# FCC and ISED Test Report

## Apple Inc
## Model: A2485

## In accordance with FCC 47 CFR Part 15B, ICES-003 and ISED RSS-GEN (Transmitters Idle)

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

FCC ID: BCGA2485 IC: 579C-A2485

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## COMMERCIAL-IN-CONFIDENCE

Document 75952054-08 Issue 02

Jensen Adams Digitally signed by Jensen Adams Date: 2021.09.22 12:15:34 +01'00'

| SIGNATURE | | | |
|---|---|---|---|
| Jensen Adams | | | |
| **NAME** | **JOB TITLE** | **RESPONSIBLE FOR** | **ISSUE DATE** |
| Jensen Adams | Manager – Technical Solutions | Authorised Signatory | 22 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 | 22 September 2021 | |
| Testing | Jaiyanth Balendrarajah | 22 September 2021 | |
| Testing | Mohammad Malik | 22 September 2021 | |
| Testing | Taha Shafique | 22 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 ISEDC RSS-GEN: Issue 5 and A1 (2019-03) 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 | 17-September-2021 |
| 2 | Updated FCC ID on Front Page | 22-September-2021 |

**Table 1**

## 1.2 Introduction

| | |
|---|---|
| Applicant | Apple Inc |
| Manufacturer | Apple Inc |
| Model Number(s) | A2485 |
| Serial Number(s) | CYQ0JJ46X9 and HV9QMW620K |
| Hardware Version(s) | REV1.0 |
| Software Version(s) | CYQ0JJ46X9: 21A290<br>HV9QMW620K: 21A102280u |
| Number of Samples Tested | 2 |
| Test Specification/Issue/Date | FCC 47 CFR Part 15B: 2020<br>ICES-003: Issue 7: 2020<br>ISED RSS-GEN: Issue 5 and A1 (2019-03)) |
| Order Number<br>Date | 0540211248<br>22-April-2021 |
| Date of Receipt of EUT | 31-March-2021 and 16-July-2021 |
| Start of Test | 28-July-2021 |
| Finish of Test | 02-August-2021 |
| Name of Engineer(s) | Matthew Dawkins, Jaiyanth Balendrarajah, Mohammad Malik and Taha Shafique |
| 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 | 2 Meters | Power | Type C | No |
| 3 x USB Type C to USB Port | 2 Meters | Power | Type C | No |
| HDMI | - | Signal / | HDMI | No |
| Headphone Port | 2 Meters | Power | Headphone Jack | No |

**Table 3**

### 1.4.3 Test Configuration

| Configuration | Description |
|---|---|
| AC Powered | The EUT was powered from a 120 V 60 Hz AC to USB type C power adapter, model number A2166.<br>Connected to the EUT were:<br>• a set of headphones to load the headphone port<br>• a TP-Link interface to load a USB type C port.<br>• a TP-Link interface to load the HDMI port. |

**Table 4**

### 1.4.4 Modes of Operation

| Mode | Description |
|---|---|
| Transmitters Idle | The EUT was configured to play audio through the headphones.<br>The EUTs display was set to maximum brightness and sleep mode was disabled.<br>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: A2485, Serial Number: CYQ0JJ46X9 | | | |
| 0 | As supplied by the customer | Not Applicable | Not Applicable |
| Model: A2485, Serial Number: HV9QMW620K | | | |
| 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 | Jaiyanth Balendrarajah, Mohammad Malik and Taha Shafique | 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

A2485, S/N: CYQ0JJ46X9 - Modification State 0

### 2.1.3 Date of Test

28-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

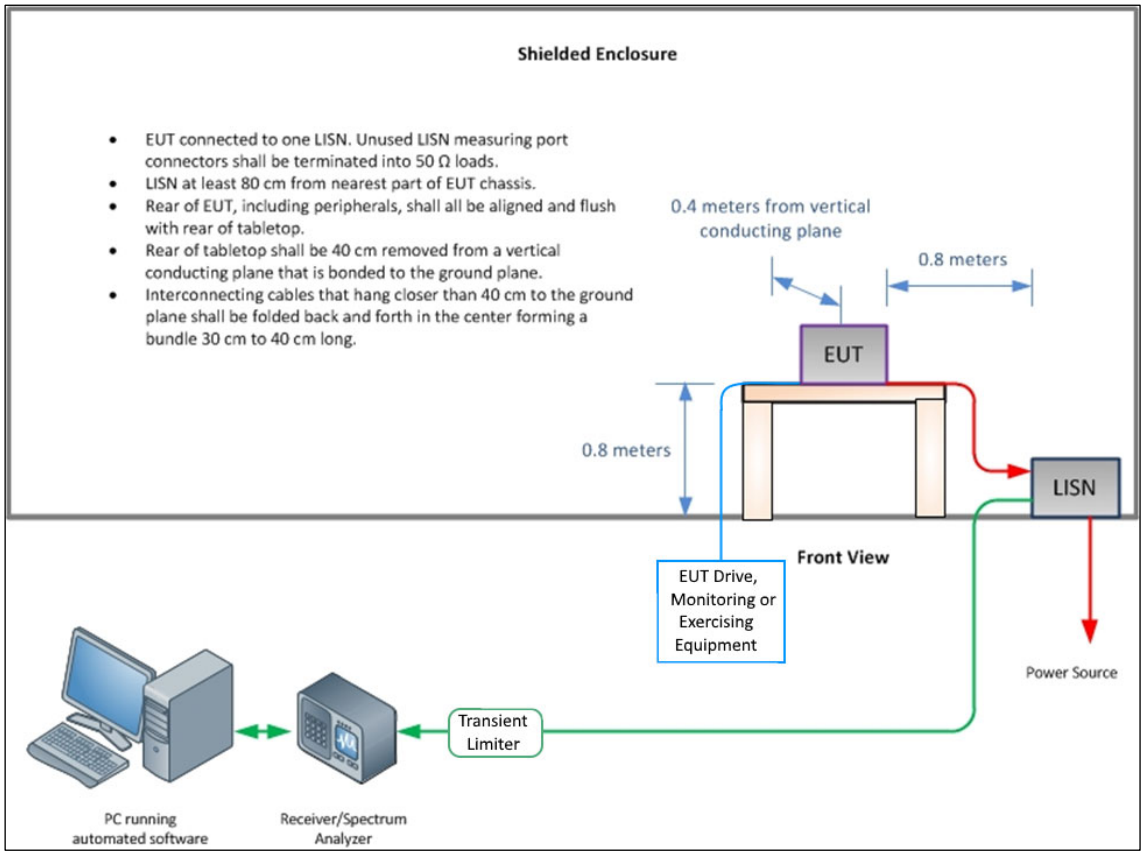


**Figure 1 - Conducted Disturbance**

### 2.1.7 Environmental Conditions

| | |
|---|---|
| Ambient Temperature | 20.4 °C |
| Relative Humidity | 64.5 % |

### 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.

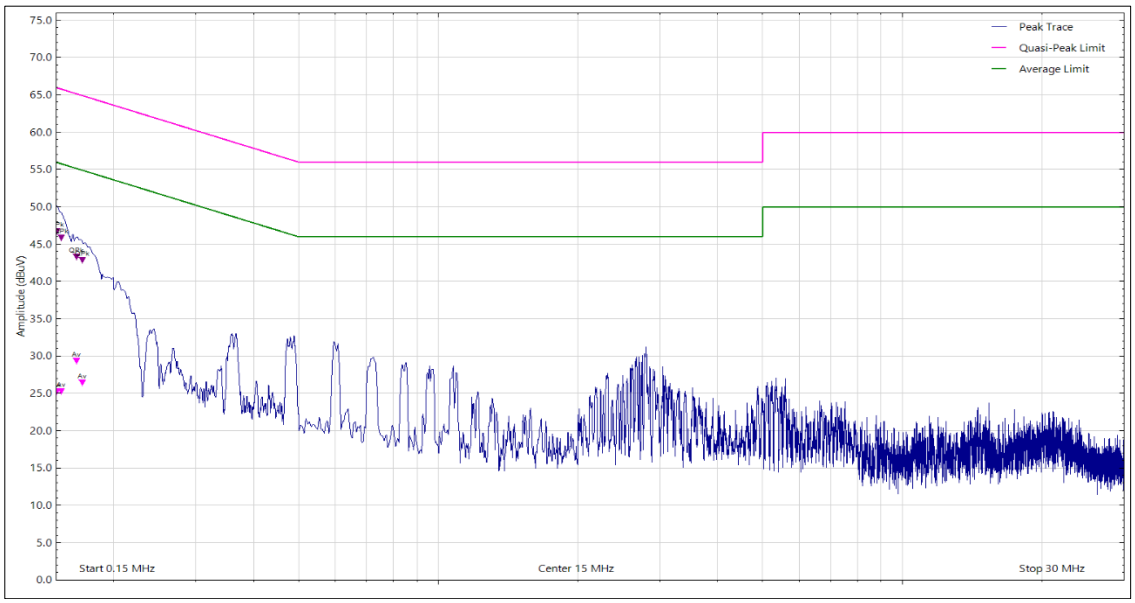


**Figure 2 - Graphical Results - AC Power Port Live Line**

| Frequency (MHz) | Level (dBµV) | Limit (dBµV) | Margin (dB) | Detector |
|---|---|---|---|---|
| 0.151 | 46.1 | 66.0 | -19.9 | Q-Peak |
| 0.151 | 24.7 | 56.0 | -31.4 | CISPR Avg |
| 0.154 | 45.3 | 65.8 | -20.5 | Q-Peak |
| 0.154 | 24.6 | 55.8 | -31.2 | CISPR Avg |
| 0.166 | 42.7 | 65.1 | -22.4 | Q-Peak |
| 0.166 | 28.7 | 55.1 | -26.4 | CISPR Avg |
| 0.171 | 42.2 | 64.9 | -22.7 | Q-Peak |
| 0.171 | 25.8 | 54.9 | -29.1 | CISPR Avg |

**Table 9**

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.

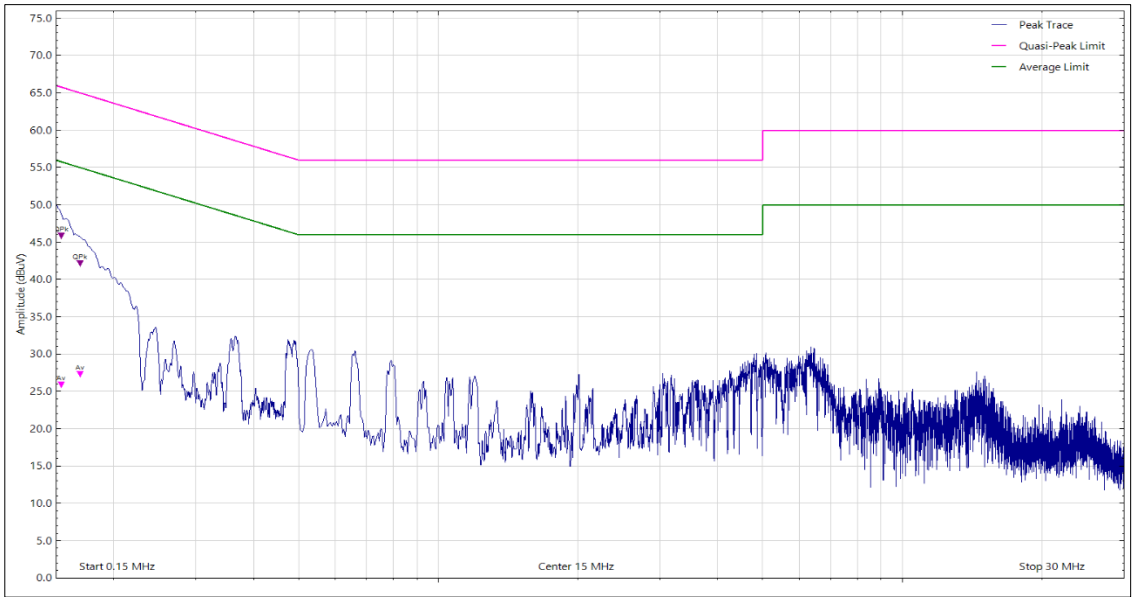


**Figure 3 - Graphical Results - AC Power Port Neutral Line**

| Frequency (MHz) | Level (dBµV) | Limit (dBµV) | Margin (dB) | Detector |
|---|---|---|---|---|
| 0.154 | 45.2 | 65.8 | -20.6 | Q-Peak |
| 0.154 | 25.3 | 55.8 | -30.5 | CISPR Avg |
| 0.169 | 41.5 | 65.0 | -23.5 | Q-Peak |
| 0.169 | 26.7 | 55.0 | -28.3 | 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.

| Instrument | Manufacturer | Type No | TE No | Calibration Period (months) | Calibration Expires |
|---|---|---|---|---|---|
| 3m Semi Anechoic Chamber | MVG | EMC-3 | 5621 | 36 | 11-Aug-2023 |
| EmX Emissions Software | TUV SUD | V2.1.11 | 5125 | - | N/A - Software |
| 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

A2485, S/N: HV9QMW620K - Modification State 0

### 2.2.3 Date of Test

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

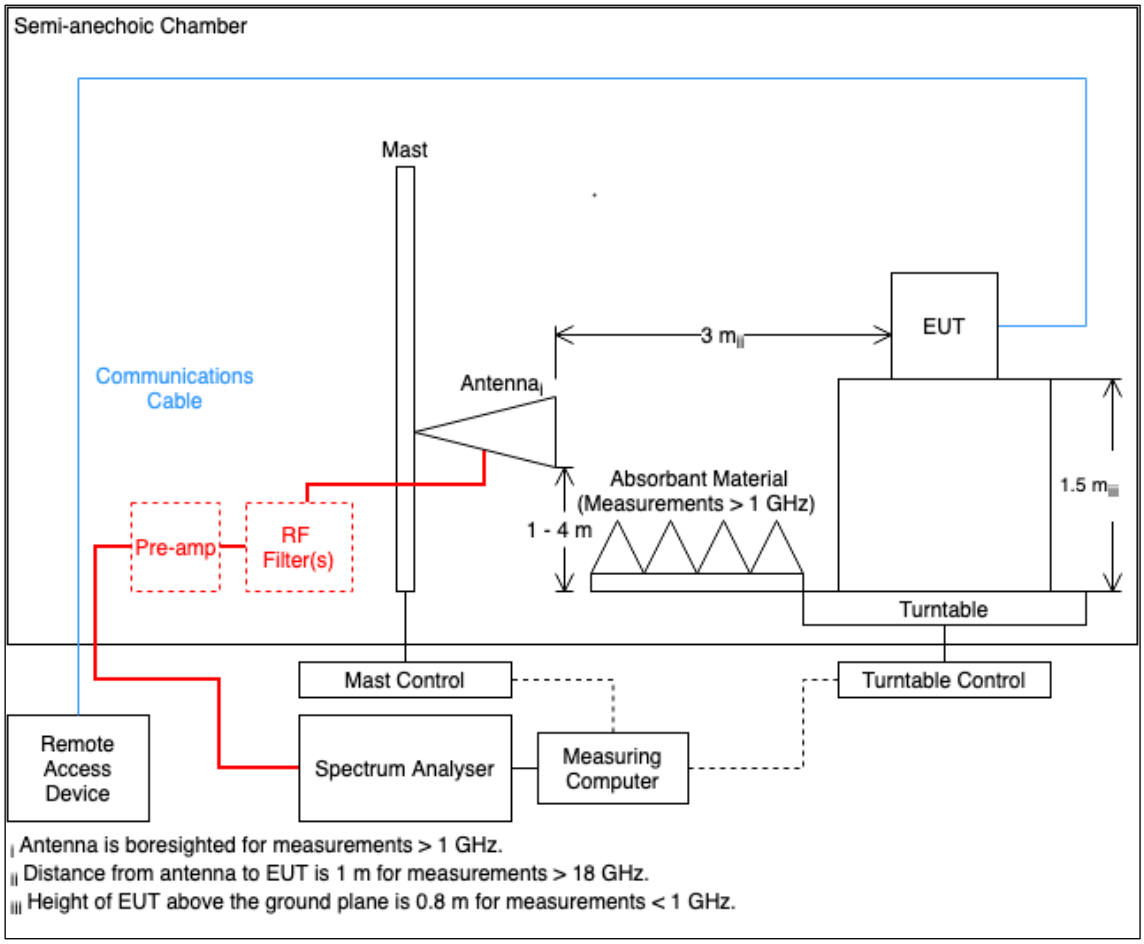


**Figure 4**

### 2.2.7 Environmental Conditions

| | |
|---|---|
| Ambient Temperature | 22.4 °C |
| Relative Humidity | 52.1 % |

### 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 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

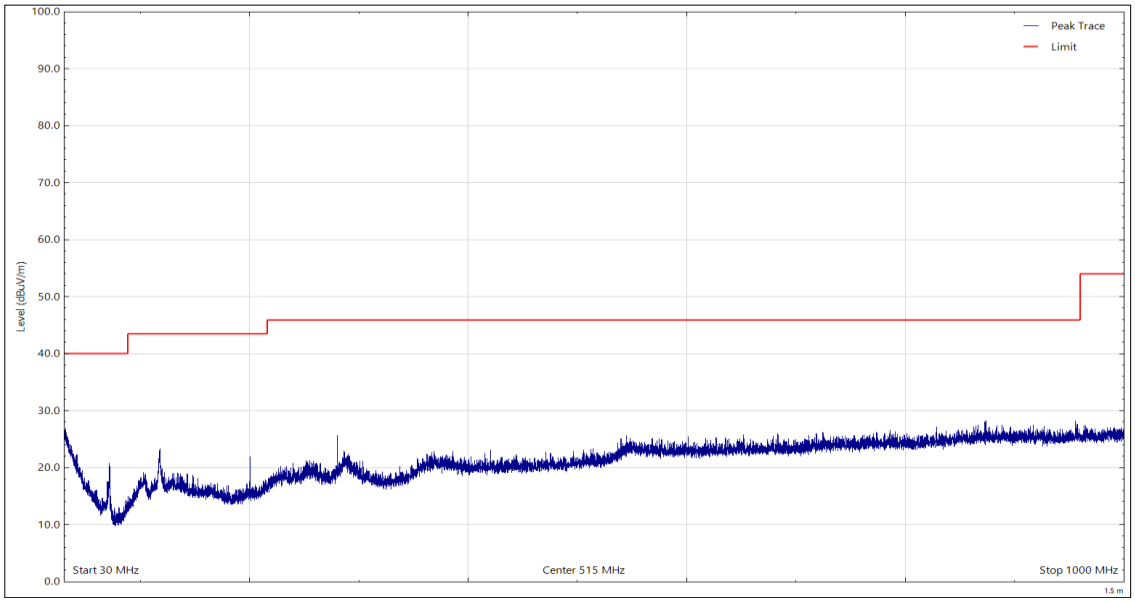


**Figure 5 - 30 MHz to 1 GHz, Quasi-Peak, Horizontal**

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

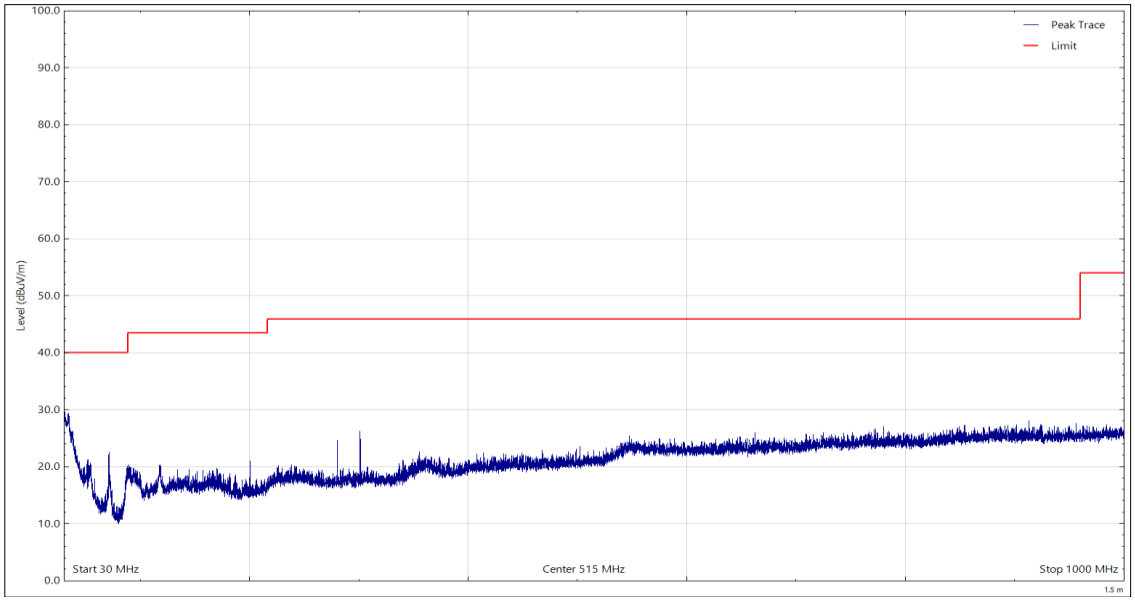


**Figure 6 - 30 MHz to 1 GHz, Quasi-Peak, Vertical**

| Frequency (MHz) | Level (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.

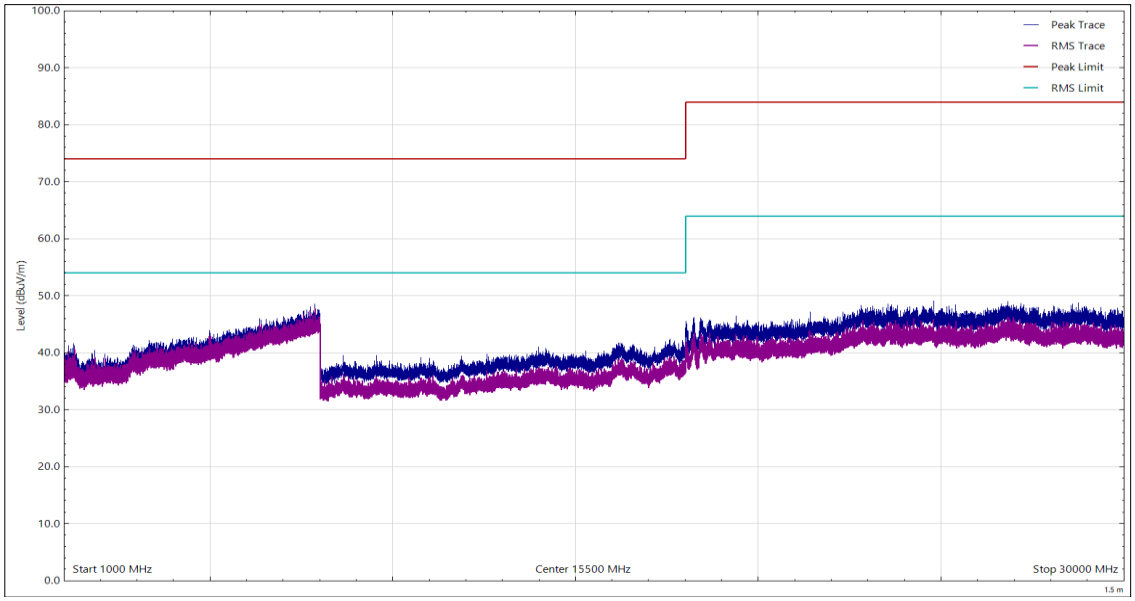


**Figure 7 - 1 GHz to 30 GHz, Peak, Horizontal**

| 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.

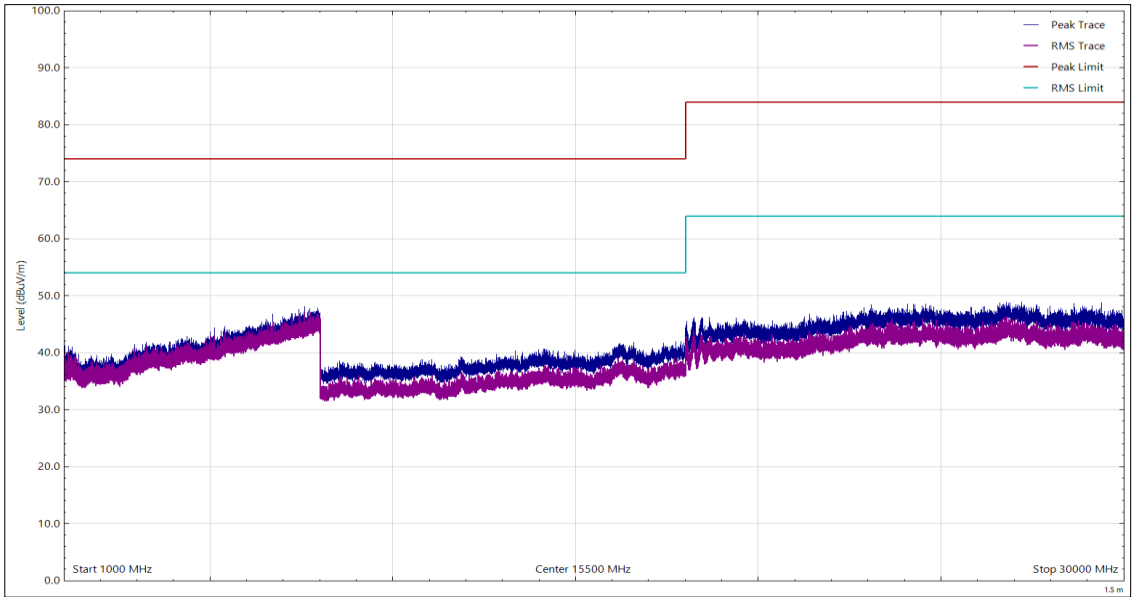


**Figure 8 - 1 GHz to 30 GHz, Peak, Vertical**

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/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 RF Chamber 11.

| Instrument | Manufacturer | Type No | TE No | Calibration Period (months) | Calibration Expires |
|---|---|---|---|---|---|
| Screened Room (11) | Rainford | Rainford | 5136 | 36 | 01-Nov-2021 |
| EmX Emissions Software | TUV SUD | V2.1.11 | 5125 | - | N/A - Software |
| EMI Test Receiver | Rohde & Schwarz | ESW44 | 5084 | 12 | 8-Mar-2022 |
| Mast | Maturo | TAM 4.0-P | 5158 | - | TU |
| Mast and Turntable Controller | Maturo | Maturo NCD | 5159 | - | TU |
| Turntable | Maturo | TT 15WF | 5160 | - | TU |
| Cable (18 GHz) | Rosenberger | LU7-071-1000 | 5102 | 12 | 12-Oct-2021 |
| 2m SMA Cable | Junkosha | MWX221-02000AMSAMS/A | 5518 | 12 | 9-Apr-2022 |
| 8m N Type Cable | Junkosha | MWX221-08000NMSNMS/B | 5522 | 12 | 24-Mar-2022 |
| 2m K Type Cable | Junkosha | MWX241-02000KMSKMS/A | 5524 | 12 | 24-Mar-2022 |
| 8 - 18 GHz Amplifier | Wright Technologies | APS06-0061 | 5595 | 12 | 25-Aug-2021 |
| Pre Amp 1 - 26.5 GHz | Agilent Technologies | 8449B | 5445 | 12 | 6-May-2022 |
| Preamplifier (30dB 18-40GHz) | Schwarzbeck | BBV 9721 | 5218 | 12 | 14-Oct-2021 |
| Antenna with permanent attenuator (Bilog) | Chase | CBL6143 | 2904 | 24 | 30-Sep-2021 |
| Horn Antenna (1-10GHz) | Schwarzbeck | BBHA 9120 B | 5215 | 12 | 1-Apr-2022 |
| DRG Horn Antenna (7.5-18GHz) | Schwarzbeck | HWRD750 | 5216 | 12 | 1-Apr-2022 |
| Horn Antenna (15-40GHz) | Schwarzbeck | BBHA 9170 | 5217 | 12 | 14-Oct-2021 |
| 1200 MHz Low Pass Filter (02) | Mini-Circuits | VLF-1200+ | 5560 | 12 | 24-May-2022 |

**Table 17**

TU – Traceability Unscheduled

# 3 Test Equipment Information

## 3.1 General Test Equipment Used

| Instrument | Manufacturer | Type No | TE No | Calibration Period (months) | Calibration Expires |
|---|---|---|---|---|---|
| Antenna (DRG) | EMCO | 3115 | 794 | 12 | 01-Apr-2022 |
| Spectrum Analyser | Agilent Technologies | E7405A | 1410 | 12 | 14-Oct-2021 |
| Programmable Power Supply | Iso-tech | IPS 2010 | 2437 | - | O/P Mon |
| True RMS Multimeter | Fluke | 179 | 4007 | 12 | 29-Oct-2021 |
| Thermo-Hygro-Barometer | PCE Instruments | PCE-THB-40 | 5473 | 12 | 01-Apr-2022 |
| Thermo-Hygro-Barometer | PCE Instruments | PCE-THB-40 | 5604 | 12 | 08-Sep-2021 |
| 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<br>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.