

FCC and ISED Test Report

Apple Inc, Model: A2304

In accordance with FCC 47 CFR Part 15B
and ICES-003

Prepared for: Apple Inc.
One Apple Park Way
Cupertino
California 95014
USA

FCC ID: BCGA2304 IC: 579C-A2304



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Document 75945250-09 Issue 01

SIGNATURE			
NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
Andy Lawson	Senior Engineer	Authorised Signatory	04 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 Part 15B and ICES-003. The sample tested was found to comply with the requirements defined in the applied rules.

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Testing	Matthew Smart	04 December 2019	
Testing	Malik Mohammad	04 December 2019	
Testing	Cristian Onaca	04 December 2019	
Testing	Jay Balendrarajah	04 December 2019	
Testing	Ahmad Javid	04 December 2019	
Testing	Faisal Malyar	04 December 2019	

FCC Accreditation
90987 Octagon House, Fareham Test Laboratory

Industry Canada 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 15B: 2018 and ICES-003: 2016 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	04 December 2019

Table 1

1.2 Introduction

Applicant	Apple Inc.
Manufacturer	Apple Inc.
Model Number(s)	A2304
Serial Number(s)	C02Z1003N5VN and C02Z1006N5VL
Hardware Version(s)	REV 1.0
Software Version(s)	A19A556 & 19A507
Number of Samples Tested	2
Test Specification/Issue/Date	FCC 47 CFR Part 15B: 2018 ICES-003: 2016
Order Number	0540176069
Date	25-February-2019
Date of Receipt of EUT	18-October-2019
Start of Test	18-October-2019
Finish of Test	31-October-2019
Name of Engineer(s)	Matthew Smart, Malik Mohammad, Cristian Onaca, Jay Balendrarajah, Ahmad Javid and Faisal Malyar
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 and ICES-003 is shown below.

Section	Specification Clause		Test Description	Result	Comments/Base Standard
	Part 15B	ICES-003			
Configuration and Mode: AC Powered - 120 V AC - (TX Idle)					
2.1	15.107	6.1	Conducted Disturbance at Mains Terminals	Pass	ANSI C63.4: 2014
2.2	15.109	6.2	Radiated Disturbance	Pass	ANSI C63.4: 2014

Table 2



1.4 Product Information

1.4.1 Technical Description

The Equipment Under Test (EUT) was a rack mounted computer with Bluetooth, Bluetooth Low Energy and 802.11 a/b/g/n/ac capabilities in the 2.4 GHz and 5.0 GHz bands

1.4.2 EUT Port/Cable Identification

Port	Max Cable Length specified	Usage	Type	Screened
Configuration and Mode: AC Powered - 120 V AC - (TX Idle)				
AC Port -	<3 m	Power	-	No
USB (x4)	<3 m	Data	Type C	No
USB (x2)	<3 m	Data	Type A	No
Head Phone	<3 m	Audio	-	-
HDMI (x2)	<3 m	Video/Audio		No
Ethernet (x2)	>3 m	Data	-	Yes

Table 3

1.5 Deviations from the Standard

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

1.6 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: A2304: Serial Number: C02Z1001N5VN			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: A2304: Serial Number: C02Z1003N5VN			
0	As supplied by the customer	Not Applicable	Not Applicable

Table 4

1.7 Test Location

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

Test Name	Name of Engineer(s)	Accreditation
Configuration and Mode: AC Powered - 120 V AC - (TX Idle)		
Conducted Disturbance at Mains Terminals	Matthew Dawkins and Matthew Smart	UKAS
Radiated Disturbance	Matthew Dawkins, Malik Mohammad, Cristian Onaca, Jay Balendrarajah, Ahmad Javid, Faisal Malyar and Connor Lee	UKAS

Table 5

Office Address:

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



2 Test Details

2.1 Conducted Disturbance at Mains Terminals

2.1.1 Specification Reference

FCC 47 CFR Part 15B, Clause 15.107
ICES-003, Clause 6.1

2.1.2 Equipment Under Test and Modification State

A2304, S/N: C02Z1003N5VN - Modification State 0

2.1.3 Date of Test

31-October-2019

2.1.4 Test Method

The EUT was setup according to ANSI C63.4, clause 5.2.

The EUT was placed on a non-conductive table 0.8 m above a reference ground plane. A vertical coupling plane was placed 0.4 m from the EUT boundary.

A Line Impedance Stabilisation Network (LISN) was directly bonded to the ground-plane. The EUT was located so that the distance between the boundary of the EUT and the closest surface of the LISN was 0.8 m.

Interconnecting cables that hanged closer than 0.4 m to the ground plane were folded back and forth in the centre forming a bundle 0.3 m to 0.4 m long.

Input and output cables were terminated with equipment or loads representative of real usage conditions.

The EUT was configured to give the highest level of emissions within reason of a typical installation as described by the manufacturer.

2.1.5 Example Calculation

Quasi-Peak level (dB μ V) = Receiver level (dB μ V) + Correction Factor (dB)
Margin (dB) = Quasi-Peak level (dB μ V) – Limit (dB μ V)

CISPR Average level (dB μ V) = Receiver level (dB μ V) + Correction Factor (dB)
Margin (dB) = CISPR Average level (dB μ V) – Limit (dB μ V)

2.1.6 Example Test Setup Diagram

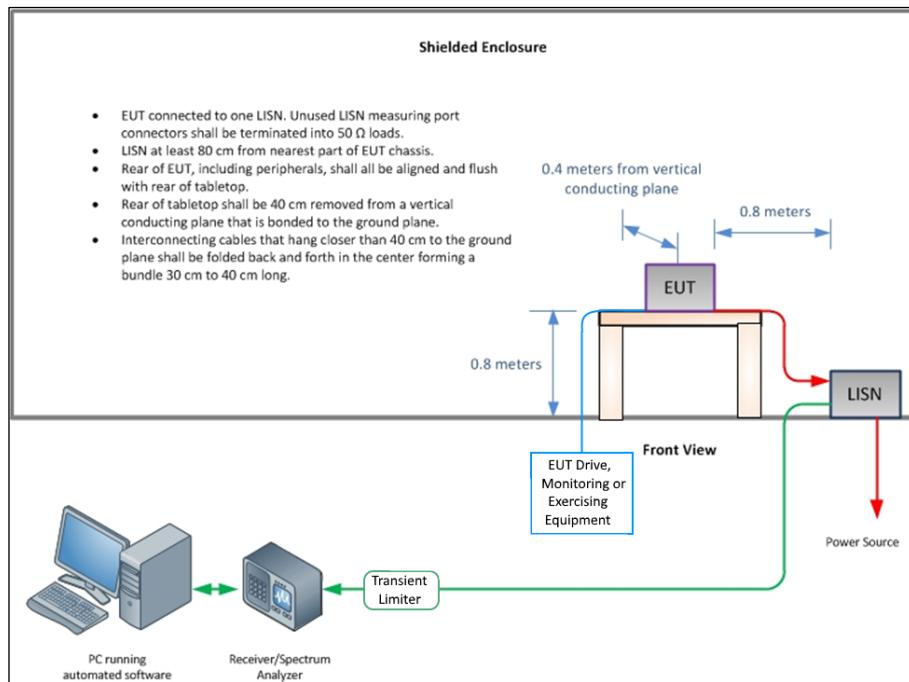


Figure 1 - Conducted Disturbance Example Test Setup

2.1.7 Environmental Conditions

Ambient Temperature 22.0 °C
Relative Humidity 45.0 %

2.1.8 Specification Limits

Required Specification Limits (Class B)			
Line Under Test	Frequency Range (MHz)	Quasi-peak (dB μ V)	CISPR Average (dB μ V)
AC Power Port	0.15 to 0.5	66 to 56*	56 to 46*
	0.5 to 5	56	46
	5 to 30	60	50

Supplementary information: *Decreases with the logarithm of the frequency.

Table 6

2.1.9 Test Results

Results for Configuration and Mode: AC Powered - 120 V AC - (TX Idle).

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

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

Detailed results are shown below.

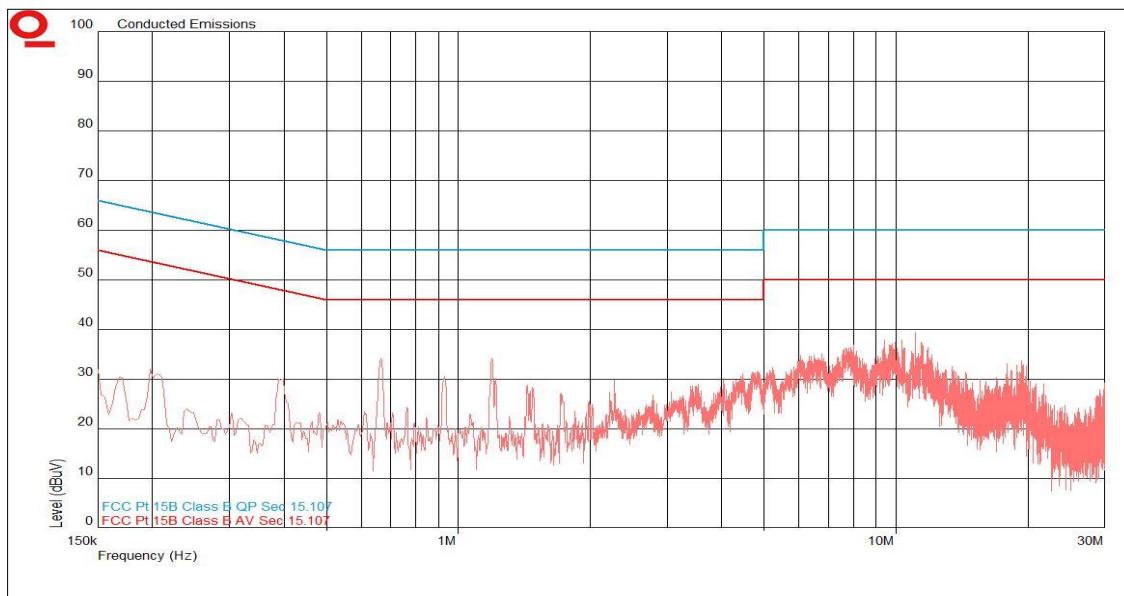


Figure 2 - Graphical Results - AC Port - Live Line

Frequency (MHz)	QP Level (dB μ V)	QP Limit (dB μ V)	QP Margin (dB)	CISPR Average Level (dB μ V)	CISPR Average Limit (dB μ V)	CISPR Average Margin (dB)
*						

Table 7

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

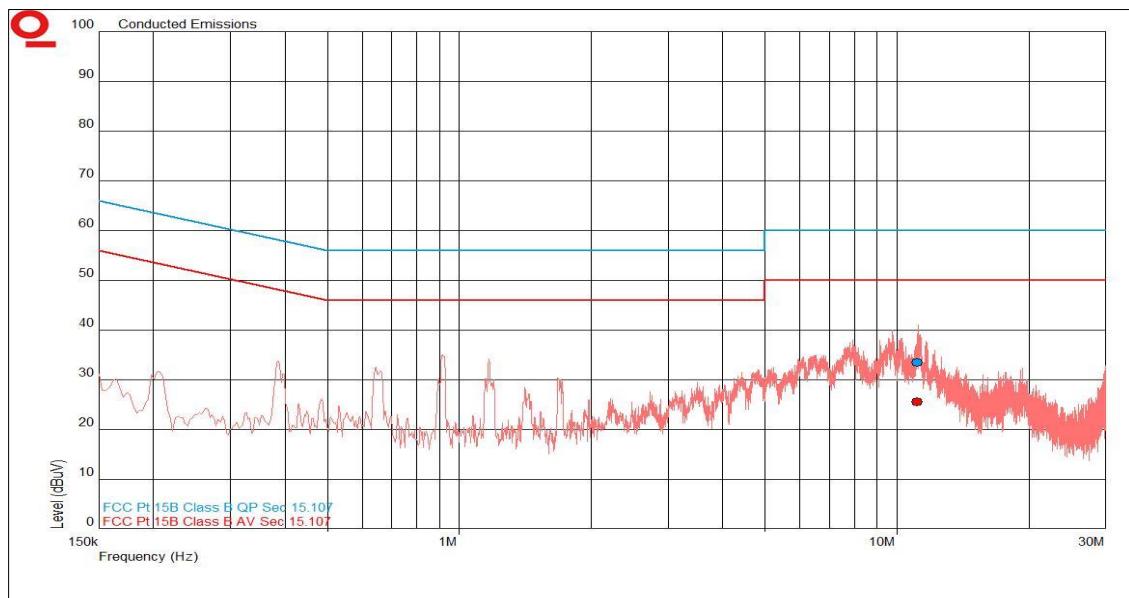


Figure 3 - Graphical Results - AC Port - Neutral Line

Frequency (MHz)	QP Level (dB μ V)	QP Limit (dB μ V)	QP Margin (dB)	CISPR Average Level (dB μ V)	CISPR Average Limit (dB μ V)	CISPR Average Margin (dB)
11.130	33.5	60.0	-26.5	25.7	50.0	-24.3

Table 8

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

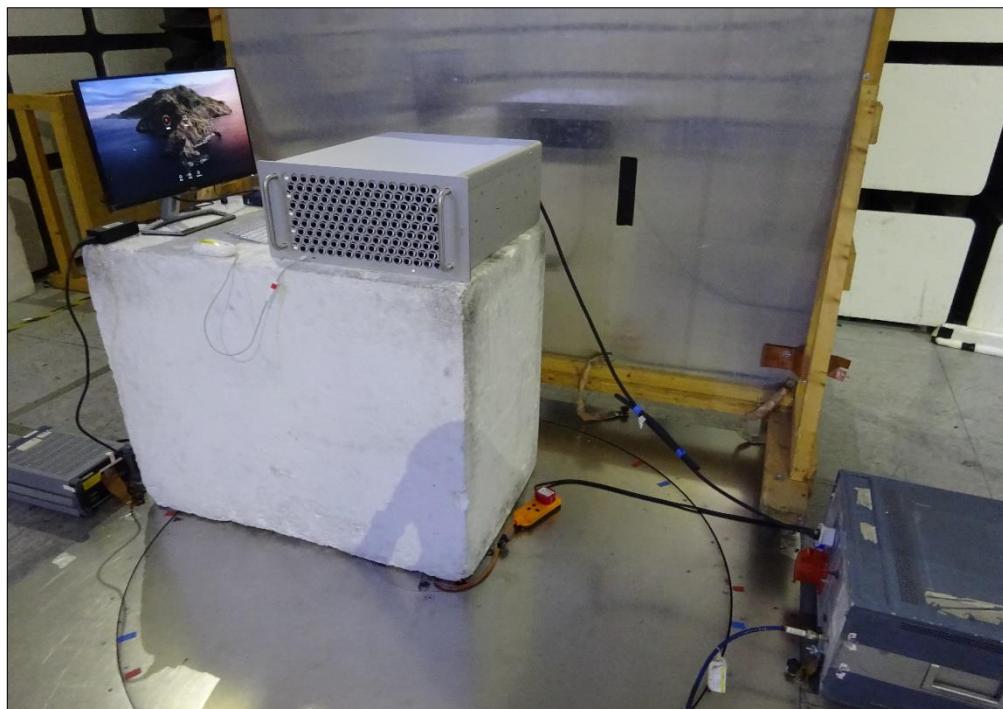


Figure 4 - Test Setup

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
Compliance 5 Emissions	Teseq	V5.26.51	3275	-	Software
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	17-Dec-2019
Transient Limiter	Hewlett Packard	11947A	2377	12	26-Feb-2020
3 Phase Artificial Mains Network (LISN)	Rohde & Schwarz	ESH2-Z5	16	12	28-Feb-2020
LISN	Rohde & Schwarz	ESH3-Z5	1390	12	20-Nov-2019

Table 9



2.2 Radiated Disturbance

2.2.1 Specification Reference

FCC 47 CFR Part 15B, Clause 15.109
ICES-003, Clause 6.2

2.2.2 Equipment Under Test and Modification State

A2304, S/N: C02Z1006N5VL - Modification State 0

2.2.3 Date of Test

18-October-2019 to 29-October-2019

2.2.4 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 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 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.

2.2.5 Example Calculation

Below 1 GHz:

$$\begin{aligned}\text{Quasi-Peak level (dB}\mu\text{V/m)} &= \text{Receiver level (dB}\mu\text{V)} + \text{Correction Factor (dB)} \\ \text{Margin (dB)} &= \text{Quasi-Peak level (dB}\mu\text{V/m)} - \text{Limit (dB}\mu\text{V/m)}\end{aligned}$$

Above 1 GHz:

$$\begin{aligned}\text{CISPR Average level (dB}\mu\text{V/m)} &= \text{Receiver level (dB}\mu\text{V)} + \text{Correction Factor (dB)} \\ \text{Margin (dB)} &= \text{CISPR Average level (dB}\mu\text{V/m)} - \text{Limit (dB}\mu\text{V/m)}\end{aligned}$$

$$\begin{aligned}\text{Peak level (dB}\mu\text{V/m)} &= \text{Receiver level (dB}\mu\text{V)} + \text{Correction Factor (dB)} \\ \text{Margin (dB)} &= \text{Peak level (dB}\mu\text{V/m)} - \text{Limit (dB}\mu\text{V/m)}\end{aligned}$$

2.2.6 Example Test Setup Diagram

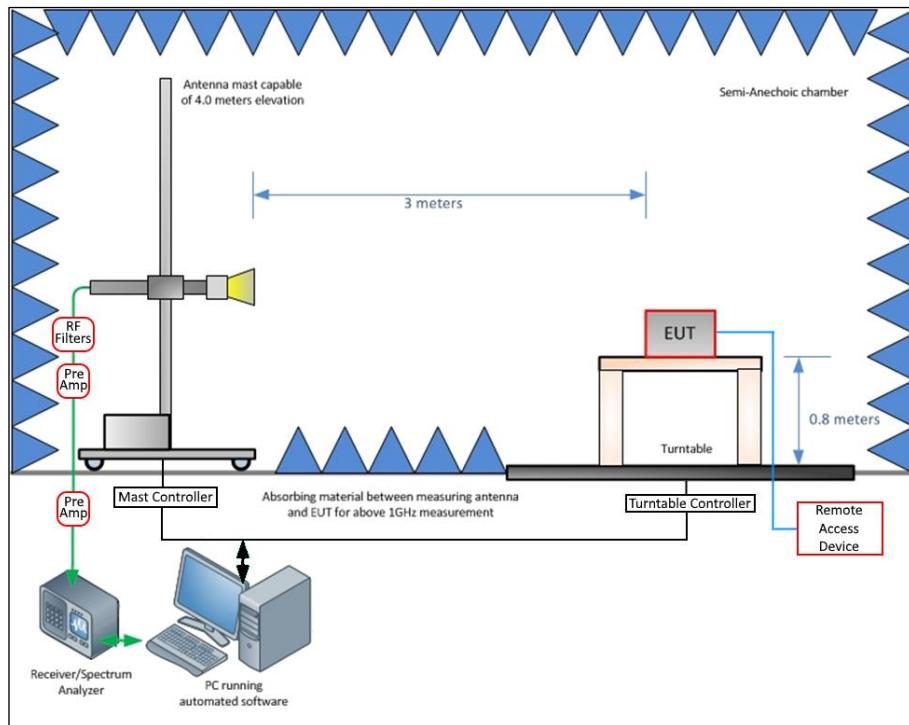


Figure 5 - Radiated Disturbance Example Test Setup

2.2.7 Environmental Conditions

Ambient Temperature 21.0 °C
Relative Humidity 52.0 %

2.2.8 Specification Limits

Required Specification Limits, Field Strength (Class B @ 3m)		
Frequency Range (MHz)	(μ V/m)	(dB μ V/m)
30 to 88	100	40
88 to 216	150	43.5
216 to 960	200	46.0
Above 960	500	54

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 10

2.2.9 Test Results

Results for Configuration and Mode: AC Powered - 120 V AC - (TX Idle).

The test was performed in accordance with 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: 5.825 GHz
Which necessitates an upper frequency test limit of: 30.000 GHz

Frequency Range of Test: 30 MHz to 1 GHz

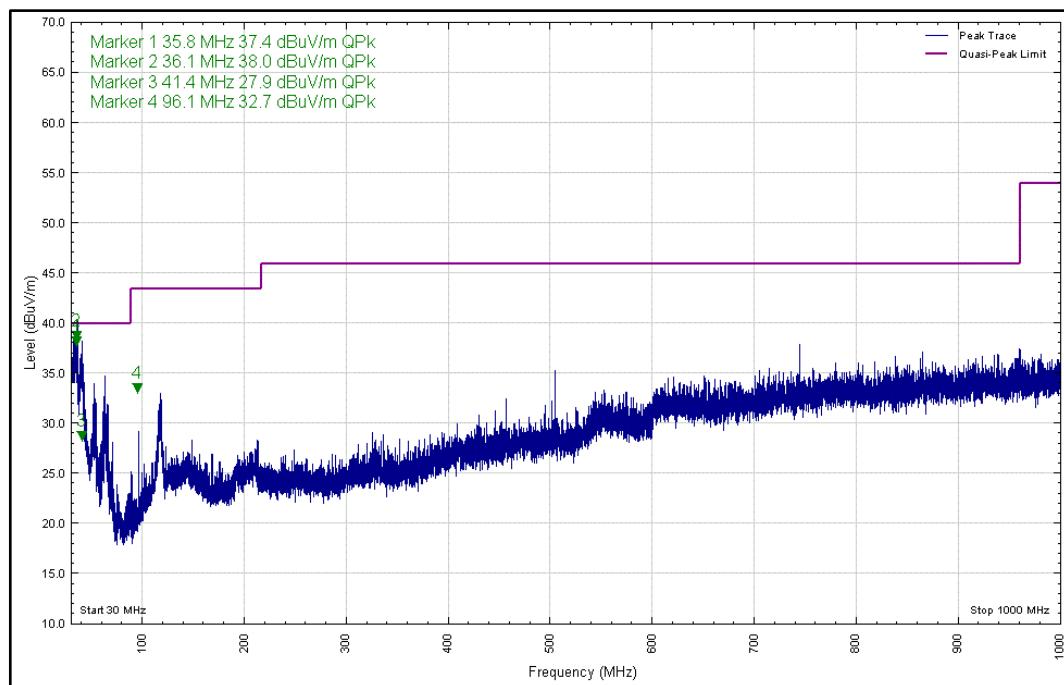


Figure 6 - Graphical Results - Vertical Polarity

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
37.166	24.9	40	15.1	QP	238	333	Vertical
36.136	37.95	40	2.1	QP	0	287	Vertical
51.771	25.36	40	14.6	QP	172	100	Vertical
62.468	31.2	40	8.8	QP	200	100	Vertical
96.021	32.37	43.5	11.1	QP	252	103	Vertical

Table 11

No other measurements were made as all other peak emissions seen were greater than 6 dB below the test limit.

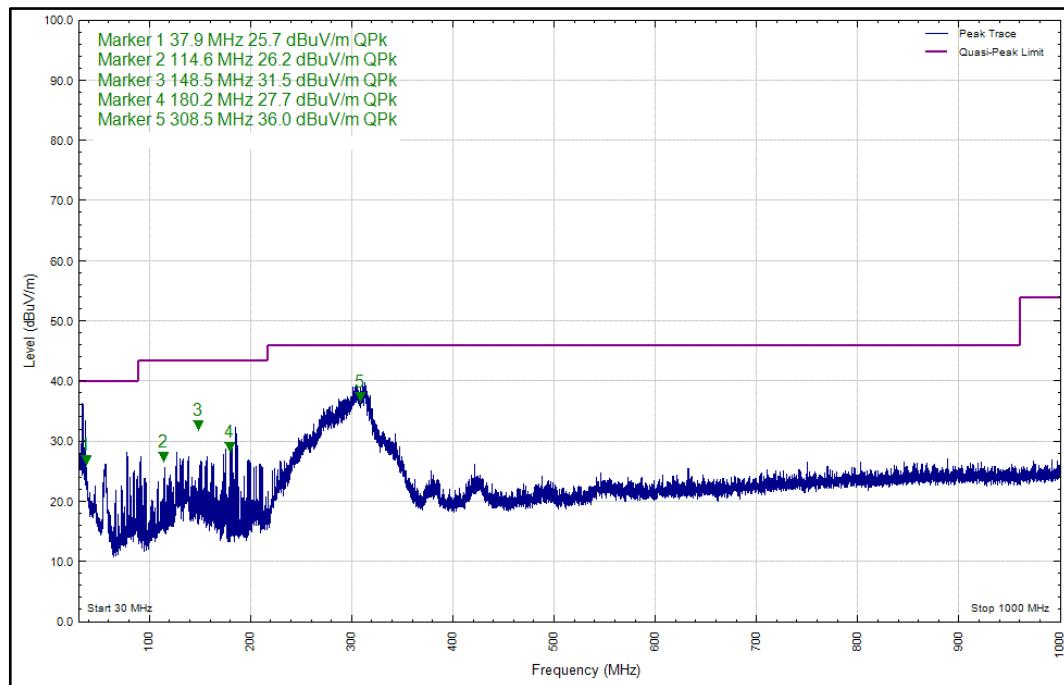


Figure 7 - Graphical Results - Horizontal Polarity

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
37.9	25.7	40	14.3	QP	8	397	Horizontal
114.6	26.2	43.5	17.3	QP	100	252	Horizontal
148.5	31.5	43.5	12.0	QP	47	168	Horizontal
180.2	27.7	43.5	15.8	QP	270	141	Horizontal
308.5	36.0	46.0	10.0	QP	136	109	Horizontal

Table 12

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

Frequency Range of Test: 1 GHz to 18 GHz

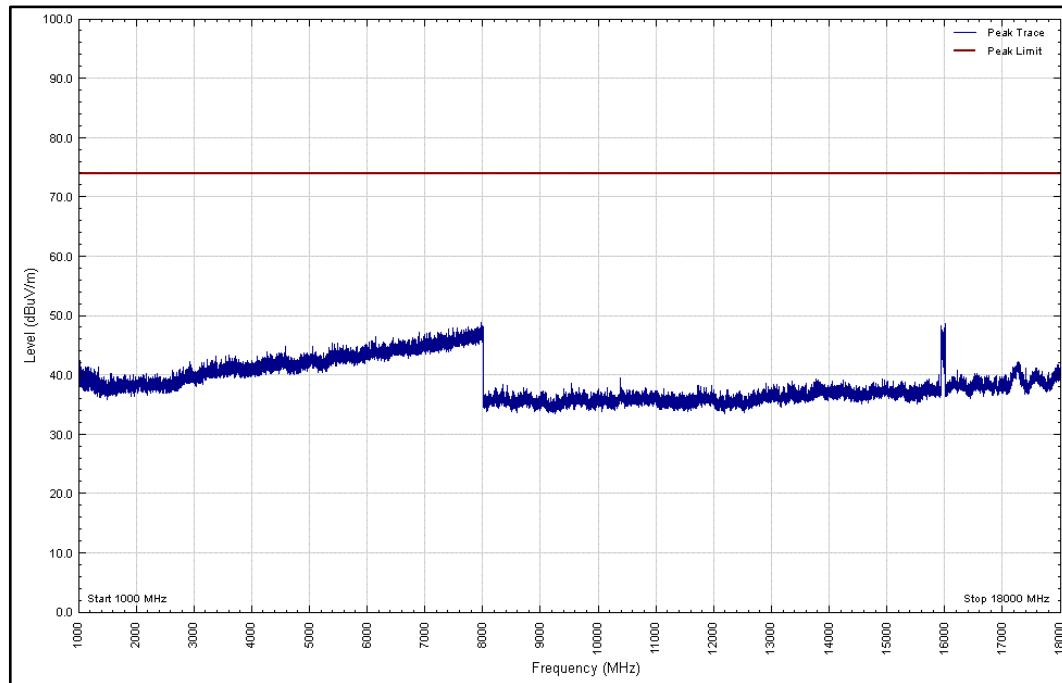


Figure 8 - Graphical Results - Vertical Polarity – Peak

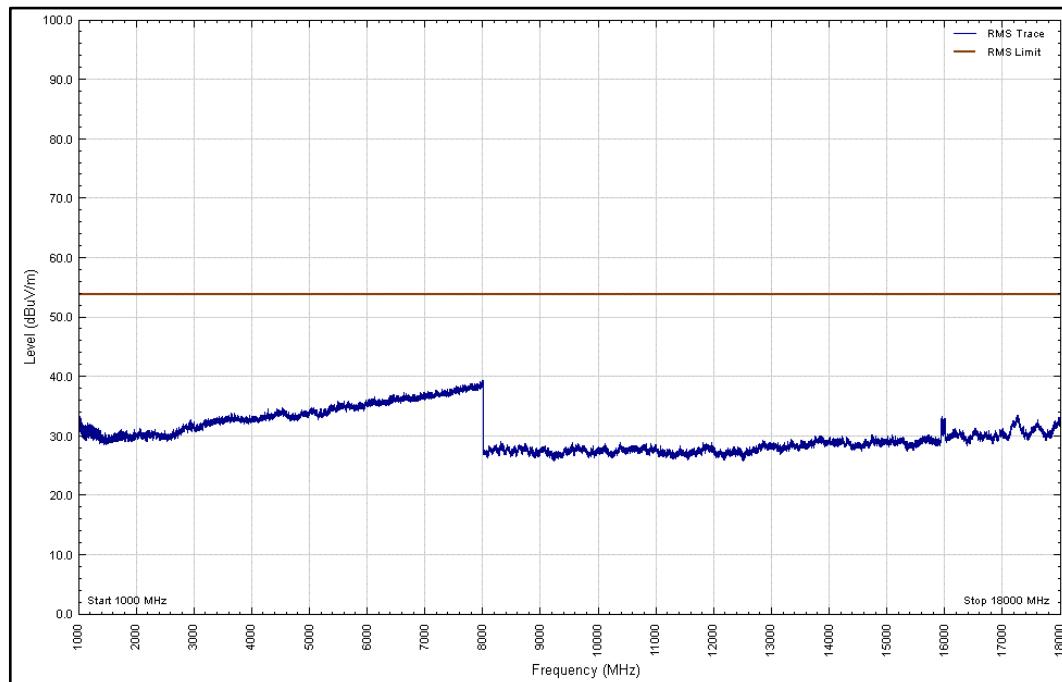


Figure 9 - Graphical Results - Vertical Polarity – CISPR Average



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

Table 13

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

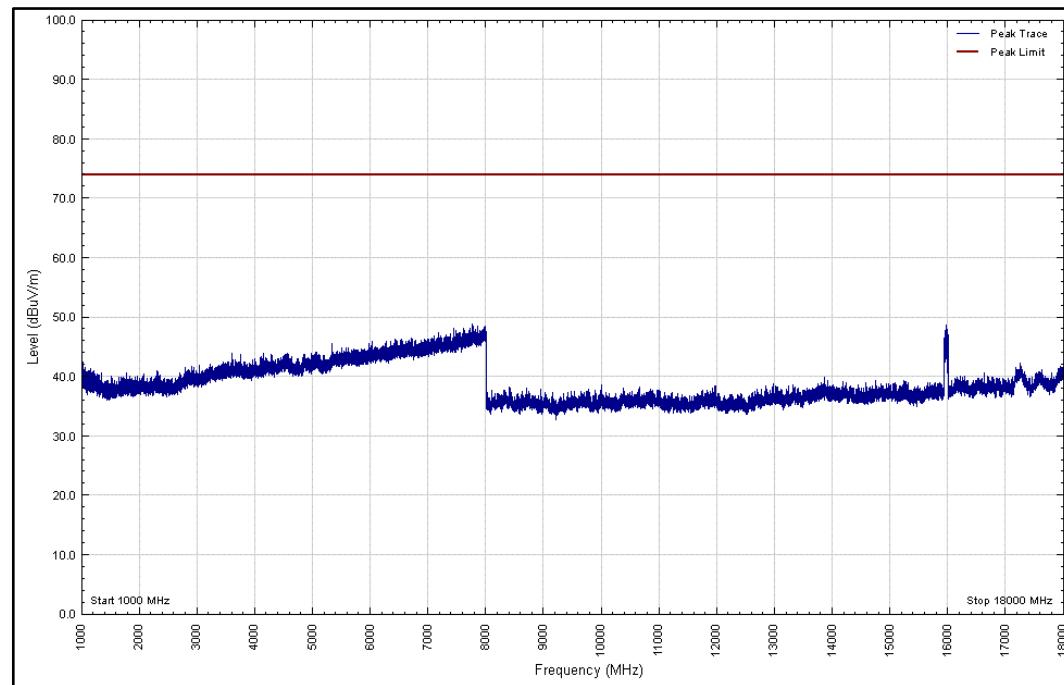


Figure 10 - Graphical Results - Horizontal Polarity – Peak

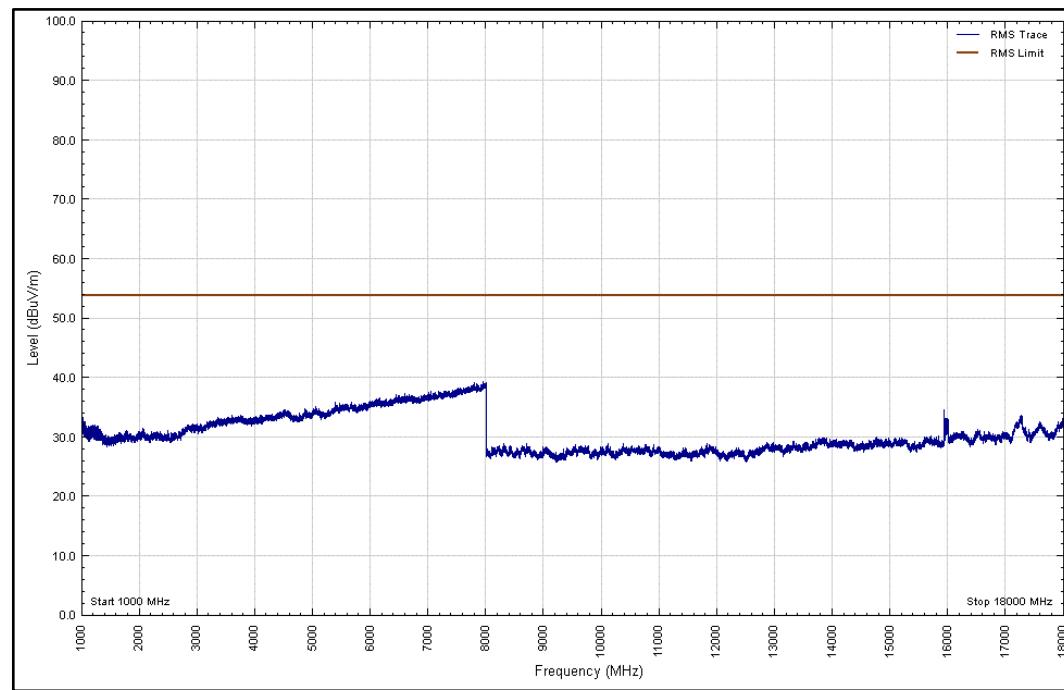


Figure 11 - Graphical Results - Horizontal Polarity – CISPR Average



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

Table 14

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

Frequency Range of Test: 18 GHz to 30 GHz

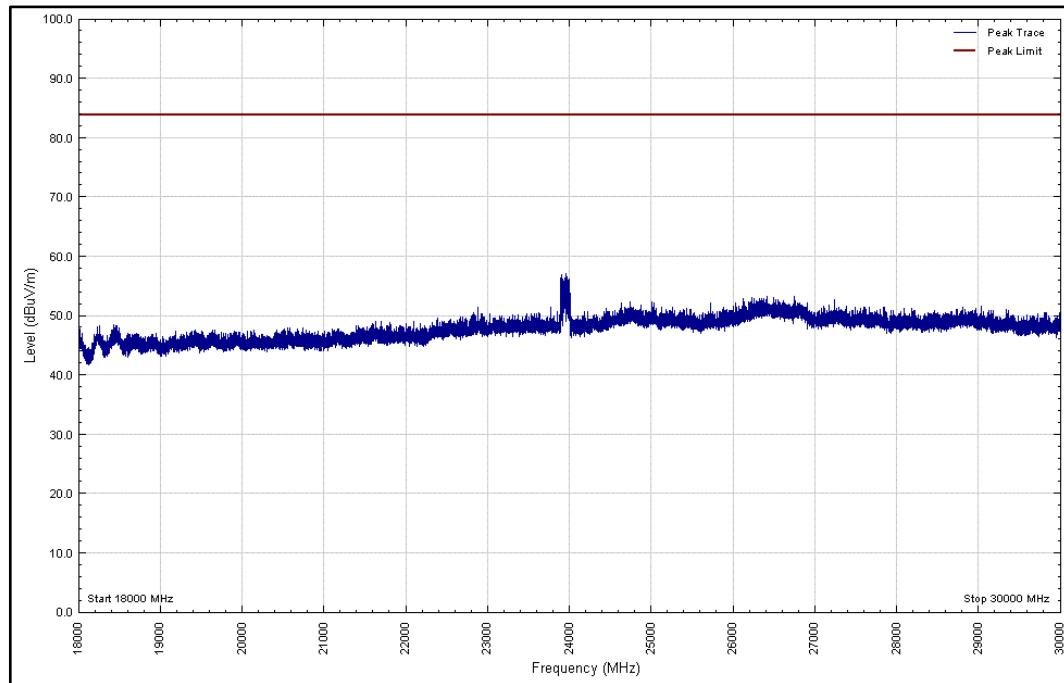


Figure 12 - Graphical Results - Vertical Polarity – Peak

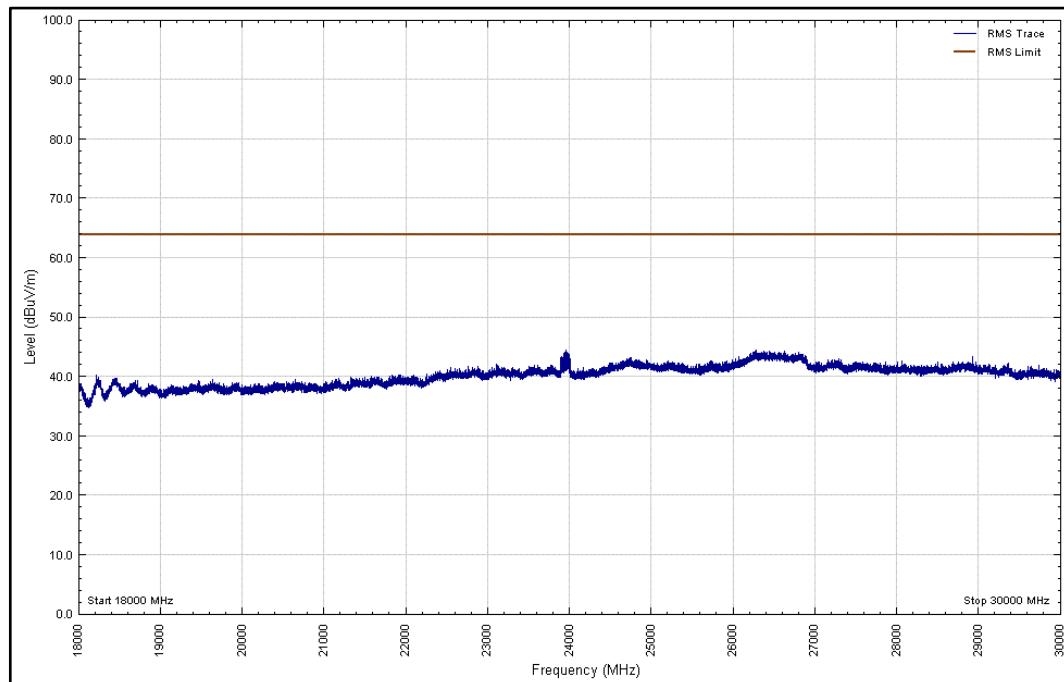


Figure 13 - Graphical Results - Vertical Polarity – CISPR Average



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

Table 15

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

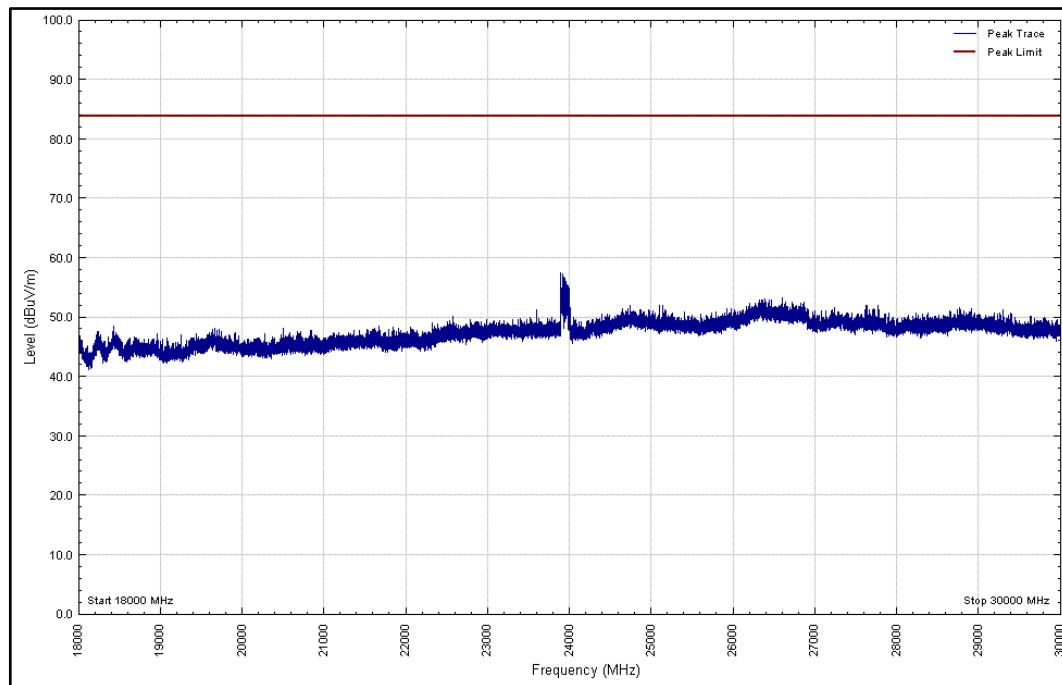


Figure 14 - Graphical Results - Horizontal Polarity – Peak

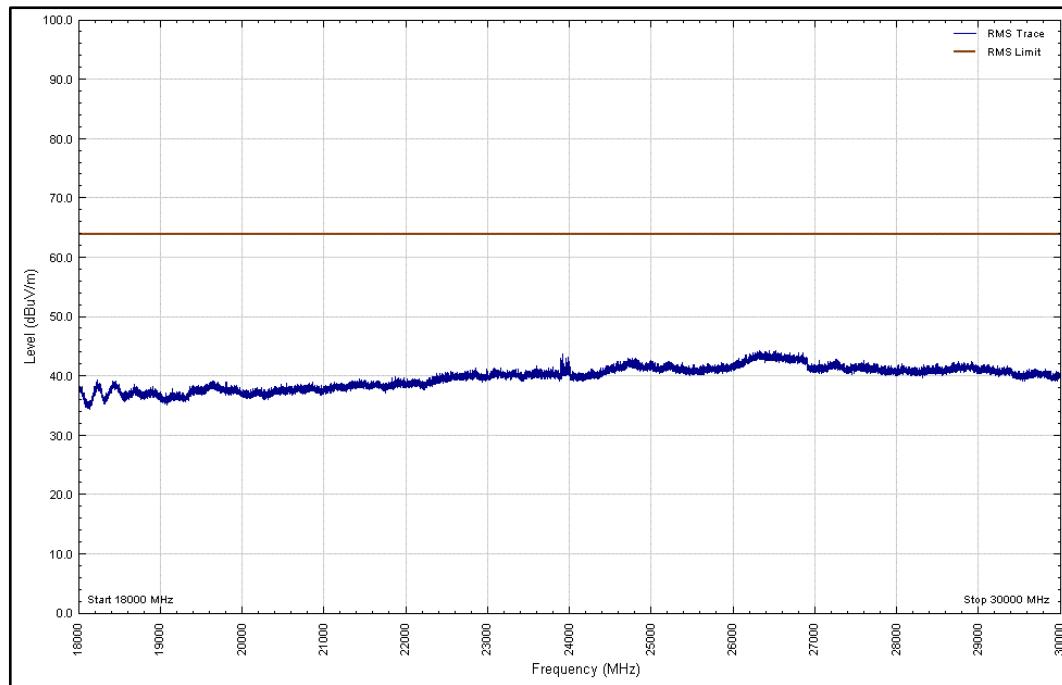


Figure 15 - Graphical Results - Horizontal Polarity – CISPR Average



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

Table 16

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

2.2.10 Test Location and Test Equipment Used

This test was carried out in RF Chamber 11.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Screened Room (11)	Rainford	Rainford	5136	36	01-Nov-2021
EmX Emissions Software	TUV SUD	EmX	5125	-	Software
EMI Test Receiver	Rohde & Schwarz	ESW44	5084	12	11-Nov-2019
Tilt Antenna Mast	Maturo GmbH	TAM 4.0-P	4811	-	TU
Mast and Turntable Controller	Maturo	Maturo NCD	5159	-	TU
Turntable	Maturo	TT 15WF	5160	-	TU
Antenna with permanent attenuator (Bilog)	Schaffner	CBL6143	287	24	15-May-2020
Double Ridged Waveguide Horn Antenna	ETS-Lindgren	3117	4722	12	05-Mar-2020
Double Ridge Broadband Horn Antenna	Schwarzbeck	BBHA 9120 B	4848	12	11-Mar-2020
Horn Antenna (1-10GHz)	Schwarzbeck	BBHA 9120 B	5215	12	11-Mar-2020
10dB/1W SMA Attenuator dc - 18GHz	Sealectro	60-674-1010-89	395	-	Class 1 (Int)
8 - 18 GHz pre amp	Wright Technologies	PS06-0061	4971	12	07-Dec-2019
8m N-Type RF Cable	Teledyne	PR90-088-8MTR	5093	12	04-Oct-2019
8m N-Type RF Cable	Teledyne	PR90-088-8MTR	5095	12	04-Oct-2019
Cable (18 GHz)	Rosenberger	LU7-071-1000	5102	12	04-Oct-2019
Cable (18 GHz)	Rosenberger	LU7-071-1000	5103	12	06-Oct-2020
Cable (18 GHz)	Rosenberger	LU7-071-1000	5104	12	05-Oct-2019
Cable (18 GHz)	Rosenberger	LU7-071-1000	5105	12	05-Oct-2019
Cable (18 GHz)	Rosenberger	LU7-071-2000	5107	12	05-Oct-2019
Cable (18 GHz)	Rosenberger	LU7-071-2000	5109	12	05-Oct-2019
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

Table 17

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
Conducted Disturbance at Mains Terminals	150 kHz to 30 MHz, LISN, ± 3.7 dB

Table 18

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.