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Testing	Graeme Lawler	16 December 2019	

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 Parts 15 and 22 and 24 (Simultaneous Transmission): 2018 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	16 December 2019

Table 1

1.2 Introduction

Applicant	MiX Telematics Europe Ltd
Manufacturer	MiX Telematics International (Pty) Ltd
Model Number(s)	MiX 44MC-3G-B
Manufacturer's Declared Variant(s)	MiX 44MC-3G
Serial Number(s)	51000125
Hardware Version(s)	1
Software Version(s)	4.4.7
Number of Samples Tested	1
Test Specification/Issue/Date	FCC 47 CFR Parts 15 and 22 and 24 (Simultaneous Transmission): 2018
Order Number Date	P0092481 13-September-2019
Date of Receipt of EUT	21-October-2019
Start of Test	04-November-2019
Finish of Test	05-November-2019
Name of Engineer(s)	Graeme Lawler
Related Document(s)	ANSI C63.10: 2013 ANSI C63.26: 2015

1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with FCC 47 CFR Parts 15 and 22 and 24 (Simultaneous Transmission) is shown below.

Section	Specification Clause			Test Description	Result	Comments/Base Standard
	FCC Part 15	FCC Part 22	FCC Part 24			
Configuration and Mode: DC Powered - Bluetooth Low Energy + 915 MHz SRD + WCDMA FDD II						
2.1	15.247 (d), 15.407 (b) and 15.205	22.917 (a)	24.238 (a)	Radiated Spurious Emissions (Simultaneous Transmission)	Pass	
Configuration and Mode: DC Powered - Bluetooth Low Energy + 915 MHz SRD + WCDMA FDD V						
2.1	15.247 (d), 15.407 (b) and 15.205	22.917 (a)	24.238 (a)	Radiated Spurious Emissions (Simultaneous Transmission)	Pass	
Configuration and Mode: DC Powered - Bluetooth Low Energy + 915 MHz SRD + GSM 850						
2.1	15.247 (d), 15.407 (b) and 15.205	22.917 (a)	24.238 (a)	Radiated Spurious Emissions (Simultaneous Transmission)	Pass	
Configuration and Mode: DC Powered - BLE + 915 MHz SRD + PCS 1900						
2.1	15.247 (d), 15.407 (b) and 15.205	22.917 (a)	24.238 (a)	Radiated Spurious Emissions (Simultaneous Transmission)	Pass	

Table 2

1.4 Application Form

Equipment Description

Technical Description: *(Please provide a brief description of the intended use of the equipment)*	he MiX 4000 LTE is a fleet product that incorporates the latest market trends. It consists mainly of an on-board computer, a 3G modem, a GNSS, an accelerometer, Low Energy Bluetooth, I/O, 2 x CAN, 2 x RS232, 4 x positive drives and a dual 434MHz / 915MHz short range transceiver.
Manufacturer:	MiX Telematics International (Pty) Ltd
Model:	MiX 44MC-3G; MiX 44MC-3G-B
Part Number:	U0032MT; U0034MT
Hardware Version:	1
Software Version:	4.4.7
FCC ID (if applicable)	2AFMS-44MC3G
IC ID (if applicable)	

Technology	DSS	BLE	GSM	E-GSM	DCS	PCS	UTMS 19	UTMS 5	UTMS 8	UTMS 2	UTMS 1
Frequency Band (MHz)	915	2400	850	900	1800	1900	800	850	900	1900	2100
Conducted Declared Output Power (dBm)	20	7	33	33	30	30	24	24	24	24	24
Antenna Gain (dBi)	0	1.4	3.5	2	3.5	3.6	3.5	3.5	2	3.6	3.7
Supported Bandwidth(s) (MHz)	25 kHz	BLE	25	35	75	60	30	35		65	60
Modulation Scheme(s)	2FSK	GFSK									
ITU Emission Designator	F1D	F1D	300K GXW	300K GXW	300K GXW	300K GXW	1M25 F9W	1M25 F9W	1M25 F9W	1M25 F9W	1M25 F9W
Bottom Frequency (MHz)	902	2402	869	925	1805	1930	791	859		1930	2110
Middle Frequency (MHz)	915	2440	881.5	942.5	1842.5	1960	806	876.5		1962.5	2140
Top Frequency (MHz)	928	2480	894	960	1880	1990	821	894		1995	2170

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		V
Max current:		A
Single Phase ☐ Three Phase ☐		

DC Power Source

Nominal voltage:	12/24	V
Extreme upper voltage:	33	V
Extreme lower voltage:	10.5	V
Max current:	4.5	A

Battery Power Source

Voltage:	3.2	V
End-point voltage:	2.5	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 (with backup battery)	°C
Maximum temperature:	60 (with backup battery)	°C

Antenna Characteristics

Antenna connector ☒			State impedance	50	Ohm
Temporary antenna connector ☐			State impedance		Ohm
Integral antenna ☐	Type:	SRD915, BLE	State impedance		dBI
External antenna ☐	Type:	GNSS	State impedance		dBI

Ancillaries (if applicable)

Manufacturer:	RF Design	Part Number:	440FT0933
Model:	External GNSS Antenna PA2	Country of Origin:	South Africa

Manufacturer:	MiX Telematics	Part Number:	440FT0073
Model:	Driver Plug	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:	MiX Telematics	Part Number:	440FT0033
Model:	Main Harness MP10	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: 18 Oct 2019

1.5 Manufacturer's Declared Variants

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

Part ID	Official Name	Modem	Description
U0032MT	MiX 44MC-3G	SARA-U201 (3G)	MiX 44MC-3G (SARA-U201) with SRD (433MHz and 915MHz)

Both variants listed above contain the same PCB (440AWZ124) and electronic circuitry. The only difference is that MiX 44MC-3G-B has a backup battery fitted and the MiX 44MC-3G not.

1.6 Product Information

1.6.1 Technical Description

The MiX 4000 is a fleet product that incorporates the latest market trends. It consists mainly of an on-board computer, a 3G modem, a GNSS, an accelerometer, Low Energy Bluetooth, I/O, 2 x CAN, 2 x RS232, 4 x positive drives and 434MHz / 915MHz short range transceiver.

1.6.2 Test Setup Diagram(s)

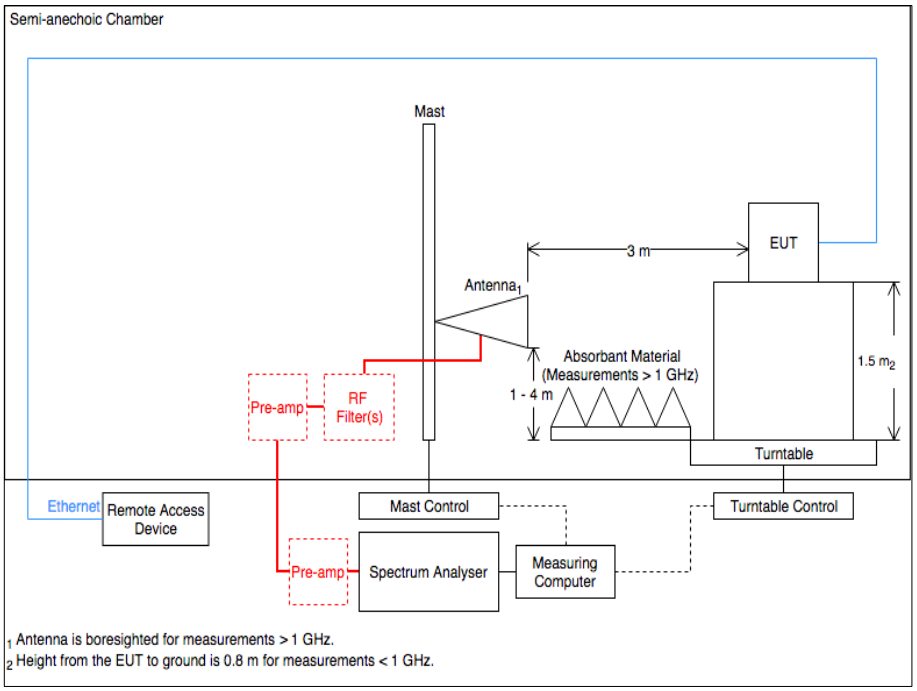

Figure 1 - Radiated Emissions

1.6.3 EUT Configuration and Rationale for Radiated Spurious Emissions

The EUT was powered by 13.6 V DC. The EUT was placed on the non-conducting platform in a manner typical of a normal installation. For an EUT which could reasonably 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.

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 44MC-3G-B: Serial Number: 51000125			
0	As supplied by the customer	Not Applicable	Not Applicable
1	To achieve 0.5dB margin on the spurious emission at 964.942MHz, the output power of the 915 MHz SRD transmitter was reduced from 127 to 34. This was only for testing in the 1900 MHz GSM band.	Benjamin VanDerMere	05-November-2019

Table 3

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 - Bluetooth Low Energy + 915 MHz SRD + WCDMA FDD II		
Radiated Spurious Emissions (Simultaneous Transmission)	Graeme Lawler	UKAS
Configuration and Mode: DC Powered - Bluetooth Low Energy + 915 MHz SRD + WCDMA FDD V		
Radiated Spurious Emissions (Simultaneous Transmission)	Graeme Lawler	UKAS
Configuration and Mode: DC Powered - Bluetooth Low Energy + 915 MHz SRD + GSM 850		
Radiated Spurious Emissions (Simultaneous Transmission)	Graeme Lawler	UKAS
Configuration and Mode: DC Powered - BLE + 915 MHz SRD + PCS 1900		
Radiated Spurious Emissions (Simultaneous Transmission)	Graeme Lawler	UKAS

Table 4

Office Address:

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

2 Test Details

2.1 Radiated Spurious Emissions (Simultaneous Transmission)

2.1.1 Specification Reference

FCC 47 CFR Part 15, Clause 15.247 (d), 15.407 (b) and 15.205
FCC 47 CFR Part 22, Clause 22.917 (a)
FCC 47 CFR Part 24, Clause 24.238 (a)

2.1.2 Equipment Under Test and Modification State

MiX 44MC-3G-B, S/N: 51000125 - Modification State 0 and 1

2.1.3 Date of Test

04-November-2019 to 05-November-2019

2.1.4 Test Method

Testing was performed in accordance with FCC Part 24, Clause 24.238 and ANSI C63.26, Clause 5.5.

Prescans and final measurements were performed using the direct field strength method. The limit line on the prescan plots was calculated from equation c) in clause 5.2.7 of ANSI C63.26.

Example Calculation:

E (dBuV/m) = EIRP (dBm) - 20log (d) + 104.8 where (d) is the far field measurement distance.
E (dBuV/m) = -13 - 20log (3) + 104.8
E (dBuV/m) = 82.26

2.1.5 Environmental Conditions

Ambient Temperature	19.3 °C
Relative Humidity	56.0 %

2.1.6 Test Results

DC Powered - Bluetooth Low Energy + 915 MHz SRD + WCDMA FDD II

The EUT was configured for simultaneous transmission in the following mode of operation:

Technology	Frequency Band (MHz)	Channel Frequency (MHz)
Bluetooth Low Energy	2400 MHz to 2483.5 MHz	2440
SRD	902 MHz to 928 MHz	915
WCDMA	FDD II	1880

Table 5 - Modes of Operation

Frequency (GHz)	Result (dBµV/m)		Limit (dBµV/m)		Margin (dB)		Angle (°)	Height (cm)	Polarisation
	Peak	Average	Peak	Average	Peak	Average			
3.757860	74.65	-	82.26	-	-7.61	-	168	1.79	Vertical

Table 6 - 30 MHz to 25 GHz Emissions Results

No other emissions were detected within 10 dB of the limit.

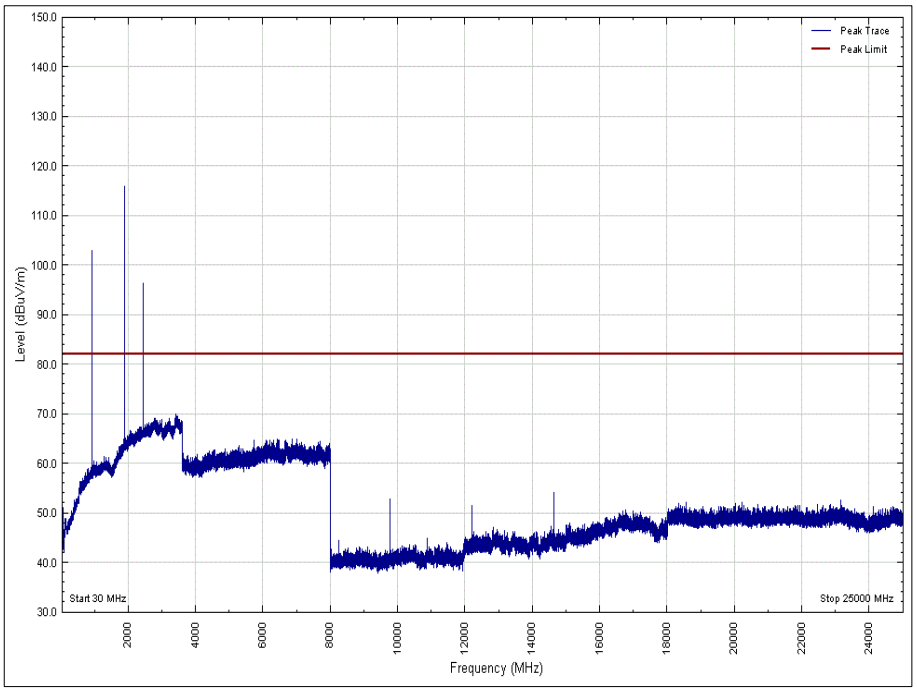

Figure 2 - 30 MHz to 25 GHz - X Orientation – Vertical

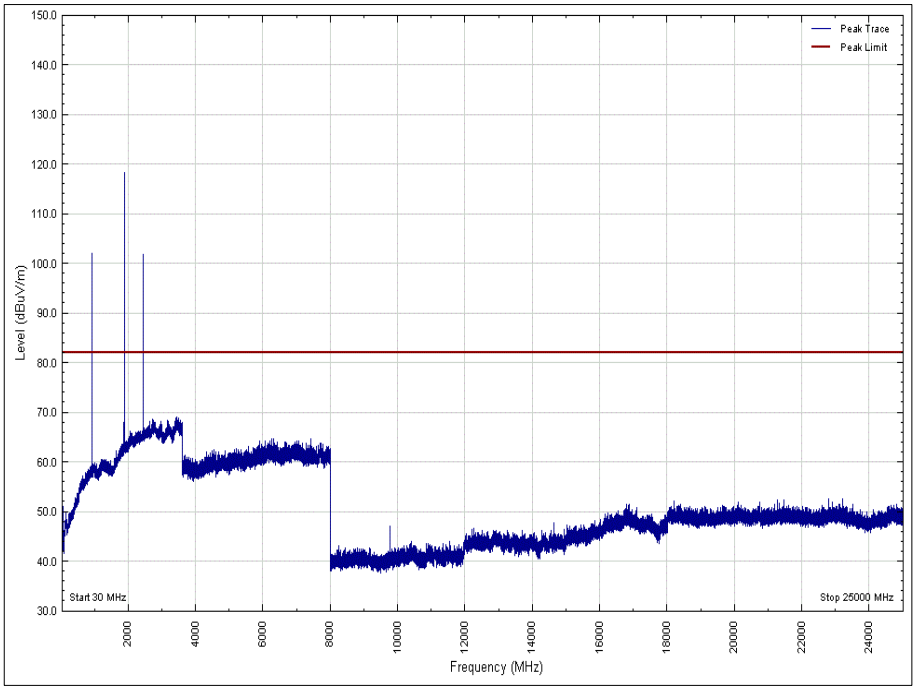

Figure 3 - 30 MHz to 25 GHz - X Orientation – Horizontal

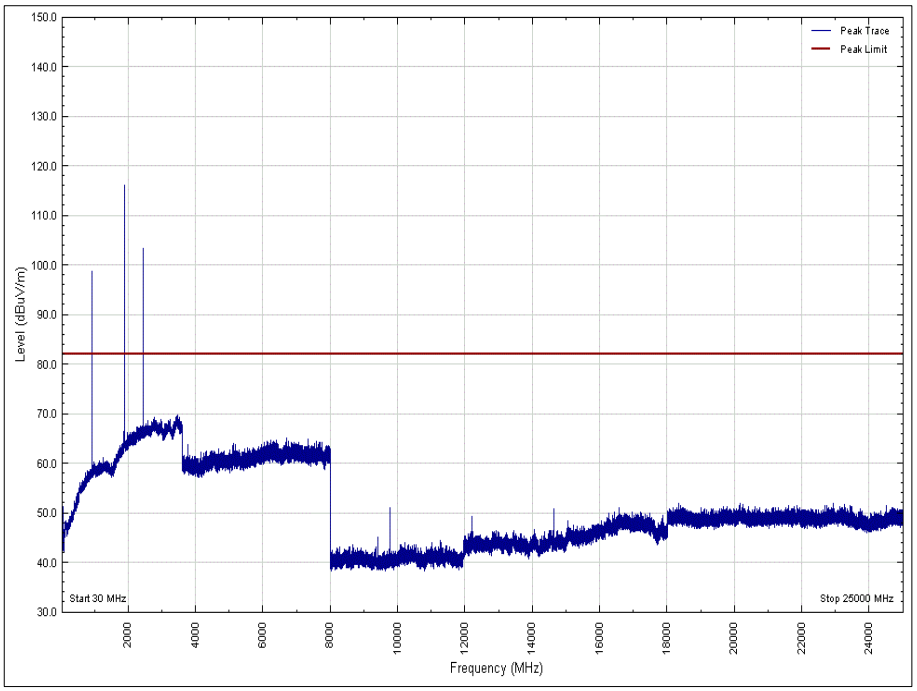

Figure 4 - 30 MHz to 25 GHz - Y Orientation – Vertical

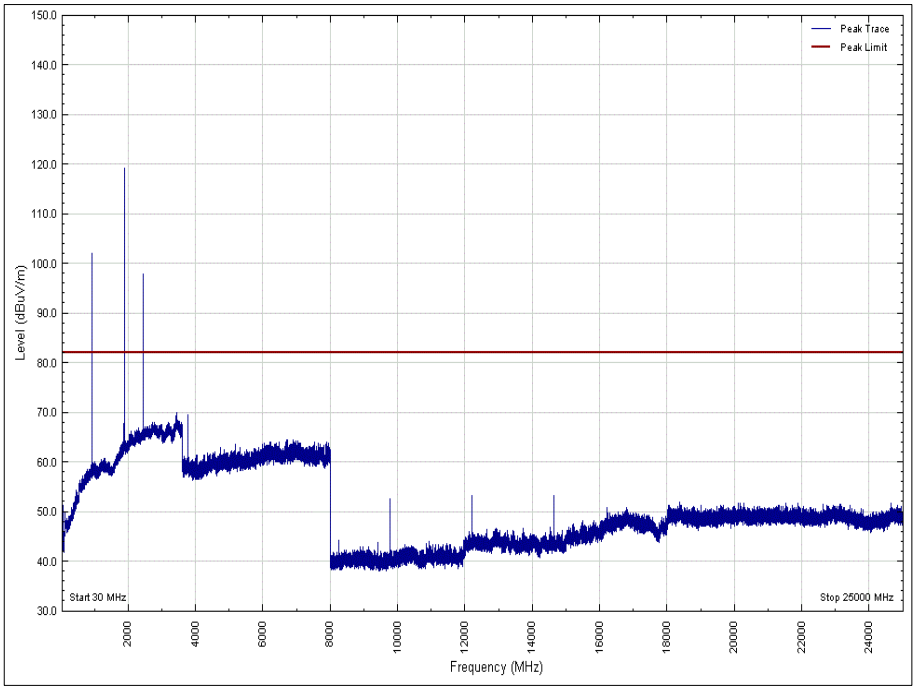

Figure 5 - 30 MHz to 25 GHz - Y Orientation – Horizontal

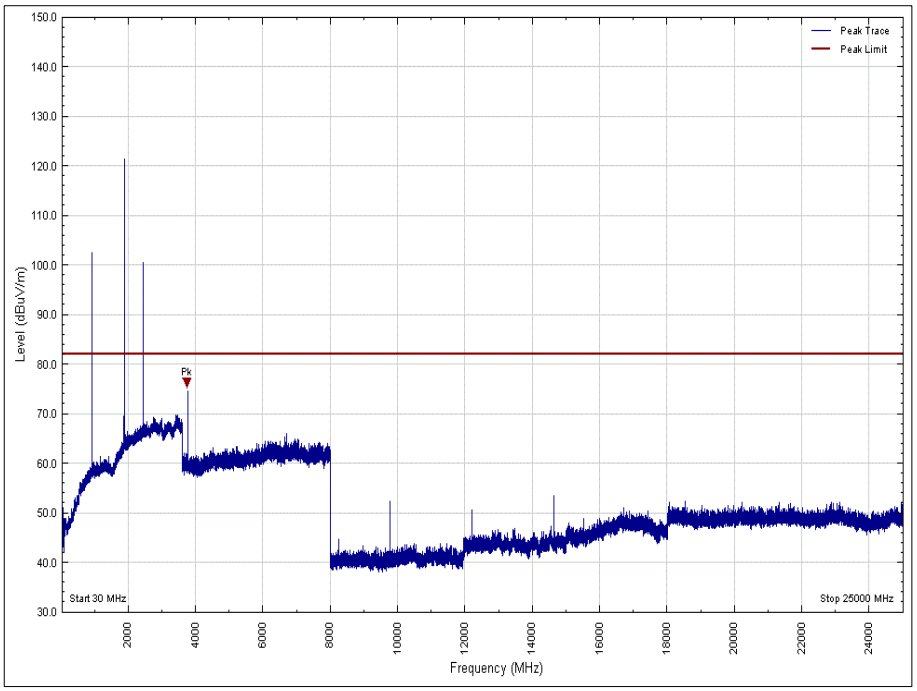

Figure 6 - 30 MHz to 25 GHz - Z Orientation – Vertical

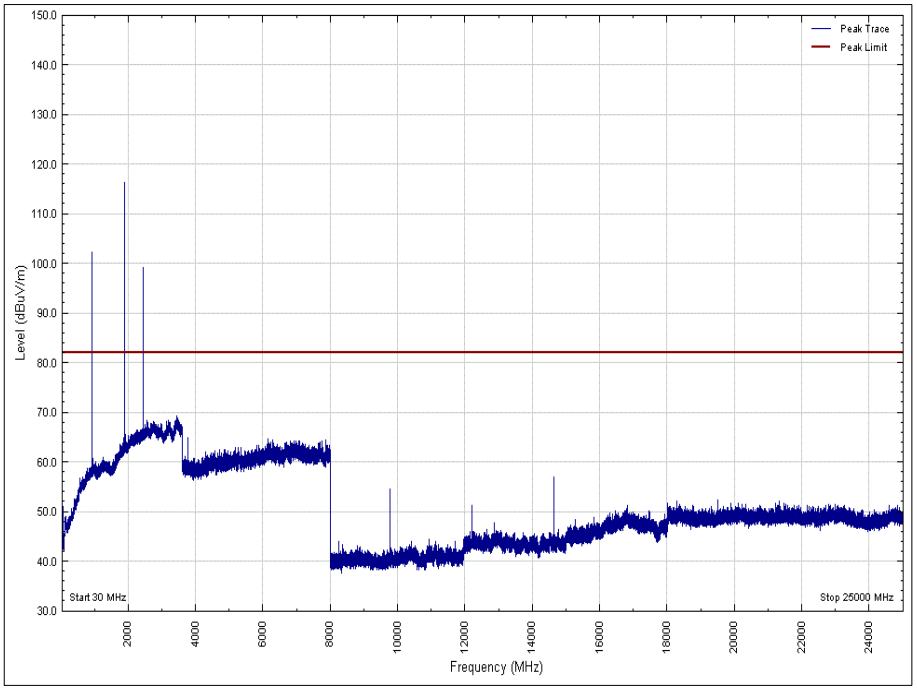

Figure 7 - 30 MHz to 25 GHz - Z Orientation - Horizontal

DC Powered - Bluetooth Low Energy + 915 MHz SRD + WCDMA FDD V

The EUT was configured for simultaneous transmission in the following mode of operation:

Technology	Frequency Band (MHz)	Channel Frequency (MHz)
Bluetooth Low Energy	2400 MHz to 2483.5 MHz	2440
SRD	902 MHz to 928 MHz	915
WCDMA	FDD V	836.4

Table 7 - Modes of Operation

Frequency (GHz)	Result (dBµV/m)		Limit (dBµV/m)		Margin (dB)		Angle (°)	Height (cm)	Polarisation
	Peak	Average	Peak	Average	Peak	Average			
*									

Table 8 - 30 MHz to 25 GHz Emissions Results

* No emissions were detected within 10 dB of the limit.

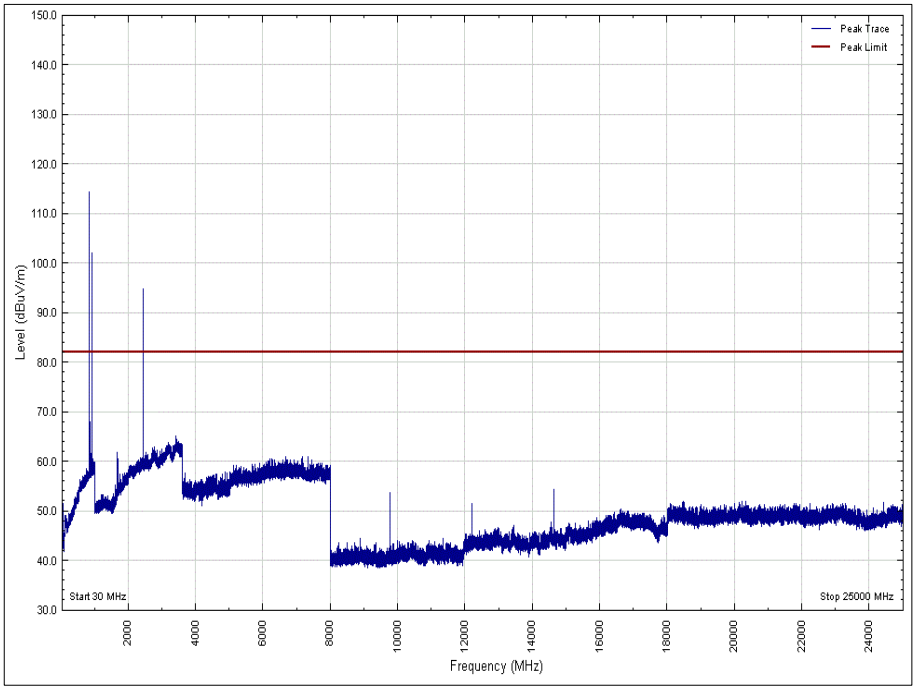

Figure 8 - 30 MHz to 25 GHz - X Orientation – Vertical

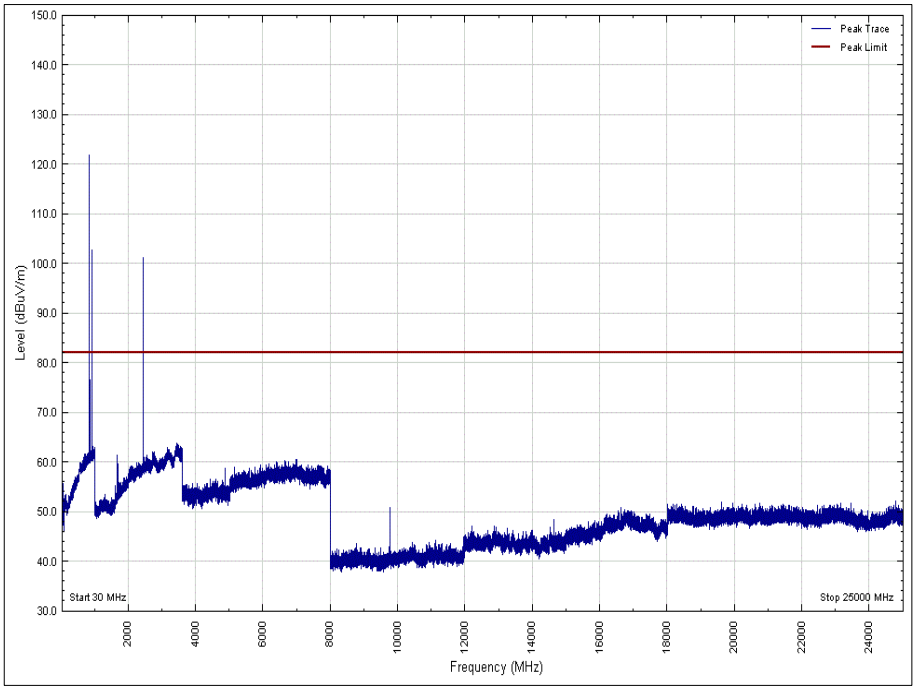

Figure 9 - 30 MHz to 25 GHz - X Orientation – Horizontal

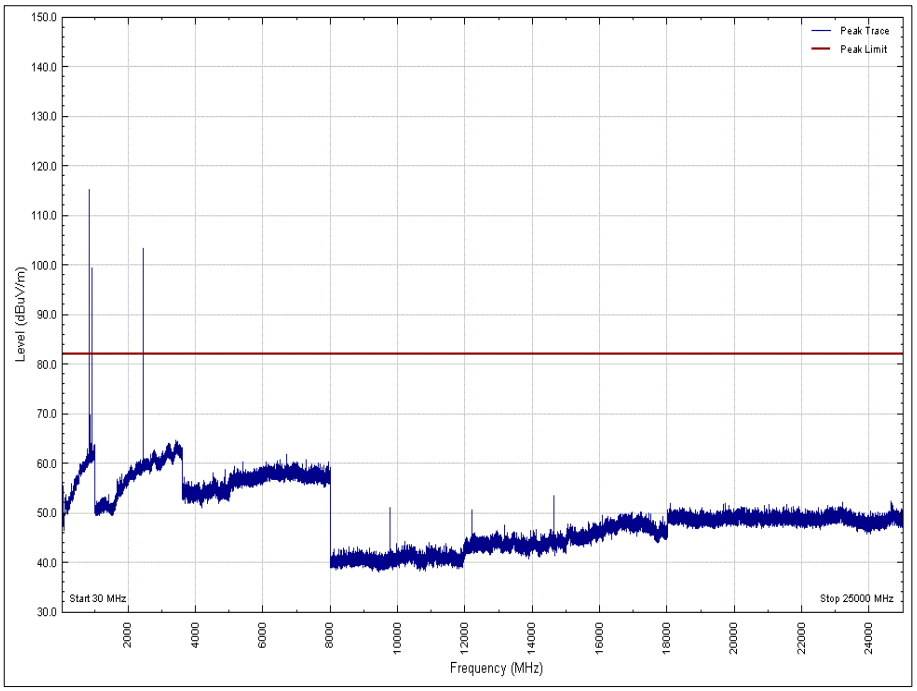

Figure 10 - 30 MHz to 25 GHz - Y Orientation – Vertical

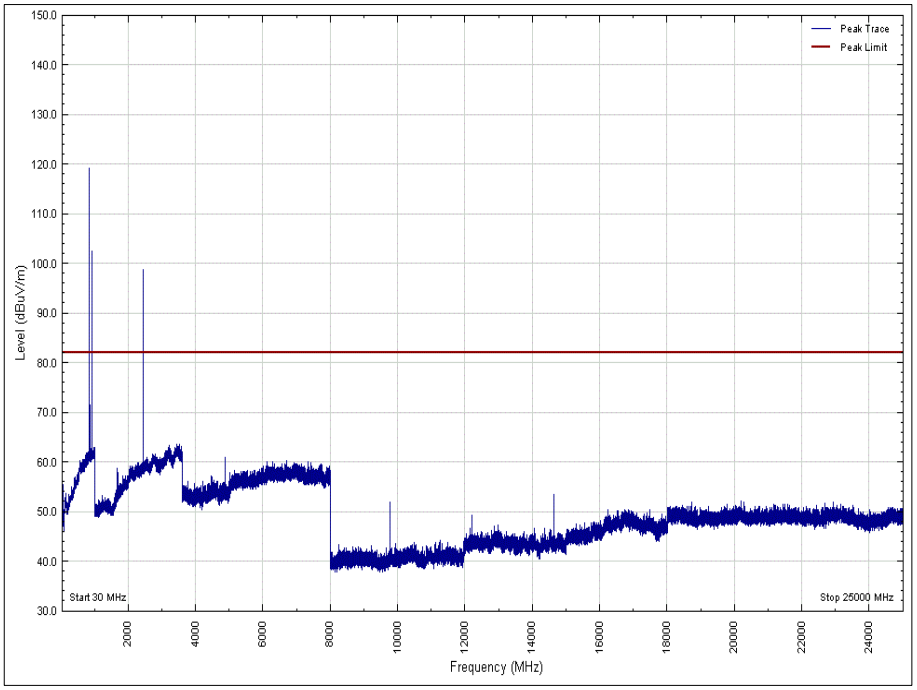

Figure 11 - 30 MHz to 25 GHz - Y Orientation – Horizontal

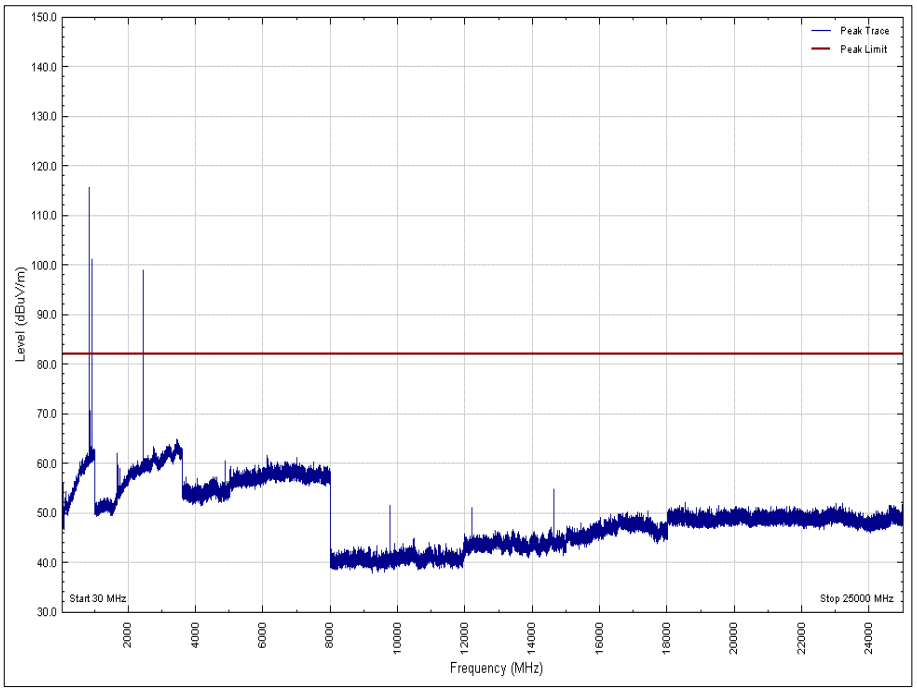

Figure 12 - 30 MHz to 25 GHz - Z Orientation – Vertical

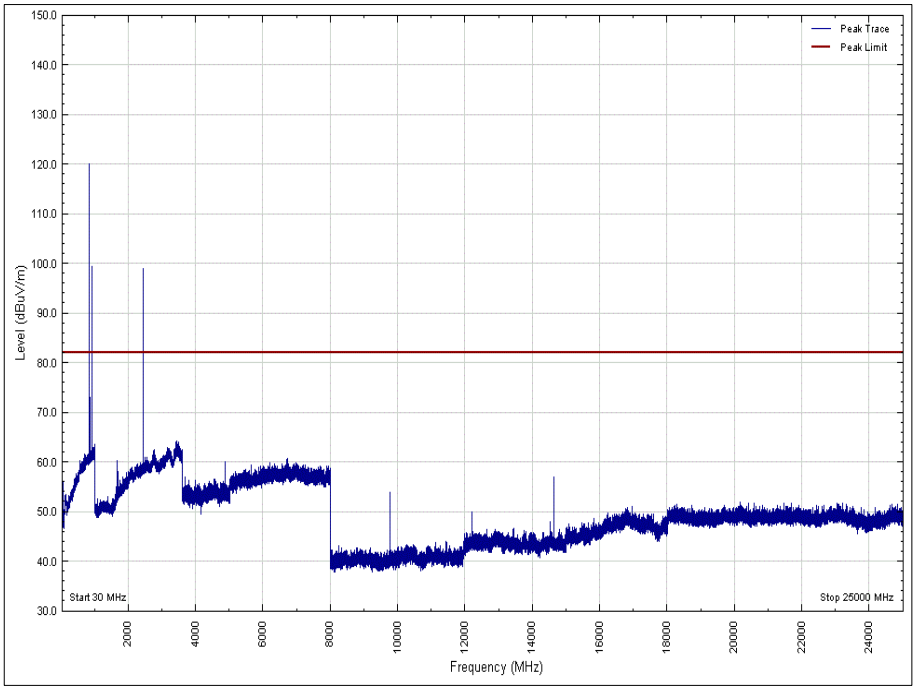

Figure 13 - 30 MHz to 25 GHz - Z Orientation - Horizontal

DC Powered - Bluetooth Low Energy + 915 MHz SRD + GSM 850

The EUT was configured for simultaneous transmission in the following mode of operation:

Technology	Frequency Band (MHz)	Channel Frequency (MHz)
Bluetooth	2400 MHz to 2483.5 MHz	2440
SRD	902 MHz to 928 MHz	915
GSM	850	836.4

Table 9 - Modes of Operation

Frequency (GHz)	Result (dBµV/m)		Limit (dBµV/m)		Margin (dB)		Angle (°)	Height (cm)	Polarisation
	Peak	Average	Peak	Average	Peak	Average			
0.757658	78.19	-	82.26	-	-4.07	-	231	1.03	Horizontal
1.672955	75.80	-	82.26	-	-6.46	-	312	1.60	Horizontal
2.508973	75.01	-	82.26	-	-7.25	-	30	1.24	Vertical

Table 10 - 30 MHz to 25 GHz Emissions Results

No other emissions were detected within 10 dB of the limit.

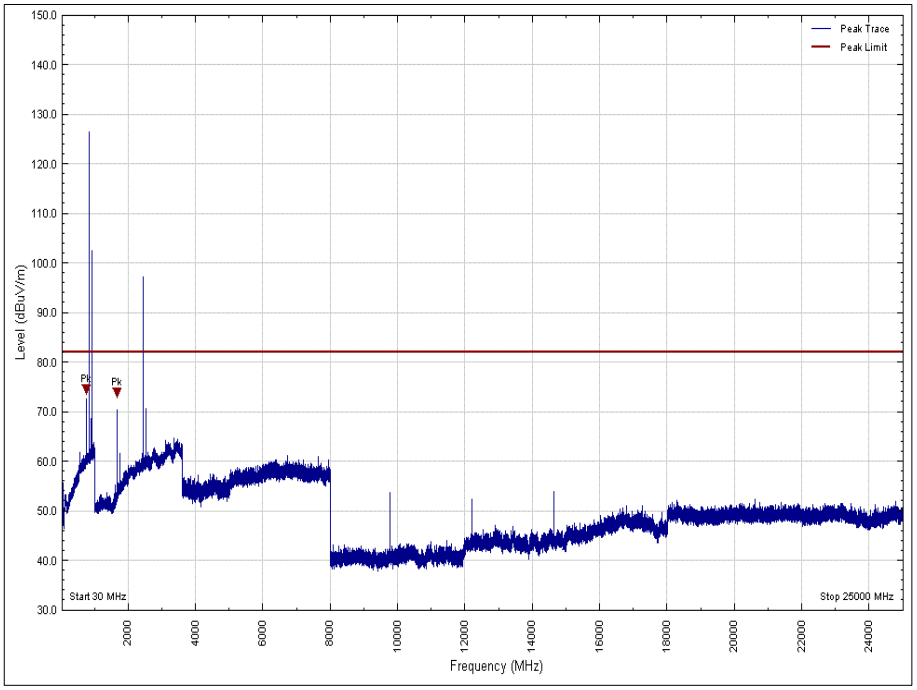

Figure 14 - 30 MHz to 25 GHz - X Orientation - Vertical

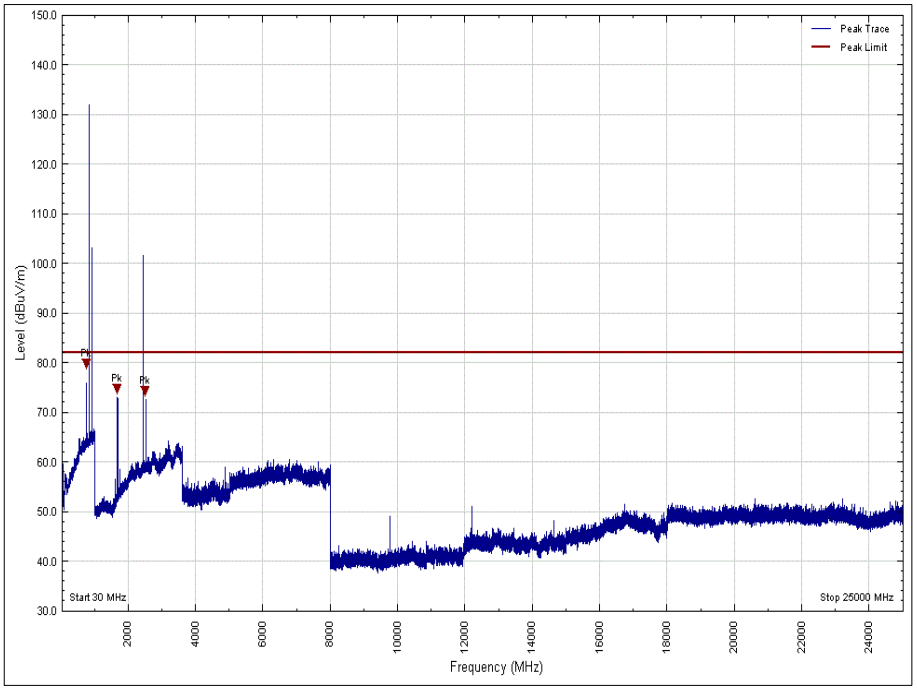

Figure 15 - 30 MHz to 25 GHz - X Orientation – Horizontal

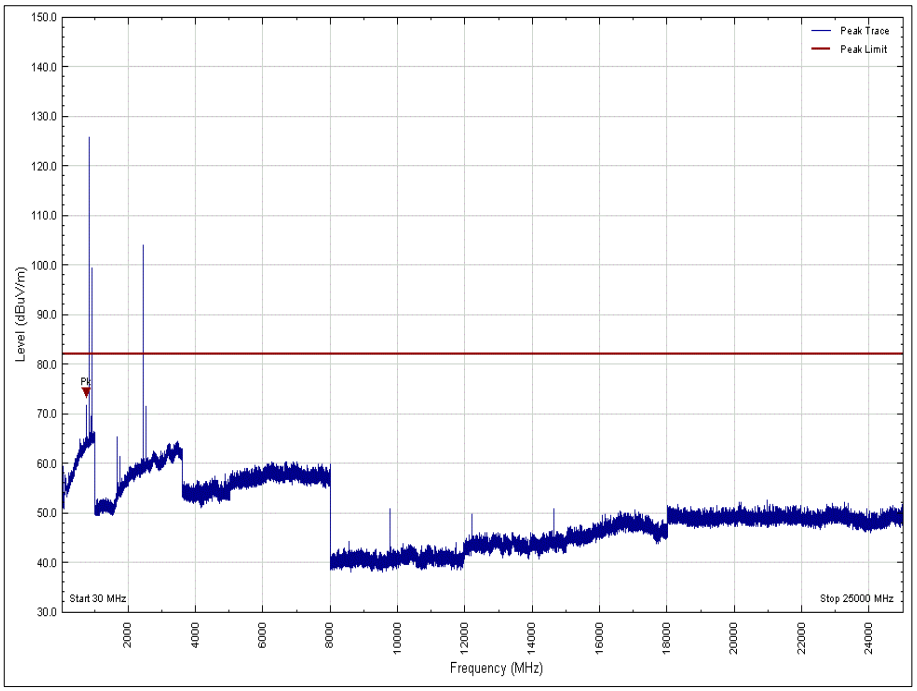

Figure 16 - 30 MHz to 25 GHz - Y Orientation - Vertical

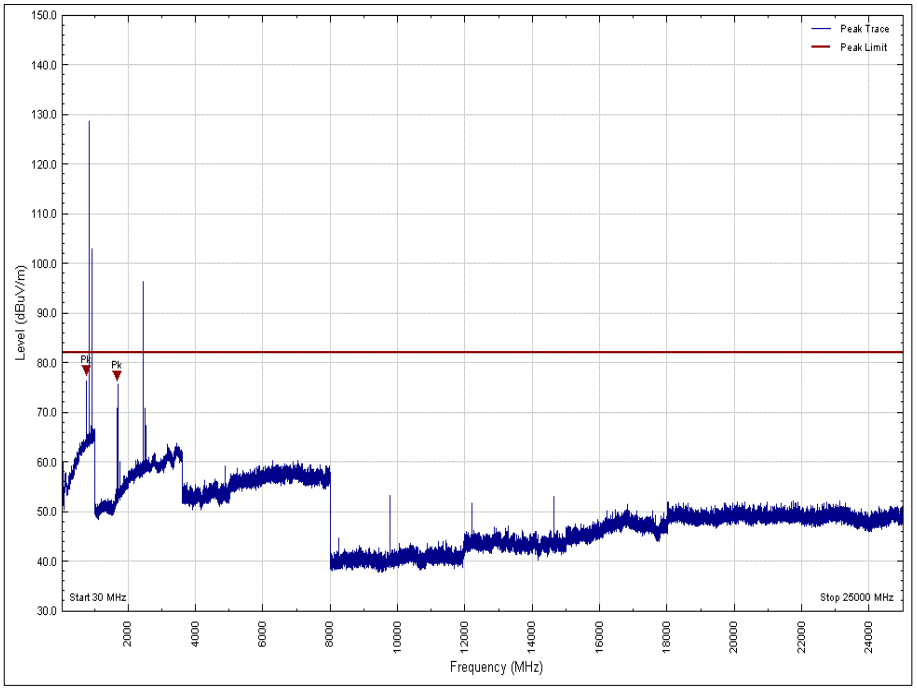

Figure 17 - 30 MHz to 25 GHz - Y Orientation – Horizontal

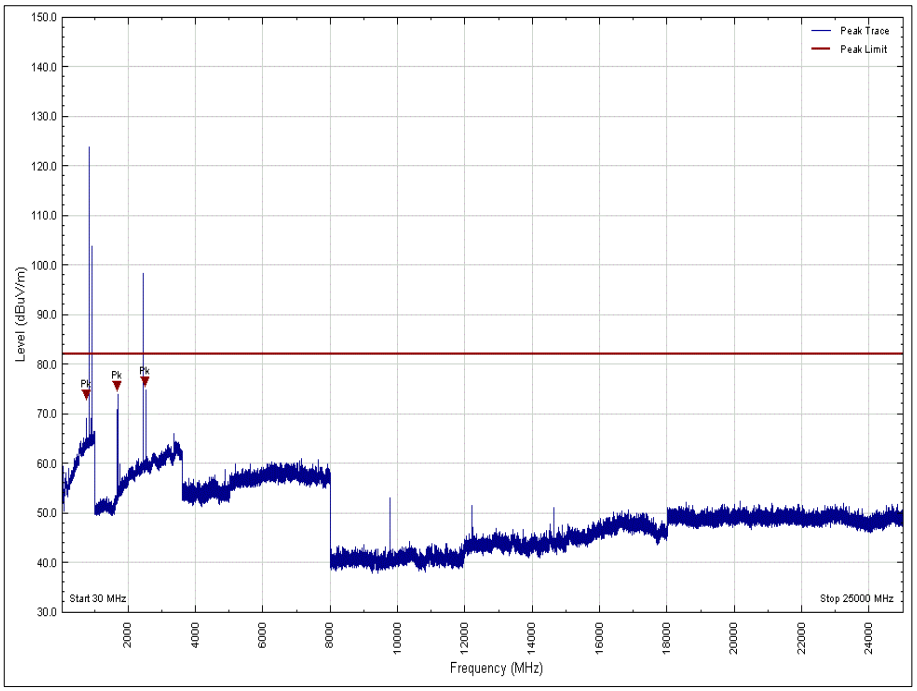

Figure 18 - 30 MHz to 25 GHz - Z Orientation - Vertical

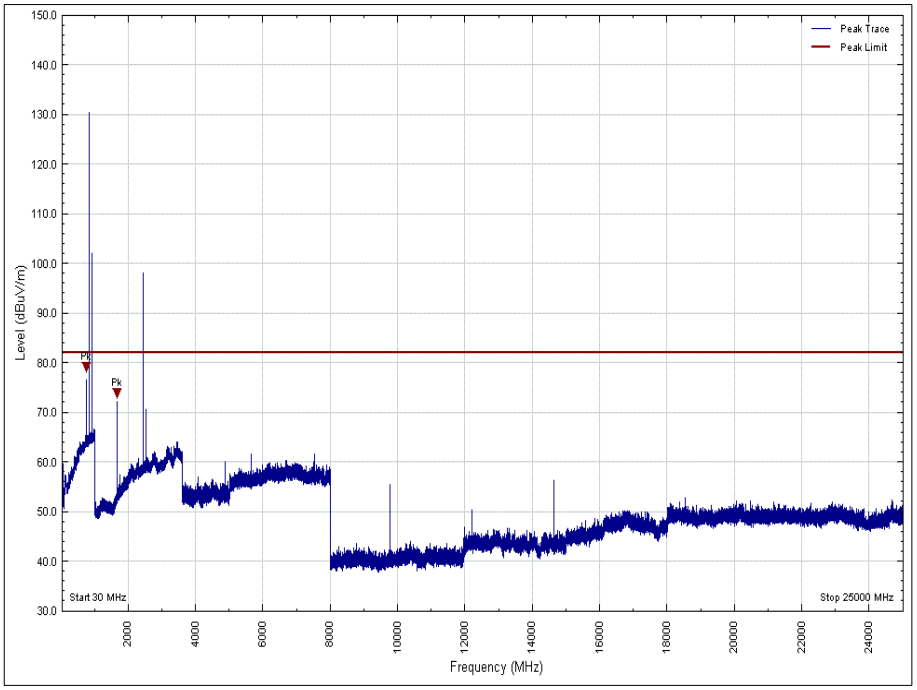

Figure 19 - 30 MHz to 25 GHz - Z Orientation - Horizontal

DC Powered - BLE + 915 MHz SRD + PCS 1900

The EUT was configured for simultaneous transmission in the following mode of operation:

Technology	Frequency Band (MHz)	Channel Frequency (MHz)
Bluetooth	2400 MHz to 2483.5 MHz	2440
SRD	902 MHz to 928 MHz	915
GSM	1900	1880

Table 11 - Modes of Operation

Frequency (GHz)	Result (dBµV/m)		Limit (dBµV/m)		Margin (dB)		Angle (°)	Height (cm)	Polarisation
	Peak	Average	Peak	Average	Peak	Average			
0.964942	81.74	-	82.26	-	-0.52	-	178	1.37	Horizontal
1.829823	81.90	-	82.26	-	-0.36	-	162	1.63	Horizontal
3.760063	73.52	-	82.26	-	-8.74	-	150	1.45	Horizontal
7.520092	76.65	-	82.26	-	-5.61	-	167	1.00	Horizontal

Table 12 - 30 MHz to 25 GHz Emissions Results

No other emissions were detected within 10 dB of the limit.

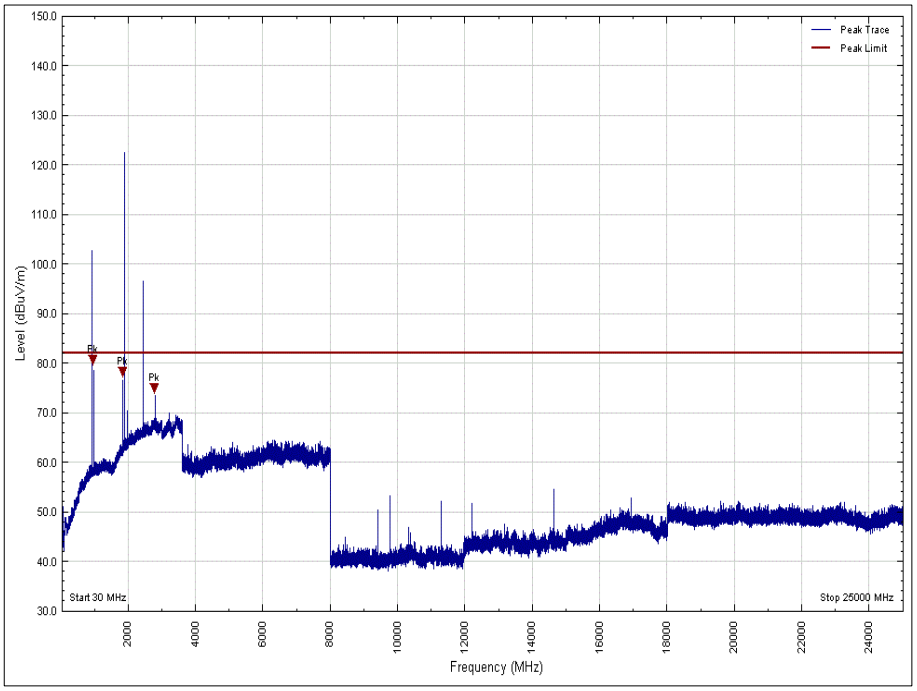

Figure 20 - 30 MHz to 25 GHz - X Orientation – Vertical

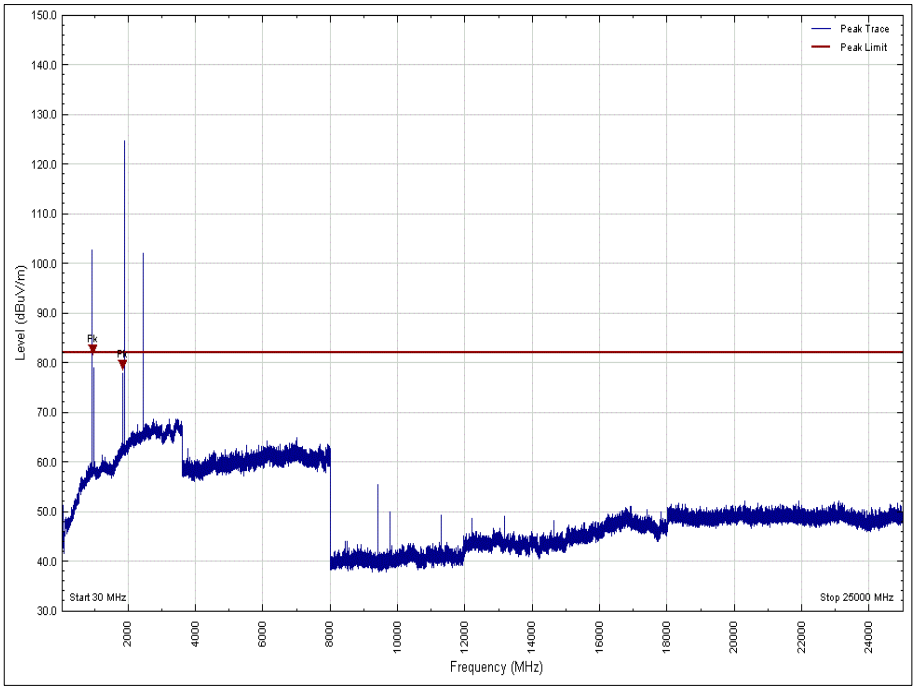

Figure 21 - 30 MHz to 25 GHz - X Orientation – Horizontal

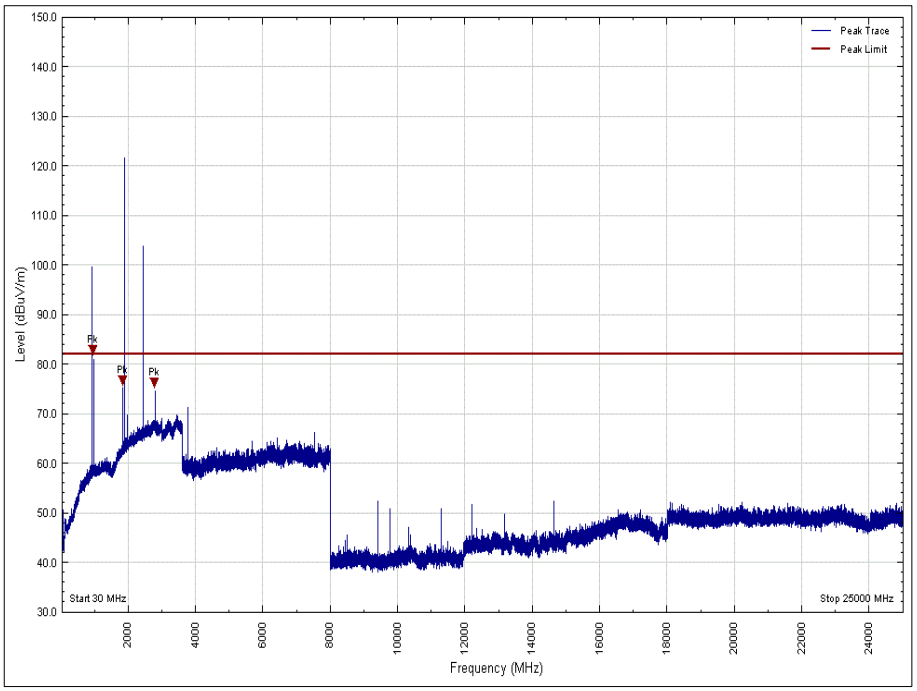

Figure 22 - 30 MHz to 25 GHz - Y Orientation – Vertical

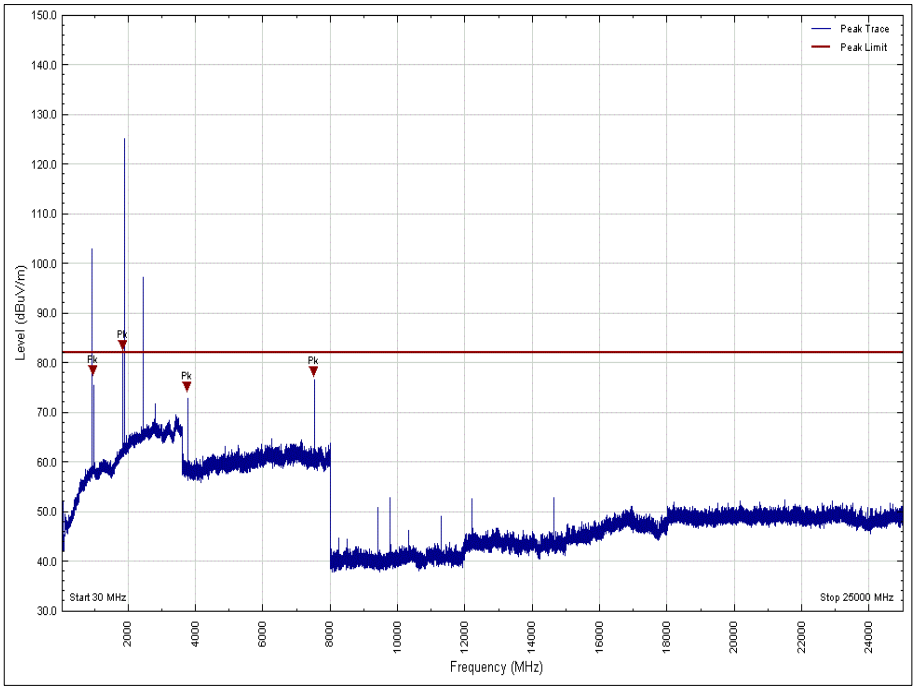

Figure 23 - 30 MHz to 25 GHz - Y Orientation – Horizontal

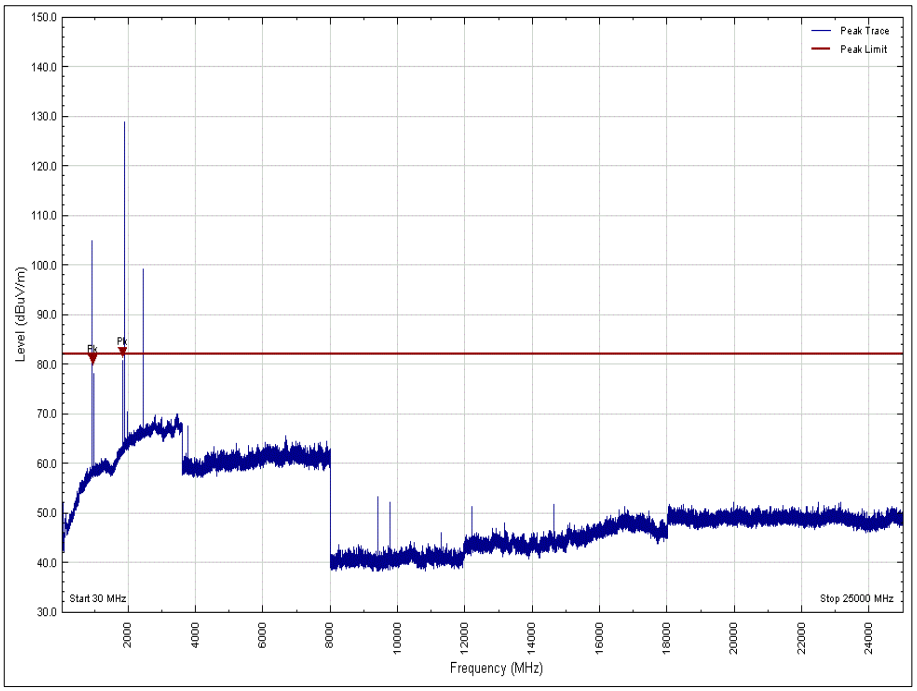

Figure 24 - 30 MHz to 25 GHz - Z Orientation – Vertical

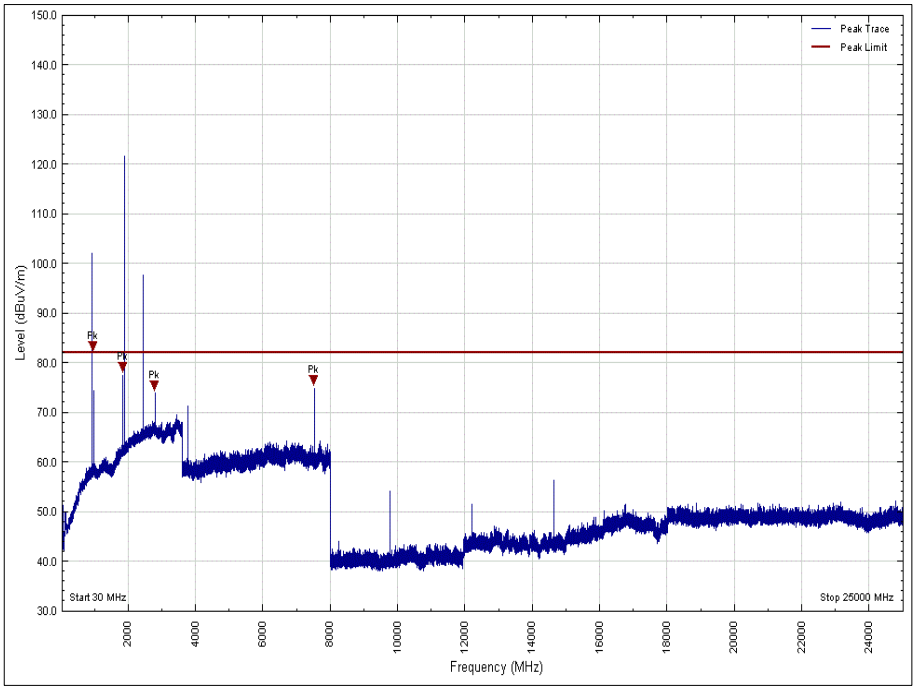

Figure 25 - 30 MHz to 25 GHz - Z Orientation - Horizontal

FCC 47 CFR Parts 15.247(d), 15.407(b), 15.205, 22.917(a) and 24.238(a)

The least stringent limit from the applicable rule parts was used to determine compliance for Radiated Emissions testing of multiple transmission sources.

The least stringent applicable limit was:

Rule Part	Limit
Part 24.238 (a)	-13 dBm (EIRP) / 82.26 dBµV/m at 3m.

Table 13 - Limit Table

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 Due
Antenna 18-40GHz (Double Ridge Guide)	Link Microtek Ltd	AM180HA-K-TU2	230	24	02-May-2020
Power Supply	Hewlett Packard	6269B	742	-	O/P Mon
18GHz - 40GHz Pre-Amplifier	Phase One	PSO4-0087	1534	12	05-Feb-2020
Screened Room (5)	Rainford	Rainford	1545	36	23-Jan-2021
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Hygromer	Rotronic	A1	2677	12	20-Feb-2020
Antenna with permanent attenuator (Bilog)	Chase	CBL6143	2904	24	30-Sep-2021
Comb Generator	Schaffner	RSG1000	3034	-	TU
Radio Communications Test Set	Rohde & Schwarz	CMU 200	3035	12	04-Jan-2020
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	17-Dec-2019
Multimeter	Fluke	177	3833	12	16-May-2020
Cable 1503 2M 2.92(P)m 2.92(P)m	Rhophase	KPS-1503A-2000-KPS	4293	12	08-Nov-2020
Cable (Rx, Km-Km 2m)	Scott Cables	KPS-1501-2000-KPS	4526	6	11-Dec-2019
1 - 18GHz DRG Antenna	ETS-Lindgren	3117	4738	12	05-Mar-2020
Mast Controller	Maturo Gmbh	NCD	4810	-	TU
Tilt Antenna Mast	Maturo Gmbh	TAM 4.0-P	4811	-	TU
Cable (18 GHz)	Rosenberger	LU7-071-1000	5099	12	06-Oct-2020
EmX Emissions Software	TUV SUD	EmX V.V1.4.8.3	5125	-	Software
1.5m 40GHz RF Cable	Scott Cables	KPS-1501-2000-KPS	5127	6	11-Dec-2019
8 Meter Cable	Teledyne	PR90-088-8MTR	5212	12	30-Aug-2020
3 GHz High pass filter	Wainwright	WHKX12-2580-3000-18000-80SS	5220	12	15-Feb-2020

Table 14

TU – Traceability Unscheduled
O/P Mon – Output Monitored Using Calibrated Test Equipment.

3 Photographs

3.1 Test Setup Photographs

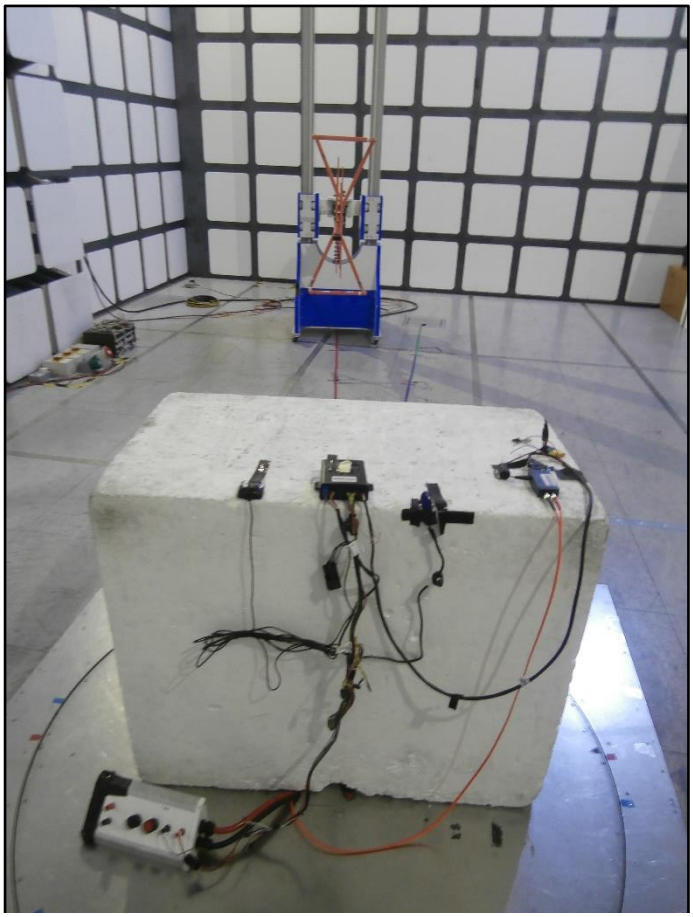

Figure 26 – Radiated Spurious Emissions 30 MHz to 1 GHz

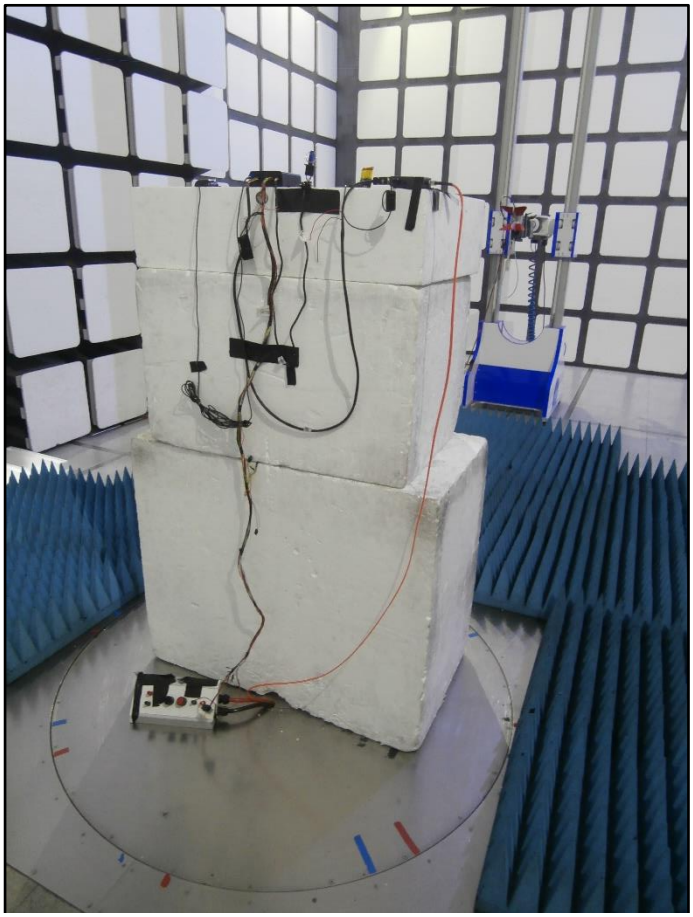

Figure 27 – Radiated Spurious Emissions 1 GHz to 18 GHz

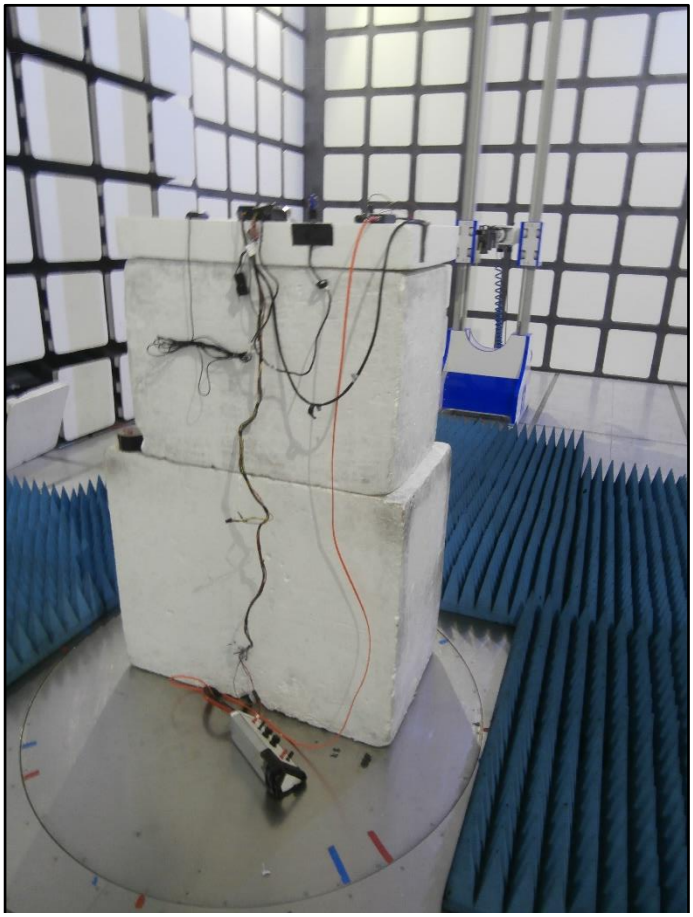

Figure 28 – Radiated Spurious Emissions 18 GHz to 25 GHz

4 Measurement Uncertainty

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

Test Name	Measurement Uncertainty
Radiated Spurious Emissions (Simultaneous Transmission)	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 40 GHz: ± 6.3 dB

Table 15

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.