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TEST REPORT

Gallagher C300480 T15 Multi Tech Reader

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

Gallagher Group 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 **Gallagher C300480 T15 Multi Tech Reader** 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 in between the 24th November and the 3rd December 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 125.0 kHz and 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 erasures.

This report contains corrections.

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	Gallagher Group Ltd
Address	181 Kahikatea Drive Melville
City	Hamilton 3206
Country	New Zealand
Contact	Mr Menardo Lazaro

5. DESCRIPTION OF TEST SAMPLE

Brand Name	Gallagher
Model Number	C300480
Product	T15 Multi Tech Card Reader
Manufacturer	Gallagher Group Ltd
Country of Origin	New Zealand
Serial Number	214459003
FCC ID	M5VC30048XB
Module FCC ID	QOQBGM111

Product Description:

The device that was tested is a Proximity Card Reader that operates on 125.0 kHz and 13.560 MHz.

Typically this device would be used to allow security access to buildings and locations.

The card reader is powered at 13.6 Vdc which was supplied using a Gallagher 6000 HS controller that was in turn powered from a 120 Vac to 13.6 Vdc representative power supply.

Testing has been carried out as a new Renesas microprocessor and a new Mifare integrated circuit have been installed.

In addition a Bluetooth Module, FCC ID: QOQBGM111, has been incorporated into the product.

Testing was carried out when the Bluetooth Module was operating to verify the operation of this device in this product.

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 125.0 kHz and 13.560 MHz antennas.

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

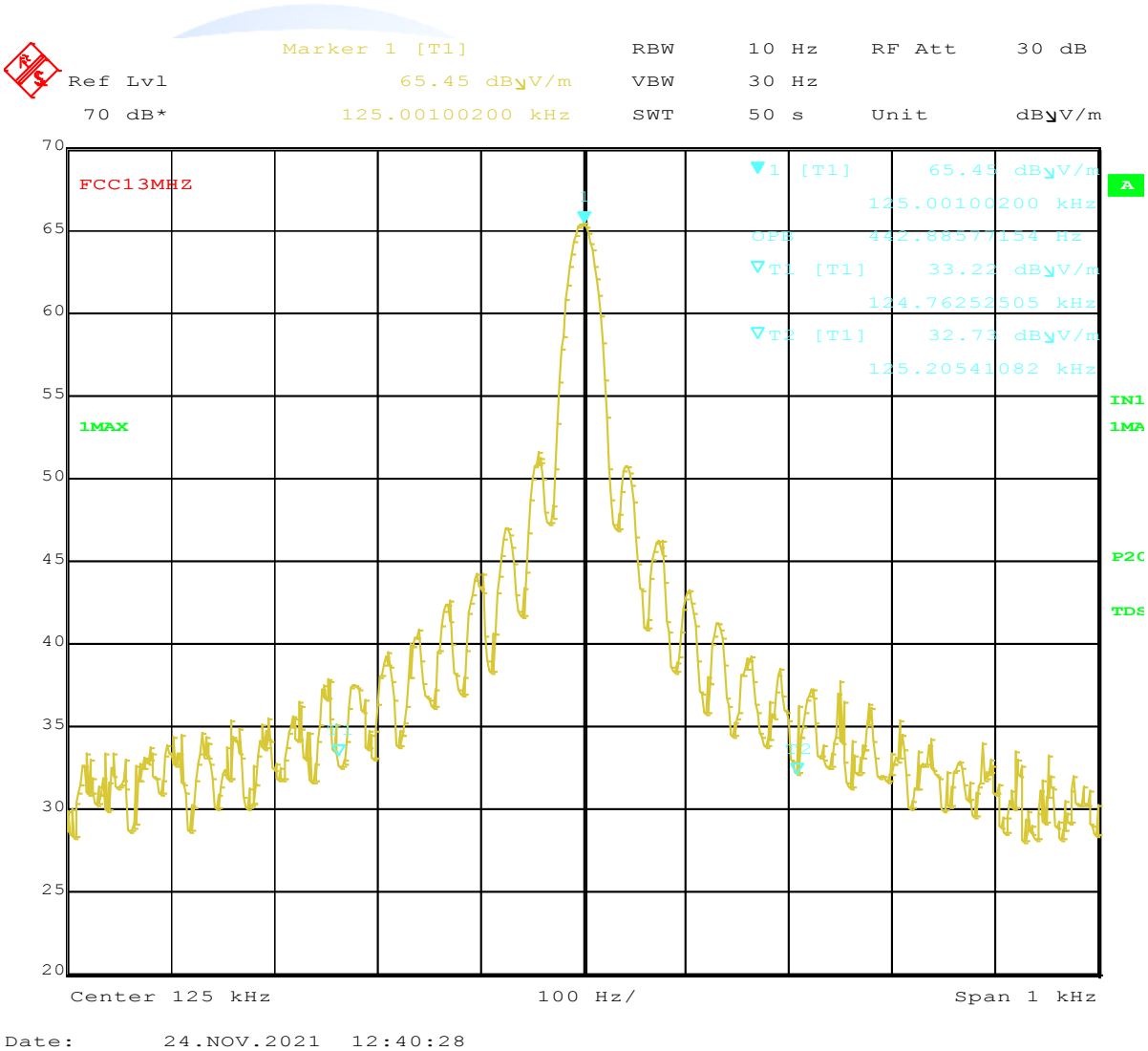
The device transmits on 125.0 kHz and 13.560 MHz.

The 125.0 kHz device will fall between the restricted bands of 90 – 110 kHz and 495 – 505 kHz.

Measurements were made using a span of 1 kHz with a resolution bandwidth of 10 Hz and a video bandwidth of 30 Hz.

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

At 125.0 kHz the modulation bandwidth was measured to be 442.886 Hz.



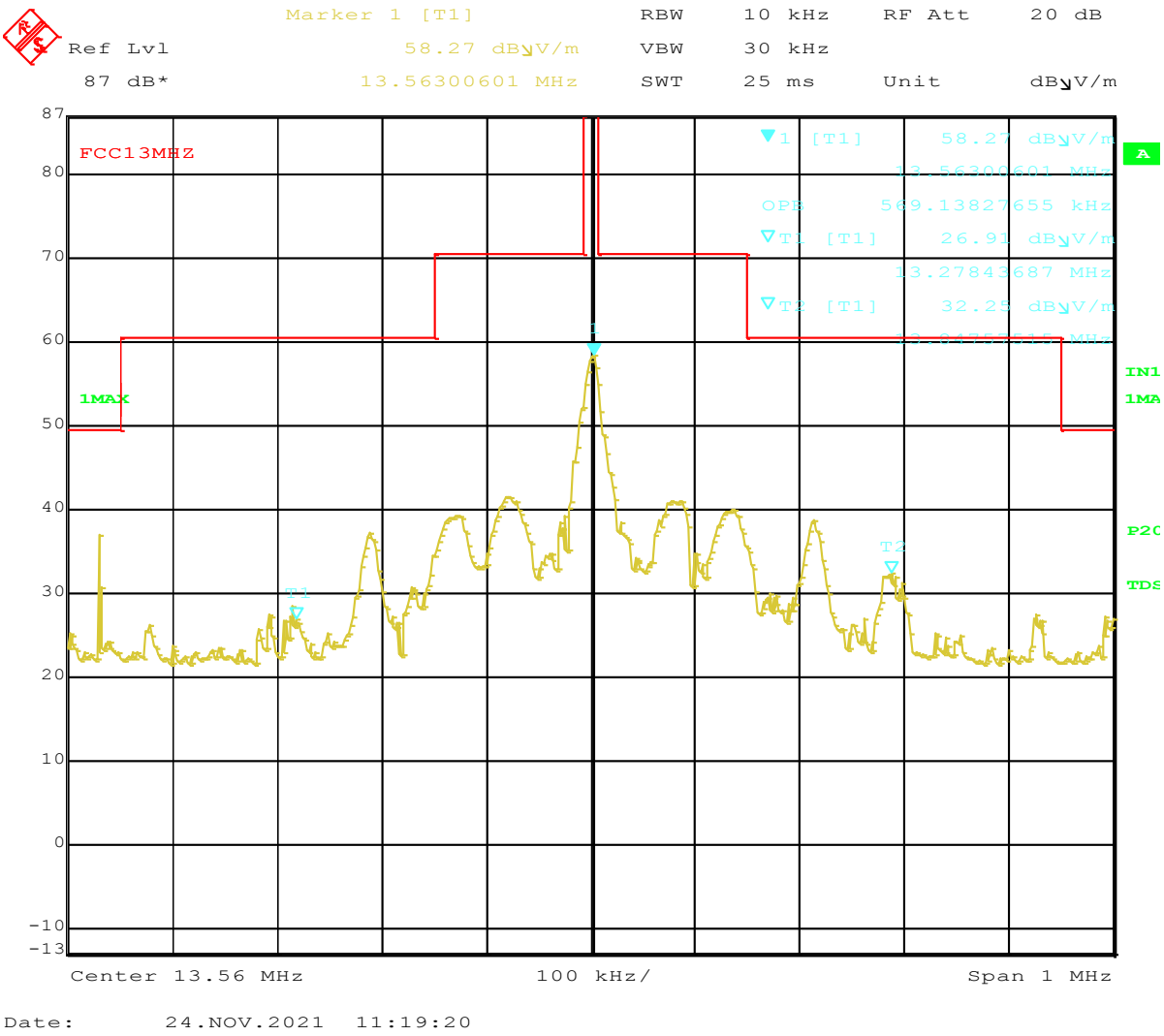
Section 15.205: Restricted bands of operation cont.

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 1.0 MHz with a resolution bandwidth of 10 kHz and a video bandwidth of 30 kHz.

A worst case modulation bandwidth of 569.138 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 supplied 13.6 Vdc to the device under test via a Gallagher 6000 Controller Module.

The Reader operates on 125.0 kHz and on 13.560 MHz and Bluetooth device operates in the 2400 – 2483.5 MHz band.

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

A second test was then carried out with the internal antenna in the Reader being replaced with a resistive dummy load.

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.

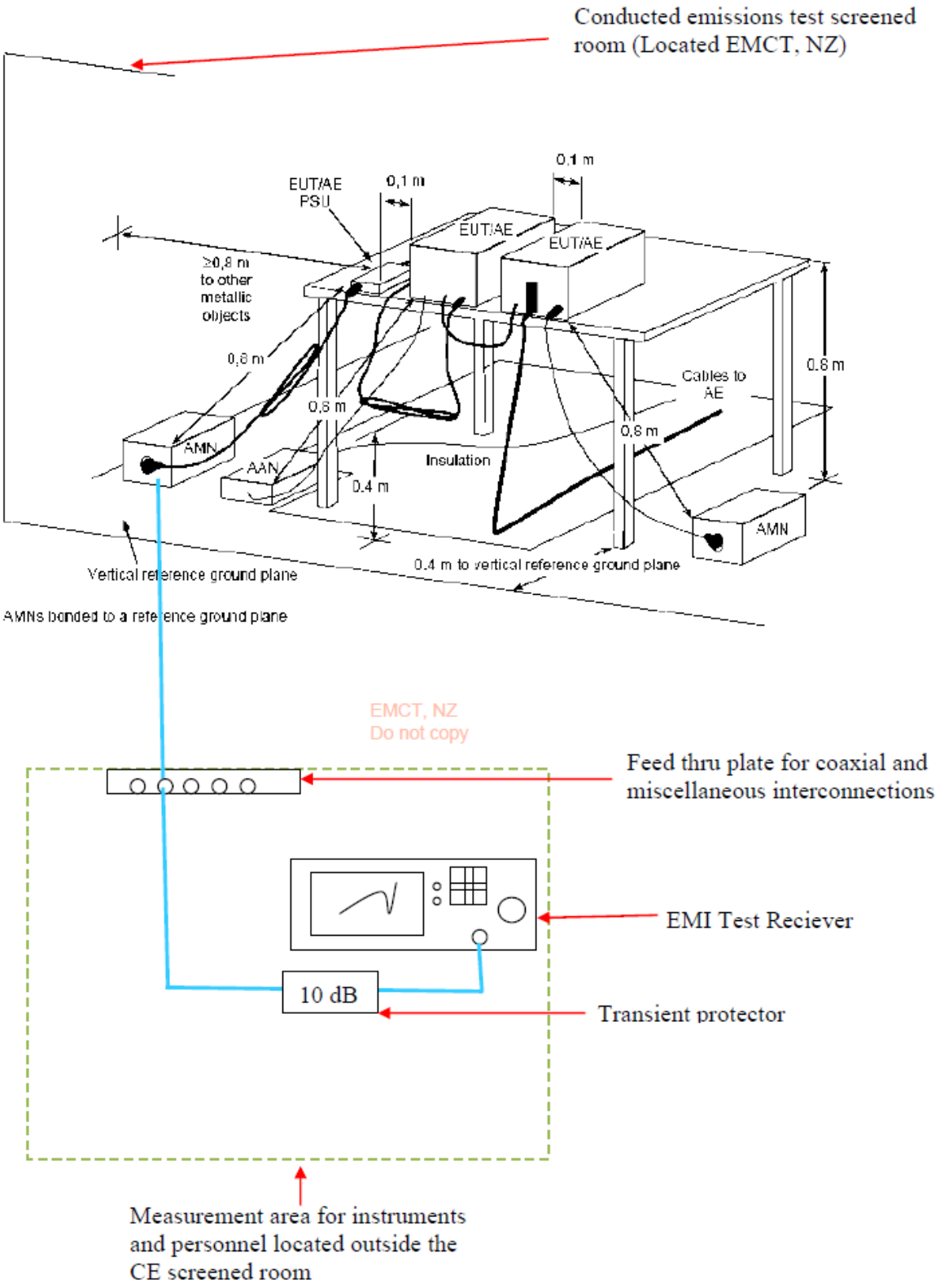
At all times the device was kept more than 80 cm from the artificial mains network.

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.

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

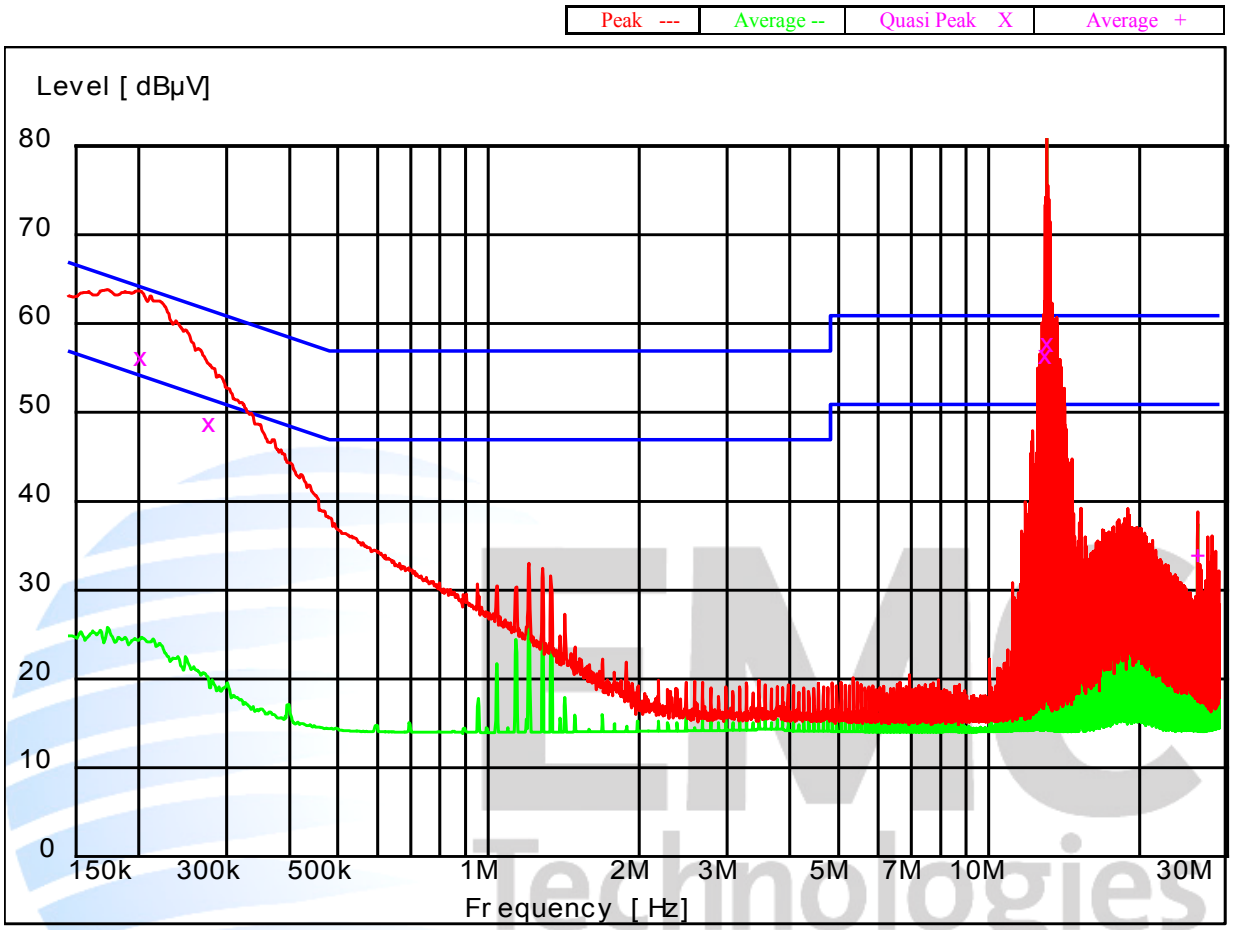
Block Diagram showing the conducted emission test setup



EMI Receiver Used: ESHS 10

Conducted Emissions – AC Input Power Port

Setup:	Device tested when powered using a representative power supply at 120 Vac 60 Hz when transmitting continuously on 125 kHz and 13.560 MHz and when the Bluetooth device was operating.



Final Quasi-Peak Measurements

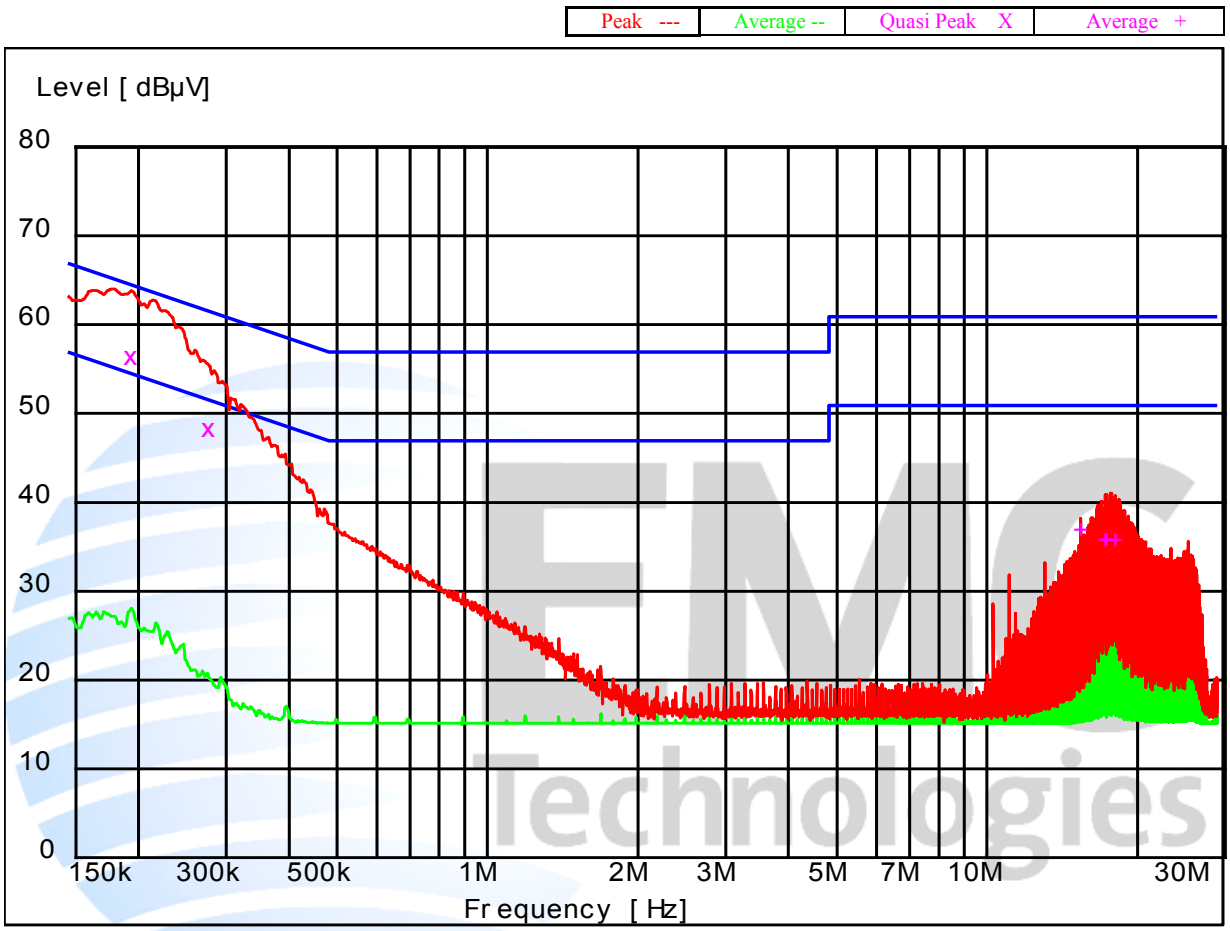
Frequency (MHz)	Level (dBµV)	Limit (dBµV)	Margin (dB)	Phase	Rechecks (dBµV)
0.210000	55.30	63.2	7.9	N	
0.288000	47.90	60.6	12.7	N	
13.484000	55.60	60.0	4.4	L1	
13.560500	92.80	60.0	-32.8	N	Fundamental
13.637000	56.90	60.0	3.1	N	

Final Average Measurements

Frequency (MHz)	Level (dBµV)	Limit (dBµV)	Margin (dB)	Phase	Rechecks (dBµV)
13.560500	88.70	50.0	-38.7	N	Fundamental
27.119000	32.90	50.0	17.1	L1	

Conducted Emissions – AC Input Power Port

Setup:	Device tested when powered using a representative power supply at 120 Vac 60 Hz when transmitting continuously on 125 kHz and 13.560 MHz with a resistive dummy load attached to the output of the 13.560 MHz device. In addition the Bluetooth device was operating.



Final Quasi-Peak Measurements

Frequency (MHz)	Level (dBµV)	Limit (dBµV)	Margin (dB)	Phase	Rechecks (dBµV)
0.201000	55.50	63.6	8.1	N	55.4
0.288000	47.40	60.6	13.2	L1	

Final Average Measurements

Frequency (MHz)	Level (dBµV)	Limit (dBµV)	Margin (dB)	Phase	Rechecks (dBµV)
15.999500	36.00	50.0	14.0	N	36.1
17.925500	34.90	50.0	15.1	N	
18.029000	34.90	50.0	15.1	N	
18.749000	34.80	50.0	15.2	N	

Section 15.209: Radiated emission limits, general requirements

Radiated emission testing was carried out over the frequency range of 10 kHz to 25000 MHz as the device contains a 125 kHz RFID device, a 13.560 MHz NFC transceiver, a 2.4 GHz Bluetooth module and a digital device that has a highest frequency in use that is less than 108 MHz.

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 using a representative AC power supply at 120 Vac 60 Hz that supplied 13.6 Vdc to a Gallagher 6000 Controller Module that in turn powered the device under test which were located directly behind the turntable on the test pad.

The Reader was observed transmitting continuously on 125.0 kHz and 13.560 MHz.

The Bluetooth device was observed to operate in the 2400 – 2483.5 MHz band.

Attached to the reader was a single 4 wire cable which enables the DC supply voltage and RS-485 communications between the reader and controller.

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.

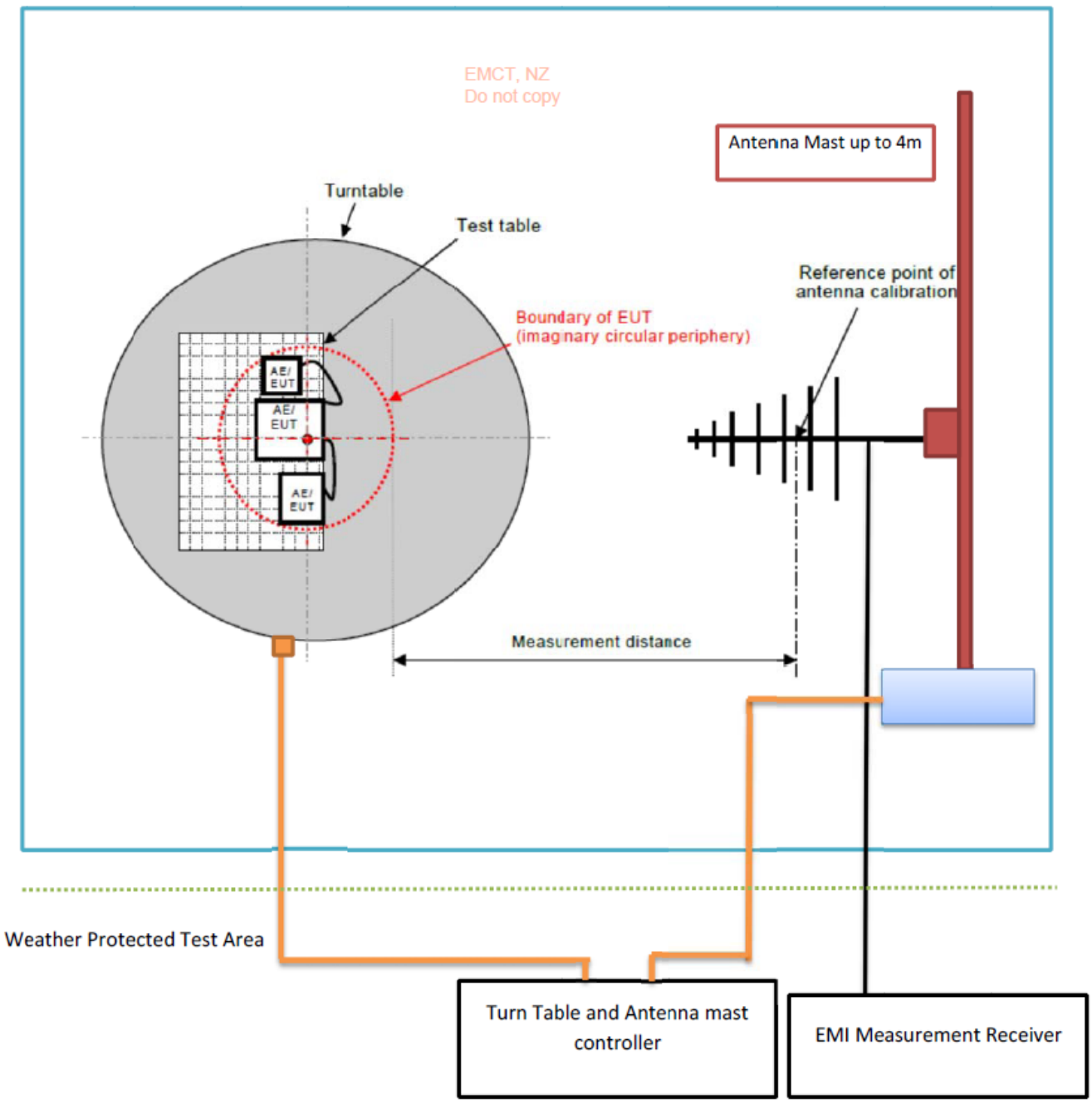
The emission level was determined in field strength by taking the following into consideration:

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

EMI Receiver Used: ESIB40

Section 15.209: 125 kHz Fundamental emission:

Measurements were made using a magnetic loop antenna and a receiver with an Average detector and a Peak detector both using a 9 kHz bandwidth

Frequency (kHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Distance (metres)
125.000	55.7	105.7	50.0	Average	3.0
125.000	74.7	125.7	51.0	Peak	3.0

Measurements were made at a distance of 3.0 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 300 metre limit between 125 – 490 kHz has been scaled by a factor of 40 dB per decade, as per section 15.31 (f) (2).

The average limit at 300 m at 125.0 kHz is 19.2 uV/m or 25.7 dBuV/m and 45.7 dBuV/m in peak.

= 25.7 dBuV/m + -40 dB/decade * (log (3) - log (300))
= 25.7 dBuV/m + -40 dB/decade * (0.477 - 2.477)
= 25.7 dBuV/m + -40 dB/decade * -2.0
= 25.7 dBuV/m + 80.0
= 105.7 dBuV/m

This gives a limit at 3 m at 125 kHz of 105.7 dBuV/m and 125.7 dBuV/m in peak

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

As a worst case indication the 13.6 Vdc supply to the card reader was varied by +/- 15% between 11.5 Vdc and 15.6 Vdc.

Voltage (Vdc)	Peak Field Strength (dBuV/m)
11.5	74.7
13.6	74.7
15.6	74.7

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

Section 15.209: 125 kHz Spurious Emissions (below 30 MHz)

A receiver with an Average detector and a Peak detector using a 9 kHz bandwidth was used between 110 – 490 kHz and a Quasi Peak detector with a 9 kHz bandwidth was used between 490 kHz – 30.0 MHz.

Frequency (kHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Comment
250.000	44.0	99.6	-	Average	Noise Floor
250.000	54.0	119.6	-	Peak	Noise Floor
375.000	46.0	96.1	-	Average	Noise Floor
375.000	56.0	116.1	-	Peak	Noise Floor
500.000	43.0	73.6	-	Quasi Peak	Noise Floor
625.000	40.0	71.7	-	Quasi Peak	Ambient
750.000	34.0	70.1	-	Quasi Peak	Noise Floor
875.000	33.0	68.8	-	Quasi Peak	Ambient
1000.000	30.0	67.6	-	Quasi Peak	Noise Floor
1125.000	32.0	66.6	-	Quasi Peak	Noise Floor
1250.000	35.0	65.7	-	Quasi Peak	Ambient
1375.000	26.0	64.8	-	Quasi Peak	Noise Floor
1500.000	28.0	64.1	-	Quasi Peak	Noise Floor
1625.000	24.0	63.4	-	Quasi Peak	Noise Floor
1750.000	24.0	69.5	-	Quasi Peak	Noise Floor
1875.000	22.0	69.1	-	Quasi Peak	Noise Floor

Magnetic loop measurements were made a distance of 3 metres with the measurement antenna being further adjusted to give the highest field strength.

The 300 metre limit between 125 – 490 kHz has been scaled by a factor of 40 dB per decade, as per section 15.31 (f) (2).

= Limit (dBuV/m) + -40 dB/decade * (log (3) - log (300))
= Limit (dBuV/m) + -40 dB/decade * (0.477 - 2.477)
= Limit (dBuV/m) + -40 dB/decade * -2.0
= Limit (dBuV/m) + -80.0

The limit between 110 – 490 kHz was increased by 20 dB when the peak detector was used.

The 30 metre limit between 490 – 1705 kHz has been scaled by a factor of 40 dB per decade, as per section 15.31 (f) (2).

= Limit (dBuV/m) + -40 dB/decade * (log (3) - log (30))
= Limit (dBuV/m) + -40 dB/decade * (0.477 - 1.477)
= Limit (dBuV/m) + -40 dB/decade * -1.0
= Limit (dBuV/m) + -40.0

The spurious emissions observed do not exceed the level of the fundament 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: 13.560 MHz transmitter below 30 MHz spurious emission measurements

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
27.120	12.3	48.6	36.3	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 fundament 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 – 1000 MHz have been made at a distance of 3 metres.

The limits as described in Section 15.209 have been applied.

A mobile phone was used to pair with the Bluetooth device in the product.

General emissions

Frequency (MHz)	Vertical (dBµV/m)	Horizontal (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result	Antenna Polarisation
48.000	25.1	-	40.0	14.9	Pass	Vertical

13.560 MHz card reader specific emissions

Frequency (MHz)	Vertical (dBµV/m)	Horizontal (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result	Antenna Polarisation
40.680	31.8	21.0	40.0	8.2	Pass	Vertical
54.240	23.4	-	40.0	16.6	Pass	Vertical
67.800	18.6	-	40.0	21.4	Pass	Vertical
176.280	20.4	-	43.5	23.1	Pass	Vertical
366.120	28.8	28.1	46.0	17.2	Pass	Vertical
352.560	27.4	31.0	46.0	15.0	Pass	Vertical
339.000	25.9	27.1	46.0	18.9	Pass	Horizontal

No further emissions were detected within 15 dB of the limit when measurements were made between 30 – 25,000 MHz using both vertical and horizontal polarisations.

Result: Complies.
Free radiation tests (30 – 25,000 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 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

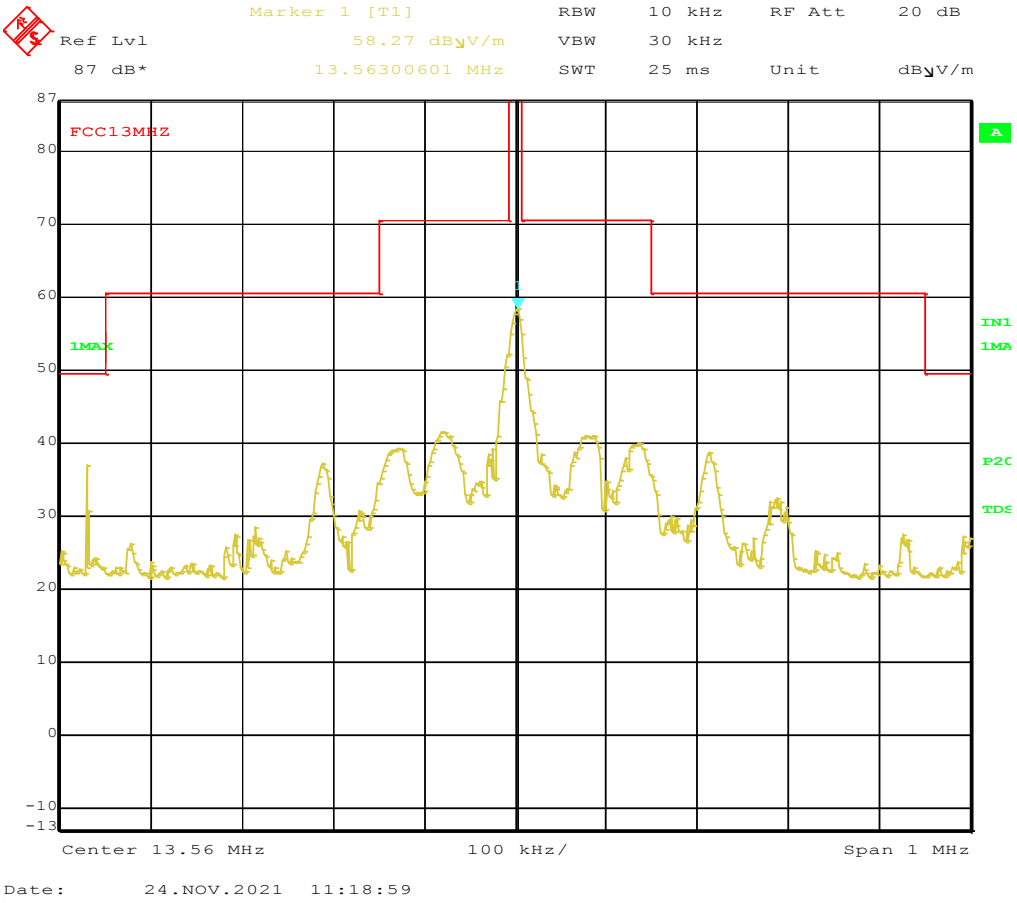
Testing was also carried out to determine whether a variation in the supply voltage would cause a significant change in field strength with the 13.6 Vdc supply to the device being varied by +/- 15% between 11.6 Vdc and 15.6 Vdc.

Voltage (Vdc)	Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
11.6	13.560	58.2	103.1	44.9
13.6	13.560	58.2	103.1	44.9
15.6	13.560	58.2	103.1	44.9

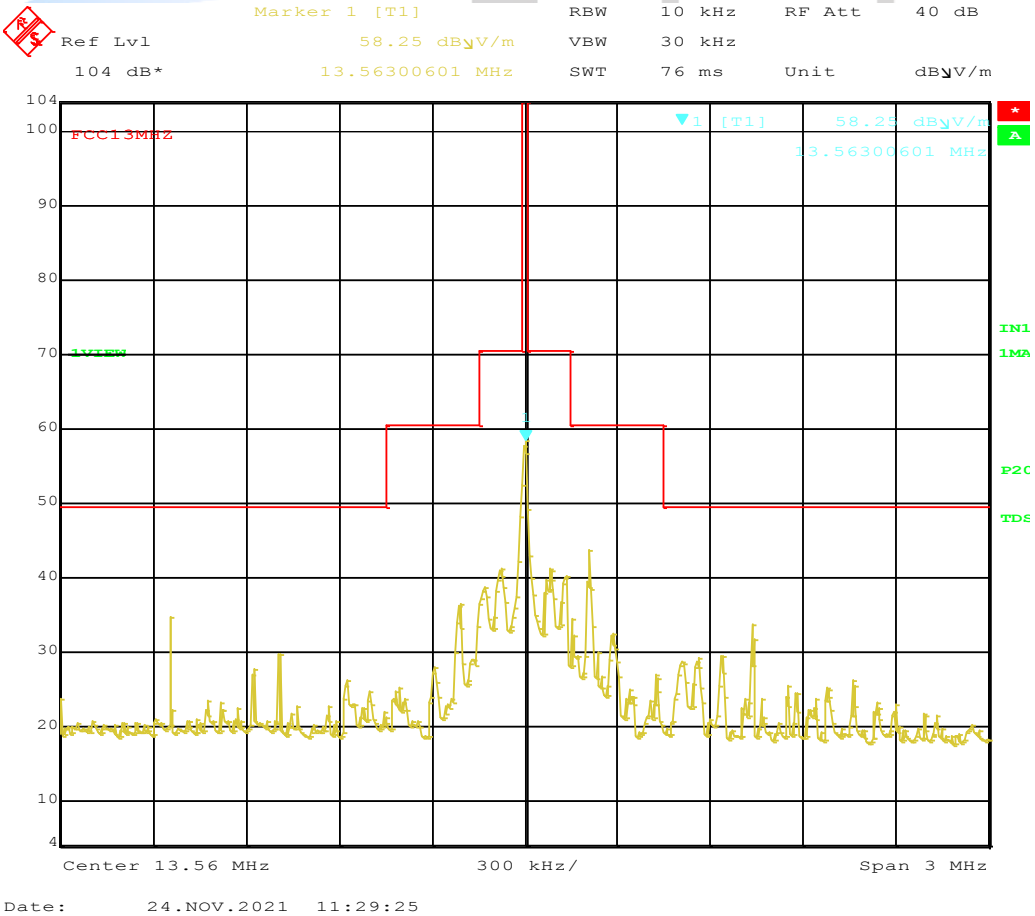
Representative spectrum analyser plots below show the carrier and modulation peaks within, +/- 0.5 MHz and +/- 1.5 MHz of the carrier.

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

Fundamental emission: +/- 500 kHz



Fundamental emission: +/- 1500 kHz



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.

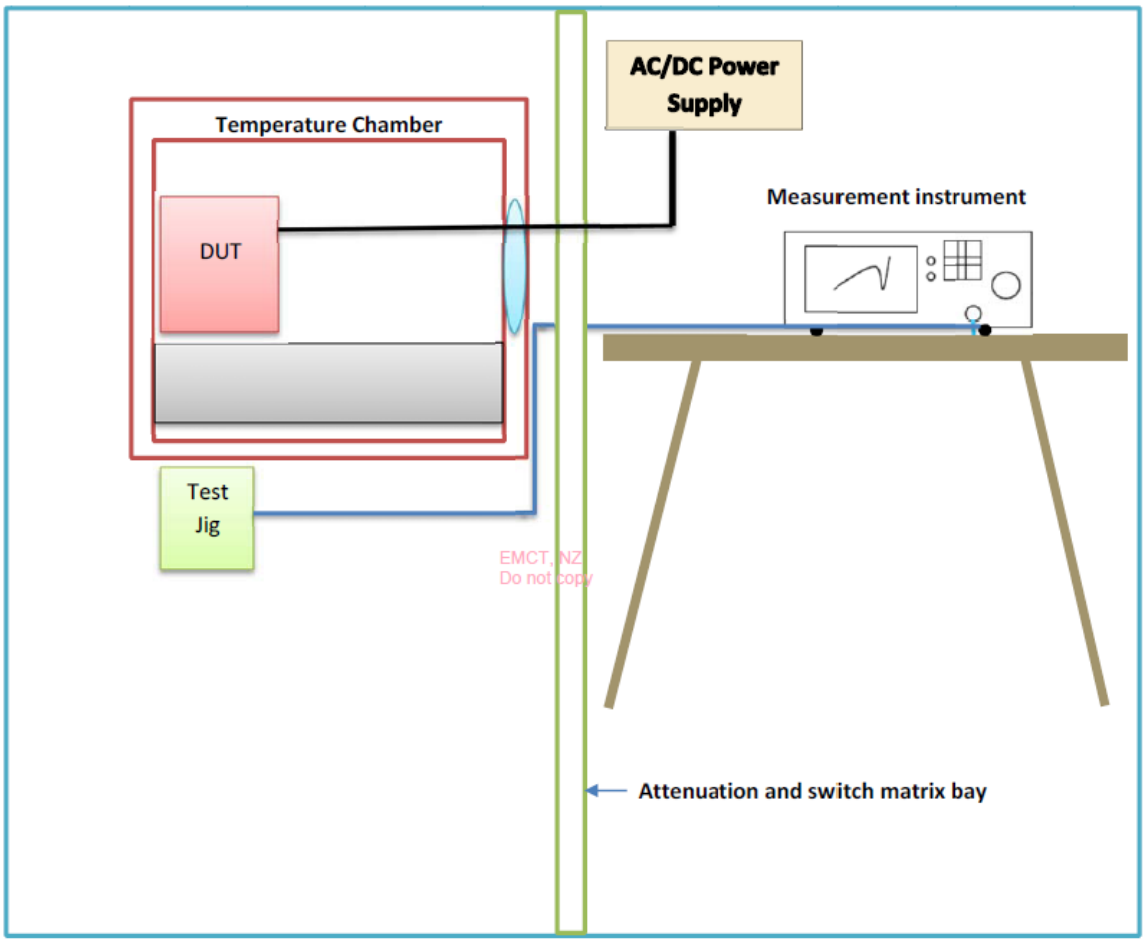
Temperature (°C)	Frequency (MHz)	Difference (Hz)
50	13.559 328	-672
40	13.559 333	-667
30	13.559 348	-652
20	13.559 353	-647
10	13.559 343	-657
0	13.559 373	-627
-10	13.559 388	-612
-20	13.559 368	-632

Input voltage was varied by +/- 15% at 20 degrees C (ambient).

Voltage (Vdc)	Frequency (MHz)	Difference (Hz)
11.6	13.559 353	-647
13.6	13.559 353	-647
15.6	13.559 353	-647

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	R&S	ESIB40
Coaxial cables (3m)	Huber and Suhner Succoflex	340521/4
Coaxial cables (1m)	Huber and Suhner Succoflex	339901/4
Voltage Variac	Powerteck	SRV-5

7. TEST EQUIPMENT USED

Instrument	Manufacturer	Model	Serial No	Asset Ref	Cal Due	Period
Aerial Controller	EMCO	1090	9112-1062	RFS 3710	Not applic	Not applic
Aerial Mast	EMCO	1070-1	9203-1661	RFS 3708	Not applic	Not applic
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 2022	2 years
Receiver	R & S	ESHS 10	828404/005	3728	27 Sept 2022	2 year
Receiver	R & S	ESIB 40	100295	INV0818	28 Aug 2022	2 year
Turntable	EMCO	1080-1-2.1	9109-1578	RFS 3709	Not applic	Not applic
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	Not applic
Thermal chamber	Contherm	M180F	86025	N/a	N/a	Not applic
Thermometer	DSIR	RT200	35	EMC4029	10 October 2022	6 years
Voltage Variac	Powerteck	SRV-5	RFS3800	-	-	Not applic

At the time of testing all test equipment was within calibration

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

Label on product

Device under test – Label on Bottom of product

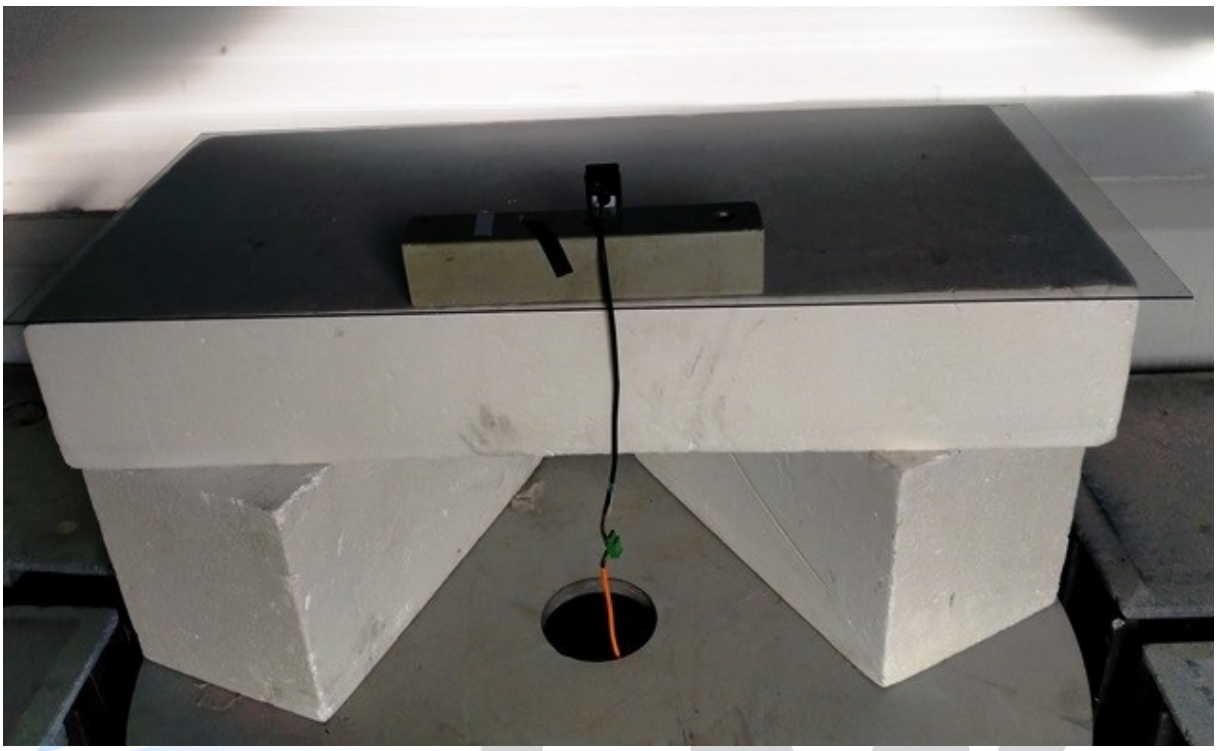
Right hand side

Front Face

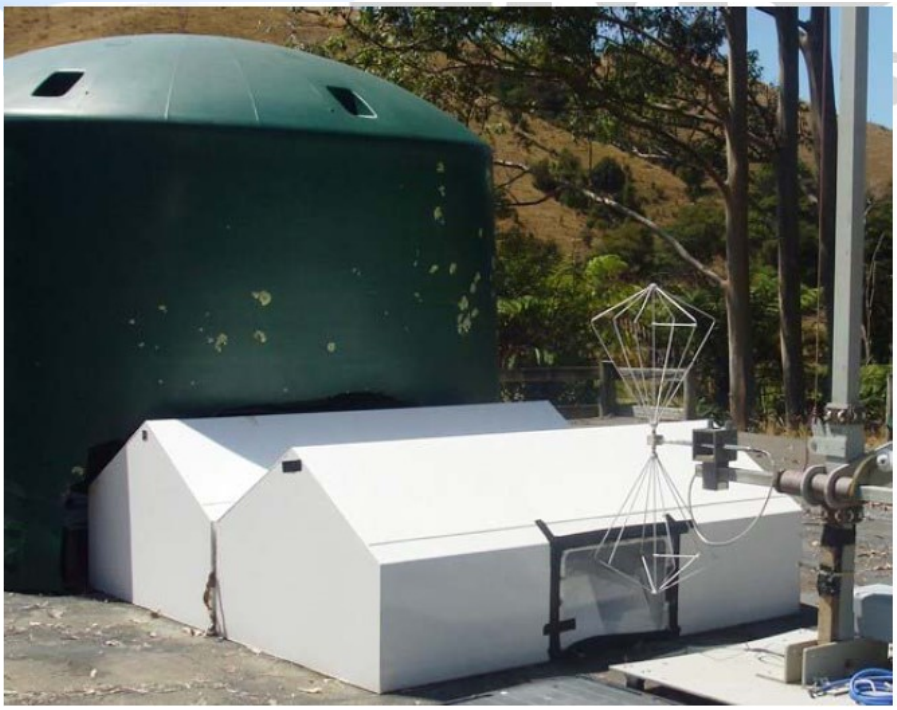
Right hand side – Left Hand Side – Top – Bottom

Conducted emissions test set up

Radiated emission test set up photos



Test Antennas Used - Biconical Antenna



Log periodic Antenna

Loop Antenna