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TEST REPORT

Saber Farm Automation Modular System – EID / RFID Reader

tested to

47 Code of Federal Regulations

Part 15 - Radio Frequency Devices

Subpart C – Intentional Radiators

for

LIC Automation 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

Table of Contents

1. STATEMENT OF COMPLIANCE

The **Saber Farm Automation Modular System – EID / RFID Reader** complies with FCC Part 15 Subpart C 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 on the 14th ,15th and 16th of June 2017 are summarised in the following table:

Clause	Parameter	Result
15.201	Equipment authorisation requirement	Certification required.
15.203	Antenna requirement	Complies. Custom antennas are attached to the Readers using specific installation instructions.
15.204	External PA and antenna modifications	Not applicable. No external devices.
15.205	Restricted bands of operation	Complies. Device transmits on 134.2 kHz
15.207	Conducted limits	Complies with a 5.5 dB margin at 13.538 MHz (Average).
15.209	Radiated emission limits - Emissions < 30 MHz	Complies with a 3.3 dB margin at 134.2 kHz (Average).
15.209	Radiated emission limits – Emissions > 30 MHz	Not tested.

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.

4. CLIENT INFORMATION

Company Name	LIC Automation Ltd
Postal Address	PO Box 20306 Hamilton 3241
Street Address	119 Maui Street Pukete Hamilton 3200
Country	New Zealand
Contact	Mr Chris Anderson

5. DESCRIPTION OF TEST SAMPLE

Brand Name	Saber
Model	-
Product	Farm Automation Modular System - EID / RFID Reader
Manufacturer	LIC Automation Ltd
Country of Origin	New Zealand
Serial Number	System not serialised
FCC ID	2AMN9-LICA-MAXBOM12

The system tested consisted of a system of EID / RFID readers operating as a Master and two slaves which was attached to a number of milking shed management devices.

The EID readers were attached to the rest of the system using RS-232 serial communications.

Attached to the Master and Slave 1 EID reader are two horizontal panel antennas which would be hung from the roof of the milking shed, at least 3 metres apart, and they would be used to read the tags on the cows passing beneath.

A third vertical panel antenna is attached to Slave 2 EID and this is used with a minimum clearance of 5 metres from the horizontal antennas for verification and phasing purposes.

The system that was tested consisted of the following individual items:

EID / RFID Readers

This consisted of:

- 3 x 1002206 TIRIS S251B EID / RFID Readers
- 1 x Wieland wipos P1 24-10 Representative Switch Mode Power Supply
- 1 x 1002248 ASI-003 RFID Antenna and stand
- 2 x ASI-LT Antenna ("Hairing Bone Entry or Overhead") plus stands
- 3 x Allflex test eartag
- 50 metre cables to supply 24 Vdc power and Cat 5e communications (synch, RS 232)
- 3 x 134.2 kHz Dummy loads

The EID readers operate on 134.2 kHz and will be "phase synchronised" in Master-Slave-Slave mode.

The 'charge-up / read' cycle is a 50 msec on and 20 msec off (ISO 11784/5 HDX).

The antennas for the EID / Readers are low frequency panel antennas.

Each antenna panel is rectangular and is approximately 100 cm x 45 cm x 6 cm

When operating the overhead panels will be set up horizontally on 1.5 m high stands, 3 m apart with the long axis in line operating in opposing / anti-phase.

The third panel is long axis vertical on a stand that supports it 45 cm clear of ground and is 5 m from the overhead panels (farm installation is always more).

During the test the vertical ASI-003 panels will be moved laterally and rotated about the horizontal and vertical axis to maximise the 134.2 kHz field strength at the test antenna.

This will provide for a worst case scenario that will be worse than any farm installation.

The Wieland power supply also powered the Accubal Kit items that are listed below

Accubail Kit

This consisted of

- 1 x 1002237 OMRON Photo Eye pair
- 1 x 1002671 OMRON M30 Proximity Switch
- 1 x 1002216 SUNX Cow in bail Photo-eye

Milk Meters

This consisted of:

Device	Serial Number	SAP Code
YieldSense 2.1	03008873	1005128
YieldSense 2.5	UID: 5909739	-
CellSense 3	03000599	1004931
CellSense 3.5	UID: 5909565	-
OWL	UID: 6096638	1005039

Typical lengths of Power and Ethernet / CANbus cables provided in order to connect these devices into the system.

All these items were placed on a wooden board and tested with the EID readers operating using a read cycle of 50 ms on / 20 ms off.

The milk meters were powered using a MW Meanwell DRP 240-24-PS (10A) Power Supply.

The Meanwell power supply also powered the Universal Dairy Automation Controller which is described below.

Universal Dairy Automation Controller (UDA)

This consisted of:

- 1 x Universal Dairy Automation Controller

This is connected to the TIRIS Reader using a RS 232 serial communications.

Typical lengths of Power and Ethernet / CANbus cables provided in order to connect the various devices in the system together

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 as it contains a transmitting device that operates on 134.2 kHz.

Section 15.203: Antenna requirement

The three EID Readers each have an external panel antenna attached.

While the EID Readers do not have unique connectors the installation of the system would need to be carried out by a professional installer in order for the system to work correctly.

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 transmitter transmits on 134.200 kHz.

This device would therefore fall between the restricted bands of 90 – 110 kHz and 495 – 505 kHz

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

Testing was carried out using a representative AC power supply system that was powered at 120 Vac 60 Hz using a representative AC power supply that supplied 24 Vdc to each of the EID card readers.

Testing was carried out with the devices operating in a read cycle of 50 ms on / 20 ms off on 134.2 kHz when dummy loads were attached to each of the antenna ports.

A tag was presented to each of the EID eartag readers.

The other ancillary items were powered using a separate 120 Vac to 24 Vdc power supply that was connected to an ancillary artificial mains network with the EID Readers and the Ancillary equipment being linked together by the RS-232 serial communications cable.

The device was placed on top of the emissions table, which is 1 m x 1.5 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 Class B limits have been applied.

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.

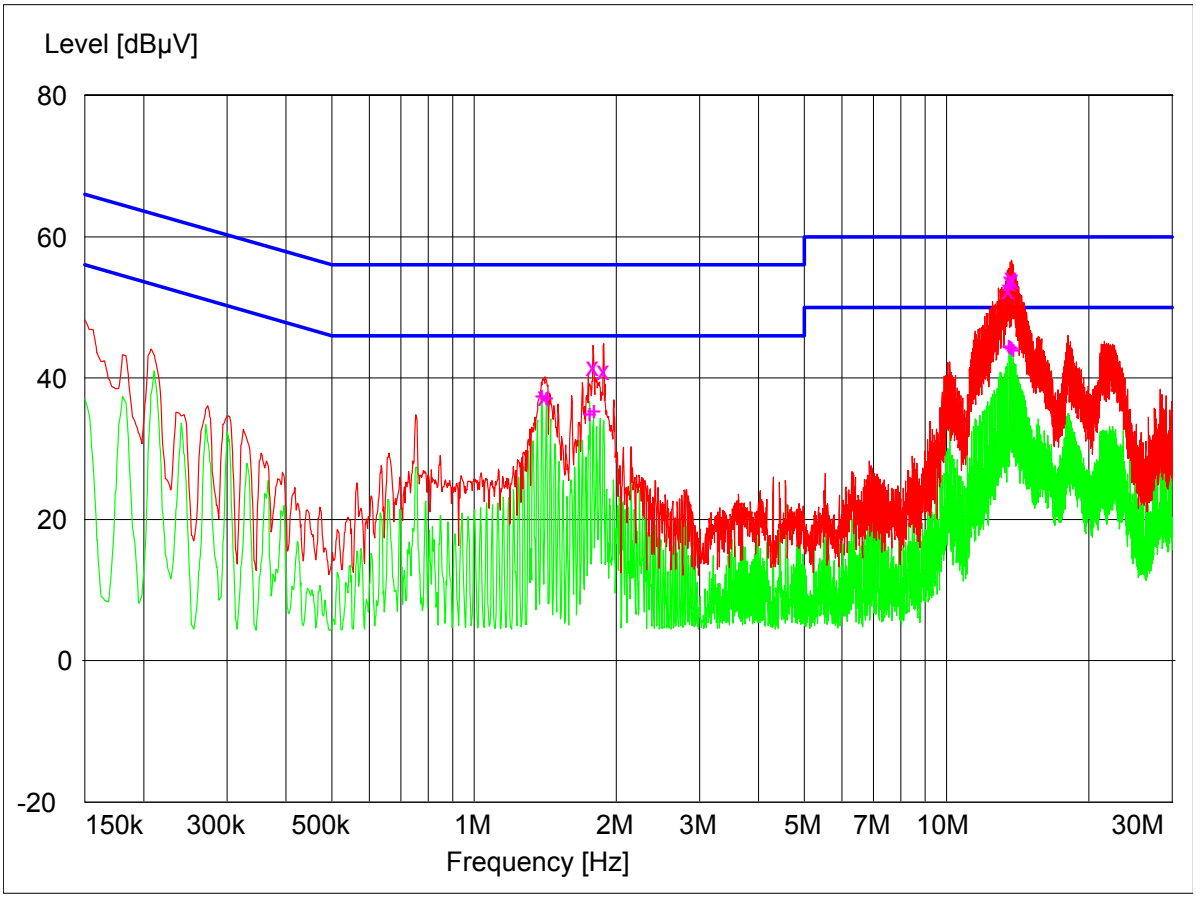
Quasi peak and average detectors have been used with resolution bandwidths of 9 kHz.

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

Conducted Emissions – AC Input Power Port

Setup:	EID Readers tested when powered at 120 Vac 60 Hz. Attached to the Readers were a number of ancillary items that were powered separately at 120 Vac 60 Hz and were connected to the Readers using a RS-232 serial connection.

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



Final Quasi-Peak Measurements

Frequency MHz	Level dBµV	Limit dBµV	Margin dB	Phase	Rechecks dBµV
1.413000	37.40	56.0	18.6	L1	
1.785000	41.70	56.0	14.3	N	
1.881000	41.00	56.0	15.0	N	
13.542500	52.50	60.0	7.5	N	
13.632500	53.60	60.0	6.4	L1	
13.727000	54.30	60.0	5.7	N	
13.821500	54.00	60.0	6.0	N	

Final Average Measurements

Frequency MHz	Level dBµV	Limit dBµV	Margin dB	Phase	Rechecks dBµV
1.392000	37.30	46.0	8.7	L1	
1.422000	37.10	46.0	8.9	L1	
1.755000	34.80	46.0	11.2	N	
1.788000	35.30	46.0	10.7	N	
13.538000	44.50	50.0	5.5	N	
13.632500	44.30	50.0	5.7	N	
13.727000	44.10	50.0	5.9	N	
13.821500	43.90	50.0	6.1	N	

Section 15.209: Radiated emission limits, general requirements

Radiated emissions testing was carried out over the frequency range of 9 kHz to 30 MHz as the intentional radiator in this device operates on 134.2 kHz.

This device also contains a digital devices that operates on a frequency that does not exceed 108 MHz.

Therefore radiated emission measurements would also be required between 30 - 1000 MHz.

Radiated measurements have been carried out on the digital device up to 1000 MHz in accordance with FCC part 15 sections 15.107 and 15.109 with the Class A limits being applied.

Results of this testing have been reported separately.

Radiated emissions 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 system that was powered at 120 Vac 60 Hz.

Testing was carried out when the Readers were operating with a read cycle of 50 ms on / 20 ms off on 134.2 kHz.

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 peak and average detectors below 490 kHz.

Above 490 kHz and below 30 MHz a quasi peak detector was used.

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

Level (dBµV/m) = Receiver Reading (dBµV) + Antenna Factor (dB) + Coax Loss (dB)

Result: Complies

Measurement uncertainty with a confidence interval of 95% is:

- Free radiation tests (30 – 1000 MHz) ± 4.1 dB

Section 15.209: 134.2 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.

The loop antenna was position with the loop vertical and also when it was horizontal.

Measurements were made when operating Master – Slave 1 – Slave 2 mode using two horizontal panel antennas and a single vertical panel antenna.

The orientation of the panel antennas was maximised to give the highest field strength when the required separations between the horizontal and vertical panel antennas are applied.

Frequency kHz	Level dBuV/m	Limit (dBuV/m)	Margin (dB)	Detector	Loop Orientation	Distance (metres)
134.2	62.6	85.0	22.4	Peak	Vertical	30
134.2	55.8	65.0	9.2	Average	Vertical	30
134.2	70.3	85.0	14.7	Peak	Horizontal	30
134.2	61.7	65.0	3.3	Average	Horizontal	30

Measurements were made at a distance of 30 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 average limit at 300 m at 134.2 kHz is 17.8 uV/m or 25 dBuV/m and 45 dBuV/m in peak.

This then gives an average limit at 30 m at 134.2 kHz of 65 dBuV/m and 85.0 dBuV/m in peak

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

Voltage (Vdc)	Field Strength (dBuV/m)
102.0	61.7
120.0	61.7
138.0	61.7

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

Section 15.209: 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.

The loop antenna was positioned with the loop vertical and also when it was horizontal.

Measurements were made when operating Master – Slave 1 – Slave 2 mode using two horizontal panel antennas and a single vertical panel antenna.

The orientation of the panel antennas was maximised to give the highest field strength when the required separations between the horizontal and vertical panel antennas are applied.

Loop Antenna Vertical

Frequency kHz	Level dBuV/m	Limit dBuV/m	Margin dB	Detector	Comment
268.400	44.0	98.1	54.1	Peak	
268.400	32.0	78.1	46.1	Average	
402.600	49.7	94.6	44.9	Peak	
402.600	43.1	74.6	31.5	Average	
536.800	43.0	52.1	-	Quasi Peak	Ambient
671.000	38.4	50.2	11.8	Quasi Peak	
805.200	34.0	48.6	-	Quasi Peak	Ambient
939.400	34.4	47.2	12.8	Quasi Peak	
1073.600	30.0	46.1	-	Quasi Peak	Ambient
1207.800	32.0	45.1	-	Quasi Peak	Noise Floor
1342.000	35.0	44.1	-	Quasi Peak	Ambient
1476.200	26.0	43.3	-	Quasi Peak	Ambient

Loop Antenna Horizontal

Frequency kHz	Level dBuV/m	Limit dBuV/m	Margin dB	Detector	Comment
268.400	45.0	98.1	53.1	Peak	
268.400	32.0	78.1	46.1	Average	
402.600	47.2	94.6	47.4	Peak	
402.600	40.6	74.6	34.0	Average	
536.800	43.0	52.1	-	Quasi Peak	Ambient
671.000	37.6	50.2	12.6	Quasi Peak	
805.200	34.0	48.6	-	Quasi Peak	Ambient
939.400	33.1	47.2	14.1	Quasi Peak	
1073.600	26.6	46.1	19.5	Quasi Peak	
1207.800	32.0	45.1	-	Quasi Peak	Noise Floor
1342.000	30.0	44.1	14.1	Quasi Peak	
1476.200	26.0	43.3	-	Quasi Peak	Ambient

Magnetic loop measurements were made a distance of 10 metres due to the high level of ambient emissions in the AM broadcast band which made measurements at 30 metres very difficult.

At each frequency the loop measurement antenna was 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).

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).

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

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: Spurious Emissions (above 30 MHz)

Testing of the digital devices contained within this device was carried out in accordance with FCC part 15 subparts A + B and in particular Sections 15.107 and 15.109.

The results of these measurements have been reported separately.

Result: Complies.
Measurement uncertainty with a confidence interval of 95% is:
- Free radiation tests (30 MHz – 1000 MHz) ± 4.1 dB

7. TEST EQUIPMENT USED

8.

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
Turntable	EMCO	1080-1-2.1	9109-1578	RFS 3709	Not applic	Not applic
Loop Antenna	EMCO	6502	9003-2485	3798	4 July 2017	3 years
VHF Balun	Schwarzbeck	VHA 9103	9594	3696	3 Feb 2018	3 years
Biconical Antenna	Schwarzbeck	BBA 9106	-	3680	3 Feb 2018	3 years
Log Periodic	Schwarzbeck	VUSLP 9111	9111-228	3785	1 Dec 2017	3 years
Mains Network	R & S	ESH2-Z5	881362/001	3805	4 August 2017	2 years
Receiver	R & S	ESHS 10	828404/005	3728	9 June 2018	2 years
Receiver	R & S	ESIB 40	100295	INV0818	27 April 2018	1 year

All test equipment was within calibration at the time of testing.

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.

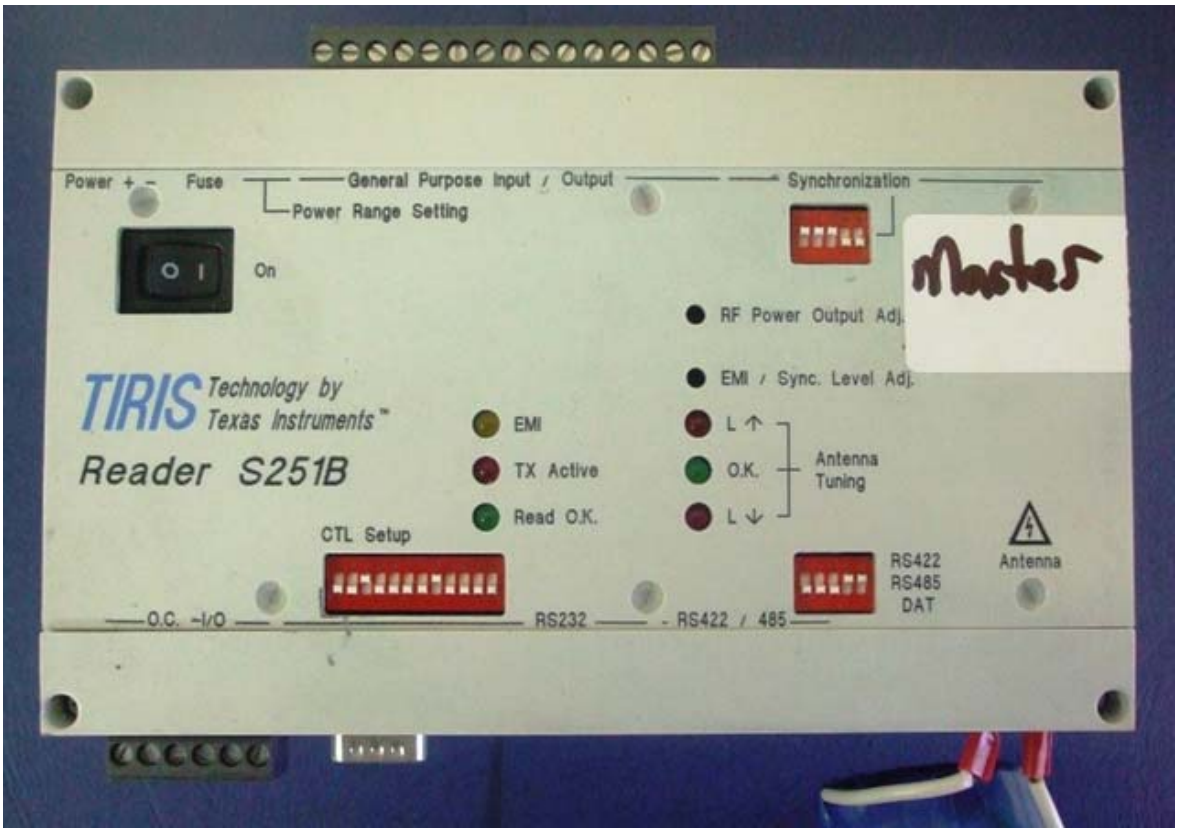
All testing was carried out in accordance with the terms of EMC Technologies (NZ) Ltd International Accreditation New Zealand (IANZ) Accreditation to NZS/ISO/IEC 17025.

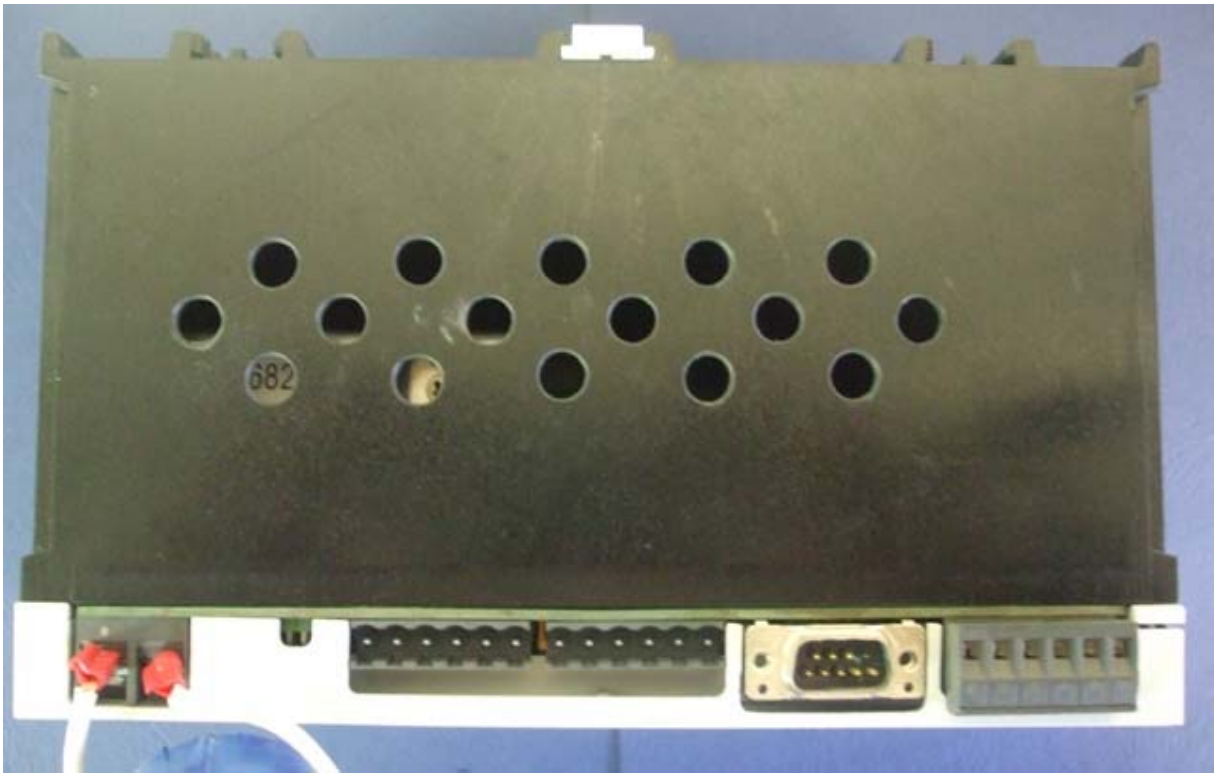
All measurement equipment has been calibrated in accordance with the terms of the EMC Technologies (NZ) Ltd International Accreditation New Zealand (IANZ) Accreditation to NZS/ISO/IEC 17025.

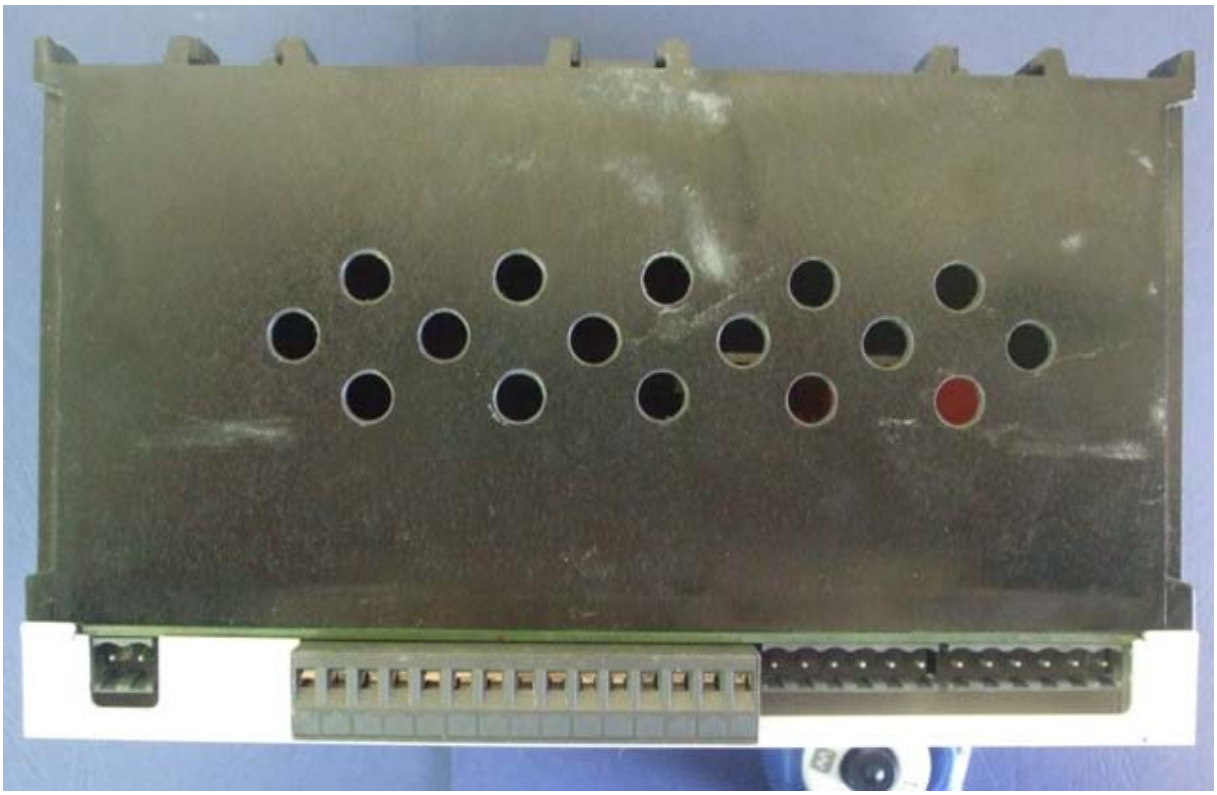
International Accreditation New Zealand has Mutual Recognition Arrangements for testing and calibration with accreditation bodies in a number of economies. This includes NATA (Australia), UKAS (UK), SANAS (South Africa), NVLAP (USA), A2LA (USA), SWEDAC (Sweden). Further details can be supplied on request.

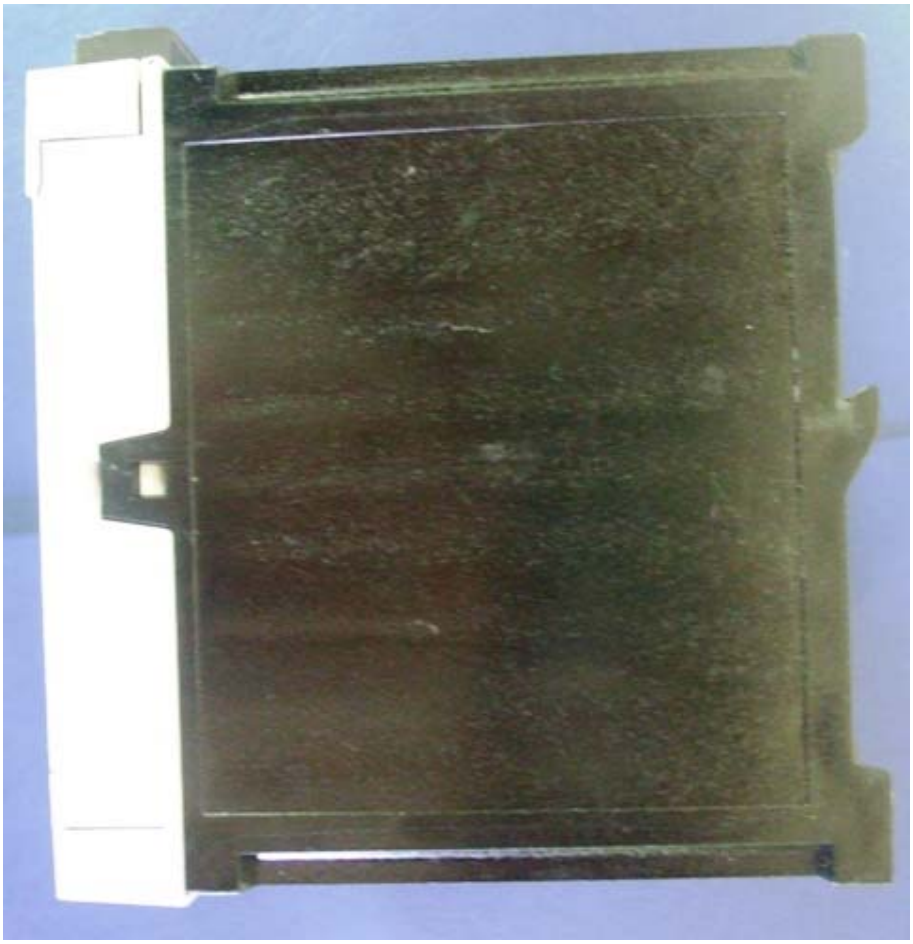
9. PHOTOGRAPHS

External Photos





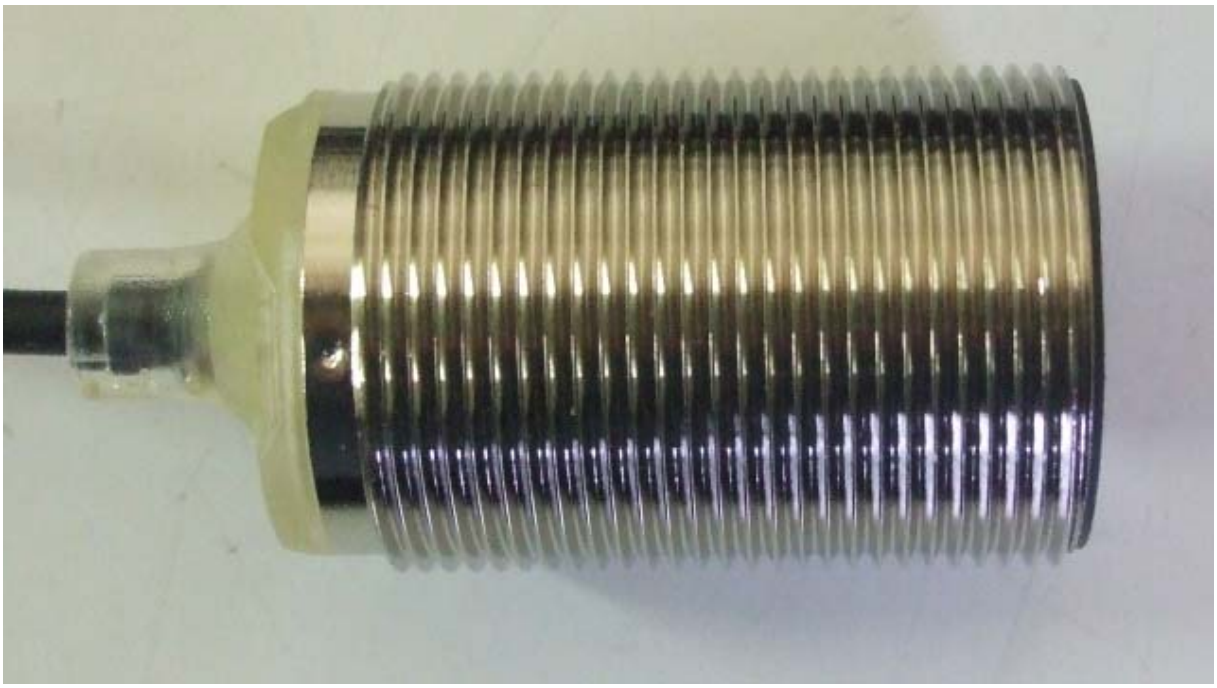




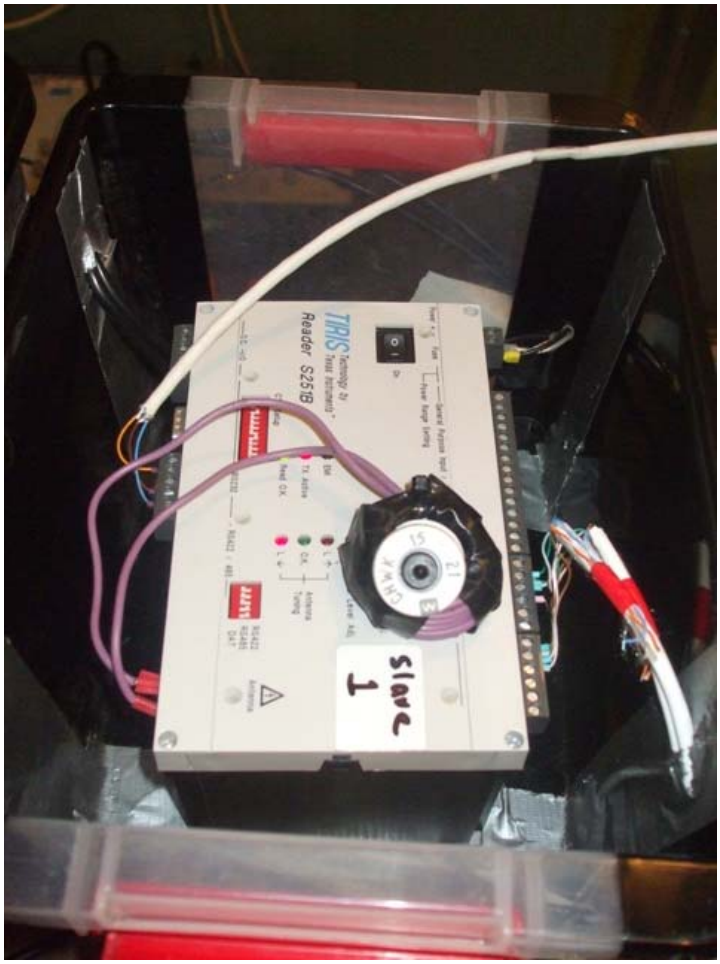
External Photos Of Items Tested - Master box

Also enclosed in the Master Box Were

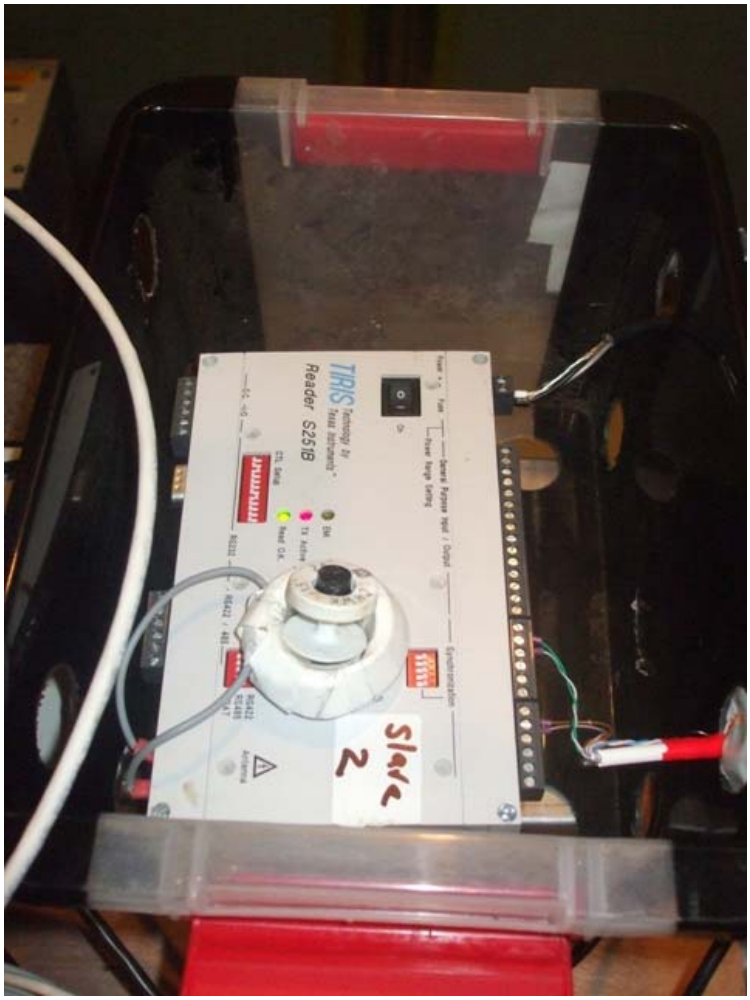
Attached to the Wieland Power Supply was the Accubail Kit that consisted of an OMRON Photo Eye pair, an OMRON M30 Proximity Switch and a SUNX Cow in bail Photo-eye



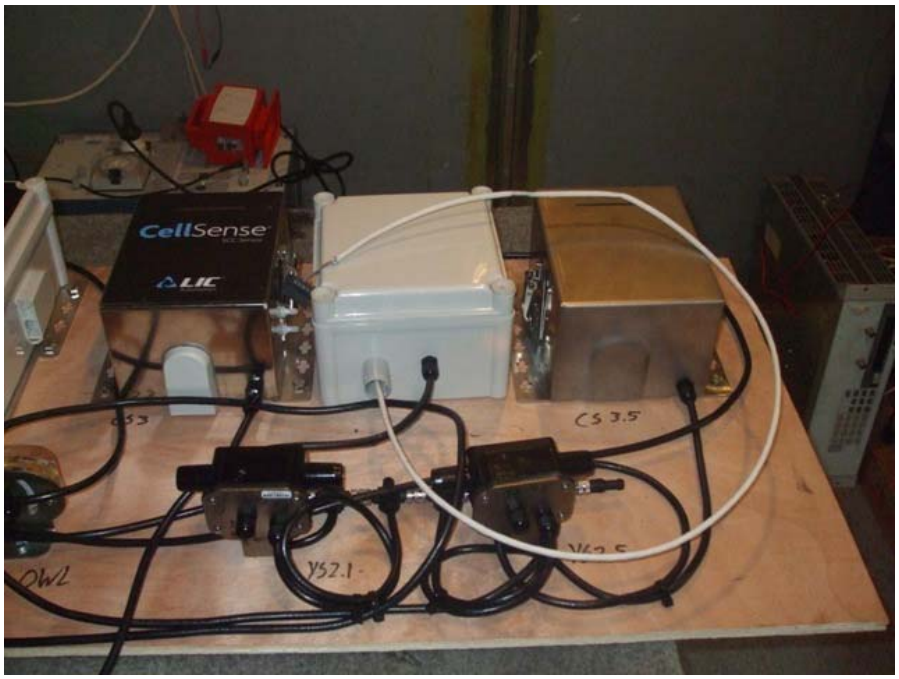
Slave 1 box

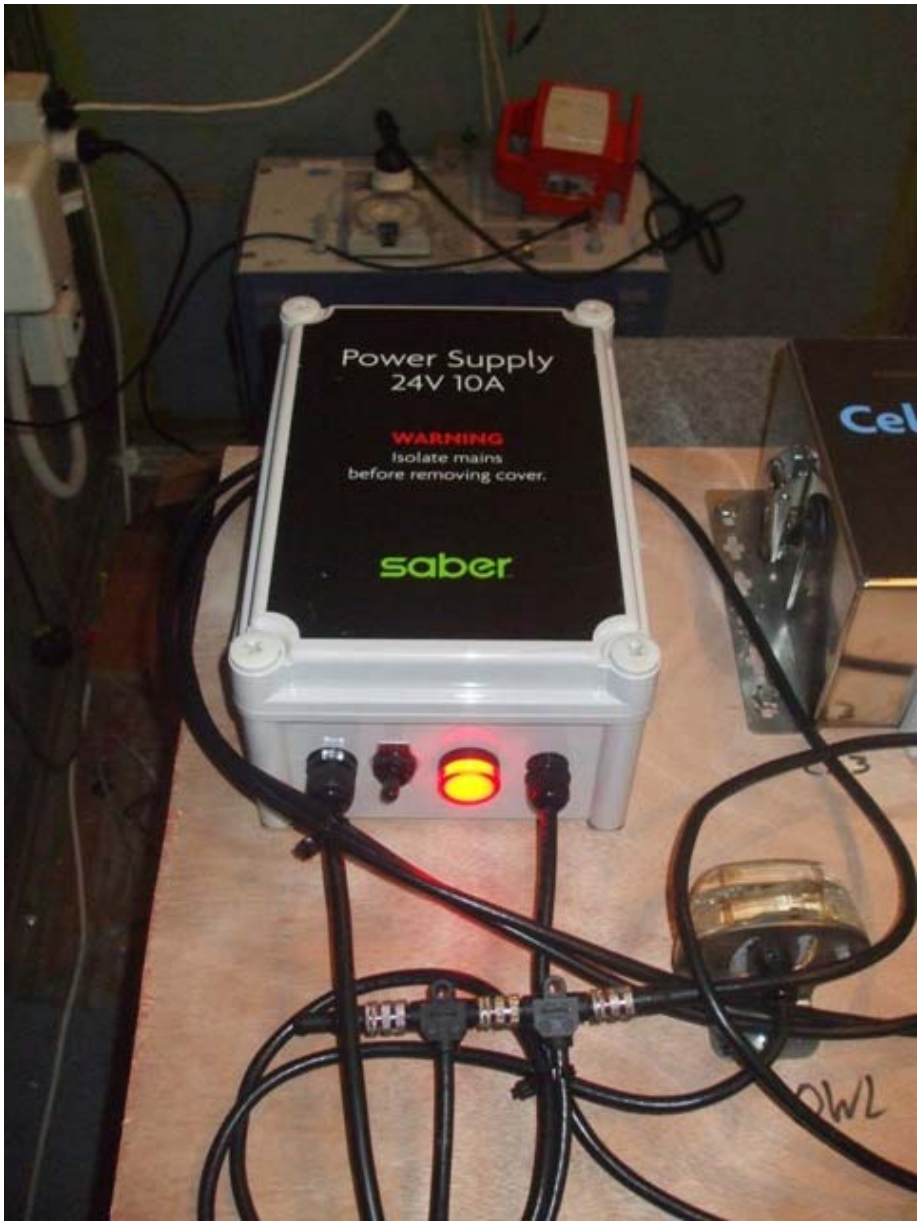


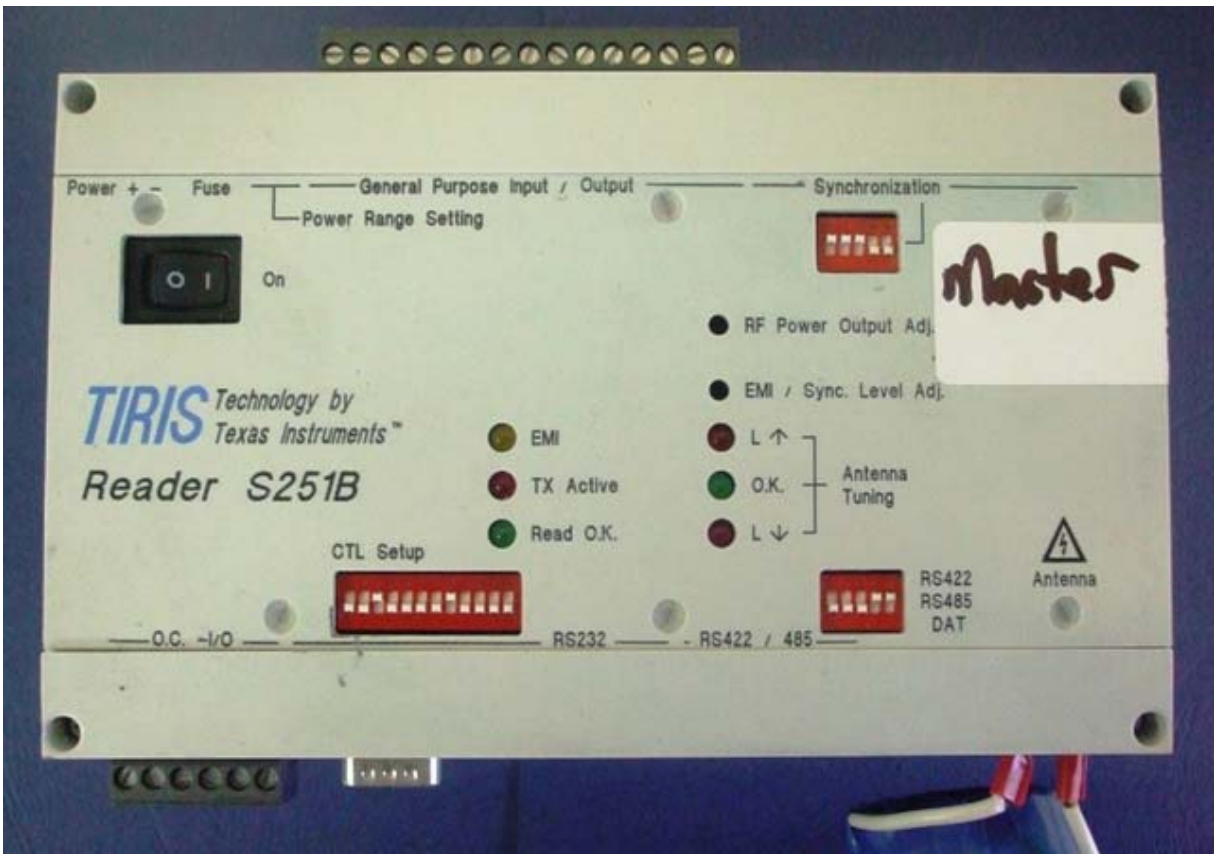
Slave 2 Box

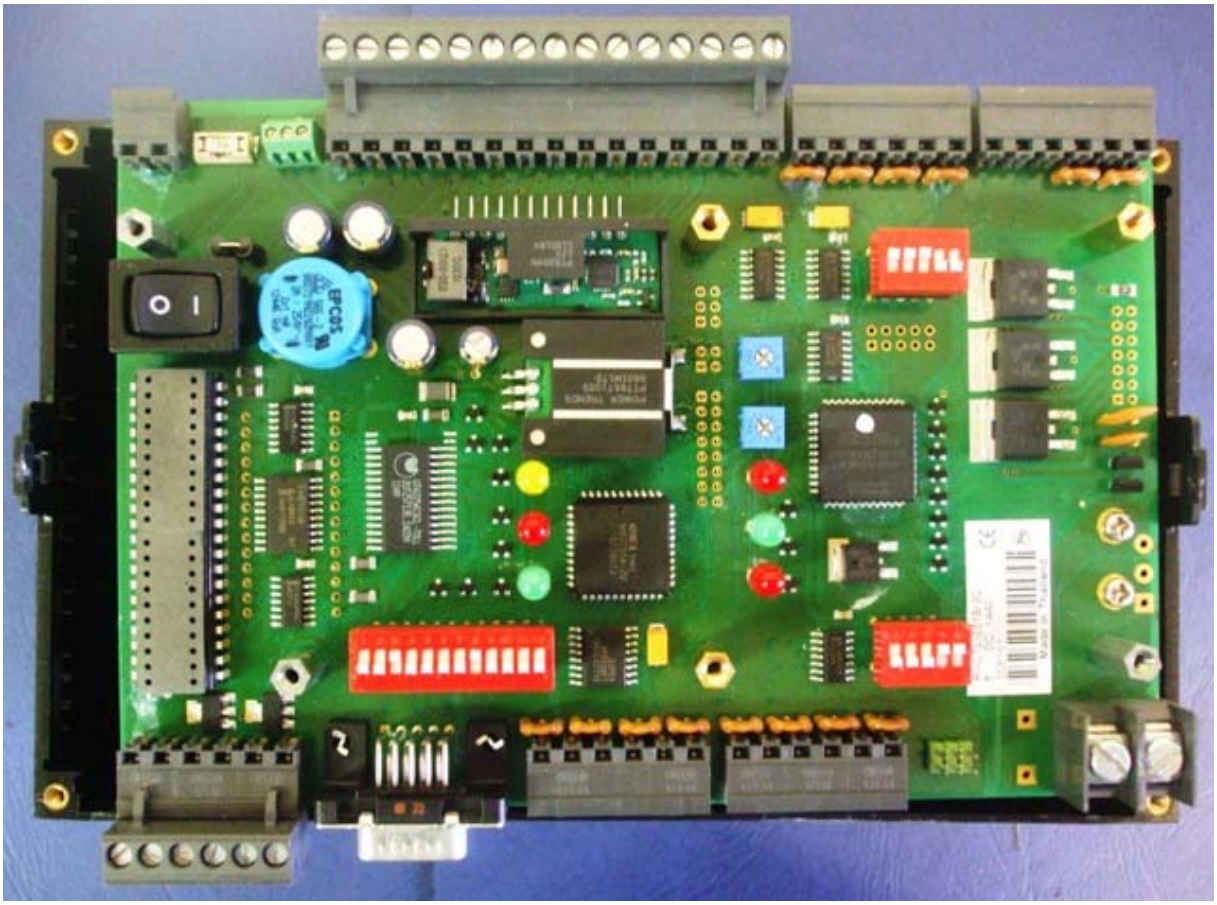


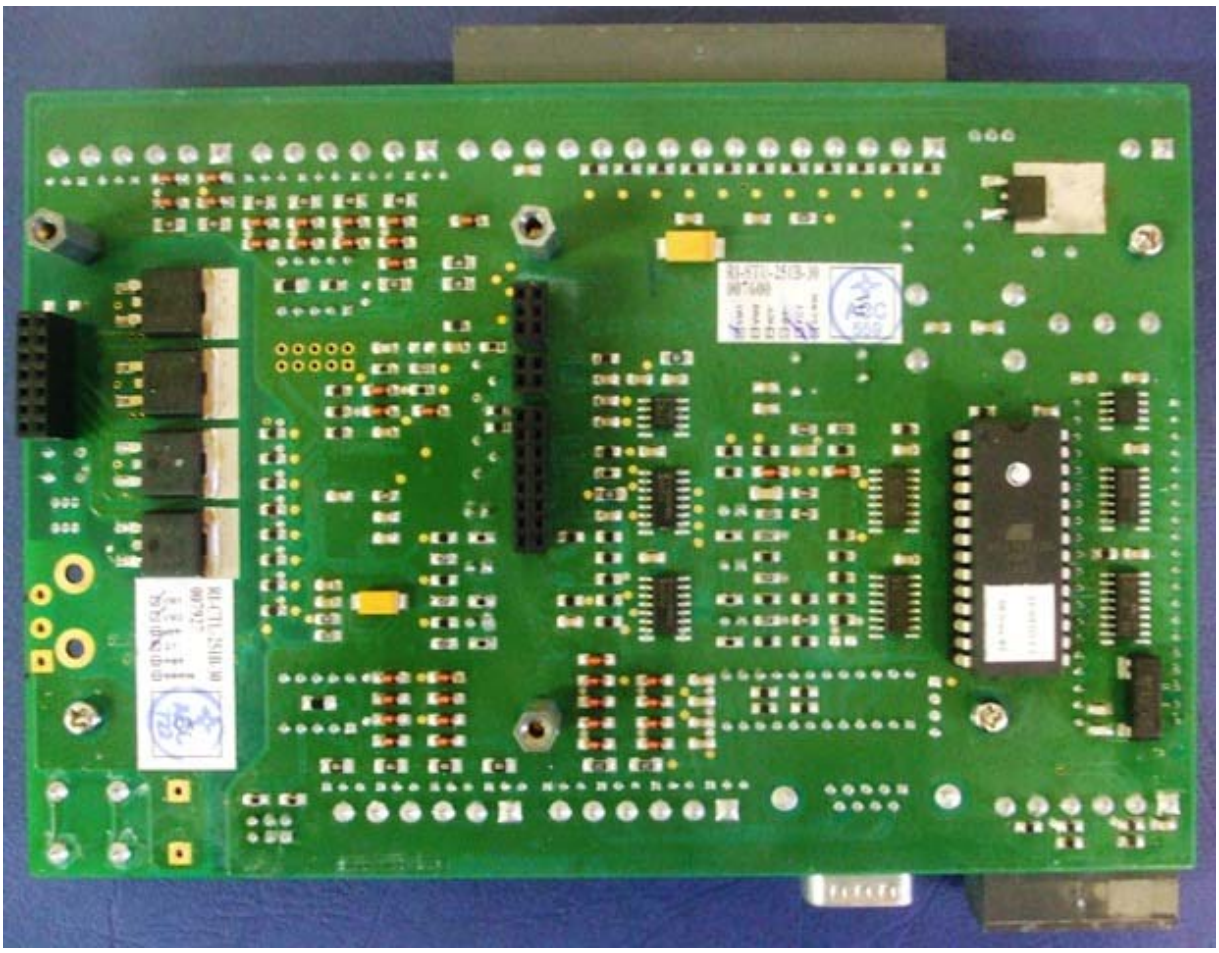
Universal Dairy Automation Controller, Cellsense, Yieldsense with Interbail/OWL Cable, OWL and Meanwell DRP 240-24-PS (10A) Power Supply

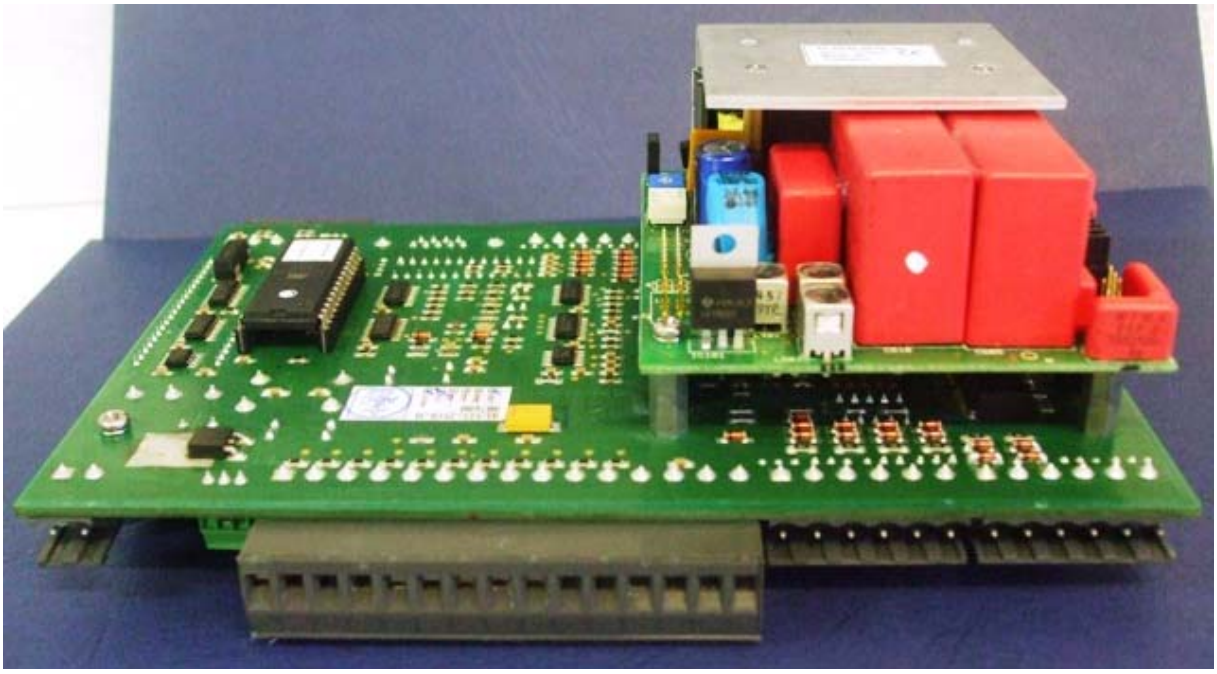


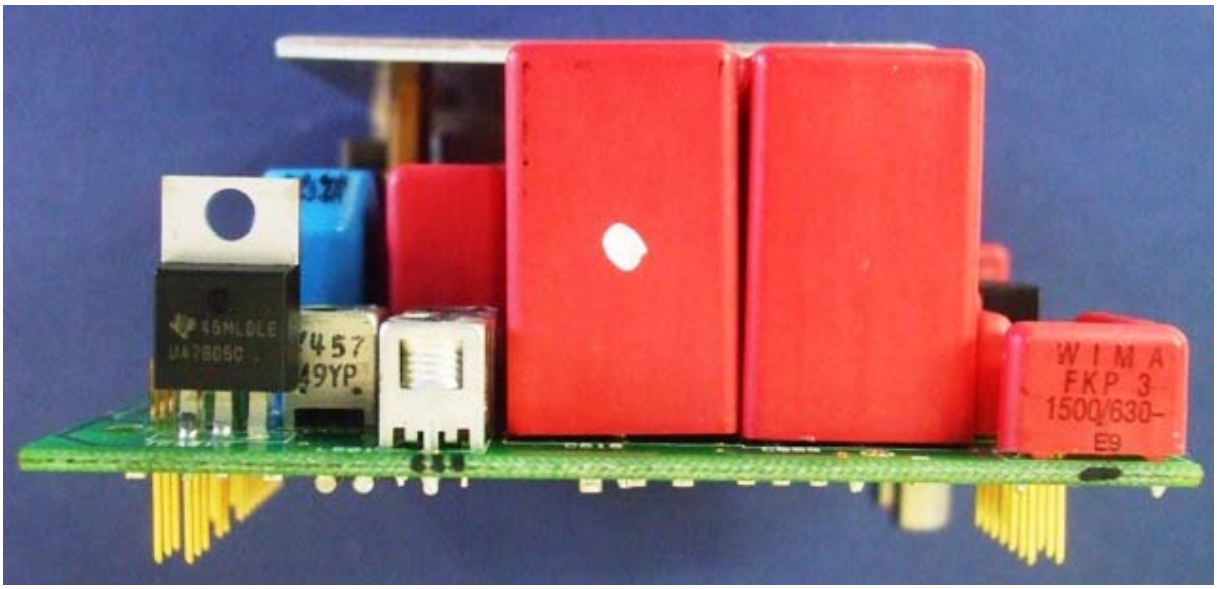


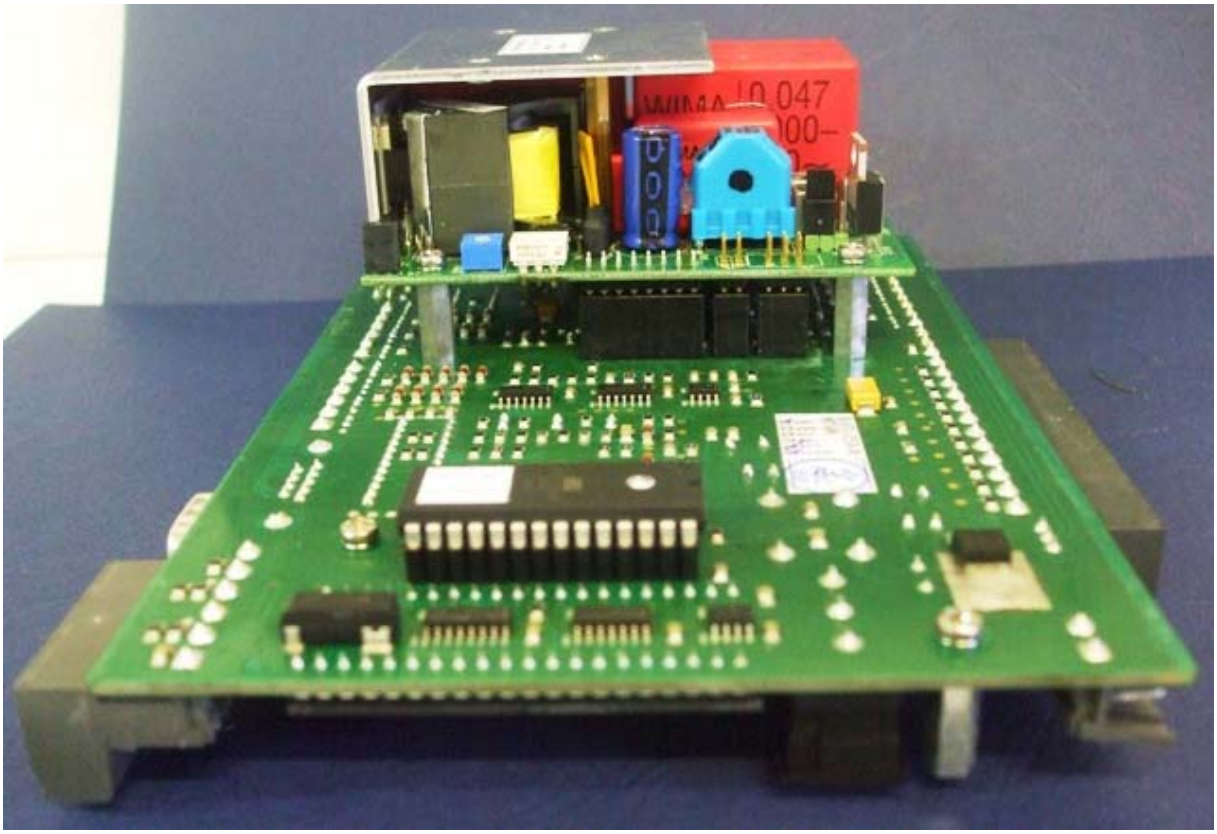


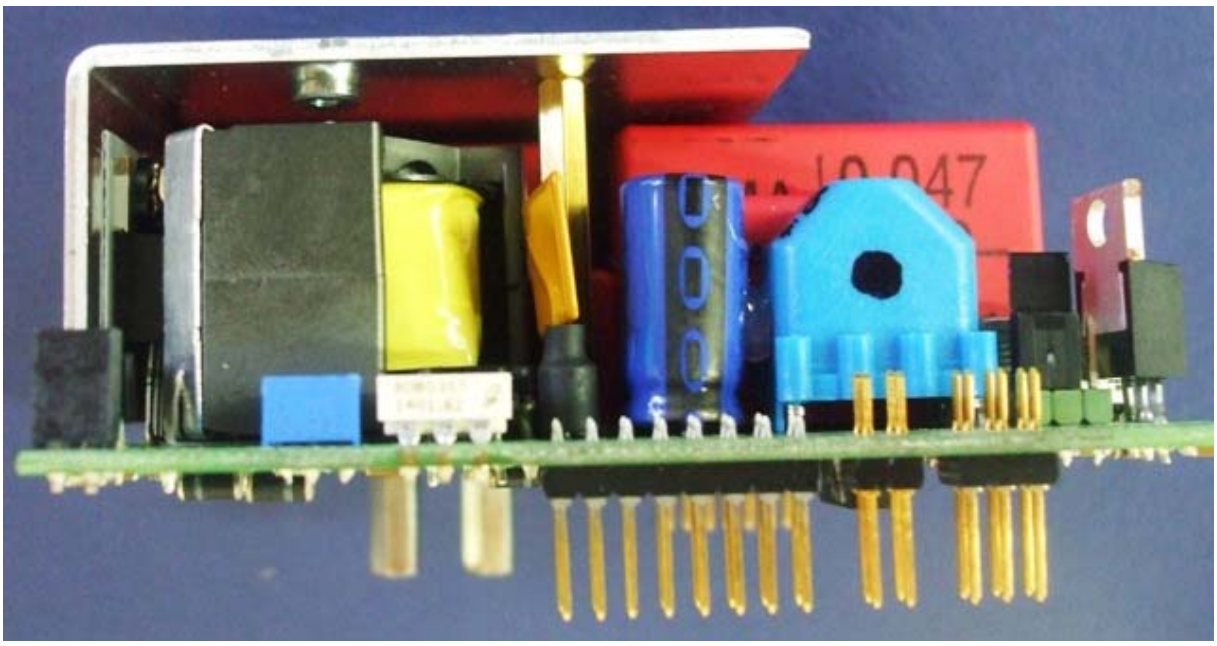


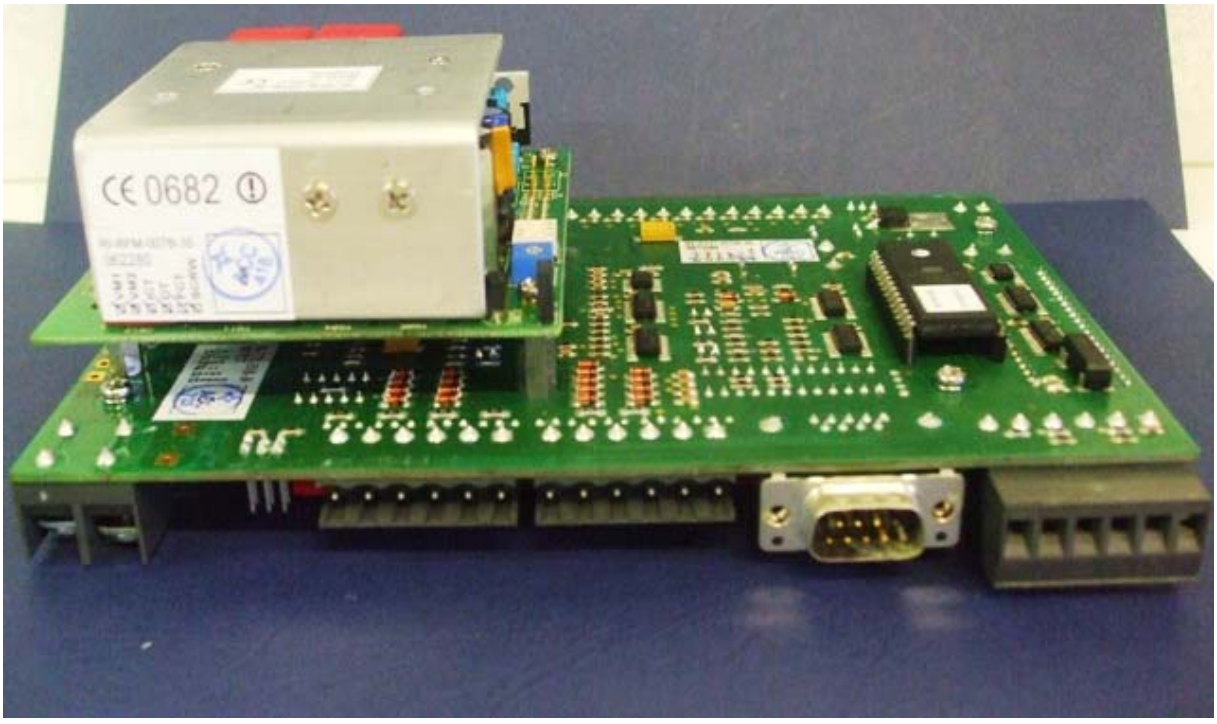


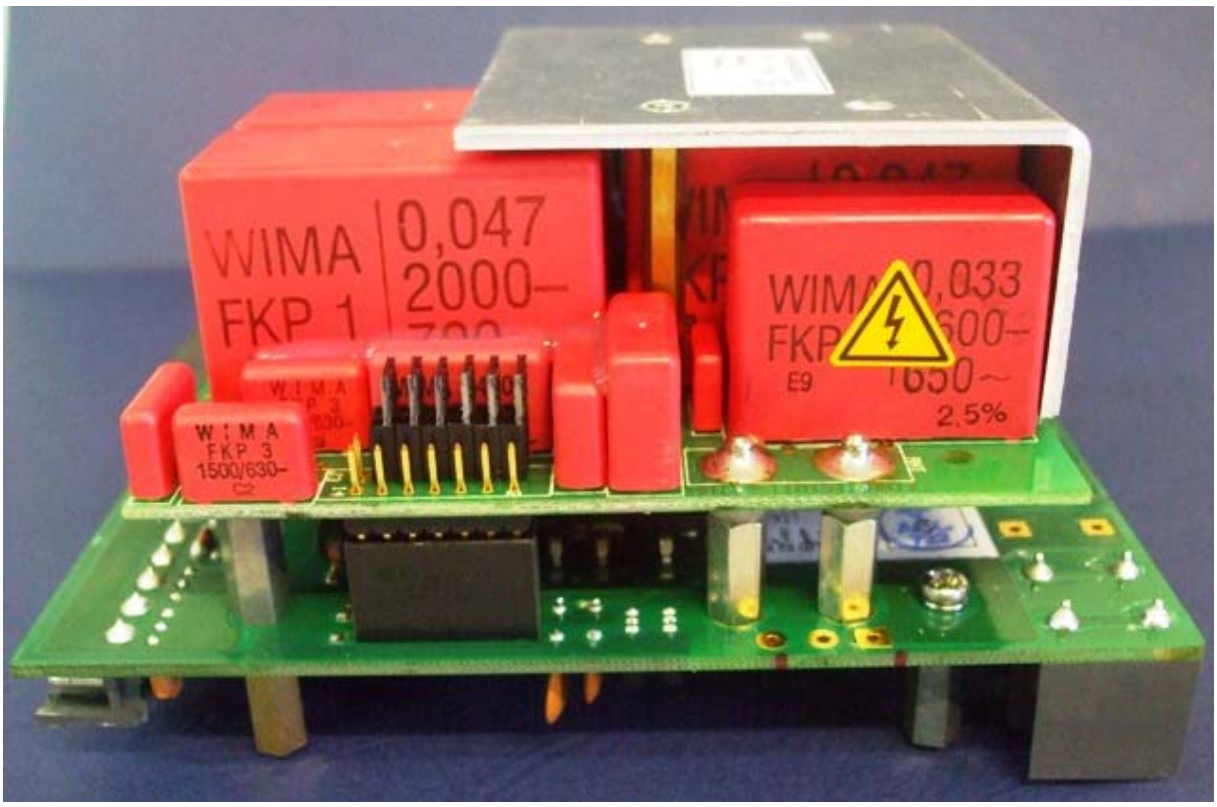


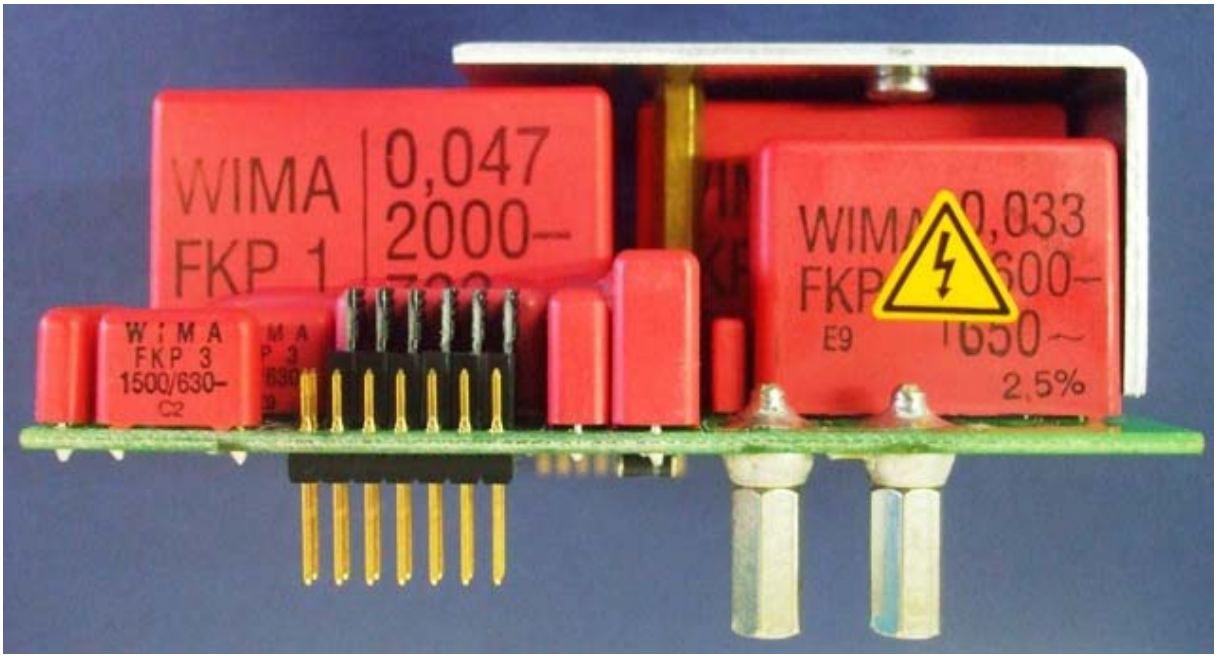


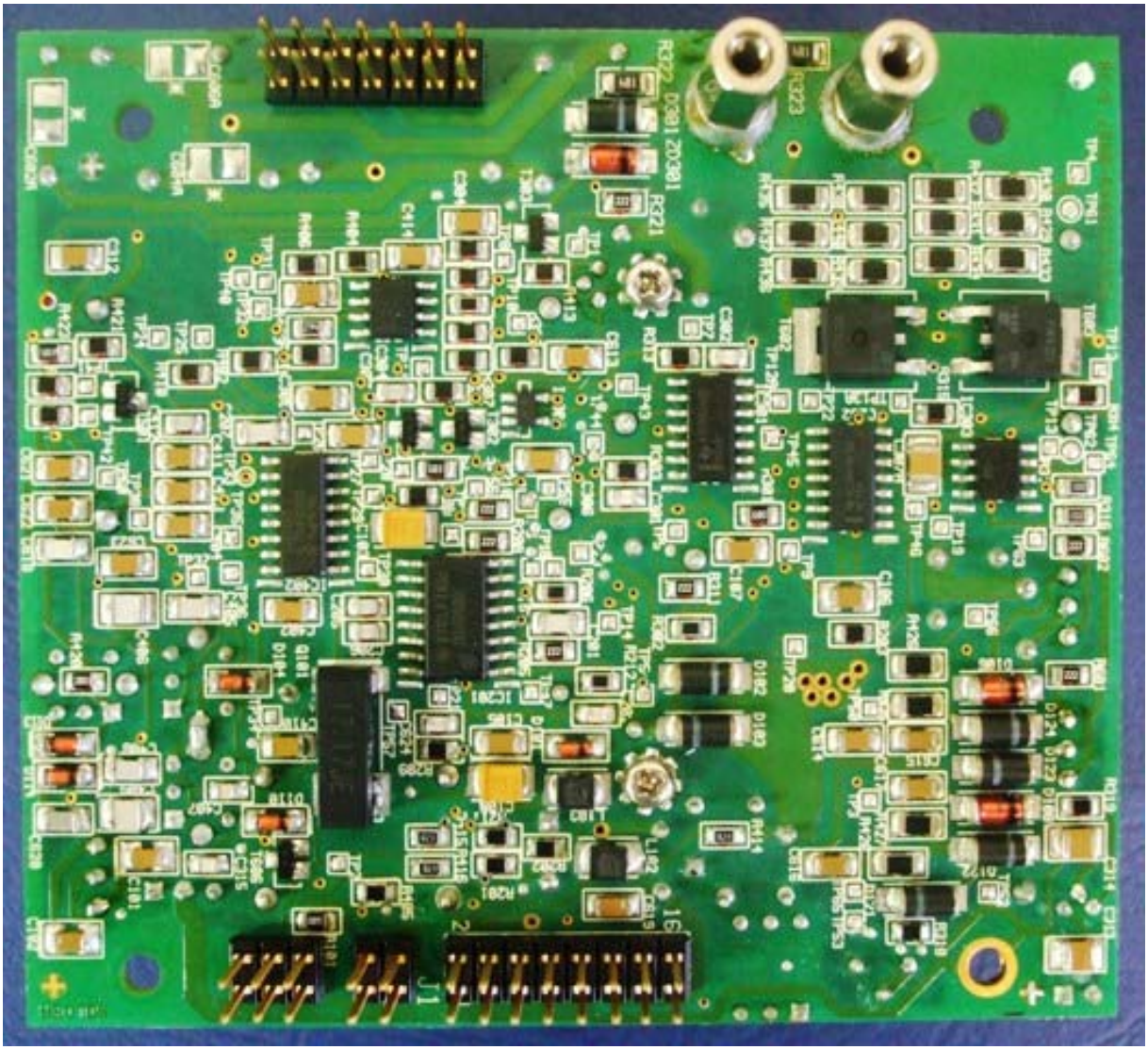




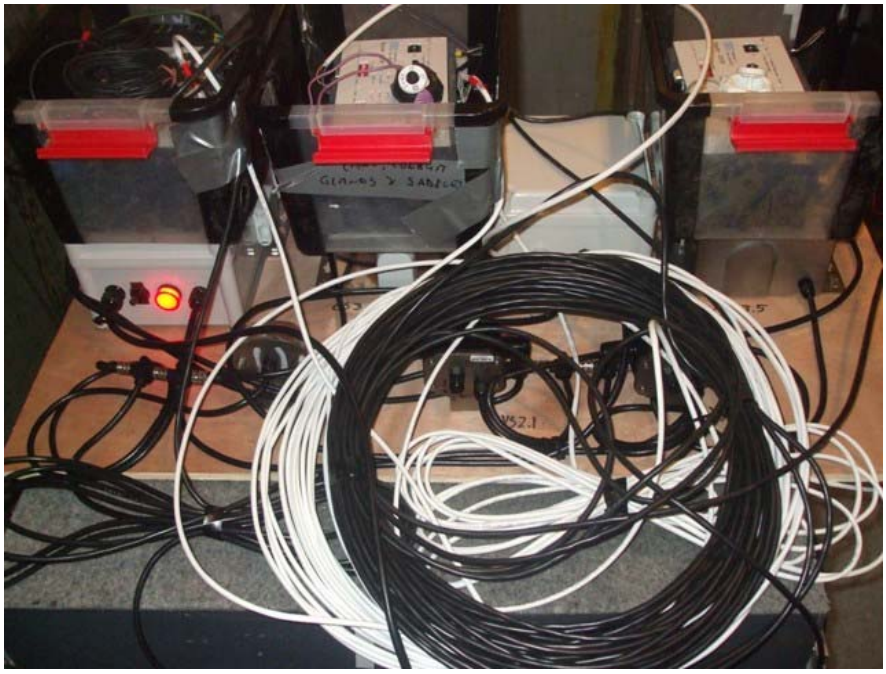








Conducted emission test set up photos



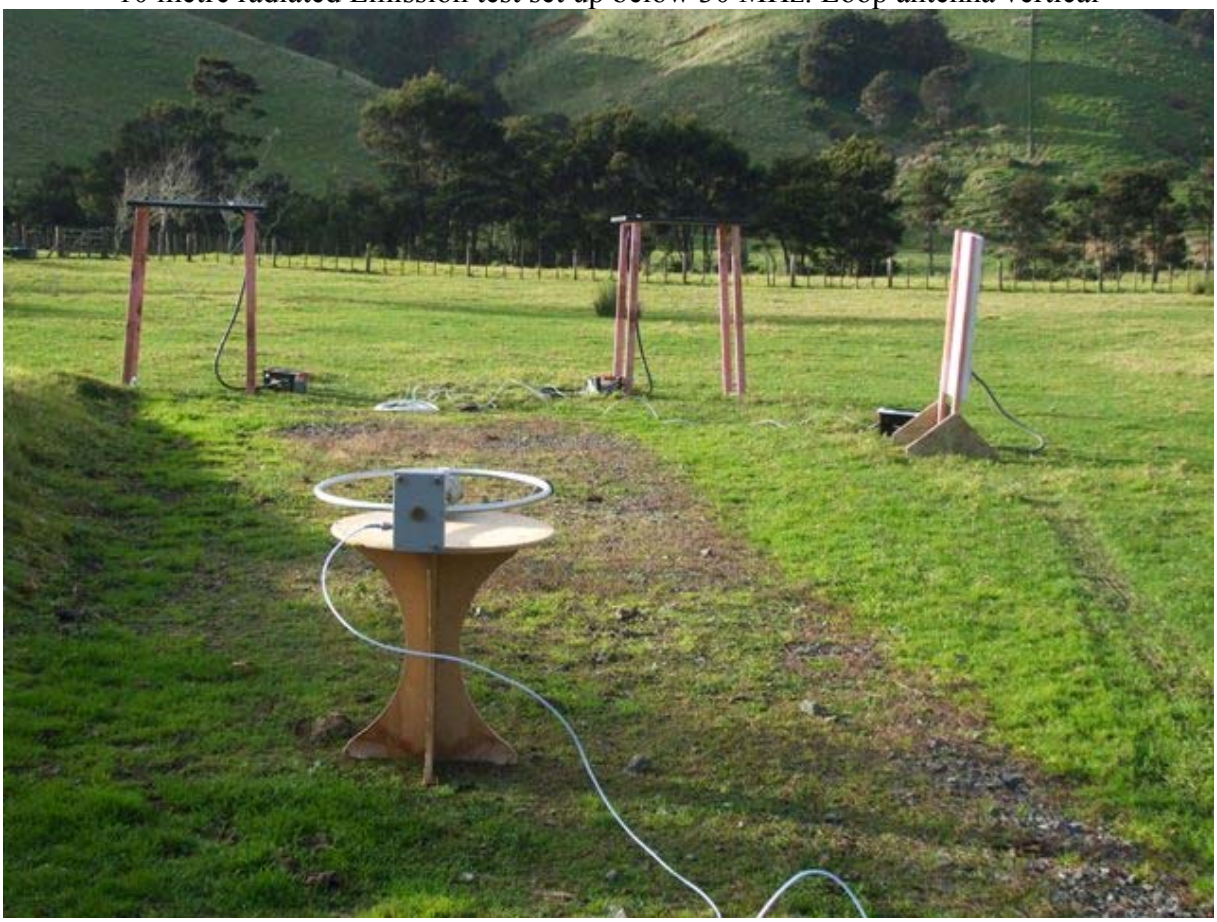
30 metre radiated emission test set up below 30 MHz. Loop antenna vertical

30 metre radiated emission test set up below 30 MHz. Loop antenna vertical

30 metre radiated emission test set up below 30 MHz. Loop antenna vertical

10 metre radiated Emission test set up below 30 MHz. Loop antenna vertical

10 metre radiated Emission test set up below 30 MHz. Loop antenna vertical



Horizontal panel antenna 1 attached to Master

Horizontal panel antenna attached to Slave 1

Test set up showing the distance between the two horizontal panel antennas

Vertical panel antenna connected to Slave 2