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## ELPRO E2-950 UHF Module Transceiver

*tested to the*

**Code of Federal Regulations (CFR) 47**

**Part 90 –Private Land Mobile Services**

*for*

**ELPRO Technologies Pty Ltd**

This Test Report is issued with the authority of:

A handwritten signature in black ink that reads "Andrew Cutler". The signature is written in a cursive style and is positioned above a horizontal line.

**Andrew Cutler - General Manager**



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

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## 1. COMPLIANCE STATEMENT

The **ELPRO E2-950 UHF Module Transceiver** complies with the limits defined in 47 CFR Part 90 when tested in-accordance with the test methods described in 47 CFR Part 2 and ANSI / TIA-603-D-2010.

## 2. RESULT SUMMARY

The results of testing carried out in September 2016 are summarised below.

Clause	Description	Result
90.203	Certification required	Noted
2.1046 90.205	RF power output Power and antenna height limits	Noted Complies
2.1049 2.202	Occupied bandwidth Bandwidths	Noted Noted
90.207 90.209 90.210	Types of emissions Bandwidth limitations Emission masks	Complies Complies Complies
2.1051	Spurious emissions at antenna terminals	Complies
2.1053	Field strength of spurious radiation	Complies
2.1055 90.213	Frequency stability Frequency stability	Noted Complies
1.1310	Radio frequency exposure limits	Complies

### 3. ATTESTATION

This report describes the tests and measurements performed for the purpose of determining compliance with the specification with the following conditions:

**The client selected the test sample.**

**The report relates only to the sample tested.**

**This report does not contain 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.

In addition this equipment has been tested in accordance with the requirements contained in the appropriate Commission regulations.

All compliance statements have been made with respect of the specification limit with no reference to the measurement uncertainty.

To the best of my knowledge, these tests were performed using measurement procedures that are consistent with industry or Commission standards and demonstrate that the equipment complies with the appropriate standards.

I further certify that the necessary measurements were made by EMC Technologies NZ Ltd, 47 MacKelvie Street, Grey Lynn, Auckland, New Zealand.



Andrew Cutler  
General Manager  
EMC Technologies NZ Ltd

## 4. CLIENT INFORMATION

**Company Name** ELPRO Technologies Pty Ltd  
**Address** 9/12 Billabong Street  
**City** Stafford  
**State** Queensland 4053  
**Country** Australia  
**Contact** Mr Harry Courtice

## 5. TEST SAMPLE DESCRIPTION

**Brand Name** ELPRO  
**Model Number** E2-950  
**Product** UHF Module Transceiver  
**Manufacturer** ELPRO Technologies Pty Ltd  
**Manufactured in** Australia  
**Serial Number** 06160380  
**FCC ID** O9P-E2-950



The device tested is a module transmitter that is intended for use in the FCC licensed bands that has previously been certified to FCC parts 90 and 101 between 932.5 - 952.0 MHz.

Class 2 permissive change testing was carried out in order to extend the frequency range of the Limited Modular Certification to 928 – 954 MHz

The device tested had the following specifications:

### **Rated Transmitter Output Power**

5.0 Watts (37.0 dBm)

### **Transmitter Frequency Operating Range**

928.0 - 954.0 MHz

**FCC Band(s): Part 90:**

929.0 – 930.0 MHz

935.0 – 940.0 MHz

**Channel Spacing:**

25.0 kHz

**Emission Designators / Modes of operation:**

16k0F1D – Data at a rate of 19200 bps using 4FSK and a symbol rate of 9600.

**Test frequency**

929.100 MHz

**Power Supply**

DC voltage supply 9-30 Vdc, typically 13.8 Vdc

**Standard Temperature and Humidity**

Temperature: +15°C to + 30° maintained.

Relative Humidity: 20% to 75% observed.

**Standard Test Power Source**

Standard Test Voltage: 13.8 Vdc

**Extreme Temperature**

High Temperature: + 50°C maintained.

Low Temperature: - 30 °C maintained.

**Extreme Test Voltages**

High Voltage: 30.0 Vdc

Low Voltage: 9.0 Vdc

## 6. TEST RESULTS

### RF power output

Measurements were carried out at the RF output terminals of the transmitter using a 30 dB power attenuator and a 50  $\Omega$  dummy load.

Measurements were carried out when the transmitter was being modulated with a data rate of 19600 bps using 4FSK and also using an un-modulated carrier with the worst case result being recorded below.

Testing was carried out at maximum rated power output of 5 watts (37 dBm).

Frequency (MHz)	Voltage (Vdc)	Rated (dBm)	Measured (dBm)
929.100	9.0	37.0	36.9
	13.8	37.0	36.9
	30.0	37.0	36.9

### Limits:

Part 90.205 specifies the maximum allowable station effective radiated power (ERP) is dependent upon the station's antenna HAAT and the required service area.

**Result:** Complies

**Measurement Uncertainty:**  $\pm 0.5$  dB

**Part 90.207 – Emission types:**

F1D: FSK (Frequency shift keying) for data transmission at 19200 bps using 4FSK and a symbol rate of 9600.

**Part 90.209 – Bandwidth limitations:**

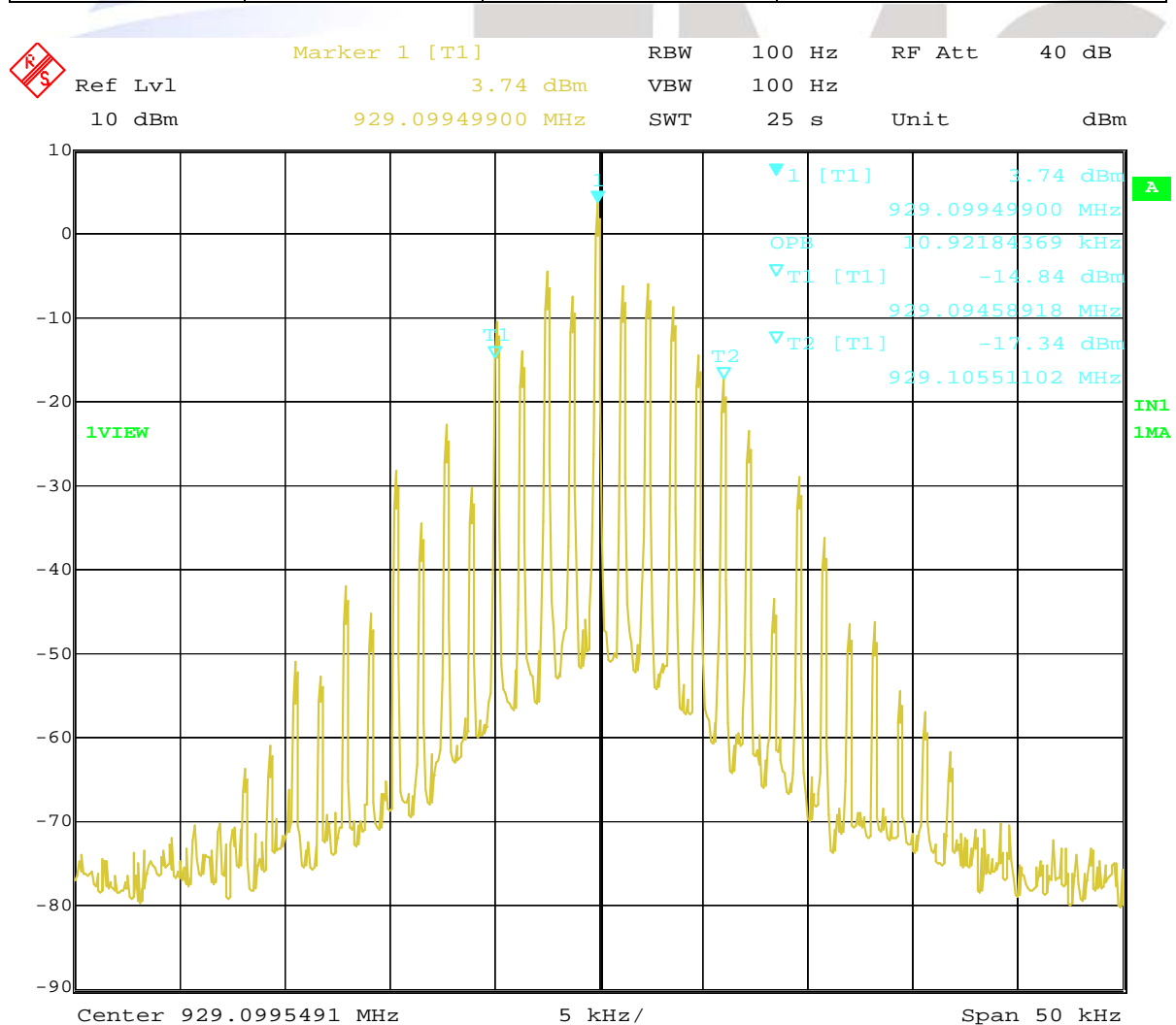
This transmitter uses Frequency Shift Keying (FSK) for data transmission at 19200 bps using 4FSK.

Measurements have been made using a spectrum analyser operating in peak hold mode and a 30 dB attenuator.

Measurements have been made using spectrum analyser with the occupied bandwidth function activated.

**Nominal Frequency: 929.100 MHz**

Emission	Channel (kHz)	Measured (kHz)	Authorised Bandwidth (kHz)
F1D	25.0	10.9218	20.0



Date: 1.JAN.1997 01:25:22

**Result: Complies.**



## Part 90.210 - Spectrum Masks

Part 90.210 states all equipment operating in other bands equipment designed to operate with a must meet the requirements of Emission Mask B or C, as applicable.

Mask B has been applied as the transmitter has an audio low pass filter.

The transmitter can operate using an authorised bandwidth of 20 kHz and a channel spacing of 25 kHz.

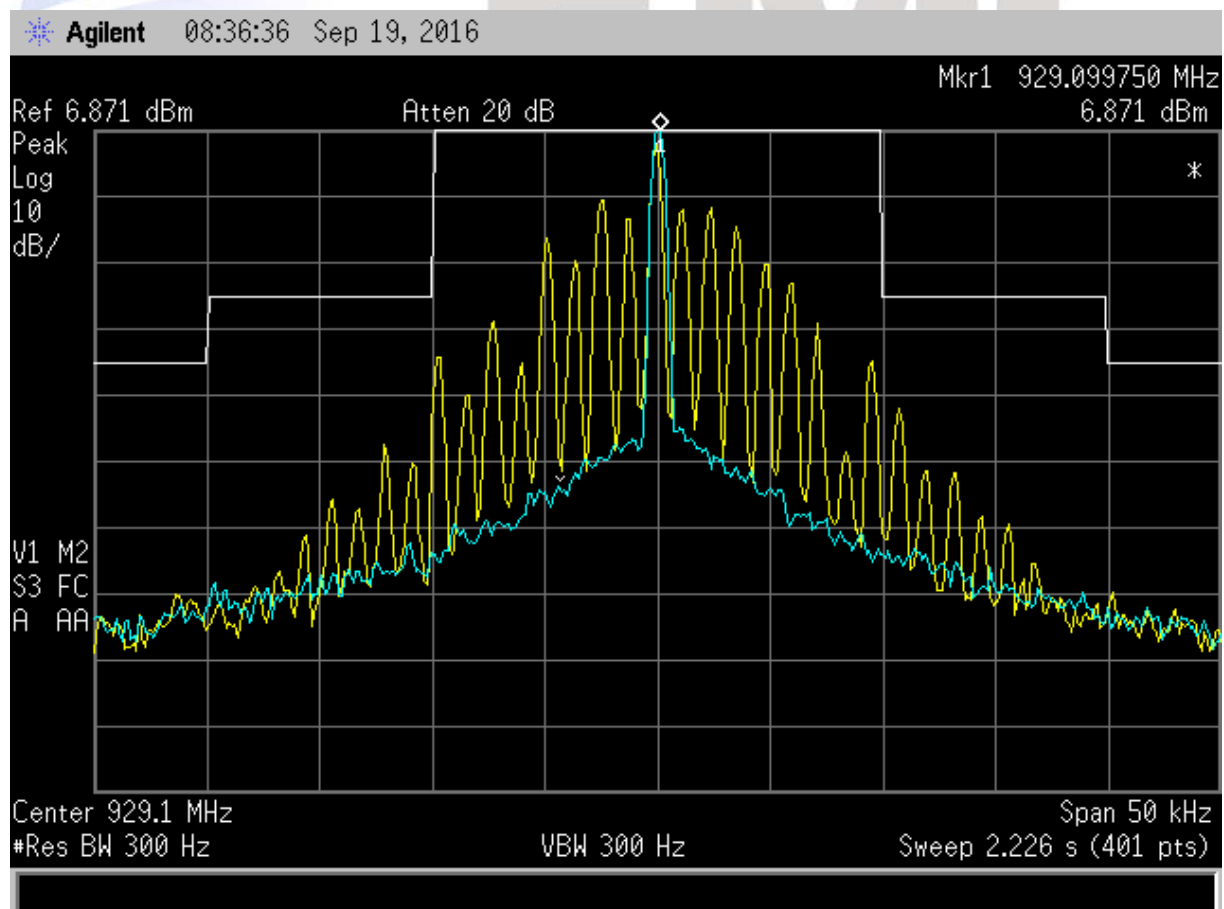
Measurements have been made of each modulation type using a spectrum analyser operating in peak hold mode and a 30 dB attenuator.

Measurements have been made when the transmitter was operating with a data rate of 19200 bps using 4FSK.

The spectrum analyser reference level was set when the transmitter was configured to transmit an un-modulated carrier with is shown as the blue trace.

Measurements were made with the spectrum analyser operating in peak hold centred on the allocated frequency.

**Nominal Frequency:** 929.100 MHz



**Result:** Complies

## Part 2.1051 - Transmitter spurious emissions at the antenna terminals

Measurements were carried out when the transmitter was being modulated with a data rate of 19600 bps using 4FSK and also using an un-modulated carrier with the worst case result being recorded below.

**Frequency:** 929.100 MHz

Spurious emission (MHz)	Emission level (dBm)	Limit (dBm)
1858.200	-48.1	-13.0
2787.300	-39.6	-13.0
3716.400	-35.1	-13.0
4645.500	-55.0*	-13.0
5574.600	-48.2	-13.0
6503.700	-51.4	-13.0
7432.800	-55.0*	-13.0
8361.900	-55.0*	-13.0
9291.000	-55.0*	-13.0

\* Noise floor measurement

### Limit:

Applied mask B, on any frequency removed from the centre of the authorised bandwidth by a displacement frequency of more than 75 kHz shall be attenuated by at least  $43 + 10 \log (P)$ .

A rated power of 5.0 watts (37.0 dBm) gives a limit of -13 dBm.

The spectrum has been investigated up to the 10<sup>th</sup> harmonic of the transmitter.

Part 2.1051 states that emissions greater than 20 dB below the limit need not be specified.

Part 2.1057 states that the spectrum should be investigated up to the 10<sup>th</sup> harmonic if the transmitter operates below 10 GHz.

**Result:** Complies.

**Measurement Uncertainty:**  $\pm 3.3$  dB

## Part 2.1053 - Field strength of the transmitter spurious emissions

Frequency: 929.100 MHz

Frequency (MHz)	Level (dBuV/m)	Level (dBm)	Limit (dBm)	Antenna	Margin (dB)	Result
1858.2000	55.1	-42.3	-20.0	Vertical	22.3	Pass
	47.2	-50.2	-20.0	Horizontal	30.2	Pass
2787.3000	55.6	-41.8	-20.0	Vertical	21.8	Pass
	53.5	-43.9	-20.0	Horizontal	23.9	Pass
3716.4000	56.6	-40.8	-20.0	Vertical	20.8	Pass
	55.5	-41.9	-20.0	Horizontal	21.9	Pass
4645.5000	47.0	-50.4	-20.0	Vertical	30.4	Pass
	47.0	-50.4	-20.0	Horizontal	30.4	Pass
5574.6000	52.6	-44.8	-20.0	Vertical	24.8	Pass
	50.3	-47.1	-20.0	Horizontal	27.1	Pass
6503.7000	50.0	-47.4	-20.0	Vertical	27.4	Pass
	50.0	-47.4	-20.0	Horizontal	27.4	Pass
7432.8000	50.0	-47.4	-20.0	Vertical	27.4	Pass
	50.0	-47.4	-20.0	Horizontal	27.4	Pass
8361.9000	50.0	-47.4	-20.0	Vertical	27.4	Pass
	50.0	-47.4	-20.0	Horizontal	27.4	Pass
9291.0000	50.0	-47.4	-20.0	Vertical	27.4	Pass
	50.0	-47.4	-20.0	Horizontal	27.4	Pass

\* Noise floor measurement

Measurements were carried out when the transmitter was being modulated with a data rate of 19600 bps using 4FSK and also using an un-modulated carrier with the worst case result being recorded.

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

Testing was carried out at EMC Technologies NZ Ltd Open Area Test Site, which is located at Driving Creek, Orere Point, Auckland. Details of this site have been filed with the Commission, Registration Number: 90838, which was last updated in June 2014

The level recorded is the signal generator output level in dBm less any gains / losses due to the coax cable and the dipole antenna.

### Limit:

All spurious emissions are to be attenuated by at least  $50 + 10 \log (P)$ . The rated power of 5 watts gives a limit of  $-20$  dBm.

No measurements were made above the 10<sup>th</sup> harmonic.

**Result:** Complies

**Measurement Uncertainty:**  $\pm 4.1$  dB

## Part 90.213 - Frequency Stability

Frequency stability measurements were made between - 30 °C and + 50°C in 10°C increments.

At each temperature the transmitter was given a period of 30 minutes to stabilise.

The transmitter was then turned on and the frequency error in Hz measured, as detailed below, after a period of 1 minute when transmitting on 929.100 MHz.

### Operating Frequency: 929.100 MHz

Temperature	Voltage 9.0 Vdc	Voltage 24.0 Vdc	Voltage 30.0 Vdc
+50°C	-106	-163	-175
+40°C	+52	-45	+59
+30°C	+28	+52	+55
+20°C	-13	+150	-85
+10°C	+190	+258	+319
0°C	+88	+89	+82
-10°C	+86	+113	+120
-20°C	+26	-44	-44
-30°C	+116	+11	+24

### Limit:

Part 90.213 states that mobile station transmitters operating between 929 – 930 MHz and between 935 - 940 MHz are required to have a frequency tolerance of 1.5 ppm.

1.5 ppm for 929.100 MHz = 1393.000 Hz.

The worst case frequency stability was observed to be:

319 Hz / 929.1 MHz = 0.34 ppm.

**Result:** Complies.

**Measurement Uncertainty:** ± 30 Hz.

## Part 1.1310 - Exposure of humans to RF fields

As per Section 1.1310 and Section 2.1091 certification of this transmitter is sought using the General Public / Uncontrolled exposure limits as detailed in OST/OET Bulletin Number 65 as the transmitter could be used in various environments using a power output of 5 watts.

In accordance with Section 1.1310 the following Maximum Permissible Exposure (MPE) power density limits have been applied:

- General Population /Uncontrolled exposure =  $0.619 \text{ mW/cm}^2$  ( $f/1500 = 929 \text{ MHz}/1500$ )

As Part 90 certification is being sought for the 929 - 930 MHz band this assessment has been carried out at 929 MHz which will give a worst case assessment.

$$\text{MPE} = E^2/3770 = 0.619 \text{ mW/cm}^2$$

Therefore:

$$E = \sqrt{0.619 * 3770}$$

$$E = 48.3 \text{ V/m}$$

The minimum distance from the antenna at which the MPE is met is calculated from the equation relating field strength in V/m, transmit power in watts, transmit antenna gain, transmitter duty cycle and separation distance in metres:

$$\text{V/m} = (\sqrt{30 * P * G}) / d$$

The rated maximum transmitter power = 5 watts.

The transmitter would typically be operated using number of antennas.

The highest gain antenna is a yagi antenna with a gain of 11 dBi (12.6).

It has been assumed that the transmitter can be used with a duty cycle of 100%.

Therefore

$$d = \sqrt{30 * P * G * DC} / E$$

$$d = \sqrt{30.0 * 5.0 * 12.6 * 1.0} / 48.3$$

$$d = \underline{0.90 \text{ metres or } 90 \text{ cm}}$$

**Result:** Transmitter will comply if the safe distance calculated above is applied.

## 7. TEST EQUIPMENT USED

Instrument	Manufacturer	Model	Serial #	Asset	Cal Due	Interval
Aerial Controller	EMCO	1090	9112-1062	3710	N/a	N/a
Aerial Mast	EMCO	1070-1	9203-1661	3708	N/a	N/a
Biconical Antenna	Schwarzbeck	BBA 9106	-	3612	03Feb 2018	3 years
Horn Antenna	EMCO	3115	9511-4629	E1526	04 June 2017	3 years
Log Periodic Antenna	Schwarzbeck	VUSLP 9111	9111-228	3785	17 Dec 2017	3 years
Power Attenuator	JFW	50FH-030-100	-	-	N/a	N/a
Receiver	Rohde & Schwarz	ESIB-40	100171	4003	16 April 2017	1 year
Thermal chamber	Contherm	M180F	86025	E1129	01 Dec 2016	6 months
Thermometer	DSIR	RT200	035	E1049	01 Dec 2016	6 months
Turntable	EMCO	1080-1-2.1	9109-1578	3709	N/a	N/a
VHF Balun	Schwarzbeck	VHA9103	-	3603	03 Feb 2018	3 years

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.

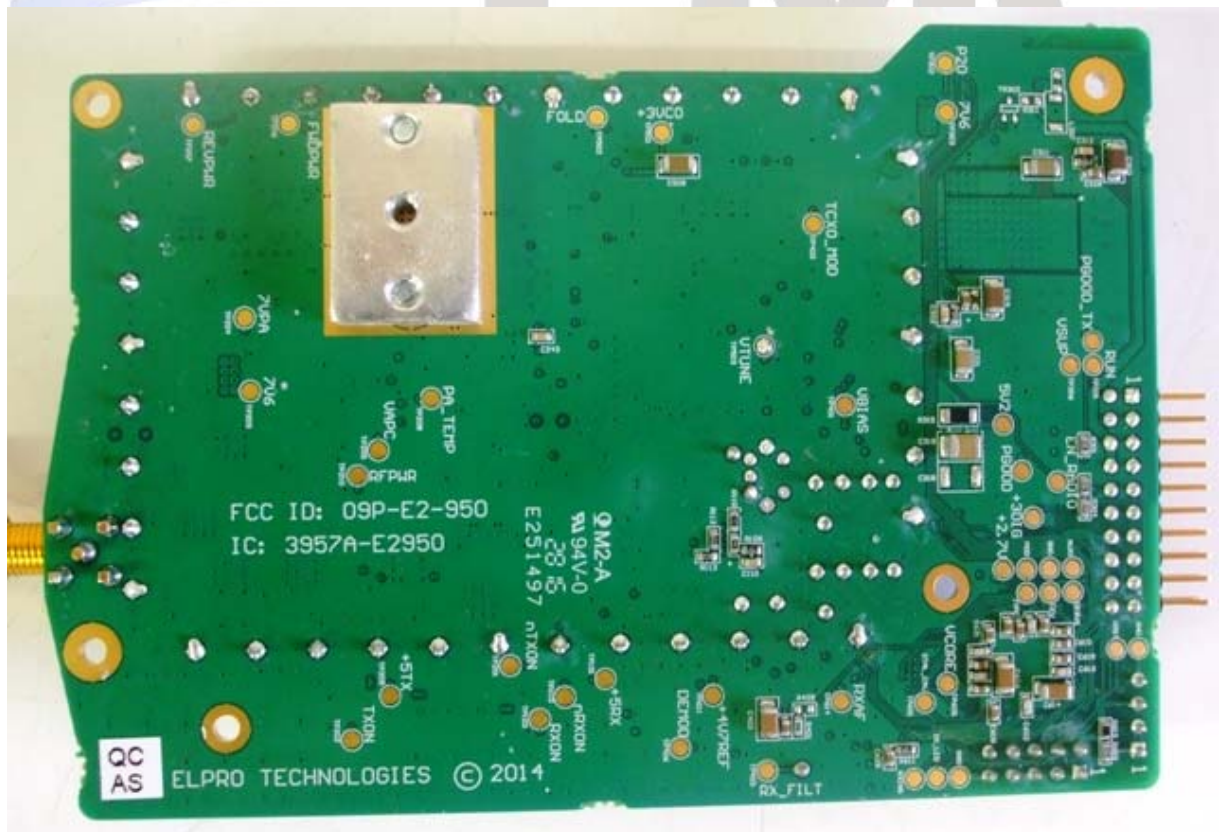
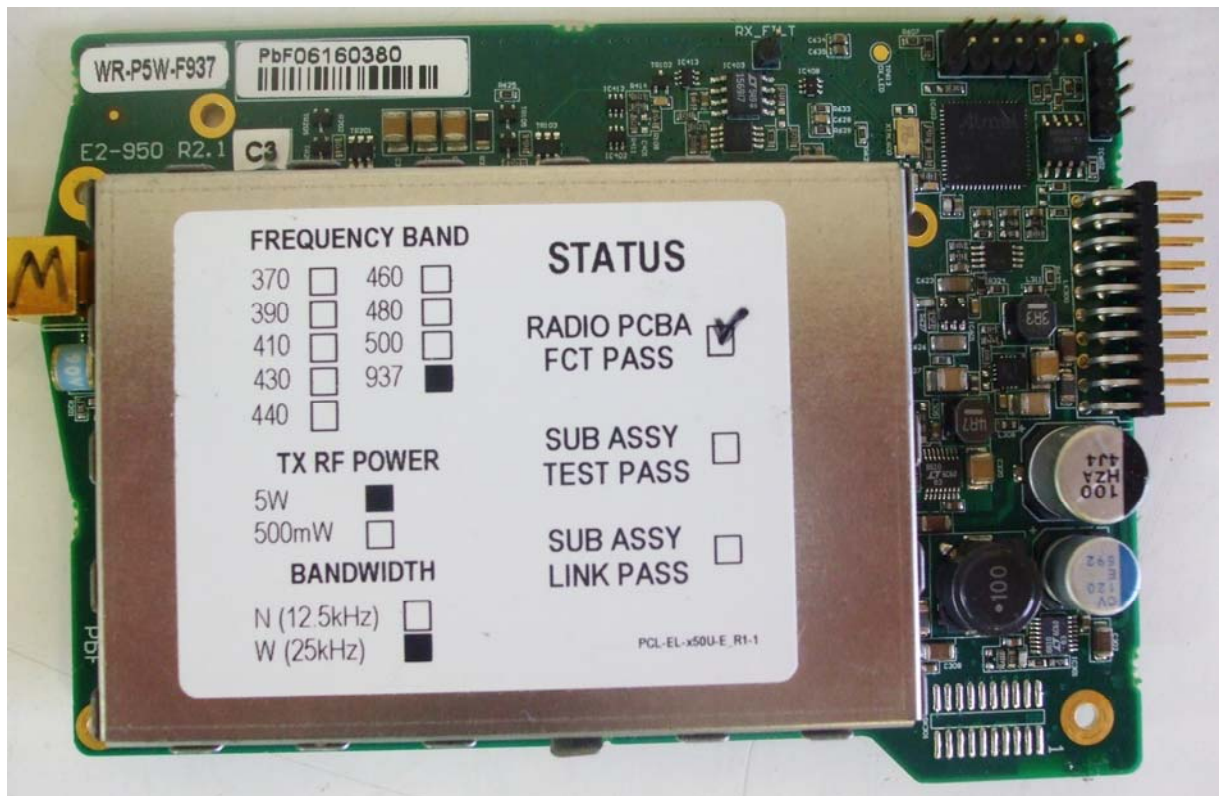
All measurement equipment has been calibrated in accordance with the terms of the EMC Technologies (NZ) Ltd International Accreditation New Zealand (IANZ) Accreditation to NZS/ISO/IEC 17025.

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

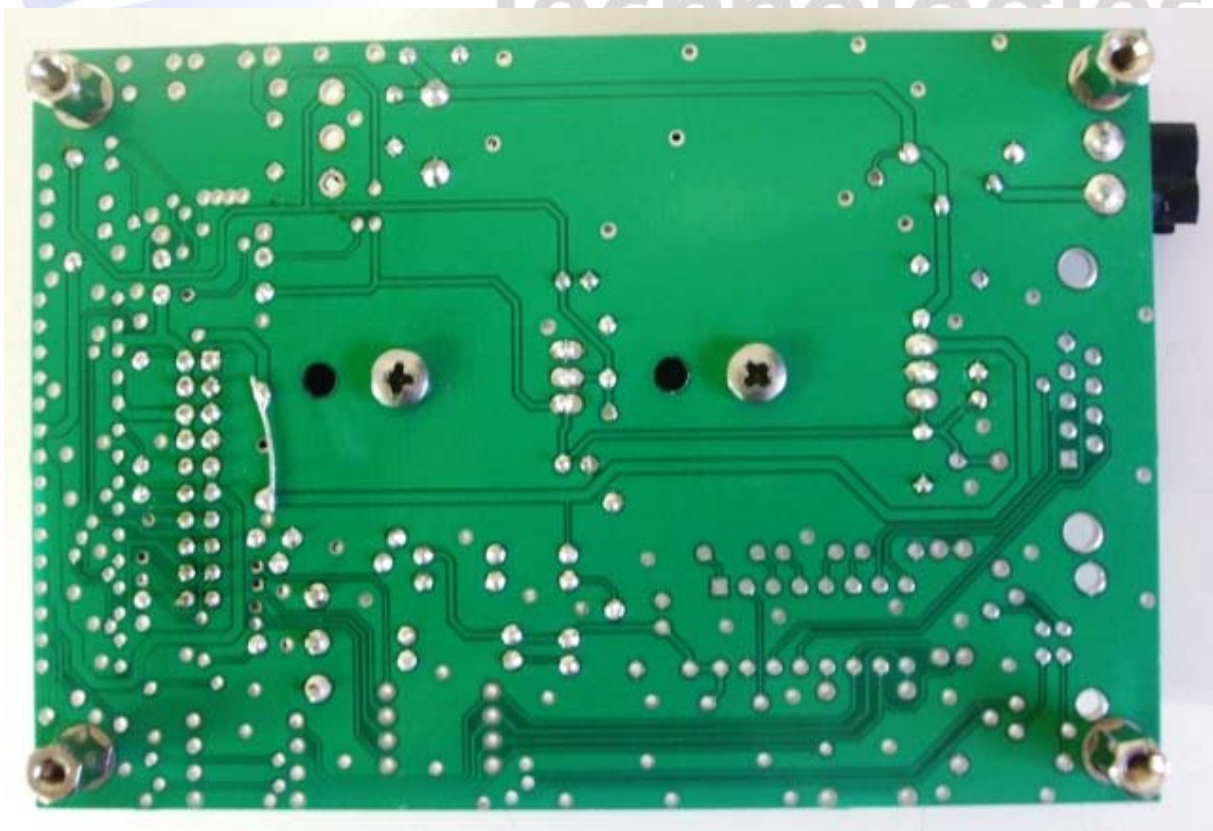
Module external and internal photos







Internal photos of the exercise power



## Radiated emissions test setup

