FCC Test Report

Technolog Ltd
Remote Telemetry Outstation, Model: Cello 4S

In accordance with FCC 47 CFR Part 15B

Prepared for: Technolog Ltd
Ravenstor Road
Wirksworth
DE4 4FY
United Kingdom

FCC ID: XUV-2172TT2400

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Document 75948801-02 Issue 01

SIGNATURE			
AJ Lawson.			
NAME	**JOB TITLE**	**RESPONSIBLE FOR**	**ISSUE DATE**
Andy Lawson	Senior Engineer	Authorised Signatory	01 Sept 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	Matthew Dawkins	01 Sept 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.

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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	01 Sept 2020

Table 1

1.2 Introduction

Applicant	Technolog Ltd
Manufacturer	Technolog Ltd
Model Number(s)	Cello 4S
Serial Number(s)	20201793756-F4 and 20201793755.92
Hardware Version(s)	2172TT2400B
Software Version(s)	4.47
Number of Samples Tested	2
Test Specification/Issue/Date	FCC 47 CFR Part 15B: 2019
Order Number Date	PO-020235 09-April-2020
Date of Receipt of EUT	28-April-2020 and 30-April-2020
Start of Test	01-May-2020
Finish of Test	01-May-2020
Name of Engineer(s)	Matthew Dawkins
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 is shown below.

Section	Specification Clause	Test Description	Result	Comments/Base Standard
Configuration and Mode: Battery Powered - Internal Battery - Idle				
2.1	15.109	Radiated Disturbance	Pass	ANSI C63.4: 2014
Configuration and Mode: Battery Powered - External Battery - 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)*	Data logger for monitoring pressure and flow in a mains water distribution network. The logger sends data periodically via SMS or a data connection with a server.
Manufacturer:	Technolog Ltd
Model:	Cello 4S
Part Number:	2172CG3517
Hardware Version:	2172TT2400B
Software Version:	4.47
FCC ID (if applicable)	XUV-2172TT2400
IC ID (if applicable)	Not Applicable

Intentional Radiators

Technology	GSM 850	LTE FDD Band 12 Cat-M1	LTE FDD Band 4 Cat-M1	LTE FDD Band 12 NB-IoT	LTE FDD Band 4 NB-IoT
Frequency Band (MHz)	824.2 to 848.8	699 to 716	1710 to 1755	699 to 716	1710 to 1755
Conducted Declared Output Power (dBm)	33 (+/-2)	23 (+/2)	23 (+/2)	23 (+/2)	23 (+/2)
Antenna Gain (dBi)	2.6 (internal ant) 4.5 (external ant)	2.6 (internal ant) 4.5 (external ant)	4.4 (internal ant) 5 (external ant)	2.6 (internal ant) 4.5 (external ant)	4.4 (internal ant) 5 (external ant)
Supported Bandwidth(s) (MHz)	0.2	1.4	1.4	0.2	0.2
Modulation Scheme(s)	GMSK	OFDMA, 16 QAM	OFDMA	OFDMA, 16 QAM	OFDMA
ITU Emission Designator	200KG7W	1M40D7W	200KD7W	1M40D7W	200KD7W
Bottom Frequency (MHz)	824.6	699.7	1710.7	699.4	1710.4
Middle Frequency (MHz)	836.4	707.4	1732.4	707.4	1732.4
Top Frequency (MHz)	848.4	715.3	1754.3	715.6	1754.6

Un-intentional Radiators

Highest frequency generated or used in the device or on which the device operates or tunes	1755 MHz
Lowest frequency generated or used in the device or on which the device operates or tunes	0 Hz
Class A Digital Device (Use in commercial, industrial or business environment) ☒ Class B Digital Device (Use in residential environment only) ☐	

Battery Power Source

Voltage:	3.6	V
End-point voltage:	3.5	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	°C
Maximum temperature:	+60	°C

Antenna Characteristics

Antenna connector ☒			State impedance	50	Ohm
Temporary antenna connector ☐			State impedance		Ohm
Integral antenna ☒	Type:	Ceramic	Gain	2.6 @ 700 & 850 4.4 @ 1700	dBi
External antenna ☒	Type:	dipole	Gain	4.5 @ 700 & 850 5 @ 1700	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)

ANCILLARIES (if applicable)			
MANUFACTURING DESCRIPTION	External Pressure Sensor	Input cable (3-way)	External antenna
MANUFACTURER	First Sensor	Technolog Ltd	Smarteq
TYPE	SS body digital water pressure sensor with flying lead	5m flying lead (unscreened)	Low profile, full dipole
PART NUMBER	SQ619-13219	CBLUT03U000	710266
SERIAL NUMBER	N/A	N/A	N/A
COUNTRY OF ORIGIN	Germany	UK	Sweden
ANCILLARIES (cont'd)			
MANUFACTURING DESCRIPTION	Input cable (12-way)	External Battery Pack	
MANUFACTURER	Technolog Ltd	Technolog Ltd	
TYPE	1.5m flying lead, unscreened cable.	3.6v primary lithium. ~400mm connection lead (unscreened)	
PART NUMBER	CBL006	2133TT3000-1	
SERIAL NUMBER	N/A	N/A	
COUNTRY OF ORIGIN	UK	UK	

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

Name: Joe Sawyer
Position held: Production Engineering Manager
Date: 26 August 2020

1.5 Product Information

1.5.1 Technical Description

The Equipment under test (EUT) was a Cello 4S.

The EUT is a battery-powered data logger primarily used for monitoring and recording parameters in a water utility network. The unit supports LTE Category M1 and NB1 with 2G fall-back.

1.5.2 EUT Port/Cable Identification

Port	Max Cable Length specified	Usage	Type	Screened
Configuration and Mode: All Configurations and Modes				
External Disk Antenna Port	3 m	Signal	SMA	No
External Pressure Sensor Port	2 m	Data	Custom	No
External Battery Port	0.5 m	Power	Custom	No
Flow Input Port	5 m	Data	3 way	No
Digital Input Port	2 m	Data	8 way	No

Table 3

1.5.3 Test Configuration

Configuration	Description
Battery Powered - Internal Battery	The EUT was powered via an internal 3.9 V DC cell battery. The EUT was connected to: A Disc Antenna A Pressure Sensor A flow sensor cable with no sensor attached A test box was connected to the digital input.
	The EUT was powered via an external 3.6 V DC battery pack. The EUT was connected to: A Disc Antenna A Pressure Sensor A flow sensor cable with no sensor attached A test box was connected to the digital input.

Table 4

1.5.4 Modes of Operation

Mode	Description
Idle	The EUT was powered with all transmitters disabled.

Table 5

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: Cello 4S, Serial Number: 20201793756-F4			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: Cello 4S, Serial Number: 20201793755.92			
0	As supplied by the customer	Not Applicable	Not Applicable

Table 6

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: Battery Powered - Internal Battery - Idle		
Radiated Disturbance	Matthew Dawkins	UKAS
Configuration and Mode: Battery Powered - External Battery - Idle		
Radiated Disturbance	Matthew Dawkins	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

Cello 4S, S/N: 20201793756-F4 - Modification State 0
Cello 4S, S/N: 20201793755.92 - Modification State 0

2.1.3 Date of Test

01-May-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.

A pre-scan of the EUT emissions profile was made at a 3m 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 formally 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

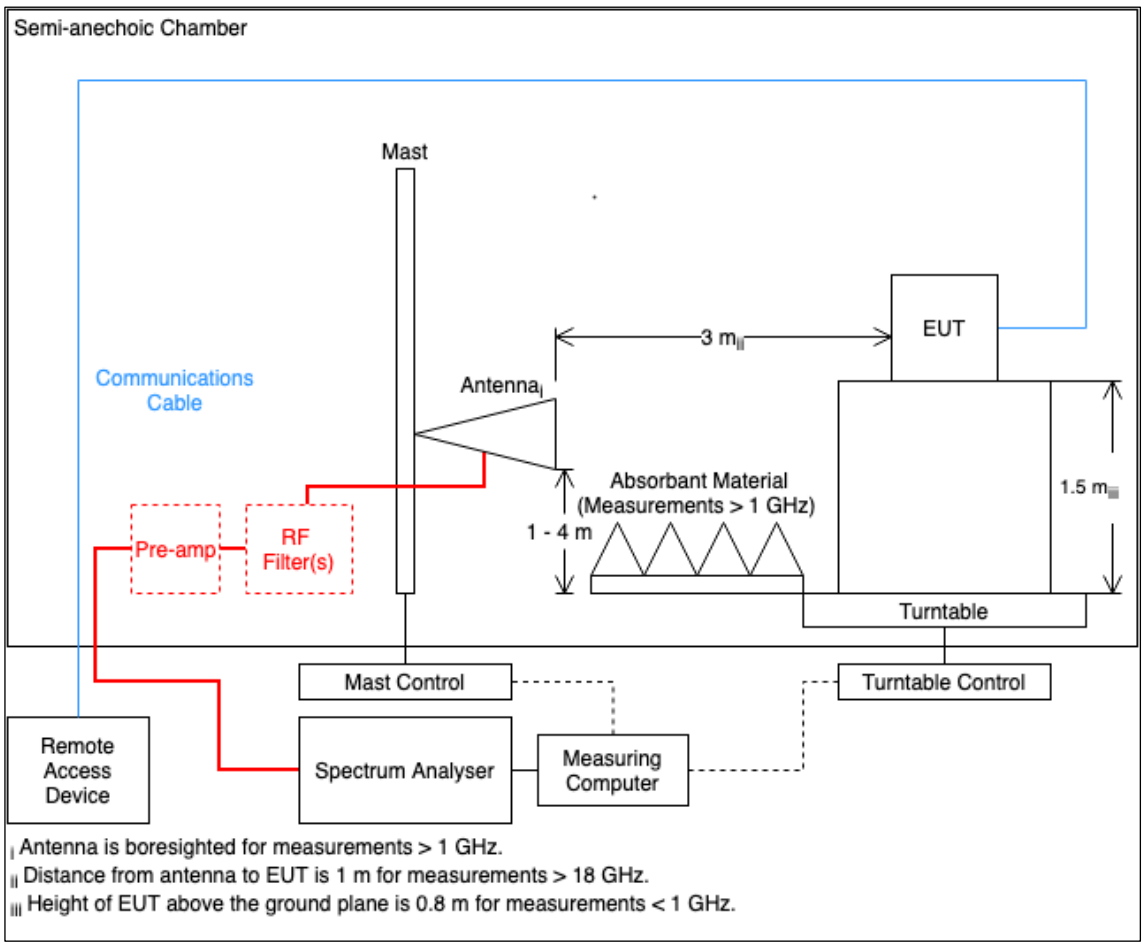

Figure 1

2.1.7 Environmental Conditions

Ambient Temperature	20.0 °C
Relative Humidity	50.0 %

2.1.8 Specification Limits

Required Specification Limits, Field Strength (Class A @ 10 m)		
Frequency Range (MHz)	(µV/m)	(dBµV/m)
30 to 88	90	39.1
88 to 216	150	43.5
216 to 960	210	46.4
Above 960	300	49.5
Supplementary information: Quasi-peak detector to be used for measurements below 1 GHz CISPR Average detector to be used for measurements above 1 GHz 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: Battery Powered - Internal Battery - Idle.

The test was performed in accordance with the Class A limits.

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

Detailed results are shown below.

Highest frequency generated or used within the EUT: 1755 MHz
Which necessitates an upper frequency test limit of: 13 GHz

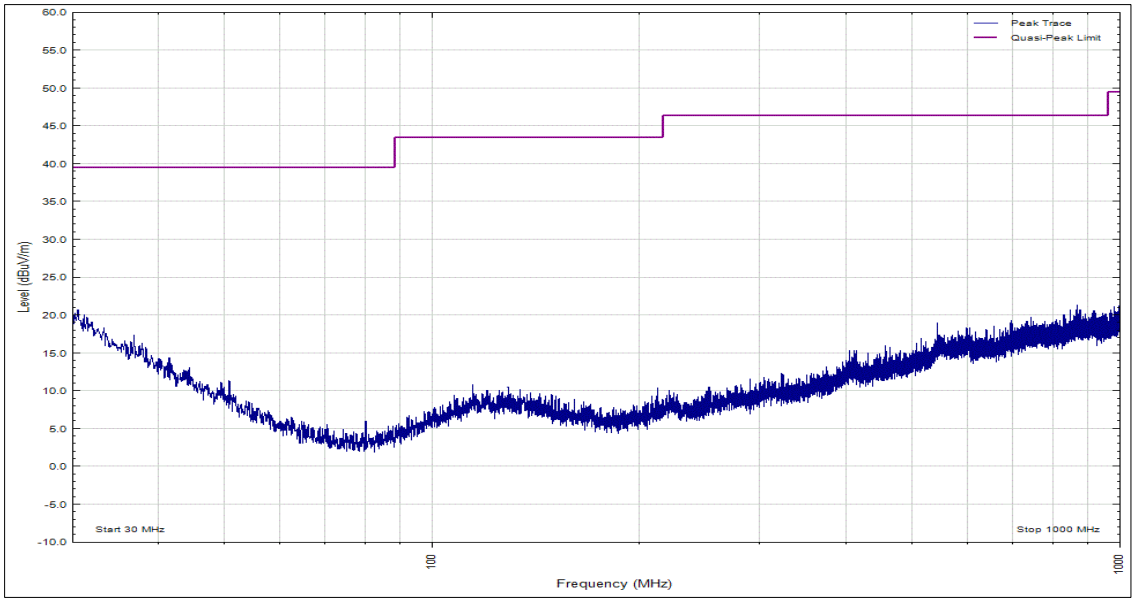

Figure 2 - 30 MHz to 1 GHz, Quasi-Peak, Horizontal

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

Table 9

*No formal measurements were made as all peak emissions seen were greater than 10 dB below the test limit.

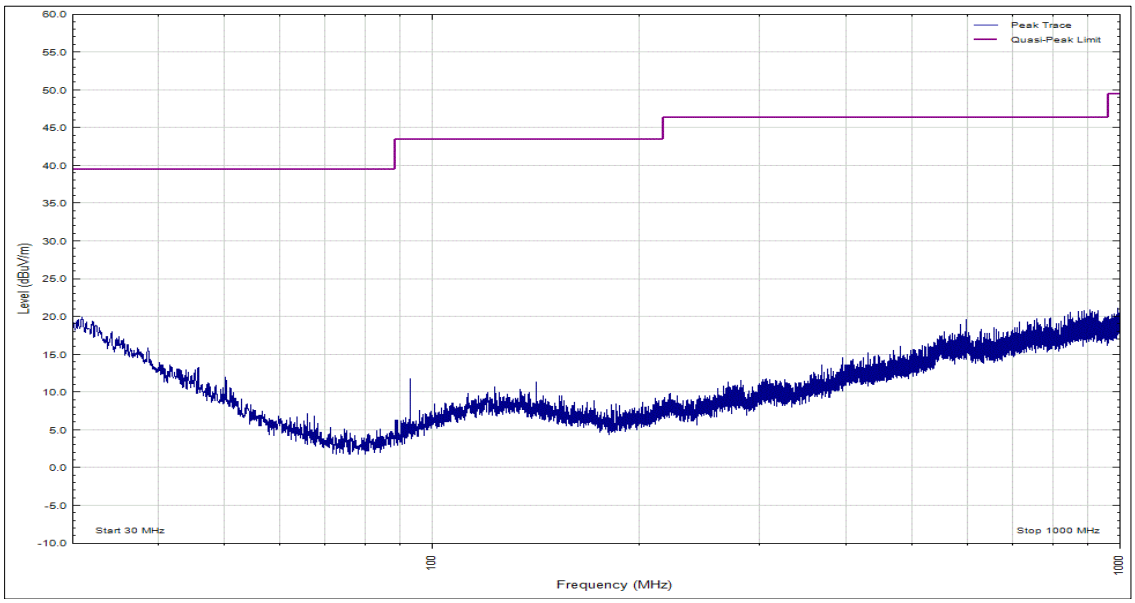

Figure 3 - 30 MHz to 1 GHz, Quasi-Peak, Vertical

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

Table 10

*No formal measurements were made as all peak emissions seen were greater than 10 dB below the test limit.

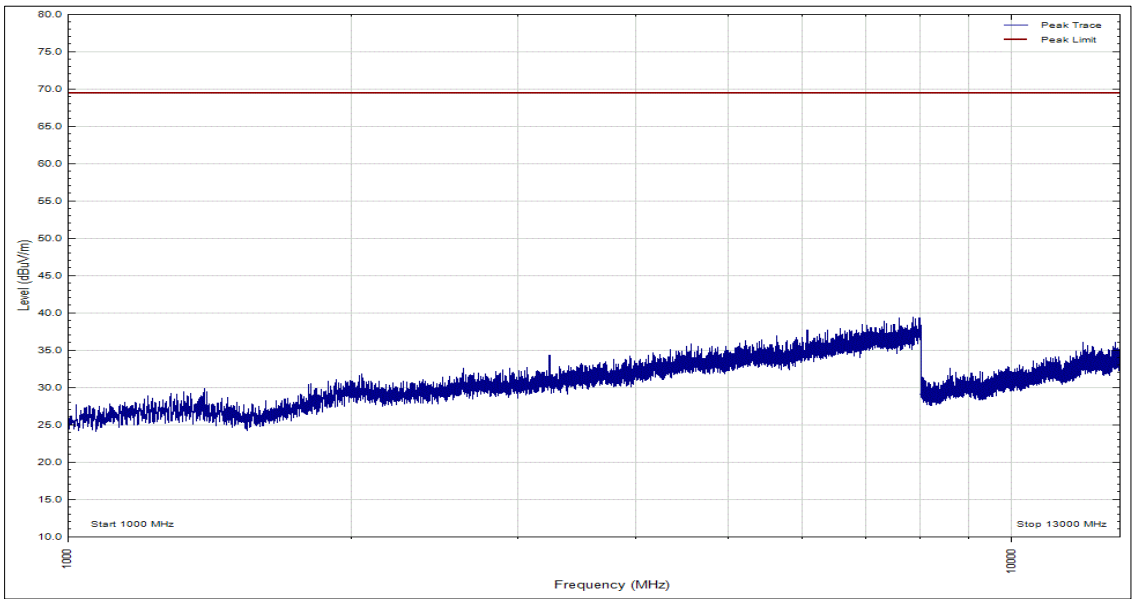

Figure 4 - 1 GHz to 13 GHz, Peak, Horizontal

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

Table 11

*No formal measurements were made as all peak emissions seen were greater than 10 dB below the test limit.

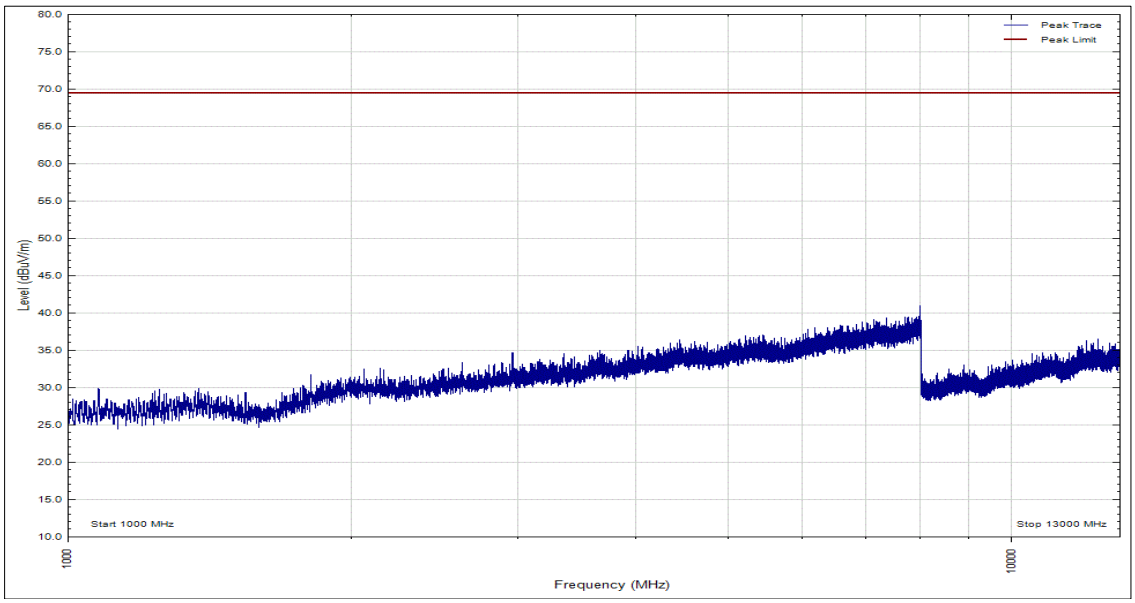

Figure 5 - 1 GHz to 13 GHz, Peak, Vertical

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

Table 12

*No formal measurements were made as all peak emissions seen were greater than 10 dB below the test limit.

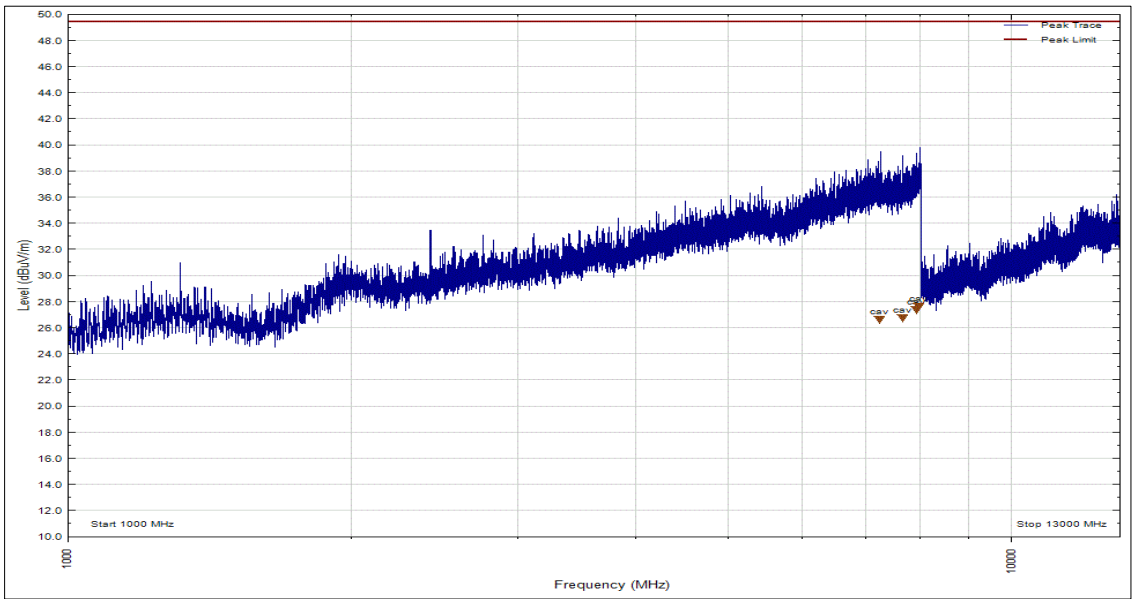

Figure 6 - 1 GHz to 13 GHz, CISPR Average, Horizontal

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation	Orientation
7246.329	26.2	49.5	-23.3	Average	219	109	Horizontal	-
7658.283	26.3	49.5	-23.2	Average	219	149	Horizontal	-
7920.416	26.9	49.5	-22.6	Average	253	234	Horizontal	-
7976.144	27.2	49.5	-22.3	Average	124	255	Horizontal	-

Table 13

No other measurements were made as all other peak emissions seen were greater than 10 dB below the test limit.

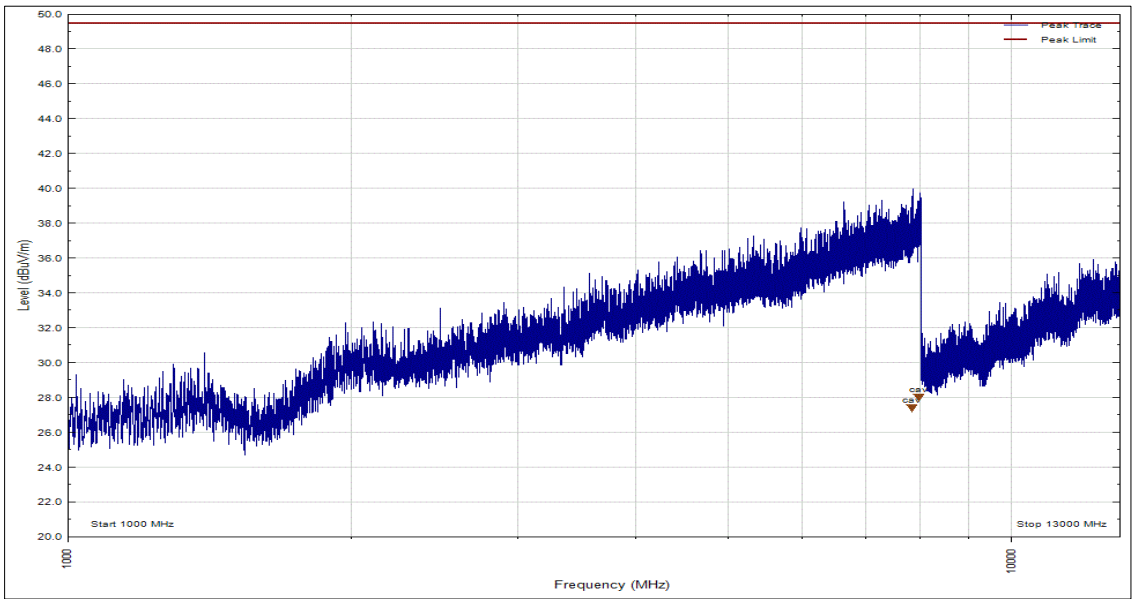

Figure 7 - 1 GHz to 13 GHz, CISPR Average, Vertical

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation	Orientation
7848.190	27.1	49.5	-22.4	Average	360	378	Vertical	-
7981.261	27.7	49.5	-21.9	Average	160	390	Vertical	-

Table 14

No other measurements were made as all other peak emissions seen were greater than 10 dB below the test limit.

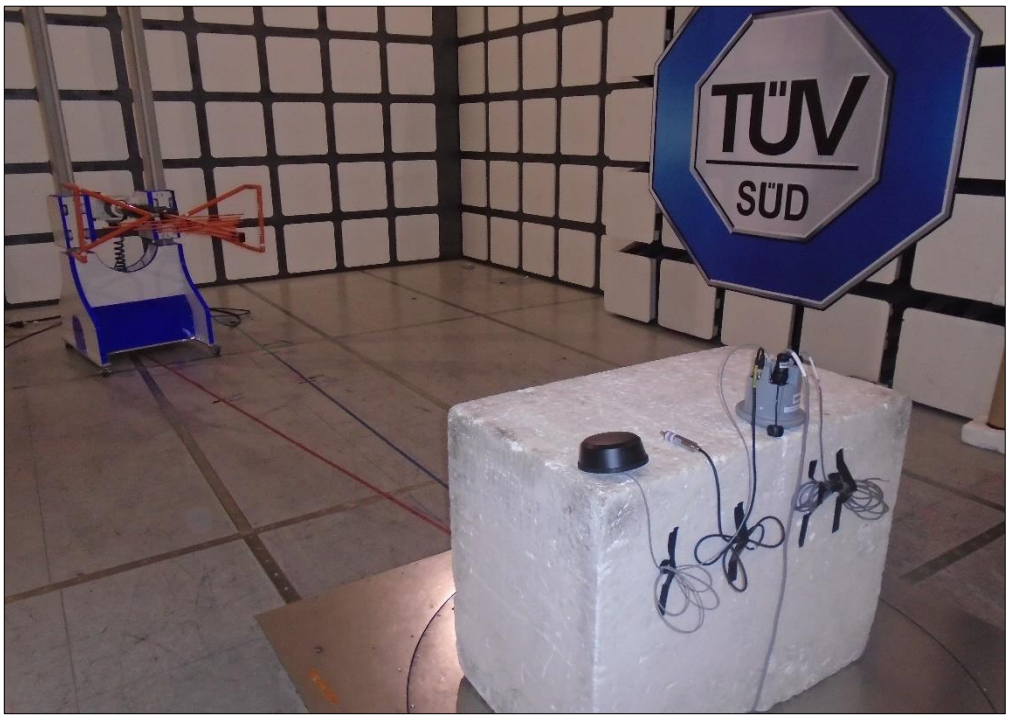

Figure 8 - Test Setup - 30 MHz to 1 GHz

Figure 9 - Test Setup - 1 GHz to 13 GHz

Results for Configuration and Mode: Battery Powered - External Battery - Idle.

The test was performed in accordance with the Class A limits.

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

Detailed results are shown below.

Highest frequency generated or used within the EUT: 1755 MHz
Which necessitates an upper frequency test limit of: 13 GHz

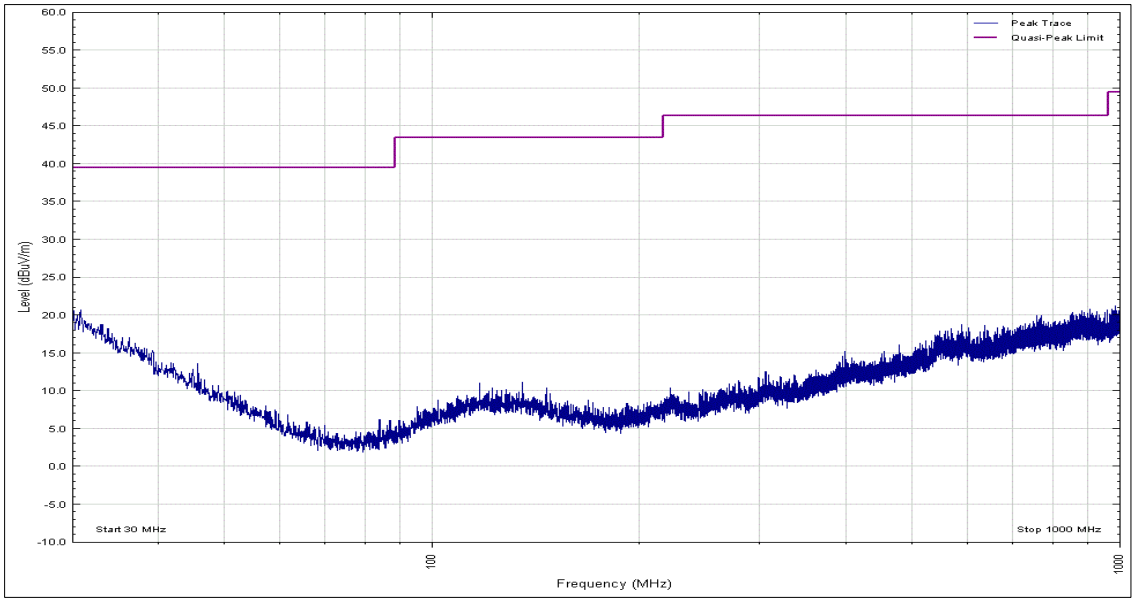

Figure 10 - 30 MHz to 1 GHz, Quasi-Peak, Horizontal

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

Table 15

*No formal measurements were made as all peak emissions seen were greater than 10 dB below the test limit.

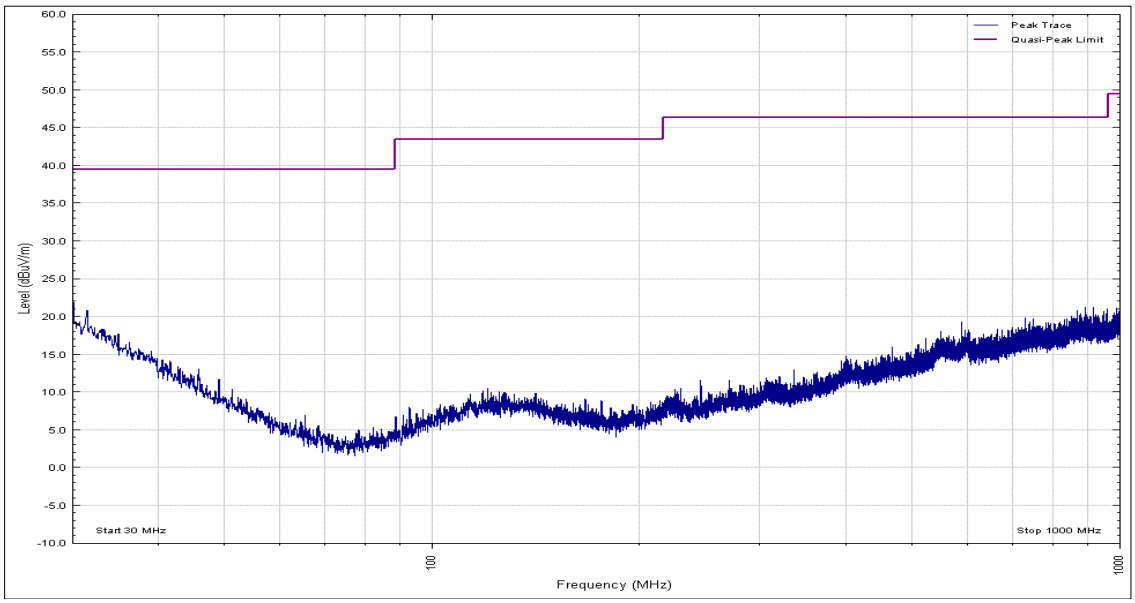

Figure 11 - 30 MHz to 1 GHz, Quasi-Peak, Vertical

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

Table 16

*No formal measurements were made as all peak emissions seen were greater than 10 dB below the test limit.

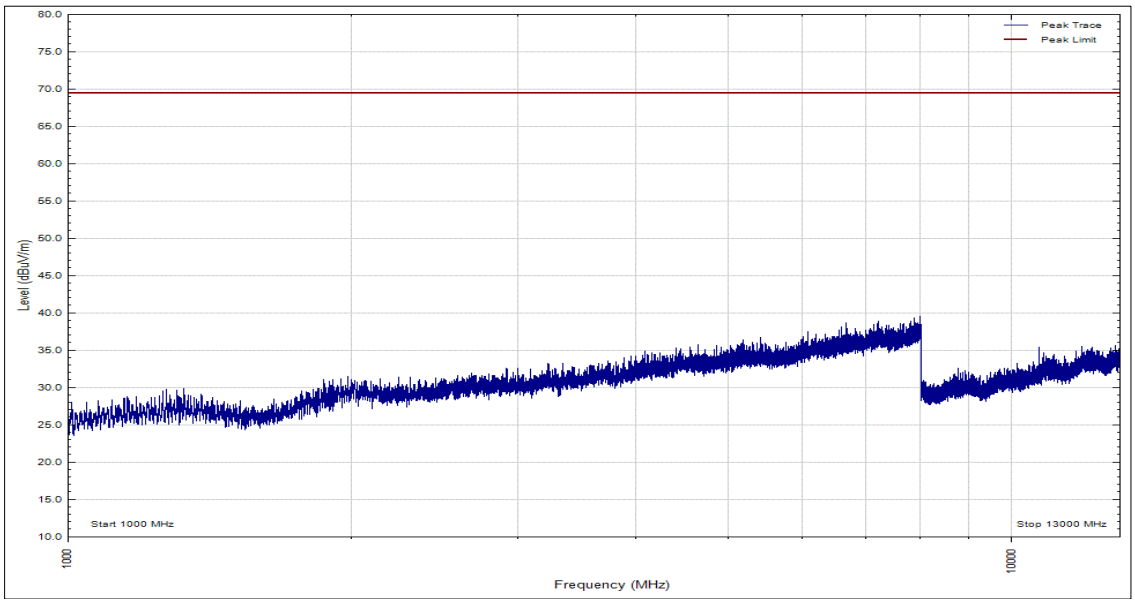

Figure 12 - 1 GHz to 13 GHz, Peak, Horizontal

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

Table 17

*No formal measurements were made as all peak emissions seen were greater than 10 dB below the test limit.

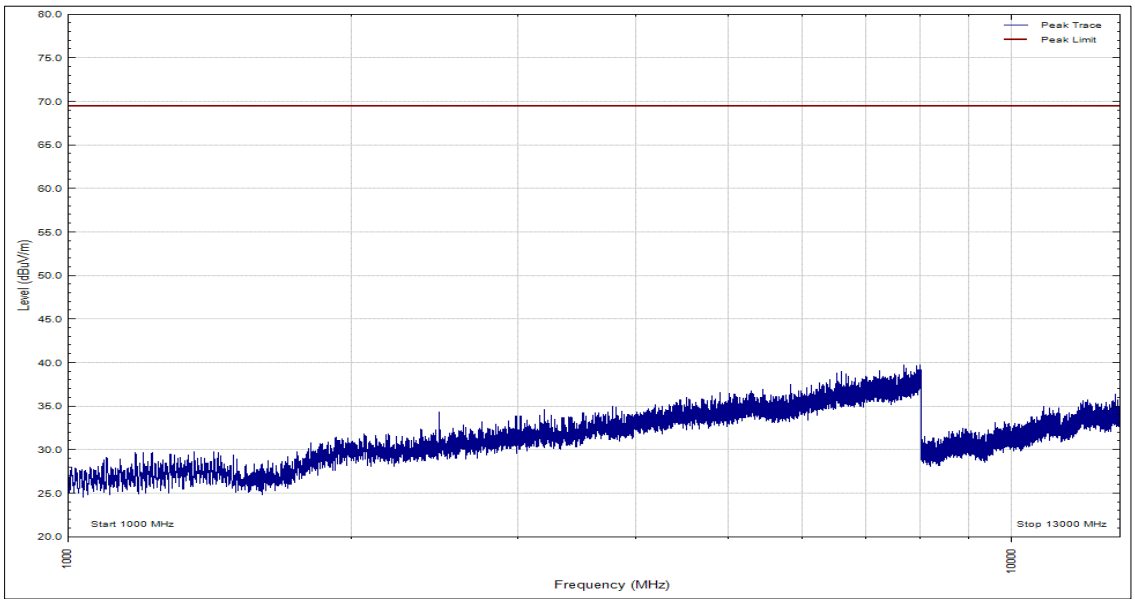

Figure 13 - 1 GHz to 13 GHz, Peak, Vertical

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

Table 18

*No formal measurements were made as all peak emissions seen were greater than 10 dB below the test limit.

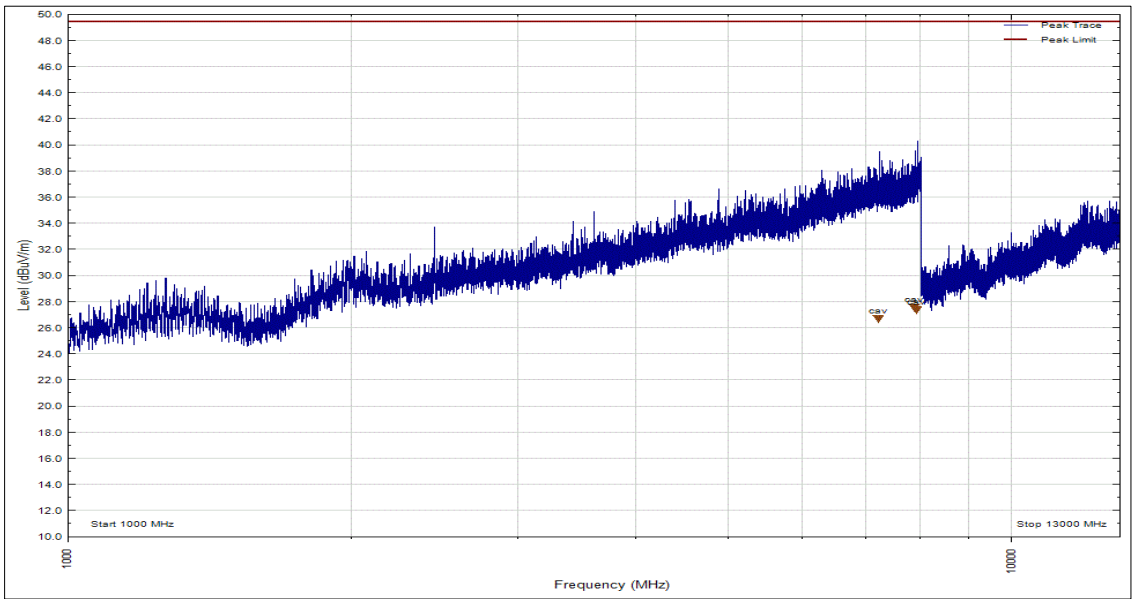

Figure 14 - 1 GHz to 13 GHz, CISPR Average, Horizontal

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation	Orientation
7223.577	26.3	49.5	-23.2	Peak	96	103	Horizontal	-
7885.073	27.1	49.5	-22.4	Peak	294	105	Horizontal	-
7935.397	26.9	49.5	-22.6	Peak	238	100	Horizontal	-

Table 19

No other measurements were made as all other peak emissions seen were greater than 10 dB below the test limit.

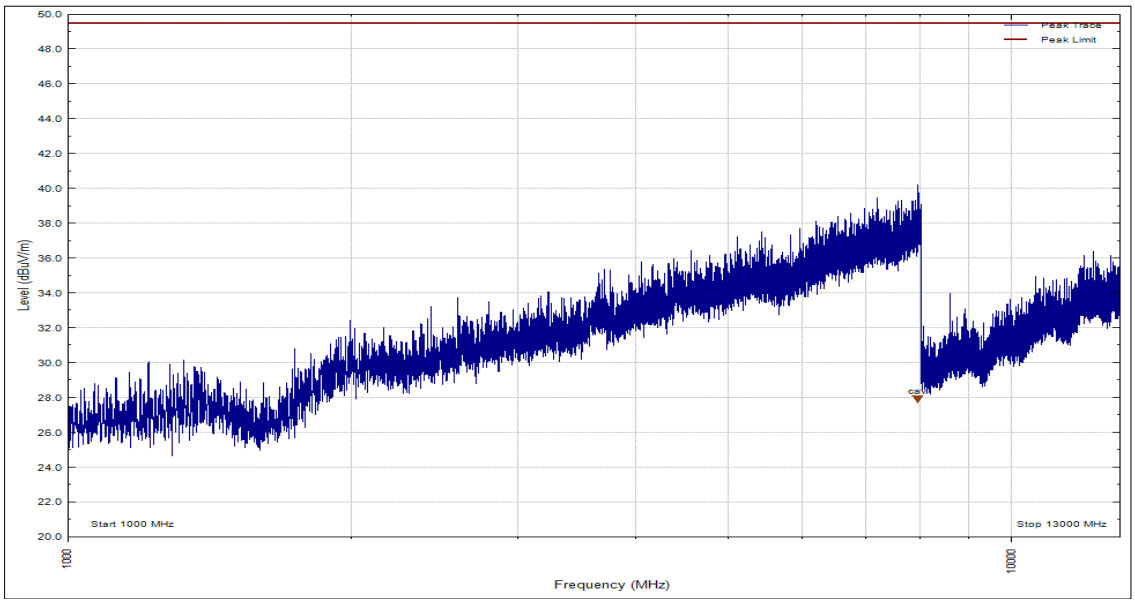

Figure 15 - 1 GHz to 13 GHz, CISPR Average, Vertical

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation	Orientation
7954.680	27.6	49.5	-21.9	Average	22	152	Vertical	-

Table 20

No other measurements were made as all other peak emissions seen were greater than 10 dB below the test limit.

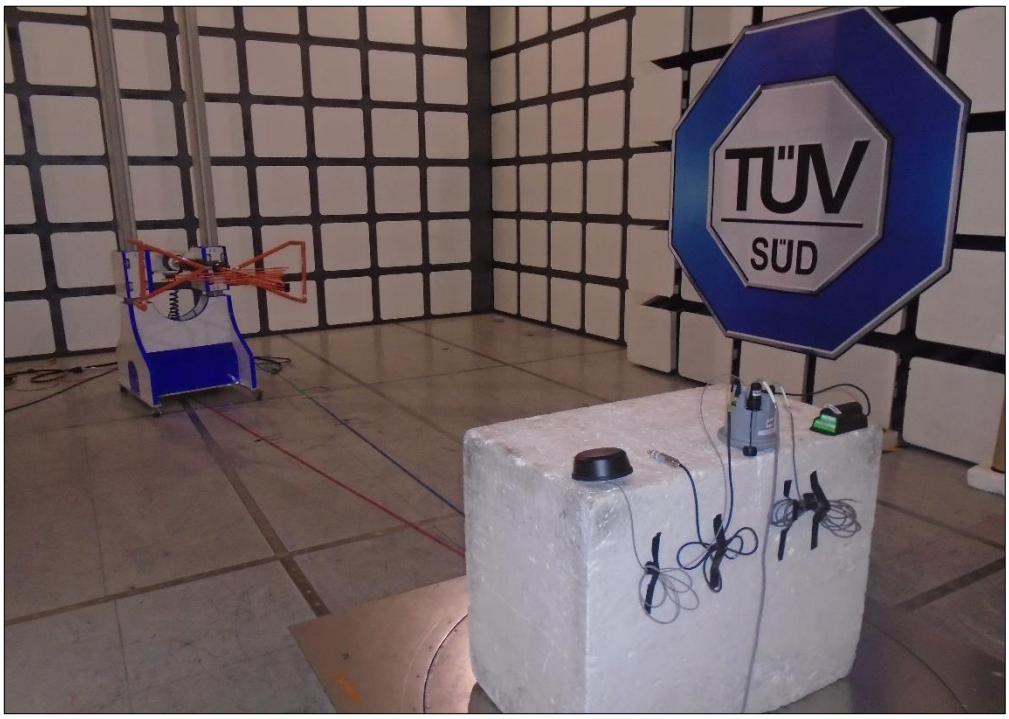

Figure 16 - Test Setup - 30 MHz to 1 GHz

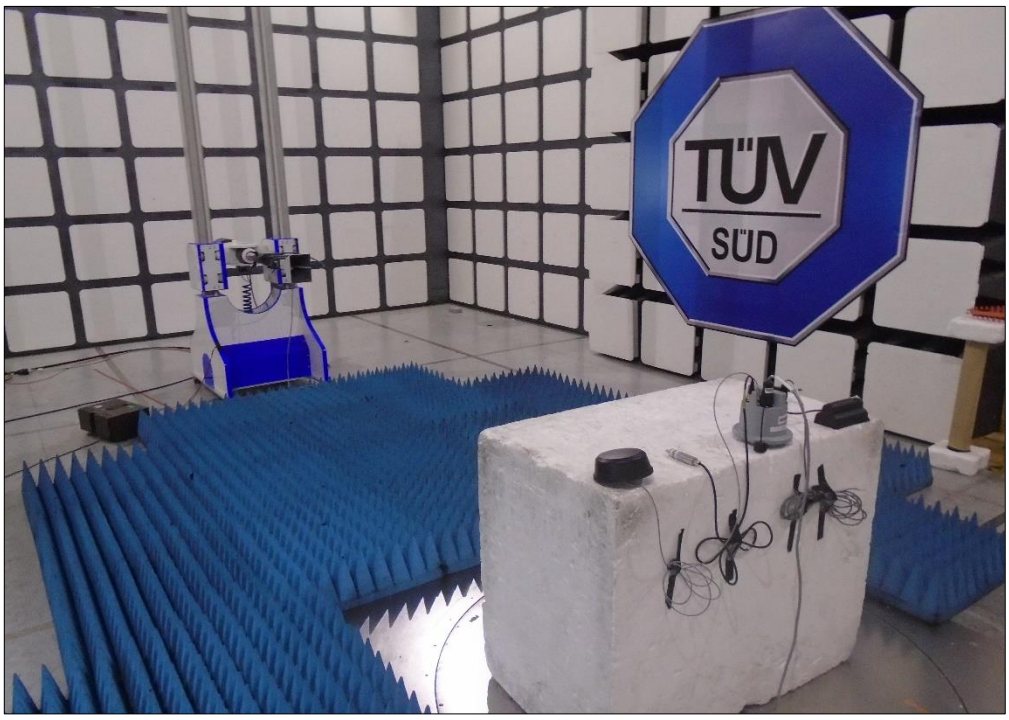

Figure 17 - Test Setup - 1 GHz to 13 GHz

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
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
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	28-Jan-2021
Triaxial accelerometer	Meggitt	66A50	4348	6	30-May-2020
Cable (Yellow, Rx, Km-Km 2m)	Scott Cables	KPS-1501-2000-KPS	4527	6	09-Jun-2020
Mast Controller	Maturo Gmbh	NCD	4810	-	TU
Tilt Antenna Mast	Maturo Gmbh	TAM 4.0-P	4811	-	TU
Double Ridge Broadband Horn Antenna	Schwarzbeck	BBHA 9120 B	4848	12	10-Mar-2021
4dB Attenuator	Pasternack	PE7047-4	4935	24	30-Sep-2021
EmX Emissions Software	TUV SUD	EmX V.V1.5.9	5125	-	Software
8 Meter Cable	Teledyne	PR90-088-8MTR	5212	12	30-Aug-2020
Cellular Signalling Box	Keysight Technologies	UXM	5267	12	05-Mar-2021
Antenna (DRG Horn 7.5-18GHz)	Schwarzbeck	HWRD750	5348	12	04-Sep-2020
Thermo-Hygro-Barometer	PCE Instruments	OCE-THB-40	5470	12	16-Mar-2021
EMI Test Receiver	Rohde & Schwarz	ESW44	5527	12	06-Feb-2021

Table 21

TU – Traceability Unscheduled

3 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 22

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.