FCC and ISED Test Report

Apple Inc
Model: A2442

In accordance with FCC 47 CFR Part 15B, ICES-003 and ISED RSS-GEN

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

FCC ID: BCGA2442 IC: 579C-A2442

COMMERCIAL-IN-CONFIDENCE

Jensen Adams Digitally signed by Jensen Adams Date: 2021.09.17 12:26:08 +01'00'

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SIGNATURE			
Jensen Adams			
NAME	**JOB TITLE**	**RESPONSIBLE FOR**	**ISSUE DATE**
Jensen Adams	Manager – Technical Solutions	Authorised Signatory	17 September 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 Part 15B, ICES-003 and ISED RSS-GEN. The sample tested was found to comply with the requirements defined in the applied rules.

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Testing	Matthew Dawkins	17 September 2021	
Testing	Mohammad Malik	17 September 2021	
Testing	Colin Brain	17 September 2021	

FCC Accreditation
90987 Octagon House, Fareham Test Laboratory

ISED 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: 2020, ICES-003: Issue 7: 2020 and ISED RSS-GEN: Issue 5 and A1 (2019-03) for the tests detailed in section 1.3.

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Glasgow G75 0QF, United Kingdom
Registered number: SC215164

TUV SUD Ltd is a
TÜV SÜD Group Company

Phone: +44 (0) 1489 558100
Fax: +44 (0) 1489 558101
www.tuvsud.com/en

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

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	17-September-2021

Table 1

1.2 Introduction

Applicant	Apple Inc
Manufacturer	Apple Inc
Model Number(s)	A2442
Serial Number(s)	NL6F4J0K4D and DNQHW6Y3WY
Hardware Version(s)	REV 1.0
Software Version(s)	NL6F4J0K4D: 21A290 DNQHW6Y3WY: 21A102280p
Number of Samples Tested	2
Test Specification/Issue/Date	FCC 47 CFR Part 15B: 2020 ICES-003: Issue 7: 2020 ISED RSS-GEN: Issue 5 and A1 (2019-03)
Order Number Date	0540218229 22-April-2021
Date of Receipt of EUT	31-March-2021 and 16-July-2021
Start of Test	23-July-2021
Finish of Test	02-August-2021
Name of Engineer(s)	Matthew Dawkins, Mohammad Malik and Colin Brain
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, ICES-003 and ISED RSS-GEN is shown below.

Section	Specification Clause			Test Description	Result	Comments/Base Standard
	Part 15B	ICES-003	RSS-GEN			
Configuration and Mode: AC Powered - Transmitters Idle						
2.1	15.107	3.1	8.8	Conducted Disturbance at Mains Terminals	Pass	ANSI C63.4: 2014
2.2	15.109	3.2	7.1	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/ax capabilities in the 2.4 GHz and 5 GHz bands.

1.4.2 EUT Port/Cable Identification

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

Table 3

1.4.3 Test Configuration

Configuration	Description
AC Powered	The EUT was powered by 120 V 60 Hz AC Mains. Connected to the EUT were a set of headphones to load the headphone port, a USB type C port was exercised using a USB type C cable and into a USB-C Dock, a charger was also connected using a USB type C power adapter.

Table 4

1.4.4 Modes of Operation

Mode	Description
Transmitters Idle	The EUT was configured to play audio through the headphones. A ping request was established with the EUT using a support laptop. The display was set to maximum brightness and sleep mode was disabled. All transmitters were disabled.

Table 5

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: A2442, Serial Number: NL6F4J0K4D			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: A2442, Serial Number: DNQHW6Y3WY			
0	As supplied by the customer	Not Applicable	Not Applicable

Table 6

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 - Transmitters Idle		
Conducted Disturbance at Mains Terminals	Matthew Dawkins	UKAS
Radiated Disturbance	Mohammad Malik and Colin Brain	UKAS

Table 7

Office Address:

TÜV SÜD
Octagon House
Concorde Way
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 3.1
ISED RSS-GEN, Clause 8.8

2.1.2 Equipment Under Test and Modification State

A2442, S/N: NL6F4J0K4D - Modification State 0

2.1.3 Date of Test

23-July-2021

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

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

2.1.6 Example Test Setup Diagram

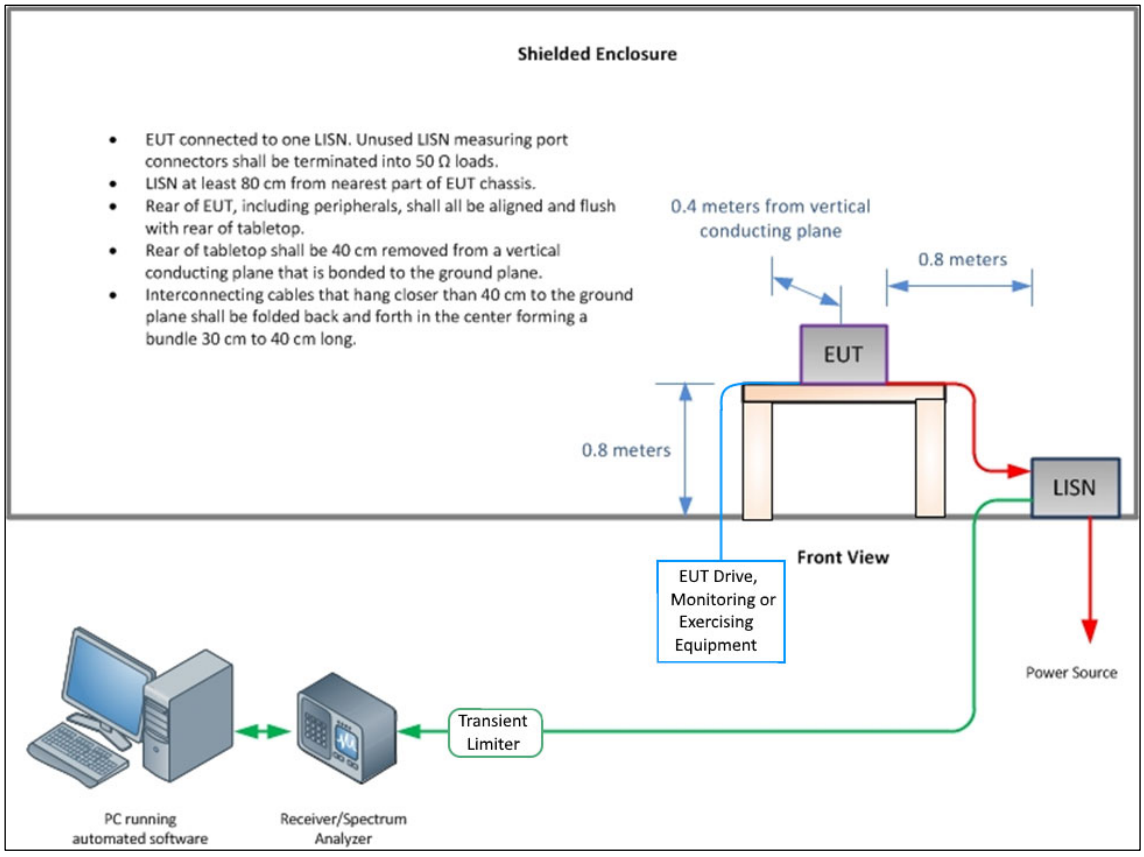

Figure 1 - Conducted Disturbance

2.1.7 Environmental Conditions

Ambient Temperature	21.0 °C
Relative Humidity	66.3 %

2.1.8 Specification Limits

Required Specification Limits - Class B			
Line Under Test	Frequency Range (MHz)	Quasi-Peak Test Limit (dBµV)	CISPR Average Test Limit (dBµV)
AC Power Port	0.15 to 0.5	66 to 56(1)	56 to 46(1)
	0.5 to 5	56	46
	5 to 30	60	50
Supplementary information: Note 1. Decreases with the logarithm of the frequency.			

Table 8

2.1.9 Test Results

Results for Configuration and Mode: AC Powered - Transmitters Idle.

This test was performed to the requirements of the Class B limits.

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

Detailed results are shown below.

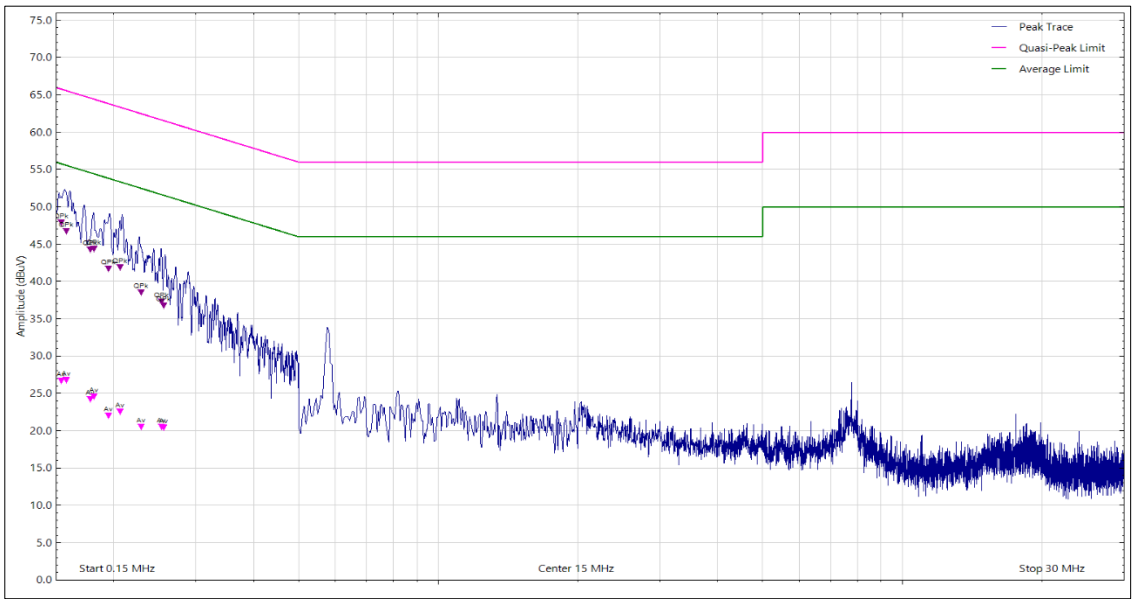

Figure 2 - Graphical Results - AC Power Port Live Line

Frequency (MHz)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector
0.154	26.1	55.8	-29.7	CISPR Avg
0.154	47.3	65.8	-18.5	Q-Peak
0.158	26.1	55.5	-29.4	CISPR Avg
0.158	46.2	65.5	-19.4	Q-Peak
0.178	23.6	54.6	-31.0	CISPR Avg
0.178	43.6	64.6	-21.0	Q-Peak
0.181	43.8	64.4	-20.6	Q-Peak
0.181	24.0	54.4	-30.4	CISPR Avg
0.195	21.4	53.8	-32.4	CISPR Avg
0.195	41.1	63.8	-22.7	Q-Peak
0.206	22.0	53.4	-31.4	CISPR Avg
0.206	41.3	63.4	-22.1	Q-Peak
0.229	19.9	52.5	-32.6	CISPR Avg
0.229	37.9	62.5	-24.6	Q-Peak
0.253	36.7	61.7	-25.0	Q-Peak
0.253	19.9	51.7	-31.8	CISPR Avg
0.256	36.2	61.6	-25.4	Q-Peak
0.256	19.8	51.6	-31.8	CISPR Avg

Table 9

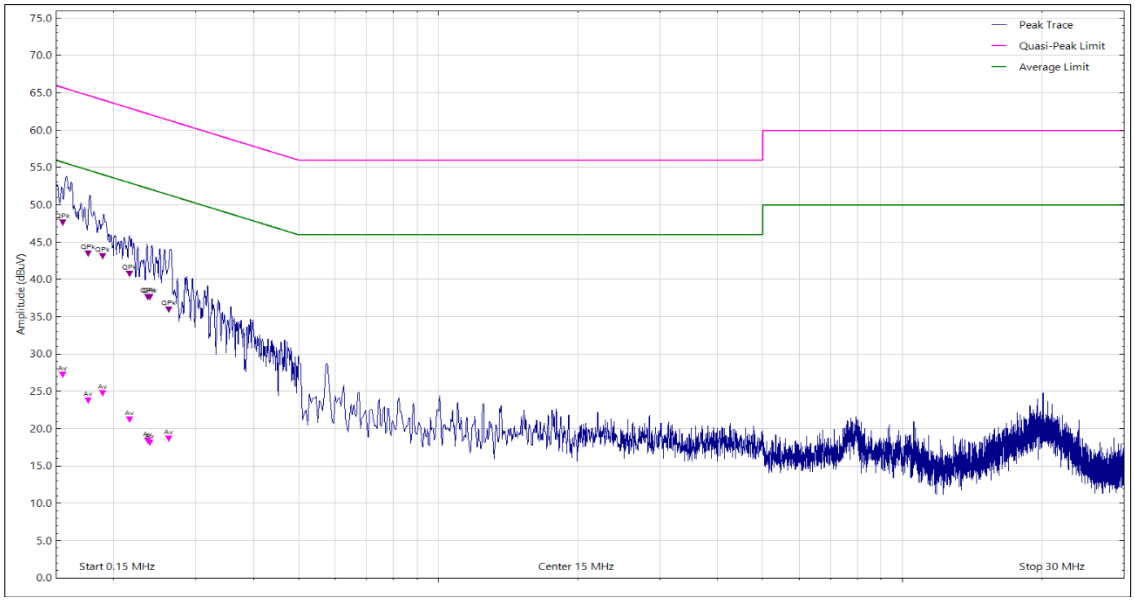

Figure 3 - Graphical Results - AC Power Port Neutral Line

Frequency (MHz)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector
0.155	47.0	65.8	-18.8	Q-Peak
0.155	26.6	55.8	-29.2	CISPR Avg
0.176	42.9	64.7	-21.8	Q-Peak
0.176	23.2	54.7	-31.5	CISPR Avg
0.189	24.1	54.1	-30.0	CISPR Avg
0.189	42.5	64.1	-21.6	Q-Peak
0.216	40.1	63.0	-22.9	Q-Peak
0.216	20.6	53.0	-32.4	CISPR Avg
0.237	37.0	62.2	-25.2	Q-Peak
0.237	17.8	52.2	-34.4	CISPR Avg
0.239	17.5	52.1	-34.6	CISPR Avg
0.239	37.1	62.1	-25.0	Q-Peak
0.263	18.1	51.3	-33.2	CISPR Avg
0.263	35.4	61.3	-25.9	Q-Peak

Table 10

2.1.10 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 12.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
3m Semi Anechoic Chamber	MVG	EMC-3	5621	36	11-Aug-2023
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	18-Mar-2022
Transient Limiter	Hewlett Packard	11947A	2378	12	12-Oct-2021
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5428	12	15-Oct-2021
Cable Assembly - 18GHz 8m	Junkosha	MWX221-08000NMSNMS/B	5732	6	05-Aug-2021
LISN	Rohde & Schwarz	ESH3-Z5	1390	12	28-Jan-2022

Table 11

2.2 Radiated Disturbance

2.2.1 Specification Reference

FCC 47 CFR Part 15B, Clause 15.109
ICES-003, Clause 3.2
ISED RSS-GEN, Clause 7.1

2.2.2 Equipment Under Test and Modification State

A2442, S/N: DNQHW6Y3WY - Modification State 0

2.2.3 Date of Test

23-July-2021 to 02-August-2021

2.2.4 Test Method

The EUT was set up on a non-conductive table 0.8 m above a reference ground plane within a semi-anechoic chamber on a remotely controlled turntable.

A pre-scan of the EUT emissions profile using a peak detector was made at a 3 m antenna distance whilst varying the antenna-to-EUT azimuth and polarisation.

Using a list of the highest emissions detected during the pre-scan along with their bearing and associated antenna polarisation, the EUT was then 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/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)

2.2.6 Example Test Setup Diagram

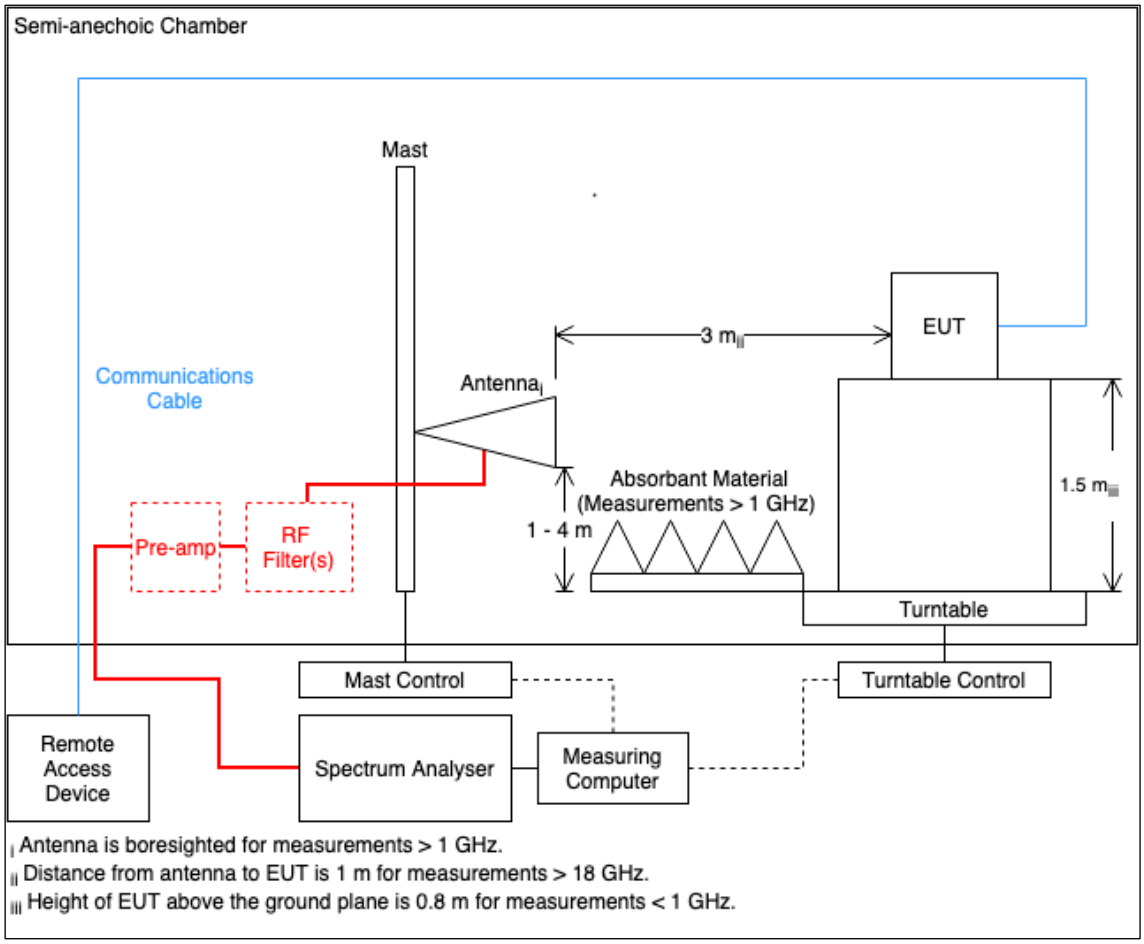

Figure 4

2.2.7 Environmental Conditions

Ambient Temperature	21.5 - 22.1 °C
Relative Humidity	57.6 - 60.4 %

2.2.8 Specification Limits

Required Specification Limits, Field Strength - Class B Test Limit at a 3 m Measurement Distance		
Frequency Range (MHz)	Test Limit (µV/m)	Test Limit (dBµV/m)
30 to 88	100	40.0
88 to 216	150	43.5
216 to 960	200	46.0
Above 960	500	54.0
Supplementary information: Note 1. A Quasi-peak detector is to be used for measurements below 1 GHz. Note 2. A CISPR Average detector is to be used for measurements above 1 GHz. Note 3. The Peak test limit above 1 GHz is 20 dB higher than the CISPR Average test limit.		

Table 12

2.2.9 Test Results

Results for Configuration and Mode: AC Powered - Transmitters Idle.

This test was performed to the requirements of 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: 5825 MHz
Which necessitates an upper frequency test limit of: 30 GHz

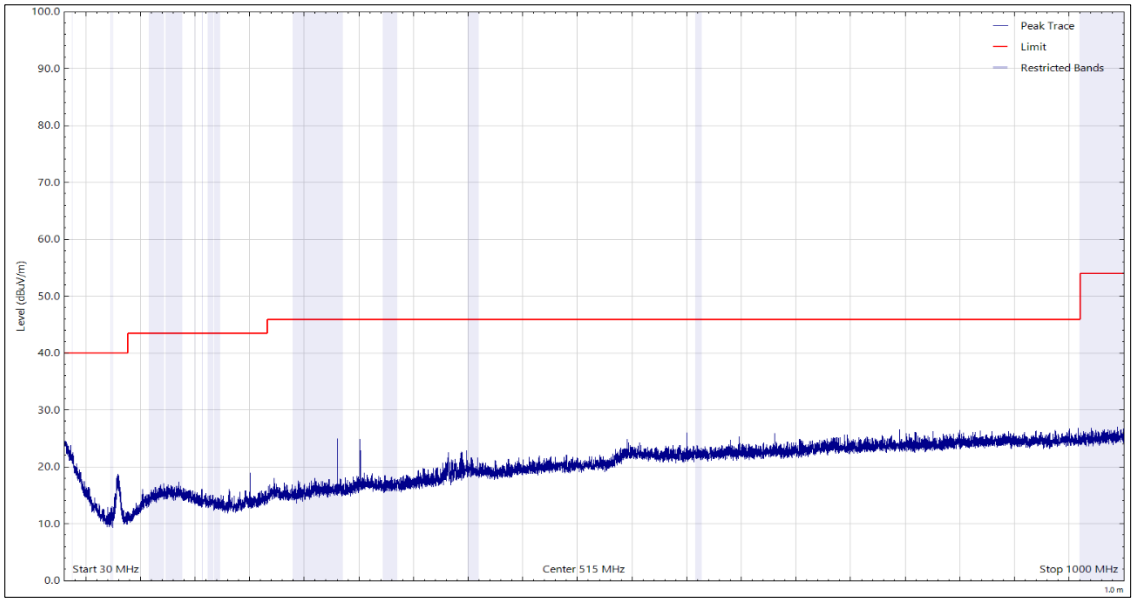

Figure 5 - 30 MHz to 1 GHz, Quasi-Peak, Horizontal

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

Table 13

*No final measurements were made as all peak emissions seen above the measurement system noise floor during the pre-scan were greater than 10 dB below the test limit.

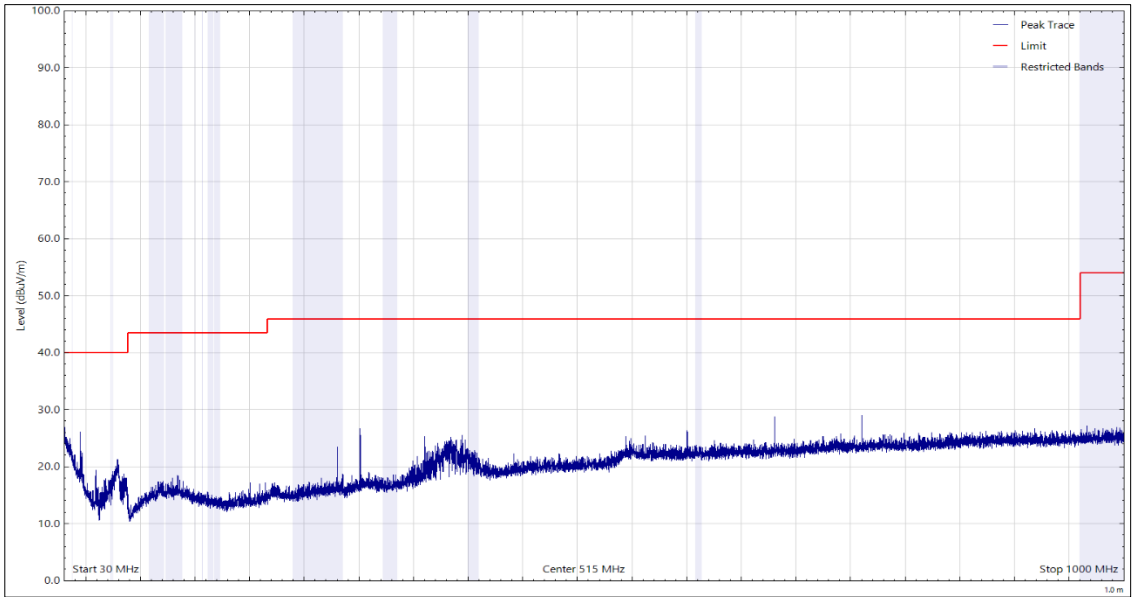

Figure 6 - 30 MHz to 1 GHz, Quasi-Peak, Vertical

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

Table 14

*No final measurements were made as all peak emissions seen above the measurement system noise floor during the pre-scan were greater than 10 dB below the test limit.

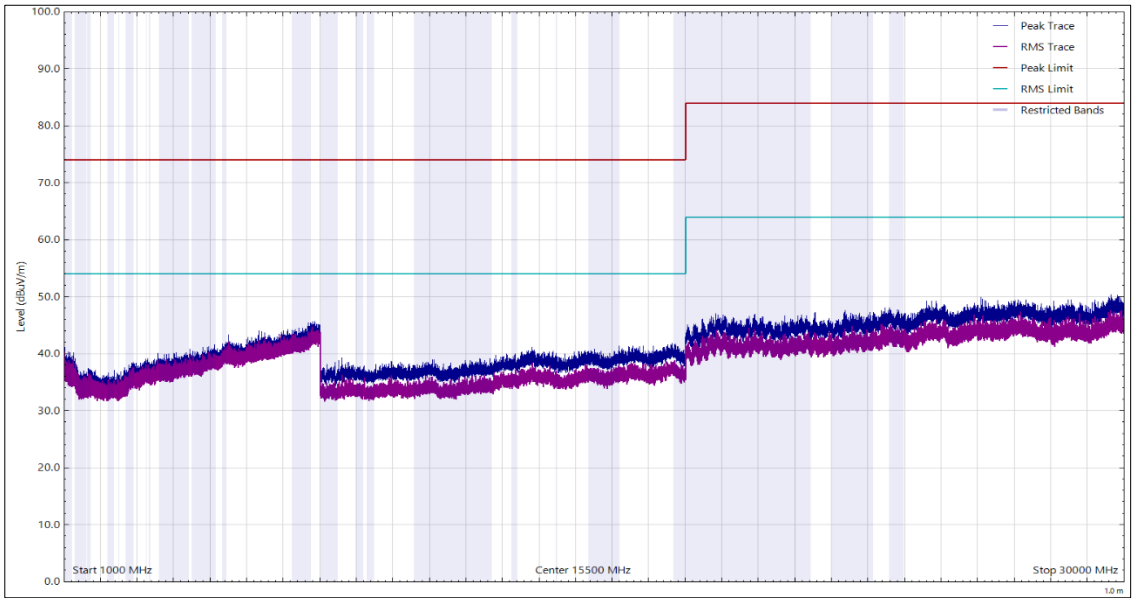

Figure 7 - 1 GHz to 30 GHz, Peak - CISPR Average, Horizontal

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

Table 15

*No final measurements were made as all peak emissions seen above the measurement system noise floor during the pre-scan were greater than 10 dB below the test limit.

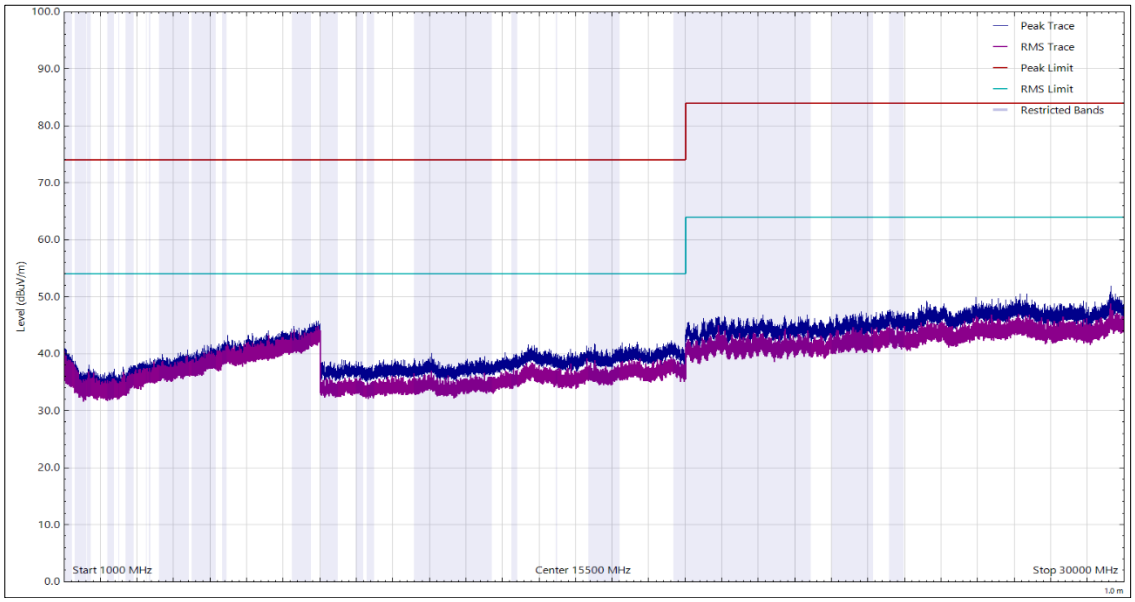

Figure 8 - 1 GHz to 30 GHz, Peak - CISPR Average, Vertical

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

Table 16

*No final measurements were made as all peak emissions seen above the measurement system noise floor during the pre-scan were greater than 10 dB below the test limit.

2.2.10 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 Expires
Antenna 18-40GHz (Double Ridge Guide)	Link Microtek Ltd	AM180HA-K-TU2	230	24	27-Jul-2022
18GHz - 40GHz Pre-Amplifier	Phase One	PSO4-0087	1534	12	02-Aug-2022
Screened Room (5)	Rainford	Rainford	1545	36	15-Apr-2024
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Antenna with permanent attenuator (Bilog)	Chase	CBL6143	2904	24	30-Sep-2021
Tilt Antenna Mast	Maturo Gmbh	TAM 4.0-P	3916	-	TU
Mast Controller	Maturo Gmbh	NCD	3917	-	TU
Double Ridge Broadband Horn Antenna	Schwarzbeck	BBHA 9120 B	4848	12	01-Apr-2022
4dB Attenuator	Pasternack	PE7047-4	4935	24	30-Sep-2021
8 - 18 GHz preamp	Wright Technologies	PS06-0061/PS06-0060	4971	6	04-Nov-2021
EmX Emissions Software	TUV SUD	V2.1.11	5125	-	Software
Preamplifier (30dB 1GHz to 18GHz)	Schwarzbeck	BBV 9718 C	5261	12	08-Apr-2022
Antenna (DRG Horn 7.5-18GHz)	Schwarzbeck	HWRD750	5348	12	22-Sep-2021
1m K-Type Cable	Junkosha	MWX241-01000KMSKMS/A	5512	12	09-Apr-2022
1m -SMA Cable	Junkosha	MWX221-01000AMSAMS/A	5513	12	09-Apr-2022
2m SMA Cable	Junkosha	MWX221-02000AMSAMS/A	5517	12	09-Apr-2022
8m N-Type Cable	Junkosha	MWX221-08000NMSNMS/B	5520	12	24-Mar-2022
2 m K Type Cable	Junkosha	MWX241-02000KMSKMS/A	5523	12	09-Apr-2022
EMI Test Receiver	Rohde & Schwarz	ESW44	5527	12	15-Apr-2022

Table 17

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

3 Test Equipment Information

3.1 General Test Equipment Used

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
Programmable Power Supply	Iso-tech	IPS 2010	2437	-	O/P Mon
Antenna (DRG)	EMCO	3115	794	12	01-Apr-2022
Spectrum Analyser	Agilent Technologies	E7405A	1410	12	14-Oct-2021
True RMS Multimeter	Fluke	179	4007	12	29-Oct-2021
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB-40	5473	12	01-Apr-2022
Cable Assembly - 18GHz 2m	Junkosha	MWX221-02000AMSAMS/B	5731	6	05-Aug-2021

Table 18

4 Incident Reports

No incidents reports were raised.

5 Measurement Uncertainty

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

Test Name	Measurement Uncertainty
Conducted Disturbance at Mains Terminals	150 kHz to 30 MHz, LISN, ±3.7 dB
Radiated Disturbance	30 MHz to 1 GHz, Bilog Antenna, ±5.2 dB 1 GHz to 40 GHz, Horn Antenna, ±6.3 dB

Table 19

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.