FCC and ISED Test Report

Apple Inc
Model: A2787

In accordance with FCC 47 CFR Part 15B and ICES-003 and ISED RSS-GEN (2.4 GHz Bluetooth, 2.4 GHz WLAN, 5 GHz WLAN, 5 GHz Narrow Band, 6 GHz WLAN)

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

FCC ID: BCGA2787 IC: 579C-A2787

Add value.
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Document 75955427-07 Issue 01

SIGNATURE			
AJ Lawson.			
NAME	**JOB TITLE**	**RESPONSIBLE FOR**	**ISSUE DATE**
Andrew Lawson	EMC Chief Engineer	Authorised Signatory	03-February-2023

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 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	James Cumming	03-February-2023	
Testing	Matthew Dawkins	03-February-2023	

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, ICES-003 and ISED RSS-GEN: 2021, Issue 7: 2020 and Issue 5 and A2 (2021-02) for the tests detailed in section 1.3.

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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	03-February-2023

Table 1

1.2 Introduction

Applicant	Apple Inc
Manufacturer	Apple Inc
Model Number(s)	A2787
Serial Number(s)	WDQCYW4692
Hardware Version(s)	REV 1.0
Software Version(s)	22E164 (Until 16-January-2023) 22E202 (After 16-January-2023)
Number of Samples Tested	1
Test Specification/Issue/Date	FCC 47 CFR Part 15B, ICES-003 and ISED RSS-GEN: 2021, Issue 7: 2020 and Issue 5 and A2 (2021-02)
Order Number Date	0540246998 25-April-2022
Date of Receipt of EUT	07-November-2022
Start of Test	06-January-2023
Finish of Test	27-January-2023
Name of Engineer(s)	James Cumming, 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 and ICES-003 and ISED RSS-GEN is shown below.

Section	Specification Clause	Test Description	Result	Comments/Base Standard
Configuration and Mode: AC Powered - Transmitter Idle				
2.1	15.107, 3.1 and 8.8	Conducted Disturbance at Mains Terminals	Pass	ANSI C63.4: 2014
2.2	15.109, 3.2 and 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 an Apple computer with Bluetooth® and IEEE 802.11 a/b/g/n/ac/ax Wi-Fi capabilities in the 2.4 GHz, 5 GHz and 6 GHz bands.

1.4.2 EUT Port/Cable Identification

Port	Max Cable Length specified	Usage	Type	Screened
Configuration and Mode: AC Powered - Transmitter Idle				
AC Power	2 m	120 V AC Power	Single phase.	No

Table 3

1.4.3 Test Configuration

Configuration	Description
AC Powered	The EUT was powered from a 120 V 60 Hz AC supply. A set of headphones was used to terminate the EUT's 3.5 mm audio jack port. A supplied wired keyboard was used to terminate the front USB-C port. A supplied mouse was used to terminate the additional rear USB-C port. An additional mouse was used to terminate the USB-A port. A switchbox was used to terminate the Ethernet port. A monitor was used to terminate the HDMI port.

Table 4

1.4.4 Modes of Operation

Mode	Description
Transmitter Idle	The EUT's intentional transmitters were turned Off. The EUT was displaying video on the EUT screen whilst playing audio through the headphones. The display was set to maximum brightness and sleep mode was 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: A2787, Serial Number: WDQCYW4692			
0	As supplied by the customer	Not Applicable	Not Applicable

Table 6

1.7 Test Location

TÜV SÜD conducted the following tests at our Octagon House Test Laboratory.

Test Name	Name of Engineer(s)	Accreditation
Configuration and Mode: AC Powered - Transmitter Idle		
Conducted Disturbance at Mains Terminals	James Cumming	UKAS
Radiated Disturbance	James Cumming, Matthew Dawkins	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, 3.1
ISED RSS-GEN, 8.8

2.1.2 Equipment Under Test and Modification State

A2787, S/N: WDQCYW4692 - Modification State 0

2.1.3 Date of Test

06-January-2023

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 Test Setup Diagram

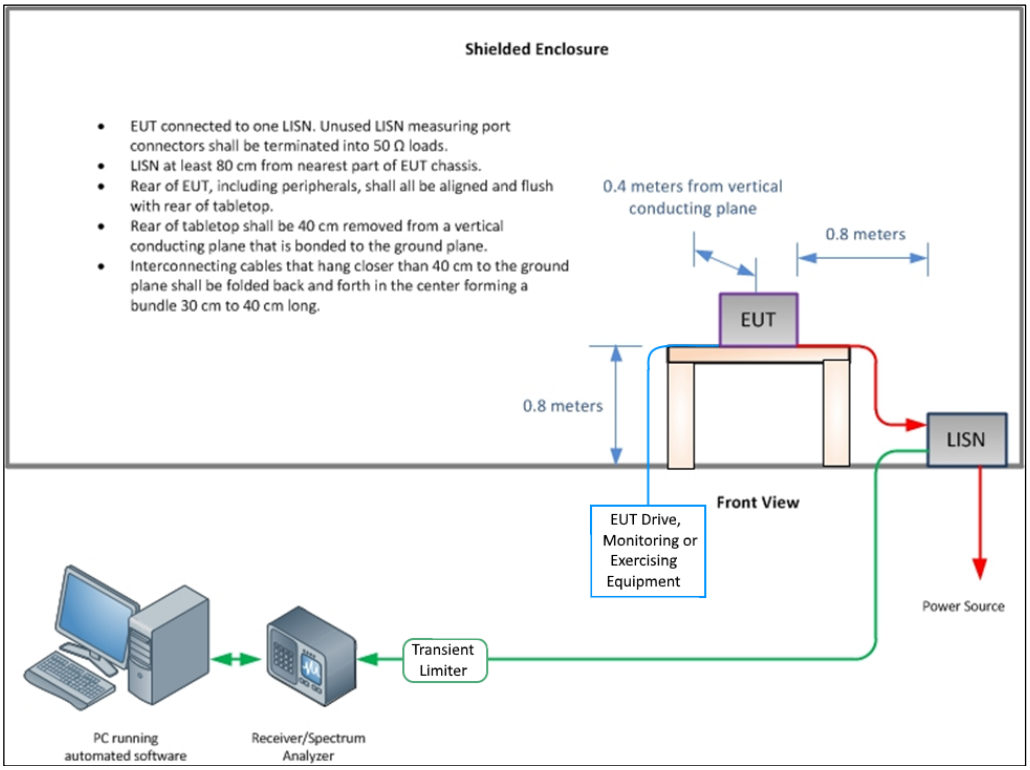

Figure 1 - Conducted Emissions – Example Test Setup Diagram

2.1.7 Environmental Conditions

Ambient Temperature	20.3 °C
Relative Humidity	51.4 %
Atmospheric Pressure	1003.0 mbar

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 - Transmitter 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.

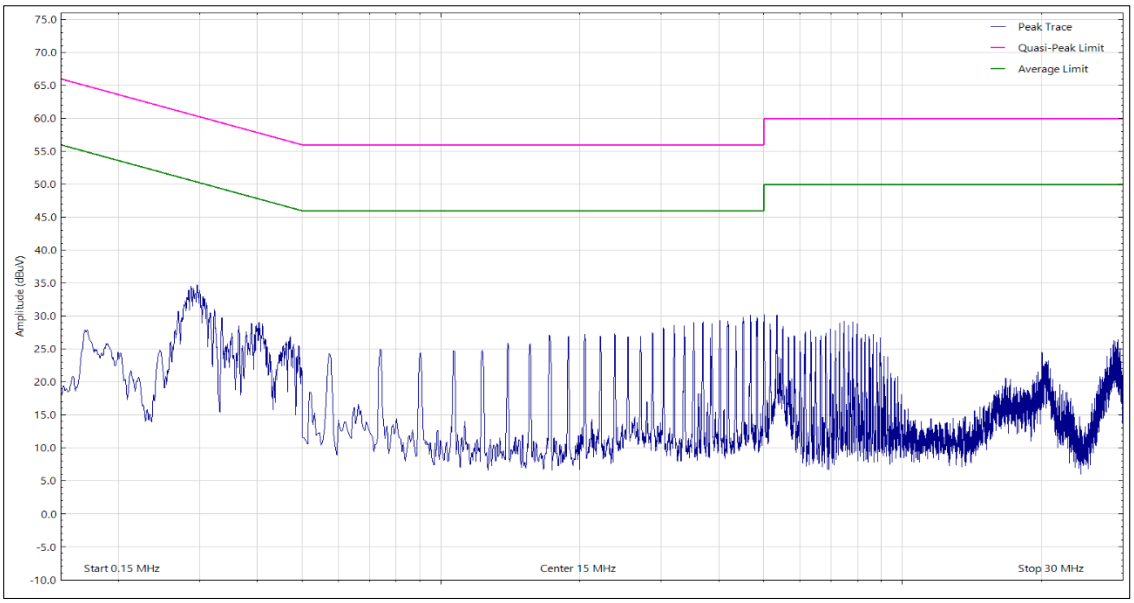

Figure 2 - Graphical Results - Live

Frequency (MHz)	Level (dBµV)	Limit (dBµV)	Margin (dB)	Detector
*				

Table 9

*No final measurements were made as all other peak emissions seen above the measurement system noise floor during the pre-scan were greater than 6 dB below the CISPR Average test limit.

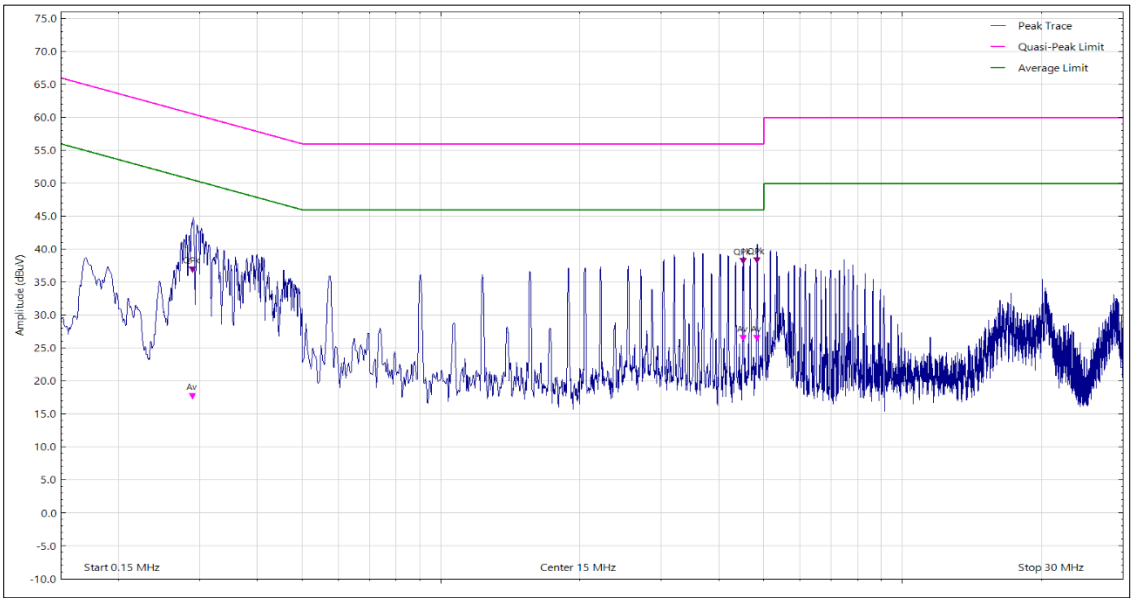

Figure 3 - Graphical Results - Neutral

Frequency (MHz)	Level (dBµV)	Limit (dBµV)	Margin (dB)	Detector
0.290	36.23	60.50	-24.27	Q-Peak
0.290	17.06	50.50	-33.44	CISPR Avg
4.509	37.48	56.00	-18.52	Q-Peak
4.509	25.85	46.00	-20.15	CISPR Avg
4.845	37.64	56.00	-18.36	Q-Peak
4.845	25.78	46.00	-20.22	CISPR Avg

Table 10

No other final measurements were made as all other peak emissions seen above the measurement system noise floor during the pre-scan were greater than 6 dB below the CISPR Average test limit.

2.1.10 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 12 and EMC Chamber 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
Screened Room (12)	MVG	EMC-3	5621	36	11-Aug-2023
Screened Room (1)	Rainford	Rainford	1542	-	TU
Emissions Software	TUV SUD	EmX V3.1.6	5125	-	Software
Test Receiver	Rohde & Schwarz	ESU40	3506	12	25-Mar-2023
Test Receiver	Rohde & Schwarz	ESW44	5379	12	01-Aug-2023
Transient Limiter	Hewlett Packard	11947A	2377	12	28-Feb-2023
Transient Limiter	Hewlett Packard	11947A	2378	12	25-Oct-2023
Termination (50ohm)	Meca	405-1	369	12	23-Mar-2023
Cable (N-Type to N-Type, 2 m)	Teledyne	PR90-088-2MTR	5199	12	22-Aug-2023
Cable (SMA to SMA, 2 m)	Rhophase	3PS-1801A-2000-3PS	4113	12	27-Jan-2023
Cable (N-Type to N-Type, 5 m)	Teledyne	PR90-088-5MTR	5206	12	04-Aug-2023
Cable (N-Type to N-Type, 8 m)	Teledyne	PR90-088-8MTR	5450	6	23-Apr-2023
LISN (CISPR 16, Single Phase)	Chase	MN 2050	336	12	04-Jul-2023
LISN (CISPR 16, Single Phase)	Rohde & Schwarz	ESH3-Z5	1390	12	31-Jan-2023

Table 11

TU – Traceability Unscheduled.

2.2 Radiated Disturbance

2.2.1 Specification Reference

FCC 47 CFR Part 15B, Clause 15.107
ICES-003, 3.1
ISED RSS-GEN, 8.8

2.2.2 Equipment Under Test and Modification State

A2787, S/N: WDQCYW4692 - Modification State 0

2.2.3 Date of Test

26-January-2023 to 27-January-2023

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.

For an EUT which could reasonable 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.

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)

2.2.6 Test Setup Diagram

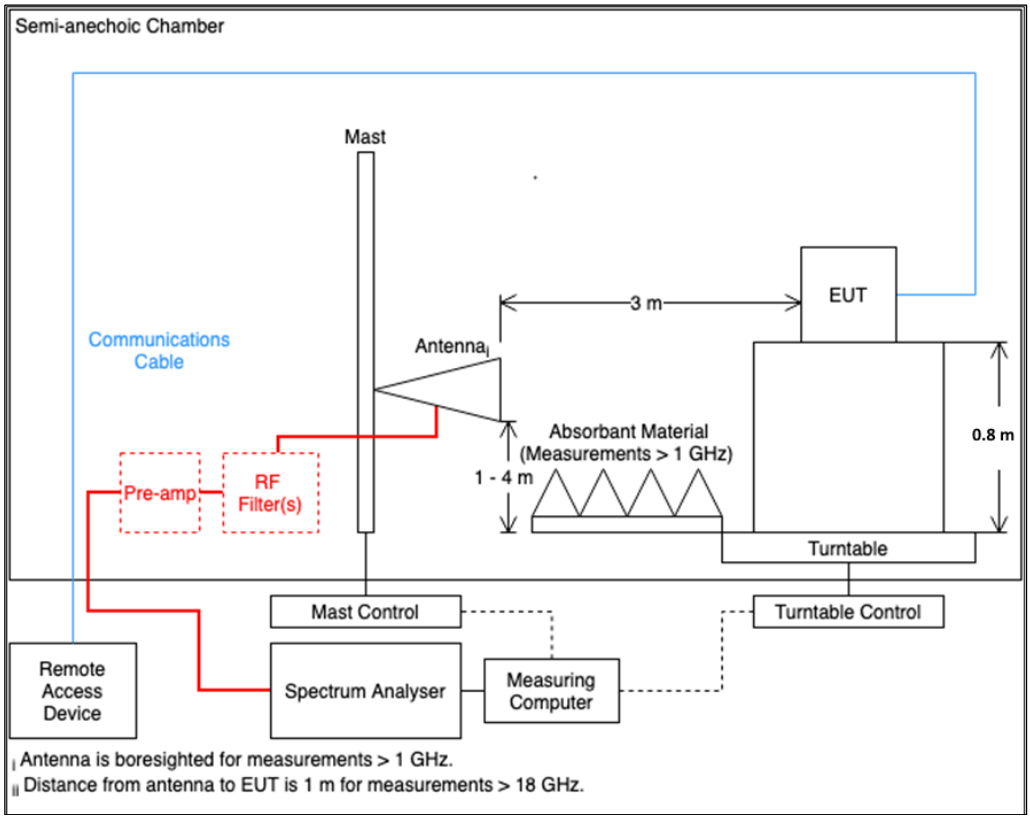

Figure 4 – Radiated Emissions - Example Test Setup Diagram

2.2.7 Environmental Conditions

Ambient Temperature	18.4 - 24.4 °C
Relative Humidity	28.7 - 39.3 %
Atmospheric Pressure	1001.0 - 1022.0 mbar

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 - Transmitter 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: 7125 MHz
Which necessitates an upper frequency test limit of: 36 GHz

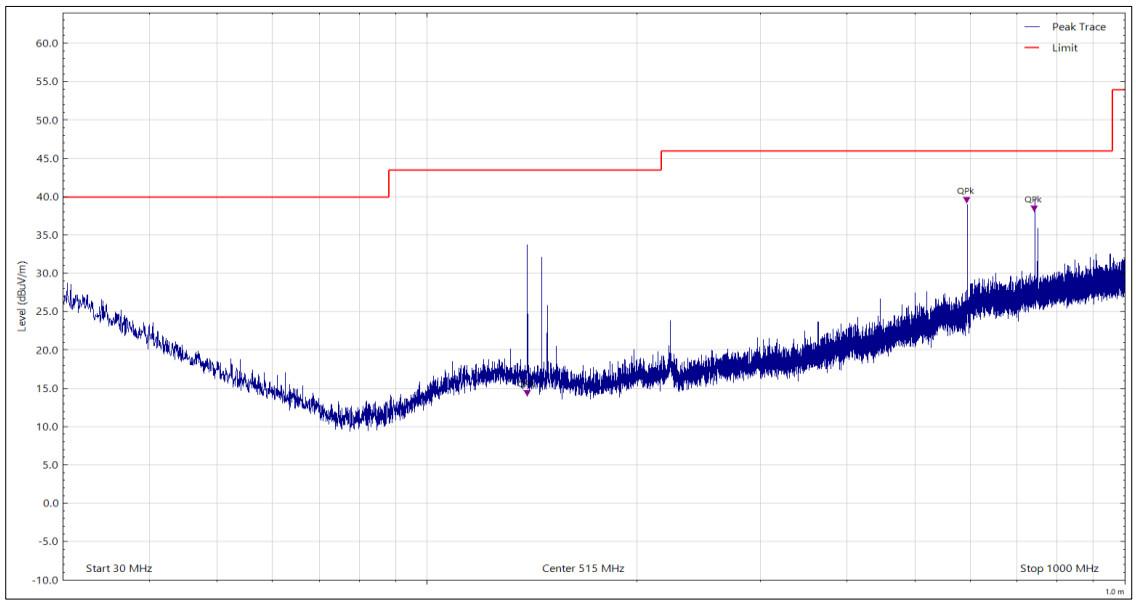

Figure 5 - 30 MHz to 1 GHz, Quasi-Peak, Horizontal

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
139.176	13.78	43.50	-29.72	Q-Peak	32	100	Horizontal
593.986	38.95	46.00	-7.05	Q-Peak	50	104	Horizontal
742.542	37.84	46.00	-8.16	Q-Peak	0	100	Horizontal

Table 13

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

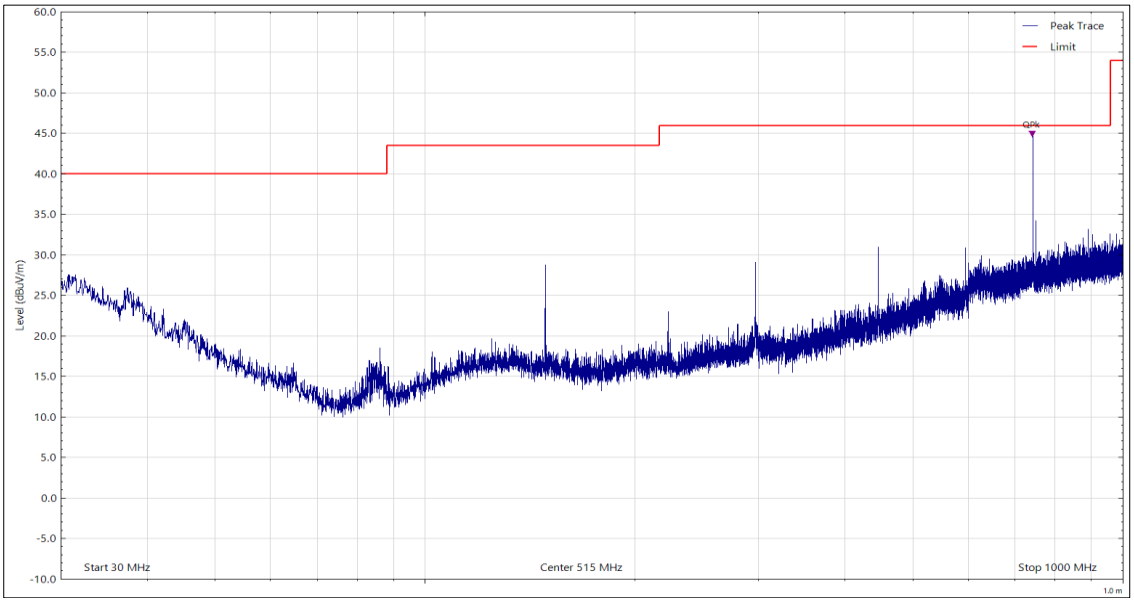

Figure 6 - 30 MHz to 1 GHz, Quasi-Peak, Vertical

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
742.514	44.38	46.00	-1.62	Q-Peak	338	100	Vertical

Table 14

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

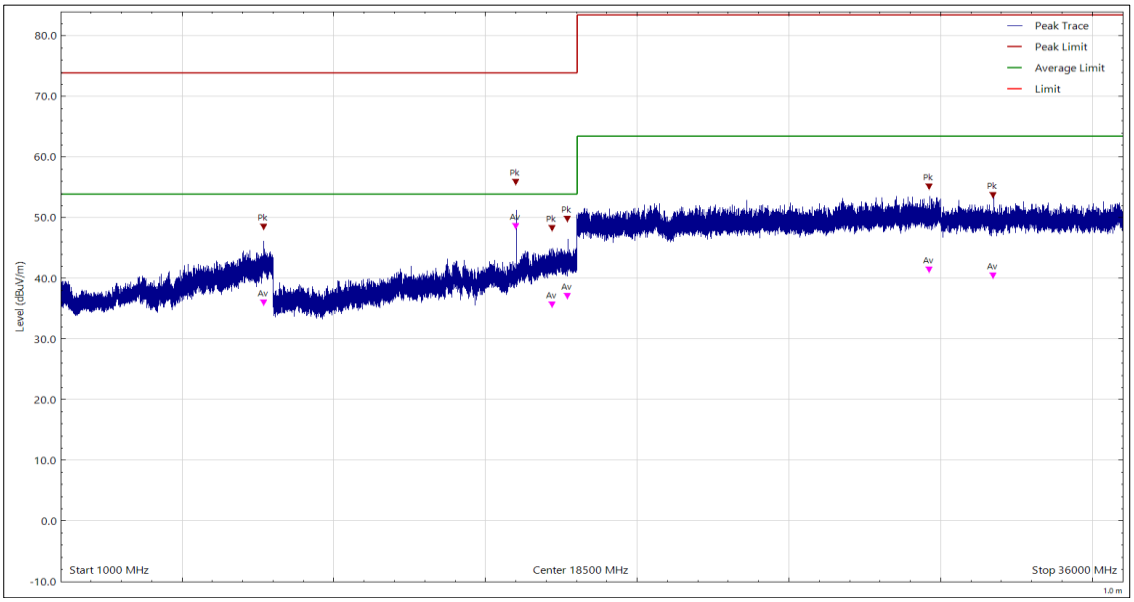

Figure 7 - 1 GHz to 30 GHz, Peak and CISPR Average, Horizontal

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
7680.806	47.79	74.00	-26.21	Peak	0	101	Horizontal
7680.806	35.24	54.00	-18.76	CISPR Avg	0	101	Horizontal
16000.121	47.82	54.00	-6.18	CISPR Avg	14	100	Horizontal
16000.121	55.19	74.00	-18.81	Peak	14	100	Horizontal
17203.303	47.50	74.00	-26.50	Peak	360	110	Horizontal
17203.303	34.90	54.00	-19.10	CISPR Avg	360	110	Horizontal
17703.160	49.10	74.00	-24.90	Peak	0	103	Horizontal
17703.160	36.34	54.00	-17.66	CISPR Avg	0	103	Horizontal
29624.985	54.36	83.50	-29.14	Peak	176	100	Horizontal
29624.985	40.66	63.50	-22.84	CISPR Avg	176	100	Horizontal
31732.959	52.98	83.50	-30.52	Peak	354	100	Horizontal
31732.959	39.76	63.50	-23.74	CISPR Avg	354	100	Horizontal

Table 15

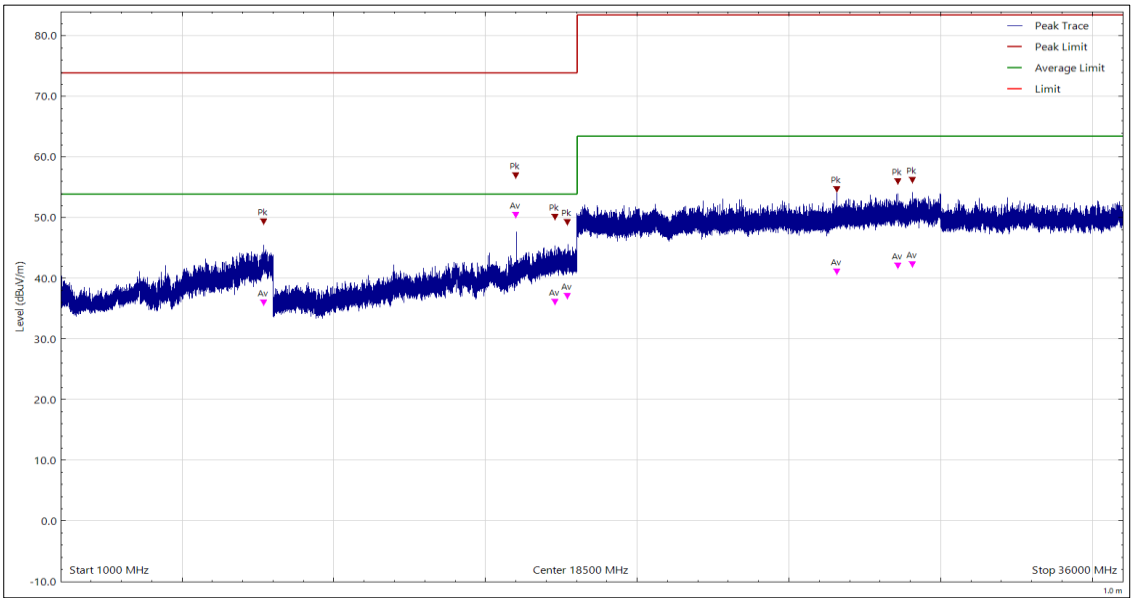

Figure 8 - 1 GHz to 30 GHz, Peak and CISPR Average, Vertical

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
7686.982	48.67	74.00	-25.33	Peak	0	110	Vertical
7686.982	35.28	54.00	-18.72	CISPR Avg	0	110	Vertical
15999.981	56.26	74.00	-17.74	Peak	2	108	Vertical
15999.981	49.74	54.00	-4.26	CISPR Avg	2	108	Vertical
17280.474	49.44	74.00	-24.56	Peak	0	105	Vertical
17280.474	35.41	54.00	-18.59	CISPR Avg	0	105	Vertical
17700.838	48.53	74.00	-25.47	Peak	10	100	Vertical
17700.838	36.36	54.00	-17.64	CISPR Avg	10	100	Vertical
26578.076	40.34	63.50	-23.16	CISPR Avg	360	100	Vertical
26578.076	53.98	83.50	-29.52	Peak	360	100	Vertical
28586.282	55.29	83.50	-28.21	Peak	336	100	Vertical
28586.282	41.40	63.50	-22.10	CISPR Avg	336	100	Vertical
29071.647	55.43	83.50	-28.07	Peak	255	100	Vertical
29071.647	41.51	63.50	-21.99	CISPR Avg	255	100	Vertical

Table 16

2.2.10 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
Screened Room (12)	MVG	EMC-3	5621	36	11-Aug-2023
Emissions Software	TUV SUD	EmX V3.1.6	5125	-	Software
Test Receiver	Rohde & Schwarz	ESU40	3506	12	25-Mar-2023
Turntable & Mast Controller	Maturo Gmbh	NCD/498/2799.01	5612	-	TU
Tilt Antenna Mast	Maturo Gmbh	TAM 4.0-P	5613	-	TU
Cable (N-Type to N-Type, 8 m)	Teledyne	PR90-088-8MTR	5450	6	23-Apr-2023
Cable (K-Type to K-Type, 1 m)	Junkosha	MWX241-01000KMSKMS/A	5511	12	14-Apr-2023
Cable (K-Type to K-Type, 2 m)	Junkosha	MWX241/B	5909	12	14-Apr-2023
Cable (K Type 2m)	Junkosha	MWX241-02000KMSKMS/B	5934	12	14-May-2023
Pre-Amplifier (1 GHz to 18 GHz)	Schwarzbeck	BBV 9718 C	5350	12	20-Oct-2023
Pre-Amplifier (18 GHz to 40 GHz)	Phase One	PSO4-0087	1534	12	23-Sep-2023
Antenna with attenuator (Bilog, 30 MHz to 3 GHz)	Schaffner	CBL6143	287	24	02-Dec-2024
Antenna (DRG, 1 GHz to 10.5 GHz)	Schwarzbeck	BBHA9120B	5611	12	16-Oct-2023
Antenna (DRG, 7.5 GHz to 18 GHz)	Schwarzbeck	HWRD750	5348	12	16-Oct-2023
Antenna (DRG, 18 GHz to 40 GHz)	Link Microtek Ltd	AM180HA-K-TU2	230	24	23-Sep-2024

Figure 9

TU - Traceability Unscheduled

3 Test Equipment Information

3.1 General Test Equipment Used

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
Power Supply	TTI	EX355R	5574	-	TU
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB-40	5474	12	25-Mar-2023

Table 17

TU - Traceability Unscheduled

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 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 115:2021, Clause 4.4.3 (Procedure 2). The measurement results are directly compared with the test limit to determine conformance with the requirements of the standard.

Risk: The uncertainty of measurement about the measured result is negligible with regard to the final pass/fail decision. The measurement result can be directly compared with the test limit to determine conformance with the requirement (compare IEC Guide 115). The level of risk to falsely accept and falsely reject items is further described in ILAC-G8.