



EMC Technologies (NZ) Ltd
PO Box 68-307, Newton
Auckland 1145
New Zealand
Phone 09 360 0862
Fax 09 360 0861
E-Mail Address: aucklab@ihug.co.nz
Web Site: www.emctech.com.au

TEST REPORT

**Etherstack Inc. SFFR615WUH1
UHF Small Form Factor Repeater**

tested to

47 Code of Federal Regulations

Part 15 - Radio Frequency Devices

Subpart A + B

for

Etherstack Inc.

A handwritten signature in black ink, appearing to read "Andrew Cutler".

This Test Report is issued with the authority of:


Andrew Cutler - General Manager



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

Table of Contents

1. STATEMENT OF COMPLIANCE	3
2. RESULTS SUMMARY	3
3. INTRODUCTION	3
4. CLIENT INFORMATION	4
5. TEST SAMPLE DESCRIPTION	4
6. RESULTS	5
7. TEST EQUIPMENT USED	13
8. ACCREDITATIONS	13
9. PHOTOGRAPHS	14

The logo for EMC Technologies is a large, semi-transparent watermark in the center of the page. It features the letters 'EMC' in a large, bold, sans-serif font, with 'Technologies' written in a smaller, lighter font underneath. To the left of the text is a stylized graphic of a globe or a signal wave, composed of several curved, overlapping bands in shades of blue and white.

1. STATEMENT OF COMPLIANCE

The Etherstack Inc. SFFR615WUH1 UHF Small Form Factor Repeater complies as a FCC Part 15 Class B Computer Peripheral device when the Class B limits contained within Subparts A + B are applied and when the methods described in ANSI C63.4 - 2003 are applied.

2. RESULTS SUMMARY

The results of testing, carried out between 12th and the 27th November 2014, are summarised below.

Clause	Parameter	Result
15.101	Equipment authorisation requirement.	This device would be classed as a Class B computer peripheral and would be subject to certification. The device also contains a receiver that would be subject to the verification process.
15.103	Exempted devices.	Device is not exempt as it contains a receiver and a digital device.
15.107	Conducted Emissions 0.15 - 30 MHz	Complies.
15.109	Radiated Emissions 30 - 2000 MHz	Complies.
15.111	Antenna Terminal Disturbance 30 – 950 MHz	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.

4. CLIENT INFORMATION

Company Name Etherstack Inc.
Address 1115 Broadway, Suite 1276,
New York, NY 10010
Country United States of America
Contact Mr Doug Chapman

5. TEST SAMPLE DESCRIPTION

Brand Name Etherstack Inc.
Model Number SFFR615WUH1
Product UHF Small Form Factor Repeater
Manufacturer Etherstack London Ltd
Country of Origin Australia
Serial Number 1200018
FCC ID 2ADAKSFFR615WUH1

The SFFR615WUH1 is a small form factor portable repeater that is self-powered and can operate as an APCO P25 standalone repeater.

Power Supply:

- DC Supply 12 Vdc 10.8 – 15.6 volt dc Max 10 amps
- AC Supply: 100 - 240 Vdc (47-63 Hz)
- Internal Batteries 11.25 Vdc Li-ION rechargeable x 2

Receiver test frequencies

Frequency (MHz)	Spacing (kHz)
380.000	12.5
450.000	12.5
520.000	12.5

6. RESULTS

Standard

The sample was tested in accordance with 47 CFR Part 15 Subpart A and B with the Class B limits being applied.

Standard

The sample was tested in accordance with 47 CFR Part 15 Subpart A and B.

Methods and Procedures

The following measurement methods and procedures have been applied:

- ANSI C63.4 – 2003

Section 15.101: Equipment authorisation requirement

This device would be classed as a Class B Computer Peripheral to which the Certification process has been applied.

The device also contains a Receiver contained within a Transceiver which would be subjected to the Verification process.

This test report contains test results for both devices and both processes with the process being indicated in brackets with regard the results being presented.

Section 15.107: Conducted limits (Certification and Verification)

Conducted emission testing has been carried out when the device was powered at 120 Vac 60 Hz using a representative AC power supply.

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

Testing was carried out in accordance with section 15.107(a) using a measuring receiver and a 50 μ H / 50 ohm artificial mains network which is also known as a line impedance stabilisation network (LISN).

Measurements on both the phase and neutral lines were made using either a Quasi Peak or an Average detector with a 9 kHz bandwidth.

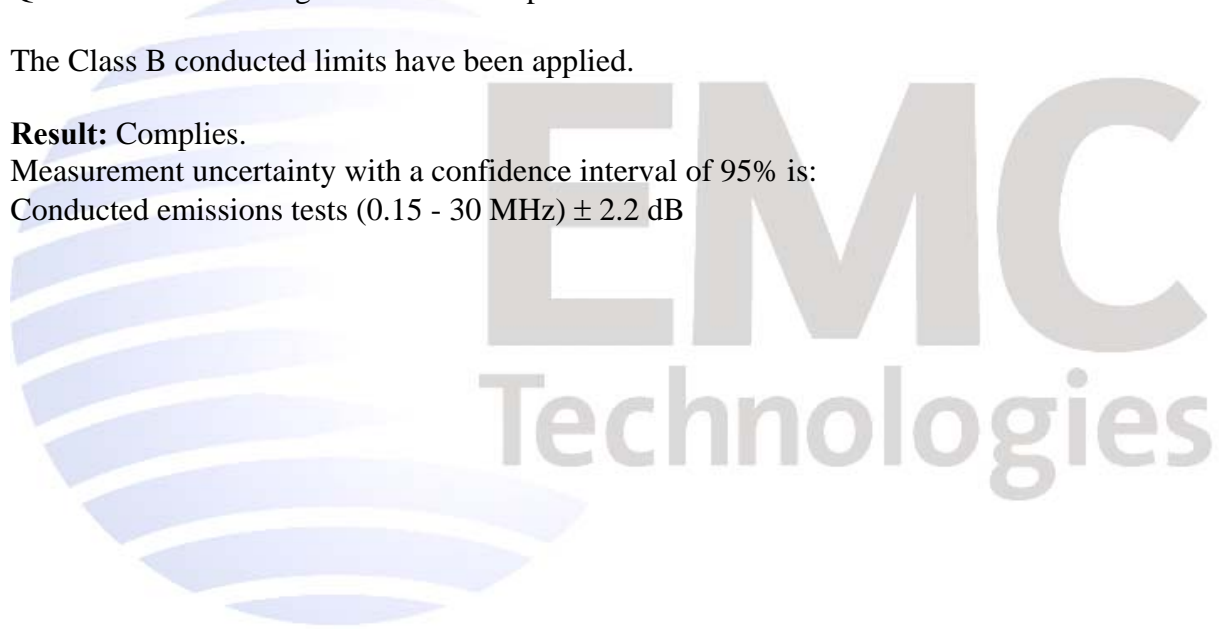
The supplied conducted emission plot is a combined plot showing the worst case of the Peak, Quasi Peak and Average levels for both phase and neutral.

The Class B conducted limits have been applied.

Result: Complies.

Measurement uncertainty with a confidence interval of 95% is:

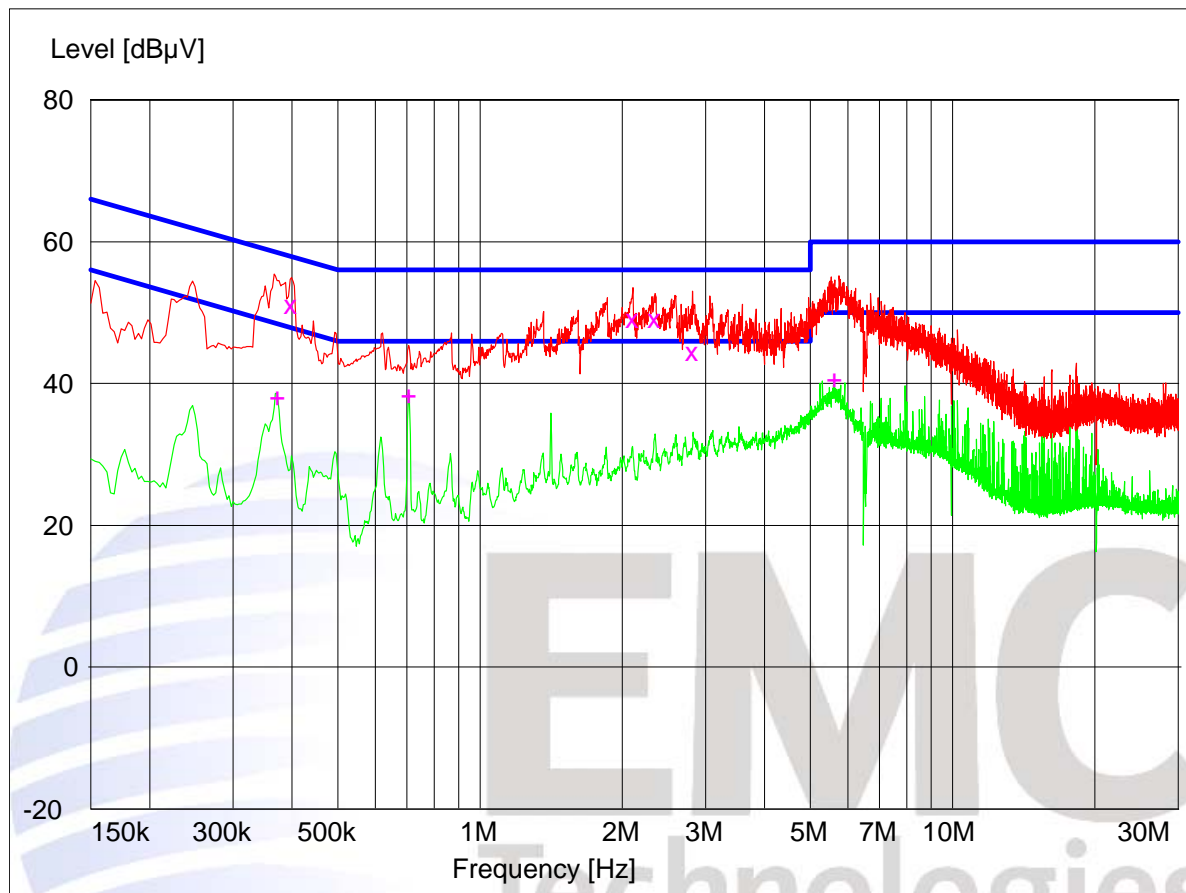
Conducted emissions tests (0.15 - 30 MHz) \pm 2.2 dB



Conducted Emissions – AC Input Power Port

Setup: Device transmitting continuously into a dummy load with the digital device active when powered by 120 Vac 60 Hz

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



Final Quasi-Peak Measurements

Frequency MHz	Level dBµV	Limit dBµV	Margin dB	Phase	Rechecks dBµV
0.399000	51.20	57.9	6.7	L1	
2.103500	49.20	56.0	6.8	L1	
2.346500	49.20	56.0	6.8	L1	
2.814500	44.50	56.0	11.5	L1	

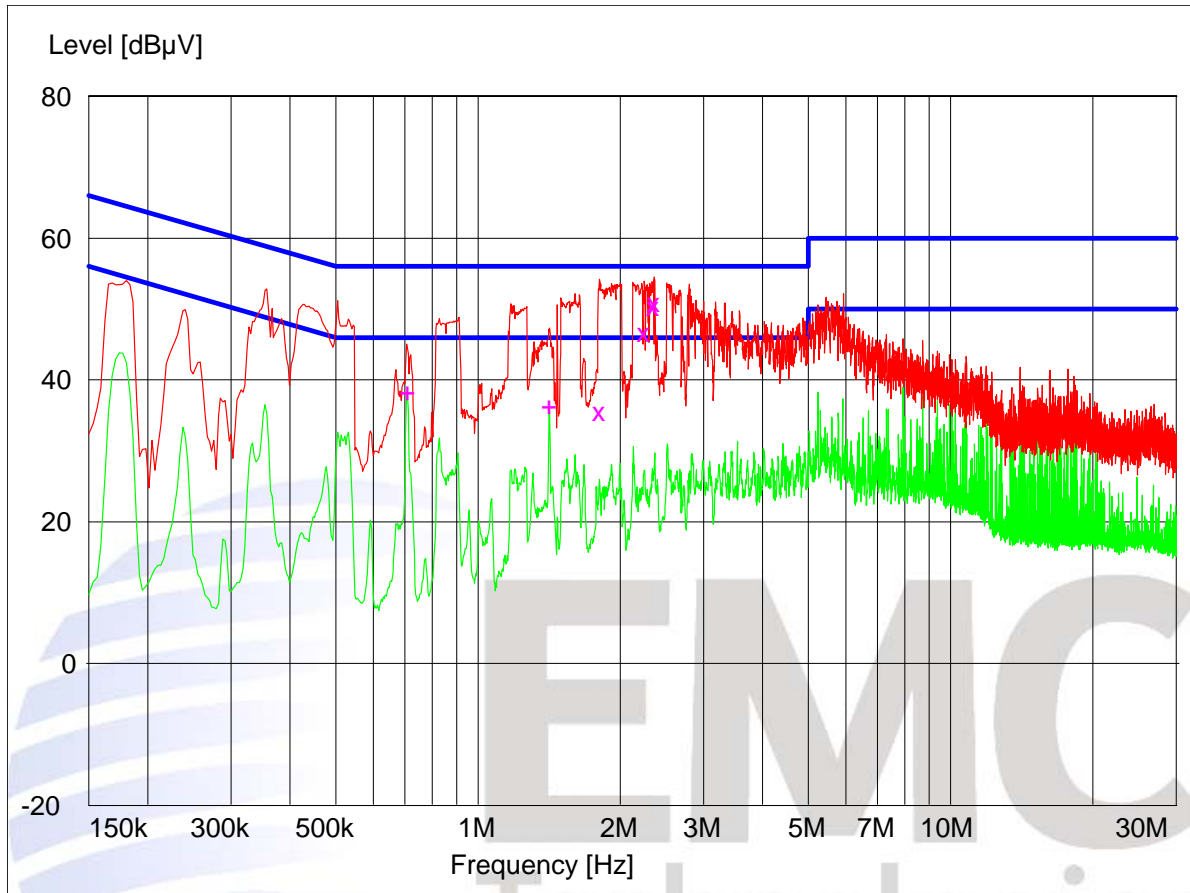
Final Average Measurements

Frequency MHz	Level dBµV	Limit dBµV	Margin dB	Phase	Rechecks dBµV
0.372000	38.20	48.5	10.3	L1	
0.705000	38.50	46.0	7.5	L1	
5.604500	40.70	50.0	9.3	L1	

Conducted Emissions – AC Input Power Port

Setup: Device in Receive / Standby mode with the digital device active when powered at 120 Vac 60 Hz.

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



Final Quasi-Peak Measurements

Frequency MHz	Level dBµV	Limit dBµV	Margin dB	Phase	Rechecks dBµV
1.806000	35.50	56.0	20.5	L1	
2.247500	46.70	56.0	9.3	L1	
2.351000	50.30	56.0	5.7	L1	
2.360000	50.90	56.0	5.1	L1	

Final Average Measurements

Frequency MHz	Level dBµV	Limit dBµV	Margin dB	Phase	Rechecks dBµV
0.708000	38.30	46.0	7.7	L1	
1.413000	36.40	46.0	9.6	L1	

Section 15.109: Radiated spurious emissions

Radiated emission testing was carried out over the frequency range of 30 to 2000 MHz as the highest frequency in use in the digital device is less than 500 MHz.

The 2nd harmonic of the highest receiver local oscillator frequency is less than 2000 MHz (1220 MHz).

Testing was carried out at the laboratory's open area test site - located at 670 Kawakawa Orere Rd, RD3, Papakura, New Zealand.

Before testing was carried out, a receiver Self Test and Internal Calibration was undertaken along with a check of all connecting cables and programmed antenna factors.

The device was placed on the test tabletop, which was a total of 0.8 m above the test site ground plane.

Measurements below 1000 MHz were made using a Quasi Peak Detector with a bandwidth of 120 kHz.

Above 1000 MHz measurements were made using a Peak Detector and an Average Detector with a bandwidth of 1 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 with an automated antenna tower.

All emissions were measured in both vertical and horizontal antenna polarisations.

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

Level (dB μ V/m) = Receiver Reading (dB μ V) + Antenna Factor (dB/m) + Coax Loss (dB) – Amplifier Gain (dB)

The Class B limits have been applied.

The receiver was tested when a dummy load was attached to the antenna port and the receiver was tuned to 380.00, 480.525 and 520.000 MHz.

The receiver has an intermediate frequency of +90.0 MHz.

The digital device was tested when an Ethernet cable was attached to the Ethernet port and the receiver was operating when tuned to 520.000 MHz.

Field strength of the receiver spurious emissions (Verification)

The receiver was tested when a dummy load was attached to the antenna port and an Ethernet cable was attached to the Ethernet port.

Testing of the receiver was carried out when it was receiving on 380.00, 450.525 and 520 MHz.

The receiver has an intermediate frequency of +90.0 MHz

No specific receiver emissions were detected with emissions observed to have a margin to the limit that exceeded 20 dB.

Result: Complies.

Measurement Uncertainty: ± 4.1 dB



Digital device spurious emissions 30-2000 MHz (Certification)

The device was tested when a dummy load was attached to the antenna port and an Ethernet cable was attached to the Ethernet port.

All other emissions observed had a margin to the limit that exceeded 20 dB.

Device was tested on an open area test site at a distance of 3 metres.

Below 1000 MHz a quasi-peak detector was used with a bandwidth of 120 kHz

Above 1000 MHz an average detector and a peak detector were used with a bandwidth of 1 MHz.

Frequency (MHz)	Vertical (dB μ V/m)	Horizontal (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result	Antenna
30.000	24.2	25.1	40.0	14.9	Pass	Horizontal
31.000	24.5	24.9	40.0	15.1	Pass	Horizontal
32.000	24.0	24.4	40.0	15.6	Pass	Horizontal
33.000	21.0	24.1	40.0	15.9	Pass	Horizontal
35.000	26.3	23.6	40.0	13.7	Pass	Vertical
36.000	25.5	23.3	40.0	14.5	Pass	Vertical
39.000	28.3	22.5	40.0	11.7	Pass	Vertical
43.000	25.1	21.0	40.0	14.9	Pass	Vertical
56.000	28.5	18.8	40.0	11.5	Pass	Vertical
63.000	24.2	-	40.0	15.8	Pass	Vertical
76.000	22.0	-	40.0	18.0	Pass	Vertical
78.000	25.0	-	40.0	15.0	Pass	Vertical
82.000	22.7	-	40.0	17.3	Pass	Vertical
208.000	22.9	28.8	43.5	14.7	Pass	Horizontal
340.000	20.7	16.5	46.0	25.3	Pass	Vertical
396.000	20.0	16.5	46.0	26.0	Pass	Vertical
400.000	24.6	21.6	46.0	21.4	Pass	Vertical
402.000	21.0	19.0	46.0	25.0	Pass	Vertical
416.000	22.5	18.2	46.0	23.5	Pass	Vertical
420.000	35.1	22.5	46.0	10.9	Pass	Vertical

Result: Complies.

Measurement Uncertainty: ± 4.1 dB

Section 15.111: Receiver spurious emissions at antenna terminals (Verification)

Testing was carried out at the antenna port.

The receiver has an intermediate frequency of +90.0 MHz

Testing was performed on receive channels 380.000, 480.525 and 520 MHz.

Frequency: 380.000 MHz

Frequency (MHz)	Level (dBm)	Limit (dBm)
470.000	-91.0	-57.0
1880.000	-92.5	-47.0

Frequency: 450.525 MHz

Frequency (MHz)	Level (dBm)	Limit (dBm)
540.525	-97.3	-57.0

Frequency: 520.000 MHz

Frequency (MHz)	Level (dBm)	Limit (dBm)
610.000	-95.2	-57.0

No other emissions observed.

Limit:

In accordance with CFR 47 Part 15, section 15.111 the power of any emission at the antenna terminal should not exceed 2 nW (-57.0 dBm).

Result: Complies

Measurement Uncertainty: ± 3.3 dB

7. TEST EQUIPMENT USED

Instrument	Manufacturer	Model	Serial No	Asset Ref	Cal Due	Interval
Aerial Controller	EMCO	1090	9112-1062	RFS 3710	Not applic	-
Aerial Mast	EMCO	1070-1	9203-1661	RFS 3708	Not applic	-
Biconical Antenna	Schwarzbeck	BBA 9106	-	RFS 3612	7 Feb 2015	1 year
Horn Antenna	EMCO	3115	9511-4629	E1526	4 June 2017	3 year
Log Periodic	Schwarzbeck	VUSLP 9111	9111-228	3785	7 Feb 2015	1 year
Mains Network	R & S	ESH2-Z5	881362/032	3628	23 Oct 2016	2 year
Receiver	R & S	ESHS 10	828404/005	3728	27 June 2015	2 year
Receiver	R & S	ESIB 40	100171	R-27-1	29 Jan 2015	1 year
Spectrum Analyser	Hewlett Packard	E7405A	US39150142	3771	7 July 2015	1 year
Turntable	EMCO	1080-1-2.1	9109-1578	RFS 3709	Not applic	-
VHF Balun	Schwarzbeck	VHA 9103	-	RFS 3603	7 Feb 2015	1 year

At the time of testing all test equipment was within calibration.

8. ACCREDITATIONS

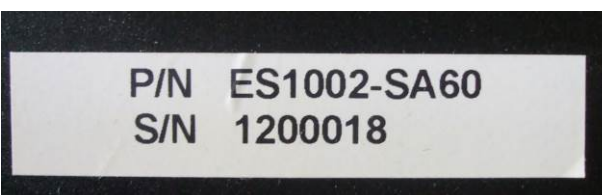
Testing was carried out in accordance with EMC Technologies Ltd registration with the Federal Communications Commission as a listed facility, registration number: 90838, which was updated in June 2014.

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



Radiated emissions setup



