# FCC and ISED Test Report

## Apple Inc
## Model: A3112

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

Prepared for: Apple Inc
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TUV SUD Digitally signed by TUV SUD Date: 2024.07.11 12:19:01 +01'00'

FCC ID: BCGA3112 IC: 579C-A3112

## COMMERCIAL-IN-CONFIDENCE

Document 75959702-11 Issue 02

| SIGNATURE | | | |
|---|---|---|---|
| | | | |
| **NAME** | **JOB TITLE** | **RESPONSIBLE FOR** | **ISSUE DATE** |
| Matthew Dawkins | Senior Engineer, EMC | Authorised Signatory | 11 July 2024 |

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 | Callum Pennells | 11 July 2024 | |

FCC Accreditation
492497/UK2010 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: 2023, 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 | 10-July 2024 |
| 2 | TE within sections 2.1.10 – 2.2.10 updated to include Thermo-Hygro-Barometer. | 11-July-2024 |

**Table 1**

## 1.2 Introduction

| | |
|---|---|
| Applicant | Apple Inc |
| Manufacturer | Apple Inc |
| EUT/Sample Identification | Refer to section 1.6 |
| Test Specification/Issue/Date | FCC 47 CFR Part 15B, ICES-003 and ISED RSS-GEN: 2023, Issue 7: 2020 and Issue 5 and A2 (2021-02) |
| Start of Test | 17-June-2024 |
| Finish of Test | 18-June-2024 |
| Name of Engineer(s) | Callum Pennells |
| 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 a portable laptop computer.

### 1.4.2 EUT Port/Cable Identification

| Port | Max Cable Length specified | Usage | Type | Screened |
|---|---|---|---|---|
| Configuration and Mode: AC Powered - Transmitter Idle | | | | |
| AC Power Port | 2 m | Power | AC to DC Power Adapter with mag safe connector | No |
| USB 1 Port | 1 m | Data | USB Type C | No |
| USB 2 Port | Unterminated | Data | USB Type C | No |
| USB 3 Port | Unterminated | Data | USB Type C | No |
| HDMI | 2 m | Data | HDMI | No |
| Audio Jack Port | Unterminated | Data | Audio Jack 3.5mm | No |

**Table 3**

### 1.4.3 Test Configuration

| Configuration | Description |
|---|---|
| AC Powered | The EUT was powered from a 120 V 60 Hz AC supply.<br>A 3.5 mm audio jack port was unterminated.<br>A mouse was used to terminate a USB-C port.<br>Two USB-C ports were unterminated.<br>A monitor was used to terminate a HDMI port.<br>PSU model: A2743 |

**Table 4**

### 1.4.4 Modes of Operation

| Mode | Description |
|---|---|
| Transmitter Idle | The EUT had all internal transmitters disabled. |

**Table 5**

## 1.5 Deviations from the Standard

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

## 1.6 Identification of the EUT

The table below details identification of the EUT(s) that have been used to carry out the testing within this report.

| Model: A3112 | | | |
|---|---|---|---|
| Serial Number | Hardware Version | Software Version | Firmware |
| HX2X6MQX6D | REV1.0 | 24A270 | WLAN: 23.10.855.0.41.51.152<br>Bluetooth: 22.1.106.862 |

**Table 6**

## 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: A3112, Serial Number: HX2X6MQX6D | | | |
| 0 | As supplied by the customer | Not Applicable | Not Applicable |

**Table 7**

## 1.8 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 | Callum Pennells | UKAS |
| Radiated Disturbance | Callum Pennells | UKAS |

**Table 8**

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, ICES-003 and ISED RSS-GEN, Clause 15.107, 3.1 and 8.8

### 2.1.2 Equipment Under Test and Modification State

A3112, S/N: HX2X6MQX6D - Modification State 0

### 2.1.3 Date of Test

18-June-2024

### 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

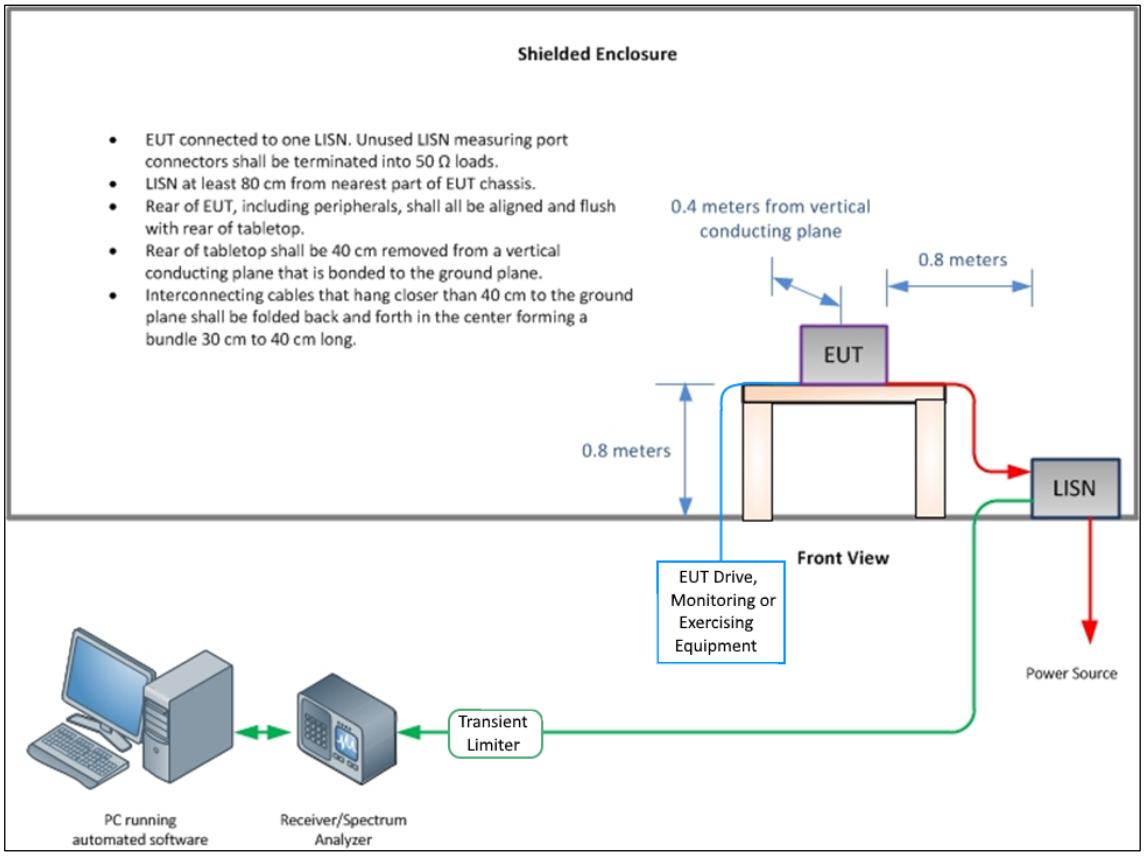


**Figure 1 - Conducted Disturbance**

### 2.1.7 Environmental Conditions

| | |
|---|---|
| Ambient Temperature | 23.0 °C |
| Relative Humidity | 39.9 % |
| Atmospheric Pressure | 1012.0 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 9**

### 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.

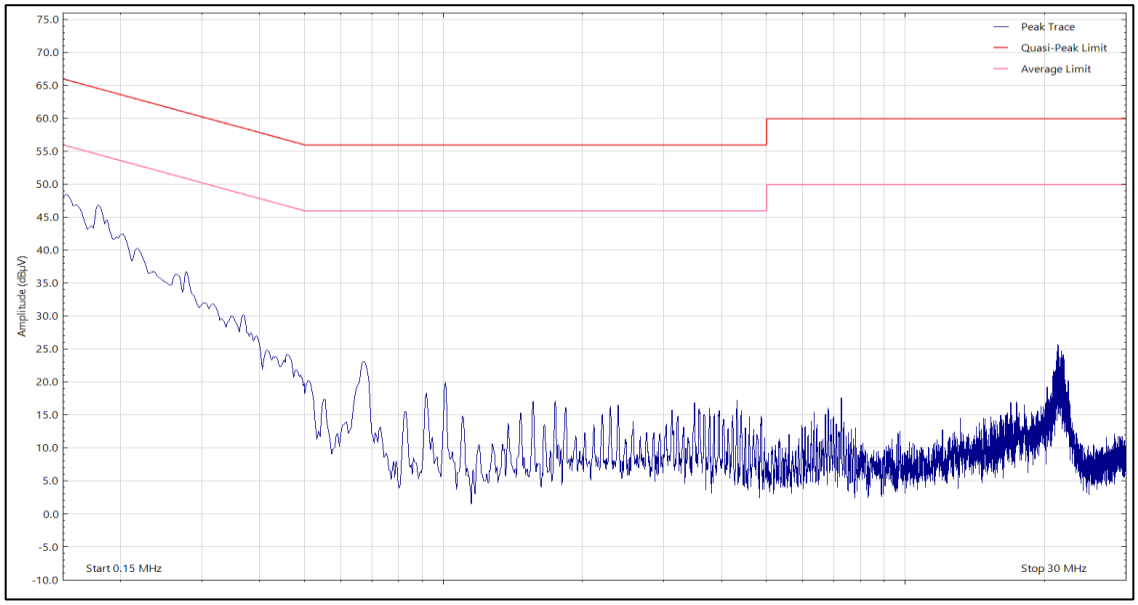


**Figure 2 - Graphical Results - Live Line**

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

**Table 10**

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

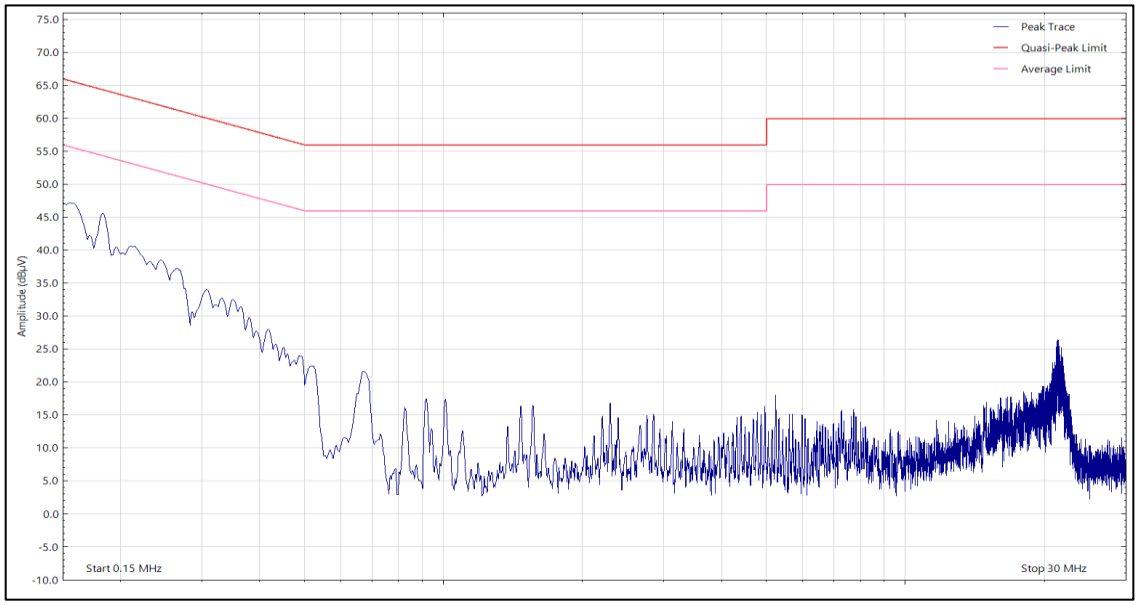


**Figure 3 - Graphical Results - Neutral Line**

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

**Table 11**

*No final measurements were made as all 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.

| Instrument | Manufacturer | Type No | TE No | Calibration Period (months) | Calibration Expires |
|---|---|---|---|---|---|
| Transient Limiter | Hewlett Packard | 11947A | 15 | 12 | 24-Oct-2024 |
| LISN (CISPR 16, Single Phase) | Rohde & Schwarz | ESH3-Z5 | 1390 | 12 | 01-Feb-2025 |
| Test Receiver | Rohde & Schwarz | ESU40 | 3506 | 12 | 17-Apr-2025 |
| Emissions Software | TUV SUD | EmX V3.2.0 | 5125 | - | Software |
| Thermo-Hygro-Barometer | PCE Instruments | PCE-THB 40 | 5604 | 12 | 22-Nov-2024 |
| 3m Semi-Anechoic Chamber | MVG | EMC Chamber 12 | 5621 | 36 | 07-Aug-2026 |
| Cable (N-Type to N-Type, 2 m) | Junkosha | MWX221-02000AMSAMS/B | 5729 | 6 | 21-Jun-2024 |
| Cable (N-Type to N-Type, 8 m) | Junkosha | MWX221-08000NMSNMS/B | 6321 | 12 | 04-Feb-2025 |

**Table 12**

## 2.2 Radiated Disturbance

### 2.2.1 Specification Reference

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

### 2.2.2 Equipment Under Test and Modification State

A3112, S/N: HX2X6MQX6D - Modification State 0

### 2.2.3 Date of Test

17-June-2024

### 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)
Margin (dB) = Peak level (dBµV/m) - Limit (dBµV/m)

### 2.2.6 Example Test Setup Diagram

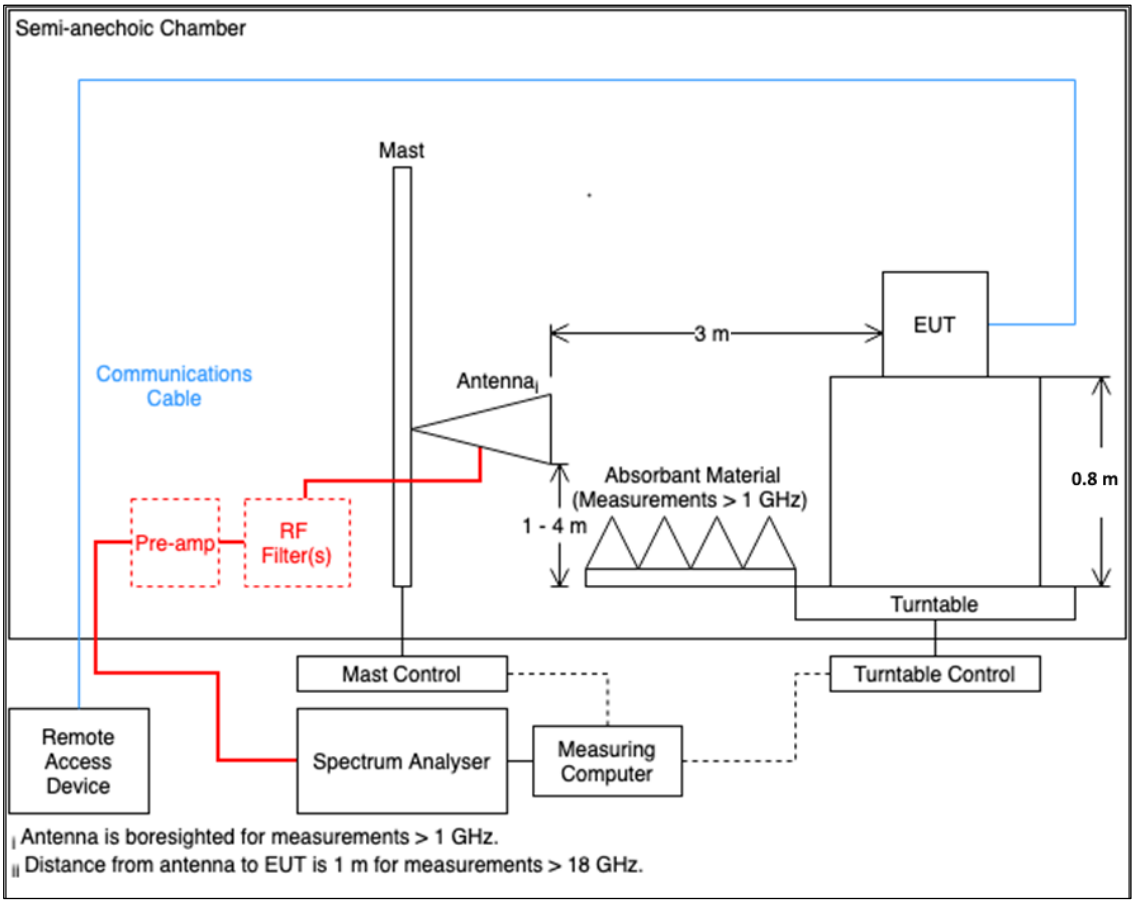


**Figure 4 - Radiated Disturbance Example Test Setup**

### 2.2.7 Environmental Conditions

| | |
|---|---|
| Ambient Temperature | 22.5 °C |
| Relative Humidity | 42.1 % |
| Atmospheric Pressure | 1008.0 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:**<br>Note 1. A Quasi-peak detector is to be used for measurements below 1 GHz.<br>Note 2. A CISPR Average detector is to be used for measurements above 1 GHz.<br>Note 3. The Peak test limit above 1 GHz is 20 dB higher than the CISPR Average test limit. | | |

**Table 13**

### 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: 7.125 GHz
Which necessitates an upper frequency test limit of: 40 GHz

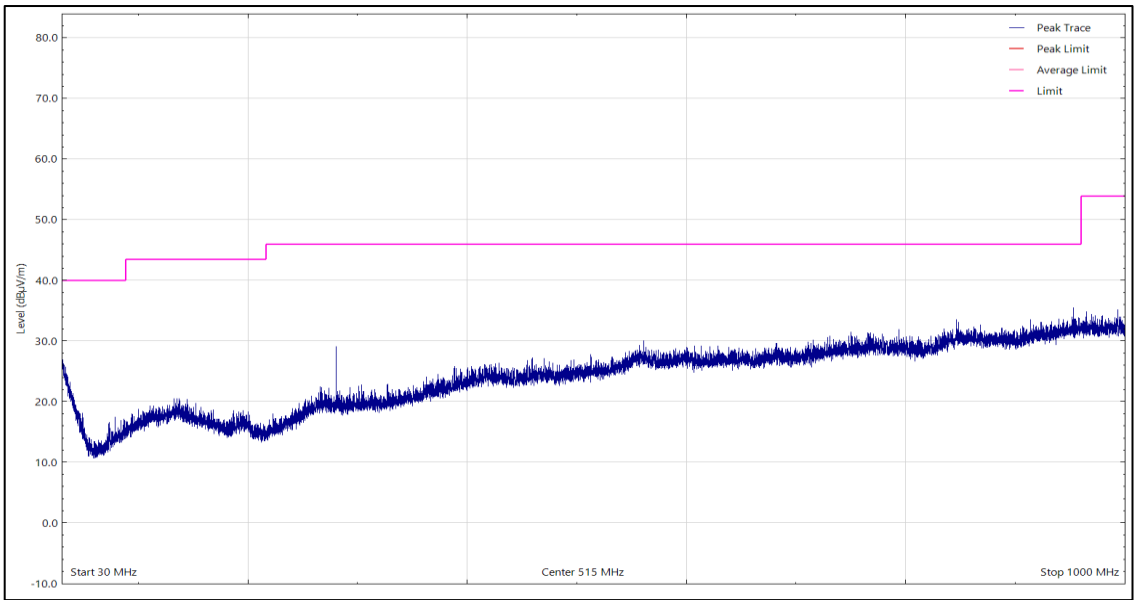


**Figure 5 - 30 MHz to 1 GHz, Horizontal**

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/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.

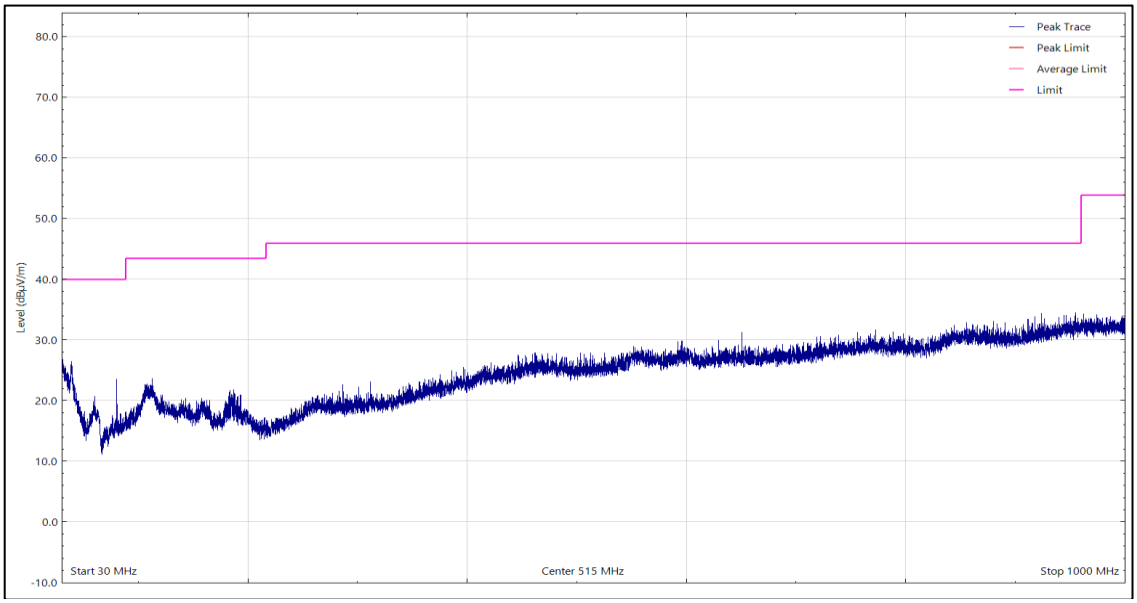


**Figure 6 - 30 MHz to 1 GHz, Vertical**

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/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.

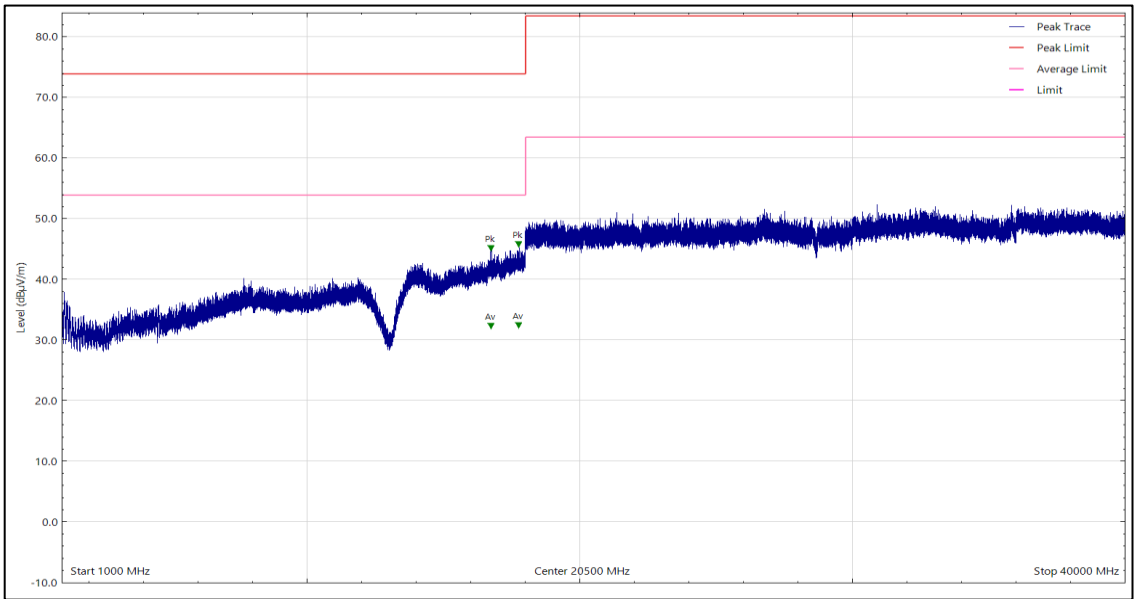


**Figure 7 - 1 GHz to 40 GHz, Horizontal**

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Detector | Angle (°) | Height (cm) | Polarisation |
|---|---|---|---|---|---|---|---|
| 16755.500 | 44.37 | 74.00 | -29.63 | Peak | 0 | 108 | Horizontal |
| 16755.500 | 31.57 | 54.00 | -22.43 | CISPR Avg | 0 | 108 | Horizontal |
| 17767.000 | 45.06 | 74.00 | -28.94 | Peak | 77 | 110 | Horizontal |
| 17767.000 | 31.72 | 54.00 | -22.28 | CISPR Avg | 77 | 110 | Horizontal |

**Table 16**

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 test limit.

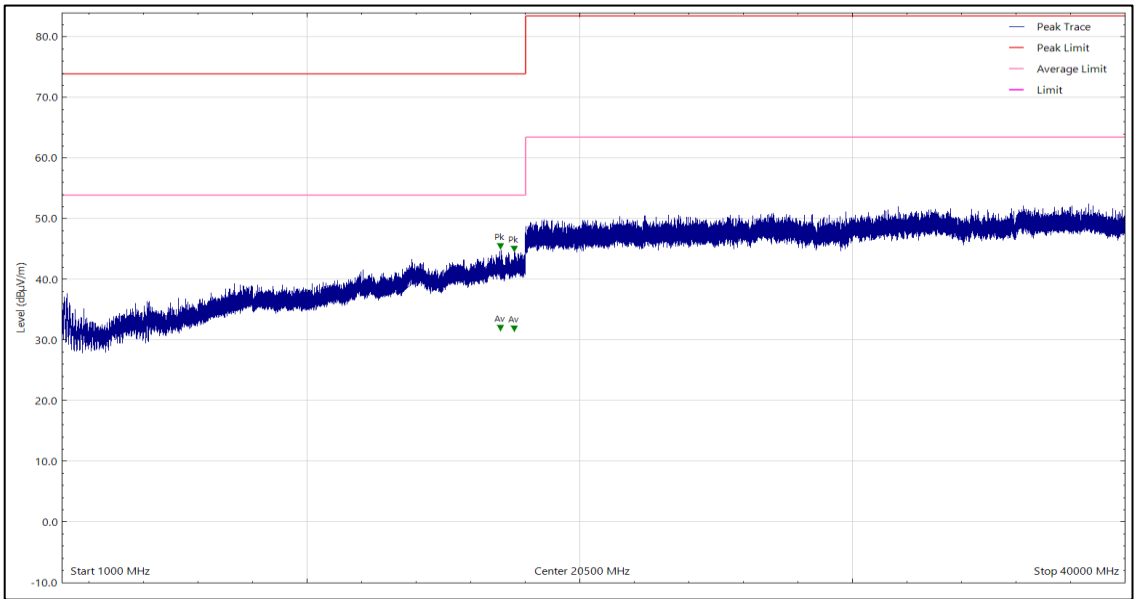


**Figure 8 - 1 GHz to 40 GHz, Vertical**

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Detector | Angle (°) | Height (cm) | Polarisation |
|---|---|---|---|---|---|---|---|
| 17103.500 | 44.68 | 74.00 | -29.32 | Peak | 45 | 110 | Vertical |
| 17103.500 | 31.20 | 54.00 | -22.80 | CISPR Avg | 45 | 110 | Vertical |
| 17598.000 | 44.30 | 74.00 | -29.70 | Peak | 360 | 146 | Vertical |
| 17598.000 | 31.18 | 54.00 | -22.82 | CISPR Avg | 360 | 146 | Vertical |

**Table 17**

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 test limit.

### 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 |
|---|---|---|---|---|---|
| Antenna (DRG, 18 GHz to 40 GHz) | Link Microtek Ltd | AM180HA-K-TU2 | 230 | 24 | 23-Sep-2024 |
| Pre-Amplifier (8 GHz to 18 GHz) | Phase One | PS04-0086 | 1533 | 12 | 26-Feb-2025 |
| Pre-Amplifier (18 GHz to 40 GHz) | Phase One | PSO4-0087 | 1534 | 12 | 13-Feb-2025 |
| Test Receiver | Rohde & Schwarz | ESU40 | 3506 | 12 | 17-Apr-2025 |
| Emissions Software | TUV SUD | EmX V3.2.0 | 5125 | - | Software |
| Antenna (DRG, 7.5 GHz to 18 GHz) | Schwarzbeck | HWRD750 | 5348 | 12 | 15-Oct-2024 |
| Pre-Amplifier (1 GHz to 18 GHz) | Schwarzbeck | BBV 9718 C | 5350 | 12 | 01-Dec-2024 |
| Cable (K-Type to K-Type, 1 m) | Junkosha | MWX241-01000KMSKMS/A | 5512 | 12 | 23-May-2025 |
| Thermo-Hygro-Barometer | PCE Instruments | PCE-THB 40 | 5604 | 12 | 22-Nov-2024 |
| Antenna (DRG, 1 GHz to 10.5 GHz) | Schwarzbeck | BBHA9120B | 5611 | 12 | 15-Oct-2024 |
| Turntable & Mast Controller | Maturo Gmbh | NCD/498/2799.01 | 5612 | - | TU |
| Tilt Antenna Mast | Maturo Gmbh | TAM 4.0-P | 5613 | - | TU |
| Antenna (Bi-Log, 30 MHz to 1 GHz) | Teseq | CBL6111D | 5615 | 24 | 15-Mar-2025 |
| 3m Semi-Anechoic Chamber | MVG | EMC Chamber 12 | 5621 | 36 | 07-Aug-2026 |
| Cable (N-Type to N-Type, 2 m) | Junkosha | MWX221-02000AMSAMS/B | 5729 | 6 | 21-Jun-2024 |
| Cable (K-Type to K-Type, 2 m) | Junkosha | MWX241-02000KMSKMS/B | 5934 | 12 | 18-Jun-2024 |
| Cable (SMA to SMA 1m) | Junkosha | MWX221/B | 5998 | 12 | 24-Oct-2024 |
| Cable (N-Type to N-Type, 8 m) | Junkosha | MWX221-08000NMSNMS/B | 6321 | 12 | 04-Feb-2025 |

**Table 18**

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 |
|---|---|
| Conducted Disturbance at Mains Terminals | 150 kHz to 30 MHz, LISN, ±3.7 dB |
| Radiated Disturbance | 30 MHz to 1 GHz, Bilog Antenna, SAC, ±5.2 dB<br>1 GHz to 6 GHz, Horn Antenna, SAC, ±5.1 dB<br>6 GHz to 18 GHz, Horn Antenna, SAC, ±4.9 dB<br>18 GHz to 40 GHz, Horn Antenna, SAC, ±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 115:2021, 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.