

FCC and ISEDC Test Report

Apple Inc
Model: A2179

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: BCGA2179

IC: 579C-A2179



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Document 75945251-09 Issue 02

SIGNATURE

NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
Andy Lawson	Senior Engineer	Authorised Signatory	07 February 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 and ICES-003. The sample tested was found to comply with the requirements defined in the applied rules.

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Testing	Connor Lee	07 February 2020	
Testing	Cristian Onaca	07 February 2020	

FCC Accreditation

90987 Octagon House, Fareham Test Laboratory

ISEDC 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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is a trading name of TÜV SÜD Ltd
Registered in Scotland at East Kilbride,
Glasgow G75 0QF, United Kingdom
Registered number: SC215164

TÜV SÜD Ltd is a
TÜV SÜD Group Company

Phone: +44 (0) 1489 558100
Fax: +44 (0) 1489 558101
www.tuv-sud.co.uk

TÜV SÜD
Octagon House
Concorde Way
Fareham
Hampshire PO15 5RL
United Kingdom



Contents

1 **Report Summary2**

1.1 Report Modification Record.....2

1.2 Introduction.....2

1.3 Brief Summary of Results3

1.4 Product Information4

1.5 Deviations from the Standard.....4

1.6 EUT Modification Record4

1.7 Test Location5

2 **Test Details6**

2.1 Conducted Disturbance at Mains Terminals6

2.2 Radiated Disturbance..... 11

3 **Incident Reports 20**

4 **Measurement Uncertainty 21**



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	29 January 2020
2	Updated AC Conducted Emissions Results and FCC ID	07 February 2020

Table 1

1.2 Introduction

Applicant	Apple Inc
Manufacturer	Apple Inc
Model Number(s)	A2179
Serial Number(s)	C02ZC009M8N2 and C02ZC00WM8M5
Hardware Version(s)	REV 1.0
Software Version(s)	19C4
Number of Samples Tested	2
Test Specification/Issue/Date	FCC 47 CFR Part 15B: 2018 ICES-003: 2016
Order Number	0540189084
Date	25-February-2019
Date of Receipt of EUT	12-November-2019 and 04-October-2019
Start of Test	23-November-2019
Finish of Test	30-January-2020
Name of Engineer(s)	Connor Lee and Cristian Onaca
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: 120 V AC Powered - Transmitters disabled					
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 laptop computer, with Bluetooth, Bluetooth Low Energy and 802.11 a/b/g/n/ac capabilities in the 2.4 GHz and 5 GHz bands.

The EUT was tested in conjunction with USB power adapter model A1882.

1.4.2 EUT Port/Cable Identification

Port	Max Cable Length specified	Usage	Type	Screened
Configuration and Mode: 120 V AC Powered - Transmitters disabled				
120 V AC Live Line	1.5 meters	Power	120 V AC Mains Supply	No
120 V AC Neutral Line	1.5 meters	Power	120 V AC Mains Supply	No

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: A2179, Serial Number: C02ZC00WM8M5			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: A2179, Serial Number: C02ZC009M8N2			
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: 120 V AC Powered - Transmitters disabled		
Conducted Disturbance at Mains Terminals	Connor Lee	UKAS
Radiated Disturbance	Cristian Onaca	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

A2179, S/N: C02ZC009M8N2 - Modification State 0

2.1.3 Date of Test

30-January-2020

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

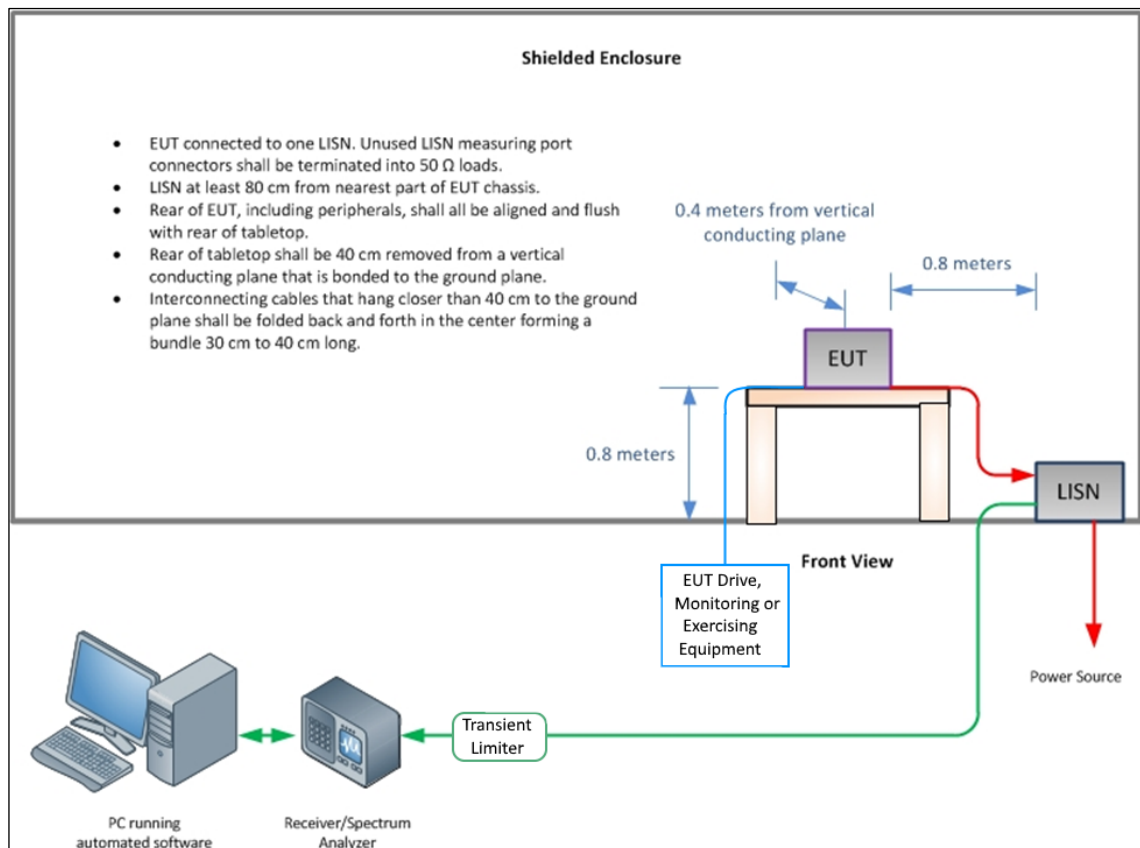


Figure 1 - Conducted Disturbance Example Test Setup

2.1.7 Environmental Conditions

Ambient Temperature 18.9 °C
Relative Humidity 49.7 %

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: 120 V AC Powered - Transmitters disabled.

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.

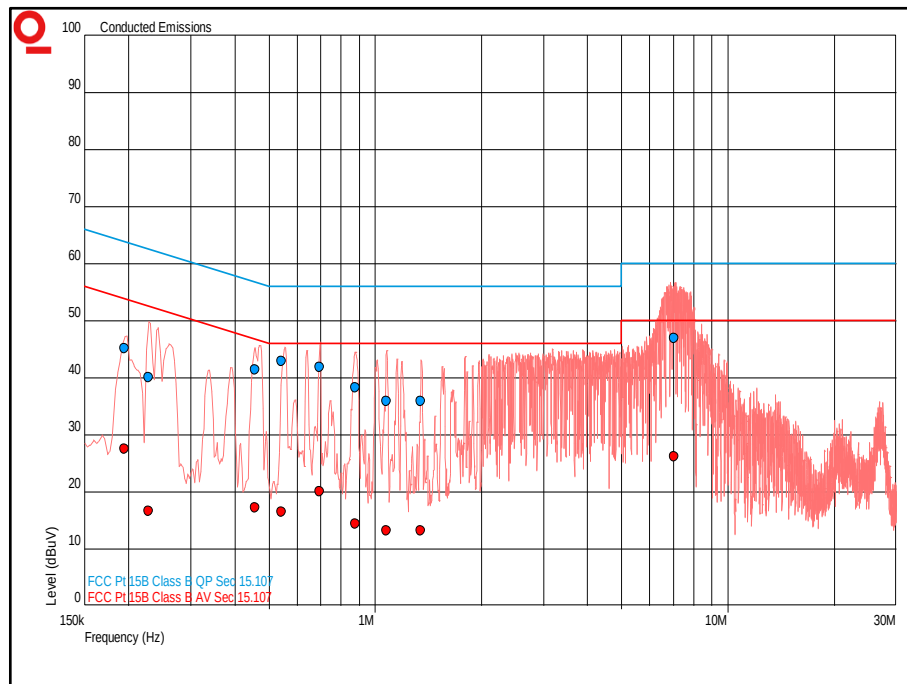


Figure 2 - Graphical Results - 120 V AC Live Line

Frequency (MHz)	QP Level (dBμV)	QP Limit (dBμV)	QP Margin (dB)	CISPR Average Level (dBμV)	CISPR Average Limit (dBμV)	CISPR Average Margin (dB)
0.195	45.2	63.8	-18.7	27.5	53.8	-26.3
0.228	40.0	62.5	-22.5	16.6	52.5	-35.9
0.457	41.4	56.7	-15.3	17.3	46.7	-29.5
0.542	42.9	56.0	-13.1	16.5	46.0	-29.5
0.696	41.9	56.0	-14.1	20.1	46.0	-25.9
0.881	38.3	56.0	-17.7	14.4	46.0	-31.6
1.075	35.9	56.0	-20.1	13.3	46.0	-32.7
1.347	35.8	56.0	-20.2	13.2	46.0	-32.8
7.042	47.0	60.0	-13.0	26.3	50.0	-23.7

Table 7 Live Line Emissions Results

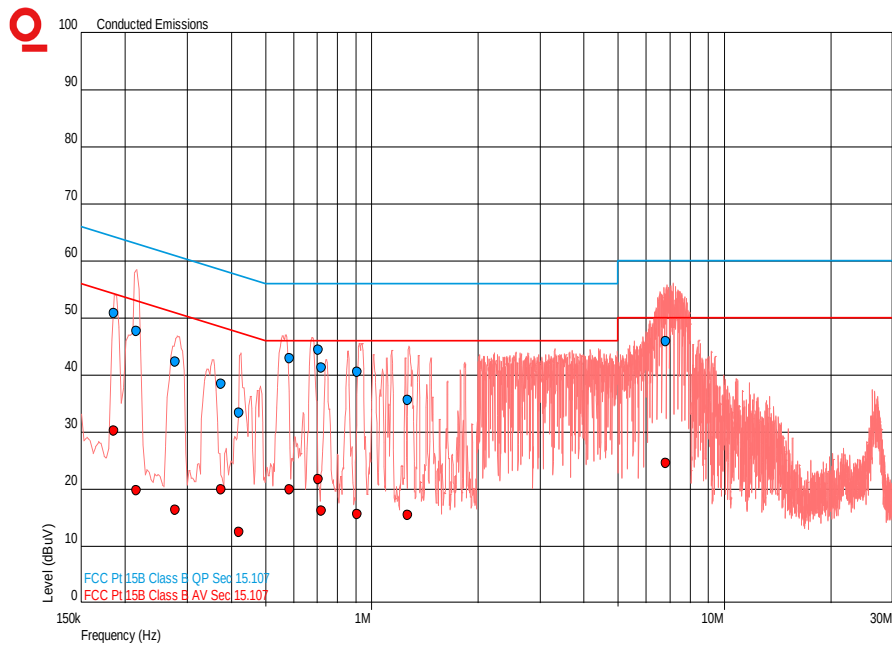


Figure 3 - Graphical Results - 120 V AC Neutral Line

Frequency (MHz)	QP Level (dBμV)	QP Limit (dBμV)	QP Margin (dB)	CISPR Average Level (dBμV)	CISPR Average Limit (dBμV)	CISPR Average Margin (dB)
0.186	50.8	64.2	-13.4	30.3	54.2	-23.9
0.216	47.7	63.0	-15.3	19.8	53.0	-33.2
0.278	42.3	60.9	-18.6	16.3	50.9	-34.6
0.375	38.5	58.4	-19.9	20.0	48.4	-28.4
0.422	33.4	57.4	-24.0	12.4	47.4	-35.0
0.585	42.9	56.0	-13.1	19.9	46.0	-26.1
0.708	44.4	56.0	-11.6	21.7	46.0	-24.3
0.722	41.2	56.0	-14.8	16.2	46.0	-29.8
0.911	40.5	56.0	-15.5	15.6	46.0	-30.4
1.269	35.6	56.0	-20.4	15.4	46.0	-30.6
6.830	45.9	60.0	-14.1	24.5	50.0	-25.5

Table 8 Neutral Line Emissions Results



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	03-Jan-2021
Transient Limiter	Hewlett Packard	11947A	2377	12	26-Feb-2020
LISN and Calibrated Extension.	Rohde & Schwarz	ESH3-Z5	1390	12	27-Jan-2021
2 Meter Cable	Teledyne	PR90-088-2MTR	5196	12	06-Oct-2020
8 Meter Cable	Teledyne	PR90-088-8MTR	5212	12	30-Aug-2020

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

A2179, S/N: C02ZC00WM8M5 - Modification State 0

2.2.3 Date of Test

23-November-2019 to 26-November-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.

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.

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.

2.2.5 Example Calculation

Below 1 GHz:

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

Above 1 GHz:

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

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

2.2.6 Example Test Setup Diagram

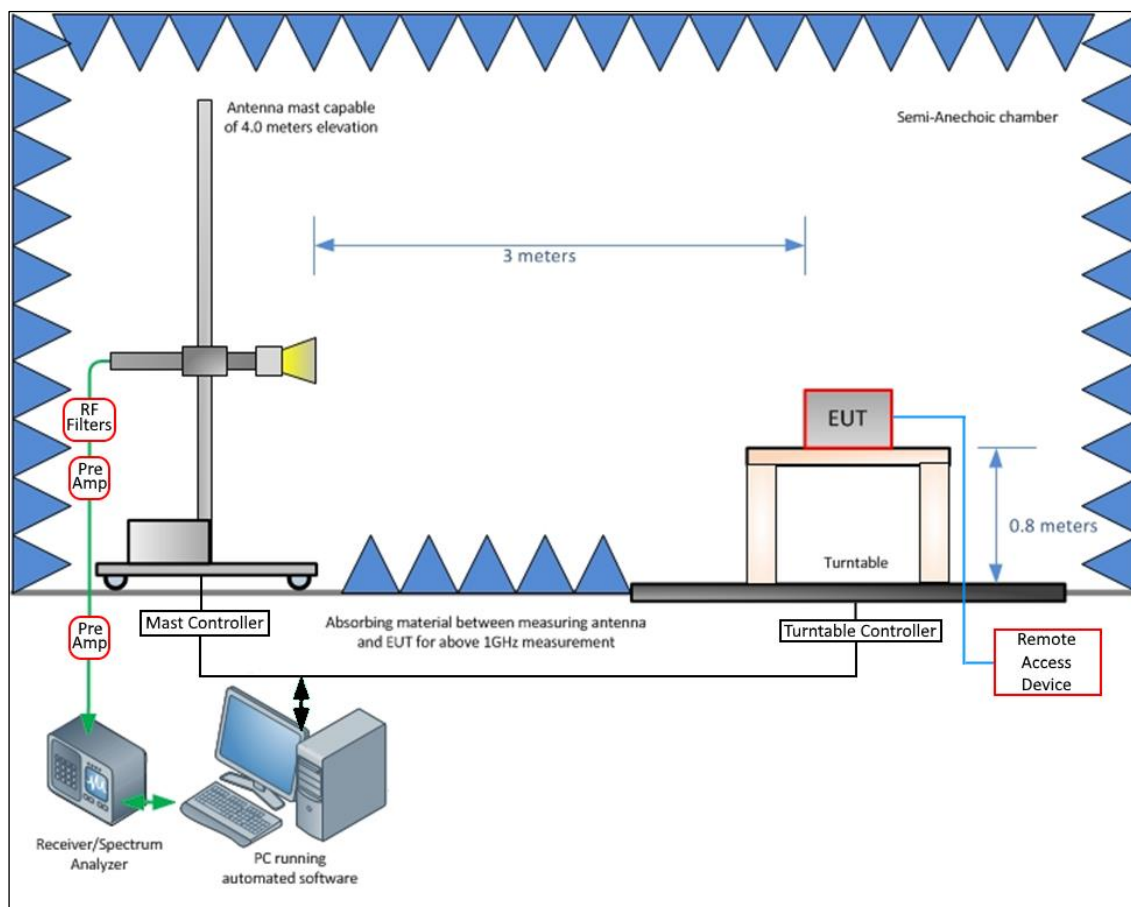


Figure 4 - Radiated Disturbance Example Test Setup

2.2.7 Environmental Conditions

Ambient Temperature 20.5 - 22.2 °C
Relative Humidity 37.2 - 54.4 %

2.2.8 Specification Limits

Required Specification Limits, Field Strength (Class B @ 3m)		
Frequency Range (MHz)	($\mu\text{V/m}$)	(dB $\mu\text{V/m}$)
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: 120 V AC Powered - Transmitters disabled.

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: 6 GHz
Which necessitates an upper frequency test limit of: 30 GHz

Frequency Range of Test: 30 MHz to 1 GHz

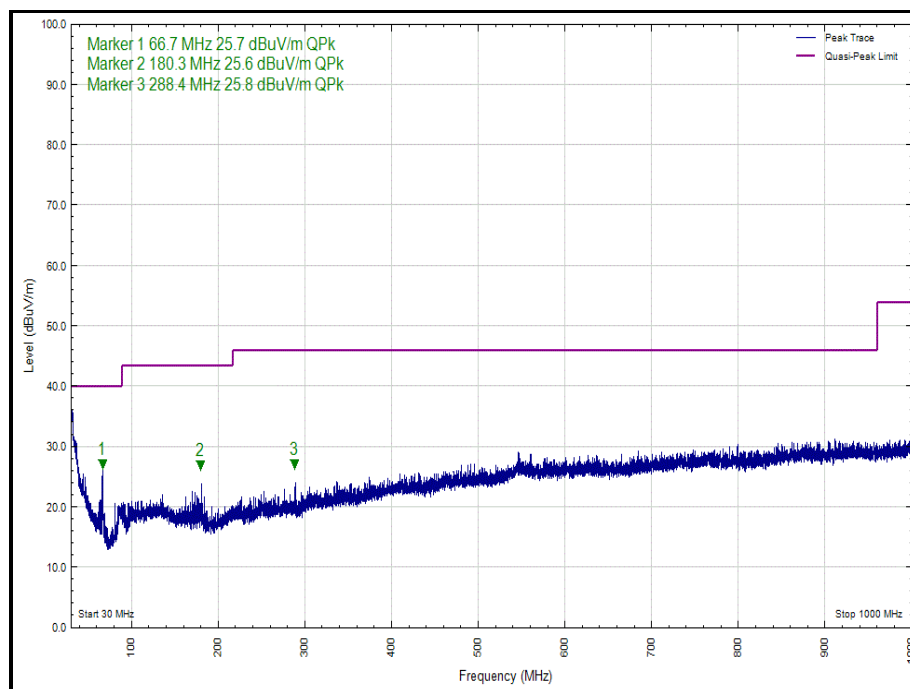


Figure 5 - Graphical Results - Vertical Polarity

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
66.672	25.7	40.0	-14.3	Q-Peak	256	273	Vertical
180.256	25.6	40.0	-14.4	Q-Peak	209	105	Vertical
288.375	25.8	47.0	-21.2	Q-Peak	173	158	Vertical

Table 11

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

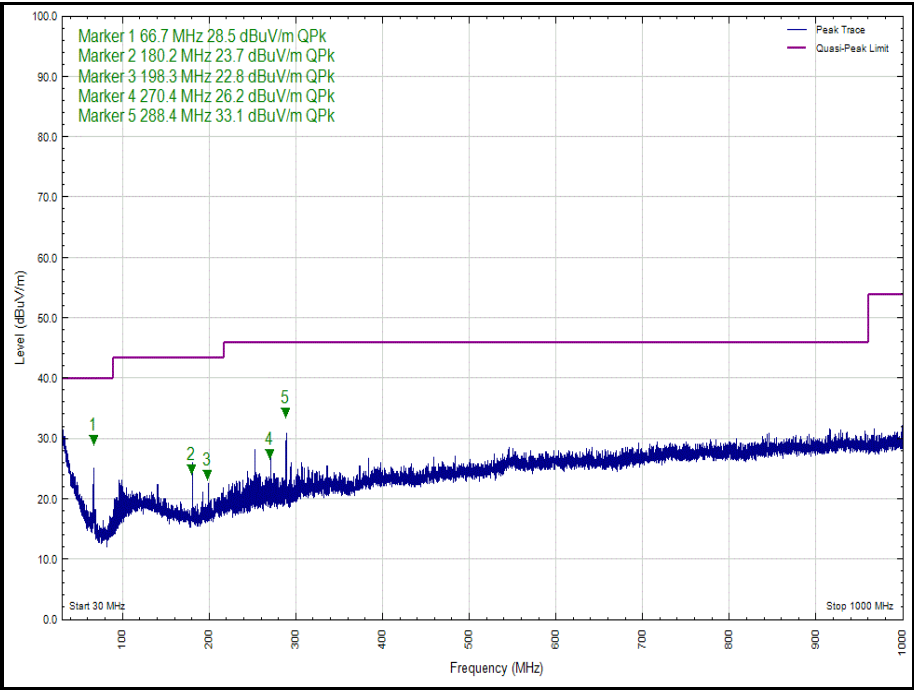


Figure 6 - Graphical Results - Horizontal Polarity

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
66.695	28.5	40.0	-11.5	Q-Peak	1	397	Horizontal
180.220	23.7	40.0	-16.3	Q-Peak	334	185	Horizontal
198.270	22.8	40.0	-17.2	Q-Peak	153	103	Horizontal
270.364	26.2	47.0	-20.8	Q-Peak	118	100	Horizontal
288.386	33.1	47.0	-13.9	Q-Peak	119	109	Horizontal

Table 12

No other formal 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 30 GHz - Peak

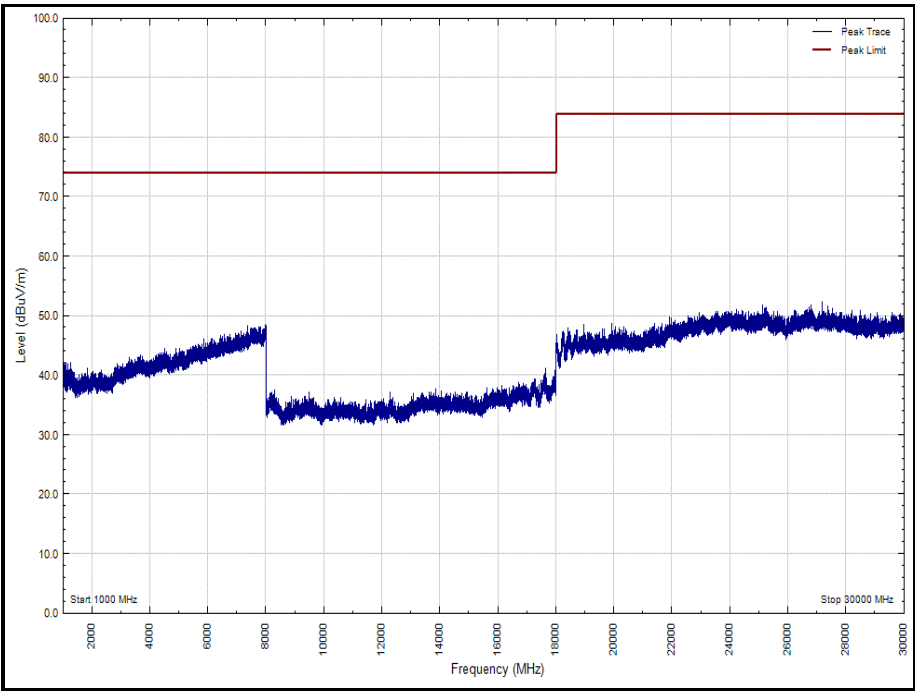


Figure 7 - Graphical Results - Vertical Polarity

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

Table 13

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



Frequency Range of Test: 1 GHz to 30 GHz - Peak

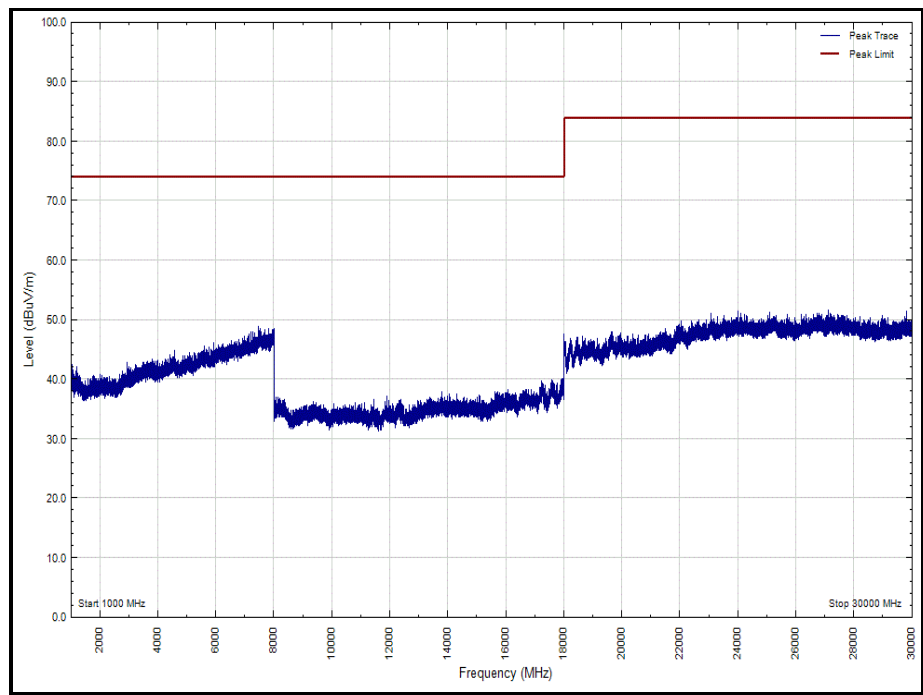


Figure 8 - Graphical Results - Horizontal Polarity

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

Table 14

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



Frequency Range of Test: 1 GHz to 30 GHz – CISPR Average

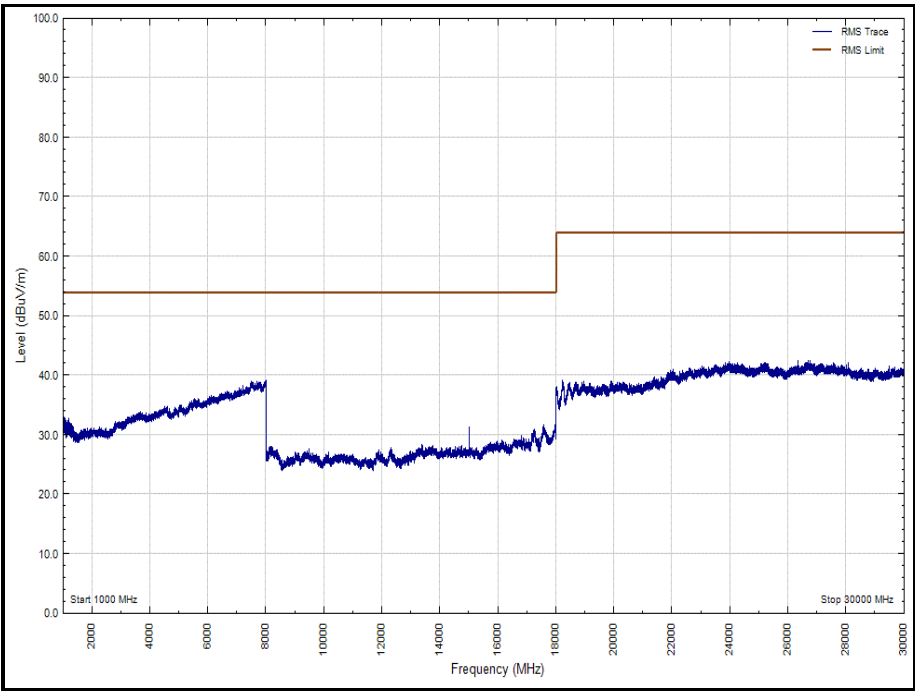


Figure 9 - Graphical Results - Vertical Polarity

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.



Frequency Range of Test: 1 GHz to 30 GHz – CISPR Average

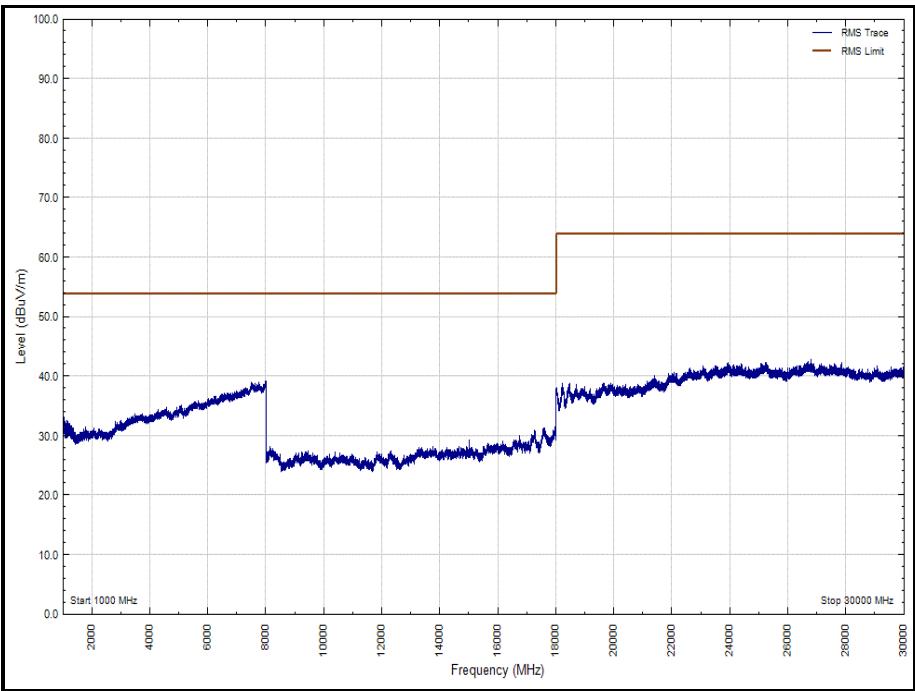


Figure 10 - Graphical Results - Horizontal Polarity

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.



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	28-Nov-2020
Mast	Maturo	TAM 4.0-P	5158	-	TU
Mast and Turntable Controller	Maturo	Maturo NCD	5159	-	TU
Turntable	Maturo	TT 15WF	5160	-	TU
Pre-Amplifier	Phase One	PS04-0086	1533	12	08-Feb-2020
1GHz to 8GHz Low Noise Amplifier	Wright Technologies	APS04-0085	4365	12	14-Nov-2020
Preamplifier (30 dB 18-40GHz)	Schwarzbeck	BBV 9721	5218	12	09-Apr-2020
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
Horn Antenna (15-40GHz)	Schwarzbeck	BBHA 9170	5217	12	09-Apr-2020
DRG Horn Antenna (7.5-18GHz)	Schwarzbeck	HWRD750	5216	12	11-Mar-2020
Hygrometer	Rotronic	HP21	4989	12	02-May-2020
8m N-Type RF Cable	Teledyne	PR90-088-8MTR	5095	12	04-Dec-2019*
Cable (18 GHz)	Rosenberger	LU7-071-1000	5104	12	09-Dec-2020
8 Meter Cable	Teledyne	PR90-088-8MTR	5212	12	30-Aug-2020
Cable (Rx, Km-Km 2m)	Scott Cables	KPS-1501-2000-KPS	4526	6	11-Dec-2019

Table 17

* At the time of testing the equipment was within calibration

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

Table 18

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.