

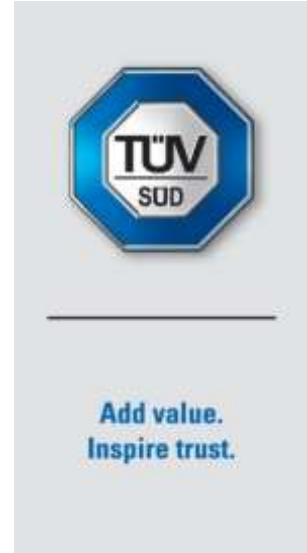
Report on the FCC Testing of:

MiX Telematics International (Pty) Ltd
Vehicle Tracking Fleet Management Device,
Model: MiX 45MC-4G-B

In accordance with FCC 47 CFR Parts 15, 24 and 27 (Simultaneous Transmission)

Prepared for: MiX Telematics Euro Ltd
Cherry Orchard North, Kembrey Park,
Swindon, SN1 2NR, United Kingdom

FCC ID: 2AFMS-45MC4G



COMMERCIAL-IN-CONFIDENCE

Document Number: 75942815-03 | Issue: 04

SIGNATURE			
NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
Simon Bennett	Chief Engineer	Authorised Signatory	19 April 2021

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, 24 and 27 (Simultaneous Transmission). The sample tested was found to comply with the requirements defined in the applied rules.

SIGNATURE			
NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
Graeme Lawler	Test Engineer	Testing	19 April 2021

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, 24 and 27 (Simultaneous Transmission): 2017.

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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	05 November 2018
2	To include a statement in section 2.1.4	19 November 2018
3	To include a hyphen in the FCC ID	19 November 2018
4	To include additional declared variants	19 April 2021

Table 1

1.2 Introduction

Applicant	MiX Telematics Euro Ltd
Manufacturer	MiX Telematics International (Pty) Ltd
Model Number(s)	Vehicle Tracking Fleet Management Device: MiX 45MC-4G-B
Manufacturer Declared Variant(s)	MiX45MC-4G MiX 450C-4G-B MiX 450C-4G
Serial Number(s)	MiX 45MC-4G-B: 45000203 / IMEI 357812090506921
Hardware Version(s)	1
Software Version(s)	1.8.0
Number of Samples Tested	1 set
Test Specification/Issue/Date	FCC 47 CFR Parts 15, 24 and 27 (Simultaneous Transmission): 2017
Order Number	P0089659
Date	21-May-2018
Date of Receipt of EUT	01-October-2018
Start of Test	03-October-2018
Finish of Test	03-October-2018
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, 24 and 27 (Simultaneous Transmission) is shown below.

Section	Specification Clause	Test Description	Result	Comments/Base Standard
Configuration and Mode: CoTX - BLE + 915 MHz SRD + LTE FDD B2 (1900 MHz)				
2.1	15.247 (d), 15.205 and 24.238 (a)	Radiated Spurious Emissions (Simultaneous Transmission)	Pass	ANSI C63.26: 2015
Configuration and Mode: CoTX - BLE + 915 MHz SRD + LTE FDD B12 (700 MHz)				
2.1	15.247 (d), 15.205 and 27.53 (g)	Radiated Spurious Emissions (Simultaneous Transmission)	Pass	ANSI C63.26: 2015

Table 2



1.4 Manufacturer Declared Variant(s)

The following variants use the same PCB and circuit, but not utilizing the Short Range Device feature (434 / 915 MHz) (components not populated):

Assembly Number	Assembly Name	Description
U0091MT	MiX 450C-4G	MiX 450C-4G (US) Electronic Unit with u-blox SARA-R410M-52B modem; No on-board Magix support
U0093MT	MiX 450C-4G-B	MiX 450-4G with Backup Battery (AU) Electronic Unit with u-blox SARA-R410M-02B modem; No on-board Magix support



1.5 Application Form

EQUIPMENT DESCRIPTION	
Model Name/Number	MiX 45MC-4G; MiX 45MC-4G-B
Part Number	440FT0187; 440FT0191
Hardware Version	1
Software Version	1.8.0
FCC ID (if applicable)	2AFMS-45MC4G
Industry Canada ID (if applicable)	
Technical Description (Please provide a brief description of the intended use of the equipment)	The MiX 4000 LTE is a fleet product that incorporates the latest market trends. It consists mainly of an on-board computer, a LTE CAT M1 modem, 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.

INTENTIONAL RADIATORS									
Technology	Frequency Band (MHz)	Conducted Declared Output Power (dBm)	Antenna Gain (dBi)	Supported Bandwidth (s) (MHz)	Modulation Scheme(s)	ITU Emission Designator	Test Channels (MHz)		
							Bottom	Middle	Top
LTE BAND12	700A	23	0.76	CAT M1	FDMA/OFDMA.16QAM	LTE M1/ X7D	699	707.5	716
LTE BAND13	700C	23	1.39				777	782	787
LTE BAND5	850	23	0.21	CAT M1	FDMA/OFDMA.16QAM	LTE M1/ X7D	824	836.5	849
LTE BAND4	1700	23	1.46	CAT M1	FDMA/OFDMA.16QAM	X7LTE M1/ X7D	1710	1747.5	1785
LTE BAND 2	1900	23	2.07	CAT M1	FDMA/OFDMA.16QAM	LTE M1/ X7D	1850	1880	1910
SRD915	902-928	20	0	25kHz	2FSK	F1D	902	915	928
SRD2400	2400-2480	7	1.40	BLE	GFSK	F1D	2402	2440	2480

UN-INTENTIONAL RADIATOR	
Highest frequency generated or used in the device or on which the device operates or tunes	2480MHz
Lowest frequency generated or used in the device or on which the device operates or tunes	699MHz
Class A Digital Device (Use in commercial, industrial or business environment) <input type="checkbox"/>	
Class B Digital Device (Use in residential environment only) <input checked="" type="checkbox"/>	



Power Source			
AC	Single Phase	Three Phase	Nominal Voltage
	N/A	N/A	N/A
External DC	Nominal Voltage		Maximum Current
	12/24 V		2A typical_max 4.5A absolute max (7.5A Fused)
Battery	Nominal Voltage		Battery Operating End Point Voltage
	3.2 V		3.2V
Can EUT transmit whilst being charged?			Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>

EXTREME CONDITIONS			
Maximum temperature	+85	°C (with no backup battery)	Minimum temperature -25 °C

Ancillaries	
Please list all ancillaries which will be used with the device.	
Code Plug, Immobilizing Relay and RS232 data link Active GPS antenna	

ANTENNA CHARACTERISTICS				
<input checked="" type="checkbox"/>	Antenna connector		State impedance	50 Ohm
<input checked="" type="checkbox"/>	Temporary antenna connector		State impedance	50 Ohm
<input checked="" type="checkbox"/>	Integral antenna	Type	LTE/BLE/SRD915/ GPS	
<input checked="" type="checkbox"/>	External antenna	Type	GPS	

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

Name: B.van der Merwe

Position held: RF Engineer

Date: 12/10/2018



1.6 Product Information

1.6.1 Technical Description

The MiX 4000 LTE is a fleet product that incorporates the latest market trends. It consists mainly of an on-board computer, a LTE CAT M1 modem, 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.

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
Vehicle Tracking Fleet Management Device: Serial Number: 45000203 / IMEI 357812090506921			
0	As supplied by the customer	Not Applicable	Not Applicable

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: CoTX - BLE + 915 MHz SRD + LTE FDD B2 (1900 MHz)		
Radiated Spurious Emissions (Simultaneous Transmission)	Graeme Lawler	UKAS
Configuration and Mode: CoTX - BLE + 915 MHz SRD + LTE FDD B12 (700 MHz)		
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) and 15.205
FCC 47 CFR Part 24, Clause 24.238 (a)
FCC 47 CFR Part 27, Clause 27.53(g)

2.1.2 Equipment Under Test and Modification State

MiX 45MC-4G-B, S/N: 45000203 / IMEI 357812090506921 - Modification State 0

2.1.3 Date of Test

03-October-2018

2.1.4 Test Method

This test was performed in accordance with ANSI C63.26, clause 5.5.

The plots shown are the characterization of the EUT. Where emissions are detected within 10 dB of the limit shown on the plots, formal measurements were carried out and presented in the results tables.

Equation c) in ANSI C63.26, clause 5.2.7 was used to convert the EIRP limit to a field strength limit.

The combinations of simultaneous transmission shown cover the possible scenarios of simultaneous transmission during the functionality of the product. The LTE bands specified have been selected to cover the lower and upper ranges of the LTE bands that will be used in North America.

2.1.5 Environmental Conditions

Ambient Temperature 23.7 °C
Relative Humidity 51.9 %

2.1.6 Test Results

CoTX - BLE + 915 MHz SRD + LTE FDD B2 (1900 MHz)

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 MHz
LTE FDD 2	1850 MHz to 1910 MHz	1960 MHz
SRD	902 MHz to 928 MHz	915 MHz

Table 5 - Modes of Operation



Frequency (MHz)	Peak Level (dBuV/m)	Peak Margin (dBuV/m)	Angle(Deg)	Height(m)	Polarity
965.366	78.0	-4.2	18	1.15	Vertical

Table 6 - 30 MHz to 1 GHz

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

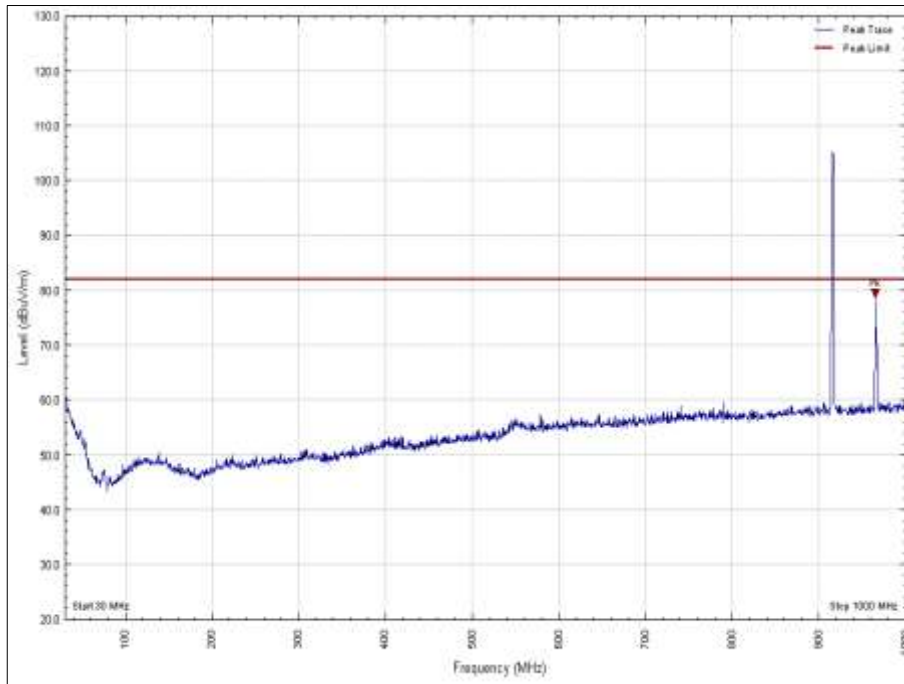


Figure 1 - 30 MHz to 1 GHz - X Orientation - Vertical

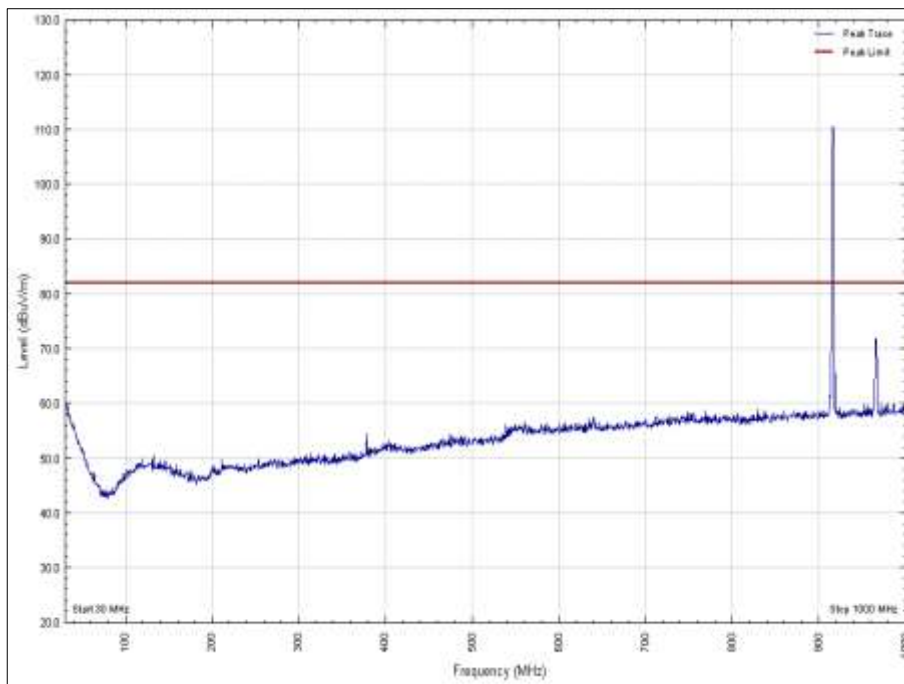


Figure 2 - 30 MHz to 1 GHz - X Orientation - Horizontal

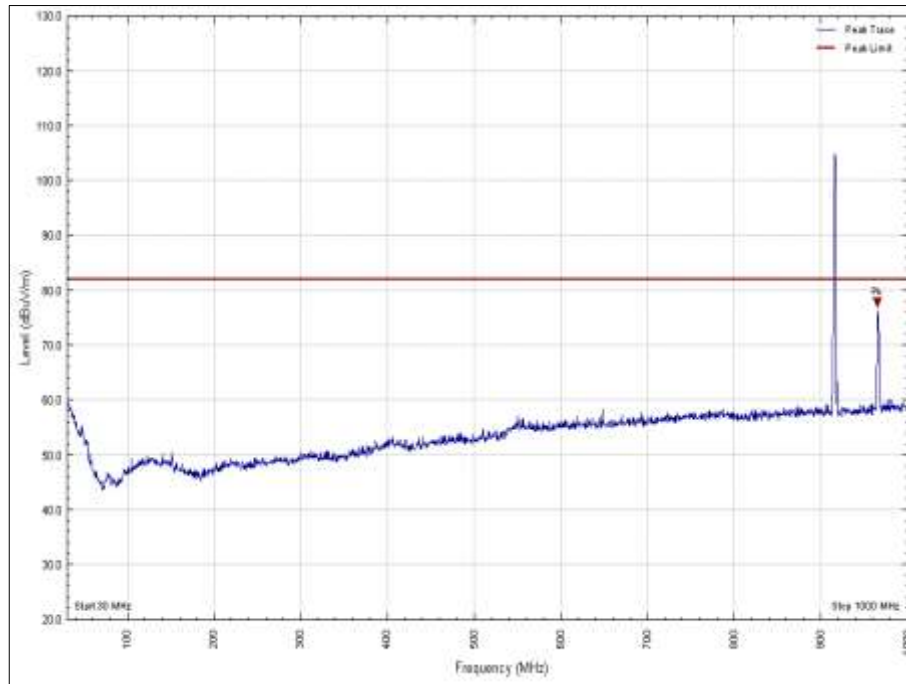


Figure 3 - 30 MHz to 1 GHz - Y Orientation - Vertical

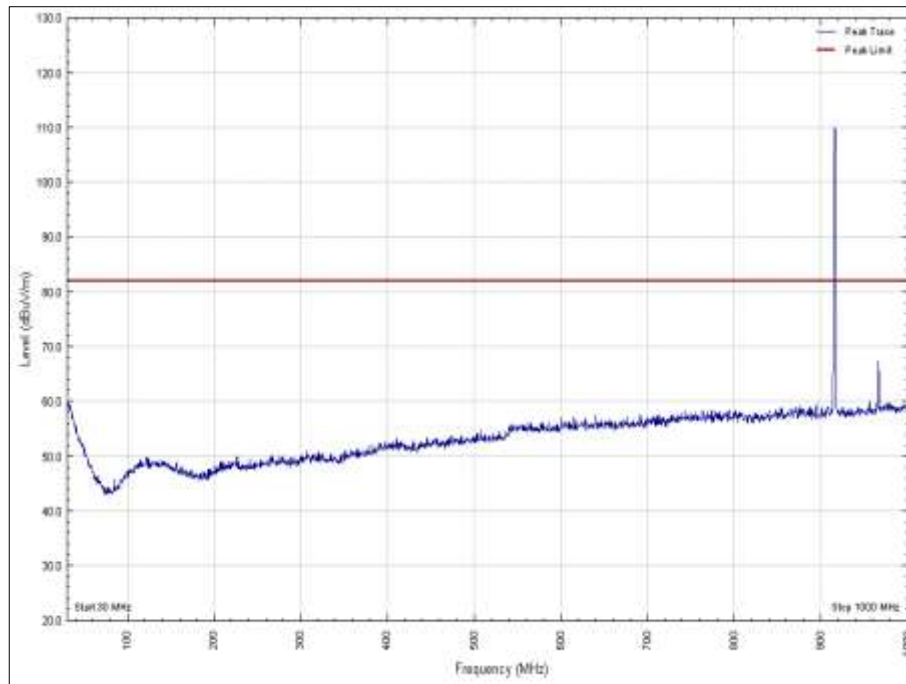


Figure 4 - 30 MHz to 1 GHz - Y Orientation - Horizontal

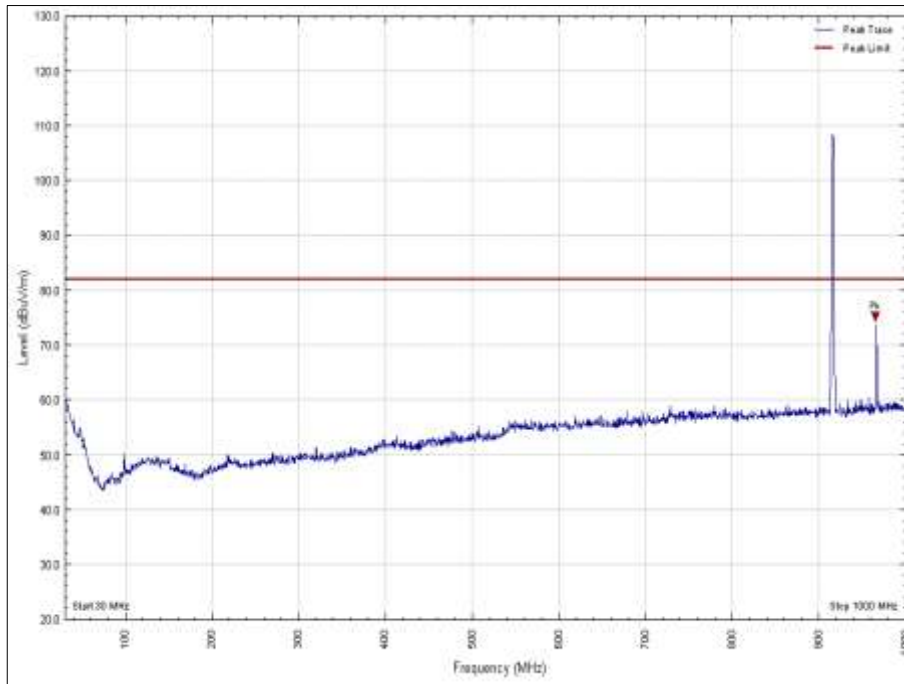


Figure 5 - 30 MHz to 1 GHz - Z Orientation - Vertical

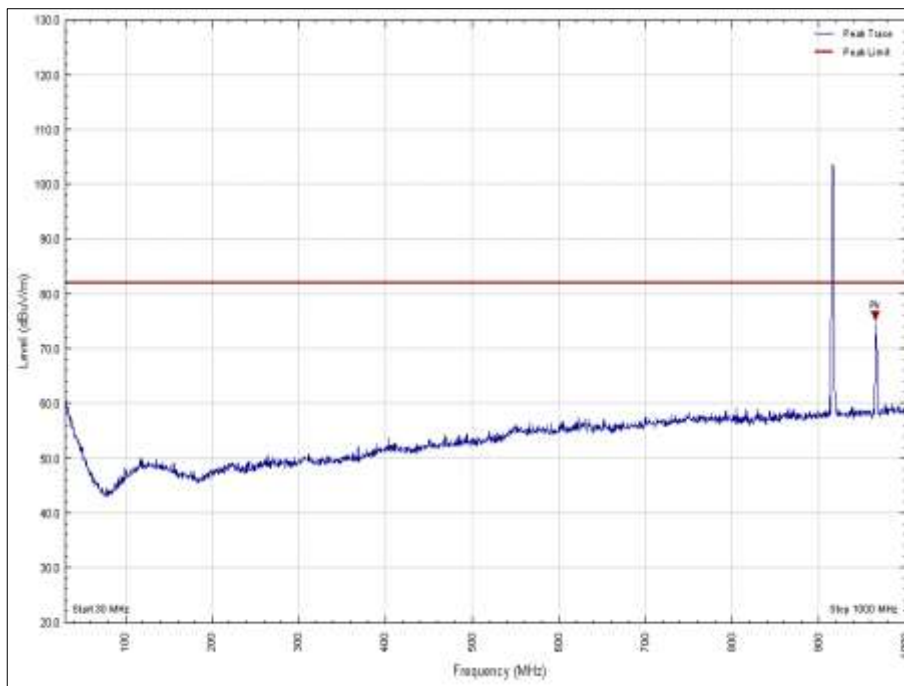


Figure 6 - 30 MHz to 1 GHz - Z Orientation - Horizontal



Frequency (GHz)	Result (µV/m)		Limit (µV/m)		Margin (µV/m)	
	Peak	Average	Peak	Average	Peak	Average
*						

Table 7 - 1 GHz to 25 GHz

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

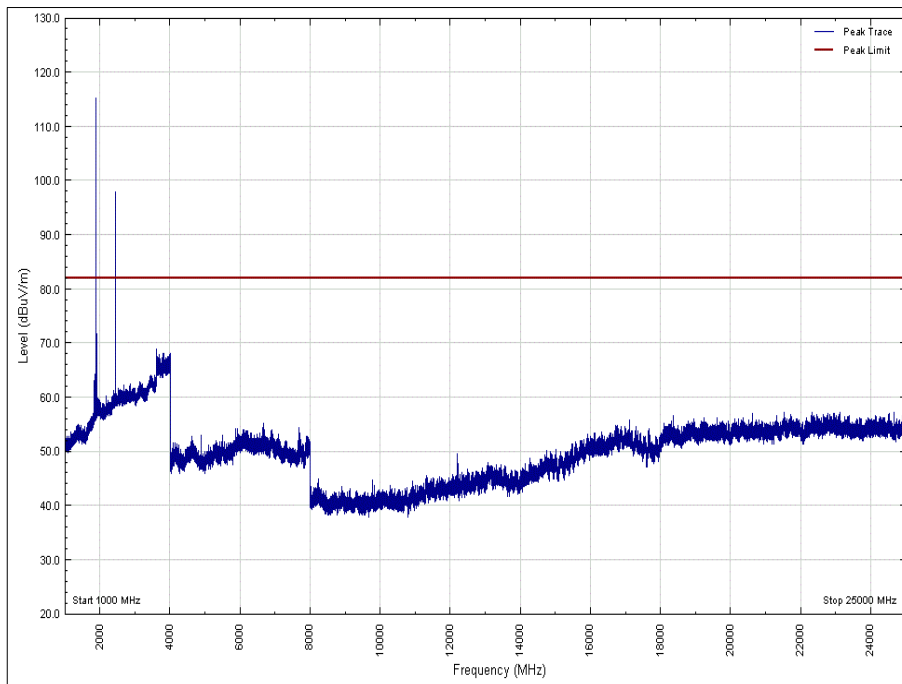


Figure 7 - 1 GHz to 25 GHz - X Orientation – Vertical

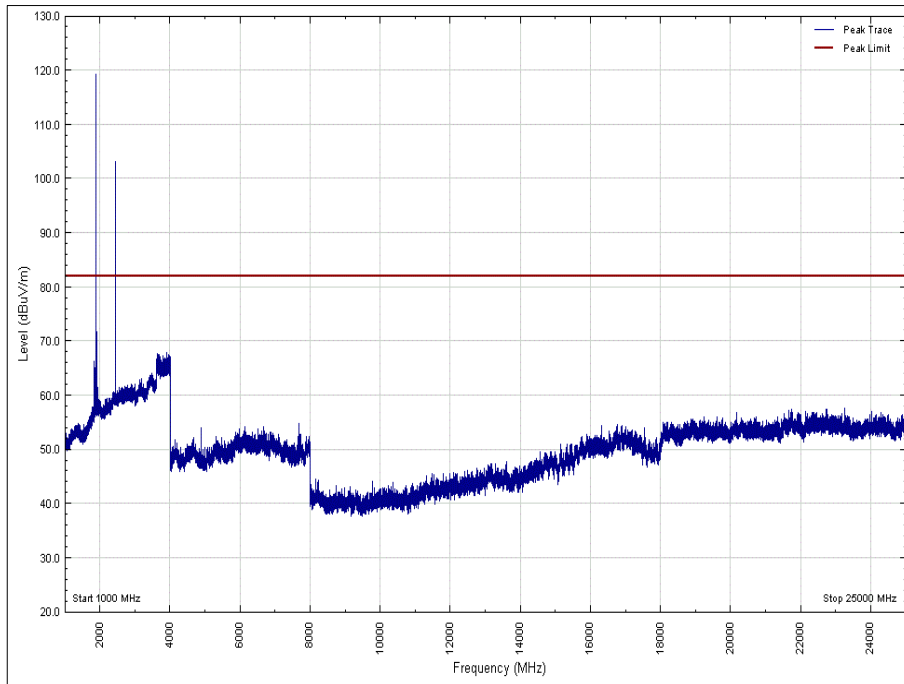


Figure 8 - 1 GHz to 25 GHz - X Orientation – Horizontal

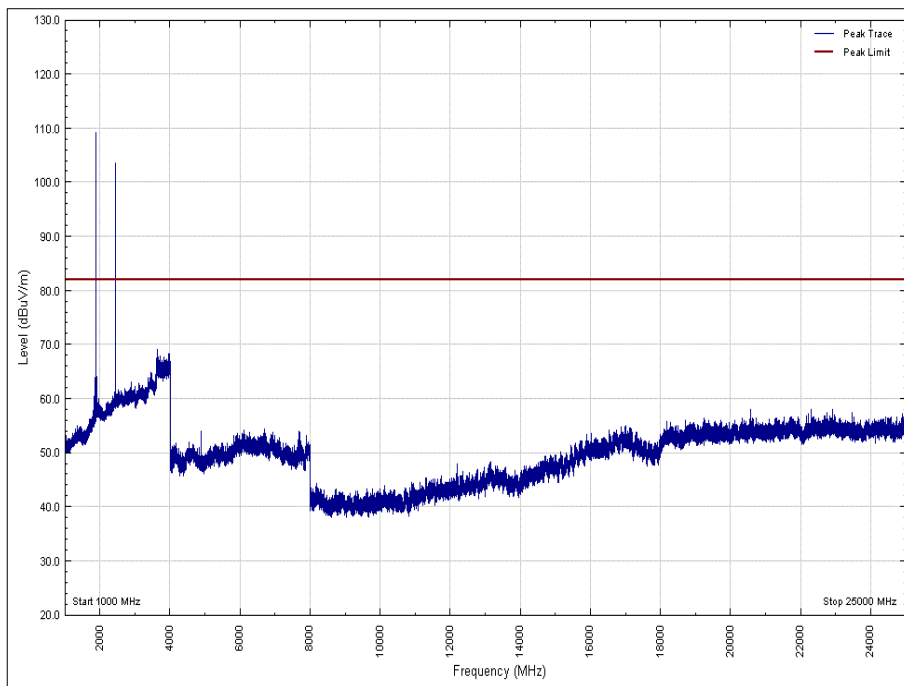


Figure 9 - 1 GHz to 25 GHz - Y Orientation - Vertical

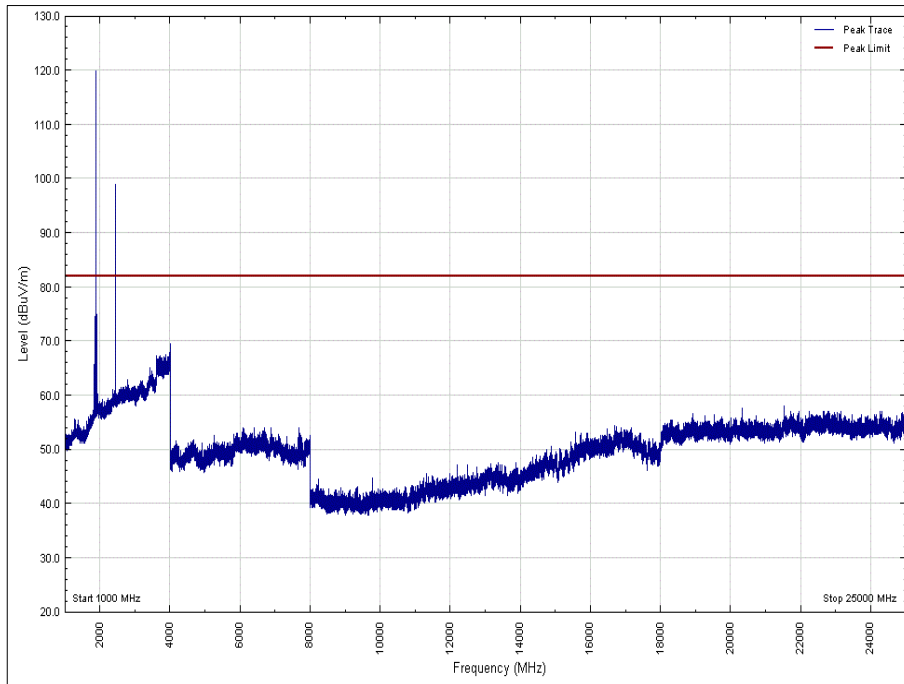


Figure 10 - 1 GHz to 25 GHz - Y Orientation – Horizontal

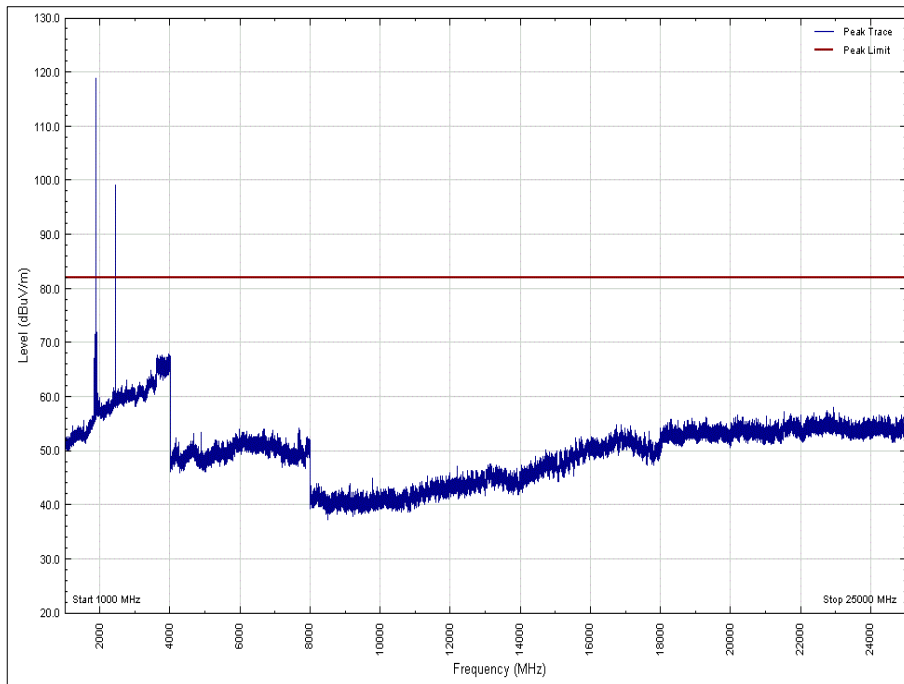


Figure 11 - 1 GHz to 25 GHz - Z Orientation – Vertical

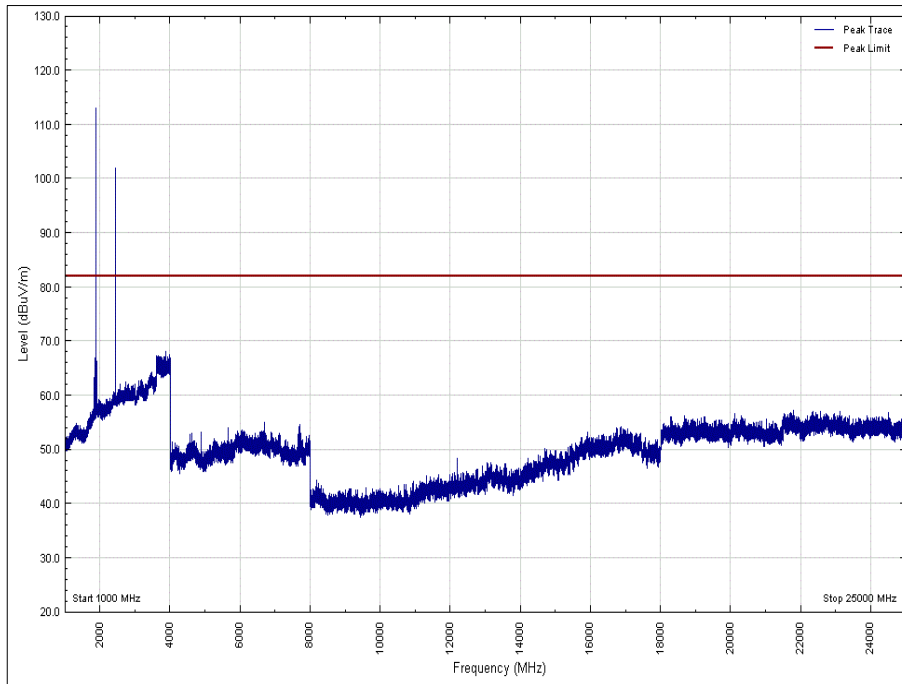


Figure 12 - 1 GHz to 25 GHz - Z Orientation - Horizontal

FCC 47 CFR Parts 15.247(d), 15.205 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 dBµV/m at 3m.
Part 15.247 (d)	-20 dBc (Outside Restricted bands of operation as detailed in 15.205).

Table 8 - Limit Table



CoTX - BLE + 915 MHz SRD + LTE FDD B12 (700 MHz)

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 MHz
LTE FDD 12	699 MHz to 716 MHz	707.5 MHz
SRD	902 MHz to 928 MHz	915 MHz

Table 9 - Modes of Operation

Frequency (MHz)	Peak Level (dBuV/m)	Peak Margin (dBuV/m)	Angle(Deg)	Height(m)	Polarity
*					

Table 10 - 30 MHz to 1 GHz

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

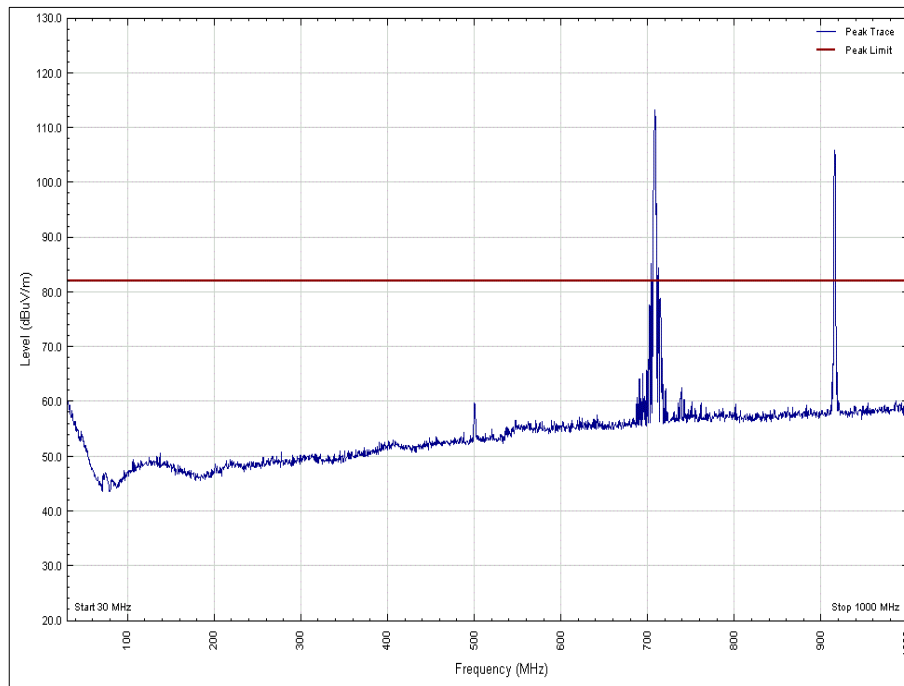


Figure 13 - 30 MHz to 1 GHz - X Orientation - Vertical

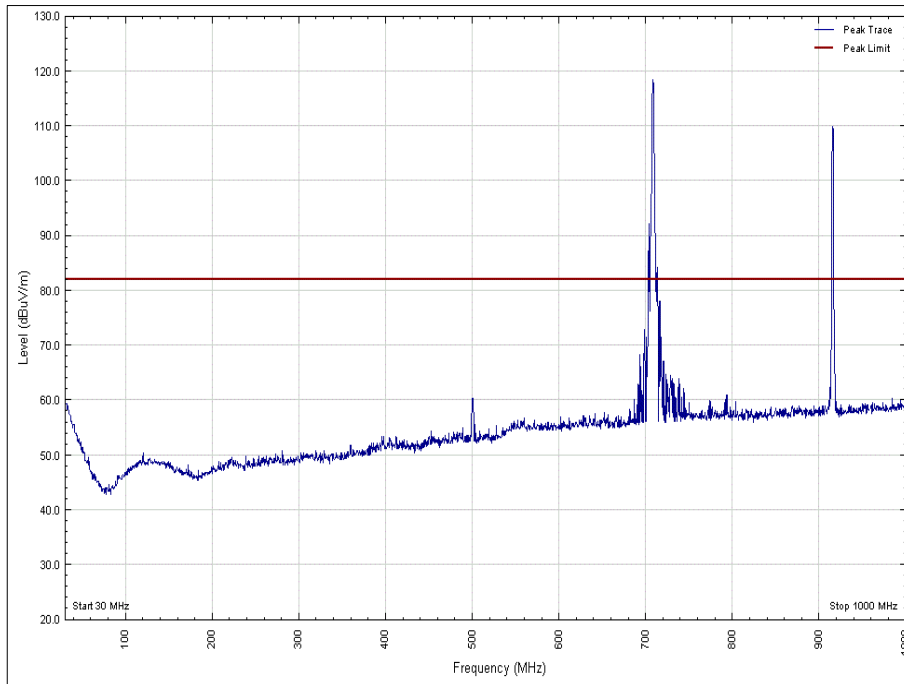


Figure 14 - 30 MHz to 1 GHz - X Orientation - Horizontal

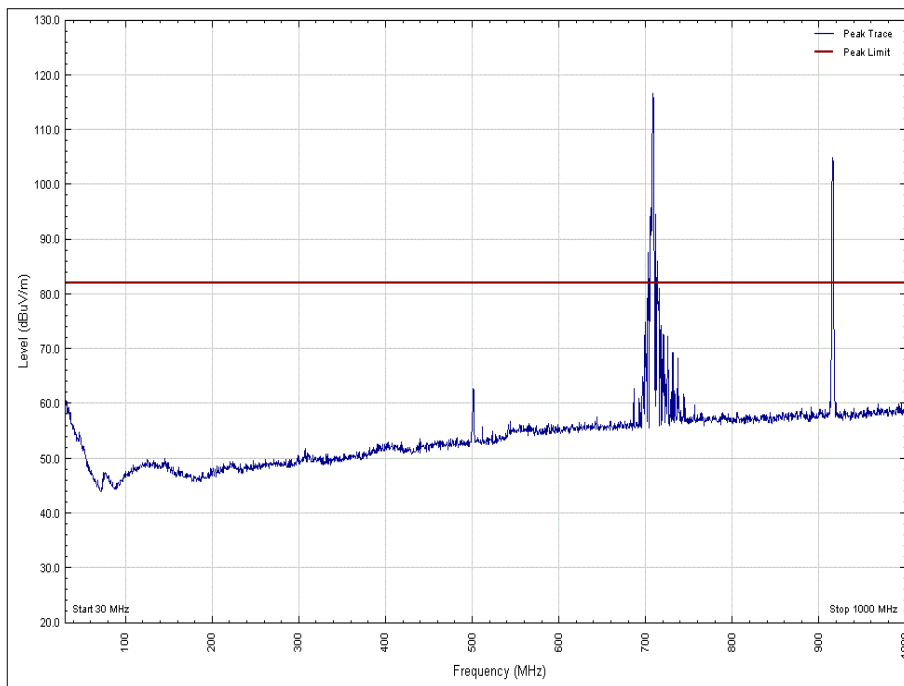


Figure 15 - 30 MHz to 1 GHz - Y Orientation - Vertical

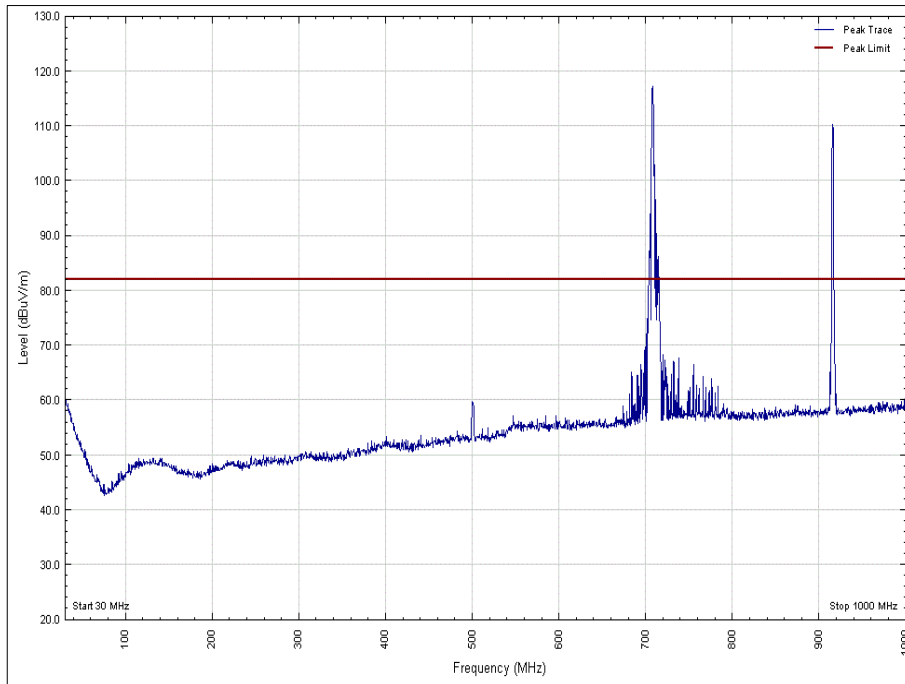


Figure 16 - 30 MHz to 1 GHz - Y Orientation - Horizontal

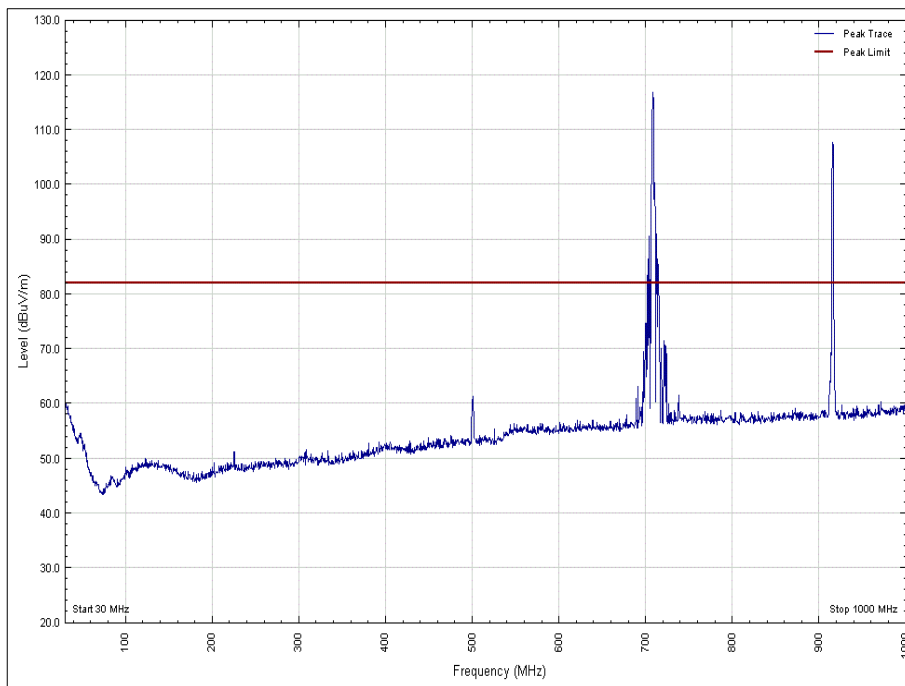


Figure 17 - 30 MHz to 1 GHz - Z Orientation - Vertical

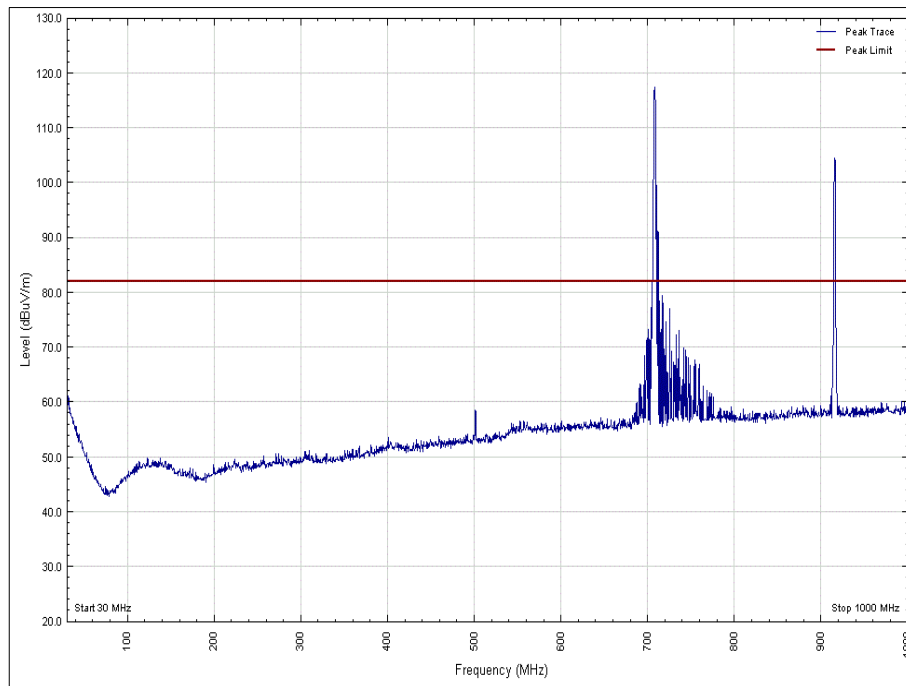


Figure 18 - 30 MHz to 1 GHz - Z Orientation - Horizontal



Frequency (GHz)	Result ($\mu\text{V/m}$)		Limit ($\mu\text{V/m}$)		Margin ($\mu\text{V/m}$)	
	Peak	Average	Peak	Average	Peak	Average
*						

Table 11 - 1 GHz to 8 GHz

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

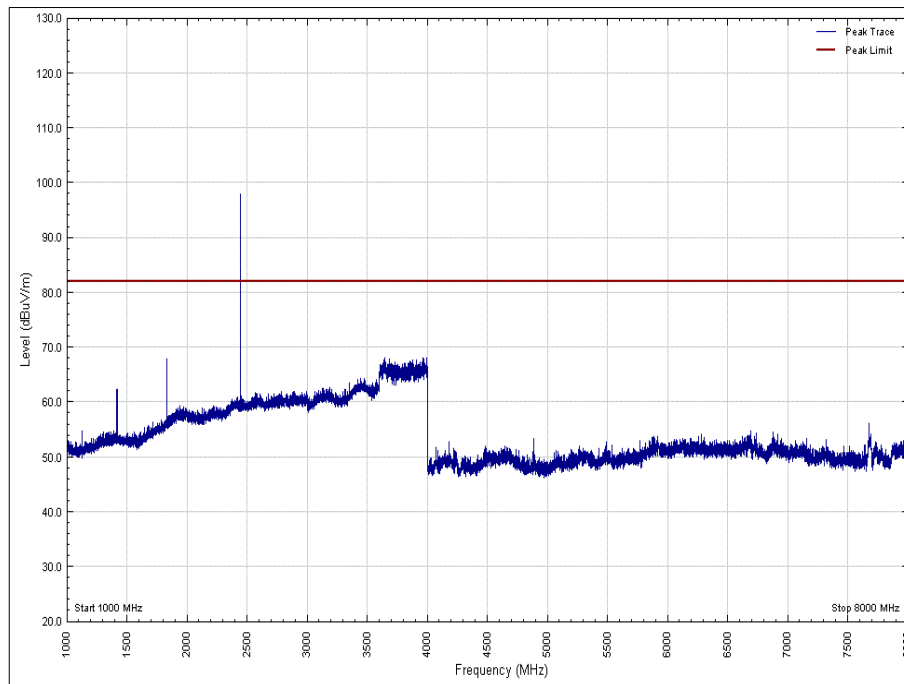


Figure 19 - 1 GHz to 8 GHz - X Orientation – Vertical

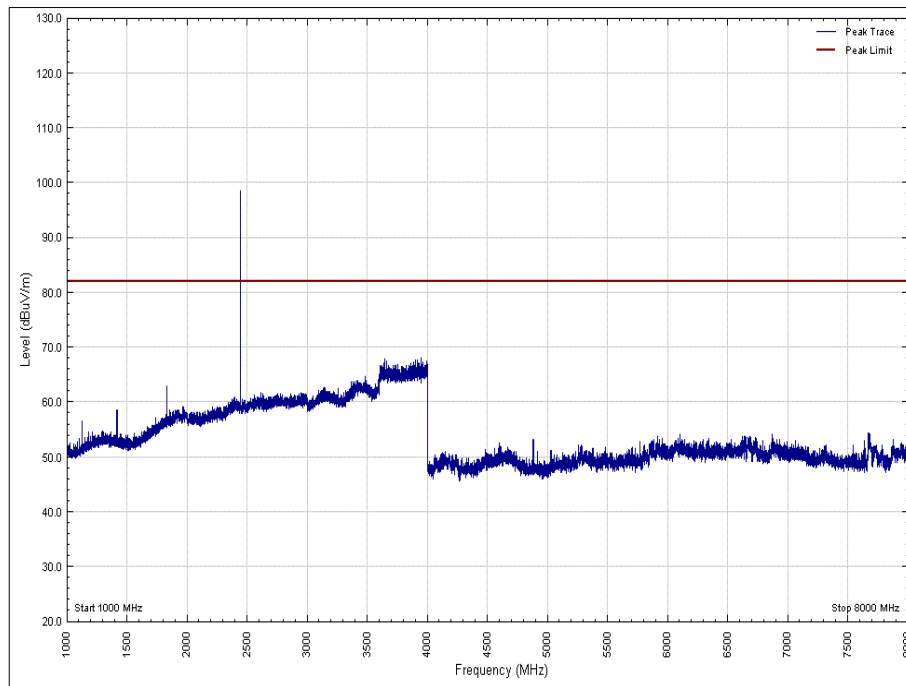


Figure 20 - 1 GHz to 8 GHz - X Orientation – Horizontal

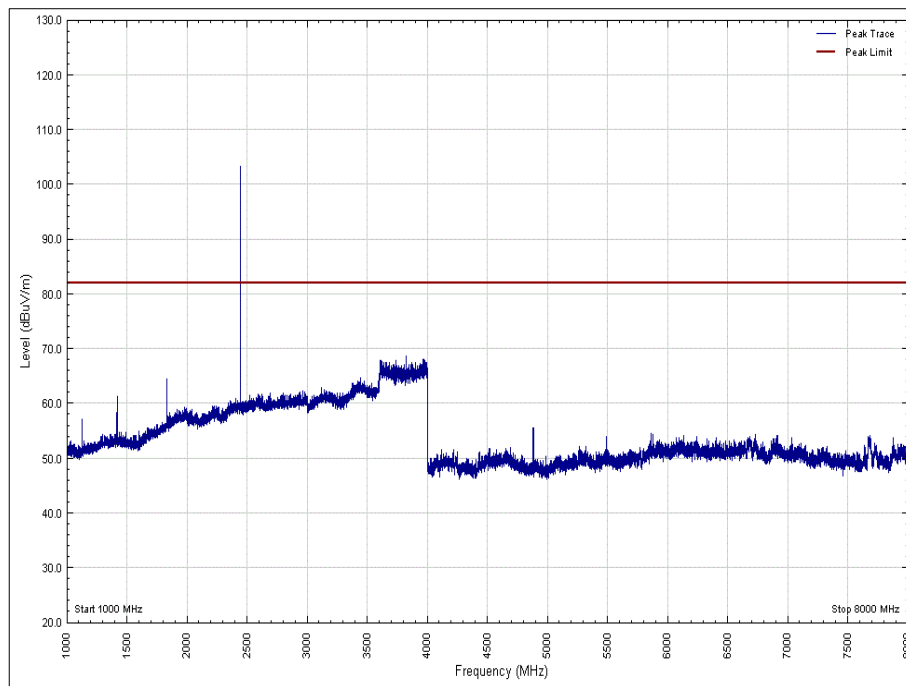


Figure 21 - 1 GHz to 8 GHz - Y Orientation - Vertical

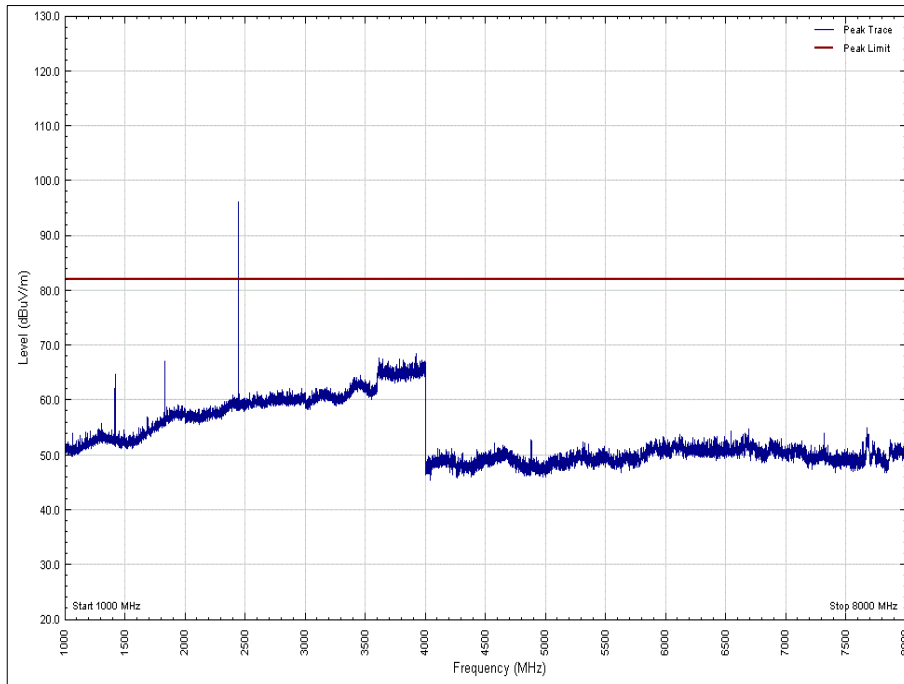


Figure 22 - 1 GHz to 8 GHz - Y Orientation – Horizontal

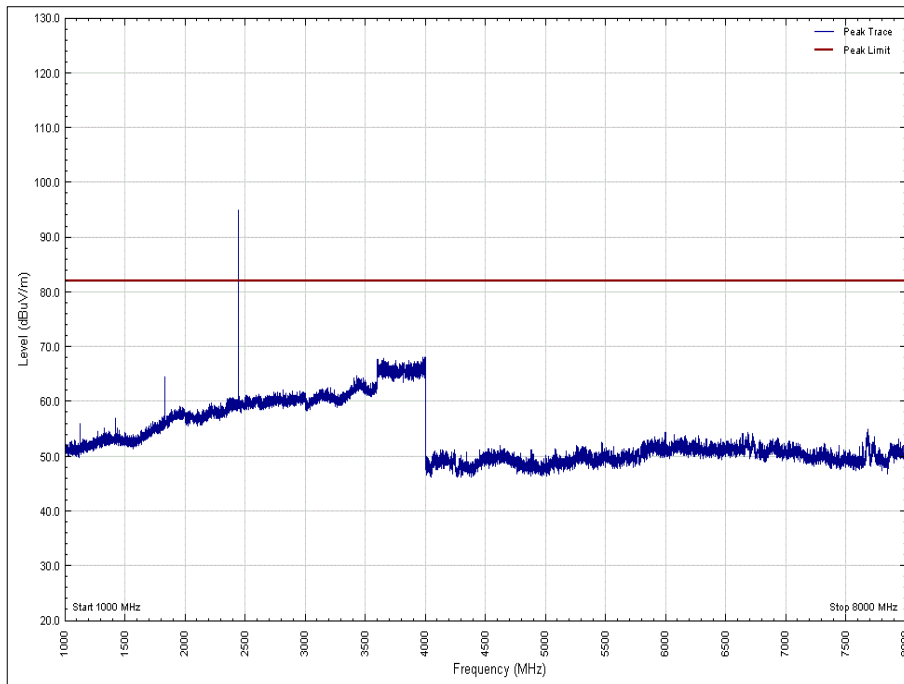


Figure 23 - 1 GHz to 8 GHz - Z Orientation - Vertical

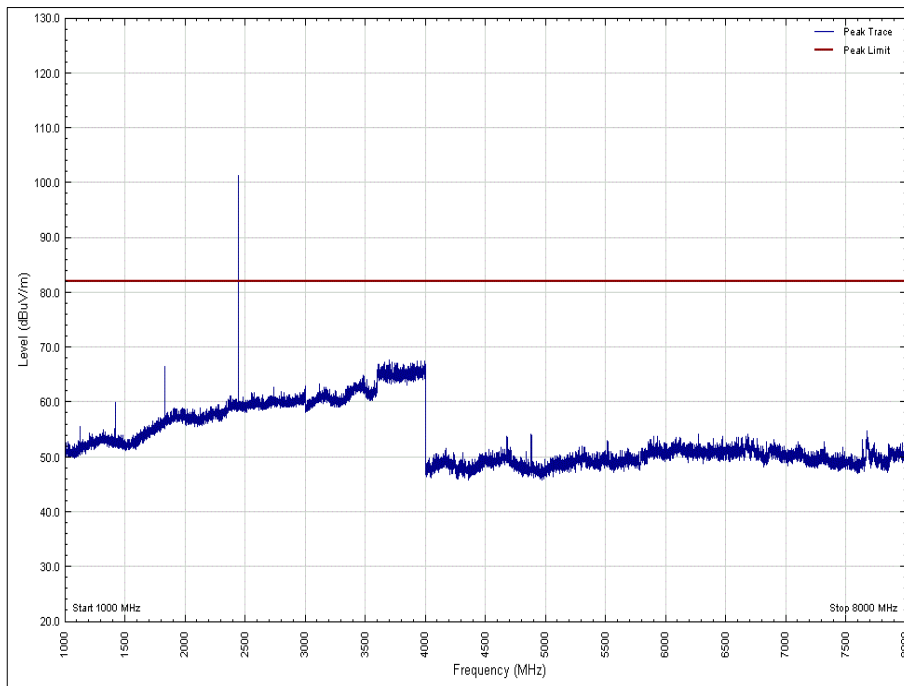


Figure 24 - 1 GHz to 8 GHz - Z Orientation - Horizontal

FCC 47 CFR Parts 15.247(d), 15.205, and 27.53(g)

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 27.53 (g)	-13 dBm (EIRP) / 82 dBµV/m at 3m.
Part 15.247 (d)	-20 dBc (Outside Restricted bands of operation as detailed in 15.205).

Table 12 - 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
Pre-Amplifier	Phase One	PS04-0086	1533	12	12-Jan-2019
18GHz - 40GHz Pre-Amplifier	Phase One	PSO4-0087	1534	12	02-Feb-2019
Screened Room (5)	Rainford	Rainford	1545	36	23-Jan-2021
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Power Supply	Hewlett Packard	6104A	1948	-	TU
Multimeter	Iso-tech	IDM101	2419	12	23-Nov-2018
Antenna with permanent attenuator (Bilog)	Chase	CBL6143	2904	24	08-Aug-2019
Comb Generator	Schaffner	RSG1000	3034	-	TU
Signal Generator	Rohde & Schwarz	SMR40	3171	12	17-Nov-2018
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	22-Nov-2018
Suspended Substrate Highpass Filter	Advance Power Components	11SH10-3000/X18000-O/O	4412	12	15-Jun-2019
1 metre SMA Cable	Florida Labs	SMS-235SP-39.4-SMS	4512	12	29-Jan-2017
Double Ridged Waveguide Horn Antenna	ETS-Lindgren	3117	4722	12	01-Mar-2019
Mast Controller	Maturo GmbH	NCD	4810	-	TU
Tilt Antenna Mast	Maturo GmbH	TAM 4.0-P	4811	-	TU
Hygrometer	Rotronic	HP21	4989	12	26-Apr-2019
Cable (26.5GHz)	Rosenberger	LU7-133-5000	5019	-	O/P Mon

Table 13

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



3 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 14