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TEST REPORT

Windcave CHU200S Rel A
EFTPOS Payment Terminal

tested to the

47 Code of Federal Regulations
Part 15 - Radio Frequency Devices
Subpart C – Intentional Radiators

Section 15.225
Operation within the band 13.110 -14.010 MHz

for

Windcave Ltd

This test report is issued with the authority of:

Andrew Cutler - General Manager

ACCREDITED IANZ TESTING LABORATORY

All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

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1. STATEMENT OF COMPLIANCE

The **Windcave CHU200S Rel A EFTPOS Payment Terminal** complies with FCC Part 15 Subpart C Section 15.225 as an Intentional Radiator when the methods as described in ANSI C63.10 –2020 are applied.

2. RESULTS SUMMARY

The results from testing carried out in March 2024 are detailed in the following table:

Clause	Parameter	Result	Page no
15.201	Equipment authorisation requirement	Certification required.	7
15.203	Antenna requirement	Complies. Antenna internal to the device.	7
15.204	External PA and antenna modifications	Not applicable. No external devices.	7
15.205	Restricted bands of operation	Complies. Device transmits on 13.560 MHz.	8
15.207	Conducted limits	Complies.	9
15.209	Radiated emission limits - Emissions < 30 MHz	Complies.	13
15.209	Radiated emission limits – Emissions > 30 MHz	Complies.	13
15.225	Radiated emission limits - Fundamental	Complies.	17
15.225	Frequency stability	Complies.	17

3. INTRODUCTION

This report describes the tests and measurements performed for the purpose of determining compliance with the specification.

The client selected the test sample.

This report relates only to the sample tested.

Measurement uncertainties with statistical confidence intervals of 95% are shown below test results. Both Class A and Class B uncertainties have been accounted for, as well as influence uncertainties where appropriate.

All compliance statements have been made with respect of the specification limit with no reference to the measurement uncertainty.

All testing was carried out as per the standard in the worst-case configuration with no deviations being applied.

Report Revision Table

Version	Change Made	Date
230313.2	Initial Issue	5th April 2024
230313.2b	Additional photos added on page 25	9th April 2024

4. CLIENT INFORMATION

Company Name	Windcave Ltd
Address	33 Wilkinson Rd, Ellerslie
State	Auckland 1060
Country	New Zealand
Contact	Niel Vivier

5. DESCRIPTION OF TEST SAMPLE

Brand Name	Windcave
Product	EFTPOS Payment Terminal
Model Number	CHU200S Release A
Manufacturer	Windcave Limited
Country of Origin	New Zealand
Serial Number(s)	NFC sample: 3523380023 Dummy Load Sample:3523380007
FCC ID	2AC2O-CHU200S
HVIN	CHU200S-A-01-00
FVIN	V1.3.8.8A1
Firmware version	V3.0.0.2
Antenna Type and Gain	The NFC antenna is a 2-turn loop antenna around the perimeter of the LCD, with gain of virtually zero.
Rated supply Voltage	5V, 1A DC USB or built-in rechargeable battery
Modulation description	ASK
Highest clock frequency in use	12 MHz crystal, CPU with 159 MHz internal PLL 27.12 MHz crystal to NFC IC
Operating frequency	13.56 MHz NFC, 2.4 GHz Wi-Fi/Bluetooth

Does the product support Bluetooth and Wi-Fi Functionality

Yes. The product contains uBlox NINA-W152 WiFi+BLE Module, and the modules have been installed as per module manufacturer instructions.

Module certification details:

Following are the FCC, ISED details of the installed Wi-Fi/BLE module.

FCC ID: XPYNINAW15

ISED ID: 8595A-NINAW15

Product Description:

The device tested is a Near Field Contactless Secure Card Reader (NFC Card Reader) that operates on 13.560 MHz.

The device also contains the following modules

- 2.4 GHz WiFi and Bluetooth Module.

Testing on the NFC device was carried out when it was was attached to a laptop computer using a USB to UART converter that was attached to the USB port on the laptop computer.

The UART convertor was attached to the device using a 1 metre length of RJ45 to Micro USB cable with the UART converter powering the device under test.

Testing was carried out using a laptop computer that used Windcave test software to exercise the test sample.

Product Image from the User manual

6. SETUPS AND PROCEDURES

Standard

The sample was tested in accordance with 47 CFR Part 15 Subpart C.

Methods and Procedures

The measurement methods and procedures as described in ANSI C63.10 - 2020 were used.

Section 15.201: Equipment authorisation requirement

Certification as detailed in Subpart J of Part 2 is required for this device.

Section 15.203: Antenna requirement: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §§ 15.211, 15.213, 15.217, 15.219, 15.221, or § 15.236. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with § 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

Result: The device has permanently attached internal 13.560 MHz antenna. Complies

Section 15.204: External radio frequency power amplifiers and antenna modifications

It is NOT possible to attach an external power amplifier to this transmitter.

Result: Complies.

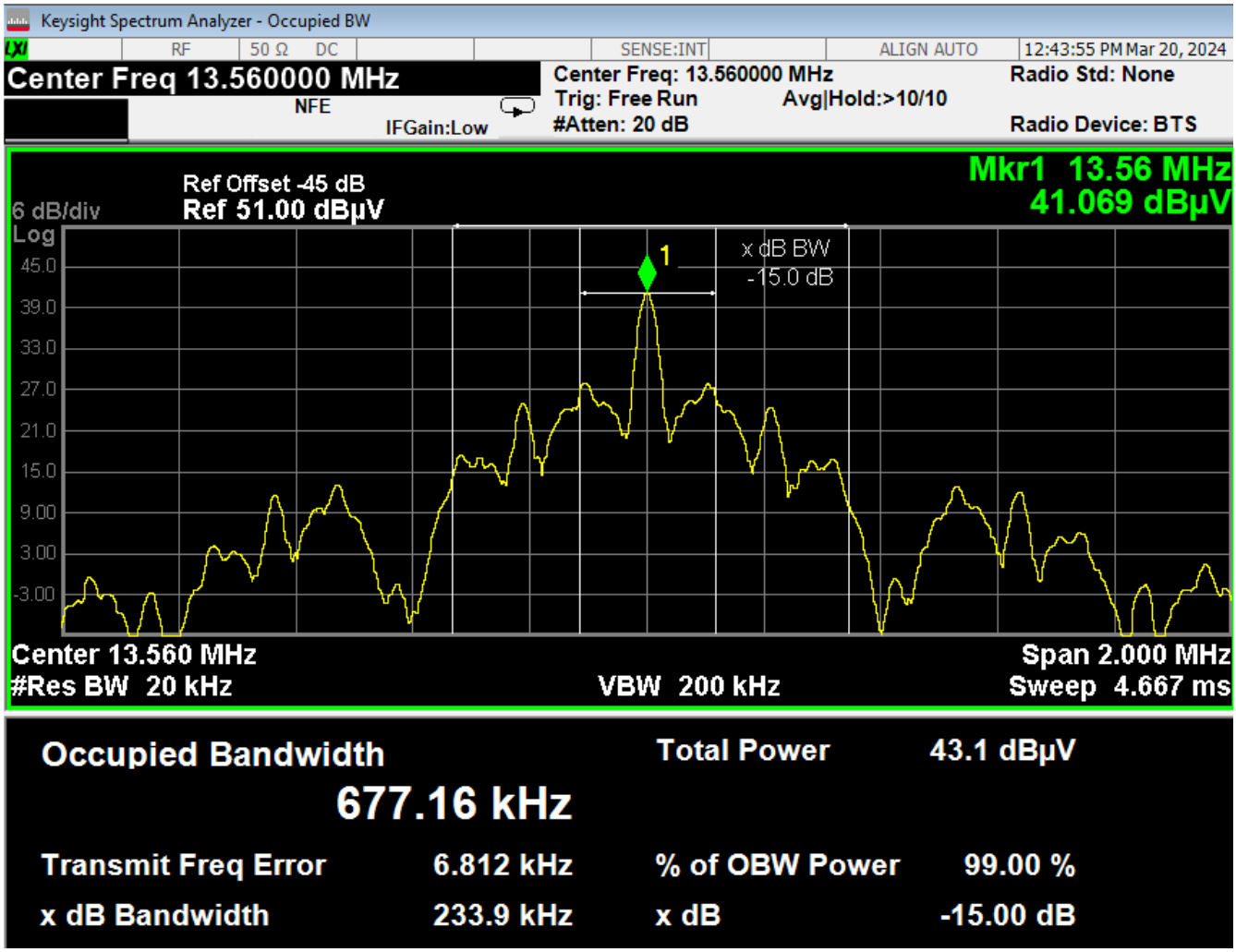
Section 15.205: Restricted bands of operation.

The 13.560 MHz device will fall into the band of 13.110 – 14.010 MHz that is covered by Section 15.225.

Measurements were made using a spectrum analyser with the 99% power points being determined.

Measurements were made using a span of 2.0 MHz with a resolution bandwidth of 20 kHz and a video bandwidth of 200 kHz.

A worst case modulation bandwidth of 677.16 kHz was measured.



Result: Complies.

Section 15.207: Conducted emissions testing

Conducted Emissions testing was carried out over the frequency range of 150 kHz to 30 MHz which was carried out at the laboratory's MacKelvie Street premises in a 2.4 m x 2.4 m x 2.4 m screened room

As it is possible for this device to be directly or indirectly connected to the Public AC mains supply testing was carried out using a representative AC power supply system that was powered at 120 VAC 60 Hz which powered the device under test via the USB to UART interface device.

The NFC Card Reader operates at 13.560 MHz.

Testing was carried out when the NFC Card Reader was operating normally with the internal antenna connected while continuously reading a card was that placed close to the reader.

The device was placed on top of the emissions table, which is 0.8 m x 0.8 m, 80 cm above the screened room floor which acts as the horizontal ground plane.

In addition the device was positioned 40 cm away from the screened room wall which acts as the vertical ground plane.

The artificial mains network was bonded to the screened room floor. At all times the device was kept more than 80 cm from the artificial mains network.

Initially a conducted emissions pre scan is carried out using a Peak detector (red trace) and an Average detector (green trace).

Worst case measurements are then made on the highest pre-scan emission levels on a limited number of frequencies using a Quasi Peak detector and an Average detectors with the results of both the phase and neutral lines being recorded in the results table.

When either the Peak or Average detector pre scan emissions appear to be over the Quasi Peak or Average limit line each peak is individually checked and confirmed to be below the applicable limit.

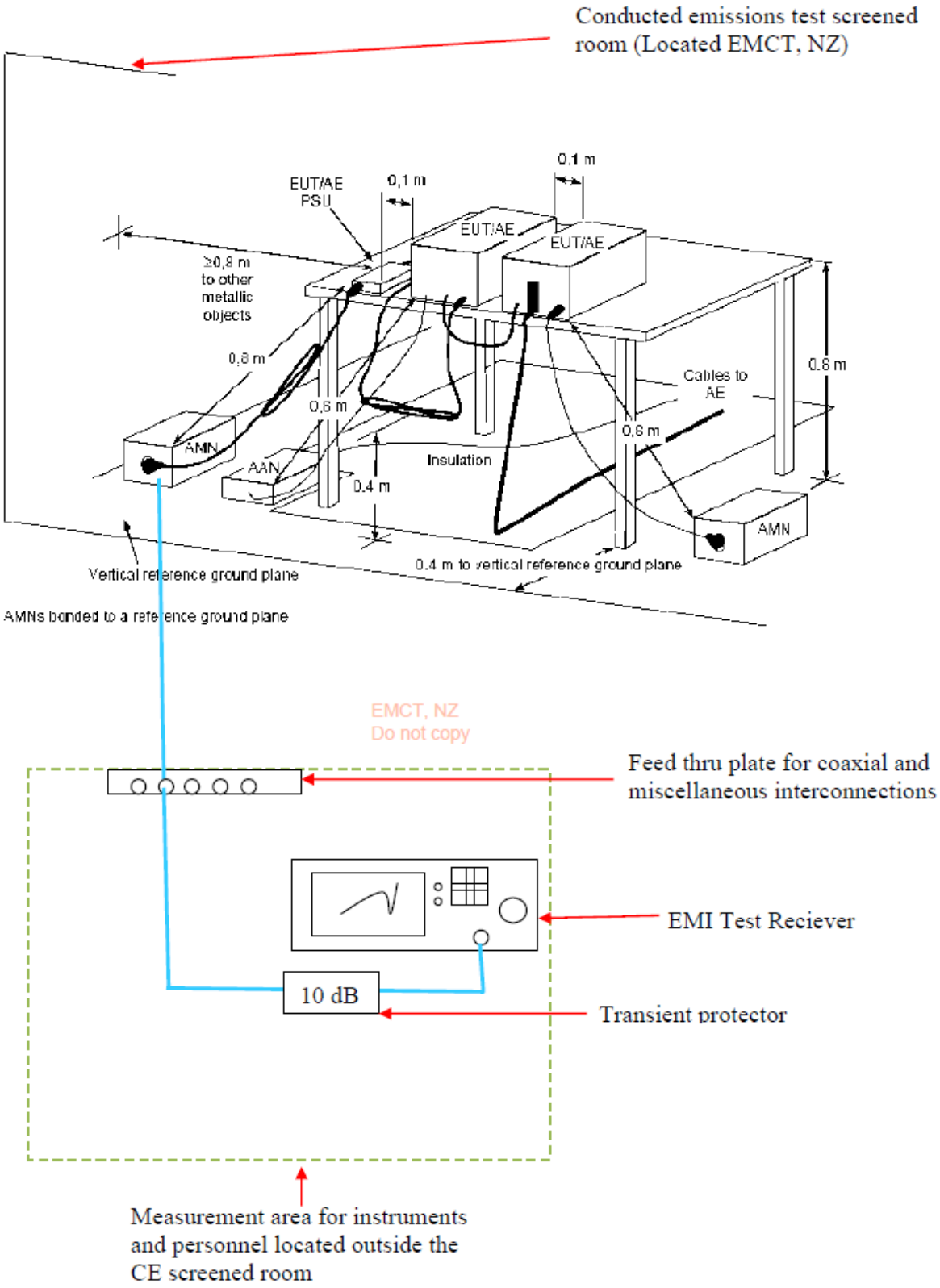
The supplied plot is combined plot showing the worst case quasi peak and average results of both the phase and neutral lines to the representative AC power supply.

Quasi peak and average detectors have been used with resolution bandwidths of 9 kHz.

Result: Complies
Measurement uncertainty with a confidence interval of 95% is:
- AC Mains port (0.15-30 MHz) ± 2.8 dB

EMI Receiver Used: ESHS 10

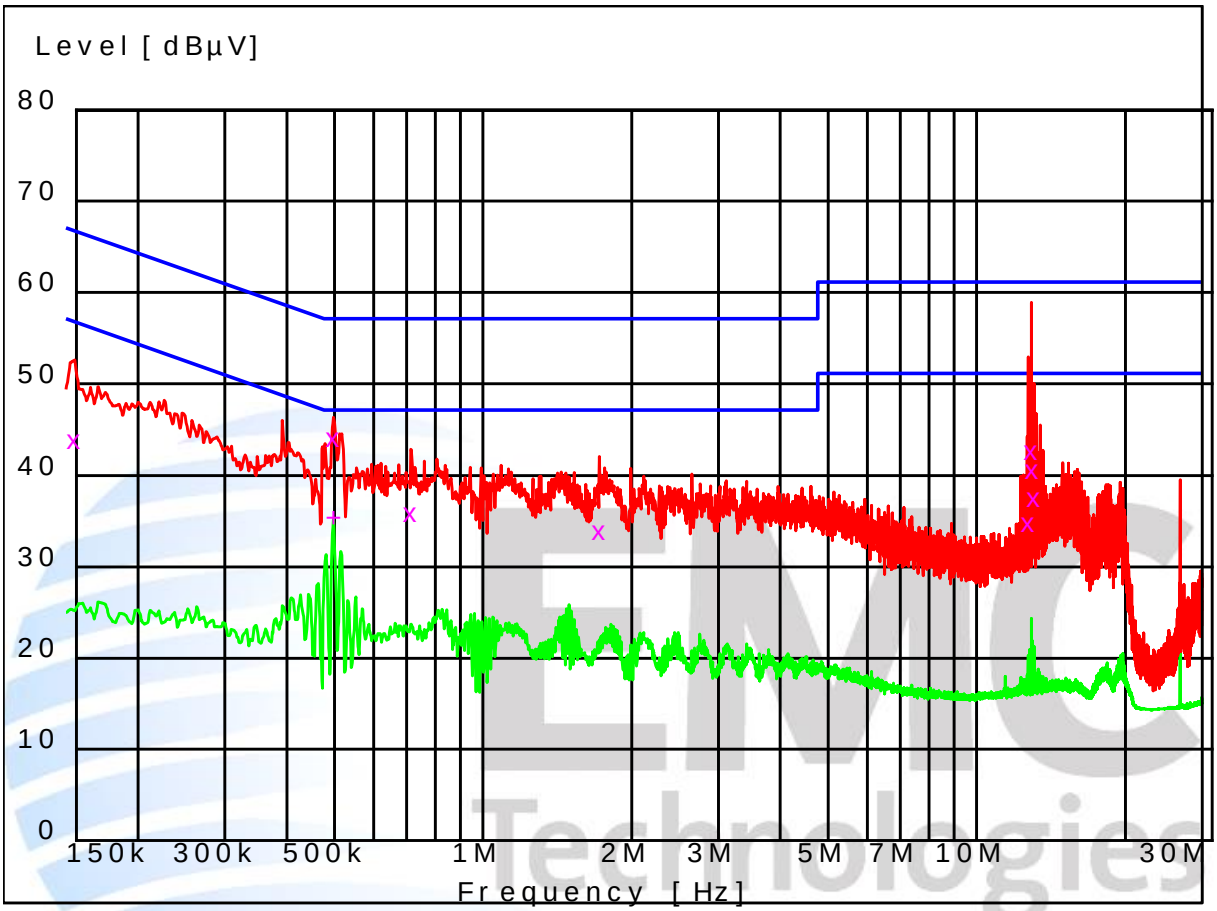
Block Diagram showing the conducted emission test setup



Conducted Emissions – AC Input Power Port

Setup:	The product is powered by 120 VAC to 5 VDC USB charger as representative power supply. NFC was running in the product through client supplied software and laptop. FCC Class B limit applied.

Peak ---	Average --	Quasi Peak X	Average +



Final Quasi-Peak Measurements

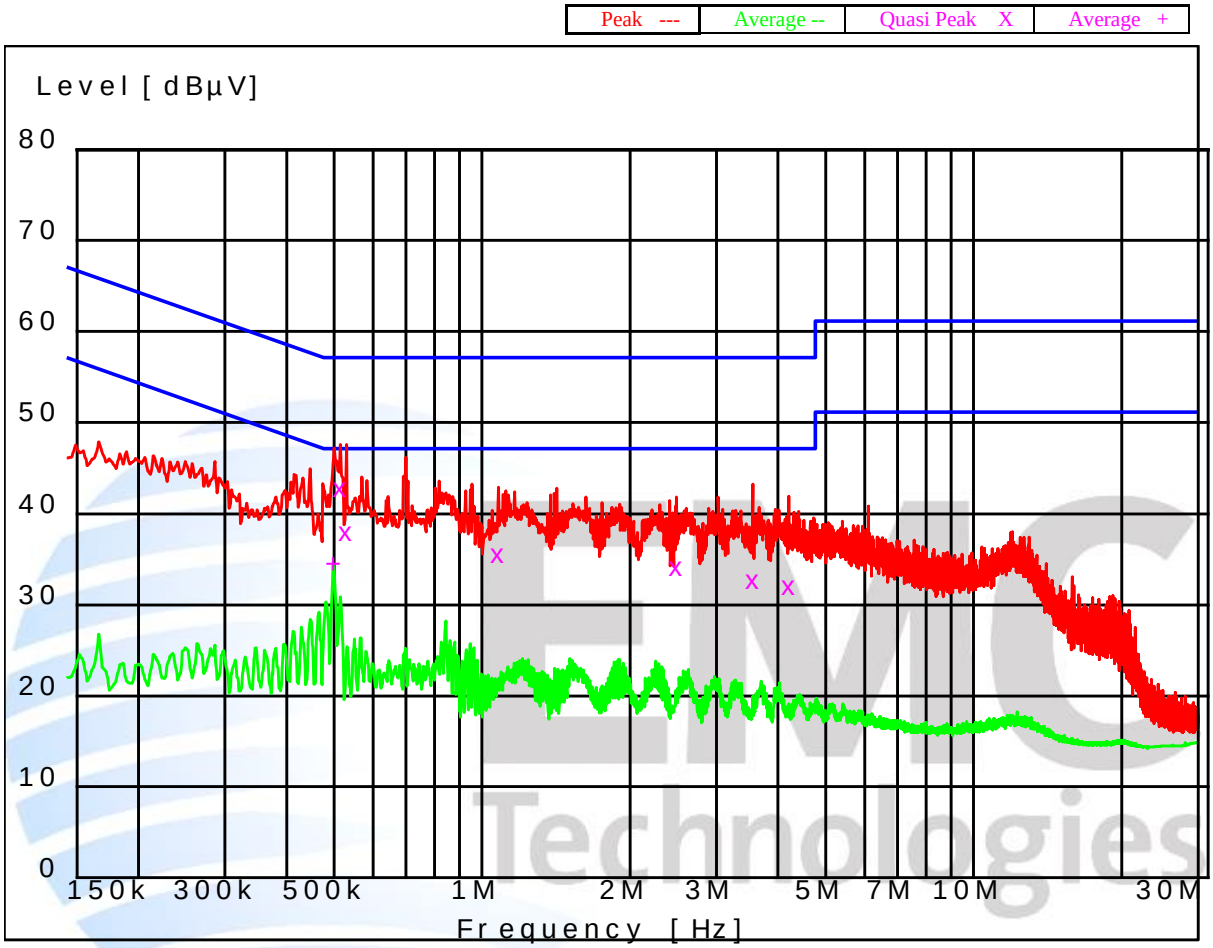
Frequency (MHz)	Level (dBµV)	Limit (dBµV)	Margin (dB)	Phase	Rechecks (dBµV)
0.156000	42.7	65.7	23.0	L1	
0.522000	43.0	56.0	13.0	N	
0.750000	34.8	56.0	21.2	N	
1.806000	32.8	56.0	23.2	L1	
13.349000	33.6	60.0	26.4	N	35.0
13.569500	41.6	60.0	18.4	L1	(NFC)
13.650500	39.5	60.0	20.5	N	
13.713500	36.4	60.0	23.6	N	

Final Average Measurements

Frequency (MHz)	Level (dBµV)	Limit (dBµV)	Margin (dB)	Phase	Rechecks (dBµV)
0.522000	34.3	46.0	11.7	L1	34.6

Conducted Emissions – AC Input Power Port

Setup:	The product is powered by 120 VAC to 5 VDC USB charger as representative power supply. Dummy load sample used. Emissions program was running in the test laptop. FCC Class B limit applied.



Final Quasi-Peak Measurements

Frequency (MHz)	Level (dBµV)	Limit (dBµV)	Margin (dB)	Phase	Rechecks (dBµV)
0.540000	41.7	56.0	14.3	L1	
0.555000	36.9	56.0	19.1	N	
1.131000	34.5	56.0	21.5	L1	
2.607500	33.0	56.0	23.0	L1	
3.728000	31.6	56.0	24.4	N	
4.416500	31.0	56.0	25.0	N	

Final Average Measurements

Frequency (MHz)	Level (dBµV)	Limit (dBµV)	Margin (dB)	Phase	Rechecks (dBµV)
0.522000	33.4	46.0	12.6	L1	

Section 15.209: Radiated emission limits, general requirements

Radiated emission testing was carried out over the frequency range of 10 kHz to 12500 MHz as the device contains a 13.560 MHz NFC transceiver and a digital device that has a highest frequency in use that is 159 MHz. The device also contains a FCC Pre certified 2.4 GHz Wi-Fi/Bluetooth module.

Testing was carried out at the laboratory's open area test site - located at Driving Creek, Orere Point, Auckland, New Zealand.

Testing was carried out when the device under test was attached to a laptop computer using a USB to UART converter that was attached to the USB port on the laptop computer.

The UART convertor was attached to the device using a 1 metre length of RJ45 to Micro USB cable with the UART converter powering the device under test.

The UART convertor was powered using a representative AC power supply that was powered at 230 VAC.

A custom programme was run on the computer which exercised all operational aspects of the device.

The device was transmitting continuously on 13.560 MHz with a NFC card being placed close to the card reader which was periodically read by the card reader.

Correct operations were indicated by an indication on the computer screen. The Wi-Fi Bluetooth module was observed to operate in the 2400 – 2483.5 MHz.

When an emission is located, it is positively identified and its maximum level is found by rotating the automated turntable, and by varying the antenna height, where appropriate, with an automated antenna tower.

Below 30 MHz a magnetic loop is used with the centre of the loop being 1 metre above the ground with measurements being made using a quasi peak detector at a distance of 10 metres.

Above 30 MHz the emission is measured in both vertical and horizontal antenna polarisations at a distance of 3 metres. Below 1000 MHz a Quasi Peak detector with a 120 kHz bandwidth is used.

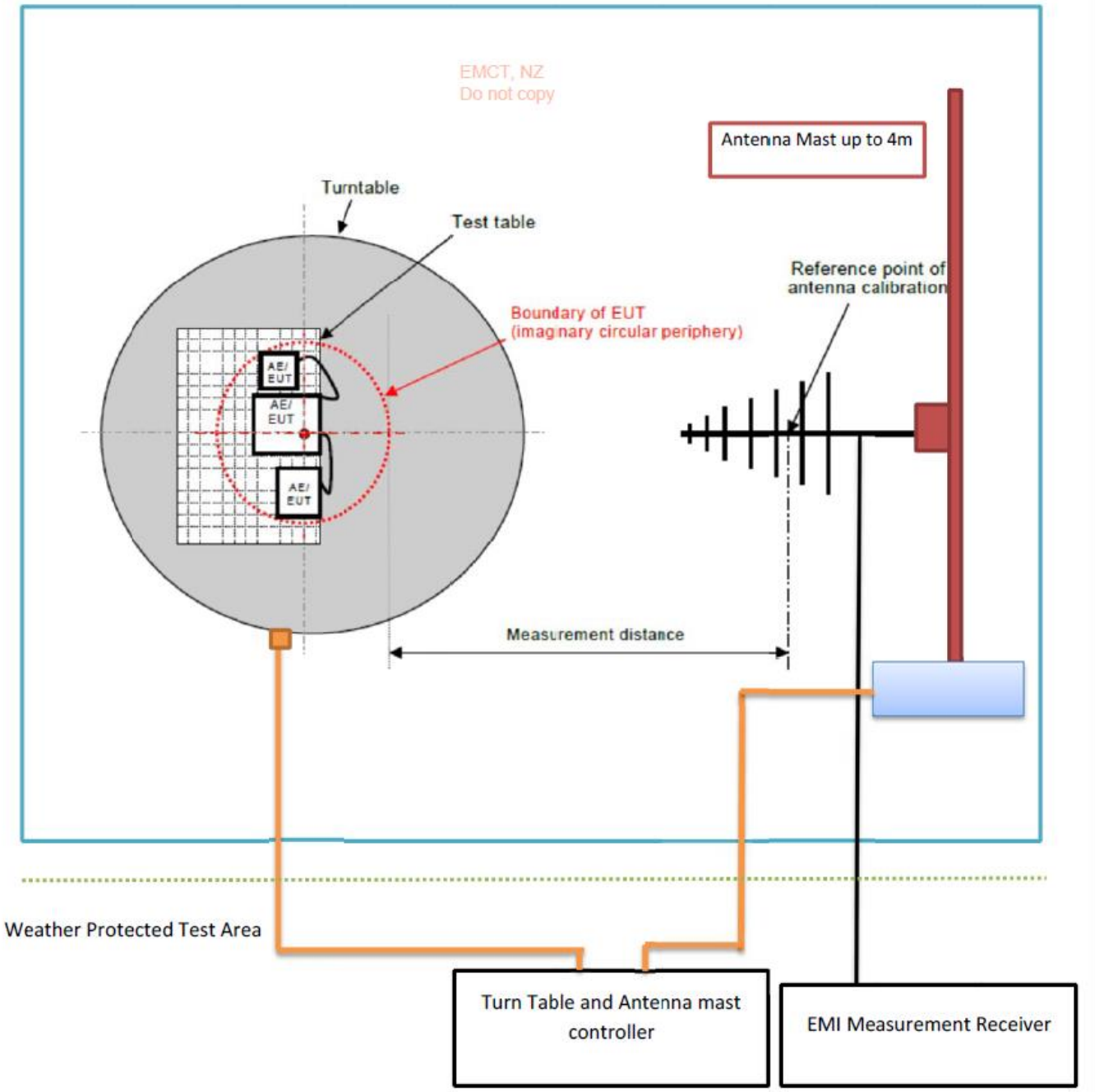
The emission level was determined in field strength by taking the following into consideration:

Level (dBµV/m) = Receiver Reading (dBµV) + Antenna Factor (dB/m) + Coax Loss (dB)

For example, if an emission of 30 dBµV was observed at 30 MHz.

45.5 dBµV/m = 30.0 dBµV + 14 dB/m + 1.5 dB

Radiated Emissions Test setup at Open area test site



Below 30 MHz: Loop Antenna; Measurement distance: 10 m

30 MHz-300 MHz: Bi conical Antenna; Measurement distance: 3 m

300 MHz- 1000 MHz: Log Periodic Antenna; Measurement distance: 3 m

Above 1 GHz: Horn Antenna; Measurement distance: 3 m

EMI Receiver Used: ESIB40

Section 15.209: 13.560 MHz transmitter below 30 MHz spurious emission measurements

Loop Orientation	Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
Loop-1	27.120	10.0	48.6	38.6	Pass
Loop-2	27.120	10.0	48.6	38.6	Pass

Testing was carried out when the device was transmitting continuously.

Magnetic loop measurements were attempted at a distance of 10 metres.

A receiver with a Quasi Peak detector with a 9 kHz bandwidth was used between 490 kHz – 30.0 MHz.

The 30 metre limit between 1.705 MHz – 30 MHz has been scaled by a factor of 40 dB per decade, as per section 15.31 (f) (2).

The limit at 27.120 MHz when measured at 30 metres is 30 uV/m or 29.54 dBuV/m.

Therefore when scaled, the limit at 10 metres will be 48.6 dBuV/m as detailed below.

= 29.54 dBuV/m + { -40 dB/decade * (log (10) - log (30))}
= 29.54 dBuV/m + {-40 dB/decade * (1.000 - 1.477)}
= 29.54 dBuV/m + {-40 dB/decade * - 0.477}
= 29.54 dBuV/m + 19.08
= 48.6 dBuV/m

The spurious emission observed does not exceed the level of the fundamental emission

Result: Complies.

Measurement uncertainty with a confidence interval of 95% is:
- Free radiation tests (100 kHz – 30 MHz) ± 4.8 dB

Section 15.209: Spurious Emissions (above 30 MHz)

Measurements between 30 – 12500 MHz have been made at a distance of 3 metres.

The limits as described in Section 15.209 have been applied.

13.560 MHz card reader specific emissions:

Frequency (MHz)	Vertical (dBµV/m)	Horizontal (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result	Antenna Polarisation
33.080	24.8	-	40.0	15.2	Pass	Vertical
37.840	19.3	-	40.0	20.7	Pass	Vertical
40.680	27.6	-	40.0	12.4	Pass	Vertical
49.680	-	23.0	40.0	17.0	Pass	Horizontal
50.880	28.1	-	40.0	11.9	Pass	Vertical
54.240	23.7	-	40.0	16.3	Pass	Vertical
65.120	28.5	-	40.0	11.5	Pass	Vertical
67.800	29.4	-	40.0	10.6	Pass	Vertical
71.600	27.6	-	40.0	12.4	Pass	Vertical
81.360	25.1	-	40.0	14.9	Pass	Vertical
122.040	26.3	-	43.5	17.2	Pass	Vertical
149.160	26.7	-	43.5	16.8	Pass	Vertical
339.000	-	29.1	46.0	16.9	Pass	Horizontal
423.160	26.7	25.9	46.0	19.3	Pass	Vertical

No further emissions were detected within 15 dB of the limit when measurements were made between 30 – 12,500 MHz using both vertical and horizontal polarisations.

Result: Complies.

Free radiation tests (30 – 12,500 MHz) ± 4.1 dB

Section 15.225: Fundamental emission:

Measurements were made using a magnetic loop antenna and a receiver with a quasi-peak detector using a 9 kHz bandwidth

FCC Part 15.225, Operation within the band 13.110-14.010 MHz states that, the field strength of any emission shall not exceed the following limits:

- 15.848 mV/m (84 dBµV/m) at 30 m, within the band 13.553-13.567 MHz
- 334 µV/m (50.5 dBµV/m) at 30 m, within the bands 13.410-13.553 MHz and 13.567-13.710 MHz
- 106 µV/m (40.5 dBµV/m) at 30 m, within the bands 13.110-13.410 MHz and 13.710-14.010 MHz
- FCC part 15.209 general field strength limits for frequencies outside the band 13.110-14.010 MHz

Measurements were made at a distance of 10 metres with the limit being determined by using the extrapolation factor of 40 dB per decade limit, as detailed in section 15.31 f (2).

The limit at 30 m at 13.560 MHz is 15,848 uV/m or 84.0 dBuV/m.

Applying the extrapolation factor of 40 dB/ per decade, the limit is 103.1 dBuV/m.

= 84.0 dBuV/m + {-40 dB/decade * (log (10) - log (30))}
= 84.0 dBuV/m + 19.08
= 103.1 dBuV/m

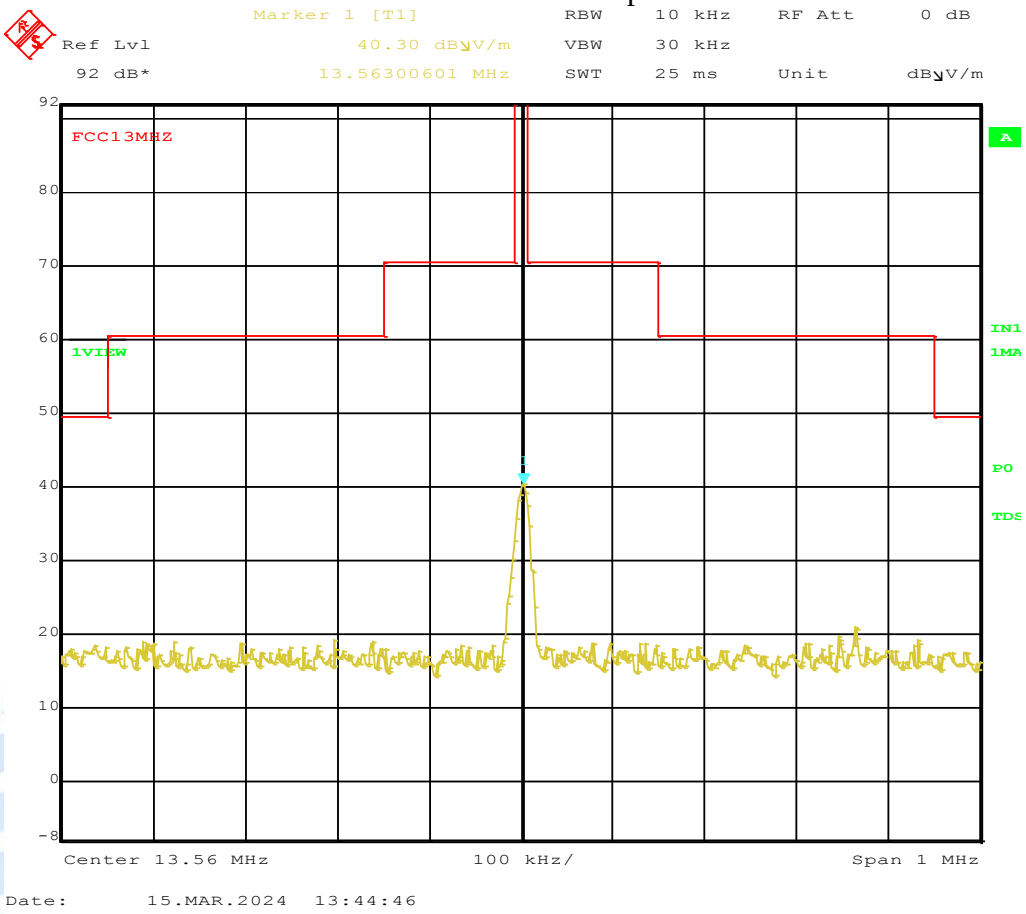
The voltage at the Input of UART which interfaces with the Device under test was varied and the results are tabulated as under:

Voltage (Vac)	Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
+15% of VAC	13.560	40.7	103.1	62.4
Nominal (120 VAC)	13.560	40.7	103.1	62.4
-15% of VAC	13.560	40.7	103.1	62.4

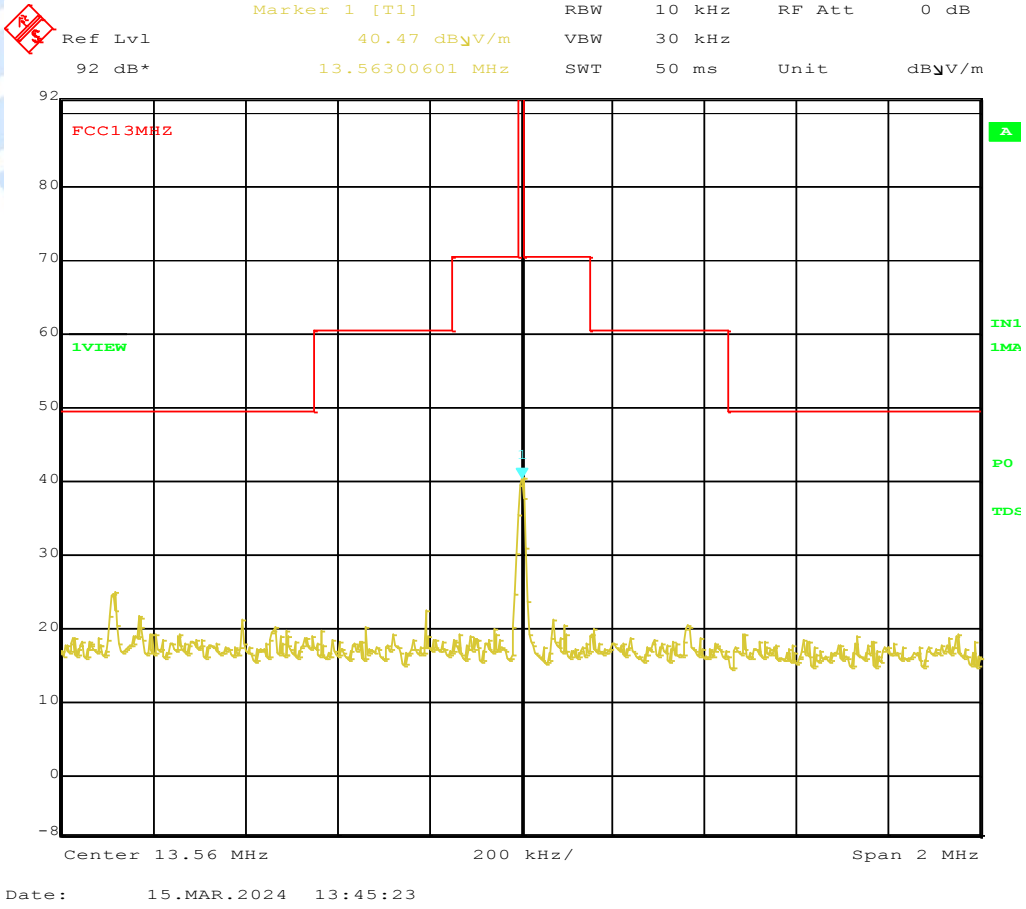
Result: Complies.

Measurement uncertainty with a confidence interval of 95% is:
Free radiation tests (100 kHz – 30 MHz) ± 4.8 dB

Mask with 1 MHz Span



Mask with 2 MHz Span



Section 15.225: Frequency tolerance:

The frequency tolerance of the carrier is required to be +/- 0.01% of operating frequency when the temperature is varied between -20 degrees C and +50 degrees C.

The device operates nominally on 13.560 MHz which gives a frequency tolerance of +/- 1,356.0 Hz.

Temperature (°C)	Frequency (MHz)	Difference (Hz)
+50	13.559990	-10
+40	13.559994	-6
+30	13.560036	36
+20	13.560036	36
+10	13.560014	14
0	13.560068	68
-10	13.560120	120
-20	13.560120	120

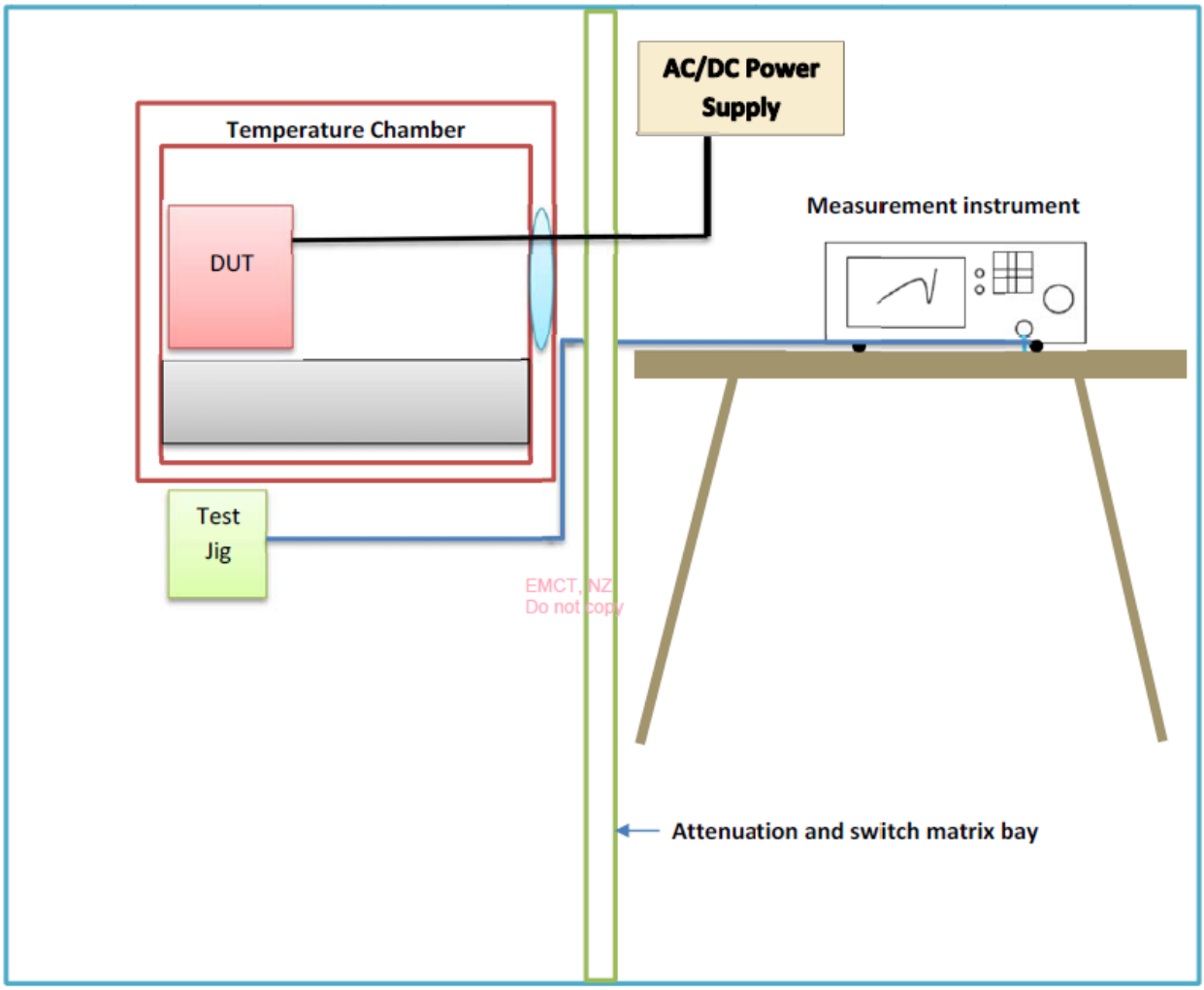
The voltage at the Input of UART which interfaces with the Device under test was varied and the results are tabulated as under:

Voltage (Vac)	Frequency (MHz)	Difference (Hz)
+15% of VAC	13.560036	36
Nominal (120 VAC)	13.560036	36
-15% of VAC	13.560036	36

Result: Complies.

Measurement uncertainty with a confidence interval of 95% is:
Frequency tolerance ± 50 Hz

Radio bay measurement setup



Following test instruments were used to carry out this test:

Instrument	Manufacturer	Model
Thermal chamber	Contherm	M180F
Thermometer	DSIR	RT200
EMI Receiver/Spectrum Analyser	Keysight	N9038A
Coaxial cables (3 m)	Huber and Suhner Succoflex	340521/4
Coaxial cables (1 m)	Huber and Suhner Succoflex	339901/4

7. TEST EQUIPMENT USED

Instrument	Manufacturer	Model	Serial No	Asset Ref	Cal Due	Period
Aerial Controller	EMCO	1090	9112-1062	RFS 3710	N/A	N/A
Aerial Mast	EMCO	1070-1	9203-1661	RFS 3708	N/A	N/A
Anechoic Material	DMAS	MT45-JT	-	-	N/A	N/A
Anechoic Material	Rantec	ERP24 2" Cones	-	-	N/A	N/A
Loop Antenna	EMCO	6502	9003-2485	3798	07 Mar 2025	3 years
Biconical Antenna	Schwarzbeck	BBA 9106	11042021A	3698	22 Nov 2024	3 years
Heliax cable	Andrews	L6PNM-RPD	22869	Oats Cable	22 Dec 2024	1 year
Log Periodic	Schwarzbeck	VUSLP 9111	9111-112	EMC 4025	15 Nov 2024	2 years
Horn Antenna	EMCO	3115	9511-4629	E1526	03 Mar 2025	3.0 years
Mains Network	Rohde & Schwarz	ESH2-Z5	881362/034	3628	02 Jun 2024	3 years
Receiver	R & S	ESIB 40	1088.2490	EMC 4030	06 Oct 2024	2 years
Receiver	R & S	ESHS 10	828404/005	RFS 3728	04 Dec 2024	2 years
Spectrum Analyzer	Keysight	N9038A	MY57290153	EMC4033	21 Nov 2024	1.0 year
Software	R & S	ESK 1 - 140	-	-	N/A	N/A
Turntable	EMCO	1080-1-2.1	9109-1578	RFS 3709	N/A	N/A
VHF Balun	Schwarzbeck	VHA9103	11042021A	3697	22 Nov 2024	3 years
Thermal chamber	Contherm	M180F	86025	N/a	N/a	N/a
Thermometer	DSIR	RT200	35	EMC4029	9 April 2028	5 years
Voltage Variac	Powerteck	SRV-5	RFS3800	-	-	N/A

All test equipment was within calibration at the time of testing.

8. ACCREDITATIONS

Testing was carried out in accordance with EMC Technologies NZ Ltd designation as a FCC Accredited Laboratory by International Accreditation New Zealand, designation number: NZ0002 under the APEC TEL MRA.

All testing was carried out in accordance with the terms of EMC Technologies (NZ) Ltd International Accreditation New Zealand (IANZ) Accreditation to NZS/ISO/IEC 17025.
All measurement equipment has been calibrated in accordance with the terms of the EMC Technologies (NZ) Ltd International Accreditation New Zealand (IANZ) Accreditation to NZS/ISO/IEC 17025.

International Accreditation New Zealand has International Laboratory Accreditation Council (ILAC) Mutual Recognition Arrangements for testing and calibration with various accreditation bodies in a number of economies.
This includes NATA (Australia), UKAS (UK), SANAS (South Africa), NVLAP (USA), A2LA (USA), SWEDAC (Sweden).

Further details can be supplied on request

9. PHOTOGRAPHS

Front Face

Side Face showing card slot

Side Face

Back Face

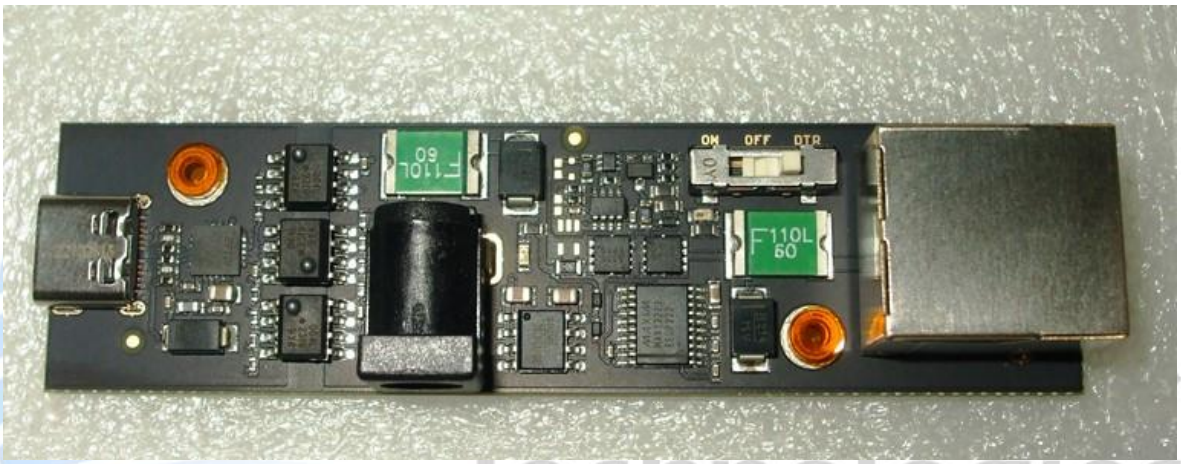
Side Face

Top Face

Charging Port

Label

Accessories



Radiated Emissions Test Setup

Biconical Antenna pointing towards Test Shed

Log Periodic Antenna pointing towards Test Shed

Loop Antenna pointing towards Test Shed

Horn Antenna pointing towards Test Shed