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TEST REPORT

Windcave CHU200M Rel C
Payment Terminal

tested to the specification

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

Table of Contents

1. STATEMENT OF COMPLIANCE

The **Windcave CHU200M Rel C 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 - 2013 are applied.

2. RESULTS SUMMARY

The results from testing carried out between the September and October 2022 are detailed in the following table:

Clause	Parameter	Result
15.201	Equipment authorisation requirement	Revised certification maybe required. Permissive change process to be applied.
15.203	Antenna requirement	Complies. Antenna internal to the device.
15.204	External PA and antenna modifications	Not applicable. No external devices.
15.205	Restricted bands of operation	Complies. Device transmits on a nominal frequency of 13.560 MHz.
15.207	Conducted limits	Complies
15.209	Radiated emission limits - Emissions < 30 MHz	Complies
15.209	Radiated emission limits – Emissions > 30 MHz	Complies
15.225	Radiated emission limits - Fundamental	Complies
15.225	Frequency stability	Complies

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
220506_3	Initial Issue	13/10/22

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
Model Number	CHU200M Rel C
Product	Payment Terminal
Manufacturer	Windcave Ltd
Country of Origin	New Zealand
Serial Number	362150020
Release Version	C
FCC ID	2AC2O-CHU200M-C

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 FCC certified module:-

- 2.4 GHz WiFi module. FCC ID: 2ADHKINC3400U

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 Ethernet cable with the UART converter powering the device under test.

The client has declared the highest frequency in use in the device is 159 MHz.

Testing was carried out using a laptop computer that used Windcave test software to exercise the test sample where the NFC transmitter was operating with the signal being modulated.

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 - 2013 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

The device has a permanently attached internal 13.560 MHz antenna.

Result: 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.

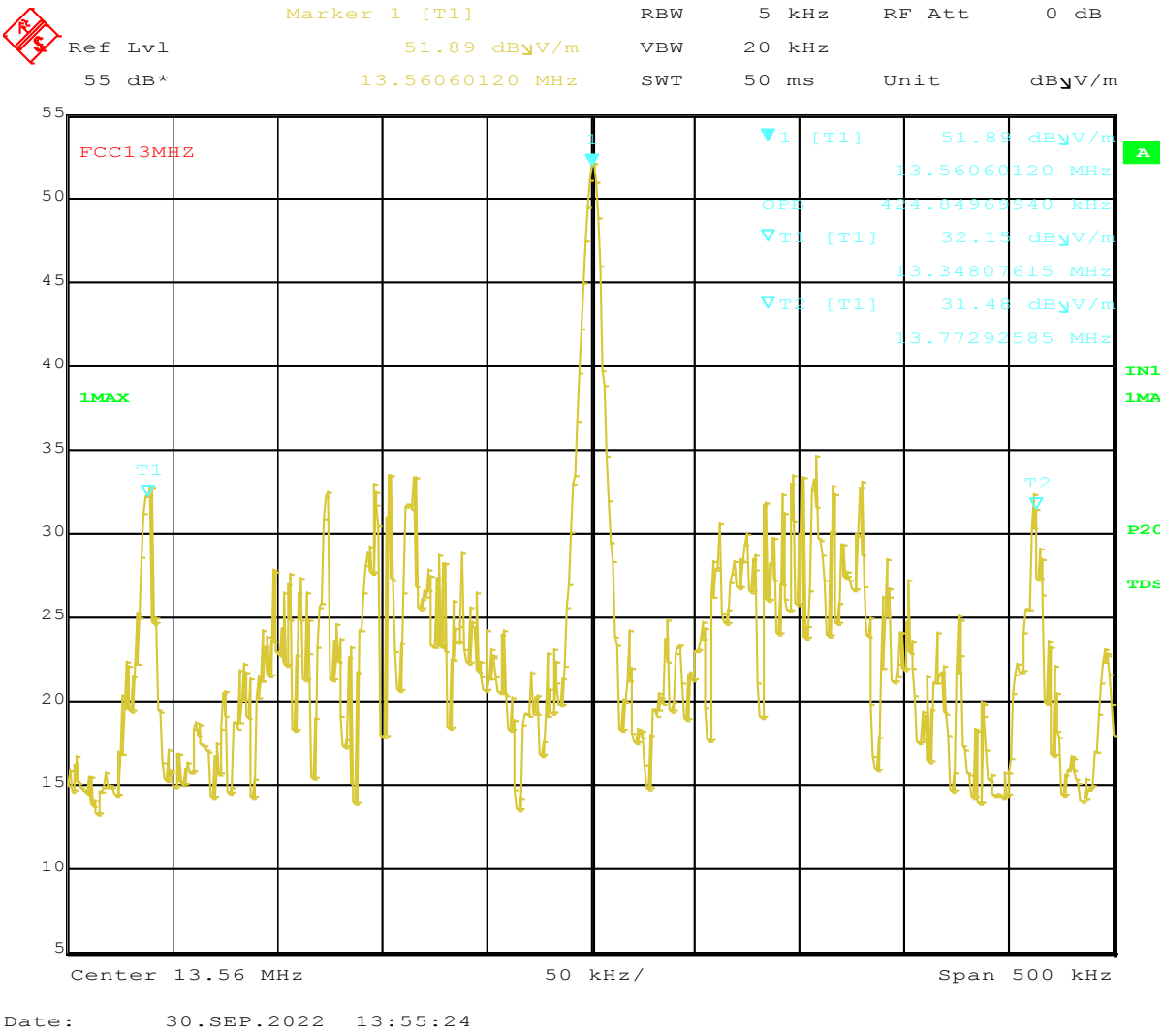
Result: Complies.

Section 15.205: Restricted bands of operation

The device transmits on a nominal frequency of 13.560 MHz.

13.560 MHz transmissions would fall into the 13.110 – 14.010 MHz band that is covered by Section 15.225.

The device was observed to have a 99% occupied bandwidth of 424.850 kHz



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.

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.

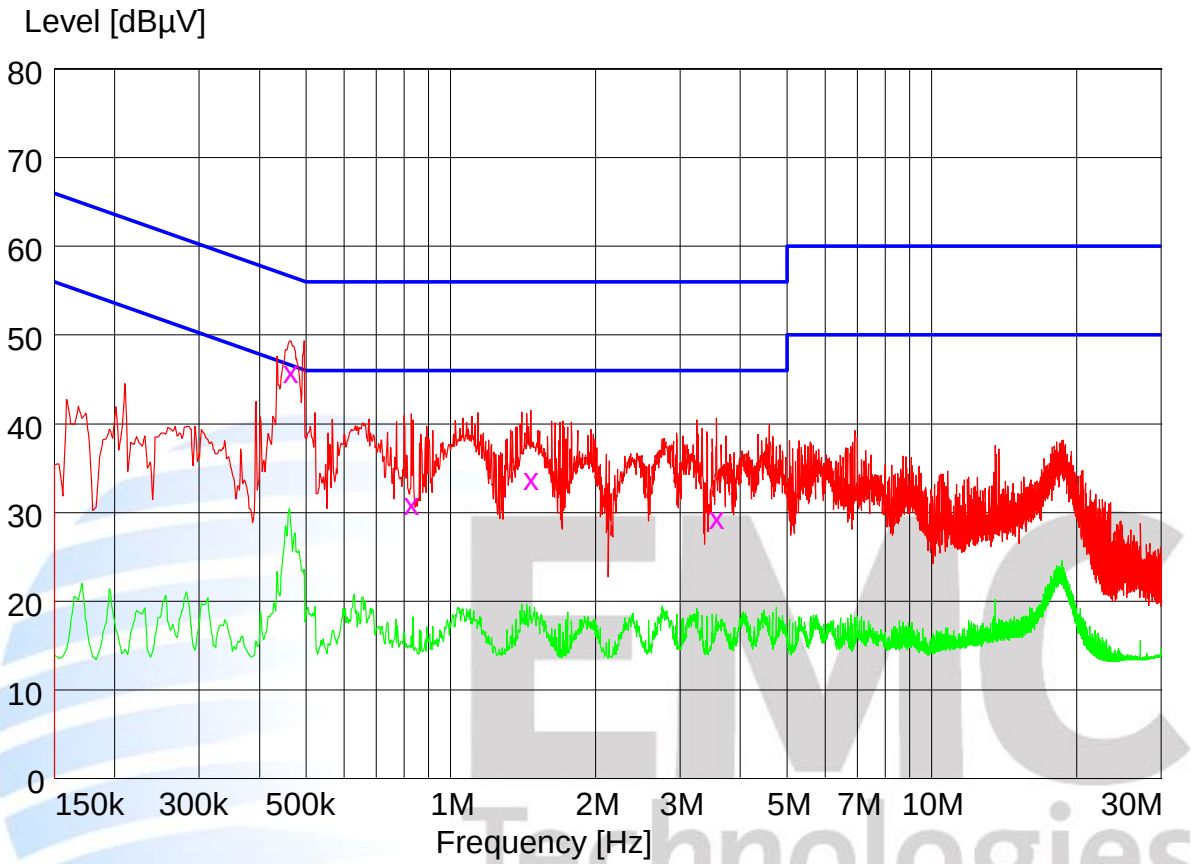
Result: Complies

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

Conducted Emissions – AC Input Power Port

Setup:	Powered by 120 VAC. Positioned on table top. Running emissions software.

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



Final Quasi-Peak Measurements

Frequency (MHz)	Level (dBµV)	Limit (dBµV)	Margin (dB)	Phase	Rechecks (dBµV)
0.465000	46.30	56.3	10.3	L1	
0.828000	31.30	56.0	24.7	L1	
1.467000	34.30	56.0	21.7	N	
3.570500	29.80	56.0	26.2	L1	
13.560000	47.20	60.0	12.0	L1	Fundamental

Final Average Measurements

Frequency (MHz)	Level (dBµV)	Limit (dBµV)	Margin (dB)	Phase	Rechecks (dBµV)
13.560000	22.9	50.0	27.1	L1	Fundamental

Section 15.209: Radiated emission limits, general requirements

Measurements between 30 – 15000 MHz have been made at a distance of 3 metres as the device contains a 2.4 GHz WiFi modem.

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 1.2 metre length of Ethernet 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 120 Vac 60 Hz.

All interconnecting cables were bundled in 40 cm long bundles.

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.

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.

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

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

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
27.120	23.3	48.6	25.3	Pass

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.

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

A measurement receiver with a quasi peak detector with a 9 kHz bandwidth was used.

The 30 metre limit 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 the scaled limit at 10 metres will be 48.6 dBuV/m.

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

No other low frequency spurious emissions were detected from the device when measurements were made from 10 kHz - 30.0 MHz

Result: Complies.

Measurement uncertainty with a confidence interval of 95% is:
- Free radiation tests (10 kHz – 30 MHz) ± 4.8 dB

Section 15.209: Spurious Emissions (above 30 MHz)

Measurements were made between 30 – 15000 MHz at a distance of 3 metres.

A receiver with a quasi peak detector with a 120 kHz bandwidth was used between 30 – 1000 MHz.

Between 1 – 15 GHz a measuring receiver with using a peak detector and an average detector with a 1 MHz bandwidth was used.

The limits as described in Section 15.209 have been applied.

30 – 15000 MHz

Frequency (MHz)	Vertical (dBµV/m)	Horizontal (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result	Antenna Polarisation
31.360	36.4	-	40.0	3.6	Pass	Vertical
47.760	29.5	-	40.0	10.5	Pass	Vertical
48.040	29.8	-	40.0	10.2	Pass	Vertical
51.760	26.3	-	40.0	13.7	Pass	Vertical
54.680	25.3	-	40.0	14.7	Pass	Vertical
61.360	19.9	-	40.0	20.1	Pass	Vertical

Testing was carried out when the NFC transmitter was operating continuously on 13.560 MHz and when the WiFi transmitter was operating on 2424 MHz

Verification measurements were made to determine whether any interactions existed between the NFC device and the WiFi modem.

No interactions were observed between the NFC transmitter and the WiFi transmitter.

The only emissions observed were from the NFC transmitter which have been recorded in the table above.

No spurious emissions were detected from the WiFi transmitter.

Result: Complies
Measurement uncertainty with a confidence interval of 95% is:
- Free radiation tests (30 – 15000 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.

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.

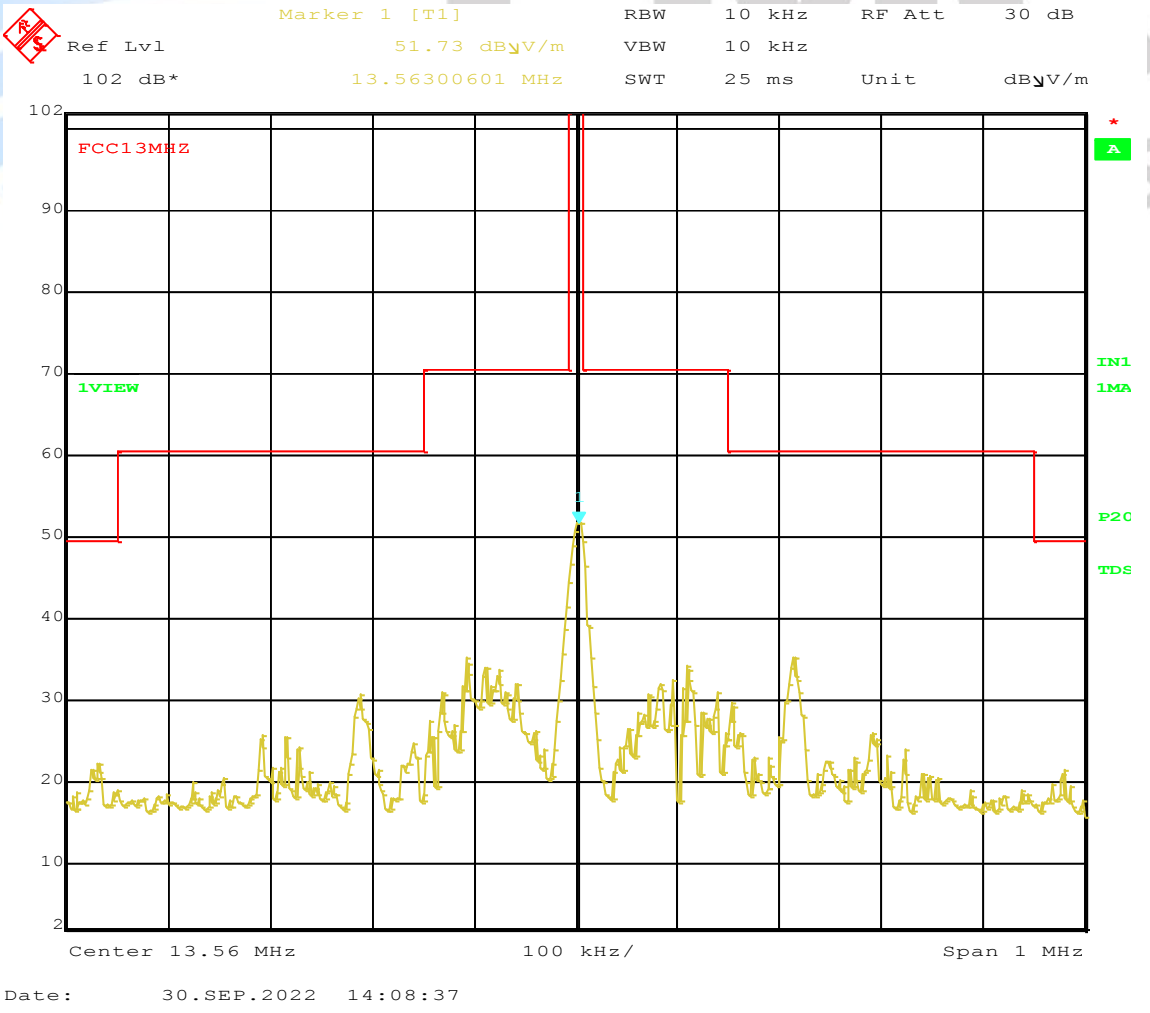
Applying the extrapolation factor of 40 dB/ per decade, the limit at 10 m is 103.1 dBuV/m.

Testing was also carried out to determine whether a variation in the DC supply voltage to the UART convertor would cause a significant change in field strength.

The 12.0 Vdc supply to the device was varied by +/- 15% between 10.2 Vdc and 13.8 Vdc.

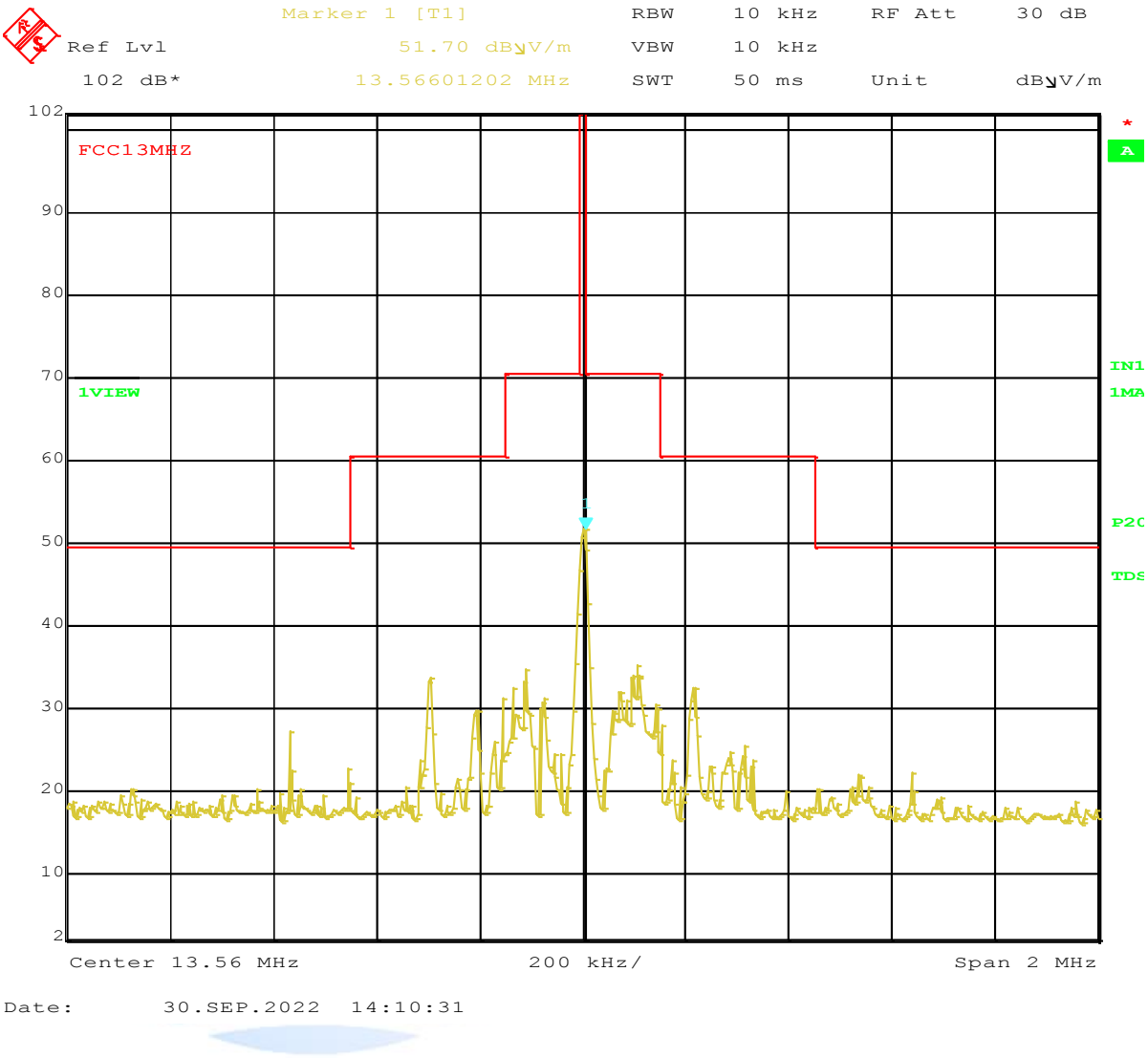
Voltage (Vdc)	Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
10.2	13.560	45.5	103.1	57.6
12.0	13.560	45.5	103.1	57.5
13.8	13.560	45.5	103.1	57.6

Spectrum analyser plot show the carrier and modulation peaks within +/- 500 kHz.



Section 15.225: Fundamental emission: cont.

Spectrum analyser plots show the carrier and modulation peaks within +/- 1000 kHz.



Result: Complies.

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

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)
50.0	13.559 882	-118
40.0	13.559 913	-87
30.0	13.559 950	-50
20.0	13.559 975	-25
10.0	13.559 959	-41
0.0	13.560 009	+9
-10.0	13.560 046	+46
-20.0	13.560 069	+69

The 12.0 Vdc supply voltage was varied by +/- 15% at 20 degrees C (ambient).

Voltage (Vdc)	Frequency (MHz)	Difference (Hz)
10.2	13.560 038	+38
12.0	13.560 055	+55
13.8	13.560 020	+20

Result: Complies.

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

7. TEST EQUIPMENT USED

Instrument	Manufacturer	Model	Serial No	Asset Ref	Cal Due	Period
Aerial Controller	EMCO	1090	9112-1062	RFS 3710	Not applic	N/a
Aerial Mast	EMCO	1070-1	9203-1661	RFS 3708	Not applic	N/a
Biconical Antenna	Schwarzbeck	BBA 9106	9124-420	3802	21 Nov 2023	2 years
Horn Antenna	Electrometrics	RGA-60	6234	E1494	6 Jan 2023	3 years
Log Periodic	Schwarzbeck	VUSLP 9111	9111-112	EMC4025	16 Nov 2023	3 years
Loop Antenna	EMCO	6502	9003-2485	3798	6 Jan 2023	3 years
Mains Network	R & S	ESH2-Z5	881362/032	3628	11 Nov 2022	2 years
Receiver	R & S	ESHS 10	828404/005	3728	23 Nov 2023	2 year
Receiver	R & S	ESIB 40	100295	EMC4030	03 Jun 2023	2 year
Turntable	EMCO	1080-1-2.1	9109-1578	RFS 3709	Not applic	N/a
VHF Balun	Schwarzbeck	VHA 9103	9124-420	3801	21 Nov 2023	2 years
Heliax cable	Andrews	L6PNM-RPD	22869	Oats Cable	30 Dec 2022	1 year
Succoflex cable	Huber and Suhner	104 3m n-n	339901/4	13938	10 Nov 2022	1 year
Succoflex cable	Huber and Suhner	104 1m n-n	340521/4	13937	10 Nov 2022	1 year
Power Supply	APT	7008	4170003	-	Not applic	N/a
Thermal chamber	Contherm	M180F	86025	N/a	N/a	N/a
Thermometer	DSIR	RT200	35	EMC4029	9 April 2023	5 years

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.

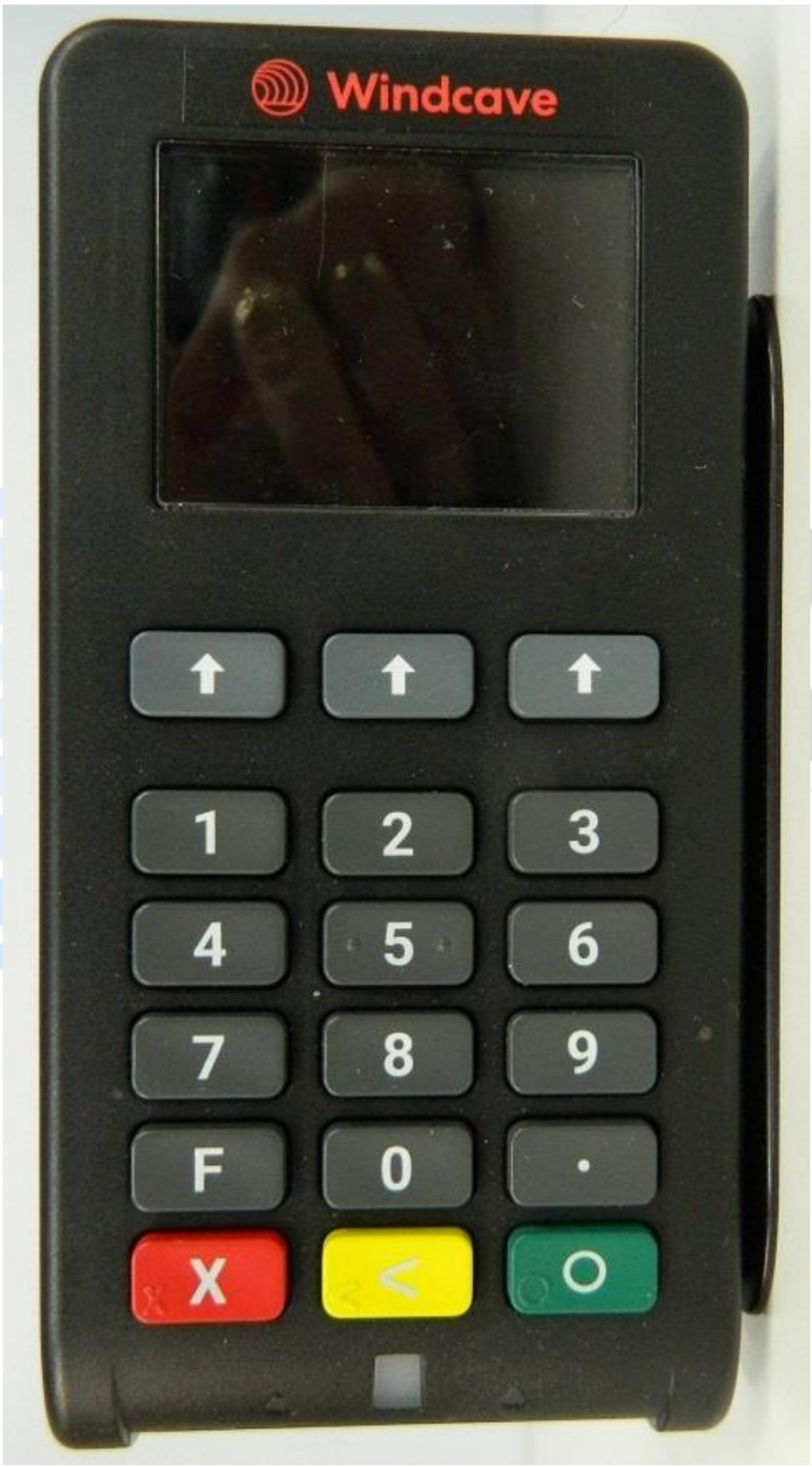
International Accreditation New Zealand has International Laboratory Accreditation Council (ILAC) Mutual Recognition Arrangements for testing and calibration with various accreditation bodies in a number of economies.

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



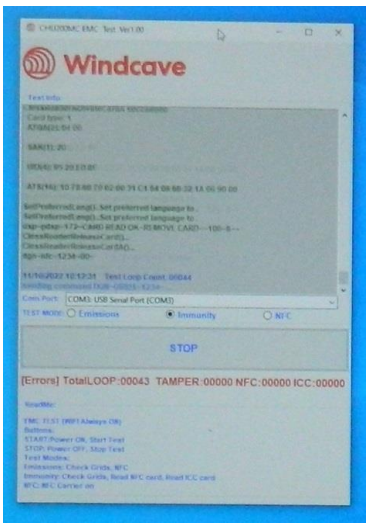
Back

Label

Power Supply

Card

Laptop software



Radiated Emission Test Set Up

Conducted emissions test set up