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TEST REPORT

Invenco P2-400 Outdoor Contactless Card Payment Module (Secure Contactless Controller)

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

Invenco Group Ltd

This test report is issued with the authority of:

Andrew Cutler - General Manager

IANZ ACCREDITED 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 **Invenco P2-400 Outdoor Contactless Card Payment Module (Secure contactless Controller)** 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 1st April 2021 and 8th July 2021 are detailed in the following table:

Clause	Parameter	Result
15.201	Equipment authorisation requirement	Certification required
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.

This report contains no corrections or erasures.

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.

4. CLIENT INFORMATION

Company Name	Invenco Group Ltd
Address	7-11 Kawana Street, Northcote, 0627
City	Auckland
Country	New Zealand
Contact	Mr Chris Henry

5. DESCRIPTION OF TEST SAMPLE

Brand Name	Invenco
Model Number	P2-400 Module
Hardware ID	-
Product	Outdoor Contactless Card Payment Module (Secure contactless Controller)
Manufacturer	Invenco Group Ltd
Country of Origin	New Zealand
Serial Number	-
FCC ID	2AC7B-G7SCC

The device tested is a Outdoor Card Payment Module (Secure Contacless Controller (SCC)) which would typically be used for the payment of fuel at a petrol station.

When operating this device would normally be installed with in a host device that would supply power and data processing capabilities.

The Outdoor Card Payment Module (Secure Contacless Controller (SCC)) contains a NFC Card Reader that operates on 13.560 MHz.

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.

Result: Complies.

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 supplied DC to the device under test.

The NFC Card Reader operates at 13.560 MHz.

Initial testing was carried out when the NFC Card Reader was operating normally with the internal antenna connected.

A second test was then carried out with the NFC Card Reader was de-activated.

The device is deemed to comply providing if the dummy load test complies and the overall emission signature for the product remains similar in both test configurations with no additional emissions being detected.

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.

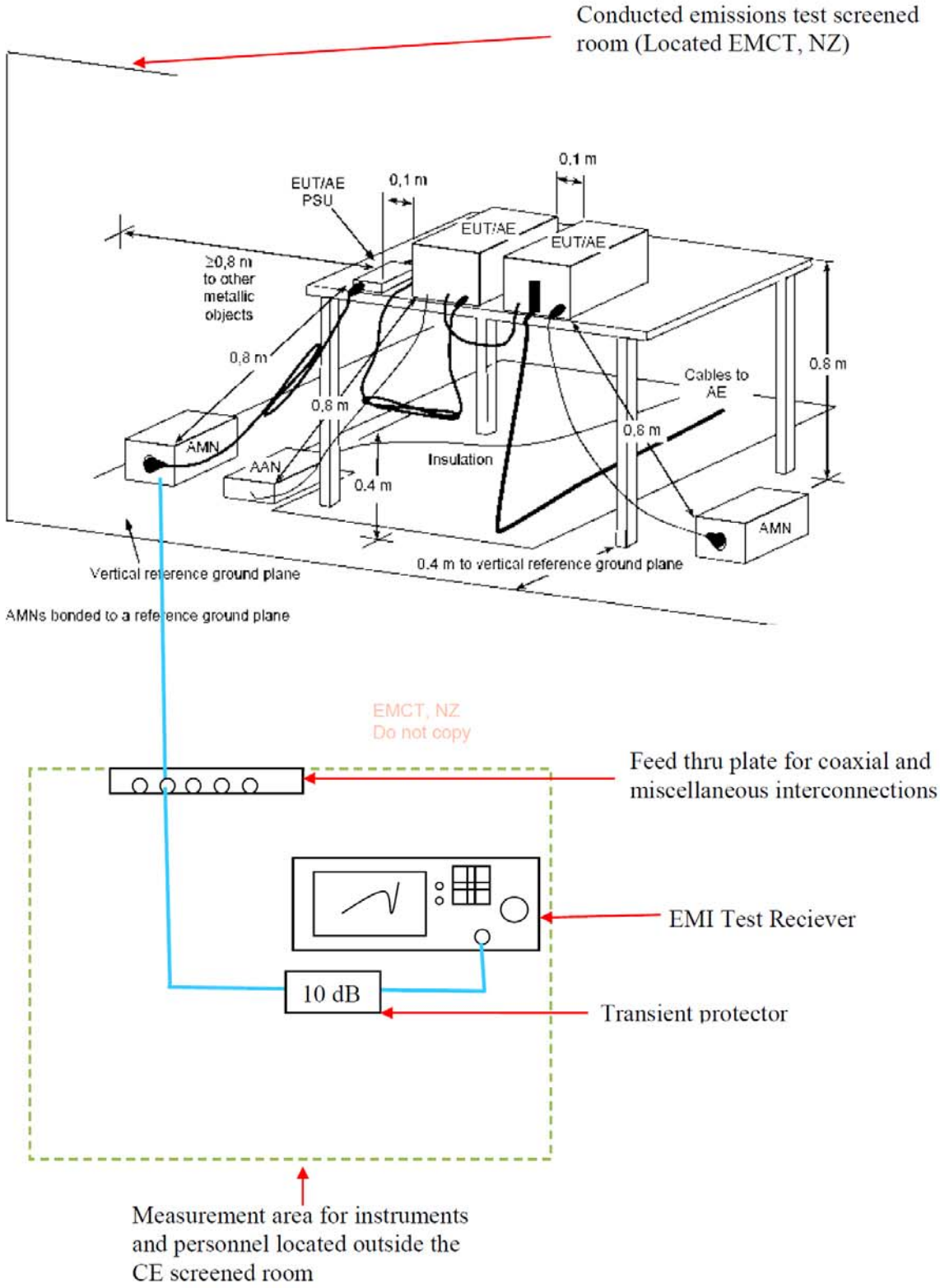
At all times the device was kept more than 80 cm from the artificial mains network.

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.

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

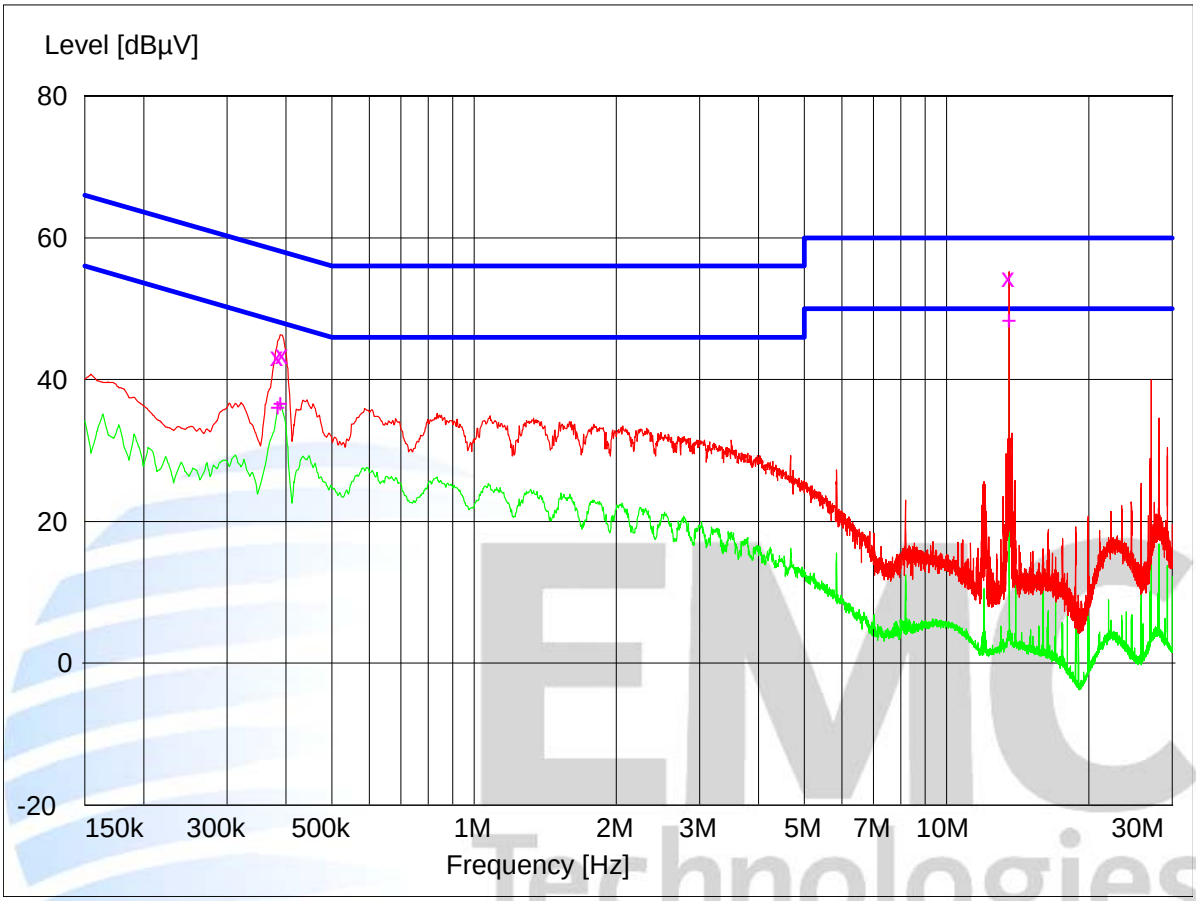
Block Diagram showing the conducted emission test setup



Conducted Emissions – AC Input Power Port

Setup:	Device tested running continuously when powered using a 120 Vac powered USB 5 Vdc power supply with the NFC running continuously.

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



Final Quasi-Peak Measurements

Frequency (MHz)	Level (dBµV)	Limit (dBµV)	Margin (dB)	Phase	Rechecks (dBµV)
0.384000	43.20	58.2	15.0	L1	
0.393000	43.50	58.0	14.5	N	
13.560000	54.40	60.0	5.6	N	*Fundamental*

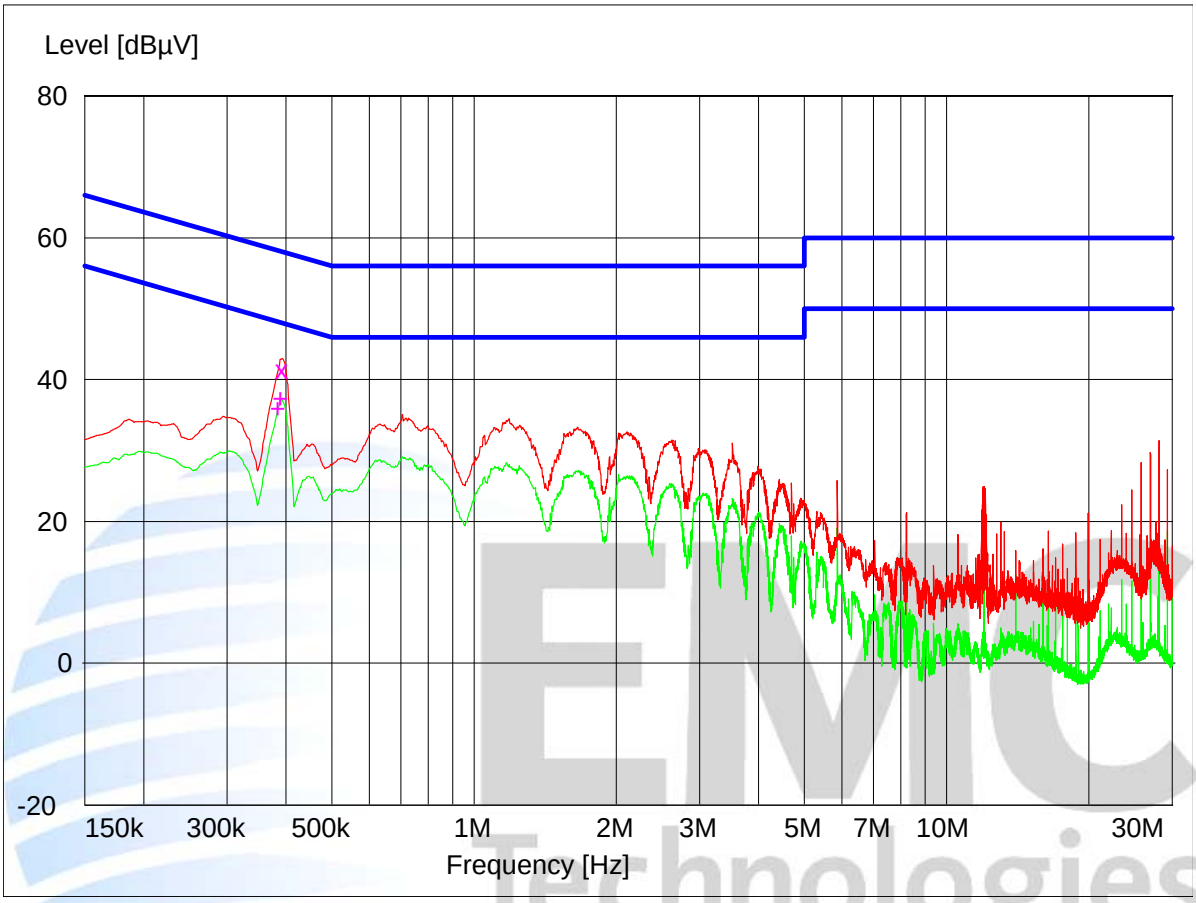
Final Average Measurements

Frequency (MHz)	Level (dBµV)	Limit (dBµV)	Margin (dB)	Phase	Rechecks (dBµV)
0.384000	36.10	48.2	12.1	L1	
0.388500	36.60	48.1	11.5	L1	
13.560000	48.30	50.0	1.7	N	*Fundamental*

Conducted Emissions – AC Input Power Port

Setup:	Device tested running continuously when powered using a 120 Vac powered USB 5 Vdc power supply with the NFC not running.

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



Final Quasi-Peak Measurements

Frequency (MHz)	Level (dBµV)	Limit (dBµV)	Margin (dB)	Phase	Rechecks (dBµV)
0.393000	41.40	58.0	16.6	L1	

Final Average Measurements

Frequency (MHz)	Level (dBµV)	Limit (dBµV)	Margin (dB)	Phase	Rechecks (dBµV)
0.384000	36.00	48.2	12.2	L1	
0.388500	37.30	48.1	10.8	L1	

Section 15.209: Radiated emission limits, general requirements

Radiated emission testing was carried out over the frequency range of 30 MHz to 2000 MHz.

Testing was carried out at the laboratory's open area test site - located at 670 Kawakawa-Orere Road, RD5, Papakura, New Zealand.

Before testing was carried out a receiver self-calibration was undertaken along with a check of all cables and programmed antenna factors were carried out.

Testing was carried out using a representative AC power supply at 120 Vac 60 Hz that powered the device under test.

The device tested when placed in the centre of the test table flat 0.8 m above the test site ground plane.

All interconnecting cables were bundled in 40 cm long bundles.

The NFC device was transmitting continuously on 13.560 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.

Above 1000 MHz an Average detector and a Peak detector with bandwidths of 1 MHz are 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

Result: Complies

Measurement uncertainty with a confidence interval of 95% is:
- Free radiation tests (30 – 5000 MHz) ± 4.1 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	16.2	48.6	32.4	Pass

The NFC device was transmitting continuously on 13.560 MHz.

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

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.

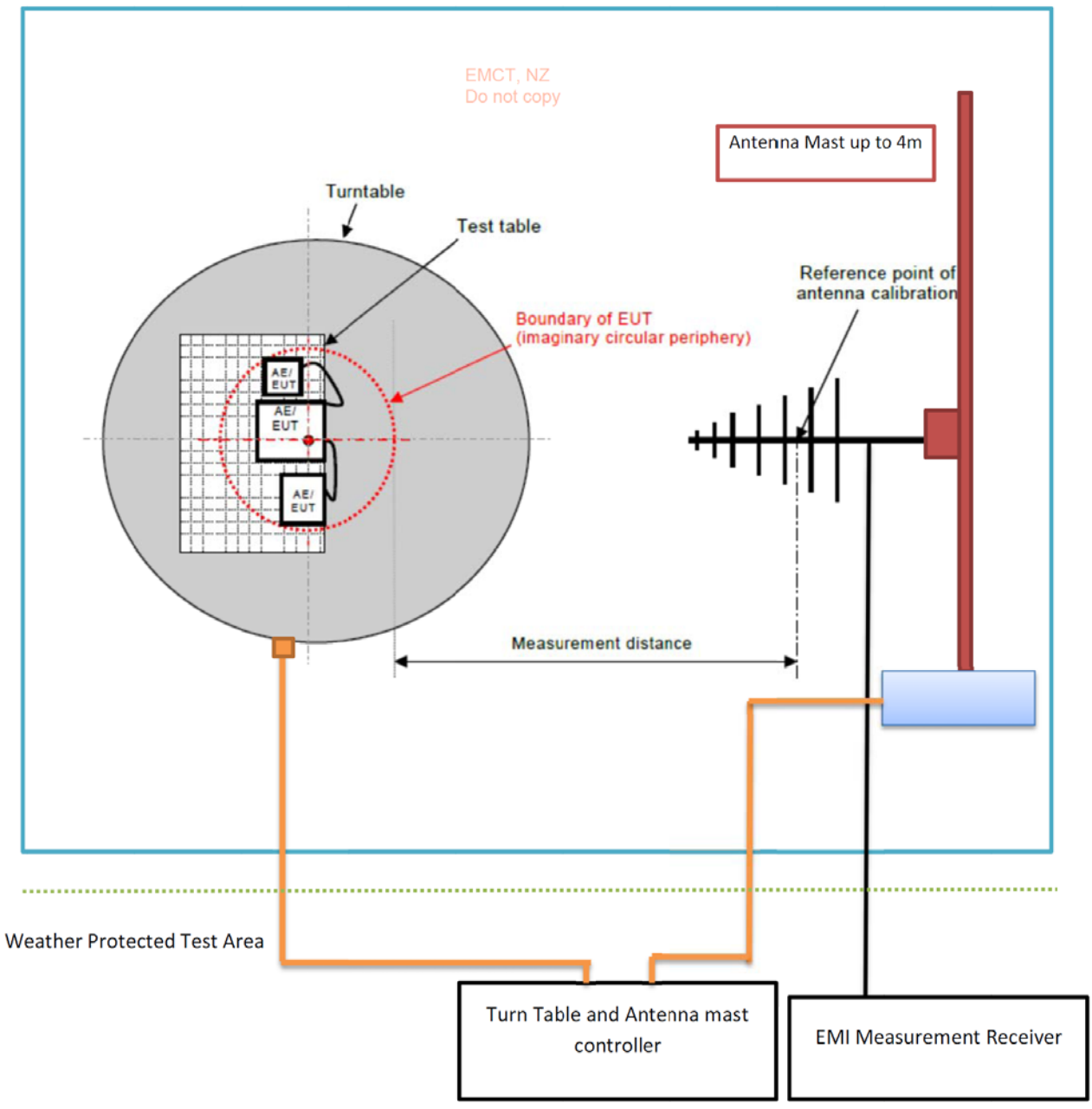
No other low frequency spurious emissions were detected from the device when measurements were attempted from 10 kHz - 30.0 MHz

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 between 30 – 2000 MHz have been made at a distance of 3 metres as shown below.

Radiated Emissions Test setup at Open area test site



Section 15.209: Spurious Emissions (above 30 MHz) - Results

The limits as described in Section 15.209 have been applied.

Frequency (MHz)	Vertical (dBµV/m)	Horizontal (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Antenna Polarisation	Detector
39.120	29.7	-	40.0	10.3	Vertical	Quasi Peak
57.100	19.9	-	40.0	20.1	Vertical	Quasi Peak
67.800	-	15.5	40.0	24.5	Horizontal	Quasi Peak
81.320	-	22.0	40.0	18.0	Vertical	Quasi Peak
85.560	20.1	26.1	40.0	13.9	Horizontal	Quasi Peak
109.320	-	26.0	43.5	17.5	Vertical	Quasi Peak
115.160	22.8	26.6	43.5	16.9	Vertical	Quasi Peak
117.480	-	25.9	43.5	17.6	Horizontal	Quasi Peak
317.080	26.5	27.3	46.0	18.7	Horizontal	Quasi Peak

No further emissions were detected within 15 dB of the limit when the measurements were made between 30 - 2000 MHz using both vertical and horizontal polarisations.

Result: Complies.
Measurement uncertainty with a confidence interval of 95% is:
- Free radiation tests (30 - 2000 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).

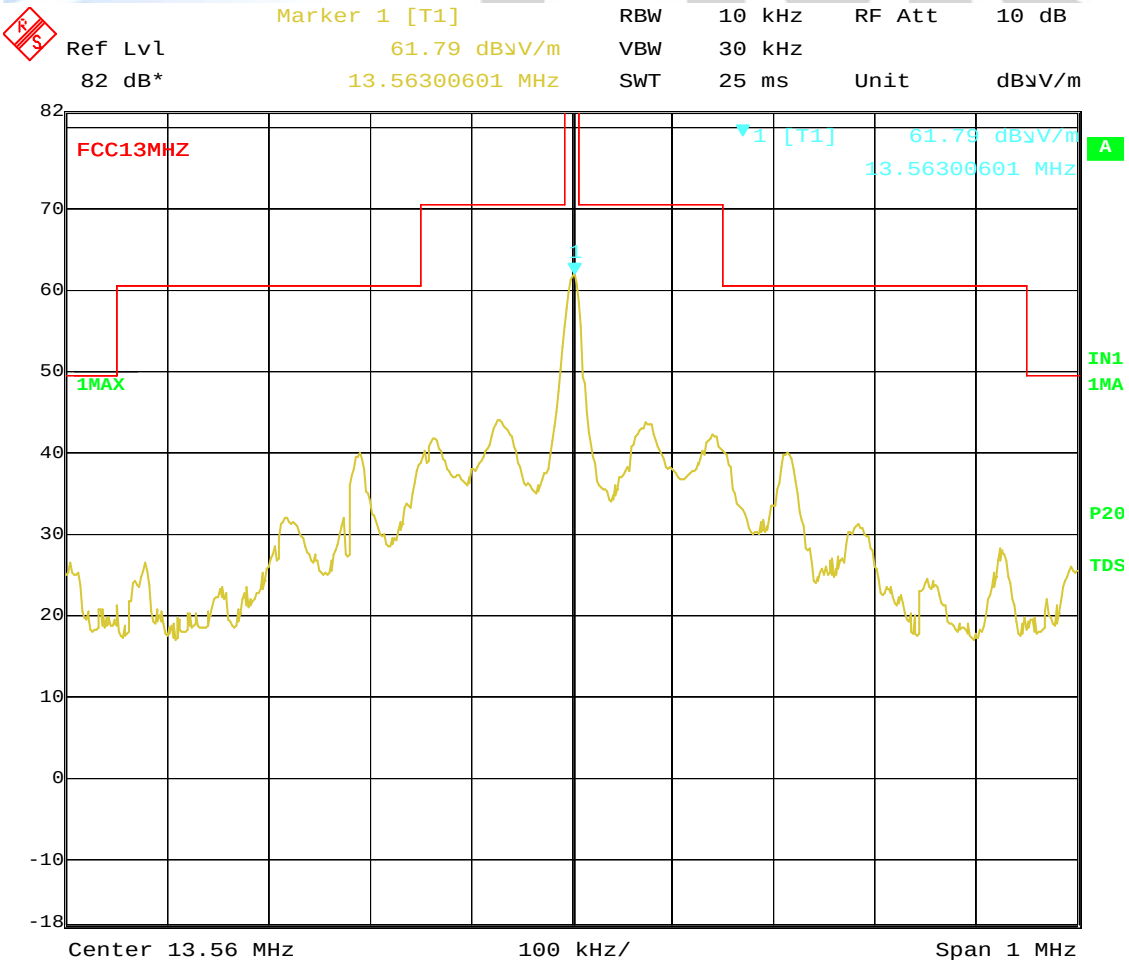
The limit at 30 m at 13.560 MHz is 15,848 uV/m or 84.0 dBuV/m.

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

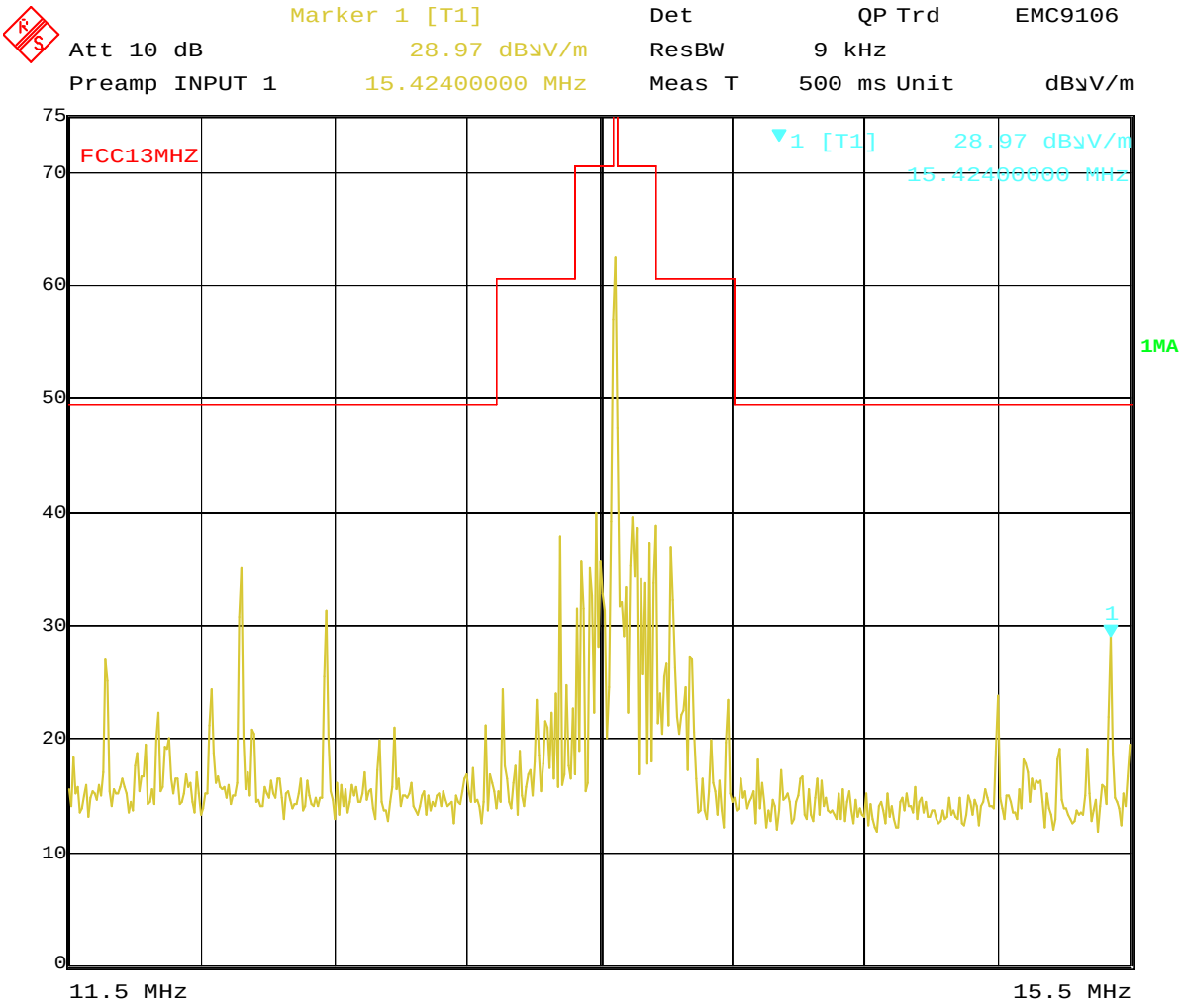
Testing was also carried out to determine whether a variation in the supply voltage would cause a significant change in field strength with the 120 Vac supply to the device being varied by +/- 15% between 102 Vac and 138 Vac.

Voltage (Vdc)	Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
102.0	13.560	61.9	103.1	41.2
120.0	13.560	61.9	103.1	41.2
138.0	13.560	61.9	103.1	41.2

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



Spectrum analyser plot showing the carrier and modulation peaks within +/- 2 MHz.



Result: Complies.

Measurement uncertainty with a confidence interval of 95% is:

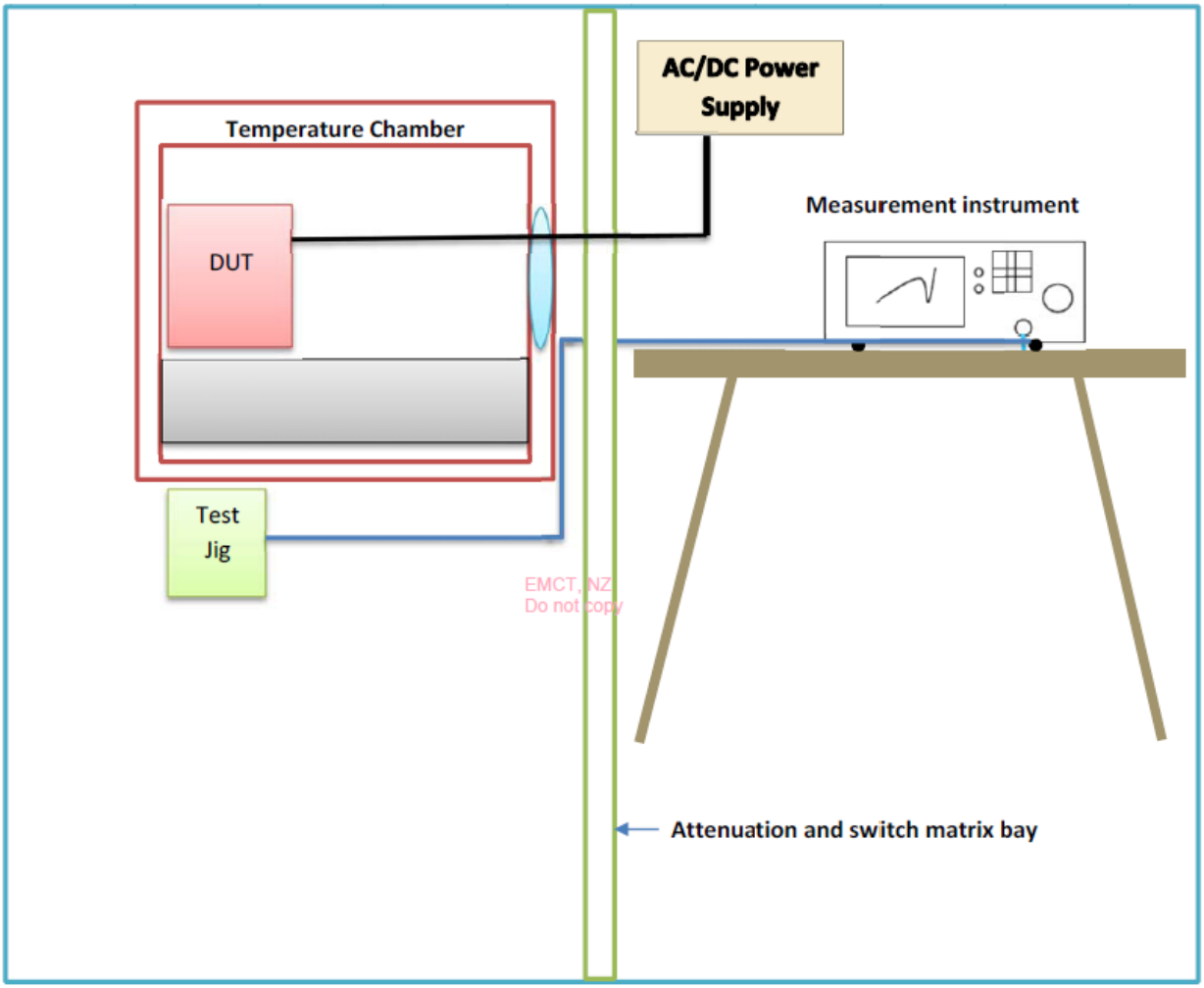
- Free radiation tests (100 kHz – 30 MHz) ± 4.8 dB

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.

Radio bay measurement setup



Following test instruments were used to carry out this test.

Instrument	Manufacturer	Model
Thermal chamber	Contherm	M180F
Thermometer	DSIR	RT200
Spectrum Analyser	R&S	ESIB40
Sucoflex 1 m Cable	Huber and Suhner	340521/4
Sucoflex 3 m Cable	Huber and Suhner	339901/4

Section 15.225: Frequency tolerance – Results

Temperature (°C)	Frequency (MHz)	Difference (Hz)
50.0	13.559 588	-412
40.0	13.559 578	-422
30.0	13.559 583	-417
20.0	13.559 598	-402
10.0	13.559 618	-382
0.0	13.559 668	-332
-10.0	13.559 708	-292
-20.0	13.559 738	-262

The 120 Vac supply voltage was varied by +/- 15% at 20 degrees C (ambient).

Voltage (Vac)	Frequency (MHz)	Difference (Hz)
102	13.559 623	-377
120	13.559 598	-402
138	13.559 623	-377

The frequency tolerance above has been calculated by subtracting the Measured Frequency from the Nominal Frequency (13.560 MHz).

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	-	3680	1 Jan 2022	3 years
Horn Antenna	EMCO	3115	9511-4629	E1526	1 Jan 2022	3 years
Log Periodic	Schwarzbeck	VUSLP 9111	9111-112	EMC4025	1 Jan 2022	3 years
Loop Antenna	EMCO	6502	9003-2485	3798	1 Jan 2022	3 years
Mains Network	R & S	ESH2-Z5	881362/032	3628	12 Oct 2021	2 years
Receiver	R & S	ESHS 10	828404/005	3728	27 Sept 2021	2 year
Receiver	R & S	ESIB 40	100295	INV0818	28 Aug 2021	2 year
Turntable	EMCO	1080-1-2.1	9109-1578	RFS 3709	Not applic	N/a
VHF Balun	Schwarzbeck	VHA 9103	9594	3696	1 Jan 2022	3 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	10 October 2021	5 years
Voltage Variac	Powerteck	SRV-5	RFS3800	-	-	N/a

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 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

Device Under Test

Device under test continued

Radiated emissions test setup - Device under test

Radiated emissions test setup - Ancillary Device

Radiated emissions test setup

Conducted emissions test set up

Conducted emissions test set up continued