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TEST REPORT

Gallagher T21 PIV Reader-White Rev1 (C305506)

Proximity Card Reader

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

Gallagher 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 **Gallagher T21 PIV Reader-White Rev1 (C305506) Proximity Card 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 14th and 23rd April 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 erasures.

This report contains corrections. The Fundamental emission plot has been added to page 16 of the test report.

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

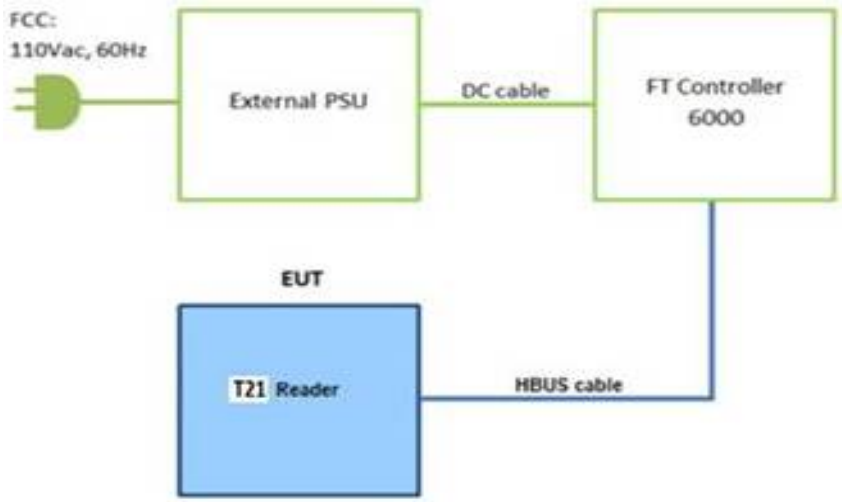
Brand Name	Gallagher
Model Number	T21 - White Rev1 (C305506)
Product	PIV Reader
Manufacturer	Gallagher Group Ltd
Country of Origin	New Zealand
Serial Number	123456789
FCC ID	M5VC30550X
Software version	vHSC5.00.12 is the Contact Reader version. vHT5.00.03 is the version of the T21 keypad reader that contains the Mifare transmitter

The device tested is a RFID card reader that operates on 13.560 MHz that would typically be used to allow security access to buldings and locations.

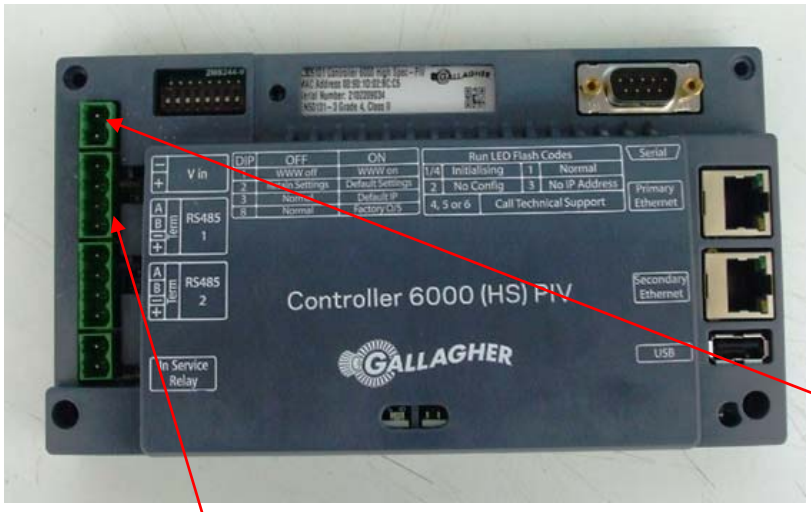
The product under test was powered at 12 Vdc that was supplied from Gallagher 6000 HS controller. The controller inturn was powered from a 110 Vac to 12 Vdc convertor pictured in figure-3.

For radiated emissions test, a long length (>10 m) orange HBUS cable was used to route DC and control signals from FT controller to the EUT, to facilitate increased physical distancing between the device and ancillaries.

Block Diagram of product with Ancillaries



Gallagher supplied controller (Ancillary)

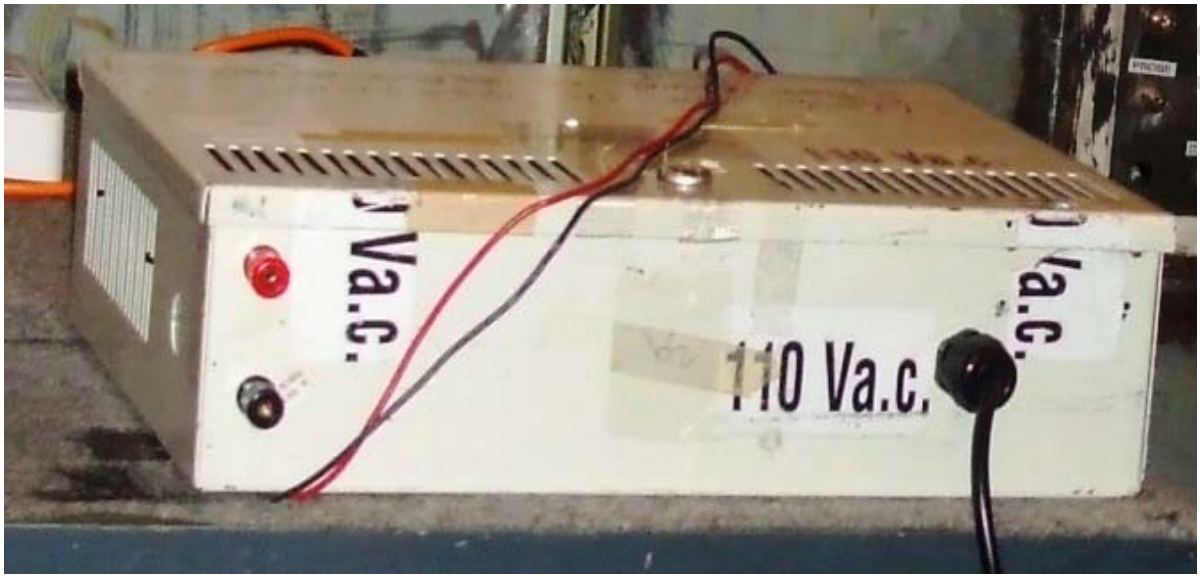


Gallagher controller 6000 (HS) has been supplied by the client to assist in the testing of Device.

The controller gets powered at 12 Vdc using client supplied 110 Vac to 12 Vdc convertor.

RS485 port connects this controller to the Device

110 Vac to 12 Vdc convertor (Ancillary)



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.

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 12 Vdc to the device under test via a Gallagher 6000 Controller Module.

The Reader operates on 13.560 MHz.

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.

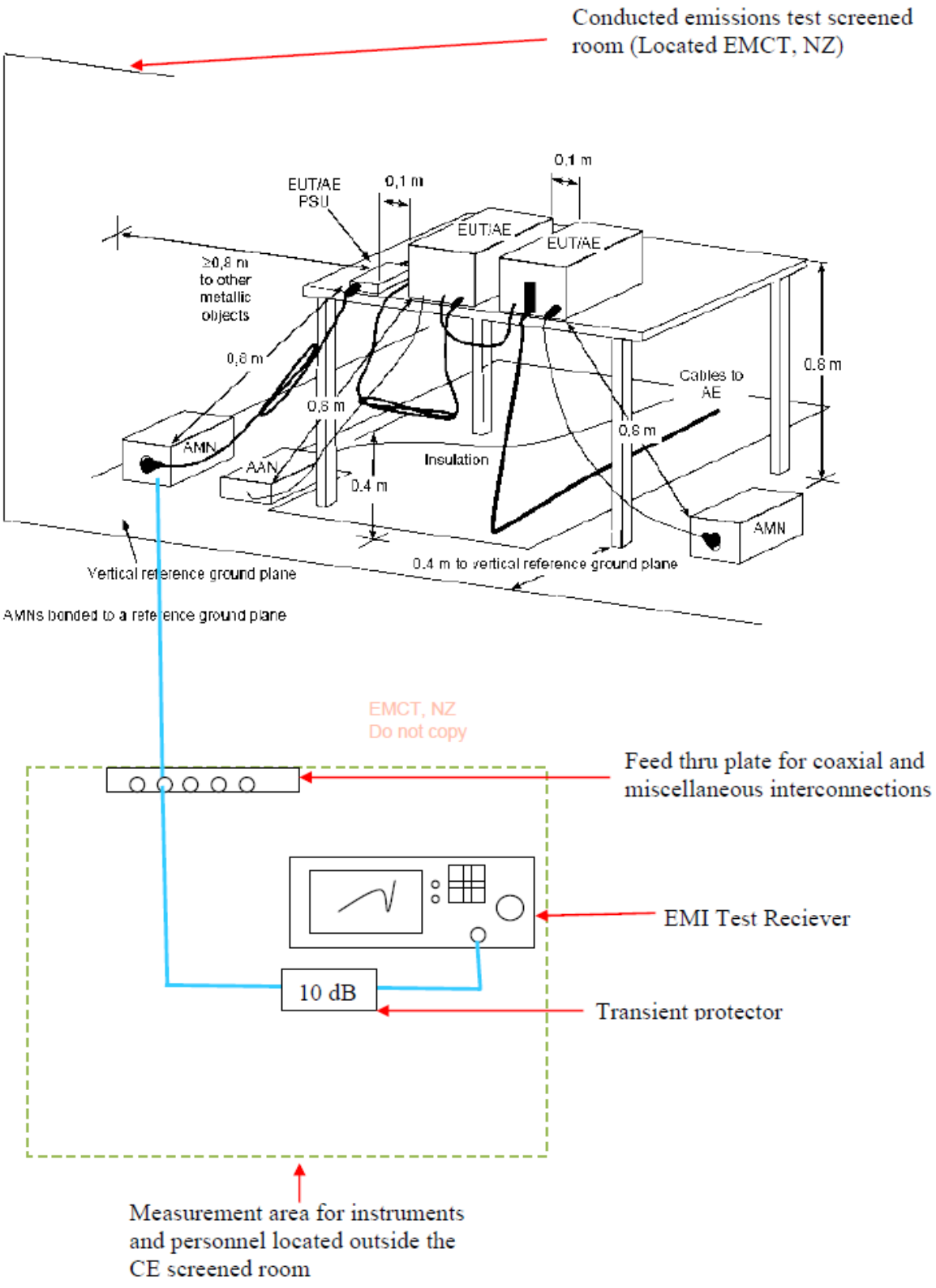
The supplied plot is combined plot showing the worst case quasi peak and average results of both the phase and neutral lines to the representative AC power supply.

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

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

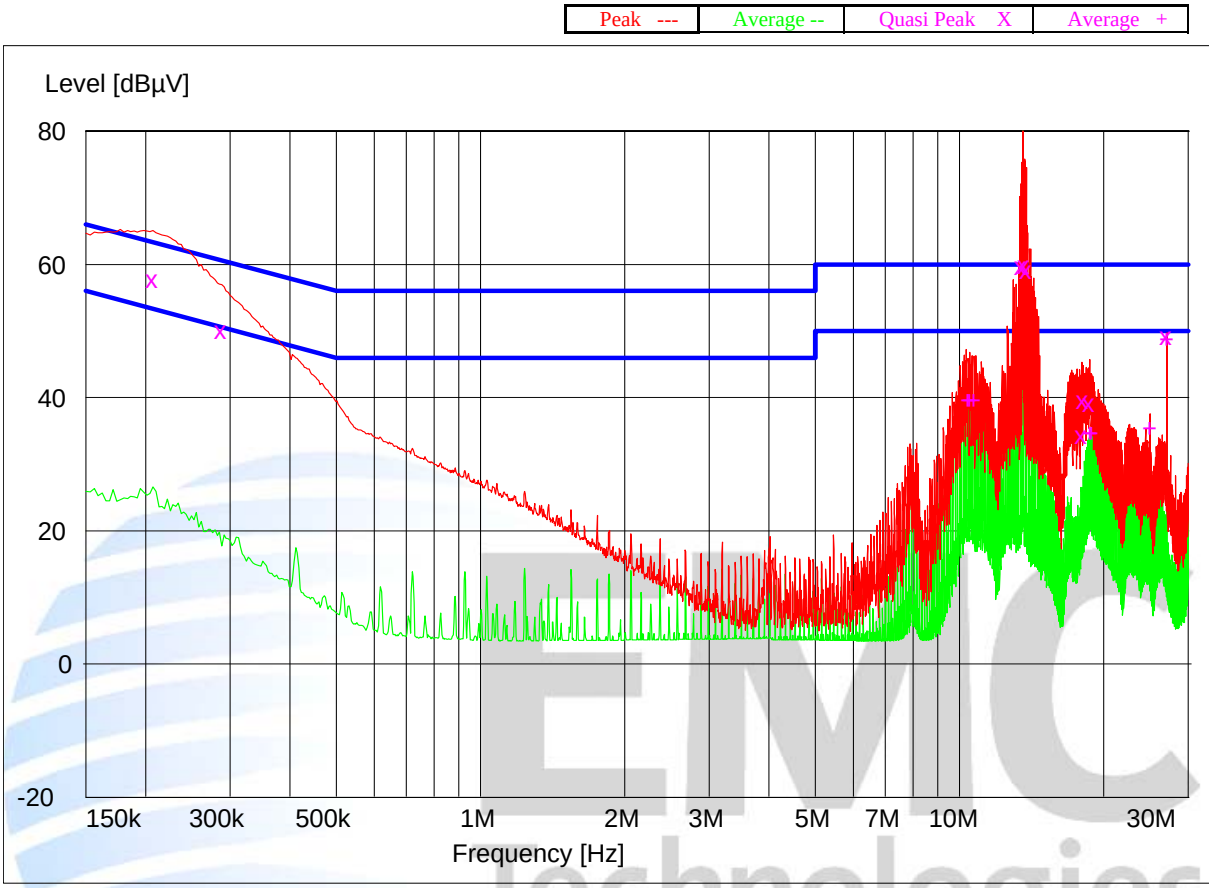
EMI Receiver Used: ESHS 10

Block Diagram showing the conducted emission test setup



Conducted Emissions – AC Input Power Port– Antenna Attached Test

Setup:	Device was tested transmitting continuously when attached to a representative power supply that was powered at 120 Vac 60 Hz which supplied 12 Vdc to a Gallagher controller 6000 device which in turn supplied 12 Vdc to the reader.



Final Quasi-Peak Measurements

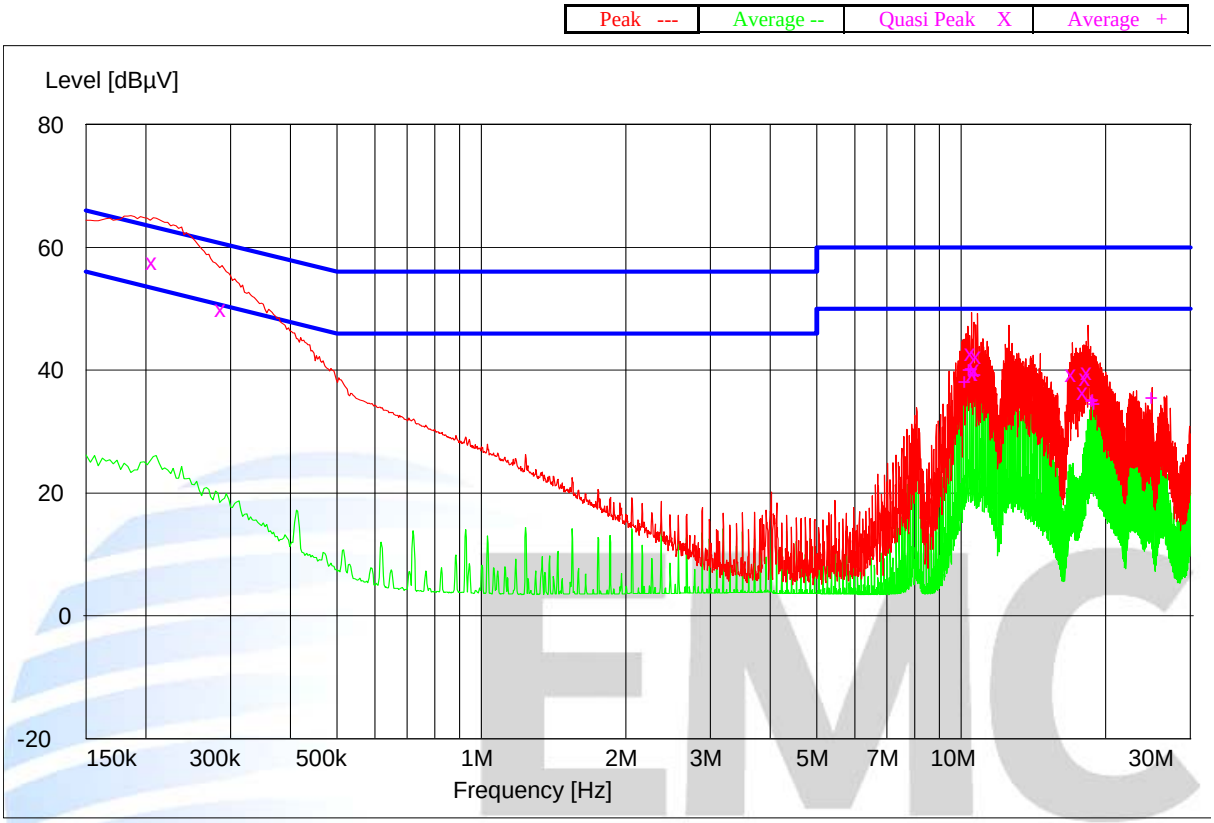
Frequency (MHz)	Level (dBµV)	Limit (dBµV)	Margin (dB)	Phase	Rechecks (dBµV)
0.207000	57.9	63.4	5.5	N	
0.288000	50.2	60.6	10.4	L1	
13.479500	59.8	60.0	0.2	L1	
13.556000	94.0	60.0	-34.0	N	Fundamental
13.691000	60.0	60.0	0.0	N	
13.772000	59.2	60.0	0.8	L1	
18.033500	34.3	60.0	25.7	N	
18.101000	39.7	60.0	20.3	N	
18.686000	39.3	60.0	20.7	N	
27.119000	49.2	60.0	10.8	N	

Final Average Measurements

Frequency (MHz)	Level (dBµV)	Limit (dBµV)	Margin (dB)	Phase	Rechecks (dBµV)
10.401500	39.7	50.0	10.3	N	39.7
10.505000	39.7	50.0	10.3	N	
10.712000	39.7	50.0	10.3	N	
13.556000	94.0	50.0	-44.0	N	Fundamental
18.749000	34.7	50.0	15.3	N	
18.852500	34.7	50.0	15.3	N	
24.999500	35.4	50.0	14.6	N	
27.119000	48.8	50.0	1.2	N	48.8

Conducted Emissions – AC Input Power Port– Dummy Load

Setup:	Device was tested transmitting continuously when attached to a representative power supply that was powered at 120 Vac 60 Hz which supplied 12 Vdc to a Gallagher controller 6000 device which in turn supplied 12 Vdc to the reader.



Final Quasi-Peak Measurements

Frequency (MHz)	Level (dBµV)	Limit (dBµV)	Margin (dB)	Phase	Rechecks (dBµV)
0.207000	57.7	63.3	5.6	N	
0.288000	50.0	60.6	10.6	L1	
10.509500	42.8	60.0	17.2	N	
10.617500	39.5	60.0	20.5	N	
10.716500	40.3	60.0	19.7	N	
10.815500	42.3	60.0	17.7	N	
17.030000	39.4	60.0	20.6	N	
18.006500	36.5	60.0	23.5	N	
18.200000	38.7	60.0	21.3	N	
18.393500	39.7	60.0	20.3	N	

Final Average Measurements

Frequency (MHz)	Level (dBµV)	Limit (dBµV)	Margin (dB)	Phase	Rechecks (dBµV)
10.199000	38.1	50.1	12.0	N	
10.401500	40.1	50.0	9.9	N	
10.505000	40.3	50.0	9.7	N	
10.712000	39.3	50.0	10.7	N	
18.744500	35.0	50.0	15.0	N	
18.848000	35.1	50.0	15.0	N	
18.951500	34.6	50.0	15.4	N	
24.999500	35.4	50.0	14.6	N	

Section 15.209: Radiated emission limits, general requirements

Radiated emission testing was carried out over the frequency range of 30 MHz to 2000 MHz as the device contains a 13.560 MHz NFC transceiver and the client has declared that the digital device is greater than 108 MHz but less than 500 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 12 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 13.560 MHz.

Attached to the reader was a single 4 wire cable which enables 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.

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

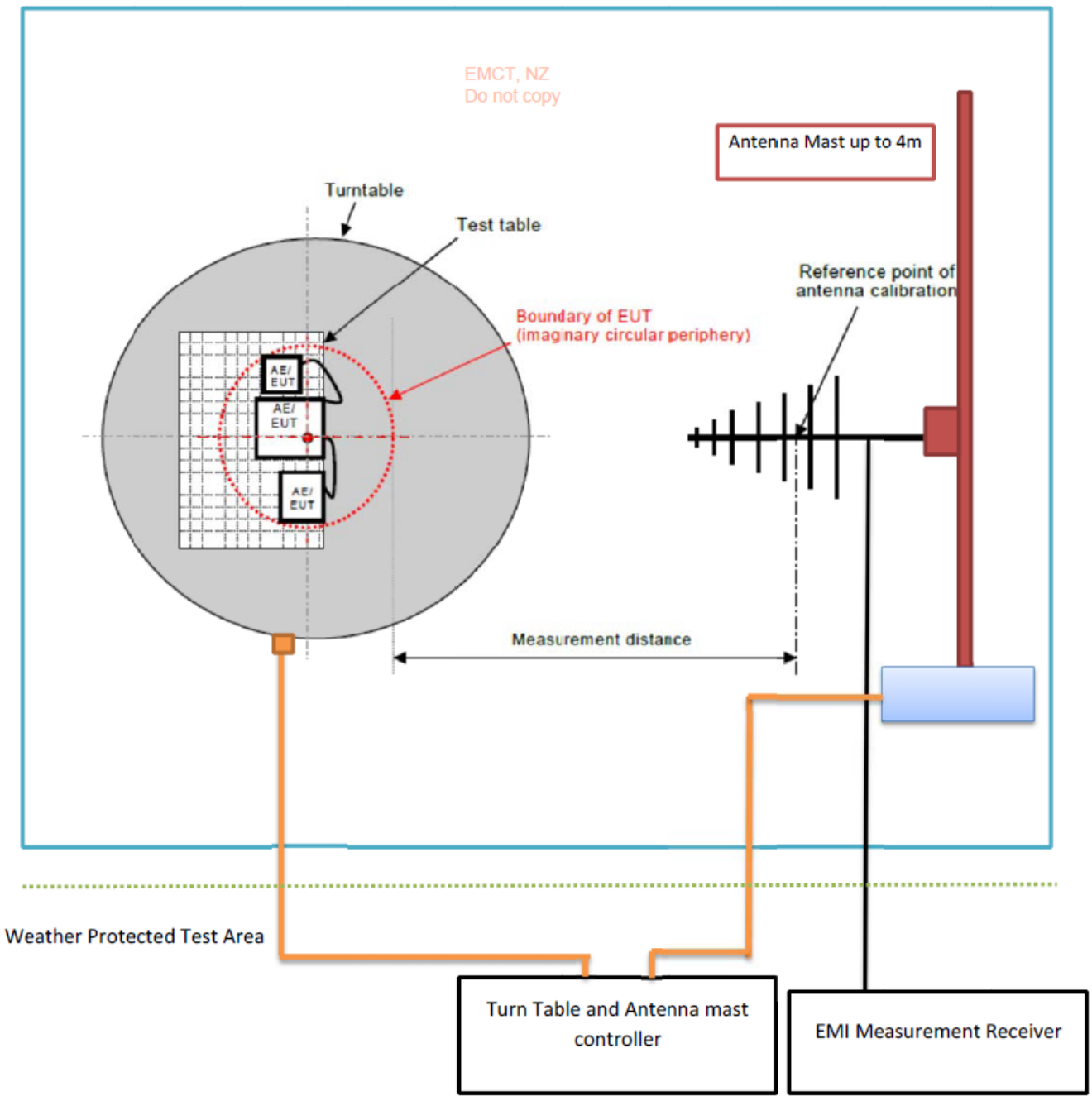
45.5 dBµV/m = 30.0 dBµV + 14 dB/m + 1.5 dB

Result: Complies

Measurement uncertainty with a confidence interval of 95% is:
- Free radiation tests (100 kHz – 30 MHz) ± 4.8 dB
- Free radiation tests (30 – 2000 MHz) ± 4.1 dB

EMI Receiver Used: ESIB40

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-2 GHz: Log Periodic Antenna; Measurement distance: 3 m

Above 2 GHz: Horn Antenna; Measurement distance: 3 m

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

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
27.12	35.3	48.6	13.3	Pass

The Reader 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 – 1000 MHz have been made at a distance of 3 metres.

The limits as described in Section 15.209 have been applied.

Frequency (MHz)	Vertical (dBµV/m)	Horizontal (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result	Antenna Polarisation
32.240	26.2	21	40.0	13.8	Pass	Vertical
40.680	39.1	23.1	40.0	0.9	Pass	Vertical
41.000	23.4	30.4	40.0	9.6	Pass	Horizontal
54.200	30.1	15.9	40.0	9.9	Pass	Vertical
62.800	31.8	17.2	40.0	8.2	Pass	Vertical
65.360	35.3	23.3	40.0	4.7	Pass	Vertical
67.800	38.3	24.5	40.0	1.7	Pass	Vertical
69.160	35.5	26.6	40.0	4.6	Pass	Vertical
71.800	36.0	26.6	40.0	4.0	Pass	Vertical
75.600	33.4	27.6	40.0	6.6	Pass	Vertical
78.160	38.9	26.5	40.0	1.0	Pass	Vertical
81.320	37.4	27.9	40.0	2.6	Pass	Vertical
84.440	38.6	27.5	40.0	1.4	Pass	Vertical
114.010	25.1	29.4	43.4	14.0	Pass	Horizontal
117.200	25.1	29.6	43.4	13.8	Pass	Horizontal
124.280	23.0	32.4	43.4	11.0	Pass	Horizontal
131.000	28.5	-	43.4	14.9	Pass	Vertical
135.560	30.8	37.6	43.4	5.8	Pass	Horizontal
143.400	33	-	43.4	10.4	Pass	Vertical
150.760	17	-	43.4	26.4	Pass	Vertical
179.960	29.4	28.6	43.4	14.0	Pass	Vertical
234.120	26.1	-	46.0	19.9	Pass	Vertical
261.840	31.7	40.3	46.0	5.66	Pass	Horizontal
419.720	25.1	23.3	46.0	20.9	Pass	Vertical
435.440	25.2	23.9	46.0	20.8	Pass	Vertical
530.880	27.7	26.0	46.0	18.3	Pass	Vertical

No further emissions were detected within 15 dB of the limit when measurements were made between 30 - 1000 MHz using both vertical and horizontal polarisations.

Result: Complies.

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.

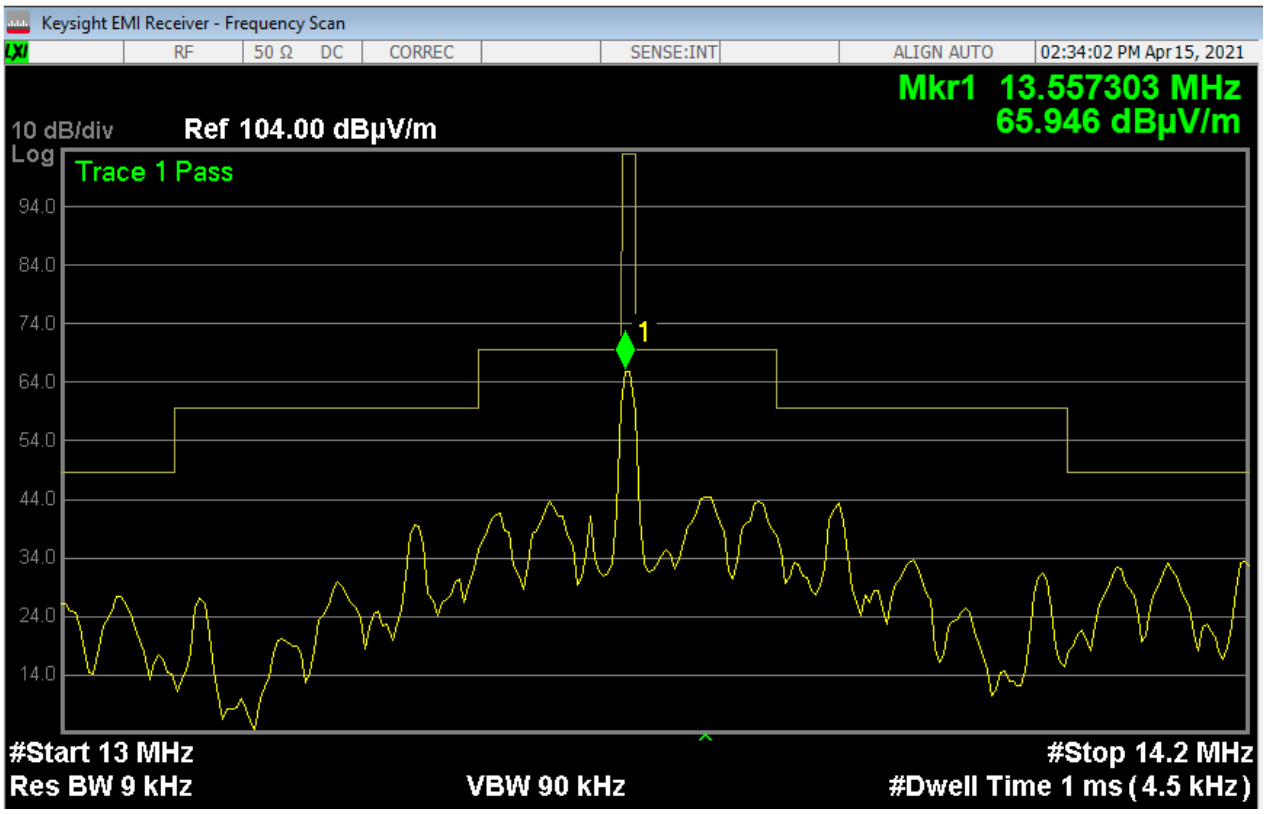
Measurements were made at a distance of 10 metres with the limit being determined by using the extrapolation factor of 40 dB per decade limit, as detailed in section 15.31 f (2).

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	65.8	103.1	37.3
120.0	13.560	65.9	103.1	37.2
138.0	13.560	66.0	103.1	37.1



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 13.56 MHz which gives a frequency tolerance of +/- 1,356.0 Hz.

Temperature (°C)	Frequency (MHz)	Difference (Hz)
50	13.559275	-725
40	13.559260	-740
30	13.559300	-700
20	13.559200	-800
10	13.559290	-710
0	13.559320	-680
-10	13.559345	-655
-20	13.559355	-645

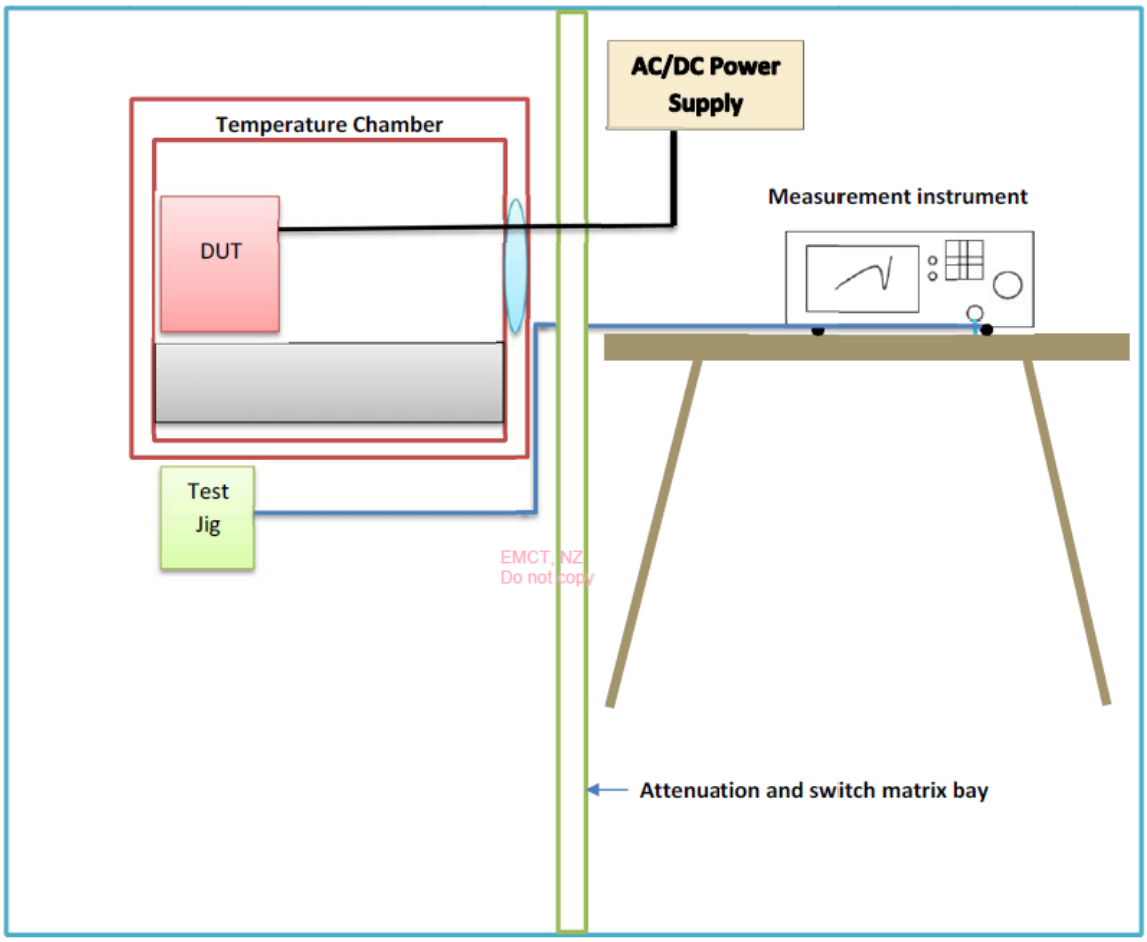
Input voltage was varied by +/- 15% at 20 degrees C (ambient).

Voltage (Vac)	Frequency (MHz)	Difference (Hz)
102.0	13.559200	-800
120.0	13.559200	-800
138.0	13.559200	-800

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 (1m+3m)	Huber and Suhner Succoflex	340521/4 339901/4
Voltage Variac	Powerteck	SRV-5 RFS3800

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 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	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 2021	5 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 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

Top face

Side face

Side face

Label

Conducted emissions test setup

Radiated emissions test set up

Radiated emissions test set up

Biconical Antenna

Log periodic Antenna

Loop Antenna